

# Chaco Culture

National Historical Park  
National Park Service  
U.S. Department of the Interior

## THE GEOLOGY OF CHACO CANYON

### THE LANDSCAPE

The landscape of Chaco Canyon is hauntingly beautiful. Sunlight and shadows play on towering rock walls where petroglyphs keep secret the history of an ancient people. The canyon floor still conceals the buried remains of Pueblo dwellings. Those which have been excavated are as mysterious as they are revealing. Visitors come from all over the world to this spectacu-

lar place to enjoy the natural beauty and to marvel at the grandeur of the ancient sandstone buildings that remain.

Chaco Canyon lies near the center of the San Juan Basin of New Mexico, which is near the southeastern edge of the much larger Colorado Plateau. This region has broad exposures of horizontal sedi-

mentary layers that have eroded into plateaus, mesas, buttes, and canyons. The rocks exposed in Chaco Canyon record an interval in the Earth's history during the Late Cretaceous Period, approximately 75 to 80 million years ago. During this time, Chaco was part of the migrating coastline of an ancient inland sea.

### THE CRETACEOUS SETTING

The name "Cretaceous" is derived from the Latin word for chalk (creta) which is a characteristic rock type of this period for many land masses in the northern hemisphere. Throughout much of the Cretaceous period, sea level was higher than the present, and portions of many continents were inundated by shallow seas. In the area of the southern Rocky Mountains, mountain building activity also produced an adjacent broad area of subsidence known as the Western Interior Basin. This basin was flooded by seas from both the Arctic and Gulf Coast regions. By the Late Cretaceous, the Western Interior Seaway was hundreds of miles wide and had divided North America into two separate land masses. The shore-

lines of this epicontinental seaway were oriented generally north-south and repeatedly shifted position to east and west in response to changes in global sea level. The Cretaceous rocks visible today in both Chaco Canyon and Mesa Verde were deposited in alternating marine and nonmarine environments as the Western Interior Seaway repeatedly inundated parts of the Four Corners area and then receded.

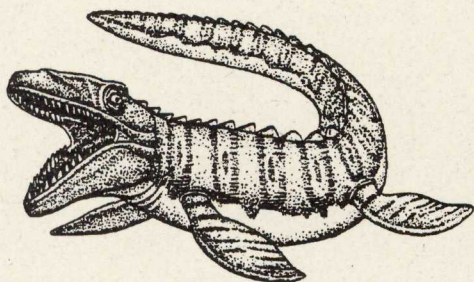
In the Late Cretaceous, much of the Southern Rocky Mountain Region was characterized by a subtropical climate which supported lowland forests of conifer, eucalyptus, ebony palm, cypress, and magnolia. Upland areas supported hardwood forests of oak, walnut,



Area Occupied by the sea.

ash, and birch. The landscape of late cretaceous Chaco Canyon resembled modern day coastal areas, such as those found on the southeastern Atlantic and Gulf coast of the United States. These mainland beach, coastal plain, and barrier island environments consist of marshes, swamps, river deltas and lagoons adjacent to beach and relatively shallow coastal waters.

### CHACO GEOLOGY



The majority of the exposed features in Chaco Canyon belong to a suite of rocks known as the Mesa Verde group. The further subdivisions of the unit are, from oldest to youngest, the Point Lookout Sandstone, the Menefee Formation, and the Cliff House Sandstone. Of these three formations, only two, the Menefee and Cliff House are

visible in Chaco, while all three are exposed at Mesa Verde. An additional two younger units, the Lewis Shale and the Picture Cliffs Sandstone, are generally exposed only near the northern boundary of the park.

## MENEFEE FORMATION

The Menefee Formation is the oldest exposed unit of the Mesa Verde Formation at Chaco and is composed primarily of siltstone and mudstone interbedded with sandstone as well as carbonaceous shale and thin coal beds. The Menefee Formation was formed from sediments deposited by rivers flowing north and east across New Mexico toward a retreating Interior Seaway.

At the edge of the seaway, the streams meandered through a wide, flat coastal plain with deltas, shallow swamps and lagoons, accumulating plant material which would eventually form thin coal beds. Common vertebrate fossils include an abundance of turtle, fish and crocodile as well as fragmentary evidence of larger creatures such as hadrosaur dinosaurs and giant marine lizards known as mosasaurs. Plant fossils found in the Menefee include leaf impressions of palm and conifer as well as specimens closely resembling modern laurel, witch hazel and camelia, suggesting a warm, moist, subtropical environment. Today, the Menefee in Chaco is visible as a slope forming unit that underlies the steep mesa walls of the more resistant Cliff House sandstone. It is especially prominent on the southern side of

the canyon, with a number of excellent exposures visible on Fajada Butte.

## CLIFF HOUSE SANDSTONE

The Cliff House Sandstone is a complex sequence of marine sandstones with locally interbedded shales which overlies the Menefee Formation. There are three principle Cliff House units visible within Chaco Canyon. The massive lower unit forms the 80-100 foot prominent cliffs throughout the canyon. An abundance of ripple marks and a wide variety of fossils are visible in this unit.

Fossils include shells and casts from clams, ammonites, snails, shark's teeth, and the knobby casts of burrows known as Ophimorpha ("dwelling place") Nodosa ("nodular"). These casts are thought to be the fossilized remains of burrows left by a small shrimp-like crustacean known as *Callianasa major*.

Immediately above the lower layer is an intermediate sandstone/shale unit. Although primarily a marine sandstone, it has locally interbed-

ded shales which were deposited in deeper water when the entire area was covered by the Western Interior Seaway. This unit is less resistant to erosion than the lower sandstone and forms gentle slopes rather than cliffs. Fossils found in this unit are similar to those of the lower sandstone.

The uppermost unit exposed in Chaco Canyon is the Upper Sandstone. It is similar in composition to the lower sandstone unit and also forms prominent cliffs and ledges. This unit represents a beach and barrier island environ-



Fajada Butte

ment similar to that of the lower sandstone unit. It was deposited in shallower water than the intermediate shale unit and reflects a lowering of the local sea level as the Western Interior Seaway receded for the last time.

## EROSION AND CLIFF FORMATION

The Menefee Formation is less resistant to erosion than the Cliff House Formation and often completely erodes from beneath the younger sandstone. The unsupported sandstone will then break away in large slabs and boulders as the undercutting reaches joints and local weaknesses. This step-wise erosion is responsible for producing both the prominent cliff faces and the debris mounds or talus slopes piled against them. When this erosional process continues, it may actually "sever" a landform into separate free standing rock masses.

One of the most dramatic examples of such erosion is the immense slab of sandstone known as

"Threatening Rock". When the ancient builders were constructing Pueblo Bonito, "Threatening Rock" rested in a precarious position just behind it. Aware of the danger that it posed, the Chacoans built an earth and masonry retaining wall beneath this massive rock slab. The slab was first described in 1901 and was referred to as the "Elephant", the Navajos called it "Braced-up Cliff", and the Park Service named it "Threatening Rock". In an attempt to predict the fall of "Threatening Rock", the Park Service took on the job of monitoring its movement.

However, there was very little that could be done to prevent its fall and on January 22, 1941,

"Threatening Rock" collapsed taking several rooms of Pueblo Bonito with it.

It is probably safe to say the only constant, geologically and otherwise, is change. Soil and rock are always on the move through weathering, erosion, gravity, and the lateral movement of the earth's continents and ocean floors. The landscape is reshaped by these forces over hundreds, perhaps thousands, of years. Rapid occurrences, like rockfalls and earthquakes, also do their share of redistributing soil and rock.