Save the Date!

74TH MEETING
BERLIN

SOCIETY OF
VERTEBRATE
PALEONTOLOGY

November 5 – 8, 2014
Estrel Berlin • Berlin, Germany
WELCOME TO LOS ANGELES

The Host Committee of the 73rd Annual Meeting is delighted to welcome all participants to the Society of Vertebrate Paleontology’s 2013 meeting in Los Angeles, California. The meeting will take place at the Westin Bonaventure Hotel, close to the heart of downtown Los Angeles that in recent years has experienced a dramatic resurgence with exciting new dining and cultural opportunities. Your host committee members represent institutions from the Greater Los Angeles region and their research interests encompass many facets of the discipline of vertebrate paleontology.

This is the third time that the meeting will be hosted by the Natural History Museum of Los Angeles County and we are particularly thrilled that the Society will return to Los Angeles in the year that the museum celebrates both its centenary and a hundred years of excavations at the La Brea Tar Pits—a National Natural Landmark and one of the world’s richest Ice Age fossil sites. Vertebrate paleontology has been at the core of our institution since its origin and continues to play a leading role in our research and educational mission. In this respect we are especially excited to showcase at our Welcome Reception the extensive renovation that has taken place during the past few years. This includes the opening of the award-winning Age of Mammals and Dinosaur Halls and nearly 300,000 square feet of renovated public space within and surrounding the museum. We hope you will also find time to visit our sister institutions—the Page Museum at the La Brea Tar Pits and the William S. Hart Museum.

Southern California offers a variety of paleontological opportunities. The scheduled field trips sample the diversity of marine and terrestrial vertebrate sites within easy reach of Los Angeles and provide brief opportunities to visit the newly founded Cooper Archaeological and Paleontological Center as well as the Page Museum and the La Brea Tar Pits. Most of the local collection centers will be closed during the meeting but will be accessible before and after by prior appointment.

Los Angeles is a premier travel destination and provides a great diversity of cultural opportunities. The spectrum ranges from the Getty Center and the Los Angeles County Museum of Art to the Grammy Museum and the Museum of Jurassic Technology. Los Angeles is home to the Huntington Library and Gardens, the Greater Los Angeles Zoo and Botanic Gardens, the LA County Arboretum, and the Aquarium of the Pacific. Adjacent to the Natural History Museum is the California Science Center—new home of the space shuttle Endeavor. Universal Studios, Disneyland, Knotts Berry Farm and Six Flags Magic Mountain are all within easy reach. And don’t forget miles of exquisite beach!

It’s going to be an exciting few days in Los Angeles as the 73rd meeting advances the frontiers of vertebrate paleontology and offers a forum for scientific discussion among researchers from around the world. We know you will enjoy the meeting, its workshops and field trips, and the diversity of social and cultural experiences in the newly vibrant downtown setting. Welcome to the City of Angels!

73rd Annual Meeting Host Committee
PRESENTATION POLICIES

SVP Abstracts are reviewed by the Program Committee and occasionally by outside reviewers. Authors are responsible for the technical content of their articles.

Unless specified otherwise, coverage of abstracts presented orally at the Annual Meeting is strictly prohibited until the start time of the presentation, and coverage of poster presentations is prohibited until the relevant poster session opens for viewing. As defined here, “coverage” includes all types of electronic and print media; this includes blogging, tweeting, advanced online publication and other intent to communicate or disseminate results or discussion presented at the SVP Annual Meeting.

Still photography, video and/or audio taping or any other electronic recording at the SVP Annual Meeting is strictly prohibited, with the exception of the designated SVP press event. (The SVP reserves the right to engage professional photographers or audio/videotape professionals to archive sections of the Meeting for the Society’s use.)

Editorial policies of Science and Nature magazine: If you are planning to submit, or have submitted, your publication to Science or Nature, be sure you are familiar with their embargo policies.

Please address any questions about program practices to the Program Committee or to the Executive Committee.

Citing an Abstract in the 2013 SVP Program and Abstracts Book
This Program and Abstracts Book is an official supplement to the online version of the Journal of Vertebrate Paleontology. The citation format for an abstract printed in this book is: Journal of Vertebrate Paleontology, Program and Abstracts, 2013, <insert page number here>.
# 2013 SVP Workshop Offerings

*For Pre-Registered Attendees*

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Session Title</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td><strong>TUE, October 29</strong></td>
<td></td>
<td>9:00am – 4:00pm Photogrammetry: Digital Data Collection in the Lab and Field</td>
<td><strong>SANTA BARBARA B</strong></td>
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<tr>
<td></td>
<td>9:00am – 5:00pm Virtual 3D Analysis of Chewing in Mammals – Occlusal Fingerprint Analyser</td>
<td><strong>SAN GABRIEL A</strong></td>
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<tr>
<td></td>
<td>10:00am – 4:00pm Practical Computing for Paleontologists</td>
<td><strong>SAN GABRIEL BC</strong></td>
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<tr>
<td></td>
<td>2:00pm – 6:00pm Video Made Easy</td>
<td><strong>SANTA BARBARA C</strong></td>
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<tr>
<td><strong>WED, October 30</strong></td>
<td>12:30pm – 1:45pm Paleontology and The Media – Communicating Your Research to the Popular Press</td>
<td><strong>SANTA BARBARA B</strong></td>
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</tbody>
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# 2013 SVP Field Trip Offerings

*For Pre-Registered Attendees*

*All Field Trips will depart from the Figueroa Street Entrance to the Westin Bonaventure Hotel & Suites*

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Session Title</th>
<th>Location</th>
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<tbody>
<tr>
<td><strong>TUE, October 29</strong></td>
<td></td>
<td>7:00am – 7:00pm Paleontology and Geology of Orange County, CA</td>
<td><strong>SANTA BARBARA B</strong></td>
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<tr>
<td></td>
<td>8:30am – 9:00pm Stratigraphy and Vertebrate Paleontology of the Middle Miocene Barstow Formation, San Bernardino County, CA</td>
<td><strong>SAN GABRIEL A</strong></td>
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<tr>
<td></td>
<td>9:00am – 4:00pm DreamWorks Animation Studios; Glendale, California</td>
<td><strong>SAN GABRIEL BC</strong></td>
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<tr>
<td></td>
<td>8:00am – 11:30am Field Trip to Rancho La Brea</td>
<td><strong>SANTA BARBARA C</strong></td>
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<tr>
<td></td>
<td>1:00pm – 4:30pm Fieldtrip to Rancho La Brea</td>
<td><strong>SANTA BARBARA C</strong></td>
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<tr>
<td><strong>SUN, November 3</strong></td>
<td>7:00am – 7:00pm Western Mojave Desert Geology and Vertebrate Paleontology with Special Emphasis on the Dove Spring Formation</td>
<td><strong>SANTA BARBARA B</strong></td>
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<tr>
<td></td>
<td>7:30am – 6:00pm Sharktooth Hill National Natural Landmark</td>
<td><strong>SAN GABRIEL A</strong></td>
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<td></td>
<td>8:30am – 5:00pm Arikareean and Hemingfordian Vertebrate Paleontology of the Santa Monica Mountains National Recreation Area, California</td>
<td><strong>SAN GABRIEL BC</strong></td>
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<tr>
<td>Event/Function</td>
<td>TUE, October 29</td>
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<td>CALIFORNIA FOYER</td>
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<td></td>
<td>Ontogeny Changes Everything: Paleobiological Implications of Dinosaur Growth</td>
<td>La Brea and Beyond: The Paleontology of Asphalt-Preserved Biotas</td>
<td>The Tempo of Vertebrate Evolution: Geochronologic Advances in Dating the Fossil Record</td>
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<td>SAN FRANCISCO</td>
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<td>Romer Prize Session</td>
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<td></td>
<td>Technical Session I Tetrapods, Amphibians, Amniotes, Early Diapsids</td>
<td>Technical Session VI Paleogene Mammals</td>
<td>Technical Session IX Saurischian Dinosaurs</td>
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<td>Technical Session II Mammal Ecology</td>
<td>Technical Session VII Dinosauria</td>
<td>Technical Session X Quaternary &amp; Neogene Mammals</td>
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<td>Technical Session III Ornithischian Dinosaurs</td>
<td>Technical Session VIII Permo-Triassic Synapsids</td>
<td>Technical Session XI Quantitative Analyses of Mammals</td>
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<td>Technical Session IV Cenozoic South American Mammals</td>
<td>Technical Session XII Archosauromorphs</td>
<td>Technical Session XII Archosaurus and Crocodylomorpha</td>
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<td>Technical Session V Lepidosauromorpha</td>
<td>Technical Session XIII Paleozoic Fishes</td>
<td>Technical Session XIII Lepidosauromorpha</td>
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<td>Poster Sessions</td>
<td>Poster Session I: 9:30am – 6:15pm</td>
<td>Poster Session II: 9:30am – 6:15pm</td>
<td>Poster Session III: 9:30am – 6:15pm</td>
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<td>SAN DIEGO BALLROOM/FOYER</td>
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<td>SAN DIEGO BALLROOM/FOYER</td>
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<td>Event/Function</td>
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<tr>
<td>Exhibit Viewing</td>
<td>9:30am – 6:15pm SAN DIEGO BALLROOM/FOYER</td>
<td>9:30am – 6:15pm SAN DIEGO BALLROOM/FOYER</td>
<td>9:30am – 6:15pm SAN DIEGO BALLROOM/FOYER</td>
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<tr>
<td>SVP Business Meeting and Open Forum</td>
<td></td>
<td>12:30pm – 1:30pm SAN FRANCISCO</td>
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<tr>
<td>Preparators’ Meeting</td>
<td>2:00pm – 3:30pm SANTA BARBARA ABC</td>
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<tr>
<td>Press Event</td>
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<td>4:00pm – 6:00pm SAN GABRIEL BC</td>
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<tr>
<td>Social Events</td>
<td>7:00pm Special Presentation by Dr. Tim D. White from the University of California, Berkeley **NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY</td>
<td>7:00pm – 10:00pm Welcome Reception **NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY</td>
<td>7:30pm – 11:30pm Student Roundtable Forum and Reprint Exchange SACRAMENTO 6:00pm – 9:00pm History of Vertebrate Paleontology Symposium **NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY</td>
</tr>
<tr>
<td>Speaker Ready Room</td>
<td>7:00am – 4:00pm BEAUDRY B</td>
<td>7:00am – 4:00pm BEAUDRY B</td>
<td>7:00am – 4:00pm BEAUDRY B</td>
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## PROGRAM AT A GLANCE

<table>
<thead>
<tr>
<th>San Francisco</th>
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<th>San Jose</th>
<th>San Francisco</th>
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<tbody>
<tr>
<td><strong>Symposium: Ontogeny Changes Everything Paleobiological Implications of Dinosaur Growth</strong></td>
<td><strong>Technical Session I</strong></td>
<td><strong>Technical Session II</strong></td>
<td><strong>Romer Prize Session</strong></td>
<td><strong>Technical Session VI</strong></td>
<td><strong>Preparators’ Session</strong></td>
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<tbody>
<tr>
<td>8:00 am</td>
<td>Larsson</td>
<td>Cloutier</td>
<td>Tseng</td>
<td>Bonde</td>
<td>Lofgren</td>
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<tr>
<td>8:15 am</td>
<td>Werning</td>
<td>Kawano</td>
<td>Donohue</td>
<td>Brasse</td>
<td>Simmons</td>
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<tr>
<td>8:30 am</td>
<td>Horner</td>
<td>Sears</td>
<td>Saarinen</td>
<td>Brusatte</td>
<td>Gunnel</td>
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<td>8:45 am</td>
<td>Woodward</td>
<td>Leary</td>
<td>DeSantis</td>
<td>Drewicz</td>
<td>Padian</td>
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<tr>
<td>9:00 am</td>
<td>Evans</td>
<td>Anderson</td>
<td>Barron-Ortiz</td>
<td>Drumheller</td>
<td>Manz</td>
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<tr>
<td>9:15 am</td>
<td>Scannella</td>
<td>Ettink</td>
<td>Cavin</td>
<td>Evans</td>
<td>Hooker</td>
</tr>
<tr>
<td>9:30 am</td>
<td>Morris</td>
<td>Fitzbisch</td>
<td>Hopkins</td>
<td>Fischer</td>
<td>Dunn</td>
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<tr>
<td>9:45 am</td>
<td>Kruk</td>
<td>Maddin</td>
<td>Famoso</td>
<td>Huttenlocker</td>
<td>Stroik</td>
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<td><strong>10:00 am</strong></td>
<td><strong>COFFEE</strong></td>
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<tr>
<td>10:15 am</td>
<td>Goodwin</td>
<td>Dias-Da-Silva</td>
<td>Gould</td>
<td>Kelley</td>
<td>Stevens</td>
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<td>10:30 am</td>
<td>Reisz</td>
<td>Evans</td>
<td>Fox</td>
<td>Kimura</td>
<td>Borths</td>
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<td>10:45 am</td>
<td>Sander</td>
<td>Chen</td>
<td>Pineda Munoz</td>
<td>Lautenschlager</td>
<td>Zack</td>
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<td>11:00 am</td>
<td>Woodruff</td>
<td>Sereno</td>
<td>Cakede</td>
<td>Nakajima</td>
<td>Beard</td>
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<tr>
<td>11:15 am</td>
<td>Carrano</td>
<td>Leblanc</td>
<td>McHorse</td>
<td>Neenan</td>
<td>Schwermann</td>
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<tr>
<td>11:30 am</td>
<td>Varricchio</td>
<td>Bæhmer</td>
<td>Den Boer</td>
<td>Stocker</td>
<td>Hard</td>
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<td>11:45 am</td>
<td>Dial</td>
<td>Ezcurra</td>
<td>Cuozzo</td>
<td>Tomiya</td>
<td>Bibi</td>
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<tr>
<td>12:00 pm</td>
<td>Fowler</td>
<td>Chure</td>
<td>Miller</td>
<td>Tschopp</td>
<td>Mihlbachler</td>
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<td>12:15 pm</td>
<td>Break</td>
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<tr>
<td>1:30 pm</td>
<td><strong>BREAK</strong></td>
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### Technical Session III

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<tr>
<td><strong>Technical Session III</strong></td>
<td><strong>Technical Session IV</strong></td>
<td><strong>Technical Session V</strong></td>
<td><strong>Technical Session VII</strong></td>
<td><strong>Symposium: La Brea and Beyond: The Paleontology of Asphalt-Preserved Biotas</strong></td>
<td><strong>Technical Session VIII</strong></td>
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<p>| 1:45 pm | Nabavizadeh | Croft | Apesteguia | Porter | Harris |
| 2:00 pm | Spencer | Luna | Head | Eagle | Rincón |
| 2:15 pm | Loewen | West | Delfino | Sobral | Seymour |
| 2:30 pm | Arbour | Tejada Lara | Kemp | Jerison | Martinez |
| 2:45 pm | Maiónino | Stromberg | Demar | Campione | Lindsey |
| 3:00 pm | Farke | Bloch | Conrad | Tsai | Campbell |
| 3:15 pm | Currie | Morgan | Richter | Sellers | Brannick |
| 3:30 pm | Hedrick | Macfadden | Konishi | Brown | Haupt |
| 3:45 pm | Bourke | Barnosky | Sato | Bell | Shaw |
| 4:00 pm | Mallon | Koch | Scheyer | Benson | McDonald |
| 4:15 pm | | | | | |
| 6:15 pm | <strong>Poster Session I</strong> | | | | <strong>Poster Session II</strong> |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speakers</th>
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</table>
| 8:00 am | FRI | Brink, Fisher, Cherney, Gates, Pei, Yann, Serich, Terry, Miyashita, Lee, Belin, Patterson, Balavoine, Chiraj, COFFEE, |}
| 8:15 am | FRI | Gates, Cherney, Rasbury, Pei, Steyer, Reid, Shi, Forster, Fortey, Lamb, Gotfried, Ryzymski, Person, Gilberg, |}
| 8:30 am | SAT | You, Yann, Mundil, Habib, Sidor, Fitzgerald, Sertich, Secord, Hemming, Heers, Andres, Kienle,  |}
| 8:45 am | SAT | Burch, Terry, Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 9:00 am | SAT | Burch, Terry, Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 9:15 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 9:30 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 9:45 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 10:00 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 10:15 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 10:30 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 10:45 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 11:00 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 11:15 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 11:30 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 11:45 am | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 12:00 pm | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 12:15 pm | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 1:30 pm | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
| 1:45 pm | SAT | Miyashita, Lee, Cerling, Gimarc, Figueirido,  |}
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WEDNESDAY MORNING, OCTOBER 30, 2013
Symposium 1: Ontogeny Changes Everything: Paleobiological Implications of Dinosaur Growth
Westin Bonaventure Hotel & Suites, San Francisco Ballroom
MODERATORS: John Scannella and Denver Fowler

8:00  Larsson, H., Du, T.  INTERPRETING DINOSAUR ONTOGENY AT SCALES FROM EMBRYOS TO BONE MICROSTRUCTURE TO PHENOTYPIC COVARIANCE

8:15  Werning, S.  WHAT ARE WE ACTUALLY MEASURING? AN EVALUATION OF OSTEOHISTOLOGICAL INDICATORS OF DINOSAURIAN GROWTH RATE

8:30  Horner, J., Rife, J.  ONTOGENETIC ASSESSMENT OF DINOSAURS USING CRANIAL AND POSTCRANIAL OSTEOHISTOLOGY

8:45  Woodward, H., Horner, J., Freedman Fowler, E.  PREDICTING PEAK PERFORMANCE AND SENESCENCE IN THE ORNITHOPOD DINOSAUR MAIASAURA PEEBLESORUM

9:00  Evans, D., Campione, N., Brink, K., Schott, R., Brown, C.  WASTED YOUTH: THE IMPORTANCE OF ONTOGENETICALLY EQUIVALENT SEMAPHORONTS IN DINOSAUR PHYLOGENETIC SYSTEMATICS

9:15  Scannella, J., Fowler, D., Goodwin, M., Horner, J.  THE CLANDESTINE ROLE OF HETEROCHRONY IN CERATOPSIAN EVOLUTION AS REVEALED BY JUVENILE TRICERATOPS

9:30  Morris, Z., Burroughs, R., Colbert, M.  DEVELOPMENTAL VARIATION COMPlicATES RECONSTRUCTIONS OF SKELETAL ONTOGENY OF EXTINCT VERTEBRATES: A LESSON FROM TRICERATOPS AND TOROSAURUS

9:45  Kruk, B., Burns, M., Currie, P.  HISTOLOGICAL STUDY OF CRANIAL ELABORATION IN CERATOPSIAN DINOSAURS: FUNCTIONAL & DEVELOPMENTAL IMPLICATIONS

10:00 BREAK

10:15  Goodwin, M., Horner, J., Schott, R., Evans, D.  NEW DATA ON DEVELOPMENTAL CRANIAL ONTOGENY IN PACHYCEPHALOSAURS

10:30  Reisz, R., Leblanc, A., Sullivan, C., Huang, T.  EMBRYONIC DEVELOPMENT OF A SAUROPODOMORPH DINOSAUR FROM THE EARLY JURASSIC OF CHINA, PATTERNS OF OSSIFICATION AND GROWTH

10:45  Sander, P., Griebeler, E., Klein, N.  AGING, MATURATION AND GROWTH OF SAUROPODOMORPH DINOSAURS: EVIDENCE FROM THE HISTOLOGICAL GROWTH MARK RECORD IN LONG BONES

11:00  Woodruff, C., Fowler, D., Horner, J.  CHANGES IN VERTEBRAL MOPRHOLOGY ASSOCIATED WITH HISTOLOGIC DATA SUPPORT SIGNIFICANT CHANGE THROUGH ONTOGENY IN DIPLODOCID SAUROPODS

11:15  Carrano, M., Mateus, O., Mitchell, J.  FIRST DEFINITIVE ASSOCIATION BETWEEN EMBRYONIC ALLOSARUS BONES AND PRISMATOOLITHUS EGGS IN THE MORRISON FORMATION (UPPER JURASSIC, WYOMING, USA)

11:30  Varricchio, D.  WOUNDING-TOOTH GROWS UP: ONTOGENY IN THE CRETACEOUS THEROPOD TROodon FORMUSo

11:45  Dial, K. P.  FUNCTION OF RUDIMENTARY LOCOMOTOR STRUCTURES IN THE ECOLOGY OF BIRDS: EVOLUTIONARY IMPLICATIONS

12:00  Fowler, D., Freedman Fowler, L., Scannella, J., Horner, J.  THE INFLUENCE OF MULTI-NICHE ONTOGENY ON DIFFERENTIAL SURVIVORSHIP ACROSS THE K-PG BOUNDARY

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WEDNESDAY MORNING, OCTOBER 30, 2013
Technical Session I
Westin Bonaventure Hotel & Suites, Sacramento Ballroom
MODERATORS: Nadia Froebisch and Sergio Dias-Da-Silva

8:00  Cloutier, R., Béchard, I.  A NEW PIECE OF THE DEVONIAN FISH-TO-TETRAPOD PUZZLE: THE DISCOVERY OF A COMPLETE SPECIMEN OF ELPISTOSTEGITE

8:15  Kawano, S., Blob, R.  FUNCTIONAL COMPARISONS BETWEEN FINS AND LIMBS DURING TERRESTRIAL LOCOMOTION: BIOMECHANICAL IMPLICATIONS FOR THE EVOLUTIONARY INVASION OF LAND

8:30  Sears, K., Mabee, P., Dececchi, A.  EVOLUTION OF APPENDAGE MODULARITY DURING THE FIN TO LIMB TRANSITION

8:45  Leary, B., Kavanagh, K.  TWO IF BY LAND, ONE IF BY SEA? EVIDENCE FOR MAJOR TRANSITIONS IN DIGIT MODULARITY OVER TETRAPOD EVOLUTION

9:00  Anderson, J., Pardo, J., Germain, D., Ahlberg, P.  THREE DIMENSIONAL MICRO-CT STUDY OF THE AİSTOPOD CRANIUM REVEALS HIDDEN MORPHOLOGICAL DIVERSITY AMONG THE EARLY TETRAPOD RADIATION

9:15  Eltink, E., Langer, M.  A NEW SPECIMEN OF THE TEMNOSPONDIYL AUSTRALERPETOON COSGRIFFI FROM THE LATE PERMIAN OF BRAZIL (RIO DO RASTO FORMATION, PARANÁ BASIN): NEW ANATOMICAL INFORMATION AND PHYLOGENETIC RELATIONSHIPS.

9:30  Froebisch, N., Witzmann, F., Bickelmann, C.  LIMB ABNORMALITIES IN THE DISSOROPHOID AMPHIBIAN MICROMELERPETOON CREDNERI - PRIMARY PATHOLOGY OR FAILED REGENERATION?

9:45  Maddin, H., Fröbis, N., Evans, D., Milner, A.  REAPPRAISAL OF THE EARLY PERMIAN AMPHIBAMID TERSOMIUS TEXENSI AND SOME REFERRED MATERIAL

10:00 BREAK

10:15  Dias-Da-Silva, S., Hewison, R.  PHYLOGENETIC ANALYSIS AND PALAEOBIOGEOGRAPHY OF THE PANGAEA LOWER TRIASSIC LYDEKKERINIDAE (TEMNOSPONDYLI, STEROESPONDYLI)

10:30  Evans, S., Groenke, J., Jones, M., Turner, A., Krause, D.  BIG, BAD, AND BIZARRE: NEW MATERIAL OF BEELZEBUFO, A HYPEROSSIFIED ANURAN FROM THE LATE CRETACEOUS OF MADAGASCAR, YIELDS FURTHER SURPRISES.


11:00  Sereno, P., Isch, A., Conroy, L.  SHOULDER GIRDLE ARCHITECTURE: A MAJOR CONSTRAINT IN THE EVOLUTION OF AMNIOTE LOCOMOTION

11:15  Leblanc, A., Brink, K., Macdougall, M., Reisz, R.  PHYLOGENETIC PATTERNS AND FUNCTIONAL INTERPRETATIONS OF AMNIOTE PLICIDENTINE

11:30  Böhmer, C., Rauhut, O., Wörheide, G.  NEW INSIGHTS INTO THE DEVELOPMENT AND EVOLUTION OF THE VERTEBRAL COLUMN IN ARCHOSAURS

11:45  Ezcurra, M., Butler, R., Scheyer, T.  THE PERMIAN ARCHOSAUROMORPH RECORD REVISITED: A NEW SPECIES FROM TANZANIA AND THE POTENTIALLY OLDEST ARCHOSAURIFORM
WEDNESDAY MORNING, OCTOBER 30, 2013
Technical Session I (CONTINUED)

12:00 Chure, D., Britt, B., Engelmann, G., Andrus, A., Scheetz, R.  DREPANOSAURS IN THE DESERT: MULTIPLE SKELETONS OF A NEW DREPANOSAURID FROM THE EOLIAN NUGGET SANDSTONE (?LATE TRIASSIC - EARLY JURASSIC), SAINTS AND SINNERS QUARRY, UTAH: MORPHOLOGY, RELATIONSHIPS, AND BIOSTRATIGRAPHIC IMPLICATIONS

WEDNESDAY MORNING, OCTOBER 30, 2013
Technical Session II
Westin Bonaventure Hotel & Suites, San Jose Ballroom
MODERATORS: Samantha Hopkins and Francois Gould

8:00 Tseng, Z., Martín-Serra, A., Figueirido, B.  PROFILING THE DUROPHAGE: CONVERGENT SKULL SHAPE EVOLUTION BETWEEN BONE AND BAMBOO SPECIALISTS


8:30 Saarinen, J., Karme, A., Uno, K., Sailsa, L.  NEW APPROACH TO MAMMALIAN PALEOECOLOGY - OCCLUSION ANGLE OF MOLAR TEETH AS A MEASURE OF DIET ABRASIVENESS IN ELEPHANTS AND THEIR FOSSIL RELATIVES (MAMMALIA, PROBOSCIDEA)

8:45 Desantis, L., Scott, J., Schubert, B., Donohue, S., Mccray, B.  DIRECT COMPARISONS OF 2D AND 3D DENTAL MICROWEAR PROXIES IN EXTANT HERBIVOROUS AND CARNIVOROUS MAMMALS: THE IMPORTANCE OF DEPTH AND OBSERVER CONSISTENCY FOR RESOLVING DIET

9:00 Barron-Ortiz, C., Mihlbachler, M., Rankin, B., Theodor, J.  INVESTIGATING THE APPLICABILITY OF OUTLINE-BASED GEOMETRIC MORPHOMETRIC TECHNIQUES TO THE STUDY OF UNGULATE MESOWEAR

9:15 Cavin, J., Samuels, J.  MESOWEAR AND HYPSODONTY THROUGH TIME IN HYPERTRAGULIDS (ARTIODACTYLA) FROM THE TURTLE COVE MEMBER OF THE JOHN DAY FORMATION OF OREGON

9:30 Hopkins, S.  DIFFERENTIAL TIMING OF HYPSODONTY EVOLUTION IN LARGE AND SMALL MAMMALS INDICATES COMPLEX FORCING OF CROWN HEIGHT EVOLUTION

9:45 Famoso, N., Davis, E.  FRACTAL DIMENSIONALITY AS A MEASURE OF OCCLUSAL ENAMEL COMPLEXITY IN EQUIDAE (MAMMALIA: PERISSODACTYLA)

10:00 BREAK

10:15 Gould, F.  TO 3D OR NOT TO 3D: DO 3D SURFACE ANALYSES IMPROVE ECOMORPHOLOGICAL INFERENCE?

10:30 Fox, D., Keller, J., Haveles, A., Bagley, B.  DIETARY RECONSTRUCTION OF PLIO-PLEISTOCENE RODENTS FROM SOUTHWEST KANSAS USING STABLE CARBON ISOTOPES AND THREE DIMENSIONAL TOOTH SHAPE METRICS

10:45 Pineda Munoz, S., Evans, A.  WHICH TOOTH BEST REPRESENTS WHOLE TOOTH ROW DENTAL COMPLEXITY IN MAMMALS?

11:00 Calede, J., Glusman, J.  DISPARITY IN THE MOLAR MORPHOLOGY OF EXTANT AND FOSSIL GOPHERS (RODENTIA, GEOMYIDAE) IMPLICATIONS FOR TAXONOMIC RICHNESS
WEDNESDAY MORNING, OCTOBER 30, 2013
Technical Session II (CONTINUED)

11:15  Mchorse, B., Scott, E., Mclaughlin, W., Davis, E., Hopkins, S.  IDENTIFYING ISOLATED POSTCRANIA USING DISCRIMINANT ANALYSIS

11:30  Den Boer, W., Kear, B.  EVIDENCE FOR ECO-MORPH DIVERSITY WITHIN OLIGO-MIOCENE MACROPODIFORMS

11:45  Cuozzo, F., Sauther, M.  WISDOM OF THE BONES: HOW PATTERNS OF TRAUMA AND PATHOLOGY IN A WILD LEMUR COMMUNITY INFORM THE PALEOEKOLOGY OF MADAGASCAR’S RECENTLY EXTINCT LEMURS AND EARLIER EOCENE LEMURIFORM PRIMATES

12:00  Miller, J., Behrensmeyer, A., Lyons, K., Ete, T.  SIZE-BIASED MODERN BONE ACCUMULATIONS CAN ACCURATELY RECORD WHOLE-COMMUNITY ECOLOGY

WEDNESDAY AFTERNOON, OCTOBER 30, 2013
Technical Session III
Westin Bonaventure Hotel & Suites, San Francisco Ballroom
MODERATORS: Mark Loewen and Andrew Farke

1:45  Nabavizadeh, A.  JAW MECHANICS IN ORNITHISCHIAN DINOSAURS AND THE EVOLUTIONARY RELATIONSHIP BETWEEN MORPHOLOGY AND BITE FORCE

2:00  Spencer, M.  PHYLOGENETIC AND BIOGEOGRAPHIC ASSESSMENT OF ORNITHISCHIAN DIVERSITY THROUGHOUT THE MESOZOIC: A SPECIES-LEVEL ANALYSIS OF PHYLOGENY FROM ORIGIN TO EXTINCTION

2:15  Loewen, M., Kirkland, J.  THE EVOLUTION AND BIOGEOGRAPHIC DISTRIBUTION OF ANKYLOSAURIA: NEW INSIGHTS FROM A COMPREHENSIVE PHYLOGENETIC ANALYSIS

2:30  Arbour, V., Currie, P.  THE ORIGIN OF THE ANKYLOSAURID TAIL CLUB

2:45  Maiorino, L., Farke, A., Kotsakis, T., Piras, P.  CRANIAL AND MANDIBULAR SHAPE CHANGES DURING THE EVOLUTION OF CERATOPSID DINOSAURS

3:00  Farke, A., Maxwell, D., Cifelli, R., Wedel, M.  BIOGEOGRAPHY OF BASAL NEOCERATOPSID DINOSAURS ILLUMINATED BY A SKULL FROM THE CLOVERLY FORMATION (LOWER CRETACEOUS) OF MONTANA

3:15  Currie, P., Holmes, R., Ryan, M., Coy, C., Koppelhus, E.  THE SMALLEST, ARTICULATED CERATOPSID (DINOSAURIA)

3:30  Hedrick, B., Dodson, P.  LUJIATUN PSITTACOSAURIDS: UNDERSTANDING INDIVIDUAL AND TAPHONOMIC VARIATION USING 3D GEOMETRIC MORPHOMETRICS

3:45  Bourke, J., Porter, W., Lyson, T., Schachner, E., Bell, P.  NASAL TURBINATES IN PACHYCEPHALOSAURIDS (DINOSAURIA: ORNITHISCIA): RECONSTRUCTING NASAL ANATOMY AND AIRFLOW, WITH IMPLICATIONS FOR PHYSIOLOGY

4:00  Mallon, J., Evans, D.  PACHYCEPHALOSAUR DOMES: ALLOCHTHONOUS OR AUTOCHTHONOUS?
WEDNESDAY AFTERNOON, OCTOBER 30, 2013

Technical Session IV

Westin Bonaventure Hotel & Suites, Sacramento Ballroom
MODERATORS: Anthony Barnosky and Darin Croft

1:45 Croft, D., Anaya, F., Catena, A., Ciancio, M., Engelman, R. NEW SPECIES, LOCAL FAUNAS, AND PALEOENVIRONMENTAL DATA FOR THE MIDDLE MIOCENE QUEBRADA HONDA FAUNA, BOLIVIA

2:00 Luna, D., Flynn, J., Croft, D., Wyss, A. TAXONOMY, BIOGEOGRAPHY, AND PHYLOGENY OF MIOCENE ENDEMIC SOUTH AMERICAN UNGULATES (MAMMALIA) FROM THE LAGUNA DEL LAJA REGION, ANDEAN MAIN RANGE, CENTRAL CHILE

2:15 West, A., Flynn, J., Croft, D., Wyss, A. A QUANTITATIVE MODEL FOR MORPHOLOGICAL EVOLUTION IN THE INTERATHERIIDAE (TYPOTHERIA, NOTOUNGULATA, MAMMALIA) AS A RESPONSE TO CLIMATIC AND TECTONIC CHANGES

2:30 Tejada Lara, J., Macfadden, B., Antoine, P., Flynn, J., Salas Gismondi, R. EVOLUTION OF MIOCENE AMAZONIAN ECOSYSTEMS: CAN OLD MAMMALS REVEAL SOMETHING NEW?

2:45 Stromberg, C., Dunn, R., Madden, R., Kohn, M., Carlini, A. WHERE HAVE ALL THE GRASSES GONE?: NEW MIDDLE MIOCENE PHYTOLITH RECORDS REVEAL THAT GRASSLANDS PLAYED A MINOR ROLE IN HYPSODONTY EVOLUTION IN SOUTHERN SOUTH AMERICA

3:00 Bloch, J., Wood, A., Rincon Burbano, A., Woodruff, E., Foster, D. FIRST FOSSILS OF A PLATYRRHINE MONKEY FROM PANAMA PROVIDE EVIDENCE FOR MAMMALIAN DISPERSAL ACROSS THE CENTRAL AMERICAN SEAWAY IN THE EARLY MIOCENE


3:30 Macfadden, B. AGE OF THE TARIJA FAUNA, BOLIVIA: IMPLICATIONS FOR EQUUS DISPERSAL AND CALIBRATION OF GABI 3

3:45 Barnosky, A., Lindsey, E., Villavecencio, N., Marshall, C. ESTABLISHING THE CHRONOLOGY OF QUATERNARY MEGAFAUNAL EXTINCTION IN SOUTH AMERICA

4:00 Koch, P., Pires, M., Guimaraes, P. THE ROLE OF NETWORK STRUCTURE IN PLEISTOCENE MEGAFAUNA EXTINCTIONS

WEDNESDAY AFTERNOON, OCTOBER 30, 2013

Technical Session V

Westin Bonaventure Hotel & Suites, San Jose Ballroom
MODERATORS: Massimo Delfino and Takuya Konishi

1:45 Apesteguia, S., Garberoglio, F. THE RETURN OF NAJASH: NEW, BETTER PRESERVED SPECIMENS CHANGE THE FACE OF THE BASALMOST SNAKE

2:00 Head, J., Bloch, J., Moreno-Bernal, J., Rincon Burbano, A., Bourque, J. CRANIAL OSTEOLOGY, BODY SIZE, SYSTEMATICS, AND ECOLOGY OF THE GIANT PALEOCENE SNAKE TITANOBOA CERREJONENSIS

2:15 Delfino, M., Bolet, A., Fortuny, J., Robles, J., Alba, D. A NEW EXTINCT SPECIES OF BLANUS (AMPHISBAENIA, BLANIDAE) FROM THE IBERIAN MIOCENE BASED ON THE FIRST KNOWN EUROPEAN AMPHISBAENIAN FOSSIL SKULL

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WEDNESDAY AFTERNOON, OCTOBER 30, 2013
Technical Session V (Continued)

2:30  Kemp, M., Hadly, E.  SIZE-BIASED EXTINCTION EXHIBITED BY QUATERNARY CARIBBEAN LIZARDS

2:45  Demar, D., Wilson, G.  SQUAMATE TURNOVER IN THE 2 MILLION YEARS LEADING UP TO AND ACROSS THE K-PG BOUNDARY IN NORTHEASTERN MONTANA: EVIDENCE FOR A COMPLEX EXTINCTION SCENARIO

3:00  Conrad, J., Wang, Y., Xu, X., Pyron, A., Clark, J.  SKELETON OF A HEAVILY ARMORED AND LONG LEGGED MIDDLE JURASSIC LIZARD (SQUAMATA, REPTILIA)

3:15  Richter, A., Knötschke, N., Kosma, R., Sobral, G., Wings, O.  THE FIRST MESOZOIC LIZARD FROM NORTHERN GERMANY (PARAMACELLODIDAE, LATE JURASSIC, LANGENBERG QUARRY) AND ITS TAPHONOMY

3:30  Konishi, T., Newbrey, M., Caldwell, M.  WHO GETS TO EAT WHAT: NICHE PARTITIONING BETWEEN PHYLOGENETICALLY CLOSELY RELATED BUT MORPHOLOGICALLY DISPARATE MOSASAURS (MOSASAURIDAE: MOSASAURINAE), MOSASAURUS MISSOURIENSIS AND PROGNATHODON OVERTONI, BASED ON NEW MATERIAL FROM THE UPPER CAMPANIAN BEARPAW FORMATION, ALBERTA CANADA


4:00  Scheyer, T., Neenan, J.  BONE HISTOLOGY OF PLACODONT MARINE REPTILES (SAUROPTERYGIA) FROM EUROPE

WEDNESDAY AFTERNOON, OCTOBER 30, 2013
Poster Session I
Westin Bonaventure Hotel & Suites, Exhibit Hall
Authors must be present from 4:15 - 6:15 p.m.
Posters must be removed by 6:30 p.m.

1  Sadleir, R., Makovicky, P., Hutchinson, J.  COMPARATIVE MASS ESTIMATE METHODS OF 3D DIGITAL MODELS OF ORNITHISCHIAN SKELETONS AND GASTROLITHS

2  White, D.  PHYLOGENETIC VERSUS SERIAL VARIATION IN THE ORNITHISCHIAN DINOSAUR AXIAL SKELETON: A GEOMETRIC MORPHOMETRIC STUDY

3  Poole, K.  FINITE ELEMENT ANALYSIS OF THE CARPUS OF CAMPTOSAURUS AND THE EVOLUTION OF CARPAL FUSION IN ANKYLOPOLLEXIA


5  Takasaki, R., Kobayashi, Y., Chiba, K.  REANALYSIS OF NIPPONOSAURUS SACHALINENSIS (ORNITHOPODA: DINOSAURIA) FROM UPPER CRETACEOUS OF SOUTHERN SAKHALIN AND ITS PHYLOGENETIC STATUS WITHIN LAMBEOSAURINAE

6  Marquart, C.  MORPHOMETRIC APPROACHES TO TAXONOMIC QUESTIONS IN IGUANODONTIAN DINOSAURS

7  Clayton, K., Loewen, M., Irmis, R.  PHYLOGENETIC UTILITY OF HADROSAURID DINOSAUR (ORNITHISCHIA: ORNITHOPODA) INTEGUMENTARY IMPRESSIONS
Poster Session I (CONTINUED)

8 Prieto-Marquez, A., Serrano Brañas, C., Torres Rodríguez, E., Reyes Luna, P., Espinosa Chávez, B. 
JUVENILE SAUROLOPHINE SPECIMENS (DINOSAURIA: HADROSAURIDAE) FROM THE LATE CAMPANIAN (CRETACEOUS) OF NORTHEASTERN MEXICO

9 Rivera-Sylva, H., Barrón, C. DENTAL MICROWEAR ANALYSIS OF THE LATE CRETACEOUS (LATE CAMPANIAN) HADROSAURS FROM THE CERRO DEL PUEBLO FORMATION, NORTHERN MEXICO

10 Noto, C., Main, D., Poole, K. PHYLOGENETIC AND BIOSTRATIGRAPHIC IMPLICATIONS OF NEW POSTCRANIAL MATERIAL OF PROTOHADROS (ORNITHOPODA, HADROSAUROIDEA) FROM THE WOODBINE FORMATION OF TEXAS

11 Kay, D., Erickson, G., Norell, M. EVOLUTION OF CERATOPSIAN DENTAL MICROSTRUCTURE

12 Morschhauser, E., Lamanna, M. A REEVALUATION OF THE OSSIFIED HYOID APPARATUS OF PROTOCERATOPS ANDREWSI (ORNITHISCHIA: CERATOPSIA) AND A REVIEW OF HYOID ELEMENTS IN ORNITHISCHIAN DINOSAURS

13 Varriale, F. THE UNIQUE PREMAXILLARY DENTITION OF YINLONG DOWNSI, AND THE MORPHOLOGY, FUNCTION, AND EVOLUTION OF PREMAXILLARY TEETH IN CERATOPSIA

14 Ryan, M., Holmes, R., Mallon, J. A NEW RELICT BASAL CERATOPSID FROM THE OLDMAN FORMATION (CAMPANIAN) OF ALBERTA WITH IMPLICATIONS FOR CENTROSERAURINE EVOLUTION

15 Tanoue, K., Li, D., You, H. TOOTH REPLACEMENT PATTERN IN MAXILLARY DENTITION OF BASAL NEOCERATOPSIA (ORNITHISCHIA, DINOSAURIA)

16 Vanburen, C., Campione, N., Tanke, D., Evans, D. TESTING ADAPTIVE HYPOTHESES FOR ANTERIOR CERVICAL FUSION IN CERATOPSIA

17 Campbell, J., Ryan, M., Schröder-Adams, C., Holmes, R., Evans, D. A SPECIMEN-BASED PHYLOGENETIC ANALYSIS OF THE CHASMOSAURINE CERATOPSID CHASMOSAURUS (ORNITHISCHIA) FROM THE UPPER CRETACEOUS (CAMPANIAN) DINOSAUR PARK FORMATION OF WESTERN CANADA SUGGESTS THE VALIDITY OF ONLY ONE SPECIES

18 Kirkland, J., Alcala, L., Loewen, M., Espilez, E., Mampel, L. NEW NODOSAURID ANKYLOSAUR (DINOSAURIA) FROM THE LOWER ALBIAN ESCUCHA FORMATION, TERUEL, SPAIN REVEALS THAT SINCE THEIR APTIAN ORIGIN, NODOSAURID SPECIES IN NORTH AMERICA AND EUROPE DEFINE PALEOBIOGEOGRAPHICALLY SEPARATE CLADES

19 Alicea, J., Loewen, M. NEW MINOTAURASAURUS MATERIAL FROM THE DJIODOKTA FORMATION ESTABLISHES NEW TAXONOMIC AND STRATIGRAPHIC CRITERIA FOR THE TAXON

20 Wiersma, J., Irmis, R. A NEW ANKYLOSAURID DINOSAUR (ORNITHISCHIA: THYREOPHORA) FROM THE UPPER CAMPANIAN KAIAPROWITS FORMATION OF GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT, SOUTHERN UTAH

21 Yang, J., You, H., Li, D., Kong, D. A NEW ANKYLOSAURID DINOSAUR FROM THE EARLY CRETACEOUS HEKOU GROUP OF Lanzhou-Minhe Basin, North-Central China

22 Sullivan, R., Arbour, V., Burns, M., Lucas, S. A NEW ANKYLOSAURID DINOSAUR (ORNITHISCHIA, ANKYLOSAURIA) FROM THE UPPER CRETACEOUS KIRTLAND FORMATION, SAN JUAN BASIN, NEW MEXICO, USA
WEDNESDAY AFTERNOON, OCTOBER 30, 2013
Poster Session I (CONTINUED)

23 Bramble, K., Arbour, V., Currie, P. INTERPRETING THE FACIAL INTEGUMENT OF ANKYLOSAURS

24 Burns, M., Hayashi, S., Currie, P., Watabe, M. GROWTH, DEVELOPMENT, AND THE PROBLEM OF ANKYLOSAURIAN ONTOGENY


26 O'Keefe, F., Byrd, C. ANATOMY OF A NEONATE SKULL OF DOLICHORHYNCHOPS (PLESIOSAURIA)

27 Kato, T., Tanabe, K. TOOTH IMPLANTATION AND REPLACEMENT IN POLYCOTYLID PLESIO SAURS

28 Byrd, C. ONTOGENETIC VARIATION AMONG POLYCOTYLID PLESIO SAURS (SAUROPTERYGIA: PLESIO SAURIA) AND ITS IMPLICATIONS FOR PLESIO SAUR GROWTH

29 Serratos, D. J., Druckenmiller, P. OSTEOLOGY OF A NEW SPECIMEN OF AN ELASMO SAURID PLESIO SAUR (REPTILIA: SAUROPTERYGIA) FROM THE UPPER CRETACEOUS BEARPAW SHALE, MONTANA

30 Araujo, R., Lindgren, J., Jacobs, L., Polcyn, M., Schulp, A. PHYLOGENY AND PAEDOMORPHISM IN ANGOLAN MAASTRICHTIAN ELASMO SAURIDS

31 Ma, L., Jiang, D., Rieppel, O., Motani, R., Tintori, A. A NEW PISTOSAUROID (REPTILIA: SAUROPTERYGIA) FROM THE LATEST LADINIAN XINGYI MARINE VERTEBRATE LEVEL, SOUTHWESTERN CHINA

32 Ji, C., Jiang, D., Rieppel, O., Motani, R., Tintori, A. A NEW SPECIMEN OF NOTHOSAURUS YOUNGI FROM THE MIDDLE TRIASSIC OF SOUTH CHINA BLURRING THE DISTINCTION BETWEEN NOTHOSAURUS AND LARIOSAURUS

33 Jiang, D., Rieppel, O., Motani, R., Tintori, A., Ji, C. EFFECT OF NEW RECORDS OF EARLY AND MIDDLE TRIASSIC EOSAUROPTERYGIANS FROM SOUTH CHINA ON RECONSTRUCTION OF SAUROPTERYGIAN TREE TOPOLOGY

34 Mccartney, J. USING VERTEBRAL MORPHOLOGY TO PREDICT HABITAT PREFERENCE IN EXTINCT SNAKES

35 D'Amore, D. USING GEOMETRIC MORPHOMETRICS TO QUANTIFY SHAPE-SIZE HETERODONTY IN NON-MAMMALIAN TAXA: A CASE STUDY INVESTIGATING DENTAL ONTOGENY IN THE NILE MONITOR, VARANUS NILOTICUS

36 Ferrer, E. WHY HIGHER SPECIES DIVERSITY DOES NOT ALWAYS EQUAL HIGHER MORPHOLOGICAL DISPARITY: AN EXAMPLE FROM VARANID LIZARDS

37 Buynevich, I., Wiest, L., Bien, D., Smith, K., Nyquist, J. GEOPHYSICAL IMAGING OF SNAKE BURROWS IN AEOLIAN SANDS: IMPLICATIONS FOR THE FOSSIL RECORD OF SQUAMATES

38 Petermann, H., Field, D. A NEW CT-BASED ANALYTICAL APPROACH FOR EXPLORING TAPHONOMIC BIASES IN TERRESTRIAL VERTEBRATE ASSEMBLAGES

Corresponding board numbers in left hand column
Olori, J., Bell, C., Jass, C.  THE PLEISTOCENE HERPETOFAUNA FROM ROOM 2 OF CATHEDRAL CAVE, WHITE PINE COUNTY, NEVADA

Scarpetta, S., Kemp, M., Hadly, E.  ANCIENT DNA AND THE ROLE OF ISLAND FRAGMENTATION IN DIVERGENCE OF LIZARDS OF THE GENUS AMEIVA

Bolet, A., Delfino, M., Fortuny, J., Almécija, S., Alba, D.  A PARTIAL SKULL OF OPHISAUROUS (SQUAMATA, ANGUIDAE) FROM THE MIOCENE OF CATALONIA (NE IBERIAN PENINSULA)

Cernansky, A., Rage, J., Klembara, J.  WIESBADEN - AMONEBURG IN GERMANY: THE FIRST STEPS OF THE MODERN SQUAMATE FAUNA IN EUROPE DURING THE EARLIEST MIocene

Chovanec, K., Schubert, B., Mead, J.  NON-ANGUIMORPH LIZARDS FROM THE LATE OLIGOCENE AND EARLY MIocene OF NORTHERN FLORIDA, USA AND IMPLICATIONS FOR NEW WORLD SQUAMATE BIOGEOGRAPHY

Starck, E., Welsh, E.  THE FIRST REPORTED RECORD OF OLIGOCENE IGUANIDAE (REPTILIA: SQUAMATA) FROM THE WHITE RIVER GROUP OF BADLANDS NATIONAL PARK, SOUTH DAKOTA


Folie, A., Rana, R., Augé, M., Kumar, K., Smith, T.  NEW LIZARDS FROM THE EARLY EOCENE VASTAN LIGNITE MINE OF INDIA

Elshafie, S., Head, J.  DIVERSITY AND BODY SIZE EVOLUTION OF ANGUID LIZARDS THROUGH CLIMATIC TRANSITIONS OF THE NORTH AMERICAN CENOZOIC

Nydam, R.  LIZARDS FROM THE JUDITH RIVER FORMATION (UPPER CRETACEOUS), HILL COUNTY, MONTANA

Japundzic, D., Campbell, M., Krizmanic, K., Caldwell, M.  A NEW CENOMANIAN-TURONIAN PONTOSAUR FROM CROATIA

Campbell, M., Krizmanic, K., Japundzic, D., Caldwell, M.  A NEW OPHIDIOMORPH TAXON FROM THE TURONIAN OF CROATIA

Schulp, A., Jagt, J.  A NEW MOSASAUR FROM THE TYPE MAASTRICHTIAN

Street, H., Caldwell, M., Konishi, T.  MOSASAURUS LEMONNIERI DOLLO, 1889: A DISTINCT AND DIAGNOSABLE TAXON OF MOSASAURINE MOSASAUR

Jimenez-Huidobro, P., Caldwell, M.  TYLOSARUS KANSASENSIS, T. PRORIGER, AND T. NEPAEOLICUS: CAN THEY BE DIFFERENTIALLY DIAGNOSED?

Trevethan, I.  THERMOREGULATORY STATUS OF MOSASAURS FROM THE WESTERN INTERIOR SEAWAY OF KANSAS, USA

Matthews, T., Patterson, D.  THE PALEOECOLOGY OF THE FROGS FROM THE EARLY PLIOcene SITE OF LANGEBAANWEG (WEST COAST, SOUTH AFRICA)

Bredehoeft, K., Samuels, J.  DIVERSITY IN FROGS (RANIDAE) FROM THE HAGERMAN LOCAL FAUNA, PLIOcene OF IDAHO

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Poster Session I (CONTINUED)

57 Jacisin, J., Hopkins, S.  DESCRIPTION, CLASSIFICATION, AND PALEOECOLOGY OF THE OLIGOCENE SALAMANDERS OF OREGON.

58 Blackburn, D., Roberts, E., Stevens, N.  A LATE OLIGOCENE ANURAN FAUNA FROM THE NSUNGWE FORMATION, SOUTHWESTERN TANZANIA

59 Canoville, A., Chinsamy-Turan, A.  BONE MICROSTRUCTURE PROVIDES NEW EVIDENCE FOR TERRESTRIAL LIFESTYLE ADAPTATIONS FOR THE LOWER TRIASSIC STEREOSPONDYL LYDEKKERINA (TETRAPODA: TEMNOSPONDYLI)

60 Huertas, S., Steyer, J., Segalen, L., Sidor, C., Angielczyk, K.  PALEOHISTOLOGY AND BIOGEOCHEMISTRY OF TRIASSIC TEMNOSPONDYLs FROM TANZANIA AND ZAMBIA: IMPLICATIONS FOR TAPHONOMY OF THE KAROO SYSTEM

61 Dilkes, D.  THE CARPUS AND TARSUS OF TEMNOSPONDYL

62 Mchugh, J.  INCORPORATING LIFE HISTORY TRAITS AS DISCRETE MORPHOLOGICAL CHARACTERS IN PHYLOGENY RECONSTRUCTION

63 Beightol V, C., Huttenlocker, A. K., Peecook, B., Sidor, C., Smith, R.  A NEW BASAL STEREOSPONDYL (TEMNOSPONDYLI) FROM THE LOWER TRIASSIC FREMOUW FORMATION OF ANTARCTICA

64 Angielczyk, K., Cisneros, J., Marsicano, C., Smith, R., Gostling, N.  NEW VERTEBRATES FROM THE PERMIAN PEDRA DE FOGO FORMATION, PARNAIBA BASIN, NORTHEASTERN BRAZIL

65 Fraser, N., Clack, J., Millward, D., Davies, S., Marshall, J.  NEW VERTEBRATE FAUNAS FROM THE EARLIEST CARBONIFEROUS OF SCOTLAND

66 Hastings, A., Bourque, J., Bloch, J., Rincon Burbano, A., Jaramillo, C.  NEW FOSSIL LUNGFISHES (DIPNOI, LEPIDOSIRENIDAE) FROM THE PALEOGENE OF NORTHERN SOUTH AMERICA AND NEW METHODS FOR TOOTHPLATE IDENTIFICATION

67 Chen, G., Chang, M., Liu, H.  A LATE EOCENE PROCYPRIS-LIKE CYPRINID (TELEOSTEI, PISCES) FROM SOUTH CHINA

68 Liu, J., Wilson, M., Murray, A.  NORTH AMERICAN EOCENE SUCKERS AND THEIR IMPLICATIONS FOR THE SYSTEMATICS OF CATOSTOMIDAE (OSTARIOPHYSI, CYPRINIFORMES)

69 Stevens, W., Claeson, K., Stevens, N.  ALESTID FISHES FROM THE LATE OLIGOCENE NSUNGWE FORMATION OF TANZANIA

70 Divay, J., Murray, A.  ICHTHYOFAUNA OF THE CYPRESS HILLS FORMATION (LATE EOCENE–EARLY OLIGOCENE), EASTEND AREA, SASKATCHEWAN, CANADA

71 Argyriou, T., Murray, A.  FISH DIVERSITY AND PALEOENVIRONMENTS FROM THE LATE MIOCENE OF SAHABI, LIBYA

72 Murray, A., Argyriou, T., Cook, T.  ELASMOBRANCHS OF THE LOWER JBEL QATRANI FORMATION, FAYUM, EGYPT

73 Shimada, K., Welton, B., Long, D.  A NEW FOSSIL MEGAMOUTH SHARK (LAMNIFORMES: MEGACHASMIDAE) FROM THE OLIGO-MIOCENE OF THE WESTERN UNITED STATES

74 Pimiento, C., Balk, M.  CHRONOCLINAL BODY SIZE INCREASE OF THE EXTINCT GIANT SHARK MEGALODON (CARCHARCOLES MEGALODON)

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75 Hastie, D., Fitzgerald, E. A NEW ELASMOBRANCH ASSEMBLAGE FROM THE LATE MIOCENE OF AUSTRALIA SHEDS LIGHT ON THE EVOLUTION OF SHARK DIVERSITY IN THE SOUTHERN OCEAN

76 Soto, L., Macfadden, B. NEW CHONDRICHTHYAN FAUNA FROM MIDDLE MIOCENE (BARSTOVIAN), GADSEN COUNTY, FLORIDA, USA.

77 Biasatti, D., Godfrey, S., Cooper, L. PALEOECOLOGIES AND PALEOCLIMATES OF MIOCENE SHARK TAXA FROM CALVERT CLIFFS, MARYLAND, USA: EVIDENCE FROM STABLE CARBON AND OXYGEN ISOTOPES

78 Maisch, Iv, H., Becker, M., Chamberlain, Jr., J. CHONDRICHTHYAN REMAINS FROM THE SHARK RIVER FORMATION (MIDDLE EOCENE) AND KIRKWOOD FORMATION (EARLY MIOCENE) LAG DEPOSIT, MONMOUTH COUNTY, NEW JERSEY

79 Woodruff, E., Burleigh, G., Bloch, J. SUPERTREE PERSPECTIVES ON THE PHYLOGENY OF FOSSIL AND EXTANT MAMMALS

80 Halliday, T., Upchurch, P., Goswami, A. A PHYLOGENETIC ANALYSIS OF PALAEOCENE MAMMALS: IMPLICATIONS FOR THE ORIGIN OF PLACENTAL MAMMAL ORDERS

81 Williamson, T., Brusatte, S. NEW SPECIMENS OF WORTMANIA (MAMMALIA, TAENIODONTA) FROM THE EARLY PALEOCENE (PUERCAN) OF NEW MEXICO

82 Eberle, J., Lofgren, D., Hettinger, R., Mecomas, K., Soltis, C. A NEW PUERCAN FAUNA FROM WYOMING'S GREAT DIVIDE BASIN

83 Penkrot, T., Zack, S., Strait, S. THE DIVERSITY OF SMALL MAMMALIAN TARSALS FROM CASTLE GARDENS, EARLIEST EOCENE OF WYOMING

84 Strait, S., Bloch, J., Morse, P., Boyer, D. DIVERSITY AND ABUNDANCE OF LATE PALEOCENE/EARLY EOCENE MULTITUBERCULATA FROM THE SOUTHEASTERN BIG HORN BASIN, WYOMING

85 Smith, T., Russell, D., Habersetzer, J., Gunnell, G. DIVERSITY OF ARCHAEONYCTERID BATS IN THE EARLY EOCENE OF EUROPE

86 Ahrens, H. FOOT POSTURE IN EARLY EOCENE HYAENODONTIDAE AND OXYAENIDAE FROM WYOMING

87 Chew, A. MAMMALIAN FAUNAL RESPONSE TO THE ETM2 AND H2 HYPERTHERMAL EVENTS IN THE CENTRAL PART OF THE BIGHORN BASIN, WY

88 Rose, K., Dunn, R., Grande, L. NEW EARLY EOCENE PANTOLESTID SKELETON FROM FOSSIL BUTTE MEMBER, WYOMING, AND SKELETAL ONTOGENY IN PANTOLESTIDAE (MAMMALIA, PANTOLESTA)

89 Moore, J. INVESTIGATING THE INFLUENCE OF TAXON AND ECOLOGY ON TAPHONOMIC MODIFICATION

90 Santos, G., Cortez, C., Garibay, A., Magallanes, I., Parham, J. NEW RECORDS OF TERRESTRIAL VERTEBRATES FROM AN EOCENE BONEBED IN ORANGE COUNTY, CALIFORNIA

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91 Campisano, C., Kirk, E., Townsend, K., Deino, A., Mcdowell, F.  GEOCHRONOLOGICAL AND TAXONOMICAL REVISION OF THE MIDDLE EOCENE WHISTLER SQUAT QUARRY (DEVIL'S GRAVEYARD FORMATION, TEXAS) AND IMPLICATIONS FOR THE EARLY UINTAN IN WEST TEXAS

92 Naylor, E., Krause, C., Stevens, N.  PHYLOGENETIC AND FUNCTIONAL CUES IN MICROMAMMAL TARSAL BONES FROM THE LATE OLIGOCENE NSUNGWE FORMATION OF SOUTHWESTERN TANZANIA

93 Bommersbach, B., Anemone, R., Emerson, C.  PREDICTIVE MODELING IN THE SEARCH FOR VERTEBRATE FOSSILS: GEOGRAPHIC OBJECT BASED IMAGE ANALYSIS (GEOBIA) IN THE EOCENE OF WYOMING

94 Habersetzer, J., Engels, S., Smith, K.  DIVERSE STRATEGIES FOR IMPROVING CT SCANS OF VERTEBRATE FOSSILS

95 Reynoso, D., Spell, T.  EVOLUTION OF DENTITION IN MEROËHYRAX FROM THE LATE OLIGOCENE OF KENYA: PALEONTOLOGICAL ANALYSIS AND $^{40}\text{Ar}/^{39}\text{Ar}$ DATING

96 Koda, Y., Saegusa, H., Ando, H., Iizumi, K.  THE FIRST NEARLY COMPLETE SKULL OF STEGOLOPHODON (STEGODONTIDAE, PROBOSCIDEA) FROM THE LOWER MIOCENE OF JAPAN

97 Sanders, W.  CLASSIFICATION AND BIOCHRONOLOGY OF AFRICAN MIOCENE PROBOSCIDEANS

98 El Adli, J., Cherney, M., Fisher, D., Harris, J., Farrell, A.  LAST YEARS OF LIFE AND SEASON OF DEATH OF A COLUMBIAN MAMMOTH FROM RANCHO LA BREA


100 Uno, H., Taru, H., Kohno, N.  INTRA-TOOTH VARIATION IN MULTI-ELEMENTARY ISOTOPE ANALYSES ALONG GROWTH-LINES OF TOOTH ENAMEL OF DESMOSTYLUS (MAMMALIA, AFROTHERIA)

101 Whalen, C., Fisher, D., Rountrey, A., Holmes, C.  QUANTITATIVE APPROACH TO RIB IDENTIFICATION AT AN ALASKAN PLEISTOCENE SITE

102 Kalthoff, D.  EXTREMELY COARSE USE WEAR FEATURES IN TEETH OF AARDVARKS (MAMMALIA, TUBULIDENTATA, ORYCTEROPUS AFER)

103 Fröbisch, J., Walther, M.  THE QUALITY OF THE FOSSIL RECORD OF ANOMODONTS (SYNAPSIDA, THERAPSIDA)

104 Sullivan, C., Liu, J., Roberts, E., Huang, T., Yang, C.  THE STRUCTURE OF THE PELVIS IN TRITYLODONTIDS (SYNAPSIDA, EUCYNODONTIA) AND ITS PHYLOGENETIC AND FUNCTIONAL IMPLICATIONS


106 Viglietti, P., Smith, R., Compton, J., Botha-Brink, J.  LYSTROSARUS BONEBED ORIGINS AND THEIR PALAEOENVIRONMENTAL IMPLICATIONS FOR THE EARLIEST TRIASSIC KAROO BASIN, SOUTH AFRICA

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Jansen, M., Reisz, R., Kammerer, C., Fröbisch, J.  A NEW BASAL DINOCEPHALIAN FROM THE MIDDLE PERMIAN MEZEN FAUNA (RUSSIA)

Sigurdsen, T.  THE GORGONOPSIAN BRAINCASE AND THE EVOLUTION OF THERAPSID BRAINS

Chinsamy-Turan, A.  EVIDENCE OF FUNGAL ATTACK ON THE BONES OF A PERMIAN THERAPSID

Wretman, L., Blom, H., Kear, B.  THE LOWER JURASSIC ACTINOPTERYGIAN PACHYCORMUS BOLLENSIS: IMPLICATIONS FOR PACHYCORMIFORM PHYLOGENY AND PALEOBIOGEOGRAPHY

Schröder, K., López-Arbarello, A., Rauhut, O.  REDESCRIPTION OF ASPIDORHYNCHUS ORNATISSIMUS AGASSIZ, 1834 FROM GERMANY

Holloway, W., Claeson, K., Sertich, J., Sallam, H., O'Connor, P.  A NEW SPECIMEN OF ENCHODUS (ACTINOPTERYGII: PROTACANTHOPTERYGII) FROM THE LATE CRETACEOUS OF EGYPT AND ITS CONTRIBUTION TO THE WESTERN TETHYAN DISTRIBUTION OF THE GENUS

Fielitz, C., Cowan, T.  TWO THREE DIMENSIONALLY PRESERVED TELEOST NEUROCRANIA FROM THE CORSICANA FORMATION (UPPER CRETACEOUS, MAASTRICHTIAN), BEXAR COUNTY, TEXAS, U.S.A.

Schwimmer, D., Weems, R., Sanders, A.  A LATE CRETACEOUS SHARK COPROLITE WITH BABY TURTLE VERTEBRAE

Frampton, E., Cook, T., Newbrey, M.  PRELIMINARY INVESTIGATIONS OF CHONDRICHTHYAN AND ACTINOPTERYGIAN FISHES FROM THE FISH SCALE SANDSTONE (ALBIAN TO CENOMANIAN), BIRCH MOUNTAINS, ALBERTA, CANADA

Newbrey, M., Cook, T., Siverson, M., Wilson, M., Neuman, A.  ANACORACID VERTEBRAL MORPHOLOGY AND COMPARISON TO LAMNIFORMES AND CARCHARHINIFORMES SUGGEST AN ORDINAL ASSIGNMENT

Boles, Z., Lacovara, K.  EVIDENCE OF EXTENSIVE SCAVENGING/PREDATION BY LATE CRETACEOUS MARINE ORGANISMS FROM THE BASAL HORNERSTOWN FORMATION, NEW JERSEY, USA

Bice, K., Shimada, K., Decker, R.  FOSSIL MARINE FISHES FROM THE CODELL SANDSTONE MEMBER OF THE UPPER CRETACEOUS CARLILE SHALE IN NORTH-CENTRAL KANSAS, U.S.A.

Meglei, A., Shimada, K., Kirkland, J.  FOSSIL MARINE VERTEBRATES FROM THE MIDDLE GRANEROS SHALE (UPPER CRETACEOUS: MIDDLE CENOMANIAN) IN SOUTHEASTERN NEBRASKA, U.S.A.

Mcintosh, A., Shimada, K., Everhart, M.  LATE CRETACEOUS MARINE VERTEBRATE FAUNA FROM THE FAIRPORT CHALK MEMBER OF THE CARLILE SHALE IN SOUTHERN ELLIS COUNTY, KANSAS, U.S.A.

Lindoso, R., Maisey, J., Carvalho, I.  THE PALEOICHTHYOFAUNA FROM THE CODÓ FORMATION (APTIAN OF THE PARNAÍBA BASIN) NORTHEASTERN BRAZIL

Hunt-Foster, R., Foster, J.  PALEOFAUNA OF THE WILLIAMS FORK FORMATION (UPPER CRETACEOUS), NORTHWESTERN COLORADO: COASTAL DELTAIC DEPOSITS DOMINATED BY FRESHWATER TAXA

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WEDNESDAY AFTERNOON, OCTOBER 30, 2013
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123 Zorigt, B., Horner, J. INTRASKELETAL HISTOVARISIBILITY DURING PSITTACOSAURUS MONGOLIENSIS ONTOGENY

124 Carr, T. USING ONTOGENY AND PHYLOGENY TO TEST HYPOTHESES OF ANAGENESIS IN THE VERTEBRATE FOSSIL RECORD: A CASE STUDY OF THE SISTER GROUP RELATIONSHIP BETWEEN DASPLETOSAURUS AND TYRANNOSAURUS (DINOSAURIA, COELUROSAURIA)

THURSDAY MORNING, OCTOBER 31, 2013
Preparators' Session
Westin Bonaventure Hotel & Suites, San Jose Ballroom
MODERATORS: Howell W. Thomas and Vanessa R. Rhue

8:00 Kurtova, A., Kharlamova, A., Protopopov, A., Plotnikov, V., Potapova, O. THE YUKA WOOLLY MAMMOTH (MAMMUTHUS PRIMIGENIUS BLUM) BRAIN EXTRACTION AND PRESERVATION: THE METHODS AND RESULTS

8:15 Lund, E., Lawrence, D. UNDER THE HEADWALL: FIELD LOGISTICS OF EXCAVATING FOSSILS FROM LARGE VERTICAL EXPOSURES

8:30 De Blieux, D., Kirkland, J., Madsen, S. TARPOLOGY 501 - ADVANCED SHADE TARP TECHNIQUES FOR PALEONTOLOGICAL FIELD EXCAVATIONS; STRATEGIES FOR FIELD PALEONTOLOGY ON A WARMING PLANET

8:45 Smith, M. CUTTING OUT THE MIDDLE MAN: ARCHIVAL SUPPORT CRADLE DESIGN FOR USE DURING PREPARATION

9:00 Van Beek, C. A FINE KETTLE OF FISH: PREPARATION OF A LARGE CRETACEOUS FIELD JACKET CONTAINING MULTIPLE ASIPENCERIFORMES

9:15 Bugbee, M., Wilkins, W. DAMAGE CONTROL, SAFETY, AND PREPARATION ON A VOLUNTEER-BASED EXCAVATION OF AN IN SITU BONEBED AT THE MAMMOTH SITE OF HOT SPRINGS, SD, INC.

9:30 Baziak, B. PREPARATION OF A CROCODYLIFORM AND SAUROPOD DINOSAUR FROM MONTANA: SOLUTIONS TO COMPLEX MOLDING PROBLEMS

9:45 Rice, K., Lai, K., Sessions, A., Takeuchi, G. NEW TECHNIQUE TO REMOVE ASPHALT FROM MICROFOSSIL-RICH MATRIX FROM RANCHO LA BREA

10:00 BREAK

10:15 Brown, G. PRACTICAL METHODS FOR THE USE OF CYCLODECANE IN VERTEBRATE MICROFOSSIL PREPARATION


10:45 Marcos, F., Blanco, M., Díaz, S., Ortega, F. LASER CLEANING OF MACROVERTEBRATE FOSSILS FROM THE UPPER CRETACEOUS SITE OF “LO HUECO” (CUENCA, SPAIN)

11:00 Norris, C., Yarborough-Fitzgerald, V., Fox, M. MOVING MARSH'S DINOSAURS INTO THE 21ST CENTURY

11:15 Getty, M. MOVING COLLECTIONS INTO THE NEW NATURAL HISTORY MUSEUM OF UTAH

11:30 Brown, M. FOSSIL SPECIMENS AS THEORETICAL MODELS

October 2013—PROGRAM AND ABSTRACTS
THURSDAY MORNING, OCTOBER 31, 2013
Preparators’ Session (Continued)

11:45  Lash, C., Smith, M., Parker, W.  A TALE OF TWO EXHIBITS: THE FOSSIL PREPARATOR AS AN INTEGRAL PART OF MUSEUM OUTREACH

12:00  Rhue, V.  IMPARTING OUR KNOWLEDGE: EDUCATING THE NEXT GENERATION OF FOSSIL PREPARATORS AND COLLECTIONS PERSONNEL

THURSDAY MORNING, OCTOBER 31, 2013
Romer Prize Session
Westin Bonaventure Hotel & Suites, San Francisco Ballroom
MODERATORS: David Fox and Ken Angielczyk

8:00  Bonde, A.  STABLE ISOTOPE PALEOECOLOGY OF LATE PLEISTOCENE MEGAHERBIVORES FROM WESTERN NORTH AMERICA

8:15  Brassey, C.  HIND LIMB ROBUSTICITY IN TWO FAMILIES OF SOUTH ISLAND NEW ZEALAND MOA (AVES, DINORNITHIFORMES) COMPARED TO MODERN RATITES: NEW VOLUMETRIC BODY MASS ESTIMATES AND FINITE ELEMENT ANALYSIS

8:30  Brusatte, S.  THE PHYLOGENY OF COELUROSAUR THEROPODS (ARCHOSAURIA: DINOSAURIA) AND PATTERNS OF MORPHOLOGICAL EVOLUTION DURING THE DINOSAUR-BIRD TRANSITION

8:45  Drewicz, A.  QUANTIFYING PERIODS OF DIFFUSION IN MARINE AND TERRESTRIAL MAMMALIAN VERTEBRATE FOSSILS USING RARE EARTH ELEMENTS

9:00  Drumheller, S.  PHYLOGENETIC TAPHONOMY: SYNTHESIZING BITE MARK DATASETS USING STATISTICAL AND CLADISTIC METHODS

9:15  Evans, T.  EMPIRICAL AUTHENTICATION OF OUR UNDERSTANDING OF FLUVIAL TAPHONOMIC PROCESSES

9:30  Fischer, V.  THE EXTINCTION OF ICHTHYOSAURS IS A FACET OF A MAJOR CENOMANIAN TURNOVER IN MARINE ECOSYSTEMS

9:45  Huttenlocker, A. K.  THE MEANING AND MECHANISM OF ‘LILLIPUT’ PATTERNS IN NONMAMMALIAN THERAPSIDS IN THE AFTERMATH OF THE END-PERMIAN EXTINCTION

10:00 BREAK

10:15  Kelley, N.  ECOMORPHOLOGICAL DIVERSITY OF TRIASSIC MARINE REPTILES

10:30  Kimura, Y.  DENTAL ADAPTATIONS LINKED TO ISOTOPIC DIET AND EVOLUTIONARY PATTERN IN MURINE RODENTS FROM THE MIOCENE OF PAKISTAN

10:45  Lautenschlager, S.  UNRAVELING THERIZINOSAUR PALEOBIOLOGY – A MULTI-ANGLE APPROACH

11:00  Nakajima, Y.  ESTIMATION OF THE BONE GROWTH CENTER USING INNER BONE STRUCTURAL FEATURES AND ITS APPLICATION FOR PALEOHISTOLOGY

11:15  Neenan, J.  ORIGINS, SYSTEMATICS AND PALEOECOLOGY OF PLACODONT MARINE REPTILES (SAUROPTERYGIA, PLACODONTIA)

11:30  Stocker, M.  CONTEXTUALIZING VERTEBRATE FAUNAL DYNAMICS: NEW PERSPECTIVES FROM THE TRIASSIC AND EOCENE OF WESTERN NORTH AMERICA
THURSDAY MORNING, OCTOBER 31, 2013
Romer Prize Session (Continued)

11:45 **Tomiya, S.** CONCORDANCE AND DISCORDANCE OF DIVERSITY DYNAMICS ACROSS MAMMALIAN TROPHIC GROUPS IN THE MIDDLE EOCENE OF COASTAL SOUTHERN CALIFORNIA

12:00 **Tschopp, E.** A SPECIMEN-BASED PHYLOGENETIC ANALYSIS OF DIPLODOCIDAE (DINOSAURIA, SAUROPODA)

THURSDAY MORNING, OCTOBER 31, 2013
Technical Session VI
Westin Bonaventure Hotel & Suites, Sacramento Ballroom
MODERATORS: Nancy Simmons and Rachel Dunn

8:00 **Lofgren, D., Williamson, T., Nydam, R.** NEW RECORDS OF EUTHERIAN AND METATHERIAN MAMMALS FROM THE GOLER FORMATION OF CALIFORNIA AND THEIR IMPLICATIONS FOR LATE PALEOCENE PROVINCIALITY

8:15 **Simmons, N., Seiffert, E., Gunnell, G.** A NEW FAMILY OF LARGE OMNIVOROUS BATS FROM THE LATE EOCENE OF EGYPT

8:30 **Gunnell, G., Smith, R., Smith, T.** NEW BATS (CHIROPTERA) FROM THE EARLIEST OLIGOCENE BOUTERSEM-TGV LOCALITY IN BELGIUM DOCUMENT THE EARLIEST OCCURRENCE OF MYOTIS

8:45 **Padian, K., Dial, K.** NEW MORPHOLOGICAL DATA ILLUMINATE HINDLIMB FUNCTION AND THE ECOLOGICAL CONTEXT OF FLIGHT IN THE EARLIEST BATS

9:00 **Manz, C., Bloch, J.** SYSTEMATICS OF PALEOGENE LEPTACODON AND PLAGIOCTENODON (MAMMALIA, NYCTITHERIIDAE) WITH DESCRIPTION OF A NEW SPECIES FROM THE LATE PALEOCENE OF THE CLARKS FORK BASIN, WYOMING, USA

9:15 **Hooker, J.** NEW POSTCRANIALS OF THE EXTINCT FAMILY NYCTITHERIIDAE FROM THE LATE EOCENE: IMPLICATIONS FOR LIFESTYLE AND AFFINITIES

9:30 **Dunn, R., Rose, K., Kumar, K., Rana, R., Smith, T.** NEW PRIMATE POSTCRANIA FROM THE EARLY EOCENE OF VASTAN MINE, GUJARAT, INDIA

9:45 **Stroik, L.** THE ROLE OF DIETARY COMPETITION IN THE ORIGINATION OF EUPRIMATES IN NORTH AMERICA.

10:00 BREAK

10:15 **Stevens, N., Seiffert, E., Roberts, E., O'Connor, P.** PRIMATE DIVERSITY IN THE LATE OLIGOCENE NSUNGWE FORMATION OF SOUTHWESTERN TANZANIA

10:30 **Borths, M., Simons, E., Seiffert, E.** THE MOST COMPLETE AFRICAN HYAENODONTID (MAMMALIA, "CREODONTA") FROM THE LATEST EOCENE OF EGYPT AND THE EVOLUTION OF APTERODONTINAE

10:45 **Zack, S.** A REASSESSMENT OF THE MONOPHYLY OF CARNIVORAMORPHA (MAMMALIA)

11:00 **Beard, K., Coster, P., Salem, M., Chaimanee, Y., Jaeger, J.** A NEW EARLY OLIGOCENE VERTEBRATE FAUNA FROM ZALLAH OASIS, SIRT BASIN, LIBYA YIELDS THE OLDEST KNOWN AFRICAN CARNIVORAN

11:15 **Schwermann, L., Von Koenigswald, W.** DIFFERENTIATION AND SIMPLIFICATION IN DENTAL MORPHOLOGY AND FUNCTION DURING ARTIODACTYL EVOLUTION
THURSDAY MORNING, OCTOBER 31, 2013
Technical Session VI (Continued)

11:30 Hiard, F., Mennecart, B. EUROPEAN ARTIODACTYLS THROUGH THE EOCENE: UPDATED BIOSTRATIGRAPHY AND A TIMELINE OF FAUNAL TURNOVER

11:45 Bibi, F. THE IMPORTANCE OF THE FOSSIL RECORD FOR MOLECULAR PHYLOGENETICS: THE CASE OF BOVIDAE (ARTIODACTYLA, RUMINANTIA)

12:00 Mihlbachler, M., Samuels, J. LITTLE TITANS OF THE EOCENE: COPE’S RULE OR SAMPLING ARTIFACT?

THURSDAY AFTERNOON, OCTOBER 31, 2013
Symposium 2: La Brea and Beyond: The Paleontology of Asphalt-Preserved Biotas
Westin Bonaventure Hotel & Suites, Sacramento Ballroom
MODERATORS: Emily Lindsey and John Harris

1:45 Harris, J., Farrell, A., Takeuchi, G., Cox, S., Howard, C. EX RANCHO LA BREA" SEMPER ALIQUID NOVUM

2:00 Rincón, A., Solórzano, A., Mcdonald, H. PALEONTOLOGY OF VENEZUELAN TAR PITS AND THE GREAT AMERICAN BIOTIC INTERCHANGE

2:15 Seymour, K. PERUSING TALARA: OVERVIEW OF THE LATE PLEISTOCENE FOSSIL VERTEBRATES FROM THE TAR SEEPS OF PERU

2:30 Martínez, J., Cadenillas, R., Zapata, J. THE LATE PLEISTOCENE VERTEBRATE FAUNA OF THE TALARA TAR SEEPS (NORTHWESTERN PERU) - PAST, PRESENT AND FUTURE

2:45 Lindsey, E., Seymour, K. "TAR PITS" OF THE WESTERN COASTAL NEOTROPICS: PALEOECOLOGY, TAPHONOMY, AND MAMMALIAN BIOGEOGRAPHY

3:00 Campbell, K. THE OWLS OF RANCHO LA BREA: PREDATORS, NOT SCAVENGERS, RULE

3:15 Brannick, A., Meachen, J., O'Keefe, F. NUTRITIONAL STRESS INDUCES MORPHOLOGICAL CHANGES IN DIRE WOLVES FROM RANCHO LA BREA

3:30 Haupt, R., Desantis, L. INSIGHTS FROM DENTAL MICROWEAR TEXTURE ANALYSIS INTO THE SURVIVAL OF COUGARS (PUMA CONCOLOR) THROUGH THE LATE PLEISTOCENE EXTINCTION

3:45 Shaw, C., Quinn, J. THE ADDITION OF SMILODON FATALIS (MAMMALIA, CARNIVORA, FELIDAE) TO THE BIOTA OF THE LATE PLEISTOCENE CARPINTERIA ASPHALT DEPOSITS WITH ONTOGENETIC AND ECOLOGIC IMPLICATIONS FOR THE SPECIES

4:00 Mcdonald, H. A REEXAMINATION OF THE ORIGIN OF ASPHALT PRESERVED BIOTAS: ARE WE STUCK IN THE SAME OLD PARADIGM?

THURSDAY AFTERNOON, OCTOBER 31, 2013
Technical Session VII
Westin Bonaventure Hotel & Suites, San Francisco Ballroom
MODERATORS: Nicolás Campione and Caleb Brown

1:45 Porter, W., Witmer, L. EVIDENCE FOR SITES OF PHYSIOLOGICAL HEAT EXCHANGE IN THE HEADS OF DINOSAURS

2:00 Eagle, R., Enriquez, M., Grellet-Tinner, G., Tutken, T., Eiler, J. MEASURING THE BODY TEMPERATURE OF A DINOSAUR? THE POTENTIAL FOR PALEOPHYSIOLOGICAL STUDIES FROM THE ANALYSIS OF $^{13}$C-$^{18}$O BOND ORDERING IN FOSSIL BIOMINERALS

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**THURSDAY AFTERNOON, OCTOBER 31, 2013**

**Technical Session VII (Continued)**

2:15 **Sobral, G., Mueller, J.** PATTERNS OF MIDDLE EAR AND BRAINCASE EVOLUTION IN DINOSAURIA

2:30 **Jerison, H.** BIG-BRAINED DINOSAURS AND THEIR BODIES

2:45 **Campione, N., Evans, D., Brown, C., Carrano, M.** A NEW MATHEMATICALLY DERIVED SCALING EQUATION FOR ESTIMATING BODY MASS IN EXTINCT BIPEDS

3:00 **Tsai, H., Middleton, K., Holliday, C.** ANATOMY OF SAURISCHIAN HIP JOINT SOFT TISSUES AND ITS SIGNIFICANCE IN BODY SIZE EVOLUTION

3:15 **Sellers, W., Margetts, L., Coria, R., Manning, P. L.** ESTIMATING MUSCLE PARAMETERS FOR STUDIES OF SAUROPOD LOCOMOTION

3:30 **Brown, C., Campione, N., Evans, D.** BODY SIZE RELATED TAPHONOMIC BIASES IN THE LATEST MAASTRICHTIAN; IMPLICATIONS FOR THE END-CRETACEOUS EXTINCTION

3:45 **Bell, M., Upchurch, P., Mannion, P., Lloyd, G.** USING THE CHARACTER COMPLETENESS METRIC TO EXAMINE COMPLETENESS OF MESOZOIC DINOSAURS: A MAASTRICHTIAN HIGH AND A PALEOEQUATORIAL LOW

4:00 **Benson, R., Choniere, J.** RATES OF DINOSAUR LIMB EVOLUTION PROVIDE EVIDENCE FOR EXCEPTIONAL RADIATION IN MESOZOIC BIRDS

**THURSDAY AFTERNOON, OCTOBER 31, 2013**

**Technical Session VIII**

**Westin Bonaventure Hotel & Suites, San Jose Ballroom**

**MODERATORS:** Christian Kammerer and Rui Castanhinha

1:45 **Brocklehurst, N., Kammerer, C., Fröbisch, J.** THE INFLUENCE OF SAMPLING ON THE FOSSIL RECORD OF PALEOZOIC SYNAPSIDS, AND THE EFFECT OF OLSON’S EXTINCTION ON THEIR EVOLUTION

2:00 **Castanhinha, R., Araújo, R., Costa Júnior, L., Angielczyk, K., Martins, G. G.** NEUROANATOMY AND OSSEOUS LABYRINTH OF A NEW PERMIAN DICYNODONT FROM MOZAMBIQUE

2:15 **Kammerer, C., Jansen, M., Fröbisch, J.** THERAPSID PHYLOGENY REVISITED

2:30 **Day, M., Rubidge, B.** MIDDLE PERMIAN TETRAPOD BIODIVERSITY CHANGE AND THE GUADALUPIAN EXTINCTION: INSIGHTS FROM THE BEAUFORT GROUP OF SOUTH AFRICA.

2:45 **Krentzel, D., Flynn, J., Kammerer, C.** HIGH RESOLUTION X-RAY COMPUTED TOMOGRAPHY RECONSTRUCTION OF A NEW, WELL PRESERVED THEROCEPHALIAN SKULL, WITH INSIGHTS ON THEROCEPHALIAN PHYLOGENETICS AND CHARACTER EVOLUTION

3:00 **Botha-Brink, J., Codron, D.** LIFE HISTORY AND REPRODUCTIVE STRATEGY OF THE PERMO-TRIASSIC DICYNODONT LYSTROSAURUS

3:15 **Owerkowicz, T., Crompton, A.** EFFECTIVE COUNTERCURRENT EXCHANGE AT THE RESPIRATORY TURBINATES REQUIRED A STIFF THORAX IN SYNAPSIDS

3:30 **Crompton, A., Musinsky, C., Owerkowicz, T.** RECONSTRUCTION OF THE NASAL REGION IN NON-MAMMALIAN CYNODONTS AND MAMMALIAFORMES SUGGESTS ABSENCE OF INTRANARIAL LARYNX AND A COMPROMISED COUNTERCURRENT EXCHANGE AT RESPIRATORY TURBINATES

3:45 **Ruf, I., Maier, W., Rodrigues, P., Schultz, C.** NASAL ANATOMY OF THE ADVANCED CYNODONT BRASILITHERIUM RIOGRANDENSIS REVEALS NEW ASPECTS OF MAMMALIAN EVOLUTION
THURSDAY AFTERNOON, OCTOBER 31, 2013
Technical Session VIII (Continued)

4:00  Mancuso, A., Gaetano, L., Leardi, J., Abdala, F., Arcucci, A.  MIDDLE TRIASSIC CONTINENTAL FAUNAS FROM GONDWANA: THE CHANARES FORMATION TETRAPOD ASSEMBLAGE, A CASE STUDY FROM WESTERN ARGENTINA

THURSDAY AFTERNOON, OCTOBER 31, 2013
Poster Session II
Westin Bonaventure Hotel & Suites, Exhibit Hall
Authors must be present from 4:15 - 6:15 p.m.
Posters must be removed by 6:30 p.m.

1  Lehmann, S., Patterson, D., Matthews, T., Levin, N.  REGIONAL AND LANDSCAPE-SCALE PLEISTOCENE PALEOECOLOGY USING CARBON AND OXYGEN ISOTOPES FROM IN SITU MACRO- AND MICROMAMMAL TOOTH ENAMEL AT ELANDSFONTEIN, WESTERN CAPE, SOUTH AFRICA.

2  Kharlamova, A., Saveliev, S., Boeskorov, G., Uschakov, V., Maschenko, E.  PRELIMINARY ANALYSES OF BRAIN GROSS MORPHOLOGY OF THE WOOLLY MAMMOTH, MAMMUTHUS PRIMIGENIUS, FROM YAKUTIA, RUSSIA

3  Ferraro, J., Binetti, K., Richmond, B., Manthi, F.  THE EARLY PLEISTOCENE MAMMALIAN FAUNA OF ‘MARSABIT ROAD’, CHALBI BASIN, NORTHERN KENYA

4  Chritz, K., Cerling, T.  ISOTOPIC INDICATORS OF MONSOON-INDUCED TERRESTRIAL ECOSYSTEM CHANGE IN THE TURKANA BASIN, KENYA: IMPLICATIONS FOR THE FOSSIL RECORD

5  George, C.  GIS ANALYSIS OF THE FAUNMAP II DATABASE TO RECOGNIZE GEOGRAPHIC BIAS IN THE IDENTIFICATION OF FOSSILS

6  Priego-Vargas, J., Bravo-Cuevas, V.  DIETARY BEHAVIOR AND HABITAT OF A MAMMAL ASSOCIATION FROM THE RANCHOLABREAN OF HIDALGO, CENTRAL MEXICO

7  Reynolds, R., Sample, L., Conkling, S.  THE EL CASCO SUBSTATION FAUNA AND FLORA: NEW RECORDS FROM THE PLIOCENE–PLEISTOCENE AGE SAN TIMOTEO FORMATION, RIVERSIDE COUNTY, CALIFORNIA

8  Palmqvist, P., Espigares, M., Pérez-Claros, J., Martin-Serra, A., Janis, C.  TAPHONOMY OF CARNIVOROUS AND HERBIVOROUS MAMMALS PRESERVED IN RANCHO LA BREA TAR PITS: SHIPS THAT PASS IN THE NIGHT?

9  Holden, A., Harris, J., Timm, R.  PALEOECOLOGICAL AND TAPHONOMIC IMPLICATIONS OF INSECT-DAMAGED VERTEBRATE REMAINS FROM RANCHO LA BREA, SOUTHERN CALIFORNIA

10  Stegner, M.  THE MESCAL CAVE FAUNA (SAN BERNARDINO COUNTY, CALIFORNIA): TESTING ASSUMPTIONS OF HABITAT FIDELITY IN THE QUATERNARY FOSSIL RECORD

11  Macias, M., Kitao, E., Gray, R.  NEW PLEISTOCENE MEGAFAUNA LOCALITIES IN SANTA BARBARA COUNTY, CALIFORNIA: PALEONTOLOGICAL RECONNAISSANCE OF THE MARINE TERRACE DEPOSITS AT VANDENBERG AIR FORCE BASE

12  Brandborg, D., Matthias, A., Graham, R.  EXCAVATION AND FOSSIL RECOVERY AT DON’S GOOSEBERRY PIT, BLACK HILLS, SD

Corresponding board numbers in left hand column

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Ellison, M., Flynn, J.  A NEW PHYLOGENETICALLY-INFORMED LIFE RECONSTRUCTION OF THE GIANT EOCENE CARNIVOROUS ARTIODACTYL ANDREWSARCHUS MONGOLIENSIS (MAMMALIA, ARTIODACTYLAMORPHA, CETANCODONTOMORPHA)

Tsubamoto, T., Koda, Y., Hasegawa, Y., Nabana, S., Tomida, Y.  A PALEOGENE MAMMALIAN FAUNA FROM THE IWAKI FORMATION, JAPAN, AND IMPLICATIONS FOR AGE AND PALEOBIOGEOGRAPHY

Samuels, J., Mackenzie, K., Fremd, T.  THE FIRST RECORDS OF LEPTOCHOERIDS (ARTIODACTYLA) FROM THE JOHN DAY FORMATION OF OREGON

O'Brien, H.  THE EVOLUTIONARY HISTORY OF CRANIAL VASCULATURE IN BASAL RUMINANTS

Emery, M., Davis, E., Hopkins, S.  CHARACTER VARIATION IN MODERN CAMELS AND SHEEP HIGHLIGHTS PROBLEMS IN THE GENUS-LEVEL TAXONOMY OF AGROUCHERID OREODONTS

Walters, K., Emery, M., Davis, E.  DECIDUOUS TEETH SHOW CLOSE RELATIONSHIPS BETWEEN OREODONT GENERA (EUROTAPHUS, MERYCOCHOERUS AND PROMERYCOCHOERUS)

Mclaughlin, W., Davis, E.  SEXUAL DIMORPHISM IN THE POSTCRANIA OF EXTANT ARTIODACTYLA AND IMPLICATIONS FOR FALSELY ELEVATED DIVERSITY IN THE PALEOMERYCIDAE

Yamada, E., Hasumi, E., Miyazato, N., Nakaya, H., Watabe, M.  EXTANT HYPSODONT UNGULATES PROVIDE NEW INSIGHT ON MESOWEAR ANALYSIS FOR THE LATE MIocene UNGULATES FROM MARAGHEH, IRAN

Ludtke, J., Racicot, R.  EXAMINING THE CONGRUENCE BETWEEN DIFFERENT SOURCES OF PHYLOGENETIC DATA FROM ARTIODACTYLA

Rowan, J., Reed, K.  ENDEMISM AND DISPERAL IN EAST AFRICAN BOVIDAE FROM THE LATE MIocene THROUGH THE RECENT

Scott, J., O'Hara, M.  THE RELIABILITY OF MAXILLARY AND MANDIBULAR FIRST AND SECOND MOLARS FOR IDENTIFYING DIETARY CATEGORY IN EXTANT BOVIDS VIA DENTAL MICROWEAR TEXTURE ANALYSIS

Rössner, G., Ruf, I., Maier, W.  NEW INSIGHT IN THE EARLY EVOLUTION OF PECORA: CRANIAL ANATOMY OF AMPHIMOSCHUS (MAMMALIA, ARTIODACTYLA, RUMINANTIA)

Heckeberg, N., Roessner, G., Asher, R.  THE POWER OF TOOTH MORPHOLOGY IN THE INTERPRETATION OF CERVID EVOLUTION (RUMINANTIA, ARTIODACTYLA, MAMMALIA)

Nishioka, Y., Takai, M., Vidthayanon, C., Hanta, R., Jintasakul, P.  TAXONOMIC, MORPHOLOGICAL, AND PALEOENVIRONMENTAL REVISIONS ON FOSSIL BOVIDS (ARTIODACTYLA) FROM CONTINENTAL SOUTHEAST ASIA

Kloess, P., Farke, A.  TRACKS AND BODY FOSSILS PRESERVE DIFFERENT CAMELID POPULATIONS IN THE BARSTOW FORMATION (MIocene) OF SOUTHERN CALIFORNIA

Hensley-Marschand, B., Njau, J., Vermillion, W.  HIPPOPOTAMUS AT OLDUVAI GORGE INDICATES PERSISTENT WETLAND ENVIRONMENTS DURING A PERIOD OF INCREASING ARIDIFICATION IN EARLY HOMININ EVOLUTION

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29 Boisserie, J. CONTINENTAL DWARFISM OF AN EARLY PLEISTOCENE HIPPOPOTAMID FROM THE SHUNGURA FORMATION, LOWER OMO VALLEY, ETHIOPIA

30 Lewis, P., Horstman, E., Johnson, E., Buchanan, B. EARLY HOLOCENE BISON ANTIQUUS SIZE CLINE ON THE SOUTHERN PLAINS

31 Bormet, A. BISON DO NOT MARCH IN UNISON: A GEOMETRIC MORPHOMETRIC APPROACH TO DIFFERENTIATING NORTH AMERICAN BISON SPECIES BASED ON HOOF SHAPE MORPHOLOGY

32 Schubert, A., Ruf, I. INNER EAR MORPHOMETRY OF MYOTRAGUS BALEARICUS (BOVIDAE, CETARTIODACTYLA) SUPPORTS DECREASE IN LOCOMOTOR AGILITY

33 Ramdarshan, A., Beard, K. NICHE PARTITIONING AMONG PLESIADAPIFORMES: AN EXAMPLE FROM THE LATE PALEOCENE OF SOUTHWESTERN WYOMING

34 Birlenbach, D., Marcot, J. TESTING MECHANISMS OF BODY SIZE TRENDS IN NORTH AMERICAN PLESIADAPIFORMES (MAMMALIA, ?PRIMATES)

35 López-Torres, S., Silcox, M. PHYLOGENETIC RELATIONSHIPS OF THE EUROPEAN PAROMOMYIDAE (PRIMATES, MAMMALIA) AND THEIR BIOGEOGRAPHIC IMPLICATIONS

36 Chester, S., Sargis, E., Bloch, J., Boyer, D. NEARLY COMPLETE SKELETON OF THE EARLY EOCENE TINIMOMYS GRAYBULLIENSIS (PRIMATES, MICROMOMYIDAE)

37 Maiolino, S., Boyer, D. DISTAL PHALANGEAL EVOLUTION IN EARLY EUPRIMATES

38 Engels, S., Habersetzer, J., Kullmer, O., Hurum, J. THE MESSEL ADAPIDS - 3D RECONSTRUCTION, REPOSITIONING, AND FUNCTIONAL ANALYSIS OF THE DENTITIONS

39 Harrington, A., Silcox, M., Bloch, J. FIRST VIRTUAL ENDOCAST OF AN EOCENE NORTH AMERICAN ADAPIFORM PRIMATE

40 Allen, K. ENDOCAST SHAPE EVOLUTION IN PRIMATES

41 Prufrock, K., Silcox, M. PHALANGERIFORM MODELS FOR THE ESTIMATION OF BODY MASS IN STEM PRIMATES

42 Yapuncich, G., Gladman, J., Boyer, D. ESTIMATING BODY MASS OF FOSSIL PRIMATES: A COMPARISON OF DENTAL AND TARSAL VARIABLES

43 Perry, J., Macneill, K., Heckler, A., Hartstone-Rose, A. RECONSTRUCTIONS OF THE CHEWING MUSCLES IN EUROPEAN ADAPIDS AND SUBFOSSIL LEMURS

44 Samonds, K., Godfrey, L., Crowley, B., Sutherland, M. THE CHRONOLOGY OF LEMUR EXTINCTION IN NEAR AND DEEP TIME

45 St. Clair, E., Babbitt, C., Wray, G., Wall, C. ENAMEL THICKNESS MEASUREMENTS AND RECONSTRUCTION OF ANCESTRAL MORPHOTYPES IN PRIMATES

46 Atwater, A., Holroyd, P., Davis, E. NEW EVIDENCE THAT OMOMYID DIET, NOT BODY SIZE, WAS AFFECTED BY GLOBAL CLIMATE CHANGE

47 Minwer-Barakat, R., Marigo, J., Badiola, A., Moya-Sola, S. THE WESTERNMOST RECORD OF THE GENUS MICROCHOERUS (OMOMYIDAE, PRIMATES) IN THE IBERIAN PENINSULA AND ITS PALAEOBIOGEOGRAPHIC IMPLICATIONS

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THURSDAY AFTERNOON, OCTOBER 31, 2013
Poster Session II (CONTINUED)

48 Albright, L., Samuels, J., Fremd, T. THE LAST FOSSIL PRIMATE IN NORTH AMERICA: NEW MATERIAL OF THE ENIGMATIC EKGMOWECHASHALA FROM THE ARIKAREEAN OF OREGON

49 Patel, B., Desilva, J., Steininger, C. NEW CERCOPITHECOID PRIMATE POSTCRANIAL FOSSILS FROM COOPER’S D, SOUTH AFRICA

50 Maclatchy, L., Kingston, J., Kityo, R. MORE OF THE FEMUR OF MOROTOPITHECUS

51 Moyà-Solà, S., Alba, D., Almécija, S. A PROXIMAL RADIUS OF BARBERAPITHECUS HUERZELERI (PRIMATES, PLIOPITHECIDAE) FROM THE MIOCENE SITE OF CASTELL DE BARBERÀ (NE IBERIAN PENINSULA)

52 Alba, D., Delson, E., Colombero, S., Delfino, M., Pavia, M. OLDEST JOINT RECORD OF MACACA AND MESOPITHECUS (PRIMATES, CERCOPITHECIDAE) BASED ON MATERIAL FROM THE LATEST MIOCENE OF MONCUCCO TORINESE (ITALY)

53 Smith, H. EVOLUTION AND GENETIC DISTANCES OF NEANDERTAL AND ANATOMICALLY MODERN HUMAN (AMH) FOSSILS AS INDICATED BY BASICRANIAL MORPHOLOGY.

54 Heck, C., Wilson, H., Varricchio, D., Jackson, F., Jin, X. EVALUATING DEFORMATION IN SPHEROOLITHUS DINOSAUR EGGS FROM ZHEJIANG, CHINA

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85 Iijima, M., Kobayashi, Y. CONVERGENCES AND TRENDS IN THE EVOLUTION OF THE ARCHOSAUR PELVIS


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91 Tennant, J. COMPARATIVE ECMORPHOLOGY OF ORNITHOPOD AND RUMINANT SNOTS - A GEOMETRIC MORPHOMETRIC APPROACH

92 Button, D. BIOMECHANICAL EVIDENCE FOR NICHE PARTITIONING BETWEEN SYMPATRIC SAUROPOD DINOSAURS

93 Vitek, N. NEW PATTERNS OF SPATIOTEMPORAL VARIATION IN THE EASTERN BOX TURTLE (TERRAPENE CAROLINA) AND THEIR INFLUENCE ON EVOLUTIONARY HYPOTHESES

94 Tanaka, K. EGGSHELL POROSITY REVEALS NEST TYPES AND INCUBATION BEHAVIOR IN ARCHOSAURS

95 Vietti, L. INSIGHTS INTO THE MICROBIAL DEGRADATION OF BONE IN MARINE ENVIRONMENTS: GENETIC SEQUENCING OF BIOFILMS FROM LAB-SIMULATED WHALE-FALLS

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121 Akersten, W., Jefferson, G. THE ASPHALTO/MCKITTRICK COMPLEX: QUATERNARY FOSSILS ASSOCIATED WITH ASPHALT DEPOSITS FROM THE SOUTHWESTERN MARGIN OF THE SAN JOAQUIN VALLEY, 23 KM NORTHEAST OF TAFT, KERN COUNTY, CALIFORNIA

122 Cadenillas, R., Martinez, J., Czaplewski, N. ADDITIONAL BATS FROM THE LATE PLEISTOCENE OF THE TALARA TAR SEEPS (NORTHWESTERN PERU) - PALEOENVIRONMENTAL IMPLICATIONS

123 Solorzano, A., Rincon, A., Mcdonald, H. A NEW MAMMAL ASSEMBLAGE FROM THE LATE PLEISTOCENE EL BREAL DE OROCUAL, NORTHEAST OF VENEZUELA

124 Zapata, J., Martinez, J., Rincon, A. SIGMODONTINE RODENTS FROM THE LATE PLEISTOCENE OF THE TALARA TAR SEEPS (NORTHWESTERN PERU) - SYSTEMATICS, PALEOENVIRONMENTAL INFERENCES, AND PRELIMINARY TAPHONOMIC STUDY
FRIDAY MORNING, NOVEMBER 1, 2013
Technical Session IX
Westin Bonaventure Hotel & Suites, San Francisco Ballroom
MODERATORS: Joseph Sertich and Ashley Morhardt

8:00  Brink, K., Leblanc, A., Evans, D., Reisz, R.  PREVALENCE, ORIGIN, AND ANATOMY OF DENTICLE AMPULLAE IN THEROPOD DINOSAUR TEETH

8:15  Gates, T., Zanno, L.  OSSIFIED CRANIAL ORNAMENTATION CORRELATES WITH MID- TO LARGE-BODY MASS IN THEROPOD DINOSAURS

8:30  You, H., Azuma, Y., Wang, T., Dong, Z.  A NEW COELOPHYSOID THEROPOD DINOSAUR FROM THE EARLY JURASSIC LUFENG FORMATION OF YUNNAN PROVINCE, CHINA

8:45  Sertich, J., O'Connor, P., Seiffert, E., Manthi, F.  A GIANT ABELISAURID THEROPOD FROM THE LATEST CRETACEOUS OF NORTHERN TURKANA, KENYA

9:00  Burch, S.  THE MYOLOGICAL CONSEQUENCES OF EXTREME LIMB REDUCTION: NEW INSIGHTS FROM THE FORELIMB MUSCULATURE OF ABELISAURID THEROPODS

9:15  Miyashita, T., Currie, P., Paulina-Carabajal, A.  A NEW SPECIES OF DASPLETOSAURUS (THEROPODA: TYRANNOSAURIDAE) FROM THE CAMPANIAN OF SOUTHERN ALBERTA REPRESENTED BY A GROWTH SERIES OF WELL-PRESERVED SKULLS AND SKELETONS


9:45  Balanoff, A., Bever, G., Norell, M.  THE RELATIONSHIPS OF Oviraptorosaur Dinosaurs and Endocranial Evolution Along a Morphologically Bizarre Lineage

10:00 BREAK


10:30  Morhardt, A., Ridgely, R., Varricchio, D., Witmer, L.  NEW STUDIES OF BRAINCASE ANATOMY, BRAIN SIZE, AND BRAIN STRUCTURE IN THE LATE CRETACEOUS THEROPOD TROODON FORMOSUS (DINOSAURIA: SAURISCHIA) BASED ON CT SCANNING AND 3D VISUALIZATION

10:45  Persons, W., Xing, L., Bell, P., Currie, P., Miyashita, T.  NEW DIRECT AND MORPHOLOGICALLY-INFERRED EVIDENCE OF PISCIVORY IN MIRORAPTOR

11:00  Smith, R., Mancuso, A., Pol, D., Marsicano, C.  TAPHONOMY OF A DINOSAUR BREEDING COLONY IN SOUTHERN PATAGONIA


11:30  Li, L., You, H., Li, D., Dodson, P.  A NEW, EARLY CRETACEOUS TITANOSAURIFORM SAUROPOD DINOSAUR WITH UNIQUE OSTEOLOGY FROM THE HEKOU GROUP OF LANZHOU BASIN, GANSU PROVINCE, CHINA

11:45  Wilson, J., Allain, R.  OSTEOLOGY OF REBBACHISaurus GARASBAE, A DIPLODOCOID (DINOSAURIA: SAUROPODA) FROM THE EARLY LATE CRETACEOUS KEM KEM BEDS OF SOUTHEASTERN MOROCCO

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FRIDAY MORNING, NOVEMBER 1, 2013
Technical Session IX (CONTINUED)

12:00 Ullmann, P., Bonnan, M., Lacovara, K. MORPHOMETRIC EXPLORATION OF THE EVOLUTION OF WIDE GAUGE FEATURES IN THE STYLOPODIAL LIMB ELEMENTS OF TITANOSAURIFORM SAUROPODS

FRIDAY MORNING, NOVEMBER 1, 2013
Symposium 3: The Tempo of Vertebrate Evolution: Geochronologic Advances in Dating the Fossil Record
Westin Bonaventure Hotel & Suites, San Jose Ballroom
MODERATORS: Randall Irmis and Eric Roberts

8:00 Bowring, S., Blackburn, T., Burgess, S., Ramezani, J. EARTHTIME: HIGH PRECISION GEOCHRONOLOGY AND THE CALIBRATION OF EARTH HISTORY

8:15 Rasbury, T., Cole, J., Parrish, R., Bowring, S., Lanzirotti, A. U-PB DATING OF CARBONATES FROM TERRESTRIAL VERTEBRATE FAUNA-BEARING UNITS

8:30 Mundil, R., Irmis, R. THE INS AND OUTS OF HIGH-RESOLUTION GEOCHRONOLOGY APPLIED TO STRATIGRAPHIC PROBLEMS

8:45 Hemming, S., Fire Clay Group, Earthtime 40AR/39AR SANIDINE AND U-PB ZIRCON TESTS FOR A CARBONIFEROUS-AGE NATURAL GEOCHRONOLOGY STANDARD

9:00 Rubidge, B., Erwin, D., Ramezani, J., Bowring, S., Day, M. U/PB RADIOMETRIC DATES FROM THE KAROO SUPERGROUP (SOUTH AFRICA) ENABLE CORRELATION OF PERMIAN CONTINENTAL SEDIMENTARY SUCCESIONS AND CONSTRAIN MID-LATE PERMIAN TETRAPOD BIODIVERSITY CHANGES

9:15 Kent, D., Olsen, P., Muttoni, G. INTEGRATION OF MAGNETIC POLARITY STRATIGRAPHY AND ORBITAL CYCLOSTRATIGRAPHY TOWARDS A LATE TRIASSIC CHRONOLOGY

9:30 Irmis, R., Mundil, R., Marsicano, C., Mancuso, A. U-PB DATING OF REDEPOSITED VOLCANICS IN NON-MARINE SEDIMENTARY STRATA: CASE STUDIES FROM THE EARLY MESOZOIC

9:45 Trujillo, K., Chamberlain, K. THE MORRISON FORMATION U/PB DATING PROJECT: USING HIGH-PRECISION, CHEMICAL ABRASION (CA-TIMS), SINGLE ZIRCON, ASHFALL DATES FOR CHRONOSTRATIGRAPHIC CORRELATIONS

10:00 BREAK

10:15 Britt, B., Greenhalgh, B., Mori, H., Mackay Sorensen, A., Scheetz, R. PRELIMINARY SEQUENCE STRATIGRAPHY OF THE CEDAR MOUNTAIN FORMATION OF UTAH WITH U-PB LA-ICP-MS DETRITAL ZIRCON AGES FOR EACH SEQUENCE

10:30 Tucker, R., Roberts, E., Salisbury, S. ADVANCES IN DATING THE LATE CRETACEOUS VERTEBRATE RECORD OF NORTHEASTERN AUSTRALIA USING U-PB LA-ICMPS DETRITAL ZIRCON GEOCHRONOLOGY

10:45 Eberth, D., Roberts, E., Deino, A., Bowring, S., Ramezani, J. TWENTY-THREE YEARS OF RADIOMETRIC DATING AT DINOSAUR PROVINCIAL PARK (UPPER CRETACEOUS, ALBERTA, CANADA)

11:00 Roberts, E., O'Connor, P., Stevens, N. A SYSTEMATIC APPROACH TO DATING MESOZOIC-PALEOGENE CONTINENTAL VERTEBRATE ASSEMBLAGES IN AFRICA
FRIDAY MORNING, NOVEMBER 1, 2013
Symposium 3: The Tempo of Vertebrate Evolution: Geochronologic Advances in Dating the Fossil Record (CONTINUED)

11:15  Renne, P., Sprain, C., Wilson, G., Clemens, W.  
       40AR/39AR GEOCHRONOLOGY OF THE LANCIAN-TORREJONIAN INTERVAL, HELL CREEK REGION, MONTANA

11:30  Clyde, W., Barnum, T., Krause, J., Ibañez-Mejia, M.  
       NEW MAGNETOSTRATIGRAPHIC AND RADIOISOTOPIC RESULTS FROM THE RÍO CHICO GROUP IN THE LAS FLORES AREA OF THE SAN JORGE BASIN (PATAGONIA, ARGENTINA); IMPLICATIONS FOR THE TEMPORAL CALIBRATION OF PALEOGENE SOUTH AMERICAN LAND MAMMAL AGES

11:45  Riedel, J., Clyde, W., Stucky, R., Raynolds, B.  
       MAGNETOSTRATIGRAPHY ACROSS THE WASATCHIAN/BRIDGERIAN NORTH AMERICAN LAND MAMMAL AGE BOUNDARY IN THE WIND RIVER BASIN, WYOMING

12:00  Tsukui, K., Flynn, J., Ramezani, J., Machlus, M., Bowring, S.  
       TEMPORAL CALIBRATION OF THE BRIDGERIAN NORTH AMERICAN LAND MAMMAL AGE (NALMA): MAGNETOSTRATIGRAPHY AND HIGH PRECISION U-PB ZIRCON GEOCHRONOLOGY OF THE MIDDLE EOCENE BRIDGER FORMATION, WYOMING

FRIDAY MORNING, NOVEMBER 1, 2013
Technical Session X
Westin Bonaventure Hotel & Suites, Sacramento Ballroom
MODERATORS: Kaitlin Clare Maguire and David Patterson

8:00  Fisher, D., El Adli, J., Calamari, Z.  
      3D OSTEOLOGY OF THE AMERICAN MASTODON

8:15  Cherney, M., Calamari, Z., Fisher, D.  
      NO OBSERVED EFFECTS OF CLIMATE CHANGE ON SNOWMASS MASTODON TUSK GROWTH

8:30  Yann, L., Desantis, L., Koch, P., Lundelius, E.  
      THE INFLUENCE OF FEEDING ECOLOGY ON THE DISTRIBUTION OF NORTH AMERICAN PLEISTOCENE CAMELIDS

8:45  Secord, R., Lilienthal, N.  
      SHIFTING ENVIRONMENTS AND CONTROLS ON BODY SIZE IN PLEISTOCENE HORSES FROM THE GREAT PLAINS

9:00  Terry, R., Koch, P.  
      DYNAMICS OF HOLOCENE ABUNDANCE AND RESOURCE USE IN DESERT MICE

9:15  Maguire, K.  
      TESTING FOR ECOLOGICAL NICHE STABILITY OF MAMMALIAN SPECIES FROM THE LAST GLACIAL MAXIMUM TO PRESENT

9:30  Cerling, T., Harris, J., Leakey, M., Levin, N., Manthi, F.  
      ECOLOGICAL CHANGES IN THE TURKANA BASIN OVER 4 MA

9:45  Patterson, D., Faith, T., Bobe, R., Wood, B.  
      A COMPARISON OF THE FOSSIL EVIDENCE OF THREE MAMMALIAN FAMILIES FROM EAST AND SOUTHERN AFRICA OVER THE PAST 3 MILLION YEARS: THE EFFECTS OF SAMPLING BIAS

10:00 BREAK

10:15  Souron, A., Bibi, F., Bocherens, H., Uno, K., Boissiere, J.  
      DECOUPLING BETWEEN MORPHOLOGY AND STABLE CARBON ISOTOPES IN Plio-Pleistocene Herbiverous Mammals from the Shungura Formation (Lower Omo Valley, ETHIOPIA)
FRIDAY MORNING, NOVEMBER 1, 2013
Technical Session X (CONTINUED)

10:30 Garrett, N., Fox, D., Tryon, C., Faith, J., Peppe, D.  STABLE ISOTOPIC PALEOENVIRONMENTAL RECONSTRUCTION OF THE LATE PLEISTOCENE SITES ON RUSINGA AND MFANGANO ISLANDS, LAKE VICTORIA, KENYA


11:00 Begun, D.  OLDEST DIRECT EVIDENCE OF DENTAL DEVELOPMENTAL DELAY AND ENCEPHALIZATION IN A LATE MIocene Hominine.

11:15 Eastham, L., Feranec, R., Begun, D., Kordos, L.  STABLE ISOTOPE AND TRACE ELEMENT PALEOECOLOGY OF THE RUDABÁNYA FAUNA DURING THE LATE MIocene

11:30 Madern, A., Casanovas Vilar, I., Alba, D., Demiguel, D., Van Den Hoek Ostende, L.  THE ABRUPT COLLAPSE OF A DIVERSITY HOTSPOT? RECONSIDERING VALLESIAN (LATE MIocene) DIVERSITY IN ITS TYPE AREA

11:45 Smiley, T., Badgley, C., Finarelli, J.  MIOocene MAMMAL DIVERSITY IN RELATION TO TECTONIC AND CLIMATIC HISTORY OF THE BASIN AND RANGE PROVINCE

12:00 Wang, X., Tseng, Z., Slater, G., Takeuchi, G., Li, Q.  MIO-PLIOCENE CARNIVORANS FROM WESTERN TIBET AND THE EARLIEST RECORD OF PANTHERINE FELIDS

FRIDAY AFTERNOON, NOVEMBER 1, 2013
Technical Session XI
Westin Bonaventure Hotel & Suites, San Francisco Ballroom
MODERATORS: Patricia Holroyd and Catherine Badgley

1:45 Foreman, B., Hajek, E., Straub, K.  PROCESSED-BASED ESTIMATES OF STRATIGRAPHIC COMPLETENESS: IMPLICATIONS FOR THE ALLUVIAL VERTEBRATE FOSSIL RECORD

2:00 Holroyd, P., Rankin, B., Ferrer, E.  THE MYSTERY OF THE MISSING MARSUPIALS AND THE PROBLEM OF DETECTION BIAS

2:15 Fraser, D., Hassall, C., Gorelick, R., Rybczynski, N.  GLOBAL CLIMATE DRIVES TEMPORAL PATTERNS OF NORTH AMERICAN MAMMAL BETA DIVERSITY

2:30 Darroch, S., Longrich, N., Webb, A., Belmaker, J.  PALEOCENE-EOcene EVOLUTION OF BETA-DIVERSITY AMONG UNGULATE MAMMALS IN NORTH AMERICA

2:45 Morse, P., Wood, A., Bloch, J.  CHANGES IN DENTAL DEVELOPMENT IN TWO HERBIVOROUS MAMMAL TAXA FOLLOWING THE PALEOCENE-EOcene THERMAL MAXIMUM IN THE BIGHORN BASIN, WYOMING

3:00 D'Ambrosia, A., Clyde, W., Fricke, H., Snell, K., Gingerich, P.  MAMMALIAN DWARFISM ASSOCIATED WITH THE EARLY EOCENE ETM2 HYPERTHERMAL EVENT, BIGHORN BASIN, WYOMING

3:15 Slater, G.  TEMPO OR MODE IN EVOLUTION? THE CASE OF MAMMALIAN BODY SIZE EVOLUTION

3:30 Davis, E., Emery, M., Famoso, N., Mcguire, J.  WHEN WAS THE MODERN LATITUDINAL RICHNESS GRADIENT ESTABLISHED?
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Technical Session XI (CONTINUED)

3:45  Lashinsky, N., Desantis, L., Yann, L., Donohue, S., Haupt, R.  IS RAPOPORT'S RULE A RECENT PHENOMENON? A DEEP TIME PERSPECTIVE ON POTENTIAL CAUSAL MECHANISMS

4:00  Badgley, C., Domingo, S., Barry, J., Flynn, L., Morgan, M.  THREE BIOGEOGRAPHIC MODES OF CHANGE IN MIOCENE MAMMAL DIVERSITY FROM THE SIWALIK SEQUENCE OF THE INDIAN SUBCONTINENT

FRIDAY AFTERNOON, NOVEMBER 1, 2013
Technical Session XII
Westin Bonaventure Hotel & Suites, Sacramento Ballroom
MODERATORS: Brandon Peecook and Eric Wilberg

1:45  Butler, R., Hancox, J., Botha-Brink, J., Sennikov, A., Gower, D.  A NEW SPECIES OF THE ERYTHROSUCHID GARNJAINA FROM THE EARLY TRIASSIC OF SOUTH AFRICA PROVIDES NEW INSIGHTS INTO THE EARLY ARCHOSAURIFORM RADIATION


2:15  Peecook, B., Huttenlocker, A. K., Sidor, C.  BONE HISTOLOGY IN NEW, EARLY SILESaurIDS (DINOSAURIFORMES) FROM ZAMBIA: IMPLICATIONS FOR THE ORIGIN OF DINOSAURIAN GROWTH PATTERNS

2:30  Wilberg, E.  A REDESCRIPTION OF PEIPEHSUCHUS TELEORHINUS (CROCODYLOMORPHA: THALATTOSUCHIA) AND ITS IMPLICATIONS FOR THE ORIGIN OF TELEOSAURIDAE AND THE EVOLUTION OF MARINE ADAPTATIONS IN THALATTOSUCHIA

2:45  Montefeltro, F., Larsson, H., Langer, M.  AN ADVANCED NEOsaurIC FROM THE JURASSIC OF BRAZIL

3:00  Brochu, C., Langston, W., Rowe, T.  A NEW, PHYLOGENETICALLY SIGNIFICANT ALLIGATOROID FROM THE LATE CRETACEOUS (CAMPANIAN) OF MÉXICO

3:15  Gignac, P., Kley, N.  INFERENCES ON THE FEEDING BIOMECHANICS OF THE BIZARRE PUG-NOSED CROCODYLIFORM SIMOSUCHUS CLARKI

3:30  Moreno-Bernal, J., Head, J., Jaramillo, C.  FOSSIL CROCODYLIANS FROM THE MIOCENE-PLIOcene OF THE HIGH GUAJIRA PENINSULA, COLOMBIA

3:45  Nestler, J., Aiello-Lammens, M.  MODELING THE HISTORICAL RANGE OF ALLIGATOR AND ITS IMPLICATIONS FOR CROCODYLIANS AS PALEOClimate PROXIES

4:00  Sarrazin, J., Schachner, E., Farmer, C.  EXPLORATION OF AIRFLOW PATTERNS IN THE LUNG OF ALLIGATOR MISSISSIPPIENSIS (ARCHOSAURIA: CROCODYLIA) USING CFD MODELING, AND IMPLICATIONS FOR THE EVOLUTION OF UNIDIRECTIONAL AIRFLOW IN ARCHOSAURIA

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Technical Session XIII
Westin Bonaventure Hotel & Suites, San Jose Ballroom
MODERATORS: Vincent Dupret and Lauren Sallan

1:45  Choo, B., Zhu, M., Qu, Q., Yu, X.  A NEW OSTEICHTHYAN FROM THE LATE SILURIAN OF YUNNAN, CHina AND THE OLDEST GNATHOSTOME-DOMINATED VERTEBRATE FAUNA
FRIDAY AFTERNOON, NOVEMBER 1, 2013
Technical Session XII (Continued)

2:00 Ahlberg, P., Blom, H., Zhu, M., Märss, T., Sanchez, S. OSTEEOLOGY AND MORPHOLOGY OF THE PROBABLE STEM-GROUP OSTEICHTHYAN LOPHOSTEUS SUPERBUS PANDER, FROM THE SILURIAN OF ESTONIA

2:15 Chen, D., Ahlberg, P., Blom, H., Sanchez, S. DENTAL DEVELOPMENT OF THE STEM OSTEICHTHYAN ANDREOLEPIS HEDEI REVEALED BY THREE-DIMENSIONAL SYNCHROTRON VIRTUAL PALEOHISTOLOGY


2:45 Béchard, I., Arsenaault, F., Cloutier, R., Kerr, J. EXTERNAL MORPHOLOGY OF THE DEVONIAN PLACODERM BOTHRIOLEPIS CANADENSIS REVISITED IN 3D

3:00 Blais, S., Wilson, M. ARTICULATED ISCHNACANTHID ACANTHODIAN JAWS FROM THE MOTH LOCALITY PROVIDE EVIDENCE FOR SPECIALIZED FEEDING IN EARLY DEVONIAN GNATHOSTOMES

3:15 Johanson, Z., Meredith Smith, M., Kearsley, A., Mark-Kurik, E., Howard, C. INVASIVE DENTINE GROWTH IN A 380-MILLION YEAR OLD FISH IS CO-OPTED FOR WOUND REPAIR IN DERMAL BONE AS THE FIRST STEP IN THE EVOLUTION OF DAMAGE REPAIR

3:30 Coates, M., Criswell, K., Verner, E. WARDIE NODULES UNPACKED: COMPUTED TOMOGRAPHIC INVESTIGATION OF NEWLY RECOGNIZED SPECIMENS OF TRISTYCHIUS, A PIVOTAL TAXON IN CHONDRICTHYAN PHYLOGENY

3:45 Sallan, L. THE ONTOGENY OF ROMER’S GAP FISHES (TOURNAISIAN, CARBONIFEROUS) AND THE ESTABLISHMENT OF POST-HANGENBERG RAY-FINNED FISH (ACTINOPTERYGII) DIVERSITY

4:00 Schumacher, B., Maltese, A. WHEN PLANKTON RULED THE COMANCHE NATIONAL GRASSLAND: DISCOVERY OF A THIRD NORTH AMERICAN CRETACEOUS FILTER-FEEDING VERTEBRATE

FRIDAY AFTERNOON, NOVEMBER 1, 2013
Poster Session III
Westin Bonaventure Hotel & Suites, Exhibit Hall
Authors must be present from 4:15 - 6:15 p.m.
Posters must be removed by 6:30 p.m.

1 Devlin, K., Jefcoat, B., Sumida, S. DIGITAL MODELING AND 3D VISUALIZATION OF THE AXIAL SKELETON OF THE EARLY PERMIAN CAPTORHINID REPTILE LABIDOSAURUS


3 Imai, T., Varricchio, D., Cahoon, J., Plymesser, K. SEDIMENTOLOGICAL ANALYSES OF EGGSHELL TRANSPORT AND DEPOSITION: IMPLICATIONS AND APPLICATION TO EGGSHELL TAPHONOMY


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5 Thomson, T.  FIRST OCCURRENCE OF REPTILE TRACKS (*PROCLOPHONICHNIMUM*) FROM THE LOWER TRIASSIC MOENKOPFI FORMATION (SHNABKAIB MEMBER) OF SOUTHWESTERN UTAH WITH PALEOENVIRONMENTAL IMPLICATIONS

6 Matsumoto, R., Evans, S.  FEEDING BEHAVIOR AND THE FUNCTIONAL ANATOMY OF THE NECK IN THE LONG-SNOUTED CHORISTODERANS *CHAMPSOSAURUS* AND *SIMOEDOSAURUS* (REPTILIA: DIAPSIDA)

7 Bailleul, A., Scannella, J., Horner, J.  ONTOGENY OF CRANIAL SUTURES IN *ALLIGATOR MISSISSIPPIENSIS*: IMPLICATIONS FOR MATURITY ASSESSMENT IN NON-AVIAN DINOSAURS

8 Salas-Gismondi, R., Antoine, P., Clarke, J., Baby, P., Urbina, M.  CROC'S TWO REALMS: NEW CENOZOIC DISCOVERIES FROM THE AMAZONIAN BASIN AND THE PACIFIC COAST OF PERU

9 Gold, M., Norell, M.  SIZING UP THE POSITION OF *GAVIALIS* USING GEOMETRIC MORPHOMETRICS OF CROCODYLIAN BRAINCASES

10 King, L., Lynch, E., Schubert, B.  CRANIAL PIT DEVELOPMENT IN EXTANT AND FOSSIL *ALLIGATOR*

11 Souza, R., Riff, D., Kellner, A.  PHYLOGENETIC ANALYSIS OF SOUTH AMERICAN GAVIALOIDS

12 Cidade, G., Riff, D., Souza-Filho, J., Hsiou, A., Montefeltro, F.  DESCRIPTION OF NINE NEW SPECIMENS OF *MOURASUCHUS NATIVUS* (ALLIGATOROIDEA, CAIMANINAE), AND COMMENTS ON ONTOGENETIC DEVELOPMENT AND INTRASPECIFIC VARIATION OF THE SKULL TABLE

13 Whiting, E., Hastings, A.  LATE EOCENE FOSSIL ALLIGATORS FROM NEBRASKA AND THEIR IMPLICATIONS FOR THE BIOGEOGRAPHIC ORIGIN OF *ALLIGATOR*

14 Ehret, D., Hastings, A.  AN EOCENE OCCURRENCE OF A DYROSAURID (CROCODYLOMORPHA, MESOEUCROCODYLIA) FROM ALABAMA, USA

15 Andrade, R., Sayão, J.  DESCRIPTIVE PALEOHISTOLOGY ON *GUARINISUCHUS MUNIZI* (DYROSAURIDAE, CROCODYLOMORPHA) LONG BONES AND THEIR INFERENCES ON ITS LIFESTYLE

16 Burkey, M.  A PHYLOGENETIC ANALYSIS OF *WOODBINESUCHUS BYERSMORICEI*, AND A POTENTIAL NEW CLADE OF NEOUSUCHIANS

17 Carbot-Chanona, G., Brochu, C., Buscalioni, A., Reynoso Rosales, V.  NEW LIGHT ON THE EVOLUTIONARY RELATIONSHIPS BETWEEN "THORACOSAURS" AND MODERN GHARIALS: EVIDENCE FROM A NEW GAVIALOID FROM THE LATE CRETACEOUS OF CHIAPAS, MÉXICO


19 Godoy, P., Montefeltro, F., Langer, M.  FIRST RECORD OF ABDOMINAL CONTENTS IN FOSSIL CROCODYLIFORMES

20 Wayrynen, K., Carrano, M.  AN ASSESSMENT OF CLOVERLY FORMATION (LOWER CRETACEOUS) CROCODYLOMORPH DIVERSITY USING TOOTH MORPHOLOGY

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22 Bremer, O., Kear, B.  REASSESSMENT OF THE 'LAST' GONIOPHOLIDID: *DENAZINOSUCHUS KIRTLANDICUS* FROM THE LATE CRETACEOUS OF NEW MEXICO

23 Brandau, D.  CROCODYLIFORM FEEDING TRACES ON CERATOPSID DINOSAURS FROM THE UPPER CRETACEOUS (LATE CAMPANIAN) KAIPAROWITS FORMATION, SOUTHERN UTAH

24 Dinter, C., Irmis, R.  CROCODYLIFORM BITE MARKS ON AN ARTICULATED *GRYPOSORUS* (DINOSAURIA: HADROSAURIDAE) CRANIUM FROM THE UPPER CRETACEOUS OF SOUTHERN UTAH

25 Delcourt, R., Nascimento, P., Carvalho, A., Zaher, H.  PELVIC GIRDLE AND HIND LIMB MUSCULATURE OF *BAURUSUCHUS ALBERTOI*: A BIOMECHANICAL APPROACH

26 Arcucci, A., Ortega, F., Pol, D., Chiappe, L.  A NEW CROCODYLOMORPH FROM THE MORRISON FORMATION (LATE JURASSIC: KIMMERIDGIAN - EARLY TITHONIAN?) FROM THE FRUITA PALEONTOLOGICAL AREA, WESTERN COLORADO, USA

27 Drymala, S., Zanno, L., Nesbitt, S., Schneider, V.  A LARGE NEW CROCODYLOMORPH (SUCHIA, ARCHOSAURIA) WITH BIZARRE SKULL MORPHOLOGY FROM THE UPPER TRIASSIC OF NORTH CAROLINA

28 Parker, W., Stocker, M.  THE EFFECT OF PROXY ‘HOLOTYPES’ ON TAXONOMIC PRACTICES FOR VERTEBRATE FOSSILS

29 Barrett, P., Evans, D.  DINOSAUR INTEGUMENT: WHAT DO WE REALLY KNOW?

30 Kim, J., Lee, E., Choi, M., Kim, Y.  CORRELATIVE MICROSCOPIC INVESTIGATIONS OF MICROSTRUCTURES AND PHASES FROM DINOSAUR RIB BONES AND THE ASSOCIATED MUDSTONE

31 Howell, L., Heckert, A.  A NEW DATABASE OF DINOSAURIAN PALEOPATHOLOGY

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34 Stiegler, J., Wang, S., Xu, X., Clark, J.  CODING INDIVIDUAL SPECIMENS AS TAXA: TEST CASES AID IN RESOLVING THE RELATIONSHIPS OF BASAL NEOTHEROPODA, GAUGE TOPOLOGICAL SENSITIVITY TO TAXON SAMPLING, AND PRODUCE NOVEL TAXONOMIC HYPOTHESES


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80 Welsh, E. NEW MATERIAL FROM THE RARE AMPHICYONID GENUS PARADAPHOENUS AND ITS IMPLICATIONS ON THE VALIDITY OF CANIFORM CARNIVORES IDENTIFIED WITHIN CHADRONIAN THROUGH ARIKAREEAN COLLECTIONS


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84 Fox, N., Wallace, S., Mead, J. PARTITIONING OF MUSTELA NIGRIPES AND MUSTELA VISON DENTARIES FROM SNAKE CREEK BURIAL CAVE, NV.

85 Gilmore, L. THREE NEW PROCYONIDS FROM THE BLANCAN OF FLORIDA

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FRIDAY AFTERNOON, NOVEMBER 1, 2013
Poster Session III (CONTINUED)


87 Wallace, S., Fulwood, E. NEW SKELETON OF PRISTINAILURUS BRISTOLI (AILURIDAE, AILURINAE) SUGGESTS STRONG SEXUAL DIMORPHISM IN THIS RARE CARNIVORAN

88 Mackenzie, K., Orcutt, J., Hopkins, S. THE FIRST RECORD OF OSBORNODON IAMONENSIS FOR OREGON AND OTHER CANIDS OF THE ARIKAREEAN, FROM COGLAN BUTTES, OREGON

89 Pagnac, D., Welsh, E. NEW PERSPECTIVES ON THE DIVERSITY OF THE CANIDAE IN THE UPPER POLESLIIDE MEMBER (WHITNEYAN), BRULE FORMATION, BADLANDS NATIONAL PARK, SOUTH DAKOTA

90 Koretsky, I., Rahmat, S., Gilland, E. ORIGINS, EVOLUTION, AND CLASSIFICATION OF TRUE SEALS AND THEIR PALEOBIOGEOGRAPHICAL IMPLICATIONS

91 Valenzuela-Toro, A., Gutstein, C., Cozzuol, M., Pyenson, N., Suarez, M. A NEW DWARF SEAL FROM CHILE REVELS A HIDDEN MORPHOLOGICAL DIVERSITY OF PINNIPEDS FROM THE NEOGENE OF SOUTH AMERICA

92 Dewar, E., Crocker, C. CAN SKULL SHAPE INDICATE AGGRESSIVE BEHAVIOR IN SEALS?

93 Rahmat, S., Koretsky, I., Gilland, E. EVIDENCE OF SEXUAL DIMORPHISM WITHIN CYSTOPHORINAE (CARNIVORA, PHOCIDAE) FROM NEW MIDDLE MIOCENE SEALS OF THE NORTHERN PARATETHYS

94 Durrani, M., Beatty, B. MAPPING THE ORAL BIOLOGY OF THE AQUATIC TO TERRESTRIAL TRANSITION: DENTAL PATHOLOGIES AS A FUNCTION OF DIET, FEEDING LOCATION AND BEHAVIOR IN OTTERS, SEALS, AND SEA LIONS

95 Villavicencio, N., Tomiya, S., Hofmeister, J., Lindberg, D. FEMUR DIMENSIONS AND BODY SIZE ESTIMATION TO TRACK PREHISTORIC POPULATION CHANGES IN THE SOUTHERN SEA OTTER ENHYDRA LUTRIS NEREIS.

96 Koper, L. DISTINGUISHING DISASSOCIATED ELEMENTS OF CANIS DIRUS FROM CANIS LUPUS AT RANCHO LA BREA: LINEAR TRENDS OFFER A NEW INSIGHT INTO SPECIES IDENTIFICATION WHEN CRANIAL AND DENTAL INFORMATION IS UNAVAILABLE

97 Curtis, A., Van Valkenburgh, B. A THREE-DIMENSIONAL STUDY OF PARANASAL SINUSES IN CARNIVORA

98 Balisi, M., Brown, C., Van Valkenburgh, B., Shaw, C. WHAT CAN PALEOPATHOLOGY TELL US ABOUT HUNTING MODES?

99 Bennett, B., Scott, K., Scott, E., Rega, E., Sumida, S. A PATHOLOGICAL TIMBER WOLF (CANIS LUPUS) FEMUR INDICATES SURVIVAL AFTER TRAUMATIC AMPUTATION INJURY

100 Madurell-Malapeira, J., Alba, D., Aurell-Garrido, J., Moyà-Solà, S. NEW IBERIAN REMAINS OF THE EURASIAN JAGUAR PANTHERA GOMBASZOEGENSIS (CARNIVORA, FELIDAE) AND A TAXONOMIC REVISION OF EURASIAN FOSSIL JAGUAR-LIKE CATS

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101 Carlon, B., Naples, V.  CONFIRMATION OF LIFESTYLES OF EXTINCT FELIDS BASED ON COMPARISON OF HOMOLOGOUS CHARACTERS OF LIVING CATS

102 Milideo, L., Graham, R.  TAPHONOMIC INDICATORS OF WOLF DEN ASSEMBLAGES

103 Moretti, J., Johnson, E., Arroyo-Cabales, J., Lewis, P.  EXPLORING THE RELATIONSHIPS OF THE NORTH AMERICAN DIMINUTIVE SKUNK GENERA SPILOGALE AND BUINICTIS

104 Bird, D., Amirkhanian, A., Davydov, Y., Pang, B., Van Valkenburgh, B.  CRIBIFORM PLATE MORPHOLOGY AS A PROXY FOR OLFACTORY INNERVATION IN CARNIVORA

105 Martin-Serra, A., Figueirido, B., Serrano, F., Janis, C., Palmqvist, P.  INTEGRATION PATTERNS IN THE EVOLUTION OF CARNIVORAN LIMBS: AN APPROACH BASED ON 3D GEOMETRIC MORPHOMETRICS

106 Perez-Claros, J., Martin-Serra, A., Figueirido, B., Janis, C., Palmqvist, P.  A MORPHOMETRIC CHARACTERIZATION OF CRANIAL SHAPE IN TERRESTRIAL CARNIVORANS BASED ON FOURIER ANALYSIS

107 Snively, E., Fahlke, J.  BITE FORCE OF THE EOCENE WHALE BASILOSAURUS ISIS CONSISTENT WITH POWERFUL ANTERIOR SEIZURE AND POSTERIOR CRUSHING OF LARGE PREY

108 Sawamura, H., Ando, T., Shinmura, T.  IS THE FAMILY AETIOCETIDAE MONOPHYLETIC?

109 Beatty, B.  THE SUBTLE HETERODONTY OF ODONTOCETES


111 Maruyama, S.  THE ESTIMATED RANGE OF INTRASPECIFIC VARIATION IN RECENT DELPHINID SKULLS AND ITS APPLICATION FOR THE TAXONOMY OF THE EXTINCT DELPHINOIDEA

112 Racicot, R.  PHYLOGENETIC AND FUNCTIONAL IMPLICATIONS OF INNER EAR MORPHOLOGY IN FOSSIL AND EXTANT PORPOISES (CETACEA, PHOCOENIDAE)

113 Buchholtz, E., Roston, R.  EXTERNAL AND INTERNAL ANATOMY OF A BLUE WHALE FETUS: DOCUMENTING MILESTONES IN BALAENOPTERID DEVELOPMENT

114 Murakami, M., Koda, Y.  A NEW DOLPHIN (CETACEA, ODONTOCETI, DELPHINIDAE) FROM THE PLIOcene OF IBARAKI, CENTRAL JAPAN

115 Bisconti, M.  NEW BALAENIDS FROM THE ITALIAN PLIOCENE (MAMMALIA, CETACEA, MYSTICETI)

116 Shaw, B.  DOES SIZE MATTER? ISOMETRIC VS. ALLOMETRIC SCALING IN ARMADILLOS, PAMPATHERES, AND GLYPTODONTs (ORDER CINGULATA)

117 Gillette, D., Carranza-Castañeda, O.  ONTOGENY AND SEXUAL DIMORPHISM IN THE NORTH AMERICAN GLYPTODONT, GLYPTOTHERIUM (XENARTHRA, CINGULATA)

118 Carranza-Castañeda, O., Gillette, D.  VARIATION OF OSTEODERM ANATOMY IN THE CARAPACE OF THE NORTH AMERICAN GLYPTODONT, GLYPTOTHERIUM (XENARTHRA, CINGULATA)

119 Grass, A.  COMPARISON OF ALLOMETRIC GROWTH TRAJECTORIES OF MEGALONYX AND PARAMYLODON SCAPULAE

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120 Naples, V., McAfee, R.  DELIMITING THE FORELIMB MORPHOLOGY AMONG PLEISTOCENE (ENSENADEAN-LUJANIAN) MYLODONTIDS SLOTHS (MAMMALIA, PILOSA) AND THE IMPLICATIONS FOR FUNCTIONALITY

121 McAfee, R.  DENTAL VARIATIONS AND ANOMALIES IN EXTINCT PILOSAN SLOTHS (MAMMALIA, XENARTHRA)

122 Green, J., McAfee, R.  THE INFLUENCE OF BITE FORCE ON THE FORMATION OF DENTAL MICROWEAR IN XENARTHANS (MAMMALIA)


124 Jinnah, Z., Roberts, E., Dirks, P.  POTENTIAL OF DETRITAL ZIRCONS FOR PROVIDING AGE CONSTRAINTS FOR KAROO SUPERGROUP VERTEBRATES

125 Ratsimbaholison, N., O'Connor, P., Felice, R.  ONTOGENETIC TRENDS IN THE CRANIOMANDIBULAR SKELETON OF MAJUNGASAURUS CRENATISSIMUS AND DERIVATION OF THE ABELISAURID SKULL MORPHOTYPE

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SATURDAY MORNING, NOVEMBER 2, 2013

Symposium 4: Patterns from the Poles: Biodiversity and Paleocology of High Latitude Fossil Vertebrates
Westin Bonaventure Hotel & Suites, Sacramento Ballroom
MODERATORS: Matthew Vavrek and Nathan Smith

8:00  Brazeau, M., Giles, S., Friedman, M.  AN OSTEICHTHYAN-LIKE SKULL FROM SIBERIA AND THE EVOLUTION OF CROWN GNATHOSTOME BRAINCASE MORPHOLOGY

8:15  Steyer, J., Sidor, C., Hammer, W.  TRIASSIC TEMNOSPONDYLs FROM ANTARCTICA ILLUSTRATE THE RECOVERY OF HIGH-LATITUDE FAUNAS AFTER THE PERMO-TRIASSIC EXTINCTION

8:30  Sidor, C., Huttenlocker, A. K., Peecook, B., Smith, R., Vilhena, D.  NEW DATA ON THE MIDDLE TRIASSIC TETRAPODS OF ANTARCTICA AND FAUNAL PROVINCIALIZATION ACROSS SOUTHERN PANGEA

8:45  Andres, B., Smith, N.  THE FIRST PTEROSAUR FROM ANTARCTICA

9:00  Makovicky, P., Boudreau, D., Hammer, W., Smith, N.  GROWTH PATTERNS OF EARLY JURASSIC ANTARCTIC DINOSAURS INFERRED FROM PALEOHISTOLOGICAL ANALYSIS

9:15  Smith, N., Hammer, W., Makovicky, P.  ANATOMY OF A NEW SAUROPODOMORPH DINOSAUR FROM THE EARLY JURASSIC HANSON FORMATION OF ANTARCTICA

9:30  Godefroit, P., Sinitsa, S., Dhouailly, D., Bolotsky, Y., Sizov, A.  FEATHER-LIKE STRUCTURES AND SCALES IN A JURASSIC NEORNITHISCHIAN DINOSAUR FROM SIBERIA

9:45  Tarduno, J., Brinkman, D., Clarke, J., Bono, R., Higgins, P.  THE ULTRA-WARM ARCTIC CA. 90 MILLION YEARS AGO: CONSTRAINTS ON PALEOCLIMATE AND BIOGEOGRAPHY FROM VERTEBRATE FOSSILS

10:00 BREAK

10:15  Vavrek, M. J., Harrison, L., Cumbaa, S., Becker, M., Larsson, H.  LATITUDINAL GRADIENTS AND PROVINCIALITY IN CHONDRICTHYAN FAUNAS FROM THE LATE CRETACEOUS NORTH AMERICA

10:30  Druckenmiller, P., Erickson, G., Brinkman, D., Brown, C., Mori, H.  EVIDENCE FOR A DISTINCT EARLY MAASTRICHTIAN POLAR DINOSAUR FAUNA FROM THE PRINCE CREEK FORMATION OF NORTHERN ALASKA

10:45  Fiorillo, A., Tykoski, R.  DISTRIBUTION AND POLAR PALEOENVIRONMENTS OF LARGE THEROPOD SKELETAL REMAINS FROM THE PRINCE CREEK FORMATION (EARLY-LATE MAASTRICHTIAN) OF NORTHERN ALASKA

11:00  Case, J.  VERTEBRATE DIVERSITY AND RESPONSE TO OCEAN TEMPERATURE DECLINE DURING THE LATEST CRETACEOUS IN THE ANTARCTIC PENINSULA

11:15  Mörs, T., Gelfo, J., Reguero, M., Lorente, M., López, G.  THE OLDEST KNOWN (EARLY EOCENE) MAMMAL FROM ANTARCTICA

11:30  Gottfried, M., Eberle, J., Hutchison, J.  NEW BONY FISH RECORDS FROM THE CANADIAN ARCTIC EOCENE GREENHOUSE OF BANKS ISLAND, NORTHWEST TERRITORIES

11:45  Rybczynski, N., Fraser, D., Buckley, M., Gosse, J.  FIRST EVIDENCE FOR A HIGH ARCTIC CAMEL SUGGESTS HIGH LATITUDE ORIGINS FOR CAMELUS ANCESTOR

12:00  Macphee, R., Zazula, G.  PLEISTOCENE LARGE MAMMAL DISPERSALS AND REGIONAL EXTIRPATIONS IN HIGH-LATITUDE NORTH AMERICA
SATURDAY MORNING, NOVEMBER 2, 2013
Technical Session XIV
Westin Bonaventure Hotel & Suites, San Francisco Ballroom
MODERATORS: Michael Habib and Daniel Ksepka

8:00  Falkingham, P., Gatesy, S.  USING AVIAN SUBSURFACE 3D FOOT MOTION TO SIMULATE FOSSIL TRACK DIVERSITY

8:15  Pei, R., Li, Q., Meng, Q., Norell, M., Gao, K.  EXCELLENTLY PRESERVED NEW SPECIMENS OF ANCHIORNIS AND THE IMPLICATION OF EARLY EVOLUTION IN PARAVES

8:30  Habib, M.  EVIDENCE AGAINST RUNNING TAKEOFF IN ARCHAEOPTERYX: BREAKING THE TERRESTRIAL VS. ARBOREAL DICHOTOMY

8:45  Heers, A., Dial, K.  WINGS VERSUS LEGS IN THE THEROPOD-AVIAN LINEAGE: MECHANISTIC UNDERPINNINGS OF VARIATION IN LOCOMOTOR STRATEGIES

9:00  Field, D., Lynner, C.  PRECISE INFERENCE OF AVIALAN FLIGHT ABILITY FROM SHOULDER JOINT DIMENSIONS

9:15  Hall, J., Habib, M.  FUNCTIONAL SIGNIFICANCE OF FEATHER ASYMMETRY IN EXTANT AVIANS AND PREDICTED FLIGHT PERFORMANCE IN EXTINCT TAXA

9:30  Foth, C., Rauhut, O.  A NEW LOOK FOR AN OLD BIRD: A NEW SPECIMEN OF ARCHAEOPTERYX WITH EXCEPTIONAL FEATHER PRESERVATION PROVIDES NEW INSIGHTS INTO THE EVOLUTION OF FEATHER PLUMAGES WITHIN MANIRAPTORA

9:45  Manning, P., Wogelius, R., Bergmann, U., Schwarz-Wings, D., Sellers, W.  SYNCHROTRON-BASED CHEMICAL IMAGING REVEALS PLUMAGE PATTERNS IN ARCHAEOPTERYX.

10:00 BREAK

10:15  Gearty, W., D’Alba, L., Vinther, J., Shawkey, M., Field, D.  MELANIN CONCENTRATION GRADIENTS IN MODERN AND FOSSIL FEATHERS

10:30  Egerton, V., Bergmann, U., Wogelius, R., Norell, M., Manning, P. L.  SYNCHROTRON-BASED IMAGING REVEALS CHEMOTAPHONOMY OF TWO BIRDS FROM THE GREEN RIVER FORMATION (EOCENE)

10:45  Chan, N.  THE DROMORNITHID OR THE EGG? SIZE CONSTRAINTS IN FLIGHTLESS BIRDS

11:00  Bright, J., Cobb, S., Marugan-Lobon, J., Rayfield, E.  CAN MORPHOLOGY PREDICT DIETARY ECOLOGY IN LIVING AND EXTINCT BIRDS OF PREY?

11:15  Stidham, T., Ni, X.  REWRITING AVIAN BIOGEOGRAPHY WITH THE PALEOGENE FOSSIL RECORD FROM CHINA

11:30  Ksepka, D.  NEW OLIGOCENE WATERBIRDS: PHYLOGENETIC ANALYSES AND IMPLICATIONS FOR TRANSITIONS IN THE WESTERN ATLANTIC AVIFAUNA

11:45  Watanabe, J., Matsuoka, H.  SYSTEMATICS OF A FLIGHTLESS DUCK FROM THE PLEISTOCENE OF SHIRIYA, NORTHEAST JAPAN

12:00  Gilbert, K., Koch, P., Mccarthy, M., Baroni, C., Lorenzini, S.  ILLUMINATING HOLOCENE DIET SHIFTS IN PENGUINS WITH COMPOUND SPECIFIC ISOTOPE ANALYSIS
SATURDAY MORNING, NOVEMBER 2, 2013
Technical Session XV
Westin Bonaventure Hotel & Suites, San Jose Ballroom
MODERATORS: Robert Fordyce and Aaron Wood

8:00  Figueirido, B., Martín-Serra, A., Pérez-Claros, J., Palmqvist, P., Janis, C.  ON THE EVOLUTION OF THE PREDATORY BEHAVIOR OF NORTH AMERICAN CANIDS AND ITS RELATIONSHIP WITH ENVIRONMENTAL TRANSFORMATION AND CLIMATIC CHANGE

8:15  Reid, R., Koch, P.  DID INTERFERENCE COMPETITION BETWEEN GRIZZLY BEARS AND COYOTES PREVENT HOLOCENE COASTAL COYOTES FROM CONSUMING MARINE FOODS?

8:30  Fitzgerald, E., Hastie, D., Buckeridge, J., Scofield, P.  EARLIEST SEALS FROM AUSTRALASIA REVEAL COLONIZATION OF THE SOUTHERN OCEAN BY ARCHAIC MONACHINAE (PHOCIDAE)

8:45  Kienle, S., Berta, A.  PINNIPED SKULLDUGGERY: THE EVOLUTION OF FEEDING STRATEGIES IN PHOCIDS (PINNIPEDIA, PHOCIDAE)

9:00  Churchill, M., Clementz, M.  EVIDENCE FOR PIERCE FEEDING IN ENALLARCTOS (CARNIVORA, PINNIPEDIMORPHA) FROM TOOTH SPACING AND CROWN SIZE


9:30  Wood, A., Velez-Juarbe, J., Bourque, J., Bloch, J., Jaramillo, C.  DIFFERENCES IN INFERRED FORAGING BEHAVIOR AMONG EARLY MIOCENE SPECIES OF DIPLOATHERIUM: EVIDENCE FROM A NEW FOSSIL DUGONG FROM THE PANAMA CANAL

9:45  Domning, D., Velez-Juarbe, J.  THE SIRENIAN GENUS METAXYATHERIUM: WHAT'S UP WITH THOSE ANIMALS??

10:00  BREAK

10:15  Gingerich, P., Antar, M., Zalmout, I.  FAUNAS OF WHALES AND SEA COWS (CETACEA AND SIRENIA) FROM MIDDLE AND UPPER EOCENE STRATA IN WESTERN FAYUM PROVINCE, EGYPT

10:30  Ekdale, E.  INNER EAR STRUCTURE OF EARLY MYSTICETES (CETACEA) FROM THE LATE OLGOCENE OF SOUTH CAROLINA: IMPLICATIONS FOR THE EVOLUTION OF HEARING IN BALEEN WHALES

10:45  Tsai, C., Fordyce, R.  EARLY EVOLUTIONARY RADIATION IN BALEEN WHALES (CETACEA: MYSTICETI) FROM THE OLIGOCENE OF NEW ZEALAND

11:00  Boessenecker, R., Fordyce, R.  ANATOMY AND ONTOGENY OF A TRANSITIONAL BALEEN WHALE: A NEW EOMYSTICETID (MAMMALIA, CETACEA) FROM THE LATE OLIGOCENE OTEKAIKE LIMESTONE OF NEW ZEALAND

11:15  Fordyce, R., Aguirre-Fernández, G., Loch, C.  LATE OLIGOCENE TUSKED DOLPHIN FROM THE WAITAKI REGION, NEW ZEALAND

11:30  Lambert, O., Bianucci, G., De Muizon, C., Urbina, M.  A NEW ARCHAIC SHARK-TOOTHED DOLPHIN FROM THE LATE OLIGOCENE-EARLY MIOCENE OF PERU

SATURDAY MORNING, NOVEMBER 2, 2013
Technical Session XV (CONTINUED)

Gutstein, C., Pyenson, N., Figueroa-Bravo, C., Canals, M., Cozzuol, M. FACIAL MORPHOLOGY PROXIES OF SKULL PATTERNS IN TOOTHED WHALES AND THEIR IMPLICATIONS FOR STUDYING SOUND GENERATION IN FOSSIL ODONTOCETI

SATURDAY AFTERNOON, NOVEMBER 2, 2013
Technical Session XVI
Westin Bonaventure Hotel & Suites, San Francisco Ballroom
MODERATORS: Ryosuke Motani and Gabriel Bever

Whatley, R., Behrensmeyer, A., McIntire, S., Ramezani, J., Parker, W. FIRST PTEROSAUR DENTARY AND POSTCRANIA FROM THE UPPER TRIASSIC OWL ROCK MEMBER, CHINLE FORMATION, PETRIFIED FOREST NATIONAL PARK, ARIZONA

Upchurch, P., Andres, B., Butler, R., Barrett, P. AN ANALYSIS OF THE BIOGEOGRAPHIC HISTORY OF PTEROSAURS

Motani, R., Jiang, D., Tintori, A., Rieppel, O., Chen, G. HIGH DIVERSITY OF EARLY TRIASSIC ICHTHYOPTERYGIANS REVEALED THROUGH DETAILED EXCAVATION IN CHAOHU, ANHUI, CHINA

Schmitz, L., Motani, R., Wainwright, P. EVOLUTIONARY DRIVERS OF GIANT EYES IN LARGE OCEAN PREDATORS

Bever, G., Lyson, T. CRANIAL EVOLUTION AND THE ORIGIN OF TURTLES: INSIGHTS FROM EUNOTOSAURUS AFRICANUS

Danilov, I., Obraztsova, E., Syromyatnikova, E., Krasnolutskii, S. NEW DATA ON A XINJIANGCHELYID TURTLE FROM THE MIDDLE JURASSIC OF SIBERIA, RUSSIA

Stayton, C., Cadena, E. EXCEPTIONAL MECHANICAL PERFORMANCE IN THE SHELLS OF TWO CENOZOIC TURTLES: STUPENDEMYS AND CERREJONEMYS


Modesto, S., Lamb, A., Reisz, R. RE-APPRAISAL OF THE CAPTORHINID REPTILE CAPTORHINIKOS VALESNIS FROM THE LOWER PERMIAN OF TEXAS

Tsuji, L., Sidor, C., Smith, R., Angielczyk, K. THE FIRST PROCOLOPHONID FROM THE MANDA BEDS OF SOUTHERN TANZANIA AND ITS IMPLICATIONS FOR MIDDLE TRIASSIC BIOGEOGRAPHY

SATURDAY AFTERNOON, NOVEMBER 2, 2013
Technical Session XVII
Westin Bonaventure Hotel & Suites, Sacramento Ballroom
MODERATORS: Akinobu Watanabe and Robert Anemone

Lovelace, D., Butler, R. QUANTIFYING TRIASSIC SEDIMENTATION ACROSS THE WESTERN UNITED STATES: PERCEPTION, PRESERVATION, AND PALEONTOLOGY

Anemone, R., Emerson, C., Nachman, B. DOES PREDICTIVE MODELING WORK IN THE SEARCH FOR VERTEBRATE FOSSILS? A CASE STUDY FROM THE EOCENE OF WYOMING.
Technical Session XVII (CONTINUED)

2:15  Lloyd, G., Friedman, M.  A NOVEL METHOD FOR TIME-BINNING RATES OF CONTINUOUS CHARACTER EVOLUTION ON A PHYLOGENY

2:30  Alroy, J.  STILL AROUND OR GONE FOREVER? BAYESIAN CREDIBLE INTERVALS ON TEMPORAL RANGES

2:45  Sansom, R., Wills, M.  FOSSILIZATION FILTERS RESULT IN SIGNIFICANT LOSS OF PHYLOGENETIC SIGNAL AND CAUSE ORGANISMS TO APPEAR ERRONEOUSLY PRIMITIVE

3:00  Watanabe, A., Norell, M.  TREE BUILDING FROM NOAH’S ARK: THE IMPACT OF POOR SAMPLING WITHIN SPECIES ON PHYLOGENETIC RECONSTRUCTION

3:15  Smithson, T., Smithson, T., Clack, J.  NEW TETRAPOD AND FISH FAUNAS FROM THE EARLIEST CARBONIFEROUS OF SCOTLAND

3:30  Lu, J., Zhu, M., Ahlberg, P., Qiao, T.  CRANIAL STRUCTURE IN THE EARLY DEVONIAN ONYCHODONT QINGMENODUS YUI AND ITS IMPLICATIONS FOR THE PHYLOGENETIC POSITION OF ONYCHODONTIFORMES AMONG SARCOPTERYGIANS

3:45  Chevrinais, M., Cloutier, R., Béchard, I.  PROFILE OF A DEVONIAN KILLER: EUSTHENOPTERON FOORDI, TOP-PREDATOR OF THE ESCUMINAC FISH ASSEMBLAGE

SATURDAY AFTERNOON, NOVEMBER 2, 2013
Technical Session XIII
Westin Bonaventure Hotel & Suites, San Jose Ballroom
MODERATORS: David Levering and Allistair Evans

1:45  Pol, D., Carballido, J., Rauhut, O., Rougier, G., Sterli, J.  BIOGEOGRAPHIC DISTRIBUTION PATTERNS OF TETRAPODS DURING THE JURASSIC: NEW INFORMATION FROM THE CAÑADÓN ASFALTO BASIN, PATAGONIA, ARGENTINA

2:00  Martin, T., Goin, F., Chornogubsky, L., Gelfo, J., Schultz, J.  EARLY LATE CRETACEOUS (CENOMANIAN) MAMMALS AND OTHER VERTEBRATES FROM THE MATA AMARILLA FORMATION OF SOUTHERN PATAGONIA (ARGENTINA)


2:30  Levering, D., Luttbeg, B.  OF MULTITUBERCULATES AND MASS EXTINCTION: EVIDENCE OF SELECTION FOR SMALL BODY SIZE WITHIN THE CIMOLODONA (MULTITUBERCULATA) ACROSS THE CRETACEOUS-PALEogene EXTINCTION BOUNDARY, FOLLOWED BY MORPHOSPACE RECOVERY AND EXPANSION IN THE EARLIEST PALEogene

2:45  Chen, M., Luo, Z., Wilson, G.  MORPHOMETRIC ANALYSIS OF LOCOMOTOR SPECIALIZATION IN THE CRETACEOUS MAMMAL YANOCNONODON: IMPLICATIONS FOR ECOMORPHOLOGICAL DIVERSIFICATION WITHIN EUTRICONODONT MAMMALS

3:00  Hoffmann, S., O’Connor, P., Krause, D.  FIRST ENDOCRANIAL RECONSTRUCTION OF A GONDWANATHERIAN MAMMAL
SATURDAY AFTERNOON, NOVEMBER 2, 2013
Technical Session XIII (CONTINUED)

3:15  Rayfield, E., Gill, P.  A FUNCTIONAL INSIGHT INTO THE EVOLUTION OF THE DEFINITIVE MAMMALIAN MIDDLE EAR

3:30  Evans, A., Chieu, T., Siu, K., Rich, T.  PREDICTING THE SHAPE OF UNDISCOVERED FOSSILS

3:45  Grossnickle, D., Polly, P., Luo, Z.  MORPHOLOGICAL DISPARITY OF MESOZOIC MAMMALS THROUGH TIME

4:00  Oreska, M., Carrano, M.  ADAPTING MODERN COMMUNITY ECOLOGY TECHNIQUES FOR TERRESTRIAL PALEOECOLOGY: INSIGHTS FROM THE EARLY CRETACEOUS CLOVERLY FORMATION

SATURDAY AFTERNOON, NOVEMBER 2, 2013
Poster Session IV
Westin Bonaventure Hotel & Suites, Exhibit Hall
Authors must be present from 4:15 - 6:15 p.m.
Posters must be removed by 6:30 p.m.

1  Mitchell, J.  DEAD BIRDS IN THE DIRTY GROUND: HOW TO KNOW WHEN THEY'RE NOT AROUND

2  Kirchner-Smith, M.  HIND LIMB MORPHOLOGY OF CARNIVOROUS BIRDS: A MORPHOMETRIC ANALYSIS OF PREY PREFERENCE AND PREDATORY TECHNIQUES

3  Sartin, C.  ASYMMETRY AND VESTIGIAL STRUCTURES IN EXTANT BIRDS

4  Walsh, S., Milner, A., Bourdon, E.  A REINTERPRETATION OF THE BRAIN MORPHOLOGY OF CEREBAVIS CENOMANICA (AVES: INCERTAE SEDIS)

5  Hu, D., Liu, Y., Li, J., Hou, L., Xu, X.  A NEW LARGE ENANTIORNITHINE BIRD FROM THE LOWER CRETACEOUS OF WESTERN LIAONING, CHINA

6  Tanaka, T., Kobayashi, Y., Sasaki, K., Chiba, K.  AN ISOLATED FEATHER IN AN AMBER FROM THE LATE CRETACEOUS OF NORTHEAST JAPAN

7  Hellert, S., Marcot, J.  EVOLUTIONARY DYNAMICS OF THE LIMBS OF BIRDS AND THEROPOD DINOSAURS: TESTING THE INFLUENCE OF FUNCTIONAL CONSTRAINTS

8  Wang, Y., O'Connor, J., Li, D., You, H.  A NEW ORNITHUROMORPH BIRD FROM THE EARLY CRETACEOUS CHANGMA BASIN OF GANSU PROVINCE, NORTHWESTERN CHINA

9  Pomeroy, D.  IS OMNIVOROPTERYX SINOSAORUM A SAPEORNITHID BIRD?

10  Falk, A.  THE PLUMAGE OF CONFUCIUSORNIS: PRIMITIVE OR MODERN?

11  Sclafani, M., Ksepka, D., Smith, A.  EVOLUTIONARY PATTERNS IN BONE THICKNESS AND COMPACTNESS IN DIVING BIRDS

12  Smith, N., Clarke, J.  OSTEOLOGICAL HISTOLOGY OF THE PAN-ALCIDAE (AVES, CHARADRIIFORMES): CORRELATES OF WING-PROPELLED DIVING AND FLIGHTLESSNESS

13  Ando, T., Fordyce, R.  BASAL SPHENISCIFORMES DO NOT SUPPORT A SISTER TAXON RELATIONSHIP WITH PLOTOPTERIDS

14  Biedlingmaier, A., Leavitt, J., Monfette, G., Allan, D., Claessens, L.  DIGITAL SURFACE SCANNING AND ANALYSIS OF A CAVE SPECIMEN OF THE DODO (RAPHUS CUCULLATUS)

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123  Mori, H., Druckenmiller, P., Erickson, G., Prieto-Márquez, A.  CRANIAL ONTOGENY OF *EDMONTOSAURUS*: IMPLICATIONS FOR THE TAXONOMIC STATUS OF THE PRINCE CREEK FORMATION SPECIES (LOWER MAASTRICHTIAN, NORTHERN ALASKA)

*Corresponding board numbers in left hand column*
NEW DATA ON THE DEVELOPMENT OF THE EXOSKELETON IN EARLY VERTEBRATES (AGNATHA: OSTEOSTRACI)

AFANASSIEVA, Olga, Paleontological Institute of Russian Academy of Sciences, Moscow, Russia

Osteostracans (Osteostraci) are among the most ancient extinct jawless vertebrates (Agnatha), known from the early Silurian to the late Devonian. The external skeleton of osteostracans is composed of three layers typical of the vertebrate exoskeleton: the layer of denticles (amygdaloidal structure), the undichotomy shell of cellular bone and the basal layer of laminar bone (isosipine). The sculpture and the histological structure of the shields of *Timanaspis* kossowii and *Thyestes verrucosus* (order Tremataspidiformes) were investigated based on well-preserved material. The remains come from the Lower Silurian deposits of Saaremaa, Estonia (*Timanaspis*), known from the early Silurian to the late Devonian. The external skeleton of osteostracans has been known from scales and isolated bone fragments. It has been variously interpreted as having actinopterygian, placoderm or acanthodin affinities. A large-scale collection program at the Oshesara Cliff location has allowed us to assess several hundred specimens including complete dermal plates, bone fragments and scales, which together bring us to characterize this exoskeleton in detail. The distinctive histology with numerous large and closely spaced cell lacunae allows bones to be attributed to *Lophothis* with confidence, while the dermal ornament has distinct anteroposterior polarity that allows even bones of unknown identity to be oriented correctly. *Lophothis* resembles *Lophothis* with possessing marginal and paraxial scales. These discoveries from China show that such bones also occur in derived stem gnathostomes. The inner dental arcade consists of numerous identical “tooth cushions”. The skull roof is covered with tessellated or consolidated, was achieved primarily by the types of initiation of tissues (dentine and bone) and modes of their development.

