2018 Preparators' Poster Session Abstracts

HISTOLOGICAL SAMPLING OF YPM 1831, THE HOLOTYPE OF TOROSAURUS "GLADIUS": FOSTERING PALEONTOLOGICAL DISCOVERIES THROUGH MUSEUM/RESEARCHER COLLABORATIONS

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Upon receiving a request for histological sampling of one of the initial specimens of *Torosaurus* described by Marsh, the Yale Peabody Museum (YPM) began collaboration with Museum of the Rockies (MOR) to further this research. MOR, following YPM's Destructive Sampling Guidelines, provided scientific rationale and a description of proposed alterations to the specimen. The request was reviewed and accepted by YPM Vertebrate Paleontology curators and collections staff, and required recording images of the process (extraction, molding, casting, restoration, thin-sectioning), as well as documenting all materials applied.

YPM 1831 was originally prepared in the 19th century, covered with a layer of plaster and paint, and repaired at a later date, making separating the sample to be sectioned an adventure. The segment to be removed was coated with Butvar B-76 @ 10% w/w in acetone. A plaster-bandage cradle was made to ensure accurate replacement of the cast. Attempting to remove the tip of the horn by forcing an existing crack caused an unplanned break. This revealed the bone was not in-filled and that there was hidden plaster reconstruction. PB002 Penetrant Stabilizer (cyanoacrylate) was used to harden the porous bone, as other adhesives would be too soft, would not penetrate as well, and could interfere with histological processing. The sample was finally removed using a Fein Multi-Master tool and a Sawzall with a diamond blade. Molding and casting took place at YPM using Mold Max 20 Silicone and Mold Max Thi-Vex Thixotropic additive (tin cure), with Polytek Liquid Plastic EasyFlo 90 for casting.

Thin-sectioning was done at MOR according to standard procedures, with adaptations for large specimens. Multiple applications of PB002 were used for stabilization throughout the process. Acrylic paint dots were applied while the segment was intact to mark cut locations and anatomical orientation before being further divided. Vacuuming time was increased for the polyester-resin embedding by decreasing the percentage of catalyst (MEKP) from 1% to 0.7%. Embedding was done in layers to improve resin infiltration. Large-format glass slides were cut from 2.2mm thick single-strength glass (SSB) at a size of 75x100 mm. Cut slides were frosted in a micro-blaster using 50 µm aluminum oxide to improve adhesion of the embedded-bone wafer. Thin-sections were ground to 175 µm on a lapidary grinder and were then ready for examination.

This case study illustrates how collaborative efforts between museums can benefit paleontology by fostering new research and discovery.

PROJECT OREODONT: TRAINING VOLUNTEERS TO PREPARE AN HISTORIC BACKLOG

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Nebraska is famously known, or more accurately, infamously known, for the Schultz and Falkenbach Oreodont Volumes. Before data analysis of this study took place, many oreodont specimens were collected by the Works Project Administration (WPA) in the 1930s and early 1940s. Later, primarily in the 1950s, University of Nebraska State Museum (UNSM) Director C.B. Schultz tasked field crews to 'head hunt' oreodonts. A small portion of these collections led to the Oreodont Volumes, while the majority languished for decades in the vertebrate fossil collections (250+) and in field jackets (647) unprepared. In 2017, a project began where these specimens were prepared and stabilized using the growing UNSM volunteer preparator program.

The volunteer oreodont project starts with study of labeled skull and jaw images along with previously prepared specimens to allow volunteers to become familiar with oreodont anatomy. The project's primary goal is to expose the dentition and other diagnostic features typically used by researchers during analysis. Initially, simple, often poor quality, skulls or jaws are given to the volunteer. The first specimen is prepared using only hand tools such as carbide needles. Close supervision along with reminders on methods and comparison to images or prepared specimens help develop volunteer confidence with the oreodonts. Simple introduction of consolidants is injected throughout the process. Once finished, specimens are reviewed then rehoused in archival boxes with simple support. As volunteer experience grows, they begin using airscribes to remove mudstones and siltstones surrounding the majority of unprepared oreodonts. Some volunteers are fearless and often over-prepare specimens, while others are nervous and hesitant throughout the preparation effort. Trying to find a balance between these two extremes can be challenging.

As of May 2018, a total of 99 specimens were completed and available for study. At this rate, the White River Collection Room's oreodonts will be in sound shape by 2019. Tackling the 647 oreodont jackets housed in fossil storage can then begin.

A NEW METHOD OF INCREASING THE EFFICIENCY OF MICRO JACKS IN THE REMOVAL OF MATRIX SURROUNDING A FOSSIL SPECIMEN.

