Point Lobos State Natural Reserve

National Natural Landmark 1967

Salinia—An Exotic Terrane

Two contrasting rock types occur at Point Lobos State Natural Reserve. The granitic-rock (porphyritic granodiorite of Monterey) and the sedimentary Carmelo Formation are part of the Salinian block, a strip along California's Coast Ranges, bounded by the San Andreas Fault on the east and other faults on the west. The Salinian block is distinguished by a geologic makeup and history dramatically different from adjacent areas on opposite sides of the terrane-bounding faults. Unraveling the mystery of how this odd block of rocks came to occupy the California coast confounded geologists until the 1960s, when the theory of plate tectonics began to be accepted. Recognizing that the Salinian block as a displaced fragment of the earth's crust was a giant step forward, but the origin of this "suspect terrane" remained to be solved.

Features:

Petrology of an exotic terrane along the plate boundary

What you can see: The unspoiled coastline at the reserve offers fabulous exposures of two contrasting bedrock units: igneous granitic rock (80 to 100 million years old) and much younger sedimentary rock (60 millions years old).

The granodiorite solidified about 80 to 100 million years ago during the Cretaceous Period, crystallizing from a pool of slowly cooling magma (molten rock) buried deep beneath the earth's surface. The distinctive salt-and-pepper appearance is due to a mix of light (quartz and feldspar) and dark (hornblende and biotite) colored minerals. The term "porphyritic" that is used in the unit's name refers to the igneous texture displayed in the rock, where large crystals (phenocrysts) of potassium feldspar stand out from a groundmass of much finer interlocking crystals. The large phenocrysts found at Point Lobos are unusual for their stretched geometries, with some more than four inches long. Criss-crossing the rock are quartz-filled cracks, dikes (intrusions), and well-developed joints (fractures). The granodiorite is best exposed along the north shore of the reserve, and to the south of Hidden Beach. More rapid erosion along fractures in the otherwise highly resistant crystalline rock has produced the picturesque rocky points, sea-washed clefts, and craggy landscapes found in these areas of the reserve.

Some 60 million years ago (during the Paleocene), after ages of uplift, erosion, and submergence of the granodiorite, the Carmelo Formation was deposited on top of the

Why it's important: At Point Lobos, the rocks offer many interesting features for inquisitive visitors to contemplate, but are of particular significance to geologists because they provide clues to decipher movements along the San Andreas Fault system and to the dynamic history that produced the California Coast Ranges.

granodiorite at the mouth of an ancient submarine canyon. Dense mixtures of mud, sand and rocks were periodically funneled down the canyon in fast-moving, turbulent flows called turbidity currents and then deposited in layered sequences known as turbidites. The results of this process are thin alternating light-colored sandstone and dark mudstone layers, with some much thicker conglomerate (rounded cobbles set in sandstone) layers. Imbedded in the turbidites are a few unusually large granodiorite boulders (up to nearly nine feet across), which were likely derived from underwater avalanches or scouring of the canyon walls by turbidity currents.

The Carmelo Formation is best viewed from Sea Lion Point southward to Hidden Beach, and in a portion of Whalers Cove on the north shore. The rocks have been tectonically tilted and washed clean along the shoreline to reveal intricate markings left by the process of deposition (sedimentary structures) and trace fossils (no actual remains, just burrows and trails). Some of the mudstone layers at the reserve reveal curious "feathered" and serpent-like tracks more than six feet long. The tracks are thought to be made by the feeding apparatus of bivalve mollusks related to clams and mussels. These marvelous exposures provide a glimpse into the processes actively at work today in the large submarine canyon located off Monterey Bay.

Origins of the Salinian Block

The rocks at Point Lobos offer one piece of the puzzle of the locational origin of the Salinian block. The problem is important to solve since by resolving the distance traveled along the San Andreas Fault, geologists can better understand the rate and magnitude of the forces involved. Fortunately there are other pieces of Salinian block to the north and south to help in this enduring mystery.

Comparisons between Salinian granitic rocks and those forming the southern Sierra Nevada and Peninsular Ranges batholiths (large bodies of intrusive granitic rock) have found close affinities in both age and chemistry. Current thinking is that the Salinian rocks formed in the area between these two batholiths, on the west side of the Mojave Desert hundreds of miles away. Starting about 27 million years ago, the rocks were dragged northward with the Pacific plate and brought to their current position by movement along the San Andreas system of faults.

In its journey northward, the Salinian block has been sliced and spread out along the California coast by movement along more than one fault in the system of related strike-slip (laterally moving) faults that form the San Andreas Fault system. Roughly 100 miles north of Point Lobos, a similar sequence of turbidites deposited on porphyritic granodiorite is exposed at the tip of Point Reyes. Comparisons of the rocks from these two dramatic headlands have found them almost indistinguishable, strongly suggesting they were once closer together, but have been separated by movement along the San Gregorio Fault (located offshore from Point Lobos) and the northern portion of the San Andreas Fault.

Final Thoughts

The landscape of Point Lobos has compelled poets and artists for generations. Notable California poet Robinson Jeffers was inspired by this "devinely superfluous beauty."

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