Geologic Features — Tonto National Monument

Why is This Important?

The geology of Tonto National Monument played an essential role in the lives of the Salado people. Studying the geologic features of the Monument allows archaeologists to understand the Salado's access to natural resources.

The geologic processes of erosion created the caves in the cliff faces. If it were not for the nature of the rock found on the cliff faces, the caves may never have formed. It was in those alcoves and overhangs that the Salado built their homes. Besides providing the raw materials for objects such as tools, geology determined the necessary construction materials available for building the cliff dwellings.

Exposed Rocks

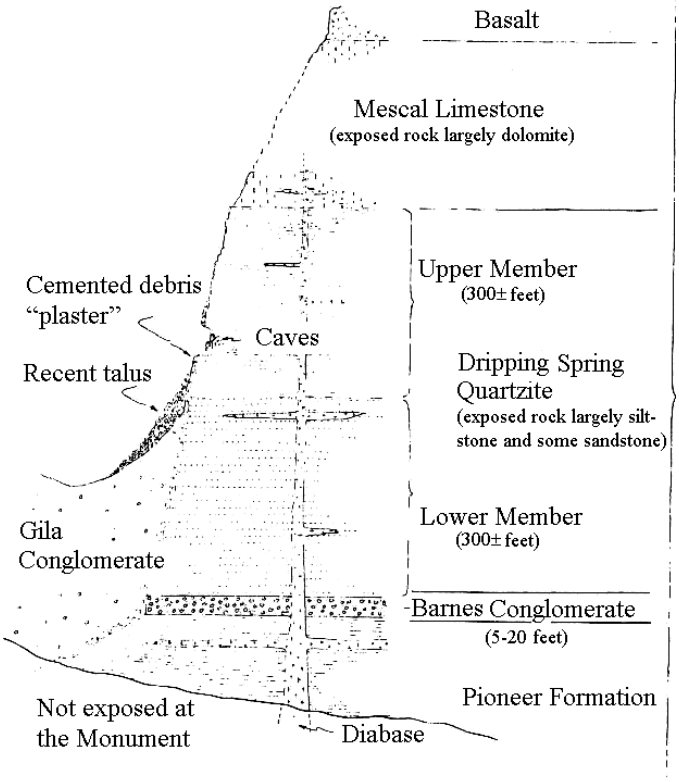
The rocks exposed at the Tonto National Monument are principally sedimentary rocks of the Apache Group and the distinctive Gila conglomerate. Some bodies of diabase are present, and a veneer of relatively recent rock debris covers parts of the lower slopes and canyon floors.

Rocks of the Apache Group were deposited a little more than a billion years ago during Precambrian time. The oldest unit of the Apache Group exposed at the Monument is the Pioneer formation, the dark maroon siltstone that crops out locally on the lower flanks of Cholla Canyon south of the visitor center. Some rocks of the Pioneer formation tend to break into thin plates, which were useful to the Salado as material for weapons and tools.

The youngest material noted at the Tonto National Monument is rock debris that is accumulating even today as a veneer on the slopes and canyon floors. This debris is composed of angular rock fragments derived from the Dripping Spring quartzite and Mescal formations in the cliffs and slopes immediately above. It is characteristically unsorted, unstratified, and unconsolidated. The fragments range even more widely in size than in the Gila conglomerate.

Basalt

A thin flow of Precambrian basalt caps the Mescal limestone. The basalt is a dense, fine-grained, dark gray to black rock, generally with a distinctive dark-reddish cast. It commonly contains scattered larger crystals of a lighter colored feldspar mineral. This basalt was not used by the Salado for implements and utensils. For such objects they generally used a black basalt filled with small, nearly spherical holes formed



Generalized Columnar Section

by gas bubbles when the rock was still molten. Such basalts are much younger than the basalt cap rock of the Mescal and occur, for example, in the valley-fill near the San Carlos Apache Reservation.

Mescal Limestone

The Mescal limestone, which overlies the Dripping Spring quartzite, caps many of the hills at the Monument. The Mescal here is light gray dolomite (calcium magnesium carbonate) near diabase bodies, though some limestone may be present at the Monument. The term "limestone" is part of the official name of the Mescal. It does not accurately reflect the composition of the Mescal at Tonto National Monument where the Mescal is largely composed of dolomite.