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Regardless of the characteristics of the matrix in which they are found, fossils nearly always require extensive preparation prior to being placed in storage, on exhibit or studied for research. This time honored process has changed only to a small degree in the last hundred or more years. Initially, collectors used picks, hammers or chisels, and for smaller specimens, dental tools to remove unwanted materials adhering to specimens. More recently, mini jack hammers and other power tools have been employed at excavation sites where generators are available. Such tools increase the efficiency of matrix removal, by probing the substrate while simultaneously vibrating it and blowing away the fragments. However, in the frequent cases where the matrix in which a fossil is embedded is concrete-like in consistency, the process remains painfully slow. While working at the Hanksville-Burpee quarry during the 2017 field season, using ME 9100s that operate at 15,000 cpm and 100-120 psi, we discovered that the simultaneous use of two micro jacks dramatically increased the efficacy of the matrix removal process. In cases such as those where the Hanksville-Burpee quarry is located, a single micro jack is able only to dig a shallow furrow in the dense, fine grained rocky matrix or to spall off small chunks of rock. In contrast, juxtaposition of two stylus points a short distance apart generated a harmonic pattern that sufficiently jarred the matrix so that it fragmented the rocky material between their tips, thus greatly shortening the time to extricate the specimen as well as allowing easier substrate removal. Experiments that varied the angles between the two micro jack styluses were conducted, as well as the distances between them. The goal was to determine the combination of distance range and stylus orientation that achieved maximum effectiveness using this dual matrix removal technique. This technique can be accomplished by moving each tool relative to the other, or by holding one micro jack steady and moving the second. Instead, the angle and distance between the styluses determines how well the two tips can interact to amplify the results each can achieve individually.

TESTING MOLDING SEPARATORS FOR COLOR CHANGE AND EFFECTIVENESS

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The matrix surrounding a fossil provides vital information, such as dating and depositional environment. To avoid any contamination, it is desirable to preserve its original status. It is, however, often necessary to use conservation materials to keep fossil specimens safe during preparation, in storage and on exhibit. Preparators are required to apply separators to the matrix when a specimen, especially a specimen in a slab, is molded. And yet, how different separators affect matrix or bone has not been clearly understood. Which separators are most effective at protecting the specimen from damage or infiltration by silicone oil? Which separators have the least long-term effect on the specimen in terms of permanent color change? Here we tested eight molding separators on three matrices to observe changes in color and texture pre- and post-molding.

Tested molding separators were conservation materials (Butvar B-76 at 5% w/v in acetone and Paraloid B-72 at 5% w/v in acetone), historically used materials (paste wax), commonly used molding separators (mold release spray and petroleum jelly), common lab supplies sometimes used as molding separators (talcum powder, dish soap, and their mixtures), as well as a control sample with no separator. These separators were applied on non-fossil-bearing rock slabs from well-known fossil localities: limestone from the Triassic Falang Formation and shales from the Cretaceous Yixian Formation and the Eocene Green River Formation. RTV, tin cure silicone rubber (Silicones Inc. G-1000) was poured on the prepared samples. The color and texture of the slabs was observed two hours after each cured mold was removed and again, after the separators were cleaned with acetone. Our results varied with the type of rocks. The limestone from the Falang Formation showed clear differences in color and texture between the separators; the silicone rubber peeled off the surface layer when the separators did not function. The shale from the Green River Formation exhibited the least difference; even on the control sample with no separator no damage was caused while molding. Overall, Butvar B-76 resulted in the least damage and color change in all three rocks, but we still recommend testing separators on small portion of any unknown matrix before molding the whole specimen.

Grant Information
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ASSESSING THE USABLE LIFETIME OF TIN AND PLATINUM-BASED SILICONE RUBBERS UNDER HIGH AND LOW STRESS ENVIRONMENTS.

