

A Fossil's Journey

If you've ever seen a fossil in the sedimentary rocks of Boulder County, you've seen the remains of a once-living organism from the geologic past. More than just a rock with the preserved evidence of former life, a fossil is a reminder of an ancient ecosystem that most likely represents a physical environment completely different from where it is found today. If our fossil, a large clam for example, closely resembles a modern form then we can reasonably infer a similar environment in the remote past for the fossil clam. Imagine an inland sea covering Boulder County!

Equally interesting is the story of survival of the shell through 80 to 90 million years from its death on the sea floor to its recovery today in an exposure of Cretaceous rock in Boulder County. Many processes are required to ensure permanent entombment in the rocks -- death of the organism, decay, removal of soft parts, burial in sediments, transformation of sediment into hard rock, and chemical replacement or alteration of the shell with new mineral substances. The containing rock is further subjected to compression by the weight of the overlying load, and movement of the rock due to plate tectonic interactions. This "parent" rock may also be subjected to subsequent mountain-building involving folding, faulting and intrusions of igneous rock. Over enormous time the shell may finally be exposed by erosion and discovered by an open space visitor. What a remarkable journey for the shell to have survived! Is it any wonder that fossils are rare and over 90% of all species that lived on earth have left no trace of their existence?

All of these events and forces subject the clam shell to stresses -- temperature changes, pressure, and the action of chemical solutions, all of which would tend to weaken and eventually destroy the shell. Sea currents and wave action may help concentrate and localize the shells. Since the shell could be carried some distance from where it died, the effects of abrasion might also reduce its chance of survival. There is also the possibility that the shell could be attacked by boring and scavenging animals on the sea floor before being covered by sediment, which would tend to fragment the shell. The fossil clam might even be recycled, going through another episode of erosion, deposition, and lithification, and end up being incorporated in a younger rock layer. All of this would suggest that the chance of any one individual clam leaving a fossil record of its existence is very slight. It is only because of prolific reproduction rates that such organisms can leave almost countless numbers of individual clams in a given area.

Other aspects of our clam fossil story are the clues revealed about the physical conditions in this inland sea based on inference from similar clams in the ocean today. With careful work and study, invertebrate paleontologists specializing in fossils clams can put limits on water depth, water temperature, salinity, clarity of the water, nutrient sources, associated organisms (also occurring as fossils sometimes) and some interactions that might have existed in this ancient marine ecosystem in Boulder County.

If the clam is a species of the group *Inoceramus*, found in the lower Niobrara Formation on Boulder County Parks & Open Space (BCPOS) properties such as Six-Mile Fold, then more can be inferred about this well known and studied group and the ecosystem in which it thrived. They were probably thickly strewn on the muddy bottom of the shallow sea with their very heavy shells possibly being an adaptation for survival in the pounding action of turbulent water and currents. Their numbers must have been enormous as they spread outward on the sea floor with sufficient food and oxygen supplied by the environment. When conditions became inhospitable for life on the sea floor, mass die-offs occurred and the shells were covered with limey mud later to become incorporated into the sedimentary record. In similar environments in the Niobrara Formation, such as the chalk beds of Kansas, these clams reached sizes of 4 to 5 feet across, became a substrate for other mollusks like oysters, and the empty shells were thought to have been a safe haven for small fish and hunting grounds for sharks to explore.

An excellent place to see these clams as fossils is at the very south end of the Six-Mile Fold BCPOS property. One needs to follow the gray limestone (part of the Niobrara formation) outcrop at the beginning of the trail southward as it snakes across the surface forming an S shape to its ending (the limestone forms a low ridge that is easy to follow). At this point proceed downhill into a steep gulley and then follow the gulley east toward Highway 36. Look at the gray bedrock for pieces of the shell material seen on edge or, more revealing, the impressions of the clams, some with the actual shell material. They can be up to 6 to 8 inches across, the shell thick, almost fibrous appearing in cross section and concentrically ribbed.

Beginning to comprehend enormous changes occurring through immense time spans is part of the appeal of seeing a fossil, but the real excitement may be contemplating past environments of these organisms and the remarkable and difficult journey through time that has allowed them to survive until this day as a fossil. As you roam our parks and open spaces and find what you believe to be a fossil, perhaps you will discover this excitement for yourself, AND REMEMBER...fossil collecting is NOT allowed on Boulder City & County Open Space properties.

~ Donn Cook, Volunteer Naturalist (2011)