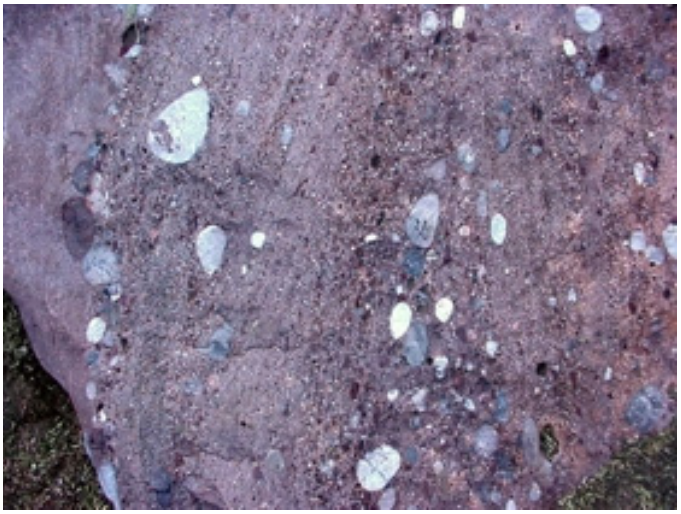
Thin streaks of chert occur in much of the Mescal and form dark gray bands oriented parallel to the bedding planes. Chert, which is composed of extremely fine-grained quartz, resists erosion, and the bands protrude from the less resistant limestone and dolomite on weathered surfaces.

Dripping Spring Quartzite

Although the Lower and Upper Cliff Dwellings are at different altitudes, they are both in the same layer of Dripping Spring quartzite. The rocks of the Dripping Spring quartzite are composed mainly of quartz and feldspar, but they also contain a very small amount of carbon and extremely fine grains of pyrite disseminated through the rock. The red and brown colors in unweathered exposure commonly are due to the feldspar minerals, and the gray and black colors result from the carbon and pyrite. Where weathered, the feldspar minerals have turned in part to clay, and the carbon and pyrite have been oxidized. The weathered rock is pale brown and yellow and is locally stained darker by surface coatings of iron minerals derived from weathered pyrite.

Barnes Conglomerate

The Barnes conglomerate, 5 to 20 feet thick, overlies the Pioneer formation. In turn, it is overlain by the Dripping Spring quartzite that consists of a lower member (composed of reddish brown sandstone and quartzite) and an upper member (composed of platy to massive black, gray, red, and brown claystone, siltstone, sandstone, and quartzite). The Barnes conglomerate consists of rounded, water-worn pebbles of older rock, but the varying size indicates they did not travel far. Some of these pebbles include quartzite, white vein quartz, jasper, and volcanic rocks. Eroded sand particles of feldspar-rich arkose create the pinkish color of the cement holding the pebbles together. Barnes conglomerate is one of the older rock layers of the Apache Group. Most of it lies below the surface. The wash in Cave Canyon cuts deep enough to expose a section of this rock layer.



Barnes conglomerate

Gila Conglomerate

The Gila conglomerate is the second youngest rock seen at the Monument. It was deposited between half a million and fifteen million years ago, after many geologic events had affected the older rocks of the area. The Gila conglomerate is valley-fill material principally composed of gravel conglomerate, which is lithified gravel (gravel hardened or cemented to a competent rock) and a few beds of sandstone and siltstone. The rock is commonly pale yellow and buff in color and poorly stratified and sorted, as indicated by areas that contain rock debris ranging in size from clay particles to boulders several feet in diameter. The degree of lithification of the Gila varies widely. Some layers are hard conglomerate or sandstone that can be broken only with a hammer, whereas others are gravelly or sandy and can be broken by hand.

At the bottom of the Gila conglomerate, the gravel is commonly cemented by caliche (calcium carbonate deposited by evaporating ground water), clayey material, and silica derived from ground water. This layer of cemented debris plaster is well exposed about 500 yards east of the visitor center and on the cliff face at the Lower Ruin. Because the Gila conglomerate was deposited in areas of irregular land forms, very much like those we see today at the edges of basins, the bottom of the Gila may actually be nearly vertical where the conglomerate filled in a steep walled valley, as at the Lower Ruin.

Diabase

Diabase was intruded into the older rocks after the outflow of basalt of the Mescal probably in Precambrian time between half a billion and one billion years ago. The diabase forms sills (tabular bodies of rock that were intruded in a molten state parallel to bedding planes), dikes (tabular bodies that cut across older rocks), and irregularly shaped masses. The diabase exposed east of the visitor center may be intruded along a fault.

Diabase is compositionally similar to basalt but has a distinctive texture. It is typically dark gray-green, due in part to abundant iron and magnesium in the rock-forming minerals. The diabase at the Tonto National Monument weathers to a characteristic olive green soil. Although not a hard rock, diabase is tough when fresh. For example, diabase is readily cut by a diamond saw, but the rock is often difficult to break with a hammer. Some of the manos and metates used by the Salado were made of this tough rock.

This fact sheet is adapted from Robert Raup's 1962 report titled *Some Geological Features of the Tonto National Monument*. It is available through the National Park Service's archives.

For Further Reading

Tonto National Monument Fact Sheets

Geologic History
Geology of Lower Ruins

Books

Waters, Michael. (1997). *Principles of Geoarchaeology: A North American Perspective*. Tucson, AZ: University of Arizona Press.