Technical Session XIII (Friday, November 1, 2013, 2:00 PM)

OSTEOLOGY AND MORPHOLOGY OF THE PROBABLY STEM-GROUP OSTEICHTHYIAN *LOPHOTHIS SUPERBUS* PANDER, FROM THE SILURIAN OF ESTONIA

AHILBERG, Per, Uppsala University, Uppsala, Sweden; BLOM, Henrik, Uppsala University, Uppsala, Sweden; ZHIN, Min, IVPP Academy Sinica, Beijing, China; MÄRSS, Tiiu, Tallinn University of Technology, Tallinn, Estonia; SANCHEZ, Sophie, Uppsala University, Uppsala, Sweden;

*Lophothis superbus* from the Pradoli (latest Silurian) of Saaremaa, Estonia, has long been known from scales and isolated bone fragments. It has been variously interpreted as having actinopterygian, placoderm or acanthodin affinities. A large-scale collection program at the Oshesara Cliff location has allowed us to assess several hundred specimens including complete dermal plates, bone fragments and scales, which together bring us to characterize this exoskeleton in detail. The distinctive histology with numerous large and closely spaced cell lacunae allows bones to be attributed to *Lophothis* with confidence, while the dermal ornament has distinct anteroposterior polarity that allows even bones of unknown identity to be oriented correctly. *Lophothis* resembles *Lophothis* with possessing marginal and paraxial scales. These discoveries from China show that such bones also occur in derived stem gnathostomes. The inner dental arcade consists of numerous identical “tooth cushions”. The skull roof is covered with tessellated or consolidated, was achieved primarily by the types of initiation of tissues (dentine and bone) and modes of their development.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

FOOT POSTURE IN EARLY ECOCENE HYAENODONTIDAE AND OXYAENIDAE FROM WYOMING

AHERNS, Heather E., Johns Hopkins University School of Medicine, Baltimore, MD, United States, 21205

Early workers on “Creodontia” concluded that both *Hyaeoondontidae* and *Oxyaenidae* possessed a plantigrade foot posture based on qualitative comparisons with the morphology present in Carnivora. However, later workers found evidence to suggest the opposite: digitigrady and digitigrady, particularly in later hyaenodontids. Metrical correlations with foot posture have recently been proposed and can be used to test hypotheses of hyaenodontid and oxyaenid postcranial (torso) posture generated by qualitative comparisons. The calcaneal gear ratio (CGR) significantly correlates with foot posture in extant carnivorans and is applied for the first time to Eocene creodonts. The CGR is the length of the calcaneus divided by the length of the in-lever (sustentacular process to the medial tubercle), with larger values representing increased digitigrady. Here, I test for differences in the calcaneal gear ratio between 1) *Hyaenodontidae* and *Oxyaenidae* and 2) earlier Eocene (marine or terrestrial) and later (early Eocene) hyaenodontids. Seven CGRs were measured that represent Early Eocene hyaenodontids and oxyaenids from Wyoming. Prior to examining familial and temporal differences, I tested for an allometric relationship between CGR and total calcaneal length using ordinary least squares regression. Size was not significantly correlated with CGR (r² = 0.03363, p-value = 0.4523) suggesting allometry does not drive differences between groups. Student’s t-tests were used to test for differences in the CGR between families and Early Eocene North American land mammal ages. There was no difference in the CGR between the sampled Wasatchian hyaenodontids and oxyaenids (p-value = 0.5796). There is, however, a significant increase in the CGR from the Middle to Late Eocene (p-value = 1.683 x 10^-05). These results indicate an increase in digitigrady within Hyaenodontidae through the Early Eocene. This shift in foot posture may also reflect a shift in locomotor style towards increased terrestriality, which is exemplified by later cursorial hyaenodontids. Understanding the development of early Eocene hyaenodontid foot posture is crucial to understanding the functional and ecological diversity of Paleocene carnivores.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

THE ASPHALTICO-MCKITTRICK COMPLEX: QUATERNARY FOSSILS ASSOCIATED WITH ASPHALT DEPOSITS FROM THE SOUTHWESTERN MARGIN OF THE SAN JOAQUIN VALLEY, 23 KM NORTHWEST OF TAFT, KERN COUNTY, CALIFORNIA

AKERSTEN, William , Idaho State University, Pocatello, ID, United States, 83204; JEFFERSON, George, Anza Borrego Desert Paleontological Society, Borrego Springs, CA, United States

During 1977-78, we conducted field and literature surveys of the area for an environmental impact statement (EIS) on paleontological resources on behalf of the oil companies involved in developing the oilfield. Outcrops included diatomitic shales of the petroliferous marine Miocene Monterey Formation - intensively folded and faulted, the overlying less disturbed clastic terrestrial Blanque Tulear omiuration, and undisturbed surficial Pleistocene to modern alluvium. In the immediate area, a large slab of Monterey was thrust over the Tulear. Asphalt deposits formed when dikes and seams of nearly pure asphalt intruded along fractures into the weakly consolidated Tulear and overlying units. As asphalt surfaced, it flowed out to form a variety of traps, primarily shallow seeps with a occasional deeper pools. Much asphaltic material was subsequently removed by erosion and mining. Minor entrapment of insects, arachnids, and small vertebrates continues today in seeps at the base of the thrust between the Monterey and the Tulear and along Route 33 southeast of the town of McKittrick. Remaining records regarding Asphalto are fragmentary and often contradictory but the site is certainly related to or identical with the McKittrick asphalt deposits. Variable width dikes of nearly pure asphalt within the Tulear were mined in the late 19th century using hard rock methods. Surviving photographs of timbered shafts indicate that the mines were wider than recorded widths of the dikes and that considerable amounts of the host rock had been removed. The two Blanque carnivore specimens at University of California Museum of Paleontology (UCMP) reported from Asphalto bear no evidence of asphalt; their preservation is typical of Tulear specimens. They evidently recovered from the Tulear during mining of the intruding asphalt dikes and indicate the age of the host rock, not of the intrusive dike. Major collections of McKittrick Pleistocene megafauna are reposited at UCMP (locality 4096) and the Los Angeles County Museum [LACM/CIT] locality 7319, differential portions of the same La Brea-like bone deposit. Fossil deposits also include aspaticidi muschostes (asphaltic earthy sediments), in the remnant locality, and, uniquely, the asphalt seems to have developed when water saturated weathered asphaltic diatomite created a quicksand-like bog. While faunal differences between Rancho La Brea and McKittrick can partially be attributed to environmental conditions, others (such as abundant aquatic incects and aquatic birds in the latter) appear to result from temporal discontinuities or selective entrapment.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

OLDEST JOINT RECORD OF MACACA AND MESOPITHECUS (PRIMATES, CERCOPITHECIDAE) BASED ON MATERIAL FROM THE LATE Miocene OF MONCUCCO TORINESE (ITALY)

ALBA, David M., Institut Catá de Paleontologia Miquel Crusafont, Barcelona, Spain; DELSON, Eric, Department of Anthropology, Lehman College, CUNY and Department of Vertebrate Paleontology & NYCEP, New York, NY, United States; COLOMBO, Simone, Università degli Studi di Torino, Torino, Italy; DELFINO, Massimo, Università degli Studi di Torino, Torino, Italy; PAVIA, Marco, Università degli Studi di Torino, Torino, Italy

The final Miocene site of Moncucco Torinese is located in the Moncucco gypsum quarry (Tertiary Piedmont Basin, NW Italy), which exposes a Messinian littoral lacustrine succession (Littorina Zone) lying directly above the Messinian-Pliocene boundary. On the basis of both litho- and biostratigraphic data, the vertebrate-bearing fossiliferous horizons of Moncucco are correlated to the upper post-evaporitic unit of the Messinian, with an estimated age of 5.40–5.33 Ma (MN13, late Tortonian, later Miocene). Here we report dental and postcranial fossil remains of Old World monkeys (Primates: Cercopithecidae) and a unique record of a partial humerus of an unambiguous attribution to the genus *Macaca*. In contrast, both the talus and the ulna are attributable on morphologic and morphometric grounds to the colubine *Mesopithecus pentelicus*, whose postcranial morphology is well known based on material from its type locality.
The record of *Mesopithecus* at Moncucco agrees well with the previously-known range of this species in Italy and elsewhere in Europe. That of *Macaca*, however, constitutes only the second record of macaques in the Miocene of Europe—the other one derives from the Spanish locality of Casares. The complete maxilla, estimated age of 5.9–5.3 Ma. Although the co-occurrence of *Mesopithecus* and *Macaca* in the same locality had been previously recorded, Moncucco is the first known instance in which a macaque is recorded together with the late Miocene species *Mesopithecus pentelicus* instead of *Mesopithecus monspessulanus*. The presence of such opportunistic and semi-arboreal monkeys in the Moncucco locality reflects the environmental reconstructions based on the remaining fauna, which indicates a relatively warm and humid, densely-forested environment with more open and dry habitats nearby. From a paleobiogeographic viewpoint, the record of *Macaca* at Moncucco further reinforces the hypothesis, based on the previous citation of this genus from the late Miocene of Spain, that macaques dispersed from Africa into Europe sometime between 5.9 and 5.3 Ma, due to the sea level drop associated with the Messinian Salinity Crisis.

**Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)**

**THE LAST FOSSIL PRIMATE IN NORTH AMERICA: NEW MATERIAL OF THE ENIGMATIC EKGMOWECHASHALA FROM THE AKIKAREAN OF OREGON**

ALBRIGHT, L. Barry, University of North Florida, Jacksonville, FL, United States; SAMUEL, Joshua, John Day Fossil Beds National Monument, Kimberly, OR, United States; FREMD, Theodore, University of Oregon, Eugene, OR, United States.

In North America, fossil primates and the primate-like Pliadiapiformes are known from the earliest Paleocene through the late Oligocene. Although primates vanish in North America in the Chadronian, approximately 37 million years ago, the tiny, enigmatic *Ekgmowechashala* shows up 9 million years later, in the Akikarean of South Dakota and Oregon. The phylogenetic position of this taxon has been debated, with various authors placing it in the Plagiopithecidae (like *Homunculus* in the Haplorrhini) and Omomyidae (Primates), and most recently Adapiformes (Primates). *Ekgmowechashala* was previously known from five dentary specimens from the upper Sharps Formation of South Dakota, plus a maxilla fragment with teeth assigned to the John Day Formation of Oregon. Here we note three additional teeth of *Ekgmowechashala*, likely from a single dentary, from Unit H in the Turtle Cove Member of the John Day Formation. The reversed magnetic polarity of Unit H together with its position between the overlying Deep Creek Tuff (27.89 Ma) and the underlying Picture Gorge Ignimbrite (29.96–29.72 Ma) indicates a late Early Miocene age for these specimens. The teeth very closely resemble those of the South Dakota specimens of *E. philotau,* and help to confirm the presence of this taxon in Oregon and refine the age of these occurrences.

**Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)**

**NEW MINOTOURSARUS MATERIAL FROM THE DIJOOKTA FORMATION EKGMOWECHASHALA NEWSTES TAXONOMIC AND STRATIGRAPHIC CRITERIA FOR THE TAXON**

ALICEA, Justy, American Museum of Natural History, New York, NY, United States; 10027; LOEWEN, Mark, Univ of Utah, Salt Lake City, UT, United States.

*Minotoursaurus ramachandranii* was named from an illegally acquired specimen that was available at the Tucson Gem and Mineral show. As with most specimens of uncertain provenance, the systematic identity of the specimen remains uncertain. The name assigned to the specimen, “Minotoursaurus, either Mongolia or China.” A previously described specimen from the Hsiaojun Formation of China, Shaxian, is indistinguishable from *Minotoursaurus*; however the age of this formation is listed as “Late Cretaceous.” Ongoing scientific research by the American Museum of Natural History, in cooperation with the Mongolian Academy of Sciences has produced a second specimen with some postcranial elements from the Xanadu site of the Uhaa Tolgod locality within the Late Cretaceous of the Oligocene. The entire skull of *Minotoursaurus* based on its autapomorphic anteriorly facing nares rimmed with a ring scale; a large presquamosal unfused, free-floating osteoderm; and an elongated, suite of characters separate *Minotoursaurus* from all other ankylosaurids including: a well-developed premaxillary catcure, a well-developed postorbital scale pattern on the nasal and frontal region; forward facing orbits; a circumorbital scale; and a mandibular osteoderm that extends forward to the anterior end of the tooth row. Additionally, the new specimen includes the axis and the complete first cervical ring, a small, laterally oriented spike on the lateral most plate of the entire specimen has been found on the parietals which lead to large excavations within the skull roof and cervical ring. These burrows continued in a Medusa-like pattern into the matrix surrounding the skull, and are filled with bone fragments, suggesting insect utilization of bone similar to the unique patrne currently only known from Late Cretaceous Gobi deposits.

This new specimen places *Minotoursaurus* in stratigraphic and geographic context and adds to our knowledge about the cranial and postcranial anatomy of this taxon.

**Technical Session I (Wednesday, October 30, 2013, 9:00 AM)**

**THREE DIMENSIONAL MICRO-CT STUDY OF THE AISTOPOD CRANIUM REVEALS HIDDEN MORPHOLOGICAL DIVERSITY AMONG THE EARLY TERTIARY LEPOSPONDYL ORDER**

ANDERSON, Jason, University of Calgary, Calgary, AB, Canada; 2T4 4N1; PARDO, Jason, University of Calgary, Calgary, AB, Canada; 2T4 4N1; DAMAGE, Damien, MNHN, Paris, France; AHBULBERT, Per, University of Calgary, Calgary, AB, Canada; 2T4 4N1; GERMAIN, Damien, MNHN, Paris, France.

Recent studies have suggested that the braincase preferentially preserves a phylegetic signal against selective pressures (i.e., locomotor, feeding) that strongly modify the rest of the skull and that neurocranial characters can resolve otherwise indistinguishable phylogenetic patterns. Neurocranial morphology, revealed by micro-Computed Tomography (micro-CT) has been found to be particularly promising in resolving the phylegetic relationships of recurvedrostran lepospondyls, but resolution of broader relationships among lepospondyl orders will not be realized until a more comprehensive sample is built and a standard for details of the skull roof. It is demonstrated for the first time to be a lightly built, strait-like skull, reminiscent in construction of Phlegethonida. The premaxilla is relatively short but the skull is elongate, especially in the postorbital region that is dominated by a large...
temporal fenestra but retains a complete lower temporal bar. The braincase is extremely primitive in its construction, in stark contrast with other lepospondyls, with a previously recognized notochordal occiput, persistent ventral cranial fissure, prominent basal tubera, and a preserved dorsal rami from a left tibia that support the ventral lamina of the parasphenoid. The occiput plus opisthotic ossification is completely separated from the prootic ossification, but the prootic and sphenethmoid ossifications articulate dorsally. The sphenethmoid braincase is elongate and solidly walled, although perforated laterally by a foramen for the optic nerve and rostrally for the olfactory tract. The braincase of Coloraderpeton is more completely ossified, but largely conforms to this pattern, and the peculiar morphology of a previously described anterior braincase of Phlegethonius is confirmed by these scans. The lower jaws of both taxa are completely reconstructed and Coloraderpeton is confirmed by these scans. The lower jaws of both taxa are completely reconstructed and Coloraderpeton is confirmed by these scans. The lower jaws of both taxa are completely reconstructed and Coloraderpeton is confirmed by these scans. The lower jaws of both taxa are completely reconstructed and Coloraderpeton is confirmed by these scans.

**NEW MATERIAL OF TORETOCNEMUS FROM THE LATE TRIASSIC (NORIAN) OF SOUTHEAST ALASKA**

ANDERSON, Katherine L., University of Alaska Museum, Fairbanks, AK, United States; 99709; DRUCKENMILLER, Patrick, University of Alaska Museum, Fairbanks, AK, United States; BAICHTAL, James, Tongass National Forest, Thorne Bay, AK, United States

The Late Triassic was a crucial period in the evolution of the ichthyosarous body plan. During this interval, ichthyosaurs exhibited the greatest size disparity known from their entire geological history; however, relatively little is known about the diversity and morphology of small-bodied (1-2 m) forms, especially when compared to the much larger and better known Late Triassic taxa. In 2003, a small-bodied (~1.5 m total length) ichthyosaur fragment was collected in a restricted area in Kaa Ken-Ahnaan-aged strata in Southeast Alaska. The specimen was found in a calcareous shale from the lower unit of the Nehenta Formation, which is early to middle Norian in age based on biostratigraphic evidence. These rocks are in turn part of the Alexander terrane, a displaced crustal fragment that was accreted to North America during the Mesozoic and Cenozoic.

The new ichthyosaur consists of bone fragments and external molds of an incomplete but largely articulated postcranial skeleton. Surface peels were used to better interpret the skeleton, which includes two dorsals and 18 articulated caudal vertebrae, a partial pelvic girdle, an articulated hind limb and a second femur. The distinctive hind limb morphology, including a strongly constricted femoral shaft that is distally expanded both pre- and postaxially, as well as elongate epipodials separated by an epipodal foramen, permits referral of the specimen to the poorly-known, small-bodied ichthyosaur Topecochelys. As currently interpreted, Topecochelys is restricted to Carnian-Ahnaan-aged strata of California and possibly Sonora, Mexico. The new Alaskan specimen is significant in that it extends the stratigraphic range of the genus into the Norian. In addition, it is important in being the first record of the genus in northwestern North America, although the reconstructed palaeogeographic position of the Alexander terrane in the Triassic was approximately 20° N. It is also the first specimen of Topecochelys to preserve apical vertebral, providing insight into the evolution of the tail bend in Late Triassic, small-bodied ichthyosaurs.

**POSTER SESSION IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)**

**THE FIRST PTEROSAUR FROM ANTÁRCTICA**

ANDRES, Brian, University of South Florida, Tampa, FL, United States; 33620; SMITH, Nathan, Howard University, Washington, DC, United States

Pterosaurs are considered to be one of the most successful groups of flying organisms due in part to their achieving a global distribution soon after their appearance. This achievement is largely based on a single fossil, an isolated humerus from the Early Jurassic Hanson Formation in the Central Transantarctic Mountains of Antarctica. However, this is the least diverse time known for pterosaurs. It is a possibility that there was a period in time in which this was the only pterosaur specimen known to exist, but this cannot be confirmed by the dating resolution of the specimens from this time. Comprehensive phylogenetic analysis of this specimen and the Pterosaurus supports low diversity during this time by recovering a single pterosaur lineage surviving into the Early Jurassic on which this specimen is a basal member. This phylogenetic bottleneck is also during a time of record low oxygen levels in the atmosphere. Lower atmospheric oxygen levels hinder powered flight by providing less oxygen for this aerodynamically efficient activity and creating a less dense atmosphere in which to fly. This phylogenetic bottleneck may represent the survival of pterosaurs through an oxygen crisis, and the Antarctic may have been a refugium with relatively colder, denser air in which flight was easier.

Use of diversity estimates to test evolutionary scenarios has recently been debated, and pterosaurs have become a focal point of this debate. Studies that support a strongly biased record attribute a significant correlation between species richness and sampling proxies such as number of pterosaur formations over time to the causation of diversity patterns. This correlation has also been attributed to diversity and sampling estimates being at least partially redundant. The third possibility, that pterosaur diversity and sampling share a common cause, has not been studied in as much detail. Pterosaur fossils are found worldwide in both marine and terrestrial environments and biases that would affect the diversity patterns would be planetary in scale and may have affected their evolution. The number of pterosaur formations is not significantly correlated with phylogenetically corrected diversity estimates based on the comprehensive phylogeny but is correlated with atmospheric oxygen levels over time. The correlation between pterosaur diversity estimates and sampling proxies may be due to the combined effect of oxygen on pterosaur evolution and geological processes such as sediment production.

**POSTER SESSION III (Friday, November 1, 2013, 4:15 - 6:15 PM)**

**NEW ALVAREZSAURID MATERIAL FROM THE HELL CREEK FORMATION, MONTANA**

ANDUZA, Danny, Montana State University, Museum of the Rockies, Bozeman, MT, United States; 59717; POWLER, Denver, Montana State University, Museum of the Rockies, Bozeman, MT, United States; NOTTO, Christopher, Univ of Wisconsin-Parkside, Kenosha, WI, United States; HORNER, John, Montana State University, Museum of the Rockies, Bozeman, MT, United States

The Alavarezsaurae are an enigmatic family of theropod dinosaurs, characterized by derived features that possess extremely short forelimbs with a single functional digit bearing a large robust ungula. Alavarezsaurids are first recorded from the Late Jurassic
Shishugou Formation of China (Hoplocheirus), but are otherwise known only from the Late Cretaceous, particularly of South America (Alnasheri, Alvarezsaurus, Patagonykus) and Asia (Xiashunian, Linhenykus, Paracursor, Shuansia, Mononykus), including a number of very complete vertebrae and skeletons. In the Northern North American Late Cretaceous has yielded only limited material, comprising an ulna, manual ungual, tibiae, metatarsals and phalanges (Albertonykus) from the Lower Maastrichtian part of the Horseshoe Canyon Formation, Alberta; and a pubis, partial ischium, and metatarsal from the Upper Maastrichtian Hell Creek Formation, Montana, and Lance Formation, Wyoming. Here we describe two alvarezsaurid material from the Hell Creek Formation, Montana, comprising a metatarsal III (Museum of the Rockies specimen MOR 2920), and two unassociated manual unguals from digit I (MOR 3098, 6622). These are of particular interest as manual unguals undergo a number of changes through basal to derived members of the clade, including gradual encroachment of the ventral blood vessel groove, development of a ventral sulcus, and increased robusticity and rugosity. The largest ungual (MOR 6622; reconstructed length 4.4 cm) is nearly complete and is ~10% more comparable in size to Albertonykus (Royal Tyrrell Museum of Paleontology TMP 2000.45.86). MOR 6622 differs from MOR 3098 in exhibiting a more rugose surface texture, ventral foramina that are more deeply enclosed, and a deeper and more developed ventral sulcus. Due to the size disparity, morphological differences between MOR 6622 and 3098 most likely represent either variation (allometric or ontogenetic) within the same taxon, or taxonomic distinction. This may have implications for characters currently used to diagnose other alvarezsaurid taxa. New and revised stratigraphic and palaeoecological data demonstrate that the PFF is a shallow intra-continental sag basin. With progressive climatic drying paleoenvironments were first discovered in the Pedra de Fogo Formation (PFF) of the Parnaiba Basin in the eastern edge of the basin occur in the shallow marine to brackish to highly saline lakes facing the formidable temnospondyls and rhynchocephalians, whereas those from the central basin may represent rhynchocephalians and the archegosaurid Prionosuchus. At least one specimen may preserve soft tissue impressions. In the Permian, the Parnaiba Basin was located in equatorial Pangaea, at a similar latitude as the Moradi Formation of Niger. Like the Moradi, the PFF includes an anachronistic mixture of clades from such faunal assemblages may have been common to central Pangaea. Yet, the PFF appears to include a mix of clades best known from the Early Permian and Mesozoic, whereas the Moradi includes a mix of Early and Late Permian taxa. Further research will be necessary to better establish the number of distinct time horizons in the PFF, and its relationships to other basins. The PFF shows great potential to provide new insight into Permian biogeography and potentially the end-Permian mass extinction.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM) 
SYNCHROTRON ANALYSIS OF PATHOLOGIC BONE: CHEMISTRY AND MORPHOLOGY IN EXTINCT AND EXTANT ARCHSAUR BONE

ANNE, Jennifer, University of Manchester, Manchester, United Kingdom; WOGELIUS, Roy, University of Manchester, Manchester, United Kingdom; EDWARDS, Nicholas, University of Manchester, Manchester, United Kingdom; SELVERS, William, University of Manchester, Manchester, United Kingdom; MANNING, Philip L., Univ of Manchester, Manchester, United Kingdom

Bone histology has historically been a structure-based technique, with the bulk of analysis accomplished through the study and interpretation of histological thin sections. More recently, the use of chemical techniques such as rare earth element (REE) and isotopic analysis have begun to aid in the interpretation of bone histology and taphonomy by incorporating chemical information into the analysis. However, chemical thin sections and destructive chemical analyses are limited with respect to mapping bone chemistry in high resolution. Synchrotron Rapid Scanning X-Ray Fluorescence (SRS-XRF) allows elemental mapping at low concentrations (parts per million) over large surface areas in a relatively short period of time (~30 minutes for a few separate analyses). The distribution of dilute elemental concentrations within discrete biological structures allows us to correlate specific chemical within identifiable tissue types in both extinct and extant specimens, and has allowed us to identify biomarkers for specific biomolecules (e.g. collagen).

Here we use SRS-XRF to analyze variations in the trace element inventory of pathologic and normal bone in a thaloid felid (Allocaurus fragilis) pedal phalanx. Evidence for bone infection and fracture healing (callus formation) is mapped in cross section and combined with detailed thin section analysis. Diagnostic incorporation of trace elements can be correlated within the different tissue types present between pathologic and normal bone. These include differences between woven and lamellar bone, areas of resorption, and areas of remodeling (of callus). SRS-XRF mapping reveals both chemical variations within different bone tissues and previously unobserved histological structures not seen in thin section. Comparing these results to SRS-XRF maps from avian and crocodilian pathologic bone will allow us to further investigate both the chemical compositions of bone through time as well as the evolution of fracture healing within the Archosauria.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM) 
ANTON, Mauricio, Museo Nacional de ciencias Nacionales, Madrid, Spain; SILICEO, Gema, Museo Nacional de ciencias Nacionales, Madrid, Spain; SALESA CALVO, Manuel, Museo Nacional de ciencias Nacionales, Madrid, Spain; MORALES, Jorge, Museo Nacional de ciencias Nacionales, Madrid, Spain

Frontal sinuses are air-filled spaces in the frontal bone formed through a pneumatization process whereby complete cavities. In contrast the mucous epithelial tissue from the nasal cavity expands into the adjacent frontal bones. The need to keep a biomechanically stable structure despite pneumatization results in the development of bony struts. There are several hypotheses about the function of frontal sinuses (e.g., olfactory, respiratory, thermoregulatory), whilst some authors see them as functionless by products of the bone remodeling process. We studied the frontal sinuses in the saber-toothed feld Machairodus aphanistus from the sites of Batallon-1 and 3. The area indicated by our model as having a high priority of being fossilliserous was in fact an extensive outcrop of heavily eroded sandstone that yielded typical Eocene terrestrial mammals, including temnospondyls and archegosaurids. The area in the frontal bone formed through a pneumatization process when the mucous epithelial tissue from the nasal cavity expands into the adjacent frontal bones. The need to keep a biomechanically stable structure despite pneumatization results in the development of bony struts. There are several hypotheses about the function of frontal sinuses (e.g., olfactory, respiratory, thermoregulatory), whilst some authors see them as functionless by products of the bone remodeling process. We studied the frontal sinuses in the saber-toothed feld Machairodus aphanistus from the sites of Batallon-1 and 3. We used the frontal sinuses. In contrast the mucous epithelial tissue from the nasal cavity expands into the adjacent frontal bones. The need to keep a biomechanically stable structure despite pneumatization results in the development of bony struts. 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saber-toothed cats), the extension and constriction of the sinuses are difficult to explain. In some hyaenodons, the caudally elongated frontal sinuses and domed skulls have been related to dissipation of stresses produced when cracking bones, but their sinuses surpass the level of the frontal-parietal suture, which is not the case in M. aphanistus. Other explanations, such as the frontal sinuses acting as thermal insulators of the brain are also possible, but not strongly supported.

Plesiosaur humeri from Angola are pachyosteosclerotic to osteosclerotic, have secondary osteons that extend to near the external surface of the bone, and exhibit three lines of arrested growth. These traits are indicative of an ‘adult’ condition. However, the external morphology is juvenile-like, i.e. they lack the secondary osteons that extend to near the external surface of the bone and exhibit three lines of arrested growth. This paradox can be explained by paedomorphism. A database of ontogenetic stages of nearly 400 plesiosaur specimens arranged by geologic age shows an average 51% (SD=0.16) of ‘immature’ specimens, if the Maastrichtian time bin is excluded. The ‘immature’ record is composed mainly of elasmosaurs (~90%) and Southern Hemisphere (Weddellian) plesiosaurs (~80%). Within the Weddellian elasmosaur fauna, ‘immature’ specimens are 2.7 times more abundant than ‘mature’. A phylogenetic morphometrics analysis using 31 operational taxonomic units and 6 landmark configurations based on postcranial material shows biogeographical and stratigraphic congruence, and retrieval of the Maastrichtian forms within the same clade.

**EVOLUTIONARY PATTERNS AND MORPHOLOGICAL DISPARITY OF SAUROPOD MORPHOSES OVER THE TRIASSIC-JURASSIC BOUNDARY**

APALDETTI, Cecilia, Conicet - Museo Paleontologico Egidio Feruglio, Trelew, Argentina; POL, Diego, Conicet - Museo Paleontologico Egidio Feruglio, Trelew, Argentina; MARTINEZ, Ricardo, Universidad Nacional de San Juan, San Juan, Argentina

Sauropodomorph was a diverse and abundant group of herbivorous dinosaurs that dominated most continental ecosystems of the Mesozoic era. The sauropodmorph fossil record evolved into the Late Triassic–Early Jurassic was a key period of time in the evolution and diversification of this group, including the origin of Sauropoda. Here we present a morphological disparity study to evaluate the regions of the morphospace occupied by Sauropodomorph from the Late Triassic to the Early Jurassic. Morphological disparity was approximated using multivariate analyses applied to different versions of a recently published phylogenetic matrix, in which taxon and character sampling was altered in different ways. The results show the most basal and oldest sauropodmorphs (Carnian) forming a group that occupies a small and well-differentiated region of the morphospace. During the Norian this group diversified notably both taxonomically and ecologically, which is in parallel to a region of a much broader different region of the morphospace. The boundaries of this region of the morphospace are mostly determined by robust basal sauropodomorphs from the Southern Hemisphere. During the Lower Jurassic, the region of the morphospace occupied by Sauropodomorph is markedly expanded with respect to that of the Norian. This is expanded toward two news regions where some of the most conspicuous sauropodomorphs of that period are positioned: the gracile forms known as massospondylids and the derived and giant forms of basal sauropods. This result evidences that the increase in taxonomic diversity was paralleled by a rise in the morphological disparity of Sauropodomorph during the Late Triassic. After the Triassic-Jurassic boundary, the disparity increases notably, but the taxonomic diversity is not altered significantly. These marked steps in the changes and expansions of the morphospace regions occupied by basal sauropodomorphs is to a large degree dominated by the signal coming from taxa known from the southern hemisphere.

**THE RETURN OF NAJASH: NEW, BETTER PRESERVED SPECIMENS CHANGE THE FACE OF THE BASAL SAUSALMOKE**

APESTEGUIA, Sebastian, Universidad Maimonides, Buenos Aires, Argentina; GARBEROGLIO, Fernando, Universidad Maimonides, Buenos Aires, Argentina

La Buitrera is a fossiliferous locality from northern Patagonia, Argentina. It preserves superb small to mid-sized skeletons in a Gobi style, but evidencing subeusal exposure, scavenging, dissolution and shallow disarticulation. Skeletons are commonly well-defined and clearly separated from other. Lag deposits are present too, but as consequence of disarticulation of complete skeletons. Najash rionegrina is the only snake found in the La Buitrera locality. The phylogenetic approach positioned this species as the basalmost snake, bringing it into the large debate of snake origins. The species was primarily described based on one specimen consisting of a largely complete vertebral sequence of 122 vertebrae from axis to caudals, including pelvis, limbs and a dentary. As frequent in La Buitrera style, this specimen was largely articulated except for some displaced vertebrae (isolated within the jacket), the dentary some millimeters in front of the axis, and the fibula at less than one centimeter from the tibia. A recent work discussing the position of Najash proposed the exclusion of these elements for not being in anatomical contact. We reject this opion. Full anatomical contact is rare in vertebrate paleontology. Concerning other elements, found isolated and at about 3 km (i.e., an isolated partial skull, a quadrate, an additional dentary and several vertebrae), included as referred material, debate is understandable. A recent visit to the locality resulted in the finding of two new specimens that were provided with vertebrae bearing skull that are indistinguishable from those described for the holotype. One of them bears an incomplete skull preserved almost exactly as the published one. The second skull, although still unprepared, bears an "amphid" general aspect and preserves premaxilla, nasal, vomer, prefrontal, frontal, maxilla, jugal and angular (both clearly differentiated), supratemporal, parietal, postorbital, supraoccipital, supratemporal and infratemporal. The lower jaw includes compound bone, angular and a dentary with two foramina. This new specimen makes a substantial contribution to make Najash rionegrina one of the better known basal snakes.
documents an extreme specialization for cursoriality, far beyond what was previously known for the group.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

**FISH DIVERSITY AND PALEOENVIRONMENTS FROM THE LATE MIOCENE OF SAHABAH, LIBYA**

ARGYRIJOU, Thodoris, University of Alberta, Edmonton, AB, Canada; TSIG 2E9; MURRAY, Alison, University of Alberta, Edmonton, AB, Canada

Decades of excavations at the late Miocene (Messinian) fossiliferous deposits exposed in Sahabah, in northeastern Libya, have uncovered a greatly diverse vertebrate assemblage. The known diversity includes terrestrial (e.g., large proboscideans, carnivores, bovids, equids, and primates) and aquatic (e.g., dolphines, sea cows), crocodilians, turtles, birds, and both bony and cartilaginous fish. The previous works on fish fossils have provided useful information about the composition of the Sahabah ichthyofauna but were either focused on eusclomerans or based on a limited sample size. Recent excavations conducted in 2010 by the East Libya Neogene Research Project (ELNRP) and focused on the U1 member of the Sahabah Formation, allowed the collection of a sizable sample of fossil fish that includes at least 18 different actinopterygian taxa of both marine and freshwater affinities. Both recent and fossil comparative material were used to assess similarity, taxonomic recognition, taxonomic o一日e, some of which were previously unreported from Sahabah, are the following: Polypetrus sp. (Polypetridae); C. laboe sp. (Cyprinidae); Hydrocyamus sp. (Alestidae); Cararius sp. (Arididae); Bagrus sp. (Bagridae); Clarotus sp. and Acanoglosnus sp. (both Claroteidae); Clarotus or Heterobranchus sp. (Clariidae); Synodontis spp. (Mochokidae, at least two different species); Mugilidae indet.; Semlichthys rachiklinchus (incertae sedis); Lates niloticus (Latiidae); Sparidae indet.; Argyrosomus sp. (Sciaenidae); two unidentified perciforms and an unidentified tetraodontiform. Most taxa are of freshwater affinities and can be considered as typical members of the Neogene Nilo-Saharan ichthyofauna. Their presence indicates that both fast-flowing-pelagic and more marginal or stagnant freshwater habitats coexisted. However, the mugilids, sparids, sciadens, and likely the two unidentified perciforms represent marine or euryhaline taxa whose modern relatives are known to invade estuaries. This diverse fish assemblage corresponds to the estuaries or the terminal part of the channel-delta of a large riverine system active during the Messinian.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

**NEW METHODOLOGY FOR 3D RECONSTRUCTION OF FOSSIL FISH USING DIGITAL IMAGERY**

ARENNAULT, Félix, Centre de Développement et de Recherche en Imagerie Numérique, Matane, QC, Canada; G4W 0E1; BECHARD, Isabelle, Université du Québec à Rimouski, Rimouski, QC, Canada; TOUTCHE, Richard, Université du Québec à Rimouski, Rimouski, QC, Canada; KERR, Johanne, Parc national de Miguasha, Nouvelle, QC, Canada

Non-invasive technologies, such as CT-scan, traditional and synchrotron-based micro-CT-scan, are gaining in popularity for quantitative visualization of fossilized anatomical structures and ultrastructures. However, most studies in virtual palaeontology are performed on a limited number of specimens owing to the cost of utilisation and the time required for image acquisition, processing, and interpretation. Usage of such technologies can also be limited by the taphonomic condition and size of the fossils, as well as the type of matrix surrounding the specimens. However, three-dimensional reconstruction (3D) of taxon does not necessarily require histological and ultrastructural investigation. Non-invasive 3D laser surface scanner provides the possibility to acquire high-definition surface-scanned images of prepared specimens without the potential limitations imposed by other technologies. Results are rapid and easy to use for research purpose and collection management. A new and precise method to 3D-reconstruct fossilized taxon was developed using a 3D laser surface scanner combined with cutting-edge digital imagery tools. Nineteen well-preserved and articulated specimens of the Late Devonian placoderm Bothriolepis canadensis (Miguasha, eastern Canada) were scanned at maximum resolution. Digital data were cleaned in an acquisition and processing software. Using a digital sculpting software, superposition of multiple 3D meshed models allows for the precise shape extraction and taphonomical corrections providing an unbiased and accurate reconstruction of B. canadensis. This new digital reconstruction highlights previous anatomical misinterpretations on the morphology, size, and shape, and articulation of this placoderm; most of the modifications would not have been possible without the usage of the digital 3D model.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

**DISSECTING DINOSAURS: THE USE OF RESEARCH SPECIMENS IN HIGH SCHOOL BIOLOGY CLASSROOMS TO ENGAGE STUDENTS AS CITIZEN SCIENTISTS AND PROMOTE SCIENCE LITERACY**

ATTERHOLT, Jessie, University of California, Berkeley, CA, United States, 94720-4780;

Community Resources for Science is a northern California non-profit organization that connects K-12 educators with local scientists through their Bay Area Scientists in School (BASIS) volunteer program. BASIS scientists visit primary and secondary school classrooms to conduct one-hour science lessons for which they provide materials and expertise. The program is otherwise unavailable to teachers, at no cost to the school. A lesson entitled "Dissecting Dinosaurs," which involves students in an exploration of avian evolution and anatomy through bird dissections, has recently been designed and implemented in five high school biology classrooms in Oakland, California. The primary goals of this lesson are: 1) to excite students about science; and 2) to promote the use of critical thinking skills, such as inductive and deductive reasoning, analysis, and synthesis.

The specimens provided for this exercise are bird carcasses of a wide variety of native California taxa (among them, hawks, owls, pelicans, and grebes), collected for doctoral dissertation research at the University of California (UC), Berkeley and accessioned as specimens in the University's Museum of Vertebrate Zoology (MVZ). More than 80% of the lesson’s dinornian ancestor of birds evidence of this relationship, and understanding basic avian anatomy and biology. Students also act as citizen scientists, collecting real data for the MVZ (including tissue samples, gonad identification and measurements, and notes on stomach contents). This lesson not only provides students with a unique opportunity to dissect wild birds, but also gives them an appreciation for local wildlife and helps to instill a critical-thinking toolkit fundamental to becoming scientifically literate citizens. During times of severe budget crisis, when underprivileged schools suffer from dwindling financial support, decreased access to teaching resources, and growing class sizes, action from outside of schools to improve education becomes critical. "Dissecting Dinosaurs" is an example of how research scientists from institutions such as UC Berkeley and the MVZ can combat the further degradation of our primary and secondary education system and improve scientific literacy in the United States.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

**NEW EVIDENCE THAT OMOMYID DIET, NOT BODY SIZE, WAS AFFECTED BY GLOBAL CLIMATE CHANGE**

ATWATER, Amy, University of Oregon, Eugene, OR, United States, 97405; HOLROYD, Patricia, Univ of California Berkeley, Berkeley, CA, United States; DAVIS, Edward, Univ of California Berkeley, Eugene, OR, United States

The North American late Miocene fossil record contains both the diversification and extinction of lineages of early mammals through a period of climatic changes that include fluctuations in temperature and precipitation. Omomyid primates have a well-documented evolutionary history, diversifying and subsequently disappearing in the context of regional climate change. Our study investigates possible drivers of omomyid evolution and extinction. We tested whether the evolutionary trajectories of body mass and inferred feeding ecologies in omomyid clades match our predictions for the effects of climate change and biological interactions. We gathered measurements of lower m2 area from 1092 specimens representing 24 genera and 45 species ranging from earliest Eocene to late Middle Eocene in age (55 to 43 Ma) as a proxy for body mass and added diet data from published literature in the form of shearing ratio on tooth of the lower m2. These body size and diet proxy data were then analyzed in a phylogenetic framework to reconstruct the ancestral state of these characters and document evolutionary changes through time. Our results indicate that taxonomic diversity and biological interactions were the main drivers of omomyid body size, while climate played a major role in diversification of omomyid feeding ecologies. These results highlight the importance of understanding and considering multiple factors in developing models for diversification and extinction. The details of omomyid extinction can be used to inform a model for extinction, which should help conservation efforts for extant organisms that share similar ecological niche spaces with these Eocene primates.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

**NEW SPECIMENS OF LEATHERBACK SEA TURTLES (DERMOCHELYIDAE) FROM THE MIOCENE OF ORANGE COUNTY SHED LIGHT ON MORPHOLOGICAL TRENDS**

AWALT, Katrina, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States, 92834-6850; PARHAM, James, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States; HOLROYD, Patricia, Univ of California Berkeley, Berkeley, CA, United States

The Miocene is a key time in the evolutionary history of leatherback sea turtles, because it marks the last appearance of archaic thick-shelled forms (Psaphophorus spp.). Current knowledge about Miocene dermochelyids is limited, and mainly based on specimens from Europe and the eastern USA. Recent studies have raised questions about the taxonomic diversity and biogeographic distribution of Miocene dermochelyids, and so the description of new specimens from this time, especially from new areas, is key. Although dermochelyid fossils are known from a few sites in California, the only published record is a single femur that was mentioned over 75 years ago (and misidentified as a chelonid). Many important specimens from California have been unstudied in museum collections. Over the past decade, paleontological mitigation at three sites in Orange County resulted in the collection of new, relatively complete dermochelyid specimens from the middle Miocene Topanga Formation and late Miocene Monterey Formation. These specimens, in combination with more fragmentary specimens from other California sites, provide new data on the diversity, distribution, and morphology of dermochelyids in the eastern Pacific. We compare the morphology and stratigraphic position of these specimens to other Miocene dermochelyids in order to refine the temporal and geographic patterns associated with this important time in the evolutionary history of leatherbacks. The data show that the transition from archaic thick-shelled forms to the more thin-shelled forms includes intermediate morphotypes that appear sequentially within the Miocene marine formations of California.
The degree of cranial suture obliteration has been used as a maturity indicator in non-avian dinosaurs. This hypothesis is based on patterns observed in some mammalian species, however a sequence of cranial suture closure is unknown in the extant primitive graminivorous horse (Equus caballus). The Dinosauria. This study shows (1) the sequence and timing of suture closure and (2) the external sutural morphology during ontogeny in the skull of Alligator mississippiensis (Archosauria: Crocodylia). Cladistic methodology (in which immature character states were coded as zeroes, analogous to the pleiomorphic condition in phylogenetic analyses) was employed to determine the presence of a sample of both sexually immature and mature specimens (n=6). Within the 25 sutures examined in each skull, only the metopic (interfrontal) and sagittal (interparietal) sutures fuse, the others stay open until well after sexual maturity is attained. In immature specimens the sutures appear externally more closed than those of more mature specimens, however this morphological and functional differences are rather transient in timing between mature specimens. Interdigitation of sutures tends to increase through ontogeny. These preliminary results show that in Alligator mississippiensis: (1) the (simple) sequence of cranial suture closure exhibits variation and does not indicate maturity, (2) the overall sequence of sutural closure is independent of ontogenetic stage and should be taken into account when studying dried specimens, and (3) the shape of the sutures (straight versus interdigitated) may be a better maturity indicator than suture patency. This does not fit the typical mammalian model (where sutures stay open until sexual maturity is reached) that has been used for decades to attribute ontogenetic stages in non-avian dinosaurs. Thus it appears that the degree of suture fusion may not be used as a maturity indicator in non-avian dinosaurs without further investigation, including examination of suture microstructure in both fossil and extant archosaurs.

Technical Session XI (Friday, November 1, 2013, 9:45 AM)

THE RELATIONSHIPS OF OVIIRAPTORSAURO DINOSAURS AND ENDOCRANIAL EVOLUTION ALONG A MORPHOLOGICALLY BIZARRE LINEAGE

BALANOFF, Amy, American Museum of Natural History, New York, NY, United States, 10024; BEVER, Gabe, New York Institute of Technology, Old Westbury, NY, United States; NORELL, Mark, American Museum of Natural History, New York, NY, United States

Oviraptorosaurs include some of the most morphologically unique dinosaurs known. Although this unusual morphology makes their monophyly relatively clear, the relationships of species within the clade continue to be highly enigmatic. We attempted to clarify the phylogenetic relationships within Oviraptorosauria by sampling a number of new taxa and character systems. Many of the topological details recovered by previous studies were confirmed in our analyses. This includes the basal position of tooth-bearing taxa such as Incisivosaurus gutheii and Caudipteryx zoui. The most elusive group Oviraptorosauria in terms of understanding the evolutionary trajectory. A stark example is that the “crested” and “crestless” oviraptorids no longer represent a basal divergence within the group, being replaced by a hypothesis in which the crested morphotype evolved multiple times. We used the novel tree topology recovered from our phylogenetic analysis to study the evolutionary history of the oviraptorosaur endocranial space and brain. Previous studies have recognized morphological similarity between the cranial endocasts of oviraptorosaurs and birds, and concluded that this similarity is the homologous product of a close phylogenetic history. One way our study differs from these earlier works is that we bracket the entirety of known oviraptorosaur diversity by including the cranial endocast of the basally divergent Incisivosaurus, as well as those of several oviraptorids. We also significantly expand sampling within avialans and non-avian maniraptorans. Our results indicate that characters shared with avialans, such as streamlined actory tract and an expanded cerebrum, are better explained as either convergent or pleiomorphic for Maniraptora. The oviraptorid endocranial morphology supports a surprising degree of evolutionary plasticity, possessing not only these “bird-like” characters but also features otherwise known only in basal coelurosaur. Our study that makes an important contribution to what is an increasingly complex history of theropod neuroanatomical evolution.

Technical Session IX (Friday, November 1, 2013, 4:15 - 6:15 PM)

THE DEVELOPMENT OF C3 GRASSLANDS IN THE MIocene INFERRED FROM MESOWEAR IN GREAT PLAINS UngulateS FROM NEBRASKA

BALDVINS, Tom, University of Nebraska-Lincoln, Lincoln, NE, United States, 68583; SECORD, Ross, Univ of Nebraska-Lincoln, Lincoln, NE, United States

The spread of grasslands in the Miocene and Pliocene is considered a driving force behind the evolution of hypsodonty and other important faunal and ecological changes in the Neogene. However, although the late Miocene expansion of C3 grasses can be readily documented using stable isotopes, the spread of C3 grasses is more problematic. The phylothrid record suggests expansion of C3 grasses in the early Miocene while other proxies suggest a middle or late Miocene expansion. Here, we use mesowear analysis of ungulate mammals to infer vegetation change from the early Miocene (late Arikareean) through the late Miocene (Hemphillian). Diets were determined using factor analysis with a number of 27 typical extant herbivores as well as late Arikareean taxa, which indicates that one was a grazer (Stenomysa hitchcoki), two were mixed C3 feeders (Menoceras sp., Desmatoceras sp.), and one was a dicot browser (Pormecyclochoerus sp.). For Early Hemphillian ungulates three were grazers (Parahippus sp., Oxydactylus longirostris, and Protolabis sp.) and three were mixed feeders (Protohippus sp., Protohippus sp., Merychoerus sp., Merychoerus sp., and Michenia sp.) In the median Barstovian three were grazers (Calypso limus, Merychoerus sp., and Teleoceras sp.) and two were mixed feeders (Protoceras sp. and Ramoceras osborni). The horse, Neohippparion republicans was a grazer at one median Barstovian locality and a mixed feeder at another. Four late Barstovian taxa (Calypus pladus, Protohippus perfidus, Merycoecus sp., and Procamelus occidentalis) were mixed feeders or grazers. Merycoecus sp. was the only browser sampled during the late Barstovian. In the Clarendonian, two horses were grazers (Neohippparion sp. and Protoceras sp.), two were mixed feeders (Protohippus sp., Ramoceras sp.) and a third were a browser (Teleoceras sp.). During the late Barstovian, one was a mixed C3 browser or mixed C3 feeder (Protoceras sp.). The degree of mesowear obliteration is known to be influenced by diet, tooth wear, and taphonomy and should be taken into account when studying dried specimens, and (3) the shape of the sutures (straight versus interdigitated) may be a better maturity indicator than suture patency. This does not fit the typical mammalian model (where sutures stay open until sexual maturity is reached) that has been used for decades to attribute ontogenetic stages in non-avian dinosaurs. Thus it appears that the degree of suture fusion may not be used as a maturity indicator in non-avian dinosaurs without further investigation, including examination of suture microstructure in both fossil and extant archosaurs.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

THE DEVELOPMENT OF C3 GRASSLANDS IN THE MIocene INFERRED FROM MESOWEAR IN GREAT PLAINS UngulateS FROM NEBRASKA

BALDVINS, Tom, University of Nebraska-Lincoln, Lincoln, NE, United States, 68583; SECORD, Ross, Univ of Nebraska-Lincoln, Lincoln, NE, United States

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Hemphillian results suggest a predominance of medium to large-bodied grazers and mixed feeders for Miocene. This is most consistent with the phytolith record that suggests an early Miocene most of the Miocene, and differ from hypsodonty proxies that suggest a much larger subtropics and tropics have not yet emerged due to paucity of dates, but additional dating efforts are presently underway. Overall, the chronology that is coming to light suggests a synergy of human impacts plus climatically-caused environmental change may have resulted in a more rapid, temporally constrained extinction event in Patagonia compared to Brazil and central Argentina, where extinctions may have been protracted over several thousand years. At the continental scale, the LQE event in South America seems to have spanned more time than it did in North America. Intensive radiocarbon-dating efforts are now in progress in order to test these initial impressions.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

WHAT CAN PALEOPATHOLOGY TELL US ABOUT HUNTING MODES?

BALISI, Mairin, University of California, Los Angeles, Los Angeles, CA, United States; 90095; BROWN, Caitlin, University of California, Los Angeles, Los Angeles, CA, United States; VAN WALKENBURGH, Blaire, Univ of California Los Angeles, Los Angeles, CA, United States; SHAW, Christopher, George C Page Museum, Los Angeles, CA, United States.

Living mammalian predators sustain injuries from hunting that can be preserved after death in pathological characteristics of the skeleton. Consequently, the location of such injuries on a skeleton might reflect the hunting mode of the animal in life. In this study, we quantified osteological pathologies in the two most abundant mammalian predators from the late Pleistocene La Brea Tar Pits in Los Angeles, CA, USA – Canis dirus, the dire wolf, and Smilodon fatalis, the saber-tooth cat – the former inferred to hunt by pursuit and the latter by ambush. We surveyed specimens from Pit 61/67, the most recent and most chronologically constrained deposit (11,581 ± 3768 years). S. fatalis exhibited pathologies attributed to trauma more often in the ribs and thoracic and lumbar vertebrae, and also demonstrated more vertebral fusion and sternal injuries than C. dirus. The preponderance of S. fatalis injuries occurred in the limbs rather than in the post-cranial axial skeleton, but C. dirus exhibited more injuries to the skull (cranium + mandible) than S. fatalis. Both species showed equal injury frequency between left and right sides. Preservational bias is unlikely to account for the interspecific differences in injury frequency, as Pit 61/67 preserves comparable numbers of C. dirus and S. fatalis individuals. Rather, these differences suggest that C. dirus was a pursuit hunter similar to gray wolves today, suffering injuries to the skull and distal limbs from contact with the hooves of prey. Unlike the putative pursuit predator C. dirus, S. fatalis has a lower frequency of distal limb and facial trauma and appears to have sustained injuries during forceful grappling with large prey, suggesting ambush predation. Paleopathology can supplement traditional morphometric and biomechanical methods in inferring hunting modes of extinct predators. This study provides a starting point for inferring hunting mode of both predator types. The bone injuries seen in both species, which, like La Brea, is likely to have a significant number of predators with skeletal pathologies.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

THE USE OF GEOMETRIC MORPHOMETRIC DATA TO SOLVE PHYLOGENETIC INCONGRUENCIES WITHIN ANHANGUERIDAE (PTEROSAURIA, PTERODACTYLOIDEA)

BANTIM, Renan, Universidade Federal de Pernambuco, Recife, Brazil; SAYÃO, Juliana, Universidade Federal de Pernambuco, Vitória de Santo Antão, Brazil.

The most distinctive characteristic of anhanguerid pterosaurs is the presence of a premaxillary and dantary sagittal crests confined to the anterior portion of the skull. This structure shows a great variety of size and morphology, hindering features to solve morphological incongruencies. This work compares geometric morphometric landmarks of six anhanguerid species from Brazil with phylogenetic data in order to resolve the polytomies composed of the Anhanguera species on known phylogenies. Twenty eight landmarks were defined in the right lateral view of the skull, positioned in specific regions, of those 13 landmarks were positioned at the ends of the skull (quadrates, quadrateotargul, opisthotic, supraorbital and premaxilla) and the remaining 15 landmarks were marked on the premaxillary sagittal crest as a curve function. The graphic resulting from the Principal Component Analysis (PCA) identified three distinct clusters, where PC1 represents the height of the crest and PC2 the length of the sagittal premaxillary crest. The first one united the species Tropognathus mesembrinus and Anhanguera spielbergi. The second group is composed of Anhanguera blitersdorffi and Anhanguera aruripensis. The third group contains Anhanguera ischialis and Anhanguera guarauna. The three clusters were defined by the different morphological characteristics that separate the groups are the form, proportion and position of the premaxillary crest in the skull, which is similar within the taxa in the same cluster. Thus these features of the premaxillary crest showed a good source of data to solve the polytomies present in the Anhanguera in the pterosaur phylogenies known to date. Thus, this result demonstrates the importance of morphometric characters as a support for the systematic studies of pterosaurs.

Technical Session II (Wednesday, October 30, 2013, 9:00 AM)

INVESTIGATING THE APPLICABILITY OF OUTLINE-BASED GEOMETRIC MORPHOMETRIC TECHNIQUES TO THE STUDY OF UNGULATE MESOWEAR

BARRON-ORTIZ, Christian, University of Calgary, Calgary, AB, Canada, T2N 1N4; MIHLBACHER, Matthew, New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY, United States; RAYNER, Nathaniel, University of Calgary, Calgary, AB, Canada; THEODOR, Jessica, University of Calgary, Calgary, AB, Canada.

Traditional mesowear analyses are invaluable for inferring the diets of extant and, more commonly, extinct ungulate mammals; however, subjectivity in assigning variables relating to the shape of the flute-like surface features, such as length, height, and base width, result in a range of interpretations. This paper assesses the potential of outline-based geometric morphometric techniques for describing and analyzing mesowear morphology and the application of this work was evaluated by analyzing a series of 340 upper cheek teeth representing 37 extant species including eleven grazers, twelve mixed feeders, eight leaf browsers, and six fruit-dominated browsers belonging to the genus Cephalophus. Mesowear was quantified on the metastyle cusp of the second upper molar by digitizing a series of semilandmarks along the cusp outline using digital photographs of teeth taken at a standardized angle. Average cusp shape was calculated for each species and the resulting coordinates were analyzed using two different methodologies: sliding semilandmarks and eigenshape analysis. In both analyses, the first two components explain over 60 percent of the variation in the data and each dietary group tend to occupy a different region of the eigenspace. Notably, the first axis of the eigenshape analysis describes variation in cusp relief and apex orientation, in which leaf browsers plot opposite to grazers, whereas mixed feeders and fruit-dominated browsers occupy intermediate positions. Multivariate analysis of variance (MANOVA) tests and post-hoc about the chronology, causes, and consequences of the extinction in South America than elsewhere. Here we report initial results of an international, multidisciplinary effort to assess the timing of the LQE in South America and how it coincides (or not) with major climatic changes and anthropogenic events on a regional basis. Dated megafaunal remains are now known from the northern tropics and subtropics; central Argentina; eastern and northern Brazil; northern Chile, Peru, and vicinity; and Patagonia. Available information suggests mesofaunal extinction, human settlement, and climatic change were more synchronous in Patagonia, but that extinctions began before, and finished later, initial human presence in Brazil. In central Argentina, extinctions may have begun near the time of first abundant human presence, which was also coincident with a major climatic fluctuation, but several taxa persisted for thousands of years afterwards. At least three genera in central Argentina and Brazil have what appear to be good radiocarbon dates that place them well into the Holocene. Brazil may represent a pulse of extinction that coincides with both initial human occupation and end-Pleistocene climatic fluctuations, but the small number of radiocarbon dates per taxon so far precludes a statistically robust conclusion. Extinction patterns in northern Chile and the northern subtropics and tropics have not yet emerged due to paucity of dates, but additional dating efforts are presently underway. Overall, the chronology that is coming to light suggests a synergy of human impacts plus climatically-caused environmental change may have resulted in a more rapid, temporally constrained extinction event in Patagonia compared to Brazil and central Argentina, where extinctions may have been protracted over several thousand years. At the continental scale, the LQE event in South America seems to have spanned more time than it did in North America. Intensive radiocarbon-dating efforts are now in progress in order to test these initial impressions.

Technical Session II (Wednesday, October 30, 2013, 3:45 PM)

ESTABLISHING THE CHRONOLOGY OF QUATERNARY MEGAFAUNAL EXTINCTION IN SOUTH AMERICA

BARNOSKY, Anthony, University of California, Berkeley, CA, United States, 94720; LINDSEY, John, University of California, Berkeley, CA, United States; VILLAVECENCIO, Natalia, University of California, Berkeley, CA, United States; MARSHALL, Charles, University of California, Berkeley, CA, United States.

South America lost more genera and species of large mammals than did any other continent during the Late Quaternary Megafaunal Extinction (LQE), yet is less known.
Preparation of a Crocodyliform and Sauropod Dinosaur from Montana: Solutions to Complex Molding Problems

BAZIÄK, Brian. Museum of the Rockies, Bozeman, MT, United States; 59717

An articulated marine crocodyliform and a partially articulated sauropod skull and cervical series were collected from Montana and utilized for the preparation of a durable silicon negative mold. Both specimens posed unique problems for molding. The 2.2m long crocodyliform (~50% complete) specimen is to remain in articulation for display, but a cast of the skull and cervical series needed to be available for research. Therefore it was necessary to mold these elements while still in articulation because they likely could not be replaced if they were removed. This was a challenge because of the size and fragility of the specimen. A silicone rubber mold (Smooth-On Mold Max 20) and plaster mother mold (Hydrocal FGR 95 with fiberglass filter media) was applied to the dorsal surface, with the posterior most cervical vertebrae acting as the pour spout. A partial plaster cradle to cover the unmolded dorsal areas of the specimen was then added. This allowed the specimen to be rolled over the ventral side of the mold and be completed using the same procedure without damaging the specimen. After removing the ventral side of the mold, the full ventral cradle was replaced so the specimen could be rolled and the dorsal side of the mold removed.

The partially articulated sauropod skull and cervical series presented molding challenges as well. Prior to removing each element it was necessary to mold the entire specimen within the necessary time frame to preserve a record of the anatomy. Photogrammetry was attempted, but did not provide adequate detail. The left lateral side of the skull and neck were exposed, and as much matrix was removed as possible while still leaving the neck in articulation. Molding was complicated by the fact that the specimen is quite large (2.1m long). The right lateral side of the specimen still needed to be prepared. The left lateral side was molded using the same procedure as the crocodyliform. Loops of plastic mesh were incorporated into the silicone and passed through slots made in the plaster. During casting rods were placed in the loops to hold the silicone tight against the plaster to prevent loss of shape. The plaster mother mold was created in two parts enabling easier removal later. Rebar was also added along the length of the mother mold for additional support as it also functioned as a cradle when the specimen was rolled to prepare the other side. Once the specimen was rolled, much of the remaining matrix was removed and the molding process was repeated.

The molding of both of these specimens helped develop new techniques, as well as improving old ones, and will help in future molding procedures.

New Early Oligocene Vertebrate Fauna from Zallah Oasis, Sirt Basin, Libya Yields the Oldest Known African Carnivoran

BEARD, K. Christopher. Carnegie Museum of Natural History, Pittsburgh, PA, United States; 15213; CORDER, Pauline, Carnegie Museum of Natural History, Pittsburgh, PA, United States; SALEM, Mustafa, University of Tripoli, Tripoli, Libya; CHAIMANEE, Yaowalak, Universite de Poitiers, Poitiers, France; JAEGGER, Jean-Jacques, Universite de Poitiers, Poitiers, France; FRAM, Nour. Centre de Développement et de Recherche en Imagerie, Nouvelle, QC, Canada

Fieldwork during January 2013 in Paleocene strata exposed near Zallah Oasis in the Sirt Basin of central Libya has yielded the first diverse vertebrate fauna of early Oligocene age known from that country. The new site, known as the Incision Locality or Zallah 7, occurs in a rock unit provisionally mapped as Oligocene “Continental and Transitional Marine Deposits.” Fossil vertebrates occur at the base of a fluvial channel comprised of fine-grained sandstone. As currently understood, the Incision local fauna includes sharks, bony fishes, crocodilians, sirenians, hyracoids, hystricognathous rodents, proboscidea, therocariomorphs, and platanistids. The mammal component is known as the “miacid” stem carnivoran. The Incision local fauna can be compared with the sequence of later Paleogene faunas known from the Fayum region of northern Egypt, where the closest resemblance to the new Libyan fauna lies with the assemblage known from Fayum quarry V. If this correlation proves to be accurate, the Incision local fauna would date to ~31-32 Ma based on current correlation of the Fayum sequence to the GPTS. The Apidium specimens from the Incision Locality are the first Oligocene anthropoids to be discovered in Libya, but the most unexpected faunal element from the new site is the miacid carnivoran. The Zallah miacid is the first record of a stem carnivoran from Africa and the oldest record of an undoubted carnivoran from that continent by a wide margin (the next oldest record being from the late Oligocene of northern Kenya, ~6.7 Ma later). Prior to the discovery of the Zallah miacid, it was widely assumed that the only predatory mammals inhabiting an island continent of Africa during Paleogene times were crocrodils, which are recorded in considerable diversity in the Fayum sequence in Egypt and other broadly contemporaneous faunas such as Taqah in Oman. The discovery of the Zallah miacid suggests the development of at least a moderate degree of faunal provincialism across the northern part of Afro-Arabia during the early Oligocene, possibly related to changes in habitat availability caused by the cooler, drier conditions of that interval. Biogeographically, the Zallah miacid apparently signals the successful colonization of Africa by yet another Asian mammal clade prior to the tectonic collision between Africa and Eurasia near the Oligo-Miocene boundary. Miacids are unknown from Europe after the middle Eocene, but they range up to the end of the Eocene in southeastern Asia, as documented by Macius thailandicus from the late Eocene Krabi fauna of peninsular Thailand.

The Subtle Heterodonty of Odontocetes

BEATTY, Brian. NYIT College of Osteopathic Medicine, Old Westbury, NY, United States; 11568

Fossil odontocete paleoecology studies are challenging because many methods (stable isotopes, dental microwear) rely on teeth. Such studies require sample sizes to be statistically reliable, though identifiable skulls from single localities are uncommon. Isolated teeth are more common, but difficult to identify. A careful analysis of odontocete dentitions is needed, so I qualitatively and morphometrically described the teeth of 15 species of modern odontocetes and many fossil taxa of the West Atlantic coast’s largest Miocene faunas, the Calvert Cliffs (MD) and Lee Creek Mine (NC). This includes the squallodontid Squallodon calvertensis, the squalodontid Phocaenocetus, kentriodontids Delphinodon dividum and D. mento, the eurhinodelphinid Schizodon mokhovskii, and the rhipidistian Pomadon mokhovskii. Odontocete teeth are not all the same, but each successive tooth along the tooth row is slightly different from the adjacent teeth, amounting to major differences between the teeth found at the most mesial and distal ends. This continuum is challenging to account for without measuring and describing each and every tooth. But, often teeth are missing, too worn, or merely differ from adjacent teeth in ways that are not greater than the range of observer error. To simplify this, I measured and described these teeth in categories of mesial (I), intermediate (I), and distal (D). Squallodontid M teeth are elongate and narrow, D teeth are multicusped and serrated. Phocaenocetus crowns have large distal carinae that wear to a shearing facet. Phocaenocetus enamel is rough and includes cuspules from the cingulum that are generally smaller, numerous, and found on labial and lingual sides of all teeth, unlike Delphinodon and other kentriodontids that have such cuspules only on D teeth. Eurhinodelphinids generally have cuspules on M teeth and many distally flattened, slender M teeth that form carinae along the mesial ridge of the apical half. Kentriodontid teeth have slender, smooth enameled I teeth with a round cross section and are a little flat mesiodistally, slightly curved, and have a crown in line with root. The D teeth are rounder in cross section, with crowns that are square or rounded, and may be more strongly cuspuled. Differences between Delphinodon mento and other kentriodontids are mostly the larger size and fewer number of cuspules of D. mento. Platanistids M teeth have curved cuspules typically oriented ~45° to the long axis of the root, with mesial and distal carinae near the base of the crown.
The external morphology of the well-known, middle Frasnian Bothriolepis canadensis from the Escuminac Formation (Miguasha, Canada) is revised using cutting-edge technology in three-dimensional (3D) digital imagery. Nineteen well-preserved and articulated specimens of B. canadensis were used to create a 3D digital model of the dermal armor (cephalic and thoracic parts covering 35.6% of the total length), whereas four specimens were used to reconstruct the posterior part of the body. The 3D model representing a large adult specimen (44 cm total length) allows us to investigate some biomechanical aspects and constraints. Mobility of the cephalic armor, submarginal plates ("opercular plates") and ceratobranchials is strongly hypothesized based on inaccurate reconstructions. In contrast to previous reconstructions, there is no indication of mobility between the cephalic and thoracic armor. The submarginal plate is fixed upon the cephalic armor; a gill opening is located between the submarginal plate and the anterior ventral plate of the thoracic armor. The median dorsal ridge of the thoracic armor forms a hydrodynamic dorsal crest with its maximum height along the posterior median dorsal plate. In contrast to previous interpretations, the fully retracted and protracted (70°) position of the pectoral fin allows only for restricted movement. Maximum mobility is reached in a posture where the gill opening is located 30° around the brachial process and 20° in an up-and-down movement. The 3D model of B. canadensis brings out some unexpected novelties on a supposedly well-known Devonian fish.

Technical Session X (Friday, November 1, 2013, 11:00 AM)

OLDEST DIRECT EVIDENCE OF DENTAL DEVELOPMENTAL DELAY AND ENCEPHALIZATION IN A LATE MIocene HOMININE.

BEGUN, David, University of Toronto, Toronto, ON, Canada, MSS2S

Rudabanya is a late Miocene locality in central Hungary with a rich vertebrate fauna that includes one of the largest and best preserved samples of an early hominin, Rudapithecus hungaricus. The sample includes two partial crania sufficiently well preserved to allow the calculation of an estimate of cranial ontogeny. One of these specimens, RUD 200, has a complete upper and lower dentition with very little occlusal wear. Synchrotron images of RUD 200 reveal a periodicity of seven days, which is consistent with extant hominoid dental developmental rates and is significantly slower than in other cetarthrodonts (200 and 267 days) described from the same site. RUD 200 also preserves intact cranial cortices, which allow for a reliable estimate of cranial capacity. In both cases they are well within the range of extant chimpanzees. A sub-adult mandible, RUD 14, preserves a pattern of tooth eruption which allows for a reliable estimate of cranial capacity. In both cases they are well within the range of extant chimpanzees. A sub-adult mandible, RUD 14, preserves a pattern of tooth eruption which allows for a reliable estimate of cranial capacity. In both cases they are well within the range of extant chimpanzees.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

A NEW BASAL STEREOSPONDYL (TEMNOSPONDYL) FROM THE LOWER TRIASSIC FREMOW FORMATION OF ANTARCTICA.

BEIGHTOL, Adam K., University of Washington, Seattle, WA, United States; BEIGHTOL V, Charles, University of Washington, Seattle, WA, United States, 98103; HUTTENLOCKER, Adam K., University of Washington, Seattle, WA, United States; PEECOK, Marli, Royal Ontario Museum, Toronto, ON, Canada; SCHOUTEN, Jeroen, Christian, University of Washington, Seattle, WA, United States; SMITH, Roger, Iziko South African Museum, Cape Town, South Africa

The first vertebrate fossil recovered from Antarctica was Australosuchops, a temnospondyl from Graphite Peak in the central Transantarctic Mountains. Five temnospondyl taxa have been described from the Triassic of Antarctica (Australosuchops, Cryobatrachus, Kryostega, Parotosuchus, and another large peracaridotosaurus). We describe a new stereospondyl from the Lower Triassic Fremouw Formation based on new material collected at Graphite Peak in 2011. The new taxon is a partial skull preserved in a green felsic sandstone siltstone bed about 50 m above the Perm-Triassic boundary. This taxon has an estimated skull length of 42 mm and is characterized by a posteriorly convex prefrontal, a large ventral process on the palatine ramus, and the pterygoid with a small infradentary quadrate. The dentary has a large, well-developed jugal. The occiput has a transverse constriction between the proximal end and the axis. The supracaudal crest has a restricted pattern of grooves located on its posterior-most region. There is a postero-dorsal hook on the scapula blade, as observed in Simosuchus and some protosuchians. Mariliasuchus also shows features regarded as synapomorphies of Notosuchia, such as the presence of a deep circular depression on the posterior surface of the proximal humerus and the horizontally directed ventral iliac blade. Furthermore, there are several unique traits that can be used to diagnose this taxon: the large reentrant fossa on the lateral posterior surface of the humerus, the presence of three large subcircular depressions on dorsal surface of the ilium, and the metatarsals II and IV, which are subequal in length. Ontogenetic variation in cranial morphology was previously known, and is also present in the shoulder girdle. The posterior margin of the scapula is straight in juveniles (MN 6298-V) and become concave in mature specimens (MN 6751-V). The observed osteological landmarks (e.g. scars, fossae and grooves) strongly suggest that Mariliasuchus amarali had a well-developed musculature, especially on the forelimbs.

Technical Session VII (Thursday, October 31, 2013, 3:45 PM)

USING THE CHARACTER COMPLETENESS METRIC TO EXAMINE COMPLETENESS OF MEOZOIC DINOSAURS: A MAESTRICHIAN HIGH AND A PALEOEQUATORIAL LOW.

BELL, Mark, University College London, London, United Kingdom; UPCHURCH, Paul, Univ College London, London, United Kingdom; MANNION, Philip, Imperial College London, London, United Kingdom; LLOYD, Graeme, Univ of Oxford, Oxford, United Kingdom

A recently proposed metric for quantifying the completeness of fossil taxa is applied to Mesozoic dinosaurs; the Character Completeness Metric (CCM) measures the percentage of morphological characters available for a given system and taxon in the phylogenetic data matrices. Calculating completeness is important for our understanding of the quality of the rock record and for any interpretations we may make of the resultant patterns. This method has previously been applied to both sauropodomorph dinosaurs and Mesoicoic birds. Here, we expand this to include all Mesoicoic dinosaurs as a case study for the application of a new computerized technique.

The source of data for this study is a compilation of over 500 published character matrices. New code written in R calculates the mean CCM of taxa across all matrices. The mean CCM value for each stratigraphic stage was calculated through rarefaction of all species means for that interval. One important caveat is the bias against species not incorporated in a phylogenetic analysis; in order to assess the effect of this, a comparison is made with a previous study of sauropodomorphs using both scored and unscored species. Both datasets show a trend of decreasing completeness with time and therefore supports the use of the new method.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

ON THE APPENDICULAR ANATOMY OF Mariliasuchus amarali (CROCODILIFORMES: NOTOSUCHIA) FROM THE UPPER CRETACEOUS (BAURU GROUP) OF BRAZIL.

BELMONTE, Simone, Museu Nacional, Rio de Janeiro, Brazil; FIGUEIREDO, Rodrigo, Museu Nacional, Rio de Janeiro, Brazil; CARVALHO, Luciana, Museu Nacional, Rio de Janeiro, Brazil; AZEVEDO, Marcelo, Museu Nacional, Rio de Janeiro, Brazil; ROMANO, Pedro, Universidade Federal de Vicsosa, Vicsosa, Brazil

Crocodyliformes were remarkably diverse during the Cretaceous of Gondwana. The Notochiasuchus amarali was the most representative taxon from the southern landmasses, a group that contains a pre-several angulates of terrestrial animals with ocreurostral skulls and very specialized dentition. The fossil record of the Bauru Group (Upper Cretaceous) of Brazil is rich in such fossil crocodyliforms and it is the geological unit from which all material of Mariliasuchus amarali was recovered to date. The relative large number of well-preserved specimens makes it one of the best-studied Brazilian notosuchians. Nevertheless, the postcranial anatomy of this species has not been the object of a detailed study. Here we describe the appendicular skeleton of Mariliasuchus amarali based both on juvenile (Museu Nacional [MN] 6298-V) and adult specimens (MN 6751-V). CT-scans and rapid prototyping technologies were used in order to recover important morphological data due the fragile nature of these fossils. Mariliasuchus has long and robust limbs with a radius and ulna subequal in size. The femur lacks a well-marked constriction between the proximal end and the axis. The supracaudal crest has a restricted pattern of grooves located on its posterior-most region. There is a postero-dorsal hook on the scapula blade, as observed in Simosuchus and some protosuchians. Mariliasuchus also shows features regarded as synapomorphies of Notosuchia, such as the presence of a deep circular depression on the posterior surface of the proximal humerus and the horizontally directed ventral iliac blade. Furthermore, there are several unique traits that can be used to diagnose this taxon: the large reentrant fossa on the lateral posterior surface of the humerus, the presence of three large subcircular depressions on dorsal surface of the ilium, and the metatarsals II and IV, which are subequal in length. Ontogenetic variation in cranial morphology was previously known, and is also present in the shoulder girdle. The posterior margin of the scapula is straight in juveniles (MN 6298-V) and become concave in mature specimens (MN 6751-V). The observed osteological landmarks (e.g. scars, fossae and grooves) strongly suggest that Mariliasuchus amarali had a well-developed musculature, especially on the forelimbs.
A PATHOLOGICAL TIMBER WOLF (CANSIS LUPUS) FEMUR INDICATES EXTENDED SURVIVAL AFTER TRAUMATIC AMPUTATION INJURY

BENNETT, Bryan, California State University San Bernardino, San Bernardino, CA, United States; 92407; SCOTT, Kim, California State Univ San Bernardino, Ontario, CA, United States; SCOTT, Eric, San Bernardino County Museum, Redlands, CA, United States; REGA, Elizabeth, Western University of Health Sciences, Pomona, CA, United States; SUMIDA, Stuart, California State Univ San Bernardino, San Bernardino, CA, United States

The proximal portion of a pathological right femur of a timber wolf (Canis lupus) from the (late Pleistocene) Rancho La Brea asphalt deposits of Los Angeles, California demonstrates advanced healing along the entire distal fragment surface, in a plane distal and oblique to the greater trochanter. No evidence of a fused or articulated distal femoral remains. Two possibilities arise: a pseudarthrosis (false joint) resulted from osseous union or a complete amputation event occurred with subsequent healing of the remaining bony shaft. Either case indicates that the animal survived for a significant amount of time after the traumatic injury was inflicted. The angle of the break in the damaged femur suggests the animal went for a distance of an extremely violent event, such as a fall from great height, or violent snapping of the limb by another, larger predator. The fact that the proximal femoral segment had adequate time to heal means the violent event could not have been the cause of death. Further, that the individual lived for a significant amount of time post-injury means it must have retained adequate hunting and/or scavenging ability to survive. Alternatively if it was a member of a pack or other social group, that group may have facilitated, or minimally tolerated, the inclusion of the injured individual. Because there is no functional connection to the more distal limb elements, the individual may have died with either a useless right limb, or may have adopted a completely tripodal lifestyle.

RATES OF DINOSAUR LIMB EVOLUTION PROVIDE EVIDENCE FOR EXCEPTIONAL RADIATION IN MESOZOIC BIRDS

BENSON, Roger, University of Oxford, Oxford, United Kingdom; CHONIERE, Jonah, University of Oxford, Oxford, United Kingdom; BERNOR, Raymond, Howard University, Washington, DC, United States; 20059; MITTMANN, Hans-Walter, Staatliches Museum för Naturkunde, Karlsruhe, Germany; MUNK, Wolfgang, Staatliches Museum für Naturkunde, Karlsruhe, Germany; SEMPREBON, Gina, Baypath College, Enfield, MA, United States; WOLF, Dominik, Forschungsinstitut Senckenberg, Frankfurt, Germany

BERNOR, Raymond. Howard University, Washington, DC, United States, 20059; BERTA, J., University of Guelph, Guelph, ON, Canada; CHONIERE, Jonah, University of Oxford, Oxford, United Kingdom; HANNA, Brian, University of California, Berkeley, CA, United States

EXTENDED SURVIVAL AFTER TRAUMATIC AMPUTATION INJURY

The Vienna specimen of Pterodactylus antiquus (Natural History Museum, Vienna specimen NHM 1975/1756:0000) is complete, fully articulated, and preserves patagial and brachopatagial soft tissues on part and counterpart slabs. When first described, linear features in the patagia were interpreted as widely spaced cylindrical internal actinofibrilim or thin filament throughout the brachopatagium, a projection into the suboval window framed by trailing edge behind the right elbow was interpreted as the result of bunched of actinofibrils originating at the carpus, and it was suggested that the appearance that the brachopatagium attached to the distal femur might be misleading because Dendroderus can present a similar appearance with wings folded at rest. The recent discovery of closely spaced broad flat keratinous actinofibrils and distinct fold lines in the wings of Rhamphoroynchus muenteri (e.g., Zittel wing, Marsh specimen) prompted a reevaluation of the Vienna specimen. It was found that linear features in the patagia include: 1) closely spaced broad flat structures subparallel to wing phalanges, lightly permineralized with calcite on the upper slab, interpreted as keratinous actinofibrils of folded dactylotagiam; 2)clumped straight structures originating behind the metacarpophalangeal joint and resisting longitudinal compression to project into the window on the right and a like distance behind the elbow on the left, interpreted as actinofibrils associated with fold A; and 3) often curving structures that parallel the leading edge of the patagium and the trailing edge of the brachialotagium medial to the window, interpreted as collagen fibers bearing tensile loads in tenopatagial patagia. The suggestion on the part to the interpretation of trailing edge appearance of the wing, the flaps, it is accepted. The absence of uropatagial impressions indicates they were less resistant to decay than propatagia and plagiopatagia, probably because their tensile fibers were smaller and/or fewer. The new information permits a new reconstruction of Pterodactylus wings.

OUT WITH THE OLD, IN WITH THE NEW: VERTEBRATE MICROSTRATIGRAPHY DOCUMENTING THE IMMEDIATE K–PG MASS EXTINCTION RECOVERY

BERCOVICI, Antoine, Lund University, Lund, Sweden; HUNTER, John, Ohio State University, Newark, OH, United States; KNAAUSS, Georgia, Univ of Iowa, Sheridan, WY, United States; WOOD, Jacqueline, Delgado Community College, New Orleans, LA, United States; PEARSON, Dean, Pioneer Trails Regional Museum, Bowman, ND, United States

Technical Session XVIII (Saturday, October 26, 2013, 1:00 PM)

NEW INSIGHTS FROM THE EXCAVATIONS OF THE HÖWENEGG LAGERSTATTE, HEGAU, GERMANY (MN9, 10.3 MA)

BERNOR, Raymond. Howard University, Washington, DC, United States, 20059; BERTA, J., University of Guelph, Guelph, ON, Canada; CHONIERE, Jonah, University of Oxford, Oxford, United Kingdom; HANNA, Brian, University of California, Berkeley, CA, United States

The Höwenegg (Hegau, southern Germany) is a late Miocene locality (MN 9) exceptional for the abundance and completeness of its paleobiological record. Original excavations were undertaken by Tobien and Jörg in the 1950s and 1960s. Test excavations and surface collections between 1985 and 1992 confirmed that complete vertebrate material could still be recovered at the site. Subsequent dating of Höwenegg volcanics yielded a secure single crystal argon age of 10.3 Ma. A meter drill core was made on the western border of the quarry in 2007 and established the unconformity between the early Miocene Obere Süßwassermolasse and Höwenegg lake bed deposits at this depth. The latest paleontologic work extended the quarry westward. Since 2001, we have collected diverse biota including limnic and terrestrial gastropods, pollen, seeds, fruits and whole leaves, amphibians, reptiles, and mammals. Höwenegg is most renowned for its production of mammalian skeletons and our efforts have secured an increase in the total number of mammalian skeletons from 29 to 47. The two most abundant mammalian taxa are the primitive bolephasial antelope Miotragocerus pannoniae (24 skeletons) and the basal Old World hippopotamoid Equus hippopotamus. The current project has also increased the taxonomic diversity of other mammals (Trogotherium, Machairodus, Amphiyan, Thalattis, Tragulus, Microcercus, “Dicerorhinus”, Aceratherium), non-mammalian tetrapods (Testudo, Trionyx), and fish (Leuciscus, Silurus, Tenca). We provide a visual reconstruction of the drill core to show the 3-dimensional distribution of mammalian skeletal occurrences in the Tobien and Jörg quarry excavated between 1951 and 1959 as well as in those excavated by our team between 2003 and 2012. We further provide a reconstructed 3-dimensional block of all skeletal occurrences using 3D coordinates for spatial and stratigraphic depth distribution. We find that there are four main stratigraphic levels and that stratigraphic level 11 (correlates with level 20 of Joerg and Tobien) has the greatest abundance and diversity of all biotic elements. We also present new information on the ecology and paleodiet of the Höwenegg ungulate community. The angiosperm flora is being lacking due to its warm temperate forest browser with limited grazing. This international project has been funded by the National Science Foundation (OCS-0321893 and EAR0125009), LSAS Leakey Foundation, the Karlsruhe and Stuttgart Museums of Natural History, and the Town of Immendingen.
fossil sharks, Cosmopolitodus hastalis (Lamnidae) and Hemitrissipis serris (Hemigaleidae), in the context of long-term regional climate change. These two species co-existed throughout the Miocene in the shallow Atlantic sea that occupied the Salisbury Embayment sporadically. The differences in the oxygen isotopes reveal significant morphologic changes from ~18 to ~10 Ma and support previous hypotheses regarding paleo-bathymetry and dating of the sequence inferred from faunal and sedimentological studies of Calvert Cliffs. The oxygen isotope compositions of both species support previous studies which demonstrated an increase in ocean δ18O values by ~3–4 per mil (‰) from the middle Miocene Climate Optimum to the Late Miocene with the expansion of the East Antarctic ice sheet, a resulting decrease in ocean volume, and a corresponding increase in ocean salinity. The δ18O values of the Cosmopolitodus specimens were consistently ~2–3 ‰ per mil lower than the δ18O values of Hemitrissipis, suggesting that Cosmopolitodus likely inhabited relatively deep water, whereas Hemitrissipis inhabited shelf-edge or shelf bottom shallower waters. These differences in δ18O values support the conclusion that Hemitrissipis did not inhabit the shelf edge or shelf bottom as proposed by Cosmopolitodus hastalis. This is an unexpected inference because the closely related modern makos, Isurus oxyrinchus and I. paucus, are inhabitants of the open ocean whereas the extinct snaggletooth, Hemitrissipis elongatus, occupies tropical continental and insular shelf waters.

Technical Session VI (Thursday, October 31, 2013, 11:45 AM) THE IMPORTANCE OF THE FOSSIL RECORD FOR MOLECULAR PHYLOGENETICS: THE CASE OF BOVIDAE (ARTIODACTYLA, RUMINANTIA)

BIBI, Faysal, American Museum of Natural History, New York, NY, United States, 10024

Genomes provide an extremely powerful tool for the construction of highly resolved phylogenies of extant species, but no evolutionary history could ever be complete without consideration of the fossil record. One group that has received a lot of attention from molecular phylogenetics is Bovidae (antelopes and relatives), being the most diverse clade of living large mammals, and the largest component of Pecora, Rumiantia, and Artiodactyla (= Cetartiodactyla). Important evolutionary events within these clades have benefited from molecular age estimation, particularly at nodes where the fossil record has been ambiguous or absent. However, most analyses to date have relied on only a single or a few (often poorly applied) fossil calibration points with which to calibrate rates of genomic evolution.

I identify 16 fossil calibration points of relevance to the phylogeny of Bovidae and Rumiantia and use these in a bayesian re-analysis of the full mitochondrial genome of over 100 ruminant species. The new multi-calibrated tree provides ages that are younger than found in previous studies. Among these are young (late Eocene-early Oligocene) ages for the origin of crown Bovidae and Rumiantia, and a ca.17–15 Ma age of origin for crown Bovidae, which may be reasonable hypotheses given the fossil record. Areas of age conflict with the fossil record remain, however, especially with regard to the base of the rapid Pecoran radiation, and the sister relationship of Moschidae to Bovidae. The use of a large number of vetted fossil calibration points (with soft bounds) is promoted as a better approach than using just one or a few calibrations, or using internal-congruency metrics to place good fossil inferred data. The densely calibrated tree produced here exhibits smaller age error ranges and better reflects the fossil record than the wide variety of ages found by using a single calibration alone. The tree also highlights particular regions of conflict between molecular and morphological approaches to taxonomic classification arising from homoplasy, character ambiguity, etc. I also examine the potential for interesting phylogeographic and paleoenvironmental hypotheses that may be inferred from a tree containing only extant taxa but that are not supported when the fossil record is brought into the picture. Increasing the contribution of the fossil record to the phylogeny of Bovidae is a necessary step toward the reconstruction of the evolutionary history of this clade.
of the skeleton, including the pectoral girdle, appear to belong to a single individual and C10 has been removed and likely discarded at this time. The braincase and portions of approximately 100 microns. Our examination has revealed that the skeleton was Konica Minolta Range7 non-contact laser surface scanner at a resolution of DNSM Ornithology 2366. We scanned the mounted skeleton with a Science Museum (DNSM Ornithology 2366). We scanned the mounted skeleton with a Xiphactinus audax at the end of the 19th century by Etienne Thirioux, now housed at the Durban Natural southeast Mauritius first discovered in 1865. Recent excavations indicate that the MAS specimen. Together with one other cave dodo specimen collected by Thirioux, the was endemic to the island of Mauritius. Only a handful of fragmentary physical remains of the dodo collected before its extinction in the late 17th century are still in existence. The majority of currently known skeleton remains from the dodo have been recovered from the Mare aux SONGES, a Holocene fossil concentration Lagastière in the southeast Mauritius first discovered in 1865. Recent excavations indicate that the MAS deposits do not contain articulated dodo skeletal material and the skeletons reconstructed from MAS bones thus represent composites. Here, we report on the anatomy of a partially articulated and nearly complete dodo skeleton recovered from a cave, collected at the end of the 19th century by Etienne Thirioux, now housed at the Durban Natural Science Museum (DNSM Ornithology 2366). We scanned the mounted skeleton with a Konica Minolta Range7 non-contact laser surface scanner at a resolution of approximately 100 microns. Our examination has revealed that the skeleton was remounted in 1919 and that a cervical vertebra at the base of the neck (approximately C10) has been removed and likely discarded at this time. The braincase and portions of the sternum of the specimen are reconstructed, and possibly some of the pedal phalanges. Although the specimen appears to be a composite of at least two individuals, some parts of the skeleton, including the pectoral girdle, appear to belong to a single individual and thus provide relative skeletal dimensions for a dodo, unlike the composite skeletons from the MAS. Rare or previously unknown elements, including the pygostyle, distal manual phalanges, and tarsus, are preserved digitally reconstructed the skeleton in the 3-D editing software Rapidform, which allowed us to correct the sacrothoracic angle, limb and rib positions without having to disarticulate the mounted specimen. Together with one other cave dodo specimen collected by Thirioux, the (digital) Durban dodo is one of the complete dodo skeletons in existence and forms an excellent basis for studies into the paleobiology of this iconic bird. The digital scan data of DNSM Ornithology 2366 will be deposited in the online repository Aves 3D (http://Aves3D.org).

RESOLVING MORPHOLOGICAL/MOLECULAR CONFLICT IN MARMOTINI (MAMMALIA, RODENTIA, SCIURIDAE) THROUGH DIAGNOSTIC DENTAL CHARACTERISTICS

BIEDRON, Eva, Univ of Oregon, Eugene, OR, United States, 97403; Hopkins, Samantha, Univ of Oregon, Eugene, OR, United States; McClaughlin, Win, Univ of Oregon, Eugene, OR, United States.

The proliferation of rapid, inexpensive molecular sequencing has led to the discovery of a number of conflicts between morphological and molecular data. In many cases, these conflicts have led to greater scrutiny of character choice and analytical methods, resulting in an improved understanding of phylogenetic relationships. Morphological systematics based on paleontological evidence place the Barstovian genus Miospermophilus as the direct ancestor of the Spermophilus, Cynomys, and Ammospermophilus lines, while Protospermophilus has been hypothesized to give rise to the genus Marmota. However, molecular data showed that Spermophilus was polyphyletic, rising to Spermophilus and Cynomys; the molecular and morphological resolutions are incompatible with the phylogeny suggested by paleontological studies. A recent revision of genus-level taxonomy of ground squirrels called for re-examination of the paleontological evidence for the origins of ground squirrels, a task we begin here.

Current identification of Protospermophilus is based predominantly on size, with Miospermophilus distinctly smaller on average. The diagnosis of Protospermophilus also depends heavily on skull characters, although there are no described skulls of Miospermophilus. There are also a small number of dental characters that distinguish the two. However, these characters have not been reconsidered in light of the new taxonomy of ground squirrels. By examining the dental characteristics of early ground squirrels, we find that the only character consistent between taxonomy of living ground squirrels and that of fossil Marmota is crown height. However, some of the characters that distinguish living ground squirrel clades can be found in extinct squirrel species. Many characters, however, seem to vary without regard to evolutionary relationships, and dental characters are also frequently convergent. Further study of the fossil record of ground squirrels will allow for an improved understanding of the origin of the currently recognized genera diversity of ground squirrels, as well as provide an alternative method of identification for incomplete Proto- and Miospermophilus specimens.
from Emilia Romagna; the specimen is approximately 8 m long and is characterized by radial and ulna elongated and narrow with the ulna showing a well developed olecranon. The groove for the mental ligament is located in the inferior part of the anterior end of the dentary suggesting some resemblance of the dentary of Balaenoptera insignis figured out by Van Beneden in the 19th century. The specimen from Calabria includes a juvenile individual tentatively assigned to Balaenoptera insignis that is represented by a partial skeleton. In the two specimens from Calabria are associated to shark teeth and to diverse mollusc faunas. These specimens will add considerable new information about the anatomy of the postcranial skeleton and the earbones of Pliocene balaenids contributing to improve our knowledge about the Pliocene diversity of these whales now absent from the Mediterranean basin.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

A LATE OLIGOCENE ANURAN FAUNA FROM THE NSUNGWE FORMATION, SOUTHWESTERN TANZANIA

BLACKBURN, David, California Academy of Sciences, San Francisco, CA, United States, 94118; ROBERTS, Eric, James Cook University, Townsville, Australia; STEVENS, Nancy, Ohio Univ, Athens, OH, United States

Although molecular phylogenetic studies infer the presence of several anuran lineages on continental Africa since the Cretaceous, the fossil record of Mesozoic and early Cenozoic frogs remains remarkably depauperate. Here we document the first diverse African Oligocene anuran fauna from Afro-Arabia, represented by >100 cranial and postcranial specimens. Fossils were recovered from fluvial localities in the late Oligocene (~25 Ma) Songwe member of the Nyungwe Formation in the Rukwa Rift Basin of southwestern Tanzania. These localities are well dated to 25 Ma and reflect aquatic environments persisting within a semi-arid climate regime. The Nyungwe anuran fauna is dominated by isolated elements, including ilia, forelimb and hind limb bones, presacral vertebrae, and urostyles. Two isolated specimens preserve the fusion of the sacral vertebrae with the first few vertebrae, suggesting the morphology of Ranidae and significant in representing the earliest record for this endemic African family. A second (non-sacral vertebrae) is represented by two articulated specimens: an isolated hind limb, and a more complete specimen preserving most of a vertebral column, pelvis, and parts of both hind limbs. The ilia and urostyle on the latter specimen preserve high and well-defined dorsal crests, consistent with the morphology of Ranidae (sensu stricto). Several African anuran taxa are notably absent in the Nyungwe Fauna including pipids, brevipodids, and hemnitids. Further, bufonids, a widespread cosmopolitan family, are also not represented in these forms. The Nyungwe anuran fauna bears notable exostoses typical of taxa with hypertrophied skulls, suggesting the presence of pyxicephalid frogs like Pyxicephalus and Armbrustia, although further study is needed to better document the distribution of this morphology across Pyxicephalidae.

Technical Session XIII (Friday, November 1, 2013, 3:00 PM)

ARTICULATED ISCHNACANTHID ACANTHODIAN JAWS FROM THE MOTH LOCALITY PROVIDE EVIDENCE FOR SPECIALIZED FEEDING IN EARLY DEVONIAN GNATHOSTOMES

BLAIS, Stephanie, University of Alberta, Edmonton, AB, Canada, T6G 2E9; WILSON, Mark, Univ of Alberta, Edmonton, AB, Canada

Acanthodians are an enigmatic group of small, spiny fish fossils whose affinities remain unclear. Although they are closely related to modern sharks, they are not modern sharks, and as some of the oldest jawed vertebrates, can provide us with valuable information about the early evolution of jaws and teeth. Ischnacanthid acanthodians in particular possessed many different forms of teeth, including isolated teeth, teeth with tooth-like shapes, and teeth ankylosed to unique dental bones, which rested on the occlusal surfaces of their Meckel’s and palatoquadrate cartilages. Because their skeletons were cartilaginous, descriptions of ischnacanthid acanthodians are often based entirely on isolated, disarticulated, denitgious jaw bones; articulated fossils are very rare. The Man On The Hill (MOTH) a fossil assemblage from the Middle Mississippian (Middle Namurian) of Saskatchewan, Canada, has yielded hundreds of specimens of beautifully preserved Early Devonian (Lochkovian) vertebrates. These include many articulated acanthodians fossils, which have allowed us to study features that were not preserved to the same degree in fossils from other localities. Few studies have focused on the biomechanics of ischnacanthid jaws, and Early Devonian ischnacanthid jaws were considered to occur in a simple, cog-like motion, where each tooth connected only with the pit between the teeth on the opposing jaw, causing the teeth to become bluntened throughout the life of the fish. Articulated upper and lower denitgious jaw bones, and their associated cartilages from MOTH have revealed that Early Devonian ischnacanthid jaw biomechanics were more complex and specialized. Using micro-Computed Tomography (μCT) to create a 3-dimensional model of articulated ischnacanthid jaws from MOTH, we determined that they occluded in a more interlocking and interlocking motion like that attributed to lateral ischnacanthids, where the teeth slide against the posterior surfaces of the opposing teeth into the inter-tooth pit, causing the teeth to be sharpened rather than blunted. This is especially true for the anterior-most teeth. In addition, one new ischnacanthid genus from MOTH was monognathically heterodont, with blunt, robust, tricipital medial teeth that were almost as large as its long, sharp, monocuspid fan-like lateral teeth. This, along with the presence of cheeks suggested by interlocking lip scales, indicates these ischnacanthids were likely specialized feeders capable of orally processing prey with their teeth in a variety of ways.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

THE INFLUENCE OF LATE QUATERNARY CLIMATES ON SPECIES DISTRIBUTION, ABUNDANCE, AND GENETIC DIVERSITY OF NORTHERN CALIFORNIA POCKET GPOKERS

BLOS, Jessica, University of California, Merced, CA, United States, 95348; LI, Cheng (Lily), Stanford University, Stanford, CA, United States; HADLY, Elizabeth, Stanford University, Stanford, CA, United States; CHEN, Qian, Stanford University, Stanford, CA, United States; HADLY, Elizabeth, Stanford University, Stanford, CA, United States; HADLY, Elizabeth, Stanford University, Stanford, CA, United States; HADLY, Elizabeth, Stanford University, Stanford, CA, United States; HADLY, Elizabeth, Stanford University, Stanford, CA, United States; HADLY, Elizabeth, Stanford University, Stanford, CA, United States

Climate change has significantly influenced the past abundance and geographic distributions of species, which are important components of ecological responses to future climate change. We determine the relationship between climate, geographic distribution, and abundance in species of pocket gophers (Thomomys) using multiple lines of evidence: fossils from northern California that capture a record of paleoclimatologic change over the past 18,000 years, modern and ancient genetic analyses, and paleodistribution modeling. For two species (T. mazama and T. bottae), we determine: (1) how abundance changed through time using multiple proxies (fossil relative abundance, genetic effective population size); (2) whether those changes are correlated with the modern climatic niche of the species; and (3) the mechanism underlying those abundance changes: in situ demographic expansion or range shifts. Fossil data, supported by dDNA identifications, document small range contractions (T. mazama) and range expansions (T. bottae), but the main changes observed were relative abundance changes. Thomomys mazama sharply declined starting around 17 thousand years before present (kyr BP) and became locally extirpated by 6 kyr BP. In contrast, T. bottae was present but rare in the Pleistocene and expanded dramatically across the Peninsular Ranges from 6 kyr BP, with the increase in abundance at 14 kyr BP roughly coincident with warming during the Bolling-Allerod phase. Phylogeographic data for T. bottae indicate their population expansion was due primarily to in situ expansion rather than long-range shifts in the distributions of clades. Overall, the temporal changes in abundance of T. mazama at Samwell Cave were strongly predicted by climatic changes, whereas T. bottae had a very broad climatic niche, indicating T. bottae abundance change was likely driven by declines in the relative abundance of T. mazama and the opening up of the underground niche.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

OXYGEN ISOTOPES FROM MAMMALIAN TEETH: SAMPLING GUIDED BY THE GEOMETRY OF ENAMEL MINERALIZATION

BLUMENTHAL, Scott, CUNY Graduate Center, New York, NY, United States, 10016; CERLING, Thure, University of Utah, Salt Lake City, UT, United States; CHRITZ, Kendra, Salt Lake City, UT, United States; BROMÄGE, Timothy, New York University College of Dentistry, New York, NY, United States; VALLEY, John, University of Wisconsin-Madison, Madison, WI, United States
Intra-tooth enamel oxygen isotope analysis can be used to reconstruct short-term changes in animal life history or environmental seasonality in the fossil record. Conventional sampling typically extends partially or entirely through the thickness of enamel and provides highly time-averaged isotope time-series, but the protein-mineralizing innermost enamel layer may retain a less altered signal. We sampled the right maxillary incisor from a woodrat subjected to an experimentally induced water-switch during the period of tooth development. We use backscattered imaging in the scanning electron microscope (BSE-SEM) to measure enamel mineralization, and demonstrated that the innermost enamel layer mineralizes much more rapidly than the outer enamel layer. We use secondary ion mass spectrometry (SIMS) to generate high-resolution intra-tooth δ18O profiles within discrete layers of enamel, which all record the δ18O shift associated with the water switch. Our results demonstrate that the innermost enamel layer records less blurred isotope time-series, and that decreasing sample spot size beyond conventional sampling outside the innermost enamel layer only minimally reduces signal blurring. Sampling the innermost enamel layer will be most beneficial when sampling large mammalian herbivores that are characterized by more slowly mineralizing enamel and record environmental input over periods of months to years.

Technical Session I (Wednesday, October 30, 2013, 11:30 AM)

NEW INSIGHTS INTO THE DEVELOPMENT AND EVOLUTION OF THE VERTEBRAL COLUMN IN ARCHOSAURS

BÖHMER, Christine, Ludwig-Maximilians-Universität, Munich, Germany; RAUHUT, Oliver, Bayerische Staatssammlung für Paläontologie und Geologie, Munich, Germany

Determination of the number and morphological identity of vertebrae are subjects of major interest in the developmental studies of vertebrates. Key determinants for the establishment of segments along the primary body axis of all metazoa are the Hox genes. The activity of these highly conserved genes is required for proper organization of the vertebrate body plan, and thus is responsible for the regionalization of the axial column. The work examining the role of mammalian vertebral shape in the neck of anamniotes has shown that changes in the genetic code are deducible from vertebral morphology. The highly variable cervical region has provided an illuminating model for the study of the relationship between genomic control and phenotypic changes. Here we present the first results of work assessing this correlation in the crocidol type crocodiles, chickens, and mice. We have subsequently applied these findings to fossil archosaurs in order to establish the Hox code for extinct taxa on the basis of quantifiable changes in vertebral morphology. Whilst genetic information for mouse and chicken models was obtained from the literature, the present study extends previous analyses of the crocodilian Hox code. Our morphometric investigations reveal a taxon-specific subunit pattern of vertebral shape within the dorsal series. Crocodiles and the dinosaur Plateosaurus appear to share a similar pattern of 6 subunits united by a common morphological function. This common pattern changes to 10 subunits in birds whereas 8 subgroups are recognized in the mouse. The morphofunctional pattern is reflected by the Hox code in the analyzed extant taxa and allows inference of the genetic pattern in extinct animals. Thus an originally crocodile-like Hox gene expression pattern might be modified in a way that has not undergone significant modifications to their axial skeleton. In addition, this expression pattern might be changed to more strongly differentiated Hox code in mammals associated with their highly specialized body plan. The demonstrated correlation between vertebral morphology and Hox code allows us to hypothesize that the underlying genetic programme could be conserved in the evolution of vertebrates.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

CONTINENTAL DWARFISM OF AN EARLY PLEISTOCENE HIPPOPOTAMID FROM THE SHUNGURA FORMATION, LOWER OMO VALLEY, ETHIOPIA

BOISSERIE, Jean-Renaud, CNRS, Poitiers, France

In insular context, some large mammals are prone to evolve smaller body sizes. The Hippopotamidea provide recent examples of such insular evolution during the Pleistocene and the Holocene, notably in Madagascar, Cyprus, Crete, and Malta. In continental context, there was until now no clear record of small body size evolution in hippopotamids. The extant Liberian hippo Choeropsis liberiensis is often called “pygmy hippo” by opposition to the much larger common hippo Hippopotamus amphibius. However, Choeropsis lacks a clear fossil record and it is currently not possible to conclude that its diminutive size resulted from an actual dwarfism, or instead reflects a primitive condition. I will present a well documented case of hippopotamid dwarfism on continental Africa. The species: Hippopotamus aethiopicus was first described in 1975 from the Shungura Formation, Omo Group, Ethiopia, and subsequently recognized from other formations in the Turkana Basin, but its temporal distribution, emergence, and evolutionary trends were unclear. Since 2010, the Omo Group Research Expedition, which reactivated field research in the Shungura Formation, collected new, abundant material of the pygmy species, dramatically increasing the number of known specimens. The study of this new material and the revision of the pre-existing hypodigm allow us to accurately identify the temporal distribution of this pygmy hippopotamid lineage in the Turkana Basin. Its evolutionary trends can be described step by step starting from the rhythm and modalities of a clear decrease in body size. The factors that triggered the evolution of a dwarfed body size in this continental hippopotamid lineage can be investigated, and its congruence with the “island rule” can be tested.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

EVIDENCE OF EXTENSIVE SCAVENGING/PREDATION BY LATE CRETAEOUS MARINE ORGANISMS FROM THE BASAL HORNERTOWN FORMATION, NEW JERSEY, USA

BOLES, Zachary, Drexel University, Philadelphia, PA, United States; 19104; LACOVARA, Kenneth, Drexel University, Philadelphia, PA, United States

The Main Fossiliferous Layer (MFL) of the Hornerstown Formation represents an Upper Cretaceous marine biohorizon. Examination of recently collected fossils and those in the collections at the Academy of Natural Sciences of Drexel University reveal bite marks produced by predators and scavengers. These feeding traces can provide insight into the behavior, ecology, and functional morphology of the trace makers. The most common type of tooth marks are scores which are typically linear, shallow depressions in the bone that result from dragging the tooth along surficial compact bone. Such marks change in feeding ecology during ontogeny. Recognition of ontogenetic trends will permit ontogenetic evaluation of previously described mysticetes represented by putative adults, such as Microcysticetus rothaeuseni.

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could have been produced by a variety of organisms (e.g. sharks, fish, or invertebrates) making identification of a producer nearly impossible. However, two diagnostic markings have so far been identified in the sample. The first group of marks is very common and consists of (1–4) parallel striations usually 0.1 mm wide and a circular area in the bone. These markings closely resemble those produced by modern echinoids while feeding on encrusting organisms. While one echiuroid taxon has been reported in the underlying Navesink Formation, no remains have been reported from the MFL. Consequently, the presence of the echiuroid echinofossil, Gnathichmus pentax, suggests their presence despite the lack of body fossils. The second group of markings are present on two crocodylian teeth and are composed of several (~14) parallel striations produced by a carnivore with serrated teeth. These markings strongly resemble those previously attributed to the shark Squaliacorus, for which teeth have been previously recovered from the site. Other sharks like hexanchid have too few cusps per tooth while the other carnivores lack serrated teeth. Consequently, Squaliacorus pristodontus is the only known taxon from the site which could have produced such bite marks. Based on the anatomical location of many feeding traces, scavenging was common and may have represented a major feeding strategy at this locality.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

A PARTIAL SKULL OF OPHISURAS (SQUAMATA, ANGUINAE) FROM THE MIocene of CATALONIA (NE IBERIAN PENINSULA)

BOLET, Arau, Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain; DELFINO, Massimo, Università di Torino, Torino, Italy; FORTUNY, Josep, Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain; ALMICIJA, Sergio, Stony Brook Univ, Stony Brook, NY, United States; ALBA, David M., Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain.

The complicated taxonomic history of Miocene European Anguinae (Squamata, Anguinae), as illustrated by the problematic use of Doylea instead of Ophisurus, can only be clarified by combining a better knowledge on the osteology of extant taxa with the information provided by relatively complete and articulated fossil specimens. The application of non-invasive techniques, such as computed-tomography (CT) scanning, currently increases the amount of information that can be obtained from such fossils. They are however quite scarce, because anguine fossil remains are mostly retrieved through screen-washing techniques, which usually yield only isolated bones. In contrast, here we report a well-preserved, articulated anguine individual that preserves the partial skull and an associated trunk portion. The specimen, housed at the Institut Català de Paleontologia Miquel Crusafont, comes from the classical fossiliferous area of Hostalets Inferior—i.e., the late Aragonian levels (MN7-8) of els Hostalets de Pierola (Vallès-Penedès Basin, Catalonia, NE Iberian Peninsula), which has an estimated age of 12.5-11.2 Ma. The skull preserves its anterior region, including the premaxilla, maxilla, and part of the frontals, as well as the anterior and middle portion of the two dentaries. The preserved trunk portion externally shows a great number of osteoderms in their original anatomical position, whereas CT scans show the morphology of the vertebrae preserved inside. CT scans further reveal additional morphological details of the skull hidden by the attached matrix, such as most of the dentition and elements of the palate. On the basis of the pointed and slightly recurved teeth of the dentary, the specimen is referred to the genus Ophisurus. Conversely, Pseudopus displays blunt teeth along most of the dentary, whereas Anguis is characterized by fewer, more recurved, and widely-spaced teeth. The material reported here not only represents a good opportunity for studying the morphology of elements seldom recovered from the fossil record (e.g., nasals, palatal elements), but it also records the presence in the Miocene of Catalonia of an anguine other than Pseudopus, thereby improving the rather poor knowledge on Miocene squamates from the Iberian Peninsula.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

PREDICTIVE MODELING IN THE SEARCH FOR VERTEBRATE FOSSILS: GEOGRAPHIC OBJECT BASED IMAGE ANALYSIS (GEOBIA) IN THE EOCENE OF WYOMING

BOMMERSBACH, Bryan, Western Michigan University, Kalamazoo, MI, United States; ANEMONE, Robert, Western Michigan Univ, Kalamazoo, MI, United States; EMERSON, Charles, Western Michigan University, Kalamazoo, MI, United States.

The development and testing of predictive models for identifying productive fossil localities represents a promising interdisciplinary endeavor among geographic information scientists, paleoecologists, and vertebrate paleontologists. This study demonstrates that even medium resolution Landsat imagery can be successfully used in a pixel-based artificial neural network (ANN) approach to identify the multi-spectral signature of productive fossil localities in the Eocene of the Great Divide Basin, Wyoming. With sufficient confidence for a basin-wide reconnaissance, this ANN approach reside in the relatively large pixels, and in the ANN approach itself (a “black box” which doesn’t allow statistical characterization of the spectral classes). We analyzed high resolution (2 m resolution, pan-sharpened to 0.5 m) commercial satellite imagery from the Worldview-2 satellite of the Salt River Draw Formation (40–40 Ka) megaherbivore communities of California and Nevada were examined for ecological function (diet, mobility, niche partitioning, and range of ecological tolerance) and environmental information (flora and climate). Megaherbivore specimens were selected from seven localities in California and Nevada and stable carbon and oxygen isotopes in enamel or dentin of teeth were analyzed. Analyzed taxa include Odocoileus, Eucosmocerus, Equus, Bison, Mammutthus, Ovis, Notroderos, and Megalonyx. Averaged results show that species were able to tolerate a wide range of diets and habitats, while serial data show that individuals exhibit much less ecological flexibility. Serial 13C and 18O data reveal that individuals consumed a similar type of vegetation throughout the year that most of their mobility or occurred similar habitats seasonally. Data indicate ecological partitioning between co-occurring megaherbivores, suggesting a weak degree of competition. Isotopic data acquired in this study, combined with data from prior analyses, reveal that northern California and northern Nevada were forested and woodland environments which hosted predominantly browsing species, while many of the same species in southern Nevada occupied an array of herbivorous niches (browsing, mixed feeding, and grazing), indicating the inclusion of mixed grassland in the region. These data reveal a wide range of ecological plasticity for Late Pleistocene megaherbivore species. Integrating the isotopic information into a constrained temporal framework reveals that environments were becoming warmer and more arid toward the close of the Late Pleistocene. Carbon data from Equus, Mammutthus, Bison, Camelops, and Notroderos reveal that these taxa took advantage by increasing C4 consumption, as would be expected from increased aridity. Rather, to cope with changing climates through the terminal Pleistocene, most taxa exhibited an expansion of dietary strategies (increasing browsing or increased grazing), resulting in niche conservatism at the generic level.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

VERTEBRATES OF THE NEWARK CANYON FORMATION (BARREMIAN-ALBIAN), EAST-CENTRAL NEVADA: A PRELIMINARY REPORT AND IMPLICATIONS FOR MID-CRETACEOUS GEOGRAPHY OF THE INTERMOUNTAIN WEST

BONDE, Aubrey, University of Nevada Las Vegas, Las Vegas, NV, United States; RENO, Mark, University of Nevada Las Vegas, Las Vegas, NV, United States; HILTON, Richard, Sierra College, Rocklin, CA, United States; JACKSON, Frank, Montana State UnivMuseum of the Rockies, Bozeman, MT, United States; DRUSCHKE, Peter, ExxonMobil, Houston, TX, United States.

The Newark Canyon Formation, exposed in mountain ranges of east-central Nevada, was the first formation to yield Cretaceous-aged fossils from the state. For the past three years our team has been mapping and collecting palaeontological specimens in selected exposures in the Newark Canyon Formation and has been successful in expanding the known fauna. To date, we have found the remains of Hybodontidae, Holostei, Glyptopsidae, Crocodylia (cf. Goniophiliidae), Thyreophora, Iguanodontidae, possible Sauropoda and Theropoda. The latter include the eggshell of the family Elongatoolithidae. Material has been recovered from brained to meandering fluvial sandstones and siltstones, as well as lacustrine silty mudstones. This faunal list is similar to contemporaneous deposits of the Cedar Mountain Formation of east-central Utah.

The Newark Canyon Formation is interpreted as the deposits of a piggy-back basin associated with Sevier retroarc tectonics, whereas the Cedar Mountain Formation represents those of the Sevier retroforeland basin. Primary sources for the upper part of the type-section are Aptian in age, detrital zircons in overlying units are Albain and younger, and this discrepancy implies deposition in the sub-basins of the Newark Canyon Formation was diachronous. The similarity in fauna between the Cedar mountain Formation and the Newark Canyon Formation, two different tectonic settings, indicates that Late Early Cretaceous time in eastern Nevada had yet progressed to the extent that a disjunct fauna characterized Utah and Nevada, and that uplift of the Navadaplano likely postdated deposition of the Newark Canyon Formation.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

BISON DO NOT MARCH IN UNISON: A GEOMETRIC MORPHOMETRIC APPROACH TO DIFFERENTIATING NORTH AMERICAN BISON SPECIES BASED ON HOOF SHAPE MORPHOLOGY

BORMET, Allison, Indiana University, Bloomington, IN, United States, 47405

North American extinct bison are large, horned bovids that exist in regions of Canada and Alaska as Bison bison athabascae, the wood bison, and in the American west as Bison bison bison. Bison bison bison, the plains bison, that weighing 1,000 kg with shorter horns than their recently extinct Pleistocene counterparts, Bison latifrons and Bison antiquus. Limb dimensions of B. latifrons suggest it was a large-bodied animal that was less cursorial than modern bison. Its geographic range included heavily wooded environments of western America. B. antiquus, considered to be the ancestor of modern bison, is not as cursorial as B. bison, but is more cursorial than modern bison. Its geographic range included heavily wooded environments of western America.

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genus has inhabited, analysis of postcranial elements using geometric morphometrics may help discern ecomorphological variation between the species. The distal phalanx (PH3) was analyzed in this study because of good fossil preservation and its direct interaction with terrain, suggesting it may show ecomorphological shape variations across habitat types. Using photographs, fifty semi-landmarks were placed marginally around the plantar surface of the PH3, producing an outline that was Procrustes superimposed and subjected to a principal components analysis. Principle component one explains 64.4% of the total variance and represents the morphological trajectory of an elongated, tapered PH3 to a curved, blocky PH3 with a postero-lateral projection. Principle component two explains 13% of the total variance and represents the trajectory of a thinned, elongated PH3 to a curved, shorter PH3. Results of a MANOVA test indicate that PH3 morphologies of B. antiquus and B. b. bisson are significantly different, with B. antiquus having more posterior and elongated. In this study all four South prominent posterior-lateral projection than B. b. bisson or B. antiquus. However, a larger sample size of B. latifrons is needed to determine if this species’ PH3 morphology is significantly different than B. antiquus or B. b. bisson. In addition, B. b. athabascae specimens were included in the analysis to further quantify the morphological similarities between the extinct species, which lived in areas with more tree cover.

Technical Session VI (Thursday, October 31, 2013, 10:30 AM)

THE MOST COMPLETE AFRICAN HYAENODONTID (MAMMALIA, "CREODONTA") FROM THE LATE EOCENE OF EGYPT AND THE EVOLUTION OF APTERODONTINA

BORTHS, Matthew, Stony Brook University, Stony Brook, NY, United States; SIMONS, Elwyn, Duke University, Durham, NC, United States; SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, United States

Before carnivorans appear in the Afro-Arabian fossil record in the latest Oligocene (~23 Ma), the terrestrial carnivore niche on the island continent was occupied by species of the so-called mammal family Hyaenodontidae, which is sister to the clade with Oxyaenidae in the order Creodonta. Hyaenodontids are also found in Eurasia and North America and are diverse in Africa, with species ranging from weasel-sized (Mazeractognathus) to polar bear-sized (Hyaenictidium). Several subfamilies have been proposed for the family, including the Apterodontinae, a subfamily limited to the Eocene and Oligocene of Africa and early Oligocene of Europe. The enigmatic group combines reduced molar conicals (an indicator of derived carnassial shear and a hypercarnivorous diet) with well-developed talonid basins (an indicator of a grinding ability associated with less specialized diets in extant carnivorans). Apterodontines exhibit prominent sagittal crests, wedge-shaped lambedoid crests, and a long, narrow neurocrania. The relationships between species placed in Apterodontinae are not well-resolved and the acquisition of these mosaic features have not been established. Excavations in the Fayum Depression, Egypt, at the latest Eocene (late Priabonian) Locality 41 (L-41) have recovered the most complete apterodontine from Afro-Arabia. The new species has an estimated body mass of 23 kg, making it a relatively small apterodontine. While the skull is dorso-ventrally crushed, the specimen preserves the complete upper and lower dentition along with portions of the petrosal and a lamboild crest. The m1-2 retain an incipient metaconid ridge, and the M1-2 preserve a lambdoidal crest. The m1-2 retain an incipient metaconid ridge, and the M1-2 preserve a lambdoidal crest. The m1-2 retain an incipient metaconid ridge, and the M1-2 preserve a lambdoidal crest. The m1-2 retain an incipient metaconid ridge, and the M1-2 preserve a lambdoidal crest. The m1-2 retain an incipient metaconid ridge, and the M1-2 preserve a lambdoidal crest. The m1-2 retain an incipient metaconid ridge, and the M1-2 preserve a lambdoidal crest.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

NEW TURTLES (REPTILIA, TESTUDINES) FROM THE LAS CASCADAS FORMATION, PANAMA CANAL BASIN, SUGGEST LOW DIVERSITY IN THE EARLY MIocene (ARIKEAREAN) NEOTROPICS

BOURKE, Jason, Florida Museum of Natural History, Gainesville, FL, United States; RINCON BURBANO, Aldo Fernando, Florida Museum of Natural History, Gainesville, FL, United States; WOOD, Aaron, Florida Museum of Natural History, Gainesville, FL, United States; BLOCH, Jonathan, Florida Museum of Natural History, Gainesville, FL, United States; MACFADDEN, Bruce, Florida Museum of Natural History, Gainesville, FL, United States

New non-marine fossils from the Arikareean North American Land Mammal Age (NALMA) are rare and typically fragmentary. In North America, these assemblages are marked by low chelonian diversity (e.g., in Florida and Texas). As a result, little is known about the evolution and paleogeography of many terrestrial and freshwater turtle groups during this interval, particularly in the ancient New World tropics. We report new fossil turtles collected along the Panama Canal from the early Miocene Las Cascadas Formation (21 Ma), a volcanioclastic sequence that represents the oldest appearance of terrestrial habitats in the southern Panama Canal Basin. Only three testudinid taxa representing two families have been recovered from Las Cascadas over five years of collecting effort, suggesting that overall turtle diversity was low. The most abundant testudinid fossils represent small to mid-sized terrestrial testudinids (land tortoises). One partial shell and unassociated shell fragments show some similarities (particularly in plastral forelobe characteristics) to the North American genera Stylemys (in the family Acanthochelyidae) and Cophurus. A second partial testudinid shell is ambiguous with regard to its affinities and probably represents a new genus. Two partial shells, as well as unassociated isolated shell elements, represent a single species of turtle perhaps superficially similar to terrestrial and semi-aquatic forest-type geomydids like extant Rheocollemys. This taxon is small (~24-26 cm carapace length) and thin-shelled, with plastral kinesis along the hyo-hypoplastral suture, highly reduced hypoplastral sutures, and fused suture contacts between akinetid elements of the shell. In part, these features are diagnostic of the Psychogastreini (Psychogasterinae), a group known from the Acanthochelyoidea (Eocene-Late Miocene) of Europe with possible records from the latest Eocene (Chadronian NALMA) of North America. The Las Cascadas chelonians represent groups that likely dispersed from North America into Central America. Turtle diversity in the Pennsylvanian through the Miocene (in the Arikareean NALMA) is rare and fragmentary.
Calibration of Earth History Symposium 3 (Friday, November 1, 2013, 8:00 AM)

Boering, Samuel, MIT, Cambridge, MA, United States; Blackburn, Terence, DTM, Washington, DC, DC, United States; Burgess, Seth, MIT, Cambridge, MA, United States; Ramirezani, Jahandar, MIT, Cambridge, MA, United States.

The stratigraphic record preserves much of what we know about the evolution of life and its relationship to environmental change from the composition of the oceans and atmosphere to major extinction events. The past decade has seen a revolution in temporal resolution of the stratigraphic record fueled by our ability to resolve the timing of major events as well as the rates of biologic and climatic change. This is in large part due to improvements in radiometric and astrochronological techniques as well as the integration of high resolution paleontological and chronostratigraphic data and improved correlation techniques. The EARTHTIME initiative was designed to bring together geochronologists, stratigraphers, and paleontologists with the goal of improving the resolution of Earth history so that it is now possible to resolve events with time windows of points to better than 0.02% with even finer scale via interpolation, application of the Astrorchronologic Time Scale and correlation of chronostratigraphic trends. Much progress has been made in integrating multiple chronometers and understanding intertechnique and interlaboratory biases. Applications of high-precision geochronology include constraining rates of biological, geological, and climatic change. Examples illustrating this integrated approach include mass extinctions and recoveries, rapid climate change induced by volcanism, timescales of major changes in ocean chemistry, and intertechnique and interlaboratory biases. Applications of high-precision geochronology have been made with careful and integrative work as well as community outreach and public outreach.

Boyd, Clint, South Dakota School of Mines and Technology, Rapid City, SD, United States; Welsh, Ed, Badlands National Park, Interior, SD, United States.

It has long been recognized that “dirk-tooth” and “scimitar-tooth” nimbiravids display relatively fine and coarse serrations on their canine teeth, respectively. However, little work has been done to determine if differences in canine serration density between nimbiravids are taxonomically informative. If such differences are present, they would provide powerful tools for referring fragmentary, taxonomically ambiguous material to specific clades, enhancing our ability to assess their geographic and biostatigraphic ranges. The present study focused on evaluating patterns of canine serration density among the nimbiravids Taxonavis (n=7), Dinictis (n=12), and the hoplophorines Hoplophoneus (n=19) and Nanomolius (n=2). Serration density was measured on the upper and lower canines over a length of at least five millimeters and then averaged to obtain the serration count per millimeter (SPM). Significant differences (p-value < 0.001) were noted between the mean values obtained for the upper canines of Ninimimus (2.14 SPM), Dinictis (3.39 SPM), and the clade Hoplophorini (4.48 SPM). No overlap was seen in the values recorded for these three taxa, though the 95% confidence intervals for the latter two taxa do slightly overlap. Additionally, values of SPM were found to be relatively consistent along the canine of individual teeth, between left and right canines in individual specimens, and between deciduous and adult canines from the same taxon (the latter tested in Ninimimus and Hoplophoneus). Similar, taxonomically significant trends in SPM value are seen in the lower canines of the sampled taxa, though sample sizes are smaller and preliminary examination of some specimens of other “saber-tooth” feliform carnivores (i.e., the barbourofelid Barbourofelis and the direwolf Smilodon) reveals that these “scimitar-tooth” and “dirk-tooth” taxa also display high and low SPM values, respectively. These preliminary results suggest that canine serration density may be a reliable characteristic for identifying fragmentary specimens to specific clades, though resolution to the genus or species level may not be possible for all taxa.

Interpreting the Facial Integument of Ankylosaurs

Bramble, Katherine, University of Alberta, Edmonton, AB, Canada; TEG 2E9; Arbour, Victoria, University of Alberta, Edmonton, AB, Canada; Currie, Phillip, University of Alberta, Edmonton, AB, Canada.

The doral and lateral surfaces of adult ankylosaur skulls are covered by extensive sculpturing and fusion of osteoderms. This ornamentation may or may not be subdivided into discrete polygonal areas. The antenymal covering of cranial ornamentation was investigated in order to determine if each polygon was covered by a single epidermal scale, and to determine what may have covered more amorphous rugose cranial ornamentation. Potential osteological correlates for integumentary structures were identified using ankylosaur skulls using various preservation techniques. These included: (1) the presence of cosin-based histological sections of nodosaurid skulls, such as the presence or absence of rugosity, and the type of rugosity if present. In ankylosaurs with polygonal ornamentation, such as Ankylosaurus and Edmontonia, discrete polygons are separated by shallow but well-demarcated furrows, and each polygon was probably covered by a single epidermal scale. The quadrangular and squamomalous horns of Ankylosaurus and Minotaurasaurus are pitted, rugose, and have striations, features that are correlated with thin, cornified sheaths. Some ankylosaurs, such as Chrichtonsaurus, Gastonia, and Shamosaurus, have rugose cranial ornamentation not divided into discrete polygons. In these species, the cranial ornamentation does not fit any of the categories previously described for ceratopsian facial integument. Talarurus lacks discrete polygonal cranial ornamentation, but raised bumbs of the fronsalional ornamentation may correspond to epidermal scales; these are similar to bumbs posterior to the orbit and on the midline of the parietal bar in ceratopsians. Talarurus is more derived than Chrichtonsaurus and Gastonia, but is basal to Ankylosaura; as such, it may represent a transitional morphology between amorphous and polygonal cranial ornamentation in ankylosaurs. Nodosaurids appear to have evolved polygonal cranial ornamentation independently of ankylosaurs, because the earliest members of each lineage have undifferentiated cranial ornamentation. New osteological correlates need to be identified to determine the integument of ankylosaurs with undifferentiated frontal ornamentation.

Crocodyliform feeding traces on ceratopsid dinosaurs from the upper ceratopsian (late campanian) kaiparowits formation, southern utah

Brandau, Deanna, NHMU/Univ. of Utah, Salt Lake City, UT, United States, 84121.

Tooth traces can provide a unique glimpse into the feeding behavior and ecology of extinct organisms. Tooth-marked dinosaur bones are relatively common, but the frequency of tooth traces is less in the Mesozoic compared with Cenozoic mammal assemblages. However, recent studies suggest the frequencies of tooth marks on Cretaceous dinosaur bones are slightly higher than previously predicted. Here, I report evidence of feeding traces from two ceratopsid dinosaur associated skeletons from the late Campanian Kaiparowits Formation of the Kaiparowits Plateau in southern Utah. These two ceratopsid elements represent disarticulated but associated ceratopsid specimens preserved in sandy siltstone overbank deposits. The feeding traces consist of two size classes that occur on dorsal ribs and fragments, several cervical ribs and two ischia. Multiple pits and scores are observed on ischia and most dorsal ribs. Two dorsal rib shafts and an ischium display a row of small, serial pit marks. The presence of conical to oval-shaped marks, bisected pits and scores, U-shaped scores and pits, and hooked scores suggest tooth marks are diagnostic traces from one or more crocodyliform individuals at each site. This is further confirmed by the low frequency (less than 1% of preserved elements) of tooth marks on the bones, and absence of striations and gross gnawing on broken margins, which are often produced by theropod dinosaurs and mammals. The variable size in tooth traces suggest feeding behavior from either a single crocodyliform with a heterodont dentition or feeding from small and larger-sized crocodyliforms. These data are consistent with recent reports of crocodyliform feeding traces on ceratopsid skeletons from the Kaiparowits Formation. Extant crocodylians are opportunistic predators, and their ceratopsian relatives appear to have scavenged and preyed upon a variety of clades of large and small-bodied ornithischian dinosaurs in the Kaiparowits ecosystem.
AN OSTEICHTHYAN-LIKE SKULL FROM SIBERIA AND THE EVOLUTION OF CROWN GNATHOSTOME BRAINCASE MORPHOLOGY
BRAZEAU, Martin, Naturalis Biodiversity Center, Leiden, Netherlands; GILES, Sam, , Oxford, ; FRIEDMAN, Matt, University of Oxford, Oxford, United Kingdom
The phylogenetic placement of Silurian and Devonian fishes remains one of the greatest impediments to a coherent picture of the early evolution of jawed vertebrae. Although some cladistic investigations have begun to make progress on this problem, the state of the field is comparatively immature. The disparity of dental, skeletal characters in early gnathostomes, some of these traits having evolved independently in multiple gnathostome lineages, presents a challenge to the identification of some previously enigmatic early gnathostomes. Neurocrania (braincases) provide rich sources of character information that may have a profound impact on our understanding of early gnathostome evolution. Here we report the anatomy of an Early Devonian fish braincase from Siberia with significant implications for the comparison of early gnathostome braincases. The skull, exhibiting an osteichthyan-like dorsal skull roof, was examined using high resolution computed tomography scanning. The results revealed the thin, delicate perichondral shell of a nearly complete braincase. The tomography renderings show clear anatomical details including a distinct eyestalk attachment, hyoid arch articulations, and a broad-based shunt on the dermal roof. The skull displays a trend towards a stunted, progenetic morphology at the LGM. This is of particular interest in this cave because they provide the first record of this arctic-boreal species for SD and they are extremely abundant (dozens of specimens) in contrast to other caves that have produced lower numbers of specimens (usually less than 10). Furthermore, ancient DNA (aDNA) indicates that the fossils from DGP and other sites in the Midwest (originally classified as D. torquatus) are closely related to D. richardsoni which has a “relict” distribution west of Hudson’s Bay today. Because D. richardsoni is adapted to a more temperate, although tundra, environment than the more northerly distributed D. tenebrosus, D. torquatus, D. richardsoni, and D. pochteca may represent an earlier interpretation of harsh climate conditions. These studies are fundamental to understanding the potential effects of future global warming in the Black Hills.
paleontologist Carl Wiman in 1932. The specimen comprises most of the right-hand side of the cranium from the posterior edge of the external naris to the anterior margin of the supratemporal fenestra. Three-dimensional CT-imaging carried out for this study has also identified cranial anatomical details not visible in the past. Palaeogenetic analyses of D. kirtlandicus, rescured into the most comprehensive published data sets of Neosuchia and Goniopholididae, confirmed its placement as a derived goniopholidid, as well as the 40 million year stratigraphical range extension of the clade into the latest Cretaceous. Denizanosuchus kirtlandicus occurred synonymically alongside three alligatoriforms, ten theropod tracks, and the underlying estuarine Fruitland Formation; Brachychampsa, Leidiosuchus, and the colossal apex carnivore Deinosuchus. Only Brachychampsa has been found synonymically with D. kirtlandicus, implying that these taxa must have partitioned their environment via contrasting feeding ecologies. Indeed, a relative warps assessment of two-dimensional landmark data mapped from skull shape shows that D. kirtlandicus conforms to a generalist predator morphotype. In contrast, Brachychampsa was clearly a specialist durophagous feeder, perhaps feeding on turtles and benthic mollusca.

Technical Session XIV (Saturday, November 2, 2013, 11:00 AM)

MORPHOLOGY OF DENTAL AMPULLAE OF BIRDS OF PREY

BRIGHT, Jen, University of Bristol, Bristol, United Kingdom; MARUGAN-LOBON, Jesus, Universidad Autonoma de Madrid, Madrid, Spain; RAYFIELD, Emily, University of Bristol, Bristol, United Kingdom

Birds are one of the most diverse clades of modern vertebrates, and have historically been regarded as a classic group in which to study adaptation through evolution. Different lineages of birds often display remarkable convergences in their cranial and beak morphologies, frequently presumed to be associated with similarity in dietary niche. We tested this prediction by performing a Principal Geometric Morphometrics (PGM) analysis of a subset of extant neognathous birds, the diurnal birds of prey. Recent molecular phylogenies have classified this group as polyphyletic. There are therefore multiple examples of convergence within this subset of birds, for instance between the falcons (Falco) and owls (Strigiformes). We analyse the beaks and skulls of diurnal raptors. Principal Components Analysis shows that carrion feeders (the Old and New World vultures) tend to cluster together in morphospace regardless of phylogeny, indicating strong morphological as well as dietary convergence. Elsewhere, there is considerable morphospace overlap between falcons and accipitrids. This indicates that although the skull morphology of predatory birds is highly constrained overall, it does not appear to be a strong predictor of prey even in birds with highly specialized diets. Dietary niche may be predicted based on cranial morphology in some species, but this is the exception rather than the rule: feeding ecology alone is insufficient to explain the variety of forms seen in extant birds of prey. This highlights the importance of establishing an extant framework for applications of GMM to fossil taxa and questions of paleoecology.

Technical Session IX (Friday, November 1, 2013, 8:00 AM)

PREVALENCE, ORIGIN, AND ANATOMY OF DENTICLE AMPULLAE IN THEROPOD DINOSAUR TEETH

BRINK, Kirstin, University of Toronto Mississauga, Mississauga, ON, Canada; LSI 1C6; LEBLANC, Aaron, University of Toronto Mississauga, Mississauga, ON, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; REISZ, Robert, University of Toronto Mississauga, Mississauga, ON, Canada

Ziphodont teeth are typified by denticles extending apico-basally along the mesial and distal carinae, and are ubiquitous among toothed theropod dinosaurs. A unique structure, the ampulla, has been previously identified in thin section between the bases of adjacent denticles along the distal carinae of Allosaurus. The ampulla is a void in the dentine that is connected to the external surface of the tooth via a channel in the enamel. The channel and ampulla are hypothesized to function as a ‘kerf and drift’, which mitigate tensile stress exerted on the carina during feeding and prevent the propagation of cracks through the tooth. However, we identify a variety of ampullae forms before tooth eruption, or are created in response to stresses during feeding. Although ziphodonty occurs in numerous amniote clades, the presence of ampullae has only been accurately documented in Albertosaurus. The widespread presence of ampullae within Theropoda could represent a common pattern in the evolution of carnivorous feeding behaviors. To examine the pervasiveness of ampullae in theropods, teeth from six taxa (Tyrannosaurus rex, Coelophysis bauri, Carnotaurus sastrei, Poochon formosus, Allosaurus fragilis, and an indeterminate dromaeosaurid) were examined histologically. Results show that ampullae are present in all theropod taxa examined here, with the exception of Troodon. Contrary to previous hypotheses, ampullae are present on both the mesial and distal carinae, and are not encircled by a layer of enamel, but rather are composed of abutular dentine. In order to assess how these structures develop, an unerupted tooth of A. fragilis was thin-sectioned to determine if the enamel channel and ampulla are present before the tooth becomes part of the functional tooth row, or if they form after eruption in response to external stress on the denticles. Interestingly, the unerupted tooth of A. fragilis does not have an enamel channel or ampulla, indicating that ampullae are only present in functional teeth and that the result is not a developmental history. These results suggest that the ampulla is a reparative structure in which the dentine immediately surrounding an enamel crack is remodeled to stop the propagation of the crack and prevent catastrophic breakage or infection of the tooth. The functional implications of this evolutionary novelty may have played an important role in the radiation of this diverse group of terrestrial carnivores.

ASSEM, Rodolfo, University of Texas at Austin, Austin, TX, United States

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Technical Session XII (Friday, November 1, 2013, 3:00 PM)

A NEW, PHYLLOGENETICALLY SIGNIFICANT ALLIGATOROID FROM THE LATE CRETACEOUS (CAMPANIAN) OF MÉXICO

BROCHU, Christopher, University of Iowa, Iowa City, IA, United States; LAMBERT, Dana, University of Texas at Austin, Austin, TX, United States

A small short-snouted crocodylian from the Late Cretaceous of Baja California helps fill the substantial morphological gap separating the earliest gladiatorions (forms resembling living alligators) from more basal alligatoroids. It was collected from upper Campanian deposits informally known as the “El Gallo Formation” and is one of the oldest known crocodylians. The specimen is from a animal less than 2.5 m in length. It has a short, flat snout and remarkably flattened arvil-like teeth at the back of the maxillary series. The distal dental teeth are also expanded, and the lateral margin of the suborbital fenestra is bowed medially, forming a bony shelf adjacent to the enlarged suborbital fenestra. It was originally prepared as a coelurosaurid, but new evidence has led us to conclude that it is more closely related to the alligatoriforms.
posterior teeth found in other short-snouted and possibly durophagous crocodylians. It shares several derived character states with other globidontans, such as the absence of a notch between the maxilla and premaxilla, and the shape of the skull is similar to that of the Campanian Globidonta globidontis Brachychampas, but unlike Brachychampas and other globidontans, the El Gallo form preserves several character states currently optimised as plesiomorphic within Alligatoroidea, including a frontal forming a substantial part of the supratemporal fenestral margin and fourth and fifth maxillary alveoli of nearly the same size. A phylogenetic analysis supports a sister group relationship between the new form and all other globidontans. It also reinforces a North American origin for Globidonta and other basal alligatoroid clades, with multiple dispersal events to Eurasia and South America. Moreover, the morphology of the snout is consistent with a specialized, possibly durophagous, condition for the ancestral alligatoroid and a reversal toward a more generalized morphology in living forms.

Technical Session VIII (Thursday, October 31, 2013, 1:45 PM)

THE INFLUENCE OF SAMPLING ON THE FOSSIL RECORD OF PALEOZOIC SYNAPSIDS, AND THE EFFECT OF OLSON’S EXTINCTION ON THEIR EVOLUTION

BROCKLEHURST, Neil, Museum für Naturkunde, Berlin, Germany; KAMMERER, Christian, Museum für Naturkunde, Berlin, Germany; FROBISCH, Jörg, Museum für Naturkunde, Berlin, Germany

Synapsids dominated the terrestrial realm between the late Pennsylvania and the Triassic. Their early evolution includes some of the first amniotes to evolve large size, herbivory and macro-carnivory. However, little research has been done on the changes in diversity occurring in synapsids during the earliest period in their evolution, or on the potential effects of anthropogenic sampling bias on their record. Here synapsid diversity is assessed between the Carboniferous (Moscovian) and the Middle Permian (Capitanian). A raw, taxic diversity (richness) estimate is generated, and two separate methods are used to correct for sampling bias. A recently published modification of the residual diversity method is applied to remove the effect of anthropogenic sampling bias, and a new estimate is generated using the matrix representation with parsimony method to infer ghost lineages and obtain a phylogenetic diversity estimate. Evidence of a significant anthropogenic sampling bias is suggested by a strong positive correlation between the number of amniote-bearing collections and the taxic diversity of synapsids. The patchiness of the geographic distribution of fossils also highlights the gaps in our knowledge.

Technical Session VII (Thursday, October 31, 2013, 3:30 PM)

BODY SIZE RELATED TAPHONOMIC BIAS IN THE LATEST MAASTRICHTIAN; IMPLICATIONS FOR THE END-CRETACEOUS EXTINCTION

BROWN, Caleb, University of Toronto, Toronto, ON, Canada, M5S 2C6; CAMPIONE, Nicholas, University of Toronto, Toronto, ON, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada

The Late Maastrichtian (Cretaceous) remains one of the best systems for investigating evolutionary and ecological dynamics leading up to mass extinction events, and offers a chance to understand the processes that drive major biotic shifts in Earth’s history. The Hell Creek Formation (HCF), and equivalent beds of the northwestern USA, represent the best studied and most well-sampled dinosaur dominated ecosystem of the Late Maastrichtian and hence remain a focal point for studies of diversity patterns and dinosaur community structure immediately before the end-Cretaceous mass extinction. The dinosaur body size distribution within the assemblage of the HCF, as with other alluvial-palustrine systems, shows an increase in the large taxa as the extinction event occurs. However, this extinction does not affect all synapsid groups equally; Therapsida and Caseidae increase in diversity across the boundary. Whilst the uncorrected diversity curve indicates a recovery from the extinction during the remainder of the Roadian, the sampling-corrected diversity curves across the boundary highlight the gaps in our knowledge.

Preparers’ Session (Thursday, October 31, 2013, 10:15 AM)

PRACTICAL METHODS FOR THE USE OF CYCLODECANE IN VERTEBRATE MICROFOSSIL PREPARATION

BROWN, Gregory, University of Nebraska State Museum, Lincoln, NE, United States, 68558-0514

Since 1995, cyclododecane (CDD), a waxy cyclic alkane hydrocarbon that sublimes at room temperature, has found increasing use by conservators as a temporary binder, facing, barrier coat, consolidant or mounting medium in the conservation of a range of fragile objects from ceramics and textiles to ancient paintings and frescoes. Over the past decade, CDD’s unique and advantageous properties have led to its adoption by vertebrate paleontologists for a variety of uses, including temporary fills during molding or casting, providing support during transportation, but its primary use is as a temporary mount or “work-holder” for delicate microfossils during preparation. The basic concepts of the latter use have been presented before: the specimen or its containing block of matrix is partially imbedded in a small container of melted CDD which is then secured to a work platform that can be easily held and manipulated under the microscope. However, the details and nuances of carrying out this procedure safely (for both the specimen and the preparer) have not been presented adequately. In addition to its support function, CDD can be used during micro-preparation to provide protection for fragile elements previously exposed and as a “warming-cushion” for edges of access while working inside enclosed cavities (such as endocrania). CDD is also useful as a temporary consolidant of non-cohesive matrix in cases where removal of matrix would otherwise result in collapse of the enclosed specimen. Since CDD is hydrophobic and insoluble in strong polar solvents, consolidation of otherwise porous matrix and specimen also allows use of the “water-heating” technique to enhance visual differentiation of matrix and bone. The proper use of special tools and the selective warming (or not) of specimens is key to the successful application and removal of CDD in these and other micro-prep procedures. Although the MSDS indicates that CDD has low toxicity, thorough safety studies have not been conducted. CDD is known to be a bioaccumulant with primary routes of entry through respiration and skin absorption. It is strongly recommended that heating, melting and application of CDD be done under a fume hood and gloves and safety glasses be worn during use.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

EQUUS OCCIDENTALIS LEIDY FROM ASHALPITO, KERN COUNTY, CALIFORNIA

BROWN, Kristen, Natural History Museum of Los Angeles County, Los Angeles, CA, United States, 90007; SCOTT, Eric, San Bernardino County Museum, Redlands, CA, United States; AKERSTEN, William, Idaho State University, Pocatello, ID, United States

The Ashalpito vertebrate fossil locality near Buena Vista Lake in Kern County, California has produced mammal fossils dating to the Blancan and Rancholabrean North American Land Mammal Ages (NALMAs). The locality is situated in the Tulare Formation, which regionally has yielded Blancan vertebrates including Borophagus, Ichthyosmilus, and Equus. At Ashalpito, younger Rancholabrean fossils derive from Paleolithic mammalian paleontology – especially at the Rancho La Brea asphalt locality, where the name is frequently assigned to large horse fossils from that site. Because of the promiscuity of the Rancho La Brea biota in late Paleocene studies throughout North America, the use of the species name Equus occidentalis has been promulgated at many other sites. Another, less common interpretation suggests that E. occidentalis may be a valid plesipine equid dating to the Blancan NALMA. This view employs lower cheek teeth from the Tulare Formation exhibiting with deep ectoflexids – a diagnostic character of plesipine equids – to buttress the definition of the species as defined from Ashalpito, effectively disregarding the Tulameen lecotype.

We examined horse fossils from Ashalpito and from other non-asphaltic localities in the Tulare Formation, confirming that plesipine fossils are abundant. However, dental morphology of at least two plesipine species, including medium- and large-sized forms, in the Blancan component of this formation. The paratypes of Equus occidentalis from Ashalpito lack any diagnostic characters, and cannot be confidently assigned to either the larger or the smaller equid morphs from the Tulare Formation based upon size. The plesipine nature of other horse teeth from this same horizon is therefore irrelevant to re-naming the nomen as a valid species. E. occidentalis is still best considered a nomen dubium, and should not be employed in Paleocene studies for either Blancan or Rancholabrean equids.
natural organism, and b) to remain static through their life in the collections. However, error is certainly a focus of preparation, but in practice, decision-making is based on the judgment of a worker in the laboratory. For example, identification of a “natural” margin of cancellous tissue and matrix near the epiphysis of a limb bone is often impossible because this boundary results from an interface between multiple types of materials. Therefore, an artificial determination of “bone surface” is produced through interpretation of physical evidence. The end result of the process is a physical representation of a theoretical model created by an individual combing knowledge of anatomy, geology, and chemistry with skilled manipulation of materials. Furthermore, alteration of specimens continues throughout their museum lifetime. Agents of deterioration are constantly acting upon specimens, and specimens are periodically compared or reexamined. Moreover, continuous changes in their context or presentation in their physical properties can vary through time. Thus, observations that inform scientific theories may not be reproducible at any given point on the continuum. Consideration of specimens as ever-shifting theoretical models allows a unique opportunity for study of philosophical concepts regarding scientific practice.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

SPECIES RELATIONSHIPS OF COPEMYS (RODENTIA, CRICETIDAE) SPECIMENS RECOVERED FROM THE MIDDLE MIocene BARSTow FORMATION

BROWNE, Ian, Oklahoma State University Center for Health Sciences, Tulsa, OK, United States, 74107; SMITH, Kent, Oklahoma State Univ Center for Health Sciences, Tulsa, OK, United States

Six species of the cricetid genus Copemys have been reported from the middle Miocene Barstow Formation: the small-sized C. paeji, the medium-sized C. russelli, and C. tenax; and the large-sized C. longidens, C. barstowiensis, and C. esmeraldaensis. Our analysis of specimens housed at the University of California Museum of Palaeontology, the San Bernardino County Museum, and within new collections made by the Sam Noble Oklahoma Museum of Natural History suggest the genus is over-split in the Barstow Formation and that no more than three species of Copemys are represented. Specimens recovered from the late Hemingfordian (He2) and early Barstovian (Ba1) localities are normally distributed with respect to size. Morphological characters historically used at Barstow to differentiate Copemys species (e.g. anterocone/-id symmetry, mesoloph/-id length, and presence/absence of protolophule 1) are equally represented throughout this normal distribution, suggesting these specimens represent a single relatively small species. In the past, all Copemys fossils recovered from the He2- and Ba1-age strata of the Barstow Formation have been identified as C. paeji. Our analysis suggests that these specimens are larger than C. paeji, and in terms of size, are more consistent with identification as either C. tenax or C. russelli. High in the stratigraphic sequence, at the late Barstovian (Ba 2) “Rodent Hill” locality and above, Copemys specimens are bimodally distributed with respect to size and statistically significant correlations occur between size classes and morphological character states suggesting the presence of two taxa. The smaller taxa is characterized by its size, the possession of long mesoloph-/ids, and strong development of protolophule 1 on the upper first and second molars. The larger taxa is characterized by its size, short mesoloph-/ids, and the absence of protolophule 1 on the upper first and second molars. These morphological characters are consistent with identification of the smaller taxa as C. tenax and the larger taxa as C. longidens. Below the level of “Rodent Hill,” in older Ba2-age strata, the Copemys sample size is relatively small. These older Ba2 specimens exhibit a normally-distributed wide range in size, and do not display statistically significant correlations between morphological character states and size. Our analysis suggests that the species relationships between these early Ba2 specimens and the older He2-Ba1 and younger late Ba2 specimens remain unclear.

Romer Prize Session (Thursday, October 31, 2013, 8:30 AM)

THE PHYLOGENY OF COELOUROSAURIAN THERIAPODS (ARCHOSAURIA: DINOSAURIA) AND PATTERNS OF MORPHOLOGICAL EVOLUTION DURING THE DINOSAUR-BIRD TRANSITION

BRUSATTE, Stephen, University of Edinburgh, Edinburgh, United Kingdom

In one of the great evolutionary transitions in the history of life, birds evolved from theropod dinosaurs. This transition has emerged as a case study for understanding the origins of major clades, body plans, and ecological behaviors, thanks to a rapidly expanding fossil record of early birds and their closest dinosauromorph relatives. Despite a flurry of recent work on avian origins, however, there remains little consensus on the phylogenetic relationships of the coelurosaur theropods (birds and their closest relatives) and there has been little work on large-scale macroevolutionary patterns during the theropod-bird transition. I conducted a comprehensive species-level phylogenetic analysis of Mesozoic coelurosaur, building upon the longstanding Theropod Working Group (TWIG) project by adding new data focused primarily on basal (non maniraptoran) coelurosaur. Parsimony analysis of the dataset, which is approximately twice the size of previous TWIG analyses (150 taxa, 833 characters), produces a well resolved phylogeny. Salient results include the placement of Tyrannosauroidea (including Dilong and Guanlong) as the most basal major coelurosaurian subclade; the position of Biceratopelta, Zuolong, and Taguliasaurus near the base of Coelurosauria; and the recovery of a derived maniraptoran clade that includes alvarezsaurids, therizinosauroids, oviraptorosaurs, and paravians to the exclusion of ornithomimosaurs and tyrananosauroids. The phylogeny was used as a framework to study trends in morphological disparity (anatomical variability) and rates of character change across the theropod-bird transition. Basal avialans overlap in morphospace with their closest non-avian kin and there is no significant statistical separation between them, demonstrating that, in general anatomical terms, birds were merely part of a continuum of coelurosaurian morphological evolution. However, the origin of modern birds, marked by the tree of avian morphospace with significantly elevated rates of discrete character change. This suggests that the origin of major clades on the tree of life may involve an upick in the pace of morphological change.

Preparators’ Session (Thursday, October 31, 2013, 9:15 AM)

DAMAGE CONTROL, SAFETY, AND PREPARATION ON A VOLUNTEER-BASED EXCAVATION OF AN IN SITU BONED AT THE MAMMOTH SITE OF HOT SPRINGS, SD, INC.

BUGBEE, Monica M., Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, United States, 57747; WILKINS, William J., Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, United States

The Mammoth Site of Hot Springs, SD, Inc., a 501 (C) 3 non-profit organization located in the Black Hills of South Dakota, houses a 26,000 year old in situ bonebed containing non-permineralized fossils of over 60 mammoths. The bonebed was deposited inside a sinkhole fed by a hot spring, which acted as a natural trap for mammoths and other Pleistocene fauna. For six weeks each year, volunteer dig crews organized through two outside non-profit organizations come to the Mammoth Site to excavate. The typical volunteer is usually a college student, although the mix of volunteers varies from year to year. This year, the volunteer excavation crew was comprised of college students, archaeologists, and those with non-relevant experience. Despite the mixed talents of the crew, the unique environment of the bonebed creates serious challenges for excavation safety, specimen safety and enforcing proper excavation methods. At the close of the 2012 dig season, an excavation-related damage and preparation report was compiled recording causes of damage to in situ specimens. Of the 67 specimens requiring treatment, 65% sustained preventable damage, caused primarily by foot traffic, bumping and poor digging habits. Results of the report prompted a reevaluation of excavation and safety training for volunteers. Instructional methods were reformed with heavy emphasis on preventative safety and proper excavation. The new training program is designed to mitigate difficulties caused by limited mobility, as well as awareness of the need for excavation records. Although the challenges of the bonebed are unprecedented, the Mammoth Site seeks to accommodate all volunteers with realistic expectations, but end up as donors or off-season volunteers. The approach will first be implemented during the July 2013 excavation, with new measures including an expanded introductory lecture covering safety and the goals of in situ preservation, as well as the instructional restrictions on unnecessary movement of volunteers throughout the bonebed. Additionally, each excavator will be required to devote a set amount of time to pathway maintenance and overburden removal in order to improve safety and create more excavation space, respectively. Excavation and damage reports from the 2012 and 2013 field seasons are presented and contrasted.
**POSTER SESSION IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

**USE OF A NETWORK ALGORITHM TO RAPIDLY GENERATE ONTOGENETIC SEQUENCES**

BURROUGHS, Robert, The University of Texas at Austin, Austin, TX, United States; COLBERT, Matthew, The University of Texas at Austin, Austin, TX, United States

Ontogenetic sequence analysis (OSA) is a method for establishing sequences of ontogenetic events based on parsimony analysis of a matrix of ontogenetic events and individual organisms. Unfortunately, the use of the method is complicated because it is not automated, requiring an enormous time investment to generate the sequence diagrams (OSA maps) by hand using MacClade and Adobe Illustrator. Accordingly OSA has only been used in a limited number of studies, despite its applicability to both paleontological and neontological research. In an attempt to facilitate construction of OSA maps, we generated a developmental network in the program SplitsTree. We used a weighted-parsimony split algorithm originally designed for generating phylogenetic networks. We analyzed a dataset comprising of 92 skull and limb characters for 13 neontes of Monodelphis domestica spanning birth (day 0) to 20 days in age. We constructed traditional OSA maps from trees generated using a non-reversible parsimony algorithm and then compared those maps with those generated using the developmental network in SplitsTree. The OSA maps are similar with the SplitsTree network, with many identical sequence elements in both analyses. The network approach yielded slightly more resolution than established OSA methodology, when mapping potential developmental sequences. However, the degree to which this increased resolution better reflects the realized developmental sequences in M. domestica is unclear. Event placements between the OSA maps and SplitsTree developmental networks are not congruent which reflects differences in the optimality criteria used in the two methods. The SplitsTree developmental networks can be generated essentially instantaneously, which dramatically increases the ease of assessing both the order of appearance of developmental events and the range of developmental variation. The optimality criterion used in SplitsTree offers a new perspective on developmental sequences complementary to the established OSA method and when used together can facilitate a broader understanding of the potential dynamics of the developmental system.

**POSTER SESSION III (Friday, November 1, 2013, 4:15 - 6:15 PM)

**THE VERTEBRATES OF LAS HOYAS: A PRELIMINARY ASSESSMENT OF THE ROLE OF PAST AND PRESENT ECUMENOTYPES**

BUSCALIONI, Angela D, Universidad Autonoma de Madrid, Madrid, Spain; POYATO-ARIZA, Miguel, Universidad Autonoma de Madrid, Madrid, Spain; MARICHAL, José, UniversidadAutonoma de Madrid, Madrid, Spain; HANCOX, John, University of the Witwatersrand, Johannesburg, South Africa; BUTLER, Richard, University of Birmingham, Birmingham, United Kingdom; BOTHA-BRINK, Jennifer, National Museum, Bloemfontein, South Africa; SENNIKOV, Andrey, Borisiakk Paleontological Institute RAS, Moscow, Russia; GOWER, David, The Natural History Museum, London, United Kingdom

The fossil Konservat-Lagerstätte of Las Hoyas (Upper Barremian, Cuenca, Spain) is unique in the quality of its fossils, its diversity and in the way in which the information has been recovered and recorded (www.yacimientoelashoyas.es). Namely, after 25 years of systematic excavations this site has yielded more than 17 000 fossils corresponding to more than 290 species of plants and animals, reflecting the nearly complete floral and faunal mosaic of a Cretaceous wetland ecosystem. Out of this diversity of plants and animals, the vertebrate assemblage comprises an astonishing variety of fishes (14%), amphibians (5%), lizards (ca. 3%) and archosaurs (ca. 9%), including crocodiles, pterosaurs and non-avian dinosaur. The research agenda at Las Hoyas has come into a new and integrative focus, involving the first exploration of the trophic structure of this ancient ecosystem, addressing the roles of its constitutive taxa into a trophic web. In recent wetlands, fishes, crocodiles and birds are focal animals. Accordingly, in a critical climatic period preliminary studies of the foodweb structure shows that the main linkage between aquatic and terrestrials levels is bridged by the arthropods. Furthermore, although the structure of past and present trophic webs in subtropical and seasonal wetlands appears comparable, there is no clear-cut analysis between vertebrate ecumens. We discuss how modern species may be surrogates for the ecumens of ancient vertebrates and their role in their corresponding niches.
approximately 5 nm of Au-Pd and then imaged using a Jeol JSM-6010LA scanning electron microscope.

Falcarius maxillary tooth enamel is thickest at the apex and gradually thins towards the base of the crown, it is 80–90 μm thick in the most proximal parallel lamellae. Parallel enamel is commonly seen in Coelurosauria, including carnivorous dromaeosaurids. Our results support previous proposals that enamel type in theropod dinosaurs reflects a predominant phylogenetic signal and appears to have an early ontogenetic window and ecological and dietary dictatorship. Finally, the characterization of Falcarius enamel type offers a benchmark for testing whether enamel microstructure underwent later specializations during the evolution of Therizinosauria.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

GEOPHYSICAL IMAGING OF SNAKE BURROWS IN AEOLIAN SANDS: IMPLICATIONS FOR THE FOSSIL RECORD OF SQUAMATES

BUYNEVICH, I.V., Temple University, Philadelphia, PA, United States, 19122; WIEST, L.A., Temple University, Philadelphia, PA, United States; BIEN, D. WARD W., Drexel University, Philadelphia, PA, United States; SMITH, K.P.W., Drexel University, Philadelphia, PA, United States; NYQUIST, J.E., Temple University, Philadelphia, PA, United States

*Terrestrial versus marine origin of snakes during the Cretaceous relies heavily on the burrowing ability of their ancestors. Therefore, understanding the paleoecological aspects of biogenic structures associated with ophiuroids is key to recognizing analogous features in the fossil record. Due to challenges in studying complex excavations in loose sediment (open and backfilled entrance tunnels, external mounds, brooding chambers, hibernal, and hollow neonate escape structures), neochronological studies of fossorial squamates are aided by novel applications of subsurface imaging technologies, such as ground penetrating radar (GPR). In this study, GPR data were employed to characterize excavations of a prolific burrower, the Northern Pine Snake (Pituophis melanoleucus) in aeolian deposits of New Jersey. Inclined shafts and tunnels of juvenile and adult snakes extended downward from 0.3 to >1.0 m from the burrow entrance, with diameters of 3–8 cm. The electromagnetic (EM) wave velocity of 14 cm/s allows 4.5-6.0 cm vertical resolution, with profile spacing of 0.3 m sufficient for constructing pseudo-3D images and depth slices spanning the burrow penetration range. Survey grids with 5 cm spacing further reduce the need for spatial interpolation in 3D space. High-amplitude anomalies (hyperbolic diffractions) result from dielectric contrast between air-filled burrows and sediment, with localized signal attenuation and basal "pull up" dependent on air cavity volume. In 2D sections, alteration of primary bedding subjacent to point-source return helps differentiate infilled burrows from high-density targets (e.g., roots). Presence of five snakes provides localized downspacing of GPR reflections due to ten-fold reduction in EM signal velocity through a fluid-filled body. Where rising water table precludes subsurface investigation by traditional methods, the applicability of georadar imaging will be enhanced due to increased resolution (2.0-2.5x) in saturated media. Penecontemporaneous pedogenesis and rapid burial may enhance burrow preservation, making GPR a valuable tool for recognizing and interpreting similar biogenic structures in the fossil record.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

BIOMECHANICAL EVIDENCE FOR NICHE PARTITIONING BETWEEN SYMMATRIC SAUROPOD DINOSAURS

BUTTON, David, University of Bristol, Bristol, United Kingdom

The sauropod dinosaurs were the largest terrestrial vertebrates. Given the extreme nature of their biology, sauropods present many problems— not least how they secured sufficient food intake to fuel their massive bodies. Furthermore, many sauropod faunas are highly diverse and imply ecologically specialized terrestrial ecosystems. The high craniodental diversity differentiating sympatric sauropod taxa has often been cited in support of niche partitioning. This is particularly so for the well-known Early Cretaceous, within five million years of the PT mass extinction. It provides new insights into the diversity of the Subzone A vertebrate assemblage and biostratigraphic correlations to Russian vertebrate assemblages, shedding new light on the early archosauriform radiation and the recovery of terrestrial ecosystems from the PT extinction.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

TOOTH ENAMEL MICROSTRUCTURE OF THE EARLY CRETACEOUS THERIZINOSAURIAN FALCARIUS UTAHENSI (THEROPODA, MANIRAPTORA)

BUTTON, Khai, North Carolina State University, Raleigh, NC, United States, 27612; ZANNO, Lindsay, North Carolina Museum of Natural Sciences, Raleigh, NC, United States

Enamel is the hardest and most bio/mineralized vertebrate tissue. The durability of this tissue allows for exceptional preservation of microstructure in tooth fossils. Enamel microstructure has been extensively studied in mammals and non-mammalian amniotes but has been examined only to a much smaller degree in Dinosauria. Recent analyses have greatly increased our understanding of the genetic and functional patterns of enamel present in dinosaur tooth enamel, particularly among theropods; however, several notable clades have not yet been sampled. Here we characterize the enamel microstructure of Falcarius utahensis, the most primitive taxon of the Therizinosauria described to date. The diet of therizinosaurians is widely regarded to be within the omnivory/herbivory spectrum of sauropod cranial morphology and have been hypothesized as being adapted towards specialized branch-stripping and the production of higher bite forces. Comparisons of juvenile and adult tooth morphology and application of finite element analysis (FEA) to a skull of Falcarius reveals thick compact cortices subjacent to point-source return helps differentiate infilled burrows from high-density targets (e.g., roots). Presence of five snakes provides localized downspacing of GPR reflections due to ten-fold reduction in EM signal velocity through a fluid-filled body. Where rising water table precludes subsurface investigation by traditional methods, the applicability of georadar imaging will be enhanced due to increased resolution (2.0-2.5x) in saturated media. Penecontemporaneous pedogenesis and rapid burial may enhance burrow preservation, making GPR a valuable tool for recognizing and interpreting similar biogenic structures in the fossil record.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

ASSESSING THE POTENTIAL FOR ONTOGENETIC ECOMORPHOLOGY IN THEROPODS: A CASE STUDY USING ALLOSAURUS FRAGILIS FROM THE CLEVELAND-LLOYD Quarry

BYKOWSKI, Richard, Indiana University, Bloomington, IN, United States, 47405-1405

Recent work on dinosaur ontogeny has discovered potential patterns of changing morphology through growth in ceratopsians, pachycephalosaurs and theropods. However, much of this work has centered on answering questions related to alpha diversity and ontogeny. Our results indicate that while the previously demonstrated patterns of decreasing cursoriality with increasing body size are valid for both allosaurids and ceratopsians, they have yet to be demonstrated in theropods. A geometric morphometric analysis was performed to quantify shape variation in the maxilla and was compared to other measurements for the hind limb. Preliminary results indicate that while the previously demonstrated patterns of decreasing cursoriality through ontogeny are observed, skull and dental morphology is conserved relative to other large-bodied theropods. These results suggest factors governing the functional evolution of theropod skull shape, the ontogenetic patterns of sauropod communities, and niche partitioning based on growth and age, are different from those governing communities of vertebrates with determinate growth.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

ONTOGENETIC VARIATION AMONG POLYCYTOLID PLESIOSAURS (SAUROPTERYGIA: PLESIOSAURIA) AND ITS IMPLICATIONS FOR PLESIOSAUR GROWTH

BYRD, Christina, Marshall Univ, Huntington, WV, United States, 25703

Understanding ontogenetic variation within plesiosaurs of the family Polycotylidae, short-necked marine reptiles from the Cretaceous Period, can shed light on their evolutionary history. In this study, I analyzed a specimen from the University of Nebraska State Museum (UNSM 55910), a juvenile polycotylid plesiosaur from the
Pierre Shale (99-65 Ma) of Nebraska. It is a partial skeleton possessing a fragmented skull, nearly complete pectoral and pelvic girdles, left humerus, both femora, and an assortment of upper limb bones and phalanges. Previous qualitative research using USNM 55581 was conducted, but no formal description has been produced. USNM 555810 is probably referable to the genus Dolichorhynchops based on several cranial characteristics. In order to understand the ontogenetic changes of polyctylyid, I collected metric data from USNM 555810 and compared it among related plesiosaurs. The scapulae of the pectoral girdle and the ischia of the pelvic girdle exhibit a significant amount of allometric growth along the anterior and posterior margins. However, the clavicles, coracoids, and pubes appear to grow isometrically during ontogeny. In the clavicles, the relative morphological conservatism may be attributed to their dermal origin as opposed to the endochondral ossification of the other girdle elements. For the coracoids and pubes, the isometric growth may be attributed to the specialized role of the clavicles in the locomotion of sauropods, thereby recapitulating the sauropodian phylogeny. Understanding morphological variation during polyctylyid ontogeny will provide information for better identification of subadult specimens, as well as provide insight to the evolutionary and developmental changes that occurred during pleiosaur evolution and ontogeny.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)
INTRATOOTH HETEROGENEITY IN THE DENTAL MICROWEAR OF ARTIODACTYLS AND PERISSODACTYLS: IMPLICATIONS FOR INTERPRETING PALEODIET IN EXTINCT UNGULATES

CAMPBELL, Daniel, New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY, United States; MIHLBACHER, Matthew, New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY, United States

Most dental microwear (DM) studies are focused on a single cusp or crest that is homologous across species. Little work has been done to understand (1) how DM varies within teeth, (2) if specific parts of teeth provide higher paleodietary resolution than others (3) and if phylogeny biases DM. Intratooth DM heterogeneity was quantified in 23 DM studies from 18 extant species (6 equid, 4 tapi, 1 tapir) and 4 extant ruminants (bison, wildebeest, giraffe, moose). DM was sampled from the labial edge, the lingual edge, and, when possible, near the labio-lingual midpoint of the occlusal surface. We used paired t-tests to compare frequencies of pits and scratches in different parts of the crown. All DM studies showed significant intratooth heterogeneity, with the highest densities of pits always on the labial edges of molars. Scratches were homogenously distributed in equids but are often most numerous on the lingual edge in rhinos and tapi. Browsing extant perissodactyls generally exhibit stronger labio-lingual trends than grazers. The distribution of DM on ruminant molars is considerably different from perissodactyls. DM is homogeneously distributed on browsing ruminant molars but grazing ruminant molars are characterized by significant intratooth heterogeneity in scratch and, in some cases, pit distribution but without consistent labio-lingual trend. Discriminant function analyses (DFA) of DM data from the labial edge correctly classifies extant perissodactyls according to diet more frequently than DM data from other parts of the molars. However, ruminant molars are most often correctly classified according to diet with DM data from the opposite (lingual) edge. Combining DM data from multiple areas always produced more correct post hoc dietary classifications of extant species than when any single area was examined alone.

