



NATIONAL MARINE
SANCTUARIES TM

**A Report to the
Sanctuary Advisory Council
Monterey Bay National
Marine Sanctuary
2003 Field Research Review**

December 2003

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
National Marine Sanctuary Program



NOAA Ocean Service



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REPORT AVAILABILITY

Electronic copies of this report can be downloaded from the Monterey Bay National Marine Sanctuary web site, <http://montereybay.nos.noaa.gov/>, under the "Sanctuary Advisory Council Meeting Agendas" section.



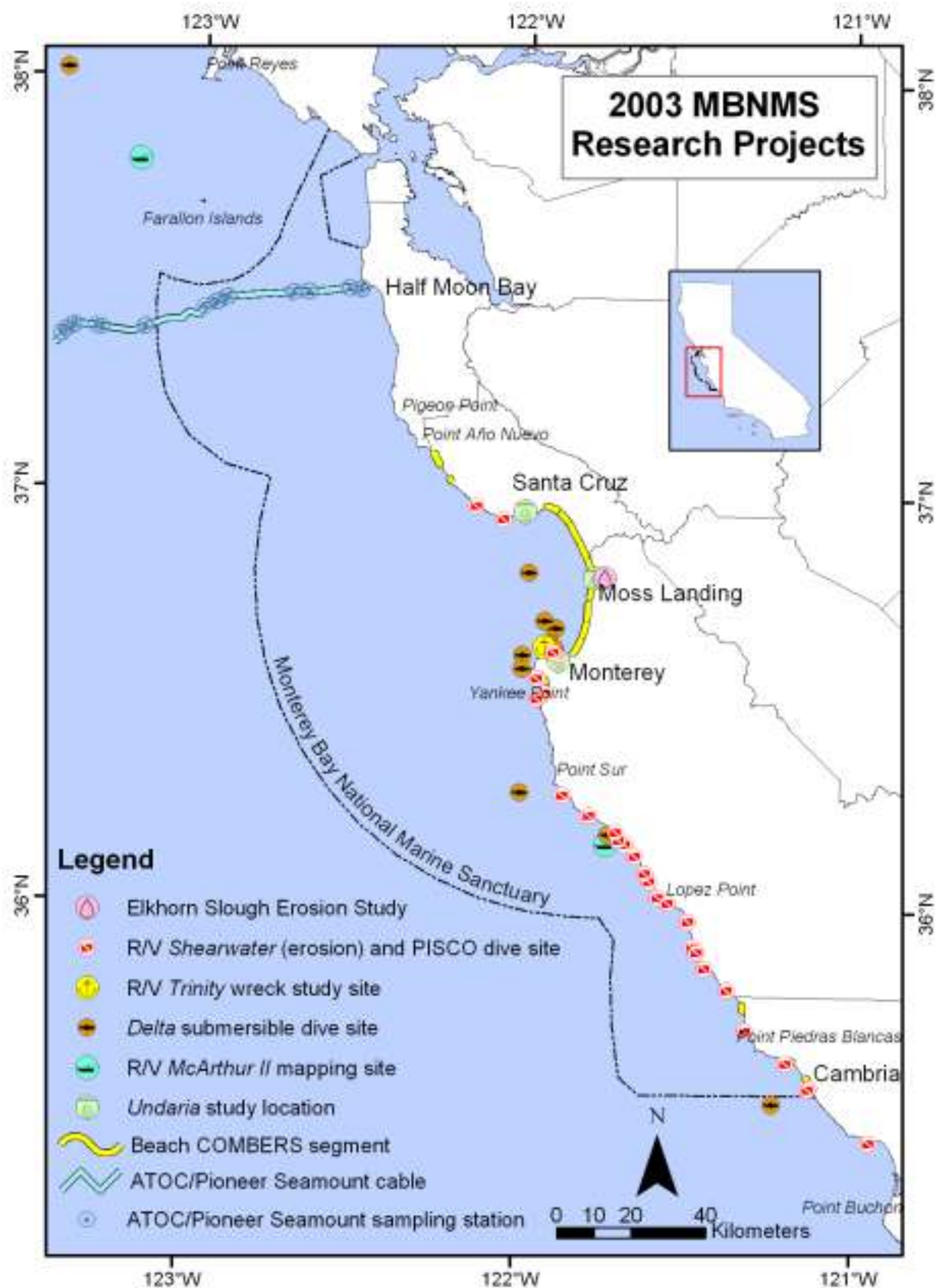
INTRODUCTION

The Monterey Bay National Marine Sanctuary (Sanctuary) Research Team increases understanding of the Sanctuary ecosystem, and interprets this information to a broad audience. The team enhances research on the Sanctuary by making scientists aware of critical management issues, reviewing existing literature and data, providing program funds to researchers, obtaining non-program grants and other funds to support regional research efforts, and by directly doing research. This research information is made available to decision makers, educators, scientists, and the public through the Sanctuary Resource Protection and Education Teams, as well as directly through web sites, reports, public presentations, and responding to individual requests for information. The Sanctuary Advisory Council working group on research (the Research Activity Panel) is an invaluable collaborator with the Sanctuary Research Team, providing guidance, expertise, and research facilities. In fact, the Sanctuary region is increasingly being recognized as a leading world center for marine science.

RV Shearwater.



This report is a review of the Sanctuary Research Team activities in 2003, with a focus on our major research cruises. In the first section of this report, we review four projects: (1) geological mapping using the NOAA R/V *McARTHUR II* (224 ft); (2) a shallow subtidal and rocky shore survey of the Big Sur coast, using the Channel Islands National Marine Sanctuary R/V *Shearwater* (62 ft); (3) fish, invertebrate, and habitat characterization, as well a shipwreck survey using the two-person *Delta* submersible ; and (4) an environmental impact survey of the Pioneer Seamount cable using MBARI's R/V *Pt. Lobos* (110 ft) and *Western Flyer* (117 ft). These projects address a range of management issues including delineation of sites sensitive to road maintenance dumping, assessing fish



