PRODUCTION OF MULTI-PURPOSE MOLDS FOR VERSATILE, DETAILED REPLICATION OF LARGE-SCALE FOSSILS: THE BASILOSAURUS ISIS CASTING PROJECT AS AN EXEMPLAR

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Museum of Paleontology and Exhibit Museum, The University of Michigan/Egyptian Environmental Affairs Agency
Reasons for Molding and Casting

--protection of originals from handling
--archiving copies
--dissemination of copies
--educational exhibition
--generation of research copies

Public whale evolution exhibit
Constraints on choices of molding and casting methods and materials

**Constraints:**
- quality of fossil material
- intended use of casts
- project budget, etc.

**Methods:**
- solid pour molds
- laminar molds
- multipiece molds
- mothermolds
- solid casts
- hollow casts
- fiberglass
- foam-filled, etc.
- rotational

**Materials:**
- latex, silicone rubber, polyurethane rubber, etc.
- plaster, urethane, polyester resin, epoxy, etc.
Step One:

GET A BIG FOSSIL WHALE
Basilosaurus *isis* replication project

Skeletal aspects of *Basilosaurus isis*

38 million years old

Archaeoceti, Cetacea
Wadi Hitan, Egypt: Excavation site
Wadi Hitan: World Heritage site

Visitor’s Center

Univ. Michigan Research Facility

Exhibit Created Around Exposed Vertebrae of *Basilosaurus*
*Basilosaurus* excavation and plaster jacketing
Step Two:

An infinite number of students with an infinite number of airscribes will eventually prepare a 65-foot-long whale out of matrix (we had 20 students, 5 airscribes, and it took a year)
... sometimes, things got a little out of hand in the lab ...
But eventually, we processed four tons of sediment to extract nearly all elements of the *Basilosaurus* specimen (WH 074), including toes, hyoids, and auditory bullae.

Student assistant with part of the skeleton arrayed on long tables.
Approach

--expense a concern: molding in polyurethane rubber, using laminating technique and backing with fiberglass and resin mothermolds

--hire students from work-study program and Undergraduate Research Opportunity Program, and take on volunteers

--cast in polyester resin mixed with talc; laminar hollow-cast method backed with fiberglass or filled with foam (weight a concern for casts to be used in mounts)

--time a concern: hire LOTS of students
Step three: molding

--clay blocking: divide up specimen into parts
--angled, low clay rims to create edges which lock into mothermolds
--use of insulation foam and hot glue to build support platforms for clay walls around specimen
--lock tabs, positive and negative, to ensure proper alignment of mold sections
--3 to 4 coats of polyurethane rubber are laminated on, about one an hour; a waxy separator is necessary between the specimen and first coat

--the clay wall is extended past the low clay rim to form a flange beyond the mold, onto which the mothermold will extend; this provides a place to drill bolt holes for reassembly later
--mold parts are flexible and supported by external mothermolds made of fiberglass and resin

--bolt holes are easily drilled through mated mothermold pieces, which are internally aligned by lock tabs.

--molds are typically about a centimeter in thickness and “flow” around the morphology

--dimensional stability seems good and fidelity of detail is reasonable
Step three: create and add plugs

--plugs useful to make molds versatile: molds can be used to make hollow, laminar casts lined with fiberglass and resin (lightweight) OR to make urethane foam-filled casts inside of laminated polyester coats (even more lightweight

--fiberglass hollow casts are typically 1/15th the weight of the original specimens

--foam-filled casts are typically half that in weight, making them ideal for mounting
--plugs are sculpted onto dixie cups, molded in RTV silicone rubber, and cast in polyurethane rubber, with a plaster inner plug insert

--one surface of a fossil is prepared with a clay ring, and polyurethane rubber is applied; the plug is pushed down into that ring to adhere to the specimen (temporarily)
--a clay wall is built around the section with the plug, with lock tabs and a low clay rim

--polyurethane rubber is layered on around and onto the plug (the plug is first sprayed with a waxy separator

--note the extended clay flange to later accommodate a mothermold flange for bolt holes
--once the mold section is ready and the plug is firmly in place, a two piece mother mold can be constructed around it, permitting demolding later

--two part mothermolds for single mold sections are often desirable to prevent damage to the specimen during demolding

--we apply clay buttons under the first of two mothermold parts to accommodate bolt heads later (to hold the pieces together)
--Foam-filled cast vs. fiberglass-lined cast

--if used for a mount, the obvious plug part will be unobtrusive

--if to be used as an isolated specimen, the plug part can be painted over and will be barely noticeable

--the foam-filled cast is literally light enough to float (the mount could be truly aquatic again!)
Step four: casting

--casting in polyurethane molds can be done using a variety of media (resins, plaster, urethanes, metals)

--we chose to work with a high quality, low shrinkage polyester resin, and mixed it with talc (for control of lamination) and pigment (to provide a base color)

--this material works well with fiberglass, is easy to paint, generates less heat and damage to molds than epoxy, and is dimensionally stable over time (and quite strong for handling)

--we generally applied three layers of talced resin, a final layer of talced resin with fiberglass (to tack the fiberglass in place), and finished the cast internally with (appropriately) finishing polyester resin

--mold parts were then bolted together and rotated by hand for even distribution of excess material
students laminating talced, pigmented polyester resin into rib mold halves for casting

The finished rib cast, prior to painting
student assistant with completed casts arrayed next to original specimens

(bonus whale cartoon)

--painted casts of the skull for display in educational exhibit case

"Can I call you back? I'm right in the middle of something."
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