



## Geology



Canyonlands National Park is a showcase of geology. In each of the districts, visitors can see the remarkable effects of millions of years of erosion on a landscape of sedimentary rock. Pictured above, the Green River has carved a channel out of rock layers that were deposited nearly 300 million years ago.

### Deposition

For hundreds of millions of years, material was deposited from a variety of sources in what is now Canyonlands National Park. As movements in the earth's crust altered surface features and the North American continent migrated north from the equator, the local environment changed dramatically.

Over time, southeast Utah was flooded by oceans, crisscrossed by rivers, covered by mudflats and buried by sand. The climate has resembled a tropical coast, an interior desert, and everything in between.

Layer upon layer of sedimentary rock formed as buried materials were cemented by precipitates in ground water. Each layer contains

clues, like patterns or fossils, that reveal its depositional environment.

For example, the red and white layers of Cedar Mesa Sandstone occur where floods of iron-rich debris from nearby mountains periodically inundated coastal dunes of white sand. Only a trace of iron is needed to color a rock red.

It is difficult to imagine such major changes and the time scale they spanned. Equally surprising is the fact that all of these rock layers were flat when they were deposited. Only recently, speaking in geologic time, have these layers eroded to form the remarkable landscape seen today.

### Erosion

Until about 15 million years ago, most of the canyonlands area was near sea level. Local uplifts and volcanic activity had created features like Capitol Reef's Waterpocket Fold and the La Sal Mountains near Moab, but then movements in the earth's crust caused the whole area to rise. Today, the average elevation is over 5,000 feet above sea level.

The uplifting of this region, known as the Colorado Plateau, marked a shift from a depositional environment to one of erosion. The Colorado and Green rivers began to down cut and are now entrenched in canyons over 2,000 feet deep. Sediment-filled storm run-off drains into these rivers, scouring the surrounding landscape into a network of tributary canyons, pour-offs and washes.

How sedimentary rock weathers depends largely on its exposure to water. An erosion-resistant caprock of White Rim Sandstone may protect a weaker layer of shale until only a thin spire remains. Examples of such "standing rocks" can be seen in both the Island in the Sky and the Maze districts.

In addition to floods, the expansion of freezing water is a powerful erosive force. As ice loosens surface material and widens cracks, everything becomes more vulnerable to the next big storm.

Another significant factor in the shaping of Canyonlands is the Paradox Formation, a layer of sea water evaporites. Deeply buried, the salts in this layer can move under the weight of the overlying rock, flowing, like toothpaste, away from the source of greatest overburden. In response, the upper layers may bow up, creating a salt dome, or erode and collapse, creating a salt valley.

This phenomenon is especially visible in the Needles, where parallel cracks or "joints" formed in the surface rock as buried layers slumped toward Cataract Canyon. These cracks are perpendicular to an older system of cracks created by the "Monument Uplift." The resulting crosshatched pattern of joints has eroded so that great blocks of sandstone have been reduced to thin spires of rock.