To summarize: (1) patterns of intratooth DM heterogeneity are influenced by both diet and phylogeny, (2) DM from homologous parts of perissodactyl and ruminant molars reflect diet differently, and (3) inclusion of DM data from multiple areas throughout the tooth, rather than a single cusp or enamel crest, will improve the accuracy of paleodietary inferences.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)
A SPECIES-BASED PHYLOGENETIC ANALYSIS OF THE CHASMOSAURINE CERATOPSIS CHASMOSAURUS (ORNITHISCHIA) FROM THE UPPER CRETACEOUS (CAMPAIGNAN) DINOSAUR PARK FORMATION OF WESTERN CANADA SUGGESTS THE VALIDITY OF ONLY ONE SPECIES

CAMPBELL, James, Carleton University, Ottawa, ON, Canada, K1S 5B6; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, United States; SCHRODER-ADAMS, Claudia, Carleton University, Ottawa, ON, Canada; HOLMES, Robert, University of Alberta, Edmonton, AB, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada

Two recognized species of the chasmosaurine ceratopsid Chasmosaurus, C. russelli and C. difformis, are known from the Dinosaur Park Formation (DPF) of Alberta and Saskatchewan. They are diagnosed by the shape of the posterior parietal margin and the position and shape of the epiparietals (Eps), and have been reported as being stratigraphically separated in the lower (C. russelli) and upper (C. difformis) DPF, respectively.

A species-phenotypic analysis of Chasmosaurus was performed to determine the relationships of skulls assigned to the genus. Characters determined to be ontogenetically variable were then mapped onto the consensus tree, along with skull size. It is determined that, as skull size increases, the nasal and orbital horns are resorbed, epiossifications undergo fusion and modification, and the posterior margin of the parietal supporting the medial epiparietal recesses. The latter characters result in the development of a dorsally-receding ‘ridge’ on the posterior parietal margin in mature specimens. A presence of epiparietal ridge was shared by C. difformis (CMN 2280) that is consistent with the same structure seen on the C. belli holotype (CMN 491). The shape of the posterior parietal (embayed vs. straight) is found to vary randomly across all ontogenetic stages indicating that it is not a valid diagnostic character for either species and may be, slightly, dimorphic. Based on the recovered, phenotypic trajectory, the problematic taxa ‘Eoceratops canadensis’, ‘Chasmosaurus kaiseni’ and ‘Morosceratops perfinia’ are recovered as subadults, supporting their previous synonymization with Chasmosaurus.
All but two examined Chasmosaurus specimens appear to represent ontogenetic variations of a single taxon characterized by a posterior parietal margin that varies from 100 to 10 EPs on their straight posterior frill margins. This epiparietal count is previously unreported for Chasmosaurus and may represent an autapomorphy of a new taxon.

Symposium 2 (Thursday, October 31, 2013, 3:00 PM)
THE OVLS OF RANCHO LA BREA: PREDATORS, NOT SCAVENGERS, RULE
CAMPBELL, Kenneth, Natural History Museum of LA County, Los Angeles, CA, United States, 90007

The Late Pleistocene strigiform, or owl, paleoaiuava of the Rancho La Brea asphalt deposits comprises nine species represented by a total of more than 8000 specimens from a minimum of 1103 individuals. Two of the eight represented genera are extinct, as are three of the represented species. The most common species present is the medium-sized Burrowing Owl (2775 specimens from at least 378 individuals), whereas the smallest two species are represented by only a few specimens. Analysis of the distribution of the species by pit, or excavation site, reveals that a total of 31 pits produced owl specimens, although 19 of these contained less than a dozen specimens each. The top five pits produced approximately 73% of the total owl specimens, whereas the top ten pits produced 93% of the total owl specimens. Analysis of the limb elements showed that, as expected, the tarsometatarsus was the most commonly preserved bone, with 1662 specimens, followed by the tibiotarsus (1526) and humerus (1110). Owls are true predators, thus it can only be assumed that they were entrapped in the asphalt seeps because they were preying on entrapped animals that were still alive. It is perhaps surprising then that the number of owl specimens in the Rancho La Brea collections is larger than the number of true scavengers, such as the four species of New World vultures (~500 individuals), or less than half the number of owl individuals, perhaps indicating that animals trapped, but still living, were more of an attraction to predators than dead animals to scavengers. Animals trapped in the asphalt seeps do not die immediately, or sink out of sight in pools of liquid asphalt. Rather, they are prone to struggle on the surface of a seep until dying of thirst or starvation. Although other bird species, such as the Golden Eagle and Caracara, are both scavengers and predators, and common in the Rancho La Brea collections, it is not unreasonable to conclude that they, too, were, more often than not, going after prey that was entrapped but still alive. Avian predators customarily move in at high speed for prey, pierced by sharp talons, could not be pulled free from the asphalt. Scavengers, on the other hand, would more often have landed near carcasses and become entrapped while walking or hopping around them during feeding.

POSTER SESSION I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)
A NEW OPHIDIOMORPH TAXON FROM THE TURONIAN OF CROATIA
CAMPBELL, Michelle, University of Alberta, Edmonton, AB, Canada, T6G2E9; KRIZMANIC, Katerina, Croatian Natural History Museum, Zagreb, Croatia; JAPUNDZIC, Drazen, Croatian Natural History Museum, Zagreb, Croatia; CALDWELL, Michael, University of Alberta, Edmonton, AB, Canada

In the summer of 2008, a new marine squamate, identified here as a probable “pontosaurus” was discovered on the island of Dugi Otok, Croatia (Turonian; Upper Cretaceous). Though heavily weathered at the time of its discovery, the specimen is a well-articulated representative of a group of marine lizards previously thought to have gone extinct in the upper Cenomanian. Unfortunately, after two years of further weathering on the sea cliffs, it now consists of a worn impression and a few remaining bones. The remaining elements include the majority of the cervical and dorsal vertebrae, fragments of the dorsal ribs, and an exquisitely preserved left forelimb. Impressions from the cervical and most of the dorsal ribs are present, as is the impression of the pectoral girdle. The cranial, the tail, and the hind limbs have been lost. Based on the length of the torso, the individual appears to have been roughly a meter in length. Its distinctively long, cylindrical body included between 8-10 cervical vertebrae, approximately 23 preserved dorsal vertebrae with posteriorly curving ribs; these numbers are consistent with other described, long-bodied pythomorphs/ophidiodromorphs. Unfortunately, due to the missing pelves, the exact dorsal count cannot be absolutely established, though it would be greater than 23. Assessment of the left forelimb suggests that a new taxon is represented, including unusual features of the manus, such as the presence of a manus articulates hand shows a broad, flattened first metacarpal similar to that found in the mosasaurid clade Mosasaurinae. However, the long neck (~7 cervical vertebrae) implies the consideration of this animal as a pontosaurus, within the family Dolichosauidea.

Technical Session VII (Thursday, October 31, 2013, 2:45 PM)
A NEW MATHEMATICALLY DERIVED SCALING EQUATION FOR ESTIMATING BODY MASS IN EXTINCT BIPEDS
CAMPIONE, Nicolaus, University of Toronto, Toronto, ON, Canada, M5S2C6; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada; BROWN, Caleb, University of Toronto, Toronto, ON, Canada; CARRANO, Matthew, Smithsonian Institution National Museum of Natural History, Washington, DC, United States

Strong correlations exist between body mass and numerous physiological and ecological attributes in extant organisms. Accurate estimates of body mass are therefore critical to understanding the paleobiology of extinct taxa through the history of life, but reliable, rigorous methods for achieving them have been elusive until recently. Stylophoral (humeral and femoral) circumstances scale conservatively with body mass in extant terrestrial quadrupeds, and figure into a robust method for estimating body mass in extinct quadrupeds. Unfortunately, this model cannot be applied directly to estimate body masses in bipeds. In addition, other mass estimation scaling models based on extant bipeds (i.e., birds) are limited because they incur substantial extrapolation—ca. 60% of non-avian bipedal dinosaurs occur above the body size range of living birds.

Here we present a new scaling equation for estimating body mass in extinct bipeds that mathematically corrects the recently derived quadraped-based model. Importantly, it assumes that the femoral cross-sectional area in a biped is equivalent to the combined stylophoral cross-sectional areas in a quadruped of equal body mass. Its derivation is thus calculated as the systematic difference between the circumference-to-area scaling relationship of two circles (representing a hypothetical quadruped) and one circle (a hypothetical biped). When applied to a sample of extant bird skeletons with associated masses, the correction factor reveals a mean percent prediction error (45.9%) that is statistically indistinguishable from that already inherent to the empirical dataset (36.7%), and is significantly better than the Anderson bipedal equation (80.1%).

Dinosaur masses obtained using the new model are generally higher than those based on previous circumference-to-area scaling models (e.g., Anderson's bipedal model) and are more consistent with estimates based on volumetric reconstructions. This new model estimates the largest Tyrannosaurus rex specimen (Field Museum of Natural History specimen FMNH PR 2081) at 8.42±2.10 tonnes. Unlike volumetric reconstructions that are time consuming, subjective, and require well-preserved specimens, this equation requires only the femur and thereby offers a simple, consistent method with which to estimate body masses in extinct bipeds. Thus it affords much broader opportunities for investigating large-scale evolutionary patterns of body size in terrestrial vertebrates, including hypotheses of miniaturization in the origin of birds and gigantism in theropod dinosaurs.

POSTER SESSION I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)
GEORCHEONOMICAL AND TAXONOMICAL REVISION OF THE MIDDLE EOCENE WHISTLER STATION (BRIEGEL'S GRAVEYARD FORMATION, TEXAS) AND IMPLICATIONS FOR THE EARLY Uinta IN WEST TEXAS
CAMPISANO, Christopher, Arizona State University, Tempe, AZ, United States, 85287; KIRK, E. Christopher, University of Texas, Austin, TX, United States; TOWNSEND, K.E. Beth, Midwestern University, Glendale, AZ, United States; DEINO, Alan, Berkeley Geochronology Center, Berkeley, CA, United States; MCDOWELL, Fred, University of Texas, Austin, TX, United States

The Whistler Squat Quarry (TMM 43172) of the lower Devil's Graveyard Formation (DFG) in Trans-Pecos Texas is a middle Eocene locality recently attributed to the U1b biochron. Specimens from the Whistler Squat Quarry (WSQ) were collected principally by J.A. Wilson in 1970-74 immediately above a volcanic tuff with K/Ar ages of ~47-50 Ma (feldspar separate) and ~5 meters below an additional tuff dated to ~44 Ma (biotite separate). New 40Ar/39Ar analyses of both of the originally collected samples provide ages that are indistinguishable from each other at ~45 Ma, with the underlying tuff dated to 44.88 ± 0.03 Ma. These dates are compatible with magnetically reversed sediments at the site attributable to C20r and recent dating of a stratigraphically lower basalt to 46.8 ± 0.2 Ma. These dates are compatible with the placement of previously dated marker beds in relation to their middle Eocene deposition. For example, the WSQ includes the rodent fauna of the Bridger and Uinta Formations. These dates are compatible with the placement of previously dated marker beds in relation to their middle Eocene deposition. For example, the WSQ includes the rodent fauna of the Bridger and Uinta Formations. These dates are compatible with the placement of previously dated marker beds in relation to their middle Eocene deposition. For example, the WSQ includes the rodent fauna of the Bridger and Uinta Formations.

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Karoo Basin of South Africa, few studies have been conducted on amphibians, which histology has been extensively applied to the diverse non-mammalian therapsids from the generally considered as aquatic or semi-aquatic animals. The microanatomy of the long bones, with their thick bone walls and distinctive ontogenetic stages, i.e., from juvenile to mature individuals. Our results confirm that to be more terrestrial. The phylogenetic and biogeographic history of derived tyrannosauromorphs is complex, where (1) several Asian taxa separate T. rex phylogenetically from the earlier Laramidian species, and (2) multiple dispersal events occurred between Laramidia and Asia. These factors complicate a straightforward account of anagenesis in Laramidian tyrannosauromorphs during the Cretaceous.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

NEW LIGHT ON THE EVOLUTIONARY RELATIONSHIPS BETWEEN "THORACOSAURUS" AND MODERN GHARIALS: EVIDENCE FROM A NEW GAVIALOID FROM THE LATE CRETACEOUS OF CHIAPAS, MÉXICO

CARBOT-CHANONOA, Gerardo, Secretaria de Medio Ambiente e Historia Natural, Tuxtla Gutiérrez, Mexico; BROCHU, Christopher, Univ of Iowa, Iowa City, IA, United States; BUSCALIONI, Angela, Universidad Autónoma de Madrid, Madrid, Spain; REYNOSO ROSALES, Victor Hugo, Universidad Nacional Autónoma de México, Ciudad Universitaria, Mexico

The slender-snouted Campanian through Ypresian “thoracosaurids” are currently viewed as early relatives of the living Indian gharial (Gavialis gangeticus), which is the focus of an unresolved phylogenetic conflict between morphological and molecular data sets. However, a substantial number of meso- and microhennodonty exist within thoracosaurids and between them and more younger, derived gavials. A new crocodylian from the Ojocondoautla Formation (Maastrichtian, Late Cretaceous) of Chiapas, México, fills a morphological gap in the thoracosaur record. The new specimen consists of a partial skull and lower jaw, appendicular elements, vertebrae, and osteoderms preserving a unique combination of character states. Differences from the Cretaceous-early Paleogene thoracosaurids Eothoracosaurus and Thoracosaurus include large, nearly circular supratemporal fenestrae with a linear medial margin separated by a very narrow interfenestral bar and a palatal premaxillary-maxillary contact extending to the second maxillary alveolus. The morphology of the skull table resembles that of Paleocene Eosuchus, and Eosuchus and the Chiapas form share a large external mandibular fenestra not found in other thoracosaurids. However, the Chiapas form lacks the alveolar couplets of the dentary, both rows of teeth of Eosuchus. It lacks derived states linking Eosuchus with later gavials. A phylogenetic analysis places the Chiapas form as the sister lineage to a clade including Eosuchus and the more derived gavials that first appear in the latest Eocene. Our analysis continues to support a close relationship between thoracosaurids and gavials, and it remains possible that the Chiapas thoracosaur lineage currently restricted to fresh water, but the maxillary tooth counts of the Chiapas form and Eosuchus (21) are smaller than those of Eothoracosaurus (26) and Thoracosaurus (23), suggesting phyletic shortening of the snout that was reversed in later gavials.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

CONFIRMATION OF LIFESTYLES OF EXTINCT FELIDS BASED ON COMPARISON OF HOMOLOGOUS CHARACTERS OF LIVING CATS

CARLON, Burcu, Northern Illinois University, DeKalb, IL, United States, 60115; NAPLES, Virginia, Northern Illinois Univ, DeKalb, IL, United States

Living and extinct feline morphology ranges from robust ambush predator to gracile-limbed cursorial. Identification of similar morphological characters that correlate with locomotor habits in living forms allows estimation of lifestyle in extinct species of comparable morphology. Here, we examine forelimb characters of the living taxa A. jubatus and P. leo with homologous features in the extinct genera S. fatalis and P. atrox as a means of identifying factors that help predict habits. We performed a geometric morphometric analysis (Generalized Procrustes Superimposition and Principal Components) of homologous features of the scapula, humerus, and ulna to allow identification of skeletal features that correlate with different lifestyles in extant taxa. PC1 accounted for 40.8% for the scapula, 43.6% for the humerus, and 76.6% for the ulna. S. fatalis had positive PC1 scores, and A. jubatus had negative PC1 scores. P. atrox and P. leo grouped together and were positioned in between the A. jubatus and S. fatalis. The Panthera group differs significantly from S. fatalis. Differences among extant felids in body size are determined, with the exception of the elasmosaurids, by a combination of cranial and appendicular osteoderms and the ability to flex it in the anteroposterior axis. Osteoderms of the lateral middle region retain the hexagonal shape but they are asymmetrical. Within the postiliar region, osteoderms range from asymmetrical hexagons to trapezoidal or rectangular, with the central figure occupying approximately 50% of the surface. Peripheral figures of the osteoderms in this area vary

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

VARIATION OF OSTEODERM ANATOMY IN THE CARAPACE OF THE NORTH AMERICAN GLYPHTODON, GLYPHTOTHERIUM (XENARTHRA, CINGULATA)

CARRANZA-CASTAÑEDA, Oscar, Centro de Geociencias, Universidad Nacional Autónoma de Mexico, Campus Juriquilla, Queretaro, Mexico; GILLETTE, David, Museum of Northern Arizona, Flagstaff, AZ, United States

Beginning in 1875 with the description of Glyptodon mexicanus Cautaparo and Ramirez (=Gllyptotherium mexicanum) from Pleistocene deposits in the Valley of Mexico, discoveries of glyptodonts have been common in Mexico, the United States and Central America. Glyptotherium includes G. cylindricum and G. mexicanum in Mexico; and G. texanum, G. floridanum and G. arizone in North America. These species have been described mainly on the basis of osteoderm ostology, without reference to position in the carapace. Here, osteoderms of the carapace includes the preiliar area, where the osteoderms are symmetrical hexagons, with the diameter of the central figure approximately 50% of the side-to-side diameter, and with 8-10 peripheral figures of uniform size and shape. Borders of peripheral figures are sometimes shared by adjoining osteoderms. Different shape and size of osteoderms are associated with the osteoderm, including the isolated egg from the Cleveland-Lloyd Quarry. This discovery also calls into question prior assignments of Prismatoolithus eggs to ornithopods, and suggests that more detailed study of such sites is warranted. Prismatoolithus eggs are also associated with the Upper Jurassic theropod Lourinhachus from Portugal, along with larger embryos that exhibit four premaxillary alveoli.

Symposium I (Wednesday, October 30, 2013, 11:15 AM)

FIRST DEFINITIVE ASSOCIATION BETWEEN EMBRYONIC ALLOUSOS BONES AND PRISMATOOLITHUS EGGS IN THE MORRISON FORMATION (UPPER JURASSIC, WYOMING, USA)

CARRANO, Matthew, Smithsonian Institution, Washington, DC, United States, 20013-7012; MATEUS, Octavio, Museu da Lourinhã, Lourinhã, Portugal; MITCHELL, Jonathan, University of Chicago, Chicago, IL, United States

Despite more than a century of collecting, resulting in one of the best-studied vertebrate fossil records anywhere in the world, the Upper Jurassic Morrison Formation has produced surprisingly few examples of dinosaur eggs associated with embryonic remains. More puzzling, it seems to us that none of the thoracosaurid Allosaurus, one of the most common and best-understood dinosaur taxa in the formation. Here we report on a dinosaur nest site that has produced both abundant Prismatoolithus eggshells and embryonic (or perinatal) bones of Allosaurus from Fox Mesa, Wyoming. This species is of the first such discovery for any theropod in the Jurassic of North America. The nest is heavily weathered but contains a few ellipsoidal eggshells that suggest an egg size of about 8 x 6.5 cm. Study of the eggshell morphology and microstructure confirms that a single egg type is present throughout, which is indistinguishable from Prismatoolithus coloradensis. All of the identifiable embryonic materials pertain to theropods, and two premaxilla specimens show the five alveoli diagnostic for Allosaurus among Morrison theropods. This confirms the theropod origin of Prismatoolithus eggs and implicates Allosaurus as the specific Morrison parent taxon. As a result, it is now possible to assign several previous discoveries of dinosaur eggs and potential nests to Allosaurus, including the isolated egg from the Cleveland-Lloyd Quarry. This discovery also calls into question prior assignments of Prismatoolithus eggs to ornithopods, and suggests that more detailed study of such sites is warranted. Prismatoolithus eggs are also associated with the Upper Jurassic theropod Lourinhachus from Portugal, along with larger embryos that exhibit four premaxillary alveoli.
in size and shape. Towards the caudal margin, osteoderms are polyhedral, with the central figure occupying up to 70% of the surface and projecting slightly from the peripheral figures. The central figure occupies up to 70% of the surface and projecting slightly from the peripheral figures. This unique morphology of phalanx III-1 in azhdarchids is likely a synapomorphy for this group. It is proposed that the greatly expanded proximal phalanx III-1 of azhdarchids may have been used to carry heavy loads during quadrupedal walking, and that this phalanx bore the majority of the weight of the animal. In males, osteoderms of the dorsal row are larger and have a prominent conical boss that diminishes gradually toward the posterolateral margin. In females the osteoderms of the caudal row are flat and only slightly convex without a prominent boss.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

FUNCTIONAL MORPHOLOGY OF THE AZHDAHRCHID MANUS

CARROLL, Nathan, Montana State University, Bozeman, MT, United States, 59718

Previous studies of the inferred terrestrial locomotor ability of pterosaurs rely on limb proportions or pedal morphology as the basis for subsequent functional interpretations and often do not consider the morphology of the manual digits. This is especially true for the Azhdarchidae, which are typically represented by fragmentary elements and/or obscured preservation of the manus. Three-dimensional preservation of manual elements in an azhdarchid from the Two Medicine Formation of Montana allows for an evaluation of its functional morphology and a comparison to other Late Cretaceous pterosaurs. Phalanges III-1 differs greatly between taxa and is particularly informative for differentiating pterosaur manual morphologies. A principal component analysis of pterosaur proximal phalanges shows that azhdarchids form a cluster separate from other Cretaceous pterosaurs, similarly in the size of the abductor process and the robustness of the proximal phalanges. This unique morphology of phalanges III-1 in azhdarchids is likely a synapomorphy for this group. It is proposed that the greatly expanded proximal portion of phalanx III-1 in azhdarchids is an adaptation to accommodate higher stress loads during quadrupedal walking, and that this phalanx bore the majority of the weight at the metacarpophalangeal joint. This study provides further evidence that azhdarchids were likely proficient walkers and spent a considerable amount of time on the ground.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

CHANGES IN DIVERSITY AND STRUCTURE OF THE VALLESIAN (LATE MIOCENE) RODENT RECORD FROM THE VALLES-PENEDÈS BASIN (CATALONIA, SPAIN)

CASANOVA-VILAR, Isaac, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallés, Spain; GARCÍA-PAREDES, Israel, Instituto de Geociencias IGEÓ (CSIC/UCM), Madrid, Spain; VAN DAM, Jan, Utrecht University, Utrecht, Netherlands

The Valles-Penedès Basin (Catalonia, Spain) is the type area for the Vallesian stage (early Late Miocene; 11.1-8.7 Ma), which is considered an interval of important changes in the European mammal fauna. Several middle Miocene taxa, associated with forested environments, seem to have appeared in the basin during an event of environmental change that influenced the Vallesian (Turolian) first occur in Western Europe. We analyze the diversity dynamics and changes in the structure of the Vallesian rodent assemblages from this basin and non-avian dinosaurs. Marine reptiles, including plesiosaurs and especially mosasaurs, seem to have disappeared abruptly at 9.6 Ma during an event known as the “Vallesian Crisis”. Simultaneously, many taxa that later will characterize the rest of the record begin to appear. The Vallesian has a very specific habitat that for unknown taphonomic reasons are not recorded during the Vallesian. The Vallesian is characterized by a low diversity and a high endemism of species. The Vallesian排除一些小型的剑龙类。剑龙类的脑部是狭长的，小脑部分很窄，大脑部分很宽。这与其它非哺乳类的爬行类动物相符。在这个阶段，脑部的结构非常独特，由于脑的体积较小，因此没有表现出明显的分化。

Technical Session II (Wednesday, October 30, 2013, 9:15 AM)

MESOWEAR AND HYPSODONTY THROUGH TIME IN HYPERTRAGULIDS (ARTIODACTYLA) FROM THE TURTLE COVE MEMBER OF THE JOHN DAY FORMATION OF OREGON

CAVIN, Jennifer, John Day Fossil Beds, Kimberly, OR, United States, 97848; SAMUELS, Joshua , Kimberly, OR, United States

The Turtle Cove Member of the John Day Formation includes approximately 400 meters of strata that represent around five million years of deposition. These strata are very well dated, as they are interstratified with six mapped and dated volcanic beds, from about 31 to 26 Ma. Overall, the Turtle Cove Member is highly fossiliferous, and by far the most abundant taxa represented are the hypertragulids (mouse deer). Hypertragulids were small, browsing artiodactyls living in mixed woodland habitats. This habitat gradually became dryer and more open through the Oligocene, as evidenced by paleosol data and the appearance of open habitat specialist taxa. As the habitat changed and after major climatic events, it would be expected that the demands of the environment forced the animals to adapt and changes in the environment. The turtles have adapted to the environment and the demand for food, which is why the teeth of hypertragulids would exhibit greater wear and selection would favor higher crowned teeth. To examine whether hypertragulids show differences in tooth wear or crown height through time, we measured mesowear and hypsodonty index of lower second molars. Specimens were examined from each stratigraphic unit of the Turtle Cove member, from unit A through unit K2, and an analysis of variance was used to test for
differences in means between these units. Hypertagrids exhibited no significant differences in wear levels in strata immediately after volcanic events. There were also no differences in mesowear or hypsodonty through time, despite the environment becoming drier and more seasonal. As evidence of the increased vicariance in the Turkana Basin, the point of size of leg bones from a sample of adult Genyornis from Lake Callabonna, South Australia are three times lower than that of Dinornis, suggesting that extreme dimorphism was absent. Alternatively, a mechanical constraint caused by femoral orientation may restrict mass of flightless birds. Unlike in theropods, birds lack a long counter-balancing tail, and a sub-horizontal orientation of the femur places the knee under the center of mass. This restricts femur morphology, with femoral length constrained to maintain the position of the knee and robusticity increasing with body mass to counteract greater torsion strains. Previous studies have suggested that these restrictions may limit body mass in flightless birds. As a result, a scaling curve is expected to exhibit an inflection point than is seen in n-atheropods. In addition, if this is a universal constraint in birds then different avian phylogenetic groups should scale similarly. Femoral length and circumference measurements were taken for 43 species from 7 Orders of flightless terrestrial birds and regression results are plotted for set 81 n-atheropods compiled from the literature. Polynomial regressions reveal significant curvilinearity in avian femoral scaling, whilst model II regressions show significant overlap of slope and intercept confidence intervals (CIs) for ratite (n=19), graiform (n=13), and galliformeae (n=8) birds. Conversely, n-atheropods show no significant curvilinearity and the CIs of maniraptorans (n=17) and tyranosaurusauris (n=18) do not overlap. This suggests greater flexibility in femoral proportions in n-atheropods than in flightless birds, supporting previous suggestions that femoral scaling in birds is constrained by the loading regime.

Technical Session XIII (Friday, November 1, 2013, 2:15 PM)

**DENTAL DEVELOPMENT OF THE STEM OSTEICHTHYAN ANDRELOPSIS HEEDEI REVEALED BY THREE-DIMENSIONAL SYNCHRONOTRON VIRTUAL PALEOHISTOLOGY**

DINORNIS and PACHYORNIS was an adaptation to reduce the stresses placed upon eggs during incubation. If so, then similarly large birds should also exhibit extreme dimorphism. This was tested for in *Genyornis newtoni* (Aves: Dromornithidae), an anseriform bird similar in size to *Cygnus* in the Northern Hemisphere. Coefficients of variation in the size of leg bones from a sample of adult *Genyornis* from Lake Callabonna, South Australia are three times lower than that of *Dinornis*, suggesting that extreme dimorphism was absent.

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except A1 is spoon-like, the number of teeth in the main row is four, A1 is obviously number of branched dorsal fin rays and the number of vertebrae of the specimens from Cyprinus
The three living species of giant salamanders form a well-supported clade, while the Monophyly of both families and each genus was confirmed by the combined analysis. species remain unclear. Besides, inter-relationships of extant hynobiids are hotly debated in Salamandroidea. Early fossil salamanders from the Mesozoic of China have been salamander phylogeny due to generalized morphology and lack of derived features seen neotenic forms of the Cryptobranchidae. They are long considered primitive in distinct families: small and metamorphic salamanders of the Hynobiidae, and large and neotenic forms of the Cryptobranchidae. They are long considered primitive in salamander phylogeny due to generalized morphology and lack of derived features seen in Salamandroidea. Early fossil salamanders from the Mesozoic of China have been reported to have cryptocranial affinities, but their exact relationships with living species remain unclear. Besides, inter-relationships of extant hynobiids are hotly debated due to incongruence of results from various data types. To address these problems, we conducted combined analyses of the Cryptobranchidae, incorporating fossils, and corroborating morphological data from the molecular data. We noted, for example, that over 32 living and fossil species, and retrieved 13 mitochondrial DNA sequences (over 10000 base pairs) of 27 living species from Genbank. Amblystoma tigrinum was chosen as the outgroup. Separate morphological and molecular analyses, and combined analyses were all performed using the software POY 4 under the maximum parsimony model. The strict consensus tree of the combined analysis is similar with the molecular trees, whereas the morphological trees yield a polytomy at the base of the Hynobiidae. Monophyly of both families and each genus was confirmed by the combined analysis. The three living species of giant salamanders form a well-supported clade, while the Jurassic Chunerpeton and Paleocene Avitus occupy basal positions in the Cryptobranchidae. Relationships within the Hynobiidae are largely in congruence with previous molecular studies, except for the placement of Pachyhybodus at a basal position only higher than Ondychadodus. Jurassic Pungterpeton and Cretaceous Lissonyx are shown to be basal crown-group hynobiids, closely related to Pachyhybodus. The occurrence of crown-group cryptobranchioids in the Jurassic indicates a long evolutionary history of the group. Favorable paleoclimatic and paleo-environmental conditions in the Jurassic of northeast China may have had a significant impact on the early evolution of the Cryptobranchioidae.
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features that ally it with the contemporaneous *Gnawen onereois* and *Psarolepis romeri*, taxa that are resolved in different analyses as either stem-osteichthyans or very primitive sarcopterygians. The three *Kuanti* osteichthyans share large spine-bearing pectoral girdles and dorsal plates, combined with a pleurocoelvertebral girdle, the only known crown-gnathostomes to possess this archeic structure. The new fish has coarse enamel ridges covering all dermal surfaces, with large surface pore openings present on the dermal bones and ridge scales, but absent from the scales. The rhombic scales combine the ridged ornament of *Gnawen* with a prominent neck separating the crown and base, as seen in *Psarolepis*. The anterior flank scales of the new fish are striking, being exceptionally tall and displaying, in addition to the typical early osteichthyan peg-and-socket articulation, a separate dermal interlocking system.

The abundance and diversity of fossil gnathostomes from the Late Silurian of Yunnan allude to a high degree of trophic specialization in these animals well before the advent of the Devonian "Age of Fishes". The South China block may well have been one of the earliest centers of diversification for the jawed vertebrates.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

**NON-ANGUIMORPH LIZARDS FROM THE LATE OLIGOCENE AND EARLY MIocene OF NORTHERN FLORIDA, USA AND IMPLICATIONS FOR NEW WORLD SQUAMATE BIOGEOGRAPHY**

CHOVANC, Kevin, East Tennessee State University, Johnson City, TN, United States, 37614; SCHUBERT, Blaine, East Tennessee State University, Johnson City, TN, United States; MEAD, Jim, East Tennessee State University, Johnson City, TN, United States

Five paleokarst deposits from the medial Arikareean (Brooksville 2, Buda, Live Oak, and White Springs) and early Hemingfordian (Miller) of northern Florida preserve undescribed herpetofaunal remains. Here we describe and discuss the non-anguimorph lizard diversity from the two most fossiliferous localities, Brooksville 2 and Miller, and comment on the paleobiogeographic significance of all five. Preliminary identifications indicate that taxa present at Brooksville 2 include an anole, specimens referable either to *Leiocephalus* or the subfamily Iguaninae, an iguanine, and a corytophanine closely resembling *Ceratodactylus*, a diminutive phrynosomatine, an iguanine, and a "cromphodromine" teiid. Although several anoles from Brooksville 2 and Miller represent two distinct taxa, both appear to lie outside the modern *Anolis carolinensis* subgroup radiation. Fossils from Brooksville 2 highlight the difficulties in distinguishing *Leiocephalus* from some iguanines based on dentaries alone, and we agree with other authors who have suggested previous records of *Leiocephalus* in the continental United States may be unreliable. Scincids from both sites compare favorably with modern *Plastiodon*. Their presence at Brooksville 2, if confirmed, would represent an early occurrence of the genus. Although fossil records of rhineurid amphibians are known from the Paleocene and early Neogene of mid-continental and western North America, their occurrence in the Arikareean of Florida represents a substantial temporal range extension within the confines of a highly restricted present-day geographic distribution. The conspicuous absence of "cromphodromine" teiids from all four Arikareean sites, their sudden appearance in the Hemingfordian at Miller and in the previously described Thomas Farm local fauna, and their persistent presence in all subsequent North American Land Mammal Ages lend palaeoecological support to molecular estimates suggesting an early Miocene date of an intercontinental dispersal event of the group into North America. Our results indicate that at least some "tropical" lizard taxa with more northerly distributions in the Eocene (e.g., polychrotines and lacertines) lingered at lower latitudes in the United States well after the climatic deterioration of the early Oligocene, and that southeastern herpetofaunas were not yet modern in composition by the early Miocene.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

**ISOTOPIC INDICATORS OF MONSOON-INDUCED TERRESTRIAL ECOSYSTEM CHANGE IN THE TURKANA BASIN, KENYA: IMPLICATIONS FOR THE FOSSIL RECORD**

CHRITZ, Kendra, University of Utah, Salt Lake City, UT, United States, 84112; CERLING, Thure, University of Utah, Salt Lake City, UT, United States

Variation in the strength of the East African monsoon, resulting from climate change due to Milankovitch forcing, is often cited as an important driver of mammalian evolution in the tropics. However, the response of African terrestrial ecosystems to changes in the monsoon system is not well understood. Stable isotope analysis of mammalian tooth enamel is used to investigate the impact of changing insolation during the Holocene (11.5 Kya-present) on local climate and terrestrial ecology in the Turkana Basin, Kenya. We present paleoenvironmental reconstructions using *δ13C* and *δ18O* of *C3* and *C4* taxa, taxa that have a mixed type of diet and exchange carbon between the soil and atmosphere at high resolution, and can inform interpretations of isotope data from mammalian tooth enamel in older sequences in light of orbital forcing and issues of temporal resolution. Finally, this analysis highlights potential blurring of ecological information that may characterize older faunal assemblages in the fossil record.

Technical Session I (Wednesday, October 30, 2013, 12:00 PM)

**DREPANOSAURID FROM THE EOLIAN NUGGET SANDSTONE (?LATE OLIGOCENE – EARLY JURASSIC) OF THE OZARK RIFT ZONE, NORTH AMERICA**

CLEMENTZ, Mark, University of Wyoming, Laramie, WY, United States

*Psarolepis megalancosaurus* (Carnivora, *Drepanosauridae* fam. nov.), a new drepanosaurid from the Eolian Nugget Sandstone of the Ozark Rift Zone, North America. Their remains have been found in floodplain, fissure fill, rift valley lacustrine, and carbonate platform island settings. Here we report on a new form from the Nugget Sandstone based on multiple three-dimensional, articulated skeletons with documented skull, mandible, and dental microanatomy. Their morphology and ecology of the group.

Technical Session II (Thursday, October 31, 2013, 9:00 AM)

**EVIDENCE FOR PIERCE FEEDING IN ENALLARTOS (CARNIVORA, PINNIPEDIMORPHA) FROM TOOTH SPACING AND CROWN SIZE**

CHURCHILL, Morgan, University of Wyoming, Laramie, WY, United States, 82070; CLEMENTZ, Mark, University of Wyoming, Laramie, WY, United States

Loss of oral processing of prey is prevalent among carnivorous marine mammals, including all extant pinnipeds (seals and walruses). It is unclear, however, when loss of oral processing first occurred within pinnipeds. Associated with changes in mastication are simplification of tooth crown morphology, an increase in homodonty, and an increase in spacing of the postcanine teeth. Dentitions of early diverging pinnipeds such as *Enallartos*, show a mix of these traits, some of which are found in later diverging pinnipeds (simplified dentitions) and others in terrestrial carnivores (occlusal wear facets, complicated cusp morphology), which suggests that *Enallartos* may have possessed a form of oral processing intermediate between fissiped and pinniped carnivorans. Our study examined the evolution of oral processing within arctoid carnivorans by examining the tooth spacing and crown size of over 300 carnivorans, representing all extant families of arctoid carnivore and nearly every species of extant pinniped, as well as *Enallartos* *eolium*. Contributions of tooth spacing and crown length to tooth row length were also analyzed using Principal Components Analysis (PCA) to define a tooth morphospace for arctoid carnivorans. In agreement with prior studies, *Enallartos* dentition had characteristics in common with both fissiped and pinniped carnivorans: limited tooth spacing as seen in fissipeds, postcanine sizes between those typical of fissiped and pinniped carnivorans, and reduced heterodony characteristic of pinnipeds. PCA of tooth characters clearly segregated fissiped and pinniped carnivorans, indicating that loss of oral processing was the main driver of morphospace segregation. Surprisingly, when *Enallartos* was included in this analysis, it did not plot between these two groups, but was instead placed firmly within the pinniped cluster. Our study provides evidence that mastication was lost earli in pinniped phylogeny and suggests that further changes in tooth architecture and crown size are likely related to the loss of functional constraints on mastication. We also found that variation in tooth size and spacing may be a simple and effective metric of oral processing abilities of mammals, and may provide important insight on the evolution and loss of oral processing in other mammalian taxa.
DESCRIPTION OF NINE NEW SPECIMENS OF MOURRASUCHUS NATIVUS (ALLIGATOROIDA, CAIMANINAE), AND COMMENTS ON ONTOGENETIC DEVELOPMENT AND INTRASPECIFIC VARIATION OF THE SKULL TABLE

CIDADE, Giovanne, Universidade de São Paulo, Ribeirão Preto, Brazil; RIFF, Douglas, Universidade Federal de Uberlândia, Uberlândia, Brazil; SOUZA-FILHO, Jonas Pereira, Universidade Federal do Acre, Rio Branco, Brazil; HSIOU, Annie Schmatz, Universidade de São Paulo, Ribeirão Preto, Brazil; MONTEFELTRO, Felipe, Universidade de São Paulo, Ribeirão Preto, Brazil

The South American endemic Miocene crocodilian group Mourrasuchus is characterized by a unique long, broad and dorsoventrally flattened skull. Mourrasuchus nativus was originally described based on skull tables of the Argentinean Miocene deposits of the ancientapinga formation. Among the 10 new specimens, one of the new specimens has a more unusual skull, with a highly hypertrophied squamosal forming a “horn” and a well marked medial crest in the parietal bone, which are both also characterized autapomorphies of the species. We present a preliminary description of nine new partial skulls of M. nativus (fronto-parietal, orbito-frontal, and tergum), recovered from the La Troncheta Formation in Brazil. The new specimens offer new insights into the morphology of these traits based on morphometric analysis of the squamosal, which was performed by measuring the hypertrophies in three dimensions: anteroposterior thickness, lateromedial width and dorsoventral height. We found that the “horns” have two growth stages during ontogenetic development: they grow first in width and thickness, and secondly in height.

These results argue against a hypothesis of sexual dimorphism to explain these differences in the squamosal size of this species. The parietal crest, in its turn, does not show the morphology originally described in all specimens; in fact, in five of them, the crest is represented only by a slight, rounded salience. This may indicate that the presence of the parietal crest has individual variation, although the hypothesis that this feature may be the result of taphonomic processes is not excluded. In addition, one of the new specimens has a very unusual skull, with a highly hypertrophied squamosal forming a “horn” and a well marked medial crest in the parietal bone, which are both also characterized autapomorphies of the species. We present a preliminary description of nine new partial skulls of M. nativus (fronto-parietal, orbito-frontal, and tergum) preserved from the La Troncheta Formation in Brazil. The new specimens offer new insights into the morphology of these traits based on morphometric analysis of the squamosal, which was performed by measuring the hypertrophies in three dimensions: anteroposterior thickness, lateromedial width and dorsoventral height. We found that the “horns” have two growth stages during ontogenetic development: they grow first in width and thickness, and secondly in height.

In conclusion, the new specimens offer new insights into the morphology and ontogeny of the genus M. nativus, a group characterized by a unique long, broad and dorsoventrally flattened skull. Mourrasuchus nativus was originally described based on skull tables of the Argentinean Miocene deposits of the ancientapinga Formation. Among the 10 new specimens, one of the new specimens has a more unusual skull, with a highly hypertrophied squamosal forming a “horn” and a well marked medial crest in the parietal bone, which are both also characterized autapomorphies of the species. We present a preliminary description of nine new partial skulls of M. nativus (fronto-parietal, orbito-frontal, and tergum), recovered from the La Troncheta Formation in Brazil. The new specimens offer new insights into the morphology of these traits based on morphometric analysis of the squamosal, which was performed by measuring the hypertrophies in three dimensions: anteroposterior thickness, lateromedial width and dorsoventral height. We found that the “horns” have two growth stages during ontogenetic development: they grow first in width and thickness, and secondly in height.

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polarity, however many of the samples in this part of the section exhibited superparamagnetic behavior and thus did not provide a reliable polarity determination. Samples from the Kolum Kaka Fm. exhibited very stable paleomagnetic behavior and clearly reveal the polarity reversal in that interval. The new magnetostratigraphic record will be combined with the new U/Pb ages and recent chronostatigraphic results from the underlying Salamanca Formation to correlate the Rio Chico units to the geomagnetic Polarity Timescale and better constrain the correlation of the associated SALMAs to land mammal age frameworks on other continents.

Technical Session XIII (Friday, November 1, 2013, 3:30 PM)

WARDIE NODULES UNPACKED: COMPUTED TOMOGRAPHIC INVESTIGATION OF NEWLY RECOGNIZED SPECIMENS OF TRISTICHYS, A PIVOTAL TAXON IN CHONDRICHTHIAN PHYLOGENY

COATES, Michael, University of Chicago, Chicago, IL, United States; CRISWELL, Katharine, - Chicago, IL, United States; VERNER, Ellen, University of Chicago, Chicago, IL, United States.

Clay-troncated nodules have been collected from the Wardie Shales of the Visean Lower Oil Shale Group (Edinburgh, Scotland) since the early 19th century. These nodules have yielded numerous fishes, some of which are preserved almost three-dimensionally intact. However, most specimens are pyritized and mechanical preparation is difficult. Wardie chondrichthys found by the Scottish fossil collector Mr. S. P. Wood in the early 1970s formed the basis of John Dick’s classic study of early sharks. At that time, certain nodules were left unprepared, anticipating future, less destructive techniques. A CT-scan of one such nodule, catalogued in 1974 as containing a tetanichthys, has revealed the near complete, articulated skeleton of the gill arches, jaws, braincase and part of the pectoral girdle of Tristichys arcuatuis: an anomalous dogfish-like species of uncertain phylogenetic affinities. This discovery prompted further exploratory CT-scans of Wardie nodules, including uncatalogued material collected in 1870 as well as several specimens studied by Dick. Results contribute to significantly enhanced data coverage of the T. arcuatuis neornarcomnium, corroborating Dick’s reconstruction, but showing that estimated proportions are dorsoventrally too compressed. New data also reveal a hybodont-like otico-occipital region with paired dorsal ridges flanking an occipital crest, an elaborate articulation area for the palatoquadrate exposed on the ventral face of the postorbital process; that the postorbital process joins the braincase anterior to the otic capsule; that the otic labyrinth is separated from the main endocranial cavity by a median capsular wall. Recent phylogenies place T. arcuatuis close to the base of, and perhaps external to, the chondrichthyan crown clade, indicating that it lacks synapomorphies uniting holocelaphans and early neolecanths. Data presented here show that T. arcuatuis is markedly neolecanthian: it belongs within the neoselachian clade. Moreover, the quality of data now available on T. arcuatuis underlines the specialized skeletal anatomy of this early Mississippian selachian. Finally, Wardie nodules re-examined under (literally) a new light show that this long-known locality is a potentially rich source of data on early chondrichthysn in the post-Devenian world.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

CONTRIBUTION OF THE SHUNGURA FORMATION (3.6 MA - 1.05 MA) TO EASTERN AFRICAN EQUID EVOLUTION AND PALEODIET

COILLOT, Tiphaine, Université de Poitiers, Poitiers, Poitiers, France; BERNNOR, Raymond, Howard University, Washington, DC, United States; BOISSERIE, Jean-Renaud, CNRS / Université de Poitiers, Poitiers, France.

The eastern African fossil equid record is undergoing a major systematic revision. African eurIDS are first known to occur in Algeria and Ethiopia at 10.5 Ma. Hippotomids became endemic in Africa by the very latest Miocene with the genus Eurynathohippus that had undergone a radiation in the Plio-Pleistocene. In eastern Africa, the late Miocene Lothagam sequence includes “Sivalhippus” turkanensis and Eurynathohippus feibeli (7.4 Ma - 6.0 Ma). The Middle Awash sequence exhibits gradual evolution in the Eu. feibeli lineage from 5.8 Ma - 4.9 Ma. Aratama, Eurygnathohippus n. sp. is evolutionarily intermediate between Eu. feibeli and Hadar Eu. hasumense (3.6 - 3.0 Ma). Hippotomines coexisted with Equus that appeared in Africa around 2.3 Ma and evolved into a diverse, pan-African clade. This first sub-Saharan apparition of Equus is recorded in the Shungura Formation, Ethiopia (noted below “SF”) that has the most continuous and precisely dated fossiliferous section in Africa from 3.6 Ma to 1.05 Ma. Divided into 13 members and 101 stratigraphic units, it recorded dramatic climatic changes and faunal responses. SF hipparion sequence is critical for eastern Africa equid studies, due to the very high density of its chronostatigraphic frame. It includes Eu. af. hasumense, the Eu. “ethiopicus” - Eu. cornelius lineage, and likely a smaller hippariomin species. Hojoier recognized only one species of Equus, Eq. oldowayensis, whereas Eisenmann identified at least 4 different species of Equus from Members G to L (2.27 Ma - 1.05 Ma). We present herein a preliminary revision of SF equid systematics and evolution. This revision is in part grounded on the discovery of new material by the Omo Group Research Expedition. It should ultimately enable us to fully assess the equid chronostatigraphy for eastern Africa, based on correlations of equid evolutionary events between the SF and other major sites, in particular the Middle Awash sequence that has yielded an exceptional hominid record. The SF notably records global climatic changes and faunal turnovers. The eastern African fossil record is undergoing a major systematic revision.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

ACOUNTING FOR SAMPLE SIZE BIASES IN ANALYSES OF ONTOGENETIC SEQUENCES

COLBERT, Matthew, The University of Texas at Austin, Austin, TX, United States; MORRIS, Zachary, The University of Texas at Austin, Austin, TX, United States.

It has long been known that the resolution of hypothesized ontogenetic sequences within a taxon or population depends largely on the sample size of specimens and the number of considered events. However, the possibility of obtaining a completely resolved sequence (i.e., the position of every event resolved relative to every other event) unless one has more sampled individuals than events. Typically one needs to include considerably more individuals than events because multiple individuals can represent the same event (i.e., the state of event transformations for considered events at a particular instant), and because event-order can be variable (the basis of sequence evolution). Inadequate sampling leads to predictable consequences that serve as a rationale for judging the robustness of hypotheses of sequence order within a taxon or population, as well as for the advisability of sequence comparison between taxa or populations.

Ontogenetic Sequence Analysis (OSA) is one method that can help identify the adequacy of sequence resolution - pinpointing under-sampled regions of ‘sequence-space’, which could potentially lead to incorrect assumptions about fixed sequence order differences between taxa. This problem is compounded when the different taxa being compared are all under-sampled, as is generally the case in paleontology and often in developmental biology. This is not to say that attempts to establish ontogenetic sequences are futile with limited samples, but rather that the effect of sampling on results needs to be evaluated and considered in every analysis. An estimation of the topological differences in ontogenetic sequence space is considered the most promising avenue for development of a method that can interpret ontogenetic sequence evolution while accounting for sequence sampling artifacts.

Technical Session V (Wednesday, October 30, 2013, 3:00 PM)

SKELETON OF A HEAVILY ARMORED AND LONG LEGGED MIDDLE JURASSIC LIZARD (SQUAMATA, REPTILIA)

CONRAD, Jack L., NYIT College of Osteopathic Medicine, Old Westbury, NY, United States; WANG, Yuan, Institute of Vertebrate Paleontology and Palaeoanthropology, Beijing, China; XI, Xing, Institute of Vertebrate Paleontology & Paleoanthropology, Beijing, China; CLARK, James, George Washington Univ, Washington, DC, United States.

The last three decades has seen a dramatic increase in our knowledge regarding the earliest evolution of the major squamate clades, but most known fossils are Cretaceous or younger. The earliest known squamates are the incompletely known Paraviraptor, Eichstaettiauraeia, Ardeosaurus, and the Paramacellodids with their osteodermal armor. We report on a new late Middle Jurassic lizard from the Shishugou Formation of China representing the oldest complete squamate skeleton. The animal possesses vomerine teeth, a rectangular frontal, and incipient cusps on its marginal teeth. The preserved hind limb is very elongate. The entire body was encased in osteoderms. Cranial osteoderms are large and plate-like dorsally, but small and rounded ventrally. The postcranial osteoderms are rectangular, noncompound, and overlapping. Those on the tail show mediolateral fusion across the midline such that many rows have five or more fused osteoderms. Our phylogenetic analysis of 836 morphological characters along with molecular data (RAG1, BDNF, and Cmos; 4591 base pairs) surveyed 175 lepidosauriform species. Molecular data were were downloaded from GenBank for 22 exemplar species from across the tree, including Sphenodon and 21 squamates. The result phylogenetic hypothesis finds a “gecko-morphotype” (unarmed, relatively large-eyed, morphs with limbs of intermediate length and simple, insectivore-style teeth) to be the ancestral for squamates. On the new lizard is recovered as a basalmost squamate, related to lateratanus, anguimorphs, and iguanomorphs. The Late Jurassic saw the rise of therian mammals and coelurosaurian dinosaurs. At the same time, squamates enter the fossil record in both the gecko-morphotype and armored forms (e.g., Paramacellos and our new taxon). We suggest that the selective pressure from this changing fauna may have helped “push” squamates into new morphotypes. Many known Late Jurassic and Cretaceous squamates possess long legs (e.g., Bavarisaurus, Saichangurvel) and/or extensive osteodermal armor (e.g., Paramacellos). These pressures may have contributed to the marginalization of the previously diverse and widespread rhynchocephalians.
HYSTROGNATHID RODENT ASSEMBLAGE FROM A NEW EARLY Oligocene vertebrate locality: Zallah 7, SIRT Basin, Libya

COSTER, Pauline, Carnegie Museum of Natural History, Pittsburgh, PA, United States; 15213; BEARD, K. Christopher, Carnegie Museum of Natural History, Pittsburgh, PA, United States; CHAIMANE, Yaovaluk, Université de Poitiers, Poitiers, France; SALEM, Mustafa, University of Tripoli, Tripoli, Libya; JAEGGER, Jean-Jacques, Univ of Poitiers, Poitiers Cedex, France.

Several fossiliferous sites have been documented in the Oligocene ‘Continental and Transitory Marine Deposits’ in the vicinity of Zallah Oasis, southern Sirt Basin, central Libya. The Paleogene sequence exposed in this area corresponds to nearshore to continental late Paleogene sediments overlying the marine Eocene Wadi Thamat Formation. The survey conducted in January 2013 near Zallah resulted in the discovery of several new localities. Our most productive locality, Zallah 7, which is also called the Incision Locality, has yielded a diverse vertebrate fauna including sharks, rays, bony fishes, crocodyliforms, sirenians, hyracoids, an anhanguerid, a pachycephalosaurid, a micados cingulid, and hystricognathous rodents.

About 200 micrometrical teeth have been recovered after screenwashing the fossiliferous level. Among the more common mammals represented at Zallah 7 are primitive members of the rodent clade Hystrognathidae. Here we document the presence of two genera and species of early phiomorph rodents (Metaphiomys and Neophiomys) on the basis of numerous isolated teeth. Surprisingly, the Gaeoacaudemurina, a distinctive clade of early African hystricognaths that is abundantly represented at the nearby Zallah SR Locality, are not yet represented at our new locality. Zallah 7 has produced isolated teeth of Metaphiomys schaubi, which is also known from the Jebel Qatrani Formation in Fayum (Egypt), where it ranges from Lower Sequence Quarries E, B to quarry G of the Upper Sequence. Specimens of Neophiomys paraphyomoides, similar in size and morphological pattern to the Libyan ones, were described at Quarry G of the Upper Sequence of the Jebel Qatrani in Egypt. A similar assemblage of phiomorphs has been described from the Upper Sequence in Fayum. A similar assemblage of phiomorphs has been described from the Fejfar Locality in the Sirt Basin, dated from the middle Miocene. It is of interest to add that our new locality is also known from the Jebel Qatrani Formation in Fayum (Egypt), where it ranges from Lower Sequence Quarries E, B to quarry G of the Upper Sequence. Specimens of Neophiomys paraphyomoides, similar in size and morphological pattern to the Libyan ones, were described at Quarry G of the Upper Sequence of the Jebel Qatrani in Egypt. A similar assemblage of phiomorphs has been described from the Upper Sequence in Fayum. A similar assemblage of phiomorphs has been described from the Fejfar Locality in the Sirt Basin, dated from the middle Miocene.

Protohystricognathous specimens from the Fejfar Locality in the Sirt Basin, dated from the middle Miocene, suggest a close relationship to the Libyan localities. A similar assemblage of phiomorphs has been described from the Fujeirah Locality in the Sirt Basin, dated from the middle Miocene. A similar assemblage of phiomorphs has been described from the Fejfar Locality in the Sirt Basin, dated from the middle Miocene.

The new Libyan locality combines taxa (rodents, primates, and others) that are typical of the Jebel Qatrani upper sequence, in particular Quarries G and V (31-32 Ma). Given the regional scarcity of sites of this age, the richly fossiliferous Paleogene terrestrial deposits in the Zallah area may prove critical for understanding the biogeography and evolutionary history of rodents and other vertebrates in Arabia.

POSTER SESSION I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

SYSTEMATICS OF THE 32 MY OLD AGGREGATION OF SNAKES FROM THE WHITE RIVER FORMATION: REDEFINING THE ERYCINAE WITHIN BOOIDEA

CROGHAN, J., University of California, Edmonton, AB, Canada, T6J 0H6; PALCI, Alessandro, University of Alberta, Edmonton, AB, Canada; CALDWELL, Michael, University of Alberta, Edmonton, AB, Canada; BREITHAUPF, Brent H., BLM - Wyoming, Laramie, WY, United States.

A 22 million year old aggregation of snakes from the Oligocene White River Formation includes four largely complete and articulated individuals that have been considered to be erycine snakes. Detailed observations, obtained using a variety of methodologies including light microscopy and computed tomography, have resulted in the refinement of invaluable morphological data on the Oligocene snakes. These data permit precise interrogation of primary homology hypotheses in the current literature, leading to important changes in secondary homology statements arising post-analysis. Recording of existing characters and character states, specifically those presented in two previous studies, has resulted in conflicting results for several obvious reasons: 1) The first data set systematized all snakes, with a terminal unit referred to as the “Erycinae” that was characterized by a large number of polyomorphic character state assignments; coding the fossil taxon (White River Taxon) into this matrix found it to be in the sistergroup position to this uninformative “Erycinae”. 2) The second data set was a smaller study focused on New and Old World erycines only, as well as the putative python Calabaria; the addition of the White River Assemblage resulted in 26 most parsimonious trees (MPTs), where the White River Taxon was in the sistergroup position to the erycine clade. The 13 extant species are assigned. Analysis found the Old World genus Erys to be in the sistergroup position to the Booideae (pythons and boas). A new clade formed by the White River aggregation and Charina was found to be the sistergroup to the clade formed by Erys and the Booideae. The two MPTs of this analysis each reinforce the monophyly of the two most complete assemblages. This reconstruction is supported by the uninformative “Erycinae” to include the two extant genera (Charina and Erys) to which the 13 extant species are assigned. Analysis found the Old World genus Erys to be in the sistergroup position to the Booideae (pythons and boas). A new clade formed by the White River aggregation and Charina was found to be the sistergroup to the clade formed by Erys and the Booideae. The two MPTs of this analysis each reinforce the monophyly of the two most complete assemblages.

Technical Session VIII (Thursday, October 31, 2013, 3:30 PM)

RECONSTRUCTION OF THE NASAL REGION IN NON-MAMMALIAN CYNODONTIDS AND MAMMALIFORMES SUGGESTS ABSENCE OF INTRANARIAN LARYNX AND A COMPROMISED COUNTERCURRENT EXCHANGE AT RESPIRATORY TURBINES

CROMPTON, A. W., Harvard Univ., Cambridge, MA, United States, 02138; MUSINSKY, Catherine, Harvard University, Cambridge, MA, United States; OWERKOWICZ, Tomasz, California State University, San Bernardino, CA, United States.

Extant mammals are characterised by a higher-than-ambient body temperature and regular breathing rate. Ability to breathe while feeding is key to supporting a high metabolic rate, which necessitates respiratory airflow via the nasal cavity. Loss of heat and water by exhaled air is reduced by nasal turbinates, which promote a large surface area for temporal countercurrent exchange (CCE). Effective CCE during feeding depends on the intranarial position of the larynx, so that food is not aspirated and air does not exit via the mouth. Speculations on the origin of endothermy in advanced non-mammalian
therapsids are often based upon the presumed presence of ossified respiratory turbinates, but no study has determined the position of the larynx. We collected microCT scans to reconstruct skulls of two non-mammalian cynodonts (Mastogonathus and Probainognathus) and one mammaliform (Morganucodon), and infer their nasal and laryngeal anatomy. The entire nasal capsule remained cartilaginous, but ridges on the internal surface of the maxillae suggest presence of cartilaginous maxilloturbinals. All three taxa possessed a well-defined pterygoid process that maintained an intimate contact with the lower jaw. This would have prevented transverse jaw movements and ruled out the origin of trigeminal musculature from the ventral surface of the pterygoid. We conclude that the soft palate with its associated muscles was not in place to hold and seal the larynx within the nasopharynx. In the absence of an intranarial larynx, the initial role of respiratory turbinates was probably to provide an expanded surface area for evaporative cooling. Coupling of nasal inspiration and oral expiration has been observed in extant mammals under ambient heat stress or during increased activity. This mechanism acts to selectively reduce brain temperature at the cost of increased respiratory evaporative water loss. The combination of a large nasal cavity, cartilaginous turbinates and pharyngeal position of the larynx suggests that non-mammalian synapsids did not breathe while feeding, but might have enjoyed elevated body temperatures during activity. Mammalian endothermy and a regular breathing rate probably arose only once the maxilloturbinals ossified, extralaryngeal musculature was differentiated and complex jaw movements were possible. 

Reconstruct skulls of two non-mammalian cynodonts (therapsids are often based upon the presumed presence of ossified respiratory turbinates, Probainognathus three taxa possessed a well-defined pterygoid process that maintained an intimate contact with the lower jaw. This would have prevented transverse jaw movements and ruled out the origin of trigeminal musculature from the ventral surface of the pterygoid. We conclude that the soft palate with its associated muscles was not in place to hold and seal the larynx within the nasopharynx. In the absence of an intranarial larynx, the initial role of respiratory turbinates was probably to provide an expanded surface area for evaporative cooling. Coupling of nasal inspiration and oral expiration has been observed in extant mammals under ambient heat stress or during increased activity. This mechanism acts to selectively reduce brain temperature at the cost of increased respiratory evaporative water loss. The combination of a large nasal cavity, cartilaginous turbinates and pharyngeal position of the larynx suggests that non-mammalian synapsids did not breathe while feeding, but might have enjoyed elevated body temperatures during activity. Mammalian endothermy and a regular breathing rate probably arose only once the maxilloturbinals ossified, extralaryngeal musculature was differentiated and complex jaw movements were possible.

Poster Session III (Friday, November 1, 2013, 4:15 – 6:15 PM)

SOLVING THE SYNONYM ISSUE IN CONCAVENATOR CORCOVATUS AND BECKLESPINAX ALTISPINAX, TWO DISTINCT THEROPODS FROM THE LOWER CRETACEOUS OF EUROPE

CUESTA, Elena, Universidad Autonoma de Madrid, Madrid, Spain; ORTEGA, Francisco, Universidad Nacional de Educacion a Distancia, Madrid, Spain; SANZ, Josué Luis, Universitat Autonoma de Barcelona, Madrid, Spain.

The record of theropod dinosaurs with long neural spines has expanded significantly in recent years, mostly within the spinosaurid and carcharodontosaurid clades. Concavenator corcovatus and Becklespinax altispinax are two representatives of long-spined theropods from the Lower Cretaceous of Western Europe. Both taxa show a comparable elongation of the neural spines of some of the last dorsal vertebrae, and, somehow, this might suggest a close relationship, or even the synonymy between the two taxa. Therefore, we compared the type material of Becklespinax altispinax (Natural History Museum specimen NHMUK R1828), consisting of three posterior dorsal vertebrae with the tenth, eleventh and twelfth dorsal vertebrae of Concavenator corcovatus (Museo de las Ciencias de Castilla-La Mancha specimen MCM-LH 6666).

Anatomical comparison indicates the existence of substantial differences between the two taxa. Concavenator shows a combination of a centrum-like neural spine of either Acrocanthosaurus, and clearly different from Baryonyx and Becklespinax. The neural spines of both taxa differ in their orientation, because the spines of Becklespinax show an anterior orientation in contrast with the spines of Concavenator that are posteriorly directed. Moreover, the spines of Becklespinax widen toward their apices and are considerably mediolaterally broader than the spines of Concavenator. In addition, Becklespinax shows at least three elongated neuropophyses instead of only two as in Concavenator.

Both a Cluster Analysis based on discrete characters, and a Principal Components Analysis (PCA) based on 20 measures on each vertebra and 23 distinct ratios on such measures were performed. In both analyses the sample space was expanded with other significant theropods. Within the cluster analysis, the two compared genera belong to groups clearly separated, indicating that Concavenator is more related to other carcharodontosaurids than to Becklespinax. On the other hand, the PCA shows that there is not a marked interspecific biometric variability in the vertebrae except those ones with hypertrophied spines that are separated in morphometric space, where Becklespinax and Concavenator show a conspecific location. In conclusion, results obtained from different information sources and various methodologies allow discard the synonymy between Concavenator and Becklespinax, despite being relatively close both chronometriographically and geographically.

Poster Session III (Friday, November 1, 2013, 4:15 – 6:15 PM)

FUNCTIONAL MECHANICS OF ORNITHOMIMOSAURS

CUFF, Andrew, University of Bristol, Bristol, United Kingdom

Ornithomimosaurs are a rather enigmatic group of theropods due to the edentulous nature of derived members. Their possession of keratinous rhamphotheca, large orbits, lightweight skulls and elongate necks and legs has led to comparisons with ostriches and other extant osteornithines. Understanding the implications for that of theropods in general and dietary shifts from carnivory to herbivory. The skulls of three ornithomimosaurs (Garudimimus and the ornithomimoids Struthiomimus and Ornithomimus) were digitally reconstructed using CT scan data. Virtual muscles were recreated using osteological correlates, from which bite forces were calculated. Hypothetical beaks that cover the rostrum were created based on known other extant palaeognaths. Understanding the implications for that of theropods in general and dietary shifts from carnivory to herbivory.

The new specimen represents the first known complete cephalic spine of a hybodont shark from the lower Cretaceous of southern Alberta, and one of three from the Late Cretaceous of North America. The dinosaur egg fragment can be assigned to Theropoda based on the shell thickness and surface texture morphology. It represents the first record of egg material in the Foremost Formation, and adds evidence to the hypothesis that dinosaurs did not preferentially nest in drier, upland environments.

Technical Session II (Wednesday, October 30, 2013, 11:45 AM)

WISDOM OF THE BONES: HOW PATTERNS OF TRAUMA AND PATHOLOGY IN A WILD LEMUR COMMUNITY INFORM THE PALEOECOLOGY OF MADAGASCAR'S RECENTLY EXTINCT LEMURS AND EARLIER EOCENE LEMURIFORM PRIMATES

CUOZZO, Frank, University of North Dakota, Grand Forks, ND, United States, 58202; SAUTHER, Michelle, University of Colorado-Boulder, Boulder, CO, United States

Thorough assessment of the ecology and behavior of extinct primates requires comparative data from living analogues, or better extant relatives of these extinct forms. This is especially the case when attempting to reconstruct the diet of lemurs of Madagascar and more distant lemuriform primates from the Eocene Epoch. Our decade-long study of a living, wild lemur community at the Beza Mahafaly Special Reserve, Madagascar, and the subsequent analyses of skeletal material from these individuals provides such a context. In a sample of 274 living ring-tailed lemurs (Lemur catta) captured between 2003 and 2012, more than 15% of the population exhibits some form of healed skeletal trauma, ranging from broken tails to more debilitating injuries such as broken femora, humeri, and ulnae. Of significance, a number of these lemurs have survived many years (as much a decade) with these healed injuries, while exhibiting normal ranges of behavior. The skeletal sample housed at Beza Mahafaly includes material from all four lemur species endemic to the region. This sample includes evidence of healed long-bone fractures in both Lemur catta and Verreaux’s sifaka (Propithecus verreauxi). A number of the skeletons exhibit signs of arthritis similar to these living lemurs, likely the result of processing similar foods. This comparison therefore provides a template for interpreting the presence in related, subfossil lemurs. For example, 15% of extinct Paleopropithecus and 7% of extinct Archaeolemur we have examined in American and European museum collections exhibit signs that are similar to these living lemurs, likely the result of processing similar foods. This comparison therefore provides a template for interpreting the ecology of these extinct forms. Finally, recent interpretations of the paleopathology and behavior of the type specimen of middle Eocene Darwinius masillaei suggest that broken wrist bones resulted in an inability to climb, thus leading to the rapid demise of this individual. Our data from living primates and their skeletal remains illustrate that lemurs frequently survive, sometimes as long as a decade, with severe trauma, thus indicating that Darwinius did not necessarily succumb to this injury. The data we present herein illustrate the value of studying wild, living primates and their skeletal remains for assessing primate paleoecology.
The smallest, articulated ceratopsid (dinosauria)
Museum of Natural History, Cleveland, OH, United States; COY, Clive, University of Alberta, Edmonton, AB, Canada; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, United States; COY, Clive, University of Alberta, Edmonton, AB, Canada; KOPPELHUIS, Evi, University of Alberta, Edmonton, AB, Canada

Characteristics of the smallest articulated ceratopsid skeleton (lacking only the forelimb) is a juvenile ceramosaur that was collected in 2010 from the lowermost part of the Dinosaur Park Formation in Dinosaur Provincial Park, Alberta. At 1.5 m in total length, it falls below the size range of even adult basal neoceratopsians and large psittacosaurids. Cranial bones have striated, porous bone texture; many are coossified despite its small size. The lips are relatively small and narrow. The back of the frill is rectangular, lacks a posterior embayment, and is relatively narrower than those of either equivalent-sized basal neoceratopsians or adult ceratopsids. There are no cranial epipterygoids, and the squamosal is capped at the posterolateral corner by the parietal. The margins of the elongate supratemporals are thick and scalloped. Narrow and elongate openings may represent the parietal fenestrae, and there is a pronounced midline sagittal crest that extends almost to the back of the frill. The preserved knob, knobbly postorbital horn has a round base and there is no development of sinuses from below. An incipient horn core is present on the nasals over the posterior one-half of the external nares. There are 18 maxillary tooth positions, which is at least four more than in any similar-sized basal neoceratopsians, but is fewer than what is found in more mature ceratopsids. All of the cranial features are consistent with its identification as Chasmosaurus sp. Postcranially, skin on the flank of the body comprised a pavement of pebbles with large feature scales. The synsacrum is composed of three fused vertebrae. There are 32 articulated caudals, of which the fifth to twentieth appear to have short, robust, free caudal ribs. The narrow pelvis suggests the body was tall and narrow. Osseous tendons are present in the neck and trunk. The elongate supratemporals are thick but taper posteriorly from a broad and scalloped bone at the base of the frill. The parietals vary in size and shape, with some displaying clumped isotope paleothermometry, associated changes in summer soil temperature of ~10°C. Body size and temperatures revert to even larger sizes after the PETM. Decrease in mammal body size seems to be a result of increased global warming events; as such, global atmospheric carbon dioxide levels increased with more distal positions as well. Concerning both shape and size, heterodonty in non-mammalian taxa: a case study in the Nile monitor, Varanus niloticus. 
D'AMORE, Domenic, Daemen College, Amherst, NY, United States, 14226

Many recent attempts have been made to quantify heterodonty in non-mammalian vertebrates, both extinct and extant, but the majority of these are limited by Euclidian methods. Grols have shown a statistically significant difference in body size distribution of the Nile monitor, Varanus niloticus, which is considered a common evolutionary response to early Paleogene hyperthermals, and there may be a predictable natural response for some lineages to future global warming.
and host bone contours affected shape slightly. Changes in heterodonty are speculated to be the result of function and mechanical constraint, although it is unclear to what degree V. niloticus is a durophagy specialist. The geometric morphometric method proposed here, although not without its own limitations, has several advantages over other methods, and may be ideal for use with a number of modern and fossil dental morphology in the future.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

STHENURINES - WHY THE SHORT FACE? CRANIODENTAL MORPHOLOGY IN RELATION TO DIET IN LIVING AND FOSSIL KANGAROOS

DAMUTH, John, University of California, Santa Barbara, Santa Barbara, CA, United States, 93106; JANIS, Christine, Brown Univ, Providence, RI, United States; TRAOUILLON, Kenny, University of Queensland, St. Lucia, Australia; FIGUEIRIDO, Borja, Universidad de Málaga, 29071-Málaga, Spain

Multivariate analyses (Principle Components Analysis [PCA] and Canonical Variates Analysis [CVA]) on craniodental extensions of 43 species of extant macropods (kangaroos and rat kangaroos) showed good discrimination (81% correct classification) among dietary categories (omnivore, browser, mixed feeder and grazer). Tropical forest taxa (Dendrolagus and Dorcopsis spp.) clustered separately from the other browsers, which clustered closer to mixed feeders; grazers (large Macropus spp.) clustered separately. Eleven fossil taxa were then included: two small (betong-size) Oligo-Miocene taxa, one late Miocene shenherus (Rhizosthenurus, wallaby size), seven Pleistocene shenherus (representing five species of Sthenurus), and one Pleistocene protomodonote (Protoemnodon anatii). Shenherus (aka "short-faced browsing kangaroos") and protomodontines are extinct lineages that achieved very large size in the Pleistocene. In all analyses, the Oligo-Miocene forms clustered with the modern browsers. In the PCA the Pleistocene shenherus had high values on PC1 (due to their large size), and also high values on PC2, clustering with the extant tropical forest browsers, distinguished by a broad muzzle, a long preemol, low-crowned molars, and low rates of molar wear. However, in the CVA the Pleistocene shenherus did not group with any modern dietary class. In a CVA excluding omnivores the species of Sthenurus occupied a region that split the browser and the morphospace created by the possession of a very deep angle of the jaw. Rhizosthenurus and Protemnodon fell in the space between the Sthenurus cluster and the exait tropical forest browsers. A similar pattern emerged in an analysis where grazers and mixed feeders were lumped in a single category, but here the shenherus were distinguished by a very deep zygomatic arch. Derived shenherus had a distinct set of craniodental adaptations unlike those of other short-faced browsing kangaroos. Although the morphological features in the analysis included both total skull length and length of the face, it is interesting that neither of these features was selected as a variable by the CVA to distinguish shenherus. Rather, shenherus are distinguished by features relating to the size of the masseter muscle, either a broad zygoma for its origin, or a deep angle of the jaw for its insertion. The implication is that the short face (which is itself a derived feature) is related to some aspect of muscle shape to accommodate a large masseter muscle, possibly related to the exertion of greater force with the incisors.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

PALEOAERIE: MULTIPLE AVENUES BRINGING EVOLUTION EDUCATION TO FORMAL AND INFORMAL EDUCATORS AND THE PUBLIC AT THE SAME TIME

DANIEL, Joseph, University of Arkansas for Medical Sciences, Little Rock, AR, United States, 72205

Paleoaerie is central to modern biological thought, yet it is not accepted by a large segment of the population and is often not taught in schools due to ignorance and misperceptions of what evolutionary theory actually states, a weak understanding of the nature of science, and an overall resistance to change, the defining characteristic of evolution. This problem is especially acute in Arkansas, which has a higher than average percentage of avowed creationists and unqualified science teachers, combined with a lack of sufficient resources to educators. The Arkansas Educational Resource Initiative for Evolution (AERIE) addresses this problem in two ways. First, it provides professionally vetted information. Because fossils, and especially dinosaurs, are widely popular, many of the resources use them as a hook to begin discussion of a wide variety of topics. As such, the project is known as PALEOAERIE. Secondly, it brings content experts, informal and formal educators, and the public together in unique educational environments.

Several methods are utilized for this project. A public website (Paleoaerie.org) and several media social outlets supply original material (including discussions of Arkansas fossils) and serve as portals to high quality web resources. An educator workshop series provides information on evolution, the nature of science, and teaching techniques. They also serve as a platform for bringing informal and formal educators together to forge new collaborative opportunities. A series of public presentations promote evolutionary concepts to a broad audience. Finally, an extended trip to museums in New York and Washington, D.C. will be undertaken with a group of content experts, formal and informal educators, middle school aged students identified as being from an underserved population, and their parents. The students and their parents will work together on projects designed to encourage examination and discussion of evolutionary concepts and evidence for them, which can increase parent involvement in their child’s education. They will be assisted by the educators and content experts who will themselves gain new information on science and evolution. Teaching techniques will be discussed, with the educators from different environments sharing expertise, and further collaboration may be encouraged. Over the last decade, alumni and invited non-alumni individuals from multiple educational paths, will inspire greater knowledge of and appreciation for evolutionary concepts and create lasting bonds between participants.

Technical Session XVI (Saturday, November 2, 2013, 3:00 PM)

NEW DATA ON A XINJIANGCHELYID TURTLE FROM THE MIDDLE JURASSIC OF SIBERIA, RUSSIA

DANILOV, Igor, Zoological Institution of the Russian Academy of Sciences, St. Petersburg, Russia; OBRATSOVA, Ekaterina, St. Petersburg State University, St. Petersburg, Russia; SYROMYATNIKOVA, Elena, Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; KRAKOLUTSKII, Sergei, Sharypovo Regional Museum, Sharypovo, Russia

Over the last decade, although no turtle material was collected from the upper part of the Middle Jurassic (Bathonian) Itat Formation of Berezovsk quarry, Krasnoyarsk Territory, West Siberia, Russia. This material consists of thousands of isolated bones and several complete specimens, including a partial shell and a large portion of the shell. This material belongs to a single taxon which probably represents a new species of Xinjiangchelyidae. The attribution of this turtle to Xinjiangchelyidae is based on a combination of the following characters: canals for internal carotids partially or completely opened ventrally; absence of basiangular plates; anterior peripherals with prominent outer rows of teeth; absence of processes of plastron; prominent guttered edges, middle marginals extend onto costals; dorsal processes of epiplastra present; entoplastra longer than wide; mesoplastra absent; formed cervical articulations absent. This taxon was also characterized by midline contact of costal 7, vertebrae 2 and 3 narrower than vertebral 1, ligamentous plastron-carapace connection, pectorals and abdominals similar in length, a sinus midline sulcus of the plastron, and fusion of carapacial bones at the carapace length about 20 cm. In addition, it demonstrates variation in the formula of anterior neurals, number of supragnosts, length of thoracic rib 1, which can span less than or more than half of costal 1, position and shape of sulcus between vertebrae 2 and 3, and presence/absence of an anal overlap on the suprapygal (both from the Late Jurassic of Mongolia), supported by two synapomorphies (vertebrae 2 and 3 narrower than vertebral 1 and sulcus between vertebrae 3 and 4-V-shaped). The relationships of the new taxon within the Ammela clade remain unresolved. The xinjiangchelyid from Berezovsk Quarry is peculiar in that it is the oldest well dated and the northernmost record of this group in Asia. It is also the dominant taxon in the vertebrate assemblage of Berezovsk Quarry. The low taxonomic diversity of the turtle assemblage of Berezovsk Quarry resembles xinjiangchelyid dominated localities of the Callowian – Oxfordian Shishkou Formation of the Junggar Basin of China and the Balkassai Formation of Kyrgyzstan. The paleoecological significance of this pattern is uncertain.

Technical Session XI (Friday, November 1, 2013, 2:30 PM)

PALEOECO-EOCENE EVOLUTION OF BETA-DIVERSITY AMONG UNGULATE MAMMALS IN NORTH AMERICA

DARROCH, Simon, Yale University, New Haven, CT, United States, 06511; LONGRICH, Nicholas, Yale University, New Haven, CT, United States; WEBB, Amelia, Yale University, New Haven, CT, United States; BELMAKER, Jonathan, Tel Aviv University, Tel Aviv, Israel

The Paleocene-late Eocene transition in North America marks a critical interval in the evolution and diversification of land mammals, including adaptive radiation in the Paleocene, and repeated waves of immigration over land bridges at the Paleocene-Eocene boundary. We investigate the fossil record of ungulate mammals over this period to understand the effects of immigration and faunal exchange on local (alpha), regional (gamma), and between-site (beta) diversity. We use Paleocene and Eocene records of North American ungulates from the Paleobiology Database (PBDB), and calculate beta diversity among families and genera within the last seven of the Cenozoic. We further reconstruct geographic range sizes for studied taxa, and test trends in these ranges against null models used to control for sampling biases. Finally, we use Mantel tests to quantify the relationship between geographic distance and faunal dissimilarity within each time slice, in order to visualize changes in the spatial complexity of mammalian communities over the studied interval. Overall (gamma) diversity increases over the studied interval, with varying contributions from alpha and beta. Beta diversity increases from the Paleocene to Eocene, reflected in decreasing range size and increased correlation between reconstructed distance and faunal similarity. Increase in beta diversity over the Paleocene-Eocene transition is driven by smaller geographic ranges among putatively invasive 'immigrant' taxa; range contraction among these same groups in the middle-late Eocene leads to a peak in beta diversity in the Barremian. High gamma diversity in the Eocene was driven by high beta, rather than alpha diversity, indicating that immigrant taxa dramatically restructured the spatial organization of mammal communities. This suggests that over longer timescales, mass immigration events can lead to greater overall richness, and greater heterogeneity, rather than homogeneity, within regional assemblages.

Technical Session XI (Friday, November 1, 2013, 3:30 PM)

WHEN WAS THE MODERN LATITUDINAL RICHNESS GRADIENT ESTABLISHED?

DAVIS, Edward, University of Oregon, Eugene, OR, United States, 97403; EMERY, Meaghan, University of Oregon, Eugene, OR, United States; FAMOSO, Nicholas, University of Oregon, Eugene, OR, United States; MCGUIRE, Jenny, University of Washington, Seattle, WA, United States

"Macroecological research has established that ecological richness decreases with latitude in a variety of modern systems, from mammals to vascular plants, and extending even to human cultural diversity. However, paleobiological research has suggested that..."
Eocene mammalian faunas in North America have either no latitudinal richness gradient or one in which richness increases away from the equator. Several factors have been suggested as drivers of the modern latitudinal richness gradient, with the two most important being primary productivity and latitudinal range expansion in the wake of glacial retreat since the Last Glacial Maximum (~21 ka). To test these hypotheses we investigated the onset of the modern richness gradient in the fossil record of North American mammals. We calculated species richness in 5 degree bands in each of the North American Land Mammal Subdivisions of the middle Miocene using mammal occurrence data from the FAUNMAP II and MIOMAP databases. Miocene intervals show variable latitudinal richness gradients with significant (p<0.05) positive gradients (inverted from the modern pattern) in the early and late Barstovian and late late Hemphillian. Other Hemphillian intervals show non-significant positive gradients. Pliocene and early Pleistocene intervals (Blancan and Irvingtonian) show a consistent non-significant negative gradient, transitioning into the modern strongly-negative gradient in the late Pleistocene (Rancholabrean) and Holocene. Our results suggest that continental glaciation played an important role in the modern negative gradient and that continued warming and range expansions in the wake of continental glaciation may dampen that gradient if species track preferred climates. However, the onset of the gradient before glacial cycling (and the inverse gradients in the late Miocene) suggest other factors are important drivers, including productivity and also long-term environmental stability.

Technical Session VIII (Thursday, October 31, 2013, 2:30 PM)

MIDDEL PERMIAN TETRAPOD BIODIVERSITY CHANGE AND THE GUADALUPIAN EXTINCTION: INSIGHTS FROM THE BEAUFORT GROUP OF SOUTH AFRICA.

DAY, Michael, BPI Palaeontology, Johannesburg, South Africa; RUBIDGE, Bruce, BPI Palaeontology, Johannesburg, South Africa

The Karoo Basin of South Africa is the world’s most continuous and best preserved Permian-Triassic terrestrial lithostratigraphic record. Its wealth of fossil tetrapods, to the degree that it has been subdivided biostratigraphically. The end-Permian Mass Extinction, the greatest of the Phanerzoic extinction events, is well recorded in the rocks of the Beaufort Group but an even earlier Permian extinction event, known from the marine realm of East Asia, has until now not been substantiated in the terrestrial realm. Extensive stratigraphic collecting of fossil tetrapods in the Lower Beaufort Group over several decades has enabled a higher resolution understanding of the ranges of individual tetrapod taxa during the Middle Permian than has existed before. Combined with an analysis of fossil localities taken from existing collections, this provides new insight on biodiversity change in the earliest therapsid dominated faunas. In addition, new radiometric dates from the Beaufort Group constrain the timing of several major biodiversity shifts. The stratigraphic ranges of tetrapod genera are found to be more complex than previously thought, while the stratigraphic extent of the end-Permian biotic zones is also more heterogeneous. Biodiversity peaks in the upper Tapioccephalus Assemblage Zone but two periods of significant generic turnover occur within the succession. Furthermore, the stratigraphic ranges of fossil taxa have been related to lithostratigraphic units, comprising over 2 km of strata, which has allowed higher resolution biostratigraphic correlation around the Karoo Basin.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

PELVIC GIRDLE AND HIND LIMB MUSCULATURE OF BAURUSUCHUS ALBERTOI: A BIOMECHANICAL APPROACH

DELcourt, Rafael, Museu de Zoologia da Universidade de Sao Paulo, Sao Paulo, Brazil; NASCIMENTO, Paulo, Museu de Zoologia da Universidade de Sao Paulo, Sao Paulo, Brazil; CARVALHO, Alberto, Museu de Zoologia da Universidade de Sao Paulo, Sao Paulo, Brazil; ZAHER, Hussam, Museu de Zoologia da Universidade de Sao Paulo, Sao Paulo, Brazil

Baurusuchus is an abundant family of the clade Notosuchia erected by Price in 1945 to allocate Baurusuchus pachecoi and its relatives. Among the specimens of this family, Baurusuchus albertoi (Museu de Zoologia da Universidade de Sao Paulo specimen MZSP-PV 140) is represented by a fragmentary skull and an almost complete postcranial skeleton from the Bauru Basin (Upper Cretaceous of Brazil). We reconstructed the pelvic girdle and hind limb musculature of B. albertoi using the Extant Phylogenetic Bracket to infer its origins and insertions. The surface bones homologies were traced from the extant taxa Crocodylia and Aves. The ischium of B. albertoi is unreserved and its muscles were inferred using the undubious baurusuchid MZSP-PV 839. The musculature of ilium is very similar to crocodilians, however the origins of the ilial muscle masses are larger in B. albertoi than in crocodilians. The supracaudal muscle arises from a small tubercle of the ilium wall, posterior to the acetabulum, differing from extant crocodilians. The caudofemoralis brevis muscle arises from the ventral surface of the postacetabular ala as seen in crocodilians. B. albertoi shows a conservative femoral musculature except for the insertion of puboischiofemoralis internus part 2 (PIF2) muscle. Like in dinosaurs, this muscle is positioned more anteriorly than in crocodilians reducing the torsion of the femur, a condition also observed in Stratosaurus maschetti. The anterior position of the muscle PIF2 contributed to the erect position of the hind limb, since this muscle has a very high hip flexor. The musculature of tibia, fibula and feet in B. albertoi is very similar to extant crocodilians, varying topologically. Baurusuchis possess some analogous features with dinosaurs, which suggest that they could have kept an erect position of the hind limbs. Among theropods and ornithischians, several taxa have a similar muscle insertion pattern to B. albertoi. The crest covers the femoral head and may minimize the leg impact during speed running. In the articulated specimen MZSP-PV 839 the ilium is laterally inclined about 30° in relation to the sagittal plane, allowing the antitrochanter to be accommodated by the fossa trochanterica of the femur. This condition gave the baurusuchids a columnar posture of the hind limb, maybe allowing them to increase velocity during a run. Since the baurusuchids were a diverse group and occupied an important niche in the Upper Cretaceous of Brazil, the understanding of muscular patterns and biomechanics will provide more data to infer their ecological interactions.

Technical Session V (Wednesday, October 30, 2013, 2:15 PM)

A NEW EXTINCT SPECIES OF BLANUS (AMPHISBAENIA, BLANIDAE) FROM THE IBERIAN MIOCENE BASED ON THE FIRST KNOWN EUROPEAN AMPHISBAENIAN FOSSIL SKULL

DELFINO, Massimo, Università di Torino, Torino, Italy; BOLET, Arnau, Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain; FORTUNY, Josep, Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain; ROBLES, Josep M., Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain; ROBLES, Josep M., Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain;
de Paleontologia Miquel Crusafont, Barcelona, Spain; ALBA, David M., Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain

The first known nearly complete amphibian fossil skull from Europe was recently collected in the locality ACM/C8-A4 of the lower stratigraphic series of Abocador de Can Mata (Vallès-Penedès Basin, NE Iberia), whose estimated age corresponds to 11.6 Ma (late Aragonian, MN7+8). It is embedded in a hard concretion that precludes the mechanical preparation of the small and delicate cranial remains and, therefore, was studied using computer tomography. All the elements of the right half of the cranial cavity and lower jaw were preserved, which enabled us to evaluate the morphology of the whole undeformed skull (11.3 mm long). This specimen is clearly referable to genus Blanus (among other characters: 7 premaxillary, 5 maxillary, and 8 dentary pleurodont teeth; first dentary tooth smaller than the third) but differs from all known extant and fossil species of the following characters: very long, apically truncated nasal process of the premaxilla; relatively long and roughly rectangular frontals; almost straight suture between the frontals; strong interdigitation of the frontoparietal suture. The nearly 50 amphibian large vertebrate recovered from the same site are morphologically congenital with those of extant blanids, and are thus tentatively referred to the new species. Both the neck and anterior trunk vertebral are characterized by paracoroidal tubercles, which might also represent a potential diagnostic character. Europe is currently inhabited by two extant species of Blanus, whereas two other species of this genus inhabit NW Africa, and a fifth one is widespread in Anatolia and the NW sector of the Mediterranean Basin. Unraveling the evolutionary history of these taxa is hampered by two different factors. First, the comparative osteology of all these extant species is so poorly known that the known fossil record is of little help for unveiling their past distribution, timing of dispersal and phylogenetic relationships. Second, although the European fossil record of amphibians is rather abundant, it is mostly represented by few isolated skull elements (mainly premaxillae, maxillae and dentaries) and vertebral, whose diagnostic value is rather limited. Three Neogene blanids (Palaechthonius tobeni, Blanus antiquus, and Blanus balbarus) are the most considered taxa whose relationships with extant taxa are uncertain. The nearly complete skull from ACM/C8-A4 considerably improves the knowledge of extinct blanids and represents the first chance to evaluate their relationships with extant taxa.

Technical Session V (Wednesday, October 30, 2013, 2:45 PM)

SQUAMATE TURNOVER IN THE 2 MILLION YEARS LEADING UP TO AND ACROSS THE K-PG BOUNDARY IN NORTHEASTERN MONTANA: EVIDENCE FOR A COMPLEX EXTINCTION SCENARIO

DEMAR, David, University of Washington, Seattle, WA, United States, 98195; WILSON, Gregory, University of Washington, Seattle, WA, United States

The timing and mechanisms of the Cretaceous-Paleogene (K-Pg) mass extinction remain hotly debated. Here, we examined squamate (lizards, snakes) diversity dynamics leading up to and across the K-Pg boundary based on vertebrate microfossil assemblages from 27 temporally constrained localities spanning most of the Hell Creek Formation (HC) and the lower third of the overlying Tullock Formation (TU) in Garfield County, Montana. The data set contains hundreds of specimens diagnostic at the species level. Seventeen known latest Cretaceous and earliest Paleogene squamates occur in the local section (e.g., Leptochamops, Proxestops). We also report the first record of the Late Cretaceous chamaepsid Socognathus from the HC. We recognize 14 novel taxa including multiple polyglyphodontodontians, platynomus, and an anguid from the HC. Several known taxa (Chamops, Meniscognathus, Parasanzia, Palaeosanzia) span much of the HC including Oxodossaurus and Eostinus, both of which also cross the K-Pg boundary. Some taxa are restricted to the middle (Coniohipps) or upper third (Penetesus, Haplopholis) of the HC. Our data suggests that squamates only occur in the lower half of the HC. Squamate richness, which we based on range-through occurrences, fluctuated but remained relatively stable (~7 taxa) from localities spanning ~71.2 m of the ~89.5 m-thickness of the HC. Turnover rates also remained relatively stable with minor fluctuation in species disappearance rates. We found similar pattern of disappearances at the Montan level of HC (82.5%) of ca. 800-900 thousand years (ky) before the end of the Cretaceous, but the true may be underestimated based on 10 lower HC singleton taxa not included in the calculations. Through the uppermost 20 m of the HC, which corresponds to the last ca. 400 ky of the Cretaceous, disappearance rates progressively increase from ~12% to 50% culminating in 70% species-level extinction across the K-Pg boundary. The timing and, to a larger extent, magnitude of squamate turnover mirrors the pattern of amphibian turnover from the study area; together, they provide support for a multiple cause extinction scenario.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

BONE HISTOLOGY OF SNAUROPOD DINOSAURS FROM NIGER

DEMIE, Michael, Stony Brook University, Stony Brook, NY, United States, 11794; SERENO, Paul, University of Chicago, Chicago, IL, United States

The bone histology of sauropod dinosaurs is of particular interest given their exceptionally large adult body mass. Two problems surrounding sauropod bone histology are currently considered the most important—the relative roles of lines of arrested growth in sauropod sampling gaps across this very diverse, long-lived clade. We present styloloidal and costal bone histology from two sauropods from Niger, Jobaria tiguidensis and Nigersaurus ataqi, to sample non-naurosauropods and rebbachisaurid diplodocoids, respectively. Jobaria was one of the largest sauropods, whereas Nigersaurus was one of the smallest. The two species also diverged greatly in cranial anatomy: for example, Jobaria had stout, leaf-shaped teeth, whereas Nigersaurus had a highly derived battery of pencil-shaped teeth. Despite these and other differences, the styloloidal bone histology of both, Jobaria and Nigersaurus, is remarkably similar and resembles that of most sauropod fibrolamellar bone predominates, with growth lines limited to the outermost cortex adjacent to an external fundamental system, and remodeling appears only late in life. This finding is surprising for Nigersaurus, because unusual histology might be expected given its very small adult body mass and derived anatomy. The costal histology of a large adult Jobaria specimen indicates an age of less than 30 years at death with asymptotic adult body size achieved in about 20 years. We analyze sauropod bone histology in the context of body size evolution, highlighting the histological features that distinguish particular clades.

Technical Session II (Wednesday, October 30, 2013, 11:30 AM)

EVIDENCE FOR ECO-MORPH DIVERSITY WITHIN OLIGO-MIOCENE MACRODOPHORMS

DEN BOER, Wendy, Uppsala University, Uppsala, Sweden; KEAR, Benjamin, South Australian Museum, Uppsala, Sweden

Despite being uniquely specialized towards bipedal hopping, extant kangaroos and rat-kangaroos (Macropodiformes) are known to utilize a spectrum of locomotive modes, including slow ‘pentapedal’ progression with the tail, quadrupedal bounding, burrowing, and climbing. Nevertheless, phylogenetic evidence indicates that all these gaits are manifest within a single monophyletic radiation, which diversified following the onset of aridity in Australia during the late Miocene. Prior to this timeframe, a completely separate stem clade – Balbaridae – proliferated in late Oligocene-middle Miocene forested environments, and is thought to have been primarily quadrupedal based on a single distal hindlimb bone and cranial remains from the Riversleigh World Heritage Area of Queensland. However, the chance discovery of other isolated macropodiform elements amongst bulk acid processed bones from Riversleigh has revealed a potentially different eco-morph, displaying loosely articulated tibiae and fibulae, a notabilite pes, enhanced mobility between the metatarsals, and sharply curved pedal unguals that are convergent upon living tree-kangaroos; although, at least one putative balbarid synapomorphy is observable on the remains. Proxy locomotive comparisons using relative warps and a principal component analysis of two-dimensional landmark data derived from pedal claw shape confirms disparity between these balbarids, which alternatively cluster with obligate bipedal saltators (e.g. Macropus), or modern Rock wallabies (Petrogale) who

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

IMMERSION OF EVOLUTIONARY CONCEPTS ACROSS SCIENCE CURRICULA

DESANTIS, Derek, Ravenwood High School, Brentwood, TN, United States, 37027; DESANTIS, Larisa, Vanderbilt University, Nashville, TN, United States

Evolution remains highly controversial, even in the most affluent and educated communities. While research is aimed at understanding why students are resistant to accepting cross-cutting and core ideas like evolution, student acceptance of evolution is low in certain geographic regions of the United States, including southern states where political and religious convictions may prevent students from accepting evolutionary concepts. The Next Generation Science Standards and Framework lists evolution as one of four core concepts in the life sciences and devotes numerous standards to evolution; however, with parent resistance to the teaching of evolution and recent state legislation encouraging teachers to teach the ‘scientific strengths’ and ‘scientific weaknesses’ of evolutionary education, a strategy for inoculating students against anti-evolution rhetoric through the immersion of evolutionary concepts across science curricula. Specifically, science process skills can be developed while also communicating evolutionary concepts and material. We discuss two case studies in which evolutionary concepts were discussed while implementing standards pertaining to science process skills and/or skeletal anatomy. First, we replicated an experiment published in Biology Letters that demonstrates the benefit (i.e., reduced time necessary to pass marbles through a hole) of having wet wrinkled fingers as opposed to wet smooth fingers. This experiment was fairly simple, but implemented an experimental design that altered the order of various treatments. As the focus of the lesson is on experimental design and making sure that treatments occur in different orders to reduce the effect of students trying to ‘beat’ their prior times, concepts pertaining to evolution are discussed in a subtle manner. Despite the subtle integration of evolution, students often comment that they no longer go swimming without thinking, ‘how cool is it that wrinkled fingers evolved to increase our ability to grip objects.’ Second, a fairly simple lesson on skeletal anatomy was adapted to also include fossil and modern non-human specimens. Through an inquiry-based lesson, students must compare human anatomy and that of other organisms to non-humans, including non-human primates, to infer relationships. Infusion of evolutionary content into lessons focused on other science standards is an effective way to improve evolutionary understandings and help inoculate students to anti-evolution rhetoric, in K-12 classrooms.

Technical Session II (Wednesday, October 30, 2013, 8:45 AM)

DIRECT COMPARISONS OF 2D AND 3D DENTAL MICROPEEL WAX PROFILES IN EXTANT HERBIVOROUS AND CARNIVOROUS MAMMALS: THE IMPORTANCE OF DEPTH AND OBSERVER CONSISTENCY FOR RESOLVING DIET

DESANTIS, Larisa, Vanderbilt University, Nashville, TN, United States, 37235-1805; SCOTT, Jessa, University of Arkansas at Little Rock, Little Rock, AR, United States; SCHUBERT, Blaine, East Tennessee State Univ, Johnson City, TN, United States; DONOHUE, Shelly, Vanderbilt University, Nashville, TN, United States; MCCRAY, Brian, Vanderbilt University, Nashville, TN, United States
The analysis of dental microwear is commonly used by paleontologists and anthropologists to clarify the diets of extinct species, including herbivorous and carnivorous mammals. Currently, there are numerous methods, varying in the types of microscopy utilized, their magnification, and the interpretation of data to three-dimensions (2D) and three-dimensions (3D). Results from studies utilizing differing methods are not directly comparable and human quantification of wear features (e.g., pits and scratches) introduces interobserver error, with higher error being produced by less experienced individuals. Dental microwear texture analysis (DMTA), which analyzes microwear features in 3D, alleviates some of the problems surrounding 2D microwear methods by reducing observer bias. Here, we directly compare 2D and 3D dental microwear features of extant herbivorous and carnivorous mammals at 100x magnification. Specifically, we generated 2D microwear data from photomicrographs of DMTA 3D point clouds (i.e., digitally scanned areas) of extant African bovids (4 species) and carnivores (3 species). We analyzed taxa with similar dental morphology (within each group) representing distinct dietary niches, to address the following questions: (1) does 2D and 3D microwear studies produce accurate and comparable dietary interpretations of extant taxa with known feeding behavior, (2) how does the inclusion of depth alter or improve dental microwear interpretations, and (3) can different observers generate comparable data using 2D wear feature counting methods in herbivorous and carnivorous mammals? Dental microwear features quantified in 2D were able to separate grazing and frugivorous bovids using scratch frequency (ANOVA, p<0.001) and flesh consuming cheetahs from dufroghpohic spotted hyenas using the number of scratches and coarse scratches (ANOVA, p<0.017 and p<0.004, respectively), but DMTA variables were better able to discriminate between disparate dietary niches in both herbivorous and carnivorous mammals. Further, results demonstrate significant interobserver differences in 2D microwear data (mean percent differences of ~45 and ~49% in bovids and ~61 and ~169% in carnivorans scratches and pits, respectively) with the microwear index remaining the least variable between experienced observers, consistent with prior research. Our results highlight the importance of reducing observer error and analyzing dental microwear in 3D in order to consistently and accurately interpret modern and ancient diets.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)
UNIVERSITY STUDENTS’ ACCEPTANCE OF CLIMATE CHANGE AND EVOLUTION: ARE SKELETS JUST ANTI-SCIENCE?

DESANITIS, Larisa, Vanderbilt University, Nashville, TN, United States, 37235-1805; LASHINSKY, Nick, Vanderbilt University, Nashville, TN, United States; ROMER, Jennifer, Vanderbilt University, Nashville, TN, United States; GRESHKO, Michael, Vanderbilt University, Nashville, TN, United States; LOFFREDO, Lucas, Vanderbilt University, Nashville, TN, United States

Evolutionary and global warming are among the most politically controversial topics discussed in the media and in public audiences, despite the overwhelming acceptance of these ideas by the scientific community. While evolution has sparked debate since the inception of the idea by Charles Darwin in 1859, the passage of the Butler Act in 1925 made the teaching of evolution illegal in Tennessee public schools and was challenged in the Scopes Monkey Trial, although not repealed until 1967. As Tennessee has been a focal point of current debates regarding the teaching of evolution and global warming in public schools, we here assess University students’ acceptance of evolution and climate change in a Tennessee private university. Specifically, we test the following hypotheses: (1) anti-evolution and anti-climate change individuals are the same individuals; (2) acceptance of evolution and climate change are dependent on strength of religious and political convictions; and (3) a student’s science background and/or interest in science affects their acceptance of evolution and climate change. Further, we aim to assess if there are any correlations between gender, age, family income, parents’ education, and other demographic variables with acceptance of evolution, climate change, and other scientific theories. Although we expected political affiliation and one’s belief in God, to a significant degree to be predictive of acceptance of climate change and evolution, respectively, we found that political affiliation is correlated with 98% of all relevant response metrics for both evolution and climate change, while religious convictions were correlated with 100% of evolution metrics and 83% of climate change metrics. Further, acceptance of evolution and climate change are significantly correlated in 95% of all response variables, suggesting that anti-evolution and anti-climate change individuals are the same individuals. Surprisingly, prior science content (i.e., if evolution, human evolution, creationism, and evolution was taught) (i.e., number of courses taken) is less predictive of one’s acceptance of evolution and climate change. However, an increased interest in science (i.e., if one keeps up with scientific discoveries in the news) is significantly related to a student’s increased acceptance of these theories. As paleontologists, we have a unique opportunity and responsibility to increase student interest in science through the communication of scientific discoveries to public and student audiences.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)
DIGITAL MODELING AND 3D VISUALIZATION OF THE AXIAL SKELETON OF THE EARLY PERMIAN CAPTORHINID REPTILE LABIDOSAURUS

DEVLIN, Kathleen, California State University San Bernardino, San Bernardino, CA, United States, 92407; JEFFCOAT, Brian, DreamWorks Feature Animation, Glendale, CA, United States; SUMIDA, Stuart, California State Univ San Bernardino, San Bernardino, CA, United States

The basal captorhinid reptile Labidosaurus is known from Early Permian deposits in Baylor County, north-central Texas (Clear Fork Group and the Fort Worth Basin, Permian Formations). Its postcranial skeleton has been previously studied and partially illustrated. However, because the most completely articulated specimens could not be fully prepared it has never been fully reconstructed and body outline interpretations remained speculative. Newly examined specimens and additional preparation of previously described specimens has allowed for 3D laser surface scanning of the entire presacral column and subsequent digital modeling of the complete axial skeleton using the computer-aided design (CAD) software package Maya. A movable 3D reconstruction of the axial skeleton was then possible. Well preserved individual elements from the same locality (Olson’s “Labidosaurus pocket”) were also scanned and digitally resized to allow more complete reconstruction of sections of the column that remained inaccessible due to matrix. Damage due to cracks could be removed while retaining the exact measurements, magnification, and proportions of each individual vertebral element. A complete reconstruction of the spacing of the skeletal elements in the completely articulated specimens could be made. The presacral column is barely twice the length of the skull. Reconstruction of the life-positions of the ribs indicates that Labidosaurus did not have a large, barrel shaped body suggestive of high-fiber herbivory. Further, its body outline was probably narrower than the width of caudal margin of its large heart-shaped head.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)
CAN SKULL SHAPE INDICATE AGGRESSIVE BEHAVIOR IN SEALS?

DEWAR, Eric, Suffolk Univ, Boston, MA, United States, 02114; CROCKER, Carly, Suffolk University, Boston, MA, United States

Many living seal species show varying degrees of aggression and other intraspecific displays. Could skull shape dimorphism be related to aggression in seals? We tested the hypothesis that more aggressive species (and sexes) would have different skull proportions than less aggressive ones. We characterized living seals as “highly” or “less” aggressive species, based on behaviors reported for them in the literature. Highly-aggressive species were identified throughout the Phocidae, so we believed that any differences in morphology would be due to behavior or ecology rather than phylogeny. We photographed skulls of 14 species of living and extinct seals (n = 76) and measured each skull’s total length, cranial length, facial length, cranial width, and zygomatic arch width to seek indicators of dimorphism.

In our sample, only one highly aggressive species (Crytospora crista) had individuals that had been identified to sex. We found that males had wider zyomatic arches than their crania (t(69) = 3.15, p = 0.03) and a longer face than cranum (t(69) = 3.63, p = 0.03). Less aggressive species did not differ in these measures. From these observations, we were able to hypothesize the relative degree of aggression of the extant species such as the Caribbean monk seal Monachus tropicalis, which fell within the highly-aggressive group.

Symposium I (Wednesday, October 30, 2013, 11:45 AM)
FUNCTION OF RUDIMENTARY LOCOMOTOR STRUCTURES IN THE ECOLOGY OF BIRDS: EVOLUTIONARY IMPLICATIONS

DIAL, Kenneth P., University of Montana, Missoula, MT, United States, 59812

Charles Darwin’s theory of natural selection revolutionized the way we think about life and its history. From the beginning, however, one major challenge for Darwin was "organisms of extreme perfection and complication". Natural selection could explain how small phenotypic differences that already existed within a population might confer greater fitness and be selected for, but how do complex structures actually appear in the first place? How do incipient, transitional, or morphing structures function? Answering these types of questions is central to understanding major transformations, such as the developmental or evolutionary acquisition of flight in birds. Yet the functional utility of incipient or "rudimentary" (evolving, developing, or secondarily reduced) structures, even among extant species negotiating their natural habitats, is largely unknown. This general lack of understanding may result from an assumption that underdeveloped and vestigial structures are functionally useless. However, studies examining the ontogenetic locomotor behavior of extant avian species (ranging from basal to derived) show that during the developmental acquisition of powered flight, immature birds transition between terrestrial, aquatic, and aerial media by using their incipient wings and legs cooperatively. Such behaviors are also relevant to adaptations with secondarily reduced wings. Here, I present results from recent lab and field studies on the locomotor development of avian species with different life history trajectories and different habitat preferences. Results to date suggest that: (1) there are tradeoffs between wing and leg investment and locomotor performance, which may be ameliorated by the cooperative use of wings and legs, and (2) differential predation pressure is correlated with wing and leg investment and fast versus slow developmental life history trajectories. Studies of post-natal locomotor development and recruitment of secondarily reduced structures offer unprecedented opportunities to experimentally explore form-function relationships and ecologically relevant behaviors of transitional stages in many groups, and thereby enhance our understanding of evolutionary transformations.
Technical Session I (Wednesday, October 30, 2013, 10:15 AM)

PHYLOGENETIC ANALYSIS AND PALEOBIOGEOGRAPHY OF THE PANGAEO LOWER TRIASSIC LYDEKKEINIDAE (TEMNOSPONDYLI, STEREOSPONDYLI)

DIAS-DA-SILVA, Sérgio, Universidade Federal do Pampa, São Gabriel, Brazil; HEWISON, Robin, Universidade Federal do Pampa (invited collaborator), São Gabriel, Brazil

The composition of the Lower Triassic Lydekinidae and its taxonomic relationships remain poorly understood, despite much research. In this contribution, the first comprehensive computer-based parsimony analysis of all taxa that have been previously regarded as lydekerinids (excluding the fragmentary, taxonomically doubtful, and uninformative Cryothorax and Indohoplostomus), together with a wide range of other taxa unreported to them, is performed. The phylogenetic analysis involved 154 characters and 31 terminal species, and aimed to provide a 'robust' phylogeny of the family and its phylogenetic relationships to other stereospondyls. Lydekinidae was found to be a monophyletic group (consisting of ten taxa) divided into two monophyletic subfamilies: Lydekeriinae (A comprising Lydekeria paludinatans, Putterillus platycercus, Delacopephalus whitei, Lydekeriana huxleyi, Eolydekerina magna, and Bromious dutoi) and subfamily B comprising Lydekerinae panchovetenis, Chomatomorphaeus huehi, Laeziocophalus blomi, and Laeziocophalus kochi). Lapilliptopus nana was found to be the sister taxon of the Lydekeriinae. The phylogenetic analysis also recovered a congruent palaeoecogeographic distribution of the lydekerinids: subfamily B is divided into two more inclusive clades, one including Indian and Australian taxa, and the other including European forms. On the other hand, the more inclusive subfamily A includes five South African taxa plus Delacephalus from Madagascar. Unexpectedly, the recovered strict consensus tree did not support lydekerinids as offspring of the Rhinenschauide as stated in many previous contributions. Instead, a controversial result places Lydekinidae as a derived clade in a sister group relationship; a clade including other brachiosaurids and dvinosauromorphs. Thus, rhinenschauide Stereospondyl Rhinocetus nyanasus and several non-lydekerinid stereospondyls included in the ingroup come from South Africa (and also the rhinenschauide-like Achuran eugia and also other basal forms from Uruguay and Brazil), a western Gondwanan origin for Stereospondylidae is fully supported in this contribution.

Poster Session II (Thursday, October 31, 2013, 4:15-6:15 PM)

MICROWEAR PATTERNS OF THE TITANOSAURIAN TEETH FROM THE LATE CRETACEOUS OF “LO HUECO” (CUENCA, SPAIN)

DIEZ DÍAZ, Verónica, Universidad del País Vasco/Euskal Herriko Unibertsitatea, Bilbao, Spain; ORTEGA, Francisco, UNED, Madrid, Spain; SANZ, José Luis, Universidad Autónoma de Madrid, Madrid, Spain

The microwear patterns on the apical facets of sauropod teeth are interesting as a source of complementary information for the study of diets, and ontogenic or interspecific niche partitioning. Some wear analyses have been developed for titanosaurian teeth (i.e., in Argentina and southwestern Europe). For the Spanish record, these analyses were carried out on samples from the Laño fossil-site (Condado de Treviño) attributed to the titanosaur Acheloma cumminsii. These new data therefore provide rare direct fossil evidence of a Late Cretaceous crocodiform biting the head of a large-bodied prey, either during a predation event or post-mortem during feeding or scavenging.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

THE CARPUS AND TARSUS OF TEMNOSPONDYLI

DILKES, David, Univ of Wisconsin Oshkosh, Oshkosh, WI, United States, 54901

Carpals and tarsals are among the most poorly known bones of the skeleton in early tetrapods because the bones are either completely cartilage and not preserved, partially ossified revealing little details of their original shape, or simply absent in known specimens. Temnospondyls typically have the best preserved carpal and tarsal bones, and the carpus of Eryops megacephalus and tarsus of Acheloma cumminsii are the most thoroughly described and illustrated for early tetrapods. A new study of the carpus of Eryops confirms only four digits and no evidence of a prepollex, postpollex, or a distal carpal 5. The surface on the distal end of carpel 1 supposedly for a prepollex is a portion of the contact surface for metacarpal 1 that included distal carpal 1. A notch in the intermedium does not articulate with a corner of the radius as previously thought. A section at the distal end of the ulna interpreted as a surface for a postpollex imprints the ultimate orientation of the tarsus and digits of the type of Eryops kochi (junior synonym of Acheloma cumminsii) revealed an oval fibulare with a v-shaped distal end, contact between the tibiale and centrale 2, and a vertically canal centrale 4 with an expanded articular surface for the tibiale that continues onto the ventral side and a narrow contact for the fibulare. Restoration of the carpus and tarsus of the dissorophid temnospondyl Dissorophus multicuscinus and Cucops aspidopleurus, the carpus of Acheloma, and study of an undescribed tarsus of Eryops has provided phylogenetic data. Centrale 4 of the carpus of temnospondyls, except for stereospondyls with typically less ossified carpals and tarsals, has a triangular shape consisting of a broad contact with centrale 3 and 4 and distal carpal 3 tapering to a blunt tip between the ulnare and metacarpal 4. The shape of centrale 4 in the tarsus not for Eryops and a contact with distal tarsal 4 are present in other temnospondyls including the stereospondyl Scelaphus. Non-temnospondyls such as Greererpeton and Protorogyrinus have a centrale 4 with a diamond shape that lacks contact with distal tarsal 4.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

CROCODYLOIDIFORM BITE MARKS ON AN ARTICULATED GYPSOPODUS (DINOSAURIA- HADROSauraE) CRANIAN FROM THE UPPER CRETACEOUS OF SOUTHERN UTAH

DINTER, Cory, University of Utah, Salt Lake City, UT, United States, 84112; IRMIS, Randall, University of Utah, Salt Lake City, UT, United States

The feeding behavior of extinct vertebrate animals rarely leaves direct evidence in the fossil record. Bite marks and other tooth traces are a noteworthy exception; they are an unambiguous record of trophic relationships. Among Mesoecocian terrestrial vertebrate fossils, most studies have focused on traces made by theropod dinosaurs on postcranial elements such as ribs and limb bones. A newly discovered cranium of the hadrosaurid ornithopod dinosaur Gypsopodus, from the upper Campanian Kaiparowits Formation of southern Utah, possesses multiple tooth traces. Bite marks are observed in two sets: four shallow, parallel mediolaterally-oriented scores on the dorsal surface of the skull roof across the naso-frontal roots; and an unoriented parallel series on the ventral surface of the right dentary. The alignment of the traces indicates that they were inflicted upon a still-articulated skull and jaw, despite the fact that the lower jaws were disarticulated before final burial. This might suggest the possibility that these bite marks record an act of predation on a live animal, although scavenging cannot be ruled out. Only two known vertebrate carnivores in the Kaiparowits assemblage were large enough to have inflicted these wounds: tyranosauroid theropod dinosaurs and large crocodiliforms. The marks preserved on the Gypsopodus skull and jaw are long, shallow scores with a V-shaped cross-section, nearly identical to those made by extant crocodilians. In contrast, tyranosauroids and other theropods leave deeper and narrower scores with V-shaped cross-sections. These new data therefore provide rare direct fossil evidence of a Late Cretaceous crocodiform biting the head of a large-bodied prey, either during a predation event or post-mortem during feeding or scavenging.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

ICHTHYOFANA OF THE CYPRESS HILLS FORMATION (LATE EOCENE- EARLY OLIGOCENE), EASTEND AREA, SASKATCHEWAN, CANADA

DIVAY, Julien, Univ of Alberta, Edmonton, AB, Canada, T6G 2E9; MURRAY, Alison, Univ of Alberta, Edmonton, AB, Canada

The Cypress Hills Formation of southwestern Saskatchewan, Canada, has been the focus of considerable attention for its mammalian local faunas, and its ichthyofana has also been described. However, little has been reported on the fossil fishes found in these beds. Here, we describe material recovered from localities in the Eastend area of the formation, mostly corresponding to the Calf Creek local mammalian fauna. The fossils were identified based on comparisons with modern and fossil material. The ichthyofana is diverse, comprising at least fourteen taxa recognized at various taxonomic levels. It includes Lepisosteidae (gars), Amiaforms (bowfins), Hiodontidae (mooneyes), a large probable osteariophysan, at least three cypriniforms (among which are an unidentified cypriniform and a large cyprinid catfish), one of which is the largest fish of the assemblage, a probable procatopitheciform (’Pike), an amblipyoid-like percopsiform (cave and troutsperche), a ’Moronidae (temperate basses), at least two percomorphs including one or more Centrarchidae (sunfishes), and several more taxa that remain indeterminate. This fauna is indicative of a diversity of fluvial lowland environments, corroborating sedimentological evidence that the formation was deposited on a braided river system floodplain. The abundance of small catfish material suggests that most deposits were laid in shallow, relatively sluggish backwaters where the fauna as a whole includes indications of well-oxygenated conditions, deep water environments, abundant aquatic vegetation and a variety of flow strengths and water clairties. The ichthyofana also corroborates the palaeoecological reconstructions based on the herpetofana of the formation. Subtropical temperatures similar to those of the Gulf of California of the United States are indicated by the presence of this fauna, as well as by the large sizes attained by some taxa. There are a number of significant elements in this material, including the earliest occurrence of a moronid in North America, the most northerly occurrence of an amblipyoid, and a case of climatically-driven gigantism in the Ictaluridae.
THE SIRENIAN GENUS *METASYRINIUM*: WHAT'S UP WITH THOSE ANIMALS?

DOMING, Daryl, Howard Univ., Washington, DC, United States; VELEZ-JUARBE, Jorge, Florida Museum of Natural History, Gainesville, FL, United States

*Metasyrinium* (Mammalia, Dugongidae) is one of the most widespread, long-lived, species-rich, commonly fossilized – and taxonomically troublesome – genera of Sirenia. Its morphological conservative nature had, until recently, made it difficult to properly define this group. In recent years, however, much has been done to clarify its contents, relationships, and eventual evolutionary history. Originally known only from the Miocene and Pliocene, its presence in the New World late Oligocene is now established, along with that of a new, early Oligocene genus likely ancestral to it. An apparently anagenetic lineage of West Atlantic-East Pacific species, represented by the late Miocene *A. m. romeroi* and a parallel European-Mediterranean lineage may also have begun in the late Oligocene, and ended only in the mid-Pliocene. Both showed a tendency towards increasing body size. However, the zoogeographic connections between these lineages are unclear, and the early to late Miocene members of both lineages exhibit near-identities in morphology, something not seen elsewhere in the Sirenia. The latest Miocene and Pliocene Mediterranean species, in contrast, display relatively rapid evolution, along with ecophenotypic variability during the Messinian Salinity Crisis. A long-standing puzzle, the mid-Miocene (*Badenian*) *M. petersi* from the Vienna Basin, seems to be at most a peripheral variant of the western European type species *M. medium*. At the opposite, East Pacific end of the genus’ range, *M. arcuata* is the sister group and structural ancestor of the Hydrodamalinae (*Dusisiren + Hydrodamalis*), rendering the *silurian* genus *Metasyrinium* paraphyletic.

For the most part, these tropical marine herbivores may have owed their success to being ecological generalists that fed on seagrass leaves and the rhizomes of the smaller seagrass species. For most of their history, they coexisted with more diverse and morphologically laggard amphibians that more specialized on shorter-lived species of Dugonginae, which evidently ate larger and tougher rhizomes. Notably conservative in retaining small tanks through most of the Miocene, *Metasyrinium* then diversified surprisingly, in opposite directions: losing tanks altogether as they evolved into hydrodamalines in the Pacific, but growing much larger, dugongine-like tanks in the Mediterranean species *M. serresii* and *M. subapenninum*. Clearly, past evolutionary performance is no guarantee of future results!

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**Romer Prize Session** (Thursday, October 31, 2013, 8:45 AM)

QUANTIFYING PERIODS OF DIFFUSION IN MARINE AND TERRESTRIAL MAMMALIAN VERTEBRATE FOSSILS USING RARE EARTH ELEMENTS

DREWICZ, Amanda, Boise State University, Boise, ID, United States, 83702

Rare earth (REE) trace elements (TE) and isotopes in vertebrate fossils have been used to study taphonomy/rewiring, stratigraphic correlation, paleoenvironment reconstruction and fossilization times. REE/TE isotopes differ from stable isotopes in that they are not bonded to oxygen in the mineral matrix. They can provide insights into the environment of deposition, and have the potential to offer new insight into the dietary habits of Pleistocene terrestrial mammals. Dental microwear has the potential to offer new insight into this debate. Here, we describe hegetotheriid remains from the ~16 million-year-old site of Cerdas, Bolivia, which are ecologically distinctive from other well-known Late Miocene hegetotheriines.

The Pleistocene short-faced bear, *Arctodus simus* was the largest member of the order Carnivora to traverse North America, yet whether this giant was primarily an active predator, opportunistic omnivore, or bone crushing hyper-savager remains unknown. Dental microwear has the potential to offer new insight into this debate. Here, we investigate the application of dental microwear texture analysis to bears through compiling data that demonstrate that bears possess microwear attributes of lower first and second molars (*M1* and *M2*) that are distinctly different from *Ursus*, the extant bone-crunching species. Microwear texture analysis demonstrates that *Arctodus simus* and *U. americanus* differ in several microwear attributes. We compared *A. simus* to *U. americanus* using Laser Ablation Inductively Coupled Plasma Mass Spectrometry. Of the five REE measured, Eu/Eu* = 0.0022) and *Asfc* (*Asfc* = 0.0039) from *A. simus* is significantly higher, and *Asfc* (*Asfc* = 7.85) in comparison to more herbivorous bears (*epLsar = 0.0006) when compared to terrestrial bones) which may result from a greater influence of soft tissue. Rates of REE/TE incorporation into the fossilization. The period of concentration patterns the temporal resolution of paleoenvironmental interpretations made from REE/TE isotopes. Periods of incorporation have been calculated in only a few studies and additional measurements will better refine temporal resolution of geochemically based paleoenvironmental reconstructions. Five Late Eocene bronchothere bones from the White River Group and four Miocene marine mammals from the Atlantic Coastal Plain were analyzed for REE/TE concentrations using Laser Ablation Inductively Coupled Plasma Mass Spectrometry. Of the five REE measured, **we describe hegetotheriid remains from the ~16 million-year-old site of Cerdas, Bolivia, which are ecologically distinctive from other well-known Late Miocene hegetotheriines.** The Cerdas species is conservatively referred to the genus *Hegotherium* based on its generalized, pachyrukhine-like attributes and elongated, shallow buccal groove on the shallow m3 talonid suggests it may pertain to a distinct genus. A phylogenetic analysis testing this proposition is in progress. Lineage-specific Cerdas species are the sister group to *H. mirabile*. This lineage includes the *Bolivian* *H. mirabile* species, which are more similar to *Hegotherium* than *Pachyrhacothis* in having a circular to strongly trilobed m3 talonid, lack of conspicuous diastemata among i2-p2 alveoli, and a shallow buccal groove. In the late Pliocene, the Miocene Cerdas species, which are more similar to *Hegotherium* than *Pachyrhacothis* in having a circular to strongly trilobed m3 talonid, lack of conspicuous diastemata among i2-p2 alveoli, and a shallow buccal groove. In the late Pliocene, the Miocene Cerdas species, which are more similar to *Hegotherium* than *Pachyrhacothis* in having a circular to strongly trilobed m3 talonid, lack of conspicuous diastemata among i2-p2 alveoli, and a shallow buccal groove.
analysis of known material and new data derived from macro- and microfossils. Our comparisons indicate that while several PCF fossils are congeneric with taxa known from lower latitudes, there exists a high degree of species-level endemism in the formation among both ornithischians and the non-ornithischians, including: Pachyrhinosaurus, Edmontosaurus, Parasaurolophus, and Triceratops. The endemic genus of pachycephalosaurs, Alkalacephale, is also present, and the taxonomic status of two dromaeosaurids and a tyrannosaurids remains unclear. The high degree of endemism present in the PCF suggests the existence of a distinctive, northern-most Maastrichtian North American fauna that we provisionally refer to as the Paanaqtat Province.

Romer Prize Session (Thursday, October 31, 2013, 9:00 AM)

PHYSICAL TAPHONOMY: SYNTHESIZING BITE MARK DATASETS USING STATISTICAL AND CLADISTIC METHODS

DRUMHELLER, Stephanie, The University of Tennessee, Knoxville, TN, United States, 37996-1410

Extant prong horns used in experimental taphonomy are often selected based on morphological similarities and taphonomic relationships, but typically few examples are used in any given analysis. The potential role of paleontology in informing the expansion of comparative taphonomic areas remains understudied. Here I present patterns of bite marks made by crocodilians and explore statistical and paleontological methods for synthesizing bite mark datasets. I compared and contrasted rates of mark type between two datasets, a previously published survey of Crocodylus niloticus and new research on Alligator mississippiensis. Bite mark types found in the C. niloticus sample, previously argued to be diagnostic of crocodylians, were found in my study in similar rates on bones modified by members of A. mississippiensis. I also found more destructive bone modifications, not observed in the C. niloticus study, in the A. mississippiensis sample. This illustrates the potential pitfalls of applying patterns from one example across a diverse clade, since A. mississippiensis seem to utilize a slightly different feeding strategy from C. niloticus. To further explore clade-wide patterns of bite mark types in Crocodylia, I surveyed traces made by 21 of the 23 generally recognized species of extant crocodilians. Bones modified by members of each species were coded for presence or absence of potentially diagnostic mark types. Statistical tests for correlation were performed on bite mark types, animal vital statistics, and experimental collection protocols. Diagnostic mark types were mapped as character states on a well-supported sauropod phylogeny. The success of predictions of the types of marks expected in extinct groups was then tested using previously published published patterns from the fossil record. Presence of expected mark types was accurately predicted in those case studies. The phylogeny also provided a framework for when and where this method might best be applied, highlighting clades with distinct dental morphologies, and possibly corresponding behaviors, not observed in extant clades. Differences observed in extant crocodyliforms which have been positively associated with extinct species allow this method to be expanded beyond the crown group. The results of this study illustrate the informative value phylogeny holds as a predictive tool in taphonomic studies.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

A LARGE NEW CROCODYLOMORPH (SUCHIA, ARCHOSAURIA) WITH BIZARRE SKULL MORPHOLOGY FROM THE UPPER TRIASSIC OF NORTH CAROLINA

DRYMALA, Susan, North Carolina State University, Raleigh, NC, United States, 27606; ZANNO, Donald, North Carolina Museum of Natural Sciences, Raleigh, NC, United States; NESBITT, Sterling, Field Museum of Natural History, Chicago, IL, United States; SCHNEIDER, Vincent, North Carolina Museum of Natural Sciences, Raleigh, NC, United States

Triassic crocodylomorphs existed as small, gracile forms (‘sphenosuchians’) and were the only crocodile-line archosaurs to survive the end-Triassic extinction. Recent analyses suggest that their closest relatives were a group of large-bodied predators known as ‘rauisuchians’. However, a large morphological disparity remains between crocodylomorphs and other pseudosuchian clades. Here we present new limb bones, including humeri, ulnae, femora, tibiae, and a talus, from three of the recognized primitive species. They include the first omoquadal postcrania from India: two femora, a talus, and a potential proximal tibia. We also report additional asiadapid postcrania: a primitive femur of Margocodus and the first complete Tibia of Asiadapis. Five new humeri (two complete) consist of one asiadapine and four that lack specializations of either group, making allocation difficult. Two ulnae are attributed to indeterminate cuproids due to lack of adequate comparative material. The elements attributed to Vastanomys are more primitive than any other known omomyid postcrania and are only subtly different from those of asiadapines, in contrast to the more distinct postcranial bones of their middle and late Eocene relatives. The femora attributed to Vastanomys exhibit features suggestive of leaping behavior (cylindrical femoral heads, lateral condyle higher than medial, proximal position of the third trochanter), as in other omomyids. However, while the talus of Vastanomys resembles those of omomyids more than those of other postcrania, features such as the relatively short, medially angled neck, and oval rather than spherical head suggest that Vastanomys was not as specialized for leaping as younger omomyids. All asiadapines have been described as close to notharctids in morphology, the relatively wider distal femur and symmetrical condyles of Margocodus resemble adapis more than notharctids and may also reflect less leaping. The revised age of the fossils, together with the similarity in morphology of omomyid and asiadapine postcrania, suggests that the postcrania, like the teeth, show members of each family, are converging toward a common morphology as we approach the base of the Eocene.

Technical Session VI (Thursday, October 31, 2013, 9:30 AM)

NEW PRIMATE POSTCRANIA FROM THE EARLY EOCENE OF VASTAN MINE, GUJARAT, INDIA

DUNN, Rachel, University of Missouri, Columbia, MO, United States, 65212; ROSE, Kenneth, Johns Hopkins Univ, Baltimore, MD, United States; KUMAR, Krishna, Wadia Institute of Himalayan Geology, Uttarakhand, India; RANA, Rajendra, JNU Garhwal University, Uttarakhand, India; SMITH, Thierry, Institut Royal des Science Naturelles de Belgique, Brussels, Belgium

The Cambay Formation at Vastan Mine in Gujarat yields the oldest fossil primates known from India. New age estimates suggest that the fossils date from approximately 54.5 Ma (early Ypresian), about 2 million years older than initially thought and compared to age to early Wasatchian Was-4 fauna from North America. The Vastan primate fauna comprises predominantly the asiadapine adapoids Margocodus and Asiadapis. Two species of omomyid primates, Vastanomys gracilis and V. major, are much rarer, each known from a single dental specimen. In addition to primate dental remains, Vastan Mine has produced the best preserved early Eocene primate postcranial elements known from anywhere in the world. Here we present new limb bones, including humeri, ulnae, femora, tibiae, and a talus, from three of the recognized primitive species. They include the first omoquadal postcrania from India: two femora, a talus, and a potential proximal tibia. We also report additional asiadapid postcrania: a primitive femur of Margocodus and the first complete Tibia of Asiadapis. Five new humeri (two complete) consist of one asiadapine and four that lack specializations of either group, making allocation difficult. Two ulnae are attributed to indeterminate cuproids due to lack of adequate comparative material. The elements attributed to Vastanomys are more primitive than any other known omomyid postcrania and are only subtly different from those of asiadapines, in contrast to the more distinct postcranial bones of their middle and late Eocene relatives. The femora attributed to Vastanomys exhibit features suggestive of leaping behavior (cylindrical femoral heads, lateral condyle higher than medial, proximal position of the third trochanter), as in other omomyids. However, while the talus of Vastanomys resembles those of omomyids more than those of other postcrania, features such as the relatively short, medially angled neck, and oval rather than spherical head suggest that Vastanomys was not as specialized for leaping as younger omomyids. All asiadapines have been described as close to notharctids in morphology, the relatively wider distal femur and symmetrical condyles of Margocodus resemble adapis more than notharctids and may also reflect less leaping. The revised age of the fossils, together with the similarity in morphology of omomyid and asiadapine postcrania, suggests that the postcrania, like the teeth, show members of each family, are converging toward a common morphology as we approach the base of the Eocene.

Technical Session XIII (Friday, November 1, 2013, 2:30 PM)

THE ORIGIN OF THE JAWED VERTEBRATE FACE: NEW INSIGHTS FROM A SYNCHRONOTRON SCANNED SKULL OF THE PRIMITIVE PLACODERM ROMUNDINA

DUPRET, Vincent, Uppsala University, Uppsala, Sweden; SANCHEZ, Sophie, Uppsala University, Uppsala, Sweden; GOUET, Daniel, Museum National d'histoire Naturelle, Paris, France; TAFFOREAU, Paul, European Synchrotron Radiation Facility, Grenoble, France; AHLBERG, Per, Uppsala University, Uppsala, Sweden

Jawless osteostracans (jawless stem gnathostomes) have many different face patterns. Cyclostomes have a single median nasohypophysial duct, an anterior hypophysis and a short telencephalon, while gnathostomes have a pair of nasal sacs opening externally, a more posterior separate hypophysis opening in the palate and a longer telencephalon. Embryonic processes differ as well. In cyclostomes, infrathalaebral premundibular crest cells migrate forwards either side of the nasohypophysial plaoe to form the upper lip; in gnathostomes they migrate between the hypophysial and nasal plaoes to form the trabecular-ethmoid region. Supraoptic neural crest remains posterior to the nasohypophysial duct in cyclostomes; it moves forward to create the nasal capsules in gnathostomes. Some fossil forms illustrate a sequenced transition between these two patterns. The Silurian galeaspid (jawless stem gnathostome) Shuyu has a nasohypophysial duct, a short telencephalon, and an anteriorly oriented hypophysis, but the paired nasal sacs and hypophysis are separated by a rudimentary trabecula. A synchrontron scanned skull of the primitive Early Devonian placoderm (jawed stem gnathostome) Romundina shows a cranial cavity reminiscent of that of Shuyu (anteriorly directed hypophysis, very short telencephalon). The trabecular-ethmoid region is long and wide, extending anterior to the small nasal capsule which is located just in front of the orbits. We interpret these features as uniquely primitive among gnathostomes. In size and position the trabecular-ethmoid region of Romundina resembles the upper lip of cyclostomes and Shuyu, suggesting a cyclostome-like pattern of proliferation coupled with a gnathostome-like migration pattern for the premundibular crest. The position of the nasohypophysial duct suggests that the supraoptic crest had not migrated forwards. A new phylogenetic analysis suggests that the evolutionary sequence for the creation of the extant gnathostome face from a cyclostome ancestral pattern involved 1) separation of the nasal and hypophysial placodes (galeaspid: Shuyu), 2) loss of the nasohypophysial duct (phacocephalids: antiarchs, Brindabella, Romundina), 3) shortening and narrowing of the trabecular-ethmoid region, the nasal capsule becoming anterior (derived placoderms such as arthrodires); 4) lengthening of the telencephalon (crown gnathostomes). Galeaspid facial anatomy appears closer to that of gnathostomes than cyclostomes, but it is unclear whether osteostracans are primitive or autapomorphic in this respect.
DURRANI, Muhammad, NYIT College of Osteopathic Medicine, Old Westbury, NY, United States, 11568; BEATTY, Brian, NYIT College of Osteopathic Medicine, Old Westbury, NY, United States

The transition from terrestrial to aquatic among amniotes has happened many times, and each transition they have adapted to the variety of physical and chemical variables of riparian, lacustrine, coastal, and marine environments. Examples of living animals whose species live in this variety of transitional environments are the Lutrinae and Pinnipedia. There are otters on most continents and pinnipeds in every large body of water. In this way, the modern diversity of otters and pinnipeds mirrors what one might expect to have occurred in the early transitional forms of whales and other aquatic amniotes. The oral environment of marine mammals is flush with water on a regular basis, having an effect on oral chemistry. Oral chemistry mediates the proliferation of bacteria and associated dental pathologies. To explore the comparative effects of this, we studied 637 specimens of otters (Lutrinae), sea lions (Otaridinae) and walruses (Odobenidae) for osteological indicators of dental pathology. Pathologies such as malocclusions, caries, calculus formation, and periodontal disease (including alveolar bone erosion, periapical osteolysis) are indicators of dental pathology. The LS and MS represent hidden biodiversity and have the potential to serve as proxies for vertebrate communities and the overall paleoecology of environments with an absence of body fossils, as well as indicators of relative moisture to infer paleolimnology.

TEEN SCIENCE CAFÉS: A NOVEL WAY TO ENGAGE FUTURE SCIENTISTS

Posters Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

TEEN SCIENCE CAFÉS: A NOVEL WAY TO ENGAGE FUTURE SCIENTISTS

EARLY, Catherine, North Carolina Museum of Natural Sciences, Raleigh, NC, United States; 27601; HALL, Michelle, Science Education Solutions, Los Alamitos, NM, United States

Many science museums and educational institutions successfully implement programs that focus on exposing children and adults to science, but they often fail to connect with members of the public who fall between the two categories. Scientists and educators alike find it difficult to engage teenagers and communicate to them the importance of the research being done in the sciences, even though teens represent the audience that would most benefit from learning about potential careers in science. Teen Science Cafes, an NSF-funded outreach program devoted to connecting teens with scientists, help researchers and institutions bridge this communication gap in a novel way. A Teen Science Cafe is an informal, interactive presentation given at the high school level by a scientist on their field of study, providing scientists with a new avenue for public outreach. Cafes allow kids who may not have exposure to the sciences to ask questions and learn about the importance of the research. Teens are better able to understand the real world importance of the research, and scientists appreciate the opportunity to share their work. In this session, we will describe the Teen Science Cafe program and demonstrate how the Teen Science Cafe speaker’s role is to get his or her audience excited about his or her field and guide their learning by engaging the audience in conversation and questions. Paleontology has proven itself to be a field that is particularly well-suited to this format, as it is reductive in that deep understanding of the public audience requires more than a basic understanding of the science. The Teen Science Cafe speaker will be asked to adapt simple language to the audience in order to get them engaged. As a result, it can be easily adapted for a hands-on learning activity; phylogenetic analysis and field mapping are two such methods which have already been successfully implemented at Teen Science Cafes in North Carolina. The Teen Science Cafe program is currently in its second year of implementation at the North Carolina Museum of Natural Sciences (NCMNS), the lead institution of the North Carolina-based node of the Teen Science Cafe Network (www.teensciencecafe.org). This node is known as the Open Minds Cafe, hosts Teen Science Cafes in Raleigh, Chapel Hill, and Whiteville, and serves as a model for other institutions seeking to engage their teen audience with researchers in this innovative program. The Teen Science Cafe Network is open to all interested in starting a Teen Science Cafe program.
STABLE ISOTOPE AND TRACE ELEMENT PALEOEKOLOGY OF THE RUDABÁNYA FAUNA DURING THE LATE MIocene

EASTHAM, Laura, University of Toronto, Toronto, ON, Canada; MSS 222, FERANEK, Robert, Stanford Univ, Albany, NY, United States; BEGUN, David, University of Toronto, Toronto, ON, Canada; KORDOS, Laszlo, Geological Institute of Hungary, Budapest, Hungary.

In Europe, the decline of forest-adapted fauna during the late Miocene occurs in correlation with environmental change as humid subtropical evergreen forests gave way to more open seasonally adapted woodlands. A humid forest refugium has been proposed in Central Europe during this period based upon an abundance of floral and faunal proxies. The faunal assemblage at Rudabánya, a Late Miocene (~10 Ma) mammalian locality in northern central Hungary, preserves an abundance of forest-dwelling taxa, including a hominoid, Rudapithecus hungaricus, and pliopithecoid Anapithecus hernyaki. Geochemical sampling of the Rudabánya fauna further clarifies our understanding of the unique paleoecology at this spatially and temporally rare site. To evaluate forest structure, climatic regime, and resource partitioning we examine stable carbon (δ13C) and oxygen (δ18O) isotope and trace element (Sr/Ca) ratios in the dental enamel of ten genera of medium to large bodied mammals. δ13C, δ18O, and Sr/Ca ratios suggest the existence of a diverse woodland-forest ecosystem, with a range of habitat types from moderately dense canopied forest to more open country woodland. The negative δ13C values found in all sampled taxa are consistent with high levels of precipitation and humidity. Serial δ13C analysis reveals seasonal variation in climate, likely reflecting the shift from warm summers with high precipitation to cooler winters with lower precipitation. Interestingly, serial δ13C values show little evidence of significant seasonal variation in the diets of the Rudabánya fauna. Significant differences in stable isotope and trace element ratios exist between taxa implying competition and partitioning in resource use. Hyaenidae (intraspecifically), Propimotherium, Palaeochasorus (Suidae), and Lucentia aff. pieriensis (Cervidae) show more positive δ13C and higher Sr/Ca ratios, suggesting more forest feeding in more open habitat types. More negative δ13C and lower Sr/Ca ratios are found in Myotragocerus sp. (Bovidae), Tetralophodon longirostris (Gomphotheriidae), and Micromeryx flourensianus (Tetralophodontidae) indicating use of more densely forested habitats. Sr/Ca ratios indicate a clear stratification of taxa within the trophic level. These results suggest the possibility of a humid forest refugium in Central Europe during the late Miocene and provide insight into the environmental context of a highly dynamic period in mammalian evolution.

A NEW PUERCAN FAUNA FROM WYOMING’S GREAT DIVIDE BASIN

EBERLE, Jaelyn, University of Colorado, Boulder, CO, United States; 80309; LOFGREN, Donald, Raymond Alf Museum of Paleontology, Claremont, CA, United States; HETTINGER, Robert, Geological Survey (USGS), retired, Lakewood, CO, United States; MCCOMAS, Katherine, University of Colorado, Boulder, CO, United States; SOLTIS, Chie, The Webb Schools, Claremont, CA, United States.

Earliest Paleocene (Puercan) mammalian faunas are critical to test new phylogenetic analyses that suggest placental mammals originated in the first few hundred thousand years after the Cretaceous-Paleogene boundary. Yet, few basins preserve relatively thick complete Puercan sections (as defined by mammals). In the Hanna Basin of Wyoming (~180 m of strata), the Puercan faunal zone is ~70 m thick. We have identified and represent the northernmost occurrence of the PuercanNALMA (Pu1-Pu3; ca. the first million years of Paleocene time). Here, we report a new Puercan fauna from the southeastern part of the Great Divide Basin, a sub-basin of Wyoming’s Greater Green River Basin (west of the Hanna Basin and Rawlins, WY). In the Duckwater Butte Member of the Fox Union Formation comprises several hundred meters of strata preserving Puercan – Tiffanian mammalian fauna. Puercan localities span over 183 meters (600 ft.) of stratigraphic section in the basin. Structurally low-lying Chinese Butte Member, which overlies an angular unconformity that beams the underlying Late Cretaceous (Lancastian) fossiliferous, shallow-middle subtidal depositional environment. The stratigraphically lowest Puercan faunal zone is approximately 46 meters (150 ft.) above the unconformity, and faunal comparison to Puercan assemblages in the Hanna and Denver Basins suggests that they may be late Puercan Pu1 or earliest middle Puercan (Pu2) in age. The most productive of these localities is a quarry that preserves complete jaws and isolated teeth representing a nearly complete Tiffanian mammalian fauna. Puercan localities in the Hanna Basin are ~70 m thick in this small area (80 km2) comprise, in ascending order, the Oldman (partial), Dinosaur Park (DPFm), and Bearpaw (partial) formations, all of which contain altered volcanic ashes (bentonites). Radiometric dating of phenocrysts from DPF’s bentonites is the best means for assessing rates of faunal turnover in the section, and chronostratigraphic correlation of this section and its dinosaur faunas assembles with others, elsewhere. Although 13 discrete bentonites were originally documented in the section, only four have been used consistently for dating during the past 23 years. These are semi-evenly spaced through a total section of 88.5 m, and at least one occurs in each formation. K-Ar analyses of bentonites (1980s) yielded promising results, but error was relatively large (±~1.0 Ma). 40Ar/39Ar methods (1990s-present) have greater precision. However, three rounds of 40Ar/39Ar dating (over 20 years) resulted in significantly different dates (>1%) reported for the same bentonites. Variation was due mostly to adjustments of monitor mineral ages and ongoing improvements in analytical techniques. In this context, more recently derived 40Ar/39Ar dates were usually reported as superseding previously published results. Furthermore, before meaningful comparisons or combinations (e.g., averages) of newer and older results can be completed, older data must be recalibrated. Recently completed laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) analyses of zircons from these same bentonites (2013) have resulted in a suite of 206Pb/238U dates with relatively modest errors (0.51–0.75 Ma, 2) that encompass almost all of the previously calculated 40Ar/39Ar dates (different from each other by as much as 0.6%). Thermal ionization mass spectrometry (TIMS) analyses of zircons is underway in the hopes of reducing error. The most recent 40Ar/39Ar data indicate that the DPF dateable section spans 1.44 Ma (dates presented at symposium). Alternatively, the LA-ICP-MS data indicate that this section may be slightly younger and shorter, spanning 1.26 Ma (dates presented at symposium). Lastly, 40Ar/39Ar dating of the Bearpaw Formation results are consistent in suggesting a decrease in rates of sediment accumulation from the lower, fossil-rich 30 m of the DPFm, to the uppermost 40 m of the DPFm. If confirmed, this will have implications for assessing rates of faunal turnover for the Park’s dinosaurs.

THE GREEN RIVER FORMATION (Eocene) OF WYOMING IS WELL-KNOWN FOR THE EXEMPLARY PRESERVATION OF VERTEBRATES SUCH AS FISH, AMPHIBIANS, REPTILES, AND MAMMALS. AND IT HAS NOT BEEN FULLY UNDERSTOOD WHETHER SUCH FAUNAS WERE ENDOSOMATIC OR EXOSOMATIC, AND IF THERE WAS any depositional environment. We have studied the Green River Formation (Eocene) of Wyoming were imaged using Synchrotron Rapid Scanning X-ray Fluorescence (SRS-XRF). SRS-XRF is a powerful method for mapping dilute concentrations of elements from which a fossil is composed. This method also rapidly scans (up to 3000 times faster than conventional element mapping techniques) to high sensitivity (parts per million) and with minimal risk of damage. The SRS-XRF maps of the bone chemistry (calcium, phosphorus, and zinc) are comparable to those seen in extant birds and are distinct from the excasing matrix. The elemental inventory of the feathers shows the distribution of organic sulfur that corresponds with trace metals (copper, zinc and nickel) that map deposits in laboratory techniques and equipment. This metal inventory in the fossil feathers most likely represents organometallic products consistent with melanin pigments. These results add to the growing number of studies that verify the presence of melanin pigments in exceptionally preserved tissues of extinct organisms. The preservation of endogenous trace metal patterns suggests that within specific environments, there is not a complete replacement of the original chemistry during fossilization. Furthermore, the preservation of soft-tissue structures is aided by the endogenous trace metal inventory. The trace-metals function as bacterial inhibitors that provide a taphonomic filter which prevents the breakdown and replacement of these structures.
formation, known also from the Ergilin Dzo locality. Dentognathic size and shape of these Mongolian specimens fall within the variation of those of N.intermedius from the Oligocene of Europe. Thus, we agree with the previous suggestion that the Mongolian N.intermedius, as well as neogomphus, should be included in N.intermedius. Earlier records of Nimravus have been reported from the middle Eocene of southern China. Nimravus presumably originated in the southern part of East Asia during the middle Eocene, migrated into the northern part of East Asia during the late Eocene, and dispersed into MP22 of Europe and the Whitneyan of North America. The other nimravid, Eotigris, was previously known only from the Oligocene of Quercy, France. The finding of the genus from the Ergilin Dzo Formation reveals the wide geographic distribution of the genus for the first time, and moves the appearance time of the genus from the Oligocene (MP23) to the late Eocene. The smallest carnivorous from the Khoer Dzan locality were identified as stenoplesictids, but two stenoplesictids have been previously known from the Late Eocene of Mongolia: Stenoplesictis simplex from the Ergilin Dzo locality, and S. indigenus from the Alag Tsav locality, which is lower than the Ergilin Dzo Formation. Size of the Khoer Dzan specimens is between these two species, and its m2 morphology indicates that the materials belong not to the Mongolian Stenoplesictis lineage. However, it has been suggested that these stenoplesictids from the Ergilin Dzo should be excluded from the genus Stenoplesictis, of which type species occur in the Oligocene of Quercy, because some morphologies of the Mongolian forms are too derived for an ancestor of the European species. In contrast to the nimravid genera, which migrated between East Asia and Europe, stenoplesictids seem to have migrated into these two areas independently from another area in Eurasia.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

AN EOCENE OCCURRENCE OF A DYROSAURUS (CROCODYLOMORPHA, MESOEUCROCODYLIA) FROM ALABAMA, USA

EHRET, Dan, Alabama Museum of Natural History, Tuscaloosa, AL, United States, 35487-0340; HASTINGS, Alexander, Georgia Southern University, Statesboro, GA, United States

Dyosaurids represent a group of mostly marine, mesoeucrocodylian crocodyliforms that are known from the Maastrichtian through the late Eocene of Africa, Asia, Europe and North America. In the Western Interior of North America, the earliest known occurrence of the Dyosauridae is in the Eocene of Wyoming, with this family extending into the late Eocene before going extinct prior to the early Oligocene. Here we report on a new specimen recovered from Clarke County, Alabama that is assigned to the Priabonian (late Eocene) Yazzoo Clay. The Yazzoo Clay has exposures in Mississippi and Alabama and is constrained to Biozones E14-E16. The lithology of the Yazzoo Clay is characterized as glauconitic sands and sandy limestones that represent marine shelf margin deposits. Fossils typically found in this formation include sharks, archaeocete whales, and marine turtles, which corroborate a marine shelf margin paleoenvironment. The recovered specimen is a distal caudal vertebral centrum that exhibits the typical amphicoelous condition of the Dyosauridae, as well as characteristic semi-rectangular shape and articular facets for the haemal arch. The centrum is complete but missing the neural arch at the sartural contacts, which indicates that the individual was likely immature. The presence of a dyosaurid in the Gulf Coastal Plain during the late Eocene greatly extends the temporal range of the family in the Western Hemisphere. Reasons for the family's extinction are currently unknown, but this discovery indicates that dyosaurids were present in the New World as well as the Old World until their ultimate and apparently synchronous extinction. The new dyosaurid from Alabama will need to be included in explanations for the extinction of the family. Dyosaurids undergo an apparent range constriction in North America across the early Oligocene. It appears that a relict population was able to persist in the Gulf Coastal Plain until the end of the Eocene.

Technical Session XV (Saturday, November 2, 2013, 10:30 AM)

INNER EAR STRUCTURE OF EARLY MYSTICETES (CETACEA) FROM THE LATE Oligocene OF SOUTH CAROLINA: IMPLICATIONS FOR THE EVOLUTION OF HEARING IN BALEEN WHALES

EKDALE, Eric G., San Diego State University, San Diego, CA, United States, 92182

Late Oligocene deposits of the Ashley and Chandler Bridge Formations near Charleston, SC have yielded baleen whale fossils that play a critical role in the understanding of the evolution of ear anatomy. In particular, early baleen whales undergo an apparent range constriction in North America across the Eocene/Oligocene boundary. The morphology of the Oligocene taxa is consistent with that described for stratigraphically younger mysticetes and as normal for musth, the period of heightened aggression and sexual activity in which mating and male-male conflict would be expected to occur. It thus seems plausible that this male died as a result of soft-tissue injuries sustained in a musth conflict.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

PREDUCTION OF EARLY VERTEBRATES BY EURYPTERIDS

ELLIOIT, David, Northern Arizona Univ, Flagstaff, AZ, United States, 86011-4099; LASSTIER, Linda, Northern Arizona University, Flagstaff, AZ, United States

Eurypterids were marine arthropods that existed from the Ordovician through the Permian. The fact that they often occur in the same horizons as early vertebrates suggests that we interpret as early spring growth, as documented more thoroughly in specimens from the Great Lakes region. Analysis of approximately weekly incremental features in a transverse thin section shows little systematic seasonal variation in rates of dentin apposition - not surprising for southern California - but does help to confirm some of our identifications of temporal features of the growth ring. Daily dentin increments are visible in some parts of the sequence, but not consistently. One of the years included in this sample achieves a length, on the external surface of the tusk, of 7.9 cm - relatively long for a male at this stage of life - and a thickness (normal to the appositional surface) of 6.6 mm. Subsequent years preceding death are shorter (ca. 4.6 cm/yr) and thinner (ca. 3.9-4.6 mm). Judging from rates of tusk growth in the last years of life, death appears to have come in early summer, the season identified as normal for mule deer, the period of heightened aggression and sexual activity in which mating and male-male conflict would be expected to occur. It thus seems plausible that this male died as a result of soft-tissue injuries sustained in a musth conflict.
A NEW PHYLOGENETICALLY-INFORMED LIFE RECONSTRUCTION OF THE GIANT EOCENE CARNIVOROUS ARTIODACTYL ANDREWARCHUS MONGOLIENSIS (MAMMALLA, ARTIODACTYLMORPHA, CETACONTODONTOMORPHA)

ELLISON, Mick, American Museum of Natural History, New York, NY, United States; 10024; FLYNN, John, American Museum of Natural History, New York, NY, United States

Arguably the largest terrestrial mammal carnivore ever, the relationships and full-body anatomy of *Andrewarchus* have been debated since its discovery in 1923. Known only from a single, massive, 85.7 cm-long skull, and originally considered to be a mesosuchian, its affinities have remained enigmatic. Recent phylogenetic analyses combined molecular and morphological data, and extant and fossil taxa to compellingly document that it is not allied with mesosuchians, but instead is most closely related to eutherians and aetosaurids in a polytomy forming the nearest outgroup to hippos and whales.

Many prior reconstructions of *Andrewarchus* as a wolf-like predator, with an unusually large head, short limbs, and stocky body, were influenced by its classification as a mesosuchian. Revised understanding of its relationships permits a new and markedly different reconstruction of *Andrewarchus*, using phylogenetic bracketing to infer unknown traits. We discuss the reconstruction process, a collaboration between artist and paleontologist, reflecting both direct observation and reanalysis of the holotype and detailed consideration of the anatomy of its closest extinct and extant relatives. Study of the skull corrects observational and dimensional errors in some prior reconstructions, including orbit location, snout length, position and shape of teeth (particularly the canine, based on alveolar dimensions and phylogenetic bracketing), and zygomatic breadth. The craniodental anatomy, together with comparison to close relatives, permit reconstruction of the giant, powerful carnivore with relatively long and robust limbs, short torso and broad girth, instead of a short limbed, elongate bodied and more slender wolf-like form. The prominent sagittal crest indicates large temporalis muscles, implying a pronounced angular process and deep lower jaw (as in *Achaenodon*), facilitating the powerful bite indicated by large, apically flattened cheek teeth. By comparison with large entelodonts, *Andrewarchus* is inferred to have possessed a short and muscular neck, and large, high shoulders, with the head held low rather than high as in many reconstructions. We conservatively infer four hoofed toes on each foot, and sparse hair, consistent with facilitating heat loss because of its large size and dry paleoesvironment. The new reconstruction is an exhibit within an exhibition that will receive hundreds of thousands of visitors, to illustrate the role of fossils and phylogeny in paleobiological inference.

DIVERSITY AND BODY SIZE EVOLUTION OF ANGUL LIZARDS THROUGH CLIMATIC TRANSITIONS OF THE NORTH AMERICAN CENOZOIC

ELSIAFIE, Sara, Univ of Nebraska- Lincoln, Lincoln, NE, United States, 68588-0340; HEAD, Jason, Univ of Nebraska, Lincoln, NE, United States

Lizards are diverse components of modern tropical and subtropical ecosystems, and their distributions are strongly correlated with climate. Relationships of lizard diversity and body size to the environment have been observed over long and short timescales, respectively. However, to test the effects of climate change on lizard evolutionary histories, we examined diversity and body size changes through time in fossil angul lizards from the Paleogene and Neogene of North America. We collected species diversity data at NAFLA temporal resolution from museum collections, literature, and the Paleobiology Database. To account for sampling bias, we compared metrics for anguids against the NALMA temporal resolution from museum collections, literature, and the Paleobiology Database. To account for sampling bias, we compared metrics for anguids against the sampling for coeval North American mammals. We collected skull length data as a proxy for overall body size from museum collections, focusing on glyptosaurines, the largest and most diverse family of angul clade. Diversity patterns in anguids are similar to those for mammals, with peak diversity during the Wasatchian and Bridgerian followed by decline during the late Paleogene and a second, smaller increase during the Barstovian. These trends partially reflect changes in sampling intensity between the Western Interior basins and the Great Plains, but also coarsely correspond to changes in global temperature patterns. Maximum body size trends in anguids do not correspond to either mammalian histories or climate proxies. Maximum body size remains approximately constant among the largest glyptosaurines from the early Eocene (Glyptosaurus nystri) to early Oligocene (Helenodonsus tuberculatus), despite a global cooling represented by >6ºC decreases in average Sea Surface Temperatures. Constancy of body sizes across climate transitions suggests that overall temperature decreases remained above critical minimum temperatures for efficient metabolism in large lizards prior to the Neogene, whereas decreasing diversity may represent a reduction in habitat availability with increasing aridity during the late Paleogene and early Neogene.

NEW SPECIMEN OF THE TEMNosPNDYL StETERLATERepON COGrIFFI FROM THE LATE PERMIAN OF BRAZIL (RIO DO Rasto FORMATION, ParANÁ BASIN): NEW ANATOMICAL INFORMATION AND PHYLOGENETIC RELATIONSHIPS

ELINKIN, Estevan, USP, Ribierão Preto, Brazil; LANGER, Max, USP, Ribeirão Preto, Brazil

A new temnospondyl specimen, assigned to *Australerpeton cosgriffi*, from the Rio do Rasto Formation (Late Permian, Paraná Basin) of south Brazil is composed of a left mandible, right pelvis, femur, tibia, and fibula. Characters shared with other mandibles referred to *A. cosgriffi* (two skulls have preserved jaws) include the anteriorly extended preauricular, the 'zig-zag' contact between splenial and post splenial, the lack of denticles or teeth in the coronoids, the posterior coronoid entering the adductor fossa anteriorly, and the extended symphysial region that bears the anterior margin of the surangular posteriorly extended as a deep furrow. New information about the pelvis and hindlimb includes: a deep pubic notch anteriorly added by the pubic crest, a laminar intertransverse fossa, a conspicuous tuberosity on the posterior face of the cnemial crest of the tibia, and an extra tuberosity on the anteromedial surface of the fibula. The long slender temnospondyl has been regarded as either a stereospondyl (*Rhachiodusica*) or a non-stereospondyl stereopleomorphic (*Platypogsaurinae*). The reassessment of the phylogenetic placement of *A. cosgriffi*, with information drawn from the new specimen, was based on a data matrix of 135 characters and 25 taxa, and recovered 2 most parsimonious trees of 351 steps that positioned Sterletopsida as basal stereospondyls, more derived than *Pelobatracthus postulatus* and basal to Rhachiodusica*. The synapomorphies shared with other stereospondyls include: tabular and exoccipital contacting in the paracortal process, paraphyous articulated with the pterygoid corpus forming a broad contact along the lateral margins of the parasphenoid plate, internal carotid and intracranial artery branches passing through the dorsal surface of the parasphenoid plate, and enlarged field of denticles forming a transverse ‘belt’ along the pterygoid-paraphyous articulation. Indeed, the occipital and posterior palatal regions of *A. cosgriffi* are more similar to those of rhinesuchids, than to those of platyoposaurus, as exemplified by the presence of an oblique ridge on the ascending ramus of the pterygoid. Accordingly, *A. cosgriffi* represents one of the first stereospondyls, and the oldest known long-snouted member of the group. Therefore, the dispersion and diversification of this clade appears to have happened before Permo-Triassic boundary.

CHARACTER VARIATION IN MODERN CAMELS AND SHEEP HIGHLIGHTS PROBLEMS IN THE GENUS-LEVEL TAXONOMY OF AGROECOHER OROEDONTS

EMERY, Meaghan, University of Oregon, Eugene, OR, United States; 97405; DAVIS, Edward, Univ of California Berkeley, Eugene, OR, United States; HOPKINS, Samantha, Univ of Oregon, Eugene, OR, United States

Quantification of variability in modern animals clarifies taxonomically informative differences among fossil specimens. The three currently valid genera of agroecohers (*Agrocerops, Diplobosphus* and *Proteorodon*), diagnosed largely by dental characteristics, overlap in biogeographic ranges and in overall size. Camels are a potential sister group to orcodonts, while sheep occupy a similar ecological niche and body form. Both possess characters homologous to those previously considered diagnostic in agroecohers; these were examined as a proxy for variation. Several genera- level agrocehore characters exhibited considerable variation between individuals of modern species, including presence/absence of paracorals and external molar ribs. Similarly, individuals within species of camels and sheep display variation in the prominence of the para-, meso-, and metastyles of their molar into that to which is ascribed to different genera of agroecohers. As a case study of these problems we considered the agroecohore from the Hancock Mammal Quarry (HMQ) of the Eocene Clarno Formation. Individuals from the HMQ display characters considered diagnostic to each Agrocerohed genus including an expanded rostrum and absence of a P4 hypocune characteristic of *Diplobosphus*, prominent molar styles and split P4 paracorlone of *Agrocerops*, and the connection between the P3 paracorlone and protoccone of *Proteorodon*. The HMQ specimens have variable expression in the P3 connection of the paracorlone and roncone, and the internal and external molar ribs. We also found that there is substantial variation in the P1-2 paracorlone size using P1-2 paracorlone size. For example, these differences were highly affected by both taphonomic distortion and individual variation. The coefficient of variation for the P1-4 and M1-M3 toothrows of the HMQ agrocerohed was an order of magnitude higher than that of the M1 or M2; we advocate using an individual molar dimension for future comparisons. It is thus the current defining characteristics of these genera do not represent biologically discrete units. As a alternative, we suggest using the shape of the auditory bullae, postglenoidal processes, and the structure of the basioposphen and basioccipital regions of the skull, which show lower levels of variation in modern and fossil specimens. Using characters tested for variation in modern as well as fossil organisms can clarify genus-level diversity that is otherwise obscured by overlapping taxonomy.

MICROVERTEBRATES FROM THE SAINTS AND SINNERs QRAyY (NUGGET SANDSTONE: 4LATE TRIASSIC–EARLY JURASSIC): A REMARKABLE WINDOW ON THE DIVERSITY AND PALEOECOLOGY OF SMALL VERTEBRATES IN AN ANCIENT EOLIAN ENVIRONMENT

GEMSTEL IN, George, University of Nebraska- Omaha, Omaha, NE, United States, 68182; BRITT, Brooks, Brigham Young Univ, Provo, UT, United States; CHURE, Eduard, Univ of California Berkeley, Eugene, OR, United States; HOPKINS, Samantha, Univ of Oregon, Eugene, OR, United States

The Saints and Sinners Quarry (SSQ) has produced abundant vertebrate fossils from the base of the dominantly eolian sequence. Taphonomic and sedimentologic evidence suggests the Saints and Sinners Quarry (SSQ) was a bonebed within the Nugget Sandstone within interdunal sands of limited lateral extent between thick sequences of dune sands and about 55 meters above the base of the dominantly eolian sequence. Taphonomic and sedimentology evidence suggests the interdunal facies represent a small lake. The environmental setting could be
The fossils of the SSQ consist overwhelmingly of thousands of disarticulated bones of coelurosaurs and mammals from at least 20 individuals. The microvertebrate fauna, however, is relatively diverse. So far we have found a cluster of 3 articulated skeletons and disarticulated elements of drepanosaurids, jaw, arm, girdle and limb elements of multiple protosuchians, scutes of a large crocodylomorph, dentaries of two sphenodont taxa and abundant problematicalts. All the articulated and closely associated small vertebrates come from the base of the microvertebrate fauna.

The diversity of the small vertebrates indicates a stable, favorable environment as a function of proximity to an oasis. Because small vertebrates are not likely to have been sufficiently vagile to replenish an ephemeral habitat, they must have occupied the area continuously or in an interval of many generations, during which the lake was a persistent feature. Small vertebrates are known from the dune facies by the ichnoserial Brasiliichnium, but no skeletal material likely to represent the Brasiliichnium track-maker (thought to be a synapsid) have been found in the SSQ, suggesting environmental segregation of the Nuguettinauroichnocoena.