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The goal of this project was to assess differences in quality and production of tin-based (TB) and platinum-based (PB) silicone rubber molds while also considering their respective rigidities under high and low stress environments. PB molds are advertised as ideal for shelf life, but are not intended for mass production, whereas TB are the opposite. We compared two PB rubbers (Mold Star 16 FAST and Dragon Skin 10 FAST) along with three TB rubbers (Mold Max 10, Mold Max 27T and Mold Max 40). These are abbreviated MS, DS, MM10, MM27, and MM40 hereafter. The casting agent was Smooth-Cast 320 urethane resin and a tooth of *Carcharocles megalodon* was used for our comparison. A one part mold was made for each mold material, and the roots of the tooth served as the pour hole for the casting agent. Every mold was cut between the roots of the tooth to create an opening to remove the casts. Two tests of quality and mold lifespan were done on each of the five mold types—a short-term, high-stress and a long-term, low-stress test. For the short-term, "torture-test", we poured the mold every eight minutes for 8–10 hours a day until the mold was exhausted to simulate a "rush production" prior to a major event. In contrast, for the long-term test we poured the mold at most twice a day to emulate occasional use in a museum. During curing, the resin reaches 60° C, which slowly causes the inside of the mold to become dry, rigid, and more susceptible to tearing. This process is exacerbated during the short-term test due to the interior of the mold constantly being subjected to high temperatures. Over the torture-test PB molds performed significantly worse than TB molds. MS16 was only able to produce 13 quality casts while MM10 produced 42 quality casts over the short-term testing. Over the long-term testing PB molds perform significantly better than in the short-term test. Initially the TB products MM27 and MM40 were noticeably more rigid when compared to MM10 or the PB products MS16, DS10. We thought the higher rigidity would result in greater resolution in the casts initially, but would then degrade like the more flexible molds. Instead we found that the more rigid materials performed significantly more poorly than the flexible molds and conclude that, due to the nature of one part molds, high rigidity materials should not be used. Our results suggest that TB molds significantly outperform PB molds over short-term testing and that the more flexible materials perform much better than rigid molding agents.

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Thank you to the Department of Geological and Environmental Sciences and the Office of Student Research at Appalachian State for funding my project.

A COMPARISON OF DENTAL MOLDING AND CASTING COMPOUNDS USED FOR MICROWEAR STUDIES

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Dental microwear analysis has been used throughout the years to reconstruct the diets of extant and extinct animals. To study microwear, negative impressions of teeth are made with a molding compound. These negative molds are then filled with a casting compound, often an epoxy resin,

to produce transparent casts. Various techniques are used to examine these casts for microwear. Here, we have investigated whether two molding compounds used for microwear analysis—the Regular Body President microSystem polyvinylsiloxane and the Sinclair Dental VPS Impression Material—are significantly different in their ability to capture microwear. A comparison of these compounds has never been done, despite both being commonly used in microwear studies. The microwear of extant ungulate species with known diets was examined with HDRI low magnification microscopy. Our sample included moose (*Alces alces*), elk (*Cervus canadensis*), bighorn sheep (*Ovis canadensis*), bison (*Bison bison*), and horses (*Equus ferus*). Preliminary results comparing total microwear counts and pit-to-scratch ratios suggest that the Sinclair and President molding compounds do not capture significantly different microwear signals. However, we have found that the compounds differ in their ease of use. The President molding compound has a shorter setting time than the Sinclair compound (2 minutes and 3.5 minutes respectively), and President has a higher viscosity. Because of these properties, President does not flow as well around the tooth cusps. More product is then wasted from having to redo molds and from the compound setting while still inside the applicator wand. We have also noticed that President does not interact well with the epoxy casting compound we use (EpoTek). When poured into President molds, the epoxy retains many more small bubbles than it does with the Sinclair molds, which leads to more discarded casts and wasted epoxy. We are now working to increase our sample size, and to expand our analysis to include a comparison of two casting compounds: EpoKwick and EpoTek. These results will help determine whether there are any significant differences between commonly used molding and casting compounds, which will help inform researchers as to which compounds are best for microwear studies.

FIDELITY OF "TRADITIONAL" VS "NEW TECH" METHODS OF FOSSIL REPRODUCTION

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When replicating a fossil for public outreach or research, paleontologists and fossil preparators use different techniques, such as molding and casting, in order to accurately duplicate the specimen. With modern technology, 3D modeling and printing can prove to be an effective alternative to displaying similar detail as the original specimen. However, detailed, quantitative comparisons between these methods are rare in paleontology. We generated a 3D model of a tooth of the giant shark *Carcharocles megalodon* using a Nikon digital camera and the computer program Agisoft Photoscan. After completion of the 3D model, the file was converted into a .stl file to be used for 3D printing. We measured the 3D model, 3D print and a cast made from Smooth-Cast® 320 liquid plastic poured in a Mold Star™ 16 FAST platinum-based silicone rubber mold. All measurements followed protocols established from previous studies. The measurements were compared to those of the original specimen, taking into consideration dimensional changes and percent error. Our research shows that the models were extremely similar to, but did not exactly replicate, the actual specimen. The average percent error was less in the cast (about 2%) and 3D model (also at about 2%), than that of the 3D print, which was significantly higher (30% when printed by a third party). This error may not be acceptable for individuals in research, but would be acceptable for outreach. Qualitatively, the 3D model depicts the original specimen most accurately. Refining and finishing techniques would have to be applied to the other replicas in order to achieve the same level of accuracy. Applications in 3D modeling and printing are diverse and can be employed with professionals working with specimens from long distances, without losing visual quality, and without the risk of damaging a specimen through delivery services. 3D modeling can be especially powerful in research due to its compatibility with virtual reality (VR), where an individual can manipulate the specimen as if they actually had it, provided they have the appropriate equipment. Molding and casting techniques are proven methods that can quickly provide multiple replicas, many of which are used for displays and public outreach events. Further studies into degradation of materials, short- and long-term costs, other logistics, and target audience preference (e.g., cast or 3D print for interactive displays) should be conducted in conjunction with studies such as this one to determine the best method within these practices.

