

### DESCRIPTION OF MAP UNITS

**UNCONSOLIDATED CONTINENTAL SHELF SEDIMENTS**

- Sa(s)m\_ru Soft, unconsolidated, rippled sediment (sand and mud)
- Sa(s)m\_eu Pockmarks or depressions, in soft, unconsolidated sediment (sand and mud)
- Sa(s)m\_p\_ru Rippled scour depression (sand and mud)
- Sa(s)m\_u7 Terrace, or possibly delta or fan, made up of soft, unconsolidated sediment (sand and mud); inferred
- Sa(s)\_ru Soft, unconsolidated sediment (sand), predominantly rippled
- Sa(s)\_ru Terrace, or possibly delta or fan, made up of soft, unconsolidated, rippled sediment (sand)
- Sa(s)\_u Soft, unconsolidated sediment (sand and gravel), on flat shelf
- Sa(s)\_p\_ru Rippled scour depressions (sand and gravel)
- Sa(s)\_u Gully of soft, unconsolidated sediment
- Sa(s)\_u Sediment-covered tar flow, inferred
- Sa(s)\_u Hummocky mounds of soft, unconsolidated delta sediment
- Sa(s)\_u Rills of soft, unconsolidated sediment

**MIXED SUBSTRATE ON CONTINENTAL SHELF**

- Sme\_cu Mixed habitat of soft, unconsolidated sediment, overlying hard, consolidated sedimentary bedrock
- Sme\_cru Mixed habitat of soft, unconsolidated sediment, covering edges of hard, carbonate mounds
- Sme\_cru Hydrocarbon-seep depression, in soft, unconsolidated sediment

**HARD SUBSTRATE ON CONTINENTAL SHELF**

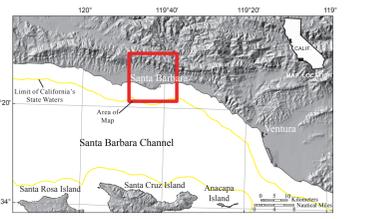
- Shd\_cu Deformed and differentially eroded, consolidated sedimentary-bedrock outcrop
- Shd\_cu Hard, consolidated sedimentary rock, boulders, or pinnacle
- Shd\_p7 Hard, consolidated boulders or pinnacles of exposed asphalt; inferred
- Shm\_e1 Hard mound composed of carbonate rock

**ANTHROPOGENIC FEATURES**

- Sa(s)\_a1u Oil-platform-generated shell hash mixed with soft, unconsolidated sediment (sand and mud)
- Sa(s)\_a1u Trawl grooves and marks, in soft, unconsolidated sediment
- Shm\_a1u Mixed habitat of soft, unconsolidated sediment, in linear trough overlying hard, anthropogenic feature (pipeline)
- Shm\_a1u Oil-platform structural-foundation framework (legs and pipes) and shell mound
- Sh\_a1u Hard anthropogenic feature (pipeline)
- Sh\_a1u Hard anthropogenic feature (grain or jetty)
- Sh\_a1u Hard anthropogenic feature (shipwreck)

**EXPLANATION OF MAP SYMBOLS**

- Contact
- Area of "no data"—Areas near shoreline not mapped owing to insufficient high-resolution seafloor mapping data; areas beyond 3-nautical-mile limit of California's State Waters were not mapped as part of California Seafloor Mapping Program
- 3-nautical-mile limit of California's State Waters
- Bathymetric contour (in meters)—Derived from modified 10-m-resolution bathymetry grids. Contour interval: 10 m



### DISCUSSION

This map shows "potential" marine benthic habitats in the Offshore of Santa Barbara map area. Marine benthic habitats represent a particular type of substrate, geomorphology, seafloor process, or any other attribute that may provide a habitat for a specific species or an assemblage of organisms. Such maps are based largely on seafloor geology, and this map integrates seafloor geology (sheet 10) with information derived from several other thematic maps of the Offshore of Santa Barbara map area: high-resolution bathymetry (sheet 1), shaded-relief imagery (sheet 2), backscatter (sheet 3), seafloor character (sheet 5), and ground truth information (sheet 6). This map also uses information from the uSEABED bottom-sampling compilation by Reid and others (2006). The combination of remotely observed data (for example, multibeam bathymetry and backscatter, seismic-reflection profiles) and directly observed data (for example, camera transects, sediment samples) translates to higher confidence in the ability to interpret broad areas of the seafloor.

To avoid any possible misunderstanding of the term "habitat," the term "potential habitat" (as defined by Greene and others, 2005) is used herein to describe a set of distinct seafloor conditions that in the future may qualify as an "actual habitat." Once habitat associations of a species are determined, they can be used to create maps that depict actual habitats, which then need to be confirmed by "ground-truth" surveying using in situ observations, video, and/or photographic documentation.

Marine benthic habitats are classified using the Benthic Marine Potential Habitat Classification Scheme, a mapping scheme developed by Greene and others (1999, 2007). In this map series, habitat classification codes are based on the deepwater habitat-characterization scheme developed by Greene and others (1999), which was created to not only easily distinguish marine benthic habitats but also to facilitate ease of use and queries within GIS and database programs. The code, which is summarized in sheet 6 of the accompanying pamphlet, is derived from several categories of the Benthic Marine Potential Habitat Classification Scheme (Greene and others, 1999, 2007), and it can be subdivided on the basis of the spatial scale of the data.