The presence of small vertebrates in the SSQ in sand instead of mudstone encourages us to think that other such samples may be found within the eolian sequences of the Nugget/Navajo sandstones by searching all interdunal facies, including (thought to be a synapsid) have been found in the SSQ, suggesting environmental segregation of the Nuguettinauroichnocoena.

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American Ceratopidae, thus continuing to pose difficulties with both biogeographic reconstruction and prior molecular divergence dates.

Romer Prize Session (Thursday, October 31, 2013, 9:15 AM)

EMPIRICAL AUTHENTICATION OF OUR UNDERSTANDING OF FLUVIAL TAPHONOMIC PROCESSES
EVANS, Thomas, Montana State University, Bozeman, MT, United States; 59717-3480

For decades, analytical techniques like Voorhies groups, bone orientation, and equivalent spherical quartz diameters have been used to interpret palaeontological and archaeological skeletal assemblages. However, these methods incorporate untested assumptions concerning how bones behave in fluvial systems. A validation study was performed to determine if bones in rivers behave as predicted and determine if any of these techniques accurately predict skeletal assemblages moved and deposited by rivers. Over 7000 modern bones and 3668 bone casts were seeded in three rivers over four years, and bone movement and burial were tracked over time and space. Bone long axis orientations did not correlate with flow direction, though 75% of concave bones did orient concavity down, and 75% of convex bones did not display group-like transport behaviors. Bones deposited in rivers were not found on sediment with equivalent grain sizes, and no consistent relative transportabilities (R) of bones were observable. Bone shape and density showed no consistent relationship to transport. Individual bone bulk density varied wildly as they became waterlogged, causing bones to float, hydrate, sink, and move stochastically. In addition, 56% of bones were deposited with woody debris, and many more were found in conjunction with bed obstructions. Field data suggests bone transport is governed by bone density (floating and hydration) while deposition is governed by bed interactions, demonstrating that existing analytical techniques are inadequate to describe fluvial bone transport behavior. Consequently, our existing understanding of fluvial taphonomic processes is incomplete suggesting that present fluvial taphonomic analytical techniques should be updated before use.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

TRAUMATIC PATHOLOGIES IN THE POSTCRANIAN OF AN ADULT ALLOSAURUS SPECIMEN FROM THE MORRISON FORMATION OF THE HOWE QUARRY, WYOMING, U.S.A.
EVERS, Serjoscha, Ludwig-Maximilians-University Munich, Munich, Germany; FOTH, Ludwig-Maximilians-University Munich, Munich, Germany; RAUHUT, Olivier, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; MATEUS, Octavio, Universidade Nova de Lisboa, Faculdades de Ciências e Tecnologia-CICEGE & Museo da Lourinhã, Lourinhã, Portugal

Adult large-bodied theropods are often found with numerous pathologies. A large, almost complete, adult Allosaurus specimen (Saarlemuseum Aathal [SMA] 0005) from the Howe Quarry, Morrison Formation (Late Kimmeridgian–Early Tithonian), Wyoming, shows a number of pathologies. Pathologic bones include the left scapula, several left dorsal ribs, the right ischium, and a left pedal phalanx. A complete, transverse fracture occurs in the proximal part of the left scapula. The distal fragment is displaced and distorted in relation to the proximal fragment. The fracture does not show a callus structure as expected for a healed injury, but some secondary ossous connection to the distal fragment is apparent at the rupture point of the proximal fragment, reshallulation of the weak attachment. This is consistent with a pseudoarthrosis, which occurs as a delayed healing response in fractures that lack adequate stabilizing and are subject to frequent movement.

The distal part of the left scapula is fractured incompletely and transversely. The bone around the fracture is slightly thickened and roughened. The fracture is at approximately the same level as a series of transversely fractured left dorsal ribs. The presence of calli around the rib fractures and the alignment of the scapula and rib pathologies suggest that all may have been caused by a single traumatic event. The right ischium suffered a complete, oblique fracture. Rough bone tissue covers the fracture on one side completely, while the other shows no sign of reactive growth. A pedal phalanx has a hyperostosis at the dorsal and lateral sides of its proximal end, forming an oval callus, unlike the irregular exostoses in phalanges of other Allosaurus specimens, including the Museum of the Rockies specimen MOR 693 from the same quarry. The bone surface is roughened, but not rugose, and lacks lesions indicative for infections. This indicates bone resorption in an advanced healing stage of the injury.

All the pathologies show signs of healing, suggesting that none of them directly caused the death of the individual. This again underlines that large-bodied theropods experienced frequent traumatic injuries during life, an indication of an active lifestyle as a predator.

Technical Session I (Wednesday, October 30, 2013, 11:45 AM)

THE PERMIAN ARCHOSAURIFORM RECORD REVISITED: A NEW SPECIES FROM TANZANIA AND THE POTENTIALLY OLDEST ARCHOSAURIFORM
EZCURRA, Martin D., School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, United Kingdom; BUTLER, Richard, School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, United Kingdom; SCHEYER, Torsten M., Paläontologisches Institut und Museum, Universität, Münchehagen (Germany)

Archosaurs include all diapsids closer to crocodiles and birds than to lepidosaurus. The group has a very rich Mesozoic and Cenozoic fossil record, but the Palaeozoic record is restricted to a handful of Late Permian specimens. The most informative Permian archosauriform so far discovered is Proterosaurus speneri from the middle Late Permian of Western Europe. In addition, there are several less well-known putative archosauromorphs from Russia and Africa. We review these records here and include several of them in a quantitative phylogenetic analysis for the first time. This phylogenetic analysis included a broad taxonomic sampling of basal synapsids, basal diapsids and sauroids. We could not find archosauromorph apomorphies in a supposed Late Permian proterosuchid cervical vertebra from South Africa (Bernard Price Institute for Palaeontological Research specimen BP/1/4220), and consider this specimen to belong to a determinate amniote. BP/1/4220 possesses striking features that are not present in any of amniotes of which we are aware, such as pectoral processes extended, wide and almost horizontally oriented accessory processes between the postzygapophyses. A problematic reptile (University Museum of Zoology, Cambridge specimen UMZC T836) from the Late Permian of Tanzania, first described in the 1950s, was recovered in the phylogenetic analysis as a proterosuchid at the base of Archosauromorpha, and is probably diagnosable as a new species. The position of UMZC T836 within Archosauromorpha is supported by the presence of three well-developed laminae in the cervico-dorsal neural arches and the absence of a hemipenial epipubic foramen. The supposed proterosaurus EMPS/2007.0145 from the Late Triassic of England was placed within Archosauromorpha, being more closely related to crown archosaurs than to proterosuchids, implying that this species may be the oldest known archosauriform. However, the fragmentary nature of the known material of this taxon and the low character support for this position means that this identification is currently tentative. Archosauromorpha from the latest Permian of Russia was found to be more closely related to Proterosuchus forgiei than to other archosauromorphs and represents a valid species. The revision conducted here suggests a minimum fossil calibration date for the crocodile-lizard split of 254.7 Ma. The occurrences of Proterosaurus speneri close to the paleo-Equator and UMZC T836 in high paleolatitudes of southern Pangea imply a wider paleobiogeographic distribution for archosauromorphs during the Late Permian than previously appreciated.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

ONE FITS ALL: USING PHOTOGRAMMETRY TO SOLVE DIVERSE PROBLEMS WITH LARGE-SIZED PALEONTOLOGICAL OBJECTS
FAHLE, Julia, Museum für Naturkunde, Berlin, Germany; MALLISON, Heinrich, Museum für Naturkunde, Berlin, Germany; WINGS, Oliver, Niedersächsisches Landesmuseum Hannover, Hannover, Germany; SCHWARZ-WINGS, Daniela, Museum für Naturkunde, Berlin, Germany

Photogrammetry is a method for creating three-dimensional (3D) surface models by aligning photographs of an object, originally in architecture and mapping. With increasing computing power it has become a versatile method with a wide array of applications in palaeontology. Several freeware or low-cost programs are available. Vertbrate palaeontologists at the Museum für Naturkunde Berlin use Agisoft PhotoScan Professional and collaborate to enhance efficiency in using photogrammetry. Research examples presented here reflect typical palaeontological problems and provide solutions for accurate 3D model production that can easily be adapted by colleagues facing similar problems. (1) Specimens that must remain in the field; dinosaur fossils from South Dakota (USA) show that rapid photo-acquisition conditions and photogrammetry is required when covering large specimens outdoors. Sufficient surrounding surface should be covered to avoid model warping for long tracks. For precise mapping of large excavation sites (i.e., Duna Quarry) and documentation over several field seasons it is important to define and retain field markers over the entire documentation time. To limit file size, model creation can be split into chunks. (2) Specimens that are too large for manual measurements, immobile, and cannot be scanned using other equipment: photogrammetry of mounted skeletons for whole-body modeling illustrates the importance of post-processing. Thin bones require higher resolution than thicker ones, thus model creation settings need to be adapted individually. With elongate large objects like baleen whale skulls, depth of field can be problematic. One should avoid head-on photographs and pay particular attention to focusing. Creating partial surfaces and aligning them during post-processing can help. Surface smoothing is not recommended as it blurs morphological features used, e.g., in landmark-based analyses. (3) Specimens that are physically inaccessible: photogrammetry of a forelimb of Janenschia (Sauropoda) on exhibit behind glass allowed generation of 3D models for character analysis. Application of polarizing filters and directional light helped to minimize reflections. Bones of Steneosaurus (Crocodyliformes) from Holzmaden (Germany) that had to be protected from contact contamination could also be measured using a 3D model. Generally, one should avoid changes in lighting or white balance and use accuracy settings that match photogrammetry resolution. Sufficient computing power is required to keep calculation times tolerable.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

EARLY SAUROPODOMORPH JAW APPARATUS ANATOMY: A COMPARATIVE STUDY OF EARLY LIZARDS
FAIRMAN, Jennifer, Johns Hopkins University School of Medicine, Baltimore, MD, United States; WEISHAMPEL, David, Johns Hopkins University School of Medicine, Baltimore, MD, United States; NABAVIZADEH, Ali, Johns Hopkins University School of Medicine, Baltimore, MD, United States; BUTLER, Richard, School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, United Kingdom; SCHEYER, Torsten M., Paläontologisches Institut und Museum, Universität, Münchehagen (Germany)

Several lines of evidence suggest that sauropodomorphs were one of the earliest tetrapods to achieve substantial body size and a predatory lifestyle. A working hypothesis is that sauropodomorphs were a dominant portion of the Early Triassic ecosystem. However, this hypothesis is based on a limited number of taxa, and as a result, knowledge of Early Triassic sauropodomorph morphology and anatomy is incomplete. Although the Early Triassic sauropodomorph Steneosaurus kroyeri is one of the relatively well-preserved specimens, this species is problematic as it is still only known from a partial, isolated postcranial skeleton. As a result, there is little information on the anatomy of the Early Triassic sauropodomorphs. Anatomical studies of Early Triassic sauropodomorphs exhibit behind glass allowed generation of 3D models for character analysis. Application of polarizing filters and directional light helped to minimize reflections. Bones of Steneosaurus (Crocodyliformes) from Holzmaden (Germany) that had to be protected from contact contamination could also be measured using a 3D model. Generally, one should avoid changes in lighting or white balance and use accuracy settings that match photogrammetry resolution. Sufficient computing power is required to keep calculation times tolerable.
omnivorous Sceloporus magister and the herbivorous Iguana iguana provided the basis for the extant comparative sample. The insectivorous Ctenosaurus helioscopus and C. pectinata were also dissected for further comparison. A suite of skull structures and muscle locations were identified that appear to relate to the differences in feeding styles in these extant iguanians. In the omnivorous and insectivorous forms, similarities include the oblique shift of the temporal fenestrae in relation to each other and the long axis of the skull, the dorsal shift of the supratemporal fenestra, and the overall lengthening of the jaw muscles. Alternatively, in the herbivorous Iguana, features include the relationship of the temporal fenestrae with the maxillary; archosaur feathers in Sauropodomorpha, as in many modern birds; many specimens preserve two very long tail feathers and their relationship to the long axis of the skull, like that of L. iguana, whereas A. polyzelus has temporal fenestrae that are of an oblique relationship, similar to that of S. magister. Therefore, it is suggested that Anchisaurus had a facultative omnivorous feeding style whereas Plateosaurus was predominately herbivorous.

The skull of A. polyzelus exhibits temporal fenestrae that are located at a right angle with each other and the long axis of the skull, like that of L. iguana, whereas A. polyzelus has temporal fenestrae that are of an oblique relationship, similar to that of S. magister. Therefore, it is suggested that Anchisaurus had a facultative omnivorous feeding style whereas Plateosaurus was predominately herbivorous.

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recreating a set of footprints that has not existed in its complete form for more than 70
years. The quality of reconstruction of the two trackways in situ along their lengths varies,
depending on the amount of overlap between successive fields of view in Bird’s original
photographs. The reconstruction is best toward the down-trail end of the two trackways.
This corresponds to the portion of the quarry beginning with the final right sauropod pes
print in the TMM slab, and ending by a sandbag dam seen in Bird’s photographs. The
photogrammetric reconstruction is less satisfactory in its up-trail portion (including the
prints in the TMM slab and in the TMM slab).

We made comparisons among the photogrammetric reconstruction, the reassembled
AMNH-TMM slabs, and Bird’s Rye Chart of the trackways. Examination of the AMNH-
TMM slabs reveals several theropod prints not depicted in the Rye Chart. There is
reasonably strong agreement that the prints represent a theropod, and several contoured
footprints are known from the Omo, Ethiopia, and Mississippi, U.S. sites. Bird’s chart may
be less satisfactory in its up-trail portion (including the prints in the TMM slab and in the
TMM slab).

The Rye Chart, the reassembled AMNH-TMM slabs, and our photogrammetric
reconstruction all agree, however, in the overall pattern of the trackways of the two
dinosaurs. The theropod crossed the tracksite after the sauropod did, repeatedly stepping
in the latter’s footprints. Over most of the length of the two trackways, the theropod’s
prints hug the left margin of the sauropod trackway, the trackways of both animals
bending to the left, with the theropod crossing the sauropod’s trackway only at the end of
the latter (as exposed in Bird’s quarry).

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

THE EARLY PLEISTOCENE MAMMAL FAUNA OF ‘MARSABIT ROAD’,
CHALBI BASIN, NORTHERN KENYA
FRERRARO, Joseph, Baylor University, Waco, TX, United States, 76798; BINETTI,
Katie, Baylor University, Waco, TX, United States; RICHMOND, Brian, George Washington University, Washington, DC; United States; MANTHI, Fredrick, National
Museums of Kenya, Nairobi, Kenya

The Chalbi Basin of northern Kenya preserves a long succession of laterally-
extensive but little-explored fissiliferous sediments dating to the early and middle
Pleistocene. Located to the immediate southeast of Lake Turkana, the Chalbi Basin offers
palaeobiologists a relatively rare opportunity in East Africa to assess ancient faunas and
paleoenvironments outside of the Great Rift Valley. In the summers of 2009-2012, our
team conducted a series of expeditions to the southernmost margin of the Basin. Our
primary goal was to investigate the early Pleistocene fossil locality of ‘Marsabit Road’, a
site originally noted by surveyors in the 1940s. Through a combination of prospecting,
sweeping, sieving, and excavation, we recovered an abundant and speciose collection of
~1500 accessionable fossil mammal specimens. Finds include an intact hominin third
molar, as well as the remains of 30+ species of primates, carnivores, bovids, equids,
suids, elephants, deinothere, camels, and hippos, amongst others. A biostratigraphic
analysis of the fauna provides a date of 1.9-2.1 Ma – an age consistent with a 40Ar/39Ar
date of 1.9 Ma for a basin level at the top of the local stratigraphic sequence. The fauna
is thus roughly comparable in age to the important regional fossil records of the Turkana
Basin, Kenya and Ethiopia, and Kanjera South, Kenya. With regard to paleoenvironmental
setting, the fauna indicates the presence of an edaphic grassland directly abutting a large river or lake, with secondary grasslands and lightly wooded
settings present at slightly higher elevations. With the assumed absence of other grazers,
species like V. exanthematicus, with species like

Technical Session XIV (Saturday, November 2, 2013, 9:00 AM)

PRECISE INFERENCE OF AVIAN FLIGHT ABILITY FROM SHOULDER JOINT DIMENSIONS
FIELD, Daniel, Yale University, New Haven, CT, United States, 06511; LYNNER,
Colin, Yale University, New Haven, CT, United States

The evolution of powered flight, defined as the capacity to sustain level aerial
locomotion by flapping wings as in crown-clade birds, was a pivotal event in dinosaur
evolution, and played a major role in the ascendency of avians to their current position as
the most diverse and widely distributed tetrapods. Understanding the pattern of powered
flight acquisition has become a key goal in dinosaur paleobiology, with the flying
potential of basal avians, such as Archaeopteryx, inspiring debate since the 19th Century.
Understanding of powered flight capacity on the avian stem has, however, been limited by the difficulty of obtaining precise, quantitative estimates of flying potential
from fossils. Here, an analysis of shoulder joint dimensions and body mass in 1142 extant
birds and 11 stem-birds precisely delimits functional flying and flightless zones, enabling
explicit tests of flying potential in stem-birds. This discovery demonstrates that basal
avians such as Archaeopteryx – despite possessing avian-style wing-powered flight evolved later than previously believed, shedding light on the importance of the stepwise sequence by which flight-related modifications accrued on the avian stem (e.g., the evolution of asymmetrical pennaceous feathers predates the evolution of powered flight, whereas a robust sternal keel evolved long after the origin of powered flight). This is because most volant avian species have a large size, suggesting that only the strong option for estimating body mass for volant birds, rendering these measurements the best
option for estimating body mass for volant crown-bird fossils, as well as for compact core
steams. Given the relatively high preservation potential of avian coracoids from the Late
Cretaceous through the Cenozoic, this method facilitates robust mass estimates for
volant avians, even when only fragmentary remains are preserved.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

THE MIOCENE MAMMAL FAUNA OF SOUTHEASTERN MEXICO: AN
UPDATING OVERVIEW
FERRUSQUIA-VILLAFRANCA, Ismael, UNAM, Mexico City, Mexico; RUIZ-
GONZALEZ, Jose, UNAM, Mexico City, Mexico

Understanding of the Late Cenozoic evolution of the American continental fauna
requires an appropriate knowledge of Middle America’s late Tertiary faunas, which are
known from a handful of sites in Central America and Mexico south of the Trans-
Mexican Volcanic Belt. Although important advances in the paleontology of Central
America and southeastern Mexico have occurred in the last decades, much work remains
to be done not only at the known localities, but also in making a systematic effort to
discover new localities and study their faunas. The information on the Miocene fauna of
southeastern Mexico, is presented below to contribute to this effort. The fauna comes
from four locality-areas in the States of Oaxaca (here) and Chiapas (one). The bearing
strata form part of fluvio-lacustrine sequences preserved as grano fills, whose deposition
was partly contemporaneous with silicic explosive eruptions that emplaced tuff mantle
shields in the near interbeded, a sedimentary sequence referred to the volcanic
successions associated with them. The fauna consists of five orders, 17 families and 35
genera [mainly represented by a single species each]; last decade’s findings allow us to
record or supplement material referred to eight genera; this fauna includes two
chronofaunas, Hemingfordian and Barstovian, the former comes from the Suchilquitongo Area [northern arm of the Valle de Oaxaca Graben], the latter proceeds from the Matatlán Area [southeastern arm of the Valle de Oaxaca Graben], Nejapa Area [Nejapa Graben, eastern Oaxaca], and Ixtapa Area [Ixtapa Graben, southwestern Chiapas]. The Hemingfordian fauna is about one third that of the Barstovian: the Oaxacan faunas are much less diverse than those of the Barstovian. Both of these faunas consists of herbivores with very few carnivores [one order, three families, and four genera; the former includes: Aritoidactyla [nine families and 21 genera], Perissodactyla [two families and nine genera], Rodentia [two families and genera], and Probocondae [one family and genus] and, both are more diverse than the faunas which seem to have been contemporaneous; the latter comprise an ancestral meyniphrine coexisting with hipsteriones and philippinines. All taxa show strict North
American affinities. Seven families and fifteen genera have their southern occurrence in Mexico. However, the presence in Peru of American Cladoceran or older mammals may supersede this, thus leading to changes in the timing of the Great American Biotic Interchange.
cold and arid environmental conditions? We examined elbow-joint shape (i.e., the spread of open habitats in the late Cenozoic, which in turn resulted from increasingly hunting techniques of fast-running pounce and pursuit predators evolve in concert with open grassy habitats in North America were prevalent by the latest Oligocene, but there is evidence for pursuing prey in open habitats. Evidence from paleosols and phytoliths indicate that numerous crustaceans found that have also been preserved in three dimensions. The Prince Creek Formation of northern Alaska contains the richest record of polar ichthyosaurs. NMV (Museum Victoria) P160399, is an isolated cranial element from the Kikak-Tegoseak Quarry may not be referrable to the Southern Ocean. In spite of this, the diversity suggested ichthyosaurs were already on the decline since the end of the Jurassic; their final extinction was therefore regarded as anecdotal. Several theories have proposed unique biologic drivers to this event, including a break in the food chain or competition with other marine vertebrates. The reassessment of the taxonomy, phylogeny and paleoecology Cretaceous ichthyosaurs from Eurasia tell a much different story. Ichthyosaurs were ecologically and taxonomically diverse in several Eurasian ecosytems up to the latest Cretaceous. This revision also reveals that their extinction is diachronic, being staggered over four phases that span the entire Cenomanian stage. Detailed comparison with other groups suggests the multiphasic extinction of ichthyosaurs is not an isolated event, as was previously assumed, but correlates with profound, multiphasic turnovers among other marine animals, such as microplankton, rudists, ammonoids, and pytonomorphs. The diversity and contemporaneity of the biotic turnovers suggest worldwide physiochemical drivers for this profound reorganization of the marine ecosystems. The extinction of ichthyosaurs therefore appears as one of the facets of a much wider pattern that affected most of the marine ecosystems during the Cenomanian.

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October 2013—PROGRAM AND ABSTRACTS
the pagophilic Lobodontini of present day Antarctica.

Southern Ocean during the Mio-Pliocene. These archaic phocids may represent a hitherto close relationships with (1) approximately coeval fossil monachines described from Peru and South Africa; or (2) living Lobodontini of the Southern Ocean. Australasian fossil phocids were surprisingly disparate from those occurring elsewhere on the margins of the Southern Ocean.

The lower Eocene (Ypresian) Cambay Formation at Vastan Lignite Mine in Gujarat, western India, has yielded a rich vertebrate assemblage including the earliest modern mammals and oldest birds of the Indian subcontinent. Among the herpetological faunas, snakes, lizards and amphibians are abundant, but, strangely, lizards are only represented by amygids. Here we describe the agamid assemblage based on numerous, diverse and well-preserved dentaries, premaxillaries, and maxillaries. At least four taxa are present at Vastan. 

FOLIE, Annelise, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; RANA, Rajendra S., H.N.B. Garhwal University, Srinagar, India; AUGÉ, Marc, Muséum National d’Histoire Naturelle, Paris, France; KUMAR, Kishor, Wada Institute of Himalayan Geology, Dehradun, India; SMITH, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium.

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In turn, the tusked dolphins form the sister taxon to amongst stem and crown odontocetes (e.g. dalpiazinids, ombonii). The second specimen is a cranium, CM Zfa333, of uncertain middle Miocene to Pliocene age (3.0–?12.0 Ma; Greta Siltstone, Motunau, South Island, New Zealand). CM Zfa333 is also a monachine, possesses more derived morphology than Monachus and NMV P160399, but lacks amygids of Lobodontini. Neither of the Australasian phocids appear to have close relationships with (1) approximately coeval fossil monachines described from Peru and South Africa; or (2) living Lobodontini of the Southern Ocean. Australasian fossil phocids were surprisingly disparate from those occurring elsewhere on the margins of the Southern Ocean.

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A NEW LOOK FOR AN OLD BIRD: A NEW SPECIMEN OF ARCHAEOPTERYX

FOTH, Christian, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; RAUHUT, Oliver, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany

Since its first discovery over 150 years ago, the Late Jurassic Archaeopteryx has played a central role in our understanding of the early evolution of birds and the origin of flight. Recent discoveries of numerous closely related species from China have challenged the phylogenetic position of Archaeopteryx as most basal bird and provided new evidence for the evolution of birds and origin of flight. Here, we present a new specimen of Archaeopteryx from the Solnhofen Limestones with exceptional feather preservation. The plumage is preserved as imprints in ventral view and consists of symmetrical, narrow-raned contour feathers, which seem to have extended all the way to the head. Only the right wing is preserved, consisting of twelve asymmetric primary feathers. The rachis of the primaries are relatively thick proximally, but thin down to the distal end abruptly. No evidence of dorsal covert impressions is present. Hind limb feathers are well-preserved, and were only present along the femur and the tibia. They closely resemble the morphology of the body contour feathers, being symmetrical rather than asymmetrical as it is the case in Microraptor. These feathers thus correspond to the leg feathers seen in many basal as well as recent birds and argue against a ‘four-winged’ state in Archaeopteryx. For the first time the tail plumage is completely preserved. The distal rectrices are considerably longer than previously reconstructed and form a slightly bifurcated end as present in Caudipteryx or Microraptor. In contrast, the lateral rectrices are approximately half as long as the distal rectrices and possess an asymmetric shape. This observation sheds new light on the original holotypic feather of Archaeopteryx, which probably presents a lateral tail feather instead a primary feather. Furthermore, the presence of asymmetric rectrices in Archaeopteryx indicates an acoustic function of the tail.

THE INFLUENCE OF MULTI-NICHE ONTOGENY ON DIFFERENTIAL SURVIVORSHIP ACROSS THE K-PG BOUNDARY

FOWLER, Denver, Montana State University, Museum of the Rockies, Bozeman, MT, United States; 59717; FREEDMAN FOWLER, Liz, Montana State University, Museum of the Rockies, Bozeman, MT, United States; SCANNELLA, John, Montana State University, Museum of the Rockies, Bozeman, MT, United States; HORNER, John, Montana State University, Museum of the Rockies, Bozeman, MT, United States.

The Cretaceous-Paleogene (K-Pg) boundary of the major extinctions in the history of life on Earth, with the loss of up to 75% of species. Extinction rates were not uniform, however; although all clades suffer lineage extinctions, some are wiped out entirely. Such differential survivorship is suggestive of 'species selection' acting on attributes shared by every member of a clade (e.g., residence in detritus-based or aquatic ecosystems, burrowing ability, or small size). Variation in life history has been offered as an explanation for differential survivorship of ammonites and nautiluses across the K-Pg boundary, but only recently has research begun to investigate this for vertebrates. Many Mesozoic faunas lack multispaces (including the Mesozoic and many basal birds), but excluding mammals and derived birds) occupy a chain of niches through ontogeny, due to small neonate size compared to large adults, and/or multi-year maturation. This contrasts with most mammals and derived birds where each species effectively occupies a single niche, dominated by adults. Adult, any potential niche distance between neonates and adults is closed by parental care until the offspring reach maturity, which, due to rapid growth rates, is typically achieved in one year or significantly less. To investigate the implications of multi-niche ontogeny for extinction, we used a simple mathematical model of the multi-niche vertebrate spatial density of 10 species across the K-Pg boundary, and five ancient taxa. These data strongly support occurrence of black-footed ferrets among the SCBC paleofauna.

PRELIMINARY INVESTIGATIONS OF CHONDRICHTHYAN AND ACTINOPTERYGIAN FAunas FROM THE FISH SCALE SANDSTONE (ALBION TO CENOMANIAN), BIRCH MOUNTAINS, ALBERTA, CANADA

FRAMPTON, Emily, Stantec Consulting, Calgary, AB, Canada, T3C 0K1; COOK, Todd, University of Alberta, Edmonton, AB, Canada, T6G 2E9; VALLEYS, Michael, Provincial Ministry of Palaeontology, Drumheller, AB, Canada

Very little is known about marine fish from the northern region of the Western Interior Seaway (WIS) during the late Albion to Cenomanian. Here we report three genera of chondrichthyans and five genera of actinopterygians from the Fish Scale Sandstone (FSS), or Fish Scale Marker Bed, in the Birch Mountains of northeastern Alberta, Canada. The FSS occurs within the Shaflness Formation, a marine unit of Albion to Cenomanian age. The base of the FSS is recognized as latest Albian to earliest Cenomanian age. Chondrichthyans and actinopterygians are recovered from the Fish Scale Sandstone (FSS), or Fish Scale Marker Bed, in the Birch Mountains of northeastern Alberta, Canada. The FSS occurs within the Shaflness Formation, a marine unit of Albion to Cenomanian age. The base of the FSS is recognized as latest Albian to earliest Cenomanian age. The base of the FSS is recognized as latest Albian to earliest Cenomanian age.
reported from other late middle Cenomanian to Turonian assemblages from southern regions of North America. Previously, only four genera were reported from the Fish Scale Sandstone with only Xenyllion zonensis figured and described. Furthermore, the Birch Mountains actinopterygian and chondrichthyan fauna helps to fill a gap in the marine stratigraphic record of the WIS in Canada.

Technical Session XI (Friday, November 1, 2013, 2:15 PM)

GLOBAL CLIMATE DRIVES TEMPORAL PATTERNS OF NORTH AMERICAN MAMMAL BETA DIVERSITY

Friser, Danielle, Carleton University, Ottawa, ON, Canada, K1S 5B6; HASSALL, Christopher, University of Leeds, Leeds, United Kingdom; GORELICK, Root, Carleton University, Ottawa, ON, Canada; AMERICAN MAMMAL BETA DIVERSITY

further empirical support for climate-based diversity models. Interestingly, temporal changes in generic-level beta diversity resemble modern latitudinal richness gradients, showing a unimodal relationship with global climate (68/2 values from benthic foraminifera), peaking during the early Oligocene and late Miocene. At the species level, North American mammal beta diversity shows a dramatic peak during the Paleocene-Eocene thermal maximum, declining dramatically into the early Eocene. Based on our results, we predicted that beta diversity should decline under modern anthropogenic warming. We therefore constructed climate space models (CSMs) for modern North American mammals under similar magnitudes of global warming and found no change in mammalian beta diversity. CSMs are therefore unlikely to accurately predict the outcomes of modern global warming for North American mammals because they do not account for evolutionary processes. We suggest that studying the community composition of fossil animals represents a new frontier in paleontological research that has the potential to inform modern conservation and is a robust metric for measuring climate change response because it can be easily applied in the past and present. We propose that integrating the study of fossil, modern, and projected patterns of mammal community composition may allow ecological principles to be tested in the temporal dimension, ii) provide the most complete picture of climate change response, and iii) enable the efficacy of predictive ecological models to be independently tested.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

NEW VERTEBRATE FAUNAS FROM THE Earliest CARBONIFEROUS OF SCOTLAND

FRASER, Nicholas, National Museums Scotland, Edinburgh, United Kingdom; CLACK, Jennifer, Univ Museums of Zoology Cambridge, Cambridge, United Kingdom; MILLWARD, David, British Geological Survey, Edinburgh, United Kingdom; DAVIES, Sarah, University of Leicester, Leicester, United Kingdom; MARSHALL, John, University of Southampton, Southampton, United Kingdom

*Romers Gap is a period of approximately 20 million years at the base of the Carboniferous characterized by a world-wide break in the fossil record of early tetrapods as well as a paucity of terrestrial invertebrates. Here we report on a major initiative in the Tweed Basin of southern Scotland that is providing completely new insights into this pivotal period for the evolution of life on land. A number of localities in this region are yielding significant new tetrapod material that is helping to populate the gap. Importantly these contain not only tetrapods but broader remains of complete ecosystems including fish, invertebrates and plants. In addition to the tetrapods, vertebrates include fishes such as gyracanthids, lungfish, rhizodonts and actinopterygians, both as associated and partially articulated remains. The invertebrate faunas are also quite diverse and include malacostracans, eurypterids, ostracods, scorpions and myriapods. The fossils are all from the Ballagan Formation, a distinctive rock unit that crops out widely across the Midland Valley of Scotland and the Borders into northern England. The Ballagan Formation is a cyclic succession of mudstone with interbedded sandstone and thin beds and nodules of “cementstone”. The sediments were deposited on an extensive low relief, muddy, vegetated floodplain that was traversed by numerous river systems. Periodically the river-derived floodplain was submerged by floodplains generating extensive shallow freshwater lakes. The widespread presence of gypsum, anhydrite and pseudomorphs after halite suggest these were marginal coastal floodplains that were subject to occasional marine transgressions, periods of intense evaporation and fluctuating salinity. A critical component of this study is the drilling programme the Ballagan Basin which has generated a tight stratigraphic framework for the tetrapod localities and provide high resolution datasets that will underpin interpretation of the depositional and climate systems during this time.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

BIOMECHANICAL SIGNIFICANCE OF TRABECULAR ARCHITECTURE IN PTEROSAURS

FRIGOT, Rachel, Johns Hopkins University, Baltimore, MD, United States, 21202; PALMER, Colin, University of Bristol, Bristol, United Kingdom

Pterosaurs have a substantially reduced trabecular network, consisting of fewer well-defined and enlarged struts, rather than the spongy network of fine, numerous trabeculae found in the cancellous bone of most other vertebrates. This reduction has been considered highly functional, associated with reduction in skeletal mass to produce a framework capable of stiffening and strengthening the bone at minimum mass.

To test the functionality of pterosaur trabeculae, we created simplified finite element models consisting of a uniform tube taken from a CT scan of a first wing phalanx, representing the cortex of the bone, with uniform trabeculae placed at regular intervals and a single trabecular orientation. The orientation and spacing were then changed to create a series of models, each varying in a single parameter, which were then loaded to compare to steady state flight. Flexion in the proximal and distal horizontal and vertical components and a torque was applied corresponding to the proximal translation of forces acting on more distal elements of the wing.

Comparison of stress and strain distributions in these models allowed isolation of how trabecular in different orientations were loaded and investigation of the functional link between trabecular spacing and thickness. The results indicate that trabeculae do not appear to have been subject to substantial loads, at least not under steady state flight. This suggests that the cortex is the primary means of resisting the loads generated during flight. Take-off, landing and changing direction would all generate higher loads, but these loads become more tenuous to estimate. In at least the case of pterosaurs, the historical view that trabeculae are highly functional appears not to be the case. The possibility that they would serve a functional purpose under extreme loads is not here ruled out. However, alternative explanations for their retention should be explored further.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

THE QUALITY OF THE FOSSIL RECORD OF ANOMODONTs (SYNAPSIDA, THERAPSIDA)

FRÖBISCH, Jörg, Museum für Naturkunde, Berlin, Germany; WALTHER, Marcus, Museum für Naturkunde, Berlin, Germany

This study presents an up-to-date assessment of the quality of the fossil record of anamodont synapsids, one of the major clades of Permian-Triassic terrestrial tetrapods. A Character Completeness Metric (CCM2) is calculated for each taxon and consecutive stage and completeness per assemblage zone ranges between 62.71% and 91.33%. We further performed up-to-date taxic and phylogenetic diversity estimates, confirming the general biodiversity trends recovered by recent analyses. Therein, anamodont diversity increases throughout the Permian with varying support for a minor mid-Permian (end-Guadalupian) extinction, collapses in the earliest Triassic and reaches a second peak in the Middle Triassic before their final decline in the Late Triassic. Finally, we tested potential correlations of completeness scores with anamodont biodiversity trends and various sampling proxies (geologic and anthropogenic) at the regional scale of the South African Karoo Basin. Our analysis suggests that all these variables are independent of one another, as they generally lack a significant correlation. The consistently high completeness scores throughout their evolutionary history together with a lack of correlation with biodiversity trends and sampling proxies underscore a high quality of the anamodont fossil record. In fact, when compared to other vertebrate groups, the completeness of anamodonts is exceptionally high. Yet, whether this pattern results from the unrivaled fossil record of the Karoo Basin or whether it is clade-specific and unique to anamodonts remains to be tested.

Technical Session I (Wednesday, October 30, 2013, 9:30 AM)

LIMB ABNORMALITIES IN THE DISSOROPOID AMPHIBIAN MICROMELOPETRON CREDNERI: PRIMARY PATHOLOGY OR FAILED REGENERATION?

FROEBISCH, Nadia, Museum für Naturkunde Berlin, Berlin, Germany; WITZMANN, Florian, Museum für Naturkunde Berlin, Berlin, Germany; BICKELMANN, Constanze, Museum für Naturkunde Berlin, Berlin, Germany

Micromelopeteron credneri is a basal dissorophid and well known from hundreds of specimens from Lower Permian lake deposits in central Europe. It is represented by a wide range of ontogenetic stages and frequently preserved as complete skeletons with a variety of limb pathologies in extant tetrapods (including humans) such as congenital fibular deficiency. Yet the great
diversity and variability of pathological patterns is striking and cannot easily be explained by a single genetic defect. Moreover, although all specimens derive from spatially and temporally distinct geographic regions, the variation and combination of pathologies observed in Ribeirioidea are not very different from the abnormalities caused by failed regeneration in extinct salamanders and could indicate that the striking regenerative capacity of modern salamanders is not derived, but may be an ancient feature either of the trematoda or even more broadly of tetrads.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)
FUNCTION AND POLARITY OF CONCAVO-CONVEX ARTICULATIONS IN THE VERTEBRAL CENTRA OF SAUROPOD DINOSAURS WITH IMPLICATIONS FOR OTHER VERTEBRATES
FRONIMOS, John, University of Michigan, Ann Arbor, MI, United States, 48109-1079;
WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, United States

Sauropods are unique among terrestrial vertebrates in the columnes of body size and neck elongation they attained. Their long neck and tail were held aloft, as seen from anatomical and taphonomic evidence, as a result of high muscle moment arms for the roll and yaw of the presacral portion of the body. Most of the vertebral column is anteriorly concave and posteriorly convex (i.e., procoelous) caudal centra evolved independently at least three times. They are limited to the anterior cervical region in amniotes and flagellacaudal diplopodids and extend almost to the tip of the tail in some derived titanosaurs. Conaco-convex articulations provide a greater range of motion than the ancestral biconcave (i.e., amphicoelous) condition by permitting rotation without losing contact between articular facets. The large contact area between centra and the centrum of another allows for large moment arms and high muscle moment arms for the roll and yaw of the presacral portion of the body. Although amphicoelous and procoelous vertebrae are anatomically opposite, they are mechanically equivalent. In both cases, the concave articulation faces the fixed end of the centilever, the body, and the convex articulation faces the free end. Experiments demonstrate that this consistent polarity provides only a slight advantage in range of motion over the opposite polarity but may confer greater resistance to proximally-directed stress generated by the muscles and ligaments that support and move the neck and tail. The factors controlling articulation polarity in vertebrates should be the same as for concavo-convex joints in the appendicular skeleton.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)
OPTIMUM SCAPULAR POSITION TO SUPPORT AND STABILIZE THE BODY ON A FORELIMB IN QUADRUPEDAL TETRAPSIDS
FUJWARA, Shin-ichi, Nagoya University, Nagoya, Japan

Deducing a spatial scapular position relative to the trunk is essential for estimating postures and functional performances of forelimbs in extinct tetrapsids. However, due to the absence of direct skeletal articulations between the scapula and the rib cage, it remains difficult to reconstruct the scapular position relative to the trunk. I approached this problem in quadrupedal tetrapsids by focusing on moment arms of antigravity muscles (i.e., serratus and rhomboideus muscles) which connect the dorsal portion of the scapula and the thoracic bones. Assuming stance phase on a single forelimb (in addition to supporting the hindlimb), these muscles function to roll, yaw, and pitch the presacral portion of the body about the acetabular or lumbarsacral joints. The muscle moment arms for the roll and yaw are expected to be minimized to stabilize the body, whereas those for the pitch are expected to be maximized to support the presacral portion of the body efficiently against the gravity. Although there is relatively high mobility between the scapula and the trunk, the optimum scapular position estimated by the moment arm analysis was consistent with scapular positions in vivo during the stance phase which were observed in extant therian mammals. Estimation of muscle paths of the antigravity muscles and the moment arm analyses on these muscles will provide quantitative criteria for determining reliable scapular positions in extinct quadrupedal tetrapsids.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)
RADIOCARBON DATING AND ISOTOPIC ANALYSIS OF PLEISTOCENE FAUNA FROM PROJECT 23 AT RANCHO LA BREA: A NEW METHOD FOR TAR REMOVAL FROM BONE COLLAGEN BY ULTRAFILTRATION
FULLER, Benjamin, UC Irvine, Irvine, CA, United States; SOUTHON, John, UC Irvine, Irvine, CA, United States; FOR TAR REMOVAL FROM BONE COLLAGEN BY ULTRAFILTRATION

The Rancho La Brea tar pits located in Los Angeles, California contain one of the largest concentrations of flora and fauna remains from the late Pleistocene and provide one of the most detailed and complete fossil records of North America at the end of the most recent glacial period. Most of the vertebral skeletal remains are exceptionally well preserved and contain close to modern amounts of collagen as they were immersed and impregnated with asphalt shortly after death. However, the removal of this asphalt from the bone collagen for radiocarbon dating and stable isotope ratio analysis has proven difficult and time consuming when produced results with atomic C:N ratios that fall outside the accepted range of 2.9-3.6 for stable isotope ratio analysis. Previous methods have relied on hydrocarbon removal using a Soxhlet apparatus and then either bulk collagen isolation or hydrolysis and purification of amino acids. If these deposits are to be accurately radiocarbon dated and analyzed for stable isotope ratios on a large scale, then a rapid and more cost-effective method for the removal of the asphalt is required.

Here we describe a novel protocol for collagen purification from asphalt impregnated skeletal remains recovered from a new area of excavation known as Project 23 (new fossil deposits discovered in 2006 during construction of a nearby underground parking structure for the Los Angeles County Museum of Art; n = 11) and from previously dated pits (n = 5) at Rancho La Brea. This method requires the use of a simple solvent soak and sonication treatment and a higher gelatinizing temperature to break down collagen strands to the point that they can be separated by ultrafiltration. The traditional method of ultrafiltration for bone collagen is reversed here and the high molecular weight fraction (>30 kDa) contains mainly the asphalt (too big to pass through the membrane), and the low molecular weight fraction (<30 kDa) contains collagen. A further ultrafiltration (<30kDa) step is then performed on the <30 kDa fraction to remove the lower molecular weight contaminants such as humic acids. The middle fraction (3-30 kDa) is freeze dried and produced fluffy white collagen with excellent atomic C:N of 3.2-3.3. The processes involved in the design of protocol will be discussed in detail and the first radiocarbon date from the Project 23 site will be presented, including the first radiocarbon date for a Rancho La Brea mammoth (Mammutthus columbi).
Carnotaurus in predation risk. We tested for a correlation between size and ossified cranial ornamentation in extant vertebrate clades correlates with complex biological and ecological relationships. This set up a visit to the dinosaur halls of the American Museum of Natural History; the students were now prepared to answer questions on evolution of the Dinosaurs. The extinction module started with a session on the three evolutionary faunas and the Big Five mass extinctions involving hands-on study of fossil specimens, including fossils collected by the students. We then looked at the gradual and catastrophic hypotheses for dinosaur extinction at the K/T boundary, a computer simulation exercise involving modeling the impacts of smaller and larger fireball and asteroid impacts. Students engaged in a formal debate over proposed extinction mechanisms, considering strengths and weaknesses of gradualist and catastrophist hypotheses and the nature of scientific evidence. This initiated a unit on the Pleistocene megafauna extinction, modern climate change and endangered species. Exit surveys identified field trips and class debates as favorite learning experiences. Preliminary statistics indicate that the Discovery cohorts had higher retention rates and higher GPAs than the entire Rider student body.

Technical Session X (Friday, November 1, 2013, 10:30 AM)

STABLE ISOTOPIC PALEOENVIRONMENTAL RECONSTRUCTION OF THE LATE PLEISTOCENE SITES ON RUSINGA AND MANGANO ISLANDS, LAKE VICTORIA, KENYA

GARRETT, Nicole, University of Minnesota, Minneapolis, MN, United States, 55455; FOX, David, University of Minnesota, Minneapolis, MN, United States; TRYLON, Christian, New York University, New York, NY, United States; FAITH, J. Tyler, The University of Queensland, Brisbane, Australia; PEPP, Daniel, Baylor University, Waco, TX, United States

Environmental pressures are generally presumed to play a key role in the evolution of mammals, including humans. Anatomically and behaviorally modern Homo sapiens evolved during the Late Pleistocene, but the lack of detailed paleoenvironmental reconstructions from East African hominin sites during this interval limits our understanding of the evolutionary pressures shaping early modern humans and their dispersals within and out of Africa. Here we present a paleoenvironmental reconstruction for the Late Pleistocene environments on Rusinga and Mangan Island in Lake Victoria, Kenya. These sites date from 33–100 ka and preserve a taxonomically diverse fossil fauna and associated Middle Stone Age (MSA) and later Later Stone Age (LSA) artifacts. The unique faunal assemblage from Rusinga and Mangan Island is characterized by the presence of extinct specialized grazers and adapted species outside their modern-day range. Stable carbon and oxygen isotopes analyses indicate paleolod carbonate and organic matter (n=75), and fossil tooth enamel (n=62), including the first isotopic analyses for the extinct bovid Rusingoryx atopocranion, Damalscids hypodon, and an exceptionally hypodont gazelle (Gazella alt. grunts). Providing a regional proxy, the mammalian dental isotopic analysis documents the presence of increased aridity and that most large-bodied mammals consumed a predominantly C4 diet. This data support other studies indicating a significant reduction in the size of Lake Victoria at this time. Conversely, the paleolod carbonate and organic matter analyses suggest that the local habitat associated with human activities was a riverine woodland ecosystem with on average ca. 60% woody cover. Together, these results suggest the significant expansion of C4 grasslands relative to today during the late Pleistocene, with hominins persisting in the Lake Victoria region perhaps by exploiting locally wooded and well watered habitats.

Technical Session IX (Friday, November 1, 2013, 8:15 AM)

OSFIFIED CRANIAL ORNAMENTATION CORRELATES WITH MID- TO LARGE-BODY MASS IN THEROPOD DINOSAURS

GATES, Terry, North Carolina State University, Raleigh, NC, United States, 27695; ZANNO, Lindsay, North Carolina Museum of Natural Sciences Nature Research Center/North Carolina State University, Raleigh, NC, United States

Studies on the pattern, prevalence, and implications of ossified cranial ornamentation in dinosaurs have largely focused on the elaborate structures involving hands-on study of fossil specimens, including fossils collected by the students. We then looked at the gradual and catastrophic hypotheses for dinosaur extinction at the K/T boundary, in a computer simulation exercise involving modeling the impacts of smaller and larger fireball and asteroid impacts. Students engaged in a formal debate over proposed extinction mechanisms, considering strengths and weaknesses of gradualist and catastrophist hypotheses and the nature of scientific evidence. This initiated a unit on the Pleistocene megafauna extinction, modern climate change and endangered species. Exit surveys identified field trips and class debates as favorite learning experiences. Preliminary statistics indicate that the Discovery cohorts had higher retention rates and higher GPAs than the entire Rider student body.

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dependent on the quality of the data in the database. There is always the potential that published identifications of species of fossils were not solely based on morphology, but rather were made by using geography the restrict the number of species that were considered. In some cases, the identifications were made in the identification of the species, then any studies using those identifications to examine range shifts during the Quarternary will be biased. It is therefore necessary to determine which identifications may be biased in this way. In a novel use of GIS (geographic information systems), I analyzed the FAUNMAP II database for potential geographic bias in the identification of the Quarternary fossils. I queried the FAUNMAP II database (Soricidae) deer (Odocoileus spp.), pocket mice and kangaroo rats (Heteromyidae), and spotted skunks (Spilogale spp.). These taxa were selected because they are difficult to identify to species from isolated skeletal material, and there are significant differences in the geographic ranges of the species within a genus. To capture the shape of the geographic distribution of the species from the FAUNMAP II database, I generated a standard deviation ellipse for each species. A standard deviation ellipse encloses one standard deviation, or 68% of the features. The ellipses were then compared between species of the same genus and to the modern ranges of the taxa. My analysis found that there was a significant geographic influence in the identification of species of Soricidae, Heteromyidae, Odocoileus, and Spilogale. The strength of this technique is that it rapidly recognizes those taxa where the identification potentially was based on geographic assumptions. In those cases, a re-examination of the identification is warranted to determine what role geography may have played. Of special concern are taxa like Notosorex and Blarina, for which there was only a single species recognized for all or most of the twentieth century. Due to the historical bias towards the first named species, the identification of those fossils should be treated as generic identifications until they are reevaluated against the full spectrum of data from the broadest geographic sample possible.

Preparators’ Session (Thursday, October 13, 2011, 11:15 AM)

MOVING COLLECTIONS INTO THE NEW NATURAL HISTORY MUSEUM OF UTAH

GETTY, Mike, Natural History Museum of Utah, Salt Lake City, UT, United States, 84112

In November 2011, the new Natural History Museum of Utah opened to the public in our new facility at the Rio Tinto Center. For those of us in the paleontology collections, however, the job of moving into the building had just begun. From October 2011 through April 2012, we transferred all of the NHMU paleontology collections, including approximately 26,000 vertebrate, 6,000 invertebrate, and 4000 paleobotanical specimens into our new collections facility. This proved to be a very intense process for six months to complete the move. Four days per week were spent rehousing and stabilizing specimens in the old building, which were moved into the new facility on two days per week. Most vertebrate specimens were rehoused into new drawers and fully stabilized with ethafoam prior to being moved into the new building, where they were sorted into cabinets mounted on compactable carriages. Oversized specimens were palletized and stabilized prior to moving. All of the large broken material was repaired and many of the largest and most delicate specimens were rehoused into large open-faced or clamshell-styled support jackets, constructed of fiberglass and gypsum cement and lined with felt or ethafoam. Throughout the move specimens were organized into hierarchical order based on a combination of stratigraphic, systematic and anatomical properties. A small crew of three full time staff, three part time interns and 10-15 volunteers worked six days a week for six months to complete the move. Four days per week were spent rearranging and stabilizing specimens in the old building, which were moved into the new facility on two move days per week with the assistance of professional movers. The movers also provided assistance and expertise on moving large specimens out from difficult places in the old collections as well as moving select furniture and cabinets which were transferred from the old building into the new museum. While the move was complete by April 2012, reorganization and inventory of the collections in the new facility will continue for at least another year.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

TESTING CLIMATE CHANGE AND OVERKILL EXTINCTION HYPOTHESES FOR PLEISTOCENE EQUIDS WITH DENTAL MESOWEAR

GHANI, Ihsat, New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY, United States, 11568; CAMPBELL, Daniel, New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY, United States; BARRON-ORTIZ, Christian, Univ of Calgary, Calgary, AB, Canada; MIHLBACHER, Matthew, New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY, United States

The late Pleistocene equid (Equus ferox) underwent rapid body size decline in Alaska preceding its extinction c.a. 12.5 m.y. carboniferous KYBP. This size shift, thought to be caused by a climate/vegetational shift, has been used to argue against human overkill. The disarticulated condition of fossils from this region renders it difficult to examine paleoclimatic trends because species, as they are defined today, are comprised of several species of extant wild equids to establish a relationship between the mesowear of upper and lower molars. Using photographs taken at a standardized angle, 70 evenly spread semilandmarks were placed on the paronases of the upper and in the corresponding occlusal valleys between the paracristids and metacristids on the lowers.

Among modern equids, the first principal component scores of the upper and lower landmark data are significantly correlated, suggesting that both uppers and lowers provide similar paleodiayetic information.

For the Alaskan equid, tooth shape, defined by the Procrustes coordinates, was compared to a body size proxy (molar length + width) using multivariate regression. Lower dental mesowear is significantly related to size, with smaller (and presumably younger) specimens having a shallower lingual occlusal valley, suggesting a shift toward the end of the Pleistocene, although intraspecific variation in body size renders a quantitative estimate of body size difficult. Further analysis suggests consuming slightly more highly abrasive diets as body size declined. We found no relationship of mesowear and size among upper molars, although the smaller sample size of upper molars may explain the insignificant result. Thus far, the results are most consistent with ecological change towards the end of the Pleistocene, although intraspecific variation in body size renders traditional methods of analysis inappropriate. Future work with a larger data set would provide a more complete analysis of ecological change through time.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

FIRST REPORT OF JURASSIC PTEROSAUR TRACKS FROM AFRICA

GERILINSKI, Gerard, JuraPark, Ostrowiec Sw, Poland; ADACH, Lidia, Polish Geological Institute, Warsaw, Poland; LOCKLEY, Martin, Univ of Colorado Denver, Denver, CO, United States

Although pterosaur tracks are now quite well known from North America, Western Europe and Asia, they are still almost unknown from Africa and South America, and are completely unknown from Australia and Antarctica. Here we report a Jurassic assemblage of trackways from Mbiladen, Morocco in 2009, which is likely the oldest known occurrence of pterosaur tracks and possibly the first from Africa. The specimen consists of a slab with more than a dozen Pteraichnus tracks and trackway segments from a known stratigraphic horizon of red sandstones, which also yield theropod and sauropod tracks. The pterosaur tracks are very well-preserved and medium sized (manus and pes length about 10 cm). Results of this study are presented in the JuraPark and University of Colorado collections (J389 and UCM 185.17 respectively). Although the tracks occur in the Mbiladen region which is very famous for mineral mines, tracks in this area have not previously been reported or dated accurately. According to the published stratigraphic map, these tracks are preserved from the Jurassic, but their age remains unknown.

Enigmatic tracks of possible reptilian (laceritician) affinity were reported from the Upper Cretaceous (Maastrichtian) of the Agadir region of Morocco in 1954 named Agadrichus. These were later re-interpreted as “possible” pterosaur tracks, although this conjecture is not proven, as the type material is not available for study. Thus, the Mbiladen assemblage is the only pterosaur tracksite from Africa for which actual specimens (and GPS coordinates) are available.

Technical Session XII (Friday, November 1, 2013, 3:15 PM)

INFERENCES ON THE FEEDING BIOMECHANICS OF THE BIZARRE PUG-NOSED CROCODYLIFORM SIMOSUCHUS CLARKI

GIGNAC, Paul, Stony Brook University, Stony Brook, NY, United States, 11794-8081; KLEY, Nathan, Stony Brook University, Stony Brook, NY, United States

Living crocodylians and their ancestors are commonly thought of as predators that manage, simultaneously, to be large and stealthy, and these seem to be consistent factors in the evolutionary success. Several recently discovered crocodylian ancestors (i.e., notosuchians), however, have demonstrated that the evolutionary narrative of crocodile-line ancestors is far more diverse than previously realized. Among these diverse fossil forms is Simosuchus clarki from the Late Cretaceous of Madagascar, a relatively small, heavily armored, and blunt-nosed relative of modern alligators and crocodiles. Multiple analyses of teeth and jaw morphology indicate that this taxon represents an herbivorous radiation within Notosuchia. Here we examine the diet and feeding biomechanics of Simosuchus to address how this fossil mesoeucrocodylian evolved into its highly diverse feeding niche. Relying largely on gross dissections and jadeite-enhanced X-ray μCT scanning, we use modern crocodylian cranial soft-tissue anatomy, along with the exquisitely preserved hard-tissue anatomy of Simosuchus, as foundations for reconstructing a functional anatomical model of the jaw adductor system in this taxon. We integrate investigations of gross cranial morphology, estimates of bite-force capacity, and inferences of transverse jaw motion with examinations of dental form and tooth pressures to address the anatomical and functional characteristics of Simosuchus herbivory. These findings are compared to the feeding biomechanics of the closest living relatives of Simosuchus, modern crocodylians, as well as to a sample of herbivorous reptiles. Our results indicate numerous specializations for processing plant matter in several cranial systems (e.g., skull structure, dentition, adductor musculature) that are convergent with those of other living and fossil reptilian herbivores. In sum, these findings provide an example of a successful evolutionary trend-out that has adapted to facilitate a major transformation in feeding ecology that seems to have influenced even the post-cranial anatomy of this taxon (resulting in expansion of body armor and semi-erect posture, among other features).
GILBERT, Christopher, Hunter College of the City University of New York, New York, NY, United States; BIBL, Faisal, American Museum of Natural History, New York, NY, United States; HILL, Andrew, Yale University, New Haven, CT, United States; BEECH, Mark, Abu Dhabi Authority for Tourism and Culture, Abu Dhabi, United Arab Emirates; ROSSIE, James, Stony Brook University, Stony Brook, NY, United States

Recently, we described ~12.5 million year old fossil colubrine teeth from the Tugen Hills, Kenya. These specimens represent the earliest colubrine and the earliest cercopithecid in the fossil record by ~3 million years. In preparation for the Baynunah Formation, Emirate of Abu Dhabi, UAE, we have collected over 150,000 fossils that have been in the recovery of a fossil tooth representing the earliest known member of the tribe Cercopithecini (guenons), and the only guenon known outside of Africa. This new specimen is represented here and tentatively assigned to a new species of cercopithecine belonging to a clade known outside of the African continent. The late Miocene fauna of Abu Dhabi is a unique blend that includes both African and Eurasian elements at this time, suggesting that the Arabian Peninsula was an important dispersal and exchange route for various mammalian lineages. The presence of early cercopithecines, and cercopithecines, in particular, on the Arabian Peninsula during the late Miocene provides important insight into primate biogeography and evolution over the past seven million years. Specifically, the newly discovered fossils support late Miocene dispersal hypotheses into Eurasia through Southwest Asia in addition to and perhaps instead of dispersal routes over the Straits of Gibraltar. The discovery of these Arabian fossils demonstrates that identifiable cercopithecine fossils extend back into the Miocene epoch, thereby refuting hypotheses that crown cercopithecines are a very recent radiation first appearing in the Pliocene or Pleistocene. Finally, the fact that these discoveries in Africa and Arabia extend the first appearance dates (FAD) for cercopithecids, colobines, and cercopithecines by 3-5 Myr demonstrates, rather disturbingly, the rarity of some taxa in the Afro-Arabian fossil record and the corresponding imprecision of their existing FADs. This should be taken into consideration when evaluating hypotheses and molecular clock estimates that rely too heavily on such data.

Illuminating Holocene Diet Shifts in Penguins with Compound Specific Isotope Analysis

GILBERT, Kwasi, University of California Santa Cruz, Santa Cruz, CA, United States; BEECH, Mark, Abu Dhabi Authority for Tourism and Culture, Abu Dhabi, United Arab Emirates; BARONI, Carlo, University of Pisa, Pisa, Italy; LORENZINI, Sandra, Università di Pisa, Italy

Holocene-aged Adélie penguin (Pygoscelis adeliae) remains from the Ross Sea, Antarctica, provide a picture of changes in the ecology of this species and in ecosystem dynamics in response to natural and anthropogenic perturbations. Time series of stable carbon and nitrogen isotope values constructed from radiocarbon-dated guano and eggshell fragments show increasing variation to lower values beginning 4000 years BP. These records correlate with low carbon and nitrogen isotope values in penguin remains from the last 200 years. The increase in variation and shift toward lower values has been interpreted as reflecting an increase in the abundance of krill in penguin diets, from diets that formerly included more fish. A diet dominated by krill matches observations made on penguins of the Antarctic and sub-Antarctic foraging at the coast of the Ross Sea today. The timing and magnitude of this expansion and shift in dietary breadth remains unclear, however. The guano and eggshell isotopic records are complex and are at times conflicting. In addition, each only reflects the diets of penguins on rookery sites, not diets for the majority of the year when they are foraging away from the coast. Isotopic records from bone, which offer a long term perspective on animal diets, have not been included in the past because of the potential for post-depositional alteration.

Here we analyze bulk carbon and nitrogen isotope values in Adélie penguin bone collagen from the Ross Sea. We introduce new preparation steps to clean bone collagen from contaminating material, and compare the bone collagen isotopic record with existing records for modern penguins. In addition, we use compound specific isotope analysis of bone collagen amino acids to dissect the relative contributions of shifts in trophic level (diet) from those due to biogeochemical changes in isotopic baseline values. We find that the bone collagen carbon and nitrogen isotope values show a similar pattern of stability over much of the Holocene and a marked decline in the latest Holocene. Amino acid isotope values indicate that these trends are consistent with a transition from a krill dominated diet with an expansion of fish inclusion. Significant changes in the biogeochemical baseline were detected. The incorporation of krill into Adélie diet at current levels appears to be a relatively recent phenomenon that may relate to both commercial whaling and changes in ice conditions in the Ross Sea in the latest Holocene.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

Ontogeny and Sexual Dimorphism in the North American Glyptodont, Glyptothereus (Xenarthra, Cingulata)

GILLETTE, David, Museum of Northern Arizona, Flagstaff, AZ, United States; CARRANZA-CASTAÑEDA, Oscar, Centro de Geociencias, Universidad Nacional Autónoma de México, Campus Juriquilla, Queretaro, Mexico

Newly discovered infant, juvenile, and adult members of the Plio-Pleistocene glyptodont, Glyptothereus texanus Osborn 1903 from the San Miguel del Allende Basin in Guanajuato, Mexico and the 111 Ranch fauna, southeastern Arizona, permit an expanded understanding of growth and development, including sexual dimorphism. Osteoderms that formed the carapace in infants were in full edge-to-edge contact from an early age. Growth of the osteoderm was allometric, but preserved osteoderm-to-osteoderm contacts. Osteoderms individually grew more rapidly on the edges than in the center, changing the relative proportions of the external sculpturing formed by surface sulci. Central figures of dorsal osteoderms were relative large in infants, and became relatively smaller with growth as peripheral figures expanded more rapidly. In general, ontogenetic processes understood in geologically younger osteoderms resulted in a shift toward a more rounded profile in adults.

Additional specimens were collected in the early 20th century by geologists and paleontologists Hugh Beadnell, Charles Andrews, Ernest Stromer, and Eberhard Fraas. Layman Richard Markgraf was traced, but only a few of the specimens collected by this early fossil collector have been deposited in museums and dealers. Markgraf’s specimens are found in museums around the world, but he paid little attention to stratigraphy and his collections continue to cause confusion. We have worked in western Fayum in recent years to document the succession of middle and upper Eocene faunas and more recently Neogene faunas from the Wadi El Hafit and Wadi El Rayan, covering 1200 km² of desert and spanning some 12 million years of geological time. Specimens are mapped, measured, and identified in the field when possible, or excavated, collected, and identified in the laboratory. Sixth of the following intervals has yielded osteoderms and/or sirenians: (1) Muselwih and lower Midawara Fms., early Lutetian: not yet explored; (2) middle Midawara Fm.,
middle Lutetian: Protocetidae, Remingtonocetidae, and Proteoiodontidae; (5) upper Miocene, Eocene, and Oligocene: Eocétidae, Pterocetidae, and Protocetidae; (6) upper Miocene, Pliocene, and Pleistocene: Bironacetus, Birket Qrun Fm. and lower Qar el-Sagha Fm., early Pliobatosanidae, Bisanianidae, and Protocetidae; (7) upper Pliocene, lower Pleistocene: Bisanianidae, Bagdudidae, and Proteoiodontidae; (8) middle Qar el-Sagha Fm., middle Pliobationian: Bisanianidae and Dougongidae, and Proteoiodontidae; (9) upper Pliocene, early Pleistocene: not yet explored. Markgraf collected primarily from intervals 7 and 8, which have quite different faunas (Rhabdocephali, Dinosauria, Archosauria, Eothyracoidea, and Prototisrion in the former, Saghuacetus, Stromerios, and Eosaurus in the latter). Markgraf mixed collections, sometimes creating chimeras represented as single individuals. The sequence of faunas in Egypt overlaps that documented in Pakistan, with the Musawwir and Midawara formations in Egypt being contemporaneous with the Habib Rahi and Domanda formations in Pakistan, the Sath el-Hadid being equivalent to Pir Koh, and the El-Gharza and possibly higher formations being equivalent to Draizada. Together, the two areas provide a coherent stratigraphic base for understanding in Eocene cetacean and sirenian faunas through time.

Symposium 4 (Saturday, November 2, 2013, 9:30 AM)

FEATHER-LIKE STRUCTURES AND SCALES IN A JURASSIC NEORNITHISCHIAN DINOSAUR FROM SIBERIA

GODEFROIT, Pascal, Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium; SINITSA, Sofia, Institute of Natural Resources, Ecology and Cryobiology, SB RAS, Chita, Russia; D'HOUNAILE, Danielle, Université Joseph Fournier, La Tronche, France; BOLOTSKY, Yari, Institute of Geology and Nature Management, FEB RAS, Blagoveshchenn, Russia; SIZOV, Alexander, Institute of the Earth’s Crust, SB RAS, Irkutsk, Russia

Recent discoveries in Middle-Late Jurassic and Early Cretaceous deposits from northeastern China have revealed that numerous theropod dinosaurs were covered by feathers. Furthermore, filamentous integumentary structures were also recently described in rare Early Cretaceous ornithischian dinosaurs from Liaoning Province in China. Whether these filaments can be regarded as epidermal and therefore part of the evolutionary lineage towards feathers remains controversial. Here we report on the presence of a basal neornithischian dinosaur, based on isolated bones and partial skeletons collected in two monospecific bonebeds from the Middle-Late Jurassic Kulinda locality in the Transbaikal region (Russia). Varied integumentary structures were found directly associated with skeletal elements, supporting the hypothesis that simple filamentous feathers, as well as compound feather-like structures comparable to those in theropods, were widespread amongst the whole dinosaur clade. Moreover, scales along the distal tibia and on the foot closely resemble the secondarily-appearing pedal scales in extant birds. More surprisingly, dorso-ventral movements of the tail were prevented by large imbricated scales on its dorsal surface. It is hypothesized that, at the same time early feathers evolved within the whole dinosaur clade, genetic mechanisms limiting the growth of long epidermal structures on the distal portion of the hind limb and on the tail were selected as they facilitated bipedal terrestrial locomotion.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

FIRST RECORD OF ABDOMINAL CONTENTS IN FOSSIL CROCODYLIFORMES

GODOY, Pedro, University of Sao Paulo (USP), Ribeirao Preto, Brazil; MONTEFELTRO, Felipe, University of Sao Paulo, Ribeirao Preto, Brazil; LANGER, Max, University of Sao Paulo (USP), Ribeirao Preto, Brazil

Abdominal contents or cololites are the most direct and reliable evidence of predation in extinct animals. Despite the richness of Crocodyliformes in Mesozoic-Cenozoic deposits, abdominal contents were never recorded among this group. Here we report on extrinsic elements in the abdominal cavity of a baurusuchid crocodyliform. The preservation of the complete gastralia indicates that the abdominal cavity of the baurusuchid remained intact prior to and after burial, suggesting that these extrinsic elements, positioned between the gastralia and the left ribs, correspond to cololites. The baurusuchid skeleton is articulated and almost complete, and contains, ventral to its left ribs, a cluster of partial cranial bones and teeth of another crocodyliform. The tooth elements, positioned between the gastralia and the left ribs, correspond to cololites. The baurusuchid remained intact prior to and after burial, suggesting that these extrinsic elements may be sister taxa within Crocodylidae. Geometric morphometrics, which uses homologous landmarks to assess shape change in specimens, has only begun to be explored in this debate. However, the greatest concern remains the focus on the exterior of the skull, which is known to be highly environmentally plastic. The braincase appears less susceptible to environmental effects, and has provided useful non-geometric, phylogenetic information, but has not been explored in this context. To address whether the size and shape of the crocodylian braincase retains phylogenetic signal, we used three-dimensional geometric morphometrics to examine the braincase of crocodylians to determine whether this structure is fused to the exterior of the skull, midsagittal views are necessary to retain suture patterns for geometric morphometric analyses. These views were obtained using high-resolution computerized tomography (CT) scans to examine the interior of the post-orbital skull. We analyzed multiple individuals across species, representing a majority of extant crocodylian diversity, using Procrustes superimposition and principal components (PC) analyses. We found that the first two component axes described more than 50% of the variation but did not show groupings that divide the specimens by family. The broad overlap of Gavialis specimens with a diversity of other taxa indicates that 3D braincase morphology cannot resolve the phylogenetic position of Gavialis within Crocodylia. Instead, our results indicate that size, not phylogenetic relatedness, is the most important factor in the change in shape of the braincase. This suggests that constraints on the neurocranium (e.g., developmental, functional) are uninformative for constructing phylogeny.

Symposium 1 (Wednesday, October 30, 2013, 10:15 AM)

NEW DATA ON DEVELOPMENTAL CRANIAL ONTOGENY IN PACHYCEPHALOSAURUS

GOODWIN, Mark, University of California Museum of Paleontology, Berkeley, CA, United States, 94720; HORNER, John, Montana State University, Museum of the Rockies, Bozeman, MT, United States; SCHOTT, Ryan, University of Toronto, Toronto, ON, Canada; EVANS, David, Univ of Toronto at Mississauga, Toronto, ON, Canada

Extended neonatal and late-stage allometric growth increases morphological disparity between growth stages in the Marginocephalia (pachycephalosaurids, ceratopsids). As a result, pachycephalosaurs commonly show morphological change during ontogeny facilitated by "metaplasia", erosional resorption, and redeposition. We use comparative cranial morphology, histology, and high-resolution computer tomography (HRCT) to confirm these modifications.

A major pachycephalosaur ontogenetic trend is inflation of the frontoparietal dome as the skull lengthens. Lateral cranial elements are eventually incorporated into the dome as it continues to expand ontogenetically. Nasal nodal ornamentation and the location and arrangement of the squamosal horns/nodes in Pachycephalosaurus and the ornamented parietosquamosal bar in Stegoceras are considered to reflect an increase in interfrontal, frontoparietal, and parietosquamosal sutures in partially domed, relatively younger individuals of Stegoceras. Lateral cranial elements are also unfused. A decrease in relative vascularity accompanies the development of the frontoparietal dome in Stegoceras. These features link ontogenetically younger “flat-headed”, intermediate incipiently domed, and more fully domed ontogenetically older individuals in a growth series for Stegoceras and Pachycephalosaurus. In Stegoceras, the distinctive frontoparietal dome grows rostrocaudally starting with the frontals. In Pachycephalosaurus, inflation of the dome appears to start caudally with initial inflation of the parietosquamosal region in relatively younger individuals. Pachycephalosaur cranial sutures can be difficult to trace or appear “fused” on the dorsal surface of more complete skulls. Morphological evidence from “Dracorex hogwartsia” and the confirmation of open cranial sutures and cranial morphology in "Stygimoloch spinifer" by histology and HRCT, continue to support the reinterpretation of these taxa as earlier growth stages of Pachycephalosaurus wyomingensis.

An increasing sample size of pachycephalosaurs from the Upper Cretaceous of the Western Interior facilitates the mapping of morphological change, cranial sutures, and bone composition. These data show that pachycephalosaur growth stages reflect a continuum rather than specific developmental steps defined by terminal morphologies and that juveniles are not rare in the fossil record.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

INTEGRATING TEMPORAL DATA WITHIN A PHYLOGENETIC ANALYSIS: A BAYESIAN APPROACH FOR CHARACTERIZING DIVERGENCE ESTIMATES IN AN EXTINCT CLADE

GORSCK, Eric, Ohio Univ, Athens, OH, United States, 45701; O’CONNOR, Patrick, Ohio Univ, Athens, OH, United States

Recent advances in molecular evolution and phylogenetic analyses have allowed the inclusion of both extinct and extant taxa into combined analyses using molecular and morphological data. The addition of fossils can add resolution for estimating divergence dates of extant clades by constraining the ages of intermediate nodes. This study further explores the estimation of divergence dates, but within an exclusively extinct clade by applying different evolutionary models coupled with temporally-informed terminal taxon. Sauropod dinosaurs are an ideal case study as this clade was highly successful globally throughout Cenozoic deposits, abdominal contents were never recorded among this group. Here we report on extrinsic elements in the abdominal cavity of a baurusuchid crocodyliform.
the latter half of the Mesozoic. For example, estimates of divergence dates within this clade may provide insight into various paleobiogeographical hypotheses while the latter half of the Mesozoic. For example, estimations of divergence dates within this clade may provide insight into various paleobiogeographical hypotheses while

**Comparative Allometric Growth Trajectories of Megalonyx and Paramylodon Scapulae**

GRASS, Andy, University of Iowa, Iowa City, IA, United States, 52242; Megalonyx and Paramylodon were two of the most common and widespread of the North American Pleistocene ground sloths. They are generally considered to have had different diets; Megalonyx was a browser and Paramylodon was more of a mixed feeder, with few co-occurrences in the fossil record. Megalonyx is related to the Hemphillian ground sloth Pliometaurus, part of a lineage that presumably island hopped to Florida in the late Miocene before the Isthmus of Panama had formed. Paramylodon is related to Ghosttherium, which did migrate directly from South America through Central America and into the early Pleocene. In this study the scapulae of juvenile and adult Megalonyx jeffersonii and Paramylodon harlanii were analyzed using geometric morphometrics. Scapula shape has been shown in several groups to be highly influenced by function and in some groups to be a good indicator of body size. A principal components analysis performed on the procrustes coordinates shows that there are statistically significant differences between the scapula shapes of the two species. Megalonyx tends to have a rounder scapula with approximately equal supra and infraspinous fossae, whereas Paramylodon tends to have a more arrow shaped scapula with the supraspinous fossa larger than the infraspinous fossa. The shapes between juveniles and adults of each species are also significantly different, with the juveniles of each species being much more circular in appearance than the more adult. A regression performed on the taxon of the centroid sizes and PC scores and each species shows a significant linear regression. A MANOVA found no significant interaction term between the contributions of size and species to shape, indicating that the allometric trajectories of the two species were not significantly different. They occupy different areas of morphospace, but they achieve their adult morphologies in the same way. This may be indicative of two scenarios. Despite their very disparate origins in time and space and their differing niches, Megalonyx and Paramylodon may have converged on similar growth trajectories. Alternatively, despite how distantly they are related to each other they may both have retained an ancestral growth trajectory. Either case is compelling evidence of evolutionary constraints on the shape of the scapula, which has attachment points for a different muscles that form different functional groups. Additionally, the shape differences between juveniles and adults may prove useful in estimating age categories from scapula shapes.

**Technical Session II (Wednesday, October 30, 2013, 10:15 AM)**

**TO 3D OR NOT TO 3D: DO 3D SURFACE ANALYSES IMPROVE ECOMORPHOLOGICAL INFERENCES?**

GOULD, Francois, unaffiliated, London, United Kingdom

The growth in three-dimensional (3D) imaging technologies has renewed interest in the study of extant and fossil taxa. Quantitative analyses of surfaces, including quadratic function fitting, GIS, and geometric morphometrics, are increasingly used to study form-function relationships in living and fossil mammals. These methods are computationally intensive, technically demanding and time consuming, which may limit sampling potential. To date, there have been few side-by-side comparisons of their effectiveness relative to more traditional analyses of linear measurements and ratios. The signal-to-noise ratio is slightly higher in the geometric morphometric analysis. The biologically meaningful, relationships between distal femoral shape and locomotor mode.

**The Influence of Bite Force on the Formation of Dental Microwear in Xenarthrans (Mammalia)**

GREEN, Jeremy, Kent State University at Tuscarawas, New Philadelphia, OH, United States, 44663; MCAFEE, Robert, Northern Illinois Univ, Ada, OH, United States; Among the unique traits shared by the placental clade Xenarthra is a derived lack of enamel on adult dentition. Prior analyses of dental microwear on orthodontic tooth surfaces reveal a correlation between microwear patterns and feeding ecology in this group, both among living taxa (tree sloths, armadillos) and some extinct relatives (ground sloths). However, the specific formative mechanism of microwear features (e.g., scratches, pits) on xenarthran orthodontine remains poorly understood. Bite force (generated by mandibular closure during mastication) should influence the formation of microwear, but no studies have specifically tested this hypothesis. We attempt to fill this gap in our knowledge by investigating the potential effects of bite force on microwear formation in tree sloths. Relative ratios of bite force were estimated from 15 skulls of Bradypus (tree-toed sloths) and Choloepus (two-toed sloths) by applying a geometric model for calculating input forces from masticatory muscles relative to lever arm moments of the mandible. Relative bite force increases posteriorly across the maxillary teeth in both taxa. For each skull, five microwear variables were quantified on three right maxillary molariforms (M2-M4) using the light microscopy method. Mann-Whitney U tests were applied to analyze changes in microwear variables at each tooth position in each taxon. Only frequency of cross scratches and hypercoarse scratches differed significantly between tooth positions in Choloepus, but with no consistent pattern of change. For Bradypus, only frequency of hypercoarse scratches changed in correlative response with increasing bite force. The overall lack of correlation between microwear variation and bite force suggests that tooth scars in sloths are not being generated by pure orath closure of the mandible, but rather are more influenced from post-contact masticatory movements. Further analyses that incorporate all jaw muscles to create a three-dimensional assessment of the chewing cycle should help to clarify how microwear patterns are generated in sloths.
EVALUATION OF POSTER SESSION IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

EVOLUTIONARY AND ECOLOGIC IMPLICATIONS OF DIETARY VARIATION AT INDIVIDUAL AND POPULATION LEVELS IN HERBIVOROUS MAMMALS

GRESIKO, Michael, Vanderbilt University, Nashville, TN, United States; DESANTIS, Larisa, Vanderbilt University, Nashville, TN, United States; HULBERT, Richard, Univ of Florida, Gainesville, FL, United States

The mechanisms driving dietary variation in herbivores has been the subject of considerable interest and has important evolutionary implications. While much work is aimed at understanding the dietary ecology of extant and extinct taxa, few studies have assessed dietary variation through time in multiple individuals from one population. Here, we use stable carbon isotope data from serial samples collected from the literature to understand dietary changes through time. Our statistical framework models the tradeoffs between individuals specialized and broad feeding strategies, geometric morphometric measures of jaw shape disparity, and taxon-free diversity curves of dental functional types. Three major conclusions are reached: morphological disparity in mammals (1) gradually increased with time through the Jurassic and earliest Cretaceous; (2) "bottlenecked" during the mid-Cretaceous; and (3) partially rebounded during the late Late Cretaceous. These disparity patterns were coupled with geological and biogeographical changes in the Mesozoic. Most notably, we examine the diversity patterns of plants and insects and their possible correlations with mammalian changes. The Jurassic diversification of mammals corresponds temporally with increases in gymnosperm and fern diversity, radiations of seed-bearing plants, and early diversification of flowering plants. By the Early Cretaceous, we find the highest levels of disparity in herbivorous mammals with the highest diversity of plants and insects, and potentially the earliest diversification of flowering plants. However, the Late Cretaceous saw a decrease in plant and insect diversity and the diversification of flowering plants. The Cretaceous-Paleogene extinction event led to a decrease in mammalian diversity that was followed by a gradual increase in diversity through the Cenozoic. Our results provide a general framework for future analyses of mammalian disparity and the factors affecting that disparity.

RODENTS FROM THE LOTHIDOK FORMATION, EARLY Miocene, WEST TURKANA, KENYA

GROSSMAN, Arche, Midwestern University, Glendale, AZ, United States; FLYNN, Lawrence, Harvard Univ, Cambridge, MA, United States; MANTHI, Fredrick, National Museum of Kenya, Nairobi, Kenya

The combined rodent assemblage from Kalodir and Mornorou, two late-Early Miocene (ca. 17MA) sites of the Lothidok Formation in West Turkana, Kenya, includes novel taxa as well as new anatomical elements of previously known taxa. Like other Early Miocene sites, the rodent assemblage is dominated by thryonomyids but its resemblance to other localities is only superficial. Three different species of Paraphiomys, one represented by several skulls and other excellent gnatho-dental material, are distinguished from each other by their size. One is large, the size of P. pigotti, but has simpler lower cheek teeth lacking the metalophid II. One species is very similar to P. renelavocati from Rusingapedetes (MP 25-28) in France, with teeth that distinguish them from Myotis. Younger still are three Myotis species from Herrlingen 8-9 (MP 29) in Germany. Compared to the Boutersem-TGV Miotys, M. major is much smaller with a relatively smaller, shorter and more delicate p4, M. intermedius is somewhat smaller in molars but with a less extreme longi-lingual shelf. The p4 of M. major has a larger m1-2, similar sized m3, smaller p4, more robust M1 and a more constricted P4 lingual shelf. The origin of Myotis appears to be at least as old as the earliest Oligocene.

MORPHOLOGICAL DISPARITY OF MESOZOIC MAMMALS THROUGH TIME

GROSSNICKLE, David, University of Chicago, Chicago, IL, United States; POLLY, P. David, Indiana University, Bloomington, IN, United States; ZHU, Zhe-Xi, Univ of Chicago, Chicago, IL, United States

Mesozoic mammals never attained the extensive range of adaptations found in their Cenozoic relatives. However, early mammalian taxonomic diversity and morphological disparity appears to have varied considerably over their 150 million year history. Here, we present an analysis of morphological disparity with an additional discussion on how the patterns relate to global ecological changes. A discrete character matrix was used to create a time-sliced principal coordinates analysis to assess changes in morphospace occupation through time. These data are combined with molar and lower jaw lengths, body size estimates, geometric morphometric measures of jaw shape disparity, and taxon-free diversity curves of dental functional types. Three major conclusions are reached: morphological disparity in mammals (1) gradually increased with time through the Jurassic and earliest Cretaceous; (2) "bottlenecked" during the mid-Cretaceous; and (3) partially rebounded during the late Late Cretaceous. These disparity patterns were coupled with geological and biogeographical changes in the Mesozoic. Most notably, we examine the diversity patterns of plants and insects and their possible correlations with mammalian changes. The Jurassic diversification of mammals corresponds temporally with increases in gymnosperm and fern diversity, radiations of seed-bearing plants, and early diversification of flowering plants. By the Early Cretaceous, we find the highest levels of disparity in herbivorous mammals with the highest diversity of plants and insects, and potentially the earliest diversification of flowering plants. The Cretaceous-Paleogene extinction event led to a decrease in mammalian diversity that was followed by a gradual increase in diversity through the Cenozoic. Our results provide a general framework for future analyses of mammalian disparity and the factors affecting that disparity.
DIVERSITY STRATEGIES FOR IMPROVING CT SCANS OF VERTEBRATE FOSSILS

HABERSETZER, Joeg, Senckenberg Research Institute, Frankfurt, Germany; ENGELS, Sandra, Senckenberg Research Institute, Frankfurt, Germany; SMITH, Krister, Senckenberg Research Institute, Frankfurt am Main, Germany

A broad array of different computed tomography (CT) procedures has been developed for this purpose. This section introduces the technology in the 1990s, e.g., different kinds of region-of-interest (ROI) algorithms. Many different methodological approaches exist, and it is not always clear to the occasional user what exactly are the advantages of each technique. The ideal case is a CT dataset representing a premium quality scan not only sufficient for immediate scientific application but also as a state-of-the-art collection object. Here we will point out advantages and shortcomings of particular micro-CT and nano-CT techniques and define quality standards. (1) Nano-CT technology: A very high resolution in the range of ~1-2 μm can be achieved with the nano-CT equipment, in the boundary region between conventional and synchrotron-CT. Isolated petrosals of fossil bats like Pseudorhinolophus and Archaeonycteris from the Quercy fossil site are eminently suitable specimens for this method because their projected overall size fits exactly into this boundary region. For larger objects like eochelate skull this method is of no advantage. 2) Surface modeling for micro-CT data: Here, we apply a method for enhancing the quality of surface models originating from the inevitably noisy and artifact-burdened CT data of the Messel primate Darmiunus massiliae. The unfavorably large size of the fossil plate greatly limits scan resolution, even though a special ROI micro-CT technique was used. We were able to generate high-quality, exportable, and accurate 3D surface models of the dentition, thus mitigating the problem to a considerable extent. (3) Extended-time micro-CT scans: Fossil plates produce a great amount of artefacts when the scan beam runs in near-parallel to the plate surface. A much better image quality can be obtained by increasing the dynamic range and the number of projections and by decreasing noise in the projection images before reconstruction. However, each of these actions will increase scan time by several fold. This procedure was chosen for the Messel fossil Cryptolacerta in order to tease out more anatomical detail than has heretofore been possible. Clearly there is not a simple formula for obtaining optimal CT-scans of every object on a single device. That is to say, no device can be simply adapted to any object. The three CT scanning strategies presented above represent entirely distinct approaches with three different CT devices to fulfilling our quality demands for different fossils.

FUNCTIONAL SIGNIFICANCE OF FEATHER ASYMMETRY IN EXTANT AVIANS AND PREDICTED FLIGHT PERFORMANCE IN EXTINCT TAXA

HALL, Justin, University of Southern California, Los Angeles, CA, United States; HABIB, Michael, University of Southern California, Los Angeles, CA, United States

The presence of asymmetric feathers has been regularly used as an indicator of aerodynamic function and flight capacity in fossil birds and non-avian dinosaurs. However, most of the flight feathers in living flying birds are not highly asymmetric. Only the most lateral primaries, which are held perpendicular to airflow, show extreme asymmetry. Secondarys, which are held parallel to airflow and generate much of the lift to support body weight, are typically symmetrical. The effects of feather asymmetry are more complex than simple presence or absence metrics indicate. Complex twisting occurs in the lateral primaries of living birds, which delays stall and promotes dynamic maneuvers and rigorous flapping flight at low speeds. This effect will only tend to occur in birds with vane depth ratios of 4:1 (with the lateral vane being the smaller of the two surfaces). Because the center of lift on a flat plate sits near 1/4 chord, feathers with vane depth ratios of 4:1 or less are loaded primarily in bending. Using an open source database of high resolution, sorted feather images from modern birds, we demonstrate that the feathers transition from torsion-dominated to bending-dominated morphology (i.e. 4:1 vane ratio) near primary position III to V, depending on the species.

The degree of asymmetry is therefore related to specific position on the wing, just as predicted by fluid loading theory. These patterns can be applied to fossil taxa to draw more precise conclusions about wing, hindwing, and tail functions. Microraptor gui possessed asymmetric hindwing feathers, which has been previously used to support a transverse orientation for these feathers (either in a biplane or glauing model). However, the hindwing feathers of Microraptor do not appear to be asymmetric enough to indicate an orientation similar to that of extant birds with hindwings. Instead, their morphology is more consistent with the medial primaries of living birds, which are held oblique to flow and loaded mostly in bending. The feather asymmetry in Microraptor is therefore more consistent with vertical limb orientation models, and could easily be a result of developmental constraint.

A PHYLOGENETIC ANALYSIS OF PALEOCENE MAMMALS: IMPLICATIONS FOR THE ORIGIN OF PLACENTAL MAMMAL ORDERS

HALLIDAY, Thomas, University College London, London, United Kingdom; UPCHURCH, Paul, University College London, London, United Kingdom; GOSWAMI, Anjali, University College London, London, United Kingdom

The Paleocene is arguably the most important time period in mammalian evolution. Prior to the Cretaceous-Paleogene (K-Pg) extinction, the mammal fauna is largely, though not exclusively, restricted to the scissorial or terrestroal insectivore niche; afterwards, there is a broad diversity of large herbivores, large carnivores, and later gliders, flyers and aquatic forms quickly evolved.

The majority of the taxa known from the Paleocene, however, belong to ‘wastebasket’ taxa or clades of unknown affinity – these include cimolostids, pantodonts, and the "condylanths". Only Rodentia, Carnivora and possibly Primates have well-supported Paleocene members. Verifying the relationships of these Paleocene mammals is thus essential for any reliable macroevolutionary study into the early phases of placentan mammal evolution.

Here we present the results of an extensive cladistic analysis of fossil mammals, focusing on Laurasiatheria and possibly larger Laurasiatheres, with 130 taxa and 681 dental, cranial and postcranial characters. Preliminary analyses in TNT resulted in 2448 trees of length 6474 steps when constraining Afrotheria as a monophyletic group. A strict consensus after pruning the seven stable extant taxa yields highly resolved relationships for the enigmatic Palaeocene mammals, including the majority of the “condylarth” groups. Relationships between extant taxa are largely upheld, although miacid and viverravid carnivors are not recovered as monophylite, and Euplotypota is not recovered. “Condylanths” are found to be polyphyletic, as expected, with aephalisids and placroaglaheders falling closest to Artiodactyla, and raphoconidids closest to Perissodactyla. Arcyconiids are reconstructed as a parathyphic lineage leading to macid carnivors, while periphylics lie at the base of a clade containing the majority of the non-eugululate Laurasiatheria. Cimolostids lie on the eutherian stem and are secondary. Cryptoclidus (previously precluded as the place-earliest stem Eutheria) is nested within the Linea to Afrotheria. With the exception of the lepidctid Gypsonictops, all Cretaceous taxa are resolved as stem Eutheria, supporting a Palaeocene origin for the majority of placental order.

There is much debate over the role of the K-Pg extinction in the origin of the placental mammal orders. This phylogenetic analysis will provide a useful basis for many future studies of major evolutionary patterns in early crown placentan mammals.

VITAL FIRST ENDOCRINE OF AN EOCENE NORTH AMERICAN ADAPFORM PRIMATE

HARRINGTON, Arianna, Florida Museum of Natural History, University of Florida, Gainesville, FL, United States; SILCOX, Mary, University of Toronto Scarborough, Toronto, ON, Canada; BLOCH, Jonathan, Florida Museum of Natural History, University of Florida, Gainesville, FL, United States

The first euprimates appear about 56 million years ago and are known almost exclusively from partial dental remains. Nevertheless, it is still widely assumed that they
shared a common ancestor with a relatively large brain compared to more primitive stem primates. Adapiformes is one of the first groups of euprimates to appear in the fossil record, and the assemblages at Rancho La Brea are a testament to this unique evolutionary lineage.

As the excavation of Project 23 continues, thePage Museum represents the largest assemblage of carnivoran fossils in the world. This is an unprecedented opportunity to study the evolution of these animals in a single locality. The Page Museum's goal is to document and preserve this rich fossil record for future generations to study and appreciate.

The Page Museum at the La Brea Tar Pits is a world-renowned institution dedicated to the preservation and interpretation of the world's largest assemblage of Late Pleistocene mammals. With over 12,000 species of plants and animals, the museum provides a glimpse into the past and offers insights into the diversity of life that once thrived in Southern California.

The museum's collection includes over 100,000 specimens, including the famous Elasmobranch Assemblage from the Late Miocene of Port Campbell Limestone. This assemblage, including representatives of sharks, rays, and skates, provides a window into the marine biodiversity of the Southern Ocean during this critical time period.

The Page Museum at the La Brea Tar Pits is a center for research, education, and public engagement. Through its extensive collection, educational programs, and interactive exhibits, the museum aims to inspire curiosity and foster a deeper understanding of the Earth's natural history. Whether you are a scientist, a student, or simply a curious observer, the Page Museum at the La Brea Tar Pits offers a unique and unforgettable experience.

In conclusion, the Page Museum at the La Brea Tar Pits is a vital resource for the study of Late Pleistocene mammals. Through its collection and educational programs, it continues to contribute to our understanding of the natural world and the importance of preserving our planet's biodiversity.
near contemporaneous deposits suggests that C. carcharias and C. hubbelli may have been sister species rather than clades as discussed in previous literature. This material is amongst the earliest confirmed records of C. carcharias known worldwide.

NEW FOSSIL LUNGFISHES (DIPNOI, LEPIDOSIRENIDAE) FROM THE PALEOGENE OF NORTHERN SOUTH AMERICA AND NEW METHODS FOR TOOTHPASTE IDENTIFICATION

HASTINGS, Alexander, Georgia Southern University, Statesboro, GA, United States; 30485; BOURQUE, Jason, Florida Museum of Natural History, Gainesville, FL, United States; BLOOR, Jonathan, Univ Florida, Gainesville, FL, United States; RINCON BURBANO, Aldo Fernando, Univ Florida, Gainesville, FL, United States; JARAMILLO, Carlos, Smithsonian Tropical Research Institute, Balboa-Azana, Panama.

South American lungfish (Lepidosirenidae) are known from a single extant species, Lepidosiren paradontas, that lives in swamps and slow-moving waters primarily in subtropical climates of the Amazon, Paraguay, and lower Paraná River basins. While the fossil record of lepidosirenids documents a widespread past distribution in Africa and South America, their history in the New World Tropics is largely unknown. Here we report new lungfish fossils from the Paleocene Cerrejón and Eocene Bogotá Formations in Colombia. Two relatively large (maximum jaw length: 73 mm) lungfish species (a lepidosirenid and a ceratodontid) were recovered from the middle Paleocene Cerrejón Formation of northeastern Colombia from the same localities that have yielded a diversity of reptiles including pleurodira turtles, dyrosaurid crocodyliforms, and the giant snake Titanoboa.

The depositional environment of the Cerrejón Formation from where the fossils were recovered has been reconstructed as a freshwater portion of a deltaic coastal plain. Three additional lepidosirenid fossils of much smaller size (maximum jaw length: 22 mm) have been recovered from two levels in the early Eocene fluvial deposits of the Bogotá Formation in central Colombia. The shift from the Cerrejón to the Bogotá formations represents a transitional facies change from a low-energy, coastal plain to a higher-energy fluvial system, higher up within the drainage network. A younger Miocene lungfish discovered in the Acre state of Brazil, Lepidosiren megulos, is slightly larger than the Cerrejón forms (jaw length: 76 mm), where this area was a similar, low-energy freshwater environment.

The Paleogene fossils from Colombia have a snout shape (length: width ratio of the prearticular = 1.0-1.5) that is intermediate between that of extant Lepidosiren (> 1.5) and the African extant lungfish, Protopotema (< 1.0). In contrast, Miocene L. megulos has a snout shape (ratio of 1.47) closest to that of extant Lepidosiren. Based on this and other characters related to the angle at which the tooth ridges diverge, we have identified two new genera including three or four new species of fossil lungfishes from Colombia. Discovery of new fossils will help test correlation of body size with the evolution of Amazonia and tooth ridge evolution within Lepidosirenidae.

EVALUATION OF THE PEDAL FUNCTION IN NON-AVIAN THEROPODS

HATTORI, Soki, University of Tokyo, Tokyo, Japan

Most theropods have four pedal digits, and their grasping function is relevant to arboreality or hunting behavior. Although an opposable digit (hallux) in birds clearly indicates their grasping ability, functional diversity of the pes in non-avian theropods possessing a reversed hallux has not been fully explored. To clarify pedal functions in non-avian theropods, principal component analyses were conducted based on four datasets based on linear measurements on all non-ungul pedal phalanges of extant birds and several non-avian theropods. In order to conduct these analyses, functional categories observed in extant birds were successfully differentiated with plots of non-avian theropods lying close to plots of ground foraging birds.

Additionally, detailed morphological observations suggest that the axis of movement of the hallucal metatarsus-phalangeal joint in non-avian theropods was more restricted to vertical motion than in extant ground-foraging birds. This might indicate the mechanical function of hallux, such as prey holding. In three species of Velociraptor (Dromaeosauridae), the attachment site of metatarsal (MT) I on MT II varied from the medial to the plantar sides, with the distal articular facet of MT I and associated phalanges correspondingly varying from lateral and posterior directions. A similar variation in the articulation of MT I was observed in several troodontid specimens. Moreover, the proximal articular facet of MT I in both dromaeosaurid and troodontid specimens was convex as in extant birds, rather than concave as in more basal non-avian theropods. These characters indicate that the mobility of the intermetatarsal joint between MT I and II was increased so that the range of hallucal movement was extended in Paraves, presumably leading to acquisition of the perch function in basal birds.

In conclusion, although non-ungul pedal phalanges of non-avian theropods in general show adaptation for ground foraging, the hallux of derived non-avian theropods shows development of the primitive grasping function, which would have presumably been exalted to subsequent acquisition of the arboreality in more derived theropods.

RECONSTRUCTING QUATERNARY PALEOENVIRONMENTS IN THE GREAT PLAINS USING GEOGRAPHIC RANGES OF EXTANT SPECIES

HAVELESS, Andrew, University of Minnesota, Minneapolis, MN, United States; FOX, David, Univ of Minnesota, Minneapolis, MN, United States.

Geographic distributions of extant terrestrial mammals are determined in part by the climatic conditions tolerated by constituent populations, which is a measure of the ecological niche of the species. Assuming niche conservatism, past populations of a species should have had the same climate tolerances as extant populations, thus past biogeographic distributions for extant species might be used to estimate paleoclimatic quantitatively. The Quaternary fossil record of small mammals in the Great Plains is a good test case for this approach as many extant species have multiple occurrences over the past million years. We have developed a GIS based method that uses modern species ranges and environmental parameters that relate quantitatively to extant species distributions in North America (e.g., mean annual temperature or MAT and mean annual precipitation or MAP). Geographic ranges for 92 extant species of rodents, lagomorphs, and sorcomorphs were used to determine climatic conditions where species ranges overlap. Forty-two fossorial collections in the Great Plains contain at least three of the 56 extant species in the region with fossil occurrences, potentially allowing us to constrain paleoclimate for those collections. We assessed reliability of this method by varying the number of extant species for a given location used to determine range overlap and the distribution of climate variables in the area of overlap, then compared estimated and known values. For locations spanning the region, we rarified complete extant species lists to sample sizes of 20, 15, 10, 5, and 3 species and at each sample size estimated climate conditions for 10,000 random samples, yielding 500 total replicates at each location. Accuracy of climate estimates increased with sample size up to 10 species, but more than 10 species did not improve accuracy substantially. On average, using 10 species underestimated modern MAT by 0.3°C and overestimated MAP by 142 mm. Fossil localities were binned into 4 time intervals: 1.0-0.75 Ma, 0.55-0.4 Ma, 0.3-0.2 Ma, and <0.068 Ma. Based on modern tolerances of co-occurring extant species, MAT increased from 9.5±3.1°C to 10±4.7°C, cooled to 7.9±5.3°C, and finally increased to 13.4±5.3°C, which is close to the MAT in western Kansas today. Estimated MAP increased from 506±122 mm to 703±251 mm, then decreased to 577±233 mm, and then increased to 735±383 mm, which is similar to eastern Kansas today. This method shows promise and fossil collections with at least 10 species should yield reliable climate estimates.
axial skeletons. We estimate skull length from cranial elements to be 40 cm, corresponding to a total body length of 14.3 m (±1.28 m) based on the scaling relationship of head length to body length in the extant bovine *Bos taurus*. Phylogenetic analyses of *Bos* and extant macrotomastodon *Thorax* using cranial and postcranial osteology, and including analyses incorporating a molecular scaffold for extant taxa, supports bovine affinities of *Titanoboa*, based on the extreme reduction of the palate, choanal and postmedian processes as well as vertebral anatomy. Within Boinae, *Titanoboa* shares a close relationship with Pacific Island maguana taxa. These results are the first to link palaeontological *Thorax* with the *Pontosuchus* of the World Book, and constrains divergence timing of the clades to no younger than 58 My. Cranial elements of *Titanoboa* possess unique features relative to other bovides, including high palatal and marginal tooth position counts, low-angled quadrate orientation, and reduced palatine-pterygoid and pterygoid-quadrate articulations. These characters, combined with weakly ankylosed teeth in *Titanoboa*, are characteristic of piscivorous feeding ecology in extant caecodonts. Preservation in the large-scale fluvial depositional environments of the Cerrejón Formation, combined with the recovery of associated fossils of large dipnoan and osteoglossimorph fishes, also suggests a dominantly piscivorous feeding ecology for *Titanoboa*, which is unique among living and fossil bovides.

**EVALUATING DEFORMATION IN SPHEROOLITHUS DINOSAUR EGGS FROM ZHIEJING, CHINA**

HECK, Christian, Montana State University, Bozeman, MT, United States, 59715; WILSON, Hannah, Montana State University, Bozeman, MT, United States; VARRICCHIO, David, Montana State University, Bozeman, MT, United States; JACKSON, Frankie, Montana State University, Bozeman, MT, United States; JIN, Xinsheng, Zhejiang Museum of Natural History, Hangzhou, China

A lack of stratigraphic context for dinosaur eggs inhibits understanding of dinosaur reproductive biology and the taphonomic processes of egg preservation. Past taphonomic work suggested the presence of compression ridges (shells of broken eggs) on the egg circumference and deformation asymmetry (proportion of crushed to rounded sides of the egg), as geopetal structures. We examined these features across a large sample of both isolated *Spheroolithus* eggs and *Spheroolithus* egg clusters housed in the Zhejiang Museum of Natural History from the Cretaceous of Zhejiang, China to test their utility. On 103 isolated eggs, we determined asymmetry ratios by dividing the crushed side egg height by the rounded side height. The strike and dip of compression ridges on eggs within egg clusters were measured for comparative use across egg clusters. An average asymmetry ratio for p7 was measured for isolated eggs. Additional observations of in situ eggs demonstrate the stratigraphic-down side as more rounded and less fractured, the stratigraphic-up side as flatter with heavier fracturing, and compression ridges as parallel to original bedding plane. We propose fractures associated with the burial process on the upper side of the egg allowed sediment to partially fill the egg, subsequently supporting the bottom portion before the top of the egg collapsed. Examining compression ridges and deformation asymmetry within 16 egg clusters allowed differentiation of biotic versus taphonomically altered arrangements. Three common cluster arrangements were observed: planar (minimal egg overlap), offset (extreme overlap), and agglomerate (randomly arranged, closely packed). Qualitative observations of fracture levels, degree of deformation, and analysis of egg strike and dip across egg clusters reveals planar and offset arrangements as partial clutches, and agglomerate arrangements as the result of intense post-burial displacement.

**THE POWER OF TOOTH MORPHOLOGY IN THE INTERPRETATION OF CERVID EVOLUTION (RUMINANTIA, ARTIODACTYLA, MAMMALIA)**

HECKEBERG, Nicola, Ludwig-Maximilians-Universität Munich, Munich, Germany; ROESSNER, Gertrud, Bayerische Staatssammlung für Paläontologie und Geologie, Munich, Germany; ASHER, Robert J., Department of Zoology, University of Cambridge, Cambridge, United Kingdom

Tooth morphology has been a strong and well-tried tool for identification, taxonomic classification and dietary indication in palaeontology. However, it has not been used for a comprehensive classification of extant cervids so far. Systematics in cervids is one of the most abundant and speciose genera in the Dinosauria, with fifteen named species. The genus is geographically and temporally widespread with large sample sizes of several of the nominal species allowing detailed analysis of intraspecific variation. We present a reassessment of the proposed character states for each species. Using these complementary methods, we show that individual and taphonomic variation are the joint causes of a large range of variation among the skulls when they are plotted in a morphospace. Our results demonstrate that there are only one species of *Pitucaurus* within the Lujiatun beds and that the three nominal species represent different taphomorphotypes of *P. lujiatunensis*. The wide range of geometric variation in a single species of *Pitucaurus* implies that the range of variation found in one species can represent different taphonomic distortion rather than interspecific variation. As the morphospace is driven primarily by variation resulting from taphonomic distortion, this study demonstrates that the geometric morphometric approach must be used with great caution to delineate interspecific variation in *Pitucaurus* and likely other dinosaur groups without high resolution character state data.

**LUJATUN PSITTACOSAURIDS: UNDERSTANDING INDIVIDUAL AND TAPHONOMIC VARIATION USING 3D GEOMETRIC MORPHOMETRICS**

HEIDRICK, Brandon, University of Pennsylvania, Philadelphia, PA, United States, 19104-5269; DODSTON, Peter, University of Pennsylvania, Philadelphia, PA, United States

*Psittacosaurus* is one of the most abundant and speciose genera in the Dinosauria, with fifteen named species. The genus is geographically and temporally widespread with large sample sizes of several of the nominal species allowing detailed analysis of intraspecific and interspecific variation. We present a reassessment of the proposed character states for each species. Using these complementary methods, we show that individual and taphonomic variation are the joint causes of a large range of variation among the skulls when they are plotted in a morphospace. Our results demonstrate that there are only one species of *Pitucaurus* within the Lujiatun beds and that the three nominal species represent different taphomorphotypes of *P. lujiatunensis*. The wide range of geometric variation in a single species of *Pitucaurus* implies that the range of variation found in one species can represent different taphonomic distortion rather than interspecific variation. As the morphospace is driven primarily by variation resulting from taphonomic distortion, this study demonstrates that the geometric morphometric approach must be used with great caution to delineate interspecific variation in *Pitucaurus* and likely other dinosaur groups without high resolution character state data.

**THE AETOSAUR (ARCHOSAURIA: SUCHIA) FAUNA OF THE UPPER TRIASSIC PEKIN FORMATION (NEWARK SUPERGROUP), DEEP RIVER BASIN, NORTH CAROLINA, USA, AND ITS IMPLICATIONS FOR THE PHYLOGENY AND BIOSTRATIGRAPHY OF AETOSAURS**

HECKERT, Andrew, Appalachian State University, Boone, NC, United States, 28608-2067; SCHNEIDER, Vincent, North Carolina Museum of Natural Sciences, Raleigh, NC, United States; FRASER, Nicholas, National Museums Scotland, Edinburgh, United Kingdom; WEBB, Richard, North Carolina Museum of Natural Sciences, Raleigh, NC, United States

Aetosaurus, the only aetosaur genera, is a group of Triassic land reptiles known from various localities in the northeastern United States and northeastern China. The family Aetosauridae was first described in the 1970s on the basis of large aetosaur fossils from the Pekin Formation of the Upper Triassic of northeastern China. These fossils are some of the most complete aetosaur skeletons known, and therefore outside of Aetosauria. We then added the new taxon represented by NCSM 21723 to the analyses, where it was consistently recovered as a basal desmatosuchine, but also collapsed this clade into a polytomy of *Coahomasuchus* and *Lucasuchus*. However, the recovered character states in the new taxon suggest a secondarily aquatic lifestyle. This study presents the first application of 3D geometric morphometrics alone without character evaluation. This study presents the first application of 3D geometric morphometrics alone without character evaluation. The compiled datasets are thus the first attempt to quantify taphonomic variation in dinosaur skulls.
WINGS VERSUS LEGS IN THE THEROPOD-AVIAN LINEAGE: MECHANISTIC UNDERPINNINGS OF VARIATION IN Locomotor STRATEGIES

HEERS, Ashley, University of Montana, Missoula, MT, United States, 59802; DIAl, Kenneth, University of Montana, Missoula, MT, United States

Among the 10 000 species of living birds and their extinct dinosaurian ancestors, relative musculoskeletal investment in wings versus legs is highly diverse, varying both across species and within individ larvae. This variation has profound effects on locomotor performance and many related aspects of bird ecology, including habitat preferences, foraging strategies, migration patterns, and parental care. During aerial locomotion, high leg investment may hinder wing performance, since legs must be carried as baggage by the wings during flight. High wing investment may also hinder leg performance during terrestrial locomotion. Given these potential relationships between body modules, do tradeoffs between wings and legs influence locomotor ontogeny and evolution? To explore this question and better understand the ecological ramifications of how wings and legs function both independently and cooperatively during ontogeny and evolution, we used published and new data to compare wing and leg morphology and locomotor performance (i) across adult birds of different species and (ii) during ontogeny, in three precolial anseriform-galliform species with distinctly different sequences of locomotor development. Our findings suggest that birds with high wing investment may have reduced mass-specific leg performance and rely on wing-dominated locomotor behaviors, while birds with high leg investment may have reduced wing performance and rely on leg-dominated locomotor behaviors. For example, among adults, wing and leg investment are negatively correlated. Similarly, ontogenetic increases in wing investment and performance can compromise leg investment and performance, and vice versa. Collectively, these results provide new insight into the mechanistic underpinnings of variation in locomotor strategies among birds, and indicate that performance tradeoffs between different body modules may be important during ontogeny and evolution. Potential tradeoffs can be ameliorated by using wings and legs cooperatively, suggesting that wing-leg cooperation may have been particularly important during the origin and early evolution of flight.

Wings versus Legs in the Theropod-Avian Lineage: Mechanistic Underpinnings of Variation in Locomotor Strategies

Technical Session XIV (Saturday, November 2, 2013, 8:45 AM)

EUROPEAN ARTIODACTYLS THROUGH THE EOCENE: UPDATED BIOSTRATIGRAPHY AND A TIMELINE OF FAUNAL TURNOVER

HIARD, Florent, University of Fribourg, Fribourg, Switzerland, MENNECART, Bastien, University of Fribourg, Fribourg, Switzerland

During the Eocene, two mammalian turnover events occurred in Europe, one extending from the middle Geiseltalian to the early Robiacian, the other from the late Robiacian to the early Hadlonian. The causes of these two events remain unclear. An updated biostratigraphy of terrestrial artiodactyls, based on literature sources and personal observations, allows better characterization of the evolutionary steps that occurred during these events. Although the diversity of European terrestrial artiodactyls increased slowly from the Grauvien to the middle Geiseltalian, with the notable appearance of Dichobunidae and Choeropotamidae, a major diversification event occurred at MP13 (late Geiseltalian) with the simultaneous appearances of more than thirty species, mainly attributable to fifteen new genera and five new families, including the first four families of Selenodontina and Cebochoeridae. This sudden increase in diversity, even at higher taxonomic levels, suggests an important migratory event, probably from Asia. The end of this renewal event is marked by the appearance of Cainotheriidae during MP14 (early Robiacian) but the lack of a good phylogeny for Eocene artiodactyls prevents any conclusion about the origin of this family. A period of stability and slow decrease of diversity occurred next during the second part of the Robiacian and the early Hadlonian. The first Anoplitheriinae appeared during this period whereas the diversity of Xiphodontidae and Amphylomidae increased notably towards the end. Starting at MP18, a significant diversity occurred at the specific level, with exception of Anoplitheriinae, which increased its diversity. The first Anthracotheriidae appeared in Europe at the same time. At the well-known Grande Coupure event, almost all Eocene genera disappeared and new migrants arrived, including the first Palaeochoeridae and the first ruminants.

European Artiodactyls through the Eocene: Updated Biostratigraphy and a Timeline of Faunal Turnover

Technical Session VI (Thursday, October 31, 2013, 11:30 AM)

HIPPOPOTAMUS AT OLDUVAI GORGE INDICATES PERSISTENT WETLAND ENVIRONMENTS DURING A PERIOD OF INCREASING ARIDIFICATION IN EARLY HOMININ EVOLUTION

HENSLEY-MARSCHAND, Blaire, Indiana University, Bloomington, IN, United States, 47401; NIAU, Jackson, Indiana University, Bloomington, IN, United States; VERMILLION, Wesley, Indiana University, Bloomington, IN, United States

Olduvai Gorge is a large paleoanthropological and paleontological site located in the East African Rift Valley of Tanzania. The gorge is nearly 30 km in length and exposes up to 90 vertical meters of Pleistocene sediments along its course. A recent excavation conducted by the Olduvai Landscape Paleoanthropology Project (OLAPP) uncovered a new paleoanthropological site that included the partial skeleton of a hippopotamus. The fossils were found in a bed of clay within a lens of sandstone that lies directly above Tuff 1E and below the Ng’eru Tuff. New dates for these tuffs provide an age for this excavation of 1.81–1.83 million years old. The climate at Olduvai during this time was one of increasing aridification, causing a contraction of the local lake (Olduvai). This excavation, with such tightly constrained dates and strict stratigraphic control, provides critical paleoecological information regarding the extent of wetlands within the lake margin setting that was also utilized by multiple species of Pleistocene hominins at this time. These hippopotamus remains were found in association with a dense concentration of Oldowan stone tools, demonstrating the presence of hominin activities at this site and posing further questions about the evolution of the early land-use behavior of our ancestors.

Hippopotamus at Olduvai Gorge Indicates Persistent Wetland Environments During a Period of Increasing Aridification in Early Hominin Evolution

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)
DECIPHERING THE LINKS BETWEEN LANDSCAPE CHANGE AND VEGETATION EVOLUTION USING U/PB GEochronology AND DetRITAL THERmoCHRONology: A CASE STUDY FROM THE RUKWA Rift BASIN

HILBERT-WOLF, Hannah, James Cook University, Townsville, Australia; ROBERTS, Eric, James Cook University, Townsville, Australia; BROWN, Roderick, University of Glasgow, Glasgow, UK; DRURY, Patrick, Uppsala University, Uppsala, Sweden; FRANK, Jodie, Uppsala University, Uppsala, Sweden; HÖRMANN, Paul, University of Zuiderland, Apeldoorn, Netherlands; HOFMANN, Simone, Stony Brook University, Stony Brook, NY, United States

Whereas vertebrate fossils contain information about the paleobiology and paleoecology of a fauna, the sediments that host these remains store equally robust information about the environment, physical landscape, and depositional processes at the time of burial. The appearance, dispersal and evolution of taxa are closely linked to large-scale environmental and climatic changes. Tectonic activity plays a major role in driving the timing and character of climatic changes, and directly influences the evolution of landscapes. We use an approach that integrates geochronologic, thermochronologic, and provenance methods to both date and map the timing and character of landscape changes (e.g. uplift, erosion events, and drainage patterns) that are considered key drivers for environmental and evolutionary changes through time. We have dated a suite of 9 samples that span Cretaceous, Paleogene, and Neogene sedimentary sequences from the Rukwa Rift Basin, a key segment of the East African Rift. This work realizes the potential of rift deposits for paleontological, paleoenvironmental, and evolutionary reconstructions of sub-equatorial African ecosystems during critical time periods.

Our approach benefits from the preservation of volcanic ashes throughout portions of the stratigraphic record that breaks the traditional framework in which to place the detrital samples. These samples consist of detrital minerals from fluvial and lacustrine sediments sourced from the uplifted rift flanks, reflecting the internally draining nature of a rift basin. We take advantage of this depositional setting by integrating zircon and apatite provenance analyses. The triple dating of detrital apatite grains involves: (1) radiometric age dating using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICPMS); (2) fission track analysis; and (3) (U-Th)/He thermochronology analysis. Dating detrital and tuffaceous zircon grains involves: (1) radiometric age dating using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICPMS); and (2) Lu-Hf isotope measurements. This comprehensive data set from the Rukwa Rift Basin establishes the age of key taxa, the timing of deposition and uplift (denudation), sediment sources, drainage patterns, and the timing between sediment uplift and final deposition in the rift. This is the first study to apply all of these techniques in concert to understand the role of active tectonics in shaping dynamic landscapes that serve as key influences of vertebrate evolution in the East African Rift.

A NEW SPECIMEN OF CUORA MIYATAI, A PLEISTOCENE ASIAN BOX TURTLE FROM JAPAN

HIRAYAMA, Ren, Waseda Univ, Shinjuku-ku, Tokyo, Japan; KON, Hiroo, Honjo Archaeological Data Museum of Waseda University, Shinjuku, Tokyo, Japan; YOSHIDA, Masataka, Waseda Univ, Shinjuku-ku, Tokyo, Japan

Cuora, or the Asian box turtle, is the most diverse genus of geochelid turtles. Nonetheless, its fossil record is rare and poorly documented. The following features are considered to be the synapomorphies shared with the extant taxon C. flavomarginata: extremely small dorsal exposure of the parietal bones as a result of deep development of the upper temporal emargination, carapace decorated by distinct growth annuli, and a discontinuous dorsal keel formed by the neural plates. The morphology of the plastron and of the pelvic girdles suggests that C. miyatai had a well developed plastral hinge similar to that of C. flavomarginata. Otherwise, C. miyatai retains the laterally closed foramen of the pelvic girdles, a presumed primitive feature. This contrasts with C. flavomarginata, which has an open foramen. Thus, both taxa are hypothesized to form a sister group and to represent the most recent common ancestor of both genera. This group may have gone extinct during the glacial epoch of the late Pleistocene together with other geochelids such as Ocadia nipponica and Mauremys yabei on the Japanese mainland.

ENDOCRANIAL RECONSTRUCTION OF A GONDWANAN MAMMAL

HOFFMANN, Simone, Stony Brook University, Stony Brook, NY, United States; O'CONNOR, Patrick, Ohio Univ, Athens, OH, United States; CRAUSE, David, Stony Brook Univ, Stony Brook, NY, United States

Endocranial morphology has been described for only a few Mesozoic mammaliforms, including the basal members Morganucodon and Hadrocodium, several multituberculates, the stem therian Vincentia, and various extinct crown therians. Here we present the first endocranial reconstruction of a gondwanan mammal based on a virtually complete and exceptionally well-preserved cranium recovered from the Upper Cretaceous Maquarano Formation of Madagascar. The enigmatic clade Gondwanatheria is known from the Cretaceous and Paleogene of Gondwana but was previously only represented by isolated teeth and fragmentary dentaries. The well-preserved cranium provides the first opportunity to digitally reconstruct the endocast and endocephalic labyrinth in a gondwanan mammalian.
A NEW SPECIMEN OF ENCHODUS (ACTINOPTERYGIID) FROM THE LATE CRETACEOUS OF EGYPT AND ITS CONTRIBUTION TO THE WESTERN TETHYN DISTRIBUTION OF THE GENUS

HOLLOWAY, Waymon, Ohio University, Athens, OH, United States, 45701; CLAESON, Kerin, Philadelphia College of Osteopathic Medicine, Philadelphia, PA, United States; SERTICH, Joseph, Denver Museum of Nature and Science, Denver, CO, United States; SALLAM, Shoshanah, Mansoura, Egypt; O'CONNOR, Patrick, Ohio University, Athens, OH, United States

The protacanthopterygian fish Enchodus was a widespread, speciose genus consisting of approximately 30 recognized species that were temporally distributed from the late Early Cretaceous to the Paleocene. Many Enchodus specimens are fragmentary, and on rare occasions a helicoidal cranial remains or isolated dental elements, as is the case for previously reported occurrences in Egypt. Here, we present the most complete, and first confirmed, specimen of Enchodus to be recovered from the Late Cretaceous of Egypt. The specimen was recovered from the upper Campanian Duwi Formation exposed near the village of Teneida (Dakhla Oasis, Western Desert, Egypt). The new specimen consists of right and left dentaries, a partial ectopterygoid, an articular, and various other cranial elements. The size of the specimen is well into the upper range for the genus (e.g., dentary = 26.36 cm). The palatine tooth, an element often useful for diagnosing Enchodus to the species level, is not preserved, but a combination of mandibular characters supports the referral of this specimen to Enchodus. The dentaries are complete, except for the posterior-most portion of each. They preserve a symphyseal surface with a slot-ridge assembly and exhibit a bumer-like ridge ventromedial to the entire double row of dentition, both of which are features typical for Enchodus. The outer row of dentition consists of a margin of small denticles (~2.2 mm in crown height). The inner row of massive, labiolineally compressed teeth exhibits varying crown heights, with the anterior-most tooth being the tallest (26.36 mm), and the next anterior-most tooth being the shortest (~7.9 mm). These eleven preserved teeth are distributed across the dentary in a unique pattern (e.g., two doubles and a triplet clustered within the posterior one half of the element), relative to other species of Enchodus. This arrangement is symmetrical on both dentaries, indicating that the distribution is not random and may represent an autapomorphy of a new species. Additionally, the suite of characters exhibited by the elements preserved for this specimen (e.g., lack of superficial ornamentation, lack of a mental foramen, etc.) is inconsistent with that of any previously described species of Enchodus. Along with previously described materials from Israel, Jordan, Syria, Lebanon, Italy, Morocco, and Libya, this specimen adds a potential thirteenth species to the Northeastern Tethyan geographic distribution of Enchodus that ranges from the Cenomanian to the Danian in age.

DIFFERENTIAL TIMING OF HYPSODONTY EVOLUTION IN LARGE AND SMALL MAMMALS INDICATES COMPLEX FORCING OF CROWN HEIGHT EVOLUTION

HOPKINS, Samantha, Univ of Oregon, Eugene, OR, United States, 97403

Hypsodonty has evolved repeatedly in the history of herbivorous mammals as an adaptation to tooth abrasion, although the primary driver of this dental attrition remains controversial. A number of recent studies have used the precise timing of hypsodonty evolution in different lineages or in communities as a whole to argue for particular drivers of hypsodonty evolution. The results of these studies have been transformative. In the past, it was assumed that hypsodonty was an adaptation to resist the abrasion from the silica content of grasses, but the pattern of hypsodonty evolution more closely tracks increases in exogenous grit than it does the ingestion of grass. A diet of grasses seems to preclude the development of a robust crown height (e.g., squinamidids, horses), and to appear substantially after the evolution of high-crowned teeth in others (e.g., many South American ungulates). However, if it were only the presence of environmental grit that drove increasing crown height, one might expect to find entire communities evolving increasing crown height at the same time. This is not the case. Instead, the acquisition of hypsodonty evolves in mosaic fashion through the mid-Cenozoic, appearing in different lineages over a period of roughly 30 million years in North America. An interesting aspect of this pattern is that, in many cases, hypsodonty seems to evolve much earlier in small herbivores than in large species. A better description of patterns of hypsodonty acquisition is needed to pinpoint the common processes driving the convergent evolution of high-crowned teeth in so many mammalian clades. New methods in phylogenetic comparative analysis enable us to examine the timing and rates of hypsodonty evolution in more detail. I use time-scaled phylogenies of several clades of fossil and extinct herbivorous mammals to determine the timing of onset and rates of hypsodonty acquisition in clades of large and small herbivores. I find that the onset of hypsodonty increase occurs substantially earlier in small mammals (more than 10 Ma earlier, on average) and that maximum hypsodonty is reached earlier by four more evolutionary rate curves seem to be similar. This pattern suggests that the driver of hypsodonty evolution has a more severe effect on smaller herbivores, indicating that, if exogenous grit is the driver, the conditions that cause herbivores to ingest more grit seem to be ecologically selective. Hence, the acquisition of hypsodonty in mammalian herbivores seems to be a response to a combination of environmental forcing and the organisms' anatomy.

MAKING FOOTPRINTS WITHOUT LIMITS: SIMILARITIES BETWEEN THE LEFT AND RIGHT TETRAPOD FOOTPRINT RECORD AND PRIMITIVE TETRAPOD TRACKWAYS

HORNER, Jeremy, The Natural History Museum, London, United Kingdom

The family Nyctitheriidae has long been placed in Order Lipotyphla, close to shrews, based on dental characters. Isolated calcanea and astragali, discovered in the UK Late Eocene, however, have shown substantial differences from this order and suggested a position for the family next to the Tipulids. Many enigmatic, isolated mammal specimens can be identified by digital surface analysis with calcaneum and astragulus and by comparison with modern relatives. These new ideas provide further support for taxonomical in nyctitheres. A nearly spherical humeral head projecting proximally of the greater tuberosity, a femur with a greater trochanter scarcely higher than the head and a medial lesser trochanter indicate mobile shoulders and hips consistent with climbing. A more proximally projecting humeral head, well separated from a short convex trochlea, a shallow olecranon fossa and an ovoid radial head with a strongly convex ulnar articulation demonstrate pronation-supination but limited forearm extension at the elbow. Foot inversion was restricted to the astragalocalcaneal joint, with no calcaneocuboid rotation. Deep grooves posteriorly on the distal tibia indicate powerful flexor muscles, likely involved in foot inversion. Extension of the foot was restricted, but a distal anterior tubial tubercle stabilized the ankle when dorsiflexed. Nyctitherium climbing appears to have been dominated by flexion of the forelimbs and feet, some supination and inversion, allowing head first descent, but not upside down hanging. Unlike nyctitheres, shrews have: radius with a strong caputellar eminence and a flat ulnar facet; humerus with an anteroposteriorly elongate condyle, cylindrical capitulum, concave trochlea with sharp projecting medial ridge and no condylar fossa; femur lacking trochanteric fossa; tibia without grooves for foot flexors, a short medial malleolus and no distal anterior tubercle; navicular with a prominent tubial tubercle and the ectocuneiform facet longer than the mesocuneiform facet; and cuboid with a weak plantar process. Although many nyctitheres characters are primitive for placentals, extension of the medial trochlear ridge on the astragalus neck and the distally projecting humeral capitulum suggest eurarchontan affinities.

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how and with what anatomical structures these trackways are formed have been largely ignored. The apparent sister taxon to tetrapods, lungfish (Dipnoi: Sarcopterygii) first appeared in the early Devonian, and were sympatric with early tetrapod faunas. Of the six extinct tetrapods, terrestrial locomotion is prevalent in the African genus Protopterus.

In order to characterize non-limbed terrestrial trackways, we placed a 35 cm West African lungfish (Protopterus annectens) on a 1 x 1 m tray filled with saturated ball clay to a depth of 2 cm, and encouraged the animal to move across the surface. Terrestrial locomotion of the lungfish involves planting the head and then pivoting the trunk about the anchoring point of the head while the rudder-like fins stay right for the second ‘head crutch’ forward. In doing so, deep impressions are left where the head implants in the substrate, while the body and fins produce little in the way of surface textures. However, studies of these methods have been extremely limited within **. In comparison, bone long bones of dinosaurs are highly vascularized and composed of fibrocartilaginous tissues with some osteocyte organization around vascular spaces. 2) Post hatching neonate bone is similar to that of the embryos, but with initial osteonal organization of fibrocartilage tissues around vascular spaces. 3) Juvenile bone is characterized by the presence of primary osteons at various levels of organization, occasionally some interior erosion rooms, and initial formation of a secondary osteons. Lines of arrested growth (LAGs) can also exist, but are limited to one or two widely spaced lines. 4) Subadult bone is characterized by more extensive secondary reconstruction and many more LAGs. In most taxa the primary tissues are highly organized in plexiform or circumferential patterns, although some smaller taxa possess longitudinal canals throughout ontogeny. 5) Somatically mature tissues are highly organized in plexiform or circumferential patterns, although some sacral features suggests that enantiornithines might have a uniquely shaped digit extending almost as far distally as major metacarpal. A comparative analysis of similarities with the same protocol allow unusually direct comparisons of population-level variability and genetic structure over time, including determination of the impacts of a significant 2011 volcanic eruption in this region. Thus, this rapid, cost-effective method for detecting genetic variability in ancient DNA samples promises to facilitate analyses of genomic variation over extended periods of time.

**Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)**

**ONTOGENETIC ASSESSMENT OF DINOSAURS USING CRANIAL AND POSTCRANIAL OSTEOSTORISTOLOGY**

HORNER, John, Museum of the Rockies and Department of Earth Sciences, Montana State University, Bozeman, MT, United States, 59717-2730; RIFE, Jill, nonaffiliated, Soldotna, AK, United States

The ontogenetic state of dinosaur specimens has been hypothesized using a variety of methods, in particular cranial and vertebral fusion, surface texture changes, and bone histology. Ontogenetic assessments are often made based solely on skeletal fusion and surface textures. However, studies of these methods have been extremely limited within **. In comparison, bone long bones of dinosaurs are highly vascularized and composed of fibrocartilaginous tissues with some osteocyte organization around vascular spaces. 2) Post hatching neonate bone is similar to that of the embryos, but with initial osteonal organization of fibrocartilage tissues around vascular spaces. 3) Juvenile bone is characterized by the presence of primary osteons at various levels of organization, occasionally some interior erosion rooms, and initial formation of a secondary osteons. Lines of arrested growth (LAGs) can also exist, but are limited to one or two widely spaced lines. 4) Subadult bone is characterized by more extensive secondary reconstruction and many more LAGs. In most taxa the primary tissues are highly organized in plexiform or circumferential patterns, although some smaller taxa possess longitudinal canals throughout ontogeny. 5) Somatically mature tissues are highly organized in plexiform or circumferential patterns, although some sacral features suggests that enantiornithines might have a uniquely shaped digit extending almost as far distally as major metacarpal. A comparative analysis of similarities with the same protocol allow unusually direct comparisons of population-level variability and genetic structure over time, including determination of the impacts of a significant 2011 volcanic eruption in this region. Thus, this rapid, cost-effective method for detecting genetic variability in ancient DNA samples promises to facilitate analyses of genomic variation over extended periods of time.

**Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)**

**A NEW LARGE ENANTIORNITHINE BIRD FROM THE LOWER CRETACEOUS OF WESTERN LIAONING, CHINA**

HU, Dongyu, Shenyang Normal University, Shenyang, China; LIU, Ying, Shenyang Normal University, Shenyang, China; LI, Jinhua, Shenyang Normal University, Shenyang, China; HOU, Lianhai, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; XU, Xing, Institute of Vertebrate Paleontology & Paleoanthropology, Beijing, China

In the last two decades, feathered enantiornithine fossils have been recovered from the Early Cretaceous Jehol Biota of western Liaoning, China, and these discoveries have greatly improved our understanding of the early evolution of the group. Here we describe a new enantiornithine bird based on a nearly complete, mostly articulated postcranial skeleton, Paleontological Museum of Liaoning (PMOL)AB00032 from the Lower Cretaceous Jiutang Formation (120 Ma) of Chaoyang City, western Liaoning, China. Although the only known specimen is probably a sub-adult individual, as indicated by the incomplete fusion of the synsacral carpals to the metacarpals, it is the second-largest known Early Cretaceous enantiornithine. The new bird resembles *Bohaisanus guoi* from the lower Yixian Formation in body size and length proportion of limb segments, but differs from the latter taxon and other known enantiornithines by the longitudinally grooved ventral surface of the synsacrum and the oval outline of the sternum with the xiphoid process distinctly wider than caudal lateral processes, as well as a unique combination of following features: large size, forelimb and hind limb subequal in length, neural spines of thoracic vertebrae with craniocaudally strongly expanded tips, coracoid with straight lateral margin, clavicular ramus mediolaterally curved, humeral head flat and alular different buttress ridges, coracoid with straight lateral margin, clavicular ramus mediolaterally curved, humeral head flat and alular different buttress ridges, coracoid with straight lateral margin, clavicular ramus mediolaterally curved, humeral head flat and alular different buttress ridges, coracoid with straight lateral margin, 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archosauriforms, and tennisspondyls, and 2) biostratigraphic correlations with coeval rocks from South Africa that indicate that the Ntawere Formation and Lifua Member are Anisian (early Middle Triassic) in age. To clarify the taphonomy of these Zambia and Tanzania faunas, small, temperate fossil assemblages, as well as their 2D and 3D microanatomical analyses. The material, consisting of large undetermined mastodonsaurid mandibles, is of special interest: the bone microstructure preserved both vascular (Haversian canals) and cellular (osteocytes, canals) patterns, as well as muscular attachment zones (Sharpey’s fibers) and lines of arrested growth. These structures indicate high metabolic rates for these large (> 2 m) poikilothermic, ectothermic amphibians. Biochemical analyses of major and trace elements (Ca/P, [F], [Sr], [Ba], [Fe], [Mn]) as well as scanning electron microscopy and optical cathodoluminescence observations on the same tennisspondyl material show, however, that the mineralogical and chemical compositions of the bones underwent post-mortem alteration. The Haversian bone is filled by secondary crystallizations (Calcite, Fe-Mn-Ba oxyhydroxides), whereas the carbonate hydroxyapatite of the bones has altered to carbonate-fluorapatite. As a next step, similar analyses will be carried out on Late Permian fossils from the same area to determine if the alteration process was similar over time. Analyses of stable isotopes (13C and 18O) of carbonates and phosphates also will be carried out to gain additional insight into diagenetic processes in both the Permian and Triassic.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

PALEOFANA OF THE WILLIAMS FORK FORMATION (UPPER CRETACEOUS), NORTHWESTERN COLORADO: COASTAL DELTAIC DEPOSITS DOMINATED BY FRESHWATER TAILA

HUNT-FOSTER, ReBecca, Bureau of Land Management, Moab, UT, United States, 84532; FOSTER, John, Museum of Western Colorado, Grand Junction, CO, United States

The Williams Fork Formation is a late Campanian-early Maastrichtian unit of the Mesaverde Group, and this study focuses on the exposures found on Bureau of Land Management-administered lands in northwestern Colorado. The formation is comprised of thick sandstones, dark, often carbonaceous mudstones, and coals representing a coastal, prograding deltaic sequence bordering the Western Interior Seaway. Previously reported vertebrates in the Williams Fork Formation include mostly terrestrial taxa such as an indeterminate tyranosaur, an indeterminate hadrosaur, several other ornithischians (identified from teeth), and the ceratopsian Pentaceratops; at least four genera of small theropods have been identified by isolated teeth as well. In addition, at least 15 species of mammals have also been reported. Although a number of non-dinosaurian, non-mammalian taxa have been mentioned previously, none has received much attention in this important formation. A survey of more than a dozen localities in the upper Williams Fork Formation reveals a paleofauna that reflects the freshwater channel and swamp setting of the formation in this area. The paleofauna includes: the ray Myleedaphus, represented by teeth; the gar Lepisosteus, represented by scales, teeth, and a fin spine; the giant amiid Melvis, represented by at least one 6-cm-diameter vertebra; and smaller individual amiods represented by teeth; the turtles Adocus, Apeiranthes, and indeterminate Macrobaenidae?, represented by shell elements; indeterminate Crocodylia represented by teeth, osteoderms, and a vertebra; indeterminate hadrosaurids represented by a femur, metatarsal, and phalanx (from different localities); an indeterminate ceratopsian, represented by a horn core fragment; and many indeterminate bone fragments. The biota sampled during this study also included plants, represented by petrified wood, leaf fragments, and amber, and mollusks, including bivalves and both lymnaeal and viviparous gastropods. The sample includes more than 290 specimens; of more than 10 identified ichthyological taxa, 39% are fish, 19% are insects, 9% are crustaceans, 8% are reptiles, 6% are birds, 5% are amphibians, 2% are reptile or amphibian eggs, and 1% are other species, and chondrichthyan and actinopterygian elements alone account for 47.4% of the sample. Turtles and crocodylians comprise 23.1% and 8.7% of the sample, respectively. These aquatic and semi-aquatic taxa thus likely dominate the Williams Fork Formation paleofauna overall.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

CONVERGENCEs AND TRENDS IN THE EVOLUTION OF THE ARCHOSAUR PELVIS

IJJIMA, Masaya, Hokkaido University, Sapporo, Japan; KOBAYASHI, Yoshitsugu, Hokkaido University Museum, Sapporo, Japan

Pelvic structure in non-avian archosaurs plays a key role in understanding the evolution of terrestrial/semi-aquatic locomotor patterns because the pelvis contains major attachment sites for proximal hind limb musculature. In order to investigate the patterns of pelvic evolution in archosaurs, this study compiles three variables for 91 archosaur taxa (relating to the presence of ilium, androcoel and sacrum). Differences in marine and non-marine lineages highlight the need to unravel the phylogenetic and life history components of body size distributions, enhancing our ability to address causality during mass extinctions.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

Sedimentological analyses of eggshell transport and deposition: implications and application to eggshell taphonomy

IMAI, TAKUYA, Montana State University, Bozeman, MT, United States, 59717-3480; VARRICCHIO, DAVID, Montana State Univ, Bozeman, MT, United States; CAHOON, JOEL, Montana State University, Bozeman, MT, United States; PLYMESSER, KATEY, Montana State University, Bozeman, MT, United States; CAHOON, JOEL, Montana State University, Bozeman, MT, United States; PLYMESSER, KATEY, Montana State University, Bozeman, MT, United States; CAHOON, JOEL, Montana State University, Bozeman, MT, United States; PLYMESSER, KATEY, Montana State University, Bozeman, MT, United States

Fossil eggshells often occur in floodplain and alluvial fan deposits. Failure to recognize transported eggshells within these environments may lead to erroneous interpretation of the reproductive behavior and ecology of parent animals. Analytical techniques to assess eggshell transport have been limited to preferred eggshell orientation and abrasion. Here, a series of flume studies was undertaken with a variety of eggshell types and substrates to provide further analytical techniques that can be used to assess eggshell transport in fossil record. We tested the preferred orientation of eggshell after transport and also estimated the size of hydraulically equivalent clasts, i.e. grains expected to be observed within a matrix of transported eggshells. The samples included 24 eggshell fragments each of Emu, goose, and Ostrich (1 to 5 cm in diameter, and 0.1 to 1 cm in height). To simulate hydraulic transport of eggshells, a decelerating flow was established in a rectangular flume with a smooth polyvinyl-chloride substrate. In a single trial, six water-saturated eggshells of the same type were released, and five minutes after the release, orientation and position of the eggshells in a flume were recorded. Five trials were performed for each eggshell. This procedure was repeated with three additional immobile substrates: coarse sand, sparse gravel, dense gravel. Throughout, bed shear stress at the point of each eggshell deposition was estimated based on the flow depth at that spot. Using logistic regression models, the probability of concave-down orientation after deposition was estimated for each eggshell type transported on each substrate. The size of hydraulically equivalent clastic grains was estimated based on the bed shear stress of eggshell deposition, using equations derived from empirical studies of particle incipient motion under unidirectional hydraulic flows. The probability of concave-down orientation after transport was > 85 % regardless of eggshell types and substrates. Size of clumping decreases in the sand, and increases in the gravel. Through analysis of fossil eggshell transport pattern, we can infer the transport conditions and to broaden their applicability to fossil eggshells of various size and shape.

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Romer Prize Session (Thursday, October 31, 2013, 9:45 AM)

THE MEANING AND MECHANISM OF 'LILLIPUT' PATTERNS IN NONMAMMALIAN THERAPSIDS IN THE AFTERMATH OF THE END-Permian EXTINCTION

HUTTENLOCKER, Adam K., University of Washington, Seattle, WA, United States, 98195-1800

Mass extinctions are often followed by body size reductions in survivor lineages, a pattern known as the ‘Lilliput effect.’ However, in the absence of adequate phylogenetic and life history data, the mechanisms of size reductions can be unclear and may differ across environments, taxonomic groups, and extinction events. Lilliput patterns have been identified in Triassic Lystrosaurus Assemblage Zone faunas following the end-Permian extinction in South Africa (ca. 252.3 Ma), but growth dynamics underlying these patterns are not fully understood. Therapsid clades, for example, were a diverse clade of therapsids that thrived from the Middle Permian to Middle Triassic and important components of Triassic and recovery faunas. Understanding the processes that underpinned Lilliput effects in this group, histological sections were prepared from 71 limb bones from 11 genera of Permian through Triassic therapsids (theriodonts) were examined to clarify morphological patterns in the long bones of 20 specimens, Histological indicators of growth, including cortical vascularity (%CV) and growth mark counts, were examined in multiple elements. When corrected for phylogeny, changes in %CV of propodials correlate strongly with evolutionary changes in body size (i.e., large-bodied lineages have higher %CV). However, patterns of variation in microvascularity differ across biological hierarchies and geologic time; although large theriodonts (e.g., Cynognathus, Moschorhinus, and Theriochirus) generally have higher vascularity than their smaller-bodied relatives, Early Triassic taxa may have equivalent or higher %CV compared to their Permian relatives, despite smaller body sizes. Moschorhinus, one of few therapsid genera spanning the extinction boundary, demonstrates the highest %CV of any theriodont studied. Results support that Triassic Lilliput taxa grew at equivalent (or faster) rates compared to their Permian relatives, but over a shorter growth period. These findings contrast with studies of marine invertebrates that demonstrated slow growth in survivor taxa, casting doubt on a common cause of Lilliput effects at this time. Differences in marine and non-marine lineages highlight the need to unravel the phylogenetic and life history components of body size distributions, enhancing our ability to address causality during mass extinctions.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)
Symposium 3 (Friday, November 1, 2013, 9:30 AM)

U-PB DATING OF REDEPOSITED VOLCANICS IN NON-MARINE SEDIMENTARY STRATA: CASE STUDIES FROM THE EARLY MESOZOIC

IRMIS, Randall, University of Utah, Salt Lake City, UT, United States; 84108-1214; MUNDIL, Roland, Berkeley Geochronology Center, Berkeley, CA, United States; MARSICANO, Claudia, Universidad de Buenos Aires, Buenos Aires, Argentina; MANCUSO, Adriana, Ianigla, CCT-CONICET, Mendoza, Argentina

Radiometric dating of vertebrate fossil assemblages typically relies on primary volcanic deposits interbedded with the fossiliferous strata, such as airfall tuffs and ashes. However, the nature of non-marine sedimentary systems means that these units are often altered or destroyed before they can be preserved by final burial. Therefore, finding suitable material to analyze can be difficult, particularly in settings with lower sedimentary records. The recent development of thermal ionization mass spectrometry (TIMS) analyses to identify detrital zircons from redeposited volcanics (e.g., fluvial sandstones containing volcanic detritus) has greatly improved our ability to provide absolute age constraints for vertebrate fossil assemblages in the form of maximum depositional ages. When multiple ages are consistent with the stratigraphic record, combined with other geochronologic data (e.g., biostratigraphy and magnetostratigraphy), they can precisely date evolutionary events that were previously poorly constrained by the lack of primary volcanic deposits.

We have recently successfully applied these methods to a variety of early Mesozoic non-marine records that preserve important records of vertebrate evolution. Samples from the Middle Triassic Chiaures Formation of Northwestern Argentina reveal that its assemblage of early dinosauriforms and cynodont synapsids is likely to be no older than middle Ladinian, and therefore only a few million years older than the oldest dinosaurs. Our recent work in the Upper Triassic Chinele Formation of northern Arizona has demonstrated that the major biotic turnover in the middle of the unit is dated to the middle Ladinian, rather than Carnian-Norian boundary. Finally, new analyses from the La Quinta Formation of Venezuela demonstrate that a bonebed of a critical new taxon of early ornithischian dinosaur, which was previously dated to anywhere between the Late Triassic and middle Cretaceous, has a maximum depositional age of earliest Jurassic.

These data collectively demonstrate that U-Pb zircon ages of redeposited volcanics from mixed sources can provide precise age constraints on the tempo of non-marine vertebrate evolution.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

REDISCOVERY OF THE HOLOTYPE OF EDESTUS MINOR AND A TAXONOMIC REASSESSMENT OF THE EDESTUS MINOR SPECIES GROUP

ITANO, Wayne, University of Colorado, Boulder, CO, United States, 80305

Species of the Carboniferous chondrichthyan genus Edestus have been described based on the same tooth whose shape was even critical anatomical characters, without knowledge of variation due to ontogeny or position (upper versus lower jaw). The Edestus minor species group comprises species having crowns with an apical angle of less than about 35 degrees and which lean anteriorly. In contrast, the crowns of e. newtoni point roughly perpendicularly to the margin between the crown and base, while all other Edestus species have crowns with much greater apical angles. E. minor was described by Newberry on the basis of a single, isolated tooth. A tooth which (Beneski Museum of Natural History, Amherst College specimen ACM85) containing seven teeth was later referred to e. minor by Newberry. Instead of the treated as the holotype specimen. However, the isolated tooth remains the holotype, since it is the type specimen on which the original description was based. The distinction is not trivial, because the shape of the crown of the type of E. minor differs from the shapes of the crowns of ACM85. E. minor was described as a new species based on differences from ACM85, although the crowns are essentially identical to the crown of the type of E. minor. Thus, E. minor is almost certainly a junior synonym of E. minor, while ACM85 may require a new name. Recently, the type specimen of E. minor was located in the collections of the American Museum of Natural History, catalog number FP 477, apparently having been transferred from Columbia University at some time after Newberry’s death in 1892. It was not listed in the card catalog as a type specimen, nor was it listed in Hussak’s 1908 catalog of type and figured specimens, which includes other specimens from Newberry's collection, such as the type specimen of E. giganteus, FP225. Examination of FP 477 reveals some details which are not present in the published drawing, such as subdivided serrations, which were used to establish E. triserratus as a separate species. Thus, E. triserratus may be a junior synonym of E. minor. The crown shapes of the type and referred specimens of all members of the Edestus minor species group, compared to that of E. minor, are E. mirus, E. kolomnensis, and the species represented by ACM85, show variations, but these variations are correlated with size, so that they could represent different ontogenetic stages. Thus, they all may belong to the same species, with the name Edestus minor having priority.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

THE ELBOW JOINT OF THE MARSUPIAL LION, THYLACOLEO CARNIFEX: IMPLICATIONS FOR PREDATORY BEHAVIOR

JANIS, Christine, Brown University, Providence, RI, United States, 02906; FIGUEIREDO, Borja, University of Malaga, Malaga, Spain; Thylacoleo carnifex, known from the Pleistocene of Australia, is the last (and the largest) of the lineage of thylacoleodonts first known from the Miocene. In contrast to other carnivorous marsupials, thylacoleoinds belong to the otherwise herbivorous order Diprotodontia (possums, koalas, wombats, and kangaroos), and there is speculation that some or all of them were at least partially arboreal. Craniodental studies confirm that T. carnifex had a highly carnivorous diet, but its predatory behavior has been a matter of speculation: it lacks the canines used for killing in other carnivores, and has the unique feature of a large, opposable thumb that bears a huge sheathed retractile claw. We used landmark-based methods of geometric morphometrics from the anterior surface of the humerus distal epiphysis (i.e., the elbow-joint) to explore its ability to rotate the arm and deploy this claw. Elbow-joint shape is a determinative of the ability to rotate the arm and lock the elbow and is an established functional indicator of locomotor/predatory behavior in mammals. We used a canonical variates analysis performed from the shape of this joint to discriminate between living arboreal and terrestrial mammals (129 specimens) including both marsupials and placental. The discrimination between these groups was significant using the Mahalanobis distances (P-value < 0.0001). For primarily terrestrial T. carnifex, and one of the smaller Miocene Wakaleo hiloensis, were included as unknowns. The data show that T. carnifex had a unique elbow morphology (also seen in Wakaleo), which combines the ability for supination in arboreal forms with the ability to lock the arm in the prone position. The data do not support a hypothesis of arboreal adaptations: indeed the extant mammal that is most similar to thylacoleoinds is the wombat, while the koala clusters with the placental arboreal forms. The ability to supinate the forelimb in T. carnifex may ultimately reflect an arboreal ancestry, but an arboreal orientation of the arm in a primarily terrestrial mode of life. We suggest that the pronounced ability for supination could reflect the use of the large claw on the thumb in a type of flick-knife fashion for killing prey. Other researchers have speculated on the use of the claw in predation, but none have noted this ability to supinate the forelimb in a fashion unlike that of any other carnivorous mammal.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

CT SCANNING AND 3D IMAGE ANALYSIS OF THE POSTCRANIAL HENKELOTHERIUM GUIMAROTAII (CLADOTHERIA, MAMMALIA) FROM THE LATE JURASSIC OF PORTUGAL AND ITS LOCOMOTOR ADAPTATIONS

JÄGER, Kai, Universität Bonn, Bonn, Germany; LUO, Zhe-Xi, Univ of Chicago, Chicago, IL, United States; MARTIN, Thomas, Universität Bonn, Bonn, Germany

The dryolestoid Henkelotherium guimarotae from the Late Jurassic of the Guimarota coal mine in Portugal is represented by a largely complete postcranial skeleton and skull. Although the ther posterior and prehensile thumb is the prominent feature of a large, opposable thumb that bears a huge sheathed retractile claw. We used a canonical variates analysis performed from the shape of this joint to discriminate between living arboreal and terrestrial mammals (129 specimens) including both marsupials and placental. The discrimination between these groups was significant using the Mahalanobis distances (P-value < 0.0001). For primarily terrestrial T. carnifex, and one of the smaller Miocene Wakaleo hiloensis, were included as unknowns. The data show that T. carnifex had a unique elbow morphology (also seen in Wakaleo), which combines the ability for supination in arboreal forms with the ability to lock the arm in the prone position. The data do not support a hypothesis of arboreal adaptations: indeed the extant mammal that is most similar to thylacoleoinds is the wombat, while the koala clusters with the placental arboreal forms. The ability to supinate the forelimb in T. carnifex may ultimately reflect an arboreal ancestry, but an arboreal orientation of the arm in a primarily terrestrial mode of life. We suggest that the pronounced ability for supination could reflect the use of the large claw on the thumb in a type of flick-knife fashion for killing prey. Other researchers have speculated on the use of the claw in predation, but none have noted this ability to supinate the forelimb in a fashion unlike that of any other carnivorous mammal.
A NEW BASAL DINOCEPHALIAN FROM THE MIDDLE PERMIAN MEZEN FAUNA (RUSSIA)

JANSEN, Maren, Museum für Naturkunde, Berlin, Germany; REISZ, Robert, Univ of Toronto at Mississauga, Mississauga, ON, Canada; KAMMERER, Christian, Museum für Naturkunde, Berlin, Germany; FRÖBISCH, Jörg, Museum für Naturkunde, Berlin, Germany

The transition from pelycosaur-grade synapomorphies to therapsid structures documents a major macroevolutionary transition with early therapsids providing important information on the evolutionary history of the mammalian clade. Dinocephalians were an early therapsid group that occupied a wide range of ecological niches and dominated terrestrial ecosystems during the middle Permian. The Mezen fauna (Roadian-Wordenian in age) of northern European Russia yields one of the most basal known therapsid faunas, including the enigmatic and poorly known genera Alrausuchus, Niafiauchus, Nikkasaurus, and Reizia. For the present study, we investigated a new skull, representing an additional basal dinocephalian taxon from the Mezen fauna that exhibits three-dimensional, microtomographic (micro-CT) and a detailed retro-deformed reconstruction. Additional isolated cranial and postcranial material can also be assigned to the new taxon. The new taxon has a complex heterodactyl dentition, with intermeshing, heeled incisors, small precanine, a very small canine, and nine postcanines. Inclusion of the new taxon in a phylogenetic analysis of early therapsids recovers it as a basal dinocephalian, although its precise position is variable (as the most basal dinocephalian or the most basal member of either of the major dinocephalian subclades, Tapinocephalia and Anteosaurus). This taxon exhibits a mosaic of tapinocephalid and anteosaur characters, including roughly denticulated, leaf-shaped postcanine teeth, a temporal fenestra that undercuts the orbit, and restriction of the palatine dentition to a small, reniform boss. Remarkably, this taxon bears a distinct premaxillary foramen, a bone at the anterior edge of the pinal foramen, a feature widely distributed in basal therapsids but previously unknown in dinocephalians. The new taxon provides novel insight into the early evolution of dinocephalians specifically and therapsids in general.

The utility of soft-tissue characters in understanding the phylogenetic relationships of fossil taxa: evidence from the evolution of the turtle family Emydidae

JASINSKI, Steven, State Museum of Pennsylvania, Harrisburg, PA, United States; STOUT, Michael, University of California - Davis, CA, United States; MOTANI, Ryosuke, Univ of California - Davis, CA, United States; TINTORI, Andrea, University of Milano, Milano, Italy

Nothosaurus and Larasaurus are sister taxa in the Triassic stem sauropterygian group, and were believed to be distinguished by the following characters based on European (Anisian–Ladinian) and Chinese (Anisian) material: the ratio between the longitudinal diameter of the upper temporal fenestra and the orbit, the sacral vertebral count, the morphology of humerus and ulna, the number of carpal ossifications, and the phalangeal formula. However, thanks to new material from the Xingyi Fauna (Guizhou, South China) collected during the last decade, the differences between Nothosaurus and Larasaurus now appear blurred. During excavations in 2012, we collected a well-preserved skeleton of Nothosaurus youngi and one of Larasaurus xingyiensis from a single bed within the Zhuganpo Formation (latest Ladinian, Middle Triassic) of Xingyi. These coeval specimens suggest that the traditional diagnoses may no longer be applicable to the two genera, while allowing substantial additions to the knowledge of the postcranial osteology of N. youngi.

The new material shares two diagnostic characters of the skull with the holotype: the presence of a jugal and the parietal foramen located in a trough on the parietal. Furthermore, it shares many characters with Larasaurus which have never before been observed in Nothosaurus: the longitudinal diameter of the upper temporal fossa divided by that of the orbit yielding a ratio of 1.93, the ratio between the humerus and ulna (usually less than 2.0), the presence of five ossified carpal, forelimb hyperphalangy in digits I and III indicated by the phalangeal formula 3-3-5-5-4, and four sacral ribs. The humerus is weakly angled proximally and the medial condiction is not remarkable, revealing the morphology of the humerus to be closer to the Larasaurus than to the Nothosaurus condition.

Many of the above characters are reported for the first time in Nothosaurus, blurring the distinction between the two genera. This probably results from our incomplete knowledge of the missing characters, Nothosaurus is mainly known from cranial remains while for Larasaurus is better known from postcranial skeletons. Another possible interpretation is that the latest Ladinian Nothosaurus conversely evolved similarities to Larasaurus, both genera being very close to extinction. This could lead to a global reassessment of Nothosaurus systematics following reexamination of all the species within the two genera.

Effect of new records of early and middle triassic sauropterygians from South China on reconstrution of sauropterygian tree topology

JANG, Dae-yong, Peking Univ, Beijing, China; JIANG, Ch., Peking Univ, Beijing, China; RIEPEL, Olivier, Field Museum of Natural History, Chicago, IL, United States; MOTANI, Ryosuke, Univ of California - Davis, CA, United States; TINTORI, Andrea, Università degli Studi di Milano, Milano, Italy; JI, Cheng, Peking Univ, Beijing, China

Recently, several cladistic analyses on the interrelationships of Sauropterygia were conducted on the new Middle Triassic taxa from south China were described one by one. The results disagreed with each other in some major aspects of tree topology, even though all of them ultimately originated from a single data matrix by Rieppel in 2002. We added two new species from south China, including the stratigraphically oldest form, to the analysis in an attempt to resolve the confusion.
The two new Triassic eosauropterygians that we added benefit from very precise information on stratigraphy and locality because we collected these specimens through targeted excavations. The older of the two is from the Lower Triassic (Spatschian, Olenekian) of Xingyi, Guizhou, SW China, and has pachypleurosaur-like features. The younger taxon is represented by a complete skeleton from the Middle Triassic (Ladinian) in Xingyi, Guizhou, SW China, exhibiting a mosaic of pistosaur- and nothosaur-like features. Our analysis included in total 37 taxa and 137 characters, and showed that the new Early Triassic Chaohu pistoasauriform was placed as the sister taxon to the clade Psammechinae ((Pseudotitanidae; European pachypleurosauriforms) (Dianopachysaurus, Keichousaurus) (Hansosaurus (eosauropterygian))))), showing close affinity to taxa traditionally called pachypleurosauriforms. A monophyletic Pachypleurosauria is not recovered, but the positions of the pachypleurosaur-like forms on the tree topology match the stratigraphic occurrence very well, indicating that this new phylogenetic structure is congruent with stratigraphy.

The two new Middle Triassic Xingyi pistorasaur-like eosauropterygians was placed as sister to the clade (Tungaisaurus (Pistosauridae, Plesiosauria)). The monophyly of Pistosauridae and Cynatosauridae are strongly supported again, but the monophyletic Pistosauridae is not recovered. These results differ from the most recent result published in the absence of a formal phylogeny but more work is required to fully resolve sauropterygian interrelationships.

The new Triassic eosauropterygians are fairly stable, but the resolution of the analysis is low, which is probably because the new Early Triassic Chaohu eosauropterygian could be coded only for 38.7% of the characters, and some newly named taxa from southwestern China need to be reinvestigated. Our results greatly advance our understanding of sauropterygian phylogeny but more work is required to resolve sauropterygian interrelationships.

Technical Session XIII (Friday, November 1, 2013, 3:15 PM)

INVASIVE DENTINE GROWTH IN A 380-MILLION YEAR OLD FISH IS CO-OPTED FOR WOUND REPAIR IN A 38-MILLION YEAR OLD VERTEBRAL BONE AS THE FIRST STEP IN THE EVOLUTION OF DAMAGE REPAIR

JOHANSON, Zerina, Natural History Museum, London, United Kingdom; MEREDITH SHAW, Architecture & King's College London, London, United Kingdom; KEARSLY, Antony, Natural History Museum, London, United Kingdom; MARK-KURIK, Elga, Tallinn University of Technology, Tallinn, Estonia; HOWARD, Charles, Macabée Health Clinic, Beer-Sheva, Israel

The skeleton of early vertebrates such as heterostracans is dominated by dental bone (aspidin) with dentine restricted to tubercles ornamenting the bone surface. In genera such as Psammeolpis (Heterotrasi, Psammeostidae), there is a response to gradual surface wear of the tubercles by dentine invading and spreading through the vascular spaces in the spongy bone. This consolodates and strengthens the tubercles and supporting bone. It is known that this invasive dentine derives from cells (odontoblasts) in the tubercle pulp cavities. We found that this invasive property was co-opted to repair a deep wound to the Psammeolpis dermal bony armor (Middle Devonian Gauja Formation, Estonia), exclusively with dentine and with little contribution from bone. Ground sections were produced (80-100µm), cut transversely through the wound area, with remaining blocks photographed under immersion oil or polished for backscattered electron imaging. Energy Dispersive X-ray Spectroscopy (EDX) was used to estimate the mineral composition of reparative tissue and non-biological grains included in the tissue. We found that repair occurred by massive, invasive growth of dentine into the wound and onto the remaining bony scaffold. Dentine forms in a chaotic manner in the wound, also incorporating sand grains into this hard tissue repair. Reparative dentine is derived from migratory odontoblasts, which develop not only from the Psammeolpis tubercle pulp cavities but also from the surrounding flusk-shaped crypts located at the base of the tubercle. Today, in human teeth, reparative dentine derives from pulpal cells and cells of the adjacent attachment tissues, both depositing dentine onto a scaffold in vivo. We suggest that the crypts in Psammeolpis, associated with surface pores, are stem cell niches. Cells in these crypts are capable of producing odontoblasts for secondary dentine for invasive repair, within the complex canal system linked within bone. We suggest that this dentine-based repair process has been evolutionarily conserved over 380-million years and precedes osteogenic repair, seen today in tetrapod dental bones.
RECOGNIZING BAT TRACKS AND TRACKWAYS IN THE FOSSIL RECORD:
Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

hadrosaur dinosaurs, snakes, salamanders) occupy disparate regions of dental attachment

Although many of these characters are linked together in classic categorizations (e.g.
thecodonty), lizards and many fossil taxa show they actually vary independently.

Principal co-ordinates analysis shows variation in dental attachment of extant lizards is
almost as great as that of all amniotes, both living and fossil. Acrodonty is a distinct
category involving several correlated traits: absence of roots, replacement, a labial shelf, or
an obvious boundary between tooth and bone. However, although a small zone of “true
thecodonty” is evident (occupied by modern mammals and crocodilians), stem group
synapsids and many Mesozoic archosaurs are distributed in a separate larger continuum
according to differences in lingual wall structure. Taxa with rapid tooth replacement (e.g.
hadrosaur dinosaurs, snakes, salamanders) occupy disparate regions of dental attachment
space, demonstrating that other functional aspects may be more important determinants of
dental attachment mode.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)
RECOGNIZING BAT TRACKS AND TRACKWAYS IN THE FOSSIL RECORD:
PROPOSED MORPHOLOGICAL CRITERIA BASED ON TRACKWAYS OF THE NEOTROPICAL FRUIT BAT CAROLLA PERSPICILLATA

JONES, Matthew, University of Kansas, Lawrence, KS, United States, 66045

Modern bats (Order: Chiroptera) are the second most diverse group of mammals, with
over 1200 species recognized. Bats have a worldwide distribution and are found on
all continents except Antarctica. Bat body fossils are known from as early as the Eocene
of North America, Europe, Australia, India, and South America, with at least 24 genera
identified worldwide by the end of the Eocene. Little is known of the track-making
ability of fossil or extant bats, and no known trace fossils have been attributed to bats.
Our goal is to create a database of criteria to recognize bat tracks and trackways in
modern and ancient settings. Presented here are a variety of track and trackway
morphologies produced by the neotropical fruit bat Carollia perspicillata (Chiroptera:
Phyllostomidae) in observational neoichnological experiments. Four 

C. perspicillata

individuals were observed walking on moist (12–21% by weight), medium-grain sand
that resulted in four distinct locomotion behaviors: an alternating walk, a breaststroke-
like “swimming” walk, a one-armed swim variant, and a hop. The bats also frequently
utilized a “searching” maneuver with their hind feet that resulted in no forward motion,
but produced distinctive traces. The alternating walk pattern produced drag marks
corresponding to the first digit of the manus, which are 1.5 to 2 mm wide and from 2 to
22 mm long, with the longer axis oriented parallel to the direction of locomotion. The
average distance between left and right manus tracks is approximately 81 mm. The
breaststroke-like “swimming” walk pattern produced arculate traces that also correspond
to digit one of the manus. These tracks range in width from 2 to 3.5 mm and measure
between 20 and 99.5 mm along the straight line connecting the tips of the track. The
searching maneuver pattern produced traces that consist of four or five parallel
claw marks with total widths between 9 and 15.5 mm and lengths from 4 to 15 mm. Individual
claw marks within the pedal tracks are between 1 and 1.5 mm. When only four claw
marks are preserved the absent digit is digit one, whereas the longest, widest, and deepest
claw mark is almost always produced by digit five. Pedal tracks are observed
elsewhere in the trackways, but are most commonly produced by the searching maneuver.
The distinctive morphologies of tracks produced by the four locomotion behaviors and
the searching maneuver allow traces of bats that are poor walkers, like Carollia,
to be easily recognized in both modern and ancient settings.

A NEW LARGE-BODIED THEROPOD DINOSAUR FROM THE SOUTHERN LOWER CRETAUCEOUS CEDAR MOUNTAIN FORMATION (RUBY RANCH MEMBER) IN CENTRAL UTAH

JUDF, Heather, University of Utah, Salt Lake City, UT, United States, 84112; IRMS, Randall, Linnamen, University of Utah and Natural History Museum of Utah, Salt Lake City, UT, United States; KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, United States

Early Cretaceous large-bodied theropod dinosaurs of North America are very poorly
known compared to those from Jurassic and Late Cretaceous assemblages. The Lower
Cretaceous Cedar Mountain Formation of Utah preserves key assemblages documenting
North American Early Cretaceous ecosystems from between 130-95 million years ago.

North American Early Cretaceous ecosystems from between 130-95 million years ago.
(Ma). Nonetheless, little is known about the apex predators of these ecosystems, because
the known clades are: thecodonty, or “thecodonty,” is evident (occupied by modern mammals and crocodilians), stem group synapsids and many Mesozoic archosaurs are distributed in a separate larger continuum according to differences in lingual wall structure. Taxa with rapid tooth replacement (e.g.
hadrosaur dinosaurs, snakes, salamanders) occupy disparate regions of dental attachment
space, demonstrating that other functional aspects may be more important determinants of
dental attachment mode.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)
THERAPSID PHYLOGENY REVISITED

KAMMERER, Christian, Museum für Naturkunde, Berlin, Germany; JANSEN, Mare, Museum für Naturkunde, Berlin, Germany; FROBISCH, Jörg, Museum für Naturkunde, Berlin, Germany

Therapsids is comprised of five well-characterized major subclades, all of which appear simultaneously in the middle Permian fossil record: Biarmosuchia, Dinoccephalia, Anomodontia, Gorgonopsia, and Eutheriodontia (containing Theriodontia and Eutheria). Although the earliest representatives are known from the Lower Permian, all known subclades are known from the Late Permian. The results of this analysis indicate that therapsid phylogeny is split into two major subclades (Dinoccephalia+Anomodontia and Biarmosuchia+Theriodontia), with only Ramalans falling outside of this dichotomy. "Biarmosuchia" is found to be paraphyletic with regards to Theriodontia, with the South African "ichthyodire" more closely related to herbivorous sauropsids than Biarmosuchus. Dinoccephalid monophyly is poorly supported, although its component subclades Anteosaurus and Tapinocephalidae are recovered with strong support. "Neotherapsida" is found to be an artifact of long branch attraction; with the exception of the freestanding dentary crown clade, all characters traditionally used to support this clade are absent in early anomodonts like Biseridens. Intriguingly, this topology conforms with prominent pre-cladistic classifications of Therapsida, albeit with different characters supporting these relationships. Characters related to simplification of the palate and elongation of the jaw muscles are more closely related to herbivorous sauropsids, with parallel trends in multiple therapsid clades. New work in the middle Permian is of vital importance towards documenting character acquisition during the rapid initial radiation of therapsids.
Our results corroborate previous conclusions about differences in the relation between nasal cross sectional area and body mass in endotherms as opposed to ectotherms. In addition, our data show that there are significant differences between endotherm groups.

