Preparation and Analysis of Fossils from the Calaveras Dam Project

Sidhant Idgunji, Xena Ross — University of California Museum of Paleontology, Berkeley, CA 94704
Cristina Robins — University of Alabama, Tuscaloosa, AL 35487

Abstract

During the rebuilding of the Calaveras Dam, excavation of the dam site yielded thousands of Miocene vertebrate and invertebrate fossils. These fossils were shipped to us to be treated, logged into a database, and preserved in the UCMP collections. Preparation ranged from well renowned methods, such as air-scribing and consolidating fossils with adhesives, to other, unconventional techniques in order to treat the various fossils that were delivered to the lab. We prepared thousands of fossilized shark teeth, whale skulls, and invertebrates, and stored the taxonomic information in a database, labeled with their field numbers (the date each fossil was found). Using our database, collecting curves were made for the invertebrates and shark teeth, giving us some insight into biodiversity. While seismic activity has convoluted the geology of the region and introduced location bias in the data, the collected specimens help elucidate the paleoecology of the region.

Fig. 1: Casts of Megalodon teeth discovered in the field

Working in the Prep Lab

Fig. 2: A view of the UCMP Fossil Prep Lab[1]

Preparation Methods

Many of the fossils, embedded in iron-rich rocks, required both destructive and delicate methods. Our team used common fossil preparation techniques:

- Molding and casting, plaster jacketing (below)

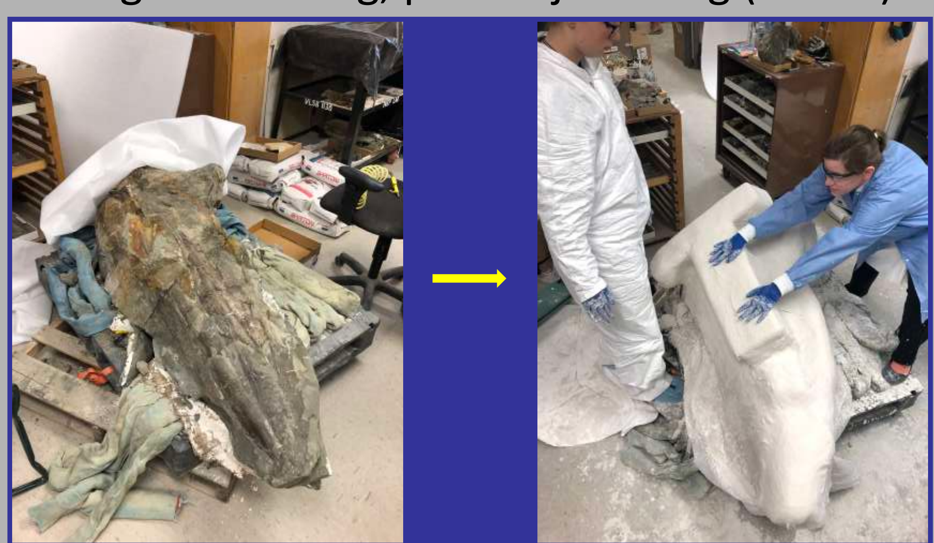

Fig. 3: Plaster jacketing proved difficult at times, especially for a whale skull the size of a boulder

- Photo-documentation, schematic drawings
- Matrix removal, air/sand abrading + air scribing
- Using mechanical force, hammer and chisel (below)

Fig. 4a,b: a. Working with hammer and chisel on iron-rich rock (left); **b.** Labeling specimens with gesso and extra-fine ink (right)

- Consolidation with butvar/acetone
- Recording of taxonomic info, labeling/storage

Analyzing Local Miocene Shark Biodiversity from Fossilized Teeth

Over 4,000 shark teeth were discovered in the Neogene rocks at Calaveras. We performed a faunal study, with a broad overview of the results shown in **Table 1**. Comparative analysis with other shark tooth showed a large variety of shark teeth, with some unique to the Calaveras area.

Table 1: Shark families

Mako	Copper
Bull	Megalodon
Sand Tiger	Hammerhead
Angel Shark	Thresher
Mackerel	Great White
Lemon	Blue
Tiger	Dogfish

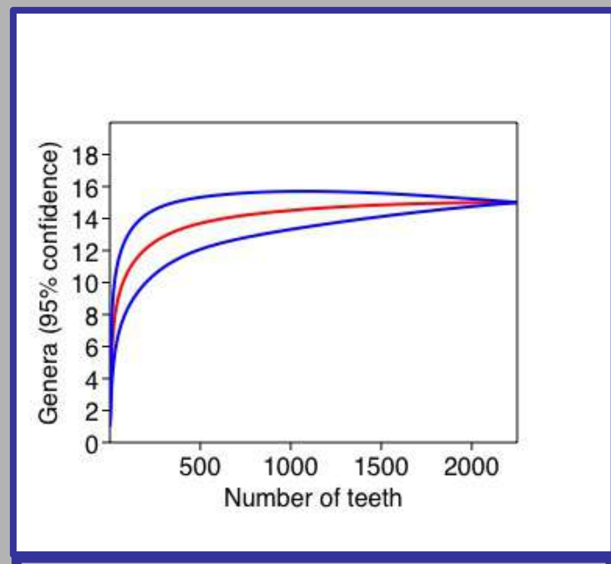

Fig. 6: Shark genera rarefaction curve

Fig. 5: Megalodon, great white shark, mako shark (left to right)