High-resolution, multibeam data, converted to bathymetric data, and shaded-relief imagery (sheet 2) allows for visualization of seafloor terrain, providing a foundation for interpretation of submarine landforms. Areas of seafloor bedrock exposures are identified by their common sharp edges and high relative relief; these may be contiguous outcrops, isolated parts of outcrop protruding through sediment cover (pinnacles or knobs), or isolated boulders. High backscatter is further indication of "hard" bottom, consistent with interpretation as rock or coarse sediment. In many locations, areas within or around a rocky feature appear to be covered by a thin veneer of sediment, identified on the habitat map as "mixed" induration (in other words, containing both rock and sediment). Broad, generally smooth areas of the seafloor that lack sharp and angular edge characteristics are mapped as "sediment" and are further defined by various sedimentary features such as erosional scars and depressions, as well as depositional features such as dunes, mounds, or sand waves. Low backscatter, indicative of "soft" bottom, also significantly aids identification and classification of sedimentary habitats.

The Offshore of Santa Barbara map area contains 26 potential marine benthic habitat types, which range from predominantly soft, unconsolidated sediment (mud to sand and gravel) to areas of hard bedrock exposures, including flat carbonate substrate and asphalt (tar) mounds. Differentially eroded, well-bedded sedimentary-bedrock outcrops (some partly covered with soft, unconsolidated sediment to produce a mixed hard-soft habitat type), as well as pockmarks, rills, and possible hummocky tar flows, complete the variety of habitats identified in the map area. Significant anthropogenic features associated with oil production, such as platforms, pipelines, and shell mounds beneath platforms, as well as trawls and a shipwreck, all produce artificial habitats for rockfish (Sebastes spp.). Trawl marks also are present as anthropogenic features.

The soft, unconsolidated sediment habitat, which includes pockmarks and inferred sediment-covered tar flows, covers 97.41 km<sup>2</sup> of the map area, representing 86.6 percent of all of the potential habitat types identified. Sediment-covered bedrock, which includes the most hard-soft habitat type, covers 11.84 km<sup>2</sup> (10.5 percent). Hard bedrock exposures cover 3.08 km<sup>2</sup> (2.7 percent), whereas anthropogenic features cover about 0.17 km<sup>2</sup> (0.15 percent). The mix of potential marine benthic habitat types provides the varied relief, in addition to the rugged and substrate hardness, that contribute to the concentration of a diverse ecosystem within an otherwise homogeneous, soft, unconsolidated sediment habitat.

Of special interest in the Offshore of Santa Barbara map area is the role of fluid flowing up to the seafloor from petroleum reservoirs at depth, which is inferred to have caused the formation of locally exposed hard, carbonate-cemented sediment substrate, carbonate mounds, pockmarks, and tar or asphalt flows. Notably, an extensive (199 km<sup>2</sup>) area of carbonate hardground (Shm\_cru), locally covered with sediment, is exposed about 5 km offshore in the northwestern part of the map area, providing potential habitat for sessile organisms. In addition, a prominent lobe (Sa(s)\_ru), possibly a sediment-covered tar flow sourced by an inferred, upslope, sediment-covered tar drain depression (Sd(s)\_ru), 0.27 km<sup>2</sup> in area, is present due south of Santa Barbara, on the northwest flank of a prominent, differentially eroded, east-west-trending bedrock platform (Shd\_cu).

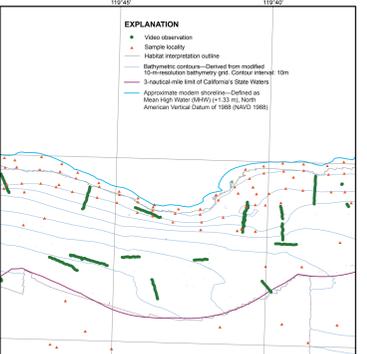


Figure 1. Map showing video-observation locations and sample localities for Offshore of Santa Barbara map area.

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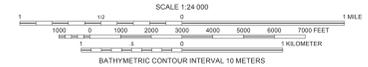
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Onshore observation data from NOAA Coastal Service Center (data collected by EarthData International in 2002-2003) and from U.S. Army Corps of Engineers (data collected by Roger Wilson in 2006). California's State Waters limit from NOAA Office of Coast Survey (Coastal Transverse Mercator projection, Zone 18N).

NOT INTENDED FOR NAVIGATIONAL USE



Potential marine benthic habitats mapped by Bryan E. Dieter, Charles A. Endris, and H. Gary Greene, 2011. Bathymetric contours by Andrew C. Roth, 2011. GIS database and digital cartography by Nadine E. Golden, Mercedes D. Erdey, and Charles A. Endris. Edited by Terry A. Lindquist. Manuscript approved for publication December 12, 2013.

## Potential Marine Benthic Habitats, Offshore of Santa Barbara Map Area, California

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