Scotts Bluff

National Park Service
U.S. Department of the Interior

Scotts Bluff National Monument
Nebraska

Geology of Scotts Bluff

Pages of Stone

The rocks of Scotts Bluff can seem very young and very old, depending on your point of reference. Ages of rock here are from 34 to 20 million years old, which place them in the Tertiary period of the geologic time scale. In comparison to the estimated age of the earth, which is about four and a half to five billion years, the rocks here are young. When compared to an average human lifetime, however, the rocks are almost incomprehensibly old.

Three Different Types of Rocks

Of the three different kinds of rock identified by geologists, sedimentary (sea bed, river, and dune deposits), igneous (volcanic), and metamorphic (rocks changed by heat and pressure), only sedimentary rocks are exposed at Scotts Bluff. Weathering and erosion of the Rocky Mountains supplied the sedments which were deposited here by wind and water in horizontal layers. These layers then became compressed by overlying sedimentary rocks. Some the sediments in the rocks here have an igneous origin. Volcanic eruptions to the west of Scotts Bluff created large amounts of ash that at times mixed with the other sediments and at other times formed distinct layers.

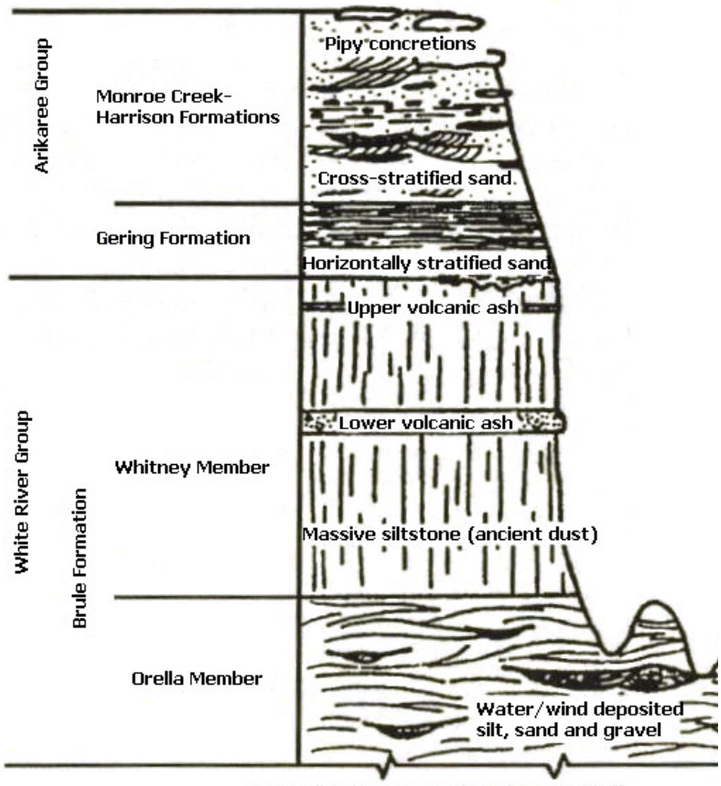
Because sedimentary rocks usually form in horizontal layers, geologists can interpret the sequence of events that occurred. Unless the rocks have been severely tilted or folded, the oldest layer can be found on the bottom and youngest on top. Knowing this helps to determine the age of the layers.

Naming Rock Layers

Geologists use a system to name rock layers that is sometimes hard to follow. It is helpful to think of rock layers as the pages of a book. Pages of a book that cover a similar topic make up a chapter, and similar chapters can also be grouped together. Geologists do the same with rock layers. Layers with similar characteristics such as grain size, composition, structures, or color are grouped into a member. Similar member formations are orgainized into a group. Each member, formation, and group is given a name, usually associated with the place where the layer was first studied or is best exposed. This system allows geologists to discuss or write about rock layers without having to repeat the characteristics each time.

The Geologic Story of Scotts Bluff

If you were to drill a well near the North Platte River, upon reaching a depth of 250 feet, you would find evidence that ancient shallow seas covered the Great Plains until 70 million years ago. A sedimentary rock called shale, which formed at the bottom of that ancient sea, is now buried below the promontories of Scotts Bluff. Geologists have named this formation the Pierre Shale. The sea receded as the Great Plains began to uplift along with the uplift of the Rocky Mountains. Meandering rivers and eastward blowing winds then began to carry weathered sand and silt from the newly formed mountains. The materials left by these rivers became the Orella Member of the Brule Formation in the White River Group (see generalized cross-section). This layer can be seen in the badlands section of the park.



Generalized Cross-section of Scotts Bluff

Next in the geologic story of Scotts Bluff, huge volcanic eruptions occurred in what is now south-central and western Colorado, beginning about 33 million years ago. These eruptions were similar to the violent eruption of Mt. Saint Helen in the state of Washington in 1980. Eastward blowing wind currents carried the volcanic ash to western Nebraska. This ash is found in the Whitney Member of the Brule Formation, mixed with silt. Two distinct ash layers are also found in the Whitney Member. The lower ash layer likely records one enormous eruption about 31 million years ago. Both of these ash layers are visible about half way up Eagle Rock.

The Gering Formation of the Arikaree Group records the development of sand dunes across western Nebraska. This formation can be viewed in Eagle Rock at the change from a massive cliff to the more layered appearance higher up. Cross-sections of Gering Formation dunes can be seen on the Saddle Rock Trail, in the Monroe Creek-Harrison Formation, the so-called "pipy" concretions of hard calcium carbonate stick out of the rock layers. The dunes and concretions scattered together among the layers indicate cyclic changes in climate about 20 million years ago. During dry periods, the sand dunes formed and moved across the plains. During wetter periods, ground water moved through some of the sand and calcium carbonate cemented the sand into the concretions.

About five million years ago, renewed uplift of the plains and decreasing amounts of sediment allowed rivers and winds to begin to erode the very sediment they had originally deposited. The uplift of the plains caused the rock layers to crack, further weakening them. In some areas, the layers containing the "pipy" concretions were not cracked, and these layers formed a protective cap over soft rock below. These areas now stand up from the landscape as the bluffs we see today. Before this uplift and erosion, the plains here were at least as high as the present top of the bluffs. Since that time, between 400 and 800 feet of sedimentary rock has been removed, and that process continues today.

The Book of Scotts Bluff

Ancient seas, streams, sand dunes and volcanic eruptions have all worked to produce the layers making up Scotts Bluff. At one time, water and wind were the forces which deposited the fine silt and ash which built up the plains until five million years ago. Today, the same forces are working to tear down the bluffs. Perhaps in another few million years there will be no bluffs at all. Water and wind will be left to begin, perhaps, another cycle of deposition.

It has taken nearly 70 million years to create the landscape at Scotts Bluff National Monument. Walking off of paved trails on the summit of Scotts Bluff can artificially increase the wearing away of the rocks by trampling protective plant cover. Walking off-trail on the summit is also dangerous, and is prohibited. With proper protection and careful use, the bluffs can remain essentially unchanged for your children and future generations to enjoy.