PREVENTATIVE MAINTENANCE AT THE MAMMOTH SITE: EXCAVATION AND STABILIZATION METHODS FOR AN ACTIVE IN-SITU BONEBED

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The Mammoth Site (The MS) of Hot Springs has been undergoing near constant investigation since 1974. Excavation continues today with both summer internship participants as well as on-site volunteer based programs. Most new discoveries of mammoth and other Pleistocene taxa produced by ongoing investigation are left in situ for observation by visiting scholars, scientists, and the public. From initial discovery to present, excavation practices and excavators have played a key role in direct outreach to the public, as well as significantly contributing to the long-term stability and management objectives for in situ excavation.

Excavation methods have varied from year to year as research goals have changed along with the physical conditions of The MS. Methodology in the 1970s was salvage driven, focusing on exposing and recovering fossils prior to backfilling between field seasons. Having transitioned to an in situ excavation in the mid-1980s, The MS sinkhole effectively acts as an exhibit space, a natural preparation laboratory, and collections archive. Current excavation techniques are slower and geared toward promoting stability of exposed specimens in a dynamic environment. This means that excavation methods have shifted to a finer scale and require attention to detail in order to produce quality display items for the visiting public. Excavators observe and react to changing sediment patterns by shifting to finer tools and techniques as they approach potential objects in the matrix, reducing the chance for large discovery marks. Small fractures resulting from the ongoing seasonal shrinking and swelling of clays indicate areas where excavators may preemptively apply appropriate consolidation and support structures. These techniques help prevent damage and present a more aesthetically pleasing and morphologically valuable new specimen. Existing in situ bones are always affected by nearby excavation in some way; however, careful methods of digging can be applied to minimize destabilization of supporting matrix. Careful observation of support pedestals allows for selective excavation of destabilized sediments preventing 'tear-away' destruction of fossils. Where needed, in situ specimens may be fitted with clay-support structures maintaining specimen integrity until the eventual removal of the fossil. These preemptive and reactive steps in turn lead to increased longevity of important specimens maintained in The MS in situ collection.

PRESERVATION AND RESTORATION OF THE PALEOICHNOLOGICAL SITE "LA VIRGEN DEL CAMPO" IN ENCISO, LA RIOJA, SPAIN FERRER

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La Rioja (Spain) has one of the best paleoichnological fossil records in the world, with almost 10,000 dinosaur footprints and around 1,000 trackways. One of the best-known sites is La Virgen del Campo, found in the Enciso locality (La Rioja, Spain). In this work, we show the preservation and restoration labors made in the summer of 2017, three years after the last field campaign.

Our first action was to complete a preliminary study of the site, locating all the points that needed intervention, and evaluating its preservation state. All the preservational concerns observed at these locations were cataloged. Secondly, all the intervention techniques used in the previous campaigns (focusing on the protocols and materials) were analyzed and the possible problems that these actions could have caused to the site. In the previous campaigns, synthetic mortars, cement, and epoxy resins were used. These materials caused color changes, stone acidification, and saline efflorescences. Finally, an intervention proposal for the 2017 campaign was done, focused on the most important needs of the site. Restoration was focused on two main points: the removal of the excess of sediment and dust (allowing us to know the real preservation state of the site) and the removal of the interventions applied in previous campaigns (which were deteriorating the site).

The inadequacy of the previously used materials and methods to the particular needs of the sites justify changing the way restoration and preservation is done in this site. Due to the lack of a clear convention on the matter, we propose for the following field campaigns the convention of the COREMANS (Intervention Criteria for Earthen Architecture) project of 2012 for the stone material intervention. This kind of intervention preservesthe preservation and the integrity of the site.

It is necessary to discard the materials that have been systematically used in the site, because they are not only obsolete, but also harmful for the fossil tracks and for the site itself. We propose the use of more stable materials like natural mortars, and changes in the fieldwork dynamics. These changes will guarantee not only long-term conservation, but also they will minimize the loss of information during excavation and the subsequent consolidation of the fossils obtained.

