



## Montaña de Oro and Morro Bay State Parks

National and State Estuary | State Historical Landmark No. 821



### Strata, Terraces, and Necks

The shoreline of Montaña de Oro State Park is an ideal place to examine and explore geologic features such as tilted and folded rock outcrops. These rocks show different strata that were deposited in horizontal layers sequentially through time. About six million years ago, these beds were deposited as flat layers, one on top of another. The layers of rock record past conditions.

#### Process/Features:

Coastal geomorphology  
and volcanism

Tectonic forces over the past three million years have tilted the beds. Where these rocks are exposed along the coast, the sloping surface reflects just the top of a thick stack of sloping strata with the oldest beds at the bottom and the youngest beds at the top. Capping the marine strata are gravels that partly covered a marine terrace. These gravels are much younger than the underlying strata and are relatively undeformed. The contact between these two deposits is called an unconformity, and represents an extended gap of time for which the geologic record is incomplete, either due to no deposition or to erasure by erosion.

Differential erosion has preferentially etched away the softer rocks, leaving ridges of harder rock as ledges extending into the surf.

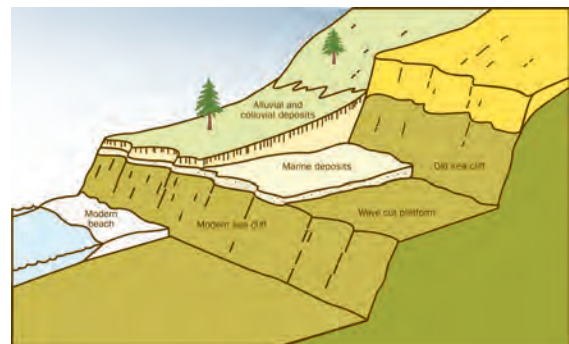


**Why it's important:** Morro Bay and Montaña de Oro State Parks are renowned for their spectacular scenery produced over millions of years by volcanic activity, plate tectonic interactions (subduction and collision), and erosion that have shaped this unique landscape.

### Marine Terraces

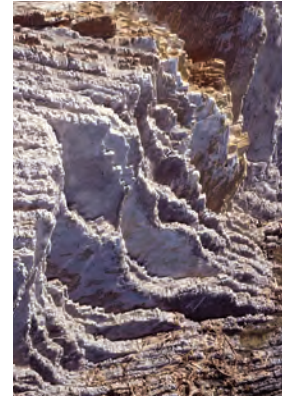
A sequence of old marine terraces that resembles a staircase leading down to the sea is cut into the slopes of the Santa Lucia Range. Marine terraces are formed by wave action, which erodes the coastline and cuts a marine platform at the base of a sea cliff. The terraces are then preserved due to fluctuations in sea level and tectonic uplift, which raises these surfaces above the sea. The slopes between the terraces were once sea cliffs.

At least 12 distinct marine terraces are found in Montaña de Oro State Park. The most prominent of these, located about 40 feet above the present sea level formed about 80,000 years ago. Older terraces are progressively more eroded, smaller, and less continuous. The oldest of these terraces is a small remnant located nearly 820 feet above sea level. Today, wave action is slowly cutting and widening the marine platform at the modern shoreline and, eventually, this too may be uplifted to form a new marine terrace.



**Marine terraces** consist of a wave-cut bedrock platform (bench) with a thin, discontinuous blanket of marine and younger non-marine deposits. The origins of the terraces are tied to changes in climate and associated fluctuations in eustatic (worldwide) sea level during the Pleistocene epoch 11,000–1.1 million years ago. Modified from Weber and Allwardt, 2001.





**What you can see:** Morro Rock is a volcanic plug, the westernmost part of a chain of extruded and eroded volcanic necks, plugs, and domes that make up the “Nine Sisters”, or “Morros.” Tilted sedimentary rocks located along the coastline of Montaña de Oro State Park show the succession of rocks that were deposited through time, as well as the effects of tectonic forces that have contorted these rocks after they were deposited. You can also see marine terraces uplifted high above the ocean and an extensive sand spit and dunes.

### **Morro Rock**

Morro Rock is the westernmost peak in a chain of hills known locally as the “Morros” or the “Nine Sisters.” These scenic peaks follow a line that extends between Morro Bay and San Luis Obispo. They are the eroded remnants of a chain of ancient volcanoes that erupted between 20 and 26 million years ago. Using radiometric dating methods, Morro Rock has been determined to be about 21 million years old. It is likely that the nine volcanoes erupted along an ancient fault. Magma flowed up along weak spots in the fault zone where it intruded near the surface or actually erupted.

Volcanic activity ceased. Erosion took over, gradually removing the softer rock that made up the flanks of the volcanoes. Today, all that remains is the crystalline “neck” of the volcano. This neck was originally the conduit for magma moving to the surface.



## Morro Bay

Visitors to the area may be surprised to find out that Morro Bay is a geologically young feature. During the last ice age when sea level was much lower, Morro Bay did not exist since the shoreline was located several miles offshore from its present position. At the time, the area of today's Morro Bay was probably a small river valley. As sea level rose during the last 10,000 years, this valley was inundated. The bay was formed when sand, pushed along the coast by ocean currents, formed the long sand spit that separates Morro Bay from the ocean. Artificial fill connects Morro Rock to the mainland and encloses the northern bay. The entrance to the harbor is regularly dredged to remove the sand that accumulates. This represents the most recent chapter of geologic history that has been in effect for millions of years.

## Final Thoughts

Today, erosion, deposition and ongoing tectonic forces continue to shape this rugged and evolving coastline.

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