Survey locations of Sanctuary Research Team field projects conducted during 2003.

populations, determining oil spill threats, basic characterization of habitats, and providing information for developing a national policy on undersea cables in Sanctuaries. The second section addresses how the research team is sharing and integrating regional research. This year, the Sanctuary Integrated Monitoring Network (SIMoN) web portal was released, providing a central, starting place for finding habitat information and monitoring trends in coastal central California. Finally, the report provides abstracts of the many presentations and publications that the Research Team has authored in 2003. Many partners were necessary for successfully completing all of these research efforts, and they are outlined in the report. For a full description of the Sanctuary Research Program, including current and historical activities, see the SIMoN web portal (<http://mbnms-simon.org>) and the Research and Monitoring section of the Sanctuary web site (<http://montereybay.noaa.gov>).

MAJOR SANCTUARY FIELD PROJECTS

The Sanctuary Research Team will address management needs for information by becoming directly involved in research efforts. This often occurs when staff expertise is needed in either the subject matter or logistical support. In this section, we review four major Sanctuary research projects that involved off-shore ship time. Information on other Research Team field projects can be found in the abstracts at the end of this report.

Seafloor Mapping of Fanny Shoal and Partington Canyon: NOAA Ship *McARTHUR II* Cruise

Principal Investigators

Jean de Marignac¹, Gary Greene^{2,3}, Roberto Anima⁴ and John Chin⁴

Other Participants

Erica Burton¹, Michael Carver⁵, Jennifer Dreyer², Holly Lopez², Lee Murai², Fred Payne⁴

Partners and Addresses

¹Monterey Bay National Marine Sanctuary, 299 Foam Street, Monterey, CA 93940

²Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039

³Monterey Bay Aquarium Research Institute, 7770 Sandholt Road, Moss Landing, CA 95039-9644

⁴United States Geological Survey (USGS), 345 Middlefield, Menlo Park, CA 94025

⁵Cordell Bank National Marine Sanctuary, PO Box 159, Olema, CA 94950 Gulf of the Farallones National Marine Sanctuary, Fort Mason, Building 201, San Francisco, CA 94123



Partington Canyon, along the Big Sur coastline.