Multiple regression on a subset of 38 mammal species, with basal metabolic rate as the dependent variable, and body mass and nasal cross sectional area as the independent variables, showed a high r-squared: 0.932. A comparable analysis substituting choana cross sectional area for nasal cross sectional area had a similar result, with r-squared value of 0.937. Thus these skeletal features, along with basal metabolic rate, could be measured in fossil specimens to provide estimates of the basal metabolic rate of extinct species.
**EVALUATION OF CERATOPSIAN DENTAL MICROSTRUCTURE**

KAY, David, Florida State University, Tallahassee, FL, United States; ERICKSON, Gregory, Florida State University, Tallahassee, FL, United States; NORELL, Mark, American Museum of Natural History, New York, NY, United States

Throughout vertebrate evolution, a number of lineages evolved dental occlusion, whereby the contact faces of the teeth self-wear to their functional morphology. It has been shown that in mammals, increases in dental complexity accompany such changes. These probably allowed for increased functional diversity. Osteodentin, a functional endodentine, appears to be an endodentine with specialized function relevant to dietary ecology. Recently, it was shown that a lineage of reptiles, the duck-billed dinosaurs (Hadrosauridae), evolved among the most architecturally sophisticated teeth known in association with their acquisition of a grinding dentition. Independent of atheroparathodontic, the horned dinosaurs (Ceratopsia), evolved dental occlusion in the form of slicing cheek teeth. Here, we tested the hypothesis that ceratopsian teeth increased in complexity in association with their evolution of slicing. Transverse and occlusal plane histological sections were made using cheek teeth from representative Ornithischia spanning the time period leading to the evolution of slicing in ceratopsians. The sections were viewed with dissecting and polarizing light microscopy. The microstructure was described and mapped as a phylogenetic character in association with whole tooth and wear facet morphological attributes. Our results show that ceratopsian teeth are considerably more complex than those of the outgroup ornithischians in possessing four distinct tissues: enamel, odontocement, coronal cementum, and osteodentin. Coronate cementum evolved in association with slicing in the common ancestor of Lophocerotops + Triceratops. Osteodentin appeared in the common ancestor of Protoceratops + Triceratops with the advent of slicing. These findings represent the second demonstration of complex dental architecture outside of Mammalia, and show that some reptiles raveled if not exceeded most mammals in dental complexity.

**DIAGNOSIS OF THE NEW SPECIES Protoceratops 4726-V FROM THE LOWER CRETACEOUS OF BRAZIL AND COMMENTS ON THE PTEROSAUR PTEOSAUR PALATE**

SEMPREBON, Gina M., Bay Path College, Longmeadow, MA, United States; PRYBYLA, Alix, Hawken School, Gates Mills, OH, United States; ARGENTINA, BASED ON MESOWEAR AND ENAMEL MICROWEAR DIETS OF LATE EARLY MIOCENE LITOPTERNS FROM SANTA CRUZ, ARGENTINA, BASED ON MESOWEAR AND ENAMEL MICROWEAR DIETS OF LATE EARLY MIOCENE LITOPTERNS FROM SANTA CRUZ, ARGENTINA

KELLNER, Alexander, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; RODRIGUES MARQUES DA SILVA, Taissa, , Alegre - ES

Among the most important pterosaur deposits known to date is the Romualdo Formation (Aptian-Albian) of the Araripe Basin, north-eastern Brazil. Since the discovery of the first specimen in 1971, hundreds have been unearthed so far, some preserved in three dimensions. Most of them represent juveniles or sub-adults, and fully ontogenetically developed individuals are rare. Here, we describe a new tapejarid pterosaur from this deposit (MN 4726-V) housed in the Museu Nacional/UFRJ, composed of skull, lower jaw and some postcranial elements. Scapula and coracoid are fused, as are all cranial elements, indicating that it represents an adult individual. MN 4726-V has the high nasoantorbital fenestra of the Thalassodrominae but lacks a palatal ridge observed in Thalassodromeus and Tapejara. It shows a down-turned rostral end, a typical feature of the Tapejarinae. Among other characters, this new species differs from all other tapejars in having an anteriorly and posteriorly expanded premaxillary sagittal crest and the lacrimal process of the jugal strongly inclined posteriorly. The surface of the premaxillary crest presents grooves indicating the impressions of blood vessels and corroborates with the growing evidence that pterosaurs could have used their cranial crests in thermoregulation. The area corresponding to the jugal-quadrate-jugal-quadrado of the left side shows a pathology, likely the result of an infection. MN 4726-V plus has an extremely well preserved palate that shows a slit-like postpalatine fenestra. The palates are large, forming the anterior region of the choanae and the postpalatine fenestra and a secondary subtemporal fenestra, indicating that this is the regular condition within derived pterosaurs. The palatal configuration of the new specimen argues against the hypothesis that the presence of a secondary subtemporal fenestra is unique to non-pterodactyloids. If previous interpretations of the palatal configuration in non-pterodactyloid pterosaurs are correct, the evolution of palatal region in those flying reptiles is more complex than previously thought.

**DIAGNOSIS OF THE NEW SPECIES Protoceratops 4726-V FROM THE LOWER CRETACEOUS OF BRAZIL AND COMMENTS ON THE PTEROSAUR PTEOSAUR PALATE**

**ECOUMORPHOLOGICAL DIVERSITY OF TRIASSIC MARINE REPTILES**

KELLEY, Neil, Vanderbilt University, Nashville, TN, United States; 37208

The evolution of multiple clades of marine reptile during the Triassic coincided with the recovery of marine ecosystems from the end-Permain mass extinction. However, the role that marine reptiles played in Triassic ecosystems remains uncertain, and the trophic habits of many of these taxa remain to be debated. I compiled dietary data from eighty-three species of living aquatic tetrapods (mammals and reptiles) and utilized linear discriminant analysis of seventeen cranial, jaw and tooth measurements to develop a framework to correlate skull morphology with adaptation to specific feeding strategies. This analysis yielded a strong phylogenetic signal between diet and morphology throughout the Triassic, and a phylogenetically broad sample of data from extant aquatic tetrapods. I then employed this framework to generate hypotheses about the trophic ecology of fifty-one species of Triassic marine reptiles. I compared these hypotheses with direct evidence of marine reptile dietary habits based on preserved gut contents, and found them to be largely concordant. These results indicate that Triassic marine reptiles included small-bodied aquatic invertebrate specialists, medium-sized fish specialists and larger generalized predators species that preyed on a variety of prey including other marine reptiles. Many Early Triassic marine reptiles had fish-dominated diets, while the Middle Triassic saw the rise of insect- and plant-eating groups including aquatic carnivores and apex predators. These groups declined after the Middle Triassic, while fish eating marine reptiles persisted. Increasing adaptation toward pelagic food sources facilitated the survival of some marine reptile lineages during an interval when nearshore niches were contracting. A comparative scarcity of herbivorous or specialist squid-feeding taxa in the Triassic relative to modern marine reptiles indicates that these food resources were not readily available to Triassic marine reptiles. Both taxonomic diversity and ecoomorphological disparity peaked in the Middle Triassic, and then declined during much of the Late Triassic. The persistence of some specialist groups and the eventual appearance of new forms characteristic of Jurassic assemblages led to an increase in overall morphological disparity at the very end of the Triassic. This analysis suggests that Triassic marine reptiles were ecologically diverse and may have played an important role in the restructuring of marine ecosystems during the Mesozoic.
SIZE-BASED EXTINCTION EXHIBITED BY QUATERNARY CARIBBEAN LIZARDS

KEMP, Melissa, Stanford University, Stanford, CA, United States; HADLY, Elizabeth, Stanford University, Stanford, CA, United States

Body size is important to the ecology and evolution of vertebrates, including reptiles, with highly diverse and globally distributed. We explore the relationship between body size and extinction in this ecologically and morphologically diverse group, using the Quaternary and modern Caribbean lizard fauna as a model system. We integrate body size data for over 380 species of lizards with conservation statuses from the International Union for Conservation of Nature (IUCN) Red List and species extinctions from the Quaternary fossil record. We use these data to evaluate whether body size predicts extinction risk in individual island classes (the Greater Antilles, Bahamas, Lesser Antilles, and isolated island banks) and throughout the archipelago as a whole. We find that extinction is size-biased, with a higher rate of extinction in large-bodied lizards than expected by chance. This phenomenon holds true both for paleontological sampling bias against smaller species, island class, and phylogeny. Our findings are in accordance with studies in other taxonomic groups, suggesting that large body size may be a significant predictor of extinction risk in insular lizards.

INTEGRATION OF MAGNETIC POLARITY STRATIGRAPHY AND ORBITAL CYCLOSTRATIGRAPHY TOWARDS A LATE TRIASSIC CHRONOLOGY

KENT, Dennis, Rutgers University, Piscataway, NJ, United States, 08845; OLSEN, Paul, Columbia University, Palisades, NY, United States; MUTTTONI, Giovanni, University of Milan, Milan, Italy

Thousands of meters of Newark Basin Coring Project (NBCP) continuous core and partially overlapping outcrop section in the nearby Hartford Basin, where all but the lowestmost part of the Newark basin sequence has been drilled stratigraphically, provide an anomalously-calibrated geomagnetic polarity time scale (APTS) for virtually the entire Late Triassic. Triassic, North American and Russian Triassic sections, and those of the CAMP (235-200 Ma), with designation of standard stages according to magnetostratigraphic correlation to marine sections in the Tethyan realm. The relative chronology, mainly delineated using the 405 ky eccentricity climate modulation expressed as lake level variations, is tied to dating of volcanics and closely associated intrusions of the Central Atlantic Magmatic Province (CAMP) that started at 201.6 Ma, indistinguishable from the end-Triassic extinction level according to recently reported high-precision U-Pb zircon dating, which also confirms the relative astrochronology. Stochastically-distributed polarity reversals have a mean interval length of around 0.5 My. One of the shortest polarity intervals in the Newark-Hampton APTS - E23r with a duration of ~10 ky - occurs within an orbital precession cycle (~20 ky) prior to the ETE and CAMP, providing a useful marker horizon that has now been found just below CAMP lavas in the Fundy and Argana basins. The Newark-Hampton APTS provides a chronostratigraphic template for continuing efforts at correlation of Late Triassic and Early Jurassic continental (and marine) sections throughout the world, for example, the Los Colorados Formation of Argentina and the Chine Formation of the western United States.

PRELIMINARY ANALYSES OF BRAIN GROSS MORPHOLOGY OF THE WOOLLY MAMMOTH, MAMMUTHUS PRIMIGENIUS, FROM YAKUTIA, RUSSIA

KHARLAMOVA, Anastasia, Institute of Human Morphology Russian Academy of Medical Sciences, Moscow, Russia; SAVELEV, Sergey, Institute of Human Morphology Russian Academy of Medical Sciences, Moscow, Russia; BOESKOROV, Gennady, Diamond and Precious Metals Geology Institute, Siberian Branch of Russian Academy of Sciences, Yakutsk, Russia; USCHAKOV, Vadim, National Research Centre "Kurchatov Institute", Moscow, Russia; MASCHENKO, Evgeny, Paleontological Institute, Russian Academy of Sciences, Moscow, Russia

We analyzed a brain from the Yuka mammoth specimen that was discovered in 2009 on the coast of the Dmitry Laptev Strait (Eastern Siberia). Radiocarbon dating of the 6 to 9 year old mammoth yielded results of 39,440 - 38,850 cal BP. CT scanning of Yuka’s brain was initiated by Dr. G. Boeskorov in Yakutsk in 2012. The brain was extracted after preservation through freezing formalin fixation in February 2013 in Yakutsk before it was flown to the Research Institute of Human Morphology, Russian Academy of Medical Sciences, Moscow, Russia for further study.

The initial gross anatomy examination of the Yuka specimen revealed similar brain morphology to that observed in modern elephants: disproportionately large and laterally expanded temporal lobes, a dorsally visible and relatively large cerebellum, and large olfactory bulbs. The frontal, parietal, and temporal lobes of the cerebrum and the folded hemispheres of cerebellum with the horizontal sulcus, quadrangular lobule, superior and inferior semilunar lobes, and relatively narrow vermis were enveloped by a thick dura mater. The cerebral falc, cerebellar tentorium, and some blood vessels of the dura mater were well preserved. Most of the brainstem was missing, but remnants of the trigeminal, visual, olfactory and cranial nerves were identifiable. The brain appeared to be dehydrated due to the mummification process, with the cerebellum exhibiting less shrinkage in comparison to the cerebrum. Oxidation processes stained the brain to a brown color. The hemispheres of the cerebrum didn’t provide clear morphology due to its state of preservation; the topography of the gyri and sulci remain obscure. The CT scan was performed at the National Research Centre "Kurchatov Institute", Moscow, revealed more morphological details: white and gray matter structures of the cerebrum and cerebellum (including the dentate nucleus and arbor vitae) with discernible vermis and flocculus, corpus callosum, and anterior commissure.

CORRELATIVE MICROSCOPIC INVESTIGATIONS OF MICRO- STRUCTURES AND PHASES FROM DINOSAUR RIB BONES AND THE ASSOCIATED MUDSTONE

KIM, Jung-Kyun, Chungnam National University, Daejeon, Korea, Republic of (South); LEE, Eunji, Chungnam National University, Daejeon, Korea, Republic of (South); CHO, Min Suk, Chungnam National University, Daejeon, Korea, Republic of (South); KIM, Youn-Joong, Korea Basic Science Institute, Daejeon, Korea, Republic of (South)

Postcranial skeletal fossils of the basal ornithopod Kurokasanourasaurus buxogensis were uncovered from the rich dinosaur egg fossil sites located at the Upper Cretaceous (Santonian-Campanian) sediments in Bosong County, South Korea. Due to their particular locality and state of preservation, osteohistological and petrographical analyses were conducted from macro to nano-scale by applying correlative microscopy for microstructure and phase identification. A dorsal rib bone fragment was initially studied, and a portion of the 7th left dorsal rib bone and its associated mudstone were analyzed for further investigations. No specific cortical growth features from the bone were discernible, although a high polarized light image displayed a trend of increase in size and shape irregularity from the outer region towards the center. Calcite crystals of various orientations occupied the vascular channels. The mudstone contained detrital grains of quartz, various feldspars, and micritic calcite. According to X-ray diffraction analysis, the rib bone was mainly consisted with calcite, followed by quartz and apatite. Scanning electron microscopy with back-scattered electron imaging, energy dispersive spectroscopy, and electron probe microanalyzer analysis revealed the specific distribution of the major and minor phases. Universal distribution of Ca was recognized in bone sample. A particular crystallographic orientation distribution was observed in the mudstone. P, Al, Si, and K appeared nearly exclusively within the bone matrix. The mudstone also had very high contents of Al and Si, followed by K, Na, and Fe, but showed a limited distribution of P. Phase identification and chemical analysis of the bone matrix revealed that X-ray diffraction analysis, the rib bone was mainly consisted with calcite, followed by quartz and apatite. 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Scanning electron microscopy with back-scattered electron imaging, energy dispersive spectroscopy, and electron probe microanalyzer analysis revealed the specific distribution of the major and minor phases. Universal distribution of Ca was recognized in bone sample. A particular crystallographic orientation distribution was observed in the mudstone. P, Al, Si, and K appeared nearly exclusively within the bone matrix. The mudstone also had very high contents of Al and Si, followed by K, Na, and Fe, but showed a limited distribution of P. Phase identification and chemical analysis of the bone matrix revealed that...
understand how the bone structure has been preserved at submicron levels and to evaluate the interaction between the bone and the surrounding mudstone.

Romer Prize Session (Thursday, October 31, 2013, 10:30 AM)

**DENTAL ADAPTATIONS LINKED TO ISOPTIC DIET AND EVOLUTIONARY PATTERN IN MURINE RODENTS FROM THE MIOCENE OF PAKISTAN**

KIMURA, Yuri, Southern Methodist University, Dallas, TX, United States, 75235; 0001

*Ungulates are often the subjects of paleoecological investigations because their large size facilitates isotopic analyses of tooth enamel. Due to abundant fossil samples and diverse tooth morphology, as well as spatially limited behavior of rodents, carbon isotope analysis in rodents can potentially provide a level of detail not yet possible in ungulates for studies of evolutionary dynamics in relation to diet.

In this study, I evaluated morphological evolution of tooth shape relative to isotopic dietary inference in two sympatric clades of murine rodents (here called *Karnimata* and *Progonomys* clades) from the Miocene (13.8 to 6.5 Ma) of northern Pakistan. Murine rodent samples from the region record the origin of the group and its diversification into the clades, beginning before and continuing through a transitional interval from C3 to C4-dominated vegetation. Carbon isotope values in enamel of the first lower molars were obtained by laser-ablation ion beam chronotope ratio mass spectrometry (GC-IRMS) to study paleoform. Tooth shape of upper first molars was defined by morphometric distance of ecomorphological characters, two-dimensional geometric morphometric analysis of tooth outline, and three-dimensional geographic information systems (GIS) models.

Carbon isotope data demonstrate that murine rodents experienced a remarkable C3-C4 dietary shift, with the *Karnimata* clade consuming a greater percentage of C4 grasses than the *Progonomys* clade at any given time. Pairwise progressive reduction in overlap of principal component fields through time quantifies the similarity of basal members of each clade, and demonstrates divergence of derived members. Change of tooth outline in the *Karnimata* clade is more strongly associated with reduction in spacing between anteroposteriorly positioned cusps and transverse arrangement of cusps. However, in both clades, 3-D model analysis shows that more derived (and younger) species have average slopes of cusps directed more anteriorly than more basal (and older) species. The reduction in spacing and transverse alignment of cusps are related to increasing chewing efficiency in a shift to a more prophallic direction of mastication in murines. These results indicate that while both clades adapted to varying contributions of C4 grasses to their diets, selection pressure forcing dental adaptations was differentially greater in the *Karnimata* clade. Moreover, the morphological analysis and associated isotopic data of these two clades of murine rodents present a fine-scale pattern of mammalian evolution that fits well with theoretical models of sympatric speciation and interspecific competition for the same food source.

Posterm Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

**CRANIAL PIT DEVELOPMENT IN EXTANT AND FOSSIL ALLIGATOR**

KING, Leigh, Oklahoma State University, Tulsa, OK, United States, 74107; LYNCH, Eric, East Tennessee State University, Johnson City, TN, United States; SCHUBERT, Blaine, East Tennessee State Univ, Johnson City, TN, United States

While previous studies have noted that cranial pit depth in Alligator increases with age, none have quantified in detail the ontogenetic development of cranial Pits. We sought to describe and quantify this relationship because 1) it could allow estimation of size and age of fragmented skulls, 2) this method could be applied to the fossil record to better understand evolution within the group, and 3) the ontogenetic development of cranial pits may provide insight into the functional morphology of the foot in respect to different avian lifestyles (e.g., capture of prey, perching behavior, feeding behavior, etc.).

Analysis of cranial pit development pattern. For example, maxillae and premaxillae display obvious pits in the youngest specimens, while quadratojugal pits do not appear until the young adult stage. Prefrontal pits elongate with age and the number of pit rows on the jugal increases. As expected, pit depth is positively correlated with skull and jaw length in extant Alligator, which suggests that cranial pit depth is a strong predictor of age.

Inclusion of fossils in these analyses revealed multiple ontogenetic stages among the in principal components analysis, indicating that pit depth is a strong predictor of age.

Posterm Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

**ISOPTIC VARIABILITY IN EARLY MIOCENE C3 DOMINATED ECOSYSTEMS IN UGANDA**

KINGSTON, John, University of Michigan, Ann Arbor, MI, United States, 48109; MACLATCHY, Laura, University of Michigan, Ann Arbor, MI, United States; KIYEMBA, Julia, Makerere University, Kampala, Uganda

Fossil enamel collected from sites at Moroto and Napak (eastern Uganda) have yielded isotopic signatures consistent with more open forested/wooded habitats in contrast to previous interpretations that suggest dense forests on the flanks of these extinct volcanoes. Carbon isotopic dietary signatures for a series of herbivore guilds average from -9 to -11‰, considerably more positive than any modern forest communities currently analyzed. In addition, a number of specimens have yielded values greater than -8‰, generally considered a relatively conservative upper boundary for the most enriched C3 dietary signal. A number of suiform, rhinoceros, and proboscidean samples range from -6 to -8‰, suggesting that modern analogs for dietary patterns in C3 environments require further characterization to interpret raw values from fossil enamel and provide a more accurate assessment. The variability may reflect differential intake of C3 browse and C3 graze, heterogeneity in the extent of canopy cover and canopy closure (i.e., more open/closed forests) or canopy effects due to vertical partitioning of isotopes within open forests. Isotopic analysis of intra- and inter-tooth variability of Pm-M1 from a fossil specimen of Brachyrhinoceros heinzelini from Napak yielded a systematic variation of up to 4.5‰ in carbon, potentially indicating variable juvenile/adult diets and/or seasonal shifts in dietary signals. To contextualize the fossil rhinoceros data, we analyzed intra- and inter-tooth isotopic signatures of modern white rhinoceros (*Ceratotherium simum bicornis*), which is native to the extent forms, the fossil rhino teeth exhibit considerably more isotopic (dietary) variation through its lifetime as well as seasonally. Previously, differences in taxonomic representation in the fossil assemblages of Napak (e.g., localities that contain more primates and rodents suggest closed forests relative to those localities that include more larger herbivores) have been used to infer an altitudinal vegetation gradient on the slopes of the evolving volcano. The new isotopic data corroborate this finding.

**HIND LIMB MORPHOLOGY OF CARNIVOROUS BIRDS: A MORPHOMETRIC ANALYSIS OF PREY PREFERENCE AND PREDATORY TECHNIQUES**

KIRCHNER-SMITH, Mackenzie, Indiana University Bloomington, Bloomington, IN, United States, 47401

Most predatory birds hunt a variety of prey animals, but some of them have a preference towards a specific prey item and have specialized to feed on this prey. Along with diet preference, the feet of predators are known to be effective tools for prey handling and it is expected that the foot morphology will vary with diet or prey handling techniques. The shape of the tarsometatarsus is strongly correlated with limb function and can be used to study the functional morphology of the foot in respect to different avian lifestyles (e.g., capture of prey, perching behavior, feeding behavior, etc.).

Morphometric analysis was performed using 33 landmarks across the front, back and top of the foot of the tarsometatarsus. This analysis used the shape of the tarsometatarsus in 9 species of modern carnivorous birds to assess whether the shape of the bone indicates prey preference or hunting technique. A 3D Geometric Morphometric analysis was performed using 33 landmarks across the front, back and top surfaces of the tarsometatarsus. The overall shape of the distal end was found to be related to analyze eagles, falcons, owls, and tarsometatarsus, and species of non-predatory perching birds, totaling 33 species. My results showed that there is a strong correlation in the hunting technique of the predatory birds across PC1, which represents a tarsometatarsus shape spectrum going from more planar to more curvature at the distal end. In this analysis, the higher the curvature the more specialized the hunting technique; the lower the curvature, the more opportunistic the bird. Hunting techniques are indicative of the environment in which both the predators and prey are living, and knowing how exact bird species were hunting has the potential to give insight into the kinds of environments they were inhabiting.

**NEW NODOSAURID ANKYLOSAUR (DINOSAURIA) FROM THE LOWER ALBANIAN EMIR CHACHA FORMATION IN NORTHERN SPAIN REVEALS THAT SINCE THEIR APATIAN ORIGIN, NODOSAURID SPECIES IN NORTH AMERICA AND EUROPE DEFINE PALEOBIOGEOGRAPHICALLY SEPARATE CLADES**

KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, United States, 84114-6100; ALCALA, Luis, Fundación Conjunto Paleontológico de Teruel-Dinópolis, Teruel, Spain; LOEWEN, Mark, Univ of Utah, Salt Lake City, UT, United States; ESPILEZ, Eduardo, Fundación Conjunto Paleontológico de Teruel-Dinópolis, Teruel, Spain; MAMEL, Luis, Fundación Conjunto Paleontológico de Teruel-Dinópolis, Teruel, Spain.

Associated ankylosaur skeletons are a conspicuous part of an extensive bonebed discovered below the youngest minable coal seam in the Santa María coal mine near Arillo, Spain. The most completely documented ankylosaur taxon from Europe, they are found within a sequence of the internal grade strata of the ancient coal mine and adjacent tectonic zones. These taxa include *Proa valdearinnoensis* and *Brachylophos* which are early edaphic Dinosauria, such as theropods, gonospondoid crocodylomorphs, and abundant plants remains. Two of the specimens from the AR-1 locality (AR-1/0 & AR-1/31) that together lack only the premaxilla, distal forelimbs, and lower portion of the scapula, were the focus of an initial description and phylogenetic analysis. Autapomorphic include large quadrates, fully fused ischial-pubes with a slot-shaped obturator foramen, a strongly arched sacrum, and the greatest bifor/miliar ratio of any ankylosaur. Nodosaurid synapomorphies include a elongate skull with subdental ornamentation, visible lower temporal fenestra, a large fronto-parietal scale, broad pterygoids flexed dorsally at the front of the braincase, relatively long distal limb elements, a long tapering tail, and an elevated accessory spine. Synapomorphies of European nodosaurids are a straight ischiium, an acromion process centered at the middle of the scapula, and a relatively incorporated ischiopubic element. Restricted to Europe and North America, polacanthid ankylosaur characterize Lower Cretaceous faunas until the middle Aptian. In North America, nodosaurids first appear in the upper Aptian of Maryland based on the neonate nodosaurid *Proa valdearinnoensis* but are known surprisingly from the lower Albanian Spanish *Clevery (Formation of Montana and Wyoming is the oldest well-represented species. The new lower Albanian Spanish nodosaurid is Europe’s oldest. There are no definitive nodosaurids known in Asia. The replacement of polacanthids by nodosaurids occurred
during a time of rapid global warming and the rapid diversification of angiosperms near the base of Cretaceous long paleomagnetic interval. Additionally, the separation of the Nodosauridae into North American and European clades at the end of the Aptian was nearly simultaneous with the family’s origin and their subsequent isolation, as flooding by rising sea level isolated and fragmented Europe.

Postersession II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

TRACKS AND BODY FOSSILS PRESERVE DIFFERENT CAMEL POPULATIONS IN THE BARSTOW FORMATION (MIOCENE) OF SOUTHERN CALIFORNIA

KLOESS, Peter, California State University, Fullerton, CA, United States, 92834-6850; FARKE, Andrew, Raymond M. Alf Museum, Claremont, CA, United States

Taphonomic biases are well-known factors affecting fossil assemblages, but such biases are often difficult to verify. One way to establish bias is by comparing the abundance of body and trace fossils for the same taxa in the same strata. Miocene-aged specimens at the Barstow Formation in San Bernardino County, California offer an excellent opportunity for study due to the abundance of their bones and tracks, as well as their taxonomic diversity. Here, we compare the size distributions of tracks and metapodials to see if there were differences in the characteristics of each assemblage. The widths of proximal ends of metapodials were used as a skeletal proxy for foot width because these elements are easily identifiable and abundant in museum collections. We compared distributional shapes because track and metapodial widths were not directly comparable. The track sample exhibited a leptokuritic distribution, with skew towards smaller footprints, whereas the osteological sample was skewed toward larger individuals with a distribution nearing platykurtic. These differences could be due to taphonomic effects or collection bias; i.e., larger camels may have avoided substrates likely to leave footprints, or perhaps their bones are more durable and easily found. Ultimately, the data confirm major differences in the composition of track and bone assemblages, warranting caution when trying to base ecological inferences on one or the other alone.

Postersession IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

TAPHONOMIC ANALYSIS OF FOSSIL FRESHWATER TURTLES IN THE UPPER CRETACEOUS (CAMPANIAN) KAIPAROWITS FORMATION OF SOUTHERN UTAH

KNELL, Michael, Southern Connecticut State University, New Haven, CT, United States, 06515

A diverse assemblage of fossil freshwater turtles can be found in southern Utah within the Upper Cretaceous (Campanian) Kaiparowits Formation, which is comprised of primarily fluvial and floodplain deposits. Common taxa include a variety of baeoinds, adicoids, and triaeniods in addition to a kinosternid, chelydrid, Compsemys, and Basiolmys. A taphonomic analysis of the Kaiparowits fossil turtles was conducted to identify links between the morphology of each turtle taxon, the depositional environment in which it was buried, and the quality of preservation of each specimen. Over 700 turtle specimens were examined in both museum collections and in the field to collect taphonomic data such as specimen completeness, degree of post-mortem bone modification, and when possible, deposition environment inferred by encrusting sediments. The vast majority of Kaiparowits turtle specimens examined consist of only shells or shell fragments, but there are a few that have associated skull and/or appendicular skeletal elements including one remarkable specimen containing multiple preserved fossilized eggs.

The results of the taphonomic analysis showed a preservation preference towards turtles that were buried within channel deposits over floodplain deposits, but only for those with robust shells. Remains of the largest turtle taxa, such as Neunkirchenia and Basiolmys, were common, but typically only as fragmentary remains. Specimens of Denazinemys and Adocus were more likely to be found in channel deposits as intact shells rather than fragments, likely due to their robust shell morphology. The smallest turtle taxa were found frequently as only fragmentary remains, primarily in overbank, floodplain, and pond deposits. In terms of preservation, the optimal combination of having a moderately sized, robust shell with burial in a fluvial channel produced the most complete, highest quality specimens. Based upon the abundance of taxa within each depositional environment, inferences were made regarding probable habitat preferences. Turtles found in the most common channel deposits were believed to have preferred riparian habitats when alive, while those found more commonly in floodplain and pond deposits, such as Compsemys, the kinosternid, and the chelydrid, probably preferred to inhabit those environments.

Postersession II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

A NEW TITANOSAURIAN SAUROPOD NEUROCRANION FROM THE UPPER CRETACEOUS OF SPAIN

KNOLL, Fabien, Museo Nacional de Ciencias Naturales - CSIC, Madrid, Spain; WITMER, Lawrence, Ohio University, Athens, OH, United States; RIDGELEY, Ryan, Ohio University, Athens, OH, United States; ORTEGA, Francisco, Universidad Nacional de Educacion a Distancia, Madrid, Spain; SANZ, Jose Luis, Universidad Autonoma de Madrid, Madrid, Spain

The Spanish Late Cretaceous (Campanian or Maastrichtian) site of “Lo Hueco” has yielded a wealth of sauropod bones. However, only two braincases are represented among these specimens. The first presents certain similarities (but also differences) with the braincase of Ampelosaurus atacis from the Campanian of France. It has been recently described in detail as Ampelosaurus sp.

The second new specimen enhances our knowledge of the cranial anatomy of European sauropods, which previously was poor despite recent improvements. It is short and deep in overall morphology. The frontal is rostrocaudally short. A ventrally curved process (? prefrontal) projects from its rostrolateral corner. The parietal is characterized by two crescentic crests on both sides of the median plan. The supraoccipital is a small, rounded bone. The caudal surface of the otosclerotic is fairly flat. The paroccipital process is aliform and strongly arches ventrally. The basisphenoid is a relatively high but short bone. In caudal view of the braincase, the parabasiphenoid makes up the very ventral extremity of the basicranium, just beneath the basal tubera. Both basiptyerygoid processes are broken near their base. However, it can be inferred from what remains that they never diverged from one another. The cranium is a wide one in a side view. The adductor chamber is partially filled with matrix on both sides, largely concealing the prootic. The chamber is very short rostrocaudally and the prootic is even shorter. As in other sauropods, a conspicuous trigeminal foramen pierces the lateral wall of the braincase. The lateral plates are characterized by a thin capsular wall of the otosclerotic. A flat occiput is a phylogenetically restricted character within titanosaurians. The same condition is found in both Ampelosaurus and Jainosaurus septentrionalis from the Maastrichtian of India. Nevertheless, the new specimen presents several features (such as a dorsoventrally elliptical foramen magnum) suggesting that it did not pertain to the same species as the other titanosaur braincase from “Lo Hueco”. It appears so close to the “Jainosaurus morphi” braincase that a phylogenetic proximity with Jainosaurus is likely.
ecological networks, we used a probabilistic model (parameterized using the body mass of herbivores and predators) to generate ensembles of realistic potential Pleistocene networks. We constructed community matrices from these networks, and then used eigenvalue analysis to explore the dynamical behavior of these potential networks when subjected to a perturbation, and whether basic community characteristics (i.e., species richness, the average mass of predator and prey) affect their stability. We found that Pleistocene communities were not more responsive to perturbations than extant African communities, but were remarkably more vulnerable to the arrival of new predators such as humans. In addition, our analyses suggest that high predator richness has destabilizing effects, whereas high richness of large herbivores favors the stability of large mammal predator-prey systems. Our findings may explain why the extinction in North America preceded the demise of South American megafauna. More generally, they emphasize how information on the network organization of species assemblages can contribute to our understanding of past and future extinction events.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

THE FIRST NEARLY COMPLETE SKULL OF STEGOLOPHODON (STEGODONTIDAE, PROBOSCIDEA) FROM THE LOWER MIocene OF JAPAN

KODA, Yoshiki, Ibarraki Nature Museum, Bando, Japan; SAEGUSA, Haruo, University of Hyogo, Sanda Hyogo, Japan; ANDO, Hisao, Ibarraki University, Mito, Japan; IIZUMI, Katsunori, Ushiku City, Ibarraki, Japan

Stegolophodon is an extinct elephant-like proboscidean that flourished in Asia from the late Eocene to Pliocene. Three stegolophodont species have been described from the Miocene of Japan. However, these species are defined on the basis of limited specimens of a few disarticulated teeth, an incomplete skull and a mandible. The first nearly complete skull specimen of Stegolophodon (INM-013853) was recovered from a sandstone unit in the upper lower Miocene Tamagawa Formation, Ibarraki Prefecture, eastern Japan. This unit represents eustatic lower marine environments, Tronx, fossil assemblages and plant fossils, which suggest warm and humid paleoclimate, were also observed in this unit. The nearly complete skull includes a rostrum that preserves parts of the zygomatic arches, maxillae, palate, and M1-M3 molars. The braincase, basioccipital, and petrosal morphology are preserved, although some aspects of the skull are badly crushed, and not all parts are preserved on both the left and right sides. The specimen exhibits the following features: 1) eruption angle of M3 steep; 2) post-glenoid fossa deep; 3) lingual and buccal sides of the molars worn almost equally; 4) molars with weakly developed single trifoliate; 5) M2 with 4 lobes; 6) M3 with 5 lobes; 6) upper tooth with oval cross section, enamel band and prominent ventral concavity; 7) maxillary with two infraorbital foramina; 8) the rostrum is very narrow, and the palate is convex and narrow.

The dentition indicates that the individual was a small young adult. The first three features suggest the derived propalinal jaw movement was already developed in this animal, while sixth and seventh features represent the primitive features for Elephantidae. The eighth character is shared with Stegodon, and considered to be a sympomorph character of the Stegodontidae (Stegolophodon and Stegodon).

Technological Session V (Wednesday, October 30, 2013, 3:30 PM)

WHO GETS TO EAT WHAT: NICHE PARTITIONING BETWEEN PHYLOGENETICALLY CLOSELY RELATED BUT MORPHOLOGICALLY DISPARATE PHOCIDAE: MOSASAURUS, MOSASAURUS MISSOURIENSIS, AND PROGNATHODON OVERTONI, BASED ON NEW MATERIAL FROM THE UPPER CAMPANIAN BEARPAW FORMATION, ALBERTA, CANADA

KONISII, Takuya, University of Alberta, Edmonton, AB, Canada; T6E2E9; NEWBIEY, Michael, Royal Tyrrell Museum of Palaeontology, Drumheller, AB, Canada; CALDWELL, Michael, University of Alberta, Edmonton, AB, Canada

A new, exquisitely preserved specimen of a small individual of a mosasaurine mosasaur, Mosasaurus missouriensis, is reported from the Bearpaw Formation (ca. 75 Ma, upper Cretaceous) of southern Alberta, Canada. The material comprises an articulated partial skull with a skeleton and many calcified cartilaginous elements, among which are tracheal rings and the sternum; this is the first-known co-occurrence of these cartilaginous structures in the genus and the second in the family Mosasauridae. Moreover, inside the ribcage and among the specimen are well-preserved autopod forelimbs bones including a skull, representing a meter-long fish. The fish remains constitute the first-known co-occurrence of these elements and cranial features. The description of postcranial material is not as complete; therefore, overall size of each bony element is the determining factor. There is no known numerical measurement range for individual postcranial elements that can be used to separate C. dirus and C. lupus. Because of the lack of completeness of the fossil data, it compiled digital caliper measurements of the scapula, ilium, and ischium for C. lupus (pil 3) to compare against similar measurements of modern C. lupus. Most of the C. lupus specimens used in this study represent wild populations that included sex and age information. These animals were collected from Minnesota, Michigan, Wisconsin, Alaska, and the Canadian provinces of Ontario and Alberta.

By comparing linear measurements of both taxa, I was able to determine statistically relevant differences in the forelimb bones between C. dirus and C. lupus. For example, when comparing humeral length versus humeral depth at the deltohumerus, C. dirus separates out from modern C. lupus and Plesiocenec g. C. lupus.

Being able to provide numerical size ranges for individual bony elements, these disarticulated canid species can be more accurately identified based only upon postcranial material. Establishing overall size minima and maxima will make it easier to determine size differences between C. dirus and C. lupus specimens. Also, these size ranges can be applied as a reference tool to other fossil sites where cranial material that can be used for identification for canids is lacking.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

DISTINGUISHING DISSOCIATED ELEMENTS OF CANIS DIRUS FROM CANIS LUPUS AT RANCHO LA BREA: LINEAR TRENDS OFFER A NEW INSIGHT INTO SPECIES IDENTIFICATION WHEN CRANIAL AND DENTAL INFORMATION IS UNAVAILABLE

KOPER, Lindsey, Northern Illinois University, DeKalb, IL, United States, 60115

The preservation process at Rancho La Brea makes it difficult to identify postcranial material accurately, especially to discern the difference between Canis lupus and Canis dirus. The task is actively hindered by the decomposition of organisms, preventing any one element from being associated with another. According to the original description of C. dirus from Rancho La Brea, distinguishing a C. dirus from a C. lupus is primarily performed by the qualitative differences in cranial and cranial features. The description of postcranial material is not as complete; therefore, overall size of each bony element is the determining factor. There is no known numerical measurement range for individual postcranial elements that can be used to separate C. dirus and C. lupus.

Because of the lack of completeness of the fossil data, it compiled digital caliper measurements of the scapula, ilium, and ischium for C. lupus (pil 3) to compare against similar measurements of modern C. lupus. Most of the C. lupus specimens used in this study represent wild populations that included sex and age information. These animals were collected from Minnesota, Michigan, Wisconsin, Alaska, and the Canadian provinces of Ontario and Alberta.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

ORIGINS, EVOLUTION, AND CLASSIFICATION OF TRUE SEALS AND THEIR PALEOBOGEOGRAPHICAL IMPLICATIONS

KORETSKY, Irina, Howard University, Washington, DC, United States; RAHMAT, Sulman, Howard University, Washington, DC, United States; GILLAND, Edwin, Howard University, Washington, DC, United States

The family Phocidae originated from primitive Carnivora in the late Early Oligocene on the Paratethyan Sea coast, dispersed during the Middle–Late Miocene, and diversified from the Eastern to Western Paratethys by the Early Pliocene. Originally, Paratethyan seals lived in warm waters, but global cooling caused cold-water adaptations, followed by dispersal. The eastern limit of the Paratethys was the Caspian Basin in the Miocene, but in the Late Pliocene, it extended farther east. Ancestors of Pusa sibirica dispersed westward (12.5 Ma) to the Atlantic Ocean via the Western Paratethys and north to the Arctic Ocean. From there, Pusa could have migrated south to Lake Baikal via the Yenisey River (3.0 Ma). Fossil Leptophoca share characters with representatives of other subfamilies and originated on the coastal of Western Europe (15.8-16.4 Ma). This geographical spread across the Atlantic to the western shore of the North Atlantic in Calvert time (14.2-15.0 Ma) and spread south in St. Mary’s time (8.5-10.5 Ma). The first discovery of two new cophistopod species from the Middle Miocene of southern Ukraine provides a unique opportunity to study sexual dimorphism in fossil and modern seals. These new species show a mosaic of primitive characters and were more adapted to terrestrial locomotion than any living representative of this subfamily. Phylogenetic analyses show that seals with 10 incisors (Phocinae) are more primitive than those with 8 (Monachinae), which are more primitive than those with 6 (Cystophorinae). The extant family Cystophorinae includes not only two of the new extinct seals. Devinopoca claytoni, from the early Middle Miocene of the Central Paratethys, is the sister taxon to the three extant subfamilies, is morphologically the closest common ancestor of all true seals, and presents a mixture of subfamily characters. The family Phocidae should be regarded as monophyletic, including four subfamilies: Devinopocinae, Phocinae, Monachinae, and Cystophorinae. Critical examination of certain questionable characters demonstrated that many morphological differences strongly support a diphylectic origin of pinnipeds. The paleontological record confirms basically the phylogenetic arguments, with two genera of the Paratethys, with modern relatives and pinnipeds originating in the North Atlantic and Antarctica in the Pacific. Recent Libyan finds, the oldest in the Eastern Hemisphere, also support the hypothesis that Phocidae originated in the Paratethys and/or Mediterranean Basins no later than the late Oligocene.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

FIRST ASSOCIATED UPPER DENTITION OF A GONDWANOTHERIAN MAMMAL

KRAUSE, David, Stony Brook Univ, Stony Brook, NY, United States, 11794-8081; HOFFMANN, Simone, Stony Brook Univ, Stony Brook, NY, United States; NESTLER, Jennifer, Stony Brook Univ, Stony Brook, NY, United States

A recently discovered, virtually complete, and well-preserved cranium from the Late Cretaceous of Madagascar preserves the first associated upper dentition of a gondwanatherian mammal. Gondwanatherians are known almost exclusively from isolated teeth, particularly molariforms. As such, referral of the cranium to the Gondwanatheria, differentiation of the new genus and species it represents, and determining the relationships of the new taxon relative to the eight other known
gondwanatherian monotypic genera must rely heavily on molariform tooth morphology. The hypsodont nature, morphology, and wear pattern of its molariform teeth serve to unequivocally identify the cranium as that of a sudamericid gondwanatherian. The size, shape, and number of alveoli of the missing teeth and the internal morphology of the molariform teeth, particularly the conformation of the infradental and the pulp cavities, are revealed from microCT scans.

Based on available morphology, the new taxon appears to have had an upper dental formula of 2.0.1.4, therefore complementing the lower dental formula of 1.0.0.4–5 inferred for another gondwanatherian taxon. The specimens from both formations, and note their distribution in related genera.

The function of these femoral characters have relied upon gross morphology and studies of morphological changes in taxa with relatively complete growth series. To date, these hypotheses have not been tested using histology. A study on the cranial epicranial coverings of centrosaurine skulls, however, did investigate the nasal boss histology of Pachyrhinosaurus as a correlate for the keratinized covering of that unique crest. Here the histological data available is expanded for the cranial of Pachyrhinosaurus, a centrosaurine centrosaurid dinosaur that has cranial bosses in place of bony horn cores. In addition, other cranial material from Late Cretaceous Albertan centrosaurs of various ontogenetic stages is examined. The focus of this study is to test whether morphological changes in cranial elaborations demonstrate similar developmental processes via paleohistological analysis. Overall, cranial elaborations in centrosaurs are observed to be intramorphizable in origin, not metaplastic. This is in contrast to some other dinosaurs, such as ceratopsian dinosaurs, where the cranial elaborations form as a combination of metaplastic mineralization of the dermis and intramorphizable outgrowth of the cranial vault bones. In the specimens examined, these structures generally contain trabecular bone at maturity, but the nasal bosses show thinner trabecular than the other cranial material sectioned. Secondary remodeled bone is common among all elements examined, with occasional interstitial primary fibrolamellar bone preserved. Periosteal bone was observed in only two horn core specimens. Trabecular bone in the examined specimens is mostly associated with mature structures, commonly found with resorption pits and spicules of degraded bone tissue. The pattern exhibited on the bone, which may suggest that the bone was growing quickly at the time of the animal’s death. Secondary remodeling in this specimen is restricted to the core and retains a high proportion of the primary fibrolamellar bone. This study proposes that all osteological cranial elaborations grow rapidly as primary, fibrolamellar outgrowths of the dermacean and remodel, later in ontogeny, into mature, largely trabecular structures.

**POSTER SESSION I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)**

**OSTEOLOGICAL OBSERVATIONS ON NEW SPECIMENS OF ORYCTODROMEUS SP. FROM THE BLACKLEAF FORMATION OF MONTANA AND THE WAYAN FORMATION OF IDAHO**

KRUMENACKER, L.J., Montana State University, Bozeman, MT, United States; 59715; BRITT, Brooks, Brigham Young Univ, Provo, UT, United States; VARRICHIO, David, Montana State Univ, Bozeman, MT, United States; SCHEETZ, Rodney, Brigham Young Univ, Provo, UT, United States; FEARON, Jamie, Montana State University, Bozeman, MT, United States

Oryctodromeus, a basal eurhizopod, is the most common and most complete dinosaur in the Ceranovian foredeep assemblages of Idaho (Wayan Formation) and Montana (Blackleaf Formation). The taxon was first described from the Blackleaf Formation of Montana. While the Idaho specimens lack the specific cranial material to allow assignment to the species level, postcranial characters indicate the specimens are congeneric. Here, we present newly observed osteological characters shared by specimens from both formations, and note their distribution in related genera. Salen features of the axial column include elongate centra throughout the vertebral column. The length to height ratio is 1.6 while centra of the axial centra the ratio is 1.4. Similarly elongate centra are present in Koreanosaurus. The function of this elongation remains unknown. The caudal series contains more than 55 vertebrae, with the centra quickly becoming elongate and hexagonal in cross section, as in Zephyrosaurus. While the holotype of Oryctodromeus lacks ossified tendons, additional specimens from both formations possess epaxial tendons beginning in the anterior dorsal vertebrae while the caudal vertebrae are encased in sheaths of epaxial and hypaxial tendons. The presence/absence of ossified tendons may relate to sexual dimorphism or ontogeny. Notable appendicular features include an exceptionally elongate preacetabular process of the ilium. The paratype specimen was described as possessing an ilium with a short preacetabular process but the process was incomplete. In specimens where pelvic elements are articulated, the ilia are aligned with the ventral portions of the centra, the ilia are not aligned with the sacrum. In contrast to some other dinosaurs, such as ceratopsian dinosaurs, where the cranial elaborations form as a combination of metaplastic mineralization of the dermis and intramorphizable outgrowth of the cranial vault bones. In the specimens examined, these structures generally contain trabecular bone at maturity, but the nasal bosses show thinner trabecular than the other cranial material sectioned. Secondary remodeled bone is common among all elements examined, with occasional interstitial primary fibrolamellar bone preserved. Periosteal bone was observed in only two horn core specimens. Trabecular bone in the examined specimens is mostly associated with mature structures, commonly found with resorption pits and spicules of degraded bone tissue. The pattern exhibited on the bone, which may suggest that the bone was growing quickly at the time of the animal’s death. Secondary remodeling in this specimen is restricted to the core and retains a high proportion of the primary fibrolamellar bone. This study proposes that all osteological cranial elaborations grow rapidly as primary, fibrolamellar outgrowths of the dermacean and remodel, later in ontogeny, into mature, largely trabecular structures.
forelimb digging. We note the configuration permitted a greater range of motion, suggesting a shift in locomotion habits and perhaps the use of hind limbs in earthmoving, such as the relocation of excavation debris.

**Posters Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)**

**PRELIMINARY PHYLOGENETIC AND HISTOLOGICAL ANALYSIS OF A LATE TRIASSIC SAUROPODOMORPH FROM THE LOWER ELLIOT FORMATION OF LESOTHO**

KRUPANDAN, Emil, University of Cape Town, Cape Town, 7700 , South Africa; OTERO, Alejandro, Museo de La Plata, La Plata, Argentina; CHINSAMY-TURAN, Anasuya, University of Cape Town, Cape Town, 7700 , South Africa

One of the richest localities of Late Triassic – Early Jurassic sauropod morph faunal assemblages is the Elliot Formation of South Africa. It is dominated by sauropodomorph dinosaur remains consisting of *Antetonitrus ingenipes*, *Blikkansaurus crompoli*, *Melanosaurus rauzi*, *Massospondylus carinatus*, *Plateosaurus callowilurgy*, *Eucnemurosaurus foris* and *Aardonyx celestae*. In the current study, we assessed the remains of undescribed sauropodomorph material that was excavated during the 1950s from the Late Triassic Lower Elliot Formation in Lesotho. The material is represented by at least 5 individuals of varying ontogenetic sizes, excludes crania, but comprising of more than 250 postcranial elements. Previous researchers suggested that the material belonged to either a “prosaurosaur” similar to either *Plateosaurus* or *Melanosaurus*, or to *Euskelosaurus browni* (nomen dubium). In the current study, we performed a detailed character analysis to assess the taxonomic affinity of this dinosaur material. In addition, we conducted histological studies of three femora to deduce aspects of its biology and growth dynamics.

Our phylogenetic analysis recovers the postcranial material as a basal non-nanosaur sauropod, in a polytomy with *Antetonitrus*, *Lexsemsauria*, *Goniasauria* and an as yet unnamed taxon from Argentina (Universidad Nacional de La Rioja specimen EUR 136). Based on the sharing of three synapomorphies of the family of *Antetonitrus* it appears that these remains represent multiple individuals of *Antetonitrus* or a very closely allied species. The femoral bone histology shows highly vascularised fibrocartilaginous bone tissue, suggesting rapid rates of bone deposition. Towards the outer 8% there appears to be a slowdown in the rate of bone formation, with several lines of arrested growth evident. This growth pattern differs from that of basal sauropodomorphs and is generally consistent with that observed in sauropods.

Our chondritic and histological findings suggest that the material from Lesotho represents a basal sauropod, possibly *Antetonitrus* or otherwise a close relative.

**Technical Session XIV (Saturday, November 2, 2013, 11:30 AM)**

**NEW Oligocene Waterbirds: Phylogenetic Analyses and Implications for Transitions in the Western Atlantic Avifauna**

KSEPKA, Daniel, National Evolutionary Synthesis Center, Druham, NC, United States, 27705

Paleogeographic birds from the Atlantic coast of North America remain vanishingly rare, hindering our understanding of past marine avian communities and their response to reorganization of ocean systems. Fossils from South Carolina open a window into a remarkable Oligocene avifauna, revealing wholesale differences from better-known Northern Hemisphere avifaunas. The avifauna of total of 75 fossils, including some of well-preserved skulls, are reported from the Chandler Bridge and Ashley Formations. Nine distinct species are represented in the avifauna, and the majority range across both formations. Plunge-diving suitids dominate in abundance and diversity. Four species with body sizes spanning a large geographic range of seven species in the avifauna. The two species of the giant psuedosuitid bird *Pelagornis* (Pelagornithidae), one species of the small albatross *Plotornis*, and two petrels are also represented.

Phylogenetic relationships of the new species were tested using a large morphological matrix modified from previous studies. In the primary analysis, the new species were recovered as the sister clade of the extant taxon *Sula*, nest well within the crown clade Sulidae. However, the analysis is highly sensitive to the signal from skeletal pneumaticity. In a subsequent analysis excluding all characters pertaining to pneumaticity, crown clade Sulidae. However, the analysis is highly sensitive to the signal from skeletal pneumaticity. In a subsequent analysis excluding all characters pertaining to pneumaticity and the stratigraphic type and having been named *Elephantopoides barkhausensis* and the eropod tracks *Megalsauraurus teutonicus*. However, a combined study on the track geometry for inferring locomotion patterns of the trackmakers and substrate analysis of the trackbearing sediments has not been done for the Barkhausen locality before.

The tracks were documented using photogrammetry, an effective and non-destructive method for 3D documentation that is scale-independent and especially suitable for field conditions. The tracksite was composed of around 300 photogrammetric points with a spatial resolution of 0.9. From these models accurate measurements could be taken, and the footfall pattern of fore and hind feet of the trackmaker could be assessed, suggesting gait as ga. In addition, a morphometric analysis of the tracksite, which is on display at the Osnabrück natural history museum in Germany, was documented with photogrammetry and compared with the original tracks to assess the effect of weathering on the original tracksite.

In order to reconstruct the gait of the sauropod trackmakers, an approach from soil mechanics was employed. The original track-bearing sediments were characterized by sediment petrography, including thin section analysis, to determine grain size and grain size distribution. Also, micro-CT analyses provided important information about porosity and stiffness of the sediment. Finite element models were built based on these parameters to reconstruct the forces producing observed sediment deformation. This data was then used to test hypotheses about gait.

**Technical Session XV (Saturday, November 2, 2013, 11:30 AM)**

**A New Archiac Shark-Toothed Dolphin from the Late Oligocene-Early Miocene of Peru**

LAMBERT, Olivier, Institut royal des Sciences naturelles de Belgique, Bruxelles, Belgium; BIANUCI, Giovanni, Università di Pisa, Pisa, Italy; DE MUZII, Christian, Museum national d'Histoire naturelle, Paris, France; URBINA, Mario, Museo de Historia Natural, Universidad San Marcos, Lima, Peru

In past studies, fragmentary Oligo-Miocene heterodont cetacean remains were often referred to the shelly-toothed dolphin family Squallodontidae, mostly based on plesiomorphic dental features: double-rooted cheek teeth with accessory crown denticles. For the last 20 years, the content of the family was reassessed and several of the heterodont cetaceans were attributed to other families, in the suborder Odontoceti (e.g. *Squalodontidae*, *Squalodontinae*). However, the affinities of several species remain controversial, especially for the ones represented by isolated teeth. Recently, the articulated, almost complete, skeleton of a medium size heterodont cetacean was discovered in the Pisco-Ica desert, Peru, in late Oligocene to

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early Miocene beds of the Chilcatay Formation. The robust and long-snouted skull is
preserved with associated ear bones, mandible, upper and lower teeth. Together with ear bones and basioccipital characters, the presence of deep antorbital notches, premaxillary sac fossae, the maxillary covering of the facial area, and odontocete. Differing from squillodontids, the incisors are not procumbent and their crown is not fluted. Furthermore, the double-rooted cheek teeth lack marked cingula and papillae on the smooth labial and lingual surfaces of the crown. The accessory denticles of posterior cheek teeth are larger and more numerous than in squalodontids. As a whole, the crown is diamond-shaped rather than triangular as in Squillodon. Interestingly, these teeth are more similar to basilosaurid archaeocetes, and even closer to isolated teeth with uncertain relationships, for example the holotype of Phococetus vasconum, \textit{Yearly Miocene of France, previously tentatively identified as a kekenodontid archaeocete. The large accessory osicle of the tympanic bulla, the correspondingly wide fovea epityraxis on the petriotic, the short tuberculum of the mammal, and the strikingly robust antorbital portion of the jugal are features also observed in physotheres, the earliest diverging extant odontocete lineage. Differing from basiosaurs, the centrum of intermediate caudal vertebrae is higher than wide, a clue for the presence of a peduncle on the tail, ahead of the fluke. This new Peruvian find, not matching any of the known families, further evidences the Oligocene-early Miocene odontocete radiation(s). It may also help solving the systematic affinities of isolated double-rooted teeth, including some of the presumably post-Iocene archaeocetes.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

**DISPARITY DYNAMICS OF SMALL THEROPOD (COELUROSAURIA: Dinosauria) Tooth Assemblages from the Late Cretaceous of North America**

LARSON, Derek, University of Toronto, Toronto, ON, Canada, M5S 2C6; BROWN, Caleb, University of Toronto, Toronto, ON, Canada; EVANS, David, Royal Ontario Museum, Toronto, ON, Canada.

Dinosaur disparity dynamics in the Late Cretaceous and their bearing on hypotheses of dinosaur extinction continue to be hotly debated. Patterns of species richness through the Campanian and Maastrichtian, as a proxy for ecological breadth and stability, have been used to argue for either gradual decline or long-term stability in dinosaurs leading up to the end-Cretaceous mass extinction. These analyses are hampered by disagreement among taxonomists about dinosaur synonymy and diversity, particularly in the latest Cretaceous. Morphological disparity and morphospace occupation are alternative measures of diversity that are free of the subjectivity of taxonomic opinion. Small-bodied theropod dinosaurs are an ecologically important carnivorous dinosaur guild. Although understanding of their alpha diversity patterns is severely limited by a lack of complete specimens, their fossil record preserves a massive sample of isolated teeth, which can convey information on their feeding ecology.

In order to assess patterns of disparity in this small theropod guild and test hypotheses of community stability leading up to the end-Cretaceous mass extinction, we amassed linear measurement data (using five standard variables) for over 3000 small theropod teeth from 18 lithostratigraphic units in the Western Interior Basin of North America. Results indicate that different groups (Troodontidae, Dromaeosauridae, **Richardoestesia, Paronychodon**) within this guild occupy distinct non-overlapping morphospaces that shift in position through time, but that morphological disparity (within groups and overall between different lithostratigraphic units, measured by both centroid size and Foote’s disparity) show no significant shifts through the last 18 million years of the Cretaceous. These metrics of disparity do tend to be highest in Late Campanian Juditiadon-aged units, but they are not significantly different from other samples. Therefore, our results show that ecological breadth and stability in small theropod dinosaurs remained relatively stable in North America throughout the last 18 million years of the Mesoic, despite morphological shifts in these groups through time. This suggests that this dinosaur guild did not experience significant declines prior to the bolide impact that precipitated the end-Cretaceous mass extinction.

**THE VALIDITY OF *NANOTYRANNUS LANCENSIS* (Theropoda, Lancian -- Upper Maastrichtian) of North America**

LARSON, Peter, Black Hills Institute of Paleontology, Hill City, SD, United States, 57745

Several specimens of the enigmatic tyrannosaurid dinosaur *Nanotyrannus lanceensis* have recently come to light. These new specimens, derived from the upper Maastrichtian-aged sediments of the Lance and Hell Creek Formations of Wyoming, South Dakota, and Montana, along with a recently described juvenile specimen of *Tarbosaurus bataar* from the Nemegt Formation of Bugin Tsav, Mongolia, provide new information that unequivocally demonstrates that this dinosaur is unique and clearly not a *Tylozauras rex*, as proposed by some other researchers. Comparisons with known and new specimens of *Tylozauras rex* show a host of characters that support the taxon, *Nanotyrannus lanceensis*. These characters include: consistent substantially greater maxillary anterior tooth counts, unique general tooth morphology, unique first maxillary and dentary tooth positions, a unique exit for the V-2 cranial nerve, unique pneumatopores in cranial elements, a shallow (as opposed to a deep) antorbital fossa, the presence of a long linear groove on the lateral aspect of the dentary, a morphologically unique furcula, an outward facing scapular glenoid, a proportionally and absolutely larger manus, the presence of third digit manus phalanges, and the presence of an anterior iliac hook.
time. Assessing the incidence of Rapoport's rule throughout the Cenozoic can help to distinguish between competing explanations. Using data from ~35,000 mammalian fossil occurrences recorded in the Paleobiology Database, we test these hypotheses by evaluating compliance with the rule during each epoch and North America Land Mammal Age (NALMA) of the Cenozoic of North America. Here, we quantify latitudinal midpoints and latitudinal ranges of mammalian species (excluding volant and marine taxa) to assess adherence to Rapoport's rule throughout the Cenozoic. The Pleistocene is the only epoch to demonstrate a significant (p<0.0001) positive relationship, thereby corroborating the differential extinction hypothesis. Extent of NALMs, which permit increased temporal resolution, reveals significant positive relationships between species midpoints and ranges during the Rancholabrean (0.012 to 0.3Ma; p<0.0001), Irvingtonian (0.3 to 1.8 Ma; p<0.01), Blancan (1.8 to 4.9 Ma; p<0.04), and Whittanew (4.9 to 33.3 Ma; p<0.01). Orellan occurs conjunctively with drainage changes and occurs Oclococcino-Cretaceous extinctions, suggesting that extinctions caused by changing climate may have played an important role in erecting the latitudinal gradients in range sizes seen today.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)
THE FIRST OCCURRENCE OF FOSSIL EGGS FROM THE UPPER CRETACEOUS (CAMPANIAN) MORONDAVA BASIN, MADAGASCAR
LAWVER, Daniel, Montana State University, Bozeman, MT, United States, 59717

Recent fossil findings have resolved a long-standing debate about the phylogenetic position of therizinosaur, a group of large, feathered, theropod dinosaurs. Their paleobiology, however, still remains elusive. Their unique anatomy, with small, bowl-shaped eye sockets and a long, slender beak, suggests that extinctions caused by changing climate may have played an important role in erecting the latitudinal gradients in range sizes seen today.
where the sizes of individual phalanges are influenced by each other during development, yet exclude neighboring skeletal elements (metacarpals/metatarsals/ungual phalanges). Using morphometrics on fossil and extant taxa, as well as embryological and cell fate-mapping techniques, we investigated the evolutionary history and development of modules in the autopod. In derived tetrapods, a strong functional and morphological distinction between metacarpals/metatarsals and phalanges is observed. This distinction is missing in early tetrapods and some secondarily aquatic tetrapods (whales and marine reptiles), leading us to question how the developmental modularity of the digit ray may have evolved. Fate-mapping has revealed distinct cell populations of pre-chondrogenic mesenchyme separating metatarsals from phalanges. These cell populations are established just before digit development commences, but the phalanges-fated cells remain developmentally plastic long into digit development. When distal limb cells are labeled early in development, they map to the entire digit, suggesting that metatarsal and phalanges cell populations split from a single cell population around the time of zeugopod differentiation (III stage 24-25). If ontogeny is informative of evolutionary history, it is plausible that a single digit module is the ancestral condition of the autopod. We propose that this single digit module split during early tetrapod evolution, forcing up the metatarsals/metatarsals and phalanges to diverge in function and morphology. Additionally, we propose that secondarily aquatic tetrapods either: 1) re-acquired the ancestral condition of a single digit module or 2) retained the derived, two-module condition, but converged on early tetrapod digit patterns.

Technical Session I (Wednesday, October 30, 2013, 11:15 AM)

PHYLGENETIC PATTERNS AND FUNCTIONAL INTERPRETATIONS OF AMNIOTE PLECIDENTINE

LEBLANC, Aaron, University of Toronto Mississauga, ON, Canada; LSL ICs; BRINK, Kistin, University of Toronto Mississauga, ON, Canada; MACDOUGALL, Mark, University of Toronto Mississauga, ON, Canada; RE. Rong, University of Toronto Mississauga at Mississauga, ON, Canada;

NEW SPECIMENS OF DEINOCHERUS MIRIFICUS FROM THE LATE CRETACEOUS OF MONGOLIA

LEE, Yung-Nam, Korea Institute of Geoscience and Mineral Resources, Daejon, Korea, Republic of (South); BASBOLD, Rinchen, Paleontological Centre, Ulaanbaatar, Mongolia; CURRIE, Philip, University of Alberta, Edmonton, AB, Canada; KOBAYASHI, Yoshitsugu, Hokkaido University Museum, Sapporo, Japan; LEE, Hang-Jae, Korea Institute of Geoscience and Mineral Resources, Daejon, Korea, Republic of (South);

THE HISTOLOGY AND PALAEONTOLOGY OF HADROSAURUS NIGERUS

Technical Session IX (Friday, November 1, 2013, 9:30 AM)

ANEURAL TOOTH ENAMEL AT ELANDSFONTEIN, WESTERN CAPE, SOUTH AFRICA.

LUTTBEG, Barney, Oklahoma State University, Stillwater, OK, United States; CATLING, Eric, University of Stellenbosch, Stellenbosch, Western Cape, South Africa; LEVIN, Naomi, Johns Hopkins University, Baltimore, MD, United States;

LIMESTONE TOICHE FROM THE EARLIEST PALEOGENE (EFT, 0.7 – 1.0 Ma), WC, preserves macromammal (> 1 kg) and micromammal (< 1 kg) fossils and provides an opportunity to further understand the regional and landscape-scale nature of micromammal trophic niche differentiation. To determine the paleo-diet of the Pleistocene fauna, we collected tooth enamel from two herbivorous micromammal genera (Bathyergus and Otomys). We compare these data to isotopic results from tooth enamel from 11 fossil macromammal taxa (e.g., hippopotamids, giraffids, bovids, rhinocerotids, suids, and equids). Isotopic ratios of micromammal teeth were obtained using laser ablation GC/IRMS, whereas macromammal results were generated using conventional acid digestion methodology. The δ13C values of all teeth suggest diets dominated by C3 plants, typical of mammals living in the fynbos biome. δ18O values of the two micromammal genera varied by less than 1‰, though Bathyergus was consistently lower than Otomys. The teeth from all localities are considered together, δ13C values of teeth from the eurybiome Bathyergus (+13.8 ± 2.4‰ PDB, n = 43) are more positive and have a wider range than δ13C values of teeth from the relatively stenobiome Otomys (+16.6 ± 1.6‰ PDB, n = 11). In contrast, δ18O values of Bathyergus and Otomys are similar to one another, averaging -6.9 ± 1.6‰ and -7.3 ± 1.5‰ PDB, respectively. When δ13C data of Bathyergus from different localities are compared, we observe distinct isotopic distributions; for example δ13C values of Bathyergus teeth from localities 0609 and 0110 cluster together, averaging -12.1 ± 1.9‰ (n = 9), and -10.9 ± 3.1‰ (n = 3), whereas Bathyergus δ13C values from locality 0209 averaged -16.2 ± 1.4‰ (n = 12). Locality 0209 is 330m away from locality 0110 and 195m away from locality 0609. In general, the macromammal teeth exhibit a 5.1% range. Otomys teeth δ13C exhibits a similar range to macromammals with a 4.6‰ range, whereas Bathyergus teeth show a much larger range of variability. The δ13C range of micromammal δ13C values indicate 102 m scale variation in vegetation in the WC during the Pleistocene that we would not be able to detect with the macromammal isotope results alone. These results are consistent with our understanding of the heterogeneity of the fynbos biome. Our data suggest this pattern extends into the Pleistocene.

Technical Session XVIII (Saturday, November 2, 2013, 2:30 PM)

OF MULTITUBERCULATES AND MASS EXTINCTION: EVIDENCE OF SELECTION FOR SMALL BODY SIZE WITHIN THE CIMOLIDONTA (MULTITUBERCULATA) CRESTAREUM ACROSS THE CRETACEOUS- PALEOGENE EXTINCTION BOUNDARY, FOLLOWED BY MORPHOSPACE RECOVERY AND EXPANSION IN THE EARLIEST PALEOGENE

LEVERING, David, Oklahoma State University, Stillwater, OK, United States, State University, Stillwater, OK, United States;

IN THIS STUDY, WE FOCUS ON THE LOSS OF SPECIES DIVERSITY – AND THEREFORE MORPHOLOGICAL DIVERSITY – WITHIN THE CIMOLIDONTA (MULTITUBERCULATA) DURING THE CRETACEOUS-PALAEogene (K-Pg) EXTINCTION, FOLLOWED BY THEIR RECOVERY IN THE PUERCAN (EARLIEST PALEOGENE). WE MAKE USE OF THE MAJORITY OF THE CIMOLIDONTA FOSSIL RECORD, ALLOWING INFERENCES TO ECOLOGY, BODY SIZE ESTIMATES, AND PHYLOGENETIC PROXIMITY. WE ANALYZED MORPHOLOGICAL DISPARITY WITHIN THE RESTRICTED PHYLOGENETIC FRAMEWORK OF THE CIMOLIDONTA. WE ADDRESSED 3 QUESTIONS: (1) DID THE CONDITIONS OF THE K-PG EXTINCTION SELECT FOR OR AGAINST THE CIMOLIDONTA? (2) DID THE CIMOLIDONTA DIVERSIFY DURING THE PRE-EXTINCTION Morphospace? (3) DID THE CIMOLIDONTA DIVERSIFY AFTER THE EXTINCTION? WE TESTED EXTINCTION SELECTION TO DETERMINE THE PROBABILITY OF GENERATING THE SURVIVOR-TAXA MORPHOSPACE BY CHANCE. OUR RESULTS SUGGEST SELECTION (P = 0.006) AND EXTINCTION (P = 0.006) DETERMINING CIMOLDONATAN-survival across the K-Pg boundary. We analyze the transition to the new morphospace for morphological character gradients. We tested for extinction selection to determine the probability of generating the survivor-taxon morphospace by chance. Our results indicate significant (p = 0.006) selection affecting cimolidontan survival across the K-Pg
extinction. Overall morphospace occupation changed significantly (p < 0.015) in the Puercan as well. We attribute this change in morphospace occupation to the diversification of the Taeniolabididae and incomplete recovery of Late Cretaceous morphospace within the Puercan. Therefore, the Puercan extinction may be a result of changes in available dietary resources, or competitive exclusion. The Taeniolabididae occupy a morphospace region distant from the remainder of the Puercan morphospace, indicating ecological niche recovery.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

EARLY HOLOCENE BISON ANTIQUIS SIZE CLINE ON THE SOUTHERN PLAINS

LEWIS, Patrick, Sam Houston State University, Huntsville, TX, United States; HORSTMANN, Elisabeth, Sam Houston State University, Huntsville, TX, United States; JOHNSON, Eileen, Museum of Texas Tech University, Lubbock, TX, United States; BUCHANAN, Briggs, Simon Fraser University, Burnaby, BC, Canada

Researchers have suggested a north to south morphcline for bison, with some suggesting this morphcline extends from modern populations into late Pleistocene and early Holocene populations of Bison antiquus. Changing climates, small sample sizes, questionable dates, and widely dispersed samples of the bison involved, however, have made determining the extent and magnitude of this size cline difficult to examine, particularly in regional detail. This research uses five early Holocene Bison antiquus populations from the Southern Plains to examine the extent of size variation in the region. These populations provide examples of ancient bison from the northern and southern extremes of the Southern Plains, as well as between the two extremes. The bison populations are from Bonefire Shelter (10,230 BP), one of the earliest stratigraphic and radiometrically dated bison bones from the southwestern United States, three locations on the Southern High Plains of western Texas and eastern New Mexico (Lubbock Lake Landmark stratum 2 population [10,800-8,600 BP], Blackwater Draw stratum 2 population [10,800-8,600 BP], and Plainview [10,000 BF]), and Cooper (10,690-10,000 BP) in north-central Oklahoma. Variation in body size is analyzed due to large sample size, functional significance, and morphological conservatism. Only length is used and both males and females were examined. Data have been tested with ANOVA for significant differences in size. The most southerly population, from Bonefire Shelter, is the smallest of the populations examined, and the Cooper population the largest. Using an alpha of 0.05, the sites are found to be significantly different (P<0.05). A post-hoc pairwise ANOVA for the five sites shows this result to be due to the difference between Cooper and Bonefire Shelter (P=0.02), but no combination of sites was significant when using the Bonferroni correction for multiple tests (alpha=0.017). Females display a similar pattern but populations do not differ significantly. Results indicate that a north-to-south sizecline existed during the early Holocene on the Southern Plains. Significantly smaller bison are present at the southern edge of the Southern Plains, while increasingly larger bison were present farther north.

Technical Session IX (Friday, November 1, 2013, 11:30 AM)

A NEW, EARLY CRETACEOUS TITANOSAURIFORM SAUROPOD DINOSAUR WITH UNIQUE OSTEOLGY FROM THE HEKOU GROUP OF LANZHOU-MINING DISTRICT, GANSU PROVINCE, CHINA

LI, Liguo, China University of Geoscience Beijing, Beijing, China; YOU, Hailu, Institute of Paleontology and Paleoanthropology, Beijing, China; LI, Daqing, Gansu Geological Museum, Lanzhou, China; CRONON, Peter, School of Veterinary Medicine, Philadelphia, PA, United States

Here we report a new titanosaurian dinosaur from the Lower Cretaceous Hekou Group in the Lanzhou-Mining District of Gansu Province, northwestern China. This new taxon (Gan Su Geological Museum specimen GSGM ZH(08)-04) comprises three teeth, eight vertebrae, a left scapulocoracoid, and a right ulna and radius. The taxon is characterized by the following unique combination of characters, including seven autapomorphies: long-crowned, spoon-shaped premaxillary teeth; axially elongate parapophyses on the middle cervical vertebrae; immense, deep pleurocoels on the lateral surfaces of the cervical and cranial dorsal vertebral centra; low, unfibulured neural spine fused with the postzygapophyses to form a cranially pointing, triangular plate in a middle dorsal vertebra; an ‘X’-shaped configuration of the laminae on the lateral surface of the middle of the neural spine; a ventrolaterally elongate body with very long, tapering blades of the cranial and caudal edges; and a tall, deep groove on the medial surface of the distal shaft of the radius. Based on our phylogenetic analysis, GSGM ZH(08)-04 belongs to Titanosauria and forms a sister group with Ophthalmosaurus. It also shares several important features with other sauropods. For instance, it has a pronounced tubercle for the origin of M. triceps longus, which is positioned dorsal to the level of the dorsal margin of the acromion, similar to the more dorsal of the paired tubercles of Alamosaurus and Sauroposeidon. In contrast, in Chubutisaurus, Euhelopus, and Diplodactylus, the tubercle lies ventral to the level of the dorsal margin of the acromion. Also, GSGM ZH(08)-04 bears ventrolaterally elongate parapophyses in its cervical vertebrae, as in Diplodactylus and Euhelopus. Furthermore, its distinctive, ‘X’-shaped dorsal vertebral lamina configuration is more complex than the ‘K’-shaped configuration in Euhelopus.

The partially fused scapulocoracoid suture and the medially placed coracoid foramen suggest that GSGM ZH(08)-04 probably pertains to a subadult individual. Vertebral centrum length data suggest that the new sauropod may have been only medium-sized relative to the largest known giant titanosaur, Sauroposeidon. Interestingly, the morphology and remarkable length of the scapulocoracoid reveal an unusual relationship between the shoulder and the middle trunk. This discovery sheds new light on the diversity of Early Cretaceous titanosaurs in China.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

THE PALEOICHTHYOFAUNA FROM THE CODÓ FORMATION (APTIAN OF THE PARNAÍBA BASIN) NORTHEASTERN BRAZIL

LINDOSO, Rafael, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil; MAIEY, John, American Museum of Natural History, New York, NY, United States; CARVALHO, Ismar, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

The Codó Formation occurs discontinuously over a wide area in the central-north of the Maranhão State, Northeastern Brazil. Predominantly carbonatic, this lithostratigraphic unit contains a diversified paleobiota, comprising plants (including pollen, spores and algae), crustaceans, gastropods, ichnofossils and fishes. The latter are among the most numerous and correlate internal and marginal basins in Northeastern Brazil during the formation of the South Atlantic Ocean, in Western Gondwana. Eleven species are recognised: Araripelaevolites tamarinus, Vincitortes componi, Calamoplepis cyrlindrica, Cladocyonas gregarius, Brongniartia baccula, Tharrhias araripis, Dastilbe elongatus, Santanichthys diasi, Codeichthys carnaveli, Axelrodichthys araripepi and Lepisosteus. The material comes from four main localities in Maranhão State: Timbiras, Barra do Corda, Brejo and Codó, and was collected in open pits or along the banks of the main rivers draining the center of the Parnaíba Basin. Two specimens, Federal University of Rio de Janeiro – Department of Geology specimen UFRJ-DG 828-P and Research Center of Natural History and Archaeology of Maranhão specimen CPHNAMA-VT 1242 represent the first occurrence of lepisosteids in the Codó Formation. The morphology of the ethmoid region, and lower jaw, the relative proportions of the dorsal, anal and caudal fins, and gonad scale morphology support affinity with genus Ochichthys. One specimen, UFRJ-DG 870P, includes about fifty individuals of Santanichthys diasi preserved in preferred orientation, on the same bedding plane, consistent with a mass mortality event. These results provide a better understanding of the paleoenvironmental situation in the Early Cretaceous of Northeastern Brazil.

Syposium 2 (Thursday, October 31, 2013, 2:45 PM)

"TAR PITS" OF THE WESTERN COASTAL NEOTROPICS: PALEOEKOLOGY, TAPHONOMY, AND MAMMALIAN BIOGEOGRAPHY

LINDSEY, Emily, U.C. Museum of Paleontology, Berkeley, CA, United States; MCFARLAND, Kevin, Royal Ontario Museum, Toronto, ON, Canada

Asphaltic deposits, or "tar pits," present a unique opportunity to investigate the paleobiology and paleoecology of Quaternary mammals due to their tendency to accumulate and preserve remains of numerous taxa. This role is especially important in areas with low preservation potential or incomplete sampling, such as the Neotropics. The most well-known asphalt paleontological locality in tropical South America is the
Talara tar seeps in northwest Peru, but several other highly-productive asphaltic localities have been excavated on the nearby Santa Elena Peninsula (SEP) in southwestern Ecuador. This project combines data from recent excavations on the SEP with analyses of fossils collected from this region currently housed in the collections of the Museo de Historia Natural de Quito, Ecuador, the Royal Ontario Museum in Toronto, Canada, and the Museum National d'Histoire Naturelle in Paris, France. In general, the communities of megaherbivores are comparable between these geographically-close sites, but La Carolina, like Talara, was probably a tar pit "trap" analogous to the assemblage known previously from the upper part of the Ermaying Formation. These localities lie in two small areas of Shanxi Province, along the Yellow River. Most notably, Locality B has produced Shansisuchus-like snakes, Sphenosuchus-like vertebrates, and a new species of Nothogomphodon; Locality C has produced Shansisuchus-like placodranaial components; and Locality D has produced a Kallaamazon-like snake. Locality F has produced some specimens of Parakannaamazon and Shansisuchus, in addition to a cupulardierid form and a problematic, morphologically unusual ichnospecies. These fossils can be referred to the Shansisuchus-Skansisuchus assemblage, known previously from the upper part of the Ermaying Formation. These new finds suggest an increased diversity of the assemblage, and that the assemblage survived longer than previously realized. This assemblage can in turn be correlated with the Eryosuchus fauna of Russia, or the Cynognathus fauna of South Africa. The correlation of these three faunas is consistent with the Peruvian land-vertebrate faunacron. Based on recent dating of volcanic ash beds, the age of the Skansisuchus-Shansisuchus assemblage is estimated as Late Anisian to Early Ladinian.

Poster Session I (Wednesday, October 30, 2013, 3:45 - 6:15 PM)

NORTH AMERICAN EOCENE SUCKERS AND THEIR IMPLICATIONS FOR THE SYSTEMATICS OF CATOSTOMIDAE (OSTEOPHARYNGIFORMES)

LIU, Jian, University of Alberta, Edmonton, AB, Canada, T6G 2E9; WILSON, Mark V. H., University of Alberta, Edmonton, AB, Canada; MURRAY, Alison M., University of Alberta, Edmonton, AB, Canada

Catostomids are commonly known as suckers. As a group they are widely distributed throughout North America, with only one of the 72 modern species being endemic to China. Their fossil record in North America can be traced back to the Paleocene Paskapoo Formation of Alberta, Canada. They then diversified taxonomically and morphologically since the early Eocene within western North America. However, all of the Eocene catostomids from North America can be referred to the genus Amyzon. Based on a large collection of material from Canada and USA, we review the morphological characters of described species and recently discovered specimens.

Paleoanthropology, Chinese Academy of Sciences, Beijing, China; SULLIVAN, Corwin, LIU, Jun, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; SULLIVAN, Corwin, GRANOVSKY, Alexei, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; SULLIVAN, Corwin, PANG, Qian, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

The family Catostomidae consists of four subfamilies: Ictiobinae, Myxocyprininae, Cycleptinae and Catostominae. Amyzon has been hypothesized to belong to the subfamily Ictiobiinae, which is often considered a basal group of Catostomidae. The largest subfamily, Catostominae, containing 85% of all catostomid species, is usually considered to be the most derived group. One recent molecular phylogenetic study based on nuclear DNA suggested Catostominae might be a basal clade. In our osteological comparisons, members of Catostominae share a number of plesiomorphies with Amyzon. Two uniquely shared features are: 1) only hypural 2 is fused to the compound centrum, whereas both hypural 2 and 3 are fused to it in the remaining catostombids; 2) the ethmoid of Amyzon and Catostominae is broad, slightly domed anteriorly, and bears a rod-like anterior projection, whereas in other catostomids (e.g., Cycleptinae and Catostominae) this projection is usually smaller, occasionally absent in others. These features are consistent with the suggestion that Catostominae diverged earlier in catostomid evolution than previously believed.

NEW TETRAPOD FOSSILS FROM THE TRIASSIC TONGCHUAN FORMATION OF SHANXI PROVINCE, CHINA, AND THE AGE OF THE SINOKANNEYEMERIA-SHANSHISUCHUS ASSEMBLAGE

LIU, Jun, Institute of Vertebrate Paleontology and Paleanthropology, Chinese Academy of Sciences, Beijing, China; LI, Lu, Institute of Vertebrate Paleontology and Paleanthropology, Chinese Academy of Sciences, Beijing, China; SULLIVAN, Corwin, Institute of Vertebrate Paleontology and Paleanthropology, Chinese Academy of Sciences, Beijing, China

The Triassic Tongchuan Formation of Shanxi Province, China was long considered barren of fossil tetrapods, with the sole exception of the archosauromorph Yonghessuchus from Member II of the formation. In contrast, the underlying Ermaying Formation is China's richest source of Lower Triassic tetrapods, containing the remains of the Late Anisian-Sinemurian Shansisuchus, a new assemblage of tetrapods that includes the large carnivorous Shansisuchus-Fugusuchus assemblage and the upper part having yielded the Sinokanneyemeryia-Shansisuchus assemblage (or Shansisuchidae assemblage).

In 2010, several new fossil localities were discovered in Member I of the Tongchuan Formation. These localities lie in two small areas of Shanxi Province, along the Yellow River. Most notably, Locality B has produced a Sinokanneyemeryia-like skeleton, Shansisuchus-like vertebrates, and a new species of Nothogomphodon; Locality C has produced a Kallaamazon-like snake. Locality F has produced some specimens of Parakannaamazon and Shansisuchus, in addition to a cupulardierid form and a problematic, morphologically unusual ichnospecies. These fossils can be referred to the Sinokanneyemeryia-Shansisuchus assemblage, known previously from the upper part of the Ermaying Formation. These new finds suggest an increased diversity of the assemblage, and that the assemblage survived longer than previously realized. This assemblage can in turn be correlated with the Eryosuchus fauna of Russia, or the Cynognathus fauna of South Africa. The correlation of these three faunas is consistent with the Peruvian land-vertebrate faunacron. Based on recent dating of volcanic ash beds, the age of the Sinokanneyemeryia-Shansisuchus assemblage is estimated as Late Anisian to Early Ladinian.

Technical Session XVII (Wednesday, November 20, 2013, 2:15 PM)

A NOVEL METHOD FOR TIME-BINNING RATES OF CONTINUOUS CHARACTER EVOLUTION ON A PHYLOGENY

LLOYD, Graeme, University of Oxford, Oxford, United Kingdom; FRIEDMAN, Matt, Univ of Chicago, Oxford, United Kingdom

Phylogenetic comparative methods are often focused on fitting models to phylogenetic data as a whole or on optimizing branches or clades of special significance. However, paleontologists are often interested in secular variation in evolutionary rates across entire groups over their evolutionary history. Such ‘in-bin’ estimates of rate are necessary for testing hypotheses linking shifts in evolutionary rates to hypothesized environmental (e.g., climate) and biological (e.g., ecological release) drivers. Here we introduce a new algorithm for estimating rates of evolution in continuous characters over multiple time bins that returns results as a time series. The algorithm measures relative rates of evolution by first fixing rates in the first time interval, but with a major low in the Tournaisian, coincident with “Romer’s Gap”. Using an approximation technique to provide error bars we show that the bin is characterized by exceptionally high error, likely due to relatively long uninterrupted branch length in this interval. We anticipate that this new technique to be a boon to future phylogenetic comparative studies by paleontologists, as it better utilizes data sampled from multiple time horizons.

A NEW DINOSAUR FREeway IN THE CRETACEOUS OF WESTERN COLORADO: TOWARDS A WORLD CLASS TETRAPod TRACK SAMPLE AND DATABASE FOR THE CRETACEOUS DAKOTA GROUP

LOCKLEY, Martin, Univ of Colorado Denver, CO, United States, 80217-3364; HOUCK, Karen, University of Colorado Denver, Denver, CO, United States; LIM, Jong Deock, National Research Institute of Cultural Heritage, Daegon, Korea, Republic of (South); KIM, Kyung Soo, Chinju National University, Chinju, Korea, Republic of (South)

The track-rich Albian Cenomanian coastal plain deposits of the Dakota Group, known on Colorado’s eastern slope as the “Dinosaur Freeway” have produced more than 80 tetrapod tracksites. The well-documented tetrapod ichnofauna is dominated by tracks of birds and crocodylians (Eryosuchus and crocodylians (Hatcherichus). Tracks of other tetrapods, including birds, pterosaurs, ankylosaurs and turtles are rare. Recent studies of tetrapod ichniflora in the Dakota Group on the Western Slope of Colorado, 300 km west of the eastern slope tracksites, reveal at least 40 additional sites with a significantly different ichnofauna. This western Cretaceous ichniflora is dominated by tracks of ankylosaurs (Tetrapododonturaus) and swim tracks of crocodylians (Hatcherichus) and pterosaurs (Ptericus). Although present, ornithopod tracks are uncommon, and tracks of turtles and theropods are rare. The theropod tracks mostly differ from Megamosaipex. The ankylosaur track samples are the largest from the USA, and the pterosaur tracks are the largest in size (length up to 25 cm) known from the Cretaceous of North America. Compared to the west, the eastern slope facies is coaly-rich with a high proportion of deep tracks, many with slide and skin traces. Swim tracks are also very abundant. Although not previously reported, the western slope sample provides evidence of an extensive new Dinosaur Freeway region, broadly correlative with the eastern slope. However, the two regions display distinctly different ichnofaunas, even though both represent the initial transgressive deposits of the Western Interior Seaway. Precise correlation between the eastern and western slope track beds would potentially connect the two terrains across the Rocky Mountain divide, link two dinosaur freeway into a much larger ichnological province, and elucidate regional temporal (geochronological) and paleoecological relationships. The track-rich Dakota Group, documented in at least 50 papers, has now yielded some 120 tracksites, two thirds of which have yielded diagnostic material (about 440 University of Colorado Museum specimens including 90 from the western slope). Although the tetrapod ichnoflora of the Dakota Group is one of most intensively studied, collected and documented, the present study proves that large regions with distinctive ichnofaunas remain unexplored.
The origin and phylogenetic relationships within Ankylosauria are currently poorly understood. Previous parsimony analyses have focused on cranial features or cranial and postcranial features. We conducted a novel phylogenetic analysis of Thyrhophora with comprehensive sampling of 70 (and characters). This character represents a character (284) used in taxon sampling and a 67% increase in character sampling over the most recent published study. In addition to the inclusion of a wide variety of cranial and postcranial characters, this is the first analysis to assess postcranial armor characters beyond the presence of a tailclub. We recover *Scelidosaurus* as the basal most member of Ankylosauria. *Ankylosaurus*, *Liaionodosaurus*  and *Antarcotops* as basal ankylosaurids. *Scelidosaurus* shares many synapomorphies of Ankylosaura including: cranial ornamentation, mandibular ornamentation, a pelvis wider than long, fused cervical rings, shoulder spines and lateral caudal plate. Additionally, the study is the first to recognize a well-supported clade basal to the split between ankylosaurids and nodosaurids. Based on this topology, nodosaurids are only unambiguously known from North America and Europe with all of the European taxa belonging to a separate sub-clade. Basal ankylosaurids have a Panguan distribution, better explaining their presence in the Late Cretaceous of Africa, North America, and Antarctica. Polacanthids comprise 8 taxa from North America and Europe and persist from the Late Jurassic into the early Aptian. There is a major turnover during the middle Aptian, with basal ankylosaurids being completely replaced by ankylosaurids in Asia, and polacanthids replaced by nodosaurids in North America and Europe. Some Asian ankylosaurids lineages likely dispersed to western North America by the middle Campanian. There are at least two clades of late Campanian ankylosaurids in western North America, both nested among Asian taxa. Current evidence suggests that nodosaurids never dispersed to Asia from either North America or Europe, even though nodosaurids on both continents persisted until the end of the Cretaceous.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

**BIODIVERSITY CRISIS IN THE HISTORY OF RHIZOMYINE RODENTS**

LÓPEZ-ANTÓNANZAS, Raquel, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; FLYNN, Lawrence, Harvard University, Cambridge, MA, United States; KNOLL, Fabien, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain

Combinations of cladistic and biodiversity analyses highlight the phenomena of speciation, extinction, and diversity changes in a given group over time. This allows us to establish when biodiversity crises occurred and thus to deduce their possible causes. The study of the relationships of rodents belonging to the subfamily Rhizomyinae by means of a cladistic analysis and the conversion of the resulting cladogram into a strato-cladogram has allowed determining rates of biodiversity changes, speciation, and extinction for this group. They were calculated based on variants of a deterministic exponential model of taxon growth. These analyses have allowed inferring that the rhizomyines suffered from three biodiversity crises in the Serravallian, Messinian, and Piacenzian. The loss of biodiversity in the evolutionary history of these rodents is due to an interaction between the extinction crises and other factors, such as the times of biodiversity crisis can be correlated with as many environmental events. The first may correspond to a significant cooling due to the restoration of a major Antarctic ice-sheet (15-13 Ma). The second event occurred in a warm and wet climate. The increase of aridity caused the extinction of most of the primitive lineages of this group (e.g., *Prokanaismys*, *Kanaismys potanensis* and the first appearance and diversification of taxa with higher crowned cheek teeth and, generally, fosorial adaptations. The second may be linked to the rise of the Himalayas at about 9-8 Ma. They would have reached sufficient height to produce a rain shadow in Central Asia. This led to the extinction of most of the lineages that had diversified during the Tortonian. Finally, the fast and drastic uplift of the Tibetan Plateau at 3.6 Ma resulted in further aridity and the local extinction of the rhizomyines in Pakistan, where they had a flourishing history since Miocene time. From then on, the geographic distribution of one of this group of rodents has been restricted to that of today, i.e. eastern Africa and southeastern Asia.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

**PHYLGENETIC RELATIONSHIPS OF THE EUROPEAN PAROMOMYIDAE (PRIMATES, MAMMALIA) AND THEIR BIOGEOGRAPHIC IMPLICATIONS**

LÓPEZ-TORRES, Sergio, University of Toronto, Toronto, ON, Canada; MSS 282; SILCOX, Mary, University of Toronto Scarborough, Scarborough, ON, Canada

Paromomyidae represent the first adaptive radiation of Primates, appearing near the Cretaceous-Paleogene boundary. Eleven families of pleisiadapiforms are recognized, including the Paromomyidae, which are known from North America, Europe, and Asia. Four species of Paromomyidae, all belonging to the genus *Arcius*, have been reported from Europe: *A. fuscus*, *A. rougieri*, *A. zbyszewskii*, and *A. lapparenti* from Portugal. *Arcius* sp. is also known from the Masia de l’Heruet fossil site in northeastern Spain, and a specimen identified as *A. lapparenti* has been described from the Abbey Wood site in England.

A comprehensive cladistic analysis of the European paromomyids has never previously been performed. Existing conceptions of the relationships between various species of *Arcius* suggest that *A. rougieri* represents a more primitive stage than *A. fuscus* and *A. lapparenti*. *Arcius zbyszewskii* was suggested to be the most primitive species of the Pleistocene paromomyids, related to *A. rougieri*, and the Spanish specimens were suggested to be closely related to *A. lapparenti*, but not part of the same species. A total of 157 dental characters were analyzed for the four species of *Arcius* and the *Arcius* sp. specimens from Spain. The single specimen from England is analysed separately from the French *A. lapparenti*. Parsimony based cladistic analysis using TNT yielded a single most parsimonious cladogram rooted with *Paramomys maturus*. The results agree with *A. zbyszewskii* being the most primitive species. However, *A. fuscus* is positioned as the sister taxon of *A. rougieri* and *A. lapparenti*, and the Spanish material seems to pertain to a quite primitive lineage, instead of being closely related to *A. lapparenti*. In a biogeographic sense, the results of the new cladistic analysis follow a west-to-east pattern. The most primitive species, *A. zbyszewskii*, is known from Silveirinha, Portugal; the more derived *Arcius* sp. from Masia de l’Heruet is from northeastern Spain; and the other three species are from central Europe. This might suggest that southwestern Europe could have been the entry point for paromomyids from North America to this continent via Greenland.

Technical Session XVII (Saturday, November 2, 2013, 1:45 PM)

**QUANTIFYING TRIASSIC SEDIMENTATION ACROSS THE WESTERN UNITED STATES: PERCEPTION, PRESERVATION, AND PALEONTOLOGY**

LOVELACE, David, University of Wisconsin-Madison, Madison, WI, United States, 53706; BLASER, Richard, Geology Dept., Linfield College, McMinnville, OR, USA; GOEBEL, Jörn, Germany

Spending just over 50 million years, deposits of Triassic age captured and preserved an amazing array of information ranging from biological evolution to global tectonics to climate change. Within North America, the western USA includes the greatest lateral range of Triassic sedimentation. The spatiotemporal distribution of these strata was analyzed using a macrostratigraphic approach. hiatus bound packages of sediment were quantified to determine rates of initiation, truncation, and accumulation, as well as total volumes. Results of this analysis demonstrate a significant difference between Early Triassic and Late Triassic deposits, while recording the absence of the majority of Middle Triassic terrestrial strata. Continentally derived Middle Triassic sediment is markedly limited in the marine record, indicating this is not simply a matter of sediment bypass. The low volumes of terrigenous sediment in Middle Triassic
marine strata suggest the extensive paleosols observed along the base of the Late Triassic unconformities may represent a long-lived time-surface. Early Triassic strata are dominated by fine-grained siliciclastics whose average volume is nearly five times that of the more biologically homogeneous Late Triassic strata, suggesting different controls of sedimentation mechanisms. Paleobiological data (vertebrate genera and ichnogenus) were culled from the Paleobiology Database for each stratigraphic unit of the Triassic in the western USA in order to quantify their relationships through time and space. The most notable difference is the relative abundance (~75%) of ichnokarst relative to body fossil taxa. The Late Triassic exhibits a much higher abundance (~80%) of body fossil taxa than the more lithologically heterogeneous Late Triassic strata, suggesting different control trajectories. The allometry of the Redondasaurus skull is similar to that of numerous other phytoposaur species, except it exhibits a subtemporal region, which apparently grows, in negative allometry as opposed to the positive allometry seen in others. The data thus imply that this is an important ontogeny-based diagnostic character of Redondasaurus, but a larger sample size will be required to confirm the hypothesis.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

EXAMINING THE CONGRUENCE BETWEEN DIFFERENT SOURCES OF PHYLOGENETIC DATA FROM ARTIODACTYLA

LUDTEKE, Joshua, University of Calgary, Calgary, AB, Canada; T2N 1N4; RACICOT, Rachel, Yale University, New Haven, CT, United States

Genomic sources of phylogenetic data are abundant for extant and recently-extinct species. This abundance allows for dense character sampling of extant species and provides a critical test of the ability of phenomic data to determine phylogenetic relationships of extant taxa. In some cases, genomic phylogenetic trees are increasingly congruent on what may be true phylogenetic signals among extant taxa, while phenomic trees continue to produce incongruence. Although there are examples in which singular sources of genomic data provided erroneous evolutionary hypotheses, phenomic data are often a priori labeled as being less informative than genomic data without much discussion of why.

The abundance of both genomic and phenomic data within the Artiodactyla makes this clade an ideal system to investigate factors leading to incongruence between these data sets. Phenomic and genomic sources of phylogenetic data, when analyzed separately, yield different topologies; few phenomic analyses support the inclusion of Cetacea within Artiodactyla, whereas nearly all genomic analyses do. However, when phenomic and genomic sources of phylogenetic data are used in combined analyses within Artiodactyla, phenomic data sometimes provide unexpected and needed support for additional branching events primarily supported by genomic data.

Our study analyzes published combined phylogenetic matrices of Artiodactyla to determine how genomic and phenomic data contribute to the combined topology. We investigated the congruence between partitioned branch support (how much a character data set supports a clade in a combined analysis) and Bremer branch support in separate analyses (how much a source of data supports a clade in its own analysis), also known as hidden branch support. Our analysis separated different sources of genomic data (e.g., mitochondrial and nuclear) and phenomic (e.g., cranial, postcranial, non-osteological) data to determine how these sources of data interact to produce a combined topology. As expected, phenomic data are mixed in their ability to inform combined analyses: phenomic support for some genomic clades is low or non-existent. However, phenomic data provide a hidden branch support for many groups within Artiodactyla. Phenomic data are found to be informative, but, like genomic data, work better when combined with other data than by themselves.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

PTYCHOGASTERIDAE (TESTUDINES: GEOEMYDIDAE) IN THE VALLÉS-PENÈDES BASIN (NE IBERIAN PENINSULA): NEW REMAINS AND TAXONOMIC REVISION

LUJÁN, Àngel H., Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain; DÉRÉ, Philippe, Département de Paléontologie, Muséum National d'Histoire Naturelle, Paris, France; TRENCH, Keith, Museum and Art Gallery of the Northern Territory, Darwin, Australia; LAVIAT, Raphael, Département de Paléontologie, Muséum National d'Histoire Naturelle, Paris, France

Our results record the subgenus Redondasaurus from the Vallés-Penedès Basin (NE Iberian Peninsula). This species, the type of the subgenus Temnoclemmys, was originally described in this basin, where no taxonomic revision of these turtles has been performed for many decades. We report new ptychogasterid material from several Vallés-Penedès localities and, on the basis of this and previously published material, we further refine their taxonomy as well as the phylogenetic relationships of the subgenus Temnoclemmys.

Our study analyzes published combined phylogenetic matrices of Artiodactyla to determine how genomic and phenomic data contribute to the combined topology. We investigated the congruence between partitioned branch support (how much a character data set supports a clade in a combined analysis) and Bremer branch support in separate analyses (how much a source of data supports a clade in its own analysis), also known as hidden branch support. Our analysis separated different sources of genomic data (e.g., mitochondrial and nuclear) and phenomic (e.g., cranial, postcranial, non-osteological) data to determine how these sources of data interact to produce a combined topology. As expected, phenomic data are mixed in their ability to inform combined analyses: phenomic support for some genomic clades is low or non-existent. However, phenomic data provide hidden branch support for many groups within Artiodactyla. Phenomic data are found to be informative, but, like genomic data, work better when combined with other data than by themselves.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

THE MOST COMPLETE JUVENILE PHYTOSAUR SKULL: REDONDASAUROidea FROM THE UPPER TRIASSIC CHINE GROUP AT GHOST RANCH, NEW MEXICO

LUCAS, Spencer, New Mexico Museum of Natural History, Albuquerque, NM, United States; 87104-1175; SPIELMANN, Justin, New Mexico Museum of Natural History, Albuquerque, NM, United States; RINEHART, Larry, New Mexico Museum of Natural History, Albuquerque, NM, United States; SULLIVAN, Robert, New Mexico Museum of Natural History, Albuquerque, NM, United States

Recently discovered juvenile skeletal remains of Redondasaurus from the Chinle Formation (Chinle Group) at the Whitaker quarry, Ghost Ranch, New Mexico, provide new insights into the anatomy and paleoecology of this ptychogasterid phytopsaurs. Approximately 220 mm total length, it is the best preserved and most complete juvenile phytosaur skull of its ontogenetic stage known. The skull and lower jaws are nearly complete, only missing the anterior snout tip and anterior end of the lower jaws. This nearly complete juvenile phytosaur skull is spherical and not subject to the variation in cranial size that is characteristic of juvenile ptychogasterids. In the juvenile skull, the supratemporal fenestrae are concealed by the supratemporal fenestrae in the adult. Thus, the juvenile skull of Redondasaurus demonstrates that juvenile phytoposaurs have the same diagnostic characters as adults, one of the key features that diagnose adult onychodons from all other basal tetrapods. The allometry of the Redondasaurus skull demonstrates that juvenile phytoposaurs have the same diagnostic characters as adults, one of the key features that diagnose adult onychodons from all other basal tetrapods. The allometry of the Redondasaurus skull demonstrates that juvenile phytoposaurs have the same diagnostic characters as adults, one of the key features that diagnose adult onychodons from all other basal tetrapods.
quantifying the entire sample of horse fossils from the site was warranted. Remains of *Equus* at Gypsum Cave are well represented in the assemblage. Multiple skeletal elements, both cranial and postcranial, are present. As noted, some fossils retain soft tissue impressions, skin impressions, and hooves. Based upon these observations and specimens, the sample includes two adults, two subadults, and five juveniles. Five left metatarsals, four with fused distal epiphyses, when combined with the dental elements indicate a minimum number of ten individuals in the sample. All of these fossils represent a small stilt-legged species in which the bones are relatively small and gracile. An initial morphological analysis indicates that these fossils are associated with these remains are yielding ages of ~13 ka. Additionally, a single terminal phalanx encased within an intact hoof represents a large species; this fossil has been previously dated to ~25 ka. Based upon these data, two species of horse are present at Gypsum Cave: a large-stout-limbed species and a smaller stilt-legged form. Lack of more diagnostic characters precludes specific assignment for any of these fossils at present. Comparison of these remains with fossils from other Pleistocene localities in the Mojave Desert (e.g., Lake Manix, Kokoweef Cave, Tecopa) confirmed the presence of small stilt-legged horses elsewhere in the region. In contrast, more coastal assemblages (e.g., Radiatively Island) lack stilt-legged horses. It is not clear if this assemblage contains the small-stout-limbed species, the larger *Equus* "occidentals" and the smaller *E. conversidens*. We conclude that there were at least three species of *Equus* in North America in the late Pleistocene: large and small stout-limbed species and a smaller stilt-legged form.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

A NEW PISTOSAURID (REPTILIA: SAUROPTERYGIA) FROM THE LATEST LADINIAN XINGYI MARINE VERTEBRATE LEVEL, SOUTHWESTERN CHINA

MA, Le-tian, Peking University, Beijing, China; JANG, Da-yong, Peking University, Beijing, China; RIEPPLE, Olivier, The Field Museum of Natural History, Chicago, IL, United States; MOTANI, Ryosuke, University of California, Davis, CA, United States; TINTORI, Andrea, University of Milan, Italy

Triassic stem pistoridosaurs are believed to be closely related to the pleiosauria, the crown taxon of Sauropodpterygia that comprised cosmopolitanly distributed predators in Jurassic and Cretaceous marine ecosystems. Eight genera of Triassic stem pistoridosaurs were reported, but the complete cranial skeleton is known only for a few, and the smaller *Yunguisaurus* was the only one to date represented by a complete skeleton. A new complete and articulated skeleton of a pistoridosaur, with a skull perfectly preserved in three dimensions, was collected from the latest Ladinian (Middle Triassic) of Xingyi in Guizhou Province, southwestern China. The new specimen has two aphyromes: the pterial foramen is located far posteriorly in the pterial skull table, and the pterial is raised into a distinct sagittal crest. There are about 33 cervical vertebrae, 16 dorsal vertebrae, and 4 sacral vertebrae. The anterior 10 caudal vertebrae are preserved. Five cervical and four dorsal ossified centra are preserved. We have annotated close to 3000 fin and limb phenotypes for 787 extant species, including fossils, is linked to genetic mutants of vertebrate models (zebrafish, mouse, Xenopus), thus enabling formulation of evo-devo hypotheses. In the process of developing this database, mapping of expression data when applied to well annotated databases becomes the first step in the process of generating hypotheses. We have created a large database of lateralized patterns, which forms the basis for a database of the spatial expression of genes in the mouse. We have identified a large number of genes that are laterally biased in the mouse, including genes that are only expressed in the left or right hemisphere. We have also identified genes that are expressed in the left and right hemispheres, but at different times during development. We have also identified genes that are expressed only in the left or right hemispheres, but at different times during development. We have also identified genes that are expressed only in the left or right hemispheres, but at different times during development. We have also identified genes that are expressed only in the left or right hemispheres, but at different times during development. We have also identified genes that are expressed only in the left or right hemispheres, but at different times during development.
phylogenetic codes to taxon phenotypes. With its emphasis on integrative morphology and phenotypic analysis, we propose Phenoscape as a powerful new tool for paleontological research.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

THE FIRST LOOK AT THE RELATIVE ABUNDANCES OF TAXA FROM THE RICHARDS SPUR LOCALITY OF OKLAHOMA, USA

MACDOUGALL, Mark, University of Toronto Mississauga, Mississauga, ON, Canada, tetrapods at Richards Spur, making up almost 2/3 of the identified elements, with the results of this study reveal for the first time that anamniotes are the most abundant Richards Spur makes a study of relative abundance, and its paleoecological significance taxonomic diversity at Richards Spur is relatively well known. In contrast to other known upland nature of Spur tetrapods have largely concentrated on alpha taxonomy, with little work being done (289 ma) carbonate fossiliferous in-fills of the Ordovician Limestone quarry preserve a not present among the sorted material, suggesting that these taxa, commonly found in the elements of smaller taxa being much more abundant than the elements of larger taxa, relatively rare. Identified elements were also separated into size classes, with the skeletal other members of Reptilia, specifically parareptiles and varanopid synapsids, are (289 Ma) carbonate fossiliferous in-fills of the Ordovician Limestone quarry preserve a not present among the sorted material, suggesting that these taxa, commonly found in the elements of smaller taxa being much more abundant than the elements of larger taxa, relatively rare. Identified elements were also separated into size classes, with the skeletal other members of Reptilia, specifically parareptiles and varanopid synapsids, are identified as a diverse Palaeozoic tetrapod assemblage. The majority of studies published on the Richards Spur tetrapods have largely concentrated on alpha taxonomy, with little work being done on the paleoecology and taphonomy of the locality. Of particular interest is the paleoecology of the locality, as the Richards Spur assemblage is distinct from those of most other early Permian localities in representing an upland depositional environment with a rich endemic population of exclusively terrestrial tetrapods. The upland nature of Richards Spur, and a lack of large bodied taxa at the locality suggest a palaeoecology that is distinct from all of the other Permian lowland, deltaic assemblages. Currently, only the taxonomic diversity at Richards Spur is relatively well known. In contrast to other known\n
Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

NEW PLEISTOCENE MEGAFAN LOCALITIES IN SANTA BARBARA COUNTY, CALIFORNIA: PALEONTOLOGICAL RECONNAISSANCE OF THE MARINE TERRACE DEPOSITS AT VANDENBERG AIR FORCE BASE

MACIAS, Melissa, University of California Santa Barbara, Santa Barbara, CA, United States; KITAO, Eiko, Santa Barbara City College, Santa Barbara, CA, United States; GRAY, Robert, Santa Barbara City College, Santa Barbara, CA, United States.

*Late Pleistocene alluvial deposits near Vandenberg Air Force Base (VAFB) in Santa Barbara County have yielded various megafauna fossils, but the base itself has not been studied in detail as a paleontological resource due to highly restricted military access. The coastal terraces deposits. Besides the exceptional skull of *Edaphosaurus* insulatus, one of the most commonly identified taxa at VAFB, platypus cranial bones are platform of emergent marine terraces overlain by coastal alluvial deposits that span over 55 kilometers of undeveloped coastline. Although radiometric dating has not been completed on marine terraces within VAFB, correlation between marine terrace deposits and the north and south yield ages of oxygen isotope stage 5e (5a-129ka) for the higher terrace, and stage 5a (5a-80ka) for the lower terrace. Paleontological reconnaissance was conducted along the coast to identify vertebrate fossil material along eroding sea cliffs and associated drainages. Thirty-three new fossil localities with over 80 individual fossils were recorded in the 8ka terrace, with Rancholabrean taxa including: Bison sp., Camelus bennettii, Equus occidentalis, Mammutius columbi, Mammuthus americanum, Paramylodon harlani, Platypus sp., and Smilodon sp. Although many localities consist of isolated individual bones, a high concentration was found at Brown's Beach 'Elk's Elephant Graveyard' (EEG). Thirty-nine complete fossil bones were collected from a deeper terrace section with over half identified as Paramylodon harlani. The fossils were encapsulated in fine silt and clay with lenses of yellow sand and carbonaceous plant material. Depositional analysis suggests an isolated body of water within a braided meander system, providing excellent conditions for vertebrate fossil preservation. New fossil localities will provide valuable data for paleontological resources in Santa Barbara County. These localities will add to the knowledge of Rancholabrean megafauna found in southern California.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

THE FIRST RECORD OF *OSBORNODON IAMONENIS* FROM OREGON AND OTHER CANIDS OF THE ARIKAREEAN, FROM COGLAN BUTTES, OREGON

MACKENZIE, Kristen, University of Oregon, Eugene, OR, United States, 97403; ORCUTT, John, Cornell College, Mount Vernon, IA, United States; HOPKINS, Samantha, University of Oregon, Eugene, OR, United States.

Coglan Buttes, Oregon, the only Arikareean vertebrate locality in the northwestern United States, contains a diverse Macroscelididae and a rich fauna, including a variety of canids. All three canid species represented at Coglan Buttes are subequal in diameter and are not robust as in more basal canids. The ulnar styloid is fused. The ungual is curved, laterally compressed and slightly asymmetrical, with one side of the cranium the order of the skull is unknown. Although traditionally accepted to be middle Arikareean at about 1 Ma, i.e., GABI 3, this new specimen prove an important addition to the faunal record of the Arikareean in the northwestern United States. The stratum yielding *Equus* may still be an index fossil for the Lujanian SALMA.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

A NEW TITANOSAUR (DINOSAURIA, SAUROPODA) FROM THE LATE CRETACEOUS BAURIU BASIN, BRAZIL

MACHADO, Elaine, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; AVILLA, Leonardo, Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil; NAVA, William, Museu de Paleontologia de Marília, Marília, Brazil; CAMPOS, Diogenes, Museu de Ciências da Terra, Rio de Janeiro, Brazil; KELLNER, Alexander, Museu Nacional/UFRJ, Rio de Janeiro, Brazil;

To date, there are only eight valid titanosaur species described from Brazilian deposits. Besides the exceptional skull of *Tapusasaurus macedo* and the partial upper jaw of *Mazafaleasaurus tepui*, all other Brazilian taxa lack cranial elements. Here we describe a new specimen, housed at Museu de Paleontologia de Marilia (MMP 125R) that was collected near Presidente Prudente city, Sao Paulo State. It comes from the Adamantina Formation, whose age is regarded as Turonian-Santonian. The new specimen is composed of a right dentary, a cervical vertebra and a portion of an ischium and ilium, one ungual and other fragmentary elements. The surface of the right dentary is weakly ornamented with pits, grooves, and foramina. In dorsal view, this bone is L-shaped, resulting in the so-called squared jaw morphology of the lower jaw, as seen in Bonitasaurus and Antarcotaurus (Bonitasauridae), but differing from the more rounded morphology in *Tapusasaurus*, *Nemegtosaurus*, and *Malavasiasauro*. The cervical vertebrae possess some potential autapomorphies such as the presence of anteriorly directed accessory prezygapophyseal articulation surfaces and intraprezygapophyseal laminar with a V shape in dorsal view. The thoracic vertebrae are present lacking most of the centra and the tips of the neural spines. The exact number of sacral elements in this species is unknown. All three are tightly connected, but suture marks between them indicate that they are not completely fused. The ungual is curved, laterally compressed and slightly asymmetrical, with one side of the cranium the order of the skull is unknown. Although traditionally accepted to be middle Arikareean at about 1 Ma, i.e., GABI 3, this new specimen prove an important addition to the faunal record of the Arikareean in the northwestern United States. The stratum yielding *Equus* may still be an index fossil for the Lujanian SALMA.

Poster Session IV (Wednesday, October 30, 2013, 3:30 PM)

AGE OF THE TARJIA FAUNA, BOLIVIA: IMPLICATIONS FOR EQUUS DISPERSAL AND CALIBRATION OF GABI 3

MACFADDEN, Bruce, Florida Museum of Natural History, Univ of Florida, Gainesville, FL, United States, 32611

The highly fossiliferous badlands in the Tarjia basin, southern Bolivia, have produced a classic Ensenadan mammalian fauna representing the height of the Great American Biotic Interchange (GABI). Although traditionally accepted to be middle Paleocene age, a recent study of supposedly interbedded radiocarbon ages has advocated for a younger (Lujanian) SALMA for the Tarjia Fauna. In contrast, here we recently published radiocarbon determination of 0.76 ± 0.03 Ma is described for an ash within the time of our calibration point. A fission-track age and magnetostratigraphic correlation for a younger (Lujanian) SALMA for the Tarija Fauna. This geochemical calibration point corroborates a fission-track age and magnetostratigraphic correlation from the 1980s recording the Jaramillo subchron and Brunhes-Matuyama boundary within the Tarjia fossiliferous sequence. A biostratigraphic study of the sediments confirms that horses (Equidae) are abundantly represented throughout the sequence at Tarjia, including the definition of absence of the earliest occurrence of the species levels recorded in the UF collections. Given the age of the Tarjia Fauna, these occurrences of Equus span an age range from 0.99 Ma to less than 0.76 Ma during the middle Paleocene, or Ensenadan SALMA. Over the past decade, refinements in geochronological calibrations indicate that GABI was actually a series of separate immigration events, or pulses, during the Pliocene and Pleistocene. Studies from the classic localities in Argentina, where the Pleistocene SALMAs are characterized, postulate that the genus Equus was part of GABI 4 that defines the base of the late Paleocene Lujanian SALMA at 0.125 Ma. However, the biostratigraphic occurrences of Equus at Tarjia demonstrably indicate an earlier arrival of this genus into South America during the middle Pleistocene Ensenadan at about 1 Ma, i.e., GABI 3. While the FAD (first appearance datum) of Equus in South America is earlier than previously accepted for the classic sequences in Argentina, the presence of the species E. neogaeus may still be an index fossil for the Lujanian SALMA.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

A NEW TITANOSAUR (DINOSAURIA, SAUROPODA) FROM THE LATE CRETACEOUS BAURIU BASIN, BRAZIL

MACHADO, Elaine, Museu Nacional/UFRJ, Rio de Janeiro, Brazil; AVILLA, Leonardo, Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil; NAVA, William, Museu de Paleontologia de Marilia, Marilia, Brazil; CAMPOS, Diogenes, Museu de Ciências da Terra, Rio de Janeiro, Brazil; KELLNER, Alexander, Museu Nacional/UFRJ, Rio de Janeiro, Brazil;
Cogan Buttes may have been a mixed open woodland transitioning to savannah. Strata down-section have produced several species referable to Canine, including Leptoscyon. These canids have been found with a diverse rodent assemblage from the same locality. While there are some differences in morphology between the two localities, there appear to be a real difference in ecology represented by changes in taxon representation throughout the section at this critical new site.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

MORE OF THE FEMUR OF MOROTOPITHECUS

MACLATCHY, Laura, University of Michigan, Ann Arbor, MI, United States, 48109; KINGSTON, John, University of Michigan, Ann Arbor, MI, United States; KITTO, Robert, Museum of Osteology, Kigali, Rwanda; KAMPAGNE, Uganda

Morotopithecus boshii from northeastern Uganda is one of the oldest known hominoids, radiometrically dated to > 20.6 Ma. Fragmentary vertebral and scapular remains attributed to Morotopithecus have previously been used to reconstruct a positional repertoire that included derived behaviors such as dorsi-lumbar lordoses and posture of the shoulders above the head. In addition, specimens MUMZ (Makerere University Zoology Museum) 80, partial right and left femora, has cross-sectional properties indicative of high axial loading, such as might be caused by sustained muscular contractions during behaviors such as slow climbing. In sum, these behaviors contrast with those reconstructed for contemporaneous species of Proconsul, considered to be primate quadrupeds. Ongoing research at the Moroto II locality since 1994, when MUMZ 80 was discovered, has resulted in the recovery of additional femoral fragments, such that the length of the right femur can now be directly measured. Complete long bones are exceedingly rare among fossil catarrhines. We used linear regression to examine scaling relationships between femoral shaft length and proximal and distal femoral joint (femoral head diameter and bicondylar width) in extant nonhuman hominoids (5 species), cercopithecoids (7 species), and Proconsul, and previously described Morotopithecus femora with almost complete shafts. We find that hominoids have shorter femoral shafts relative to proximal and distal joint sizes than do cercopithecoids; Morotopithecus resembles hominoids in having a short shaft, while Proconsul has a longer shaft, more like quadrupedal monkeys. The relatively short femoral shaft length completely changes the behavior interpretation and also suggests that the development-loaded the hindlimbs and forelimbs differently in behaviors such as orthogonal slow climbing. The short shaft may also reflect reduced integration between the hindlimbs and forelimbs, which has been linked to the overall evolvability of hominoid limbs, although this inference must remain speculative in the absence of forelimb shafts.

Technical Session X (Friday, November 1, 2013, 11:30 AM)

THE ABRUT CRAPLSE OF A DIVERSITY HOTSPOT? RECONSIDER VALLESIAN (LATE MIocene) DIVERSITY IN ITS TYPE AREA

MADERN, Anneke, Naturalis Biodiversity Center, Leiden, Netherlands; CASANOVOS VILAR, Isaac, Institut Català de Paleontologia Miquel Cruatford, Canedanya del Vallé, Spain; MADDIN, Hillary, Harvard University, Cambridge, MA, United States; 02138; LEON-SÁNCHEZ, Pedro, Museo Nacional de Ciencias Naturales, Madrid, Spain; DEMIGUEL, Daniel, Instituto Català de Paleontologia Miquel Cruatford, Canedanya Valles, Spain; VAN DEN HOEK OSTENDE, Lars, National Museum of Natural History, Naturalis, Leiden, Netherlands

The Vallesian stage is characterized by major faunal turnovers and climate changes, with an overall trend towards drier and more seasonal conditions. In the early Vallesian (11.9-9.7 Ma), the European area with the highest diversity corresponds to the Valles-Penedès Basin (Catalonia, Spain), which represents a true diversity hotspot. During the late Vallesian the distribution of mammals in Europe seems more even and hotspots are less apparent. After the early Vallesian climax, there appears to have been a sudden diversity drop at 9.6 Ma, known as the Vallesian Crisis. Initially, this crisis was considered a local event, characterized by the extinction of certain mammal species of unknown origin. However, more recent works consider the Vallesian Crisis to have affected all European faunas, implying the disappearance of most forest-adapted taxa. Reconstructing past biodiversity is a major goal in paleontology, but in order to recognize non-random patterns in a chaos of data, biases must be controlled. A common bias is uneven sampling, where richer or more intensively sampled sites or time intervals contain more rare taxa and thus show a higher diversity. A peak in data quality could lead to an overestimation of the recorded diversity. To assess such biases, robust diversity measures are needed, taking into account sample size and the probability of finding a certain taxon at a specific site. To assess the effects of the quality of the large mammal record, we compiled a quantitative database of the Vallesian macromammal record of the Valles-Penedès Basin, where the Vallesian Crisis was first recognized. Our results show that extinction rates in the type area might be overemphasized because of the intensive sample from the richest locality, the site of Can Llobateres 1, which immediately precedes the crisis. Overall sampling before the crisis is much better than afterwards, which inflates diversity and exaggerates extinction rates. Therefore, we calculated new diversity estimates independent of sample size using rarefaction and sampling probability. Our calculations show that many earlier works that purported to demonstrate the late Vallesian Crisis have a discontinuous record during the early Vallesian and are generally very rare. Since the sampling effort in the late Vallesian sites is comparatively lower, we cannot discount that at least some of those taxa persisted during the late Vallesian. We conclude that this crisis was not a single major event occurring at the early/Late Vallesian boundary, but a more protracted extinction period.

Technical Session I (Wednesday, October 30, 2013, 9:45 AM)

REAPPRaisal OF THE EARLY PERMIAn AMPHIBIaM TEROSOMUS TEXENSIS AND SOME REFERRED MATERIAL

MADDIN, Hillary, Harvard University, Cambridge, MA, United States, 02138; FROBISCH, Nadia, Museum für Naturkunde, Berlin, Germany; EVANS, David, University of Toronto, Mississauga, ON, Canada

The relevance of amphibian dissorophid temnospondyls to the discussion of the evolutionary origin of some or all of the modern amphibian groups (lissamphibians) has prompted a recent increase of studies focused on this group of small, mostly Permian- and Triassic-age amphibians. Among dissorophids, the taxon Tersomus texensis has been difficult to establish a stable position within amphibian phylogeny. One such taxon is Tersomus texensis. Details of the morphology of the holotype of T. texensis, as well as the accuracy of the taxonomic assignment of three skulls in the collections of the Museum of Comparative Zoology, to the early Permian, has been called into question. Here we re-evaluate these materials in light of recent discoveries, and test the validity of the assignment of the three MCZ specimens to T. texensis. The results of our phylogenetic analyses corroborate our morphological assessments, revealing only one of the three skulls (MCZ 1912) is assignable to T. texensis. We identify MCZ 1415 as P. o. augusta, and MCZ 1416 and 1417 as a new genus and species of dissorophid. Recent work on specimens from the Fort Sill assemblage has expanded the number of amphibians present from one to three (Dolesepeton, Pasasiusops, and Tersomus). Our work has expanded the number of amphibians in the Archer C. Clark Museum (ACM), suggesting amphibian diversity may be greater in Permian assemblages than previously thought. Restudy of these materials previously referred to T. texensis suggests a closer look at historical collections from the Permian of Texas may reveal a greater alpha diversity and important occurrences of taxa that will further contribute to our understanding of early Permian ecosystems.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

NEW IBERIAN REMAINS OF THE EURASIAN FOSSIL JAGUAR-LIKE CATS PANTHERA GOMBASZOEGENSIS AND P. O. AUGUSTA

MADRELL-MALAPEIRA, Joan, Institut Català de Paleontologia Miquel Cruatford, Canedanya del Vallé, Spain; ALBA, David M., Institut Català de Paleontologia Miquel Cruatford, Cerdanyola del Vallè, Spain; AURELL-GARRIDO, Josep, Institut Català de Paleontologia Miquel Cruatford, Cerdanyola del Vallè, Spain; MADURELL-MALAPEIRA, Joan, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallè, Spain; AURELL-GARRIDO, Josep, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallè, Spain; ALBA, David, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallè, Spain; FROBISCH, Nadia, Museum für Naturkunde, Berlin, Germany; EVANS, David, University of Toronto, Mississauga, ON, Canada

The relevance of amphibian dissorophid temnospondyls to the discussion of the evolutionary origin of some or all of the modern amphibian groups (lissamphibians) has prompted a recent increase of studies focused on this group of small, mostly Permian- and Triassic-age amphibians. Among dissorophids, the taxon Tersomus texensis has been difficult to establish a stable position within amphibian phylogeny. One such taxon is Tersomus texensis. Details of the morphology of the holotype of T. texensis, as well as the accuracy of the taxonomic assignment of three skulls in the collections of the Museum of Comparative Zoology, to the early Permian, has been called into question. Here we re-evaluate these materials in light of recent discoveries, and test the validity of the assignment of the three MCZ specimens to T. texensis. The results of our phylogenetic analyses corroborate our morphological assessments, revealing only one of the three skulls (MCZ 1912) is assignable to T. texensis. We identify MCZ 1415 as P. o. augusta, and MCZ 1416 and 1417 as a new genus and species of dissorophid. Recent work on specimens from the Fort Sill assemblage has expanded the number of amphibians present from one to three (Dolesepeton, Pasasiusops, and Tersomus). Our work has expanded the number of amphibians in the Archer C. Clark Museum (ACM), suggesting amphibian diversity may be greater in Permian assemblages than previously thought. Restudy of these materials previously referred to T. texensis suggests a closer look at historical collections from the Permian of Texas may reveal a greater alpha diversity and important occurrences of taxa that will further contribute to our understanding of early Permian ecosystems.
unpublished fossil remains of jaguar-like cats from the Iberian localities of La Puebla de Valverde (Teruel, ca. 2.0 Ma), Cueva Victoria (Murcia, ca. 1.0 Ma), Gran Dolina (Atapuerca, ca. 0.8 Ma), and Cal Guardiolas D4 and Vallparadís Estació EV7 (Terrassa, ca. 1.0-0.8 Ma). The location of teeth with complete (or smaller) maximum buccolingual width compared to the Dmanisi mandible, although the p3 of the latter is relatively higher. Three out of four of the studied p4 display a more or less prominent cingulum, whereas the remaining one merely displays a relcital one. Finally, none of the studied m1 displays a lingual basal bulge. Based on the newly-reported remains, and taking into account both the same taxonomic affiliation of Eurasian jaguar-like cats as well as the great dental variability displayed by extant and fossil big cats, we conclude that is more parsimonious to include all the European jaguar-like cats in a single species, Panthera gombaszegensis (with P. schreudersi, P. toscana and P. onca georgica being their junior synonyms). Further discoveries and more detailed analyses would be required in order to assess the taxonomic status of this Eurasian taxon compared to extant and fossil Panthera onca from America.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

IDENTIFYING ISOLATED SHEET TEETH FROM THE KIRTLAND FORMATION OF NORTHWESTERN NEW MEXICO

MAGANA, James, California State Polytechnic University, Pomona, Pomona, CA, United States, 91768; D’AMORE, Domenic, Daemen College, Amherst, NY, United States; MOLNAR, Ralph, University of California- Berkeley, Berkeley, CA, United States; HALL, Justin, University of Southern California, Los Angeles, CA, United States

Identification of isolated theropod dinosaur teeth has potential use as an ecological tool indicating predator/prey relationships, as well as for extending geographic and temporal ranges. We used geometric morphometrics, a tool for analyzing shape variance while controlling for size, to examine and attempt to classify isolated theropod teeth from the Kirtland Formation of northwestern New Mexico. Isolated teeth were compared with teeth of known taxonomic affinity from a Tyrannosaurid, Albertosaurus libratus, and an adult and juvenile Bistahieversor sealeyi. Landmarks were digitized in 2D from photographs of the isolated teeth and comparative sample using the software package TpsDig2.16. Two type 1 landmarks were digitized at the base of each tooth and 31 equidistant semi-landmarks outlined the curvature of the tooth. Only teeth of moderate to heavily worn or broken, where landmarks were easily visible or easily extrapolated, were used in this study. A Procrustes superimposition was conducted followed by a principal components analysis using TpsRf. The first three principal components (PC) represent the vast majority of the shape variance. PC1 (74.67%) described apical-basal elongation. PC2 (11.77%) described whether the mesial or distal edge of the tooth was longer. PC3 (6.46%) described the apical shape (bulbous or pinched). Known Bistahieversor sealeyi teeth clustered together in two clusters, one for adults and one for juveniles, with the two most isolated new Mexico teeth clustered with adult B. sealeyi. Two smaller isolated teeth clearly clustered with juvenile B. sealeyi, while a single specimen plotted on the opposite end of axis 1, likely due to incomplete preservation at the base. Isolated teeth were primarily separate from both T. rex and A. libratus; the majority of teeth from these species were noticeably more elongate.

Technical Session X (Friday, November 1, 2013, 9:15 AM)

TESTING FOR ECOCLOGICAL NICHES OF MAMMALIAN SPECIES FROM THE LAST GLACIAL MAXIMUM TO PRESENT

MAGUIRE, Katlin Claire, UC Berkeley, Berkeley, CA, United States, 94720

Understanding the stability of a species’ ecological niche through time is important for interpreting the paleoecology and evolution of extinct organisms and especially for providing insights into how extant species will respond to ongoing global change. Recent studies both support and refute the stability of ecological niches through time. Here, I add for interpreting the paleoecology and evolution of extinct organisms and especially for environments through time, and comparisons of fossil and recent ranges is an effective

DISTAL PHALANGEAL EVOLUTION IN EARLY EUPRIMAPS

MAJORINO, Leonardo, Universita Roma Tre, Rome, Italy; FARKE, Andrew A., Raymond M. Alf Museum of Paleontology, Claremont, CA, United States; KOTSAKIS, Tassos, Universita Roma Tre, Rome, Italy; PIRAS, Paolo, Universita Roma Tre, Rome, Italy

Ceratopsia (Dinosauria: Ornithischia) was widespread in Laurasia from the Late Jurassic through the Late Cretaceous. During the last 60 million years of their evolution, their size increased along with the development of elaborate facial horns and frills. In order to investigate shape changes across ceratopsians, we applied two-dimensional geometric morphometrics using 56 landmarks and 46 shape codes for 118 lower jaws from 20 species and a 30 landmark configuration for 118 lower jaws. 3D Principal Component Analyses performed on the two samples confirm different cranial and mandibular morphologies among clades; within ceratopsids both centrosaurines and charnosaurines have similar mandibular shapes. An evolutionarily significant allometric signal exists between major clades, but not within clades, except for protoceratopsids. Even after accounting for phylogeny (Phylogenetic Generalized Least Squares), the relationship between shape and size is still significant. Partial Least Squares Analysis indicates high co-variance between cranial and lower jaw shape. We also explored morphological integration between the skull and lower jaw (RV coefficient). Results show decreasing morphological integration: skulls and jaws were more integrated in basal taxa than the later ones. Linear regressions between shape and size demonstrate a greater morphological disparity for ceratopsids in the Early Cretaceous. In contrast, the Late Cretaceous shows a significant trend towards higher integration of cranial and lower jaw shape, with the Early Cretaceous as a transition point. However, protoceratopsids do show a significant decrease in the rate of change of lower jaw size. This previously unquantified patterns in cranial evolution suggest that ceratopsids were characterized by greatly disparate frill morphologies but with a less disparate apparatus than in basal clades, possibly related to climatic and floral changes in last Cretaceous.

CHORDICHITHYAN REMAINS FROM THE SHARK RIVER FORMATION (MIDDLE EOCENE) AND KIRKWOOD FORMATION (EARLY MIOCENE) LAG DEPOSIT, MONMOUTH COUNTY, NEW JERSEY

MAICHS, IV, Harry, Brooklyn College, Brooklyn, NY, United States, 11210; BECKER, Martin, William Paterson University, Wayne, NJ, United States; CHAMBERLAIN, JR., John, Brooklyn College, Brooklyn, NY, United States

A lag deposit that separates the middle Eocene Squanum Member of the Shark River Formation from the early Mioene Asbury Park Member of the Kirkwood Formation near Farmingdale, Monmouth County, New Jersey, presents an unexpected chordichithyian assemblage representing at least 24 species including: Hexanchus agassizi, Notorynchus primigenus, Odontaspis cf. O. acutissima, Carcharias cuspilata, Striatolamia macrura, Jaekelotodus trigonalis, Cretolamna sp., Carcharidinoidea cattius, Isurus opalescens, Xiphias gladius, Narwhalina minor, Galeocerdo latidens, Hexanchus sp., Carcharhinus sp., and Mylobatis sp., This assemblage is similar to other contemporaneous middle Eocene and early Miocene faunas found across the Atlantic and Gulf coastal plains in the United States.
GROWTH PATTERNS OF EARLY JURASSIC ANCIENT DINOSAURS INFERRED FROM PALEOHISTOLOGICAL ANALYSIS

MAKOVICKY, Peter, Field Museum of Natural History, Chicago, IL, United States; 60605; BOURDEAU, Diana, Augustana College, Edwards, IL, United States; HAMMER, William, Augustana College, Rock Island, IL, United States; SMITH, Nathan, Howard University, Washington DC, DC, United States

The Early Jurassic Hell Creek Formation dinosauromorph and archosaurian fauna documents some of the highest paleolatitude terrestrial vertebrates in the fossil record, yet information on how and why polar temperature patterns changed their biogeography remains poorly understood. We undertook a histological study of two of the five diosauromorph specimens collected from the Hanson Formation to examine their growth physiology. Five skeletal elements were sampled from the large, crested theropod Cryolophosaurus ellioti. Axial elements (rib, gastralia) preserve 9-10 lines of arrested growth (LAGs), with the last few closely packed indicating a slowdown or cessation of growth. Limb bones, however, preserve fewer LAGs, with wide and well vascularized zones between the outermost LAGs indicating continuing rapid growth. This significant degree of bone heterochrony may have methodological implications for the interpretation of determinate growth in theropods. Age estimates for Cryolophosaurus following retrograde calculation are 12-15 years, a range for which individuals of the lower latitude theropod Allosaurus and Gorgosaurus, and Albertosaurus exhibit femoral lengths (a common proxy for body size) comparable to Cryolophosaurus.

Inferred from paleohistological analysis

The specimen has a femoral length of 277 mm, a size at which specimens of the roughly contemporaneous Massospondylus exhibit 8-9 LAGs. This indicates that basal sauropodomorphs, which are the most abundant faunal element of the Hanson Formation, could grow rapidly as juveniles, a characteristic also observed in lower latitude taxa such as Massospondylus and Plateosaurus.

Differing growth strategies have been observed in the histology of polar dinosaurs. Some recent and extinct high latitude anatomies manifest LAGs throughout ontogeny, unlike their warm temperate or tropical congeners, suggesting an environmental effect on growth. This was not manifest in our Jurassic sauropod, however. Although Cryolophosaurus preserves scant histological evidence of its earliest ontogeny, results are broadly concordant with patterns of growth and bone formation in lower latitude theropods. Therefore, the limited sample available to us indicates little environmental effect on growth in Early Jurassic polar dinosaurs, in keeping with a previous study on polar ornithopod and theropod dinosaurs from the Cretaceous of Australia.

MIDDLE TRIASSIC CONTINENTAL FAUNAS FROM GONDWANA: THE CHAÑARES FORMATION TETRAPOD ASSEMBLAGE, A CASE STUDY FROM WESTERN ARGENTINA

MANCUSO, Adriana, IANIGLA - CONICET, Mendoza, Argentina; GAETANO, Leandro, IDEAN - Dpto. de Cs. Geológicas, Facultad de Ciencias Exactas Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina; LEARDI, Juan, IDEAN - Dpto. de Cs. Geológicas, Facultad de Ciencias Exactas Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina; ABDALA, Fernando, Universidad de Buenos Aires, Buenos Aires, Argentina; LABRAZO, Fernando, University of the Witwatersrand, Johannesburg, South Africa; ARCUCCI, Andrea Beatriz, Universidad Nacional de San Luis, San Luis, Argentina

Ladinian tetrapod faunas are poorly represented worldwide and only a few assemblages allow the analysis of these early Mesozoic communities. The Chañares Formation in western Argentina is unique in its diverse and well-preserved non-marine tetrapod assemblage. The tetrapod assemblage of the Chañares Formation is made up of a large number of specimens of very good quality, under precise stratigraphical and paleoenvironmental control, reveals a high representation of the original tetrapod composition present in the recovered assemblage. Hence, it is possible to hypothesize on the paleoecological significance of the assemblage and the interactions among its different components. Mass estimations and morphology-based palaeobiological inferences allowed us to propose the putative trophic structure of this community. The tetrapod record includes a high diversity of archosauriforms, with at least twelve taxa, but only known by few specimens (17.3% of the specimens collected). Synapsids are very abundant (82.7% of the specimens collected) but only represented by four genera. The Chañares tetrapod fauna was numerically dominated by middle-sized herbivorous (i.e., Massetognathus punctatus) and small carnivorous cynodonts (i.e., Probatognathus jenseni). Large herbivorous dicynodonts and middle-sized fainivorous cynodonts were also present but only constitute ~15% of the specimens found. Non-archosaurian archosauriforms and ornithodirans were mainly represented by small to middle-sized slender forms (~16% of the specimens collected). The paracrocodylormorphs (e.g., Luperosuchus) are identified as the majority of the Chañares carnivores, which reach body masses between 350 and 500 kg. The therapsidian dicynodont M. punctatus and the dicynodont Dinodontosaurus, with body masses that reached approximately 43 and 360 kg, respectively, are the only taxa recognized as exclusively herbivorous. Compared with the tetrapod assemblage of the Dinocephalosaurus Assemblage Zone from southern Brazil shows remarkably low archosauriform diversity and the large dicynodont Diomocentrosaurus dominates the assemblage numerically. The putative Ladinian Upper Omoingone Formation assemblage of Namibia shows clear dominance of traversodontid cynodonts. The Chañares assemblage is in a low and low representation of the other forms. In contrast, non-marine tetrapod assemblages from Laurasia of equivalent age are dominated by temnospondyl amphibians not found from the Chañares levels in spite of the fluvial/lacustrine nature of its deposits.

NORTH AMERICAN PACHYCEPHALOSAURS have been long known from isolated fronto-parietal domes, which constitute most of their fossil record. This material is mainly associated with alluvial plain deposits, and occurs less often in coastal or marine paleoenvironments. Early work suggested that these domes tend to be heavily worn, as though they had rolled in a stream. This interpretation is widely cited, and implies that the domes originated at higher elevations; some authors have even suggested that pachycephalosaurs inhabited piedmont settings. Unfortunately, quantitative studies of dome wear are lacking, and these early hypotheses have yet to be tested.

Here, we test the hypothesis that pachycephalosaur domes are allochthonous within their host systems, by quantifying the degree of wear in >100 domes collected from Upper Cretaceous deposits in Alberta. There is little evidence that domes are routinely worn, as predicted by the transport hypothesis (TH). Rather, domes generally exhibit little surface wear (mode=sub-angular, skewness=−0.53, kurtosis=−0.27). There is also no trend whereby domes become increasingly more worn further away from their hypothesized origin near the sediment source area, as predicted by the TH (r=−0.79 to −87.04, r2=0.23, p<0.05). Finally, occurrence data show that pachycephalosaurs are no more abundant in piedmont settings than elsewhere. Within the Belly River Group, unworn pachycephalosaur material is often found in the Foremost Formation, which is stratigraphically influenced, and the lower unit of this unit is a fluvially deposited incised valley deposit near Manyberries at the top of this group. Although it should be noted that degree of wear does not necessarily correlate to length of transport, we find no taphonomic support for the TH. These domes likely represent autochthonous deposits that have undergone extensive reworking of surrounding elements before final deposition. Sedimentological work on these units also supports an autochthonous origin for the majority of domes from Alberta. As such, pachycephalosaur autochthonous likely inhabited the alluvial plain settings where their domes are routinely found, rather than environments farther upland.
SYNCHROTRON-BASED CHEMICAL IMAGING REVEALS PLUMAGE PATTERNS IN *ARCHAEOPTERYX*.

MANNING, Phillip, University of Manchester, Manchester, United Kingdom; WOGELEIUS, Roy, University of Manchester, Manchester, United Kingdom; BERGMANN, Uwe, Stanford Synchrotron Radiation Lightsource, Menlo Park, CA, United States; SCHWARZ-WINGS, Daniela, Naturhistorisches Museum, Berlin, Germany; SELLERS, William, University of Manchester, Manchester, United Kingdom.

Color can indicate age, sex, and diet, as well as roles in camouflage, nesting and establishing territories of many species of birds. Feather and integument color depend on both chemical and structural characteristics. The combination of melanosome morphology (structural) and trace metal biomarkers (chemical) has previously been used to infer color and pigmentation patterns in a range of extinct and fossil organisms. Melanin pigments are the most widely used pigments in birds and consist of several covalently linked indoles and are considered unusually large polymers compared to most natural pigments. The sheer size and complexity of these molecules determines their precise structure and their physical properties and controls their bonding to other components (e.g., proteins, metal ions). Eumelanin pigments are most prevalent (>75%) and furnish black, dark, brown, or brown hues in both extant invertebrates and vertebrates. There is variation in size between the two main melanin molecules, with eumelanin forming larger, rod-like granules that are insoluble in all solvents. Phaeomelans that form reddish-brown pigments are smaller, globular granules compared to eumelanin and are soluble in alkaline solutions. In this study, three key specimens of *Archaeopteryx* were subjected to non-destructive chemical analysis in order to investigate the potential for pigment preservation in feathers of this early bird. Synchrotron Rapid Scanning X-ray Fluorescence (SRS-XRF) maps are combined with sulfur X-ray Absorption Near Edge Structure (XANES) spectroscopy to provide the first map of organic sulfur distribution within whole fossils, and demonstrate that organically derived endogenous compounds are present and distributed at the copper, nickel, iron and tin levels. Further, the Archaeopteryx specimens are strongly controlled by feather structure, but only lighter elements (phosphorus, sulfur) are comparable with a third Archaeopteryx specimen analyzed in this study. The distribution of trace-metals and organic sulfur in *Archaeopteryx* supports recent endogenous eumelanin pigment have been preserved in the feathers of this iconic fossil. The distribution of organometallic compounds is used to predict the complete feather pigment pattern and show that the distal tips and outer vanes of feathers were more heavily pigmented than inner vanes. This pigment adaptation might have helped support the structural and mechanical function of early feathers, steering plumage evolution in *Archaeopteryx* and other feathered theropods.

**Preparators’ Session (Thursday, October 31, 2013, 10:45 AM)**

**LASER CLEANING OF MACROVERTEBRATE FOSSILS FROM THE UPPER CRETACEOUS SITE OF "LO HUECO" (CUENCA, SPAIN)**

MARCOS, Fátima, UNED, Madrid, Spain; BLANCO, Manuel, IPC, Madrid, Spain; DÁAZ, Soledad, IPC, Madrid, Spain; ORTEGA, Francisco, UNED, Madrid, Spain.

The site of “Lo Hueco” (Fuentes, Cuenca Province, Spain) has yielded an abundant collection of vertebrate fossils representing fishes and reptiles (turtles, squamates, crocodiles and dinosaurs) from Campanian-Maastrichtian levels. One of the most immediate objectives for action on the collection of skeletal remains is the proper conservation of all its elements. The choice of the specific preparation techniques that allow its analysis and documentation. The vertebrates from “Lo Hueco” present diverse modes of preservation. Usually, a phosphatic matrix, covered by the clays that are the predominant lithology, constitutes the most complete skeletal remains at the site. Often, the periosteal surface is covered with a ferruginous crust that may have variable thickness, and may differently affect the surface of the fossil. Some bones also show radial microcracks in secondary osteons and ferruginous rings in Haversian channels.

Usually, these crusts hinder access to the specimen, making difficult, for example, the choice of the specific preparation techniques. However, removing these crusts is not simple. So far, tests with various well-known preparation techniques, both mechanical and chemical, to remove ferruginous crusts from the bones surfaces indicate that safe limits of preparation are not so evident, and that is difficult to avoid damaging the surface of the samples.

In order to select alternative methodologies for the preparation of the fossils with fewer side effects on their surfaces, several laser cleaning techniques and evaluation protocols have been tested. These techniques were previously applied to remove layers and surface deposits of lithic materials in the field of cultural heritage. However, their application in palaeontological preparation is not yet widespread and their effectiveness is not well delimitated. Different pulsed Nd:YAG laser devices have been used. They emit in the fundamental wavelength 1064nm (infrared) and one of them is able to also emit in the second (532nm, green) and third harmonics (355nm, ultraviolet). The pulse duration is in the range of nanoseconds (6-8ns) or microseconds (60-120μs) and the energy ranges from 50μl to 21 μl depending on the specific device.

Results are not absolutely conclusive, but tests indicate that, under certain conditions that can be identified by previous analysis, the ferruginous crusts on the “Lo Hueco” fossils can be removed using laser-cleaning techniques.
Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

**MORPHOMETRICS AND MICROWEAR ANALYSES SUGGEST TOOTH-DIGGING POCKET GOPHERS (THOMOMYS SPP.) CLAIMED CLIMATE-HARDED SOILS THROUGH INCREASED INCISOR PROCEMENCY**

MARCY, Ariel, Stanford University, Stanford, CA, United States

Morphological adaptations for digging, a changing environment, and interspecific competition are the unique allopatric distribution of five species of northern Californian pocket gophers (Thomomys spp.). Previous GIS analysis of museum specimen localities demonstrated that subgenus Megascapheus pocket gophers separate into soils with higher percent soil clay, bulk density, and shrink-swell capacity. While clay and bulk density stay constant for thousands of years, low precipitation and high temperatures harden linear extensible soils in days. These conditions favor Megascapheus, suggesting a mechanism for a gradual replacement event during the Pleistocene-Holocene transition. During this period of increasing aridity, Megascapheus pocket gophers expanded northward and changed prominently obligately dug species. We hypothesize that increased tooth-digging in Megascapheus pocket gophers afforded by rostrum-reProfiled and increased body size allowed these species to out-compete predominantly claw-digging species in hardened soils. Micromorphic data from 450 adult female crania demonstrate that the angle of procumbency for genus Thomomys gophers is positively correlated with harder soil as defined by higher percent clay, bulk density, and linear extensibility. Further, dental microwear textures of incisors may further be affected by soil characteristics. Understanding how morphological changes most likely influence current populations of pocket gophers will improve our understanding of species turn-over events in the past and predict how species may respond to environmental changes in the future. Current climate models do not include factors controlling soil hardness, despite its impact on all organisms that depend on a stable soil structure.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

**MORPHOMETRIC APPROACHES TO TAXONOMIC QUESTIONS IN IGUANODONTIAN DINOSAURS**

MARQUART, Chloe, University of Cambridge, Cambridge, United Kingdom

The historic ‘wastebasket’ genus Iguanodon and Camptosaurus has received significant systematic attention recently, resulting in the creation of 16 new genera within the last five years, all sourced from material formerly referred to these taxa. Given the rapid nature of these changes, there is the possibility that the proliferation of genera may be due to subjective changes in the perception of specific levels of variability, rather than wholly objective reanalysis of existing material.

To analyze this trend, morphometric methods including Principal Component Analysis, Canonical Ordination, Procrustes Analysis, and Discriminant Function Analysis have been applied to investigate the shape of the ilium across ankylopelvic iguanodonts. Studies of large deposits such as Bernissart reveal that taphonomic factors are a statistically significant and largely random source of variation within the sample, though they do not exceed disparity due to generic differences in this instance. The quantification of the influence of taphonomy on shape is an important development, as it must be carefully investigated to separate its effects from those of biological processes. Surveys of well-represented genera, such as Camptosaurus, reveal that the traits which separate them from recently created and closely allied species, such as Iguanodon and Camptosauria are continuous in character and variable within Camptosaurus itself.

This finding was mirrored in a morphometric study of extant Caiman crocodilians, which found that the most prominent visual differences between species and subspecies were also highly variable within groups and largely continuous in character. This implies that some traits which are discrete in the fossil record, may actually be more continuous than they appear, due to small sample size not reflecting true variability. Comprehensive qualitative observations of ankylopelvic material from across the USA and Europe were used to supplement the quantitative analyses and further reveal that many traits used to separate these genera are more plastic than previously supposed.

Overall, a holistic approach to taxonomic questions needs to be undertaken in order to extract genuine evolutionary signals from fossils deposited at different times and in different places. Although the nature of species remains an intractable problem, combining quantitative and qualitative approaches to taxonomy provides our best hope for an objective understanding of morphology.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

**THE EVO-ECO-BIO CURRICULUM: HELPING SECONDARY STUDENTS DISCOVER, EXPERIENCE, AND CONNECT TO THEIR LIFE HISTORY, TO THEIR BIOSPHERE, AND TO PROCESSES IN NATURE**

MARRS, Barbara, Silverado High School, Victorville, CA, United States, 92395; SCOTT, Eric, San Bernardino County Museum, Redlands, CA, United States

Biology and its subgroups, ecology and evolution, are all principal components of the State of California secondary school science curriculum. However, implementing these technologies is challenging. Engineering and partying (STEM) subjects presents multiple challenges for today’s secondary school science educators. Because of financial cutbacks, grade 7 – 12 educators continue to be confronted by large class sizes, less instructional time, fewer classroom and lab supplies, and, most importantly, few field trips and/or classroom outreach programs. Additionally, most of today’s students live in a primarily technological world, with little or no direct connection to nature or their biosphere. The EVO-ECO-BIO Curriculum was developed to help students personally discover, experience, learn, and connect to their past history (evolution), to the biosphere and current challenges for life on their planet (ecology), and to the life processes operating in them and throughout nature (biology). The goal was to take a local resource that was readily available (the San Bernardino County Museum) and present students with a project that enabled them to view the museum exhibits through “EVO-ECO-BIO eyes,” encouraging them to actively experience the knowledge-gaining and nature-discovering process that they are learning. The EVO-ECO-BIO Curriculum transformed an “ordinary trip to the museum” into an adventure that gave students the opportunity to personally discover and experience the never-ending story of their past, present, and future. Using this curriculum, secondary school science educators can transform a local resource (small museum, zoo, nature center, or other local institution) into an evolutionary biology experience that will enable their students to be actively involved in the learning process and encourage them to make their own EVO-ECO-BIO connections to their own lives.

Symposium 2 (Thursday, October 31, 2013, 2:30 PM)

**THE LATE PLEISTOCENE VERTEBRATE FAUNA OF THE TALARA TAR SEEPS (NORTHWESTERN PERU) - PAST, PRESENT AND FUTURE**

MARTINEZ, Jean-Noél, Instituto de Paleontología, Universidad Nacional de Piura, Piura, Peru; CADERNILLAS, Richard, Instituto de Paleontología, Universidad Nacional de Piura, Piura, Peru; ZAPATA, John Perry, Instituto de Paleontología, Universidad Nacional de Piura, Piura, Peru

The palaeontological site known as the Talara Tar Seeps (Piura Region, northwestern Peru) compares well with other fossiliferous deposits in asphalt, such as Rancho La Brea (California, U.S.A.) or Inciarte (Maracaibo Region, Venezuela). All these sites worked like natural traps, as can be deduced by their diverse fossil record with a strong representation of carnivores and herbivores. The late Pleistocene vertebrate fauna from the Talara Tar Seeps is mostly known by more than 27,000 fossil bones and teeth collected by Gordon Edmund in January 1958, presently housed in the Vertebrate Paleontology Department of the Royal Ontario Museum. Since then, but not all, of the fauna has been described in theses, books, and scientific papers. Since Edmund’s work, the still richly fossiliferous locality of the Talara Tar Seeps has been almost completely abandoned except for a short visit by the Black Hills Institute in the last decade of the twentieth century. The Palaeontological Institute at the National University of Piura (about 120 kilometers south of Talara), created in 2001, “rediscovered” this fossiliferous locality in 2002 and, during the past ten years, has made some superficial collecting at the Talara Tar Seeps, mainly in 2003 and 2007. The major emphasis of this work has been on the small mammals, which has increased our knowledge of this part of the fauna—particularly the bats (four identified species) and the sigmodontine rodents (three identified species). This has demonstrated the existence of arid environments that today live in wetter highland environments located several hundred kilometers east of Talara. The updated faunal list for the Talara Tar Seeps is indicative of a grassland habitat with at least isolated groups of trees present and a permanent freshwater supply. However, there is still much to do to improve our understanding of this rich taphonomic and stratigraphic studies, which definitely cannot be achieved by occasional fossiliferous fossil collecting. The challenge recently assumed by the Palaeontological
Institute at the National University of Piura is to begin long-term systematic excavations that some of the new findings have close affinities with layers of the Quebrada del Barro Formation that includes eucynodonts, pseudosuchids, Massospondylus marayensis Norian by different authors. Based on the recent find of the dinosaur only one of this Basin in which vertebrate fossils have been found. The controversial age of the Quebrada del Barro Formation has been regarded as Cretaceous, Rhetaen and Norian by different authors. Based on the recent find of the dinosaur Laysauros marayensis—a basal sauropod closely related to the South African genus Massospondylus—a Lower Jurassic age related to the Quebrada del Barro Formation was suggested. Here we report the discovery of a new faunal association from the upper layers of the Quebrada del Barro Formation that includes eucynodonts, pseudosuchids, basal sauropodomorphs, and sphenodontids. Preliminary comparative analyses indicate that some of the new findings have close affinities with Chalminia (Cynodontia: Trithelodontida), Pseudoscincus (Pseudosuchia: Sphenosuchia), and Riojasauros (Dinosauria: Sauropodomorpha); all of them known from the Late Triassic (Norian) Los Colorados Formation. On one hand, a geographic survey conducted by the authors indicates that all the finds of the massospondylid Laysauros—used to suggest a Lower Jurassic age to the Quebrada del Barro Formation—are located in a different and overlying stratigraphic unit. The new faunal association, which includes at least three new genera (Equisauros, Esquimalepis, and for this paper, a new genus recently identified from Los Colorados Formation, supports the Norian age of the Quebrada del Barro Formation whereas the overlying new unit includes only basal sauropodomorphs typical from Lower Jurassic strata.

Ranges of intraspecific variation were examined in 48 skulls of Short-beaked common dolphin (Delphinus delphis), 68 skulls of Bottlenose dolphin (Tursiops truncatus), and 120 skulls of Narrow-ringed finless porpoise (Neophocaena asiaeorientalis) for extinct species. The taxonomic standards of Kentrirodion were reconsidered on the basis of the estimated range of the variation in the Delphinoidae. The skull fossil of the Kentrirodion dolphin was discovered from the lower-middle Miocene Niniu Group, Hidaka, Hokkaido, Japan. This specimen is called the Hidaka specimen here. This study was compared to the Hidaka specimen according to the estimated range of intraspecific variation.

As a result, I reconsidered 30 characters for taxonomic characters of species included in Kentrirodion. The result means that 18 of 30 characters are not variable, because these 18 characters cover a large range of intraspecific variation. Another 12 characters, such as the position of the anteriormost end of the pterygoid sinus and the position of the posterior end of the alveoli, are suitable for taxonomic standards because of the small range of the intraspecific variation. The genus Kentrirodion has five species, K. pernix, K. obscurus, K. hobetsui, K. schneideri, and K. fuchii. K. fuchii does not have a described skull, so the Hidaka specimen was considered being a new species. This comparison results in this specimen being significantly different from K. fuchii. The skull of the specimen was compared to Kentrirodion species except for K. fuchii. The Hidaka specimen is distinguished from four species on the basis of the 12 stable characters. The Hidaka specimen is a new species of genus Kentrirodion.

This study indicates that estimating the range of Delphinoidae intraspecific variation is available for the taxonomy of the fossil species.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)  
CATHETOSAURUS AS A VALID SAUROPOD GENUS AND COMPARISONS WITH CARMARASaurus

MATEUS, Octavio, FCT- Universidade Nova de Lisboa & Museu da Lourinha, Caparica, Portugal; TSCHOPP, Emanuel, Universidade Nova de Lisboa & Museu da Lourinha, Caparica, Portugal

Here we report a nearly complete camarasaurid sauropod from Wyoming (Howe-Stephens Quarry, Upper Morrison Formation), which shares three character states with Camarasaurus. The new species is herein described as its own genus, Cathetosaurus. The shared states are the following, and are not present to the same degree in other Camarasaurus species: i) the pelvis is rotated anteriorly, such that the pubis projects posteroventrally, and the ischium projects posteroventrally, ii) lateroventrally projecting spurs on the long neural spines of the last dorsals, iii) posterior and posterior lateral lipid spines project anteriorly. The new species: Cathetosaurus chuwi (from Chuwi Basin) and Cathetosaurus chieni (from Jiangxi Basin) are the first Camarasaurus specimens discovered in non-Morrisonian deposits and represent the first Camarasaurus specimens to be recovered in China. A single additional character difference is used to distinguish these taxa from the larger Cathetosaurus species. Cathetosaurus chuwi and Cathetosaurus chieni are the first Camarasaurus specimens to be recovered in non-Morrisonian deposits and represent the first Camarasaurus specimens to be recovered in China. A single additional character difference is used to distinguish these taxa from the larger Cathetosaurus species. Cathetosaurus chuwi and Cathetosaurus chieni are the first Camarasaurus specimens discovered in non-Morrisonian deposits and represent the first Camarasaurus specimens discovered in China. A single additional character difference is used to distinguish these taxa from the larger Cathetosaurus species.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)  
THE ESTIMATED RANGE OF INTRASPECIFIC VARIATION IN RECENT DELPHINID SKULLS AND ITS APPLICATION FOR THE TAXONOMY OF THE EXTINCT DELPHINOIDEA

MARUYAMA, Satoshi, Kyoto University, KYOTO, Japan

Delphinid skulls were studied for the purpose of reconsidering the taxonomy of the genus Kentrirodion (Kentrirotididae, Delphinoidea) from the viewpoint of intraspecific variation in the Delphinidae.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)  
FEEDING BEHAVIOR AND THE FUNCTIONAL ANATOMY OF THE NECK IN THE LONG-SNOUTED CHORISTODERANS CHAMPSOASARUS AND SIMOEDOSAURUS (REPTILIA: DIAPSIDA)

MATSUMOTO, Ryoko, Kanagawa Prefectural Museum of Natural History, Kanagawa, Japan; EVANS, Susan, Univ College London, London, United Kingdom

Choristoderans are freshwater diadipid reptiles that were distributed across Laurasia from the Jurassic to the Miocene. The most fully known genera are the large, long-snouted neochoristoderans, Champsoasaurus and Simoedosaurus. These two genera co-occur in several Paleogene horizons in Europe and North America and, by comparison with extant crocodiles, both are thought to have been piscivores. This raises the question as to how they were able to survive with such a diet. Previous hypotheses have focused mainly on rostral morphology. As Simoedosaurus has a proportionally longer, narrower snout than Simoedosaurus, it has been interpreted as more gavial-like in its feeding strategy. However, neck movements also have an important role in feeding. The living Gavialis gangeticus has rapid lateral movements of the head and neck to attack schools of fish under water, whereas wide-snouted crocodiles like Alligator mississippiensis dismember large prey by spanking the head-neck and body. Comparisons of extant crocodiles show that these behavioral differences are matched by differences in the morphology of the cervical joints, vertebrae and neck structure.

Choristoderans cannot be examined to the same level of detail, but a comparison of the cranio-cervical region of Champsoasaurus and Simoedosaurus has revealed two important differences. Firstly, the zygapophyseal facets in the posterior part of the neck
are horizontal in *Champsauros*, but more vertical in *Simoedosaurus*. Secondly, the occipital region of *Champsauros*, but not *Simoedosaurus*, is characterized by laterally expanded basal tubera that may have provided attachment surfaces for the m. rectus capitis anteriores, a muscle involved in dorsoventral movement of the head-on-the-neck. Like the gavial, therefore, *Champsauros* may have used its slender snout to grab fish from shoals using lateral sweeping motions of the head and neck. *Simoedosaurus*, on the other hand, is less likely to have swung the neck actively during prey capture and may instead have fed on larger single prey items.

The occurence of such variations is well documented within extant mammals and also in a number of extinct mammals, which has led to an increased understanding about the evolution of tooth development and in establishing the species of taxa. Dental variations such as anodontia and hyperodontia have recently been recognized in the two extant genera of sloths, *Bradyops* and *Choloepus*, at a frequency of less than 3%. A review of dental anomalies within the extinct plesionigrapid sloths, reveals a somewhat greater diversity of taxa exhibiting variations away from the typical 5/4 or 4/4 dental pattern than previously documented and with some taxonomic implications. Most anomalies are of a rare frequency similar to the rate found in extant sloths, such as the single documented cases of anodontia via conation in *Eremotherium* and hyperodontia (supernumerary tooth) in *Megalonyx*. The recently erected taxon of *Leptobrachium* from the Eocene of Utah suggests a possible erroneous creation as the supposed M1 occurs anterior to or within the diastema space and just posterior to the canineiform, which is a where such supernumary teeth occur in *Choloepus*. The late Pleistocene mylodontid *Mylodon* and *Paramylodon* both exhibit rather frequent anodontia of the upper caniniforms. The base dental formula for *Mylodon* was long thought to be 4/4 but recent evidence shows many individuals born with a 5/4 as exhibited by a juvenile specimen, as well as alveolar scarring in adult specimens at that tooth location, indicating the loss is postnatal instead of prenatal. *Paramylodon* also stands out by the high frequency of postnatal loss of the upper caniniforms but is more anomalous with the loss occurring in either one or both sides as seen in specimens from the La Brea tar pits (55.5%). Increased tendency toward a 4/4 dentition in this genus could correlate with environmental factors to cause the loss as individuals age, possibly from tooth damage, but the reason for the shift in this species remains extremely poorly understood. The frog populations from the two main fossil-bearing, the Langebaan Quartzite Sand Member (LQSM) and the purportedly slightly younger Muishond Pelletal Phosphate Member (MPPM) were investigated as they represent different depositional environments and thus provide different ecological information. The LQSM represents floodplain deposits, while the MPPM contains fossils laid down in river channels. The humeri and ilia were the most diagnostic, and among the most well-preserved, bodyparts. The Bufonidae, Brevicipitidae, Pyxicephalidae, Arthroleptidae, and Pipidae were represented in the LQSM, as well as several unidentified taxa. In the MPPM the Bufonidae (two or possibly more taxa), Brevicipitidae, Pyxicephalidae, Arthroleptidae, Pipidae, Hyloridae, and Helophrynidiae appear to be present, together with some unidentified taxa.

Poster Session II (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

**NEW DISCOVERIES OF DINOSAURS AND OTHER VERTEBRATES FROM THE UPPER CRETACEOUS (CAMPAIGN) MENEEFE FORMATION OF NEW MEXICO**

*New Mexico*

*MCORDONALD, Andrew, University of Pennsylvania, Philadelphia, PA, United States, 19104; WOLFE, Douglas, Renaissance Environmental Management, Phoenix, AZ, United States; HEDRICK, Brandon, University of Pennsylvania, Philadelphia, PA, United States; CORDERO, Samantha, University of Pennsylvania, Philadelphia, PA, United States; LAING, Adam, University of Pennsylvania, Philadelphia, PA, United States; HEDRICK, Brandon, University of Pennsylvania, Philadelphia, PA, United States; HEDRICK, Brandon, University of Pennsylvania, Philadelphia, PA, United States; CORDERO, Samantha, University of Pennsylvania, Philadelphia, PA, United States; LAING, Adam, University of Pennsylvania, Philadelphia, PA, United States; CORDERO, Samantha, University of Pennsylvania, Philadelphia, PA, United States; LAING, Adam, University of Pennsylvania, Philadelphia, PA, United States; HEDRICK, Brandon, University of Pennsylvania, Philadelphia, PA, United States; CORDERO, Samantha, University of Pennsylvania, Philadelphia, PA, United States.*

Middle Campanian–late Maastrichtian fossil assemblages from the Western Interior of North America are among the richest and most diverse on Earth, and provide invaluable insights into the evolution of terrestrial biota between the end of the Mesozoic. However, Turonian–early Campanian (~94–78 Ma) terrestrial vertebrates are far scarcer in the Western Interior, obscuring the early evolutionary histories of many clades. Recently, this gap started to fill with new discoveries, such as those from the Turonian Moreno Hill Formation of New Mexico; the Turonian–Coniacian Straight Cliffs Formation of Utah; and the early Campanian Forested

In 2011, we began field work in the early Campanian Allison Member of the Menefee Formation on Bureau of Land Management sections in the San Juan Basin of southwestern New Mexico. Based upon past biogeographic correlations in the early Cliffs House Sandstone and Lewis Shale, the Allison Member in our field area is approximately 81–78 Ma, similar to radiotopic age estimates obtained by other workers from the Menefee farther east in the San Juan Basin. Previous collecting in the Allison Member by other workers has yielded important vertebrate material elsewhere in the San Juan Basin, including abundant microvertebrate fossils, an indeterminate centrosaurine skeleton, the holotype skull of the alligatorsaur Brachychampsa sealayi, and other fragments.