The majority (~80%) of the shark teeth belong to Carcharhinus (requiem sharks), Isurus (mako sharks), Squalus (Dogfish Sharks) and Squatina (Angel Sharks). These sharks tend to populate the Euphotic and Disphotic zones, meaning the Calaveras Area may have been submerged 15 million years ago. Getting a better understanding of the shark diversity might allow us to perform a stronger paleoecological analysis.

Preparation of Whale Skulls

Fig. 7: The process of moving the pieces of rock and whale skull from the plaster jacket to the sandbox, then putting together the whale mandible and constructing a schematic. Whale skull and rib assembly often involved manipulating large boulders like a puzzle

Fig. 8: Whale vertebral column cross section

Fig. 9: Single whale vertebra, air scribed

Hundreds of very delicate pieces of whale skull, mandible, rib, and vertebrae were discovered at the site, embedded in a tough matrix of iron, sulfur, and silica. In addition, many of the fossils exhibited slicked-slides and were thoroughly fragmented; evidence that they had been at the mercy of the Calaveras Fault. This made preparation difficult, and hundreds of hours were spent on these fossils alone. Sledgehammers, chisels, saws, and extra-large air scribes were heavily relied upon.

Fig. 10: Underside of baleen whale skull

The dense sediment, along with millions of years of seismic activity proved to be a challenging obstacle. However, as of now, over 20 whale skulls were prepared: 4 baleen, 2 toothed. One exciting discovery is a new species of baleen whale. New research questions are frequently arising, and possible future experiments include studies of intraspecies variation, and geologic mapping of the whale skulls to understand changes in ecology over the last 15-20 million years.

Analysis of Invertebrate Fossils

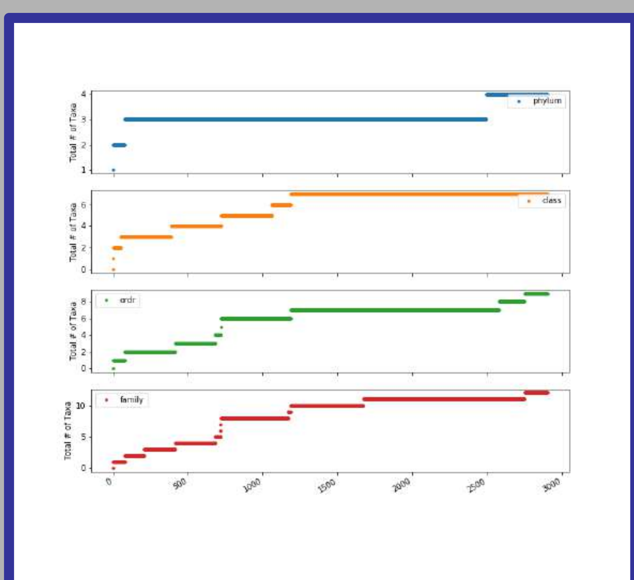

Fig. 11: Invertebrate collection curves

Collecting curves were generated (from phylum to family) for ~3,000 specimens, with a total taxonomic diversity of 4 phyla, 7 classes, 9 orders, and 12 families. Over 90% of the fossils belong to the phylum Mollusca, and over 75% are of the class Bivalve. There are also a significant amount of Gastropods present.

Much like the shark teeth, the taxonomy of the discovered invertebrates can give us an insight into the paleoecology. However, the convoluted geology of the Calaveras Area makes it difficult to stratigraphically separate different specimens.

Fig. 12a,b: Bivalves

Acknowledgements

Thanks to Xena Ross for her shark teeth data and figures, to James P. Walker for working hard in the field to send us fossils, and to Cristina Robins, who has led this project and always supported us. I am grateful to all my mentors and coworkers at the UCMP who I have gotten to work with over the last three years.

References

1. https://ucmp.berkeley.edu/calaveras-project/
2. https://github.com/bombay-bullet/github-upload

Summary + Future Research

The identification and preparation work done by the members of this project has laid the foundation for data analysis that will provide ecological insight into the region 15 Ma. In addition to the shark teeth, whale skulls, and various invertebrates, the Calaveras fossil repository boasts some impressive specimens. This includes seal and sea lion fingers and vertebrae, hundreds of fish scales and bony fish vertebrae, and very well-preserved plant material. One of the most significant finds is the teeth and rib of Desmostylus, a tusked, aquatic marine mammal that resembles a hippopotamus. These discoveries are just the beginning, and there is a lot of scientific promise in the Calaveras collection at the UCMP.

Fig. 13: Desmostylus tooth, prepared by air scribe[1]