PREPARATION AND TRANSPORTATION OF A COMPLETE MAMMOTH SKULL FROM CHANNEL ISLANDS NATIONAL PARK, CALIFORNIA, U.S.A.

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The Larramendy Mammoth skull was recovered from Santa Rosa Island, Channel Islands National Park (CHIS), California in September 2016. The specimen is dated to approximately

13,393 ± 80 cal BP, and is the best preserved mammoth skull recovered from CHIS to date. The skull has both tusks intact and is missing only its right jugal, which was separated along the suture lines. The skull was buried in a thick layer of gravel, and though some minor deformation has occurred, the overall shape of the skull is well preserved. Sinus cavities in the nasal, frontal, parietal, and occipital regions of the skull, as well as the pulp cavities of the tusks, were never infilled with sediment and remain hollow. The extreme fragility of the occipital and parietal regions necessitated a delicate approach to preparation. To prevent collapse during preparation, exterior bone around the hollow sinuses had to be consolidated prior to cleaning away sediment. Temporary Japanese paper bandages were applied to reinforce cracks around the hollow areas. Consolidated sediment was then removed from adjacent surfaces using acetone and small, soft brushes. Paraloid B-72 in acetone was used for all consolidation of the specimen and adhesion of paper.

Initial preparation was begun by the primary author at the Santa Barbara Museum of Natural History in Santa Barbara, California in 2017. The skull was later moved to The Mammoth Site (MS) in Hot Springs, SD to continue preparation and research. Potential collapse of the hollow areas during transport was a significant concern. To prevent damage in transit, all exposed surfaces of the skull were consolidated, including visible interior surfaces of the sinus cavities, by using long, flexible bottle tips to access difficult to reach areas and undercuts. All exposed exterior surfaces were covered with a layer of Japanese paper applied as thin, overlapping strips. The paper acted as reinforcement for the bone, and to aid in reconstruction should any breaks or collapse of hollow areas occur as a result of unpredictable road conditions. The skull was then rejacketed, and secured inside a plywood crate using wooden braces and expanding foam. The crate was placed on rubber anti-fatigue floor mats in a moving truck and driven nearly 1400 miles to MS. The move was completed successfully with no damage to the specimen sustained duringtravel.

THE IMPACT OF EXCAVATION AND DOCUMENTATION ON ANALYSIS AND INTERPRETATION: A LOOK AT THE ICHNOLOGICAL INTERPRETATIONS AT THE MILL CANYON DINOSAUR TRACKSITE, UTAH

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The Mill Canyon Dinosaur Tracksite (MCDT) was discovered in 2009 approximately 14 miles north of Moab, Utah, on land managed by the Bureau of Land Management's Moab Field Office. Initial investigation of this Early Cretaceous tracksite yielded a unique vertebrate ichnofauna, including dinosaurian, crocodilian and avian tracks. Didactyl trackways of *Dromaeosauripus* represent the first trackways of this ichnotaxon reported from North America. Due to the scientific importance of the site and its proximity to outdoor recreation opportunities, a resource management approach was developed that emphasized scientific research, public visitation, and education. Between 2013 and 2015, overlying sediment was removed from the site for ichnological research, resulting in the discovery of at least 10 named ichnotaxa. Included in the census were an additional *Dromaeosauripus* trackway, as well as large-, medium- and small-sized tridactyl theropod tracks and trackways. Also present are *Caririchnium*-like ornithopod trackways and sauropod trackways. Between 2015 and 2017, ADA compliant footpaths, boardwalks, interpretative signs, a shade structure, an expanded parking area, and a pit toilet were installed.

Traditional ichnological documentation began at the site in 2009, and hand-held, closerange photogrammetric documentation was conducted in the isolated exposed areas in 2010. In 2014, after spring excavation and prior to the construction of the boardwalk, systematic photogrammetric documentation of the main track surface was conducted using a high resolution digital camera with remote trigger mounted on a monopod to acquire nadir, overlapping photographs. In May 2017, after completion of the boardwalk and facilities, the entire developed area was photogrammetrically documented using a 3DR Solo equipped with a Ricoh GR II camera. The MCDT was photographed at a variety of heights ranging from 7.5 meters above the main track surface to 76 meters over the developed area. Due to the approach utilized to capture photogrammetric imagery of the site, all three episodes of photography were processed together in Agisoft PhotoScan in a unified coordinate system. The resulting digital data set provides a unique look at the evolution of a tracksite from a documentation and interpretation perspective; both in terms of the impact of exposure to the elements on potential morphological changes to the tracks themselves, as well as how limiting the window to the track surface may impact current and future interpretations.