

Map of marine benthic habitat south of Partington Canyon.

Science Crew (from left to right): Greene, Payne, Anima, de Marignac, Chin, Burton, Dreyer, and Lee (Carver and Lopez missing). Photo: Carver, NOAA.

Strong currents in the area appear to keep the rock outcrop swept clean of sediment although sand and gravels may be concentrated within the fractures and joints of the rock.

### Partington Canyon Survey

#### *Geology*

Much of the geology along the coast in the study area is of the Franciscan Complex, which includes greywackes, greenstones (meta-volcanics), serpentine, and other rock types. The Sur Series rocks of limestone and dolomite, as well as some Cretaceous sandstone and turbidite units are also incorporated into the Franciscan Complex in this region and crop out along the coastal cliffs. The Franciscan Complex weathers into a mixture of sediment types including clays, gravels, and large boulders called “knockers”. When transported to the sea, generally by gravity slides or via fluvial means, these eroded rocks and sediment



are sorted and then concentrated in the marine environment by the dynamic oceanographic processes there. The whole region is prone to severe mass movement, and large blocks and masses of rock regularly fail providing a large amount of very coarse-grain detritus to the continental shelf. This material is sorted by wave and current activity into sand, gravel, and boulder lag deposits. The fine-grain material is probably swept away to the deeper parts of the offshore area because of the strong wave and current regime, and the narrowness of the continental shelf.

#### *Marine Benthic Habitats*

Based on our interpretation of the side-scan reflectivity and backscatter data, it appears that the majority of the Slate Rock area consists of a sediment-

covered, probably sand, shelf with occasional large boulders, pinnacles, and rock outcrops. Many coarse-grained rippled sediment stringers were imaged.

It was difficult to image the full extent and depth of Partington Canyon, mainly because of its steepness and the inability to navigate the side-scan sonar in and around the canyon from a large ship. However, the upper walls and shelf area adjacent to the canyon were imaged and show exposed bedrock walls locally covered with boulders and other debris, which indicate an active canyon. North of the canyon, large boulder fields appear to represent landslide deposits. This area is located just offshore of the Big Sur coast that has experienced extensive landslide events throughout the recent geologic past and some of these deposits may have traveled several kilometers offshore to reach the upper continental slope. In one location approximately 2 km offshore, a large debris field was imaged and may be another landslide deposit. This is an area just offshore of where the California Department of Transportation has done extensive work repairing Highway 1, which was taken out by a massive slide several years ago.

The shelf area off Pfeiffer Point consists mainly of sediment, possibly sand, with many distinct patches and stringers of rippled sediment that probably alternates between coarse-grained sand or gravel and fine-grained sand. The concentration of the coarse-grained patches appears to be higher near Point Sur and decreases south of the Point Sur platform. This suggests that sediment is being transported around the point and southward toward the head of Partington Canyon whose head is located on the coast and would intercept littoral transported sediment, thus acting as a terminus to a sediment cell (a sediment cell that appears to extend from Carmel Canyon in the north to Partington Canyon in the south). The upper slope in this area is comprised of boulders, rock debris, and rock outcrops. Based on the irregular, erosional-like pattern imaged on the side-scan sonographs, it appears as if the bedrock may be exposed along much of the upper continental slope. In other areas the slope is covered with landslide debris, either older landslide deposits that occurred during a lower stand of sea level or modern deposits that traveled out across the continental shelf to the upper slope.

The nature of the geology and the geological processes both at sea and on land provide the means to develop diverse habitats. We have initially identified several different types of habitats, which include: boulders, rippled sand, gravel patches and stringers, pinnacles, bedrock outcrops, boulder fields, caves, crevices, and scour depressions. In many places where boulders, pinnacles, and rock exposures were imaged, large fish masses were observed in the side-scan sonographs, extending as much as 10 m above fairly high relief rock features.

### Relevance to Resource Management

The Sanctuary Integrated Monitoring Network (SIMoN) Science Committee recommended that habitat characterization be a high research priority. It is critical that sanctuary managers know the distribution of resources within the

Sanctuary. Sediment transports and seafloor characteristics are important factors for consideration of underwater cable routes, and assist the California Department of Transportation in developing a sound management plan for the maintenance of scenic U.S. Highway 1. The habitat map may assist in detecting essential habitat for groundfish and benthic invertebrates.

These surveys revealed an extensive and a fairly geologically complex basement and bedrock outcrop in the Fanny Shoal area. The structural complexity and extensive amount of Tertiary sedimentary rock exposures was not anticipated and suggest that a combination of tectonic activity (wrench fault tectonics associated with transform movement) and shelf erosion from the last transgression (sea level rise) sculptured an intricate rock outcrop that remains unburied and well scoured of sediment.