Abstract

In July 2003, the Monterey Bay National Marine Sanctuary in collaboration with 3 other federal agencies and two local research institutions led a six days research cruise aboard the NOAA Ship *McARTHUR II*. The United States Geological Survey (USGS) provided sidescan sonar technology to survey the seafloor at Fanny Shoal in the Gulf of Farallones National Marine Sanctuary, and in the vicinity of Partington Canyon in the Monterey Bay National Marine Sanctuary. The surveys revealed an extensive and a geologically complex basement and bedrock outcrop in Fanny Shoal, and a narrow continental shelf that is experiencing considerable littoral sediment transport in the Partington Canyon area. The Center for Habitat Studies at Moss Landing Marine Laboratories processed the data collected in Partington Canyon and produced a habitat map of the area surveyed. Fanny Shoal data will be processed and inventoried at the USGS in the coming year.

Study Objectives

The objectives of this research cruise were to map the seafloor at Fanny Shoal in the Gulf of Farallones National Marine Sanctuary, and the vicinity of Partington Canyon in the Monterey Bay National Marine Sanctuary.



NOAA ship *McARTHUR II*.

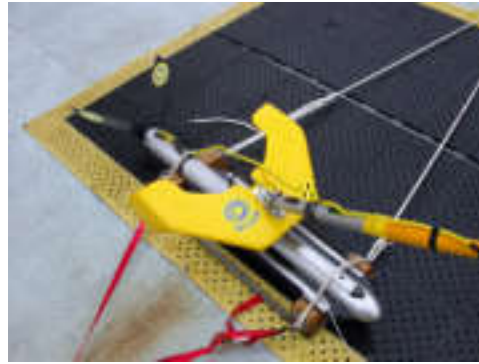
Methods

Field operations were conducted from July 1 to 6, 2003, aboard the NOAA Ship *McARTHUR II*, a 224-foot vessel operated by NOAA Marine and Aviation Operations. The ship was acquired from the U.S. Navy in 2002 and converted by

Klein 3000 dual frequency side-scan sonar system.

NOAA from an ocean surveillance vessel to a multiple-disciplinary science platform capable of a broad range of missions. The *McARTHUR II* conducts oceanographic research and assessments throughout the eastern Pacific, including the U.S. West Coast, Central and South America. The *McARTHUR II* carries a complement of 5 officers, 17 crew members and up to 15 scientists.

A successful day and a half survey was completed at Fanny Shoal with the collection of approximately 160-line km of side-scan sonar images. Approximately 140-line km of side-scan sonar images were collected in the Partington Canyon area. Weather was windy, cool, and foggy with rough seas and the survey was prematurely terminated due to deteriorating weather



conditions with increasing wind, gusting to 62 knots. The survey of the Partington Canyon area was divided into 3 different, but contiguous, sections. They are from south to north: Slate Rock (or Big Creek North), Partington Canyon, and Pfeiffer Point. The reason for the division was because of weather conditions in the area. The initial area of interest extended from the head

of Partington Canyon northward to the Point Sur platform. Unfortunately, high winds and fog prevented surveys in the north area, so the study area was extended to the south, located in the lee of the Point Sur headland and somewhat protected from the weather.