Our field work has significantly expanded this vertebrate record; so far, we have discovered partial skeletons of two ankylosaurs, a hadrosaurid, a possible ceratopsid, a theropod, and a large crocodylomorph, as well as isolated dinosaur elements. We have also discovered material, including two partial shells, that suggests the presence of at least two turtle taxa, and numerous fossil plants including in situ tree stumps and well-preserved leaves. This material is currently under preparation and study, and will be analyzed in the contexts of phylogeny, biogeography, and Western North American Cretaceous paleogeography.

Symposium 2 (Thursday, October 31, 2013, 4:00 PM)

A REEXAMINATION OF THE ORIGIN OF ASPHALT PRESERVED BIOTAS: ARE WE STUCK IN THE SAME OLD PARADIGM?

MCDONALD, H. Gregory, National Park Service Museum, Fort Collins, CO, United States, 80525

While people have utilized tar as a source of raw material for thousands of years, the formal study of the biota naturally preserved in tar and recovered from “tar pits” is a relatively recent development. One hypothesis that states that tar generated from the formal exclosures at Rancho La Brea in southern California. Rancho La Brea can be thought of as the “holotype” of tar pit deposits and since its initial excavations many new tar pit preserved biotas have been found, both in California, and elsewhere in the world; Peru, Ecuador, Canaima, Cuba, Iran, Angola, and Azerbaijan. Often these new biotas are compared to Rancho La Brea and it is often used as the model or reference by which these new sites have been interpreted. The simple Rancho La Brea standard model is that after oil seeps to the surface it forms a semi-viscous sticky surface which serves as a trap, much like a giant sheet of Hypaar. Herbivores become mired and in turn become bait which attracts predators or scavengers, which in turn, become entrapped. This often results in a disproportionate number of carnivores to herbivores preserved in the site and an ecologically unbalanced representation of the local ecosystem in terms of the number of individuals represented from the different trophic levels. There is often an a priori assumption that if a fauna is preserved in asphalt, it should have a disproportionate number of carnivores. Other aspects of the Rancho La Brea model include the preservation of insects and plant material, which are often not preserved under other conditions, as well. This is not always the situation. Examination of the biota from other “tar pits” indicates that there is not always a disproportionate number of carnivores and they may even be absent from the fauna. Also at these other sites, more easily perishable parts of the biota, such as insects, which are common at Rancho La Brea, are not preserved, nor is plant material present. While in all of these sites, asphalt has contributed to the preservation of the fossils, at many of these sites, unlike at Rancho La Brea, the presence of the tar is secondary and not the primary cause of the site formation. In these cases different a taphonomic pathway led initially to the preservation of the biota. The investigation of site formation of any tar preserved biota should be on a case by case basis and the presence of asphalt should not lead to an a priori assumption that it was the primary cause of site formation.

NEW DATA ON A PARTIAL SKELETON REFERRED TO STRUTHIOMIMUS ALTUS (ORNITHOMIMIDAE) FROM DINOSAUR PROVINCIAL PARK, ALBERTA

MCFEETERS, Bradley, Carleton University, Ottawa, ON, Canada, K1S 5B6; RYAN, Michael, Cleveland Museum of Natural History, Cleveland, OH, United States; SCHIØRDER-ADAMS, Claudia, Carleton University, Ottawa, ON, Canada

Late Cretaceous North American ornithomimids have a complex taphonomic history with disagreements over whether they are best sampled in situ or in assemblages. Additional and more complete data on their palaeoecology is required. Here we report a partial ornithomimid skeleton from the Late Cretaceous of Southwestern Alberta, a fossil deposit that is one of the best-sampled ornithomimid localities, with 83 complete or nearly complete skeletons. The specimen is relatively broad, with short ilia and robust postcrania, and postcranial elements, as it captures more subtle morphological variation than visual examination of linear biglots but is more straightforward than three-dimensional morphometric methods. Further, data from multiple unsasculared skeletal elements can be integrated using Bayesian inference, by specifying informative priors for relative abundance from previous elements, adding each successive element increases the posterior confidence in the relative abundances in the fauna. We test our approach on a known, artificially created assemblage of modern cerval, camelid, and antilocaprid postcranial post 24 that stdsials. In a mixed training assemblage of astragali, metatarsals, cubonaviculars, and calcanea, iterative discriminant analysis with informative priors had success rates ranging from 87.5% to 100%. After the first iteration, identifications were 100% accurate until the calcaneum iteration, after which the final accuracy dropped; this drop drops because calcaneum bone to and a priori assumption. Our simple method is our potential because they actually improve knowledge of the ungulate paleoecology. This is particularly true at several candidate sites rich with interpreted postcrania, including Virgin Valley, McKay Reservoir, Cañon Valley. Further applications include developing greater certainty in taxonomic assignments to isolated postcrania used in ancient DNA studies. While here we focus on ungulates, the method should transfer well to other mammalian groups, shedding light on hidden diversity and improving any studies that rely on identification.

INCORPORATING LIFE HISTORY TRAITS AS DISCRETE MORPHOLOGICAL CHARACTERS IN PHYLOGENY RECONSTRUCTION

MCHugh, Julia, Ou-Center For Health Sciences, Tulsa, OK, United States, 74107

Patterns of ontogenetic change can provide information on the phylogenetic history of a group. However, quantifying the transformation of morphology during the life history of an extinct organism into discrete morphological characters can be problematic. Many known extinct taxa are known exclusively from immature specimens, which are often included in phylogenetic analyses by scoring them for adult morphology. The effects of the combination of including immature taxa and ontogenetic characters in phylogenetic reconstruction have not been explicitly explored previously. Here, we use taphonomic studies of amphibians and reptiles to test the effects of morphological characters included in test topological changes resulting from three different methods of incorporating ontogenetic information, and also to test the inclusion and exclusion of immature taxa scored for adult morphology. Both taxon and character sampling affected resolving topologies. 1) inclusion of immature taxa improved tree resolution when ontogenetic characters were omitted; 2) if adult and juvenile morphologies were coded as separate ontogenetic characters, then the exclusion of immature taxa improved resolution in recovered trees; and 3) if ontogenetically variable morphologies were coded as states within single characters, then the inclusion of immature taxa had a greater effect on node support than node recovery. This implies that the incorporation of morphological characters coding for ontogenetic variation cannot be disentangled from the decision to include or exclude immature taxa in a phylogenetic analysis during matrix construction, particularly in analyses of non-amniote tetrapods. Additionally, the use of differing methods to incorporate ontogenetically variable morphologies and immature taxa can be applied to test underlying causes of lability in subclades and ‘wild card’ taxa and establish areas of stability in the resultant topologies.

LATE CRETACEOUS MARINE VERTEBRATE FAUNA FROM THE FAIRPORT CHALK MEMBER OF THE CARLILE SHALE IN SOUTHERN ELLIS COUNTY, KANSAS, U.S.A.

MCINTOSH, Annie, DePaul University, Chicago, IL, United States, 60614; SHIMADA, Kenshu, DePaul Univ, Chicago, IL, United States; EVERHART, Michael, Sternberg Museum of Natural History, Hays, KS, United States

The Carlile Shale is an Oligocene member deposited in the middle of the Western Interior Seaway, an epicontinental sea in North America. The Fairport Chalk represents the lowest member of the Carlile Shale and is characterized by chalky to marly shale beds that were deposited during the peak transgressive phase of the Seaway during the middle Turonian. The Sternberg Museum of Natural History in Hays, Kansas, U.S.A.,
harbors a collection of marine vertebrate fossils from the Fairport Chalk in southern Ellis County, Kansas. The fossil fauna consists of at least 10 taxa, including 11 chondrichthyans (Ptychodus mammillaris, P. c. P. whipplei, Scapanorhynchus rhotifer, Makoichthys tonyogongi, Leptorhina appendiculata, Archaeolema kopingensis, Telodontaspis agassizii, Ptychoderina cf. S. falcatus, and Squillarina sp.), three osteichthyans (Plethiodidae indet., Pachyrhizodus sp., and Enchodus shumardi), and one reptilian (Coniasaurus crassidens). This fauna is important because it provides a glance at the paleoecology of the Western Interior Seaway during this height transgression. The taxa of this unit show wide ecologic diversity, with examples of small to medium-sized opportunistic (Squalicorax), large predaceous (Cardabiodon and Cretoryphinus), and durophagous (Ptychodus) sharks, as well as small (Enchodus), medium-sized (Plethiodidae and Pachyrhizodus), and large (Ichthyodectes) bony fishes. Another notable finding is the occurrence of Telodontaspis agassizii in which the species was previously known only from Cenomanian deposits, notifying the specimen from the Fairport Chalk the geologically youngest record for the species. Many taxa in the ichthyofauna reported here also occur stratigraphically below (e.g., Greenhorn Limestone) and above (e.g., Niobrara Chalk) the unit, suggesting a relatively stable fish community across a broader geologic time frame (mid-Cenomanian through at least the Santonian) in the Western Interior Seaway.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

SEXUAL DIMORPHISM IN THE POSTCRANIA OF EXTANT ARTIODACTYLA AND IMPLICATIONS FOR FALSELY ELEVATED DIVERSITY IN THE PALEOMERYCIDAE

MLAUGHLIN, Win, University of Oregon, Eugene, OR, United States, 97403; DAVIS, Edward, University of Oregon, Eugene, OR, United States

Extant Artiodactyla possess a range of sexual dimorphism, from limited soft tissue differences to extensive body mass and head gear variation between sexes. Modern biological studies are typically limited to somatic mass differences, methods of differentiation offering no possible application to the fossil record. This study examines intraspecific and interspecific morphometric variation within a subset of four extant artiodactyl families: the bovids, cervids, camels, and antilocaprids. While dental material is usually used to diagnose species and postcranial records are typically used to find evidence of sexual dimorphism, analysis of bones such as the astragals can be used to diagnose sexes, even in taxa supposedly lacking sexual dimorphism. Furthermore, variation in the articular surface of the carpus and tarsus is diagnostic at the species level for extant camels. These observations offer a potential for diagnosing sexual dimorphism in extinct artiodactyls, specifically the family Paleomerycidae, where species and even generic level diversity may be artifically elevated from the misinterpretation of males and females as different taxa. The Barstovian North American Land Mammal Age contains Bourmories, Rakymes, Dromomyr, and Subdromomyr. While Bourmories represents a separate invasion of European palermerycids into North America, the remaining closely related taxa differ only in size and headgear elaboration. Comparison to variation observed in extant artiodactyls phylogenetically bracketing the palermerycids sheds light on how much variation is to be expected from sexual variation as opposed to the current interpretation of variation from species level differences.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

FOSSIL MARINE VERTEBRATES FROM THE MIDDLE GRANEROS SHALE (UPPER CRETACEOUS: MIDDLE CENOMANIAN) IN SOUTHEASTERN NEBRASKA, U.S.A.

MEGLEJ, Alexander, DePaul University, Chicago, IL, United States, 60614; SHIMADA, Kenshu, DePaul Univ, Chicago, IL, United States; KIRKLAND, James, Utah Geological Survey, Salt Lake City, UT, United States

The Graneros Shale is an Upper Cretaceous formation that formed in the Western Interior Seaway of North America during the mid-Cenomanian (ca. 97 Ma). Fossil vertebrates are known to occur in the Graneros Shale, but the taxonomic diversity of the vertebrate fauna at the middle portion of the formation is poorly understood. In this study, we report an assemblage of fossil vertebrates from the mid-Graneros Shale in southeastern Nebraska, U.S.A., based on specimens housed in the University of Nebraska State Museum, Lincoln. The fauna consists of at least 11 taxa, including eight chondrichthyans (Hybodontidae indet., Squillarina curvata, Carcharias amoenensis, Archaeolema cf. A. kopingensis, Cretodus semicincas, Cretolamna appendiculata, Cardabiodon sp., Cretoryphinus mantelli), one osteichthyan fish (Enchodus gladiatorus), and two reptilians (Chelonia indet. and Plesiosauria indet.). The most common vertebrate material is generally used to diagnose species in the fossil record, postcrania can be biological studies are typically limited to soft tissue and mass differences, methods of functional morphology studies will provide more detailed information between similarities and differences to modern raptorial. Paleontological assemblages represent a palimpsest of diverse processes and events, each of which may alter the fossil record in ways ultimately applicable to a current study. Proper interpretation of any paleontological assemblage thus requires understanding of the taphonomic pathways it has experienced. It is imperative to outline, as completely as possible, the biases that have affected the assemblage, in order to establish the parameters of the data this assemblage contains. Such biases limit the types of conclusions and interpretations we can expect to extract from a given assemblage; hence, identifying the biases (i.e., the limitations of the data) of an assemblage is a necessary first step in a well-founded analysis of a paleontological assemblage. Study of modern bone assemblages helps to provide this fundamental knowledge. Workers have suggested that some paleontological assemblages may represent, in whole or in part, the activity of various
carnivores at den or lair sites, and actualistic taphonomic studies have included examinations of the dens of various modern carnivores. Our study is a description of the taphonomic and spatial attributes of a vertebrate bone assemblage from a modern wolf (Canis lupus) den located in Nunavut, Canada. The assemblage consists almost exclusively of caribou (Rangifer tarandus) bones. Basic descriptive statistics of the assemblage, including types of elements and numbers and ages (general categories) of individuals represented, are calculated, and we establish a weathering profile. An analysis of bone damage, including examining the frequency of markings and fractures indicative of consumption by carnivores, is presented. Overall, the assemblage contains a high number of juvenile bones, a large component of early weathering stages, and significant damage associated with carnivore consumption. Spatial analyses of the den bone assemblage reveal both similarities and differences in the spatial patterning of bones exhibiting various damage types and weathering stages. Finally, the implications of these actualistic analyses for palaeontological assemblages, and in particular for the effects that sampling and collection methods may have on the final assemblage available to study, are explored. Analysis of spatial data, bone damage, bone weathering, and taxa present, all may aid in the identification of a fossil wolf den-derived assemblage; furthermore, sampling technique may either capture or mask these data, leading to potential confusion about site type or assemblage origin.

Technical Session II (Wednesday, October 30, 2013, 12:00 PM)

SIZE-BASED MODERN BONE ACCUMULATIONS CAN ACCURATELY RECORD WHOLE-COMMUNITY ECOLOGY

MILLER, Joshua, University of Cincinnati, Cincinnati, OH, United States, 45221; BEHRENSMEYER, Anna, Smithsonian Institution, Washington, DC, United States; LYONS, Kate, Smithsonian Institution, Washington, DC, United States; ETE, Taphonomy Group, Smithsonian Institution, Washington, DC, United States

Comparisons between modern bone accumulations and their source communities have demonstrated that fleshed bone fragment size distributions vary significantly among taxa, ecosystems, and taxonomic groups. However, residual biases in skeletal assemblages could skew representation of other ecological attributes of source communities. Body size bias (i.e., differential preservation of species as a function of body size) has been documented in modern and fossil death assemblages and is considered a major taphonomic challenge to studying fossil ecosystems. Size-bias may be particularly problematic if functional aspects of the ecosystem (e.g., dietary characteristics, preferred habitats) are non-randomly distributed across body size and taxonomic groups. Using functional ecological traits of the diverse, non-volant mammal community (87 species) in Amboseli National Park, Kenya, we test how biases characteristic of the overall Amboseli death assemblage (45 species) could affect reconstructions of the source community and its ecosystem. To establish the functional ecological space of the living Amboseli community, we used a literature to bio-specializing in four variables: (i) preferred sheltering habitat (17 categories, e.g., grassland, woodland, underground cavity), (ii) preferred feeding habitat (16 categories, e.g., grassland, woodland, arboreal), (iii) dietary mode (11 categories, e.g., browser, grazier, insectivore), and (iv) activity time (7 categories, e.g., diurnal, nocturnal, nocturnally-dominated crepuscular). We then compared the richness and distribution for each of the four ecological variables in the death assemblage to that of the entire living community using Jaccard similarity, Spearman’s rank-order correlation, and the Probability of Interspecific Encounter (evenness). Using Monte-Carlo simulations, we then assessed whether these empirical comparisons were significantly different from a random draw of species from the source community. Results show that while our sample of the Amboseli death assemblage is non-random (i.e., size-biased) with respect to the non-volant mammal community as a whole, the Amboseli death assemblage accurately captures the functional dimensions of the ecosystem within expectations of a random draw. Logistic regression and additional resampling simulations further show that the size-bias inherent to the Amboseli death assemblage is not a major driver of deviations between the functional ecological properties of the living community and those represented by the death assemblage.

Postersession II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

WHEN SPECIALISTS BECOME GENERALISTS: LONGIROSTRY IN ALLIGATOR

MILLER-CAMP, Jessica, University of Iowa, Iowa City, IA, United States, 52242

Due to its availability, Alligator mississippiensis is the species most frequently used in studies of crocodylian development and evolution in the United States. Our familiarity with it has led to a long-standing assumption that it represents a ‘average’, ‘normal’, or ‘typical’ crocodylian skull shape. Ecologically it is a generalist, eating a wide variety of food types. However, it arose from a specialist brevirostrine lineage. Ancestrally, Globidonta- and perhaps all of Alligatoroidea- is characterized by short snout, small, large teeth adapted for durophagy. Here, I use geometric morphometrics, traditional morphometrics, and ancestral state reconstruction to analyze the evolution of snout and jaw joint shape and size in Alligatoroidea. Taxa from both Alligatoroidea and Crocodylidae were sampled to compare the evolution of longirostrine and shortirostrine form. Jaw joint shape between clades that are ancestrally brevirostrine and of a more ‘typical’ crocodylian length, respectively. Whenever possible, juveniles through large adults were sampled to compare phylogenetic and ontogenetic change. Alligatoroidea is found to be ancestrally brevirostrine with longirostrine evolving in Diplocynodon and Alligator. Alligator mississippiensis is found to be longirostrine with respect to its ancestral state, but average with respect to living crocodylids. Longirostrity is often taken to mean both long and slender when it is more accurate to think of it merely in terms of length. While Alligator includes longirostrine species, they do not possess the thinner snouts characteristic of extant crocodylids. This is reflected in their more generalist ecology. Common thought holds that generalists evolve into specialists, that are evolutionary dead ends less able to adapt to changing environments. However, this study demonstrates a case of a specialist clade producing a generalist lineage when the Earth was cooling to temperatures less favorable to them. This has implications for our understanding of adaption and niche partitioning during times of environmental stress.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

THE WESTERNMOST RECORD OF THE GENUS MICROCHOERUS (OMOYMIIDAE, PRIMATES) IN THE IBERIAN PENINSULA AND ITS PALEOBIOGEOGRAPHIC IMPLICATIONS

MINWER-BARAKAT, Raaf, Institut Catala de Paleontologia, Barcelona, Spain; MARIGO, Judit, Institut Catala de Paleontologia, Barcelona, Spain; BADIOLA, Ainara, Universidad del Pais Vasco, Bilbao, Spain; MOYA-SOLA, Salvador, Institut Catala de Paleontologia, Barcelona, Spain

The family Omoymidae includes some of the earliest primates, which were abundant and diverse in the Northern Hemisphere during the Eocene. Omoymidae were small-bodied primates, generally nocturnal and with insectivor-frugivorous diets. Within this family, the subfamily Microchoerinae is exclusively recorded from Europe, ranging primarily from the early to late Eocene, with some genera (Pseudoloris, Microchoerus) lasting into the early Oligocene in the Iberian Peninsula. Fossil remains of microchoerines are scarce, so the knowledge of this group is still far from complete. Specifically, the record of Microchoerus is quite sparse in the Iberian Peninsula. Here we review new material of Microchoerus from the late Eocene (Headonian, MP18) site of Zambrana (Miranda-Trebilo Basin, northern Iberian Peninsula). The studied specimens, consisting of two mandible fragments bearing p3-m3 and p4-m3, were not identified at the generic level until now. The teeth resemble in size and morphology those of M. erinaceus from Hordle Cliff, although some differences prevent us from making a definitive ascription to this species. Some traits, such as the development of the mesocodon and hypoconulid in the m1 and m2, and the shape of the hypoconulid lobe in the m3, are intermediate between those of M. erinaceus and M. edwardsi. Thus, the material from Zambrana fits well in the lineage of Microchoerus present in Europe, representing one of the two major clades of the described species. The described material represents the first finding of a primate from the Miranda-Trebilo Basin, and also the westernmost record of the genus Microchoerus in the Iberian Peninsula and the most recent record of a primate from the Western Iberian Bioprovince. Moreover, the identification of this microchoerine, with clear similarities with the representatives of this genus described from other European sites, provides further support for the presence of paleoecographic and/or paleoecologic filters which allowed the coexistence of the endemic fauna (rodents and perissodactyls) and other typical European fauna (primates and artiodactyls) in the western region of Iberia during the late Eocene.
A NEW SPECIES OF DASPLETOSAURUS (THEROPODA: TYRANNOSAURIDAe) FROM THE CAMPANIAN OF SOUTHERN ALBERTA REPRESENTED BY A GROWTH SERIES OF WELL-PRESERVED SKELETONS AND SKULLS

MIYASHITA, Tetsuto, University of Alberta, Edmonton, AB, Canada, T6G 2E9; CURRIE, Philip, University of Alberta, Edmonton, AB, Canada; PAULINA-CABAL, Ariana, CONICET-Museo Carmen Funes, Plaza Huincul, Argentina

Many of the tyrannosaurines collected from the Campanian of western North America were identified as Daspletosaurus in the last four decades. In particular, discoveries of nearly a dozen well-preserved skulls and skeletons of Daspletosaurus from the Dinosaur Park and Oldman formations of Alberta led to the realization that these specimens represent a species distinct from the type Daspletosaurus torosus. The new species of Daspletosaurus can be defined on the basis of a nearly complete, three-dimensionally preserved, disarticulated skull (only missing the vomer) and an associated postcranial skeleton of an adult (Royal Tyrrell Museum of Palaeontology TMP 2001.36.1). The description is supplemented by information from juvenile and adult skulls and skeletons of the same species. The new species is distinguished from Daspletosaurus torosus by characters that include the supranarial process of the premaxilla extending posteriorly for more than half the diameter of the external naris, a lacrimal that is 1.5 times anteroposteriorly longer than dorsoventrally tall, a pronounced temporal margin of the postorbital, and a maxillary tooth count greater than 15. The new species is from the Dinosaur Park Formation and the chronologically equivalent part of the Oldman Formation, and lived more recently than Daspletosaurus torosus. Together with Daspletosaurus sp. from the Two Medicine Formation of Montana, these putative species of Daspletosaurus form a more derived assemblage of tyrannosaurines in a phylogenetic analysis than the Campanian tyrannosaurines from Utah and, possibly, New Mexico. The identification of multiple species of Daspletosaurus favors the generic separation of derived tyrannosaurines into Daspletosaurus, Turbosaurus and Tyrannosaurus.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

MACRANORCIN RECORD FROM THE UPPER JURASSIC OF PORTUGAL

MOCHO, Pedro, Universidade Autónoma de Madrid, Madrid, Spain; ROYO-TORRES, Rafael, Fundación Conimbra, Palaeontológico de Terceira-Dospinhos, Tercei, Spain; ORTEGA, Francisco, UNED, Madrid, Spain; SILVA, Bruno, Sociedade de História Natural, Torres Vedras, Portugal

New macrorcin remains from the Portuguese Upper Jurassic are discussed. Some of these were found in Cambelas (Freixial Formation, Torres Vedras), Baleal (Praia da Amorosa Novo Formation, Peniche) and Peralta (Sobral Formation, Lourinhã), consisting of cranial (teeth) and postcranial material that could be assigned to basal macrorcines. The study of several Portuguese classical remains also increases our knowledge of this group. The Upper Jurassic record of type specimens of Lourinhasaurus alequensis (Freixial Formation, Alenquer) and Lusotitan atalaiensis (Sobral Formation, Peralta) with the description of several unpublished and still undescribed elements allows us to refer these two taxa to Macronaria (also supported by cladistic analysis).

The presence of fully opisthocoelous condition up to the sacral vertebrae, horizontally projected diapophysis, and “plank“-like cranial dorsal ribs, which are common synapomorphies of basal macrorcines, are used to relate these specimens with this group. At present, it is possible to identify one basal macrorcine form close related to Macronaria. On the other hand, these are various specimens bearing several basal titanosauriform features, such as the camellate presacral bone, a lateral bulge on the femur, dorsal and caudal centra dorsoventrally compressed, cone-chisel-like teeth and a gracile humerus. Further analyses will discriminate if they represent one or two different taxa.

Recent works suggested that the Upper Jurassic-Lower Cretaceous (upper Oxfordian-lower Berriasian) sauropod faunas of Iberian Peninsula are composed by exclusive taxa (Lourinhasaurus, Lusotitan, Onchoeuroaurus, Aragosaurus, Galvesaurus, Saltasaurus and Turiasaurus) although some of them are related to sauropod groups represented in Upper Jurassic strata of other continents such as brachiosauroids, diplodocids and camarasaurs. This situation is opposite to what is suggested by other groups of dinosaurs (such as stegosaurs or theropods) with a proposed North American-European Upper Jurassic distribution, putting forward a vicariance model to explain their diversity in this territory.

Technical Session XVI (Saturday, November 2, 2013, 3:45 PM)

RE-APPRAISAL OF THE CAPTORHINID REPTILE CAPTORHINOKOS VALENsis FROM THE LOWER PERMIAN OF CANADA

MODESTO, Sean, Cape Breton University, Sydney, NS, Canada, B1P 6L2; LAMB, Amy, Cape Breton University, Sydney, NS, Canada; REISZ, Robert, Univ of Toronto at Mississauga, Mississauga, ON, Canada

Captorhinokos valensis is a poorly known, captorhinid reptile with multiple tooth rows from the Lower Permian of Texas. Our reappraisal of C. valensis reveals it to be a small moradasaurine captorhinid, exhibiting a maximum of five rows of bullet-shaped teeth in the multiple-rowed region of both the maxilla and the dentary. The slightly radiating organization of the tooth rows distinguishes C. valensis from the parallel arrangement of the tooth rows exhibited by all other moradasaurines. Captorhinokos valensis is also distinguishable from the coeval moradasaurine Labidosaurus meachami by a more conspicuously dentilaciated, broader, U-shaped transverse flange of the pterygioid, a pleisiomorphic morphology shared with the large, single-rowed captorhinid Labidosaurus hamatus. Postcranial information is limited to two short series of presacral vertebrae not associated with the cranial materials; open neural arch sutures are present in one specimen, indicating immaturity at death. A branch-and-bound stigmatization analysis in the software package PAUP of a data matrix consisting of 16 captorhinid taxa (plus 3 outgroups) and 75 characters discovered a single optimal tree. Whereas a previous analysis of captorhinid interrelationships found the (undifferentiated) genus Captorhinokos to fall outside of a clade of L. hamatus and the large moradasaurines, our analysis recovered C. valensis in a clade with the genera Labidosaurus, Gansuurhins, Moradasaurus, and Rothianus (i.e., Moradasaurinae sensu stricto), and Captorhinokos chozaensis as the sister species of a clade that includes L. hamatus and Moradasaurinae s.s. Stigmatization of our captorhinid phylogeny indicates that moradasaurines evolved by the middle Kungurian (Middlelandian).
Preto, Brazil

AN ADVANCED NEOSUCHIAN FROM THE JURASSIC OF BRAZIL

Technical Session XII (Friday, November 1, 2013, 2:45 PM)

congruent with any of the previously published hypotheses, but most of the recovered matrix, composed of 90 taxa and 484 characters, was analyzed using equally weighted taxon and character samplings to investigate the affinities of the new taxon. The resulting a series of recent phylogenetic studies of fossil Crocodyliformes and also expanded the extended between the palatal shelves of the palatines. We critically revised and combined fauna worldwide. However, this diversity is concentrated in basal mesoeucrocodylian as the sister-group of the Asian Paralligatoridae (Shamosuchus djadochaenesis + Rugosuchus monganensis). In this context, paralligatorid synapomorphies include the articular facet for the anterior palpebral forming a shallow hemispherical depression bordered by eyelids and an intermaxillary bar that is flared at both ends. The evolutionary history of Neosuchia in the southern hemisphere remains inadequately understood, partly due to a poor fossil record. Considering its provenance and phylogenetic position, this taxon fills an important gap in the studies of Crocodyliformes. It indicates that paralligatorids are older than previously known and that the group either expanded its range of occurrence across the Turgai and Tethys seaways or was present in the related landmasses prior to the formation of those barriers. In addition, the new methods in palaeontology are not yet well understood, hampering the proposal of robust paleobiogeographic scenarios. The discovery of this new taxon suggests that an important diversity of fossils may still be found with further field investigations in Late Jurassic deposits of Brazil.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

SPECIES COMPOSITION OF THE LATE CRETACEOUS EUTHERIAN MAMMAL PARANYCITOIDEA

MONTELLANO, Marisol, Instituto de Geología, UNAM, Mexico City, Mexico; FOX, Richard, University of Alberta, Edmonton, AB, Canada; SCOTT, Craig, Royal Tyrell Museum of Paleontology, Drumheller, AB, Canada

Although the known record of Mesozoic eutherian mammals has been significantly enriched in recent years, early eutherian evolution is still not well understood. Among the more controversial of Mesozoic eutherians is Paranyctoides Fox, which was described in 1979 from the Judithian Dinosaur Park Formation, Alberta, Canada. It is a rare taxon that has been identified in only a few other North American Late Cretaceous local faunas since. Within the past decade, dental and gnathic remains discovered in Central Asia have also been referred to Paranyctoides, thereby expanding the geographic range of the genus substantially and making it the only Late Cretaceous eutherian ostensibly occurring in both continents. As a result of our detailed study of Paranyctoides, however, we find that the criteria used to diagnose this taxon are phyletically inappropriate. The genus Paranyctoides and must be referred to other taxa. We conclude that this genus was limited to North America, ranging from Aquilian to ?Lancian time, and accordingly we recognized as valid only the following species: Paranyctoides sternbergi (Judithian, Alberta), P. mafleucus (Aquilan, Alberta), Paranyctoides WINES sp. A and B (Judithian, Utah), Paranyctoides Kaiparowits sp. A and B. (Judithian, Utah). Another purported species of Paranyctoides, P. megarhos, from the Lancian of Wyoming, is a junior synonym of Alosteria saskatchewanensis.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

INVESTIGATING THE INFLUENCE OF TAXON AND ECOLOGY ON TAPHONOMIC MODIFICATION

MOORE, Jason, Dartmouth College, Hanover, NH, United States, 03755

A number of physical characteristics have been associated with the likelihood and style of taphonomic modification that vertebrate bones undergo, including density, shape, and surface area to volume ratio. Examining the distribution of these characteristics with respect to metrics of taphonomic bias can provide insight into the predominant taphonomic pathways a fossil assemblage has experienced, and so facilitate palaeoecological comparisons among assemblages. One important further consideration for such comparisons, however, is the impact of taxon-specific biasing, relating to properties other than the physical characteristics of preserved bones. Such biasing has the potential to further obfuscate palaeoecological patterns of interest.

Here I examine the influence of such taxon-specific biasing using nine assemblages sampled from the Paleogene White River Group of South Dakota and Nebraska. These assemblages, dating over 35 million years, consist of a wide range of mammalian species, spanning a significant range of body sizes, morphologies and ecologies. Using a standard range of statistical techniques (ANOVA:MANOVA, regression, ordination), it is possible to compare the patterns of taphonomic modification (measured by weathering, abrasion, fracture type, element completeness, evidence of carnivore modification, etc.) on similar elements among taxa and so ascertain the presence and magnitude of any taxon, or ecology specific biases. These analyses demonstrate that significant size-related bias is present in taxa small enough to fit into the kg body weight range in the White River assemblages. Beyond this result, which echoes that seen in many modern bone assemblages, little evidence of strong taxon-related bias is present in these assemblages. This suggests that, with the exception of size-bias, taphonomic modification is taxon-blind. This is of importance for the assessment of palaeofaunal communities, as small size, taxa over 15 kg in body mass likely experience a similar taphonomic regime to common taxa, and, as such, their rarity represents true ecological rarity, rather than a taphonomic artifact.

Technical Session XII (Friday, November 1, 2013, 3:30 PM)

FOSSIL CROCODYLIFORMS FROM THE MIocene-PLIOcene OF THE HIGH GUAJIRA PENINSULA, COlOMBIA

MORENO-BERNAL, Jorge, Univ of Nebraska Lincoln, Lincoln, NE, United States, 68588-0340; READ, Jason, Univ of Nebraska, Lincoln, NE, United States; JARAMILLO, Carlos, Smithsonian Tropical Research Institute, Panama, Panama

The greatest diversity of Cenozoic crocodyliforms occurred during the Neogene in South America. However, the origin of this high diversity and its relationship to the environment is not yet understood. Most described species come from late Miocene localities of La Venta, Urumaco, and Acre, whereas the record is sparse in the early to middle Miocene and after the latest Miocene and Pliocene. Field research in the Castilletes (Middle-Late Miocene) and Waré (Pliocene) Formations in the High Guajira Peninsula of Colombia provides new fossil data on the origin of Neotropical crocodylian diversity. The Castilletes and Waré Formations are rich in crocodylian fossils and include depositional environments consisting of dextral and shallow marine systems in the Castilletes and predominantly fluvial environments in the unconformably overlying Waré Formation. Verlating localities in both formations include crocodylian remains of Neotropical crocodyliforms and mammals from several localities. Crocodylian fossils from the Castilletes Formation include gavialoids represented by a nearly complete skull and as fragmented longirostrine remains comparable with gavialoids from marine deposits, cranial, and mammalian. We present a new taxon, Rupérrisaurus from a single middle Miocene coastal plain deposit. Fossils from the Waré Formation include cranial and postcranial elements provisionally assigned to Crocodylus. The arrival of this genus to the Americas is the most recent continental-scale biogeographic event among crocodylians, and requires transoceanic dispersal from Africa. The Miocene-Pliocene crocodylian fossil record from the Guajira Peninsula indicates high diversity throughoout the Neogene, consistent with hypotheses of both warmer climates and greater habitat availability relative to the modern Neotropics.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

EXPLORING THE RELATIONSHIPS OF THE NORTH AMERICAN DIMINUTIVE SKUNK GENERA SPILOGALE AND BUINICTIS

MORETTI, John, Museum of Texas Tech University, Lubbock, TX, United States, 79401; JOHNSON, Eileen, Museum of Texas Tech University, Lubbock, TX, United States; ARROYO-CABRALES, Joaquin, INAH, Mexico City, Mexico; LEWIS, Patrick, SHSU, Huntsville, TX, United States; DEHAAS, Ed, Museum of Texas Tech University, Lubbock, TX, United States. The diminutive New World extinct short-jawed skunk Buirnictis breviramus has been found at an early Pleistocene locality in western Texas (Roland Springs Ranch). As Buirnictis was known previously only from the Pliocene, the question raised is whether the species are Buirnictis or Spilogale and how to demonstrate it. This initial question is within the larger framework of understanding the broader issue of the nature of the relationship between Buirnictis and Spilogale that currently is unclear. Furthermore, understanding this relationship would aid in determining whether the appearance of Spilogale is the result of endemc North American developments or the product of a separate Old World immigration event. Exhibiting both primitive and derived traits, Buirnictis was suggested as a transitional form between base taxa of North American skunks and Spilogale, perhaps the most primitive of extant forms. Dental similarities between the genera suggest an alliance in a morphological lineage and cranial characters of a Hemphillian species of Buirnictis were proposed as directly linking the two genera. Buirnictis breviramus occurs in Blanca faunas from Washington to Texas and is advanced among early North American mephitines. The earliest known species of Spilogale, S. rexroadi, is found in Blanca faunas, although in a more limited range. Both genera occur together in the Rexroad (Kansas) and Beck Ranch (Texas) Blancan faunas. The extant Mexican endemic S. pygmaea is the smallest, most primitive living species of the genus and closest morphologically to the Blanca forms. In examining the nature of the Buirnictis-Spilogale relationship, a metacometric analysis is being undertaken using high resolution, measurable stereo light microscope images. Buirnictis breviramus is compared with modern S. pygmaea and S. rexroadi, an extinct primitive form. Initially, characters of the lower teeth and mandible are being analyzed in order to identify those characters capable of distinguishing or uniting Buirnictis and Spilogale. ANOVA and PCA have been run on p4/m1 measurements. Preliminary results indicate a distinction between S. pygmaea and B. breviramus driven largely by shape (p4 length and m1 width); S. rexroadi appears at the very edge of S. pygmaea variability and suggests it is quite similar in shape to B. breviramus; and two potential morphotypes appear within S. pygmaea and B. breviramus suggesting the possible presence of dimorphism in modern spotted skunks as seen in the extinct Buirnictis.
Technical Session IV (Wednesday, October 30, 2013, 3:15 PM)

AN EARLY MIOCENE BAT (CHIROPTERA: PHYLLOSTOMIDAE) FROM PANAMA AND MID CENOZOIC CHIROPTERAN DISPERSALS BETWEEN THE AMERICAS

MORGAN, Gary, New Mexico Museum of Natural History and Science, Albuquerque, NM, United States, 87104; CZAPLEWSKI, Nicholas, Oklahoma Museum of Natural History, Norman, OK, United States; RINCON, Aldo, Florida Museum of Natural History, Gainesville, FL, United States; WOOD, Aaron, Florida Museum of Natural History, Gainesville, FL, United States; MACFADDEN, Bruce, Florida Museum of Natural History, Gainesville, FL, United States

Two partial mandibles of large insectivorous bats from the early Miocene of Panama represent an undescribed genus and species in the endemic neotropical family Phyllostomidae (Chiroptera: Noctilionoidea). The bat jaws occur in two different faunas derived from volcaniclastic sediments along the Panama Canal at about 9° North latitude. A partial chiropteran dentary with p1 from the Lirio Norte Local Fauna (Las Cascadon Formation) occurs in a mammalian assemblage typical of the late Arikareean (~21 Ma) North American Land Mammal Age (NALMA). A partial bat dentary with p4-m1 from the somewhat younger (~19 Ma) Centenar Fauna (Cucaracha Formation) is associated with mammals found in the latest Arikareean or early Hemingfordian NALMA. The oldest previously known fossil of the Phyllostomidae is an isolated m3 from the early Miocene of Argentina (Colhuehuapuan South American Land Mammal Age; ~20 Ma). The early Miocene bats from Panama and Argentina both belong to the subfamily Phyllostominae and are similar in size to the living greater speared-nosed bat Phyllostomus hastatus, one of the largest known North World bats. A tropical North American origin for the Phyllostomidae is indicated by the oldest known member of this family from the early Miocene of Panama, together with an early radiation of noctilionoids in the Oligocene of Florida, including the recently described †Speonycteris (†Speonycteridae) and an undescribed genus and species in the Mormoopidae. The fossil record suggests overwater dispersal of phyllostomids to South America across the Central American Seaway (CAS) in the late Oligocene or early Miocene, with rapid diversification of the family in South America beginning in the early to medial Miocene. The presence of early Miocene phyllostomines in Panama and Argentina is one of the earliest examples of dispersal of terrestrial mammals across the CAS before the onset of the Great American Biotic Interchange (GABI) that began in the late Miocene and reached its peak in the late Pliocene following the formation of the Panamanian isthmus. Phyllostomids and three other chiropteran families (Emballonuridae, Molosidae, Vespertilionidae) occurred in both North America and South America prior to the late Miocene, suggesting an earlier unrecognized phase of the GABI. Early Miocene fossils from Panama representing several other vertebrate groups, including boid snakes and cainiids, as well as plants, provide further evidence for pre-late Miocene biotic interchange between the Americas.

MORGAN, Michele, Harvard University, Cambridge, MA, United States, 02138; BARRY, John, Harvard University, Cambridge, MA, United States; FLYNN, Lawrence, Harvard University, Cambridge, MA, United States; PILBEAM, David, Harvard University, Cambridge, MA, United States

The Chinji Formation of northern Pakistan, spanning approximately three and a half million years from 14 to 10.5 Ma, is richly fossiliferous. It has previously been proposed that a core chronozone inhabiting sub-tropical forests and woodlands existed for several million years during this time. Here we analyze the mammalian faunal record from four well-sampled 100 ky time slices to assess the degree of faunal stability and change between three Chinji Fm. intervals (13.6 Ma, 12.3 Ma, 11.4 Ma) and the Nagri Fm. (10.1 Ma). Taxonomic identifications for more than 10000 fossil specimens identified to nearly species were assigned to one of three body-size categories, small (< 1 kg; fossils primarily recovered from screening sediment), large (1 – 800 kg) and mega (>800 kg), to test if faunal change occurs similarly across differently sized mammals. The mammalian fauna is quite stable across all size categories between 12.3 and 11.4 Ma, a period of global climatic stability. Most of the faunal change during the Chinji Fm. occurs between 11.4 and 10.1 Ma. A major faunal turnover is recorded between 11.4 and 10.1 Ma; less than 50% of taxa present at 11.4 Ma persist at 10.1 Ma. This late Miocene faunal turnover accords with previous ecophenological studies of body-size distribution within guilds and stable isotope analyses of enamel apatite. In the Siwaliks, the consumption of C4 grasses is first detected in equids at 10.1 Ma. Within these general trends, the faunal responses of small mammals, large mammals, and megaherbivores differ across the four time slices. Small mammals show the greatest variation in species richness, while large mammals show the greatest variation in species abundance, frequency of occurrence and composition. C4 grasses change in both diversity and faunal composition. Together these patterns highlight the complexity of mammalian faunal change. Although there is no support for an enduring Chinji chronozone, there is a million year period of relative faunal stability in the middle of the Chinji Fm. that is followed by a major faunal turnover in the late early Miocene.

Technical Session IX (Friday, November 1, 2013, 10:30 AM)

NEW STUDIES OF BRAINCASE ANATOMY, BRAIN SIZE, AND BRAIN STRUCTURE IN THE LATE CRETACEOUS THEROPOD TROODON FORMOSUS (DINOSAURIA: SAURISCHIA) BASED ON CT SCANNING AND 3D VISUALIZATION

MORHARDT, Ashley, Ohio University, Athens, OH, United States, 45701; RIDGELY, Ryan, Ohio University, Athens, OH, United States; VARRICCHIO, David, Montana State Univ, Bozeman, MT, United States; WITMER, Lawrence, Ohio University, Athens, OH, United States

The Late Cretaceous theropod dinosaur Troodon formosus has often been considered the ‘smallest’ dinosaur due to its large brain-to-body size ratio. Digital cranial endocasts (‘stereolithographic Troodon’) from the Discovering Dinosaurs (DB) and the Two Medicine Formation (Montana) were examined using CT scanning and 3D visualization. This technique allows for nondestructive observation of internal cranial anatomy otherwise obscured by bone and/or matrix. Features readily associated with the endocast of Troodon (e.g., large and discrete cerebral hemispheres, cranial nerve canal locations for CN V–XII, ventrolaterally placed optic lobes, prominent cerebellum, relatively large floccular recess, and overall relatively large size) are apparent. Comparison of study endocasts shows two distinct morphologies associated with the occipital sinuses, in one case being ‘peaked’ (dorsally extended, mediolaterally compressed) and the other case being ‘rounded’ (dorsal surface gently convex, shows no dorsal extension, and is not mediolaterally compressed). Peaked morphology corresponds more closely with that of the related Mongolian troodontid Zanabazar, which also was analyzed for this study. This variability may have implications for the causal morphology of the cerebellum in both taxa. Similar to previously described material, vascular impressions can be seen on the medial surface of the laterosphenoids of Troodon, allowing assessment of the rostroventral extent of the optic lobes and cerebral hemispheres. Additionally, composite brain models were constructed for Troodon in the modeling software Maya, using Gross Anatomical Brain Region Approximation (GABA) wherein 3D ellipsoids were modeled to represent major brain regions (olfactory lobes and tracts, cerebral hemispheres, optic lobes, pituitary, cerebellum, brainstem). Thus, brain regions underlying the digital endocast are modeled as ellipsoids, the limits of which are based on the osteological correlates of soft-tissue structures visible on endocasts, as identified by comparison with extant taxa. Brain models offer a new brain size–range estimate and new insights into cerebellar form and function for the brain of Troodon. Reconstructed brain structure in these troodontids is indeed very birdlike, and is consistent with that of other paravians such as dromaeosaurids and basal birds, but assessments of the ‘smallest dinosaur’ claim await broader-scale analyses of relative brain size and brain-region evolution, which are currently underway.

Post-Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

CRANIAL ONTOGENY OF EDMENTOSAURUS: IMPLICATIONS FOR THE TAXONOMIC STATUS OF THE PRINCE CREEK FORMATION SPECIES (LOWER MAASTRICHTIAN, NORTHERN ALASKA)

MORI, Hirotsugu, University of Alaska Fairbanks, Fairbanks, AK, United States, 99709; DRUCKMILLER, Patrick, Univ. of Alaska Museum, Fairbanks, AK, United States; ERICKSON, Gregory, Florida State University, Tallahassee, FL, United States; PRIETO-MÁRQUEZ, Albert, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany

Dinosaur diversity at high palaeolatitudes is poorly understood but has important implications for resolving questions regarding fauna provinces in Laramidia. The temporally and geographically wide-ranging Edmontosaurus is an important case in point. The Liscomb Breccia, in the lower Maastrichtian Prince Creek Formation of northern Alaska, has produced thousands of isolated elements of a single species of hadrosaurid referable to Edmontosaurus. However, the vast majority of the remains come from young juveniles, approximately one-fourth to one-third of the adult size, making a species-level assignment challenging. We attempt to address the taxonomic status of the Alaskan material by first characterizing the morphological changes that occur during ontogeny in Edmontosaurus. We conducted a morphometric analysis of Edmontosaurus using a three dimensional composite reconstruction of the skull of the Alaskan material and compared this to 19 nearly complete skulls of adult E. regalis (late Campanian) and E. annectens (late Maastrichtian). For shape changes that are difficult to visualize in this morphometric analysis, we applied simple bivariate plots and comparative morphometric analysis, referring both complete and incomplete Edmontosaurus specimens. We found that the Alaskan material has different proportions of the cranial endocast and is different in shape compared to most described Edmontosaurus species, but assessments of the ‘smallest dinosaur’ claim await broader-scale analyses of relative brain size and brain-region evolution, which are currently underway.
DEVELOPMENTAL VARIATION COMPlicates reconSTRUCTIONS of SKELETAL ONTOGENY of EXTINCT VERTEBRATES: a LESSON FROM TRICERATOPS AND TORSORUS

MORRIS, Zachary, The University of Texas at Austin, Austin, TX, United States; 78705; BURROUGHGS, Robert, The University of Texas at Austin, Austin, TX, United States; COLBERT, Matthew, Univ of Texas at Austin, Austin, TX, United States  

Studying the biology of extinct organisms can be complicated by many factors, but one critically important consideration is development. When not properly assessed, ontogenetic variation can lead to difficulties in phylogenetic analyses and taxonomic assignments. However, quantifying developmental variation can be tremendously difficult given a limited number of specimens and the completeness of those specimens. A recent debate about whether or not T. rex is a polyporatop on the most posterior portion of the jaw was highly conserved. This led to the development of the Teethtron model of tooth size and shape. The Teethtron model predicts that the molar size and shape of Protoceratops andrewsi should be increased in size and shape. This prediction was tested by comparing the molar size and shape of Protoceratops andrewsi to those of other ceratopsians. The results of these comparisons suggest that the molar size and shape of Protoceratops andrewsi is consistent with the Teethtron model. This finding provides further support for the hypothesis that Protoceratops andrewsi had a large, robust molar size and shape. These results also suggest that the Teethtron model provides a useful tool for understanding the evolution of ceratopsian morphology.

An isolated tooth and an intermediate phalanx of terrestrial mammals were exhumed in Seymour/Marambio Island from a basal marine horizon of the Acantilados geological unit. These remains were recovered indicate an early Eocene age. So these two fossils represent the earliest records of terrestrial mammals from Antarctica. The tooth is a left talonid fragment of m2 without roots identified as cf. ?entonconulid mesial to the entoconid probably close the talonid valley lingually. The Hypoconulid is small and is connected to the entoconid by a faint postcristid. An a wrinkled surface not seen in the sharper lingual side. A large hypoconid fill the talonid basin is not so wide but is particularly deep. ?entonconulid mesial to the entoconid probably close the talonid valley lingually. The Hypoconulid is small and is connected to the entoconid by a faint postcristid. An a wrinkled surface not seen in the sharper lingual side. A large hypoconid fill the talonid basin is not so wide but is particularly deep.
additional specimens revealed a much broader scatter of morphology than known before, and a single allometric equation can no longer fit all samples.

Four distinctive morphotypes are found in our collection. By far the most common is Chaohusuchus yangi, resurrected because it can now be clearly distinguished from the type species, C. geishanensis. This latter species is extremely rare, with only two specimens known to date. In addition, we have two new species, a robust form and an extremely short-snouted form, but these two are also rare, being represented by 4 and 1 specimens, respectively. The four species are distinguished based on suites of cranial and postcranial characters; the three hominoid characters alone can readily delineate the four. A linear discriminant analysis of the forelimb measurements allowed 100% correct reclassification.

We also collected parts of a significantly larger ichthyosaur but the specimens are too fragmentary to diagnose a new species. Overall, at least four and probably more species of ichthyopterygian inhabited Chaohu in the Early Triassic. Given that rare species are difficult to recover, it is possible that we are vastly underestimating the global diversity of ichthyopterygians in the Early Triassic. Suggestions have been made in the past that other Lower Triassic ichthyosaurs may be as common as, or even more common than, one species although such has not been established based on well-preserved skeletons.

**Posterior Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)**

**A PROXIMAL RADIUS OF BARBERAPITHECUS HUERZELERI (PRIMATES, PLOPICTHECIDAE) FROM THE MIocene SITE OF CASTELL DE BARBER (NE IBERIAN PENINSULA)**

Moya-Sólar, Salvador, ICREA at Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona, Barcelona, Spain; ALBA, David M., Institut Català de Paleontologia Miquel Crusafont, Barcelona, Spain; ALMÉCIJA, Sergio, Stony Brook University, Stony Brook, NY, United States

Barberapithecus huerezleri (Primates, Plopiicthecidae) was described in 2012 on the basis of dental remains from a Late Miocene of Castell de Barber (Vallès-Penedès Basin, NE Iberian Peninsula). Despite some similarities with the plopiicthecine Plopiicthecus, Barberapithecus displays a set of dental derived features supporting its inclusion in the crouelanne tribe Anapihecin. Whereas the postcranial anatomy of the Plopiicthecidae is well known based on partial skeletons, the anatomy of Barberapithecus is more than one species although such has not been established based on well-preserved skeletons.

Based on proximal articular measurements of the radius, a body mass of 4.3 kg (95% confidence interval 3.9–4.8 kg) is estimated for IPS66267, which fits well with estimates around 4–5 kg based on the teeth of the holotype (female) individual. This supports an attribution of IPS66267 to Barberapithecus, and discounts an alternative attribution to the large-bodied hominoid primate that is also recorded at this site. This proximal radius displays a similar morphology to that observed in non-hominoid anthropoids (other than atelines) as well as Epiphiolophus and extinct East African primitive catarinines (Similus and Deduphoticus). The radius of Barberapithecus displays a relatively short and robust neck that is strongly compressed antero-posteriorly; a proximodistally expanded proximal radioulnar joint on the anteromedial portion of the head; a pronounced lateral lip; a restricted articular surface for articulation with the humeral capitulum; and a tilted and oval radial head. Barberapithecus therefore lacks the functional features that, in hominoids and atelines, are functionally related to suspensory supports an attribution of IPS66267 to Barberapithecus, and discounts an alternative attribution to the large-bodied hominoid primate that is also recorded at this site. This proximal radius displays a similar morphology to that observed in non-hominoid anthropoids (other than atelines) as well as Epiphiolophus and extinct East African primitive catarinines (Similus and Deduphoticus). The radius of Barberapithecus displays a relatively short and robust neck that is strongly compressed antero-posteriorly; a proximodistally expanded proximal radioulnar joint on the anteromedial portion of the head; a pronounced lateral lip; a restricted articular surface for articulation with the humeral capitulum; and a tilted and oval radial head. 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The success and diversification of ichthyosaurian dinosaurs is due to a substantial array of phylogenetically distinguishing characters, including important functional adaptations. Previous studies have addressed cranial musculoskeletal function; specifically, ichthyosaurian humeri have considerable morphological diversity in jaw structure, especially among subclades, but also among genera within a given subclade. In this study, relative muscle forces among genera within ichthyosaurian subclades as well as among these clades were calculated using 2D lever arm methods. Such lever arm mechanics estimate relative adductor muscle force for one side of the mandible independent of other muscles, allowing an assessment of the effect of jaw size, posture, and bone in complex morpophologies of jaw adductor muscles in basal ornithomorphs and margonieoplosa of a strong caudal bone force in hadrosauroidea and ceratopsids. A relatively low bite force is also shown among thcracopsids, especially ankylosaurs, as well as a transition from a distal bone force in basal stem species to a more mesial bone force in advanced stem species. Perturbation analyses constructing hypothetical jaw morphologies with coracoid processes removed, as well as the jaw joint raised to the level of the tooth row, and a combination of both alterations were also analyzed to explore the effect of these jaw morphologies on the mandibular mechanical advantages for each taxon. In all taxa, both the ontogenetic process and jaw joint increase moment arm length and therefore increase the mechanical advantage of the jaw apparatus. In more basal ornithischian taxa, lowering the jaw joint increased mechanical advantage to a higher degree than the presence of a coracoid eminence. However, throughout the evolutionary transition to genera that are independently derived in each subclade, the presence of a more prominent coracoid process was far more influential in increased mechanical advantage than the lowered jaw joint, a trend seen in previous studies. These analyses help elucidate general evolutionary trends in mandibular mechanical advantages across theroploarichia through taxa and show that these complex feeding apparatuses within different clades as well as morphological convergences between clades.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

A BASAL THUNNOSSAURIAN FROM IRAQ REVEALS DISPARATE PHYLOGENETIC ORIGINS FOR CRETAECEOUS ICHTHYOSAURS

NAISH, Darren, University of Southampton, Southampton, United Kingdom; FISCHER, Valentin, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; LISTON, Jeff, National Museum Scotland, Edinburgh, United Kingdom; GODFROIT, Pascal, Royal Belgian Institute of Natural Sciences, Brussels, Belgium

A new thunnosaur from the Kurdistan region of Iraq represents the first post-Triassic ichthyosaur from the Middle East. The specimen is an articulated partial skeleton that includes a partial skull, complete left forefin, partial ribcage and anterior section of the vertebral column. Associated palynomorphs uncontroversially date the specimen (preserved on a loose slab of matrix) to the late Hauterivian-Barremian interval of the Early Cretaceous. A posterior projection on the humerus, short and trapezoid humerus, enlarged intermedium, and trapezoidal cervical and anterior dorsal neural spines represent autapomorphies. Forefin morphology is archaic: the carpals, metacarpals and phalanges form a mosaic similar to that of Triassic-Early Jurassic parvipelvians, accessory digits are absent, and notching is present on the leading edge of the first digit. These and other characters indicate exclusion of the Iraq ichthyosaur from Ophthalmosauridae, the only ichthyosaur clade currently known from the Cretaceous. A phylogenetic analysis of Parvipelvia – the largest yet produced – recovers the new taxon (the sister taxon of Ichthyosaurus community) as a clade identified by a new taxon as the sister taxon of Ichthyosaurus community, thereby invoking a ghost-lineage of more than 60 million years. Inclusion of the new taxon in analyses produced by other authors also resulted in exclusion from Ophthalmosauridae, though relationships with other neichthyosaurs are less resolved than in our analysis. We conclude that the new taxon represents an extensive clade of more than 40% of Ichthyosaurus community and retained an ‘Early Jurassic’ grade of pectoral anatomy into the Cretaceous. Ophthalmosauridae and members of the Ichthyosaurus lineage therefore both persisted beyond the Jurassic. Clearly, both have highly contrasting evolutionary histories and retained an ‘Early Jurassic’ grade of pectoral anatomy into the Cretaceous.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

DELIMITING THE FORELIMB MORPHOLOGY AMONG PLEISTOCENE (ENSENADIAN-LUJANIAN) MYLODONTIDS SLOTHS (MAMMALIA, MAMMALIA) FROM THE EARLY PLEISTOCENE KONSO FORMATION, SOUTHERN ETHIOPIA

NAKAYA, Hideo, Kagoshima University, Kagoshima, Japan; SUWA, Gen, University of Tokyo, Tokyo, Japan; ODE, Satoru, Kagoshima University, Kagoshima, Japan; ASAEW, Berhane, R. V. R. S.; Addis Ababa, Ethiopia; BAEYENS, Yonas, A. R. C. C., Addis Ababa, Ethiopia

The early Pleistocene Konso Formation crops out in the Konso area at the southern end of the Main Ethiopian Rift. The Konso Formation has yielded a number of vertebrate fossils, including hominids. This presentation is based on a study of the Konso Formation 1.8 Ma horizon of the Konso Formation. Well-preserved skulls of Equus from the Late Cenozoic of Africa are very rare, known only from E. koobiensis from east of Lake Turkana and a few skulls from North and South Africa. Previous researchers mentioned some similarities of these fossil Equus with E. stenonis from Europe or extant E. Quagga from south of Africa. This Konso skull shows similarities with the skull of E. Asinus africamus in the ratio diagram pattern of metric data that compare extant and fossil Equus skulls. However, the size of the Konso skull is larger than the size of E. A. africamus skulls. One possibility is that this Konso skull represents a new species of genus Equus, perhaps the first fossil record of subgenus Asinus from Sub-Saharan Africa.

Poster Session III (Saturday, November 2, 2013, 4:15 - 6:15 PM)

A NEAR-COMPLETE SKULL OF EQUUS (EQUIDAE, PERISSODACTYLA, MAMMALIA) FROM THE EARLY PLEISTOCENE KONSO FORMATION, SOUTHERN ETHIOPIA

NAYAKAYA, Hideo, Kagoshima University, Kagoshima, Japan; SUWA, Gen, University of Tokyo, Tokyo, Japan; ODE, Satoru, Kagoshima University, Kagoshima, Japan; ASAEW, Berhane, R. V. R. S.; Addis Ababa, Ethiopia; BAEYENS, Yonas, A. R. C. C., Addis Ababa, Ethiopia

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Romer Prize Session (Thursday, October 31, 2013, 11:00 AM)

ESTIMATION OF THE BONE GROWTH CENTER USING INNER BONE STRUCTURAL FEATURES AND ITS APPLICATION FOR PALEOHISTOLOGY

NAKAIMIKA, Yasuhisa, Steinmann Institute for Geology, Mineralogy and Paleontology, University of Bonn, Bonn, Germany

Recent advances have seen remarkable progress in knowledge of bone histology of fossil and recent tetrapods. However, despite the three-dimensional nature of internal limb bone structure, two-dimensional comparison of single transverse thin sections as a convenient standard has been performed. Sections were most often sampled from mid-diaphyseal level, or mid-shaft, which is defined as the most constricted region of the diaphysis. Since the transverse section from this level is likely to pass the center of ossification of a bone, it is believed that such section yields the strongest ecological signals and the best preservation of ontogenetic records such as lines of arrested growth. The middle diaphysis, or the pathway of major blood vessels, can be seen by bone wall in a long bone develops during embryogenesis, and continues to connect internal and external bone spaces throughout ontogeny. Therefore, if nutrient canals do not drift within compact bone, growth center of a bone can be estimated by tracing the path of nutrient canal internally. Here the author validates the utility of the three-dimensional structure of nutrient canals as the basis of the ontogenetic center or true mid-shaft using micro-focus CT scanner and thin sections. Stylopalial and zeugopodial limb bone specimens of various mammals, birds and reptiles were scanned using high-resolution CT scanner and visualization of nutrient canals was performed. Several thin sections were taken from a bone so that they pass through different nutrient canals. As the result, nutrient canals surrounded by periosteal bone, but not endosteal bone. This indicates that the nutrient canal does not drift within compact bone, and that the center of ossification is located at the intersection point of the extension of nutrient canal and the longitudinal axis. The validity of this method was supported by the observation of more eveoryl canal in the bone with medallary cavity where the center of ossification is also identified by the structural center of encochondral cancellous bone. The center of ossification is not always located in the morphological mid-shaft but in far proximally or distally to that in case of bones with complex geometry. CT scanning techniques allow the portion of bone without nutrient canal to be defined and the center of ossification. In conclusion, three-dimensional inner bone structures including nutrient canal are useful in conjunction with comparative osteohistological studies for estimating ontogenetic pattern from a single bone of an extinct animal.
diversification, as teasing apart homology from homoplasy has been difficult with the current sample of taxa. Here we present the postcranial anatomy of *Azendohsaurus madagaskarensis*, an early archosauriform from the Middle-Late Triassic of Madagascar. *Azendohsaurus madagaskarensis* comes from a monotypic clade containing an ontogenetically variable sample, with preservation ranging from whole, disarticulated bones, to articulated partial skeletons. From this boneyed, the entire anatomy of the taxon is represented. *Azendohsaurus madagaskarensis* possessed an elongated neck, short tail, and stocky limbs. The manus and pes have unexpectedly short digits, terminating in large, curved ungual phalanges; together with the skull, knowledge of the postcranial skeleton elevates *A. madagaskarensis* to another highly apomorphic and bizarre Triassic archosauriform. Even so, recovery, description and analysis of the full anatomy of *A. madagaskarensis* provides clues to understanding the radiation of other, more problematic and specialized taxa, including the North American Late Triassic archosauriforms *Triplosaures* and *Tetrapeteron*. For example, *A. madagaskarensis*, *Triplosaures*, and *Tetrapeteron* share a dorally hooked quadratojugal, and enlarged, lanceolate jugals, whereas *Triplosaures* and *Tetrapeteron* share a ventrally expanded quadratojugal and a hand of elongate, curved scapular blade, preaxillary maxilla. We tested these observations in a newly constructed phylogenetic analysis centered on Triassic archosauriforms and archosauriforms. We find that *A. madagaskarensis*, *Triplosaures*, *Spinosuchus*, and *Tetrapeteron* form a clade within Archosauriforms, but the relationships of this clade to other groups of Triassic archosauriforms (e.g., archosauromorphs, rhychoosaurs, stantyphostropheids) remains poorly supported. The newly recognized clade containing *A. madagaskarensis*, *Triplosaures*, and *Tetrapeteron* demonstrates high disparity of feeding adaptations even within a closely related group of basal archosauriforms.

### Technical Session XII (Friday, November 1, 2013, 3:45 PM)

**MODELING THE HISTORICAL RANGE OF ALLIGATOR AND ITS IMPLICATIONS FOR CROCODYLIANS AS PALEOClimatic PROXY**

NESTLER, Jennifer, Stony Brook University, Stony Brook, NY, United States; AIELLO-LAMMENTS, Matthew, Stony Brook University, Stony Brook, NY, United States.

Crocodylians and their fossil relatives are regarded as climate-sensitive and their spatial distributions are often used to reconstruct, or act as proxy for, palaeoclimate. However, crocodilian tolerances are not universal to the group and we know very little about which climate variables drive changes in crocodilian species distributions. The genus *Alligator* contains two extant species, *A. mississippiensis* and *A. sinensis*, and several fossil species. Unlike other crocodilians, *Alligator* is able to tolerate freezing temperatures for extended periods, allowing them to live in temperate climates. *Alligator mississippiensis* has a broad range across the southeastern United States, while *A. sinensis* is typically a thermally encapsulated species and found in a handful of locations in the province of eastern China. To test which climate variables drive *Alligator* range evolution and to provide rigorous estimate of past distributions, we compiled a database of individual extant occurrences and 19 bioclimatic variables for the Recent. Using the software package Maxent and five bioclimatic variables, we modeled the distribution of *Alligator* at the present, the last glacial maximum (~21 ka), and last interglacial period (~120-140 ka) to track its expansion and contraction with climate change. The results show that the range of *A. mississippiensis* expanded northward during the last interglacial period and severely contracted during the last glacial maximum. The range contraction is supported by low mitochondrial DNA diversity, which is thought to indicate a population bottleneck in the Late Pleistocene. Additionally, the modern range of *A. mississippiensis* extends farther north than is currently recognized. This is corroborated by both historical and fossil data, indicating that the range extent is subject to climate change. Despite the expansion and contraction of the range with climate, the model indicates that the minimum annual temperature and the mean temperature for the coldest quarter of the year may not be the most limiting factors in their range. This has biogeographic implications for the dispersals of the genus from North America into Asia, and indicates that more research is required to fully understand the limiting factors of their range.
Bovid artiodactyls are much diversified in the late Neogene fauna of southern Asia. Previous workers suggested that the faunal assemblages of the Irrawaddy sediments and the Tha Chang sand pits are more endemics than that in northern South Asia. In order to revise taxonomical positions of Bovid artiodactyls, we examined the existing floor and installation of a new floor that would withstand the weight of the bones and teeth, and decay analyses. Eight most parsimonious trees were recovered. The strict consensus tree is shown in Figure 1. The new material fills numerous gaps in our knowledge of Protocohadros skeletal anatomy and ontogeny, and provides insight into hadrosaurid evolution.

Preparation’s Session (Thursday, October 31, 2013, 11:00 AM)

MOVING MARSH’S DINOSAURS INTO THE 21ST CENTURY

NORRIS, Christopher, Yale Peabody Museum of Natural History, New Haven, CT, United States; 06511; YARBOURGH-FITZGERALD, Vicki, Yale Peabody Museum of Natural History, New Haven, CT, United States; FOX, Marilyn, Yale Peabody Museum of Natural History, New Haven, CT, United States

In 1926, the Peabody Museum constructed what was then a state-of-the-art storage facility to house the dinosaur collections of Othniel Charles Marsh, including type specimens of such iconic taxa as Apatosaurus, Stegosaurus, Camarasaurus, and Triceratops. The hand-made metal storage featured an innovative design of adjustable, wire mesh pullout shelves. Though advanced for its time, this storage system was far from ideal, being subject to corrosion and exposing specimens to mechanical damage through vibration. The storesroom itself was dungeon dark and had no climate control; fluctuations in temperature and humidity added stress to already failing 1870’s hide glue joints. In 2000 the Museum was able to deal with specimen-level issues, but the larger problem of the storage area itself remained. In 2009, the Museum made a successful application to the Save American Heritage from that Threat Program, based on the significance of Marsh and his discoveries to the history of the United States. Recently the Peabody Museum has been able to move these important specimens into new compactorized storage, in a newly renovated and climate-controlled space in an adjacent building, with access controlled by a new security system. The renovation of this space called for complete removal of the existing floor and installation of a new floor that would withstand the weight of the bones and the compactors. The new well-lit, white Delta Designs compactors feature pullout shelving that’s at eye level, smoothly, with the touch of a finger, making it easier for researchers to study any specimen on the shelf. This move has enabled us to reorganize the collection, reuniting elements from specimens that were formerly dispersed around the original room. Specimens are now arranged taxonomically and within taxon by catalog number. As the specimens are moved into the new storage facility their condition is being monitored, any needed repairs made, specimens are rephotographed, and both the original location and the new location are databased. This presentation describes the long process through which, step-by-step, we have been able to improve the accessibility and stability of these specimens.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

TAXONOMIC, MORPHOLOGICAL, AND PALEOENVIRONMENTAL REVISIONS ON FOSSIL BOVIDS (ARTIODACTYLA) FROM CONTINENTAL SOUTHEAST ASIA

NISHIYA, Yuichiro, Primate Research Institute, Kyoto University, Aichi, Japan; TAKAI, Masanaru, Primate Research Institute, Kyoto University, Aichi, Japan; VIDTHAYANON, Chavalit, Mekong River Commission, Vientiane, Laos; HANTA, Takai, Masanaru, Primate Research Institute, Kyoto University, Aichi, Japan; POOLE, Karen, The George Washington University, Washington, DC, United States

Sivaportax dolabella

Squalicorax

Proleptobos birmanicus

Sivaportax giganteus

Meniscognathus

ORNITHOPODA, HADASUROIDEA) FROM THE WOODBINE FORMATION OF TEXAS

NOTO, Christopher, University of Wisconsin-Parkside, Kenosha, WI, United States, 53141-2000; MAIN, Derek, Univ of Texas at Arlington, Irving, TX, United States; POOLE, Karen, The George Washington University, Washington, DC, United States

Protohadros was originally described as the most basal member of the Hadrosauridae, based on a reasonably complete skull but scant postcrania from the Arlington Member of the Woodbine Formation (Cenomanian). Subsequent analyses place it outside HADASUROIDEA as a stem taxon among a series of increasingly derived hadrosaurids, although some ambiguity in its position exists. Furthermore, recent work has demonstrated the complicated and mosaic nature of hadrosaurid evolution leading up to the presence of the Hadrosauridae, especially in the very basal skeleton; suggesting more postcrania are needed to better resolve relationships within stem hadrosaurids.

Skeletal material excavated from the Arlington Archosaurom SAA in Dallas, TX, represents previously unknown postcranial elements attributed to Protohadros. Material comes from multiple individuals and growth stages including a scapula, coracoid, humerus, ulna, ilium, ischium, pubis, femur, tibia, fibula, ribs, axis, and vertebrae. Cranial material includes teeth and a near complete dentary. The material displays a unique basal iganiform morphology and features derived characteristics in hadrosaurids that are not seen in other taxa. The AAS is located in the Lewisville Member, which underlies the Arlington Member, and consists of coastal delta plain deposits. Lithostratigraphy, biostratigraphy, and fossil mammal biofacies suggest the site is part of the Lewisville Member, making it older than originally reported. Similar isolated ornithomimid remains from Lewisville Member exposures in the area suggests Protocohadros was a relatively common taxon in these environments.

Both cranial and postcranial characters were scored for Protohadros in a matrix of 35 taxa and 218 characters. A preliminary parsimony analysis was performed using the software package TNT 1.1 using the defaults of the xmult command. This runs multiple searches using a combination of algorithms and was followed by symmetric resampling and decay analyses. Eight most parsimonious trees were recovered. The strict consensus tree is shown in Figure 1. This new material fills numerous gaps in our knowledge of Protocohadros skeletal anatomy and ontogeny, and provides insight into hadrosaurid evolution.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

RECONSTRUCTING AN ANCIENT PLAYA MUDFLAT USING HIGH- DYNAMIC-RANGE IMAGING ALONG AN EXPOSED SECTION OF THE FLUVIAL-LACUSTRINE DEPOSITS OF THE COPPER CANYON FORMATION, DEATH VALLEY NATIONAL PARK, CALIFORNIA

NYBORG, Torrey, Loma Linda University, Loma Linda, CA, United States, 92354; NURMI, Neil, Resources Management, Death Valley National Park, Death Valley, CA, United States; JANSEN, Birgitta, Resources Management, Death Valley National Park, Death Valley, CA, United States

Extremely well preserved fossil tracks and trackways of mammals and birds are preserved in playa mudflat deposits of the Copper Canyon Formation. Twenty-six ichnocoecies of cat, camel, horse, mastodon, and bird tracks have been identified from 60+ localities spanning over 1800 m of fluvial-lacustrine deposits. The Formation is exposed within Copper and Coffin Canyons on the west side of the Black Mountains in southern Death Valley National Park, California in a tectonic basin associated with right steps within a low angle normal fault system that extended Death Valley and uplifted the Black Mountains. Uplift has deformed the basin into a large syncline. Detailed measured sections within the Copper and Coffin Canyons reveal that the distribution of the tracks is widespread and is only limited to the degree to which the rocks crop out. Most rock exposures are very limited. However, along the limbs of the syncline the deposits dip up to 70 degrees exposing large areas of the ancient playa mudflat deposits. At one of these limbs we used high-dynamic-range imaging to capture multiple standard photographs using exposure bracketing. This process produces an image of greater dynamic range and thusly greater definition. Stitch software was then used to reconstruct a portion of the playa mudflat. Using this technique a plethora of mammal and bird tracks and associated sedimentary structures can be clearly seen, which allows insight into the potential number and distribution of tracks still buried within the 1800 m fluvial-lacustrine deposits of the Copper Canyon Formation.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

PHYLLOGENETIC AND BIOSTRATIGRAPHIC IMPLICATIONS OF NEW POSTCRANIAL MATERIAL OF PROTOHADROS (ORNITHOPODA, HADASUROIDEA) FROM THE WOODBINE FORMATION OF TEXAS

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Soricognathus, and several indeterminate chamopsiid specimens. Most of the chamopsiid specimens are too fragmentary for specific identification. Additional scincomorph species include cordyliform and paramacellodid-cordylid-grade jaw fragments. Anguimorphs include a few platynotan vertebrae and numerous platynotan jaw fragments. Some of the jaw fragments are tentatively referable to Parasaurus, but most specimens are too fragmentary for further identification. Additional anguimorph remains include a jaw fragment comparable to the glyptosaurus Odaxosaurus, anguid osteoderms, and osteoderms with a pronounced pustulat anatomical ornamentation similar to that known for both monotremes and plesiadapiforms. Byrd and Mones also report several potential jaw fragments referable to Iguanidae (Iguanidae) based on the presence of high-crowned, narrow-shafted, tricuspid teeth with flaring accessory cusps.

The localities in Hill County, Montana are approximately 90 km north of the classic locality of the Goodrich Formation. Many of the skull and vertebrate remains in the Chouteau Formation from the only other lizard fossils (Chamops segnis, Leptochamops denticulatus, Odaxosaurus piger, Eumecolestes lanceolatus, Parasaurus wyomingensis, Paraderma horteri) of the Judith River Formation have been reported. These original localities produced some relatively well-preserved jaws, but most specimens are fragmentary and the species-level taxonomic precision of the original identifications requires re-evaluation.

Among the relatively well-sampled lizard faunas from the Judithian, the Judith River fauna is one of the lowest in taxonomic diversity. As with most other known Judithian faunas (ranging from northern Mexico to southern Alberta) the Judith River Formation shares the presence of platynotan, Odaxosaurus, and non-chamopsiid scincomorphs. The high diversity of chamopsids is most similar to the nearby faunas of southern Alberta. If confirmed, the presence of iguanians in the Judith River Formation would be an important addition to a meager record currently restricted in the Upper Cretaceous to northern latitude localities.

Postter Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

THE EVOLUTIONARY HISTORY OF CRANIAL VASCULARITY IN BASAL RUMINANTS

O'BRIEN, Haley, Ohio University, Athens, OH, United States, 45701

Artiodactyls possess a highly specialized cranial vascular structure known as the carotid rete. The carotid rete is an intracranial thermoregulatory arterial meshwork that replaces the carotid artery. Sitting within a sinus of cooled venous blood, this structure is capable of selectively cooling the brain and delaying hydrologically costly responses to heat stress, such as panting and sweating. As such, the carotid rete is hypothesized to be selectively advantageous for artiodactyls as climate has changed across the Cenozoic. Within Artiodactyla, the most speciose clade is the Ruminantia. Hypothesized to be selectively advantageous for artiodactyls as climate has changed across the Cenozoic. Within Artiodactyla, the most speciose clade is the Ruminantia.

This study examines the phylogenetic and paleoecology to elucidate the evolutionary history of the carotid rete within the Tragulidae. Arterial patterns were confirmed in additional tragulid taxa first by radiopaque latex vascular injection, CT scanning, and digital dissection of a Moschiola meminna. Next, osteological correlates for cranial vascular patterns, including external cranial foramina and intracranial impressions (i.e. carotid canal), were scored for all extant species of tragulids. It was determined that all contemporary tragulids lack a carotid rete. Osteological correlates were then sought in extinct, primitive ruminants, including Leptoternex and Hipsiodus. Osteological correlates in fossil ruminants indicate that the most primitive members of this group possessed a carotid rete. The homologous ancestral to the carotid rete is not clear. Ancestral state character reconstruction reveals a secondary loss of the carotid rete within Tragulidae. These results suggest that basal ruminants likely possessed this evolutionarily advantageous cranial vascular pattern.

Postter Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

ANATOMY OF A NEONATE SKULL OF DOLICHORHYNCHOPS (PLESIOSAURIA)

O'KEEFE, F. Robin, Marshall University, Huntington, WV, United States, 25555; BYRD, Christina, Marshall Univ, Suffolk, VA, United States

We describe a neonate polyodontid plesiosaur skull from the Sharpton Springs member of the Pierre Shale (Campanian). The skull is represented by most of a dermal plate, with the bone exhibiting all ontogenetic stages. Other elements include the postparasphenoid, parietal, and the opercular. The parasphenoid and cephalopterygoid, and the endochondral basi-phenoid, exoccipital, and prootic. The suspensorium is complete on the left side, although the quadrate has dropped out. The rostrum, consisting of the right maxilla and fused premaxillae, is complete back to near the level of the frontal suture. Both hemimandibles are present.

The endochondral elements of the skull are poorly ossified and the braincase is completely disarticulated, including the exoccipital. The parasphenoid has a significant anterior rostrum, a character diagnostic for Dolichorhynchops, as is the articulation of the cephalopterygoid; however, the pterygoid plates are very narrow, more than in Trinacromerum. The entire skull was surprisingly narrow, with a high, arched suspensorium and a well-developed sagittal crest. This character is also diagnostic to the genus Dolichorhynchops, and we therefore refer the neonate to that taxon. Reconstruction of the orbital region is not possible, but given the proportions of the skull the eye would have been large. Of the hemimandibles, the left is better preserved, and allows a confident estimate of skull length. The mandibular symphysis appears to have been entirely cartilaginous, and completely enclosed the anterior ends of the coronoid and splenial. There are three teeth preserved. 10 of them still residing in alveoli. The teeth are small, but similar to adult Dolichorhynchops teeth. In summary, the skull of the neonate is relatively high and narrow, with a relatively short, gracile snout and large eyes. The dermal skull is delicate, and the endochondral elements are poorly ossified. A

Postter Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

VARIATION THROUGH TOOTH WEAR OBSCURES THE DIFFERENTIAL DIAGNOSES OF THE HEMPHILLIAN CASTORIDS DIPSIDOS STORTONI AND DIPSIDOS SMITHI

GLORI, Jennifer, SUNY Oswego, Oswego, NY, United States, 13126; BELL, Christopher, The University of Texas at Austin, Austin, TX, United States; JASS, Christopher, Royal Alberta Museum, Edmonton, AB, Canada

Herpetofoamns are known from a number of Quaternary cave deposits throughout the Great Basin of the western United States, but most are restricted chronologically to the late Pleistocene and Holocene. Excavations in Room 2 at Cathedral Cave, Nevada, resulted in the recovery of more than 900 specimens of reptiles and amphibians. Given current maximum age estimates for faunal Room 2 (146.02 ± 2.584 to 153.7 ± 6.4 ka), reptile and amphibian fossils from Cathedral Cave represent one of the earliest documented vertebrate faunas in western North America. Quaternary remains include representatives of Aspidoscelis, Crotaphytus, Gambelia, and Phrynosoma. Additionally, remains of both gracile and robust forms of other phrynosomatids are present, as are representatives of colubrid and vipersnakes, and two species of turtle (Gopherus agassizii and an unidentified species of Emydidae).

The presence of Gopherus particularly is anomalous given climate estimates for the Pleistocene of the Great Basin. The Cathedral Cave record indicates a resident population of Gopherus, and forces reconsideration of a nearby record previously disregarded as a case of transportation by humans. At the least, the presence of turtles in the Room 2 faunal assemblage is indicative of the substantial terrestrial distribution of those taxa in western North America during earlier portions of the Pleistocene that are not otherwise represented in the Great Basin.
abundances by site, including analysis of variance, correlation analysis, and ordination, while attempting to control for differences in site-level taphonomy and stratigraphy.

Our results highlight a degree of spatial heterogeneity in the Cloverly metacommunity. While zoogeographically distinct sites exhibited different osteological assemblages, the two most distinctive sites contained bones of a four-legged animal with a large skull, possibly a sauropod. These were recovered in greater frequency than others; we recovered numerous sauropod and ornithischian fossils (e.g., albanerpetontids, atoposaurids) possibly bridging the aquatic and terrestrial environments. Other taxa were both common and widespread, including amniote (i.e. lizard and mammal) relative abundances, which we interpret as a metacommunity. The two richest sites exhibited significantly different osteological assemblages, and these differences suggest that the temporal CCE associated with modern endothermy may not have been operational in earlier faunas. Prior to the origin of a stiffer thorax, morphology of respiratory turbinates may have been shaped by factors other than heat and water conservation.

Technical Session VI (Thursday, October 31, 2013, 8:45 AM)

NEW MORPHOLOGICAL DATA ILLUMINATE HINDLIMB FUNCTION AND THE ECOLOGICAL CONTEXT OF FLIGHT IN THE EARLIEST BATS

PADIAN, Kevin, Univ of California Berkeley, Berkeley, CA, United States, 94720-4780; DIAL, Kenneth P., University of Montana, Missoula, MT, United States

Reconstruction of the evolution of chordate flight is challenging because, whereas the earliest bats are clearly capable of flight, their immediate luarasaurian outgroups provide no useful information about intermediate states between fully volant bats and their terrestrial ancestors. To date, the postcranial morphology of early bats has been less than attention than the skull and teeth, and the principal problem assessed has been whether flight preceded echolocation. New preparation of the postcranial of the most basal bat Onychonycteris and comparative character analysis of other basal fossil bats (Icaronycteris, Palaeochiropteryx) reveal a variety of unusual morphological features that could imply on functional and ecological origin of bats. Newly revealed anatomical features of Onychonycteris and comparative re-examination of other basal bat postcranial data suggests that the trochanteric of the proximal ends of the femur in Onychonycteris were not typically mammalian but subequal, and the head was offset laterally, as in crown-group bats, indicating a relatively “modern” hip flexure and a later orientation of the hindlimb. However, details of the tarsus and the clavus, both manual and pedal, in these basal bats suggest a different ecological context than would be evident from the basal conditions of living crown-group bats. The functional morphology of the forelimb and hindlimb indicate scampialar bats that imply climbing tree trunks and rock faces. Phylogenetic analysis, integrated with analysis of functional traits, suggests a sequence of simplification and reduction of claws, coupled with increased size, and an eventual shift from generalized scampialar bats to inverted perching that could not be used in living bats today.

NEW FOSSIL EGGS, EGGSHELL, AND PERINATAL OSTEOLOGICAL REMAINS FROM THE EGG MOUNTAIN LOCALITY, UPPER CRETAaceous TWO MEDICINE FORMATION, MONTANA, USA

OSER, Sara, Montana State University, Bozeman, MT, United States, 59715

EGG Mountain is one of several dinosaur nesting sites at the Willow Creek Antcline (WCA) in the Upper Cretaceous Two Medicine Formation of Montana. Two unidentified egg clutches (Type I eggshell), fragmentary eggshell (Type II), and osteological remains were recently discovered on the south side of Egg Mountain in homogenized siliclastic gray mudstone. Micritic limestone above the egg-bearing strata contains insect cocoons with helical ridges (Rubidachinus) and burrows consistent with the ichnogenera ichnotherid and ichnusophus. The presence of ichnusophus, indicating a well-drained paleosol. The objectives of this study are to 1) describe the eggs and eggshell, 2) determine nesting environment, and 3) assign the osteological remains to taxon. Analytical methods include petrographic microscopy, cathodoluminescence imaging, and scanning electron microscopy. Microscopy permits identification of egg microstructure, calculation of gas conductance, and assessment of diagenetic alteration.

The two clutches of Type I eggshell contain 7-12 eggs randomly distributed in elliptical areas. The highly compressed 12x12 cm eggs are 1-2 cm thick and lack ornamentation. The 0.5 mm thick eggshell shows diagenetic alteration that obscures microstructure, inhibiting ontological assignment. Type II eggshell is 0.8-1.3 mm thick and is dispersed throughout a 0.7 m interval of mudstone, overlapping with the egg clutches. In thin section, shell units are delineated and are comprised of radiating wedges with sweeping columnar extinction. These features, saggomatoburcallate ornamentation, and prolactolaculate pores allow assignment to Spheroolithus. Spheroolithus and Type I eggs respectively have gas conductances values 17-34 times and 30 times higher than avian eggs of the same mass, suggesting incubation occurred in a high humidity and low oxygen environment. Osteological remains occur at and below the clutches. The small size of the bones and lack of fusion between the dorsal centra and neural arches indicate an embryonic or early hatching developmental stage. Articulation of the dorsal vertebrae with ribs and the close association of the maxilla and premaxilla suggest little or no transport prior to burial. The morphology of the humerus and skull elements is consistent with the Hadrosauridae, however, the developmental stage and incomplete nature of the specimen inhibits further assignment. Although Spheroolithus eggshells are associated with nests containing juvenile hadrosaurs elsewhere in Montana, they are rare at Egg Mountain and further documentation of hadrosaur hatching sites at this locality.

Technical Session VIII (Thursday, October 31, 2013, 3:15 PM)

EFFECTIVE COUNTERCURRENT EXCHANGE AT THE RESPIRATORY TURBINATES REQUIRED A STIFF THORAX IN SYNAPSIDS

OWERKOWICZ, TOMASZ, California State University, San Bernardino, CA, United States, 92407; CROMPTON, A. W., Harvard University, Cambridge, MA, United States

Temporal countercurrent exchange (CCE) of heat and water, which occurs at the respiratory turbinates, allows for considerable energy conservation in extant endotherms. Scaling of respiratory turbinates surface area correlates with field metabolic rate in mammals, but not birds. This suggests nasal cavity dimensions can potentially serve as a proxy in elucidating metabolic rates of extinct synapsids. Temporal CCE depends on cooling and warming of the turbinate mucosa by the inspiratory and expiratory airflows, respectively. This mechanism is effective only when inspiration is followed by expiration before the nasal mucosa can be reperfused and rewarmed. Such a breathing pattern – inspiration preceding expiration – is observed in extant mammals at rest. Extant reptiles show the opposite pattern – expiration precedes inspiration (E/I), with an apneic period of variable duration thereafter. This dichotomy of breathing patterns is determined by the divergent lung structures and thoracicmorphologies of mammals and reptiles. Reptilian faveolar lungs are very low and surface-volume (SA/V) ratio, low surface tension and weak elastic recoil. Reptiles, therefore, do not need a stiff ribcage to counteract elastic lung recoil. Mammalian bronchovascular lungs have a high SA/V ratio, high surface tension and strong elastic recoil. Lung collapse in mammals is prevented by submucosal pressure and neural pressure inside the ribcage. Thoracic stiffness in mammals depends on a suite of characters: a muscular diaphragm, a long ossified sternum and short costal cartilages. In contrast, most reptiles (with the obvious exception of turtles) retain relatively compliant ribcages comprised of a short cartilaginous sternum and long costal cartilages. We propose that the breathing pattern of synapsids could have changed from reptilian (I/E) to mammalian (E/I) only when thoracic stiffness was sufficiently high to oppose elastic lung recoil. Although single sternal elements are found in various therapsids, an ossified segmented sternum (manubrium+sternebrae) is lacking for most synapsid taxa. The earliest record of sternunulae from Jurassic trachydontid, even

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through gradual expansion of the nasal cavity is evident in Triassic therapsids. This suggests that the temporal CCE associated with modern endothermy may not have been operational in earlier synapsids. Prior to the origin of a stiffer thorax, morphology of respiratory turbinates may have been shaped by factors other than heat and water conservation.

Posters Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

NEW PERSPECTIVES ON THE DIVERSITY OF THE CANIDAE IN THE UPPER POLESIDE MEMBER (WHITNEYAN), BRULE FORMATION, BADLANDS NATIONAL PARK, SOUTH DAKOTA

PAGNAC, Darrin, South Dakota School of Mines, Rapid City, SD, United States, 57701; WELSH, Ed, SWCA Environmental Consultants, Rapid City, SD, United States

The Cedar Pass Member of the Brule Formation, restricted to the upper Poleside Member of the Brule Formation, contains representatives of most vertebrate families found in the White River Group. The paleofauna of the Poleside Member is generally interpreted as exclusively Whitneyan in age, while Arkainean assemblages are typically restricted to the overlying Sharps Formation. Historically, the dominant canid representative in the White River Chronofauna has been Hesperocyon, but increased hesperocyonid diversity is recorded in the Whitneyan of South Dakota and Nebraska with the genera Metocyon, Cynodontemus, Sunkahetanka, and Osbornotherium. However, it is in the generically diverse Canidae of the Cedar Pass faunus that the only hesperocyonid representative and abundance is notably low. Borophagine diversity and abundance is exceptionally high, with Archaeocyon, Cynoptotherium, Phalacocton, Oxytocyon, and Oxytocyon represented. The Whitneyan has generally been typified by the first substantial canid diversification event, with hesperocyonids in higher abundance than borophagines. Based on our sample, the Cedar Pass faunus demonstrates a reversal of this trend with the Borophagidae dominating canid ecology. The abundance and diversity of borophagine canids suggests a greater affinity with early Arkainean faunas than the previously interpreted Whitneyan categorization for the upper Poleside Member. Only two Orelian holodiver taxa are represented. Cluster analyses utilizing Dice, Jaccard, Kulczynski and Ouchi similarity indices were utilized to compare the Cedar Pass canid faunus with that of Orelan, Whitneyan and early Arkainean faunas across the western United States. Three of these clusters cluster the Cedar Pass fauna, suggest that the early canid fauna of the Cedar Pass fauna is interpreted as Whitneyan in age. One candidate faunas from South Dakota and Nebraska, whereas one, the Kulczynski index, clusters Cedar Pass with early Arkainean sites of North Dakota and Nebraska. The Arkainean affinity of the Cedar Pass fauna suggests an earlier diversification of borophagine canids in the Great Plains than previously interpreted.

New perspectives on the diversity of the Canidae in the upper Poleside Member (Whitneyan), Brule Formation, Badlands National Park, South Dakota.

Posters Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

TAPHONOMY OF CARNIVOROUS AND HERBIVOROUS MAMMALS PRESERVED IN RANCHO LA BREA TAR PITS: SHIPS THAT PASS IN THE NIGHT

PALMVOIST, Paul, University of Malaga, Malaga, Spain; ESPIGARES, M. Patricio, University of Malaga, Malaga, Spain; PÉREZ-CLAROS, Juan A., University of Malaga, Malaga, Spain; WELSH, Ed, SWCA Environmental Consultants, Rapid City, SD, United States

The Rancho La Brea tar pits are a “Fossil-Lagerstätte” of plant and animal life during the late Paleocene. The sediments, sands and clays deposited as algal fans of ephemeral lakes were periodically covered by petroleum of the underlying Tertiary sandstones. According to current consensus, herbivorous mammals would wander into this sedimentary environment, become trapped in asphalt and eventually die, attracting predators that would also become stuck. Later, the carcasses would be covered by alluvial deposits. This scenario is in agreement with the abundance of carnivores (90%
of the assemblage), but does not explain the lack of articulated skeletons, nor the role played by fluvial transport in the accumulation of bones. The only detailed taphonomic study, performed on a single tar pit, showed that most bones were not subject to a significant degree of fluvial transport, but were buried shortly after death. Here we test these data with contingency tables for differences between carnivores and herbivores. Results showed that the proportion of bones without evidence of transport or showing a minimum degree of fluvial abrasion is 51.2% (8007/15499) for carnivores and 28.5% (721/2526) for herbivores (t = 21.97; p < 0.001). Similarly, the frequency of bones with advanced weathering (weathering stage 2 to 3) is 16.2% (2258/1560) for carnivores and 32.5% (814/2507) for herbivores (t = 41.21; p < 0.001). This suggests that the frequencies of vertebrae and ribs versus the frequencies of long bones, which differ in hydrodynamic behavior and resistance to weathering, also show differences between carnivores and herbivores, which confirms that they experienced different taphonomic circumstances. Specifically, herbivores show a lower preservation completeness than carnivores, as their appendicular skeleton is biased to half of the original bone elements. This could suggest, that after the entrapment of ungulates, carnivores dismembered the exposed limbs of their carcasses.

**Poster Session IV** (Saturday, November 2, 2013, 4:15 - 6:15 PM)

**CRANIAL ANATOMY OF THE PROBLEMATIC CARBONIFEROUS-PERMIAN LEPOSPONDYL BRACHYCHIDECTES NEWBERRY: NEW INFORMATION FROM MICRO-CT**

**PARDÓ, Jason, Univ of Calgary, Calgary, AB, Canada, T2N 1N4; Anderson, Jason, Univ of Calgary, Calgary, AB, Canada**

Lepospondyls is a highly diverse group of small-bodied anamniotes from the late Paleozoic of North America, Europe, and North Africa. Phylogenetic analyses have in recent years generated a lepospondyl phylogeny between dermochelyid sea turtles and Microbrachiosauria. Recent work has made major progress in clarifying the anatomy and relationships of the Recumbirostra (a clade which encompasses the majority of “microsaurs”), but the relationships of the remaining lepospondyl taxa (especially the Aistopoda, Nectridea, Adelospondylus, and Lylophora) remain considerably less well understood. The lylophorans are especially problematic; significant reductions in the dermal and postcranial skeleton make this group difficult to place within lepospondyl phylogeny, and have led some workers to suggest that lylophorans may be closely related to the microsaurs (e.g., Allegaert and Schultze). However, the use of employing x-ray computed tomography have unlocked the braincase as a source of phylogenetic information within lepospondyls, but only limited braincase data is available for lylophorans. In order to facilitate comparison between lylophorans and other lepospondyls, we scanned a partial ontogenetic sequence of the lylophoran Brachydectes newberryi from the Council Grove Group of Kansas and Nebraska, USA. The anterior braincase is robust and heavily ossified, with an anterior (sphenethmoid) ossification bracing the palate against the skull roof and a posterior (orbitosphenoid) ossification contacting the parietal. The columnella ethmoidalis is partially ossified in larger specimens. Dorsal projections of the basiopphenoid (pleurophoid) are robust and brace solidly against the skull roof. The pleurophoiods are separated from the prootic by a fissure that encompasses foramina for both the maxillary branch of the trigeminal as well as a dorsal vein in a similar arrangement to that seen in the brachydeictid Carcassochelys. The other skull elements are well ossified ventrally but retain an unossified window dorsally between the prootic and opisthotic. The occiput is roofed by an ossification of the synotic tectum (“supracapsula”) with a well-ossified ascending process exposed dorsally between the posttemporal and the occipital plate. The nasal capsule is separate from the anasarc architecture. The anasarc neurocranium is distinct from other microbrachiomorphs but shows numerous similarities with the braincase of recumbirostra, especially brachydeictchelys.

**Poster Session V** (Saturday, November 2, 2013, 4:15 - 6:15 PM)

**THE EFFECT OF PROXY ‘HOLOTYPES’ ON TAXONOMIC PRACTICES FOR VERTEBRATE FOSSILS**

**PARKER, William, The University of Texas at Austin, Austin, TX, United States, 78712; STOCKER, Michelle, The University of Texas at Austin, Austin, TX, United States**

Holotype specimens, especially historic ones, are the basis for taxonomic and ultimately phylogenetic arguments, but often are fragmentary and may preserve few diagnostic character states. Frequently, better-preserved, referred specimens are used as proxy ‘holotypes’ for the purpose of additional specimen referrals as well as for constructing new species and other taxonomic categories. That practice is problematic when utilizing apomorphy-based fossil identifications because the precise taxonomic affinities of the proxy materials with respect to the original type specimens may not be clearly identified with specific morphological or diagnostic morphometric characteristics. Therefore, referrals were made using geographic or stratigraphic similarities, which is circular when examining the paleogeographic distributions or chronologic durations of those taxa. The problem of proxy ‘holotypes’ is not restricted to a particular clad or time period, and taxonomic practices involving the Late Triassic aetosaurian tax Taphoforms cocconarium and the Middle Jurassic small theropod Iguanodon bernissartensis show the same problems broadly in the paleontological literature, yet their utility is based entirely on referred, rather than type, specimens that may not represent single taxonomic entities. Our apomorphic examination of the holotype specimens of those aetosaurans designates those taxa as nomina dubia and such taxonomic instability has direct consequences for Late Triassic biostatigraphy and biochronology because these taxa were considered index taxa for proposed biozones. Designation of neotypes, renaming of the diagnostic material, or continued use of proxy ‘holotypes’ all provide some level of solution with respect to this proxy holotype problem. Nevertheless, our recommendation is best determined on a case-by-case basis. It is crucial that taxonomic referrals be based solely on comparisons with a standard set of specimens (ideally type specimens) to ensure repeatability and consistency of specimen referrals. The use of apomorphic character states to refer new material to existing taxa provides a testable and repeatable evidentiary basis for referring new material to taxa, but only if those characteristic states are reflected in the reference specimens. Referrals based on apomorphies present in the type materials avoid geographic and stratigraphic biases and allow type and referred materials to be precisely integrated into larger paleobiological studies exploring the spatial and temporal evolution of extinct taxa.

**Poster Session III** (Friday, November 1, 2013, 4:15 - 6:15 PM)

**ONTOGENY OR PHYLOGENY? CLADISTIC PLACEMENT OF A JUVENILE DROMAEOSAURID FROM THE LOWER CRETACEOUS OF MONTANA**

**PARSONS, William, Buffalo Museum of Science, South Wales, NY, United States, 14139; PARSONS, Kristen, Buffalo Museum of Science, South Wales, NY, United States**

Dromaeosauridae are a group of theropod dinosaurs found in the Late Jurassic to the Late Cretaceous of both the Northern and Southern Hemispheres. Phylogenetic analyses place MCZ 8791 basal to Deinonychus antirrhopus and as a sister taxon to Bambiraptor feinbergorum, but of the 66 characters coded for MCZ 8791, it shares all but one with Deinonychus. That single differing character is a pneumatic foramen in the anterior maxilla. MCZ 8791 shares a character with Bambiraptor in the length of the edges of this foramen show evidence of continuing growth and thus are of a variable ontogenetic nature. Further data has been obtained through landmark shape graphing of the lateral profiles of the second pedal ungual of several dromaeosaurids. Comparisons of the landmark points between taxa shows a marked difference in pattern that can confirm the taxonomic similarity of MCZ 8791 and Deinonychus. Also, the identical structure and number of denticles on the maxillary teeth further confirm this identification. Beyond the characters that have already been coded, some further differences have been observed, some are evidence of a juvenile growth stage and thus are ontogenetic. The juvenile identification of those features is due to the possession of at least one element such as regions of bone/cartilaginous transitional growth; juvenile histological character; and/or open, undeveloped cortical surfaces. Other differences are not diagnostic and the most consistent and most significant is evidence to argue that they are additional variable ontogenetic characters. Examples of these are the presence or absence of maxillary interdental plates, the elongate cranial, possible concave profile of the dorsal edge of the anterior portion of the skull, the slender mandibular rami, the length between the maxillary teeth, the angle of ranging of the maxillary teeth, the length of manual II-2 phalans, the mid-shaft width of pedal II-1 phalans, the distance between the ventral apex of the flexor tubercle and the ventral limit of the proximal articulating facet on pedal ungual 3, the ratio of the
thicknesses of the bony wall to the medullary cavity of the fibula, and the thickness of the bony wall of the distal end of the femur. If MCZ 8791 is a juvenile Deinonychus, then the identification of these further ontogenetic features contributes to our knowledge of dromaeosaurid ontogeny.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

NEW CERCOPITHECID POSTCRANIAL FOSSILS FROM COOPER’S D, SOUTH AFRICA

PATEL, Biren, University of Southern California, Los Angeles, CA, United States, 90033; DESILVA, Jeremy, Boston University, Boston, MA, United States; STEININGER, Christine, University of the Witwatersrand, Johannesburg, South Africa

There are several highly fossiliferous localities in the Blyde River Canyon, South Africa. The Cooper’s Cave System has been known since 1938 and has produced a rich fossil assemblage, including some of the earliest known Paranthropus robustus. In 2001, excavations began at a new locality, Cooper’s D, which dates to approximately 1.4 – 1.5 Ma. Although hominins are relatively rare in the assemblage, remains of cercopithecoid primates are much more common. Craniodental fossils currently indicate the possible presence of at least three large bodied cercopithecoid primates including an adult specimen. In 2011, a bonebed was discovered in the upper Ntawere Formation of Zambia. It preserved cyanodont material, and it contains at least nine silesaurids of the same size class (femur length ~ 150 mm). A giant silesaurid femur (~ 370 mm) was recovered from a nearby locality. Though not assignable to a previously known genus, the silesaurid specimens are numerous enough to permit destructive osteohistological study. Comparison to Late Triassic silesaurids and true dinosaurs provides an evaluation of the early evolution of dinoform traits, such as the origins of rapid, dinosaur-like growth rates. In the Zambian silesaurids, the thin cortex is almost completely composed of parallel-fibered bone, though regions of fibrolamellar bone are present in areas of rapid growth, such as the fourth trochanter. This is in contrast to the predominantly fibrolamellar bone of the Nyasasaurids, early dinosaurs. By the Late Triassic silesaurid Silesaurus opolensis, though the latter shares the presence of small vascular channels with the Zambian specimens. Most vascular canals are primary ostioles in the smaller specimens whereas in the giant femur primary ostioles are restricted to the intercostal and simple canals dominate the subperiosteal bone, indicating a reduced growth rate at larger size if all the femora belong to the same taxon. Vascular canal diameter generally decreases toward the periosteal margin and the canals are mostly longitudinal, although regions of subecticular to weak radial anastomoses are present and extend to the periosteal margin. Nyasasaurus and early dinosaurs are characterized by much higher levels of vascular connectivity. There are no traces of growth marks in any specimen. The Zambian specimens are important because they pertain to only the second non-dinosaurian dinoform sampled histologically and because they may represent a growth series from an Anisian-aged bird-like archosaur.

Technical Session XIV (Saturday, November 2, 2013, 8:15 AM)

EXCELLENTLY PRESERVED NEW SPECIMENS OF ANCHIORNIS AND THE IMPLICATION OF EARLY EVOLUTION IN PARAVES

PEI, Rui, American Museum of Natural History, New York, NY, United States, 10025; LI, Quanguo, China University of Geosciences, Beijing, China; MENG, Qingjin, Beijing Museum of Natural History, Beijing, China; NORELL, Mark A., American Museum of Natural History, New York, NY, United States; GAO, Ke-Qun, Peking Univ, Beijing, China

Anchionis husleyi is a primitive paravian dinosaur reported from the beds of Tiaojishan Formation, western Liaoning, China, at the age of the Middle Jurassic. It was regarded as a pre-Archaeopteryx eocochosaur that is among the earliest members of Paraves. With extremely well preserved feathers, Anchionis is also the first non-avian dinosaur whose plumage coloration is revealed. Anchionis plays an important role in understanding the early evolution of Paraves and the origin of birds. However, the phylogenetic position of this enigmatic species is still debated. Based on the current study of Anchionis provides additional information on the morphology and phylogeny of this taxon. All new specimens are well preserved with complete and well-exposed skeletons, revealing new and detailed anatomical information on the skull and the postcranial skeleton. Although all new specimens can be referred to as Anchionis, they show a small degree of variation in body sizes and some morphological traits such as the humerus/femur proportions, which result from intraspecific and ontogenetic variation. As one of the earliest members of the Paraves, Anchionis exhibits many primitive characteristics observed in Archaeopteryx, basal troodontids and basal dromaeosaurids. Preliminary phylogenetic analyses were conducted with the most updated information on maniraptorans, especially deinonychosaurians, but both maximum parsimony and maximum likelihood criteria. Anchionis is recovered to form a monophyletic group with Anchiornis based on characters such as enlarged maxillary fenestrae, and this group is placed at the basal position of the monophyletic Troodontidae. Anchionis possesses typical troodontid features such as a groove on the lateral surface of the dentary, but it lacks some traditional troodontid traits such as a large number of cheek teeth and the subarcuate mandibular symphysis. The placement of Anchionis into the Troodontidae indicates some avian-like features are present at the earliest stage of the deinonychosaurian evolution, and it gives opportunities to revise the early character evolution within the clade of Paraves.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

THE DIVERSITY OF SMALL MAMMALIAN TARSALS FROM CASTLE GARDENS, EARLIEST EOCENE OF WYOMING

PENKROT, Tonya, Arizona State University, Phoenix, AZ, United States, 85004-0696; ZACK, Shawn, , Phoenix, AZ, United States; STRAIT, Suzanne, Marshall University, Huntington, WV, United States

Castle Gardens is an exceptionally rich micromammal locality in the Willwood Formation, southern part of the Big Horn Basin, Wyoming (Wa-0 bioregion). The mammalian fauna from Castle Gardens documents an earliest Eocene assemblage and includes both dental material, which constitutes the bulk of the material preserved at the locality, and a substantial amount of postcrania. Among the latter, proximal tarsals are the most abundant elements, with a total of 284 small tarsals (under 5 mm in length for astragal and 8 mm for calcanei) currently known, included 168 astragali and 216 calcanei, which can be sorted into at least ten and nine morphs, respectively. Most of these morphs can be reassigned with each other and with taxa represented by dental remains based on size and on representing the subadult and identifiable tarsals from other localities. Among non-eutherian taxa, multituberculate is represented, as are two marsupials, based on astragalar morphology. Eutherians include one archontan, likely referable to Niptomomys, and several morphs that likely pertain to “insectivores”, including Macrocranion, a small mychair in at least 8 small mychair tarsal morphs. Tarsals of Macrocranion are the most abundant in the Castle Gardens sample, matching the dental abundance of this taxon, and are virtually identical to Macrocranion tarsals from Dornaal. The two mychair tarsal morphs show minor but
consistent morphological differences, but both closely resemble taxa of Cryptotopos. Finally, many of the very smallest elements show substantial water wear which makes clear delineation of morphotypes difficult, but at least three astragalar and calcaneal morphotypes are present. Of the small astragalar and calcaneal morphotypes likely include tarsals pertaining to the diminutive “insectivores” known dentally from Castle Gardens, Ratiodontines and Paraportierodon. The presence of at least one additional morph may indicate the presence of a taxon at Castle Gardens that is not yet documented dentally. All of the very small elements differ substantially from tarsals of Macroceratodon and Nyctitheriidae, indicating that the taxon they represent are unlikely to be closely allied to these forms.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

USING MESOWEAR AND MICROWEAR TO INFERR THE DIET OF ASTRAPOTHERIUM FROM THE LATE EARLY MOECENE OF SANTA CRUZ, ARGENTINA

PEREZ, Nicole M., Case Western Reserve University, Cleveland, OH, United States; 44106; CROOK, A., Case Western Reserve University, Cleveland, OH, United States; KELLLOWAY, Tara L., Case Western Reserve University, Cleveland, OH, United States; PRBYLBA, Alish, Hawkins School, Gates Mills, OH, United States; TOWNSEND, K.E. Beth, Midwestern University, Glendale, AZ, United States

Astrapotheres are an extinct group of ungulates that lived in South America from the Paleocene to at least the middle Miocene. Neogene astrapotheres, which are placed in the family Astrapotheriidae, are characterized by their large size (one to several tons), retracted nasal bones (suggestive of a proboscis), canine tusks, and low-crowned, lophodont cheek teeth. Based on craniodental and postcranial morphology, ecological habits of astrapotheres have generally been compared to living tapirs (Tapiridae), rhinos (Rhinocerotidae), elephants (Elephantidae), and/or hippopotamuses (Hippopotamust). The goal of this study was to use dental mesowear and low-magnification enamel microwear to infer astrapotheres feeding ecology relative to these possible modern analogs. Our study was based on 38 specimens of Astrapotherium from the late Paleocene of Mocinco (Hurdajiguald Age) Santa Cruz Formation of southern Argentina (Sanctuariec SALMA). Dental mesowear and low-magnification smearwear are two well-established, taxon-independent methods of paleodietary reconstruction that have been used by many investigators to assess diet in ungulates. Mesowear uses tooth cusp shape to gauge accumulated dietary abrasion (food-on-tooth wear) relative to attrition (tooth-on-tooth wear). We used a mesowear “ruler” based on modern ungulate teeth to score mesowear of astrapotheres upper molars on a scale from 0 (high, sharp cusps) to 3 (flat, blunt cusps). Microwear represents small scars left on tooth enamel by food. We scored astafortherium microwear on clear epoxy casts using low magnification (3X) on a Leica MZ 12.5 stereo microscope with an ocular reticle that delineated a standard measuring area (0.4 x 0.4 mm). The microwear variables scored included numbers of pits, scratches, and gouges. The size, depth of pits were assessed qualitatively as was the texture of scratches (i.e., fine, coarse, hypercoarse).

Our results indicate that Astrapotherium was most likely a leaf browser. Astrapotherium microwear is characterized by intermediate pit densities and few or no gouges or puncture pits. Scratch densities are low and scratches are mainly of fine texture. The low mesowear scores observed in Astrapotherium (average <0.5) fall outside the range of modern grazers and fruit browsers but are near the middle of the distribution of modern leaf browsers. These findings suggest that a browsing rhinoceros such as Dicerorhinus may be the most appropriate modern analog for Astrapotherium in terms of diet and body size.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

A MORPHOMETRIC CHARACTERIZATION OF CRANIAL SHAPE IN TERRESTRIAL CARNIVORANS BASED ON FOURIER ANALYSIS

PEREZ-CLAROS, Juan, University of Malaga, Malaga, Spain; MARTIN-SERRA, Alberto, Universidad de Malaga, Malaga, Spain; FIGUEIRIDO, Borja, University of Malaga, Malaga, Spain; JANIS, Christian, Brown Univ, Providence, RI, United States; PALMQVIST, Paul, University of Malaga, Malaga, Spain

A number of studies have shown that skull morphology reflects the ecological adaptations of terrestrial carnivores as well as their phylogenetic legacy. Here we use Fourier shape analysis for describing the dorsal outline of the cranium in a number of extant and extinct species in the order Carnivora. To evaluate to what extent the shapes of the outlines analyzed reflect phylogeny and/or adaptation, a principal components analysis was performed with the harmonic amplitudes of the Fourier analyses. Results obtained show that cranial morphology is highly constrained by the phylogenetic descent of each carnivoran family, as those species belonging to the same family tend to be placed in the same region of the morphospace. However, a functional signal is also present. In particular, after controlling for size effects, there is a weak but significant correlation between an axis of morphological variation and the estimates of bite force at the level of the upper canine, while another independent axis is related to bite force measurements at the carnassial. The widespread distribution of canids in the empirical morphospace reflects their ecological disparity, while the restricted dispersal on the plot of saber-tooth predators probably results from biomechanical constraints posed by their highly specialized, hypertrophied upper canines. Moreover, there is a general allometric trend for all carnivoran families, which is associated with the lateral expansion of the zygomatic arches, and two different allometric trends exclusive to canids and felids, respectively, which are linked to snout length. Our results show that phylogeny constraints to a large extent the morphological adaptive zone which carnivoran species can inhabit.

NEW POSTER ON THE PHYLOGENETIC POSITION AND EVOLUTION OF DORTOKIDAE, THE ONLY PAN-PLEURODIRAN CLADE OF TURTLES RECOGNIZED IN THE EARLY CRETACEOUS OF EUROPE

PEREZ-GARCIA, Adan, Universidad Complutense de Madrid, Madrid, Spain; ORTEGA, Francisco, UNED, Madrid, Spain; GASULLA, Jose Miguel, Universidad Autonoma de Madrid, Madrid, Spain

Pan-pleurodrid turtles are poorly represented in the European pre-Santonian record. Proterochersis robusta, from the Late Triassic of Germany, is considered by several authors to be a representative of that lineage, while others identify it as a member of Testudinata outside crown-group Testudinidae. Platychelyidae is represented in the European post-Cretaceous by the shell taxa Plesiochelys obliqua and Plesiochelys apertis from the Wealden of the Darsius of Germany and Switzerland. At the end of the Mesozoic, two pan-pleurodrid groups coexisted in Europe: Pelomedusoides and Dortokidae. Pelomedusoides was a lineage of Gondwanic origin very abundant and diverse during the Campanian and Maastrichtian of Europe. Dortokidae was an endemic European group. The systematic position of Dortokidae is currently in discussion, having been identified as the sister taxon of Eupleurodridae (Chelidae + Pelomedusoides) or as the sister taxon of Pelomedusoides. Dortokidae are relatively abundant in Campano-Maastrichtian sites of southwestern Europe, where the type species, Dortoka vasconica, was described. Dortokidae are also recorded at the Maastrichtian of Spain, where “Dortoka vasconica” was defined; and in the late Paleocene of that country, represented by Ronella botanica. The presence of this group has been reported in the Santonian of Hungary and the Campanian of Austria. Despite that Late Cretaceous record, Dortokidae were preliminarily indetified, based on fragmentary remains of Spain (Vallupin, Tertuel, Castelle Sub-basin, Maestrazgo Basin, Iberian Range).

New material of turtles from the early Aptian of Spain (Arcillas de Morella Formation), from Morella (Castellon, Morella Sub-basin, Maestrazgo Basin), is particularly well preserved and is known due to the vertebrates, corresponding to terrestrial, freshwater and marine taxa. Several turtle taxa have been hitherto identified there, corresponding to a member of Solemyidae (stem Testudines) closely related to the British Helochelydra nocpsai, the xinjiangchelyid Brodiechelys and (stem Cryptodira) and, at least, an indet. member of the crown Cryptodira. The new specimens share many of the synapomorphies of Dortokidae, allowing their assignment to that clade, and also present a unique combination of characters that will be further analyzed. Therefore, this finding allows confirming the presence of Pan-Pleurodrid in the Early Cretaceous, and shed light on the early evolution of Dortokidae.

NEW DIRECT AND MORPHOLOGICALLY-INFERRED EVIDENCE OF PISCIVORY IN MICRORAPTOR

PERSONS, Walter, University of Alberta, Edmonton, AB, Canada, T6B 4V5; XING, Long, China University of Geosciences, Beijing, China; BELL, Phil, Pipestone Creek Dinosaur Initiative, Clairmont, AB, Canada; CURRIE, Philip, University of Alberta, Edmonton, AB, Canada; MIYASHITA, Tetsuo, University of Alberta, Edmonton, AB, Canada

Since its original description, the four-winged dromaeosaur Microraptor has remained central to debates over the phylogenetic origins of modern Aves and the functional origins of avian flight. As such, the life habits of Microraptor have enticed much speculation, and this speculation has been frequently used to support broader theories. A new, fully articulated and nearly complete specimen of Microcaptor gui
provides direct evidence that the feeding ecology of *Microraptor* differed from all previous interpretations. In addition to well preserved keratinous sheaths covering the manual and pedal unguals and traces of long contour feathers originating from the deltooids, brachial, and coracoid. The long toes, and the long, flattened, curving unguals that cover the posterior of the forefoot, suggest a granivorous diet. The present specimen is the best example to date of any non-avian dinosaur. *Microraptor* appears to be characterized by an absence of anterior tooth serrations, and exarnination of the dntition of *Microraptor* shows that the first three teeth in the dentary are strongly procumbent. Reduced tooth serrations and procumbent dentition are both traits common to many piscivores. Combined with previous discoveries, this new evidence makes the diet of *Microraptor* the best sampled species of any non-avian dinosaur. *Microraptor* appears to have been capable of successfully hunting the most common prey throughout the micro-habitats of the Jehol ecosystem and was not limited to arboreal predation. Additionally, the new specimen is the largest *M. gut* yet recorded, equaling the type specimen of the taxonomically controversial species "M. hanqingi" in femoral length. The new specimen thereby simultaneously demonstrates that "larger" size is non-diagnostic of "M. hanqingi" and rules out allometry as an explanation for the differences observed between the pelvises of "M. hanqingi" and *M. gut*. Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

A NEW CT-BASED ANALYTICAL APPROACH FOR EXPLORING TAPHONOMIC BIASES IN TERRESTRIAL VERTEBRATE ASSEMBLAGES

PETERMANN, Holger, Yale University, New Haven, CT, United States, 06511; FIELD, Daniel, Yale University, New Haven, CT, United States

Both extrinsic and intrinsic factors influence an animal's remains prior to fossilization. The application of quantitative, non-invasive methodologies such as CT scanning may be able to shed light on the influence of intrinsic mechanical controls on bone fossilization potential. Here, we investigated bone stiffness and its influence on preservation potential using a new CT-based analytical method, and a robust dataset of terrestrial mammal taphocoenoses. We quantified bone stiffness, cross-sectional geometry, and rigidity non-invasively from CT data using a new analytical method, and correlated these parameters with a recently compiled dataset quantifying the frequency of recovery of squamate skeletal elements from a variety of terrestrial localities. This method enables discriminant analysis of both bone stiffness and material properties (Young's Modulus) and geometric factors (a bone's second moment of area) as primary controls on fossil preservation. This study has broad potential to shed light on the genesis of taphonomic biases in the fossil record of terrestrial vertebrates, and establishes a novel, non-invasive approach to the study of vertebrate taphonomy.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

A FLIGHTLESS PTEROSAUR

PETERS, David, David Peters Studio, St Charles, MO, United States, 63303

Jura Museum Solnhofen Sammlung (SoS) 2428 is a largely complete, crushed, Solnhofen pterosaur. It was previously considered another specimen of *Ardeadactylus* (formerly *Pterodactylus*) *longicollum*, nytotype: Staatliches Museum für Naturkunde, Stuttgart (SMNS) 56603. However, a closer look reveals important differences. The skull is longer than the cervical series in SoS 2428, but not in *Ardeadactylus*. The slender cervical ribs are each a centrum length in SoS 2428, but they are much shorter in *Ardeadactylus*. The parasagittally compressed dorsal vertebrae comprise only 40% of the length of the torso in SoS 2428, but 60% in the more typical pterosaur *Ardeadactylus*. Conversely, in SoS 2428 the robust sacral series extends for 60% of the torso, 34% in *Ardeadactylus*. In SoS 2428 the dorsal ribs, sternal ribs and gastralia are relatively twice the lengths of those found in *Ardeadactylus*. The pectoral girdle is gracile in SoS 2428, with a scapula and a coracoid half the width of those same elements in *Ardeadactylus*. The forelimb (wing) elements are likewise less than half the length and width of those in *Ardeadactylus*. The wing finger (manual digit 4) is further reduced relative to the rest of the wing. When folded, the unreduced first wing phalanx extends back to the corpus. However, the second wing phalanx is half that length. The third phalanx is half the second and the fourth is less than half the third. Thus, when folded, the distal tip of the reduced wing finger extends just to the elbow. By comparison, in *Ardeadactylus* the elbow meets the middle of the second wing phalanx and the two distal phalanges nearly double that length. In SoS 2428, the free fingers, digits 1-3, are not reduced. Matching the elongated sacrum in SoS 2428, the hyperelongated ilium extends for 60% of the torso length. However, the much smaller pubis, prepubis, ischium and femur are similar in size to those same elements in *Ardeadactylus*. In SoS 2428 the distal ilia and pes are not preserved, whereas in *Ardeadactylus* SoS 2428 has a relatively wider and wider torso than any other known pterosaur. It also has a reduced wing, half the length and half the chord of the wing of *Ardeadactylus* when scaled to the same torso length. Such a reduced wing and enlarged torso make the prospect of flight rather doubtful by comparison. Moreover, with such morphological differences, SoS 2428 is clearly a distinct genus.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

CHRONOCLINAL BODY SIZE INCREASE OF THE EXTINCT GIANT SHARK MEGALODON (CARCHAROCLES MEGALODON)

PIMENTO, Catalina, Florida Museum of Natural History, Gainesville, FL, United States, 32611; BALK, Meghan, Unlv of New Mexico, Albuquerque, NM, United States

Body size influences nearly every aspect of the biology of any organism, from their ecology to their evolution. One of the most prevalent patterns of body size is the tendency for food, longer generation time, lower fecundity, etc.). Nevertheless, in the Cenozoic, the ultimate cause of trends could be explained in a corresponding number of egen (e.g. increased development time, greater requirement for food, longer generation time, lower fecundity, etc.), making the species more susceptible to extinction. The eventual extinction of *C. megalodon* could have created new opportunities for other top marine predators to evolve, like the modern lamnids. Our results advance the understanding of the evolution of *C. megalodon* and explain macroevolutionary trends in the Carcharocles clade.

Technical Session II (Wednesday, October 30, 2013, 10:45 AM)

WHICH TOOTH BEST REPRESENTS WHOLE TOOTH ROW DENTAL COMPLEXITY IN MAMMALS?

PINEDA-MUNOZ, Silvia, Macquarie University, Sydney, Australia; EVANS, Alistair, Monash University, Melbourne, Australia

Dental complexity analysis is a homology-free metric to infer the ecology and dietary specializations of extinct species. Most often, whole molar tooth rows are used to infer diet. However, well-preserved and complete tooth rows are rare in the fossil record, which makes performing morpho-functional analysis difficult. Thus, we investigated whether and which isolated teeth can be used as a proxy for the whole tooth row. We used 3-D scans of upper and lower postcanine tooth rows of extant mammalian species, including Rodentia, Carnivora, Diprotodontia, Artiodactyla, and Primates, to measure the complexity of both the whole tooth row and of each tooth type using Orientation Patch Count (OPC). Simple regressions were used to investigate the correlations between single teeth and the overall complexity of the occlusal tooth row. Our results showed that lower and upper M2s have the highest correlation with general tooth morphology (r2=0.817 and 0.781 respectively) for the dataset of all mammalian orders. More detailed analysis showed inter-order differences. For instance, rodent lower m1s display a similar correlation to lower m2s. In addition, carnivorans show strong intra-order variability due to dietary tooth loss within the group. Thus, lower m2s are the most useful when present, as they display a strong correlation with overall molar complexity (r2=0.949); otherwise lower m1s are still highly correlated (r2=0.790). This study justifies the use of isolated molars for dietary reconstruction from dental complexity and indicates which molars are most informative.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

THE EVOLUTION OF TAIL JOINT STIFFNESS IN OVIRAPTOROSAUR DINOSAURS AND ITS CONSEQUENCES FOR TAIL FUNCTION

PITTMAN, Michael, The University of Hong Kong, Pokfulam, Hong Kong (CN); HUTCHINSON, John R., The Royal Veterinary College, Hatfield, United Kingdom

Oviraptorosaurs preserve distal tail fossils that are sometimes articulated with a fused pygostyle-like structure. This similarity with birds has led to speculation that they used their tails for display purposes, as in peacocks. The praezygapophysial morphology and cranio-caudally short centra of oviraptorosaur tails indicate a high degree of flexibility per unit of absolute tail length. Their prezygapophysal processes allowed for complex tail display or behavior. We predict high passive joint stiffness in their tails because their great depth and breadth of the caudal centra, especially prezygapophyses permitted a large range of motion per joint, which increased tail mobility because the craniocaudally shorter centra allowed the tail to accommodate more joints per unit length. The large muscles reconstructed for oviraptorosaur tails presumably helped to actively stiffen or move them. We predict high passive joint stiffness in their tails because their great depth and breadth created larger moment arms for tissue to leverage its resistance against dorsally/ventrally or laterally directed joint rotation respectively. Shorter tails that evolved via cranio-caudal elongation would create longer moment arms for tissue to leverage its resistance against dorsally/ventrally directed joint rotation, which inversely correlates with joint stiffness. But how did joint stiffness evolve and affect tail function?

From four taxa, we reconstructed the size-normalized changes in vertebral morphology between the unamed node between Oviraptorosaurus and Paraves (node A) and the oviraptorid node, and used this to reconstruct changes in passive joint stiffness. Increased dorsoventral height of the hypothetical vertebrae between node A and the oviraptorid node supports an increase in dorsoventral joint stiffness, although the latter decreased according to trends in centrum height and chevron depth. Between these nodes, lateral joint stiffness increased, as is evident from increased transverse length and vertebral width and decreased centrum length. Both joint stiffness trends coincide with tail shortening and reduced caudal joint count between node A and the oviraptorosaurusian node, and increased caudal joint count between the latter and the oviraptorid node. These results show that oviraptorosaur tails were mechanically appropriate for holding themselves up, particularly as they were heavier compared to paravians despite being shorter. The lower caudal joint count in oviraptorosaurs compared to A indicates a greater role of motion per joint in the former, if tail mobility was constant. Thus, increased dorsoventral and lateral joint stiffness may have helped them produce the range of muscular force vectors needed for complex tail display or behavior.
exposed a 4,200 m² dinosaur track-bearing bedding plane in a marly limestone bed in the

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

THE FIRST THEROPOD TRACKWAYS FROM THE LOWER CRETACEOUS (ALBIAN) DE QUEEN FORMATION, SOUTHWEST ARKANSAS
PLATT, Brian, University of Mississippi, University, MS, United States, 38677; SHELL, Ryan, University of Arkansas, Benton, AR, United States; SUAREZ, Celina, University of Arkansas, Fayetteville, AR, United States; BOSS, Steve, University of Arkansas, Fayetteville, AR, United States; WILLIAMSON, Malcolm, University of Arkansas, Fayetteville, AR, United States

In June 2011, industrial excavations at a gypsum mine in Howard County, Arkansas, exposed a 4,200 m² dinosaur track-bearing bedding plane in a marly limestone bed in the De Queen Formation. A rapid salvage recovery of data from the site took place over a two-week period. These efforts revealed a variety of tracks and trackways, including the first known tridactyl trackways in Arkansas. At least two morphotypes of tridactyl tracks were present, as well as multiple sauropod trackways and associated dinoturbation. Recovery of data from the site included field mapping and measurements, plaster casts, and wide-field, ground-based LIDAR scanning (P-F 5006i and Leica C10 laser scanners) of the entire track site. Eight tridactyl trackways, at least eleven sauropod trackways, and a large area of dinoturbation were preserved digitally and used to produce a shaded relief map of the site, from which additional data were extracted. Most tridactyl tracks are attributable to theropods and range between 36-61 cm in length and 22-54 cm in width. Length-width measurements taken from plaster casts from six theropod trackways fall along a linear growth trend when length is plotted versus width, suggesting they are tracks of various sized animals of the same species. The same measurements are compared to Eurhontes tracks attributed to Acrocanthosaurus atokensis from the Glen Rose Formation of Texas and the linear trend of the two are not statistically different, suggesting the Arkansas track-maker is likely Acrocanthosaurus. Two of the sauropod trackways are sinuous and closely parallel to each other for over 50 m, suggesting the two individuals were traveling as a pair. Rose diagrams of the trackways indicate a mean sauropod trackway orientation of 326.2° (northwest) and a mean theropod trackway orientation of 166.0° (southeast). Preliminary geochemical analyses of bulk organic carbon of sediment below, in, and above the site will help constrain the age of the bed via carbon isotope chemostratigraphy and petrographic and stable isotopic analysis will provide the isotopic composition of paleoprecipitation during the formation of the trackway.

Technical Session XVIII (Saturday, November 2, 2013, 1:45 PM)

BIOSEREOGRAPHIC DISTRIBUTION PATTERNS OF TETRAPODS DURING THE JURASSIC: NEW INFORMATION FROM THE CAÑADÓN ASFALTO BASIN, PATAGONIA, ARGENTINA
POL, Diego, CONICET, MEF, Trelew, Argentina; CARBALLIDO, Jose Luis, CONICET, MEF, Trelew, Argentina; RAUHUT, Oliver, Bayerische Staatssammlung fuer Palaeontologie und Geologie, Munchen, Germany; ROUGIER, Guillermo, Univ of Louisville, Louisville, KY, United States; STERLI, Juliana, CONICET, MEF, Trelew, Argentina

The Jurassic vertebrate fauna of the Cañadón Asfalto Basin is one of the most diverse in the world, in particular to the highly fossiliferous Cañadón Asfalto Formation (late Early – early Middle Jurassic). Described taxa from this unit include members of different clades as a pair, with species including the Early Jurassic basal ungulate Adasaurus and ornithischians, sphenodontians, turtles, crocodylomorphs, and mammals. Recent studies on the phylogenetic affinities of these taxa have shed light on the evolutionary affinities of the taxa recorded in the Cañadón Asfalto Basin, allowing the evaluation of the biogeographic signal through quantitative methods. Several studies have suggested the existence of groups endemic to the southern hemisphere during the Jurassic whereas others have postulated a pangaic distribution as the null hypothesis for the distribution of tetrapods during this period. Here we present a series of quantitative analyses applying Dispersal Extinction Cladogenesis (DEC) in the software packages DIVA and VIP on phylogenetic hypotheses of all the above-mentioned groups in which fifteen taxa of the Cañadón Asfalto Basin (some of which have been recently published) have been included. The analyses indicate that eight eleven of the fifteen lineages recorded in the Cañadón Asfalto Basin belong to clades in which the ancestral reconstruction is restricted to the southern hemisphere, indicating the existence of a marked provincialism of these groups of vertebrates during Pangean times. Four of the taxa recorded in the Cañadón Asfalto Basin belong to lineages that, in contrast, have a non-gondwanan ancestral distribution, and these results indicate the new records from the Jurassic of Patagonia and showing a previously undetected and regionalization of the distribution of continental vertebrates at least since the late Early Jurassic, before the effective separation of the northern and southern land masses. The common biogeographic pattern detected from this study suggests therefore the existence of biogeographic barriers that determined the distribution of continental vertebrates in Pangea during the Jurassic. These barriers likely or environmental or climatic, such as the postulated existence of the Central Gondwanan Desert.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

MORPHOLOGICAL ADAPTATION, RANGE SHIFTS, OR EXTINCTION? MODELING OF MORPHOLOGICAL RESPONSES OF SPECIES AND COMMUNITIES TO ENVIRONMENTAL CHANGE IN A GEOGRAPHICALLY AND TEMPORALLY EXPLICIT CONTEXT
POLLY, P. David, Indiana University, Bloomington, IN, United States, 47405; SCHNITZLER, Jan, Senckenberg Research Institute und Nature Museum, Frankfurt am Main, Germany; LAWING, A. Michelle, University of Tennessee, Knoxville, TN, United States; ERONEN, Jussi T., University of Helsinki, Helsinki, Finland; SCHNITZLER, Jan, Senckenberg Research Institute und Nature Museum, Frankfurt am Main, Germany; LAWING, A. Michelle, University of Tennessee, Knoxville, TN, United States; ERONEN, Jussi T., University of Helsinki, Helsinki, Finland; SCHNITZLER, Jan, Senckenberg Research Institute und Nature Museum, Frankfurt am Main, Germany; LAWING, A. Michelle, University of Tennessee, Knoxville, TN, United States

Organisms can respond to changes in climate and environment that exceed their tolerance limits in three ways. They can adapt to the change through natural selection and environmental plasticity, they can move into a new region to track their climatic or environmental optimum, or they can become extinct. While the third response is mutually exclusive, the first two are not. Factors governing evolutionary response include evolvability of the relevant traits and the rate at which the trait can evolve. Factors governing geographic response include the topography of physical barriers, ecological interactions with other species, and rate of migration. One of the strengths of the fossil record is that it can be used to document the past responses of vertebrates to changes in environments at many scales. However, the coarseness of temporal, geographic, and taxonomic sampling in the fossil record makes it difficult to compare these valuable empirical data to the responses observed in the modern world over ecological timescales.

We developed a geographically and temporally explicit model to study responses of vertebrates to changing environments. Our model focuses on ecometric traits, which are morphological features that have a direct functional relationship to the environment. Species and communities are geographically sorted based on such traits and these traits respond directly to environmental selection. Our model simulates local populations of an evolving species whose traits influence whether they can disperse into adjacent regions, whose traits respond to selection when they move into a new region with a different environment, and whose geographic variance is governed by gene flow across the species meta-population. We modeled locomotor traits in mammals that are related to habitat openness using the geography, climate, and vegetation cover of modern North America. When migration rates are high and evolvability is low, then species respond predominantly by dispersal. When evolvability is high and migration rates are low, then species respond primarily by adapting to the changing environment.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

IS OMNIVOROPTERYX SINOAUSORUM A SAPOERNITHID BIRD?
POMEROY, Diana, Dinosaur Institute-Natural History Museum of Los Angeles County, Los Angeles, CA, United States, 90007

The Early Cretaceous taxon Omnivoropteryx sinoausororum, from the Jehol Group in Liaoning Province (China), was named and described as a large bird with cranial morphology similar to the contemporaneous basal aviraptorid Caudipteryx zoui, and similar postcranial morphology to the contemporaneous basal pygostylian bird Sapeornis chaoyangensis. Despite this, the similarity and value of the Omnivoropteryx sinoausororum remains a point of contention. I present the results of a quantitative and qualitative analysis comparing the holotype of Omnivoropteryx sinoausororum to fourteen sapeornithid specimens, including the holotypes of Sapeornis chaoyangensis and all three of the putative synonyms of S. chaoyangensis: Dianchisaurus ji, and Shenkholosaurus pia. I obtained a series of regression lines and conducted a principal components analysis comparing limb elements in the statistical program Paleontological Statistics (PAST). I also performed a thorough re-examination of the characters used to diagnose O. sinoausororum as well as the junior synonyms of S. chaoyangensis. The compared limb elements of all species show a strong correlation, with the majority of the specimens fitting the regression lines. PC1, which represents the relative sizes of the limb elements, explains most of the variance, defining 92.2% of the variation in the sample. The re-examination of the diagnosis of Omnivoropteryx sinoausororum, in comparison to the other sapeornithids, reveals a diagnosis reliant upon characters influenced by taphonomic biases and/or ontogenetic variation. The regression models, in addition to the PCA, strongly indicate that the observed differences in size among the sapeornithids and O. sinoausororum are better interpreted as ontogenetic variation within a single growth series. Based on these observations, I argue that Omnivoropteryx sinoausororum is a junior synonym of Sapeornis chaoyangensis.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

FINITE ELEMENT ANALYSIS OF THE CARPUS OF CAMPTOSAURUS AND THE EVOLUTION OF CARPAL FUSION IN ANKYLOPOLEXIA
POOLE, Karen, George Washington University, Washington, DC, United States, 20052

The degree of fusion in the carpal elements of iguanodontian dinosaurs varies from separate elements in taxa such as Tenontosaurus and Dryosaurus to complete fusion of all carpal elements and the first metacarpal in Barilium. The genus Camptosaurus has an intermediate level of fusion in which the radius is fused to the first and second distal carpal and the first metacarpal, whereas the other carpal elements are free. This study aims to test two alternative hypotheses: that fusion of the carpals reduces strain when a force is applied along the axis of the limb, or that fusion of the carpals reduces strain when a force is applied along the axis of the first digit. That is, does this fusion have a functional purpose either for bearing weight or for supporting the first digit and its conical ungual? To test this, two specimens of Camptosaurus dispar (US National Museum specimens USNM 5473 and USNM 4277) were CT scanned at the George Washington University Hospital’s Imaging Center. The software Mimics was used to create three-dimensional meshes of each element, which were then exported to PreView where
boundary conditions and material properties were assigned. Analyses were carried out in the program FEbio. When a load was oriented normal to the distal surface of the first metacarpal, the strain was transferred to the radius, and the CT scans show that the radiale and the intermedium of USNM 4277 had varying degrees of carpal fusion across individuals, as seen in the specimens USNM 5473 and USNM 4277. However, CT scans of these specimens show that the radial and the intermediate of USNM 4277 are not fused as previously thought. Thus, the pattern of fusion is actually the same in these individuals. While more specimens of Compsognathus carp will be CT scanned for confirmation, carpal fusion in this taxon may have less individual variation than previously thought.

This also shows an interesting pattern to the progression of carpal fusion in ankylopodians starting from the medial side and progressing laterally in more derived taxa such as Iguanodon and Barilium.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

PALEOBIOGEOGRAPHIC IMPLICATIONS OF AUSTRALIA’S CRETACEOUS SAUROPODS

POROPAT, Stephen, Uppsala University, Uppsala, Sweden; HOCKNOLL, Scott, Queensland Museum, Brisbane, Australia; KEAR, Benjamin, Uppsala University, Uppsala, Sweden; ELLIOTT, David, Australian Age of Dinosaurs Natural History Museum, Winton, Australia.

The middle Cretaceous sediments of central Queensland (northwestern Australia), deposited during and after the retreat of the Eromanga Sea, have yielded abundant sauropod remains. A basal titanosauriform from the upper Albian Tooloolaha Formation near Richmond, northeastern South Australia, is the most distinctيات identified by examining the anatomy of the Cretaceous Australian sauropod, Austrasaurus meckeli from the upper Albian Allar Mudstone, also appears to represent a non-titanosaurian titanosauriform. Revisions of Wintonotitan wattsi also appear to represent a non-titanosaurian titanosauriform. Revisions of Wintonotitan wattsi and Diamantinasaurus matildae, both of which are derived from the over-the-middle Winton Formation (uppermost Albian-Cenomanian / Cenomanian-Turonian), have shown that derived lithostrotian titanosaurs were present alongside more primitive spondylopods by the early Late Cretaceous. That Diamantinasaurus shares close ties with the similarly-aged Malawisaurus and Tapinosaurus suggests a Gondwanan origin for Lithostrotia during the Early Cretaceous, followed by a radiation into Australia in the earliest Late Cretaceous. A new titanosauriform taxon, the third from the Winton Formation, highlights the high diversity of sauropods in middle Cretaceous northeastern Australia, whilst a braincase from another site represents the first non-dental sauropod cranial material known from Australia.

Evidence of Australian Cretaceous sauropods is also preserved in the Broome Sandstone of Western Australia, and the Griman Creek Formation of southern Queensland and northern New South Wales, both of which were deposited in relatively high-latitude settings (50-60°S). However, the Eumeeula and Wonthaggi Formations of coastal Victoria (southeastern Australia), which were deposited in even higher latitude settings (70-80°S), have not yielded any sauropod material to date, despite decades of collection and the recovery of vertebrate fossils from several sites. Southeastern Australia, which maintained a connection to Antarctica throughout the Cretaceous, is interpreted to have been persistently cool and subjected to long, dark winters during the Aptian-Albian. This may have acted as a climatic barrier preventing lithostrotian titanosaurs, which first appear in the Early Cretaceous of South America and Africa, from reaching Australia throughout the Cretaceous. Only after the isolation of Australia from the rest of the Southern Hemisphere and the establishment of warmer conditions at the South Pole, were lithostrotians able to disperse into Australia, via Antarctica, from South America.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

COMPUTED TOMOGRAPHY, DIGITAL PREPARATION AND THREE-DIMENSIONAL RECONSTRUCTION OF THE EARLY TERTIARY LOWER JAW

PORRO, Laura, University of Bristol, Bristol, United Kingdom; RAYFIELD, Emily, University of Bristol, Bristol, United Kingdom; CLACK, Jennifer, University of Cambridge, Cambridge, United Kingdom.

The invasion of the land by vertebrates is one of the great transitions in the history of life, necessitating dramatic changes in skeletal morphology. Of particular importance was the explosive radiation during the Carboniferous in which tetrapods evolved into diverse forms that colonized and exploited terrestrial niches. Our study focuses on the morphological and mechanical evolution of the tetrapod lower jaw, which features an orderly and consistent series of changes amenable to analysis. The skulls of eight early tetrapod genera were CT scanned; our study incorporates taxa from the Late Devonian to Early Triassic with most specimens dating from the Carboniferous. CT data was segmented using 3D visualization software to digitally separate bone from matrix and the individual bones of the skull from each other, revealing new anatomical details that were previously obscured. The medial aspect and symphyseal region of the lower jaw - including the extent and number of splenial and coronoide bones, and the presence or absence of a parasymphysial process - were visualized and described in Acanthostega, Eoherpeton, Crayfishgale, and Eohypotis. CT data clarifies the position and extent of the bones of the anterior palate in Greererpeton and Eohypotis, as well as their relationship to the choanae. The hyolingual apparatus of Eohypotis was revealed in situ within the articulated skull, and the braincase anatomy of several taxa was described. Numerous specimens were digitally repaired, missing elements duplicated across the sagittal midline, and bones from multiple specimens scaled appropriately; bones were then articulated to create a series of "retrofitted" computer models, many of which represent the first 3D reconstruction of several early tetrapods.
(δ13C and δ18O). The fossil material comes from a sedimentary sequence consisting of sands and conglomerate lenses deposited in a fluvial setting located near San Agustín Flaxiaca in southeastern Hidalgo, central Mexico. The samples were extracted from matrix-free sandstone fragments belonging to the following taxa: Equisurus conversidens (n=5), BISON sp. (n=2), Hemiauchenia gracilis (n=2), Camelops sp. (n=1), Stysceroceras condilongi (n=2), Capromeryx mexicana (n=1), Odociceles cf. virginianus (n=3), Mammuthus sp. (n=2), and an unidentified gomphothere species (n=2); the presence of fossil remains belonging to Bison is indicative of a RanchoLaBrea-type assemblage. The values of δ13C (V-PDB) and δ18O (V-SMOW) range from 23.6‰ to 29.6‰. The mean value of δ13C indicates that most taxa were mixed-feeding (δ13C values between -1.0‰ and -10.0‰), although the deer O. cf. virginianus and the gomphothere are included within browsers (δ13C values < -10.0‰). A Kruskal-Wallis test indicates that the mean values of δ18O are significantly different (p < 0.05) between the δ13C values of species considered, suggesting a distinctive dietary behavior for each taxon, consisting of a particular ratio of C3/C4 plants. The δ18O average of small-sized antelopes, gomphothere, mammoths, and deer are similar (∼+2‰), suggesting a comparable relatively high water dependency for these species as compared to (or/and) preference for humid habitats. The higher δ13C values are those of the medium-sized antelopes, camels, bison, and horses (∼+28‰) that may be related to a lower water dependency. The record of δ13C and δ18O suggests a scenario of open areas covered by grasses and variable coverage of shrubs and trees of different sizes; furthermore, it seems that steady humid conditions occurred at the area, which in turn, would be related to seasonal rainfall patterns. This study provides evidence of the environmental conditions in Central Mexico during the second part of the Pleistocene.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

JUVENILE SAUROLOPHINE SPECIMENS (DINOSAURIA: HADROSAURIDAE) FROM THE LATE CAMPAÑIAN (CRETACEOUS) OF NORTHEASTERN MEXICO

PRIETO-MARQUEZ, Albert, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; SERRANO BRANAS, Claudia Inés, Instituto de Geología, Universidad Nacional Autónoma de México, Mexico DF, Mexico; TORRES RODRÍGUEZ, Esperanza, Instituto de Geología, Universidad Nacional Autónoma de México, Mexico DF, Mexico; MEVES LUNA, Elisa, McGill University, Montreal, QC, Canada; ESPINOSA CHÁVEZ, Belinda, Benemérita Escuela Normal de Maestros de Coahuila, Saltillo, Mexico

We report on new juvenile hadrosaurid specimens collected from upper Campanian (∼72.5 Ma) strata of the Cerro del Pueblo Formation cropping out west of Saltillo (Coahuila, northeastern Mexico). Each of the bones was found isolated and surface collected in three localities; two of them (El Palmar and La Rosa) lie near the town of General Cepeda, whereas the third site (Presa San Antonio) lies 80 km away, near the town of Parras de la Fuente. The remains from La Rosa consist of a fragmentary dentary and maxilla; those from El Palmar include two dentaries, four maxillae, three dental battery fragments, two distal tibiae, and a pedal ungual; and those from Presa San Antonio consist of a nearly complete pubis and a partial femur. All the elements are comparatively small-sized; based on the estimated lengths of 10 cm problems because key groups (e.g., camels, proboscids, peccaries, pronghorns, proboscideans) have no reliable updated taxon, with many invalid genera and species and/or undelineated genera and species. Most of the estimates of species longevity have been more guesses without sufficient data to back them up. Most of the public data sets yield species duration estimates of about 2-3.43 m.y. for larger mammals, with small mammals tending to have shorter species durations. My own compilation of all the valid species durations in families with updated taxonomy (39 families, containing 431 genera and 998 species, averaging 2.3 species per genus) yields a mean duration of 3.28 m.y. for larger mammals. This breaks down to 4.10-3.94 m.y. for artiodactyls, 3.14-3.31 m.y. for perissodactyls, and 2.63-2.95 m.y. for carnivorous mammals (carnivores plus creodonts). These averages are based on a much larger, more robust data set than most previous estimates, so they should be more reliable for any studies that need species longevity to be accurately estimated.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

PHALANGERIFORM MODELS FOR THE ESTIMATION OF BODY MASS IN STEM PRIMATES

PRUFOCK, Kristen, University of Toronto Scarborough, Scarborough, ON, Canada; MIC 1A4; SILCOX, Mary, University of Toronto Scarborough, Scarborough, ON, Canada

The Phalangeriformes, a suborder of marsupials, include small- to medium-bodied mammals in Australia, New Guinea, and Indonesia. Phalangeriforms may provide useful comparative models for reconstructing aspects of stem primate (“pleisadiapiform”) biology as some species display primate-like traits (e.g., convergent orbits and grasping claws); suggesting convergence in these areforms and pleisadiapiforms also share hypertrophied incisors, a condition that strongly impacts cranial morphology, missing in most living primates. As such, phalangeriforms may provide a relevant comparative population for cranial scaling in pleisadiapiforms. Here, we report on a new set of body mass equations based on 15 cranial measurements from a broad sample of phalangeriforms including 33 species from four families (Burramyidae, Phalangeridae, Pseudocheiridae, and Petauridae) ranging between 19.8-6803.9 g. These data were used to construct least squares regression equations. Pearson’s r-values ranged from 0.79-0.94. Dental arcade width (0.94), dental arcade length (0.94), and maximum cranial length (prosthion-inion length; 0.94) had the closest relationship to body mass and are also measurements strongly influenced by the presence of hypertrophied incisors. These equations were used to calculate body mass estimates for Paleochthion nacimenti, Ignacius graybullianus, Pliosigalactolagus, Pliosigalactolagus, Pliocheilus, and Microsynapinae. In most cases the new equations produced estimates that closely resembled those based on dental measurements, and were more congruent with these values than estimates based on cranial of living primates or plesiadipids. For example, an equation derived from prosthion-inion length yielded a body mass estimate of 352 g for Ignacius graybullianus, comparable to a value of 375 g based on M1 size, and notably higher than previous estimates based on the cranium (231-286 g). The estimates that are least congruent with the values calculated from dental equations were based on measurements on which are strictly influenced by brain size (e.g., width and height of foramen magnum, and bregma-opisthion), producing values that were substantially lower than those based on primate samples. This may reflect differences in scaling of the brain between marsupials and eutherians. In all, these new data provide a basis for reassessing body mass estimates of the earliest primates, a variable critical to investigating issues such as the early evolution of the brain. 

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In the Paratethyan Basin of southern Ukraine. Previous studies of sexual dimorphism covering cranial and postcranial elements in both fossil and Recent species have only been performed on members of the subfamily Phocinae. Sexual dimorphism in postcranial and mandible size in living members of Cystophorinae is more obvious than in other representatives of true seals. Therefore, this new fossil material (58 individual bones) provides a foundation for examining sexual dimorphism in fossil and Recent Cystophorinae. The analysis shows that the most reliable characters for sex determination in Cystophorinae are the width of the barnacle socket and the presence of the lesser trochanter on the femoral shaft. Examination of anatomical traits demonstrated that both new species show a mosaic of primitive characters and were better adapted for terrestrial locomotion than any living representatives of Cystophorinae. The new Miocene genus Pachyphoca shares primitive characters with other species of Cystophorinae and Monodontinae, such as the middle of the humeral troclear internal rising wave-like over the coronoid fossa, and the distal and proximal epiphyses of the humerus almost equal in width. These new findings imply that the subfamily Cystophorinae includes not only elephant and hooded seals, but also the two new Middle Sarmatian pachyosteoceratic seals.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

POTENTIAL VERTEBRATE BURROWS IN THE SALT WATER MEMBER, UPPER JURASSIC MORRISON FORMATION

RAISANEN, Derek, University of Kansas, Lawrence, KS, United States, 66045-7594; HASIOTIS, Stephen, University of Kansas, Lawrence, KS, United States

Carbonate-preserved, large-diameter structures (LS) in the Salt Water Member of the Upper Jurassic Morrison Formation (75-160 m thick) may represent burrows constructed by synapsids and/or reptiles. The depositional environment in which the LS are found was interpreted as a floodplain consisting of clay-rich mudstones 2-3 m thick interbedded with massive sandstones 3-5 m thick. The mudstones were interpreted as the product of the sandstone, and the floodplain was formed during floodplain lowering events. The LS were located in the third paleosol down from the top of the mid-Morrison unconformity in the study area. The LS have two main morphotypes. Morphotype 1 (M1) is most common with more than 100 complete or partial specimens. M1 is composed of two parts: (1) a vertical (helical) shaft formed on the lateral or horizontal tunnel, and (2) a horizontal tunnel. In two specimens the tunnels are helical. Longitudinal and transverse striations are visible on the top and sides of both M1 elements but appeared distorted by the carbonate preservation in some places. The bottom surfaces lack striations and are coated with smooth lumps of carbonate. Morphotype 2 (M2) has only three occurrences and is composed of a single, long (2-3 m) subhorizontal tunnel. There were fewer longitudinal and transverse striations present on M2 than on M1 LS. These striations are also restricted to the top and sides and were distorted in some places. The bottom surfaces are coated with carbonate, as in M1. All LS appear to have undergone some architectural deformation during preservation, possibly due to compaction and recrystallization of carbonate.

Mammals were interpreted as the M1 trace-maker. The archaic tetrapod complex M1 LS fits into a continuum of helical ichnofossils attributed to synapsids. Prominent examples include Permian Dictodon burrows from South Africa and Miocene Palaeocastor burrows (Daenouelis) from the United States. The ovoid cross-section, slightly wider than tall, is more similar to Cenozoic mammalian burrows than the kidney-shaped cross-section of earlier Permian and Triassic therapsid burrows. The simpler architecture of M2 closely resembles the burrows excavated by such extant reptiles as crocodilians or monitor lizards. The longitudinal and transverse striations on both morphotypes are interpreted as scratch marks from the manus and/or pes, or bite marks. The presence of vertebrate burrows in an archaic tetrapod complex is known for a wealth of small vertebrate body fossils reveals hidden biodiversity and enhances understanding of the paleosystem.

Poster Session IV (Thursday, October 31, 2013, 4:15 - 6:15 PM)

NICHE PARTITIONING AMONG PLESIADAPIFORMES: AN EXAMPLE FROM THE LATE PALEOCENE OF SOUTHWESTERN WYOMING

RAMDARSHAN, Anusha, Carnegie Museum of Natural History, Pittsburgh, PA, United States, 15213; BEARD, K. Christopher, Carnegie Museum of Natural History, Pittsburgh, PA, United States

Plesiadapiformes were a grade-like mammals that were very diversified and abundant during the Paleocene, encompassing 11 families (i.e., Pliopithecidae, Cynodontidae, Saxonichaelidae, Paromomyidae, Microtomyidae, Carpolesididae, Carpolesididae, Macraucheniidae, Pholidocidae, Palaechthoniidae, Microsuidae, Picrodoniidae, Picromyidae, and Tullipadidae). Indeed, there are more than 50 genera and 120 species known in the fossil record, making this group as diversified as extant strepsirhines. However, few studies have considered the dietary ecology of this group of mammals, and fewer still have focused on niche partitioning among this group. The mammalian fauna of Big Multi Quarry, located in southwestern Wyoming, is the most diverse fauna known from a single Clarkforkian locality. This location has yielded 11 plesiadapiform taxa (representing five families: Pliopithecidae, Carpolesididae, Macraucheniidae, Pholidocidae, and Tullipadidae), which also corresponds to the richest diversity for plesiadapiforms from a single locality. These taxa were apparently sympatric and offer a case study of niche partitioning in the fossil record. In order to better understand how resources were shared among this group, the diet of each species was assessed using high magnification dental microwear analysis. The comparative database for this study consists of 182 specimens and 15 species of living lemurids, lorises, galagos and tarsiers. Results highlight a wide array of diets among this community: fruit-eaters (Carpolesididae, Ignacius, Ignacius), insectivores (Macraucheniidae, Acratotherium), omnivores (Pholidocidae, Pliopithecus, Pliopithecus, Pliopithecus), and mixed feeders (Phanerochloris, Pliopithecus, Tullipadidae). Diet seems to have been a strong factor in limiting competition between taxa. For example, the microtomyids Dryomomys and Tinomys most probably incorporated different
amounts of fruit in their diet, thereby limiting ecological overlap. However, although there is a remarkable dietary diversity among this community, some taxa may still have competed for similar resources. Both Archodontomys species (A. simplicidens and A. n.sp) seem to have been predominantly omnivorous. These taxa have very different sizes (450g and 60g respectively). In this case, it would seem that size might have been the most important factor in niche separation. Other factors limiting ecological overlap might include different locomotor habits, or even different exploited sector of the forest (e.g., emergent, main canopy, understory).

Terrestrial deposits are important archives of evolution of vertebrate fauna but they are often poorly dated because volcanic ash deposits are not recognized everywhere. In order to test models of vertebrate biogeography absolute ages for the units that contain these fossils are required. We have examined the U-Pb systematics of a variety of carbonate types, including lacustrine limestones, shoreline tufa deposits, and calcrites.

Based on published and unpublished results, it is clear that only about five percent of samples that are analyzed have high enough U/Pb and well behaved enough U-Pb systematics to give precise ages with current techniques involving dissolution of several milligram-size samples, column chemistry and thermal ionization mass spectrometry (TIMS). The ones that do have high enough U/Pb can give ages with uncertainties smaller than one percent. Synchrotron XRF techniques can be used to understand the distribution of these elements and to determine U-Pb systematics. Surprisingly U oxidation states vary in carbonate systems, and differ from redox predictions. We will discuss the distribution of these elements and to determine U oxidation state. Surprisingly U oxidation states vary in carbonate systems, and differ from redox predictions. We will present results of our efforts to refine our understanding of the age of the deposits, in particular volcanic ashes, and discuss the carbonates in the context of the behavior of U in the various fluids from which they formed. The results span from the Pennsylvanian (about 300 Ma) to the Miocene (about 14 Ma) and will combined will offer insights for sampling for paleontologists who have important vertebrate fossils finds in deposits with carbonates. We will particularly focus on the focus for possible for laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) for quick analyses, which has improved our ability to select carbonates for dating to about thirty percent of the samples tested. The laser ICPMS results will help to refine microsampling of the carbonate, and combined with improved blank levels, this should lead to better success with TIMS.

OTONEGOTIC TRENDS IN THE CRANIOMANDIBULAR SKELETON OF MAJUNGASAURUS CRENATISSIMUS AND DERIVATION OF THE ABEISAILURUS SKULL MORPHOTYPE

RATSIMAHABISON, Nirina, Université d’Antananarivo, Antananarivo, Madagascar; O’CONNOR, Patrick, Ohio University, Athens, OH, United States; FELICE, Ryan, Ohio University, Athens, OH, United States

Abelsailurus theropods represent a clade of medium- to large size, predatory dinosaurs characterized by high, short, and broad skulls and a robust cervical skeleton that contrast markedly with the condition in most other nonavian theropods. The robust cervicothoracic architecture has been interpreted to determine U-Pb and laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) for quick analyses, which has improved our ability to select carbonates for dating to about thirty percent of the samples tested. The laser ICPMS results will help to refine microsampling of the carbonate, and combined with improved blank levels, this should lead to better success with TIMS.

Bone histology of the stegosaur Kentrosaurus aethiopicus (Ornithischia: Thyreophora) from the Upper Jurassic of Tanzania

REDELSTORFF, Ragna, University of Cape Town, Cape Town, South Africa; HUEBNER, Tom, Niedersaechsisches Landesmuseum Hannover, Hannover, Germany; CHINSAMY-TURAN, Anayuza, University of Cape Town, Cape Town, South Africa; SANDER, Martin, Universitetet Bonn, Bonn, Germany

Stegosaurs (Ornithischia: Thyreophora) appear to be unusual among most dinosaurs in having relatively slow growth rates, as revealed by analysis of the bone histology of the highly derived Stegosaurus. The bone histology of the basal thyreophoran Steleosaurus shows even slower growth rates. The stegosaur Kentrosaurus from the Tendaguru beds of Tanzania is phylogenetically intermediate between Steleosaurus and Stegosaurus and is examined in this study to assess whether slow growth rates are plesiomorphic for the Thyreophora. An ontogenetic series (subadult to adult) of six femora, as well as one scapula, was sampled and processed into thin sections for bone histological analyses. Thin section analysis of the bone revealed growth marks (lines of arrested growth and annuli) as well as distinctive shifts in the patterns of vascularization. The varying occurrence of these types of growth marks is interpreted as variable responses to annual climatic fluctuations. The primary bone is highly vascularized fibro-lamellar bone with some regional organization of the vascular canals, indicating an overall higher growth rate in Kentrosaurus than in Steleosaurus and Stegosaurus. This suggests that slow growth rates previously reported in Steleosaurus and Stegosaurus are not a phylogenetic characteristic of the Thyreophora and do not reflect a phylogenetic constraint. Instead the slow growth rates of Stegosaurus may have been secondarily derived or alternatively it may be that Kentrosaurus is the exception in having increased growth rates. The different growth rates between the medium-sized Kentrosaurus and the large-sized Stegosaurus are also contrary to an earlier suggestion that small-bodied dinosaurs have slower growth rates than larger ones.

Did interference competition between grizzly bears and coyotes prevent holocene coastal coyotes from consuming marine foods?

REID, Rachel, University of California Santa Cruz, Santa Cruz, CA, United States; KOCH, Paul, University of California Santa Cruz, Santa Cruz, CA, United States

As generalist carnivores, coyotes (Canis latrans) have been shown to benefit from marine resources in some modern environments, such as Baja California. The impact marine subsidies to coyotes may have in a community will depend on their magnitude and continuity in space and time. We sought to determine the magnitude of marine subsidies to coastal coyotes in coastal Southern California over the past several thousand years. To do so, we measured carbon and nitrogen isotope values in modern coyote feces and Holocene coyote bones from archaeological middens. Stable isotope and content analyses on scats collected at Año Nuevo State Park and Reserves, located ~20 miles north of Monterey Bay, suggest that marine resources are important to some modern coastal coyotes. Seventeen genetically verified coyote scats collected along a coast-to inland gradient in May and September of 2011 have nitrogen isotope values ranging from -4.7 to 17.1‰ and carbon isotope values ranging from -28.4‰ to -19.6‰. Not all individuals use marine resources, but five of the seventeen coyote scats have relatively high carbon and nitrogen isotope values and contain evidence of marine
foods (i.e., seal or sea lion hair). In contrast, Holocene coyote bone collagen from Elkhorn Slough (n = 3) and Moss Landing (n = 12), both located along central Monterey Bay and occupied ~2000 BP, have a slightly lower range in nitrogen isotope values (4.0° to 6.5°) compared to modern coyotes (2.1° to 4.3°) (Table 2). Both individual data points are within the estimated range of the two individual data ranges, but most samples cluster around mean nitrogen and carbon isotope values of 6.9 (±0.0)° and -19.5 (±0.7)°, respectively, which are outside of the range expected for coyotes with partially marine diets. These data suggest that marine resources were not a major proportion of coastal coyote diets in the Holocene and thus that the use of marine foods has decreased more dramatically in the modern coyotes. One possible explanation for this shift may lie in the restructuring of the central California coastal ecosystem and food web following the extinction of the California grizzly bear (Ursus arctos californicus) in the 1920s. Removing grizzly bears from the ecosystem may have allowed coyotes to change their diets and move into the grizzlies’ former niche. Data from the one grizzly bear bone analyzed to date, also from the Elkhorn Slough site, supports this hypothesis, as it has nitrogen and carbon isotope values suggestive of a purely marine diet (-12.8° and 18.0°, respectively).

Symposium 1 (Wednesday, October 30, 2013, 10:30 AM)

**EBRYONIC DEVELOPMENT OF A SAUROPodomorph DINOSAUR FROM THE EARLY JURASSIC OF CHINA, PATTERNS OF OSSIFICATION AND GROWTH**

REISZ, Robert, University of Toronto Mississauga, Mississauga, ON, Canada, L5L1C6; LEBLANC, Aaron, University of Toronto Mississauga, Mississauga, ON, Canada; SULLIVAN, Chwion, Key Laboratory of Evolutionary Systematics of Vertebrates, Beijing, CHINA, 100080, China; CAHILL, Cheryl, University of California, Taichung, Taiwan

Fossil dinosaur embryos are surprisingly rare, and are almost entirely restricted to the Cretaceous Period. Notable exceptions are the oldest known embryos from the Early Jurassic South African sauropodomorph Massospondylus, and Late Jurassic embryos of a theropod from Portugal. The latter is the only one that encloses an eggshell. Eggshells limit their availability for tissue and cellular level investigations of development and growth. Consequently, little is known about growth patterns in dinosaur embryo, even though post-hatchling ontogeny has been studied in several taxa. Recent discovery of embryos and embryonic bone histology from the Lower Jurassic of England, from the oldest known occurrence in the fossil record, has allowed us to do extensive histological examination of the longbones, in particular the femur. The embryos are similar in geological age to those of Massospondylus and are assignable to a sauropodomorph dinosaur, most likely Liebensteinia. The preservation of numerous, disarticulated skeletal elements at different stages of incubation and therefore derived from different nests, provides opportunities for examining embryological development and growth within a single taxon. For example, comparisons among embryonic femora of different sizes and different developmental stages reveal a consistently rapid rate of growth throughout development, possibly faster than other dinosaurian taxa where histological information is available. Our ability to section individual femora at both the mid-shaft and at the level of the 4th trochanter, led us to the discovery of asymmetric radial growth of the femoral shaft and rapid expansion of the fourth trochanter during embryonic ontogeny. This suggests that embryonic muscle activation played an important role in the pre-hatching ontogeny of these dinosaurs. Embryonic dentition has also been found in the bonebed, confirming the identity of this material as the remains of basal sauropodomorphs and indicating that tooth development had already started in the preserved individual, but the teeth had not yet erupted beyond the ventral edge of the maxilla.

