

Erosion in the millions of years since the impact has washed away any meteorite debris, and now provides a glimpse into the interior of the impact structure, exposing rock layers that were once thousands of feet underground.

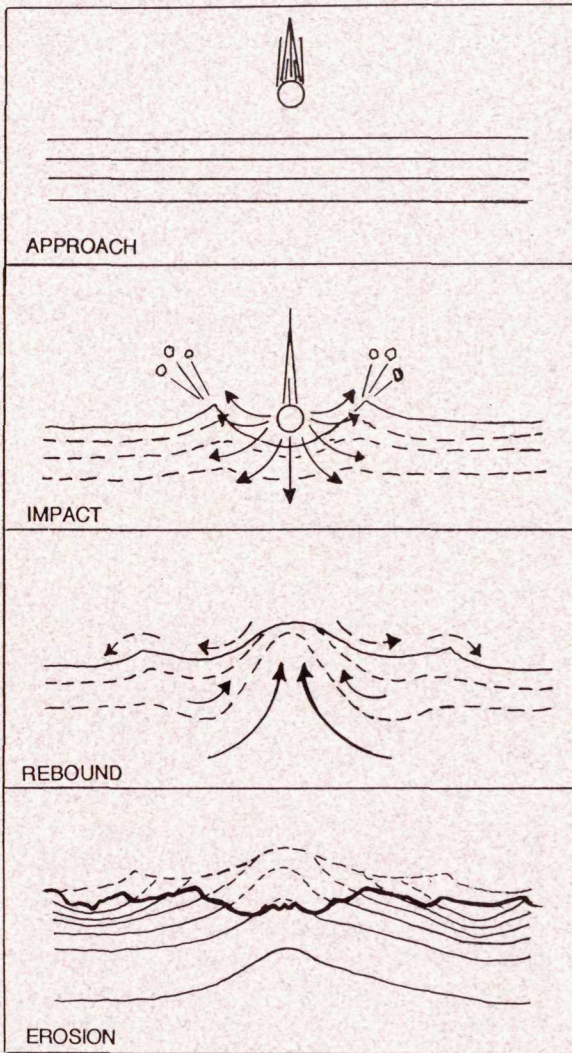


Figure 4. Illustration of the meteorite impact theory (Lunar Source Book, 1988)

## Other Theories?

Other theories for the origin of Upheaval Dome have been proposed by geologists over the years. One of the earliest theories, called the cryptovolcanic (hidden volcano) origin, has since fallen into doubt because of lack of evidence.

The hydrotectonic (water built) surge tube theory is a recent proposal. A water surge can form when movement along deep underground faults explosively forces a tube of ground water upward. The surface explosion which occurred when this water blasted out of the ground may have formed the beginnings of Upheaval Dome.

As long as the origin of Upheaval Dome is debated, various theories for its origin will be proposed. Perhaps Upheaval Dome was created by forces not yet even understood by today's scientists.

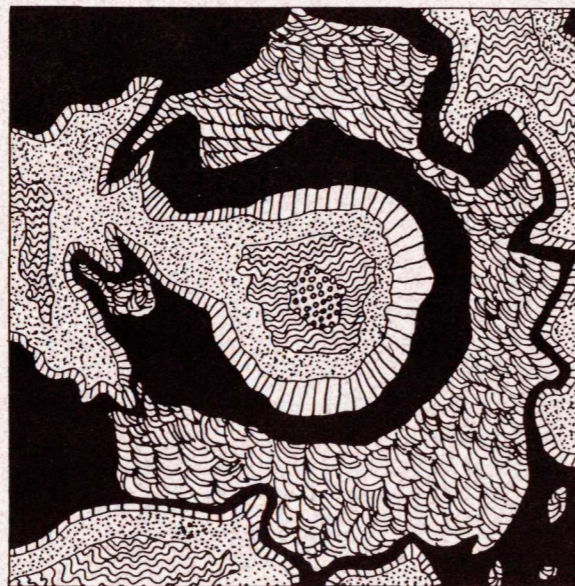


Figure 5. Geologic Map of Upheaval Dome (After Mattox, 1975)

## Upheaval Dome Today

Whatever the origin of Upheaval Dome -- salt dome, meteorite impact, hydrotectonic surge tube, or something unknown -- it is a result of the erosion of a structural dome. Rock layers now at the surface were once buried at least a mile underground. The central part of the dome -- where folding was most intense -- was weakened the most and is where the greatest erosion took place. While some call this feature a crater, it is not a "crater" in the traditional sense of the word, but simply another example of the erosion which created Canyonlands National Park.

