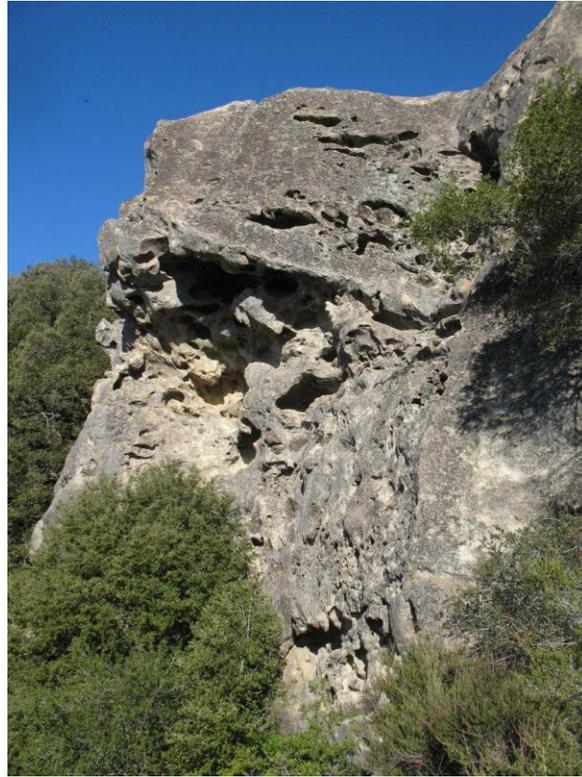


Geology of Castle Rock State Park By Stu Langdoc

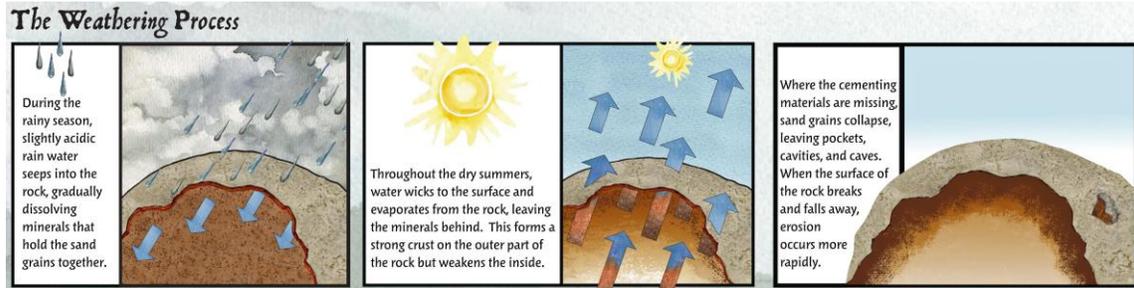


Goat Rock

An outstanding feature of Castle Rock State Park are the sculpted rock outcrops that are found in many areas of the park, but primarily along Castle Rock Ridge. These rock outcrops, called bosses by geologists, are formed from very thick layers of Vaqueros Sandstone which have been exposed at the surface. The smooth and rounded rock shapes are interrupted by unique formations called collectively tafoni. Geologists believe that finger pockets to whole cave systems are carved out of the rock by a chemical “cavernous weathering” process which occurs because of the rock, rainwater, and the wet winters and dry summers of California’s Mediterranean climate.

The park’s Vaqueros sandstone is a sedimentary rock that is similar to mortar. It is formed of large-grained sand held together with a cementing material, primarily calcium carbonate. Sandstone, like most rock, has within it minor cracks and crevices through which rainwater can penetrate into the interior of the rock. Rainwater is not pure but contains very small amounts of mild carbonic

acid because of a natural process that occurs when water reacts with the carbon dioxide in the air. As the mildly acidic rainwater percolates into the interior of the rock, it gradually dissolves the calcium carbonate that cements the sand grains together. This slow penetration and dissolving process goes on throughout the rainy winter season.



During the dry summer season the entrapped water slowly wicks to the surface of the rock by capillary action. The water brings with it both the dissolved carbonic acid and cementing material, mostly calcium carbonate, from between the grains of sand which form the interior of the rock. At the surface of the rock the water evaporates, leaving behind the dissolved calcium carbonate, producing a hard crust of up to two feet thick at the exterior of the rock. This crust of harder rock, called a duricrust, makes the exterior of the rock resistant to weathering, but in the interior of the rock wherever the cementing material is missing, the sand grains will collapse in the face of any weathering forces, leaving behind a cave, cavity, or pocket. Over time, perhaps hundreds of years, the crust grows harder and harder as more and more cementing material is moved from the interior to the exterior. This results in ever-enlarging caves, some of which are as much as 15 to 20 feet wide, 10 to 12 feet high and 8 to 10 feet deep.

The cementing calcium carbonate is not evenly distributed, nor is it uniform in concentration or chemical content. This helps to account for the unending variety and size of the sculpturesque formations and surfaces found in the park's rocks. It also helps account for other features found in the rock. In addition to the tafoni caves and sculpted surfaces, there are features that are called "fretworks" or "stone lattice", "cannonballs", and "fossilized tree trunks". "Fretworks" or "stone lattice" are other terms for what geologists call alveolar weathering and are features that are present in the interior of most of the caves. It is thought that they result from the same process that forms tafoni but form below the duricrust. Calcium carbonate appears to concentrate in a web of joints or small shears in the rock or as rainwater dissolves the cementing material, the cement spreads outward and deposits in a ridge where two of these spreading areas meet. Erosion scours out the weakly cemented sand between the areas of concentration, leaving the more strongly cemented sandstone in a raised relief of

septa, or fretworks. Some of the fretworks formations are quite extensive. The cannonballs are fairly large spherical masses that appear a dark reddish brown because they contain iron oxide as well as higher concentrations of calcium carbonate. The fossilized tree trunks also contain iron oxide and are of about the same color as the cannonballs but are a different shape. They both stand out in relief on exterior surfaces and in the interior of caves, as they are harder than the surrounding rock. Geologists are less sure of the origins of these features than they are of the caves and sculpted surfaces.



Fretworks



Cannonballs

The above description of geologists' theory of how the Vaqueros Sandstone tafoni, associated caves, fretworks, and cannonballs are possibly formed was derived from reference 2.) GEOLOGY, pages 8-10, reference 3.) pages 43-48 and reference 4 for a more general description of weathered caves in local sandstone.

REFERENCES

- 1.) Harvey and Stanley Associates, 1984 Castle Rock State Park Resources Description and guidelines for restoration Partridge Farm, Boisseranc Unit.
- 2.) Harvey and Stanley Associates, 1978, Geological Features of Special Interest, from Natural Resources Inventory of Castle Rock State Park and the Upper San Lorenzo River Basin.
- Reference 3.) Harvey and Stanley Associates, 1978, Geological Features of Special Interest, from Natural Resources Inventory of Castle Rock State Park and the Upper San Lorenzo River Basin.
- Reference 4.) Grantz, A. March 1976 Sandstone Caves (tafoni) in the Central Santa Cruz Mountains, San Mateo County, California, California Geology.)