



## Del Norte Coast Redwoods State Park



Photo: CalTrans Staff

### Geologic Goulash

The cliffs tell a story of inexorable natural forces that only recently have been understood in light of plate tectonic theory. The rocks revealed in the sea cliffs are from the Franciscan Complex—the dominant geologic material underlying the entire Coast Ranges geomorphic province. The Franciscan Complex is made up of an accumulation of over 40,000 vertical feet (almost eight miles) of sandstone, shale, serpentine, chert, and greenstone (metamorphosed submarine volcanic rocks). The complex originated as oceanic floor and the accumulated sediments on top of it which have been scraped, bent, subducted and mashed against the North American continent.

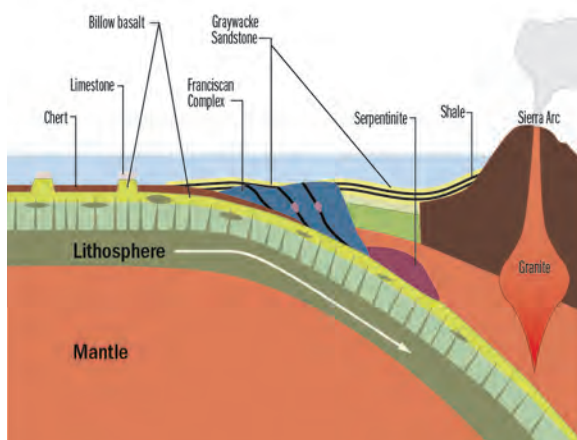
#### Feature/Process:

Coastal geomorphology overprints on an exhumed accretionary complex



**What you can see:** Sea stacks, eroded remnants from the Franciscan mélangé geologic unit. The mélangé is the result of a tectonic plate collision that has been ongoing for at least the last 20 million years.

The rocks of the Franciscan Complex have been uplifted with the edge of the North American plate as subduction of the Gorda plate continues beneath it. The compression and uplift from this tectonic collision of oceanic and continental plates have produced an area of rugged topography along the north coast. In Del Norte Coast Redwoods State Park, the Franciscan Complex is represented by two similar units referred to as “broken formation” and “mélangé.” Both are intensely sheared and fractured sandstone, siltstone and shale. “Broken formation” is a fractured assortment composed mainly of gray, thickly bedded sandstone with siltstone and shale interbeds. Mélangé is highly sheared, dark gray siltstone and shale with isolated blocks of more intact material. Within the mélangé unit, some blocks of different kinds of rock are large enough to be mapped separately. These blocks may be graywacke, greenstone, chert or



**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:** The rugged cliffs of Del Norte Coast Redwoods State Park are composed of some of the most tortured, twisted, and mobile rocks of the North American continent. The rocks are mostly buried beneath soils and covered by vigorous redwood forests, which thrive in a climate famous for summer fog and powerful winter storms. The rocks only reveal themselves in steep stream banks, along road and trail cut banks, along the precipitous coastal cliffs and offshore in the form of towering rock monuments or sea stacks.

serpentine. The contrast in strength between the hard, relatively unfractured blocks and a weak sheared shale leads to rapid erosion of the matrix. The *mélange* near False Klamath Cove apparently had a number of large blocks, which now stand as offshore rocks and sea stacks along the coast and just offshore.

### Erosion and Landslides

Uplift of such weak rocks as the Franciscan Complex *mélange* leads to an unstable and active landscape. Winter storm waves beat on the base of the cliffs, removing the weaker shale and undercutting the slopes above. Erosion and landslides on the ocean-facing slopes are so frequent that soil cannot be retained, and vegetation

cannot gain a foothold. Large landslides, some over a hundred feet thick, underlie many of the slopes and gradually move large blocks of rock down to the ocean waves. Weak rocks and sheared materials of the Franciscan mélange produce earthflow landslides in the vicinity of Wilson Creek; farther north, the rock is not as weak and the land slides as intact blocks.

### **Final Thoughts**

Precarious State Highway 101 has to accommodate the repeated shrugs of the landscape, as periodic landslides either deposit rocks and debris on the road, or take the entire roadbed for a ride down on massive, deep-seated landslides. The highway has been relocated inland more than once in response to the unstable terrain. This rugged and active nature has produced a dramatic meeting of land and sea—with relatively few and minor human intrusions rapidly erased by the ever changing terrain.

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*Photos: Don Braun (except where noted)*