Digital side-scanning sonar data were collected with a Klein 3000 dual frequency side-scanning sonar system (100 & 455 kHz) provided by the USGS. Parallel transect lines, 2 to 15 km in length, were run at a speed ranging from 1.5 to 4 knots depending on water depth and local conditions. Precise navigation and positioning were done with a differential global positioning system (dGPS) and the USGS YoNav navigation system. All data were collected at a 200 m swath width (100m/channel) and line spacing was 150 m giving a 50% overlap. A meter wheel was not on the side-scan sonar cable winch, so amount of cable out was not accurately determined. A general estimate of 120-150 m offset between the side-scan sonar fish and GPS antennas was estimated. Most data were processed aboard using the Center for Habitat Studies' Triton-Elics ISIS processing system and a preliminary (non-geo-referenced) mosaic was constructed for the Fanny Shoal survey. The side-scan data collected at Fanny Shoal and Partington Canyon during this cruise will be processed and inventoried by the USGS and should be available to the public by summer 2004.

The Center for Habitat Studies at the Moss Landing Marine Laboratories processed the data collected at Partington Canyon and constructed marine benthic habitat maps. Because layback information was not collected during

the side-scan survey, the data was manually georectified in ArcGIS using approximations of layback and then snapping files to what limited bathymetric features were available for correlation. Due to the sparsity of high resolution bathymetry and the irregular bathymetry over which the survey was carried out, potential positional accuracy is most likely on. Using processed side-scan data, layouts (maps) were created in ArcView. A scale of 1:10,000 was chosen for habitat interpretations. Seven marine benthic habitat types were defined from the side-scan sonar imagery dataset using a marine benthic habitat characterization scheme modified after (Greene et al. 1999).

Findings

Fanny Shoal Survey

Geology

Based on the fractured and jointed patterns and the linear and curved forms imaged in the side-scan sonar data, geologists interpreted the site to contain extensive areas of rock outcrop consisting of both plutonic and sedimentary rock types. Based on the known terrestrial and nearshore geology, the outcrop appears to be comprised of a central core of plutonic rock (most probably Cretaceous granite) with likely late Tertiary (most probably Miocene Monterey Formation) and sedimentary rocks (most probably Pliocene Drakes Bay Formation or Purisima Formation) lapping onto, or faulted against, the plutonic core. The sedimentary rocks range from fairly thick massive beds (characteristic of the Purisima Formation) to thin repetitive beds (characteristic of the