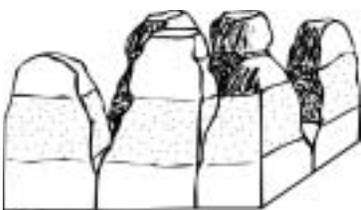
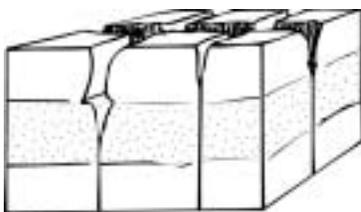
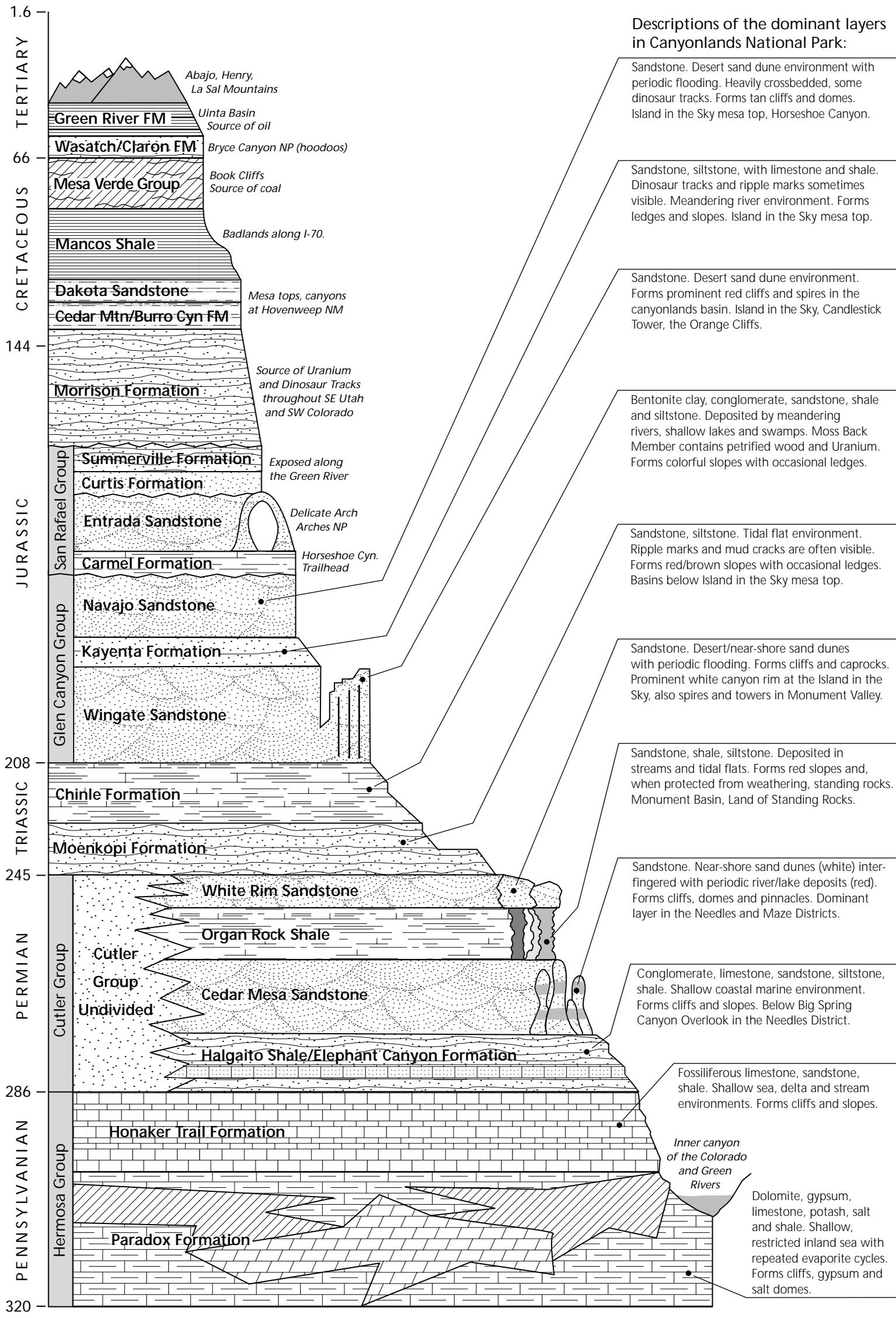


Illustration of how crosshatched joints eroded to form spires of rock in the Needles District.

# Rock Sequence of the Canyonlands Area

This sequence shows the deposited layers from youngest (top) to oldest (bottom). For clarity, the entire record of visible layers in this area is shown, including those not found in Canyonlands. Older rocks are not exposed in SE Utah, except for Precambrian rocks along the Colorado River in Westwater Canyon. Geologic names are actively debated and vary regionally, so sometimes two names are listed.



GEOLOGIC PERIOD  
Millions of Years Ago

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