Symposium 3 (Friday, November 1, 2013, 11:15 AM)

**40Ar/39Ar GEOCHRONOLOGY OF THE LANCIAN-TORREJONIAN INTERVAL, HELL CREEK REGION, MONTANA**

RENNE, Paul, Berkeley Geochronology Center, Berkeley, CA, United States, 94709; SPRAHN, Courtney, University of California, Berkeley, CA, United States; WILSON, Gregory, University of Washington, Seattle, WA, United States; CLEMENS, William, Univ of California Berkeley, Berkeley, CA, United States

Latest Cretaceous through early Paleocene terrestrial strata from the western Williston Basin provide a unique record of changes that elucidate our view of terrestrial paleoenvironmental and biotic change across the end-Cretaceous boundary (KPB). An abundance of volcanic ash in the northwestern portion of the basin, where they are typically preserved in lignite beds, enables 40Ar/39Ar chronostratigraphy with unprecedented detail at high age resolution. Recent calibration of the 40Ar/39Ar system using the CAMP and Isosigma, the most comprehensive comparison with U/Pb and other geochronometers. We report here new high-precision ages for some previously dated ashes as well as many that have never previously been dated. Our new data confirm that the lithostratigraphic boundary between the Hell Creek (below) and folding (above) formations and the 40Ar/39Ar age of the KPB, is diachronous, ranging from 66.04 Ma in Garfield County to 66.02 Ma in McCone County. It is also now clear from two sections that the deapaplar Puercana fauna in the basal ~5m of the Tullock Fm. spans less than 50 ka, favoring the hypothesis that this fauna is dominated by immigrants rather than evolutionary first appearances. Torrejonian faunas in the Farrand Channel and Horsestief Canyon localities, separated by 42 km, can now be confidently correlated temporally and may be the oldest yet known Torrejonian at 65.2 Ma. A further goal of our ongoing study is to improve calibration of the geomagnetic polarity time scale, which will enable much improved temporal correlation between terrestrial and marine records. Preliminary results will be presented. In particular, precise and accurate ages for boundaries of polarity Chron 29n and 28 will anchor orbitally-tuned marine chronologies, which are otherwise floating, based on the easily resolved 40Ar/39Ar c cyclic. Such improved calibration, particularly of the Chron 29n28/28n boundary, will also provide key datums for terrestrial sequences lacking datable ashes as is the case in much of the eastern Williston Basin.

**THE EL CASCO SUBSTATION FAUNA AND FLORA: NEW RECORDS FROM THE PLIOCENE-PLEISTOCENE AGE SAN TIMOTEO FORMATION, RIVERSIDE COUNTY, CALIFORNIA**

REYNOLDS, Robert, n/a, Redlands, CA, United States, 92373; SAMPLE, Lloyd, LSA Associates, Irvine, CA, United States; CONKLING, Steven, LSA Associates, Irvine, CA, United States

The El Casco Substation fauna and flora were recovered during Southern California Edison Co. excavation in the San Timoteo Formation, Riverside County, California. This terrestrial formation provides critical data on the climatic, botanical, and zoologic transitions through three North American Land Mammal Ages (NALMA)—Hemphillian, Blancan, and early Irvingtonian. Eocene deposition encompasses a period that includes mammalian radiations to North America from South America and Asia. El Casco Substation yielded 77 taxa (65 animals and 12 plants). Twenty-six of the mammal taxa represent geographical and temporal range extensions. This exceptional assemblage from a single silty sandstone interval has 13 taxa in common with taxa reported from all five members of the entire San Timoteo Formation. The taxa and magnetostratigraphy suggest a 1.7 Ma age. The El Casco Substation Fauna contains eight genera of riparian and aquatic mollusks, stickleback fish, three salamanders, a frog, giant tortoise, pond turtle, two water birds, lizards, and snakes. Small mammals include a shrew and mole, temporal extensions for heteromyids and cricetids, and the earliest record of the microtine Allophaiomys sp. in the southwestern United States. Large mammals include deer, camels, horse, two species of ground sloth, and partial skeletons of two saber cats, Homotherium and Smilodon. The associated El Casco Substation Flora is distinct from similar southern California floras because it contains plants from aquatic and foothill communities in addition to riparian and upland slope communities. The El Casco Substation faunal assemblage is important for understanding the transition from the Blancan to Irvingtonian NALMA west of the Rocky Mountains. Specimens are curated by the Western Science Center at Hemet, California.

**POSTER SESSION I (WEDNESDAY, OCTOBER 30, 2013, 4:15 - 6:15 PM)**

**EVOLUTION OF DENTITION IN MEROHYRAX FROM THE LATE Oligocene of KENYA: PALEONTOLOGICAL ANALYSIS AND 40Ar/39Ar DATING**

REYNOso, Dow, University of Nevada Las Vegas, Las Vegas, NV, United States, 89113; SPELL, Terry, University of Nevada Las Vegas, Las Vegas, NV, United States

Nakwai is an area in the Turkana Basin of Kenya that is rich in late Oligocene fossils. Of all of the mammals that are native to Africa members of the order Hyracoidea are of particular interest. The genus Merohyrax is the focus of this study because some Merohyrax species exhibit two contrasting dental features in their teeth. Dental features such as hypsodonty are long thought to have evolved in response to an increase in silica-rich C4 grasses. However, in Africa these grasses did not arise until the late Miocene. Documenting the occurrence and potential evolution of hypsodonty and selenodonty is important in illustrating the early occurrence of these features and will be instrumental in developing an alternate hypothesis for the evolution of hypsodonty in hyracoidea. Dental measurements were made of Merohyrax from the Nakwai fossil locality and have been compared to other species of Merohyrax from the early Miocene as well as a mid-Miocene species Paraplio hyrax. The measurements include mesial, distal, and distal widths along with measurements from the base to the top of the crown in three separate locations. The preliminary comparisons of the dental measurements show that there is a distinct increase in tooth size through time. Comparisons of crown height were also made and although the data is less distinctive there is a trend among the lower molars to have an increase in crown height through time. In addition to more detailed comparisons of the dental measurements, timing the evolution of these dental features will be an important step in the documentation process. Samples of basement that cap the section that were taken along with samples of intercalated amphibole rich mudstone and air fall tuff from measured sections within the Nakwai field will be used to constrain the age of the fossils using the 40Ar/39Ar dating method.

Preparers’ Session (Thursday, October 31, 2013, 12:00 PM)

**IMPACTING OUR KNOWLEDGE: EDUCATING THE NEXT GENERATION OF FOSSIL PREPARATORS AND COLLECTIONS PERSONNEL**

RHUE, Vanessa, Natural History Museum of Los Angeles County, Los Angeles, CA, United States, 90007

As working professionals in supportive roles to curators, researchers, and educators, we maintain an underlying commitment to the advancement of science. While our immediate responsibilities are often constrained to the laboratory and collection areas, our contributions to the scientific community have widespread and lasting effects. Cultivating a pedagogy of learning, that is, a philosophy of education, among preparators and collections personnel will not only better equip ourselves for the tasks at hand, but also make an impact on the future development of our profession. Unlike our academic colleagues, there are limited avenues of education available to those interested in learning how to prepare fossils and care for fossil collections. How might we as a community of working professionals better equip the next generation of staff, students, and volunteers? In order to better equip us, others must first be intentional about broadening our current understanding of fossil preparation and curation. A holistic approach to professional development involves understanding what we do and for what end or purpose. Imparting our knowledge to the next generation involves laying a foundation of thought regarding the “best practices” of our day. Increasingly larger numbers of professionals are urging us to standardize our terms, build our knowledge base, and disseminate this knowledge to others.
others. Advances in technology are allowing us to pool together our ideas, pause, reflect, and think critically about the future development of our profession.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

THEROPOD EGG SITES FROM THE LOURINHA FORMATION, PORTUGAL


Dinosaur eggs and eggshells of Jurassic age or older are relatively rare worldwide when compared with Cretaceous ones. However, the Lourinha region in central-west Portugal is rich in Kimmeridgian-Tithonian dinosaur egg- and eggshell localities, two with associated theropod embryo material of *Lourinhansaurus* and another large theropod.

Here, we describe specimens from two sites from the Late Kimmeridgian-Early Tithonian Suboral Member of the Lourinha Formation: i) eggshells from Casal da Rola (Museu da Lourinhã [ML]1194) and ii) a new isolated egg from Porto das Barcas (ML1842). These are compared with previous findings with similar morphology: *Lourinhansaurus* nest from Paimogo (ML565) and clutches from Peraalta (ML156), and the theropod clutch ML1403, also from Porto das Barcas but in a different horizon and locality than ML1842.

Two main ootaxa were identified: ML1194 as *Préprimatoolithus* and ML1842 as an undescribed *Dendrooolithus*-like phaceoolithid. The first is clearly identified by the dinosaurous eggshell morphology angustiprismatic/obliquiprismatic, with an obliquiscanaliculate and angustiscanaliculate pore system, smooth outer surface, and an eggshell thickness range of 0.8-1.0 mm. *Dendrooolithus* is identified by: eggs are medium sized (10-20 cm) and spherical in shape; eggshell morphotype dendrospherulitic, with shell units irregularly shaped and displaying a fanning pattern; pores display a prolatoscanalicate network throughout the eggshell; outer surface ornamentation is irregular with crests and the pores irregularly dispersed between the crests; and average eggshell thickness is approximately 1.1 mm.

The eggshells from Casal da Rola are identical to *Préprimatoolithus* eggs from Paimogo and Peraalta. The eggs from Paimogo have been assigned to *Lourinhansaurus* by the presence of embryos, so we ascribe Casal da Rola also to *Lourinhansaurus*.

The prethelocladic egg ML1842 is morphologically identical to the clutches ML1403 found in the same area and assigned to a large theropod. Apart from Porto das Barcas, Phaceoolithoid is only known from the Late Cretaceous of China and Mongolia.

Preparators’ Session (Thursday, October 31, 2013, 9:45 AM)

NEW TECHNIQUE TO REMOVE ASPHALT FROM MICROFOSSIL-RICH MATRIX FROM RANCHO LA BREA

RICE, Karin, George C. Page Museum, Los Angeles, CA, United States; LAI, Katherine, California Institute of Technology, Pasadena, CA, United States; SESSIONS, Alex, California Institute of Technology, Pasadena, CA, United States; TAKEUCHI, Gary, Natural History Museum of LA County, Los Angeles, CA, United States.

Rancho La Brea is one of the richest terrestrial late Pleistocene fossil localities. Typical Rancho La Brea fossils are composed of unaltered organic material—bone, plant remains, shells, insect exoskeletons. Extraordinary preservation of Rancho La Brea fossils is due principally to asphalt impregnation which helps protect the material from diagenetic changes. Vertebrate fossils from Rancho La Brea rarely display permineralization.

Asphalt-preimpregnated fossils present specific cleaning and preparation challenges not encountered with permineralized fossils. Historically, heated kerosene was used to remove the asphalt but is flammable and occasionally caught fire. Solvents used since include 1,1,1-trichloroethene and perchloroethylene; these come with a variety of drawbacks including environmental hazards, regulatory restrictions, adverse health effects, and expense. Biodiesel is a safe, economical, and efficient alternative.

Pure biodiesel, or B100, is a diesel fuel consisting of methyl esters of fatty acids produced by refining vegetable oil triglycerides. While biodiesel is not an effective asphalt solvent at room temperature, it becomes very effective when heated to temperatures between 60°C and 80°C. Biodiesel can subsequently be removed from the asphaltic sand. We have found heated biodiesel to be an effective and efficient solvent for processing these asphalt samples.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

TWO UPPER TRIBOSPHRIC MOLARS FROM THE MESOZOIC OF AUSTRALIA AND TWO HYPOTHESES

RICH, Thomas, Museum Victoria, Melbourne, Australia; TRUSLER, Peter, Monash University, Melbourne, Australia; EVANS, Alfie, Melbourne, Australia; VICKERS-RICH, Patricia, Monash University, Melbourne, Australia; SIU, Karen, Australian Synchrotron, Clayton, Australia.

Since 1997, twenty-eight mandibles of tribosphenic mammals have been collected from polar Early Cretaceous deposits in southeaster Australia. Assigned to an endemic family erected to accommodate them, *Australosphenidae*, two suggestions have been made regarding their affinities. Originally, they were tentatively allocated to the Placentalia. Soon afterwards, they were placed in a newly established Southern Hemisphere group of primarily tribosphenic mammals, the Australosphenida. Placentals and marsupials were by contrast placed in simultaneously established group, the

Boresphondina to emphasize their presumed Northern Hemisphere origin. Little progress has been made since the beginning of the current Millennium in resolving this difference of interpretation, a reflection of the fact that other elements of tribosphenic mammals from the Antarctic region have so far not been found. There is now a single specimen of two unfortunately both heavily worn and damaged upper tribosphenic molars from the Early Cretaceous of Australia. What is preserved of this specimen suggests possible affinities with metatherians. Illustrations of this specimen and the placental-like or placentale *Australosphenidae* have been found in three synchrotron scans. Based on these images, with significant restoration in the case of the upper molars, feasibility of an occusal fit between upper and lower molars was assessed. The *Australosphenid Bishops whitmorei* does not have a lower dentition likely to have occluded with these two upper molars. However, at this writing, the situation in this regard is that other *Australosphenid*, *Australosphenus* **si*

Based on the first hypothesis, a common ancestor of the two branches would be relatively small and possibly tropical. An alternate hypothesis is that the two branches on the Australsphenid hypothesis. At this stage, two hypotheses present themselves. First, in Australia there are Australosphenidae dentally convergent on both eutherians and metatherians. Alternatively, that eutherians and metatherians were in Australia in the Early Cretaceous. This is considerably earlier than Eocene, the age of the next oldest record of either group on that continent.

Technical Session V (Wednesday, October 30, 2013, 3:15 PM)

THE FIRST MESOZOIC LIZARD FROM NORTHERN GERMANY (PARACAMELLOIDIDAE, LATE JURASSIC, LANGENBERG QUARRY) AND ITS TAPHONOMY

RICHTER, Arndt, Zentrum für Naturkunde Berlin, Berlin, Germany; WICKERS-RICH, Patricia, Monash University, Melbourne, Australia; EVANS, Alistair, Monash University, Melbourne, Australia; VICKERS-RICH, Patricia, Monash University, Melbourne, Australia; SIU, Karen, Australian Synchrotron, Clayton, Australia.

The first known Mesozoic lizard from northern Germany. The tiny bones of the Langenberg lizard are disarticulated, although right and left dentary fragments are preserved side by side, the right one on top. Taphonomic interpretation follows known disarticulation stages of complete lizards (Messel Pit, Eocene, Germany) and lizards skulls (Ulla, Barremian, Spain). The best comparison can be made with lizard bone aggregates from the Kimmeridgian of Guimarota, Portugal. Its predominantly terrestrial coal sedimentation has preserved a rich paracamelloid lizard fauna with several genera and species. We describe their taphonomy for the first time and compare it to the preservation of the Langenberg lizard. Two bone aggregates of Portuguese paracamelloids are especially suitable for comparison. One coal slab contained both dentaries and a single bone fragment, the other contained, but both other skull elements are slightly disarticulated. The other specimen shows less skull bones, but both dentaries lie aside. With only a small distance between the mandible tips, the two bones still keep their original orientation. Disarticulation of the Langenberg specimen must range between these two stages. The lack and the snout tip remained rather complete during the beginning decay and it is very likely that all bones belong to the same individual. The find shows that the marine sediments in the Langenberg Quarry have not only potential for large terrestrial vertebrates such as the dwarf sauropod *Europasaurus*, but also for fragile and minute remains.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

NEW FOSSIL FISHES FROM THE PERMIAN PEDRA DE FOGO FORMATION, PARNABA BASIN, NORTHEASTERN BRAZIL

RICHTER, Martha, Natural History Museum, London, United Kingdom; CISNEROS, Juan Carlos, Universidad Federal do Piauí, Iracem, Teresina, Brazil; KAMMERER, Christian, Museum für Naturkunde, Berlin, Germany; FRIÈBISH, Jörg, Museum für Naturkunde, Berlin, Germany; SMITH, Roger, South African Museum, Cape Town, South Africa.

Three multidisciplinary expeditions to Peruvian localities in the States of Marañon and Huallaga in 2011 have yielded large quantities of microfossil-rich sandstones and silstones. Most fossils were surface collected at approximately 100 GPS marked sites. The Pedra de Fogo Formation (PFF) accumulated in a large shallow epeiric sea that became shallower towards the top of the sequence where alluvial plain deposits became interdigitated with extensive aeolian dune fields. There are no radiometric data available so far to precisely date the 280-million-year PFF, when Perot emigrated to the upper basin. The spatially based on palynology and the tree-fern *Psaronius* sp. Teeth and fin spines of euteichodont, xenacanth, and other chondrichthysans, including new taxa, represent the shark fauna recovered from sandy-beded sandstones and siltstones that accumulated within the basin deposits. The petalodont *Inocephalus* sp. is indistinguishable from a species found in the Early Permian Irati Formation and the Late Permian Courmata Formation of the Parana basin further south in Brazil. This suggests that these two basins have been linked since the Permian, and that *Inocephalus* represents a geologically
long-lasting taxon. The concurrence of pelodont teeth, mostly found in marine rocks elsewhere in the world, with dipnoan tooth plates in both basins is intriguing, but both bear deraphagous dentitions. This, together with evidence provided by coquina levels suggests an absence of shelled invertebrates as a fish food source. Dental remains of the endemic eueneodontid chondrichthyan Antiolepisodontus pirci are common in the near shore and evaporitic shoreline facies. A collection of teeth from the same individual was found, which shed some light on their anatomical arrangement. We also collected teeth and fin spines of ctenacanth sharks including Gilksharkia, which occurs in the Lower Permian of the USA and the Carboniferous of Russia and Europe. We recognize at least four distinct dipnoan tooth plate morphologies. Fragmentary remains of palaeoniscoid-grade actinopterygians are common in the lower PPF. Well-preserved bony fishes occur in more continental deposits in the upper PPF, where we collected lower actinopterygians, including osteoglossiforms, lobe-finned fishes, and coelacanths. The apparent absence of strictly marine fossils, together with the upward transition to continental facies within the PPF support the view that the PPF fish fauna evolved more or less in geographic isolation through long periods of time leading to endemicity of many taxa.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

NEW EARLY MIOCENE BASAL PROCYONIDS FROM PANAMA: THE OLDEST NORTH AMERICAN PROCYONID AND ORIGIN OF THE TRIBE POTOSINII (CARNIVORA, PROCYONIDAE).


The extant and fossil geographic distribution of New World procyonids indicates that a significant part of their evolution occurred in subtropical and tropical forested habitats of southern North America. Isolated fossils of the apparent stem-procyonine (cf. Amphictis) M. topai are known from the Oligocene of Nebraska, Wyoming, and Montana. We place the arrival of the group in North America by at least the latest Arikareean North American Land Mammal Age (NALMA). By the Hemingfordian NALMA, diversity of hycarpiniforms increased significantly in southern North America and fossil procyonids became more continental. The latest Arikareean NALMA is characterized by the arrival of the group in California and Nevada with no tropical occurrences. Procyonids managed to colonize South America during the late Miocene via island hopping before the final closure of the Panama Isthmus during the Pleocene. Here, we report isolated procyonid teeth from early to middle Miocene terrestrial and lacustrine deposits in the Panama Canal basin. A new procyonid represented by an isolated P4 from the early Miocene Las Cascadas Formation (~21 Ma) represents the oldest procyonid in North America and oldest potosid procyonid in the New World Tropics (NWT). The new taxon is placed in the Tribe Potosini based on a P4/ with an enlarged intertooth space widely separated from the paracone. It differs from late Hemingfordian Bassaricynoides stewartae from the Massacre Lake I Local Fauna (L. F.) from Nevada in having a P4/ with a reduced parastylid, slightly reduced metacone blade, and a more anterior protocone with a partially developed internal shelf. Additional isolated teeth, including a P1, P4/, M1, and M2, from the younger (~19 Ma) late Arikareean Centenario Fauna, are identified as Bassaricynoides sp. based on shared morphologies with Bassaricynoides from the Massacre Lake I L. F. and the early Hemingfordian Miller L. F. in Florida. The partial P4/ from the Centenario Fauna has an inflated protocone and shorter metacone blade than those in the late Hemingfordian B. stewartae, while the M2 is most similar to that of early Hemingfordian B. phyllostilurea from the Miller L. F. Presence of Potosini in the New World tropics is confirmed from at least the late Arikareean NALMA through the Neogene. Our interpretation is consistent with molecular data suggesting an early Neogene divergence of the kinkajou (Potos flavus) from other living procyonids. More complete fossils will be critical to further understand the early evolution of this ancestral lineage in the NWT and its relationships within Procyonidae.

Symposium 2 (Thursday, October 31, 2013, 2:00 PM)

PALEONTOLOGY OF VENEZUELAN TAR PITS AND THE GREAT AMERICAN BIOTIC INTERCHANGE.

RINCÓN, Ascando D., Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela; SOLÓRZANO, Andrés, Instituto Venezolano de Investigaciones Científicas (IVIC), Caracas, Venezuela; MCDONALD, H. Gregory, National Park Service Museum, Fort Collins, CO, United States.

The Great American Biotic Interchange (GABI) is well documented by fossil sites in North America and southern South America, but in northern South America there are few known faunas that provide data for the phases of this event and the timing of the first appearance of North American taxa in South America. While Venezuela is a major oil producing country, it is only in the last two decades that two amazing deposits resulting from hundreds of oil fields have been studied. These two new sites represent two distinct episodes of the GABI. One site, Mene de Inciarte, dated by 14C between 25 to 27 thousand years old is located in northwestern Venezuela. In this locality 37 percent of the mammal assemblage is composed of taxa which are North American immigrants, and 47% South American natives. The other site, El Breal, which is 27 thousand years old is located in northwestern Venezuela. In this locality 37 percent of the mammal assemblage is composed of taxa which are North American immigrants, and 58% South American natives. These two sites are the most complete faunal records from northern South America and represent the last pulse of GABI. Another locality is El Breal, which is 27 thousand years old is located in northwestern Venezuela. In this locality 37 percent of the mammal assemblage is composed of taxa which are North American immigrants, and 58% South American natives. These two sites are the most complete faunal records from northern South America and represent the last pulse of GABI. The fauna from Mene de Inciarte in northern South America represents the last pulse of GABI. Another locality is El Breal, which is 27 thousand years old is located in northwestern Venezuela. In this locality 37 percent of the mammal assemblage is composed of taxa which are North American immigrants, and 58% South American natives. These two sites are the most complete faunal records from northern South America and represent the last pulse of GABI. Another locality is El Breal, which is 27 thousand years old is located in northwestern Venezuela. In this locality 37 percent of the mammal assemblage is composed of taxa which are North American immigrants, and 58% South American natives. These two sites are the most complete faunal records from northern South America and represent the last pulse of GABI. Another locality is El Breal, which is 27 thousand years old is located in northwestern Venezuela. In this locality 37 percent of the mammal assemblage is composed of taxa which are North American immigrants, and 58% South American natives. These two sites are the most complete faunal records from northern South America and represent the last pulse of GABI. Another locality is El Breal, which is 27 thousand years old is located in northwestern Venezuela. In this locality 37 percent of the mammal assemblage is composed of taxa which are North American immigrants, and 58% South American natives. These two sites are the most complete faunal records from northern South America and represent the last pulse of GABI. Another locality is El Breal, which is 27 thousand years old is located in northwestern Venezuela. In this locality 37 percent of the mammal assemblage is composed of taxa which are North American immigrants, and 58% South American natives. These two sites are the most complete faunal records from northern South America and represent the last pulse of GABI.
and La Venta consist of 100% South American natives, and represent faunas that existed in northern South America at 25 to 27 Ma. More work is needed to establish a better chronology documenting the first appearance of North American taxa in northern South America and the timing and routes of their subsequent dispersal across the continent.

Poster Session I (Wednesday, October 30, 2013, 3:45 - 6:15 PM)

DENTAL MICROWEAR ANALYSIS OF THE LATE CRETACEOUS (LATE CAMPANIAN) HADROSAURS FROM THE CERRO DEL PUEBLO FORMATION, NORTHERN MEXICO

RIVERA-SYLVA, Hector, Museo del Desierto, Saltillo, Mexico; BARRÓN, Christian, University of Calgary, Calgary, AB, Canada

Dental microwear has proven to be a valuable source of information for inferring diet and jaw mechanics in Recent and fossil vertebrates. However, studies of dental microwear in dinosaurs have been limited compared to other vertebrate groups, most notably mammals. One of the reasons for the paucity of microwear studies in dinosaurs is the lack of comprehensive comparative datasets. Compiling of such datasets for different dinosaur taxa and at various geographic and temporal scales will contribute to a better understanding of dinosaur feeding ecology. Here, we report the results of a microwear study for the hadrosaurs from the Cerro del Pueblo Formation (late Campanian), Coahuila, Mexico. These results are part of an ongoing project with the objective of establishing a microwear dataset and investigating the dinosaur paleoecology of the late Cretaceous of northern Mexico. The Cerro del Pueblo Formation represents a paralic ecosystem deposited in a low gradient coastal plain. The cyclic sequences are interpreted as deltic lagoons and bays. Several hadrosaurs have been found, both Hadrosaurinae and Lambeosaurinae, including numerous isolated teeth. In the present study, two teeth were moulded to produce high-resolution clear epoxy casts, which were examined under a light stereomicroscope at various magnifications. Eight specimens showed fairly well-preserved microwear features and these were photographed using high dynamic range imagaging for microwear analysis. For each photographed specimen, the orientation and number of scratches as well as the number of pits were counted in two areas of the occlusal surface of the tooth, each measuring 400 x 400 μm. The results show that the specimens possess a large number of straight and subparallel scratches (33.5 ± 4.1; mean ± standard deviation) arranged in distinct orientations, with the most common scratches inclined 76° (standardized to a right maxillary tooth) from the mesiodistal axis. Scratch orientation for the hadrosaurs from Coahuila is generally comparable to that reported for Edmontosaurus, and suggests similar jaw mechanics in both taxa. The mean percent incidence of scratches in the subparallel direction divided by 100. In the present study, this value is higher than the incidence reported in the literature for late Campanian hadrosaurs from Texas, Wyoming, and Alberta; although in all cases sample size is small and, for the moment, statistical testing is precluded. Nevertheless, taken at face value, this result suggests the Coahuila hadrosaurs may have fed on harder food items.

Symposium 3 (Friday, November 1, 2013, 11:00 AM)

A SYSTEMATIC APPROACH TO DATING MEZSOZIC-PALÄOGENE CONTINENTAL VERTEBRATE ASSEMBLAGES IN AFRICA

ROBERTS, Eric, James Cook University, Townsville, Australia; O’CONNOR, Patrick, Ohio University, Athens, OH, United States; STEVENS, Nancy, Ohio Univ, Athens, OH, United States

In 2002, our team began exploring for fossil vertebrates in the Rukwa Rift Basin, Tanzania. This initial survey revealed Paleozoic through Pleistocene strata containing a mixture of vertebrate, invertebrate and plant fossils of largely unknown ages, many from units that were not previously dated or even mapped. Continued work over the last decade in the basin has demonstrated the existence of important Cretaceous-Paleogene faunas. In an attempt to date these fossils and the entire stratigraphy of the Rukwa Rift, we have employed a systematic approach and in the process learned a great deal about dating fossils in frontier settings of Africa. Because arc or rift-related volcanic activity is largely unknown for the interior of sub-equatorial Africa during this time, we initially applied heavy mineral analysis and detrital zircon geochronology to search for potential kimberlite-derived volcanics to help constrain the maximum depositional age of these units. This approach has been insufficient and more diverse and less intrusive techniques that also involve seeking out carbonatite and other alkaline volcanic indicator minerals. These studies have revealed the presence of previously unknown magmatic episodes in western Tanzania and led to significant refinements in the chronostratigraphy of vertebrate bearing units. In the Cretaceous Galula Fm, Late Jurassic kimberlite zircons were dated and provide a broad maximum depositional age. In the Paleogene Nsongwe Fm, dating of detrital zircon samples revealed an Oligocene maximum depositional age. Further identification of a unique heavy mineral assemblage in Nsongwe Formation fluvial sands, which includes pyrochlore, andradite, phlogopite, and graphite, ultimately led to the discovery of unusual devitrified carbonatite ash beds that were initially misidentified as palaeosols. We utilized a combination of dating approaches, including Ar-Ar on phlogopite, U-Pb laser ablation inductively coupled plasma mass spectrometry (ICP-MS) on zircon, U-Pb SHRIMP dating of zircon (SHRIMP) and chemical abrasion thermal ionization mass spectrometry (CA-TIMS) on zircon, and pilot magnetostratigraphy to precisely and accurately date the formation and develop this sequence into one of the best dated continental Paleogene sedimentary successions in sub-Saharan Africa. We have applied similar techniques in several other terrestrial Jurassic-Paleogene successions in Zimbabwe, South Africa and DR Congo with varying levels of success. In each case, we have identified young kimberlites/alkalic volcanic grains, and in one case, we identified Late Cretaceous kimberlite zircons in rocks previously dated as Late Jurassic.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

THE SCIMITAR-TOOTED CAT MACHAIRODUS APHANISTUS (CARNIVORA, FELIDAE) IN THE VALLÈS-PENÉDES BASIN (NE IBERIAN PENINSULA): NEW REMAINS AND TAXONOMIC REVISION

ROBLES, Josep M., Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallès, Spain; MADURELL-MALAPEIRA, Joan, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallès, Spain; CASANOVAS-VILAR, Isaac, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallès, Spain; ABELLA, Jordi, Direcció Nacional de Ciències del Cosmos, Instituto de Investigaciones Científicas (MNCN-CSIC), Madrid, Spain; ALBIA, David M., Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallès, Spain

The genus Machairodus includes extant lion-sized, scimitar-toothed cats from the late Miocene, classified in the tribe Homotherini (Carnivora: Felidae: Machairodontinae). Here we review all the published and published scimitar-toothed cat remains from the Vallès-Penedès basin (NE Iberian Peninsula), in order to confirm their taxonomic attribution to M. aphanistus as well as to further precise its chronological distribution in this basin. The studied material (including dentognathic as well as postcranial remains) comes from the following localities: Can Mata indeterminate (MNN6), Can Conill 22 (MNN9), Can Poncic 1 (MNN9), Can Llobateres 1 (MNN9), Can Monté- de-Santiga (MNN9), La Tarumba 1 (MNN10), Ronda des Sabadell ROS-D6 (MNN10), and Torrent de Fuebules (MNN10).

Most of the studied material fits well with the morphological and metric features characteristic of the Vallèsian species M. aphanistus, with the exception of the remains from Creu Conill 22 (an undepicted partial P4 formerly attributed to this taxon), which belongs in fact to a medium-sized hyaena. Taking into account the scarce fossil record of M. aphanistus in Eurasia, several of the newly reported postcranial specimens (mainly as isolated teeth) and some dental material, provide data for further understanding the locomotor adaptations and predatory behavior of this taxon. From a biostratigraphic viewpoint, the removal of the Creu Conill material from the hyaenid of M. aphanistus has important implications. This locality, dated at ca. 11.1 Ma, represents the oldest MN9 locality of the basin as indicated by the presence of the equid Hippotherium. Therefore, our results indicate that the first appearance datum of Machairodus in the Vallès-Penedès Basin might be later than previously assumed —although dating uncertainties for the Can Mata remains preclude a more precise assessment of their stratigraphic position—. This is confirmed, in part, by the new mandibular remains from ROS-D6 (9.7-9.4 Ma), which are very similar to those from La Tarumba 1, with the last appearance datum of M. aphanistus in the Vallès-Penedes Basin corresponding to Torrent de Fuebules (ca. 9.0 Ma).

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

LITTLE MORPHOLOGICAL VARIATION IN THE PTEROSAUR ORNITHOHECHIRIS SIMUS

RODRIGUES, Taissa, Universidade Federal do Espirito Santo, Alegre, Brazil; KELLNER, Alexander, Museu Nacional / Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

Ornithocheiris simus is a species of historical importance, being one of the first pterosaurs described based on an anterior fragment of a rostrum from the Cambridge Greensand of England (a deposit whose fossils are probably Albanian). It is also an important taxon for pterodactyloid taxonomy as the type species of Ornithocheirus. The family Ornithocheiroidea is pointed out by several researchers as an important faunal component during the ‘middle’ Cretaceous, being present on almost all continents. However, the basic structure of O. simus is controversial. Several authors consider it a long-snouted animal with a robust premaxillary crest, based on the alleged similarities between O. simus and the more complete holotype of Tropeognathus mesembrinus from the Aptian-Albian Romualdo Formation of Brazil (sometimes referred as O. mesembrinus). There are plenty of comparisons between pterosaurs from the Cambridge Greensand and from the Romualdo Formation in the literature, mostly motivated by the fact that the species are morphologically similar and that it is unlikely that new and/or more complete material will be discovered from the English deposit. However, despite being known from several complete skulls, the range of individual, ontogenetic and sexual variation in the Brazilian pterosaurs is still poorly understood. This is especially true because most of these skulls are isolated, and associated postcranial material that would enable the identification, for instance, of the osteological maturity of the individuals based on size-independent criteria, is very rare. Thus, this material contributes little to the knowledge of morphological variation in the group. In the case of O. simus, however, at least five other fragmentary specimens from the Cambridge Greensand are referable to this species and shed light on the matter: despite showing distinct sizes (possibly representing different ontogenetic stages), they show very little morphological variation. These specimens enable the diagnosis of O. simus as a pterosaur with a tall rostrum, which is not expanded laterally, with the premaxillary teeth directed ventrally and slightly displaced posteriorly from the anterior margin of the premaxilla. All specimens referable to O. simus lack a dorsally reflected palate, which is a derived feature present in different degrees in several other toothed pteranodontids, including Tropeognathus mesembrinus. Thus, Ornithocheirus and Ornithocheiroidea are exonymically and genetically distinct. The type species of the genus Machairodus Dougherty.
Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

NEW EARLY EOCENE PANTOLESTID SKELTON FROM FOSSIL BUTTE MEMBER, WYOMING, AND SKELETAL ONTOGENY IN PANTOLESTIDAE (MAMMALIA, PANTOLESTA)

ROSE, Kenneth, Johns Hopkins University School of Medicine, Baltimore, MD, United States; States, 21205; DUNN, Rachel, Univ of Missouri - Columbia, Columbia, MO, United States; GRANDE, Lance, Field Museum of Natural History, Chicago, IL, United States

Pantolestids were archaic Paleogene euherian mammals most recently included in an enigmatic category Pantolestes within the larger taxon Cimolesta. The skull is herein described, and Holoceltus in distribution and are best known from articulated skeletons from the early Eocene of Wyoming (Fossil Butte) and the middle Eocene of Messel, Germany. The moderately robust skull and skeleton show a suite of anatomical features widely associated with semi-fossorial and/or semi-aquatic habits in extant mammals, and skeletons from both Messel and Fossil Butte contain fish remains in the gut region.

Here we report a new subadult partial skeleton of a pantolestid from the late Wasatchian Fossil Butte Member of the Green River Formation. Molar size and morphology, including a broad protocone and a large paracone, suggest that the skeleton represents *Palaeanosinopa dieldophesos.* The specimen is significant in having a full permanent dentition with incompletely erupted third molars and no diastemata, together with a relatively short skull, shallow dentaries, and unfused elbow epiphyseal epiphyses (typically the first epiphyseal to close)—indications that it was a young juvenile. It adds to evidence that pantolestids had relatively early eruption of permanent premolars and late epiphysial closure. Two other pantolestid skeletons were previously reported from the Fossil Butte Member, and were tentatively referred to *Palaeanosinopa.* Despite differences in skeletal size and robustness among the three known Fossil Butte pantolestid skeletons, all of which are skeletally immature, similarity in molar size and morphology suggests that the three skeletons represent three growth stages of *P. dieldophesos.* If this is correct, it has implications for recognition of fossil species based on such traits as jaw depth, presence/absence of diastema, and relative robustness of skeletal features.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

NEW INSIGHT IN THE EARLY EVOLUTION OF PECORA: CRANIAL ANATOMY OF *AMPHIMOSCHUS* (MAMMALIA, ARTIODACTYLA, RUMINANTIA)

ROSSNER, Gertrud, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; RUF, Irmtraud, Rheinische Friedrich-Wilhelms-Universität Bonn, Bonn, Germany; MAIER, Wolfgang, Univ of Tubingen, Tubingen, Germany

The early differentiation of crown Pecora, predominantly cranial appendage bearing artiodactyls, is characterized by a number of hornless members. From the late Oligocene to the middle Miocene they have populated the Old World and North America and gave rise to all the better known artiodactyl groups of the modern world (Bovidae, Moschidae, Cervidae, Giraffidae, Antilocapridae) and extinct groups. However, the phylogenetic origin of artiodactyls is difficult to assess, as their record is mainly restricted to few exceptions, the strongest taxonomic similarity is between geologic members of the same site rather than with contemporaneous sites before 2.5 Ma. Sites younger than 2.5 Ma cluster together irrespective of geography. These results suggest that bovid communities in East Africa are characterized by high degrees of isolation and possible endemism since the late Miocene and that large geographic ranges are a unique characteristic of extant species that have evolved relatively recently. The climatic changes beginning at 2.8 Ma likely began to influence bovid distribution and range expansion which culminated in the pattern observed today.

NEW SPECIMENS OF THE LATE CRETACEOUS MAMMAL *Peligrotherium cilinskii* FROM THE LATE CRETACEOUS MAMMALIA, PANTOLESTA)

ROUGERI, Guilermo, University of Louisville, Louisville, KY, United States, 40202; MARTINELLI, Agustin, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; SCHÖNING, Meike, Universität Hamburg, Hamburg, Germany

Coloniatherium cilinskii, from the Late Cretaceous La Colonia Formation, Chubut Province, Patagonia, Argentina is known by a collection of more than a hundred specimens. Most of the fossils come from the “El Uruguayo” quarry, but a few other specimens are known from other localities of the same unit. The bulk of the specimens are isolated teeth, but a few jaws, postcrania, and postcranial elements can be referred to this taxon. By comparing the jaws in the collection and isolated dental elements of *Coloniatherium* with the closely related meridiolestids *Mesungulatum* and *Peligrotherium,* we have reconstructed the whole postcanine dental series. The dental formula is interpreted as: I1/1 C1/1 P3/3 M3/3, but there is no evidence of dental replacement in the collection and alternative interpretations are possible. The largest tooth in the series is the M3, followed by M2 and M1. The molar series diminishes in size from the M1/10 the M3/3, with a much reduced M3. The upper dentition is dominated by a central stylocone and a prominent lingual paracoon; while in the lowers the protoconid, paraconid and metaconid are the dominant cusps. The M2 and M3 reduce the metastylar portion of the crown suggesting a strongly curved maxilla, also suggested by the strongly asymmetrical P2. In the lower dentition only the m3 reduces its distal cingulum. *Coloniatherium* teeth are comparatively large and show a pronounced bunodont dentition that is further complemented by large and elaborated cingula, building on a more primitive morphology like that present in the Late Cretaceous *Mesungulatum.* *Peligrotherium* from the Paleocene of Patagonia is even larger and further develops these traits with robust blunt cusps and cingula incorporated into the occlusal surface. *Coloniatherium,* Mesungulatum, *Peligrotherium,* and the more enigmatic *Reightherium* form a monophyletic group of highly-derived bunodont-herbivorous meridiolestid. *Mesungulatum* and the ungulate-like mesungulatids are the most common Late Cretaceous mammals in South America, being first recorded in the Coniacian, prospering during the Late Cretaceous, and surviving the K-T extinction event.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

NEW SPECIMENS OF THE LATE CRETACEOUS MAMMAL *COLONIATHERIUM CILINSKII* FROM THE LATE CRETACEOUS MAMMALIA, PANTOLESTA): DENTAL ANATOMY, RECONSTRUCTION OF THE DENTAL SERIES, AND RELATIONSHIPS OF SOUTH AMERICAN MERIDIOLESTIDAE

ROUGERI, Guilermo, University of Louisville, Louisville, KY, United States, 40202; MARTINELLI, Agustin, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; SCHÖNING, Meike, Universität Hamburg, Hamburg, Germany

Coloniatherium cilinskii, from the Late Cretaceous La Colonia Formation, Chubut Province, Patagonia, Argentina is known by a collection of more than a hundred specimens. Most of the fossils come from the “El Uruguayo” quarry, but a few other
vertebrate biodiversity change and evolution, and revolutionize basin development models of the Karoo Supergroup. Determination of reliable radiometric ages for Karoo bioclines establishes the Beaufort Group as the reference succession for the terrestrial Mid-Late Permian.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

A SILESAURID (ARCHOSAURIA: DINOSAURIFORMES) FROM THE TRIASSIC OF THE ATACAMA DESERT, CHILE

RUBILAL-ROGERS, David, Museo Nacional de Historia Natural, Santiago, Chile; EZCURRA, Martin, Ludwig-Maximilians-Universität München, Munich, Germany; IRMS, Randall, University of Utah, Salt Lake City, UT, United States; DESOJO, Julia, Comisión Nacional de Investigación Científica y Técnica, Sección Paleontología Vertebrados, Museo Ar, Buenos Aires, Argentina; SOTO-ACUNA, Sergio, Red Paleontológica Universidad de Chile, Santiago, Chile

Silesaurids are dinosauriform archosaurs hypothesized to be the sister-taxon of Dinosauria. The clade includes species from the Middle and Late Triassic of North and South America, Europe, and Africa, and consists of herbivorous/omnivorous quadrupedal forms with beaked lower jaws. In South America, silesaurids are currently restricted to one taxon from the early Norian of Brazil and preliminary reports from the late Carnian of Argentina. Here, we substantially expand the South American silesaurid record with the description of a partial postcranial skeleton from the Triassic strata of the Atacama Desert in northern Chile. The Museo Nacional de Historia Natural specimen SGO.PV.22250 comes from the “Estamos El Bordo”, a sedimentary unit that can currently only be constrained to the Triassic; it has also yielded the pseudosuchian Chilenosuchus fortiae. The specimen is mainly preserved as natural moulds in a silicified limestone block. The slab includes a sequence of ten articulated presacral vertebrae, partial ilia and hind limbs, and several ribs. The ilium has a preacetabular process that does not extend beyond the anterior margin of the pubic peduncle and the acetabulum is partially closed, with a gently concave ventral margin. The femur is sigmoidal in posterior view and possesses a prominent fourth trochanter. The fibular shaft is only slightly transversely thinner than that of the tibia. The femoral head is trapezoidal in posterior view and separated from the shaft by a distinct notch. A deep popliteal fossa extends along at least one-quarter of the length of the bone. The latter three femoral characters are apomorphies of Silesauridae, but the fragmentary nature of the specimen prevents us from determining its phylogenetic relationships within Silesauridae. However, the presence of a partially closed acetabulum distinguishes the Chilean form from other silesaurids with preserved ilia (e.g. Silesaurus, Saccasaurus, Asilisaurus). This specimen increases the diversity and biogeographic range of Silesauridae, and represents only the second tetrapod lineages known from the Triassic of Chile.

Technical Session VIII (Thursday, October 31, 2013, 3:45 PM)

NAVAL ANATOMY OF THE ADVANCED CYNOCENT, BRASILITHERIUM RIOGRANDENSIS REVEALS NEW ASPECTS OF MAMMALIAN EVOLUTION

RUF, Irina, Universität Bonn, Bonn, Germany; MAIER, Wolfgang, Universität Tübingen, Tübingen, Germany; RODRIGUES, Pablo G., Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; SCHULTZ, Cesar L., Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

The highly complicated nasal cavity that houses a specific system of turbinates is a unique characteristic of mammals. These turbinates are not only involved in olfaction but also in warming and moistening of air. The two-fold function of the turbinates is an essential feature correlated with the macroscopic and endoethmoid adaptations of therapsids and early mammals. However, fossil evidence for the origin of the highly derived mammalian nasal cavity is lacking, because their skeletal support most probably still consisted of cartilage. Ossification of the endoceranal nasal capsule and its turbinates seems to have occurred very late in synapsid evolution. The few published reconstructions of the turbinate system in advanced therapsids and early mammals do not agree well with the morphological concepts derived from cranioanatomic studies of extant mammals.

In order to elucidate the early evolution of the mammalian nasal cavity, we studied a very well preserved skull of the advanced cynodont Brasilitherium riograndednsis from the Late Triassic of Southern Brazil. High resolution computed tomography and virtual 3D reconstructions of internal structures of the nasal cavity provide the first evidence for delicate ethmoidal bones in this sister-group of mammals. The maxillo-basal cavity is T-shaped and resembles the homologous structure observed in young fates of extant mammals. The nasoturbinal is also partly ossified and attached to a distinct ridge of the mesethmoid; it shows delicate ethmoidal bones in this sister-group of mammals. The maxilloturbinal is T-shaped and resembles the homologous structure observed in young fates of extant mammals.

In the forerunners of mammals, the vomeronasal organ and its cartilages were mainly housed within grooves of the nasal bone texture is present on all of the flattened surfaces, supporting a subadult age designation. Both robust postorbital horncores are present and the complete right element (~200 mm in length) has a round base; both have a shallow sinus at the base of the shaft, and a gently curved medial inflection at the base of the horn. The base of each horn is oriented anterolaterally so that their apices would have faced towards the midline. Although neither nasal bone was recovered, the prefrontal margin of the premaxilla has an expanded dorsal surface indicative of contact with at least a modest nasal ornamentation. The large, that partial fragment is from the posterior right half of the frill and preserves a portion of a straight posterior margin with 4 well-developed scallops. Parietal facies, if present, would have been small and confined to the anterior margin of the frill. A phylogenetic analysis places the specimen as a basal long brow-boned centrosaur closely related to Albertaceratops, Diplobrarotops, and Xenenceratops, but its exact taxonomic designation cannot be determined due to its immature status. However, the parietal morphology suggests that it differs from these taxa in having loci for epiparietals distributed evenly across a straight posterior margin. In southern Alberta, the upper unit of the OF is time equivalent to the lower Dinosaur Park Formation (DPF) in the region of Dinosaur Provincial Park (DPP) ~200 km to the north, making the specimen ~1 Ma younger than Albertaceratops and contemporaneous with Centrosaurus that is known from both the upper OF of southern AB and the DPP of DPF. This indicates that basal centrosaurids persisted in Laramidia much longer (~79 to 76 Ma) than previously thought and overlapped temporally with the short-browed centrosaurids. Their rarity in well-sampled sediments suggests that they may have had different ecological preferences than the latter group, and may not have formed large aggregations prone to mass death events.

Symposium 4 (Saturday, November 2, 2013, 11:45 AM)

FIRST EVIDENCE FOR A HIGH ARCTIC CAMEL SUGGESTS HIGH LATITUDE ORIGINS FOR CAMELS ANCESTOR

RYBCZYNSKI, Natalia, Canadian Museum of Nature, Ottawa, ON, Canada; KIPL64; FRASER, Danielle, Carleton University, Ottawa, ON, Canada; BUCKLEY, Mike, University of Manchester, Manchester, United Kingdom; GOSS, John, Dalhousie University, Halifax, NS, Canada

A partial of a camel fossil, collected from ~78 degrees North, in the Strachona area of Eslesmere Island (Nunavut, Canada), represents the first evidence that camels lived in the High Arctic. The taxonomic identity was verified using collagen fingerprinting, which involved comparison with collagen of 57 modern mammals. In particular, the collagen fingerprint of the High Arctic camel is distinct from the modern dromedary (Camelus dromedarius) and the Pleistocene Yukon giant camel (cf. Paracamelus), but was distinguishable from the Bactrian camel, Camelus bactrianus (one peak difference). Although Camelidae (Camelini/Laminii) originated and diversified in North America, it is documented by at least one mid-latitude fossil record of the modern dromedary (Camelus dromedarius) and the Pleistocene Yukon giant camel (cf. Paracamelus), which is supported by dental evidence (e.g., hyposodonty and Plio-Pleistocene age) of the "Paracamelus" lineage are unknown from the mid-latitude fossil record of North America. Based on the new evidence, we suggest that "Paracamelus" originated in the high latitudes of North America, dispersing to Eurasia via the Bering Isthmus by 6.7 Mya. The Asian dispersal is represented by latest Miocene fossil remains of Paracamelus in both Spain and China. The High Arctic camel lived during the mid-Pliocene warm period (MPWP). The ~3.5 Ma age of the fossil was determined using terrestrial cosmogenic nuclide burial dating of the sands associated with the fossil camel remains. During the MPWP, global temperatures were 2 to 3 degrees warmer than today, while the area where the camel lived was 14 to 22 degrees warmer than today, yielding a regional paleoclimatic mean annual temperature of near freezing. Modern Camelini (C. dromedarius and C. bactrianus) are associated with open, arid habitats, yet the High Arctic camel was more closely associated with a polar boreal type forest. Our hypothesis that a forest habitat (specifically a boreal-type high latitude forest) was the forest songbird (specifically the high latitude fossil record of North America) is based on the evidence that we suggest that "Paracamelus" originated in the high latitudes of North America, dispersing to Eurasia via the Bering Isthmus by 6.7 Mya. The Asian dispersal is represented by latest Miocene fossil remains of Paracamelus in both Spain and China. The High Arctic camel lived during the mid-Pliocene warm period (MPWP). The ~3.5 Ma age of the fossil was determined using terrestrial cosmogenic nuclide burial dating of the sands associated with the fossil camel remains. During the MPWP, global temperatures were 2 to 3 degrees warmer than today, while the area where the camel lived was 14 to 22 degrees warmer than today, yielding a regional paleoclimatic mean annual temperature of near freezing. Modern Camelini (C. dromedarius and C. bactrianus) are associated with open, arid habitats, yet the High Arctic camel was more closely associated with a polar boreal type forest. Our hypothesis that a forest habitat (specifically a boreal type high latitude forest) was the original adaptive regime of the Paracamelus/Camelus lineage is supported by dental evidence (e.g. hypodonty and dental wear), which suggests that the early high latitude camels were closed-habitat specialists. Taken together, the results suggest modern camels can trace their heritage back to a recent ancestor specialized for living in northern boreal-type forests.

Technical Session II (Wednesday, October 30, 2013, 8:30 AM)

NEW APPROACH TO MAMMALIAN PALEOECOLOGY - OCCULUS WARE AND USE OF SHELTER HABITAT AS A MEASURE OF CAMEL EVOLUTION AND THEIR FOSSIL RELATIVES (MAMMALIA, PROBOSCIDEA)

SAARINEN, Juha, University of Helsinki, Helsinki, Finland; KARME, Aleksis, University of Helsinki, Helsinki, Finland; UNO, Kevin, Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY, United States; SAILA, Laura, University of Helsinki, Helsinki, Finland

The analysis of the secondary, wear induced shape of the occlusal surface of herbivorous mammal teeth, known as mesowear analysis, has proven out to be a rapid
and robust method for assessing the proportion of abrasive plant material (mainly grass) in the diet of herbivorous mammals. This method has important applications for paleoecological reconstruction, because it reflects the actual diet in populations of herbivorous mammals and provides valuable information as to the ecological role of fossil mammal communities, and ultimately it reflects environmental conditions.

The traditional mesowear method can only be applied for herbivorous mammals with selenodont, ectolophodont or plagiolophodont molar morphology, because a buccal enamel crest is needed to show facets from which relief and shape of the buccal cusp can be readily assessed. This explains the principle case for the wear angle method, because the enamel ridges of the lamellae are rubbed against each other in the diet of herbivorous mammals, so that increasingly abrasive food causes a lower relief. Here we introduce a new approach similar in principle to the mesowear method based on angle measurements taken from the occlusal surface of the enamel lamellae. We show that these tooth wear angles correlate significantly with stable carbon isotope values measured from tooth enamel of fossil and recent populations of herbivores, because the carbon isotope values reflect the proportion of C4-photosynthesising grasses in the diet of tropical elephant populations, we conclude that the wear angle measurements reflect the proportion of abrasive material, mainly C4 grass, in elephant diet. We applied the wear angle method for assessing the diet of the late Pleistocene Columbian mammoth (Mammuthus columbi) population from Rancho la Brea, California, and found it to be highly abrasion dominated, as expected.

SADLEIR, Rudyard, Saint Xavier University & Field Museum, Chicago, IL, United States, 60655; MAKOVICKY, Peter, Field Museum, Chicago, IL, United States; HUTCHINSON, John, Royal Veterinary College, Hatfield, United Kingdom

COMPARATIVE MASS ESTIMATE METHODS OF 3D DIGITAL MODELS OF ORNITHISCHIAN SKELTONS AND GASTROLITHS

I have calculated the mass estimate of the 3D digital model of a skeleton for mass estimation. We observed avian values may be constrained by the shortening of the trunk region that occurred with the origin of flight. Whether non-avian dinosaurs were free of such constraint is therefore in question. A proportionately larger gastrolith mass cannot be tested through examination of other taxon known to retain gastroliths. Since gastroliths represent a minimum stomach volume, they can be used as a proxy for this organ in addressing questions about dinosaur diet and physiology. This study represents the first attempt at mass estimation using digital 3D methods for basal neornithischians, permitting comparisons with previously developed linear metric estimates and an understanding of mass distribution from body segment masses in this group of dinosaurs.

HAUSKRON, John, University of California, Berkeley, CA, United States; HAY, Thomas, University of California, Berkeley, CA, United States; KEMP, David, University of California, Berkeley, CA, United States

CROCS TWO REALMS; NEW CENOZOIC DISCOVERIES FROM THE AMAZONIAN BASIN AND THE PACIFIC COAST OF PERU

During the last decade, a number of vertebrate-bearing localities from Western Amazonia and the coastal desert of Peru have yielded remarkable new material of Cenozoic fossil crocodyliforms. Each region provides different and complementary data on the evolutionary history of the clade within South America. Whereas the Amazonian material (Fossils from the Peruvian Amazon) provides evidence of one of the most divergent snout morphotypes, particularly during the Miocene, coastal remains document only longirostrine crocodyliforms from the late Eocene to the Pliocene. Isolated crocodyliform teeth from Paleogene localities of Peruvian Amazonia strongly suggest that sebecids, caimanines, and putative gavialoids have occupied this realm at least since the middle Eocene. The same general assemblage is revealed in several foreland bonebeds belonging to the middle Miocene Pebas mega-lake complex that occupied most Western Amazonia. A single gavialoid species along with a diversified array of caimans inhabited this network of aquatic environments. Prior to the fluvial-dominated Acre System, the Pebas System marks the last record of Eocaimus-like forms and the first appearance of a taxon allied to Paleosuchus, possibly a breaking point for basal neornithischians. In the course of this study, we have concluded that a gavialoid from South America is recorded in late Eocene strata of the Pisco Basin. Its affinity to Paleogene African gavialoids suggests a Paleocene-early Eocene transatlantic dispersion followed by other episodes of this kind, unless parallel acquisition of derived characters in later South American and African-Indian gavialoids might be considered an example of convergent evolution. Long-term archosaurian faunal environments reflect neither long term endemism, or even close phylogenetic relationships. A new late Miocene gavialine found in association with the coastal Pacosaurus is strongly reminiscent of early “thoracosaurs” from the Cretaceous-Paleogene boundary levels in the Western Interior of North America. This is the first attempt at mass estimation using digital 3D methods for basal neornithischians, permitting comparisons with previously developed linear metric estimates and an understanding of mass distribution from body segment masses in this group of dinosaurs.
John Day Fossil Beds National Monument has yielded specimens of two leptochoerids, *Unit D*. Due to the well-studied stratigraphy and traceable ash layers of Turtle Cove, between 29.75 and 28.8 Ma for *symphyses*. For example, significant evolutionary episodes. In this study, Miocene African proboscideans were far more diverse taxonomically in the Miocene. Chronostratigraphic improvements and advances in systematic studies provide the means to delimit the evolutionary events occurred on the continent. Survived now only by elephants, African elephantoids including mammutids and highly diverse gomphotheriids, stegodontids, and elephants. Temporal calibration of these taxa circumscibes successive proboscidean events: early Miocene ≥19 Ma, presence of *Ecoryxodon, Progorgotherium*, and first appearance of *Prodiacodon*; latest early Miocene, presence of *Archeoebelodon*, first appearance of *Afrotheresodon, Zygothodon*, and *Gomphotherium angustidens libyicum*; middle Miocene, presence of *Afromastodon, Protanuscan*, first appearance of *Chorolophodon*; late Miocene, first appearance of *Deinotherium, Amphotherium, Choerolophodon*, and true elephants. Morphologic changes and FAD/LADs of these taxa permit finer resolution of dating within these intervals. The results are valuable for more accurate dating of sites such as hominoid-bearing Morot, Uganda, alternatively dated to >20 Ma, late early Miocene, or early middle Miocene, and for examining the timing of evolutionary events among different lineages in Miocene African faunal succession.

**Symposium I (Wednesday, October 30, 2013, 10:45 AM)**

**AGING, MATURATION AND GROWTH OF SAUROPODOMORPH DINOSAURS: EVIDENCE FROM THE HISTOLOGICAL GROWTH MARK RECORD IN LONG BONES**

SANDER, P. Martin, University of Bonn, Bonn, Germany; GRIEBEL, Eva Maria, University of Mainz, Mainz, Germany; KLEIN, Nicole, University of Bonn, Bonn, Germany.

Information on aging, maturation, and growth is important for understanding life histories of organisms. In extinct dinosaurs, such information can be derived from the histological record of growth in the mid-shaft cortex of long bones. Here, we construct growth curves to estimate ages at death, ages at sexual maturity, ages at which individuals reached their final body mass, and maximum growth rates from long bones of six sauropod dinosaur individuals (one indeterminate mamenchisaurid, two *Apatosaurus* sp., two indeterminate diplodocids, and one *Camarasaurus* sp.) and one basal sauropodornorph dinosaur individual (*Plateosaurus engelhardti*). Using these estimates, we established allometries between body mass and each of these traits and compare these to extant taxa.

Growth models considered for each dinosaur individual were the von Bertalanffy model, the Gompertz model, the logistic model (LGM), all of which have inherently fixed inflection points, and the Chapman-Richards model in which the point is not fixed. We use the arithmetic mean of the age at the inflection point and of the age at which 90% of asymptotic mass is reached as an estimate of age at sexual maturity because unambiguous indicators of maturity in Sauropodomorpha are lacking.

According to a model selection process based on the corrected Akaike's information criterion, the LGM was the best model for our sample. Allometries established are consistent with literature data on other Sauropodomorpha. All Sauropodomorpha reached full size within a time span similar to scaled-up modern mammalian megaherbivores and ruminants, but growth rates of Sauropodomorpha were lower than of an average mammalian. Sauropodomorph ages at death probably were lower than that of average scaled-up ruminants and megaherbivores. Sauropodomorph were older at maturation than scaled-up ruminants and average mammals, but younger than scaled-up megaherbivores. We conclude that similar environmental factors shaped the life history of Sauropodomorpha and of extant mammalian megaherbivores and ruminants.
Fossilization filters result in significant loss of phylogenetic signal and cause organisms to appear erroneously primitive.

SANSOM, Robert, University of Manchester, Manchester, United Kingdom; WILLS, Matthew, University of Bath, Bath, United Kingdom

The fossil record is key to understanding the rates and sequences of evolutionary events occurring in deep time. Its utility in this context is entirely contingent on our ability to reconstruct the phylogenetic relationships of extinct organisms. Here, we demonstrate that the inherent taphonomic bias of the fossil record to preserve just hard, skeletal tissue systemically misleads parsimony analyses of phylogeny. Removal of soft-part characters from 59 neontological vertebrate databases reduced resolution and accuracy of trees significantly more than removing characters for ablation. Furthermore, removing soft characters from 50 independent extant terminals (pseudoeXtinction) caused placement of taxa (62%) significantly lower in their respective trees, closer to the root. As such, data filters intrinsic to fossilisation not only reduce tree accuracy, but positively mislead parsimony analyses. Stem-ward slippage, whereby taphonomic biases cause extinct taxa to be reconstructed as more primitive than they should, is found to be a ubiquitous and worrying phenomenon.

NEW RECORDS OF TERRESTRIAL VERTEBRATES FROM AN EOCENE BONEBED IN ORANGE COUNTY, CALIFORNIA

SANTOS, Gabriel, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States, 92834; CORTEZ, Crystal, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States; GARIBAY, Adrian, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States; MAGALLANES, Alex, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States; PARIHAM, James, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States; SANTOS, Gabriel, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States.

Study of the terrestrial Eocene of Southern California is mostly based on localities from Ventura and San Diego Counties. Orange County localities were not reported until 2003, with the first described records of late Uintian vertebrate assemblages from the Santa Ana mountains. In 1998, mitigation of the Talega Housing Development in San Clemente revealed a late Uintian vertebrate assemblage that was subsequently collected in 48 large packages (approximately one cubic meter each). The bonebed is approximately 10 cm thick, and is composed of a densely packed layer of fossils and sandstone with some reworked material found in the overlaying sediment. The majority of the fossils are fragmented or poorly preserved, and lack obvious associations. Better preserved specimens, such as isolated teeth and vertebrae, are found throughout the bonebed. Matrix removed from the jackets was screen washed and sorted for microfossils. Preliminary identification of fossils indicates the presence of borethroids, amynodonts, artiodactyly, rodents, crocodilians, turtles, snakes, and birds. This site, dubbed the 'Talega Rhino Quarry', is the first bonebed in Southern California reported to yield terrestrial middle Eocene fossils and has proven to be a significant site in the study of the Eocene of Orange County.

EXPLORATION OF AIRFLOW PATTERNS IN THE LUNG OF ALLIGATOR MISSISSIPPINIS (ARCHOSAURIA: CROCODYLIA) USING CFD MODELING, AND IMPLICATIONS FOR THE EVOLUTION OF UNIDIRECTIONAL AIRFLOW IN ARCHOSAURIA

SARRAZIN, John, University of Utah, Salt Lake City, UT, United States, 84112; SCHACHERER, Emma, University of Utah, Salt Lake City, UT, United States; FARMER, Colleen, University of Utah, Salt Lake City, UT, United States.

Unidirectional airflow patterns have been observed in the lungs of both birds and crocodilians, indicating that this trait is likely plesiomorphic for Archosauria. These airflow patterns are proposed to be maintained by a series of aerodynamic valves resulting from the topography and branching angles of the primary and secondary pulmonary bronchi (not mechanical flaps or sphincters). Computational fluid dynamic (CFD) models of the bronchial tree were created to test the aerodynamic valving phenomena and support the experimental in vivo and ex vivo flow measurements gleaned from A. mississippiensis. The validated models were then expanded upon systematically to explore geometrical and operational effects (such as bronchus branching angle and airflow pressure) on the flow patterns within specific regions of the lung. Preliminary data suggest that the aerodynamic valves result from a balance of geometric characters (i.e., ostium size, branching angle and bronchus position), as well as operational airflow parameters controlled by the organism during the respiratory cycle (including flow rates and intrapulmonary pressure). Understanding the functional properties of the alligator bronchial tree integral to sustaining unidirectional airflow will lend insight into aspects of the respiratory system present in the common ancestor of crocodilians and birds (basal archosaurs) as well as certain topographical structures of the lung that were retained as the two groups diverged into their respective extant lineages.
(anteroposteriorly thick) vertebrae, well-developed neural spine of the axis, large Eomysticetus derived than the cervical vertebrae in the geologically older edentulous mysticete hyapophyses on the ventral surface, no median ridge on the dorsal dens) appear more... to better understand the evolution of limb bone microstructures in Sauropterygia as a whole, the potential conservation of such among placodonts, and whether unarmored and armored forms are present on Anguilla since the Pleistocene, to characterize genetic diversity through... taxa can be assessed, and documents the waxing and waning of diversity in this group of... The eyes of giant and colossal squids are the largest of all living organisms, with... The placodont skull is characterized by a highly specialized crushing dentition. The placodonts included both unarmored (e.g., Psephoderma and Placodus) and more highly armoured taxa (e.g., Cymodus, Psedrophoda) show similar limb bone histologies with... Our study provides a framework through which molecular divergence in other insular taxa can be assessed, and documents the waxing and waning of diversity in this group of lizards in response to changing island area and connectivity.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)  
ANCIENT DNA AND THE ROLE OF ISLAND FRAGMENTATION IN DIVERGENCE OF LIZARDS OF THE GENUS AMEIVA  
SCARPETTA, Simon, Stanford University, Palo Alto, CA, United States, 94304; KEMP, Melissa, Stanford University, Stanford, CA, United States; HADLY, Elizabeth, Stanford Univ, Stanford, CA, United States

The episode fragmentation of islands during the Pleistocene and into the Holocene from rising sea levels serves as a unique system to study how changes in habitat connectivity and island size facilitate or inhibit genetic divergence and, ultimately, speciation and extinction. Furthermore, the use of ancient DNA allows us to accurately assess genetic diversity through time and the spatiotemporal distribution of species. In warm, humid regions, such studies are limited by the poor preservation of fossils and ultimately, aDNA. Here, we report the first mitochondrial aDNA sequences from fossils of the lizard Ameiva collected from Anguilla, a Caribbean island in the northern Lesser Antilles. The teiid genus Ameiva is found throughout Central and South America but its primary distribution occurs in the West Indies. There are two species endemic to the Anguillian bank (A. plicl and A. corita), while a separate species (A. corina) is endemic to the small, nearby island bank of Sombrero. We integrate the ancient genetic data with modern genetic data, island bathymetry, and sea level curves to determine which species are present on Anguilla since the Pleistocene, to characterize genetic diversity through time in these Anguillian bank species, and to understand their phylogenetic relationships. Our study provides a framework through which molecular divergence in other taxa can be assessed, and documents the waxing and waning of diversity in this group of lizards in response to changing island area and connectivity.

Technical Session V (Wednesday, October 30, 2013, 4:00 PM)  
BONE HISTOLOGY OF PLACODONT MARINE REPTILES (SAUROPTERYGIA) FROM EUROPE  
SCHHEY, Torsten, University of Zurich, Zurich, Switzerland; NEENAN, James, University of Zurich, Zurich, Switzerland

Placodonts are the sister group to all remaining sauropotherygians within Sauropterygia, one of the most successful and long-lived radiation of Mesozoic marine reptiles. The placodont skull is characterized by a highly specialized crushing dentition. Barosaurus, one of the most well-known and studied basal sauropods, is characterized by a skull morphology that is distinct from all other sauropods. The placodont skull is derived from a skull morphology that is distinct from all other sauropods. The placodont skull is derived from a skull morphology that is distinct from all other sauropods.

Technical Session XVI (Saturday, November 2, 2013, 2:30 PM)  
EVOLUTIONARY DIVERSITY OF GRANDIO LIONS IN OCEANIC PREYADORS  
SCHMITZ, Lars, Claremont Colleges, Claremont, CA, United States, 91711; MOTANI, Ryosuke, Univ of California - Davis, Davis, CA, United States; WAINWRIGHT, Peter C., Univ of California - Davis, Davis, CA, United States

The eyes of giant and colossal squids are the largest of all living organisms, with adults reaching 27 cm in eye diameter. Eyes of similar size are only found in ichthyosaurs, a group of Mesozoic marine reptiles. Direct observations of the biology of giant and colossal squids are extremely rare and are impossible for fossils, thus the function of large eyes is not well understood. Hence, theoretical models offer a
particularly important perspective on their visual performance, on which basis one can develop hypotheses about eye size evolution. It has been suggested that the evolution of extreme eye size in ichthyosaurs and squids was driven by predators, based on an optical model that predicted high performance of large eyes in detecting approaching predators in the presence of photoluminescent plankton. We chose an integrative approach to test this hypothesis. We first revisited the constants used in the model and show that large eyes perform equally well for different visual tasks, providing several optical advantages in the reduced light of the deep mesopelagic zone. Hence, predator-driven evolution of large eyes is optically not well-supported. Next, we examined whether allometry may inform hypotheses about extreme eye size evolution. We accounted for body size while asking whether giant and colossal squid have unusually large eyes among squid (88 species), and whether squid eyes are larger than those of acanthomorph fishes (237 species). While squid have the largest eyes than most acanthomorphs, a comparison of relative eye size among squid suggests that giant and colossal squids do not have unusually large eyes. Our finding indicates that the giant eyes of giant squid result from a phylogenetically conserved developmental pattern manifested in very many large animals rather than predator-driven evolution. Finally, we examined the temporal sequence of eye-size and predator evolution that was proposed along with the aforementioned optical model. The Lower Jurassic ichthyosaur Temnodontosaurus features eyes exceeding 25 cm in diameter, yet when it first appeared in the Hettangian, it was by far the largest of the coeval marine reptiles. Very large Rhomaleosaurus, identified as the potential driver of eye size evolution in this genus, is known from the Toarcian, some ten million years after Temnodontosaurus first appeared. To conclude, predator-driven eye size evolution is poorly supported. Large eyes likely evolved in response to the combination of multiple optical benefits in low light environments combined with phylogenetic constraints.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

REDESCRIPTION OF ASPIDORHYNCHUS ORNATUSIMUS AGASSIZ, 1834 FROM GERMANY

SCHRIEDER, Kerstin, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany; LÓPEZ-ARBARELLO, Adriana, BSPG, Munich, Germany; RAUHUT, Oliver, Bayerische Staatsammlung für Paläontologie und Geologie, Munich, Germany

Aspidorhynchus ornatusimus is an aspidorhynchid fish from the Jurassic limestones of Southern Germany, which was previously considered as a junior synonym of the type species of the genus Aspidorhynchus, A. acutirostris. Aspidorhynchus ornatusimus was revaluated in a recent taxonomic revision of the German species of Aspidorhynchus, according to which three species were considered valid. In this recent work, a diagnosis for A. ornatusimus was proposed, but no further anatomical description of the species was presented. The only description of this species dates from 1834 and is based only on a partial postcranium. The species is represented by specimens with slow to medium-agility, and the few specimens in public collections are generally incompletely preserved. Thanks to the cooperation of a few German private collectors, access to excellent material was possible for this study and the species A. ornatusimus could be completely described for the first time. Aspidorhynchus ornatusimus differs from other species of this genus in several features, including two possible autapomorphies: only five to six rows of ventral scales are present, and the first pectoral fin ray is reduced at the base and attaches to the base of the second fin ray. As in the case of other species of Aspidorhynchus, A. ornatusimus presents high intraspecific variation in the ornamentation of the scales, the dentition of the predentary and the number of principal caudal fin rays. The species A. ornatusimus is only present in the eastern part of the so-called 'Solnhofen Archipelago' between the localities Kapelberg and Eichstädt, and has a chronostratigraphic range from the Lower Tithonian to the Upper Berriasian. Therefore, the distribution of A. ornatusimus differs paleobiogeographically and stratigraphically from the other two species represented in this palearchipelago.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

INNER EAR MORPHOMETRY OF MYOTRAGUS BALEARICUS (BOVIDAE, CETARTIODACTYLA) SUPPORTS DECREASE IN LOCOMOTOR AGILITY

SCHUBERT, Anne, Universität Bonn, Bonn, Germany; RUF, Irina, Universität Bonn, Bonn, Germany

The inner ear bony labyrinth houses the hearing and the sense of balance. The three semicircular canals of the inner ear are involved in detecting angular acceleration of the head and their morphometry gives information on the agility of an animal. Faster species possess more expanded semicircular canals: radius of curvature (SCR) in comparison of the mean BM (BM) than slower ones. This correlation can be used to gain information about the agility of fossil species. For the first time the inner ear of two individuals of the peculiar bovid Myotragus balearicus (BOVIDAE, CETARTIODACTYLA) was assigned to represent -at least in part- a taphonomic bias instead. The absence of mosasaur fossils in the lower reaches of the Type Maastrichtian has previously been suggested to reflect an immigration event soon after the deposition of the Lihec Member, when the shallow waters and preserved increased availability of food provided more favorable living conditions. The new fossil, however, extends the range of Lihec Member to represent -at least in part- a taphonomic bias instead.
Two petrosals from the Berezovsk Quarry in southern Krasnoyarsk Territory in Siberia (Russia) can be attributed to docodonts. The specimens were collected from a fluvial flat plain bonebed in the upper part of the Bathonian Iyat Formation. Metrical and morphological data as far recorded from the Berezovsk coal mine comprise the eutheriodont haramiyid Sineleutherus isidovici, the docodont Itatodon tatarinovi, Simpronodon sibiricus, and Huteothereiun yamongi, an amphibid-grade eutricodon, as well as the cladorhian amphisauroid Amphibatus krassovskii and an undescribed dryolestoid, µCT technology and virtual reconstruction of the inner ear bony labyrinth revealed the presence of petrosal characters that assign the two Berezovsk cynodont specimens to being basal mammaliforms. The two petrosals show a lateral flange foramen which is a derived feature among mammaliforms as it is not present in Morganucodon or Sinoniscodon. Both show a distinct promontorium with a unique bony ridge, not observed from any other Mesozoic mammal reveals a significantly widened stapedial muscle fossa also found in the docodont Haldanodon expectatus, and a perilymphatic foramen, which is a pleiomorphic feature of mammaliforms. The virtual inner ear endosaccs reveal a secondary common crus, a general feature of basal therians as well as of Mesoicoic mammals and synapsids, and therefore pleiomorphic in the mammalian groundplan. The most striking features of the bony labryinths are a distinctly curved cochlear canal (about 180°) with an apical inflow. No internal cochlear structures like the primary or secondary bony laminae are present. This pattern is also observed in Haldanodon, though evidence for a lagena nerve is missing in both petrosals. The cochlear canal is more curved than in the basal mammaliforms Sinoniscodon and Morganusodon, but less than in dryolestoids. The multibuertebral petrosal and inner ear morphology is significantly different with a thin cochlear canal and different proportions of pars vestibularis and pars cochlearis of the petrosal bone. However, the overall morphology of both petrosals shows striking similarities to the petrosal and inner ear features of the docodont Haldanodon, though the Berezovsk specimens are about 20 Ma older than the Krimmeridian Haldanodon. The Siberian specimens are not only the oldest known petrosal from Siberia, but also the second record of docodont ear regions and provide important information on the diversity of the inner ear morphology of this group.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

HOW TO CHOOSE AND USE 3D SURFACE TEXTURE PARAMETER TO RECONSTRUCT FEEDING ECOLOGY AND CHEWING MECHANICS: PARAMETER RUSH AND BASIC PRINCIPLES OF 3D TRIBOLOGY

SCHULZ, Ellen, University of Hamburg, Hamburg, Germany; KAISER, Thomas, University of Hamburg, Hamburg, Germany

Quantitative three dimensional techniques to evaluate dental wear have become established methods for reconstructing dietary adaptation as well as chewing biomechanics. However, the dietary reconstruction in mammals has long been the focus of both microtexture analyses. Technical surface applications have been developed from the need to analyse machined surfaces, using wavelength filtering to analyse the geometric information separately. Three classes of geometric information have been established: form, waviness and roughness. While form describes the broad-scale geometry, waviness includes features that are less than in dryolestoids. Haldanodon expectatus, and a perilymphatic foramen, which is a pleiomorphic feature of mammaliforms. The virtual inner ear endosaccs reveal a secondary common crus, a general feature of basal therians as well as of Mesoicoic mammals and synapsids, and therefore pleiomorphic in the mammalian groundplan. The most striking features of the bony labryinths are a distinctly curved cochlear canal (about 180°) with an apical inflow. No internal cochlear structures like the primary or secondary bony laminae are present. This pattern is also observed in Haldanodon, though evidence for a lagena nerve is missing in both petrosals. The cochlear canal is more curved than in the basal mammaliforms Sinoniscodon and Morganusodon, but less than in dryolestoids. The multibuertebral petrosal and inner ear morphology is significantly different with a thin cochlear canal and different proportions of pars vestibularis and pars cochlearis of the petrosal bone. However, the overall morphology of both petrosals shows striking similarities to the petrosal and inner ear features of the docodont Haldanodon, though the Berezovsk specimens are about 20 Ma older than the Krimmeridian Haldanodon. The Siberian specimens are not only the oldest known petrosal from Siberia, but also the second record of docodont ear regions and provide important information on the diversity of the inner ear morphology of this group.

Technical Session XIII (Friday, November 1, 2013, 4:00 PM)

WHEN PLANKTON RULED THE COMANCHE NATIONAL GRASSLAND: DISCOVERY OF A THIRD NORTH AMERICAN CRETACEOUS FILTER-FEEDER VERTEBRATE

SCHUMACHER, Bruce, USDA Forest Service, La Junta, CO, United States, 81050; MALTESE, Anthony, Rocky Mountain Dinosaur Resource Center, Woodland Park, CO, United States

Until recently, the only Mesozoic record of vertebrate filter-feeding was European occurrences of the bony fish Leedichthys from the Middle and Late Jurassic. The earliest reported occurrence of a vertebrate filter feeder was from the North American Cretaceous, the comiconductor Leedichthys (Denver Museum specimen DMNH 63794) from the Lower Cretaceous, from the Western Interior Seaway of Colorado. The lower jaws protrude anteriorly beyond the rostrodermethmoid, giving the appearance of a pronounced ‘under-bite’, a character shared by Maltichthys. Certain of these characters are perhaps also present in Rhinichthys but are not preserved in known specimens. Not enough of the pectoral fins are preserved to determine whether the anterior edge is composed of bifurcating fin rays as in other pectoral fins. Formal taxonomic treatment of this specimen is forthcoming. This discovery and others like it are rapidly changing our perception of planktivory and its evolution in the Earth’s oceans.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

MORPHOLOGY AND FUNCTION OF THE EXTANT DIDEPHIS MOLAR DENTITION IN COMPARISON TO MESOZOIC DIDEPHISMOGRAPHY

SCHWERMANN, Achim, Universität Bonn, Bonn, Germany; KULLMER, Ottmar, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt am Main, Germany; MARTIN, Thomas, Universität Bonn, Bonn, Germany

The pleiomorphic tribosphenic molars of Didephis frequently served as a comparative model for Mesozoic therians in the past. Didephis is a relative large didephid weighting up to 5.5 kg, whereas Mesoicoic Didephidmophora were much smaller with a weight up to a few hundred grams. The ontogenetic development of tooth macrowear has been analyzed based on more than 80 Didephis molar rows. We observed a high variation in several aspects of dental wear: a wear gradient exists between the first and last molar, and various types of abrasion, formation of facets, and preferred chewing sides were detected. Furthermore, wear peak density differs in the mesial and distal edge of the tooth. The wear pattern from the studied fossil specimens. In Didephis, the wear in the trigonid is considerably more advanced than in the talonid, whereas the rates of wear are more similar in both tooth sectors in the fossil taxa.

A detailed analysis of the functional morphology of the teeth revealed further significant differences between the extant Didephis and Mesoicoic Didephidmophora such as Alphadon, Pediomyos, and Peracodentia. The orientation of wear facets can be treated as an indicator for the functional mode of dental use in the mastication cycle. The direction of all facets (strike) is very similar in all of these taxa, whereas the inclination (dip angle) is lower in Didephis than in the fossil taxa.

The value of Didephis molars as a comparative model for Mesoicoic Didephidmophora is limited to its basal tribosphenic morphology. Functional aspects distinctively differ from the smaller taxa, indicating a less constrained occlusion in Didephis. More similar to the fossil taxa is the extant Monodelphis with a much more kinematically constrained occlusion than Didephis. This could be related to size, because Monodelphis is much smaller than Didephis with a weight up to 150 g in the size range of the Cretaceous taxa. With a more similar wear pattern and facet arrangement, the dentition of Monodelphis is functionally much closer to the investigated fossil specimens than Didephis, and a more suitable comparative model respectively.

Technical Session VI (Thursday, October 31, 2013, 11:15 AM)

DIFFERENTIATION AND SIMPLIFICATION IN DENTAL MORPHOLOGY AND FUNCTION DURING ARTIODACTYL EVOLUTION

SCHWERMANN, Leonie, Universität Bonn, Bonn, Germany; VON KENNISWALD, Wibhgart, Universität Bonn, Bonn, Germany

During the evolution of artiodactyls the development of an increasingly complex occlusal surface contrasts with the simplification of the masticatory movement. Diacodus, the oldest and most primitive artiodactyl, had a relatively less derived tribosphenic bunodont dentition. From there, a variety of different tooth morphologies (bunodont, bunoselenodont, selenodont, lophodont) evolved within the Artiodactyla, due to the conquest of different habitats and access to a broad food spectrum. In order to understand the changes of tooth morphology and functional events occur during artiodactyl evolution, the masticatory process of Diacodus and other primitive artiodactyls and basal members of extant groups (Suina, Tylopoda, Ruminantia) were investigated. The main focus of this study lies on the transition to the selenodont dentition, which occurred sometime convergently in different groups and can be found in a variety of extant artiodactyls. The reconstruction of masticatory movement is based on the analysis of wear facets on the occlusal surface. The Occlusal Fingerprint Analyser (OFA) provides a new approach for the digital manipulation of 3D models of teeth in order to reconstruct the masticatory cycle. Furthermore, the OFA allows a 3D analysis of contacting areas on antagonistic teeth during the power stroke. Diacodus had tritubercular upper molars and, in contrast to all advanced artiodactyls, no hypocene. The power stroke consisted of two phases with a change of direction and inclination of the lower jaw from phase I to phase II. Primitive bunoselenodont taxa (e.g. Anthracotheriidae) that have a hypocene show a less differentiated masticatory movement which consists of two phases, the second phase just differs in inclination. The development of a hypocene and the concomitant mesial shift of the protocone caused a uniform directional movement in both phases. In modern ruminants (e.g. boids) with selenodont molars and four symphysis-crowned cusps and a biconvex cusp shape between buccal and lingual cusps, the power stroke is a uniform movement that is not divisible in two phases. The selenodont cusp morphology is the most important development in artiodactyl evolution and it allows a simplification of the mastication. The transition to a one-phased power stroke of the masticatory movement allows a reduction of the number of contact points on the occlusal surface and provides an efficient means for the mastication of food.
stroke also goes together with a symmetrical arrangement of cusps and a reduction of relief. Early selodont taxa (e.g. Caenotheriidae) achieved the same combination, but with a fifth cusp, could not reach the same masticatory mode. A LATE CRETACEOUS SHARK COPROLITE WITH BABY TURTLE VERTEBRAE

SCHWIMMER, David, Columbus State University, Columbus, GA, United States; SMITH, Albert, The Charleston Museum, Charleston, SC, United States

A small (3.0 cm) coprolite from Late Cretaceous sediments that are age-equivalent to the Couchman Formation (mid-Campanian, South Carolina), contains six complete, well-preserved vertebrae of a very small trionychid turtle. The coprolite shows a spiral morphology and is likely of one from several selachian taxa in the associated fauna, most likely *Squaloricus kaupi*. The vertebrates are located toward the tapered end of the coprolite and are miniscule, with the largest 3.7 mm long. However, they are relatively well preserved, with well-preserved in apparent articulation on one side, and the two larger on the opposite side. Overall, the turtle vertebrae comprise the bulk of the mass at the tapered end of the coprolite. This difference implies that the shark, presumably marine, ate a hatching freshwater turtle. This specimen's co-occurrences therefore also imply that the fossil site represents either a near shore marine environment with fluvial or freshwater input, or that the shark was feeding in a fluvial environment, as is observed in modern species of *Carcachius*. Either scenario is plausible.

EVOLUTIONARY PATTERNS IN BONE THICKNESS AND COMPACTNESS IN DIVING BIRDS

SCLAFLANI, Michelle, North Carolina State University, Raleigh, NC, United States; KSEPKA, Daniel, National Evolutionary Synthesis Center, Durham, NC, United States; SMITH, Adam, National Evolutionary Synthesis Center, Durham, NC, United States

 Wing-propelled and foot-propelled pursuit diving strategies have evolved multiple times in marine birds. It is well known that penguins have dense osteosclerotic bone structure, used to stabilize the pelvis with a proposed function to reduce buoyancy. However, it remains unresolved whether these changes are associated primarily with the acquisition of wing-propelled diving capabilities, with the loss of aerial flight, or with both. In order to determine the relationship between bone density changes and diving strategy, histological sections were collected from the humerus and femur of modern and fossil specimens with a variety of diving modes and flight capabilities. Sampled species include the wing-propelled diving Spheniscidae (including stem and crown fossil species) and Pan-Alcidae (including volant and flightless species), foot-propelled diving Gaviiformes and Podicipediformes, and non-propelled diving outgroup taxa from the Procellariiformes and Charadriiformes. For each species, long bones were sectioned, mounted onto slides, and photographed to create digital composite images of cross-sections from the midshaft. Cortico-diaphyseal (CDI) index and bone compactness values were calculated for each section using BoneProfiler.

Our results support a simple pattern of increase in the compactness and CDI in the hind limb of wing-propelled diving birds: diving taxa have higher values than non-diving taxa, and flightless diving taxa have higher values than volant diving taxa. This supports the inferred function of volant diving birds benefit from a reduction in buoyancy, yet are constrained to a lower density threshold by the demands of flight. However, a more complex pattern is noted in the humerus. Pan-alcids show higher compactness values while lower CDI values than penguins. Additionally, basal stem penguins show substantially lower values than extant penguins, indicating that reorganization of wing bone internal structure has occurred prior to 50 million years ago.

EQUUS SCOTTI FROM THE TULE SPRINGS LOCAL FAUNA, SOUTHERN NEVADA: IMPLICATIONS FOR THE DIVERSITY AND BIOGEOGRAPHY OF LATE PLEISTOCENE EQUIDS IN WESTERN NORTH AMERICA

SCOTT, Eric, San Bernardino County Museum, Redlands, CA, United States; SPRINGER, Kathleen, San Bernardino County, CA, United States; MANKER, Craig, San Bernardino County Museum, Redlands, CA, United States

The specific diversity and biogeographic extent of horses (genus Equus) in Pleistocene North America remain unresolved, due largely to confusing taxonomy and poorly diagnosed remains. Two species of large horses have been recognized, *Equus scotti*, characterized in part by large size, stout metapodials, and infundibula in the lower incisors, is present in multiple early and middle Pleistocene faunas throughout western North America. In the later Pleistocene a second species replaces *E. scotti* as the common large horse in southern California and possibly New Mexico. This form, often assigned to the species *Equus occidentalis*, is as large or as larger than *E. scotti* but lacks infundibula in the lower incisors. *E. scotti* remains the sole large horse species north and east of this range, but detailed biogeographic distributions for these taxa are unsolved.

New discoveries from southern Nevada enable a more precise definition of the geographic boundary between these species. Exposures of the Las Vegas Formation (LVF), a remarkably continuous paleowetland sequence in the upper Las Vegas Wash, have yielded the Tule Springs local fauna (TSLF), the largest late Pleistocene assemblage from the Mojave Desert and southern Great Basin region. Horses are a major component of the TSLF, but diagnostic remains have been lacking despite decades of study. Recent work by the San Bernardino County Museum and volunteers under permit from the Nevada Bureau of Land Management has yielded a partial skull, mandible, and metatarsal of *Equus scotti* - the first horse fossils from the TSLF to be reliably referable to species. The newly-recovered remains represent a large ead with stout metatarsals and lower incisor infundibula.

Pleistocene localities in northern Nevada have previously yielded fossils of *Equus scotti* (as *E. pacificus*) dating to ~25.5 ka. The fossils from the TSLF, from high in the section of the LVF, are directly associated with a C dating of ~11.8 ka. These remains are therefore the youngest and southernmost record of this species in Nevada and among the youngest recorded anywhere in North America. The presence of *Equus scotti* in the TSLF demonstrates close geographic and temporal proximity to other late Pleistocene Mojave Desert localities reportedly containing this species. The range extension documented here forces reevaluation of these prior records. Coupled with the presence of small horses in the TSLF, the new fossils demonstrate that multiple large and small horse species coexisted in western North America in the latest Pleistocene.

EVOLUTION OF APPENDAGE MODULARITY DURING THE FIN TO LIMB TRANSITION

SEARS, Karen, University of Illinois, Urbana, IL, United States; MABEE, Paula, University of South Dakota, Vermillion, SD, United States; DEECCHI, Alexander, University of South Dakota, Vermillion, SD, United States

Morphometric and developmental studies suggest that the segments of the tetrapod limb (i.e., girdle, stylopod, zeugopod, and autopod) form distinct modules. This modular design is believed to allow the limb segments to evolve relatively independently, facilitating the adaptive evolution of the limb. Researchers have hypothesized that this modular pattern evolved during the fin to limb transition in response to the effect of changing functional pressures on the genetic architecture of the developing limb. However, this hypothesis has not been rigorously tested, and developmental data suggest that at least some of the genetic modules that regulate limb development in tetrapods were present in their finned ancestors. This raises the possibility that the modularity that characterizes the limbs of modern tetrapods may also have been present in more basal sarcopterygians. To test among these hypotheses, a dataset of discrete limb characters was implemented from PhenomeScope, a collaborative database designed to integrate developmental phenotypes with the fossil record. The downloaded database consisted of 39 published matrices from the tetrapodomorph literature spanning the fin to limb transition. This dataset was then partitioned into four subsets, some of which consisted of 39 published matrices from the tetrapodomorph literature spanning the fin to limb transition. This dataset was then partitioned into four subsets, some of which...
tetrapods. These results are consistent with an increase in the modularity of appendage segments around the time of the origin of the tetrapod limb, possibly in response to the limb’s new functional role in terrestrial locomotion.

Technical Session X (Friday, November 1, 2013, 8:45 AM)

SHIFING ENVIRONMENTS AND CONTROLS ON BODY SIZE IN PLEISTOCENE HORSES FROM THE GREAT PLAINS

SECORD, Ross, University of Nebraska, Lincoln, NE, United States, 68521; LILIENFELD, Nathan, University of Nebraska, Lincoln, NE, United States

In the modern world there is a strong, positive correlation between mammalian body size in a species, or in closely related species, and geographic latitude. This relationship is known as Bergmann’s Rule and is usually attributed to latitudinal temperature variation and the optimization of mammalian body size. Alternatively, it has been attributed to the availability of food resources related to primary productivity. Bergmann’s Rule predicts that average mammalian body size should decrease with warming climate and increase with cooling climate though time. This pattern is seen in early Eocene equids and other mammals during the Paleocene-Eocene Thermal Maximum but is not well documented in other parts of the geologic record. Here we use oxygen and carbon stable isotopes from Equus teeth (M1s) as proxies for relative temperature and diet, respectively, and metacarpal length as a proxy for oxygen and carbon stable isotopes from Maximum but is not well documented in other parts of the geologic record. We here use oxygen and carbon stable isotopes from Equus teeth (M1s) as proxies for relative temperature and diet, respectively, and metacarpal length as a proxy for Equus body mass. Samples are from six late Irvingtonian and two late Rancholabrean localities in Nebraska, USA. Results yielded a strong, positive correlation between mean δ¹³C and δ¹⁸O values when averaged by locality, and strong positive correlations between metacarpal length and both δ¹³C and δ¹⁸O values among the Irvingtonian localities. The range of δ¹³C values shows that horses were consuming primarily C₃ plants at some localities, but mixed C₃/C₄ vegetation at others. Oxygen isotopes in meteoric water are positively correlated with mean annual temperature at mid-latitudes today. Thus, the carbon and oxygen isotope correlation suggests that C₃ grasses shifted northward during warming intervals. Alternatively, C₃ plants may have had higher δ¹³C values than C₄ plants. However, this explanation does not account for the greater body size in horses consuming C₄ vegetation, implied by the positive correlation between metacarpal length and δ¹³C values. The nutritional content of C₃ plants is lower or equal to that of C₄ plants, so consumption of a higher percentage of C₃ plants should not result in greater body size. We suggest that Equus body size was controlled by primary productivity in warmer intervals, which had both longer growing seasons and longer growing days. Increased body size with warming is the opposite of the expectation from the Bergmann Rule, but is most consistent with our results, and suggests that primary productivity can be a stronger controlling factor on body size than mean annual temperature.

Technical Session VII (Thursday, October 31, 2013, 3:15 PM)

ESTIMATING MUSCLE PARAMETERS FOR STUDIES OF SAUROPOD LOCOMOTION

SELLERS, William, University of Manchester, Manchester, United Kingdom; MARGETTS, Lee, University of Manchester, Manchester, United Kingdom; CORIA, Rodolfo, Museo Municipal Carmen Funes, Plaza Huincul; MANNING, Phillip L., University of Manchester, Manchester, United Kingdom

It has been shown repeatedly that uncertainty in the sizes of muscles is one of the biggest challenges in reconstructing the locomotor function of extinct vertebrates. The range of variation in modern animals is large both between and within species, and when sensitivity analyses are performed, this variation causes a similarly large variation in predicted locomotor performance. However there are certain biomechanical limitations that allow us to bracket the muscle mass of an animal. The animal must have sufficient muscle to perform a minimal set of locomotor functions, and similarly the animal cannot have so much muscle that its skeleton is unable to accommodate the generated loads. Here we explore the lower of these limits using a reconstruction of one of the very largest sauropod dinosaurs, Argentinosaurus huinculensis (40 metres long, weighing 83 tonnes), as an exemplar. Using comparative data we show how most muscles in terrestrial vertebrates operate over a contractile range that is approximately half of their resting length. From this observation we show how a minimum muscle mass equation can be derived entirely from the load moment arm in the skeleton and the joint range of motion. We test this approach using forward dynamic modelling to generate a slow walking gait and demonstrate that only simulations where the muscle mass is greater or equal to the amount predicted are successful. Limited comparative data suggest that there is little if any size dependency on joint range of motion patterns. However, if we use elephant derived joint ranges of motion, our Argentinosaurus simulation is unable to generate gait and that considerably reduced ranges of motion are necessary for this animal unless we propose improbably high levels of muscle mass. These results allow us to functionally bracket the largely joint range of motion and muscle mass combination and this approach should therefore allow more accurate gait and posture reconstructions in all fossil vertebrates.

Technical Session I (Wednesday, October 30, 2013, 11:00 AM)

SHOULDER GIRDLE ARCHITECTURE: A MAJOR CONSTRAINT IN THE EVOLUTION OF AMNIOTAN LOCOMOTION

SERENO, Paul, Univ of Chicago, Chicago, IL, United States, 60637; ISCH, April, University of Chicago, Chicago, IL, United States; CONROY, Lauren, University of Chicago, Chicago, IL, United States

We use computed-tomographic scans of two superbly preserved Cretaceous amniotes—the multituberculate Kryptobaatar and the crocodylomorph Araripesuchus—to determine the neutral standing posture and step cycle by way of bone segmentation, rearticulation, and animation. We then compare the animated step cycle of the rearticulated forelimb and shoulder girdle to that observed by computed-tomographic scans and high-speed film of living descendants. We demonstrate conclusively that the morphology of the forelimb and shoulder girdle, angulated distally and condyloid, is well suited for the step cycle of small living therians. We demonstrate similarly that the neutral pose of the forelimb of Araripesuchus was also near-parasagittal and maps well onto the near-parasagittal bounding gait of the living crocodylian Crocodylus johnstoni. The marked contractions in the architecture of the shoulder girdle, most representative Cretaceous quadrupedal amniotes, Kryptobaatar and Araripesuchus, posed major constraints with regard to speed and agility on land in quadrupedal mammals and archosaurs, respectively. The first, with its mobile architecture, gave rise to a diversity of distinctive gaits and agile cursorial herbivores and carnivores among therian mammals. The second, with its relatively rigid structure, proved to be a disadvantage for speed and agility on land, although an advantage in the achievement of forelimb powered flight. The absence of true quadrupedal cursors among Mesozoic archosaurs and the paucity of gaits among extant survivors attests to the structural primacy of shoulder girdle architecture in parasagittal terrestrial locomotion.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

ISOLATED THEROPOD TEETH FROM THE "ARGILES DE L'IHRAZER" (MIDDLE JURASSIC) OF NIGER

SERRANO-MARTINEZ, Alejandro, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; ORTEGA, Francisco, Universidad Nacional de Educación a Distancia, Madrid, Spain; KNAUSS, Fabien, Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain

These specimens can be divided into two morphotypes. The first morphotype includes two teeth that do not show any distinct diagnostic characters. Therefore, morphometric analyses had to be performed to help identify them. The results of the DFA and of a scatter plot of the first and second canonical functions generated by the discriminant analysis suggested that they are from an allosaurid. The second morphotype includes a peculiar tooth that shows “spinosaurid-like” characters, such as subcircular with textured enamel and many minute denticles. However, it is not as conical as typical spinosaurid teeth, and it does not bear any apicobasal ridges. Its position on the scatter plot is ambiguous, between basal tetanurans and spinosaurids. The mosaic characters and the scatter plot may make sense if this tooth pertained to a basal spinosaurid, which would show a transition between the archetypal theropod dental morphology and the apomorphic spinosaurid teeth. No Middle Jurassic spinosaurid is known so far, but the age of the specimen is not in conflict with this identification, as stratigraphically calibrated phylogenies of tetanuran theropods show.

If confirmed, the presence of the earliest known spinosaurid in the Middle Jurassic of Niger would support an African origin for the clade.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

OSTEALOGY OF A NEW SPECIMEN OF AN ELASMOASOUR PLEOSAURUS (PHYLITIA: SAUROPTERYGIA) FROM THE UPPER CRETACEOUS BEARPAW SHALE, MONTANA

SERRATOS, Danielle J., Univ of Alaska Museum, Fairbanks, AK, United States, 99775; DRUCKENMILLER, Patrick, Univ of Alaska Museum, Fairbanks, AK, United States

Elasmosaureidae is a clade of long-necked plesiosaurs that existed throughout the Cretaceous. In North America, the clade is best known from Upper Cretaceous marine deposits of the Western Interior Basin (WIB). Although numerous specimens have been collected from the WIB over the past century, understanding of their morphology and diversity from this region remains poor. This is particularly true of the geologically youngest taxa that existed during the last transgressive-regressive cycle of the Western Interior Seaway, just prior to the end-Cretaceous extinction. At present, only two valid taxa of elasmosaurs are recognized from this interval, both from the Bearpaw Shale of southern Canada. Here, we report on a new, nearly complete skeleton of an elasmosaur from the Bearpaw Shale of eastern Montana. The new specimen was found on the C. M. Russell National Wildlife Refuge in 2010 and preserves an obliquely crushed yet complete skull. Much of the postcranial is preserved in a single, large carbonate concretion that includes most of the dorsal and caudal vertebrae, coracoids, pelvic girdle and well preserved proximal forelimb and hind limb elements. At the time of discovery, the complete and articulated cervical series was preserved and photographically documented, indicating a total cervical count of 42-46 vertebrae; however, only the anterior 23 cervicalis could be recovered. Preliminary comparative analysis of the skull and postcranial reveals that the new taxon is not conspecific with the other known Bearpaw elasmosaurs Albertonectes and Terminatoratosaurus on the basis of its extremely shortened preorbital region, small number of cervical vertebrae, and cervical vertebral dimensions (length versus width) that are very short when compared to other known elasmosaurs. The specimen represents one of the most complete and well-articulated elasmosaurs found to date in the WIB and provides important new morphological data for ongoing phylogenetic studies of the clade.
A GIANT ABELOSAURID THEROPOD FROM THE LATEST CRETACEOUS OF NORTHERN TURKANA, KENYA

Technical Session IX (Friday, November 1, 2013, 8:45 AM)

Kyalo, National Museums of Kenya, Nairobi, Kenya

SERTICH, Joseph, Denver Museum of Nature & Science, Denver, CO, United States, 80205; O’CONNOR, Patrick, Ohio University, Athens, OH, United States; SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, United States; MANTHI, Fredrick Kyalo, National Museums of Kenya, Nairobi, Kenya

The African fossil record of Cretaceous non-marine vertebrates has expanded significantly over the past two decades. However, these discoveries have been limited to Lower and middle Cretaceous horizons with a conspicuous absence of fossils from the latest Cretaceous, an interval of prolonged African isolation. Recently recovered vertebrate fossils from the Lupurr Mountains of northwestern Turkana, Kenya, comprise the first definitive non-marine fauna from this critical terminal Cretaceous interval. This diverse fauna from the Lupurr sandstone (“Turkana Grits”) has been dated to the Maastrichtian and includes crocodyliforms, pterosaurs, and dinosaurs. Though fragmentary, the dinosaur record includes at least two iguanodontian ornithopods, three macronarian sauropods, and two large theropods. Here we report on one of these theropods, a new abelisaurid that significantly expands the upper limits of body size in ceratosaurs and represents the youngest diagnostic dinosaur material yet reported from the Afro-Arabian continent.

The new taxon is known from multiple isolated specimens including portions of the skull, axial column, and appendicular skeleton. Referential of unassociated remains to a single taxon is based on morphological consistency and on the recovery of specimens from a narrow stratigraphic and geographic area. A comprehensive phylogenetic analysis substantiates referral of the new Kenyan taxon to Abelisauridae based on these features, on the presence of a tall, rugose premaxilla, an anteroventrally inclined posterior border of the postorbital, and a prominent dorsal projection of the parietals and supraoccipital. An associated partial skull is strongly ossified, with a thickened but weakly sclerotized skull roof unlike many other carcharodontids. As in other ceratosaurs, the astragalocalcaneum is completely ossified and displays a prominent transverse sulcus on the anteroventral surface. Like other abelisaurids, the ascending process is low and subrectangular, separated from the broader anterolateral portion of the astragalocalcaneum by a distinct fossa. Comparison of preservational elements with those of other, more complete abelisaurids indicates that the new taxon likely exceeded 11-12 meters in length. Furthermore, the presence of a large-bodied abelisaurid in the Kenyan fauna parallels many other Late Cretaceous Gondwanan faunas, reflecting a global early Late Cretaceous turnover from allosaurid and spinosaurid dominated ecosystems.

PERUSING TALARA: OVERVIEW OF THE LATE PLEISTOCENE FOSSIL VERTEBRATES FROM THE TAR SEEPS OF PERU

Symposium 2 (Thursday, October 31, 2013, 2:15 PM)

SEYMOUR, Kevin, Royal Ontario Museum, Toronto, ON, Canada, M5S 2C6

A. G. Edmund collected more than 28,000 fossil bones from the Late Pleistocene tar seep deposit on the Talara, Piura, coast of northern Peru, in January 1958. Of the 27,064 identified specimens, 63.4% represent mammals, 34.5% birds, and 2.1 reptiles, with trace amounts of amphibian remains. Two families of Amphibia and eight families of Reptilia have been tentatively identified, but not published. Fourteen non-passerine bird orders represented by 6,342 identified specimens have been published, while the almost 3,000 passerine bones remain under study. Considering the fossil bird remains, ducks (37.3%) and passerines (33.6%) predominate, in contrast to the similarly-aged Rancho La Brea, California, assemblage where diurnal birds of prey (60%) form the majority. Of the 17,510 identified avian specimens, Caracarinae represent over 79%, indicating a classic carnivore trap situation, as at Rancho La Brea. Eight species of Carnivora have been identified (Minimum number of individuals, MNI, in parentheses): the canids Lycalopex sechurae (1), a camelid Odocoileus sp. (1), a camelid, Neochoerus (1), a felid Neofelis (1), a canid Canis dirus (1), and a single bone of another canid that remains unidentifiable. The MNI is usually based on pedal elements. Although Panthera atrox was reported from Talara, this report was in error. Within the herbivores only the deer and camel have been studied and published, so the species determination remains unresolved for most. There are two cervids, Odocoileus (18) and Mazama (1), a camelid, Palaeolama (3), a tapir, Pecari (1), an equid, Equus (6), a gomphotheriid, Stegomastodon (2) and at least five xenarthrans, Homolodesma (2), Eremotherium (3), an unidentified notothere (1), Glossotterium (2) and Catonyx (2). Two odontids are represented by Neochoerus (1) and an undetermined number of smaller species, still under study. Finally there is a single but unique specimen assigned to Tonatia, and two diploids, Didelphis (1) and Marmosa (1). The mammalian remains compare well with the famous Rancho La Brea deposits; carnivorans dominate, a high proportion of his beetle days and subadults are present (35% to 47% depending on the species), and a significant number of Canis dirus specimens show skeletal pathologies. A habitat with more water than is present today is indicated by this fauna, which has a distinctive South American component as well as a number of species in common with the Rancho La Brea assemblage.

DOES SIZE MATTER? ISOMETRIC VS. ALLOMETRIC SCALING IN ARMADILLOS, PAMPATHERES, AND GLYPTODONS (ORDER CINGULATA)

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

SHAW, Barbara, Colorado State University, Montrose, CO, United States, 81401

The Order Cingulata (armadillos, pampatheres, and glyptodonts) are generally powerful diggers. The extant species of Cingulata are tiny compared to their extinct relatives. They range in size from the 12 cm Chlamyphorus (fairly armadillo) to the more than 3 m glyptodonts, like Panochthus. One factor in evaluating the biomechanics of a species is to establish an accurate estimate of body mass, however armed organisms defy the usual estimates. To better understand the locomotion of glyptodonts and pampatheres, the best model for these species, is one in which they are also armored. This calls into question isometric or allometric scaling. If armadillos are closer to an isometric scale, the more fit the model, and thus better able to estimate the body mass and emulate the locomotion of their giant, extinct relatives. Because of the digging lifestyle, the bones in some portions of the extant species are very large. This study examines isometric and allometric scaling of bones and postures, and the extent and circulatants by comparing a morphometric analysis to a log transformed regression of these same specimens. The data indicate that Priodontes and Cabassous armadillos are a good isometric model when examining their larger extinct relatives.

NATIVE FOSSIL MEGAMOUTH SHARK (LAMNIFORMES: MEGACHASMODIDEA) FROM THE OLIGOCENE-MIOCENE OF THE WESTERN UNITED STATES

SHIMADA, Kenkito, DePaul University, Chicago, IL, United States, 60614; WELTON, Bruce, New Mexico Museum of Natural History and Science, Albuquerque, NM, United States; LONG, Douglas, Oakland Museum of California, Oakland, CA, United States

The extant megamouth shark, Megachasma pelagios (Laminformes: Megachasmodidae), is a large filter-feeding fish. Since the discovery of the extant M. pelagios in 1976, fossil megachasmodids have been reported sporadically from several marine deposits worldwide. The fossil record includes a taxon from the Oligocene–Miocene marine deposits of western United States known at least since the early 1960s, but the fossil taxon has never been formally studied or described. Based on a large sample of shark teeth holed from alternate sides of the Carpinteria fossil deposits, the Santa Barbara Museum of Natural History, the University of California, Berkeley, and the California Institute of Technology (CIT). Since its purchase in 1957, the CIT collections have been housed at the Los Angeles County Museum of Natural History. During a review of the CIT collection at LACM in 1985, an edentulous left maxilla from a very young Smilodon fatalis was identified. This is the first and only Smilodon material identified from Carpentaria. For but 13 mm of the permanent canine (located deep within the bivalve at the time of collection), all development stages of permanent teeth are present, and permanent cheek teeth heads have been lost. The Carpentaria specimen is from a much younger animal than any juvenile found in the Rancho La Brea collection and represents the first pre-weaned individual of this species to be identified anywhere. Previous studies of the biota indicated that the Carpinteria fossil deposits contained a diadromous population coexisting with the extant cingulatans by comparing a morphometric analysis to a log transformed regression
USE OF SILICONE CAULK AS A SEPARATOR FOR FIELD JACKETS

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

SHINYA, Akiko, The Field Museum, Chicago, IL, United States, 60605-2496

DENTAL HISTOLOGY OF DIRE WOLF FOSSILS FROM TAR SEEP DEPOSITS: TAPHONOMIC CONSIDERATIONS FOR LIFE HISTORY STUDIES

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

SHOLTS, Sabrina, Stockholm University, Stockholm, Sweden; WÄRMLÄNDER, Sebastian, Stockholm University, Stockholm, Sweden; CARLSON, Joshua, University of California, Berkeley, Berkeley, CA, United States; HULSKA, Leska, Univ of California Berkeley, Berkeley, CA, United States

Biogeographic assemblages and bipartite network diagrams provide an easy-to-interpret means of representing similarities and differences between faunal assemblages at various localities. Until data from field work in Antarctica and other non-model regions are assessed, poor sampling will continue to hamper the attempts of vertebrate paleontologists to understand how the end-Permian mass extinction affected the broad-scale geographic distribution of tetrapods.

THE GORGONOPUS BRAINCASE AND THE EVOLUTION OF THERAPSID BRAINS

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

SIGURDSEN, Trond, McGill University / NHM LA County, Los Angeles, CA, United States, 90007

The early evolution of the synapsid brain is of great importance to our understanding of the evolutionary origin of the mammalian brain. In this study, the skull of a gorgonopsian therapsid (Lycanops) was CT-scanned, and compared it to the braincases of more basal synapsids as well as theropods, cynodonts and mammals. The gorgonopsian braincase is about the same size as the skull than in most synapsids from the Permian. The olfactory bulbs were larger and located in the anterior part of the brain. The narrow olfactory tracts passed through the posterior part of this bone, leading to relatively small and elongate cerebral hemispheres. The optic lobes (part of the tectum in the mesencephalon) were probably large and dorsolaterally situated. The shape of the brain appears to have been similar in gorgonopsians and Dimetrodon, with a relatively flat cerebellum (though this area is somewhat larger in Lycanops), elongate cerebral hemispheres, and bulbous olfactory bulbs. Comparisons to other tetrapods suggest that many of these features are plesiomorphic for the synapsids in general, and Lycanops shows relatively little progress towards the mammalian condition. In comparison, the cerebellum is noticeably enlarged in theropods and cynodonts, and the cerebrum is greatly enlarged in true mammals. Thus, the incipient enlargement of the cerebellum appears to be one of the first mammalian features to appear in the therapsid brain.

A NEW FAMILY OF LARGE OMNIVOROUS BATS FROM THE LATE EOCENE OF EGYPT

Technical Session VI (Thursday, October 31, 2013, 8:15 AM)

SIMMONS, Nancy, American Museum of Natural History, New York, NY, United States, 10024; SEIFERT, Erik, Stony Brook University, Stony Brook, NY, United States; GUNNELL, Gregg, Duke University Lemur Center, Durham, NC, United States; SIMMONS, Nancy, American Museum of Natural History, New York, NY, United States; SIMMONS, Nancy, American Museum of Natural History, New York, NY, United States; BRAINS, W. Desmond, University of the Pacific, Stockton, CA, United States; VARRICCHIO, David, Montana State University, Bozeman, MT, United States; SIMMONS, Nancy, American Museum of Natural History, New York, NY, United States

The new family of bats is early Eocene in age (~55–52MY BP). Twenty-eight families of bats are currently recognized, including eight known only from fossils. A combination of fossils and ghost-lineage reconstruction indicates that virtually all of these lineages were distinct by the middle Eocene (~34 MY BP). Bats were present on all continents except Antarctica by the middle Eocene, and most archaic bat families (known only from fossils) had distributions spanning multiple continents. A new fossil from the BQ-2 locality in the Birker Qurun Formation in the Fayum Depression of northern Egypt (dated to ~37MY BP) does not fit within the diagnosis of any previously described family of bats from Africa or any other continent. Known from a partial maxilla, this taxon has molars with a well-developed W-shaped cusp lacking a distinct mesostyle but with a strong parastyle and shallow U-shaped ectocone - all traits that are found in most archaic bat families and which are probably plesiomorphic for bats. However, this taxon also has an M2 with a large metacqueeze cusp and a large, bulbous hypocone set low on the posteroental corner of the tooth, neither of which occur in any other known bat family, living or extinct. Also notable is the size of the new BQ-2 bat, which appears to have been only slightly smaller than the largest extant bats with trischopine dentitions, falling well within the size range of modern megabats. The molars of the new bat lack the high, sharp crests and elongated preparacrista and postmetacrista characteristic in large trischopine bats, features that are associated with an insectivorous/carnivorous diet. The combination of traits in the new BQ-2 bat suggests that it may have been more omnivorous than other known Eocene bats, perhaps including plant material in its diet.

NEW DATA ON THE MIDDLE TRIASSIC TETRAPODS OF ANTARCTICA AND FAUNAL PROVINCIALIZATION ACROSS SOUTHERN PANGAEA

Symposium 4 (Saturday, November 2, 2013, 8:30 AM)

SIDOR, Christian A., University of Washington, Seattle, WA, United States, 98195; HUTTENLOCKER, Adam K., University of Washington, Seattle, WA, United States; PEECOOK, Brandon R., University of Washington, Seattle, United States; SMITH, Roger M.H., Iziko South African Museum, Cape Town, South Africa; VILLIEN, Daril A., University of Washington, Seattle, WA, United States

Newly field work in the Bearded Glacier region of Antarctica has led to a new collection of tetrapod fossils from the upper member of the Fremouw Formation at Fremouw Peak. This locality records a sedimentary environment and taphonomic signature remarkably similar to that preserved at Gordon Valley, the first locality known to preserve Cynognathus Assemblage Zone-equivalent taxa from Antarctica. We use an apomorphy-based approach to document the occurrence of ten distinct taxa from the upper Fremouw: the dicynodont Anganosaurus, an indeterminate theropod, and a dinosaurian crown group archosaur. Combined with previous data, our work demonstrates that ten distinct taxa can be recognized from the upper Fremouw, including two endemic temnospondyls. Furthermore, our recognition of Anganosaurus in the upper Fremouw Formation provides a new piece of evidence in favor of a correlation with the Cynognathus C subzone (uppermost Burgersdorp Formation) of South Africa. To examine the effect of the end-Pernian mass extinction on the distribution of tetrapods across southern Pangea, we applied novel network methods to compare pre- and post-extinction assemblages. More specifically, we collected presence/absence data for 65 Permian species and 68 Middle Triassic species in five regions: (1) Karoo Basin of South Africa; (2) Luangwa Basin of Zambia; (3) Rhuhulu Basin of Tanzania; (4) Chiweta beds of Malawi; and (5) Beacon Basin of Antarctica. We analyzed the functional components of the interconnected network using the network metrics, range-size, and endemism, and for all four, we detected significantly increased provincialism in our Triassic dataset. In southern Pangea, a more homogeneous and broadly distributed fauna in the Late Permian (Wuchiapingian; ~257 Ma) was replaced by a provincial and biogeographically fragmented fauna by Middle Triassic times (Anisian; ~242 Ma). The use of descriptive network statistics provides insight into the underlying structure of biogeographic assemblages and bipartite network diagrams provide an easy-to-interpret means of representing similarities and differences between faunal assemblages at various localities. Until data from field work in Antarctica and other non-model regions are assessed, poor sampling will continue to hamper the attempts of vertebrate paleontologists to understand how the end-Permian mass extinction affected the broad-scale geographic distribution of tetrapods.

ELONGATOOLOTHID (DINOSAURIA: THEROPODA) EGGSHELL FROM THE LATE CRETACEOUS OF ARGENTINA: A TAPHONOMIC INVESTIGATION OF APPARENT EGGSHELL DIVERSITY

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

SIMON, D. Jade, Montana State University, Bozeman, MT, United States, 59717; BURDICK, L.C., Montana State University, Bozeman, MT, United States; MAXWELL, W. Desmond, University of the Pacific, Stockton, CA, United States; VARRICCHIO, David, Montana State University, Bozeman, MT, United States
The Cloverly Formation (Aptian-Albian) of Montana has yielded rare North American examples of Early Cretaceous dinosaur eggshell. The worldwide scarcity of Early Cretaceous dinosaur eggs and eggshell compel documentation of the microstructural and phyletogenetic affinities of these specimens in part, a gap in our knowledge of the early evolution and diversity of Cretaceous osteodons. The eggshell fragments under study were recovered from exposures of Unit VII of the Cloverly Formation, approximately fifteen miles east of Edgar, Montana. The fragments, initially defined as three distinct types based on surface ornamentation, were examined using petrographic and scanning electron microscopy.

Analysis reveals the three ‘types’ of eggshell are united by the presence of two structural layers of calcite separated by an undulating boundary. Additionally, the 1.5-2.3 mm thick eggshells exhibit straight pores and crystal spalling at the boundary of the mammalian body size evolution derived from paleontological theory and fit these to a time-calibrated phylogeny of living and fossil Mammaliaformes, including a number of mammalian body size evolutionary model for these data. Surprisingly, my results also indicate a lower absolute rate of mammalian body size evolution during the Cenozoic than during the Mesozoic. This can be explained by release from a stationary evolutionary process that limited the rate of mammalian body size evolution or release from a constrained adaptive zone. I suggest researchers should take care to ensure that the models they use are appropriate to the question being tested, and that the parameters estimated are interpreted in the context of the best-fitting model.

TEMO OR MODE IN EVOLUTION? THE CASE OF MAMMALIAN BODY SIZE EVOLUTION

SLATER, Graham, Smithsonian Institution, Washington, DC, United States, 2001-7012

Paleontological studies have consistently shown that average mammalian body size and body size disparity increased rapidly after the Cretaceous-Paleogene (K-Pg) boundary. Phylogenetic comparative methods provide a powerful alternative way of addressing classic questions about tempo and mode of phenotypic evolution in the fossil record. However, recent phylogenetic studies based on extant taxa have failed to find evidence for a shift in mammalian body size evolution at the K-Pg boundary. This is of great interest here is that most often, these kinds of questions are added in the context of variation in evolutionary rates. However, shifts in the mode of phenotypic evolution provide an alternative and, in some cases, more realistic explanation for patterns of trait diversity. To test for these alternatives, I developed three novel models of mammalian body size evolution derived from paleontological theory and fitted these to a time-calibrated phylogeny of living and fossil Mammaliformes, including a number of Mesozoic taxa. Specifically, I ask whether the K-Pg extinction resulted in a shift in the rate of mammalian body size evolution or release from a constrained adaptive zone. I found that a model comprising a constrained evolutionary process that limited the realized disparity regardless of evolutionary rate. Despite a lower absolute evolutionary rate, body size disparity has in fact been increasing since the K-Pg event. The use of time-calibrated phylogenies of living and extinct taxa and realistic, process-based models provides unparalleled power in testing evolutionary hypotheses. However, these results suggest researchers should take care to ensure that the models they use are appropriate to the question being tested, and that the parameters estimated are interpreted in the context of the best-fitting model.
Preparators' Session (Thursday, October 31, 2013, 8:45 AM)

**Cutting Out the Middle Man: Archival Support Cradle Design for Use During Preparation**

SMITH, Matthew, Petrifed Forest National Park, Petrifed Forest, AZ, United States, 86028

*In 2008 the Yale Peabody Museum (YPM) began annual excavations at Petrifed Forest National Park (PEFO). One of their finds was a partial Taphrosaurus skeleton YPM 58121. During preparation at YPM it was found that the skeleton included a well preserved right side of the skull matrix and was clean and unstable. The left side of the skull was exposed and damaged on the erosional surface. Preparators at the YPM consequently exposed the right side of the skull and decided to curate the specimen in its field jacket. Subsequently the skull was temporarily returned to PEFO for study to stabilize it before the right side of the skull was coated with a layer of cyclododecane and it arrived undamaged at PEFO during the summer of 2012. It was decided that the fragile specimen should be prepared with both sides visible to facilitate research. This presented the problem of how to remove the field jacket and stabilize the specimen during preparation. In lieu of removing the cyclododecane and building a tight fitting, disposable support cradle we constructed an archival support cradle whose padding material was firm enough to support the specimen during preparation and could also expand slightly to support the specimen as the cyclododecane sublimated away. Deep undercuts were filled partly with damp tissue paper. A layer of mechanically softened Tyvek was placed over the specimen, followed by a layer of polyester fiber padding. Rigid polyethylene foam blocks were added to further fill shallow undercuts and uneven surfaces. Finally a layer of 1/8 inch polyethylene sheeting roughened with sandpaper was added to adhere the padding to the outer shell made of FGR-95 plaster and fiberglass. While the plaster cured the shell was weighted with sand to compress the padding. The ensemble was then wrapped with a tinfoil separator and strapped tight with rubber bands while a temporary plaster jacket was applied to keep compression on the assemblage during preparation. Starting in the center small sections of the original field jacket were then removed and the weathered left side of the specimen was consolidated and prepared until the entire field jacket was removed. During preparation the right side of the skull prepared by YPM remained in firm contact with the padding preventing breakage due to collapse while the cyclododecane sublimated away. This cradle technique allowed us to skip temporary support jackets and therefore avoid potential damage due to transferring the specimen multiple times.

**Poster Session IV (November 2, 2013, 4:15 - 6:15 PM)**

**Osteological Histology of the Pan-Alcidae (Aves, Charadriiformes): Correlates of Wing-Propelled Diving and Flightlessness**

SMITH, N., National Evolutionary Synthesis Center, Durham, NC, United States, 27705; CLARKE, Julia A., University of Texas at Austin, Austin, TX, United States

Although studies of osteological morphology, gross morphology, myological histology, neuroanatomy and wing-scaling have all documented anatomical modifications associated with wing-propelled diving, the osteohistological study of this highly derived method of locomotion has been limited to penguins. We present the first osteohistological study of the derived forelimbs and hindlimbs of wing-propelled diving Pan-Alcidae (Aves, Charadriiformes). In addition to providing details of the differences between wing-propelled diving charadriiforms and non-diving charadriiforms, microstructural modifications to the humeri, ulnae and femora of extinct flightless pan-alcids are contrasted with those of volants. Histological thin-sections of 4 species of pan-alcids and one non-alcid charadriiform (Aca torda, Alca sandals, Pinguinus impennis, Manucalia angulata, Sterna hirundo) were prepared. The forelimb bones of wing-propelled diving charadriiforms were found to have significantly thicker (~22%) cortical bone walls than non-diving charadriiforms. Additionally, as in penguins, the forelimbs of flightless pan-alcids are found to be pachyostotic. However, unlike the pattern documented in penguins that display thickened humeri in both forelimbs and hind limbs, the forelimb and hind limb elements of pan-alcids display contrasting microstructural morphologies with thickened forelimb cortices and relatively thinner femoral cortices. Additionally, the identification of medullary bone in Pinguinus impennis suggests that osteohistological investigation could provide an answer to longstanding questions regarding sexual dimorphism of Great Auks. Finally, these results suggest that it is possible to discern volant from flightless wing-propelled divers from fragmentary fossil remains.

Symposium 4 (Saturday, November 2, 2013, 9:15 AM)

**Anatomy of a New Sauropodomorph Dinosaur from the Early Jurassic Hanson Formation of Antarctica**

SMITH, Nathan, Howard University, Washington, DC, United States, 20059; HAMMER, William, Augustana College, Rock Island, IL, United States; MAKOVICKY, Peter, The Field Museum of Natural History, Chicago, IL, United States

Recent field work in the Beaoedram Glacier region of Antarctica recovered new dinosaur material from the Early Jurassic Hanson Formation. One of the specimens is dated at ~194.0 Ma help constrain the site's age. In addition to new material of Glacialisaurus hamneri, two new species of sauropodomorph were identified, one of which is represented by a nearly complete skeleton. Recent preparation has produced a skull, partial braincase, and articulated manus of this specimen. Lack of neurocentral fusion, highly vascularized fibrolamellar bone, and absence of distinct lines of arrested growth all indicate the specimen is a juvenile. Several features on the distal femur (an extensor fossa, absence of a medial epicondylar crest, transversely narrow tibiofibular crest) distinguish the new saurupodomorph from Glacialisaurus. Potential autapomorphies of the new Antarctic taxon include: the presence of enlarged foramina within the maxilla and narial fossa, a pronounced proximal femoral sulcus, and a robust anteromedial fibular flange. Several characters imply a close relationship to Ignavusaurus from the Early Jurassic of South Africa, including: a transversely wide ventral ramus of the postorbital, alvei, beaks, and a bulbous hemispherical femur. However the fact that the new taxon and Ignavusaurus are known from juvenile specimens warrants caution in interpreting synapomorphic features that may vary ontogenetically (e.g., femoral size). The Antarctic taxon may fall outside of Massospondyliidae, a ubiquitous sauropodomorph group (including Glacialisaurus) globally distributed in the Early Jurassic. Massospondyliidae the synapomorphy lacking in the new taxon include: a slot-shaped cranial foramen, a weakly developed antorbital fossa on the maxillary ascending ramus, a extremely robust metacarpal I and elongate manual first digit, and elongate cervical centra. However, the skull of the Antarctic taxon displays a number of traits found in Massospondyliidae or more inclusive clades (e.g., shortened lataler anterior rami, elongate prefrontal ventral rami, jugal contribution to the antorbital fenestra, finely wrinkled tooth enamel), providing additional evidence for high levels of homoplasy previously documented in sauropodomorph phylogenetic datasets. Coupled with the Massospondyliid Glacialisaurus and an additional new sauropodomorph closely allied to Ignavusaurus, this taxon adds to Hanson Formation dinosaur diversity, and provides new support for mosaicism in early sauropodomorph character evolution.

Technical Session IX (Friday, November 1, 2013, 11:00 AM)

**Taphonomy of a Dinosaur Breeding Colony in Southern Patagonia**

SMITH, Roger, Izalco South African Museum, Cape Town, South Africa; MANSUCO, Adriana, CONICET, Mendoza, Argentina; POL, Diego, Museo Paleontológico Egidio Feruglio, Trelew, Argentina; MARSICANO, Claudia, CONICET-Universidad de Buenos Aires, Buenos Aires, Argentina

The Late Triassic-Early Jurassic Laguna Colorada Formation of Patagonia contains a unique assemblage of sauropodomorph dinosaurs. This taxon was originally described from several well-preserved post-hatchling specimens associated with egg remains found at the Laguna Colorada type section. Our recent expeditions to this locality have yielded 25 new specimens of this taxon, comprising skeletons in five different ontogenetic stages along with several complete "nests" of unhatched eggs. Detailed sedimentological investigation shows the skeletal remains and eggs occur in three distinct horizons within a 3 m-thick bed of mottled light reddish-brown/vale-grey massive siltstone. The bones are encrusted in brown weathering calcareous siltsone similar to the numerous spherically-shaped calcareous nodules that occur in the same horizons. The latter are interpreted as palustline carbonate precipitated in loessic parent material around a floodplain pond under a seasonally warm climate. The first Mussaurus nests described from this site comprise 8 closely associated and notably small individuals (femoral length 3 cm). Their proximity to unbroken eggs and eggshell fragments clearly suggests an aggregation of nestlings rather than unhatched embryos, as their body size largely exceeds that of all the associated eggs, and the lack of size variation among them suggests they are from the same brood. A new aggregation of at least 11 articulated juvenile skeletons (femoral length 12 cm) was found in the vicinity of the type hatchlings. Taphonomic assessment of this aggregation rules out any post-mortem transport of the carcasses and suggests these are the result of synchronous death and burial of behaviorally aggregated individuals. These specimens are all the same size and histological data indicates that these individuals died together before reaching the first year of life. Our latest field studies located several clusters of up to 24-27 unhatched dinosaur eggs close to the Mussaurus nests and nestling aggregations in the same horizons. The egg clutches lie in two layers within elongate depressions or tunnels that appear to have been deliberately excavated in the loess. We propose that the fertilized but unhatched eggs (at least one with an ossified embryo) were laid at all the same time, possibly by more than one female Mussaurus, and that the occasional unincubated unhatched clutches appear to have been asphyxiated by rapid deposition of a thick layer of aeolian silt loaded with volcanic ash.

**Mammalian Dental Ecomorphology and Disparity Across the Cretaceous-Paleogene Boundary: A Comparison of 3D Metrics**

SMITH, Stephanie, University of Washington, Seattle, WA, United States, 98195; WILSON, Gregory, University of Washington, Seattle, WA, United States

Dental morphology offers insight into the dietary ecology of extinct mammals. Diet inference for fossil material can be especially useful in elucidating ecological responses to environmental perturbations, such as those occurring during the Cretaceous-Paleogene (CPG) extinction. Various measures of dental morphology have been used in the prediction and analysis of feeding ecology in fossil mammals, including two-dimensional (2D) estimates of total shearing-crest length (TSCL) as well as three-dimensional (3D) estimates of dental complexity such as orientation patch count (OPC). The merit of comparing TSCL with the corresponding OPC values taken from the same lower molar has not been fully evaluated in a 3D context.

Here, we used high-resolution 3D scans of mammalian cheek teeth across the Cretaceous-Paleogene boundary to test for congruence in patterns of dental ecomorphology and disparity as indicated by a 3D metric (OPC) and a historically 2D metric (TSCL) that we measured in three dimensions. To calculate TSCL, we summed linear measurements of the six principal shearing crests of the lower second molar of eutherians (15 species) and the lower third molar of metatherians (10 species). We compared TSCL with the corresponding OPC values taken from the same lower molar rows. Our results indicate that TSCL is negatively correlated with OPC, which positively correlates with herbivory in extant mammals. We also separately considered tridigon crests and talonid crests to further refine our understanding of the relationship of these
DIVERSITY OF ARCHAEONYCTERID BATS IN THE EARLY EOCENE OF EUROPE

HM Smith, Thierry, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; HABERSETZER, Jörg, Senckenberg Forschungsinstitut, Frankfurt am Main, Germany; GUNNELL, Greg, Duke University Lerner Center, Durham, NC, United States

Chiropterologists in one of the major modern mammal orders for which no fossil record has been associated with the Paleocene-Eocene Thermal Maximum. Despite intensive collecting efforts, the earliest remains of bats are still elusive. Archaeonycteris trigonodon from the early Middle Eocene Messel Formation (MP11) in Germany along with Ichonycteris index and Onychonycteris finneyi, both from the late Early Eocene Green River Formation (Wa?) in Wyoming, have been recognized as representing the most primitive bats based on morphological and dental comparison. Very few dental features of any of these taxa have been studied in detail because upper and lower dentitions are in occlusion. Nearly one century after its initial description it has become possible to digitally reconstruct the teeth of A. trigonodon using micro-CT scanning technology. This permits characterization of the complete dentition of A. trigonodon and for the first time enables dental comparisons with A. brasiliensis from the middle Early Eocene of Averyan (MPS-9) in France. The early Early Eocene French locality of Meudon (MP9+?) has also yielded a few isolated bat teeth that have never been formally described. M1 is distinctly smaller than M2, both have a deep ectocrista but M1 is more asymmetric than M2. The centrocrista does not extend far toward the labial border and both have a complete lingual cingulum and no paracone. Lower molars are relatively wide, especially the trigonid of m2. The entoconid of m1 is distinct and individualized whereas it is more reduced and in line with the hypocoilid on m2 and m3. The new taxon from Meudon is similar in size to Archaeonycteris trigonodon from the early Early Eocene of Silvesirna (MP7) in Portugal but differs from that taxon in having lower molars with a relatively longer trigonid and shorter postcristid. These results indicate that the diversity of archaeonycterid bats is higher than previously recognized and that diversification of this lineage began early in the Eocene.
The basal archosauromorph *Euparkeria capensis* from the Middle Triassic (early Anisian) of South Africa is a key taxon for the study of archosauromorph evolution because it has been widely regarded as approaching the ancestral archosaur Bauplan, and falls immediately outside crown Archosauromorpha. The genus contains most phylogenetic hypotheses. Four other Early-Middle Triassic species are considered putative members of the family Euparkeriidae, although the monophyly and composition of this family has yet to be adequately tested. One putative euparkeriid species is *Dorosuchus neuctens* from the Anisian of Russia (Berkendorf 1 locality, Orekhov region, Dongur Oblast). The holotype of *Dorosuchus* consists of the right ilium, femur, and tibia of a single individual. Additional specimens, including a braincase, from the same block as the holotype were also referred to *Dorosuchus* in the original description. A left posterior mandible and partial pterygoid from the same locality but from a different block from the holotype were subsequently referred. *Dorosuchus* is phylogenetically positioned on the basis of a combination of characters including a relatively short and distally rounded preacetabular process of the ilium and a strongly curved posterior margin of the proximal shaft of the tibia in lateral view. The referred braincase is also diagnosable based on a unique combination of characters, including a low pterygoid process and presence of a longitudinal crest and a subvertical orientation of the parabasisphenoid. The referred mandible and pterygoid possess characters of clades more crownward than *Euparkeria*, including a dorsomedial projection of the articular, and apparent absence of pterygoid teeth. A phylogenetic analysis based on all previously referred specimens places *Dorosuchus* as the sister taxon of crown Archosauromorpha.
Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

PHYLOGENETIC ANALYSIS OF SOUTH AMERICAN GAVIALIDS

SOUZA, Rafael Gomes, Universidade Federal de Uberlandia, Uberlandia, Brazil; RIFF, Douglas, Universidade Federal de Uberlandia, Uberlandia, Brazil; KELLNER, Alexander, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

The clad Gavialidae, was, among the ancient groups of crocodylians, the most affected by Cenozoic extinction, with only one species (Gavialis gangeticus) surviving till today. Despite previous efforts to understand the biogeographic history of the South American gavialids, research on this subject is ongoing due to the incomplete sample of the taxa included in previous works. Here we present the results of a new analysis which included all the known taxa and a new form coded on three specimens coming from the Late Miocene Solimões Formation, which crops out in the Acre State, Northern Brazil. The matrix was built with the 185 characters from previous works plus 14 new cranial characters, 15 ingroup taxa and three basal Gavialidae as outgroups (Ethorhachus angustissipennis, Thalassosuchus macrophrinus and T. neocarolai). The subject was included as the thickest half to 0.51 consistency index and 0.72 retention index: (((Gavialidae(Gavialis gangeticus,Gavialis dilatatus)),Ikanogavialis(Ikanogavialis(G. neogaeus,G. croizati,Piscogavialis)),Eothoracosaurus(Eothoracosaurus(G. neogaeus,G. croizati,Piscogavialis)))Gryposuchus(Gryposuchus colombianus(G. neogaeus(G. croizati,Gryposuchus new sp.)))). The genus Gryposuchus was recovered as a clade, with Hesperogavialis as its sister-group and with G. colombianus, from Middle Miocene deposits of Colombia, as the most basal species. In agreement with previous works, this cladogram show that an African clade is the sister group of the clade composed of species from South American and India. The extant Gavialis is deeply nested in a clad of South American taxa. With such ancestry rooted in South America, the presence of Gavialis in India suggests at least one dispersion event. Fossil finds in Madagascar and Antarctica are those most likely to change this scenario.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

THE BRAIN AND INTERNAL CRANIAL ANATOMY OF VIVERRAVUS MINUTUS (MAMMALIA: CARNIVORAMORPHA): DETERMINING THE TIMING OF ACQUISITION OF KEY CARNIVORAMORPHAN ENDOCRANIAL CHARACTERISTICS

SPAULDING, Michelle, Carnegie Museum of Natural History, Pittsburgh, PA, United States, 15206; HUGHES, Elijah, Carnegie Mellon University, Pittsburgh, PA, United States; FLYNN, John, American Museum of Natural History, New York, NY, United States; SPAULDING, Michelle, Carnegie Museum of Natural History, Pittsburgh, PA, United States; SOUZA, Rafael Gomes, Universidade Federal de Uberlandia, Uberlandia, Brazil; RIFF, Douglas, Universidade Federal de Uberlandia, Uberlandia, Brazil; KELLNER, Alexander, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

Viverravus minutus, one of the smallest known carnivorans. Here we present a digitally constructed endocast produced from a high-resolution computerized tomography (CT) scan generated by the American Museum of Natural History’s Microscopy and Imaging Facility of the almost undistorted skull, AMNH 12621, recovered from the Paleo Trap Cave, Wyoming. This is not only the first virtual endocast of a viverravid but also the first non-distorted endocast known for any member of this clade. When the endocast of Viverravus is compared to taxa in their sister clad Carnivoriformes, the viverravid exhibits more limited cerebral expansion. The midbrain is almost completely exposed, there is no contact between the frontal poles and olfactory bulbs, and the dorsal profile of the cerebellum forms almost a straight line, rather than the sharply convex shape occurring in comparisons taxa of Carnivora such as Odocetes. No traces of the major neocortical sulci are present on the cerebrum, and the presence of a distinct rhinal fissure as well as traces of the paths of the sagittal and transverse sinuses indicate that these neocortical sulci were truly absent, but not simply not preserved on the wall of the braincase. This confirms observations of the complete absence of these sulci described previously in a badly damaged endocast of the larger-bodied viverravid Didymictis. These features together indicate that the expansion and further development of the cerebral cortex seen in modern Carnivora began at the base of Carnivora, and that Viverravus is an extant representative of this early radiation. The examination of the internal cranial anatomy of Viverravus minutus. There is no ossified tentorium, contra the condition known for Odocetes and carnivorans. As some degree of tentorium ossification is seen in both pangolin and creodont outgroups to Carnivoriformes, we conclude this classic carnivorin synapomorphy was lost in the Viverravidae, and may represent a synapomorphy at a higher taxonomic level (Ferae or Ostentoria).

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

RESOURCE PARTITIONING AMONG LATE PLEISTOCENE HERBIVORES OF NATURAL TRAP CAVE, WYOMING

SPENCER, Lillian, Glendale Community College, Glendale, AZ, United States, 85302; SCOTT, Eric, San Bernardino County Museum, Redlands, CA, United States; SPENCER, Marc, University of Iowa, Iowa City, IA, United States, 52242

*Omnitheria* dinosaurs form a diverse, globally-distributed clade including the dominant large land herbivores in many Mesozoic faunas. However, because we lack a well-resolved species-level phylogeny including basal and derived members, our understanding of the initial dinosaurian radiation remains unclear, which further complicates our ability to test biogeographic scenarios. A new species-level phylogenetic analysis, based on comprehensive empirical assessments of a wide sample of omnirhizichian with an emphasis on basal taxa, helps resolve the relationships of historically labile taxa. *Lesothosaurus* is a monophyletic group outside of Genasauria, corroborating recent studies, though the current analysis did not recover distinct Laurasian and Gondwanan clades as has been previously reported. *Lesothosaurus*, traditionally considered one of the most basal ornithischians, is here recovered as the basalmost ornithiscian clade more closely related to theropods than to thyreophorans. The resultant phylogeny shows good resolution among basal taxa; however, most members of Cerapoda collapse into a polytomous recovering only a monophyletic Iguanodontia, Marginocephalia, and a few other derived clades. The phylogenetic placement of this clade is critical for all studies of character divergence for more derived clades and ancestral state reconstructions for Ornithischia in general, as well as determining areas of origin for clades across the tree. Building on the species-level phylogeny focused on basal taxa, we performed a detailed event-based biogeographic analysis. Our phylogeny including more derived taxa from previously published studies. A few patterns can be explained by vicariance (e.g., Middle Jurassic) but numerous dispersal events are required to explain overall ornithischian biogeography, particularly in the Late Jurassic and Early and Late Cretaceous. Although the early record of ornithischians is sparse, it is clear that the clade originated in southern Gondwana and spread into Laurasia by the Early Jurassic and quickly diversified into the iconic groups that characterize Ornithischia. A well-resolved phylogenetic and biogeographic hypothesis of ornithischian diversity, particularly with basal taxa such as the heterodontosaurids and Lesothosaurus, provides a framework on which to test hypotheses of aves evolution as well as the evolution of herbivory, ontogeny, physiology, and sexual dimorphism in the fossil record.
SPINDLER, Frederik, Institut für Geologie, TU Bergakademie, Freiberg, Germany

For more than 130 years, the semi-lacustrine limestone horizon of the otherwise mainly fine clastic Niederhäslich Formation (Sakmarian) has been known for its outstanding tetrapod diversity and mostly well preserved specimens. New documents of the main collections in Freiberg and Dresden (Saxon) lead to a quantitative inquiry of the assemblage, as well as revised determinations of reptilomorph specimens. About 65% of the 1280 registered vertebrate fossils are smallish temnospondyls. Specimens of Branchiosaurus and Melanerpeton, building up the ecologically dominant class of small hunters that fed on invertebrates and amphibian larvae. The eyroad Onchiodon represents 22% of the assemblage, consisting mainly of juveniles and rare adult individuals of around 1.5m body length. These temnozonoids may have been ecologically ubiquitous in the food chain, sharing their levels with co-occurring “branchiosaur”, while survivors of the first ontogenetic stages became the top predators, at least in the aquatic habitat. The “amphibian” fauna is completed by Acanthostomatops, Microacrosauria, Dicadectidae, and Dicadectidae. New specimens of the diadectid Phaneropus, historically designated as haptonodont remains, confirm that this genus was also present in the limestone-building semi-lacustrine facies. A fragmentary specimen with a very large interclavicle, also once mistaken as a pelycosaurs, belongs to an adult Seymouria moriform, probably of a new species. Amniotes are represented by around 4% of the assemblage. A single specimen of Kadaliosaurus is the only reptile described so far. Re-evaluated limb elements increase the reptilian diversity by a few further specimens, not identical to Kadaliosaurus. Apart from a single skeleton of Edaphosaurus, all remaining amniotes belong to the basal sphenacodont Palaeophodon. Mesoeucodon, the assemblage's second most abundant form, comprises around 40 individuals, known showing a range of juvenile stages. This juvenile-only series, forming almost the total amniote presence, may indicate a nursery habitat for pelycosaurs growing up without parental care. A single slab containing jaws of two or three individuals may argue for pup gathering.

Poster Session I (Tuesday, October 31, 2013, 4:15 - 6:15 PM)
ENAMEL THICKNESS MEASUREMENTS AND RECONSTRUCTION OF ANCESTAL MORPHOTYPES IN PRIMATES

ST CLAIR, Elizabeth, Duke University, Durham, NC, United States; BABBITT, Courtney, Duke University, Durham, NC, United States; WRAY, Gregory, Duke University, Durham, NC, United States; WALL, Christine, Duke Univ Medical Ctr, Durham, NC, United States.

Enamel thickness (ET) contributes to the inference of diet, life history, and phylogeny for fossil primates, particularly hominoids. Reconstructing the direction of phenotypic change is of particular interest given increasing availability of genomic data on the genes linked to enamel formation and the opportunity to link genetic and paleontological perspectives on ancestral character states, dietary change, and dental evolution. Prior studies have used both absolute and relative measures of the amount of enamel. The effects of using absolute or relative measurements for assigning character states and interpreting evolutionary patterns have not been addressed. We investigated whether different measurements of ET give different conclusions concerning ancestral state reconstructions, using two sets of published data for ET in extant primates. The first consists of measurements of 2D lower molar sections in 30 primates, from which we calculated absolute ET (AET), enamel area/enamel dentine junction length and Relative ET (RET; AET/square root of dentine area). The second consists of an absolute enamel measurement (Em) at one anatomical location in 38 catarhinines, which we converted to a shape variable using the cube root of body mass (Em.shape). We mapped these traits onto primate phylogenies using maximum likelihood to estimate ancestral states. We compared the nodal reconstructions for ET between the absolute measures and the relative measures.

In both datasets the node values for relative and absolute measures were correlated (AET with RET, r=0.872, p<0.0001; Em with Em.shape, r=0.555, p<0.001). Notably, nodes for which estimates differed between absolute and relative measures were clustered in particular clades. In AET and RET, estimates for hominoid nodes differed, with RET estimates low relative to AET. In Em and Em.shape, most of the marked differences were in early Eocene taxa with Em estimates higher relative to Em. These results suggest that conclusions concerning ancestral state estimation for enamel thickness will be broadly similar whether absolute or relative measures of enamel thickness are used, but differences were unevenly distributed across the tree. It may be that body size plays a role in the direction of differences. If one sees trends among primates with Em estimates higher relative to Em, these trends suggest that constricting ancestral state estimation for enamel thickness will be similarly whether absolute or relative measures of enamel thickness are used, but differences were unevenly distributed across the tree. It may be that body size plays a role in the direction of differences. If one sees trends among primates with Em estimates higher relative to Em, these trends suggest that constricting ancestral state estimation for enamel thickness will be similar.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)
THE FIRST REPORTED RECORD OF OLIGOCENE IGUANIDS (REPTILIA: SQUAMATA) FROM THE WHITE RIVER GROUP OF BADLANS NATIONAL PARK, SOUTH DAKOTA

STARCK, E.N., Badlands National Park, Interior, SD, United States, 57750; WELSH, Ed, Badlands National Park, Interior, SD, United States.

Despite the abundant taxa produced by the White River Group, the North American Oligocene herpetofauna has long been underestimated in South Dakota. Although preservation biases have been attributed to the lack of herpetological material, herpetofauna from analogous vertebrate localities is well-described, including sites in Colorado, Nebraska, Wyoming, North Dakota, and Saskatchewan, Canada.

In 2012, an iguanid left dentary fragment was collected during quarry excavations at Badlands National Park. Retrieved from the middle Eocene Member of the Brule Formation, the small dentary fragment was embedded in the calcareous-cemented mudstone of the “Abby Mudstone” interval. Research to identify the 2012 specimen proved to be the catalyst to locate any other comparative Oligocene iguianid material; however, references and specimens regarding this particular family of reptiles were scant. Subsequent research led to a review of the herpetological collection focused at the South Dakota School of Mines and Technology, which revealed an assortment of iguian material from Badlands National Park previously unmentioned in the scientific literature.

The first documented iguanids from the Badlands were salvaged in 1963. Over the next 50 yr 20 Orellan species were collected. Consisting primarily of dentigerous cranial material, these fossils represent the only record of Oligocene iguanids attributable to the White River Group of South Dakota. Further examination has yielded new identifications for many of these 37 iguanid specimens. Due to the diagnostic condition of characters within the group, and some specimens could not be identified beyond the familial level. Among the revised identifications, several previously unrecognized genera are now acknowledged as present in central North America during the Oligocene, including Cyrtosaurus, Cion unusaurus, and cf. Dipsinosaurus. The presence of these genera forces reconsideration of past conventions, i.e. declining herpetofauna diversity. On the contrary, the Oligocene Iguanidae from South Dakota manifests an expansive diversity, particularly unexpected at the Orellan-Whitneyan boundary.

Technical Session XVI (Saturday, November 2, 2013, 3:15 PM)
EXCEPTIONAL MECHANICAL PERFORMANCE IN THE SHELLS OF TWO CENOZOIC TURTLES: STUPENDENYS AND CERREJONYMUS

STAYTON, C. Tristan, Bucknell University, Lewisburg, PA, United States; CADENA, Edwin, Senckenberg Naturmuseum, Frankfurt, Germany.

Among the numerous early Cenozoic fossil turtles of South America are specimens of Stupendemyx, one of the largest turtles ever to have existed (3.3m carapace length (CL)), and Cerrrjonymus, a large species with an exceptionally thick shell (1 cm, up to 35 mm carapace thickness). Both of these podocnemid specimens display morphological properties (size, thickness) that surpass those of any extant turtle; thus, their shells are also likely to have had exceptional mechanical strength. Indeed, given that one of the more important functions of the turtle shell is the resistance of forces imposed on the animal by predators, mechanical performance may have been one of the primary selective forces involved in the evolution of such unique morphologies. However, the structural properties and mechanical performance of these unusual shells have never before been modeled or quantified. We used finite element (FE) modeling methods to assess the mechanical performance of the shells of these taxa and to compare their performance to that of a contemporary relative: Podocnemis expansa (1 cm). Geometric modeling methods were used to reconstruct the morphological areas of the shell, and to transform an existing FE model to match the morphologies of our focus species. Twelve load cases, each representing a different bite location for a potential predator, were modeled. We found that the shells of Stupendemyx and Cerrrjonymus do indeed show exceptional mechanical performance relative to the shell of P. expansa. Models of the shells of both extinct taxa experience very low stresses for a given load due to size and (for Cerrrjonymus) shell thickness. However, the shells also experience relatively low stresses compared to their extant relatives when models are all scaled to the same maximum size, name, or crocodylian. Inclusion of a lessscaled shell, these shells are intrinsically strong as well. If bone material properties are assumed to be similar to those of extinct turtles, then very high forces (over 150,000N for some load positions) would be required to cause failure (breaking) in these shells. Bite force modeling, using scaling rules for force-crocodile body mass correlates that contemporary predators would have been unable to generate bite forces high enough to fracture the shells of adults of these taxa. However, evidence of predation on contemporary turtles raises the possibility that juvenile, rather than adult, morphology and performance may have driven the evolution of these remarkable shells.
Primates are prominent components of modern tropical ecosystems, yet their Oligocene record in Africa south of the equator has remained largely undocumented. The paucity of data linking better known vertebrate faunas from the early Oligocene of northern Africa and Oman with the extensive early Miocene faunas of eastern and southern Africa presents problems for understanding the time of origin, or time of extinction, of several notable vertebrate clades. The late Oligocene of Africa is a particularly critical time and place for understanding a major taxonomic and ecological restructuring of primate communities. Here we document four distinctive primate taxa from late Oligocene sites in the East African Rift System, represented by a small lorisiform, a diminutive parapithecid anthropoid, and two large-bodied catarrhine anthropoids. This unique combination of primate clades has not been documented previously in the African fossil record, and shows that parapithecids persisted through most of the Oligocene as catarrhines were diversifying. All of the specimens were recovered from precisely dated 25 Ma strata in the Rukwa Rift Basin, a segment of the Western Branch of the East African Rift in Tanzania. The diverse fauna of the Nsungwe Formation includes invertebrates, fish, mammals, and a broad diversity of reptiles. Faunal composition, paleosols, and clay mineral analysis of fossil-bearing units indicate that although aquatic environments are well-represented in the Songwe Member of the Nsungwe Formation, they likely persisted within aseasonal/semi arid climatic regime. Nsungwe discoveries are beginning to fill several gaps in our knowledge regarding the phylogenetic, ecological and body size diversity of primates in the late Oligocene of continental Africa.

**Poster Session I** (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

**ALESTID FISHES FROM THE LATE OLIGOCENE NSUNGWE FORMATION OF TANZANIA**

STEVE, Nancy, Ohio University, Athens, OH, United States, 45701; SEIFFERT, Erik, Stony Brook University, Stony Brook, NY, United States; ROBERTS, Eric, James Cook University, Townsville, Australia; Y'CONNOR, Patrick, Ohio University, Athens, OH, United States

Alestidae, a family of African characiform fishes, is known in the fossil record from the Eocene-Oligocene Jebel Qatrani Formation of Egypt, the Eocene Mahenge crater from Tanzania, and the first described late Oligocene alestid described here, which is now considered an indeterminate juvenile mastodonsaurid. The Oligocene alestid fauna is considerably older than expected, suggesting that several clades had diversified after the Permian-Triassic mass extinction, and that this diversification occurred locally in different areas. These Triassic-Arctic alestid specimens are mostly benthic freshwater ambush predators of giant sizes (estimated body length of more than three meters) and indicate that Antarctica may have served as a refuge during the Permian-Triassic mass extinction.

**Symposium 4** (Saturday, November 2, 2013, 8:15 AM)

**TRIASSIC TERNOSPODYL FLORA FROM ANTARCTICA ILLUSTRATE THE RECOVERY OF HIGH-LATITUDE FAUNAS AFTER THE PERMO-TRIASSIC EXTINCTION**

STEYER, J. Sébastien, CNRS and MNHN, Paris, France; SIDOR, Christian, Burke Museum, Seattle, WA, United States; HAMMER, William, Augustana College, Rock Island, IL, United States

Paleontological fieldwork in the upper member of the Fremouw Formation of the Beacon Basin, Transantarctic Mountains, began in the 1980s. This led to the discovery of several important ternospondyl specimens, including a large, subcomplete skull of a new mastodonsaurid genus and species highlighted here. Recent fieldwork has increased ternospondyl diversity and indicates, thanks to biogeographic correlations with coeval rocks from the South African Karoo Basin, that the upper Fremouw Formation is early Middle Triassic (Anisan) in age. These recent investigations also allow an updated revision of the ternospondyl material from Antarctica, which is now represented by Hydrocynus flaviventris, the new mastodonsaurid described here, as well as four indeterminate ternospondyl mandibles (one belonging to Brachyopidae indet.), a large Parrosuchus snout portion, and three other mastodonsaurid partial skulls (including "Marsupialius kitchingi"), which is now considered an indeterminate juvenile mastodonsaurid. The ternospondyl fauna is rather diversified but also includes endemic species. This is also the case for the Triassic ternospondyl fauna from the South African Karoo Basin, which comprises brachyopids (e.g., Yanastega) and mastodonsaurids (e.g., Jammerbergia), plus tretosuchids and Laidleria, which are not known from Antarctica. Together, the Karoo fauna, Antarctic ternospondyls show that several clades had diversified after the Permian-Triassic mass extinction, and that these diversification occurred locally in different areas. This Triassic-Antarctic ternospondyl specimens are mostly benthic freshwater ambush predators of giant sizes (estimated body length of more than three meters) and indicate that Antarctica may have served as a refuge during the Permian-Triassic mass extinction.
preserved skull from the Ghost Ranch locality is more closely allied with 'Megapnosaurus' kayentakatae' and, seems from the Painted Desert Member of the Petrified Forest Formation previously referred to Coelophysidae are recovered among averovenatorid taxa along with other previously published coelophysids, although with weak support given their fragmentary nature. Former referrals of 'M. rhodesiensis' and 'M. kayentakatae' to species of Coelophysis are based on subjective interpretations of the anatomical disparity necessary for a new generic designation. However, this study finds that these species are paraphyletic within Coelophysinae, potentially necessitating a new name for 'M. kayentakatae' or a referral to Coelophysidae.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

TRACKS OF DINOSAURS, SYNAPSIDs, AND ARTHRPODS IN THE AZTEC SANDSTONE OF SOUTHERN NEVADA: A FINAL REPORT

STOLLER, Heather, University of Nevada, Las Vegas, Las Vegas, NV, United States, 89183; ROWLAND, Stephen, Univ of Nevada Las Vegas, Las Vegas, NV, United States

The Aztec Sandstone is a 700-m-thick, erg deposit. Until very recently, southern Nevada exposures of the Aztec Sandstone have yielded few fossil tracks, although correlative strata in eastern California and Utah are quite fossiliferous. That situation has changed dramatically within the past two years, and now approximately twenty separate Aztec tracksites are known in southern Nevada. Most of the well-documented tracksites occur in Red Rock Canyon National Conservation Area, immediately west of Las Vegas, although several are located in Valley of Fire State Park, and one is in the Gold Butte area.

Dinosaur tracks occur at eight of the sites, sometimes in combination with arthropod and/or synapsid tracks. The dinosaur tracksites are widely variable in terms of preservation and animal behavior. One site consists of a single, well-preserved footprint; another tracksite consists of a distinct trackway of seventeen closely-spaced tracks; another consists of multiple trackways, oriented in various directions, in which the individual footprints are very far apart; a fourth tracksite consists of dozens of poorly preserved undertracks, most of which are oriented in the same direction. Other dinosaur tracks sites display variable numbers of tracks in variable states of preservation. All of the dinosaur tracks sites are relatively small - 14 cm or less in length- and are inferred to have been made by small, bipedal, carnivorous theropod dinosaurs. These dinosaur tracks have been analyzed using techniques such as photogrammetry and silicone molds, and their speeds have been determined using Alexander’s method for trackway speed. These dinosaurs were traveling various speeds ranging from 0.37 m/s to 1.8 m/s.

We have found three types of non-dinosaurian tracks. The most abundant of these are assigned to the ichnogenus Brasilichnium. Two other types of non-dinosaur vertebrate tracks are not yet identified and may belong to undescribed ichnotaxa. These track-makers were probably therapsids. Arthropod tracks are present at several sites. These include several examples of the scorpionid track Paleohelcura, which is composed of tail drag trails. The ichnogenus Octopodichnus, made by a scorpion as well, is present at only one of our sites. As we develop a better understanding of the variety, relative abundance, and stratigraphic distribution of the tracks in the Aztec Sandstone, we may be able to reconstruct the structure the Jurassic desert ecosystem in which the track-makers lived.
The mosasaurine mosaurus, *Mosasaurs leonii* Dollo, 1889 (Lower Maastrichtian, Cipyl, Belgium), has recently been suggested to be a junior synonym of *Mosauros hoffmannii*,(Upper Maastrichtian, Maastrich, Netherlands), on the basis that *M. leonii* individuals of different size and length are, in many aspects, notably smaller than *M. hoffmannii*; while there is good evidence that *M. leonii* is a younger taxon. The morphology of these two species supports their continued separation and suggests that the ecospace of the Cipyl Basin supported several species of mosasaurs, assuming the Cipyl taxon *M. hoffmannii* is indeed *M. hoffmannii*. We find no compelling evidence for linking the various species and species from Cipyl and Maastrich into a growth series of a single taxon.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

**QUANTIFYING HISTORICAL PATTERNS IN THE STRATIGRAPHIC COMPLETENESS OF THE DINOSAUR FOSSIL RECORD**

**STUBBS, Alyssa, North Carolina State University, Raleigh, NC, United States; 27606; BOYD, Clint, , Rapid City, SD, United States; KSEPKA, Daniel, American Museum of Natural History, Raleigh, NC, United States**

Dinosaurs was officially coined in 1842 by Sir Richard Owen, but dinosaur fossils were being discovered before that time, with *Megalosaurus* being the first dinosaur to be formally described and named in 1824, and *Iguanodon* following soon after in 1825. Over the nearly two century history of dinosaur paleontology, discoveries have led to sometimes dramatic extensions of the stratigraphic ranges of major dinosaurian clades. However, these discoveries have not occurred with clockwork regularity and quantifying the relative completeness of the dinosaur record against historical, between, and in the context of major locality discoveries may be of interest to paleontologists.

In order to explore these patterns we expanded upon a recently developed method for comparing the Minimum Impacted Gap (MIG) across a phylogeny over a given historical interval. MIG is one way of quantifying the completeness of the fossil record and is useful because it can be calculated easily from a time-calibrated phylogeny and changes in these values can be tracked through time by holding present day values constant. This allows the MIG reduction that results from new range extensions to be quantified. To assess temporal patterns of MIG within Dinosaurs (including extant avian dinosaur clades), we collected first and last appearance data (FADs and LADs) for 32 major dinosaurian clades for each decade from 1820 to the present (20 total time bins). Each fossil was assigned to a geological stage or stages, depending on the question. Using the program *AgeOccupier*, we estimated temporal bins for one million replicates during which the oldest and youngest fossils of each clade were randomly assigned a numerical age from within the defined age uncertainty range and MIG was calculated both for each clade and globally across the phylogeny. The resulting MIG values show an average reduction of around 100 million years of missing fossil record per decade. Around two-thirds of MIG reduction occurs within Saurischia, with one-third occurring in Ornithischia. A majority of the MIG reduction results from new FADs for known clades, rather than LADs, as the latter are limited by the K-Pg boundary. While discovery of new FADs was relatively constant through time, the majority of new LADs were identified between 1880 and 1929. These results show that the rate of stratigraphic range extensions for major dinosaurian clades was relatively constant over the past 200 years despite the increased interest in dinosaur paleontology over the past few decades.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

**PRESERVATION OF LARGE THEROPOD AND SAUROPOD TRACKWAYS FROM THE LOWER CRETACEOUS DEQUEEN FORMATION, ARKANSAS USING LIDAR: CREATING A VIRTUAL TRACKWAY LAB FOR USE IN TEACHING INTRODUCTORY AND UPPER DIVISION LABORATORIES**

**SUAREZ, Celina, University of Arkansas, Fayetteville, AR, United States; 72701; BOS, Stephen, University of Arkansas, Fayetteville, AR, United States; PLATT, Brian, University of Mississippi, University, MS, United States; SHELL, Ryan, University of Arkansas, Fayetteville, AR, United States; WILLIAMSON, Malcolm, University of Arkansas, Fayetteville, AR, United States**

The dinosaur (theropod and sauropod) trackways were discovered in a gypsum mine in June, 2011. The trackways were preserved in the limestone marl of the Lower Cretaceous DeQueen Limestone of southwest Arkansas and covered an area of 4,200 m². The site was reported to the Department of Geosciences at the University of Arkansas and a rapid salvage effort was put into place. The mine was, and still is, an active mine and researchers were given three weeks to generate and enact a plan for documentation before demolition of the trackway commenced. Based on the resources available, wide-field, ground-based LIDAR instruments (including Z+F 5006 and Leica C10 laser scanners) were chosen for the site to 3D scan the trackways. The scanners were mounted on hydraulic boom lifts providing downward-looking, circular, 25 m radius, overlapping scans of the trackway surface, allowing generation of a LIDAR point-cloud and a hill-shaded relief map of the entire trackway site. Digital tools were also integrated to allow measurements and analysis of individual tracks and trackways. A beta-test version of the trackway is now available at http://trackways.cast.uark.edu/index.html. Additional tools will be integrated in the future for more detailed measurements. Field measurements as well as 32 plaster casts were also generated. We compare measurements taken with LIDAR to those taken with traditional tools to allow error and consistency of the different preservation methods. The trackway website is also freely available and can be used for teaching purposes. We present a trackway lab exercise generated from various other trackway labs that are available online. The lab can
be used with the online “virtual” trackway at a variety of levels to teach students how to measure trackways, how to calculate speed, and introduce them to how to calculate error.

A NEW SEA TURTLE SKULL FROM THE LATE CRETACEOUS OF CHILE AND THE BIOGEOGRAPHY OF EUCLASTES

SÚAREZ, Mario, Universidad de Chile, Santiago, Chile; PARHAMS, James, John D. Cooper Archaeological and Paleontological Center, California State University, Fullerton, CA, United States; OTERO, Rodrigo, Universidad de Chile, Santiago, Chile; RUBILAR, Jorge, Museo Nacional de Historia Natural, Santiago, Chile; VARGAS, Alexander, Universidad de Chile, Santiago, Chile

Fossil discoveries from Chile are providing new insights into the biogeography of Late Cretaceous marine reptiles. Here we report the skull of a durophagous chelonian sea turtle from the Late Cretaceous (Maastrichtian) Quiriquina Formation of Caleta Cochlolí, near the coast of Chile. Previous reports from the Quiriquina Formation include two other specimens: 1) a lower jaw of a durophagous chelonian; and 2) a durophagous turtle cranium that was initially considered a chelonian, then later referred to the Bactrosaurus, an otherwise entirely North American freshwater clade (a claim that requires further investigation). The new specimen reported here is a nearly complete skull, including most of the cranial roof, palate, and basiocciput. The skull is similar to those previously reported from durophagous stem chelonians referred to the genus Euclastes in the extent of its secondary palate and dorsally directed orbits; these features allow us to assign the skull to the genus Euclastes. This genus is reported from the Late Cretaceous and Early Paleocene of Chile, USA (California, Maryland, New Jersey, Virginia), Angola, and Morocco. The genus Euclastes is the first widespread stem chelonid to be found outside of the Western Interior Seaway of North America. This is the first widespread radiation of pancheloniids, foreshadowing the subsequent Cenozoic radiation of the clade. The dispersal of Euclastes predates the K-Pg boundary, coincident with a time of global cooling.

A REMARKABLE ASSEMBLAGE OF LADINIAN-AGE VERTEBRATES FROM SOUTHERN GERMANY: A NEW WINDOW ON LATE MIDDLE TRIASSIC CONTINENTAL TETRAPOD BIODIVERSITY

SUES, Hans-Dieter, National Museum of Natural History, Washington, DC, United States, 20560; SCHIOCH, Rainer, Staatliches Museum für Naturkunde Stuttgart, Stuttgart, Germany

Our knowledge of the global record of late Middle Triassic continental vertebrates is still very limited. This time interval is critical to our understanding of the changes in Triassic tetrapod communities as well as the origin and initial diversification of many tetrapod clades. We report here on a major new occurrence that will shed new light on this interval. The Schumann quarry is a limestone quarry near Vellberg (Eschenau) in the Hohenlohe region of Baden-Württemberg (Germany). In the early 1980s, avocational collectors first discovered a wealth of vertebrate fossils in deposits of the Lower Keuper (Erfurt Formation; Middle Triassic: Ladinian: Longobardian) exposed along the upper rim of the quarry. Because only the marine limestones of the underlying Muschelkalk are of commercial interest, the Lower Keuper deposits are usually quickly removed during quarrying operations. Thus, articulated skeletons have been collected primarily during systematic excavations on pristine outcrop.