The origin of Upheaval Dome may always be a geologic puzzle. The earth is a highly complex scientific laboratory. Perhaps the greatest lesson to be learned from Upheaval Dome is not of the forces which created it, but of our understanding of our planet: despite all we know, mysteries still abound!

A list of references and further information is available at the Visitor Center.

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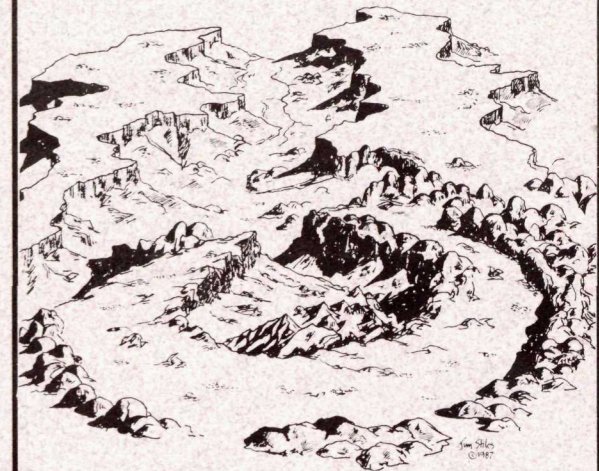
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# Upheaval Dome

## Trail Guide

0.5 mile



## Island in the Sky District

Canyonlands National Park



## Setting the Scene

The landscape of Canyonlands National Park has been sculpted by erosion. Water, wind, and gravity have worked together over millions of years to carve canyons, mesas, buttes, and spires. Canyonlands is characterized by flat-lying layers of rock consisting of multicolored sandstones and shales of varying hardness. Each of these layers responds differently to the force of erosion. Hard layers yield vertical cliffs; softer rocks form slopes.

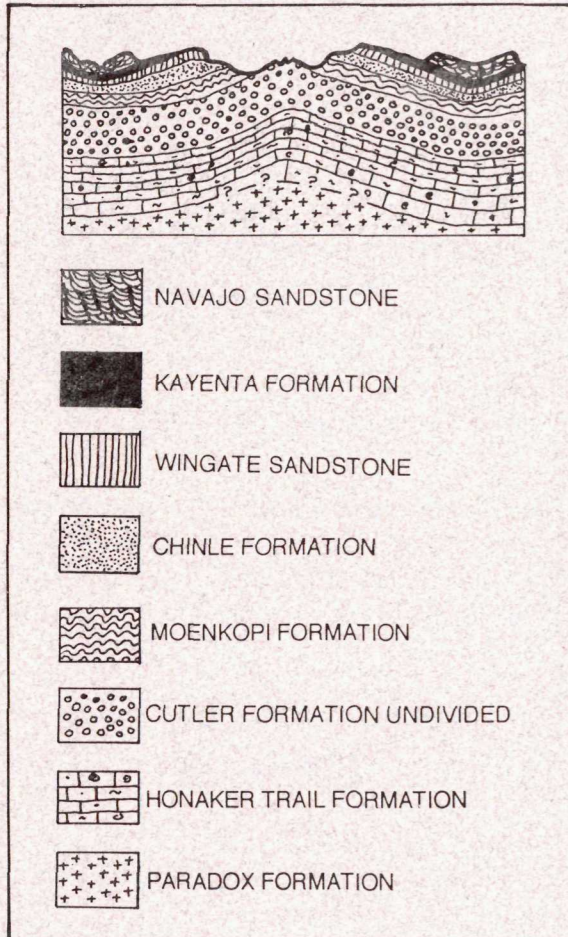


Figure 1. The structure of Upheaval Dome (after McKnight, 1940)

Canyonlands is a place of geologic order. Layer upon layer of rock systematically records chapters of the park's past. Generally speaking, these layers have not been altered, tilted, or folded in the millions of years since they were laid down as sediments by ancient seas, rivers, or winds.

