Seashells in the Shiprock area

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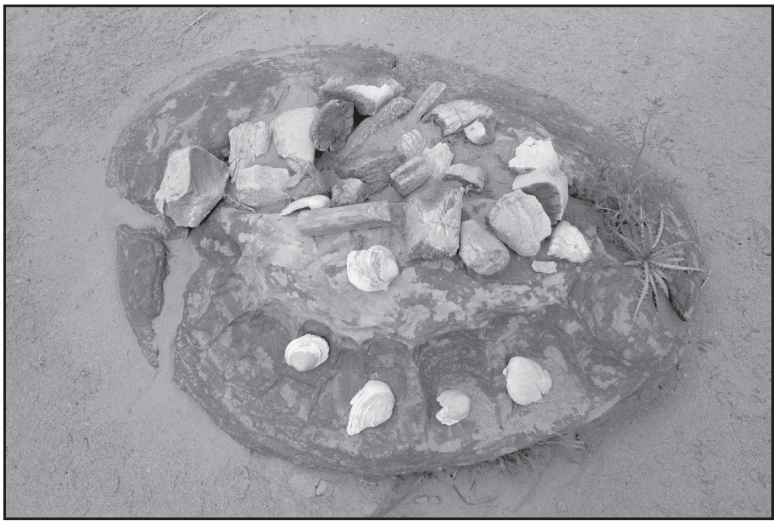
Why do we find seashells (*yoo' łigaii*) in the San Juan Basin around Burnham, Shiprock, and Gad'íí'áí? The fact is that these are not actually shells, but shell *fossils*—all that is left of hard-shelled animals that once lived beneath the waters of an ancient sea. These animals got mixed up in sand and mud that much, much later were turned into solid rock—*sandstone* (*tsé dizéígíí*) and *mudstone* (*tsé hashtł'ishníí*). Shell fossils that you find lying loosely on the ground (See photos this page) were worn out of those rocks by rain and wind. If you look around, you will probably also find exposures of rock that still contain fossils.



How can we know that these fossils actually were seashells? The best evidence is that they are very

Shell fossils found by Darryle Barber, Burnham, NM

similar in appearance to seashells that can be found along the world's ocean beaches today. Geologists like to say that "the present is key to the past," meaning that we can study features of the Earth that exist today in order to get an understanding of what the Earth was like millions and even billions of years ago. Using this approach, geologists have determined that the entire Four Corners region was at or near sea level, and much of it was submerged under a long-gone sea, from about 100 million to about 70 million years ago. This interval of the Earth's deep history is called the *Late Cretaceous Period*. The sea advanced over the Navajo Nation from northeast to southwest, and extended about as far as central Arizona. Lands to the west and northwest of there, much of today's western Arizona, Utah and Nevada, stayed dry.

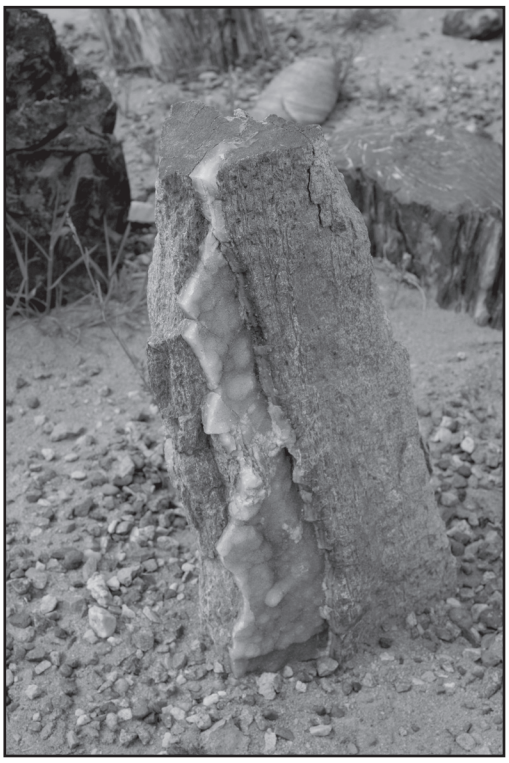
Other kinds of fossils found in the same area offer more evidence that whole region of the Navajo Nation was under the sea in the geologic past. Pieces of *petrified wood* (*tsé nástáán*) are fossil remains of trees that once grew along the Late Cretaceous coastline and were buried in sand by floods. Petrified wood (See middle photo, page 21) really does look like wood, but it is actually rock that slowly took the place of the wood after the trees became buried. And the black layers of coal *(łeejin*) that occur along with the sandstone and mudstone in the San Juan Basin are fossils as well! These are the remnants of lush

wetlands that spread out along the coast of the ancient sea, just like the wetlands that are found along today's Gulf Coast.

As the plants in the Late Cretaceous wetlands grew and died, their dense remains accumulated underneath the dark, swampy water. As more and more plant debris, and later mud and sand piled on top, the plant material was gradually compressed and heated until all that remained was a deep black rock composed largely of the element carbon. Because of its high carbon content, coal is a rock that burns, which is why it is mined for use as a fuel. Dinosaurs lived in and near these wetlands in the Late Cretaceous Period, which is why their fossil bones and tracks (footprints in rock!) can be found.

Seventy million years ago, the San Juan Basin was a lush coastal region at sea level, but today it is a high desert, in places over a mile above sea level in elevation. What lifted it so high? Geologists are still studying how the San Juan Basin lifted from sea level to a high desert, in places over a mile above sea level, over the past seventy million years. While the exact details and timing of the process are under debate, it appears that it began when a great slab of the Pacific Ocean floor was pushed underneath the southwestern corner of the North American continent from west to east, beginning about 80 million years ago. This slab compressed and wrinkled the crust of the continent, and started the uplift of what are today's Colorado Plateau and Rocky Mountains. About 40 to 30 million years ago, at a time geologists call the Paleogene Period, the slab of sea floor began to sink into Earth's deeper interior. Hotter rock squeezed up from below to take the place of the slab, and this lifted the entire region even higher. It sounds dramatic, but these changes happened so slowly that if you had been around at that time, you would not have felt or noticed the changes, except possibly an occasional volcanic eruption or earthquake somewhere in the vicinity.

Today, the primary forces shaping the landscapes of the Navajo Nation involve erosion, which is the wearing down of mountains and rocks by streams and rivers (*tó dahníłínígíí*) and the desert winds (*níyol*). Water and wind are gradually carving deep into the San Juan Basin, leaving some of the hardest rocks standing alone, like Ship Rock (*Tsé bit'á'í*) or Hogback (*Tsétaak'áán*), while slowly grinding other rocks back into sand and mud that travel away down the San Juan River (*Tooh*). Erosion is also what extracts the seashell fossils, petrified wood, and other fossils from the rock layers.



A Barber fossil that glitters in the light

Editor's note. Semken is an Associate Professor of Geology at Arizona State University. He also taught Geology at *Diné* College in Shiprock for many years. LEADING THE WAY readers will be especially interested to review the "English-Navajo Thesaurus of Geological Terms" he published with A. Blackhorse and P. Charley in the 2003 New Mexico Geological Society Guidebook from the 54th Field Conference.