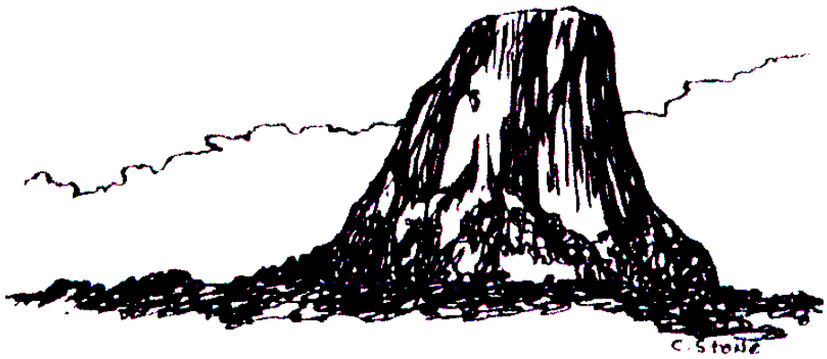
Geology



Devils Tower rises above the surrounding grassland and Ponderosa pine forests like a rocky sentinel. Northern Plains tribes have worshipped near this remarkable geologic formation for thousands of years. Fur trappers, explorers, and settlers alike were awed by the tower's majesty. In 1906, President Theodore Roosevelt established Devils Tower as our nation's first national monument. Many have gazed at the Tower and wondered, "How did this amazing formation form?"

THE STAGE IS SET

Most of the landscape surrounding Devils Tower is composed of sedimentary rocks. These rocks are formed from broken or dissolved fragments of other rocks and are usually deposited by water or wind.

The oldest rocks visible in Devils Tower National Monument were laid down in a shallow inland sea. This sea covered much of the central and western United States during Triassic time, 225 to 195 million years ago. This dark red sandstone and maroon siltstone, interbedded with shale, can be seen along the Belle Fourche River. Oxidation of iron rich minerals causes the redness of the rocks. This rock layer is known as the Spearfish Formation.

Above the Spearfish formation is a thin band of white gypsum, called the Gypsum Springs formation. Gypsum is an important mineral resource commonly used in making drywall. This layer of gypsum was deposited during the Jurassic time, 195 to 136 million years ago.

Seas retreated and returned. Gray-green shales deposited offshore in deep marine environments were interbedded with fine-grained sandstones, limestones, and sometimes thin beds of red mudstone. These rock layers, called the Stockade Beaver member, are part of the Sundance Formation—also of Jurassic age.

The Hulett Sandstone member, also part of the Sundance formation, is a yellow, fine-grained sandstone deposited on an ancient beach. Resistant to weathering, it forms the nearly vertical cliffs that encircle the Tower itself.

Seas retreated and advanced; landforms developed and eroded. New sediments were deposited. Approximately 50 to 60 million years ago, during Tertiary time, pressures within western North America climaxed, uplifting the Rocky Mountains and the Black Hills. At this time or shortly after, magma (molten rock) welled up toward the surface of the earth, intruding into the already existing sedimentary rock layers.

THE TOWER IS FORMED: AN ONGOING DEBATE

Geologists agree that Devils Tower was formed by the intrusion (the forcible entry of magma into or between other rock formations) of igneous material. What they cannot agree upon is how that process took place and whether or not the magma reached the land surface.

Numerous ideas have evolved since the official discovery of Devils Tower. Geologists Carpenter and Russell studied Devils Tower in the late 1800s and came to the conclusion that the Tower was indeed formed by an igneous intrusion. Later geologists searched for more detailed explanations.

In 1907, scientists Darton and O'Hara decided that Devils Tower must be an eroded remnant of a laccolith. A laccolith is a large, mushroom–shaped mass of igneous rock which intrudes between the

layers of sedimentary rocks but does not reach the surface. This produces a rounded bulge in the sedimentary layers above the intrusion. This idea was quite popular in the early 1900s when numerous studies were done on a number of laccoliths in the Southwest.

Other ideas have suggested that Devils Tower is a volcanic plug or that it is the neck of an extinct volcano. Although there is no evidence of volcanic activity - volcanic ash, lava flows, or volcanic debris - anywhere in the surrounding countryside, it is possible that this material may simply have eroded away.

The simplest explanation is that Devils Tower is a stock—a small intrusive body formed by magma which cooled underground and was later exposed by erosion.

The magma which formed Devils Tower cooled and crystallized into a rock type known as phonolite porphyry. It is a light to dark-gray or greenish-gray igneous rock with conspicuous crystals of white feldspar. Hot molten magma is less dense and occupies more volume than cool hardened rock. As the rock cooled, it contracted, forming hexagonal (and sometime 4-, 5- and 7-sided) columns separated by vertical cracks. These columns are similar to those found at Devil's Postpile National Monument in California but those at Devils Tower are much larger.

THE TOWER IS UNCOVERED

Until erosion began its relentless work, Devils Tower was not visible above the overlying sedimentary rocks. But the forces of erosion, particularly that of water, began to wear away the soft sandstones and shales above and around the Tower. The much harder igneous rock of the Tower survived the onslaught of erosional forces, and the gray columns of Devils Tower began to appear above the surrounding landscape.

As rain and snow continue to erode the sedimentary rocks surrounding the Tower's base, and the Belle Fourche River carries away the debris, more of Devils Tower will be exposed. But at the same time, the Tower itself is slowly being eroded. Rocks are continually breaking off and falling from the steep walls. Rarely do entire columns fall, but on remote occasions, they do. Piles of rubble, broken columns, boulders, small rocks, and stones, lie at the base of the Tower, indicating that it was, at some time in the past, larger than it is today.

Eventually, at some time far in the future, even Devils Tower itself will erode away!

FOR MORE INFORMATION

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Devils Tower website: www.nps.gov/deto

Views of the National Parks: http://www2.nature.nps.gov/views/#