Upheaval Dome is quite different, however. In an area approximately three miles (5km) across, rock layers are dramatically deformed. In the center the rocks are pushed up into a circular structure called a dome, or an *anticline*. Surrounding this dome is a downwarp in the rock layers called a *syncline*. What caused these folds at Upheaval Dome? Geologists do not know for sure; the origin of Upheaval Dome remains unclear.

In 1940, geologist E.T. McKnight described Upheaval Dome as the "most peculiar structural feature that has yet been found in southeastern Utah." Since then, a number of theories have been proposed to explain its origin. The most widely accepted--and debated--theories are the "salt dome" theory and the "meteorite impact" theory.

### Salt Dome?

A thick layer of salt, which now underlies southeastern Utah including Canyonlands, formed over millions of years when ancient landlocked seas evaporated. As a rock, salt possesses some unusual properties. First, when under pressure from thousands of feet of overlying rock, it can flow "plastically," similar to ice moving at the bottom of a glacier. Salt is also less dense than sandstone. The net result is that slowly, over millions of years, salt can flow up through rock layers as "salt bubbles" that create salt domes and deform the surrounding rock.

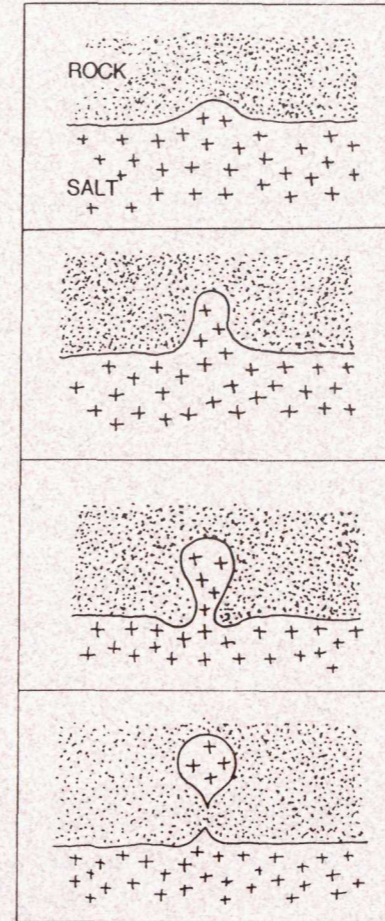


Figure 2. Development of salt bubble (After Schultz-Ela & Jackson)

When geologists first suggested that Upheaval Dome was the result of a salt dome, they believed the landform resulted from erosion of the rock layers above the dome itself. Recent research suggests that a "salt bubble" and the overlying rock have been entirely removed by erosion and the present surface of Upheaval Dome is now the pinched off stem below the missing bubble. If true, Upheaval Dome would have the distinction of being the most deeply eroded salt structure on earth.

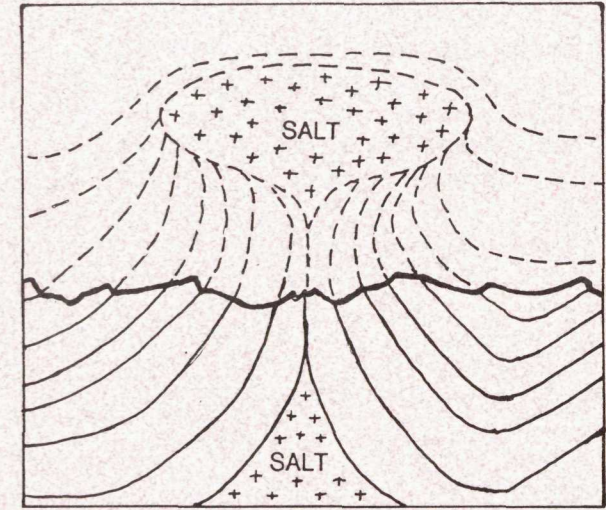


Figure 3. Erosion has revealed the pinched off stem

### Meteorite Impact?

Meteors can--and do--collide with the earth. When they do, they make impact craters. Meteor Crater in Arizona is a well-known example of a small, recent impact crater. If Upheaval Dome is a meteorite crater, it would be much older and larger.

Some geologists estimate that roughly 60 million years ago a meteorite with a diameter of approximately one-third mile hit at what is now the Upheaval Dome site. The impact created a large explosion shooting dust and debris high into the atmosphere. The impact initially created an unstable crater that partially collapsed. As the earth around Upheaval Dome established equilibrium, the rocks underground heaved upward filling the void left by the impact.