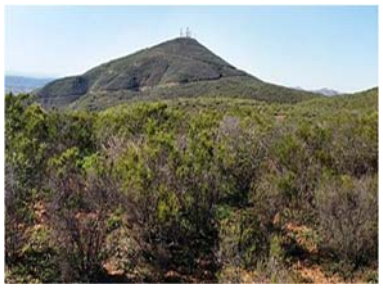


Friends of Los Peñasquitos Canyon Preserve

Geology of Los Peñasquitos Canyon, Carmel Valley, and Black Mountain

Canyons

Overview

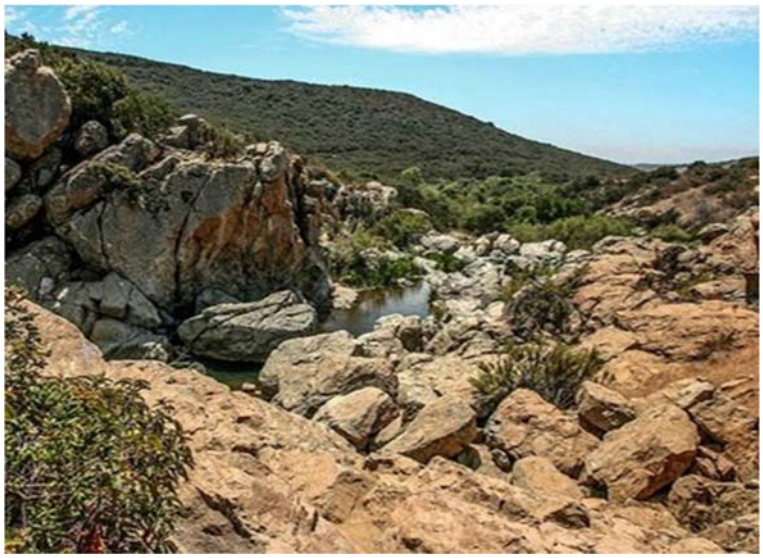
Part of what makes the Los Peñasquitos Canyon special are the rocks that are underfoot and serves as the foundation for the plants to grow. Because the canyon has been preserved and allowed to retain its relatively undisturbed state, we don't always see the rocks. But with a keen eye, and knowing where to look, we can all enjoy another chapter of the beauty of Los Peñasquitos Canyon.

The current landscape of the canyon began over 150 million years ago when the coastline was further to the east and the area where the canyon is today was part of a marine embayment.

The adjacent Carmel Valley and Del Mar Mesa areas share this same geology (**Carmel Mountain Preserve** and **Del Mar Mesa Preserve**).

"Peñasquitos" means "little cliffs" in Spanish. The canyon walls are gently sloped terraces of marine sediments, with bluffs ranging from 200 to 400 feet above sea level. Peñasquitos Creek flows from the hills in Poway, through the canyon, and to the ocean at Torrey Pines State Beach. Along the creek, there are clay, silt, sand and gravel soils that have been deposited by upstream erosion and downstream movement during storms. Most of the soils in the canyon are cobbly loams and rocky silt loams, with large coarse-grained components. Undisturbed soils have a "cryptogamic" surface crust that is home to tiny drought-resistant moss, lichens, and hundreds of little invertebrates.

Peñasquitos Formation



The oldest rocks in the canyon are called the Peñasquitos Formation, an assemblage of marine volcaniclastic sedimentary rock. Results of recent age dating studies found that the rocks are between 150 and 140 million years old, placing it in the Upper Jurassic geologic period. The best place to see the rocks of the Peñasquitos Formation are at the waterfall.

The Peñasquitos Formation was formed when volcanic ash, clays, silts, sands, and sandy pebbles were deposited in a shallow embayment or trench along the continental edge. The sediments and volcanic rock were mildly metamorphosed, by heat and pressure, into shales and metavolcanics rocks when the igneous rocks of the Southern California Batholith intruded into the accumulated sediments and volcanic rocks.

The La Jolla Group

The La Jolla Group rocks began as sediments that were deposited on top of the Peñasquitos Formation, along the shoreline, and on sand beaches and lagoons. A current day example of the types of sediments that accumulated in these areas can be seen at Torrey Pines State Beach. The sediments deposited in the lagoon on the east side of the Torrey Pines Road consists of clays and muds. Sediments deposited on the beach includes sands and gravels. Silts are deposited offshore.

The rocks of the La Jolla Group began as sediments that were deposited in lagoons, beaches, and in the ocean during the Eocene Era, about 40 million years ago, when sea level was much higher. As the sediments got thicker, they compressed and through a process called lithification became the rocks we now see. Based on the type of sediment and where they were deposited, the rocks of the La Jolla Group have been divided into four distinct formations, listed from the oldest to youngest:

The Del Mar Formation is a coarse- to fine grained, buff colored sandstone.