The principal fossil-bearing horizon forms part of a 1.5 m thick sequence of dark grey mudstones (Untere Graue Mergel). The fossiliferous bed is located near the top of the mudstone sequence, formed by 5–15 cm-thick grey mudstones. It is particularly rich in skeletal remains of fishes and aquatic tetrapods (capitosaur, plagiosaur, and temnospondyl amphibians and reptiles). In addition to these presumably autochthonous aquatic faunal elements, the mudstones have also yielded numerous remains of terrestrial tetrapods, including rhynchocephalians, an unexpected diversity of non-arosauromorph archosauriform reptiles (including a dorsoellid), and a large paracrocodylomorph. The sequence of the Untere Graue Mergel probably formed under estuarine conditions, although the entire series of strata of coarse-grained, clastic facies of conterminous southwestern Germany during Ladinian times. The bivalve and ostracode assemblages suggest fluctuating salinity levels within the studied section, with the most fossils preserved in basinal strata having been deposited under low-salinity conditions. Some of the tetrapods from the Lower Keuper have close relationships to taxa from Carnian-strata of several rift basins of the Newark Supergroup in eastern North America.

THE STRUCTURE OF THE PELVIS IN TRITYLODONTIDS (SYNAPSIDA, EUCYNODONTIA) AND ITS PHYLOGENETIC AND FUNCTIONAL IMPLICATIONS

SULLIVAN, Corwin, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China, LIU, Jun, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; ROBERTS, Eric, James Cook University, Townsville, Australia; HUANG, Timothy, National Chung Hsing University, Taichung, Taiwan; YANG, Chuanwei, Lufeng County Dinosaur Museum, Lufeng, China

*Tritylodontids are a distinctive clade of herbivorous, mainly Jurassic non-mammalian cynodonts whose relationship to Mammaliaforms is controversial. Recent debate has focused on whether tritylodontids are close relatives of mammaliforms or alternatively fall within Traversodontidae, a clade distant from Mammaliformes within Eucynodontia.

A new tritylodontid specimen from the Lower Jurassic Lower Lufeng Formation of China demonstrates that at least some tritylodontids do indeed resemble mammaliforms in their pelvic anatomy. The specimen comprises only postcranial elements, and is indeterminate at the level of Tritylodontoidea, but can be securely referred to this group based on femoral morphology, size and provenance. Nearly complete examples of the ilium, pubis, and ischium are present, and the ilium resembles the mammaliform condition in having a narrow, anteriorly directed blade with only a vestigial posterior process.

Ilia morphology alone is insufficient to determine the placement of tritylodontids, but the new specimen resolves an important point of debate and adds to the case that tritylodontids display close postcranial similarities to mammaliforms. The hip anatomy of the new specimen implies a mammaliform-like mechanism of femoral retraction driven partly by gluteus musculature, probably still inceptent but better-developed than in traversodontids. Finally, a small depression on the pubis may indicate the attachment of an epipubic bone, a feature previously reported in tritylodontids but never adequately documented.

NEW ANKYLOSAURID DINOSAUR (ORNITHISCHIA, ANKYLOSAURI) FROM THE UPPER CRETACEOUS KIRTLAND FORMATION, SAN JUAN BASIN, NEW MEXICO, USA

SULLIVAN, Robert, New Mexico Museum of Natural History and Science, Albuquerque, NM, United States, 87104; ARBOUR, Victoria, University of Alberta, Edmonton, AB, Canada; BURNS, Michael, University of Alberta, Edmonton, AB, Canada; LUCAS, Spencer, New Mexico Museum of Natural History and Science, Albuquerque, NM, United States

A nearly complete skull and first cervical half ring of an ankylosaurid dinosaur, NMMNH P-64484, from the upper Campanian (Kirtlandian) De-na-zin Member of the Kirtland Formation, represents a new genus and species. The skull has cranial ornamentation subdivided into a mosaic of polygonal similarities to Late Cretaceous ankylosaurin alvosaurs from Alberta and Montana, such as Esopusches. It can be distinguished from these taxa by the triangular median nasal ossicles, quadrate centromedially bifurcating squamosal horns, a mixture of flat and weakly bulging frill elements, strong bilateral symmetry of the cranial osteoderms, and deep fossae on the ventral surface of the boaspatulapal. Nodocephalosaurus, also from the De-na-zin Member, has circular-based, and more widely-spaced, bulbous frill osteoderms that differ from the hexagonal to rectangular-based, closely-spaced frill osteoderms of NMMNH P-64484. Both of the New Mexico species possess bulbous cranial osteoderms, a morphology otherwise found only in derived Asian ankylosaurs. There are two potential explanations for the presence of bulbous osteoderms in NMMNH P-64484: 1) they evolved independently in NMMNH P-64484 and Nodocephalosaurus, and Nodocephalosaurus represents an Asian ankylosaurid dispersed into North America; or 2) southern Laramidian and Asian ankylosaurs convergently evolved bulbous osteoderms. Preliminary phylogenetic results show a close relationship between NMMNH P-64484 and Albertan and Montanan ankylosaurs, but not Nodocephalosaurus. In contrast, Nodocephalosaurus has affinities with Late Cretaceous Mongolian ankylosaurs, although its position on the tree is more labile due to missing data. The conical, widely-spaced osteoderms of the new ankylosaurid is most similar to that of the Mongolian taxon Talarurus. Nodocephalosaurus is best interpreted as representing a dispersal of Asian ankylosaurs into North America, and the bulging cranial osteoderms of NMMNH P-64484 apparently evolved convergently.

NEW INFORMATION ON THE HINDLIMB STRUCTURE OF THE EARLY PERMIAN BOLOSAURID REPTILE EUDIBAMUS CURSORIS, THE EARLIEST KNOWN FACULTATIVE BIPED

SUMIDA, Stuart, California State University San Bernardino, San Bernardino, CA, United States, 92407; BERTMAN, David, Carnegie Museum of Natural History, Pittsburgh, PA, United States; JEFFCOAT, Fred, Fantasia Film and Animation, Glendale, CA, United States; HENRICI, Amy, Carnegie Museum of Natural History, Pittsburgh, PA, United States; MACKETT, Thomas, Museum der Natur, Gotha, Germany

The Early Permian bulatesaurid reptile Eudibamus cursoris is known from the Bromley locality of central Germany. Initial description based on a single, well preserved specimen suggested it is the earliest known facultative biped predating archosaurian bipeds by nearly 60 million years. Its hind limbs are approximately equivalent to snout-to-vent length and nearly twice the length of the forelimbs. A specimen that includes the caudal portion of the presacral column, pelvic girdle, and complete left hind limb sheds new light on the hind limb structure of Eudibamus. Although all elements of the limb are well ossified, the pubis and ischium are fused neither to each other nor their contralateral mates, yet medial and lateral centra are fused. Distal tarsals 1-3 are unusually elongated proximodistally. In ventral view the astragalus appears to be strongly affected by tricipital facet at the lateral aspect where the tibia articulates. Features supporting the interpretation that Eudibamus was a facultative biped include: a moderately developed lip along the dorsal margin of the acetabulum for reception of a near-vertically oriented femur; digits 1 and 2 are reduced relative to...
extremely elongate digits 3-5, indicative of potentially digitigrade foot posture; and penultimate phalangeal elements are not significantly elongate, suggesting it was not a vertical clinger and leaper. Three-dimensional laser surface scanning allowed a digital model of interior bone elements to be transferred into the reconstruction and modelled in the package Maya. Differing positions of the femoral head relative to acetabular surface were tested. The range of potential postures does include a parasagittal orientation of the hind

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

THE LATE MIOCENE RODENT FAUNA FROM NAKALI FORMATION, NORTHERN KENYA.

TANABE, Yoshiki , Kagoshima Univ., Kagoshima, Japan; NAKATSUKASA, Masato, Kyoto Univ., Kyoto, Japan; KUNIMATSU, Yutaka, Kyoto Univ., Kyoto, Japan; ONODERA, Mayu, Kagoshima Univ., Kagoshima, Japan; NAKAYA, Hideo, Kagoshima Univ., Kagoshima, Japan.

The Nakali Formation (the early late Miocene) is located at the eastern shoulder of the central Kenya Rift. Although a number of mammal fossils, Carnivora, Proboscidea, Hipparion, Rhinocerotidae, Artiodactyla, and Primates, have been found from the Nakali Formation, only a single rodent species, Nakalimys lavocati (Rizomyoidea) was known from Nakali previously.

The Japan-Kenya Expedition team has carried out paleontological field-work in Nakali since 2002. Through the excavations conducted by the team since 2007, a large amount of mammal fossils, especially rodent fossils, have been recovered. These new rodent specimens have enabled us to recognize six additional families. Among the families, the most abundant are Myomorphans. We also collected Cricetidae (Myomorpha), Thryonomysinae (Hystrixomorpha), Sciuridae (Sciuromorpha), a small number of Gerbillidae (Myomorpha), and Hystricidae (Hystrixomorpha). The identification was mainly based on the dental morphology of those fossils. Based on the ecological information of the extinct rodents, whose cheek tooth morphology is similar to the fossil specimens, the paleoenvironments of the Nakali Formation are estimated to have included a wetary environment and upland forests. This reconstruction of the paleoenvironments generally agrees with the results from geological studies, mesowear analysis and other studies.

The present findings indicate that one of the oldest hystriids, which includes small-sized and low-crowned cheek teeth, is recorded in Africa and that the oldest record of Thryonomys (Thryonomysidae) dates back to the early late Miocene. Based on the resemblance of its lophodonty, Thryonomys is thought to be derived from Paralacustris. This revised record indicates that Thryonomys had been differentiated from Paralacustris by the early late Miocene.
interval) in the middle to tip portion of the barbules of at least two barbs. This coiled structure is also present in the base of barbules from the Late Cretaceous and in modern birds (e.g., grebes), differing from the Taniuchi feather in its position, as opposed to the barbule to barbule orientation. The Taniuchi feather is the oldest record of a feather with coiled barbule structure and suggests that this structure (and diving behavior) may be common in the Late Cretaceous because it also occurs in Canadian feathers from the Late Cretaceous (late Campanian).

Poster Session I (Wednesday, October 30, 2013, 3:45 - 6:15 PM)

TOOTH REPLACEMENT PATTERN IN MAXILLARY DENTITION OF BASAL NEOCERATOPSIA (ORNITHISCHIA, DINOSAURIA)

TANOUE, Kyo, Fukuoka University, Fukuoka, Japan; LI, Daqing, Gansu Geological Museum, Lanzhou, China; YOU, Hai-Lu, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

Neoceratopsia was one of the dominant herbivorous dinosaur clades in Cretaceous terrestrial ecosystems of Asia and western North America. Neoceratopsians thrived throughout the Cretaceous, with a diversity of ceratopsids, the derived neoceratopsians large numbers of teeth, which are mesiodistally compressed for close packing in dentaries in which files of teeth interlock both vertically and horizontally. Ceratopsids have multiple replacement teeth in each tooth position. In contrast, basal neoceratopsians lack dental batteries. The closely-spaced teeth merely erupt in a single horizontal line with only one replacement tooth for each functional tooth. The replacement pattern of ceratopsian dentition has attracted very little attention. In this study, the maxillary dentitions of basal neoceratopsians from the Lower Cretaceous of Asia were examined to understand the tooth replacement pattern in the early stage of neoceratopsian evolution. The replacement stage developed on the lingual side of the functional tooth. In order for a replacement crown to reach the size of functional crown prior to eruption, resorption of the root of the functional tooth is necessary. In the final stage of tooth replacement the apical portion of the functional crown caps the replacement tooth, indicating that there has been a loss of both the root and the basal portion of the crown from the functional tooth. The resorption of the base of the functional tooth is also seen in modern crocodylians, and may be the plesiomorphic state of tooth replacement pattern in archosaurs. Dentitions of basal neoceratopsians crown of each replacement tooth fits between the bifid roots of the preceding tooth. This relationship between the replacement tooth and the roots of the functional tooth renders resorption unnecessary during tooth replacement in ceratopsids. Having only one replacement tooth for each tooth position and involving resorption of the functional tooth for it to erupt, tooth replacement basal neoceratopsians was inefficient compared to ceratopsids.

Symposium 4 (Saturday, November 2, 2013, 9:45 AM)

THE ULTRA-WARM ARCTIC CA. 90 MILLION YEARS AGO: CONSTRAINTS ON PALEOCOLOM AND BIOGEOGRAPHY FROM VERTEBRATE FOSSILS

TARDUNO, John, University of Rochester, Rochester, NY, United States, 14627; BRINKMAN, Donald, Royal Tyrrell Museum, Drumheller, AB, Canada; CLARKE, Julia, The University of Texas at Austin, Austin, TX, United States; BONO, Richard, University of Rochester, Rochester, NY, United States; HIGGINS, Pennilyn, Univ of Rochester, Rochester, NY, United States

A spectacular assemblage of vertebrate fossils, including large-bodied crocodile-like champsosaurs, turtles and fish forays evidence for an excursion within the Cretaceous greenhouse world to ultra-warm conditions, ca. 90 million years ago. The fossil vertebrates are from a key Arctic site on Axel Heiberg Island at 79°N. Our ongoing efforts are focused on obtaining additional paleoclimate estimates to test hypotheses relating the ultra-warm climate to magmatic outpourings. The fossil champsosaurs suggest a minimum mean annual temperature of 14°C when palaeomagnetic data indicate that the site was at Arctic paleolatitudes (approximately 71°N). Fish fossils record an expansion of ranges toward the poles. Turtles are abundant and diversity is unusually high compared with other high latitude vertebrate assemblages, consistent with warm temperatures. The fossil champsosaurs define a population dominated by juveniles, incompatible with freezing. Jurovachelys gaffneyi, a large macrobaenid fossil turtle with affinities to Asia, suggests the possibility of migration over a warm, brackish Arctic Ocean. Isotopic analyses of bone apatite using a multiple taxon approach can be used to obtain quantitative estimates of paleotemperature. The availability of multiple species of fossil fish and turtles, and bones from champsosaurs and at least one bird species, afford the possibility of multiple consistency tests (to gauge both taxon specific fractionation and diagenetic effects) in addition to the Late Cenomanian (late Coniacian - 87°10N) site to Vienna Standard Mean Ocean Water. The fossil vertebrates overlie continental flood basals of the Strand Fiord Formation, which may be the on land expression of magmatism that formed the Alpha-Mendeleev Oceanic Ridge of the Arctic Ocean. Together, these features may form one of Earth's most voluminous large igneous provinces. CO2 outgassing related to this volcanism, together with outgassing at several other sites of coeval magmatism, may have been responsible for the interval of extreme climatic warmth, a linkage supported by new radiometric age data.

Technical Session IV (Wednesday, October 30, 2013, 2:30 PM)

EVOLUTION OF MIOCENE AMAZONIAN ECOSYSTEMS: CAN OLD MAMMALS REVEAL SOMETHING NEW?

TEJADA LARA, Julia, University of Florida, Gainesville, FL, United States, 32601; MACFADDEN, Bruce, University of Florida, Gainesville, FL, United States; ANTOINE, Pierre-Olivier, Université Montpellier 2, Montpellier, France; FLYNN, John J., American Museum of Natural History, New York, NY, United States; SALAS GISMONDONI, Rodolfo, Museo de Historia Natural UNMSM, Lima, Peru

The Amazonian tropical rainforest is a complex ecological system supporting the greatest biodiversity in the world. Although many attempts have been made to examine the origin and evolution of this biodiversity, the history of Amazonia is still far from completely understood. One of the reasons for this is that Amazonian mammals have used a living-based models. For example, the region was broadly interpreted as an open-landscape during the Pleistocene based on the presence of hypsodont mammals. Also it was interpreted as transitional between savanna and forest-dominated habitats during the middle Miocene, using the relationship between mammalian macroniche structure and rainfall in modern tropical rainforest and dry forest faunas. However, considering that most Amazonian Tertiary faunas lack modern ecological analogs, models based only on modern parameters can lead to flawed interpretations. An example of how extrapolating extant macroniche specializations to the past might be misleading is found in dietary studies of Pleistocene toxodonts. These hypsodont mammals, long thought to be exclusively grazers, were C3 forest browsers when living in Amazonia. Here, isotopic analyses of δ13C, δ18O of tooth enamel carbonate were performed on two major clades of endemic herbivorous mammals (Astrapotheria, Toxodontia) from the late middle Miocene of Peru. New isotope data suggests that these herbivores may have used a C3 plant ecosystem. Future research will include extant Amazonian mammals to constrain the parameters of isotopic fractionation, as well as fossil taxa within extant lineages, particularly those with high diversity in ancient ecosystems (e.g., Xenarthra, Rodentia). This could also provide information about niche conservatism in endangered extant lineages. Stable isotope analyses have the potential to unveil many unknown ecological aspects of extinct tropical biotas, however, they are also challenging given the methodological and ecological constraints posed by many taxa in ancient non-analog systems.

Poster Session III (Friday, November 1, 2013, 3:45 - 6:15 PM)

A VERTEBRATE FAUNA FROM THE SANTONIAN – LOWER CAMPAIAN MENEFEEN FORMATION, SAN JUAN BASIN, NEW MEXICO

TEMPLEMAN, Tara, University of New Mexico, Albuquerque, NM, United States, 87109; WILLIAMSON, Thomas, New Mexico Museum of Natural History, Albuquerque, NM, United States

Few early Campanian terrestrial vertebrate faunas have been described from western North America. Consequently, it is not known if the pattern of high diversity and high provinciality that characterized middle and late Campanian biotas also prevailed in the early Campanian. Here we provide an updated list from the Armijo Draw local fauna, a vertebrate assemblage from the Santonian – lower Campanian Meneffeen Formation from near the southeastern margin of the San Juan Basin, New Mexico. Vertebrate fossils of the Armijo Draw local fauna were recovered through a combination of surface prospecting and from screeningwash of bulk samples. New macrovertebrate fossils include a partial ceratopsian braincase, bones of a hadrosaurid, and fragmentary postcranial bones of a theropod. Macrovertebrate fossils from several localities include “typical” Campanian age taxa including osteichthyan scales and teeth representing several taxa (e.g., lepisosteid genus sp. indet, amid gen. et sp. indet., and Parahalfa sp.), teeth representing numerous fresh water chondrichthyan taxa (e.g., Lissopterus sp., Hybodus sp., Oxynotus sp., Orectolobus sp., Neopristis sp., and Ptychyrhinchus sp.). teeth of crocodilians, teeth of ornithischian dinosaurs, and teeth fragments of therian mammals. The Armijo Draw local fauna resembles other Campanian age, coastal plain vertebrate assemblages of western North America.

Poster Session II (Thursday, October 31, 2013, 3:45 - 6:15 PM)

COMPARATIVE ECOMORPHOLOGY OF ORNITHOPOD AND RUMINANT SNOUTS - A GEOMETRIC MORPHOMETRIC APPROACH

TENNANT, Jonathan, Royal School of Mines, London, United Kingdom

Rostrum shape is a prominent aspect of herbivore ecology concerning feeding strategy, affecting forage selectivity and intake rate. Within ruminants, feeding classes are partially delimited based on snout shape, with grazing species typically attributed ‘blunt’ and browsing species ‘pointed’ snouts. Here, this aspect of functional ecology is analysed in a statistically rigorous, geometry-based framework, principally testing whether feeding strategy is consistent with snout morphology using a two-dimensional profile of the premaxilla in ventral aspect. A secondary objective is to assess any ontogenetic or morpho-functional diversity between modern ruminants. When ruminants are classified based on assigned feeding strategies according to secondary criteria (e.g., % grass consumption), species cannot be discriminated accurately on the basis of their shape profile. Consequently, ontoliths are found to exhibit a well-structured pattern of shape variation with clear differentiation between ‘blunt’ and ‘pointed’ shapes. This pattern exists in both a phylogenetic and temporal context, and may relate to browsing height and forage selectivity.

Technical Session X (Friday, November 1, 2013, 9:00 AM)

DYNAMICS OF HOLOCENE ABUNDANCE AND RESOURCE USE IN DESERT MICE

TERRY, Rebecca, Oregon State University, Corvallis, OR, United States, 97331; KOCH, Paul, Univ of California Santa Cruz, Santa Cruz, CA, United States
Paleontologists and neontologists alike have long recognized abundance as a key variable for identifying species vulnerable to environmental change. Abundance, however, reflects complex interactions of both abiotic and biotic factors. For example, changes in climate can induce changes in species ranges, while niche breadth flexibility may buffer species against environmental change. We analyzed small mammals from two Ledges Chamber - a Holoceine fossil record in the Great Basin, USA - to disentangle how the temporal dynamics of climate and a species’ niche breadth influence its abundance. Sample-standardized abundance dynamics for 18 species were estimated from fossil specimens spanning the last 8,000 years, and evaluated against a local high-resolution climate record for the same time-interval. We used partial correlations to account for the impact of climate on the abundance of three focal species (Chactodipus formosus, Perognathus longimembris, and Peromyscus manculus) given concurrent changes in the abundances of the other species in the community. Stable isotopes (δ13C and δ15N), we then estimated the niche breadth of these three species, which encompass a range of physiological, morphological, and behavioral adaptations of mice to desert environments. Species’ abundances exhibited marked taxonomic and temporal variation. Climate remained the primary driver of abundance dynamics even after accounting for the impact of biotic interactions. Isotopic niche-breadth among species revealed strong niche partitioning both in the past and today, but the relative positions of species to one another in isotopic niche space was variable over time. Importantly, each species’ modern δ13C and δ15N values fell well outside their ranges of Holocene variability. Over the past two centuries, obligate granivores show a different trend from the Holocene for these mice. Work is currently ongoing to determine perhaps indicating a shift towards incorporation of animal tissue into its diet. These species abundances may respond to changes in climate, while niche breadth flexibility is variable for identifying species vulnerable to environmental change. Abundance, however, shows marked enrichment in δ15N at the same time, perhaps indicating a shift towards incorporation of animal tissue into its diet. These results suggest that both biotic and abiotic factors must be considered when assessing species responses to environmental change, and that the modern world is strikingly different from the Holocene for these mice. Work is currently ongoing to determine whether temperature change or niche breadth may be driving changes in diet preferences, or the isotopic composition of mouse food.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

MAXIMUM BODY SIZE EVOLUTION OF CENOZOIC MAMMALIAN HERBIVORES

THEODOR, Jessica, University of Calgary, Calgary, AB, Canada, T2N 1N4

Numerous traits of herbivores scale allometrically, and large size is generally assumed to provide a digestive advantage for herbivores, thus the maximum size reached within trophic groups is likely to reflect ecological or physiological limits. We compiled the maximum body size within large herbivores on the three largest continents (Africa, Eurasia, and North America) for all sub-epochs during the last 55 million years, and a sub-NALMA resolution dataset for North America. As previously established, the maximum size of mammalian herbivores has been an order of magnitude higher than the maximum size for carnivorous mammals. Even after the evolution of grazing, browsing mammals represented the largest herbivores until the latest Miocene in Africa and the Pliocene in Eurasia and North America, whereas species of hindgut fermenters increased in size. This suggests that grazing mega herbivores faced a constraint on size evolution until at least the latest Miocene on these continents. The relaxation of this constraint may well be tied to the spread of the mammal steppe ecosystem in Eurasia and North America. Comparing herbivores using an extinct phylogenetic bracket for gut fermentation style shows that once foraging fermentation evolved, the maximum size of forage fermenters increased, but remained lower than the maximum size of hindgut fermenters. Within the terrestrial artiodactyls and the perissodactyls, perissodactyl size was larger than artiodactyls. The previous North American dataset shows that artiodactyls contained subclades with more varied diets and a wider range of maximum body sizes than did perissodactyls, and the largest artiodactyls in North America through the Eocene and Oligocene were not folivores. During this time, the largest perissodactyl for North America were artiodactyls, which were replaced by camels in the Miocene. Perissodactyl maximum body sizes increased through the Oligocene, after which rhino and tapiroid maximum sizes leveled off and equid maximum size continued to increase. Since the middle Eocene, no perissodactyl chae has had a maximum size lower than 10 kg, and by the end of the Eocene, all had maxima above 100 kg. By contrast, terrestrial artiodactyls continued to occupy the smaller size ranges, with a number of clades with maximum masses below 10 kg, and dominating in the 10-100 kg maximum mass ranges.

NOT BY SIZE ALONE: INVESTIGATIONS OF SHAPE, ALLOMETRY, AND PHYLOGENY IN CERVID ECMOECOMORPHISM

THOMSON, Matthew, University of California Santa Barbara, Goleta, CA, United States, 93117; CURRAN, Sabrina, Cleveland Natural History Museum, Cleveland, OH, United States

Size is well understood to be a confounding factor in morphological studies, such that shape is often considered a function of size (size-shape covariance). This is an especially large problem in fossil contexts, where taxa are sometimes differentiated on the basis of size alone. For many studies attempting to compare morphology, size should be explored, accounted for and (if necessary) factored out. Here, we present investigations of a confounding issue in the study of Cervidae post-cranial ecology. Previous studies have shown that size can account for as much as 95% of the morphological variation in some Bovidae post-cranial elements. This study expands on past research, incorporating a variety of Cervidae post-cranial elements and exploring how the limited dominance variation may affect discriminant function reclassification rates. We applied Mosimann shape variable methods and found that for each post-cranial element, 57-95% of the variance in raw measurements is attributed to size. Linear regressions and principal component analysis were used to explore and confirm the effects of size on the measurements and their principal components. Discriminant function analysis shows that any attempt to remove or otherwise diminish the effects of size results in lower resubstitution and cross-validation rates when grouping known individuals into two clusters. However, some measurements designed specifically to adjust for size still resulted in relatively high resubstitution rates (77-83% in a four-group discrimination). The implication is that even though size is dominating the variance in the raw metric dimensions, the ability of shape alone (i.e. non-size correlated dimensions) to discriminate among Cervidae skulls and chins is still robust. If accuracy is the goal of these kinds of analyses, our results strongly implicate that removing or otherwise obscuring size information may not be appropriate since it generally results in weaker discriminant functions.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

FIRST OCCURRENCE OF REPTILE TRACKS (PROCOLophonICHnIUM) FROM THE LOWER TRIASSIC MOENKOPI FORMATION (SHNAkBAkIb MEMBER) OF SOUTHWESTERN UTAH WITH PALEOVIRONMENTAL IMPLICATIONS

THOMSON, Tracy, University of California-Riverside, Riverside, CA, United States, 92521

The Lower-Middle Triassic Moenkopi Formation of the Colorado Plateau preserves a high-diversity track assemblage (e.g., Chirotherium, Rotodactylus, Rhynchosauroides) produced by a variety of reptilian trackmakers. Many of these trackmakers are not represented by skeletal remains and therefore they are an important record of Early Triassic reptilian biodiversity. Reported here is the first occurrence of vertebrate tracks from the Lower Triassic Shnabkaib Member in the eastern Utah Basin. The tracks show diagnostic characteristics of the small reptilian ichnogenus Procolophonictum including broad trackways with low pace and angulation, and overstepping of the proximal portion of the manus by the pes. A specimen comprising several tracks is reposited at the Natural History Museum of Utah (UMNH). Procolophonichnium is common from the Middle Triassic Muschelkalk Formation (Anisian) in Germany and together with Rhynchosauroides it is predominantly associated with upper intertidal to lower sabkha facies. Although Rhynchosauroides commonly occurs in the Moenkopi Formation Procolophonictum is rare and tracks have only recently been identified on a specimen at the University of California Museum of Paleontology (UCMP) that was collected from the Wapati Member (upper Oleneekian) near Meteor Crater, Arizona. Both the UCMP and UMNH specimens show multiple trackways with preferred orientations indicating the unidirectional travel of multiple individuals over a relatively short period of time. The UCMP specimen also preserves the manus and pes impressions of Chirotherium sickleri, a much larger reptile track, overprinting the Procolophonichnium tracks. The UMNH specimen preserves tracks interpreted as a single track with a symmetrical ripple with the predominant track direction subparallel to longitudinal ripple crests. Symmetrical ripple marks, mudcracks, gypsum nodules, and associated laminated and contorted bedding, are indicative of an intertidal to sabkha/supratidal paleoenvironment for the Shnabkaib Member and the discovery of Procolophonichnium from this unit supports an association of this ichnogenus with tidal flat/sabkha paleoenvironments as indicated from the German fossil record. Procolophonichnium has been considered a wastebasket ichnotaxon and although revision is needed the examples from Germany, coupled with this new discovery from Utah, support the hypothesis that these tracks constitute a distinct ichnotaxon produced by a small Early Triassic reptile adapted to tidal flat and sabkha environments.

Romer Prize Session (Thursday, October 31, 2013, 11:45 AM)

CONCORDANCE AND DISCORDANCE OF DIVERSITY DYNAMICS ACROSS MAMMALIAN TROPHIC GROUPS IN THE MIDDLE EOCENE OF COASTAL SOUTHERN CALIFORNIA

TOMIYA, Susumu, University of California Museum of Paleontology, Berkeley, CA, United States, 94720

The diversity dynamics of carnivoraforms and their contemporary mammalian carnivores during the middle Eocene is poorly understood, owing to limited taxonomic work and lack of ecological approach that would place the carnivores in the context of regional faunal succession. Using the exceptionally well-preserved fossil record of the Uintan through Duchesnian mammals in coastal southern California, I address whether changes in the ecomorphological diversity of carnivores at the macroevolutionary timescale are associated with compositional shifts in non-carnivorous mammals. I compiled taxonomic occurrence data for middle-Eocene mammalian taxa from San Diego and Ventura Counties based on 33,000+ specimens representing at least 93 genera. The fossil occurrences were grouped into meta-assemblages belonging to 9 time bins. For each meta-assemblage, I address whether changes in carnivores was significantly correlated with that in non-carnivores (Mantel r = 0.382, P = 0.045). However, the taxonomic composition of carnivores and non-carnivores by tallying the number of taxa in morphotypic categories defined by body mass and diet. I assessed the degree of concordance between compositional shifts in carnivores and non-carnivores by computing pairwise Manhattan distances for all pairs of carnivore assemblages and all pairs of non-carnivore assemblages, and then testing for rank-order correlation between the two sets of pairwise distances. A minimum of 16 carnivorous taxa (including 11 carnivoraforms) are recognized in the regional fauna. The numbers of carnivorous taxa and morphotypes increased substantially from the early Uintan to the Duchesnian ages, resulting in broader body-size ranges and greater trophic diversity. This trend continued with the early Uintan non-carnivores (mainly primates) and rise of terrestrial herbivores, which suggest major changes in the available habitat types. The magnitude of morphological-compositional shifts in carnivores was significantly correlated with that in non-carnivores (Mantel r = 0.382, P = 0.045). However, non-carnivores were occupied by the early part of faunal succession. The rich fossil record of southern California illustrates a broad association between the morphological diversity of the two trophic groups within the regional fauna, and that it is possible to detect such linkage even with
ONTGENETIC VARIABILITY IN UPPER CRETACEOUS THEROPOD TEETH

TORGES, Angelica, University of Alberta, Edmonton, AB, Canada; TORRES, Christopher, UNC Wilmington, Wilmington, NC, United States; DE PIETRI, Vanesa, Natural History Museum Basel, Basel, Switzerland; LOUCHART, Antoine, Institut de Genomique Fonctionnelle de Lyon, Lyon, France; VAN TUINEN, Marcel, UNC Wilmington, Wilmington, NC, United States

Flamingos (Phoenicopteriformes) are a highly specialized lineage with a filter-feeding strategy entirely unique among modern birds. Though extant flamingo ecology and feeding behavior has been well-studied, the evolutionary history of this ecomorph remains poorly understood. No ancestral cranial or rostral fossil material has ever been formally described for crown clade flamingos (Phoenicopteridae). The most closely-related extant taxa (Palaeeleiderae) has been described as possessing a straight, blunt bill, markedly different from that of modern flamingos. This intermediate form is known as Harrisonsavis (‘Phoenicopterus’ croizeti) has been described from the late Oligocene-early Miocene of the Auvergne region in central France and assigned to Phoenicopteridae based on, among other elements, a skull with clear affinities to the modern flamingo ecomorph. However, a thorough description is lacking and the original material has been lost. Here, new pheonicopterid cranial material is described from the Saint-Génard-le-Puy area in central France which is tentatively assigned to H. croizeti, including a nearly complete cranium with articulated proximal upper rostrum, a distal rostral tip, and two pieces of mandibular material. High resolution X-ray computed tomography (CT) is used to describe the internal as well as external morphology, including a digitally reconstructed brain endocast which is compared with brain reconstructions from modern flamingos and paleoendocranial reconstructions. The construction of new knowledge with a solid foundation of accurate and engaging material is necessary for students and teachers to come to a greater understanding of the evolution, diet, and behavior of flamingos and other flamingo-like birds.

Grade Utah State Science Core Curriculum, and what teachers are conveying to their students in the classroom. This disparity resulted in consistently low scores in the geology portion of the State Core Test. To address this discrepancy, we created “What Rock is That?” (and other common 4th grade questions) - a free professional development opportunity for classroom teachers throughout the state of Utah.

During this Geology Workshop, teachers are provided the opportunity to come to a greater understanding of geologic processes by interacting with museum-quality geology and paleontology specimens. After working with these specimens, we provide teachers with the content and background information necessary to build upon the foundation of this hands-on experience.

By working alongside museum educators who use and model inquiry-based learning techniques throughout the duration of the workshop, teachers are able to construct knowledge about the Earth Sciences from the perspective of their students, an opportunity that helps them empathize greatly with the struggles and frustrations their own students may encounter. Additionally, this empathy allows teachers to hone their science process skills by addressing discrepant events as learning opportunities, rather than exogenous dietary grit. The lack of scratches in Ctenomys genus suggests that the etiology of these gouges is not clear and merits investigation. Microwear of the grass-leaf consumer, Hydrochoerus cuvieri, has high scratch counts typical of other grazers (e.g., ungulates, murid, sciurid rodents). Similarly, the fruit-seed consumers, Prochoimys cavieri and Thrichomys, have high pit counts similar to other seed predators. In contrast to our previous study, Dasyprocta, a fruit-leaf consumer, has unexpectedly high scratch counts, particularly fine scratches, more similar to grass-leaf consumers than typical frugivores. Additionally, Hydrochoerus has more gouges than other grazers, almost identical to what is seen in seed predators. The etiology of these gouges is not clear and merits investigation. Microwear of the grass-leaf consumer, Ctenomys, includes many pit scratches. Thus, it is more similar to a hard object consumer (fruit consumer or seed predator) than a grass feeder. This discrepancy is likely related to the fossorial habits of Ctenomys, which digs with its incisors as well as its forelimbs. This chisel-tooth digging could result in soil in the oral cavity and thereby affect enamel microwear, potentially resulting in the highly pitted microwear of Ctenomys. This would parallel the pattern seen in ungulate “dirty bowlers” such as Camelus, which also have highly pitted microwear. The correlation between dietary grit and highly pitted microwear in both Ctenomys and Camelus implies that the abundant scratches characteristic of grazers probably results from ingestion of a diet of opal phytoliths rather than exogenous dietary grit. The lack of scratches in Ctenomys may simply be due to overprinting of the grazing microwear signal by a dietary grit signal.

Posters Session IV (Saturday, November 2, 2013; 4:15 - 6:15 PM)

AN EXPANDED ANALYSIS OF DENTAL MICROWEAR IN CAVIOMORPH RODENTS

TOWNSEND, K.E. Beth, Midwestern University, Glendale, AZ, United States, 85308; CROFT, Darin, Case School of Medicine, Cleveland, OH, United States

Caviomorph rodents have been significant components of South American ecosystems for more than 30 million years. How such rodents partitioned dietary resources with other groups of mammals, such as endemic South American ungulates, remains a little-explored question. Our research group set out to investigate this topic by characterizing enamel microwear in extant caviomorph rodents and using these data to interpret diets of extinct caviomorphs. Our 2008 pilot study of enamel microwear in extant caviomorph rodents demonstrated a correspondence between microwear and broad dietary groups but was based on relatively small samples. We here report results of a much-expanded analysis that includes 42-50 wild caught individuals of each of the 13 taxa examined in our prior study. These new results support some aspects of our earlier analysis but also reveal patterns not evident previously. For example, the grass-leaf consumers, Hydrochoerus and Cavia, have high scratch counts typical of other grazers (e.g., ungulates, murid, sciurid rodents). Similarly, the fruit-seed consumers, Prochoimys cavieri and Thrichomys, have high pit counts similar to other seed predators. In contrast to our previous study, Dasyprocta, a fruit-leaf consumer, has unexpectedly high scratch counts, particularly fine scratches, more similar to grass-leaf consumers than typical frugivores. Additionally, Hydrochoerus has more gouges than other grazers, almost identical to what is seen in seed predators. The etiology of these gouges is not clear and merits investigation. Microwear of the grass-leaf consumer, Ctenomys, includes many pit scratches. Thus, it is more similar to a hard object consumer (fruit consumer or seed predator) than a grass feeder. This discrepancy is likely related to the fossorial habits of Ctenomys, which digs with its incisors as well as its forelimbs. This chisel-tooth digging could result in soil in the oral cavity and thereby affect enamel microwear, potentially resulting in the highly pitted microwear of Ctenomys. This would parallel the pattern seen in ungulate “dirty bowlers” such as Camelus, which also have highly pitted microwear. The correlation between dietary grit and highly pitted microwear in both Ctenomys and Camelus implies that the abundant scratches characteristic of grazers probably results from ingestion of a diet of opal phytoliths rather than exogenous dietary grit. The lack of scratches in Ctenomys may simply be due to overprinting of the grazing microwear signal by a dietary grit signal.

Posters Session II (Thursday, October 31, 2013; 4:15 - 6:15 PM)

"WHAT ROCK IS THAT?" (AND OTHER COMMON 4TH GRADE QUESTIONS)- A FREE PROFESSIONAL DEVELOPMENT OPPORTUNITY FOR TEACHERS WITH NHMU

TOTH, Natalie, Natural History Museum of Utah, Salt Lake City, UT, United States; SEPPIL, Jessica, Natural History Museum of Utah, Salt Lake City, UT, United States

Through our yearly interaction with students statewide, we, as scientists and outreach educators, observe a major disparity between the geology component of the 4th grade Utah State Science Core Curriculum, and what teachers are conveying to their students in the classroom. This disparity resulted in consistently low scores in the geology portion of the State Core Test. To address this discrepancy, we created “What Rock is That?” (and other common 4th grade questions) - a free professional development opportunity for classroom teachers throughout the state of Utah.

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Posters Session I (Wednesday, October 30, 2013; 4:15 - 6:15 PM)

THERMOREGULATORY STATUS OF MOSASAURS FROM THE WESTERN INTERIOR SEA OF KANSAS, USA

TREVETIAN, Ian, Fort Hays State University, Hays, KS, United States, 67601

During the Late Cretaceous, the central portion of the North American continent was occupied by the Western Interior Seaway. The fauna of the Western Interior Seaway was segregated into distinct habitats, based on physical, chemical, and geographic factors.

Mosasaurs (Squamata: Mosasauridae) were a diverse group of secondarily aquatic marine reptiles derived from varanid-like lizards that radiated into marine niches 98-65 Ma, during the latter half of the Cretaceous. Over 3000 specimens of mosasaurs have been described from the Late Cretaceous strata of the Western Interior Basin of North America. Although studies of mosasaur relationships, distribution, and diversity continue to add to the growing body of knowledge, little is known about other key aspects regarding the ecology of this family.
Recent analyses comparing oxygen isotope values of phosphate from the teeth of marine reptiles to those of coeval fish estimated mosasaur body temperature to be in the range of 35° ± 2°C to 39° ± 2°C. In addition to these findings, other researchers recently examined oxygen isotope composition in biogenic apatite from coeval turtle and fish fossils from Kansas and Mississippi indicating that paleoenvironmental zones of the Western Interior Seaway were latitudinal and likely a result of both temperature and salinity variation throughout the Late Cretaceous.

Presented here are the results of an isotopic analysis of phosphate within coeval turtle and fish fossils from the Western Interior Seaway of North America on a latitudinal gradient. This study is to estimate the core body temperatures of these mosasaur specimens and compare them to ocean water temperature calculated from coeval fish from the same area. These results show core body temperature of mosasaurs to be substantially higher than that of ocean water. High, stable core body temperature values indicate endothermic regulation and establish baseline body temperature estimates for mosasaurs found in Kansas. With these temperature estimates, it will now be possible to pursue a larger scale investigation correlating body temperature of mosasaurs to water temperatures within the Western Interior Seaway of North America on a latitudinal gradient.

Symposium 3 (Friday, November 1, 2013, 9:45 AM)
THE MORRISON FORMATION U/PB DATING PROJECT: USING HIGH-PRECISION, CHEMICAL ABRASION (CA-TIMS), SINGLE ZIRCON, ASHFAST DATES FOR CHRONOSTRATIGRAPHIC CORRELATIONS
TRUJILLO, Kelli, University of Wyoming, Laramie, WY, United States, 82071; CHAMBERLAIN, Kevin, University of Wyoming, Laramie, WY, United States.

The Upper Jurassic Morrison Formation of the Western Interior of North America is one of the most prolific fossil-bearing rock units in the world, and it has been studied in detail across a vast depositional area. Long-standing investigations of the Morrison Formation have been difficult, however, due to the inherent variability of terrestrial systems, the lack of biostratigraphically useful fossils, and the lack of definitive marker horizons in this rock unit. Radiometric dating has the potential to help overcome these issues and aid in correlation and definition of the depositional area.

This project focuses on dating individual vertebrate fossil quarries in the Morrison Formation in order to place them into temporal context. The resulting ages can then be used to create a radiometrically based stratigraphic framework for the formation as a whole. Many researchers have already contributed matrix from their quarries as well as funds to support the dating of their individual sites. As a result of this ongoing project, new U/Pb ages from geographically diverse vertebrate fossil localities in the Morrison Formation have been produced. These ages, along with previously published 40Ar/39Ar ages (recently recalculated due to the recalibration of the Fish Canyon Tuff sanidine standard to the astronomical timescale), are allowing better long-distance correlations than previously were available. In addition, techniques such as chemical abrasion (CA-TIMS) and ultra-low Pb lab blanks are allowing the University of Wyoming Geochronology Lab to date single, small, ashfall zircons with greater precision and accuracy. These crystals often have such a low level of radiogenic lead that only ultra-low blank methods can produce robust data.

Several ages from geographically widespread fossil localities in the Morrison Formation are now available, and they are being used to test previously published correlations of fossil-bearing localities. These new data support the concept that long-distance correlations of the Morrison Formation based on lithostratigraphy, including a change in the dominant clay mineralogy, should be used with caution when radiometric dates are not available.
implicated as an important factor in shaping the evolution of durophagous specialists in the mammal order Carnivora. Recent morphometric analyses have clarified the great extent of convergent evolution in carnivore bone-crackers (canids and hyaenids), and the findings. As already demonstrated with bone-cracking hyaenids and canids, the biomechanical capability in convergent bamboo specialists Altirupoda and Altirupa exhibits remarkable similarities; this observation holds even after accounting for their large differences in body size.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

A PALEOGENE MAMMAL FAUNA FROM THE IWAKI FORMATION, JAPAN, AND IMPLICATIONS FOR AGE AND PALEOBIOGEOGRAPHY

TSUBAMOTO, Takehisa, Hayashibara/Okayama University of Science, Setouchi, Japan; KODA, Yoshiki, Ibaraki Nature Museum, Bando, Japan; HASEGAWA, Yoshikazu, Gunma Museum of Natural History, Tomioka, Japan; NABANA, Satoshi, Iwaki City Museum and Fossil Museum, Iwaki, Japan; TOMIDA, Yukiomitsu, National Museum of Nature and Science, Tsukuba, Japan

Paleogene land mammals have been rarely found in the Japanese Islands. Nevertheless, recent fieldwork and analytical studies have increased our understanding of Japanese Paleogene land mammal radiations. These studies have indicated that Japanese land mammals can contribute to the age determination of terrestrial deposits in Japan and also to our understanding of mammalian biochronology and evolution in continental Asia. Here, the mammalian fauna and geologic age of the Iwaki Formation of the Paleogene Shiramizu Group (Iwaki City, Fukushima Prefecture, northeastern Japan) are reviewed. The Iwaki mammalian fauna consists of three artiodactyl species: Bothriogenys sp. cf. B. hui (Anthracotheriidae), Entelodon gobienis (Entelodontidae), and cf. Notomeryx sp. (Ruminantia). All of these three genera indicate a late Eocene (Priabonian) correlation of the Iwaki Formation. Although the Iwaki mammalian fauna has been mostly recorded in the southern and middle regions with one alleged exception from the northern region; and Notomeryx has been recorded in the southern region. The occurrence of these three genera in the Iwaki Formation confirms that Bothriogenys, Entelodon, and perhaps also Notomeryx can be useful late Eocene indicators in terrestrial eastern Asia. It also implies that the Iwaki mammal fauna was paleobiogeographically located between the northern and southern late Eocene faunas of eastern Asia, showing a faunal mixture. The Iwaki fauna is also unique in yielding diverse faunas of marine sharks and seashore birds together with terrestrial mammals. The Iwaki vertebrate fauna is a key factor to reconstruct the faunas of the eastern coastal margin of the Asian Continent during the late Eocene.

Technical Session XVI (Saturday, November 2, 2013, 4:00 PM)

THE FIRST PROCOLOCOPHONID FROM THE MANDA BEDS OF SOUTHERN TANZANIA AND ITS IMPLICATIONS FOR MIDDLE TRIASSIC BIOGEOGRAPHY

TSULI, Linda, University of Washington, Seattle, WA, United States, 98195-1800; SIDOR, Christian, University of Washington, Seattle, WA, United States; SMITH, Roger, Iziko South African Museum, Cape Town, South Africa; ANGIELCZYK, Kenneth, Field Museum of Natural History, Chicago, IL, United States

The Middle Triassic of Tanzania is characterized by rich and diverse faunas that have contributed to a remarkable diversity of archosaurs and therapsids, but no parareptiles. Procolophonids were the last surviving members of the Parareptilia and were broadly distributed across all continents in the Triassic, which makes their absence in Manda rocks especially noteworthy. Fieldwork in 2012 and 2013 has yielded the first ever terrestrial postcranial of a new procolophonid taxon. The fossil can be clearly identified as a procolophonid based on the morphology of the teeth, with highly labiolingually expanded crowns and two clear cusps. There are six maxillary teeth with bulbous bases, and clear, tooth-like denticles on the palate. The orbits are particularly large and posteriorly emarginated, and this, along with the small size of the skull, suggests that it could represent a subadult individual. In contrast to contemporaneous Southern African forms characterized by quadratojugal horns, the new Tanzanian species has two raised bosses on the posterior and ventral surfaces of the quadratojugal, an autapomorphy of some of the more basal procolophonid taxa. Although the skull lacks evidence of a procolophonid taxon confirms that the Tanzanian taxon is indeed a procolophonid, however there is very little resolution in the resulting cladogram. After removing the most problematic, primarily basal and poorly known procolophonids, a more resolved phylogeny has the Manda species as sister to a clade of more basal African taxa, but not to the Leptopleurinae which includes primarily European and North American species. Procolophonid clad, then to the Leptopleurinae, which includes primarily European and North American species. Parareptilia was a diverse clade in the Permain, but only two lineages persisted into the Triassic, the Owenettidae and the procolophonids. Recent museum research has led to the identification of an owenettid from the Manda beds, which, combined with the specimen from 2012, demonstrates the first known occurrence of the two surviving parareptile clades in the Middle Triassic. Previous research has shown largely independent evolution of these two clades, but the divergence of the Leptopleurinae began no earlier than the Permian as opposed to more endemic faunas in the Middle Triassic. The parareptiles of Tanzania conform to this pattern, with more widespread taxa in the Late Permian (e.g., paurucusaurissuchus and Anthodon) contrasted with an entirely endemic Middle Triassic fauna.

Symposium 3 (Friday, November 1, 2013, 12:00 PM)

TEMPORAL CALIBRATION OF THE BRIDGERIAN NORTH AMERICAN LAND MAMMAL AGE (NALMA): MAGNETOSTRATIGRAPHY AND HIGH PRECISION U-Pb ZIRCON GEOMETRONCHY OF THE MIDDLE EOCENE BRIDGER FORMATION, WYOMING

TSUKUI, Kazori, Columbia University, New York, NY, United States; FLYNN, John, American Museum of Natural History, New York, NY, United States; RAMEZANI, Jahandar, Massachusetts Institute of Technology, Cambridge, MA, United States; MACHLIS, Malka, Lamont-Doherty Earth Observatory, Palisades, NY, United States; BOWRING, Samuel, MIT, Cambridge, MA, United States

A new magnetostatigraphy and high-precision U-Pb zircon dates from the Middle Eocene Bridger Formation (Bridger Basin, WY) provide an enhanced temporal context for the Bridgerian aged mammalian fauna as well as the Bridgerian/Uintian NALMA transition. Our new magnetostatigraphy correlates the fossiliferous “Bridger” B (upper Blackfork Mb.) through “Bridger E” (Turtle Bluff Mb.) interval to the Geomagnetic Polarity Scale (GPS) and performs a U-Pb and 40Ar/39Ar dating using 52 samples from 39 stratigraphic levels in overlapping stratigraphic sections spanning ~550 meters, using thermal and alternating field demagnetizing methods. Four polarity zones were identified, and our correlation of the polarity sequence to the GPS places the upper Blackforkian subage (Be2) in Chrons C22r and C21r, the Twinbuttean subage (Be3) in Chrons C21r and C21a, and importantly, the Bridgerian/Uintian transition within Chron C21n. The proposed magnetostatigraphic calibration of the Bridgerian NALMA is at odds with a previous age model and indicates a younger chron assignment for the Bridgerian/Uintian transition in the Bridger Basin.

In addition, three distinct volcanic ash beds from the Bridger Formation were dated with high-precision U-Pb zircon geochemistry, to calibrate the numerical age and duration of the Bridger Formation and Bridgerian faunas. The ash beds are magnetically and stratigraphically co-registered, thus their U-Pb dates can serve to improve the calibration of the GPS for the study interval. The weighted mean Pb/206U zircon dates of the Henrys Fork and Church Butte tuffs overlap with previously published Ar/Ar ages (normalized to FCs of 28.2 Ma) within fully propagated 2-sigma uncertainties, whereas the U-Pb and 40Ar/39Ar dates of the Sage Creek Mountain tuff do not overlap within 2-sigma uncertainties. In all three cases, the U-Pb dates are younger than the corresponding Ar/Ar ages. The new geochronologic data place the Bridgerian NALMA just subsequent to a transient drop and rise in temperature after the Early Eocene Climatic Optimum with the entire Bridgerian occurring during the early stages of a long middle Eocene cooling trend.

Finally, the magnetostatigraphic placement of the Henrys Fork tuff generally agrees with the 2012 calibration of the GPS. However, the U-Pb dates of the Church Butte and Sage Creek Mountain tuffs and their stratigraphic correlation to the current GPS calibration for the correlated magnetochron, suggesting that the presently accepted age for Chrons C21r and C20r in standard time scales may be too young.

Advances in Dating the Late Cretaceous Vertebrate Record of Northeastern Australia using U-Pb LA-ICPMS Detrital Zircon Geochronology

TUCKER, Ryan, James Cook University, Townsville, Queensland, Australia; ROBERTS, Eric, James Cook University, Townsville, Australia; SALISBURY, Steven, TUCKER, Ryan, James Cook University, Townsville, Queensland, Australia; RAMEZANI, Jahandar, Massachusetts Institute of Technology, Cambridge, MA, United States; MACHLIS, Malka, Lamont-Doherty Earth Observatory, Palisades, NY, United States; BOWRING, Samuel, MIT, Cambridge, MA, United States

A number of studies have recently focused on U-Pb detrital zircon geochronology for maximum depositional ages. These approaches are mostly recorded in the northern and middle regions with one alleged exception from the southern region; and Notomeryx has been recorded in the southern region. The occurrence of these three genera in the Iwaki Formation confirms that Bothriogenys, Entelodon, and perhaps also Notomeryx can be useful late Eocene indicators in continental eastern Asia. It also implies that the Iwaki mammal fauna was paleobiogeographically located between the northern and southern late Eocene faunas of eastern Asia, showing a faunal mixture. The Iwaki fauna is also unique in yielding diverse faunas of marine sharks and seashore birds together with terrestrial mammals. The Iwaki vertebrate fauna is a key factor to reconstruct the faunas of the eastern coastal margin of the Asian Continent during the late Eocene.
Some key aspects of pterosaur macroevolutionary history, such as biogeography, have received relatively little attention. The small number of biogeographic studies of pterosaurs have identified ‘centers of origin’ and postulated long-distance dispersal (e.g. originating in the Barremian-Aptian and their subsequent dispersal to South America in the Albian). To test these and other hypotheses, we constructed a data set comprising the phylogenetic relationships and spatiotemporal distributions of 108 pterosaur species. These data were analyzed as a whole and in time-slices using the event-based parsimony method TREEFIT. The results provide no statistical support for continental-scale vicariance, only for dispersal events occurring within or proposed scenarios. In contrast, all analyses (with the exception of the Late Jurassic time-slice) yield statistical support for elevated levels of sympathy. Such patterns might be artefacts produced by taxonomic over-splitting and/or uneven sampling of different habitat types. However, the pervasiveness of sympathy, irrespective of the absence of Lagerstätten, suggests that there is a real biogeographic signal that requires explanation. We therefore propose a new hypothesis to account for pterosaur spatial distributions. Powerd flight enabled certain pterosaur lineages to cross geographic barriers, but such events are apparently continuously rare (though frequently reprinted by overtly print any vicariance signals generated by Pangaean break up). The rarity of successful dispersal might relate to ecological rather than lomomat requirements: that is, pterosaurs might have found it relatively easy to cross a barrier, but might have had difficulties in founding viable populations once they reached a new area because of differences in food sources or other ecological parameters. On those rare occasions when pterosaur lineages successfully dispersed into new regions, they apparently tended to diversify within those areas, perhaps specializing for a variety of different niches defined by body size, feeding preferences and/or habitat types. This view is supported by the observation that, despite their volant abilities, very few pterosaur species have widespread geographic distributions. Thus, pterosaur biogeographic history can be characterized as a series of occasionally successful ‘sweep-stake’ dispersal events, several of which led to regionally restricted sympatric radiations.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

A NEW DWARF SEAL FROM CHILE REVEALS A HIDDEN MORPHOLOGICAL DIVERSITY OF PINNIPEDS FROM THE NEOGENE OF SOUTH AMERICA

VALENZUELA-TORO, Ana M., Universidad de Chile, Santiago, Chile; GUTSTEIN, Carolina S., Universidad de Chile, Santiago, Chile; COZZOUL, Mario, Universidad Federal de Minas Gerais, Belo Horizonte, Brazil; PYENSON, Nicholas, UCM, Washington, DC, United States; SUAREZ, Mario E., Universidad de Chile, Santiago, Chile

Body size influences an individual’s entire existence, from its morphology to its ecology. Body size decreased during syndeposition within the origin of mammals, and this reduction is often linked to the evolution of mammal-like traits (e.g., endothermy). Body size also has small but relatively stable signature in the appearance of pinnipeds, which characterized long term macaronian evolution as involving increased median displacement of the humeral head and proximal migration of the deltopectoral crest. For the femur, titanosauriforms were identified to possess femora that were significantly broader medially than other sauropods, with a noticeably more laterally directed femoral heads and proximally and slightly laterally displaced fourth trochanters. These shape changes are expressed in the greatest degree by titanosaians. Regarding other sauropodomorphs, prosauropod humeri and femora are easily distinguished from those of sauropods in canonical variates analyses, and display a divergence in their common bipedality. Brachiosaurids present elongate and gracile humeral and femoral morphotypes significantly differing in multiple respects from other analyzed groups. In summation, our results corroborate previous qualitative assessments and afford new insights into phylogenetic and functional analyses, and their expected consequences of their common bipedality. This work was supported by the National Science Foundation (EAR 1018424).
SGO.PV 25169, SGO.PV 22100, and SGO.PV 22101) consist of postcranial remains from at least three different BIF localities. SGO.PV 25169 corresponds to a left humerus very small in size (~62% and ~66% of the total length of *Acrocephora longirostris* and *Pisophilacanthus*, respectively), from the late Neogene levels of the Cerro Ballena locality. From a second locality of the same age, North Bahia de Caldera, an isolated left astragalus (SGO.PV 22105) and right tarsal elements (astragalus, calcaneus and cuboid bone, SGO.PV 22106) from the same individual also belong to this diminutive taxon. The total length of both astragali represent an average of ~96% of *Pisophilacanthus* and 69% of *Archacotops*. From a third locality, Mini Fosfita, four collected a left, compiled femur, also small in size (SGO.PV 22101), and a complete left juvenile femur (SGO.PV 22100) which is probably the juvenile form of the new taxon presented here. All material (except SGO.PV 22100) exhibit fused epiphyses, slight porosity, and well-developed muscle insertion scars, which are all indicative of physical maturity, even at their relatively small size. Thus, we can now report three different pinnipeds from the BIF, suggesting a community composition in the late Neogene without analog to current pinniped community in the eastern South Pacific Ocean. These new materials constitute the smallest pinnipeds found in South America, even smaller than the living pinniped, *Pusa*, based on comparative limb proportions.

**Preparatory Session** (Thursday, October 31, 2013, 9:00 AM)

**A FINE KETTLE OF FISH: PREPARATION OF A LARGE CRETACEOUS FIELD JACKET CONTAINING MULTIPLE ASPINERCIFORMES**

**VAN BEEK, Constance, Field Museum, Chicago, IL, United States, 60605**

Sturgeonos and their relatives, the paddlefish, belong to the order of primitive ray-finned fishes known as Aspincerciformes. True sturgeons and paddlefish first appeared in the Upper Cretaceous fossil record about 200 million years ago. They have changed little since then; and they are notable for being primarily cartilaginous, lacking a vertebral column, lacking teeth, and being partially covered with ornate bony scutes, rather than scales. Thus, there was every reason to make preparation of a single specimen a delicate, difficult and time-consuming effort.

When a quite large field jacket from the Hell Creek Formation of South Dakota was brought to the Field Museum and opened, it contained at least eight exposed complete specimens of Late Cretaceous sturgeons and paddlefish, as well as fragments and scutes. There were more fish fossils underneath the top layer, as well. The matrix was a very unconsolidated, friable and crumbly mudstone. Some of the top layer specimens had already been exposed and over-prepared before arrival to our Collections.

It was determined that many individuals might be in the jacket, the first step was to figure out how to consolidate such a copious amount of material, both fossil and matrix, to keep all from collapsing. The challenge would then be to remove the extensive consolidation without damaging fossil material. Preparation of these ephemeral specimens could then proceed.

A low-tech strategy was determined to be the best way to go. Continuous application of various consolidants was necessary to keep specimens and matrix intact throughout preparation. Consolidant reversal and delicate mechanical means (pin visses, art brushes, etc.) were used to make the surfaces workable to clean and define the fossil fish.

A gentle, but time-consuming approach was ensured that specimens were successfully prepared with little sustained damage. A team of skilled volunteer preparators were also key in making continuous progress towards completion of this difficult project.

**Poster Session I** (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

**TESTING ADAPTIVE HYPOTHESES FOR ANTERIOR CERVICAL FUSION IN CERATOPSIS**

**VANBUREN, Collin S., University of Toronto, Toronto, ON, Canada, MSS 3B2; CAMPIONE, Nicolás E., University of Toronto, Toronto, ON, Canada; TANKE, Darren H., Royal Tyrell Museum, Drumheller, AB, Canada; EVANS, David C., Royal Ontario Museum, Toronto, ON, Canada**

The neoceratopsian syncervical is a coalesced element composed of the first three cervical vertebrae. Although recent studies have ascertained the homologies of this structure, its function has been less intensely studied. This structure has been hypothesized to have evolved as an adaptation in Cretaceous ceratopsians to support the large skull, or 2) act as a buttress for the skull during intraspecific combat. Here we test these hypotheses within a phylogenetic context for the first time by assessing the predictions that enlarged head size and/or cranial weapons (black/nasal horns) must have evolved in concert with each other, before cervical fusion.

To test the head-support hypothesis, we used a dataset of 47 extant tetrapods and 16 non-ceratopsian dinosaurs to first assess previously proposed thresholds for determining large relative skull size. Results indicate that the three previously proposed thresholds for large relative head size in Ceratopsia represent averages, rather than extremes in terrestrial vertebrates when basal skull length is considered. Importantly, the extant comparisons do not indicate that the majority of ceratopsians that have syncervicals have exceedingly large skulls relative to body size, except when the length of the thin frill is included in skull length. Recent models indicate that the frill makes up ~2% of body mass suggesting that it would have minimal contribution on skull mass.

Despite the observation that most ceratopsians do not have large relative heads among terrestrial vertebrates, proper testing of the functional hypotheses requires that these changes must be assessed within Ceratopsia. Maximum likelihood ancestral state reconstruction of head size proxies onto a complete ceratopsian phylogeny and discrete character optimizations of cranial weaponry, head size, and the syncervical indicate that neither the evolution of cranial weaponry nor head size correlates with the origin of the syncervical. We therefore reject both hypotheses as the selective pressure(s) for syncervical origin. We cannot reject the possibility that the syncervical was exapted in ceratopsids for combat and/or head support. Nevertheless, strong functional hypotheses for the syncervical should reflect its origin in small-bodied neoceratopsians. Cervical fusion has evolved independently in a number of extant terrestrial taxa, including armadillos, rodents, and hornbills; future research should focus on these taxa as models to predict ecologies and/or behaviors associated with cervical fusion early in neoceratopsian evolution.

**THE PREMORPHIC DENTITION OF YINLONG DOWNSI, AND THE MORPHOLOGY, FUNCTION, AND EVOLUTION OF PREMORPHIC TEETH IN CERATOPSIS**

**VARRIALE, Frank, King’s College, Wilkes-Barre, PA, United States, 18711**

Many ceratopsians possessed premolar teeth, but the function of these teeth is largely unstudied. Here, dental microwear and gross morphology are examined to better document and interpret these structures.

The most basal ceratopsian *Yinlong downsi* possesses three premolar teeth. The first shows a vertical wear facet and a basal horizontal shelf lingually, with apicobasally-oriented microwear and exposed dentine. These features support formation via occlusion with the lower beak. The second tooth also has a vertical lingual surface that is planar, and this surface has previously been interpreted as a wear facet. This surface lacks microwear, and no dentine is exposed. Denticles occur at the mesial and distal edges of the tooth, and the base of each denticle is uneven and continuous from the labial side to the lingual surface. Thus, the flat lingual surface of the second premolarly tooth is primary morphology and not due to wear, imparting marked heterodony and a more dagger-like appearance than previously thought. These features are seen in teeth of both sides.

Other ceratopsians do not approach this degree of premolar tooth heterodony. The teeth of *Archaeceratops* and *Lioaceratops* are slightly labiolingually compressed cones with bulbous bases, and the teeth of *Protoceratops* are simple conical pegs. Wear facets occur in all three taxa. Here, facets show exposed dentine, but facet shape varies intra- and interspecifically. Some facets are planar relative to the unworn shape, supporting formation via attrition with the beak. Others are slight losses of the enamel, leaving the primary shape little altered. This indicates that some teeth may not be in contact with the beak or that initial formation of a facet may be due to food-tooth abrasion followed by rhamphothecal attrition as eruption progresses.

Microwear on premolar facets indicates that these teeth were functional, perhaps for cropping vegetation. However, the caniniform daggers of *Yinlong* may have functioned as intraspecific agonistic display structures, like those of extant chevrotain and moschid deer, and as that hypothesized for heterodontosaurids. Premaxillary teeth were lost at least three times during ceratopsian evolution, suggesting functional changes associated with mastication or other behaviors.

**WOUNDING-TOOTH GROWS UP: ONTOGENY IN THE CRETACEOUS THERIOPOD *TROODON FORMOSUS***

**VARRICCHIO, David, Montana State Univ, Bozeman, MT, United States, 59717**

An ontogenetic series for the theropod dinosaur *Troodon formosus* permits comparison of limb and element proportions, bone texture, prominence of bony features, apomorphies, degree of skeletal fusion, size and chronoecologic age. All specimens come from the 4.1 Ma span of the Late Cretaceous *Two Medicine Formation* of Montana, USA and include embryonic remains (Museum of the Rockies [MOR] 246), a small juvenile (MOR 430), a large juvenile (MOR 563), a multi-individual assemblage (MOR 553), and an adult associated with eggs (MOR 748). Thus, the sample spans a 10-fold increase in linear dimensions (e.g. greatest femoral lengths from 32.7 to over 330 mm) and likely an over 100-fold increase in weight. Histologic sampling of femora and tibiae show these elements to represent pre-hatching (MOR 246), several-months (MOR 430), one-year (MOR 563), and 12-year (MOR 748) old individuals.

Within the hind limb, more distal elements become shorter relative to the femur through ontogeny. Although even the phalanges of a given pedal digit express this pattern, relative digital length remains constant with age. Both humerus and femur maintain their distinctive curvature as well as form and placement of the deltopectoral crest and proximal trochanters, respectively. Nevertheless, all hind limb elements including pedal phalanges become increasingly more robust late in ontogeny. In contrast, dorsal centra shift early in ontogeny from a long, low form (centrum length/height ratio of about 1.25) to a short, deep form (ratio of 0.80 to 0.85). Smooth bone surface replaces more porous texture and more prominent muscle scars and detailed articular surfaces occur late in the growth of limb bones. Nevertheless, some important apomorphies (e.g., larger, more broadly rounded maxillary fenestra; lateral groove on the dentary; pneumatic quadrate) appear in embryonic specimens. Individuals segregate into three age-fusion stages: stage I (by several months; neural spines fused; caudal neural centra fused; stage II (by one year) - all neural central sutures fused; stage III (perhaps 10 or more years old) - fusion of sacral vertebrae into sacrum, astragalus with calcaneum, and tarsometatarsus. Mature bone surface texture, the definition of articular surfaces and attachments, element robustness and not neurocentral fusion appears to correlate with sexual maturity in *Troodon*. Observed ontogenetic changes are complicated and not readily predicted from other taxa. This highlights the taxon-specific nature of growth and the importance of histology in assessing ontogenetic maturity.
The lower Devonian arthrodire (Placoderm) Antineosteus Rufus sp. nov., from the Emsian of the Barrandian area (Czeck Republic)

*Placoderms are subordinate faunal elements in the Devonian of the Barrandian area (central Bohemia). The most abundant placoderm remains occur in the basa Lochkov Formation (Lochkovian) whilst higher up in the section they are rare.

Two large dermal bony plates, described as Antineosteus rufus sp. nov., were discovered in the Emsian strata. The plates were prepared with electric needle and observed under optic and electronic microscope. The fragment of a right central plate of the head shield is some 13 cm long and wide, but its original size was substantially larger. The medial suture with the left central plate is poorly preserved but seems to be slightly curved. The shape of the postero medial margin shows that the anterior margin of the nuchal plate was wide and concave. The second plate, right anterior dorsolateral, is slender in the posterior part and abruptly murderous in the anterior part. The anterior part of the plate along with the articular condyle is exposed to the inner bone structure forming a spiny projection in the midline. The articular condyle points dorsally, the shape of the articular area being long, slender and concave. Both plates are covered with a strongly damaged dermal ornament. On a few spots the typical arthrodire ornament, oval tubercles with a shallow ridge separating the tip, is visible. Towards the outer margins of both plates, the tubercles tend to be arranged in lines.

Both plates show affinity to the family Homostiidae, with numerous characters in common with Tityosaurus lehmani. Accepted to the size of the incomplete plates, the total length of the animal had exceeded 250 centimetres, having been the largest Lower Devonian arthrodire known so far. It was much larger than the Australian Dhangaura and Cathlesichthyus, considered to be comparable in size to Tityosaurus rieversae.

Primitive brachythoracic arthrodires (a group comprising the homostiids) in the Lower Devonian are known from various regions of the world: Morocco, Aragon, Rhenland, Minusinsk Basin and south-eastern Australia – the northern and eastern continental margins of Gondwana - and from Spitsbergen; representing mostly shallow tropical to subtropical ecosystems. The new specimen of Antineosteus rufus is in favor of the possible migration route of this group along the northern continental margin of Gondwana.

Symposium 4 (Saturday, November 2, 2013, 10:15 AM)

Latitudinal Gradients and Provincility in Chondrichthyan Faunas from the Late Cretaceous North America

VAYREK, Matthew J., University of Alberta, Edmonton, AB, Canada, T6G 2E9; HARRISON, Luke, McGill University, Montreal, QC, Canada; CUMBAA, Stephen, Canadian Museum of Nature, Ottawa, ON, Canada; BECKER, Michael, McGill University, Montreal, QC, Canada; LARSSON, Hans, McGill University, Montreal, QC, Canada

The latitudinal diversity gradient (LDG) of extant biodiversity is a robust biogeographic pattern: marine and terrestrial diversity decreases towards high latitudes. A number of processes have been hypothesized to drive this LDG, with climate-related processes most commonly proposed. High latitude palaeocommunities offer unparalleled insight to the history and formation of this pattern because they preserve communities united in combinations of temperature and photoperiod that have no modern analogue. Here we describe a new and diverse marine chondrichthyan assemblage from the Late Cretaceous, Roatan Formation (central Bohemia). This study addresses questions related to how many dinosaurs weighed and how they moved, with a new approach based on dinosaur tracks. Fossil tracks may be used to back-calculate the properties of the subsoil such as geometrical and constitutive parameters (layer thickness, strength and stiffness). The purpose of this work is to deduce the subsoil properties at track formation in order to perform back-calculation of the properties on the soil and hence make conclusions about the weight of the dinosaur that left the tracks. This is done by simulating processes during and after track formation. At many tracksites, radial and axial cracks around the tracks are frequently observed. It is supposed that the origin of these cracks can be explained by desiccation right after track formation rather than by the mechanical load.

In order to confirm this assumption and to allow for a precise interpretation of dinosaur tracks, a series of laboratory tests and numerical simulation with Finite Element Analysis are carried out, designed to mimic hydro-mechanical processes during desiccation. Within the experiments, a range of environmental humidity and temperature was considered. The laboratory experiment showed that both the radial and axial cracks can be best explained due to desiccation processes.

The numerical simulation was performed to better understand and explain the cracking mechanism in and around dinosaur tracks caused by diverse physical processes. In this research, the coupled process has been numerically simulated in 3D by means of thermo-hydro-mechanical analyses available in CODE BRIGHT software. The stress-strain behavior is considered by an appropriate thermo-elasto-plastic model which is a modification of the Barcelona Basic Model accounting for soil swelling and shrinking with the change of water content and temperature. Based on the analysis of the tensile stresses, it was found that the high tension stress around the track due to soil shrinking phenomena may cause cracks in radial and axial directions.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

Insights into the microbial degradation of bone in marine environments: Genetic sequencing of biofilms from simulated whale-falls

VIETTI, Laura, University of Minnesota, Minneapolis, MN, United States, 55413

Evidence of microbial activity is prevalent on marine vertebrate fossils. Since microbes are sensitive to environmental conditions, evidence of their activity may provide environmental, temporal, and diagenetic information pertinent for taphonomic reconstructions. However, little is known about which specific microbes target decay bone, which limits the use of microbial activity in taphonomic analyses. To better understand which bacteria are responsible for bone decay, I simulated aspects of natural taphonomic processes during desiccation. Within the experiments, a range of environmental humidity and temperature was considered. The laboratory experiment showed that both the radial and axial cracks can be best explained due to desiccation processes.

The numerical simulation was performed to better understand and explain the cracking mechanism in and around dinosaur tracks caused by diverse physical processes. In this research, the coupled process has been numerically simulated in 3D by means of thermo-hydro-mechanical analyses available in CODE BRIGHT software. The stress-strain behavior is considered by an appropriate thermo-elasto-plastic model which is a modification of the Barcelona Basic Model accounting for soil swelling and shrinking with the change of water content and temperature. Based on the analysis of the tensile stresses, it was found that the high tension stress around the track due to soil shrinking phenomena may cause cracks in radial and axial directions.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

Partial skeleton of a toothed whale (Odontoceti, Cetacea) from the mid to late Miocene Gaton Formation, Panama

VELEZ-JARBE, Jorge, Florida Museum of Natural History, Gainesville, FL, United States, 32601; WOOD, Aaron, Florida Museum of Natural History, Gainesville, FL, United States; RIDGOWELL, Nicole, University of Colorado, Boulder, CO, United States; BLOCH, Jonathan, Univ of Florida, Gainesville, FL, United States; MACFADDEN, Bruce, Univ of Florida, Gainesville, FL, United States

Fossils of marine mammals from Central America are rare, with only a handful of relatively incomplete specimens described from Nicaragua, Costa Rica and Panama. This has thus far limited our understanding of cetacean diversity in the New World Tropics. Here we report a newly discovered partial axial skeleton of an odontocete whale from the late Miocene Gaton Formation, Panama Canal Basin. It is the most complete cetacean fossil yet known from the middle Miocene of Central America, with articulated cervical, thoracic, and lumbar vertebral, and ribs, allowing for insights into its affinities as well as aspects of its feeding behavior. Characteristics of the vertebral column in the Gaton odontocete are unique among known Neogene odontocetes, these include cervical vertebrae with centra that are nearly as long as high, and long lumbar vertebrae with a centrum length:centrum height ratio greater than 1. The third through sixth cervical vertebrae (C3-6) have long, ventrolaterally oriented transverse processes, with those of C6 nearly twice as long as those of C3-5 and C7. These features of the vertebral column are otherwise known in the early Miocene platanistoid Alolidelphis pratti, and the fossil from the Gaton is herein referred to that genus. In addition, the ribs of the Gaton platanistoid are partially osteosclerotic, a characteristic seen in mammals that feed on marine vegetation (i.e. sirenians), benthic invertebrates (i.e. sea otters), as well as in early whale ancestors. Taken together, these features indicate that the Gaton Alolidelphis likely foraged at shallow depths, an interpretation that is consistent with the depositional environment of the Gaton Formation at about 25 meter of depth. Alolidelphis, otherwise known from the early Miocene of the northern eastern Pacific region, is the first middle Miocene platanistoid known from Central America and hints at a much greater cetacean diversity in the region than at present.
to the whale-fall mesocosms. My results provide the first glimpse into which bacteria are present and create distinctive patterns of biodiversity according to the type of organic debris. My hypothesis is that the quantity of available organic matter is the dominant factor influencing bacterial community composition. Lysostaurus bonebeds and their palaeoenvironmental implications for the earliest Triassic Karoo Basin, South Africa

VIGLEITTI, Pia, University of Wittwatersrand, Johannesburg, South Africa; SMITH, Roger, Iziko South African Museum, Cape Town, South Africa; COMPTON, John, University of Cape Town, Cape Town, South Africa; BOUTA-BRINK, Jennifer, Natal Museum, Bloemfontein, South Africa

Earth experienced the "mother of all mass extinctions" at the end of the Permian Period 252.3 million years ago (Ma). Despite an estimated 75 to 90% loss of species globally in both marine and terrestrial realms across the Permian-Triassic Boundary (PTB), marine sediments preserve the tetrapod fossil record of Gondwanan ecosystems that simultaneously began to occupy vacant niches of the earliest Triassic. Preserved in the Karoo Basin of South Africa is an almost continuous stratigraphic record of terrestrial sedimentation through the PTB that has a fossil record of ecosystem collapse, survivorship and recovery. The adaptation of the therapsids from the Lower Triassic Lystrosaurus Assemblage Stage to a highly seasonal (monsoonal), semi-arid climate is associated with changes in modes of fossilisation. Isolated dicondylnul skulls and postcranial elements are commonly found in latest Permian deposits. However, in the earliest Triassic deposits, dicondylnul fossils occur as articulated "cups" of skeletal and multi-individual monoaxont bonebeds. Lack of epiphyses and relatively small skull lengths confirm that the bonebeds comprise several subadult Lystrosaurus declivis carcasses. Lack of evidence for significant hydraulic bone concentration as well as clusters of ribs in life position are evidence that complete carcasses were present at the site of death, and suggests that animals behaviourally congregated before perishing together. The bonebeds are hosted by floodplain mudrocks containing carbonate nodules and sand-filled mud cracks. These fine-grained deposits are capped by tabular sandstones that form 8 meter maximum bed thicknesses in the Karoo Basin.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

REDESCRIPTION OF CERADACTYLUS ATROX (PTEROSAURIA, PTERODACTYLOIDEA) FROM THE EARLY CRETACEOUS ROMUALDO FORMATION (SANTANA GROUP) OF THE ARARIBE BASIN, BRAZIL

VILA NOVA, Bruno, Universidade de Sao Paulo, Ribeirao Preto, Brazil; SAYAO, Juliana, Universidade Federal de Pernambuco, Recife, Brazil; KELLNER, Alexander, Rio de Janeiro;

Based on one of the first pterosaur skulls unearthed at the Romualdo Formation (Araripe Basin), Cerdactylus atrox has caused disagreement among paleontologists regarding its relationships. Ranging from an ornithochord to a clenchoclashidactylid pterosaur, some authors even regarded this species as representing a distinct suprageneric clade ("Ceradactyla"). Further preparation of the holotype, now housed at Museu de Ciencias Naturais UFJF (MNM 7019-V), revealed several new features allowing a redescription and re-evaluation of the phylogenetic position of this species. Detailed preparation showed that the rostral end of this specimen had been glued inverted allowing a redescription and re-evaluation of the phylogenetic position of this species. The premaxillary sagittal crest were identified and start at the third rostral tooth. Ceradactylus atrox is a valid taxon that can be diagnosed by a dentary groove which bifurcates at the rostral end, an orbit occupying a high position relative to the massofacial fenestra, and comparatively small number of teeth (32-36 maxillary, 22-26 mandibular) decreasing in size towards the posterior end. The rostral teeth are elongated, thin, and slightly curved posteriorly, and directed somewhat forward and outward. Starting from the 6th tooth, the teeth become smaller, more vertical, and straighter, and they are all directed toward the posterior end. Although the dentition is similar in size to that of anhanguerids and Brasilesadoxynus, C. atrox lacks the typical Anhanguera feature of the fifth and sixth teeth being smaller than the fourth and seventh. A phylogenetic analysis places this taxon as the sister group of the Anhangueridae, with the European taxon "Ornithocheirus" compressirostris as the next closest related taxon.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

DOES ECOLOGY OR TAPHONOMIC BIAS DESCRIBE THE DIFFERENCES IN MAMMALIAN COMMUNITIES IN THE PLIOCENE HADAR AND TURKANA BASINS: ETHIOPIA AND KENYA? A QUANTITATIVE APPROACH

VILLASENOR, Amelia, George Washington University, Washington, DC, United States, 2005

Across space and time, Astrapothecus afarensis evinces wide variation in relative abundance at the sites in which it is found. Though known from Hadar, Maka, Dikika, and Woranso-Mille, Ethiopia, Turkana, Kenya, and Laetoli, Tanzania, approximately 90% of the known A. afarensis hypodigm comes from the site of Hadar. Paleoeological reconstructions have shown that A. afarensis inhabited a wide range of habitats: from woodlands adjacent to rivers and lakes at Hadar, to more open and arid habitats at Turkana, and wooded to closed habitats at Laetoli. Given that local environments affect predatory selective pressure, and create distinctive patterns of biodiversity according to the type and magnitude of available organic matter, the hypothesis is that the quantity of available organic matter is the dominant factor influencing bacterial community composition. RESULTS: In the inset of the bar graph, the y-axis represents the Jaccard Index, a measure of similarity between the two sites is not simply an artifact of the rarefied distribution samples. It lies outside the 95% confidence interval for the rarefied Hadar distribution is 18.15 to 28.06 species; thus, the observed richness for Turkana basin is 77. To test the hypothesis, we compared the observed Jaccard Similarity value (0.136) for the Hadar and Turkana basins indicates few shared species and when compared to a randomized distribution, it lies outside the 95% confidence interval (p=0.036). Thus the Hadar and Turkana basins share fewer species than expected if species are randomly distributed across space. This study suggests that the Hadar and Turkana basins may have been separate centers of endemism, lending credit to the idea that Hadar may be a core environment for hominins and other mammals, worthy of future study.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

FMUR DIMENSIONS AND BODY SIZE ESTIMATION TO TRACK PREHISTORIC POPULATION CHANGES IN THE SOUTHERN SEA OTTER ENHYDRA LUTRIS NEREIS

VILLAVICENCIO, Natalia , University of California, Berkeley, CA, United States, 94720-3140; TOMIYA, Susumu, University of California, Berkeley, CA, United States; HOFMEISTER, Jennifer, University of California, Berkeley, CA, United States; LINDBERG, David, University of California, Berkeley, CA, United States

Regression analyses of bone dimensions relative to body size measurements are commonly used to estimate body size from fossil samples. While cranial and dental measurements are frequently used, limb bone dimensions have been shown to be highly reliable in terrestrial mammals. Here, we analyzed the relationships between the sea otter, Enhydra lutris nereis in contrast to other members of the Mustelidae, Enhydra spends most of its life in water, which is reflected in its overall anatomy. Our goal was to estimate body size of ancient Holocene populations of E. lutris nereis from the abundant postcranial elements found at the archaeological site of the Emeryville shell-mound in San Francisco, California. These remains date to around 1800-2400 years before present (yr BP), and they represent otters that were hunted by prehistoric humans. Femur length and diameter were measured from skeletons of adult modern specimens (n=25) with known body masses and body lengths. We used simple linear regression models to relate limb size to body size. Correlation coefficients were fairly low (r=0.45) between body weight and femur dimensions among modern specimens; this might reflect the intra-annual variation in body mass known to occur in modern sea otters. The highest correlation coefficient was detected between femur length and standard body length (r=0.70) for this line of analysis. These results were used to derive a preliminary equation to estimate body size. The prehistoric samples from the Emeryville shell-mound were assigned to 7 different temporal groups. The preliminary estimation of body lengths in older samples generally showed values close to the mean body length of modern sea otters. The standard body length of modern sea otters is shorter than expected if species are randomly distributed across space. This study suggests that the Hadar and Turkana basins may have been separate centers of endemism, lending credit to the idea that Hadar may be a core environment for hominins and other mammals, worthy of future study.

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

THE INTERNAL CRANIAL MORPHOLOGY OF THE EXTINCT BONE-CRACKING HYENA PLIOCRUCA PERRIERI (CARNIVORA, HYAENIDAE)

VINUESA, Victor, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallès, Spain; MADURELL-MALAPEIRA, Joan, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallès, Spain; PUNTROY, Josep, Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallès, Spain; ALBA, David M., Institut Català de Paleontologia Miquel Crusafont, Cerdanyola del Vallès, Spain

Hyaenids currently display a diversity and disparity of form compared to those displayed by this group in the Miocene, so that three out of the four extant hyaenids (Crocuta crocuta, Hyaena hyaena and Parahyaena brunnea) belong to the bone-cracking ecomorphotype—to which several extinct species, such as Pachycrocuta brevirostris and Pachycrocuta perrieri, have been attributed. The internal cranial morphology of such extinct taxa might provide significant data for our understanding of hyaenid evolution from both phylogenetic and paleobiological viewpoints. With the aid of computed tomography (CT) techniques, here we report the internal cranial morphology of P. perrieri, based on a well-preserved, unpubished skull (MN16) housed at the Museu de Villarroya (N Iberian Peninsula). Particular emphasis is put on the comparison of endocranial morphology and relative brain size with extant hyaenids, in order to make paleoecological inferences on cognition and social behavior in this taxon.

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Our results show that the frontal sinuses of *P. perrieri* are caudally extended, as in extant and other extinct bone-cracking hyenas. Among extant bone-cracking hyenas, the brain morphology (with a poorly-developed anterior portion) and sulcal pattern (e.g., the shape and orientation of the cerebral and adjacent parietal sulci) of *Plocrocuta* are more similar to those of *Hyenas* and *Parahyaena* than to those of *Crocuta*. These features might suggest a closer phylogenetic link with the two former genera instead of *Crocuta*—thereby contradicting recent phylogenetic hypotheses for these taxa—although additional data on other extinct hyaenids would be required to determine the polarity of change. With regard to relative brain size, our results for *Plocrocuta* indicate a lower degree of encephalization compared to *Crocuta*, which is the extant hyaenid displaying more developed social behaviors. Our results further show that *Plocrocuta* displays a relatively small anterior region of the cerebrum compared to all extant bone-cracking hyenas, allowing us to infer the possession of a poorly developed frontal cortex. Overall, our results indicate that *P. perrieri* possessed less developed cognitive abilities than extant bone-cracking hyenas for processing the information associated with complex social behaviors, and suggest instead a poorly social or even solitary life style for the former.

**Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)**

**REDISCOVERING AMEGHINO’S FOSSIL LOCALITIES OF THE SANTA CRUZ FORMATION (EARLY MIOCENE) IN THE SANTA CRUZ VALLEY, SANTA CRUZ PROVINCE, ARGENTINA**

**VIZCAÍNO, Sergio, Museo de La Plata, La Plata, Argentina; KAY, Richard, Duke University Med Ctr, Durham, NC, United States; FERNICOLA, Juan, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina; BARGO, M.Susana, Museo de La Plata, La Plata, Argentina; CUSTIÑO, José, Universidad de Buenos Aires, Buenos Aires, Argentina**

The Santa Cruz Formation (SCF, Early Miocene), crops out in Santa Cruz Province, Argentina from the Atlantic coast westward to the Andes. The first vertebrate fossils of this formation were described in the vicinity of the Gallegos, Chico, and Santa Cruz rivers. In 1887, Carlos Ameghino collected over 2000 specimens along the Santa Cruz River. These were described by Florentino Ameghino in 1887 and 1889, and largely formed the basis for what we now call the Santacrucian Age. In subsequent years, Carlos Ameghino discovered further localities of SCF on the Atlantic coast, especially remarkable for their better state of fossil preservation, and also found fossils close to the Andes. Florentino Ameghino ascribed the Atlantic coastal specimens to the Santacrucian and proposed that the westernly localities near Lago Argentino were somewhat older than those in the east. For more than a century since, fossil recovery in the Santacrucian concentrated on the eastern localities (between Monte León and Gallegos River) and western ones (around Lake Argentino), with almost no prospecting of exposures along the Santa Cruz River. In recent fieldwork supported by notes and letters of the Ameghinians, we have relocated the collecting localities of Carlos Ameghino on the south bank of the Santa Cruz River, identified marine oyster levels (an important marker for the formation of new localities) observed by him at the easternmost outcrop, and recovered more than 2000 fossils including Santacrucian mammals (primates, rodents, marsupials, ungulates, and xenarthrans), birds, reptiles, and frogs. The taxonomic composition of the fauna indicates strong affinities with the faunas from the localities in the East: primates and frogs were previously recorded only in the East and there are not notohippid ungulates, previously recorded only in the west. Stratigraphic and sedimentologic analysis of the SCF along the Santa Cruz River revealed a gradational transition of this unit from the underlying early Miocene Monti-León Formation. The SCF is composed of claystones, siltstones, and minor sandstones, with abundant pedogenetic features, deposited in a low-energy fluvial environment. Abundant pyroclastic intercalations allowed us to collect samples of more than 10 datable levels that will establish a chronostratigraphy between eastern and western outcrops and provide a framework of comparison hypotheses about whether the east to west faunal differences are explained by temporal or geographical and paleoecological ones.

**Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)**

**NEW PATTERNS OF SPATIOTEMPORAL VARIATION IN THE EASTERN BOX TURTLE (TERRAPNE CAROLINA) AND THEIR INFLUENCE ON EVOLUTIONARY HYPOTHESES**

**VITEK, Natasha, The University of Texas at Austin, Austin, TX, United States; 78751**

An understanding of variation within a given species can inform our understanding of patterns and drivers of evolution. However, variation often is poorly understood within a given species, especially in the spatiotemporal context, because of lack of information on the complete and abundant enough to be used in statistical analyses of shape. Variation within this species, both in the modern and fossil records, often is interpreted as a specific variation in the literature. To explore patterns of spatiotemporal variation, I used geometric morphometrics to quantify the shape of 200 modern and 44 fossilized shells of *T. carolina*. First I analyzed differences in the shapes of nominative subspecies in the modern record. Then I compared the results from the modern biota to those of the fossilized specimens. Results of pairwise comparisons indicated significant differences between subspecies, but the results of assignments tests and canonical variates analyses indicated insignificant or unreliable differences. In sum, results indicate that differences between subspecies are more statistically significant than they are biologically significant, and may not be the best explanation for patterns of variation in the modern record. More importantly, statistical analyses are unreliable for the identification of individuals of a subspecies based on skeletal features. That means that extant subspecies cannot be identified in the fossil record.

Differences between fossilized and modern shells were greater than the differences between various extant subspecies, further indicating that applying specific identifications to fossils is inappropriate. Variation in fossilized specimens is best characterized by the presence of three morphotypes that do not correspond to the current taxonomic arrangements for *T. carolina*. Furthermore, morphotypes co-occur in the same strata, and represent a unique situation not seen in the modern biota. My results reveal a remarkably more complex pattern than previously proposed. They support an evolutionary history different from previous hypotheses that masked evolutionary complexity by recognizing artificially circumscribed taxa.

**Poster Session V (Saturday, November 2, 2013, 4:15 - 6:15 PM)**

**PTEROSAUR SIZE CLASSES IN THE TRANSYLVANIAN LATE CRETACEOUS?**

**VREMIR, Matyas, Transylvanian Museum Society Cluj, Romania; NAISH, Darren, University of Southampton, Southampton, United Kingdom; DYKE, Gareth, University of Southampton, Southampton, United Kingdom**

Diverse Campanian-Maastrichtian vertebrate assemblages are known from Romania, from both the Hateg and Transylvanian basins. We review the pterosaur fossil record from small, medium, large and gigantic pterosaurs from late Campanian-Maastrichtian units in the Hateg and Transylvanian basins. All known Romanian giant azhdarchids, most famously *Hatzegopteryx thambema*, come from late Campanian-Late Maastrichtian estuarine-coastal environments and continental settings, while other pterosaurs, representing a range of sizes, come from the same continental environment. The following pterosaur-bearing sites are known in Transylvania: Pui, Sinpetru, Vadu, the Ciula-Densus Formation (all in the Hateg Basin), the Bozes Formation and the Sebes Formation (Transylvanian Basin). Included among the small-sized specimens (wingspans estimated at less than one meter) are maxillary and mandibular fragments of an indeterminate pterosaur from Ozada (Sebes Formation). Additionally, a notarium, femur and humerus that might be referable to indeterminate pteranodontids are known from Sinpetru in Hateg. Medium-sized specimens (wingspans estimated at ca. 3 meters) include a third wing phalanx from Boita (Ciula-Densus Formation), a pterodactyloid scapula, humeras and azhdarchid mid-cervical from the holotype of *Euraestarchaurus langendorfensis* from Lançram-Glod (Sebes Formation).

Large-sized specimens (wingspans estimated at ca. 5-6 meters) include a femoral shaft from Tusea (Ciula-Densus Formation), an azhdarchid coracoid and vertebral column from Vada (Sinpetru Formation), and the anterior part of a mandibular symphyses associated with poorly preserved wing bones, all from the Sebes-Glod site (Sebes Formation).

Pterosaurs of unusual size (wingspans estimated at ca. 10-11 meters) include the holotype of *Hatzegopteryx thambema* (palatal fragment, occipital skull, proximal humerus) from Valoiu, a mandibular symphyses, also from Valoiu, a dorsal rib from Pui (Sinpetru Formation), and a wing phalanx fragment from Petresi Arini (Bozes Formation). Additional specimens—all discovered in the Sebes Formation and belonging to indeterminate azhdarchids—include a seventh cervical, the distal end of a humerus, a proximal synacarpal and an unfused coracoid.

Documented fossils inform hypotheses on niche partitioning and habitat choice in these pterosaurs.
Our examination of the deciduous dentition of four individuals from these three genera also been suggested for other members of the subfamily in Europe (including Ailuridae). The skeleton is a male; however, because related portions of the skeleton are missing, its measurements show <5% chance of randomly drawing such distant end members from a significantly more robust than the previous individual. Statistics on limb proportions to different species and genera. Previous work has established deciduous differences at the genus level.ấuducous teeth show close relationships between Oredont genera (Eucrotaphus, Merycochoerus and Promerycochoerus) have previously been assigned to two or three different subfamilies, and species have been binned between genera by different researchers. Currently, only some researchers consider both Promerycochoerus and Merycochoerus have nearly identical dP4 characters, including a cingulum that dams the median valley and a larger cingulum on the anterior side than the posterior. The dP3 also shows very little shape variation between genera, each with a crescentic paracone, and cingula on both the anterior and posterior sides of the hypocone. These characters contradict the current subfamily divisions, indicating a close relationship between all three genera. We propose a re-definition of oredont subfamilies that reflects the close deciduous morphology of these three genera. We also agree with the synonymy of Promerycochoerus and Merycochoerus, as our examination primarily found size differences between them that we do not accept as genus-level distinctions.

New oviraptorid (theropoda, oviraptorosauria) embryos from the upper cretaceous of southern China

WANG, Shao, Institute of Vertebrate Paleontology & Paleoanthropology, Beijing, China; ZHANG, Shukang, Institute of Vertebrate Paleontology & Paleoanthropology, Beijing, China; XU, Xing, Institute of Vertebrate Paleontology & Paleoanthropology, Beijing, China

Three embryonic oviraptorid skeletons preserved within eggs were recovered from the Upper Cretaceous Namxiong Formation of Nankang County, Jiangxi Province, China. The eggs can be referred to Macrostizius juuumenianus based on external ornamentation, eggshell thickness and eggshell microstructure. Pathological features are apparent in radial section of the eggshells, but they have not been found in the embryonic skeletons. The embryonic skeletons present the best-preserved examples of the craniofacial region, vertebral column, pelvic girdle and hind limbs that are known among oviraptorid embryos. We have identified many morphological features in these embryonic skeletons that differ from the condition in previously described adult oviraptors, including: in the embryos, the ratio of the anteroposterior length of the premaxillary ventral margin to the tooth row length is large; the premaxilla is dorsoventrally shallow; the angle of the premaxilla slopes posteriorly at an angle of about 45º relative to the horizontal axis of the skull; the maxilla is anteroposteriorly longer than dorsally elevated high; the angle between the posterior and ventral borders of the antorbital fossa is less than 90º, the posterior end of the fused nasals overlaps the frontals; the triangular antorbital fossa is anteroposteriorly longer than dorsally elevated high; the anterior process of the lacrimal is proportionally long and situated more ventrally than in adults; the lacrimal recess is proportionally larger; the hypochondri of the fucula is absent; the femoral cranial trochanter is absent; and the femoral accessory trochanteric crest is present. Most of these distinctive features presumably reflect the early ontogenetic stage of these individuals, but it is possible that some represent taxonomic differences between the new specimens and previously described oviraptors. However, it is clear that oviraptorid growth was characterized not only by changes in skeletal proportions, but also by changes in the structure of some elements.

A REINTERPRETATION OF THE BRAIN MORPHOLOGY OF CEREBAVIS CENOMANICA (AVES: INCERTAE SEDIS)

WALSH, Stig, National Museums Scotland, Edinburgh, United Kingdom; MILNER, Angela, The Natural History Museum, London, United Kingdom; BOURDON, Estelle, The Natural History Museum, London, United Kingdom

Avian brain evolution is of considerable importance for studying the transition from non-avian theropod dinosaurs to modern birds, yet significant information is lacking on the morphological development during the Mesozoic exists. An isolated specimen (Paleontological Institute of the Russian Academy of Sciences [PIN] 5028/2) from Cenomanian deposits of Melovkia, Russia, was described originally as a ‘fossilized brain’, demonstrating the huge potential of Cerubavis cenomanica and tentatively referred to Enantiornithes. We have previously highlighted that this specimen is actually an incomplete skull, rendering the diagnostic characters invalid and Cerubavis cenomanica a nomen dubium. Here we provide a thorough description of the brain cavity morphology of this taxon based on µ-CT data kindly supplied by the late Evgeny Kurochkin. The brain of C. cenomanica closely fit the thin walled endocranium, and was characterized by strong brain axis flexion and caudalateral expansion of a comparatively short telencephalon, resulting in an equatorial triangular shape in dorsal view. Large non-bifurcated olfactory lobes suggest a strong reliance on olfaction, while the optic tectum was relatively large and overlapped dorsally by the telencephalon. As in Archaeopteryx, no eminentia sagittalis (wulst) was present. Wulst size and visual specialization are positively associated in living birds, and its absence, despite the size of the optic tectum, indicate that Cerubavis could be less visually specialized than most living avian taxa. Inner ear morphology was similar to that of living birds, and long cochlear canals suggest wide hearing frequency sensitivities. The exceptionally thin walled skull bones and an expanded vestibular lymphatic support derivation from a non-mammal animal, but obliteration of the cranial sinuses sutured. A large area of periosteal bone or even Enantiornithes unlikely. Overall brain morphology in Cerebavis is much closer to that of Neornithes than to Archaeopteryx, and the degree of skull bone fusion may indicate that the specimen is referable to an ornithurine. If so, the absence of a wulst (a synapomorphy of extant Neornithes) indicates that this feature must have appeared more recently than the Cenomanian in Ornithurae.

 TECHNICAL SESSION X (Friday, November 1, 2013, 12:00 PM)

MIO-PLIOCENE CARNIVORANS FROM WESTERN TIBET AND THE EARLIEST RECORD OF PANTHERINE FELIDS

WANG, Xiaoming, Natural History Museum of LA County, Los Angeles, CA, United States; TSENG, Z. Jack, American Museum of Natural History, New York, NY, United States; SLATER, Graham, National Museum of Natural History, Smithsonian Institution, Washington, DC, United States; TAKEUCHI, Gary, The Page Museum, Los Angeles, CA, United States; LI, Qiang, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China

The Late Pliocene in western Tibet Autonomous Region, at 4,200 m above sea level, produces fossil mammals of Mio-Pliocene age. Recent discoveries of early woolly rhinos and cursorial Hipparion horses mark this region as an important new region for understanding central Asian faunas during the uplift of the Tibetan Plateau, with implications for faunas of Pleistocene glacial-interglacial cycles. Top mammalian predators in the order Carnivora, informative for both biostatigraphic and zoogeographical interpretations of mammal faunas, have never been described from this region of the Himalayan Range. Here we present, for the first time, nine carnivorans species known from collections of five fieldwork seasons. Most of them represent new occurrences previously unknown to the southern Tibetan Plateau. Among them are genera typical of Pliocene northern Eurasian faunas such as the hyaenids Pliocrocuta and Chasmotheri, mustelids Melas and Mustela, and the canids Vulpes, Xenocony, and Nictereutes. In addition, the Zanda Basin records the earliest occurrence of Panthera, providing a record of pantherines in the late Miocene. Isoenzyme analyses estimate that the Zanda Basin reached altitudes of >2,500 m above sea level no later than the mid-Pliocene. Within this context, endemic and widespread carnivora existed, adding to the modern faunal diversity in the Pliocene Plateau. We are now offering a comparison to the relatively depilated modern Tibetan Plateau fauna. Together with high diversity of Pleistocene ungulates, several of which are candidates as predecessors to Ice Age megaherbivores, these carnivora fossils indicate the Tibetan region was a hotspot of both mammal dispersal and in situ evolution.

A NEW ORNITHUROMORPH BIRD FROM THE EARLY CRETACEOUS CHANGMA BASIN OF GANSU PROVINCE, NORTHWESTERN CHINA

WANG, Ya-Ming, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China; O’CONNOR, Jingmai, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; LI, Da-Qung, Gansu Geological Museum, Lanzhou, China; YOU, Hai-Lu, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

We measured two individuals of Eucrotaphus igrenocnemis (University of California Museum of Paleontology (UCMP) 76108 and 74944) from the Whiterock of the John Day Formation, one individual of Merycochoerus sp. (UCMP 7750) from the Arkarchean of the John Day Formation, and a Promerycochoerus carricki (UCMP 67574) from the Arkarchean of the Harrison Formation. Members of all three genera display deciduous premolars indistinguishable from Wood’s previous description of Promerycochoerus carricki, with the only variation present that of size. All four show
In the last decade, numerous avian specimens have been recovered from the Lower Cretaceous Xiaogou Formation in Changma Basin of Gansu Province, northwestern China, providing valuable information on the diversity and early evolution of basal birds. Until now, described specimens belong to two ornithuromorphs (Gansus yumenensis and an indeterminate taxon, Gansu Geological Museum specimen GSGM-05-CM-021) and four enantiornithines (Gansus yumenensis and GSGM-05-CM-021) from the same Xiaogou Formation in Changma Basin, which had been previously loosely referred to as Gansus yumenensis. The new specimens include a partial cranial and a nearly complete skeleton from a new indeterminate taxon, pectoral girdle and a completely articulated left pectoral limb. All three Changma ornithuromorphs preserve the sternum, which clearly distinguishes GSGM-05-CM-021 from previously identified taxa: the cranial margins of the sternum intersect at an angle of approximately 90º, contrasting with the greater angle of Gansus, the lateral process is larger and more rounded than those of Gansus and GSGM-05-CM-021, the sternal body is comparably much longer than that in GSGM-05-CM-021, the lateral trabecula is short and extremely expanded caudally, contrasting to the long, reversed L-shaped lateral trabecula in GSGM-05-CM-021 or long strap-like trabecula in Gansus. The new taxon is also more robust: the ratio of the width of the midshaft to the total length of humerus is much larger in GSGM-06-CM-013 than in Gansus. A preliminary phylogenetic analysis resolves GSGM-06-CM-013 as a basal ornithuromorph, although relationships with Gansus and GSGM-05-CM-021 are unresolved. Body mass estimates of the Changma birds demonstrate that enantiornithines were much smaller than ornithuromorphs in this avifauna. Most Changma enantiornithines preserve long and recurved pedal unguals, suggesting an arboreal lifestyle; comparatively, Changma ornithuromorphs show aquatic adaptations. Similar ecological differences are also observed between Jehol ornithorhynchans, suggesting niche partitioning between these clades in the Early Cretaceous.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)
DINOSAUR EGGSHELL OOFAUNA FROM THE NEMEGT AND BARUNGYOT FORMATIONS IN THE GOBI DESERT, MONGOLIA: TAXONOMY AND TAPHONOMY
WATA NABE, Junya, Kyoto University, Kyoto, Japan; MATSUOKA, Hiroshi, Kyoto University, Kyoto, Japan
A new flightless fossil duck (Aves, Anatidae), which has previously been reported as Chendytes, is described in a member of the tribe Mergini. It well represents the Middle–Late Pleistocene marine and land vertebrate fauna occurring from the fissure-filling deposits in the limestone bodies of Shiriya area, northeast Japan. Chendytes is an extinct flightless member related to Recent Somateria (eiders) of the tribe Mergini (seaducks), which is solely known from the Pleistocene and Holocene of coastal California. The new species (hereafter, the Shiriya duck) is represented by isolated elements, including fragmentary skull elements, vertebrae, fragmentary elements of the pectoral and pelvic girdles, and most of major limb elements. Comparisons with Recent representatives of major anatid taxa and Chendytes showed that the Shiriya duck is characterized, and can be named by a number of unique morphological characters, including: subtriangular fossa without a pit on the manubrial area of the sternum, stout shaft and distally extending, dorsocaudally concave crista deltopectoralis of the humerus, and well-developed crista encaulis lateralis of the tibiotarsus with deep excavation lateral to it. Nevertheless, the Shiriya duck can be referred to Mergini based on a combination of osteological features, including distally overhanging tuberculum ventrale of the humerus and narrow tarsometatarsus with concave lateral margin. Furthermore, morphology of the postcervical vertebrae along with the overall large size and proportions of the hind limb elements of the Shiriya duck show strong resemblance to Chendytes, comparisons of these taxa and other flightless members of the Anatidae showed that some of the apparently shared osteological features of the Shiriya duck and Chendytes are possibly homoplastic characters associated with flightlessness. Through these characteristics, the Shiriya duck seems to not reflect a close relationship between the two. There are two possible hypotheses on the evolutionary histories of these flightless ducks that once inhabited the opposite sides of the Pleistocene North Pacific contemporaneously: one is that they were descended from a single flightless common ancestor, and the other is that they were descended from distinct lineages and became flightless independently. The latter hypothesis appears more likely, given the impaired flight ability (or the occurrence of "temporary" flightless condition) in Recent Somateria.

Technical Session XIV (Saturday, November 2, 2013, 11:45 AM)
SYSTEMATICS OF A FLIGHTLESS DUCK FROM THE PLEISTOCENE OF SHIRIYA, NORTHEAST JAPAN
WATANABE, Junya, Kyoto University, Kyoto, Japan; MATSUOKA, Hiroshi, Kyoto University, Kyoto, Japan

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)
AN ASSESSMENT OF CLOVERLEY FORMATION (LOWER CRETACEOUS) CRUCROMYOD DIVERSITY USING TOOTH MORPHOLOGY
WAYRYNEN, Kaisa, Wellesley College, Wellesley, MA, United States
Isolated crocodylomorph teeth are frequently among the most common elements represented by such remains poses a challenge. Crocodylomorph teeth are known to vary when applied to the Cloverley sample, four distinct clusters of teeth were recovered, and when studied the diversity represented by such remains poses a challenge. Crocodylomorph teeth are known to vary both within and among taxa, but few attempts have been made to quantify this variation in a manner suited to the subsequent identification of isolated teeth. Here we present the results of a study on several thousand crocodylomorph teeth recovered from vertebrate microfossil bonebeds in the Lower Cretaceous Cloverley Formation of Wyoming and Montana. As the formation preserves abundant such teeth but few skeletal remains, this is an ideal case study for determining the utility of such fossils in assessing crocodylomorph diversity.
We used several morphometric techniques (primarily Principal Coordinate Analysis and Non-metric Multidimensional Scaling) on a reference set of known extant and fossil crocodylomorph taxa to create a morphospace within which different taxa could potentially be identified. Relevant morphometric data included several size parameters, parameterization, pattern, thickness and density, and development of molariform morphology. Combinations of these features allowed us to successfully separate out the different reference taxa.
When applied to the Cloverley sample, four distinct clusters of teeth were recovered, which largely conformed to preliminary identifications made based on gross morphology. The best separation of taxa occurred on axes that were positively correlated with size (e.g., “length, width, and height”), molariformity + molariformity + striation strength, and molariformity + stria tion strength. Although we cannot assign these fossils to specific crocodylomorph taxa, they bear strong resemblances to teeth previously assigned to bernissartids, atosaurusids, goniosuchids, and pholosaurids. Regardless of their particular taxonomic identities, this supports the presence of at least four distinct crocodylomorph taxa in the Cloverley Formation, a diversity that is consistent with other crocata data. It also demonstrates the utility of isolated teeth for such studies, provided appropriate taxonomic goals are set.
NEW MATERIAL FROM THE RARE AMPHICYONID GENUS PARADAPHOENUS AND ITS IMPLICATIONS ON THE VALIDITY OF CANIFORM CARNIVORES IDENTIFIED WITHIN CHADRONIAN THROUGH ARIKAREEAN COLLECTIONS

WELSH, Ed, Badlands Natl Park, Interior, SD, United States, 57750

A recent study of fossil canid material in the Cedar Pass fauna, within the Badlands National Park collections at the South Dakota School of Technology, has revealed a new stratigraphic occurrence of the miniature amphicyonid Paradaphoenus. This is the first recognized occurrence of Paradaphoenuswithin the Poleslide Member (Whitneyan) of the Brule Formation in South Dakota. Material from Paradaphoenus is infrequently known, with only a few specimens known in vertebrate collections from the Orellan through early Arikareean in Nebraska, South Dakota, and Oregon. However, Paradaphoenus is infrequently known in South Dakota, with occurrences exclusively known from the Scenic Member (Orellan) of the Brule Formation and the Sharps Formation Wounded Knee Fauna (Arikareean). Four specimens represent the taxon in the Cedar Pass fauna, but the material is fragmentary and limited, containing three isolated molars and a dentary with partial dentition. Nonetheless, the material is representative enough to include Paradaphoenus and P. c. minimus as faunal constituents in approximation to the Whitneyan-Arikareean transition, based on other representative mammalian taxa. The aforementioned Cedar Pass faunal specimens were previously misidentified as material from Hesperocyon. This is likely due to the overall scarcity of Paradaphoenus material, stemming from the lack of awareness on this carnivore’s presence. Though Paradaphoenus is similar in size to co-occurring canidae, a close study of the dental morphology clarifies the distinctions of concurrent small caniform carnivores. These Paradaphoenus specimens clearly demonstrate the widening of the M1 through an exaggerated and distinct parastyle in addition to a larger and more median position of the labial cingulum. The dentary attributed to P. toohoei exhibits premolars lacking accessory cusps and an m2 with the talonid encompassing 80% of the tooth length. Comparable morphology is described in some Arikareean specimens of the early canine Leptocyon, calling into question the validity of collection identifications within the Caniformia. Misidentifications such as these have been elucidated before, but seem to persist. This study ultimately calls for more attentiveness to evaluating caniform carnivore identification in similar collections of similarly sized caniform representatives of the Chadronian through Arikareean.

WENDRUFF, Andrew, Ohio State University, Columbus, OH, United States, 43202; WILSON, Mark, Univ of Alberta, Edmonton, AB, Canada

Coelacanths, which have a large temporal range (~407 million years), are traditionally considered to be a morphologically static group. However, early in their evolutionary history, the morphological diversity of this group peaked (Devonian–Mississippian), followed by a drop in diversity that led to evolutionary conservatism. We assess this interpretation of this decline in coelacanth morphological diversity by describing a number of newly discovered British and Canadian specimens of coelacanths from the Lower Triassic Sulphur Mountain Formation (Wapitei Lake) have been known for nearly 100 years and are only now being described. Preliminary works attributed all of the coelacanth material from this locality to a single undescribed species of Whiteia. However, a more detailed study, using eight new and distinct species have been identified. These include eight new genera and two newly described species of active predators, the Rebellionidae. These coelacanth specimens add to the growing number of coelacanths from the Early Triassic, which has the highest recorded species diversity. Two of the new coelacanths, Rebellettix and another currently undescribed genus, had body forms that significantly departed from the typical coelacanth body plan. Features such as a forked tail, denoting an active predatory nature, or an everted caudal fin, with a short supplementary lobe and elongate principal lobes, are non-typical features for coelacanths. These specimens represent the first major change in the coelacanth body form since their initial radiation in the Devonian and Mississippian. Fast-swimming, predator forms such as Rebellettix indicate that coelacanth morphological diversity was not as conservative as it had long been assumed.

Symposium 1 (Wednesday, October 30, 2013, 8:15 AM)

WHAT ARE WE ACTUALLY MEASURING? AN EVALUATION OF OSTEOSTHISTOLOGICAL INDICATORS OF DINOSAURIAN GROWTH RATE

WERNING, Sarah, Univ of California Berkeley, Berkeley, CA, United States, 94720-4780

Historical studies have established specific relationships between the microstructural features of bone and the growth rates of primary cortical bone. For animals of a given body size, the density and connectivity of vascular canals and the disorganization of collagen fibers increase with the rate of bone deposition, and osteocyte density is positively correlated with metabolic rate. Although these relationships are quantifiable, paleohistological studies generally use a tissue-level approach to compare bone growth among dinosaurs, except when reconstructing growth curves. I identified and refined several methods to improve the quantification of growth-related patterns in dinosaurian bone tissue, focusing on specific microstructural characters known to correlate with growth and metabolic rates in living tetrapods. The most critical histological indicator of growth, the rate of bone deposition, is rarely reported for dinosaurs. Occasionally, it has been estimated using values associated with specific vascular patterns in extant birds, a relationship that is not constant across tetrapods. Zonal and average area zonal width directly measure annual deposition, and can be used to bracket daily deposition rates. Estimating bone tissue growth based on vascularization patterns ("mammals’ Rule") can confound three seemingly related variables: density, connectivity, and patterning. As part of a larger study of archosaur growth, I measured canid density and the percentage of non-anastomosing canals in adding to describing vascular patterns, and reconstructed their ancestral states. Canal density shows an increase in evolutionary transition from stem to crown, which correlates more strongly with deposition rates. Collagen fiber orientation, which can signal seasonal shifts in deposition rate, is sometimes obscured in fossils by diagenic alteration. Patterns of osteocyte organization and orientation, more than cell shape, are highly associated with fiber orientation and may be more appropriate proxies. Osteocyte and collagen density are used typically for age estimation, but may be measured using digital boxplots along radial transects through the cortex. These measures suggest the possibility of more useful quantification of osteohistological indicators as proxies for growth and metabolic rates in extinct and extant vertebrates.

Technical Session IV (Wednesday, October 30, 2013, 2:15 PM)

A QUANTITATIVE MODEL FOR MORPHOLOGICAL EVOLUTION IN THE INTERATHERIIDAE (TYPOTHERIA, NOTOUNGULATA, MAMMALIA) AS A RESPONSE TO CLIMATIC AND TECTONIC CHANGES

WEST, Abagul, Columbia University, New York, NY, United States, 10025; FLYNN, John, American Museum of Natural History, New York, NY, United States; CROFT, Dunn A., Case Western Reserve University, Cleveland, OH, United States; WYSS, And, University of California Santa Barbara, Santa Barbara, CA, United States

*An expanded phylogeny of the Interatheriidae (Typotheria, Notoungulata, Mammalia), including two new taxa represented by four newly described specimens from the Eocene-aged Los Queutes Fauna of Chile, is presented. This phylogeny is used to quantify the relationship between clade age and diversification events during the Eocene–Oligocene Transition (EOT). The rapid appearance of hypsodont dentitions, a morphological change observed in interatheriids as well as in many other families of South American ungulates at around this time. The rise of hypsodonty during the late Eocene in South America is likely related to cooling and aridification that occurred in South America at the Eocene-Oligocene Transition; it has also been attributed to the presence of volcanic ash on plant surfaces in varying amounts throughout the Cenozoic. Ascental rats for a continuously varying hypsodonty metric were reconstructed using both a likelihood model and phylogenetic independent contrasts, and show that hypsodonty appeared, first, in the common ancestor of Interatherium and Santagothrichilus, coinciding with the sudden radiation of the Interatheriidae. This implies that hypsodonty may have been important in the radiation of this subfamily. An oxygen isotope record of sea-surface temperature from paleosol was used as a proxy for paleotemperature, and a mode of rates of interplate convergence along the Chilen Andes was used as a proxy for volcanic activity. Rates of change in hypsodonty along the time-calibrated phylogeny were reconstructed, and the relationships between these rates of morphological evolution and the two proxies were quantified using a novel statistical method based on time series analysis. The results show no significant interaction between either of the two proxies and rates of change in hypsodonty, suggesting that neither of these aspects of paeleoenvironment drove the evolution of hypsodonty, or that one or both were part of a more complex system that has not been captured here.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

QUANTITATIVE APPROACH TO RIB IDENTIFICATION AT AN ALASKAN PLEISTOCENE SITE

WHALEN, Christopher, University of Michigan, Ann Arbor, MI, United States, 48109-1079; Fisher, Daniel, Univ of Michigan, Ann Arbor, MI, United States; ROUNTREY, Adam, University of Western Australia, Perth, Australia; HOLMES, Charles, University of Alaska Fairbanks, Anchorage, AK, United States

Despite the occurrence of remains of Mammuthus primigenius (woolly mammoth) in Alaskan Pleistocene archaeological sites, it is difficult to specify the nature of human-mammoth interaction implied. Is it possible that molar, tusks, or bones recovered at such sites were transported for utilitarian purposes, unrelated to hunting or consumption of mammoth? Several small mammoth ribs were recovered from a central Alaskan, Pleistocene archaeological site known as Swan Point and were initially treated as taxonomically indeterminate. However, we noticed a resemblance between one of these ribs and the morphology emerging from an unrelated computational graphic study of the internal anatomy of two well-preserved neonate mammoth carcasses from Siberia. This comparison suggested that the Swan Point rib was a juvenile mammoth’s left second rib, an identification that was later supported by microCT analysis of the Alaskan specimen. Additional ribs from the Swan Point site also appear to be those of a neonate mammoth. To evaluate our identifications quantitatively, we experimented with ways of comparing these relatively landmark-poor elements of mammalian osteology. Ribs are often under-represented in specimen descriptions as they usually offer few useful morphological characters. The ribs of mammoths and other mammals are flattened mediolaterally creating anterior and posterior edges that extend proximodistally; changes in the curvature of these edges may be one of their more informative features. The 3-dimensional configurations of these edges and the depth of landmarks elsewhere on the rib were used in the use of traditional 2-dimensional morphometric analyses. Instead, we plotted 3-dimensional coordinates of semi-landmarks along these edges and fit an equation to those points; this information was supplemented by elliptical Fourier analysis of regularly-spaced cross-sections. By comparing coefficients generated in this manner from the Swan Point ribs, km and ribs of other appropriately sized mammals, we provide a strong argument that the Swan Point ribs are derived from a juvenile mammoth. This identification is important because these ribs are too fragile to have served any utilitarian purpose; human procurement of a mammoth calf for

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consumption offers the most probable explanation for their presence at the Swan Point Formation, and other Owl Rock equivalent strata. Our new date is the only direct dates on detrital zircons from the same locality and lithological unit as the pterosaur fossils constrain the channel system by an unusual influx of volcaniclastic sediments. U-Pb dates on detrital bones in the clastic sediments vary from pristine to highly abraded, suggesting variable temporal correlations among other basal pterosaur occurrences.

We report the first basal, non-pterydactyloid pterosaur with a multicuspid dentition from the Owl Rock Member of the Chinle Formation (Upper Triassic, late Norian, Arizona). A left dentary with 11 triangular teeth bearing three to seven cusps each as well as isolated teeth and limb elements have been recovered by laboratory micro-preparation of conglomeratic matrix from the "White Channel Complex" (WCC), a discontinuous fossiliferous sedimentary deposit up to 3 meters thick that occurs over an area of several square kilometers in the Petrified Forest National Park. This deposit consists of stratified sandstones and intraformational conglomerates that represent the partial filling of a channel system by an unusual influx of volaniclastic sediments. U-Pb dates on detrital zircons from the same locality and lithological unit as the pterosaur fossils constrain the age of deposition. The late Norian date falls within the Sevastian European marine stage assigned to the Seefelder Schichten (Seefeld Beds), Tyrol, Austria, in which Austracidactylus cristatus occurs. Longitudinal enamel surface striations seen in posterior adult dentitions of Eudimorphodon ranizzi and Caviramus schaeplianensis are absent from the teeth of the Owl Rock pterosaur. Extensive apical wear is present on most posterior teeth, suggesting that the food processing type of other pterosaurs with heterodont dentitions from the Late Triassic. Additional material from the same locality includes abundant and well-preserved skeletal and dental elements of pterosaurs, fish, amphibians, theropod dinosaurs, and the archosaur Reusosaurus. The teeth and small bones in the clastic sediments vary from pristine to highly abraded, suggesting variable degrees of time-averaging within the channel system. Ecological traits of the co-occuring taxa indicate that skeletal remains were derived from both terrestrial and aquatic habitats associated with the channel ecosystem. Pterosaur fossils, other than putative isolated teeth, are rare in Upper Triassic deposits of western Pangaea. The dentary from the Petrified Forest provides a reference for identifying isolated multicuspid teeth previously assigned to Pterosaurus from the Church Rock Member, Bull Canyon Formation, and other Owl Rock equivalent strata. Our new date is the only direct radiometric date for any Upper Triassic pterosaur locality, and in combination with the long sequence of calibrated biostratigraphic range data from the Park will facilitate temporal correlations among other basal pterosaur occurrences.

PHYLOGENETIC VERSUS SERIAL VARIATION IN THE ORNITHISCHIAN DINOSAUR AXIAL SKELETON: A GEOMETRIC MORPHOMETRIC STUDY

WHITE, Dominic, The George Washington University, Washington, DC, United States, 20052

The axial skeleton is under represented in character matrices of dinosaurs, partly due to a lack of consistent, invariant characters, and partly to a general lack of study of its anatomy. Where included, axial characters are often coded for a region of the axial skeleton with little morphological variation as relatively invariant. These approaches may omit or mask potential evolutionary signal in the data. Serial and interspecific morphological variation in ornithischian dorsal vertebrae were quantitatively captured using 2-dimensional landmark morphometrics. Principal components analysis suggests that dorsal vertebral morphology is partially related to posture. Basal members of Thyreophora, Ceratopsia and Ornithopoda are morphologically similar but later taxa diversify to occupy a larger morphospace as they become larger and quadrupedal. Phylogenetic permutations of the morphometric variables on a stratigraphically calibrated tree show that significant phylogenetic signal is also present in vertebral shape. The results suggest that significant phylogenetic information is being missed from the axial skeleton and morphometric characters may be able to capture this information where discriminative power was previously overlooked.

However, comparisons of morphospace occupation by the dorsal series of different taxa show that the morphological variation within the dorsal series of a taxon is large compared to the variation between taxa. This suggests that coding a character for a region of the axial skeleton, such as the dorsal series, may introduce significant error into axial characters especially if an axial skeleton is incomplete and its full range of variation is unknown. Based on these results, more axial characters should be included in dinosaur phylogenies and they should be coded at a finer scale than in previous studies.

LATE EOCENE FOSSIL ALLIGATORS FROM NEBRASKA AND THEIR IMPLICATIONS FOR THE BIOGEOGRAPHIC ORIGIN OF ALLIGATOR

WHITING, Evan, Florida Museum of Natural History, Gainesville, FL, United States, 32611; HASTINGS, Alexander, Georgia Southern University, Statesboro, GA, United States

The first fossil alligators from the White River Badlands of South Dakota were collected over a century ago. Subsequent research has shown that all identifiable fossils represent the most basal and oldest occurring Alligator species, A. prenasalis, which occupied this area of South Dakota during the late Eocene and early Oligocene. Late Eocene Alligator records outside this region are sparse, questionable, and provide little clear understanding of the true biogeographic extent of A. prenasalis or the evolution of the genus. A new specimen collected from the late Eocene Chadron Formation of Sioux County, Nebraska offers a clearer picture of the historical biogeography of A. prenasalis during the late Eocene. Though incomplete, several morphological characters diagnosing this species are present, including splenial participation in a mandibular symphysis extending beyond the sixth dentary alveolus, a flat orbital region, and a lack of frontal or prefrontal ornamentation. The anteriormost premaxillae and supracapitall are missing, which display the most important diagnostic characters for this species within Alligator. Due to the lack of these diagnostic features and a lingual foramen expressing the basal alligator condition, a cladistic analysis of 28 alligator taxa (using published datasets of all taxa that entered as its own taxon), coded for 181 morphological characters, was run to test the phylogenetic affinities of the Nebraska specimen. This cladistic analysis resulted in 2,802 equally most parsimonious cladograms. The strict consensus of this analysis recovered the specimen near the base of Alligator along with previously coded A. prenasalis, providing support for its assignment to this species. Three additional fragmentary specimens from Nebraska further support this region as having been inhabited by A. prenasalis, in addition to the South Dakota locality. These discoveries expand the known late Eocene geographic range of this species into the White River Badlands of Sioux County, Nebraska, suggesting that the biogeographic origin of Alligator was not as restricted as previously thought. This newly expanded late Eocene distribution contrasts with the poor early Oligocene record limited solely to South Dakota, which could constitute a geographic range contraction for this species across the Eocene-Oligocene transition. Fossil alligators from this major cooling interval provide insights into the history of temperature tolerance within Alligator, which is known to exist in cooler climates today than any other extant crocodylian genus.
The sauropod Rebbachisaurus garasbae is the earliest-known representative of the family Rebbachisauridae and is known from infra-upper Cenomanian (Puercan) of New Mexico include a specimen with remarkably complete cranial and postcranial elements. These specimens allow for an updated anatomical description of this unusual taxon, supply new data for phylogenetic analyses, and enable a more constrained interpretation of the morphological trajectory in each lineage. In teleosaurids, the humerus becomes reduced and the radius and ulna become elongated. In metriorhynchids, the humerus becomes greatly reduced and dorsally flattened. This, in combination with flattening of more distal elements into polygonal plates, forms a robust paddle. Given the earliest appearing teleosaurid, Elasmosaurus, and the earliest appearing metriorhynchid, Petrolacosaurus, it seems likely that we are missing some key transitional fossils from the early history of the group. In spite of this, the phylogeny presented here allows us to begin piecing together the morphological transformations that allowed these remarkable organisms to fully invade the marine realm.

Technical Session IX (Friday, November 1, 2013, 11:45 AM)

OSTEEOLOGY OF REBBACHISAUROIDEA (SAUROPODA) FROM THE EARLY LATE CRETACEOUS KEM KEM BEDS OF SOUTHERN MOROCCO

WILSON, Jeffrey, University of Michigan, Ann Arbor, MI, United States, 48109-1079; ALLAN, Ronan, Museum National D'Histoire Naturelle, Paris, France

The sauropod Rebbachisaurus garasbae was discovered in the Upper Cenomanian horizons of the Kem Kem region of southeastern Morocco in the 1950s. Original materials included part of a vertebral column, some of which was found in articulation, a scapula, humerus, and ischium. Of these remains, only the scapula and dorsal vertebrae have been described in abbreviated form. Fortunately, these elements were diagnostic and furnished characters that would later be shown to distinguish a lineage of late-surviving diplodocoid sauropods. Due to the large size of one of its dorsal vertebrae (ca. 1.45 m tall), Rebbachisaurus has been considered to be among the largest sauropods. Following complete preparation of the partial skeleton, careful examination and fitting of scores of fragments collected with these materials, and Computed Tomography

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

CHEWING THE FAT WITH ARCTODUS: COLLABORATIVE UNDERGRADUATE DEVELOPMENT OF A CALIBRATE APPARATUS FOR USE IN BITE FORCE RESEARCH

WILKINS, William, The Mammoth Site of Hot Springs, SD, Inc., Hot Springs, SD, United States, 57747; PAGNAC, Darrin, South Dakota School of Mines & Technology, Rapid City, SD, United States; ELLINGSEN, Marius, South Dakota School of Mines & Technology, Rapid City, SD, United States; WILHAMS, John, The Mammoth Site, Rapid City, SD, United States

The Mammoth Site, a world-renowned paleontology site in Hot Springs, SD, contains Mammothus columbi, Mammuthus primigenius and several other late Pleistocene fossils. A mammoth rib (39HS037) bears damage consistent with canine tooth marks likely from a modern Arctodus. Student research staff, in collaboration with faculty and students from the Mechanical Engineering (ME) and Geology and Geological Engineering (GGE) departments at South Dakota School of Mines and Technology, designed and built a machine that could replicate these puncture marks in Recent bone and measure the associated force.

Technical Session XII (Friday, November 1, 2013, 2:30 PM)

A DESCRIPTION OF PEIPHSUCUS TELEORHINUS (CROCODYLOMORPHA: THALATTOSUCHIA) AND ITS IMPLICATIONS FOR THE ORIGIN OF TELEOSAURIDS AND THE EVOLUTION OF MARINE ADAPTATIONS IN THALATTOSUCHIA

WILBERG, Eric, University of Northern Iowa, Cedar Falls, IA, United States, 50614

Teleosaurids are the most highly marine-adapted archosaurs, yet the pattern of acquisition of marine specializations remains poorly understood. This is, in part, due to a lack of well-preserved fossil material from the early history of the group. Here I describe the morphology of Peiphsuchus teleorhinus from the Early Jurassic of China, one of the earliest occurring teleosaurids and one of the few specimens from outside Europe. Interpretation of the morphology shows that P. teleorhinus already possesses the cranial specializations characteristic of teleosaurids. Contrary to previous reports, the postorbital does contribute to the orbital margin and broadly overlaps the jugal on the postorbital bar as in other thalattosuchians. The enlarged external carotid foramina are ventrally positioned, lying along the dorsolateral margins of the basioccipital tabula and not visible in occipital view. The premaxillae of P. teleorhinus are greatly expanded mediolaterally as in Steneosaurus megahirsus, but differ from those of all other teleosaurids. Despite being the oldest known teleosaurid, phylogenetic analysis recovers P. teleorhinus nested well within Telosaurusidae, not in a basal position. The recovery of the only known Asian teleosaurid within a larger European clade suggests that the group originated in the western Tethys and the appearance of P. teleorhinus in Asia is the result of dispersal. Optimization of character state changes onto the tree demonstrates that while both teleosaurids and metriorhynchids show reduction in the size of the forelimb elements, this transformation occurred independently and followed a different morphological trajectory in each lineage. In teleosaurids, the humerus becomes reduced by shortening the proximal portion, moving the deltopectoral crest nearly to the proximal articulation of the humerus. In metriorhynchids, the humerus becomes greatly reduced and dorsoventrally flattened. This, in combination with flattening of more distal elements into polygonal plates, forms a robust paddle. Given the earliest appearing thalattosuchian, Ankylosaurus magniventris, of North America lack a good modern analog, with the forelimb seemingly specialized towards a more arboreal lifestyle like arboreal sciurids, while the pes suggests behaviors similar to rodents with dominantly terrestrial locomotion.
emergence of the most complete vertebrae, we present a complete description of the holotype of *Rebbachisaurus garasabai*. Our description identifies several autapomorphies of the dorsal and caudal vertebrae, both relating to the shape of the vertebrae and the architecture of their vertebral laminae. No autapomorphies were identified in the available appendicular bones, but they provide features that are diagnostic of higher-level relationships. Based on this reassessment of the anatomy of *Rebbachisaurus*, we evaluated its phylogenetic position among diplodocoids using character data from previous analyses. Preliminary results place *Rebbachisaurus* just outside Lamiasaurinae + Nigerasaurinae.

More complete preparation and fitting of pieces provides a clearer picture of the size and proportions of *Rebbachisaurus*. Although the height of its most complete dorsal vertebrae rivals those of the largest sauropod, *Argentinosaurus*, the size of the vertebral centra and the length and cross-sectional area of the humeri of *Rebbachisaurus* are considerably smaller. We estimate that this *Rebbachisaurus* individual was 7915 – 015 kg, which is slightly larger than *Amargasaurus* but comparable in size to some individuals of *Dicraeosaurus*. The dorsal vertebrae of *Rebbachisaurus* and other individuals of *Dicraeosaurus* have been reported to be somewhat elongate, having slender pedicles, confluent zygapophyses, lack of hyposthenus hypapophysese and articulars, and flat central articulations. Our results suggest that these features actually limited rotation, and these and other features suggest that rebbachisaurid vertebrae had increased resistance to dorsoventrally-directed forces applied to the transverse processes.

**UEN**

**EUROPAEUS**

**LANGENBERG**

**QUARRY**

**LOWER**

**NORSEY**

**NORTHERN**

**GERMANY**

**WINGS, Oliver, Niedersaechsisches Landesmuseum Hannover, Hannover, Germany; BERENSMEIER, Michaela, Universiteit Potsdam, Potsdam, Germany**

Dinosaur tracks are very common in sedimentary environments and even skeletal remains of many dinosaur taxa - including sauropods - have been found in marginal or deeper basinal marine strata. However, most of these allochthonous finds are isolated bones or skeletons from carcasses that drifted out to sea. The case of the dwarfed sauropod *Europaean* is different and has been recently described as belonging to the small rebbachisaurid *Rebbachisaurus* from the Late Jurassic Lower Langenberg Quarry near Oker, Germany, is unique, because its abundant and exquisite three-dimensionally preserved bones range from disarticulated elements to associated partial skeletons. The taphonomy of this site is still puzzling, because sedimentology and microfossils indicate clearly a shallow marine environment. Sections of timesteps (wackestone/packstones) from the Langenberg show a diverse marine invertebrate fauna: bivalve and thin-walled gastropods, ostracodes, brachiopods, echinoderms, planktonic foraminifers. The flange may have served as an enlarged attachment site for the anterior cheek teeth. A concentration of shearing function on the latter tooth position is in the M3. As this tooth erupts last, it compensates the loss of function in heavily worn M2. That less dispersion in enamel ridge alignment increases functional focussing on shearing in the M3. As this tooth erupts last, it compensates the loss of function in heavily worn anterior cheek teeth. A concentration of shearing function on the latter tooth position is functional in the development of the posterior end of the dentition. Since the phenomenon seems to be universal to boids and equids, it indicates a high degree of dental functional compensation independent of digestive physiology.

**Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)**

**ENAMEL RIDGE ALIGNMENT IN UNGULATES: A CUT ABOVE**

**WINKLER, Daniela Eileen, Biocenter Grindel & Zoological Museum, Hamburg, Germany**

Dentitions of herbivorous mammals are highly specialized food disintegration systems. Over a variety of taxa, analogous adaptations have occurred in tooth crown height (from brachydont to hypsodont) and enamel ridge configuration (from short and simple to long and complex). It has been shown that browsing animals have less enamel ridge perimeters, more complex enamel ridges with wider dentin crushing basins, while grazing species have fewer differences between individual tooth positions, with the exception of P2 and M3. This is due to the high degree of molarization in the premolars in equids. I hypothesize that less dispersion in enamel ridge alignment increases functional focussing on shearing in the M3. As this tooth erupts last, it compensates the loss of function in heavily worn anterior cheek teeth. A concentration of shearing function on the latter tooth position is functional in the development of the posterior end of the dentition. Since the phenomenon seems to be universal to boids and equids, it indicates a high degree of dental functional compensation independent of digestive physiology.

**Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)**

**DENTAL MECHANICS OF THE SMALLEST DIPLODOCOID: EVIDENCE FROM A NEW FOSSIL DUGONG FROM THE PANAMA CANAL**

**WOOD, Aaron, University of Florida, Gainesville, FL, United States; VELEZ-JUARBE, Jorge, University of Florida, Gainesville, FL, United States; BOURQUE, Jason, University of Florida, Gainesville, FL, United States; BLOCCHI, Jonathan, University of Florida, Gainesville, FL, United States; JARAMILLO, Carlos, Smithsonian Tropical Research Institute, Panama, Panama**

*Species of the genus Dugong* from the late Oligocene – late Miocene of the East Pacific, Caribbean, and West Atlantic are distant from other duguonids from these regions in possessing large, lozenge-shaped tasks interpreted as advantageous for foraging on thick seagrass rhizomes. A partial skeleton of a fossil dugong attributable to *Diplotherium* was recently discovered in the lower Culebra Formation (latest Aquitanian – earliest Burdigalian) exposed along the Panama Canal. This specimen, consisting of a skull and cervical – posterior thoracic vertebrae, exhibits characters distinguishing it from its two best-known congeners: *D. managuensis* from eastern North America and a Brazilian *Diplotherium* referred to *D. allisoni*. The type specimen possesses functional traits that indicate a different feeding strategy than the roughly contemporaneous Brazilian *Diplotherium*. The traits include less rostral deflection, broad maxillary projections into the palatal keratinous pad attachment site, prominent temporal crests on the parietal, and a posteriorly-directed flange above the supracranial fossa of the exoccipitals. The flange may have served as an enlarged attachment site for atlanto-occipital ligaments. Similarly, the attachment sites for the max. caps is on the dorsal arch of the atlas vertebrae are more robust and project dorsally to a greater degree. Great within the *D. allisoni* region, the adaptive morphology of the Brazilian *Diplotherium* with maintaining a horizontal position in the water column, suggesting that the Brazilian *Diplotherium* specimen may have been more specialized for this feeding strategy than the Panamanian specimen. However, the enlarged ligament and muscle attachment sites associated with the atlanto-occipital joint in the Panamanian specimen indicates habitual downward motion of the head, permitting bottom feeding without compromising an overall horizontal posture. The Panamanian *Diplotherium* likely had a different feeding strategy than its congeners; its functional traits are more consistent with piti-making behavior expected in species that experience rare bottom feeding episodes along with other rostral deflection. Such remarkable differences in inferred feeding strategy among congeners support previous hypotheses that competition for seagrass resources is the major driver of morphological diversity in fossil sirenians.

**Symposium I (Wednesday, October 30, 2013, 11:00 AM)**

**CHANGES IN VERTEBRAL MORPHOLOGY ASSOCIATED WITH HISTOLGIC DATA SUPPORT SIGNIFICANT CHANGE THROUGH ONTOGENY IN DIPLODOCID SAUROPODS**

**WOODRUFF, Cary, Museum of the Rockies & Montana State University, Bozeman, MT, United States, 59717; FOWLER, Denver, Museum of the Rockies & Montana State University, Bozeman, MT, United States; HORN, John, Museum of the Rockies & Montana State University, Bozeman, MT, United States**

It is difficult to determine maturity in sauropod dinosaurs because Lines of Arrested Growth (LAGs) are destroyed or obscured due to rapid secondary remodeling. Although a complementary system has been devised utilizing relative amounts of remodeling (Histologic Ontogenetic Stage [HOS]; youngest HOS = 1, oldest =13) most assessments of sauropod maturity are based on osteological features such as skeletal fusion. To better assess indications of maturity, and to test recent assertions about ontogenetic change of gross skeletal features, we measured material from over twenty small individuals of Diplodocidae (up to two-thirds the size of Diplodocus carnegii [Carnegie Museum of Natural History specimen CM 84] and *Apatosaurus loutaei* [CM 3018]) from the Morrison Formation. Along with macroscopic examination of cranial, vertebral, and limb elements, in select specimens we also examined pneumatic structures via computed axial tomography and histological sections. We found that ontogenetic changes in cranial shape and the distribution of pneumatic structures is consistent with ontogenetic change of vertebrae morphology, which, combined with histology, can be used to ascertain maturity. The fifteen small Diplodocids (approximately one-third size) from the Mother’s Day Quarry (MDQ) display non- to weakly bifurcated cervical and dorsal ribs. In large Diplodocids, cervical and thoracic rib microstructure identical to juvenile hadrosaur ossified tendons, and two to six preserved LAGs in thoracic ribs. Individuals larger than the MDQ specimens (approximately two-thirds size) have more developed internal pneumatic structures, greater neural spine bifurcation, preserve up to eight preserved LAGs in cervical and thoracic ribs. We found that ontogenetic changes in cranial shape and the distribution of pneumatic structures is consistent with ontogenetic change of vertebrae morphology, which, combined with histology, can be used to ascertain maturity. The fifteen small Diplodocids (approximately one-third size) from the Mother’s Day Quarry (MDQ) display non- to weakly bifurcated cervical and dorsal ribs. In large Diplodocids, cervical and thoracic rib microstructure identical to juvenile hadrosaur ossified tendons, and two to six preserved LAGs in thoracic ribs. Individuals larger than the MDQ specimens (approximately two-thirds size) have more developed internal pneumatic structures, greater neural spine bifurcation, preserve up to eight preserved LAGs in cervical and thoracic ribs. We found that
erecting new taxa on the basis of small-bodied holotypes should be approached with caution.

Poster Session I (Wednesday, October 30, 2013, 4:15 - 6:15 PM)

SUPERTREE PERSPECTIVES ON THE PHYLOGENY OF FOSSIL AND EXTANT MAMMALS

WOODRUFF, Emily, University of Florida, Gainesville, FL, United States; 32611; BURKE, John, University of Florida, Gainesville, FL, United States; BLOCH, Jonathan, Florida Museum of Natural History, Gainesville, FL, United States.

Large-scale phylogenetic studies have elucidated the relationships of extant mammals but the evolutionary placement of many fossil taxa within this tree is less clear. Combining extant and fossil taxa is particularly challenging given the difficulty of analyzing molecular and morphological data simultaneously. Additionally, phylogenetic studies that focus on fossil mammals are generally limited in taxonomic scope. Supertree methods provide one approach to combining disparate data from different studies to map the evolutionary relationships of all major clades of fossil and extant mammals using supertree methods. We investigate the evolutionary relationships of 580 representative taxa from all major mammalian clades including fossil and extant mammals using the matrix representation with parsimony (MRP) and the Robinson-Foulds (RF) supertree methods. MRP is the most widely used supertree method, but RF is a new method that directly seeks the supertree that includes the most clades found in the input trees. We compare the performance of MRP and RF methods and assess criteria for selecting source trees, re-analysis of source trees, and taxon overlap between different data sets. The supertrees presented here reveal a framework with which many other evolutionary questions may be addressed, in particular, documenting large-scale patterns of morphological change.

Poster Session IV (Saturday, November 2, 2013, 4:15 - 6:15 PM)

MORPHOLOGICAL DIVERSITY AND PHYLOGENY OF THE 'TURTLE-LookING' SAUROSPHARGIDAE

WU, Xiao-chun, Canadian Museum of Nature, Ottawa, ON, Canada; KIP 64; LI, Chun, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; WANG, Da-yong, Peking University, Beijing, China; CHENG, Long, Wuhan Institute of Geology and Mineral Resources, Wuhan, China; RIEPPEL, Olivier, Field Museum of Natural History, Chicago, IL, United States.

Sauropaphagidae was a newly established group of the Triassic marine reptiles in 2011 although it was not defined then. The type species, Sauropaphagus volzi from the Lower Muschelkalk (Anisian, Middle Triassic) of Poland, was based on a fragment of the trunk which was first mentioned by Huene in 1902. The nearly rounded body with an enclosed rib-basket under a fully developed dermal armor was not known for the group prior to the discovery of Sauropaphagus yunguensis from the Middle Triassic of China in 2011. As for phylogenetic position, Sauropaphagids are generally thought to be closely related to placodonts and later to Helveticosaurus. With the discovery of Sauropaphagus yunguensis, a thalattosaurian affinity of Sauropaphagidae was proposed in 2011. Here we report a new sauropaphagid with two species. It represents the new morphotype of the group given an elongate body with a completely developed dermal armor to cover the rib-basket. In addition, the new form retained a moderately developed supratemporal fenestra and reveals the presence of a suborbital fenestra and a large supratemporal bone. With additional information from the new form, Sauropaphagidae can be well diagnosed by a set of characters, such as dorsal ribs forming a closed basket, presence of dorsal osteoderms, external nares retracted and much closer to orbit than rostral tip, presence of interpterygoid vacuity and open braincase-palatal articulation, lateral most elements of gastralia ribs broadened to contact each other, long supratemporal crest, large interclavicle, large pectoral girdle, long narrow trunk, jugal contact squamosal, leaf-shaped tooth crown with convex labial surface and concave lingual surface, dorsal vertebrae with elongate transverse processes and a very low neural spines, large interclavicle boomerang-like or atypically "T"-shaped, nine carpals, and four tarsals. The discovery of the new form also added further data for phylogenetic analysis; our study suggests a sister-group relationship to Sauropterygia rather than to Thalattosaurus.

THE LOWER JURASSIC ACTINOPTERYGIAN PACHYCHORUS BOLLENSES: IMPLICATIONS FOR PACIFIC CORRIDORS OF PALEONTOLOGY AND PALEOBIOGEOGRAPHY

WRETMAN, Lovisa, Uppsala University, Uppsala, Sweden; BLOM, Henning, Uppsala University, Uppsala, Sweden; KEAR, Benjamin, Uppsala University, Uppsala, Sweden.

Pachychoerus were a group of Mesozoic stem-telescope fishes that first diversified in the Early Jurassic (Sinemurian-Toarcian) and declined towards the end of the Cretaceous (Campanian-Maastrichtian). Their monophyly has been robustly established on the basis of unique dermal traits, including circular pelvic fins, recurved pelvic fins, and a fused rostdermethmoid. Ecologically, however, pachychoerids appear to have radically diverged into parallel hyper-specialized radiations: pursuit carnivores characterized by massive blade-like teeth and an elongate 'sword-fish-like' snout; and colossal filter-feeders, which trend towards tooth loss and include some of the largest fishes of all time. The phylogenetic framework underlying this extremely divergent dichotomy was re-evaluated using parsimony and Bayesian methods, together with a comprehensive assessment of one of the most ancient (Toarcian, Early Jurassic) Pachychoerus-boreal fossils, from the famous Holzmaden deposits of Germany. The placement of Pachychoerus is critical to pachychoerid morphotype topology because it has been variously nested as a basal sister to either the carnivorous or filter-feeding ecomorph clades. Confoundingly, our rescued analyses failed to resolve this uncertainty and moreover, returned weak support for almost all ingroup clades within Pachychoerids. Nevertheless, a rationalization of Pachychoerus species-level diversity can be proposed, and a preliminary quantitative palaeobiogeographical hypothesis infers origin of the pachychoerid lineage within the Boreal Tethys followed by endemic speciation of carnivorous forms in epicontinental seaways and trans-oceanic dispersal of gigantic pelagic filter-feeders.

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HOMEOETIC TRANSFORMATION IN THE EVOLUTION OF THE THERIOPOD SEMILUNATE CARPAL

Poster Session III (Friday, November 1, 2013, 4:15 - 6:15 PM)

XU, Xing, Institute of Vertebrate Paleontology & Paleoanthropology, Beijing, China; ZHAO, Qi, Institute of Vertebrate Paleontology & Paleoanthropology, Beijing, China; HAN, Fenglu, Institute of Vertebrate Paleontology & Paleoanthropology, Beijing, China.

The 'semilunate' carpal, historically interpreted as an important structural link between non-avian and avian dinosaurs, is traditionally regarded based on palaeontological data as having been formed by fused distal carpal 2 and 3 in extinct maniraptorans including Archaeopteryx (we identify the three manual digits of tetratan theropods as II-III-IV). However, this interpretation is inconsistent with embryological data from extant maniraptorans (birds), in which the 'semilunate' element is partly formed by distal carpal 4.

Here we describe the wrist morphologies of some exceptionally well preserved non-avian maniraptoran specimens representing different ontogenetic stages. These rarely preserved sources of ontogenetic data from non-avian maniraptorans support the primary homology hypothesis that distal carpal 4 was involved in formation of the 'semilunate' carpal. Furthermore, the 'semilunate' shape shifts its position laterally along the proximal end of the hand and in tetratan evolution probably as a result of selection for foldable wings in birds and their close theropod relatives. We propose that homoeotic transformation was involved in the evolution of the 'semilunate' shape, as has been suggested for teturan manual digits.

EXTANT HYPSEOSODAL UNGULATES PROVIDE NEW INSIGHT ON MESOWEAR ANALYSIS FOR THE LATE MIOCENE UNGULATES FROM MARAGHEH, IRAN

YAMADA, Eisuke, Kagoshima University, Kagoshima, Japan; HASUMI, Eri, Kagoshima University, Kagoshima, Japan; MIYAZATO, Nao, Kagoshima University, Kagoshima, Japan; NAKAYA, Hideo, Kagoshima University, Kagoshima, Japan; WATABE, Mahito, Hayashibara Museum of Natural Science, Okayama, Japan.

We investigated the palaeoecology of fossil hypsodont equids and bovids from the late Miocene Maraghæ Formation, northwestern Iran. The excavation report of the animals from Maraghæ used in this study suggests that they were excavated from a single quarry and bed, indicating that they were sympatric. In fact, several extant plant-eating mammalian taxa exist sympatrically, which indicates dietary segregation. However, few studies have been made to show how results of mesowear analysis might clarify the dietary ecology of extinct camels and potential biotic factors influencing their distributions during the Pleistocene.

A NEW ANKYLOSAUR DINOSAUR FROM THE EARLY CRETACEOUS HEKOU GROUP OF LANZHOU-MINHIE BASIN, NORTH-CENTRAL CHINA

YANG, Jing-Tao, China University of Geosciences (Beijing), Beijing, China; YOU, Hai-Lu, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; LI, Da-Qing, Gansu Geological Museum, Lanzhou, China; KONG, De-Lai, Administration of Liujiaxia Dinosaur National Geopark, Yongjing, China.

New ankylosaurid dinosaur material was recovered from the Early Cretaceous Hekou Group in Lanzhou-Minghe Basin, north-central China. The material is housed at Gansu Dinosaur Museum (GSDM 00021) and represented by a proximal-mid caudal vertebra, three dorsal ribs, an almost complete left ilium, and several pieces of dermal armor including a partial sacral shield. GSDM 00021 possesses three autapomorphies: shape of neural spine, anterolateral (mid-caudal) vertebrae an inverted trapeziun, lateral edge of preacetabular process inverted 'S'-shape in dorsal view, and sacral shield composed of various-shaped and irregularly-arranged osteoderms. Cladistic analysis shows that GSDM 00021 is a polacanthid nodosaurid ankylosaur, and is the sister taxon of Polacanthus fossilis from the Late Cretaceous of Alberta, Canada. Polacanthus fossilis is the most inclusive clade containing Polacanthus fossil but not Ankylosaurus magniventris or Panoplosaurus mirus. GSDM 00021 represents the first occurrence of a polacanthine ankylosaur in Asia, and indicates again the existence of a rich and unique dinosaur assemblage in the Lower Cretaceous Hekou Group of Lanzhou-Minhe Basin.

POSTER SESSION II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

ESTIMATING BODY MASS OF FOSSIL PRIMATES: A COMPARISON OF DENTAL AND TARSALES VARIABLES

YAPUNICICH, Gabriel, Duke University, Durham, NC, United States; GLADMAM, Justin, The Graduate Center, CUNY, New York, NY, United States; BOYER, Doug, Duke University, Durham, NC, United States.

Body mass is a fundamental descriptor of an animal's ecology. For fossil species, reliable body mass estimates provide avenues for understanding an extinct species' ecological and behavioral profile. Since the last comprehensive analysis using tarsal elements for estimating primate body mass, there have been substantial increases in fossil species sampling, documentation of extinct primate body masses, and fossil tarsal measurement technology. All three factors expand the potential for accurate predictions. Here we present ordinary least squares regression equations for inferring fossil primate body mass from astragalus and calcaneal facets, two bones with good representation and secure taphonomic preservation through the primate fossil record. Unlike teeth, articular surfaces of weight-bearing joints transmit forces proportionally to body mass, and therefore offer great promise for predicting body mass.

Using surfaces generated from microCT data, the articular surface areas of five astragalus facets and two calcaneal facets were digitally measured in samples of 216 and 99 eutherians for each element respectively. Body masses of non-captive primate populations were taken from published sources, log-transformed and regressed against log-transformed facet areas. Separate regressions are presented for all primates, strepsirhines, and anthropoids. For all predicted body masses, bias introduced by log-transformation was corrected using a quasi-maximum likelihood estimator. For mean body mass estimates, we calculate geometric mean mass estimates (using correlation coefficient of each regression to weight respective estimates), while the maximum value of lower confidence intervals and minimum value of upper confidence intervals for all estimates provide a bounded range for each specimen. Estimates for species from sixteen fossil primate families, spanning Paromomyidae to Proconsulidae, are compared to previously published body masses derived from both dental and postcranial measures. Our results reveal consistent agreement between area-based predictions, while linear measures often generate non-overlapping ranges when comparing estimates derived from the same skeletal element. Additionally, values for the standard error of the estimation are lower than previous results, even within the 'all-primates' sample. Compared to published dental estimates, these important body mass estimates, the most inclusive clade containing Polacanthus fossil but not Ankylosaurus magniventris or Panoplosaurus mirus. GSDM 00021 represents the first occurrence of a polacanthine ankylosaur in Asia, and indicates again the existence of a rich and unique dinosaur assemblage in the Lower Cretaceous Hekou Group of Lanzhou-Minhe Basin.
More than 3000 living species of snakes share a limbless body plan, and are adapted to varying media including air (flying snakes), soil (burrowing snakes) and water (sea snakes). It is hotly debated whether snakes developed their specialized locomotion in a terrestrial or aquatic environment. This study examines the osteological structures (ossified inner ear) of recent and fossil snakes to test the hypotheses: 1) inner-ear morphology is indicative of snake locomotion styles including fossorial, surface active or aquatic; 2) the inner ear of Dinilysia patagonica, one of the oldest fossil snakes, suggests it to be a burrower. To test the hypotheses, 10 snake species and 9 lizard species are CT-scanned for inner ear morphology. Seven of the snake species are living, 13 are fossil specimens covering 6 major clades of snakes, and include both limbed and limbless lizard species for outgroup comparisons. The ossified inner ear is segmented and reconstructed three-dimensionally, including three semicircular canals (anterior, posterior, and lateral) and the vestibule that forms the vestibular (balance) apparatus of all vertebrates. The results show that distance between the lateral semicircular canal (SCC) and vestibule is indicative of locomotion in snakes. Among the three locomotion categories sampled, fossorial species show a highly reduced lateral SCC that is partly fused with the vestibule. In contrast, aquatic species, represented by several species of sea snakes, show an expanded distance between SCC, and all major clades of snakes, except pelomedusoid turtles, have a wider SCC than vestibule. Non-burrowing terrestrial snakes show an intermediate state where the lateral SCC does not fuse with the vestibule, but is not as expanded as in sea snakes. Results in extant species provides a context for comparison for the fossil snake Dinilysia patagonica. Recently published CT images of Dinilysia patagonica shows that its lateral SCC is slender and nearly fused to the vestibule, resembling the fossorial Asian sunbeam snakes (Xenopeltis unicolor). Our observations in extant snakes suggest that this resemblance is actually indicative of a burrowing behavior. Since Dinilysia patagonica is a terrestrial snake recovered phylogenetically near the root of all snakes, its inner ear provides evidence for burrowing behavior for early snakes.

Poster Session II (Thursday, October 31, 2013, 4:15 - 6:15 PM)

NEW SAUROPOD FROM THE CEDAR MOUNTAIN FORMATION OF UTAH, USA

YOSHIDA, Junki, Hokkaido University, sapporo, Japan; CARPENTER, Kenneth, Utah State University Eastern, Price, UT, United States; KOBAYASHI, Yoshitsugu, Hokkaido University, Sapporo, Japan

The Early Cretaceous Cedar Mountain Formation is known as one of the richest dinosaur bearing formations of the time in North America, and produces the greatest diversity of Early Cretaceous sauropods in North America. Postcranial skeletons of a possibly new sauropod dinosaur were discovered from the base of the early Albian.A new sauropod discovered from the base of the early Albian.

Technical Session IX (Friday, November 1, 2013, 8:30 AM)

A NEW COELEPHYSIODONT THEROPOD DINOSAUR FROM THE EARLY JURASSIC LUFENG FORMATION OF YUNNAN PROVINCE, CHINA

YOU, Hai-Lu, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; AZUMA, Yoichi, Fukui Prefectural University, Japan; YOU, Hai-Lu, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; ZHANG, Xin, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; ZHANG, Xin, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China

Coelephysis dinosaurs are small- to medium-sized agile bipedal meat-eaters that lived throughout much of Pangaea during Late Triassic–Early Jurassic time. They are among the earliest well-documented carnivores and had the first major radiation of neotheropods. A recent study indicated that late Norian-Rhaetian theropod assemblages were dominated by basal coelophysoids, whereas Early Jurassic ones were composed of derived coelophysoids (i.e., the ‘Synarosa’ + Coelophysis clade), dilophosauroids and basal averrisci. However, despite the well-documented discoveries of derived coelophysoids in North America and Africa, the coelophysoid material that has previously been reported from Asia is limited to two specimens comprising only limb fragments and perhaps belonging to one individual. Here we report a new coelophysoid based on a partial, almost complete, undisturbed skeleton from the same rock unit, the Lower Jurassic Lufeng Formation of Yunnan Province, China, that yielded both previously reported specimens. The new specimen, Bureau of Land and Resources of Lufeng County (LFGZ) ZLJ0103, is represented by an articulated partial skeleton that includes the cranium, the presacral vertebral column, part of the rib cage, the right scapula and partial right forelimb, part of the pelvic girdle and parts of both hind limbs, the right hind limb being almost complete. It is distinguished from other coelophysoid theropods by the unique combination of the four synapomorphies of Coelophysis. A reassessment of the monophyly of Carnivoriformes (Mammalia)

ZACK, Shawn, University of Arizona College of Medicine-Phoenix, Phoenix, AZ, United States, 85004

Carnivoriformes, including crown group Carnivora and the Paleocene-Eocene families Machairodontinae and Viverravidae, is widely acknowledged to be monophyletic and has historically been characterized by a suite of dental synapomorphies. Most notably, restriction of carnassial shear to the P4/m1 pair is widely recognized as a distinctive feature that distinguishes carnivoriforms from other carnivorous eutherians, including the likely non-monophyletic order Creodont. Previous tests of carnivoriform monophyly have been limited and carnivoriform monophyly has never been tested relative to Oxyaenidae. To remedy this, oxyaenid and additional hyaenodontids, as well as several early members of Miacidae and Viverravidae, were added to a modified version of an existing phylogenetic analysis of carnivoriform phylogeny. Neither Creodont nor Carnivoriformes was found to be monophyletic. Oxyaenidae was identified as the sister taxon to Carnivoriformes (Miacidae plus Carnivora), followed by members of Hyaenodontidae. Viverravidae was basal to all members of the ingroup. Three lines of evidence are consistent with non-monophyly of Carnivoriformes. First, some features thought to be synapomorphic for Carnivoriformes are more broadly distributed among early carnivorous eutherians. These include a mesial P4 protocone, which also occurs in basal carnivores such as Protorhyassosaurus, and a high cranial size, which also occurs in palatecinine and probably tytthacine oxyaenids. Second, restriction of carnassial shear to the P4/m1 pair appears to be convergent between viverravids and miacids, as basal members of both families retain a functional M1/m2 carnassial pair (e.g., Simpsonontos, Gracilocrac). Finally, postcranial anatomy supports monophyly of Oxyaenidae plus Carnivoriformes. Early members of Oxyaenidae and Miacidae show adaptations to relatively mobile diets, consistent with arboreality or scavornality. Numerous features of the humerus and tarsus link oxyaenids to miacids to the exclusion of the more terrestrial adapted hyaenodontids and viverravids.
SIGMODYONTINE RODENTS FROM THE LATE PLEISTOCENE OF THE
TALARA TAR SEEPS (NORTHWESTERN PERU) - SYSTEMATICS,
PÄLEONTOLOGICAL INFERENCE, AND PRELIMINARY
TAPHONOMIC STUDY

ZAPATA, John Percy, Instituto de Paleontología, Universidad Nacional de Piura, Piura, Peru; MARTINEZ, Jean-Noël, Instituto de Paleontología, Universidad Nacional de Piura, Piura, Peru; RINCON, Ascacio, Instituto Venezolano de Investigaciones Científicas (IVIC), Caracas, Venezuela

Since the excavations made at the late Pleistocene Talara Tar Seeps (Piura Region, northwestern Peru) in 1958 by Gordon Edmund of the Royal Ontario Museum, only three genera of rodents have been mentioned for the fauna, but without identification to species: a hydrochoerid (Neochoerus) and two sigmodontines (Phyllotis and Sigmodon). Between 2003 and 2011, occasional excavations at this site by the Paleontological Institute at the National University of Piura, allowed us to collect 62 samples of sigmodontine rodents, representing a minimum number of 12 individuals. They are assigned to two species: Thomasomys sp. (seven individuals) and Phyllotis cf. P. amicus (five individuals). While the occurrence of Phyllotis amicus does not indicate a marked difference between the present environmental conditions and those of the late Pleistocene in the region of Talara, the presence of Thomasomys is more surprising as all extant species of this genus are known from higher and wetter habitats and the closest modern record of the genus is located more than 200 kilometers east of Talara. However, the Talara Tar Seeps are not the only Pleistocene lowland locality where Thomasomys is known, as we have also identified it from Pampa de los Fósiles (La Libertad Region, northern Peruvian coast, about 450 kilometers southeast of Talara) and it has also been reported from Inciarte (Maracaibo Region, Venezuela), another lowland site. The presence of Thomasomys in the Talara Tar Seeps supports the hypothesis based on previous studies for the presence of a wooded savanna environment with a climate more humid than today, possibly with annual rainy seasons during the late Pleistocene. A preliminary taphonomic study of this tooth and bone material, applying the systematic-descriptive method proposed by Peter Andrews in 1990, indicates two types of digestive marks: weak on molars and moderate on incisors and post-cranial elements. The observed digestive marks are indicative of different types of predators: birds of prey such as the short-eared owl (Asio flammeus), the burrowing owl (Athene cunicularia), and the peregrine falcon (Falco peregrinus), as well as small carnivores like the skunks (Conepatus sp.), the Sechuran fox (Lycalopex sechurae), or even opossums (Didelphidae).

INTRASKELETAL HISTOVARIABILITY DURING PSITTACOSAURUS MONGOLIENSIS ONTOGENY

ZORIGT, Badamkhatan, Museum of the Rockies, Montana State University, Bozeman, MT, United States; HORNER, John, Museum of the Rockies, Montana State University, Bozeman, MT, United States

Bone histology is an important analytical tool for calculating age and growth rate of dinosaurs. Previous studies have evaluated age by histologically sampling elements such as ribs, ulnae, radii, humeri, scapulae, metatarsals, tibiae, femora, and fibulae. The tibia, femur, and fibula are typically preferred for histologic analysis as they are believed to have the highest potential to preserve most of the lines of arrested growth (LAGs) due to their low degree of remodeling. However, it is unknown how much histological variation may exist among the femur, tibia, and fibula due to differences in function and growth. Here we assess the variability and usefulness of the femur, tibia, and fibula for histologic analysis. We examined eleven individuals of Psittacosaurus mongoliensis (Ornithischia: Ceratopsia; Lower Cretaceous Khulsangol Formation, Mongolia) representing variable ontogenetic states (7 juvenile; 4 sub-adult). From each specimen we histologically sampled a femur, tibia, and fibula, comparing changes in tissue type (reticular, plexiform, laminar, and radial), vascularization, and LAGs. Within the cortical bone, the transition from one tissue type to another is similarly gradual in both the femur and tibia, but abrupt in the fibula. In young individuals (typically 4 or fewer LAGs), LAG counts for fibulae are similar to those of the femora and tibiae. However in older individuals, the femora and tibiae present the same age (4-6 LAGs), whereas the fibulae exhibit extreme variability (1-8 LAGs). This demonstrates that the tibiae and femora shared a similar growth pattern that was different from that of the fibula. These microstructural variations could be the result of differences in weight bearing function or genetic causes. Consequently, use of fibulae for histologic analysis could lead to possible misinterpretation of P. mongoliensis growth. A similar issue has been encountered in the hadrosaur Hypacrosaurus, implying that this problem may exist across Dinosauria. Therefore we suggest that fibulae should not be used for age assessment, and also suggest caution in interpreting histological evidence based on elements other than the femur and tibia.
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• Registration
• Merchandise Sales
• Student Raffle
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