Salt Point State Park

Tectonic Collision

Features/Process:
Seismic and tectonic geomorphology along tectonic plate boundary, exotic terrane, and tafoni

Salt Point State Park lies within the Coast Ranges, the geological equivalent of what an automobile safety engineer would refer to as the “crumple zone”, deformed in the collision between the North American and the Pacific tectonic plates. About 25 million years ago instead of colliding head-on, these two plates began to grind sideways past each other along the San Andreas Fault zone. The oceanic crust to the west of the San Andreas Fault (Pacific plate) has moved several hundred miles northward relative to the continental crust (North American plate) on the east side of the San Andreas Fault.

The park spans a section of the collision zone—the San Andreas Fault—and includes pieces of both the Pacific and North American tectonic plates. Metamorphic rocks on the east side of the San Andreas Fault, known as the Franciscan Complex, consist mainly of greywacke (a “dirty sandstone” with significant components of broken rock fragments and sheared silty matrix), shale, serpentine, chert and greenstone that have

What you can see: Tafoni and tilted layers of sandstone that formed deep below the sea, 40–60 million years ago and 200 to 260 miles to the south. The rock layers formed through successive turbidity currents—the equivalent to undersea landslides with thick plumes of sediment. The visible grains in the rock layers were suspended particles in those slurries.

Photo: Mike Fuller

been slightly cooked, squeezed, and mashed against and onto the North American continental plate. Sedimentary rocks west of the San Andreas Fault, known as the German Rancho Formation, consist of alternating layers of sandstone, conglomerates, and mudstones. These rocks formed in submarine channels and on deep-sea fans at oceanic depths where deep currents deposited mud, sand, gravel, cobbles, and boulders. The weight of the sediment and the precipitation of minerals between the rock particles cemented the grains together and eventually transformed the loose sediment into solid sedimentary rock.

Tectonic Uplift

The uplifted marine terraces tell a story of spurts of uplift followed by periods of relative tectonic stability. In addition to tectonic uplift, sea level fluctuated about 200 feet or more during the Ice Ages. The sea sent breakers crashing against the solid bedrock, plucking it apart grain by grain. The waves carved away at the bedrock creating a gently sloped platform that terminates in a steep sea cliff landward of the platform. As the polar ice thickened during the Ice Ages, the ocean receded, stranding a mantle of beach deposits on the bedrock-carved shelf, forming an uplifted terrace.

Gerstle Cove Marine Reserve (one of the first protected underwater parks in California) is the site of an embryonic terrace still being formed. It is occupied by tide pool communities that include anemones, starfish, and myriads of bottom-dwelling animals and plants. Kelp and fish communities populate the shallow water that shifts back and forth 10 to 15 feet above the beach deposits. Constant abrasion of sand and gravels against the rock slopes cuts the terrace that someday may be uplifted.

Photo: Mike Fuller

Why it's important: Salt Point State Park is one of the few parks where the visitor can see well-developed tafoni—a unique sort of rock art created by weathering. How and why tafoni forms remains a geological mystery. The beds that formed from density currents reveal undersea processes and conditions that are rarely witnessed. These exposures are a magnet for study by amateurs, students, and professional geologists. The beds lie immediately west of the San Andreas Fault and provide a key timeline and geologic marker for fault studies.

Sea Stacks and Differential Erosion

Seacliffs exist because of the destructive force of waves and erosion. The hydraulic force and abrasion created by waves attack the foot of the cliff and begin to erode areas of weakness such as joints, cracks, and faults. Some of the sandstone layers are less resistant to the wind and waves and so are removed faster. Gradually, the erosion may form small caves, many of which can be found along the base of the current sea cliff.

Continued erosion may widen the caves forming arches that may or may not be attached to the mainland. Wave attack at the base of an arch and weathering of the roof of the arch weakens the structure until the roof of the arch collapses, leaving a sea stack (an isolated column of rock). The stack may continue to erode, eventually collapsing to form a stump which may be covered by water at high tide. Finally, the stack may be completely planed away by the waves.

Both recent and ancient sea stacks can be observed in the park. Recent sea stacks are located just offshore where thunderous waves impact the rocks and provide a spectacle of waves, wind, and splash. Ancient and relict sea stacks can be seen on the dry terrace as piles of rocks.

Tafoni

Salt Point State Park is named for the cliffs and crevices where salt from ocean water crystallizes in sandstone depressions. The native Kashaya Pomo gathered salt here for centuries. Salt crystallization is part of a unique and beautiful type of weathering where rock surfaces are pitted, forming a honeycomb-like network of pockets known as tafoni (the Italian word for cavern).

Precisely how and why tafoni is formed continues to confound geologists, though the presence of saline moisture appears to be instrumental in the process. Splash and spray rinse rock surfaces with saline-rich waters. As salt water evaporates, salt crystallizes between sand grains and small fractures in the rock. The salt crystals loosen sand grains in the less-cemented sandstone. Additional physical weathering (for example wind, rain, and waves) removes the loosened grains to create the lacy, box-like texture on exposed sandstone along the cliff faces.

Final Thoughts

The restless sea sculpts away at land's end and is constantly creating new landforms and recycling the materials of old ones.

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