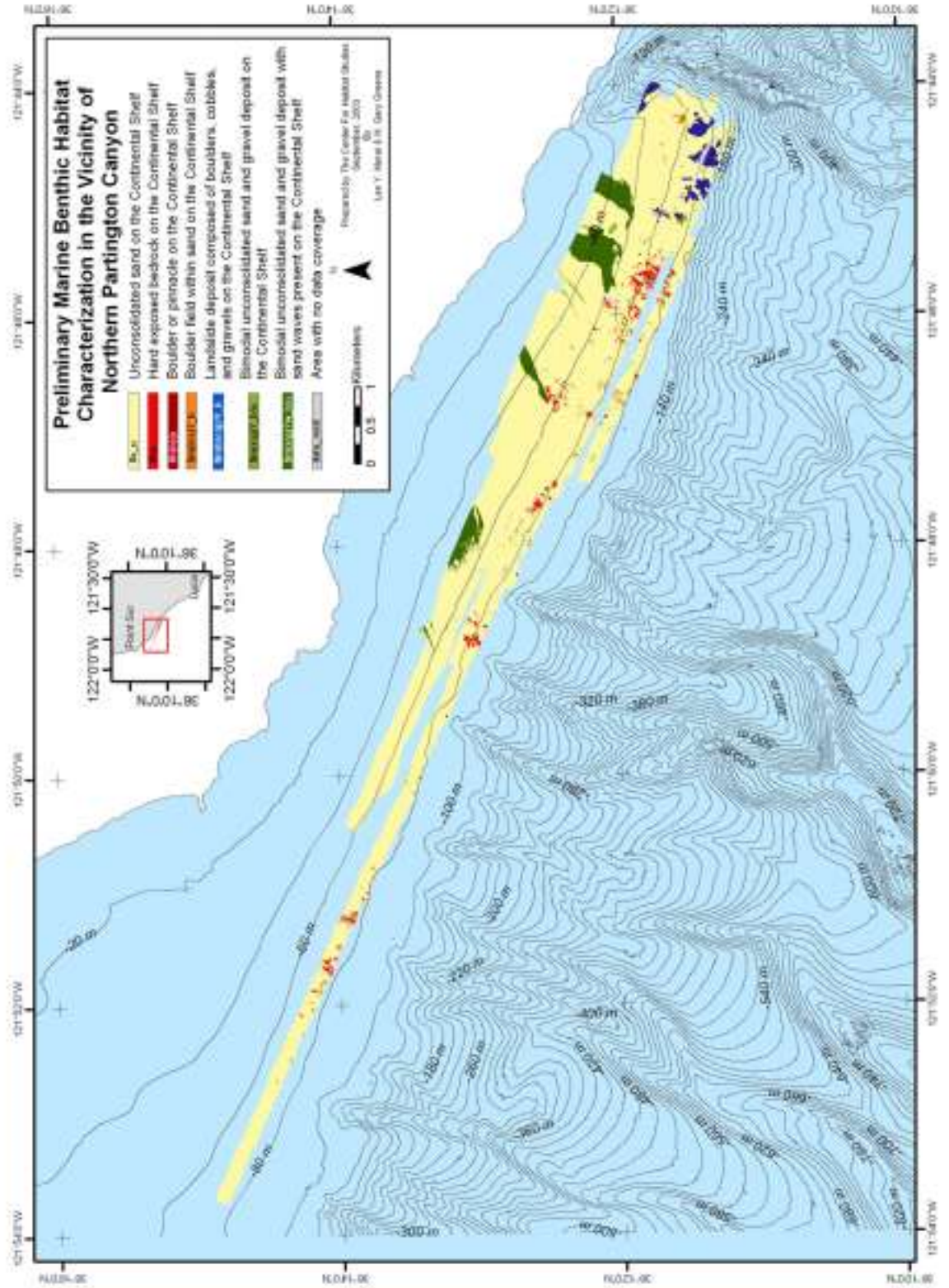
rhythmically bedded Monterey Formation or Santa Cruz Mudstone). Much of the sedimentary rock is differentially eroded producing a serrated surface expression. The sedimentary rocks vary in dip from nearly flat-lying to steeply dipping. They are highly deformed with many folds. Both the plutonic and sedimentary rocks exhibit several sets of fractures and joints. More major through-going faults were identified and have a general East-West trend, oblique to the onshore regional structural trend.



