

CLUES IN THE ROCKS

PRESERVATION OF FOSSILS: AN INTRODUCTION TO TAPHONOMY

*Full fadom five thy coral lies, Of his sclerites spar is made.
The pearls of mollusk calcitize, Naught skeletal that doth fade
But shall its ions rearrange, Into something new and strange
Algae hourly ring each shell, With a micrite rind 'neath the ocean swell.*

Fakespar (R.G.C. Bathurst, 1967)

Introduction

Fossils are defined as any preserved evidence of ancient life. Fossils include a wide range of forms: everything from shells and bones to burrows, footprints and feces.

There are several major sources of bias in the fossil record. The first is that organisms with hard parts (shells, bones, teeth) are more likely to be preserved than soft-bodied organisms (e.g. jellyfish, etc.). The second major bias is that marine organisms are much more likely to be fossilized than terrestrial organisms. This is because terrestrial areas are more prone to erosion than marine areas which are below base level. As a consequence of these major sources of bias, the most common fossils are the shells of marine, invertebrate organisms (e.g. clams, corals, etc.).

Additional bias enters the fossil record because certain conditions must generally be met for preservation to occur. Perhaps the most important condition is early burial. Rapid burial reduces the negative impacts of scavengers, microbial decomposers and physical weathering. Taphonomy is the general name for the study of post-mortem effects. Any process that operates on the organism from the moment of death to collection of its fossilized remains by a geologist is considered a taphonomic process. Of the wide variety of taphonomic processes, the most fundamental is preservation as a fossil.

Modes of Preservation

Fossils may be preserved in a number of ways. The most obvious way, or mode, is by preservation of the **original material**. In other words, the original bones, shell or teeth are preserved in an essentially unaltered state. Many fossils are preserved by **replacement** of the original material. For example, a shell that was originally calcite may be replaced by pyrite. A similar, but slightly different mode is known as **permineralization** (petrification). In this process, original voids such as cells are filled with a mineral. After this infilling, the remaining tissue (cell walls in the case of petrified wood) decays. The new voids created by this decay are then filled. Permineralization, therefore, is a two-step process.

Fossils may also be preserved as **molds** and/or **casts**. Molds are impressions of an object. The original shell has been dissolved away leaving a void. When **molds** are filled with sediment, the result is a **cast**, a replica of the original object.

Under extraordinary conditions, original soft tissues may be preserved. Under chemically reducing conditions, soft tissues may lose their volatile components leaving behind a **carbonized film**. Such films often preserve spectacular detail, even cell structure! Some soft tissues may make **molds** in the burial sediment, which may later become **cast**, which preserves a crude image of the original organism. Soft tissues may also be preserved by more exotic modes such as: **freezing, natural mummification, encasement in amber, or tar**.

Markings made by organisms are known as **trace fossils** or **ichnofossils**. Ichnofossils include such things as: **burrows, tracks, trails** and, **borings**. Tracks and trails are fairly self-explanatory. **Burrows** are tubes or other structures made by organisms in the sediment. Such structures may be used for dwelling or feeding or other activities. **Borings** are similar tubes, etc. made in hard, even lithified, substrates. **Coprolites** may also be considered ichnofossils. The term **coprolite** was coined by the famed American dinosaur hunter O.C. Marsh. The etymology of **coprolite** may be linked to the Greek *kopros* (dung) or may reflect Marsh's animosity toward his arch-rival E.D. Cope. These peculiar objects are fossilized feces. A great deal of ecological information may be derived from the study of **coprolites** (e.g. Who was eating what?).

Assignment

Examine the labeled examples of various modes of preservation. Please study these samples carefully so that you are comfortable with recognizing various modes of preservation. After you have studied the labeled samples, **examine the undescribed fossils, describe the mode of preservation and describe each in terms of the detail of preservation. You should also use the General Guide to Fossil Identification to identify these fossils.**