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A systematic comparison of different fossil preparation, and their utility for preparing different types of rock.

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A systematic comparison of different fossil preparation, and their utility for preparing different types of rock.

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Capstone Approval Page

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A systematic comparison of different fossil preparation, and their utility for preparing different types of rock.

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A SYSTEMATIC COMPARISON OF DIFFERENT FOSSIL PREPARATION, AND THEIR UTILITY FOR PREPARING DIFFERENT TYPES OF ROCK.

HONORS THESIS ABSTRACT

The fragile nature of many fossils, particularly large ones, necessitates "jacketing" – removal of the fragile bones in situ, with the surrounding sediment, encased in plaster. Fossil preparation entails the use of specialized lab facilities and appropriate tools to make the specimen ready for scientific study or display in museums by removing the surrounding sediment (also sometimes called matrix; Brown et. al. 2009). There are two major ways to separate fossils from the surrounding rock: manual preparation and acid preparation. Manual preparation, also sometimes called mechanical preparation, is the use of physical force to carefully remove the sediment from around the fossil. Preparation is often done using hand tools such as chisels and hammers, airscribes, abrasives, and glues. Acid preparation, on the other hand, uses chemicals, usually acetic acid buffered with calcium phosphate, to dissolve the surrounding rock and make it more breakable, eventually separating it from the fossil. Sometimes preparators can accomplish their goal by using just one of the two preparation methods. However, in cases where the matrix is very compact, a combination of both methods may yield the best results. This project sought to gain experience in both major types of fossil preparation, compare these different techniques, and determine their effectiveness in preparing fossils of varying sizes and degrees of preservation.

HONORS THESIS ABSTRACT
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Introduction

Fossils are found embedded in different types of sediments, with varying levels of hardness. The softest sediment is chalk, followed by mudstone, or siltstone which is also fine grained and usually soft. Next is sandstone, which can be either soft and unconsolidated, or cemented and hard with varying grain sizes. These sediment types can often be easily separated from fossils they encase using airscribes and other hand tools.

Conglomerates, which is the next hardest type, may require a combination of both manual and acid preparation. The final level is hematitics, which contains a layer of iron concretion (Amaral, 1994). With this is mind, a preparator may already have an idea of what methods to use from the moment he or she sets eyes on the matrix.

For my project, a specimen collected from Madagascar in 2015 (field number *15270*) was to be prepared. From a superficial observation of the surrounding matrix, it could easily be determined that I was going to work on a hard rock or conglomerate. The matrix looked very dense, like a rock with a bone poking out on top. Since I was preparing a fossil encased in conglomerates, a combination of both preparation methods would likely yield the best results.

Fig. 1. Matrix from Madagascar

Methods

Manual Preparation

Materials – Airscribe, safety goggles, gloves, glue.

Procedure

As stated earlier, I first started with manual preparation. The matrix was placed under a fume hood to reduce exposure to dust. The common tool used in the lab is the Paleotools airscribe, pictured in figure 2 below, which is very efficient at removing rock. The airscribe is hooked to an air compressor and works like a miniature jackhammer. The airscribe is held onto the sediment, and not the bone. With the constant vibration of pulses of air, pieces of the sediment begin to fall off, revealing the bone. However, since I was dealing with a very hard matrix, the airscribe could barely break pieces of the sediment. After about 6 days of manual preparation, the airscribe was only able to make surface markings on the matrix, as seen in figure 3. When I attempted to apply more pressure, a part of the bone sticking out of the matrix broke off. I concluded that manually preparing this matrix was going to require more time and energy, and could damage the specimen. Pursuing acid preparation seemed like the best strategy.

fig. 2. Airscribe from Dr. Samonds Lab

fig. 3. Airscribe markings on the matrix

Acid Preparation

Materials – Measuring cylinder, acetic acid, calcium phosphate (buffer), plastic container with lid, sieve.

Procedure

Acid preparation, also called chemical preparation is another method of removing matrix from a specimen. Even though the use of acid as a means of a means of freeing fossils from sediment has been in existence for quite a long time, it is not as widely used (Grant, 1989). As explained on the American Museum of Natural History website, "While mechanical preparation uses physical forces to remove matrix from around a specimen, in chemical preparation various compounds are used to dissolve the surrounding matrix" (Amaral, 1994). For this experiment, acetic acid was used. A 5% solution of acetic acid was made, and a small amount of calcium phosphate was added as a buffer. It is important to add the buffer because it prevents the acid from dissolving the bone while it dissolves the matrix around it. The matrix was placed in the acetic acid solution, the container was covered and allowed to sit for a week. It is important to note that the reaction between the matrix and the acid solution releases calcium dioxide gas (bubbles) and it is, therefore advised to do this under the fume hood.

fig. 4. Matrix in acetic acid solution.

Results

After a week in the acid solution, the matrix was removed and allowed to dry in a sieve. There was a slight color change on the matrix. Knowing that the matrix was softer than it used to be, it was brought back to the fume hood for further mechanical preparation. With this softer matrix, the airscribe worked easily. After two days of manual preparation, a bulk of the matrix had been removed from around the bone as pictured below. At this point It was observed that the bone was not very deeply embedded within the matrix (this assumption could not be made prior to this point). In other words, preparators are not supposed to assume that they know where the bone is because "fossils can be shattered or distorted while lying in the ground for millions of years" (Amaral, 1994). On day three after acid preparation, the fossil was fully separated from the matrix by manual preparation.

fig. 5. Matrix after acid preparation

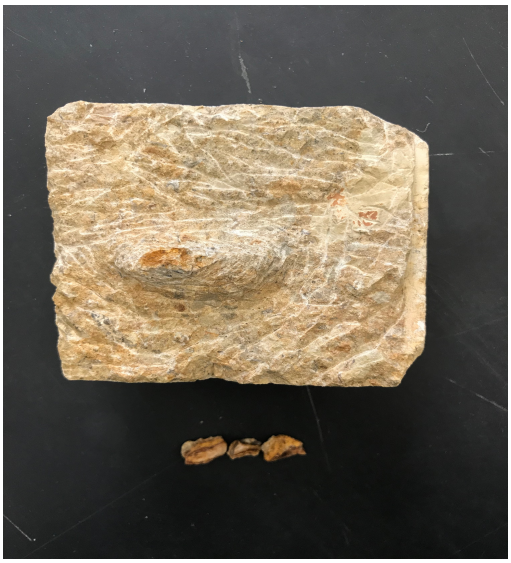

fig. 4. Fossil separated from matrix

Conclusion

Before a fossil is used for research or display, it must go through the hands of a preparator. A mistake made by the preparator can affect how research will proceed, thus making a preparator's job is very crucial in the field of paleontology and anthropology. Currently, the two methods mentioned above, mechanical and chemical preparation, also sometimes simply referred to as manual and acid preparation are the two major ways preparators use to remove fossils from matrix. Although, both methods are effective, the combination of the two fossil preparation methods, speeds up the preparation process, and saves time and energy. Acid preparation reduces the risk of damaging fragile bones by softening the matrix, making it easier to be worked on with hand tools.

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