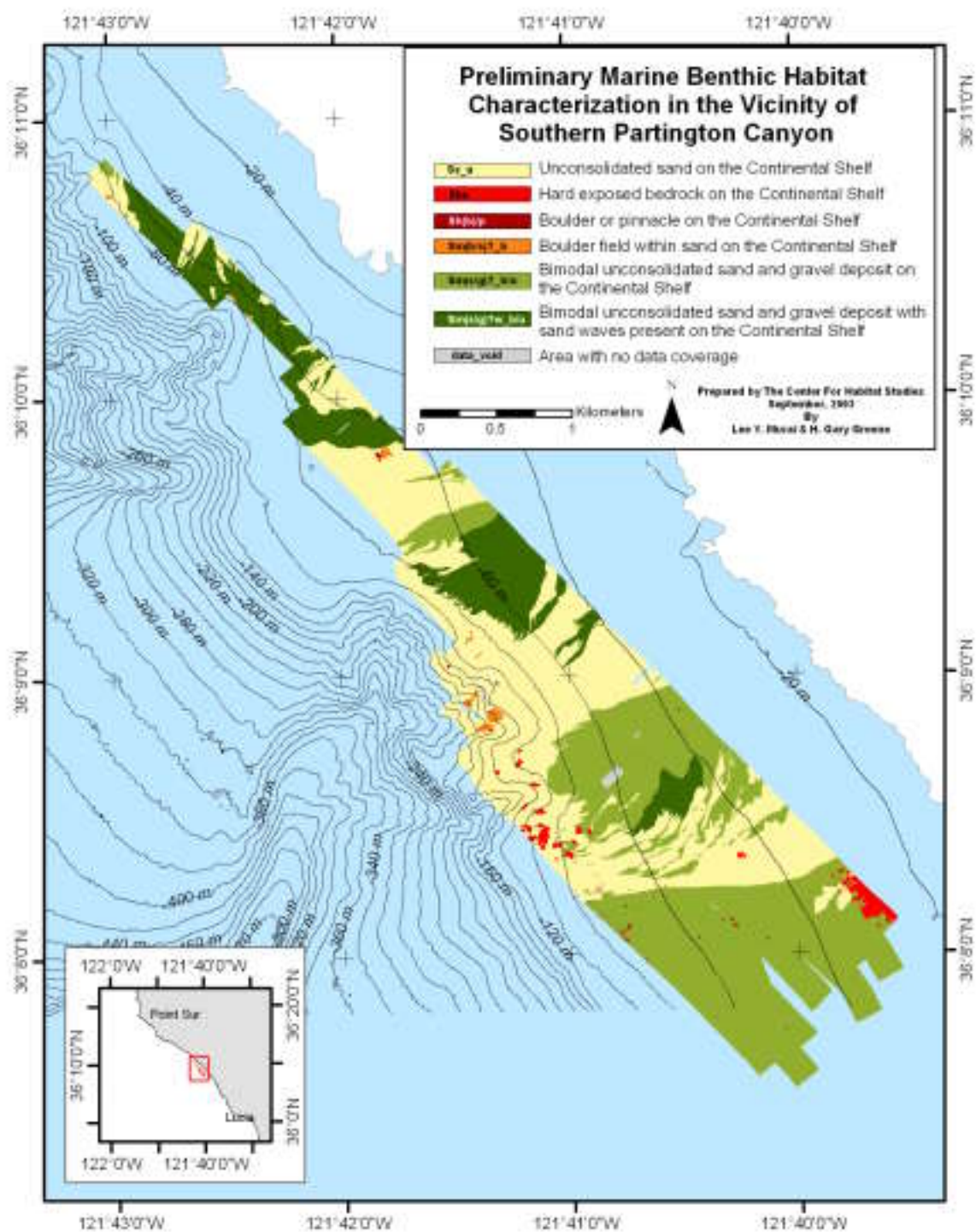
Scientists don survival suits during a drill.

Marine Benthic Habitats

Based on the geologic interpretations and the backscatter patterns of the side-scan sonar data, a variety of marine benthic habitats were initially identified. These habitats consist primarily of craggy rock with many cracks and crevices, boulders, pinnacles, scarps, interfaces, sand, gravel patches, and caves. These habitats are close together as the rock exposures are surrounded with boulders and coarse-grain (gravel and sand) rippled sediment patches and stringers.



Map of marine benthic habitat north of Partington Canyon.



Map of marine benthic habitat south of Partington Canyon.

Science Crew (from left to right): Greene, Payne, Anima, de Marniac, 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

Principal Investigators

Steve I. Lonhart¹, Mark Carr², Andrew DeVogelaere¹, William J. Douros¹, Holly J. Price¹, Pete Raimondi²

Other Participants

Sarah Fangman³, Scott Kathey¹, Aaron King¹, Chad King¹, Chris Mobly³, Dana Wilkes⁴, and many UCSC divers¹