The Ardath Formation is a grey shale. The shale is made up of expansive clay and can easily be broken up.

The Scripps Formation consists of a lower coarse conglomerate and an upper buff colored sandstone. Soils developed upon the lower conglomerates usually supports the growth of grasses, whereas the soils developed on the sandstone supports lush growth of coastal scrub chaparral.

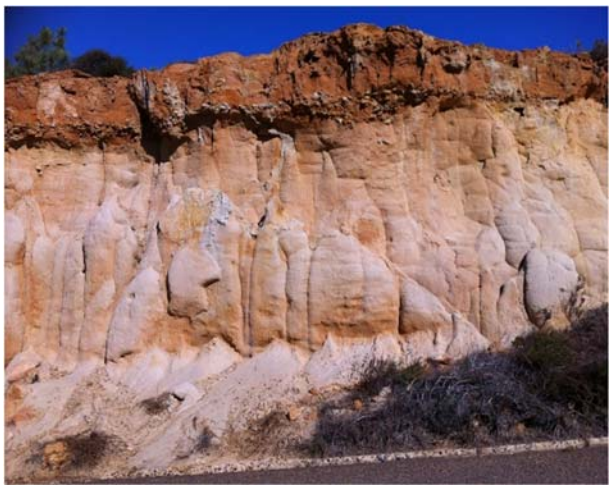
The Friars Formation consists of interbedded white sandstone, and a green claystone.

The Poway Group

The sediments that became the Poway Group were deposited on top of the La Jolla Group in the late Eocene approximately 40 million years ago. In contrast to the sediments of the La Jolla Group, Poway Group sediments were deposited were deposited in non-marine and nearshore marine and lagoonal environments. There are three distinct formations that make up the Poway Group, and the only formation that is found in the canyon is the Stadium Conglomerate.

The Stadium Conglomerate is generally composed of metamorphosed rhyolitic and dacite volcanic and volcaniclastic gravels and cobbles interbedded with sandstone. The presence of gravels and cobbles suggest that the sediments were carried by a large river before they were deposited. Studies indicate that the gravels and cobbles originated in an area near present day Sonora, Mexico, and the river transported them to the present location.

The Lindavista Formation can be found throughout the coastal margin of San Diego. It was deposited on a 6-mile-wide wave-cut terrace during the early Pleistocene, approximately 1.5 million years ago. These sediments include both marine and terrestrial deposits. The Lindavista Formation is composed of a pebble conglomerate. The most distinguishing features of the Lindavista Formation is its red color and resistant nature, which acts as a cap rock on the mesa tops; the presence of weathered, red hematite pebbles; and the characteristic hummocky topography where mima mounds and vernal pools can be found.



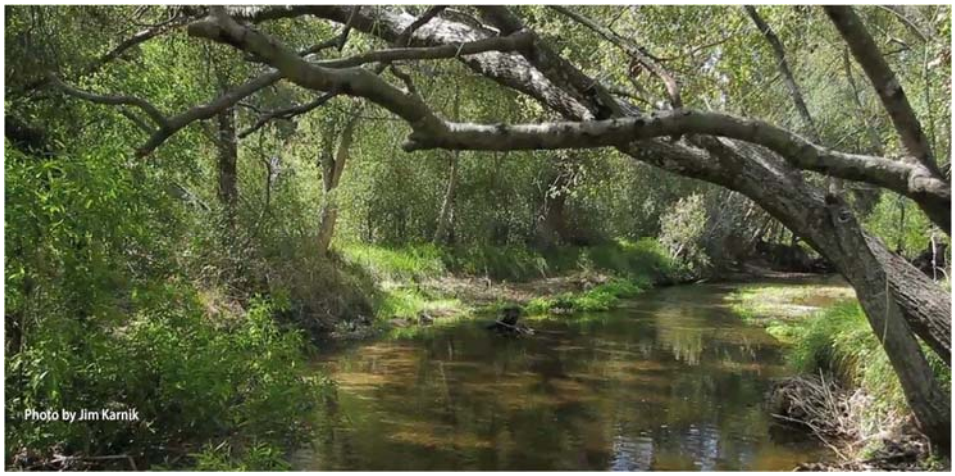
(photo at Torrey Pines State Park shows LindaVista as the upper formation)

The sediments of the Bay Point Formation were deposited in the Pleistocene, approximately 1.4 million years ago. The sediments were deposited in marine and non-marine environments.

The Bay Point Formation consists of brown, fine- to medium-grained sandstone with abundant fossils.