Survey results of the Partington Canyon area revealed a narrow continental shelf that is experiencing considerable littoral sediment transport. Sediment sources appear to be from the north and from the erosion of step cliffs south of Point Sur. In addition, extensive mass movement of detritus appears to have been deposited on the upper continental slope in the survey area, which may have resulted from subaerial landslides that skipped across the shelf from the coastline, or stretched from the coastline to the slope with their proximal parts buried. In addition, Franciscan Complex-like rocks appear to crop out on the upper slope and may represent the paleo-coastline and nearshore area formed during the last sea level stillstand. Partington Canyon is eroded into bedrock and its upper walls are locally covered with boulders and landslide deposits.

## **Marine Resource Surveys Related to CalTrans/ Highway 1: R/V *Shearwater* Cruise**

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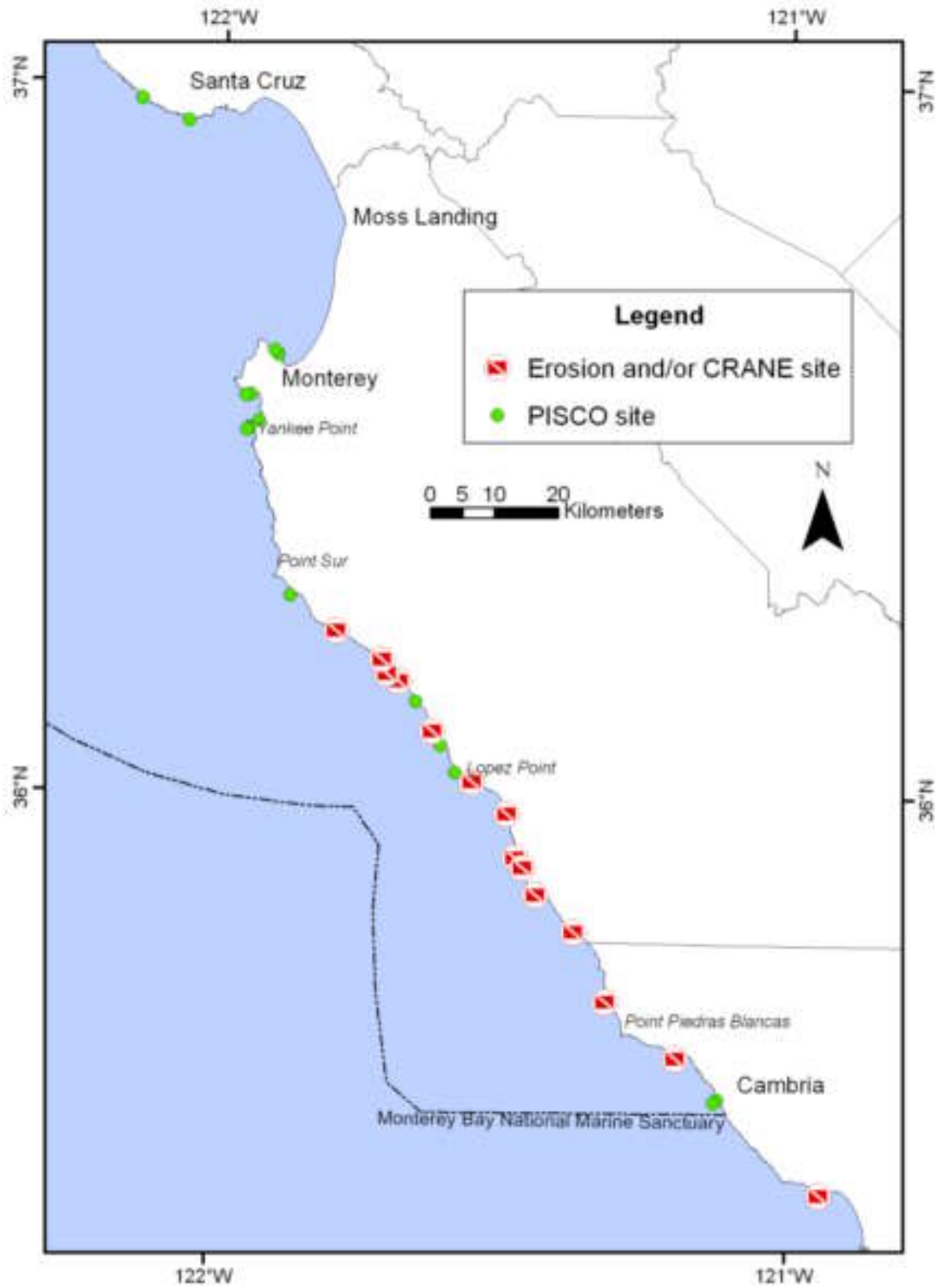
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Dive sites for the Erosion, CRANE, and PISCO projects.