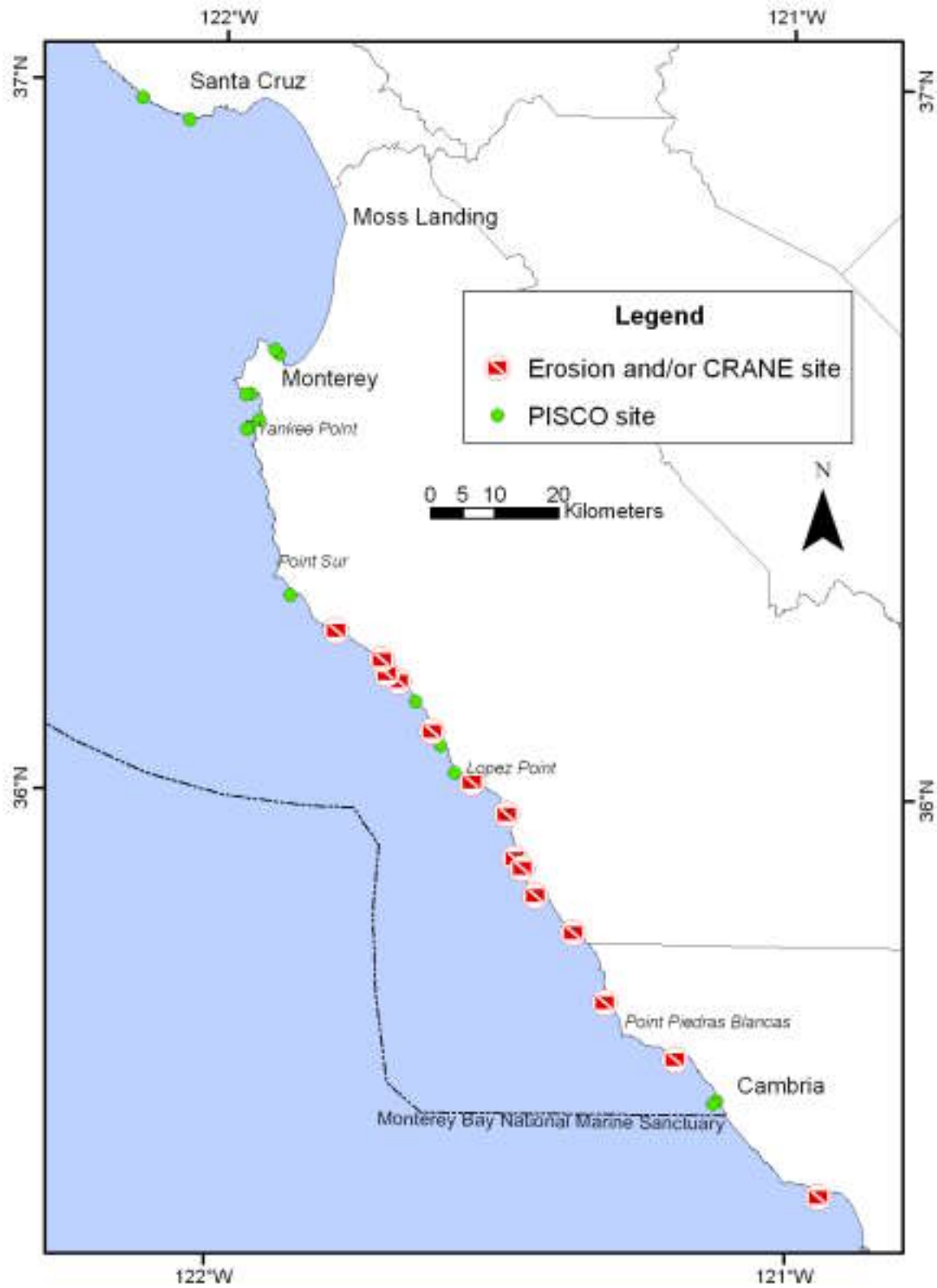
Partners and Addresses

¹Monterey Bay National Marine Sanctuary, 299 Foam St, Monterey, CA 93940

²Department of Ecology and Evolutionary Biology, Long Marine Laboratory, 100 Shaffer Road, University of California, Santa Cruz, CA, 95060

³Channel Islands National Marine Sanctuary, 113 Harbor Way, Suite 150, Santa Barbara, CA 93109

⁴NOAA Marine and Aviation Operations, 1801 Fairview Ave E., Seattle, WA 98102



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