Alluvium and Slope Wash

Geologic processes continue to deposit sediment in the canyon. Peñasquitos Creek continues to carry sediments. When the flow in the Creek is such that it overflows the banks, those sediments are deposited on the floodplain. These deposits that consist of loose sands and gravels are called alluvium. Sediments carried from the cliffs during rain events and deposited near the base of the cliffs are called slope wash.



Black Mountain

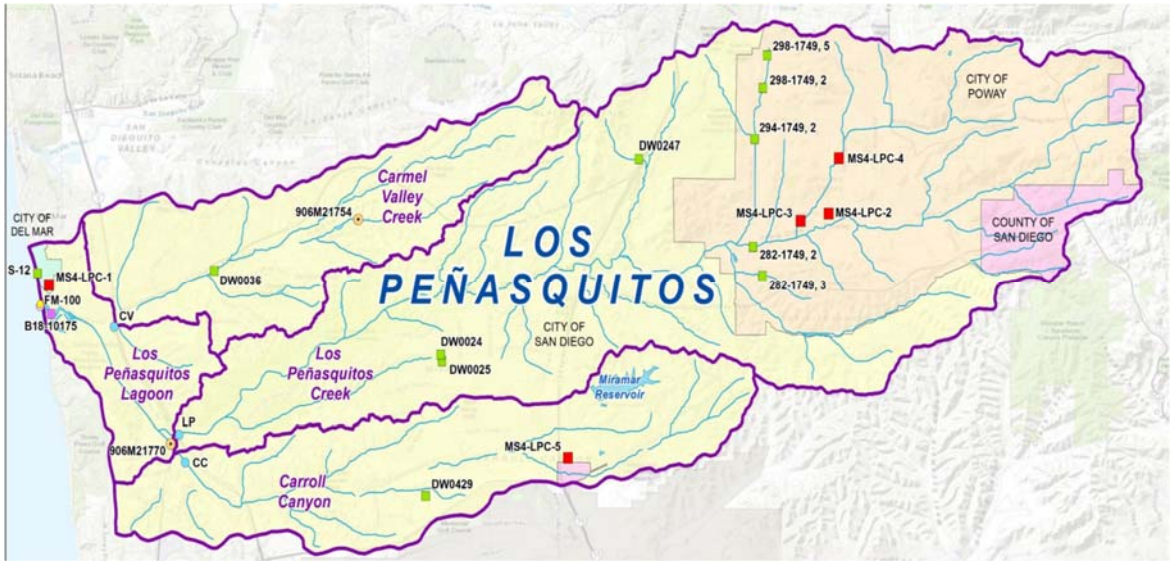
The rocks that makes up Black Mountain are very different than those that you will find in Los Peñasquitos Canyon, or the Del Mar Mesa preserves. They differ in the types of rocks, how they were formed, and when they formed. One of the most apparent differences can be seen by just looking at Black Mountain. In comparison to the rocks of Los Peñasquitos Canyon, which have been eroded, forming the canyon, the rocks of Black Mountain are very resistant to weathering, creating the mountain itself. The soils that have formed on Black Mountain supports dense chaparral.

The rocks that makes up Black Mountain are a collection of metasedimentary rocks consisting of conglomerates, sandstones, and siltstones, interlayered with metavolcanic rocks consisting of volcanic flows, volcanic tuffs, and volcanic breccia. The terms metasedimentary and metavolcanics means that the at some point in time the sediments and volcanic rocks were exposed to heat and pressure that changed the rocks from easily erodible sediments and volcanic rocks into the hard, resistant rocks that we see today.

(Black Mountain, from the south)

The rocks of Black Mountain are part of the Santiago Peak Volcanics. The Santiago Peak Volcanics are found in an elongate band that extends from Orange County into Mexico. The rocks originated from volcanic eruptions and erosion and deposition of sediments about 120 million years ago. These rocks were mildly metamorphosed during emplacement of the Southern California Batholith, into the rocks we see today along Black Mountain.

One of the most unique geologic features of Black Mountain is the abandoned arsenic mine. Arsenopyrite is found in irregular and discontinuous pods within the metavolcanics. Arsenic ore was extracted from the early to mid-1900s. The mine has been closed off to the public.



Watersheds

Los Peñasquitos Creek flows from the hills in Poway, westward through the canyon, and to the ocean at Los Peñasquitos Lagoon and Torrey Pines State Beach. Along the creek, there are clay, silt, sand and gravel soils that have been deposited by upstream erosion and downstream movement during storms.

Carmel Valley creek and Carroll creeks drain smaller areas and also flow into Los Peñasquitos Lagoon. More information about lagoon programs at http://www.lospenasquitos.org/ .

June 6, 2020, Barry Pulver, Geologist, bpulverret@gmail.com

Penasquitos Canyon Black Mountain