



Patrick's Point State Park



Uplifted Terrace and Sea Stacks

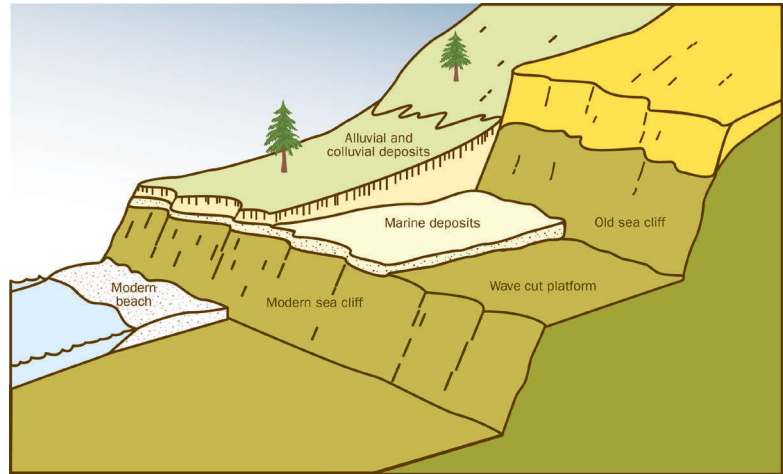
Most of Patrick's Point State Park rests on an ancient marine terrace uplifted from the sea approximately 83,000 years ago. The terrace averages about 200 feet above the modern sea level and is covered with wave-deposited sand and gravel. Offshore the waves are carving a new bedrock platform, which will serve as the base for a new terrace.

Features:

Coastal geomorphology and agate pebbles

Resistant rock outcrops protruding above the ancient terrace (Ceremonial Rock, Lookout Rock, and Wedding Rock) are ancient sea stacks like the modern ones now visible offshore amidst the crashing surf. Regional uplift and global sea level changes have elevated Ceremonial Rock and Wedding Rock out of the surrounding ocean: Ceremonial Rock towers 107 feet over the 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.



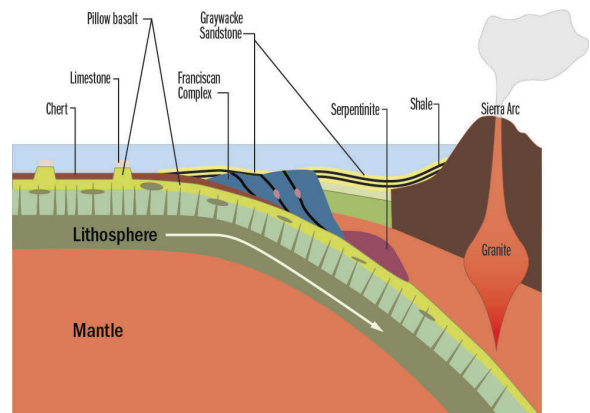
Franciscan Complex

The Franciscan Complex, exposed along the base of the cliffs south of Agate Beach, is well-named because it is an extremely complicated mix of rocks that accreted to the western edge of the North American plate when the Pacific seafloor subducted beneath the continent. This collision produced a vast pile of rock material derived from both the deep ocean and the continental shelf, mixed and cooked by volcanic and tectonic activities to produce a goulash of mixed-origin rocks.

The floor of the Pacific Ocean was, and still is, being forced under North America as the two sections of earth's crust (plates) slowly collide with one another. As the Pacific plate descended below the North America plate, it dragged seafloor sediments and under-water landslide deposits along with it. The entire sediment/crust package was altered physically and chemically under the overriding plate as it was compressed and deformed under tremendous pressures, yet at relatively low temperatures.

The result is called a *mélange* (French for "mixture"). The fine-grained portion (matrix) of the *mélange* is generally shale-rich, heavily sheared, very weak, and easily eroded. Blocks within the *mélange* can vary in size from inches to many hundreds of feet across.

The block composition can vary widely because of the mixing action that occurred within the subduction zone. Relatively unaltered shale, and sandstone, chert, and limestone that were not buried deeply are easily recognized. But deeply buried, highly altered metamorphic blocks in the *mélange* bear little resemblance to their



Franciscan Complex: The geologic formation that composes much of the Coast Ranges. It formed as a pile of rock and sediments that were scraped off a subducting plate to accumulate along the edge of the continent. It consists of numerous rock types encased in a highly convoluted matrix. Adapted from Bob Lillie, 2005.

Why it's important:

Patrick's Point State Park displays a snapshot of geologic processes that have shaped the face of western North America, and that continue today. The rocks exposed in the seacliffs and offshore represent dynamic interplay between the subducting oceanic tectonic plate (Gorda plate) and the continental North American tectonic plate. The boundary between the subducting oceanic plate and the continent has been filled with a massive pile of material literally scraped off the oceanic floor and crust, partially subducted, and then pasted to the western edge of the North American continent.



ancestral volcanic rocks of the seafloor. The bedrock at the bottom of the Agate Beach trail started out as a neat, orderly package of interbedded sandstone and shale. Forces within the subduction zone tore it apart and created the weak, chaotic rock package we see today. These different types of rocks are often found right next to one another.

Eventually, over millions of years, the material jammed into the trench was compressed between the two plates. Compression then helped to push up the leading edge of the continent, creating the complicated pattern of regional faulting, folding, uplifted terraces and dramatic mountain topography we see today throughout the North Coast region.

Agates

The popular and prized agates of Agate Beach are resistant pebbles, washed and rounded by stream transport, deposited in sediments along the ancient coastline of North America, and exposed locally by modern wave action.

The source of the pebbles is unknown, but they probably came from volcanic rocks in the ancestral Klamath Mountains to the north and east. Once transported to the ocean via the ancient stream and river system along this part of the California coast, the pebbles were further rounded and polished by constant washing and grinding against sand and each other in the modern surf zone.

What you can see:

Exposed in the cliffs and sea stacks are complicated layers of mashed and mangled rock. You can look closely at the rock and see folds, fractures, and a variety of layers. These are evidence of the enormously powerful tectonic forces that deform this region.

On a larger scale, you can see the remnants of former seafloor preserved in the sea stacks and flat marine terraces. These forms are evidence of tectonic uplift, sea level fluctuations, and powerful, relentless forces of pounding waves. Waves erode the seacliffs in episodic pulses that peel away vertical slices from the ocean-facing seacliffs.



The agates are composed of quartz crystals (silicon dioxide – SiO₂) so tiny that they are barely visible even when viewed under a microscope. Color variations are due to minute amounts of impurities included in the mineral matrix. The variety of color and transparency are a compelling attraction for many park visitors as they sift through the beach pebbles, searching for little treasures that help produce a unique connection to this aesthetic environment.

Final Thoughts

With repeated visits one may view subtle signs of slow change but we will have to simply imagine how those tiny snapshots in time fit into the never-ending movie that is the geologic evolution of Patrick's Point State Park.

*Written by Jim Falls, California Geological Survey
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