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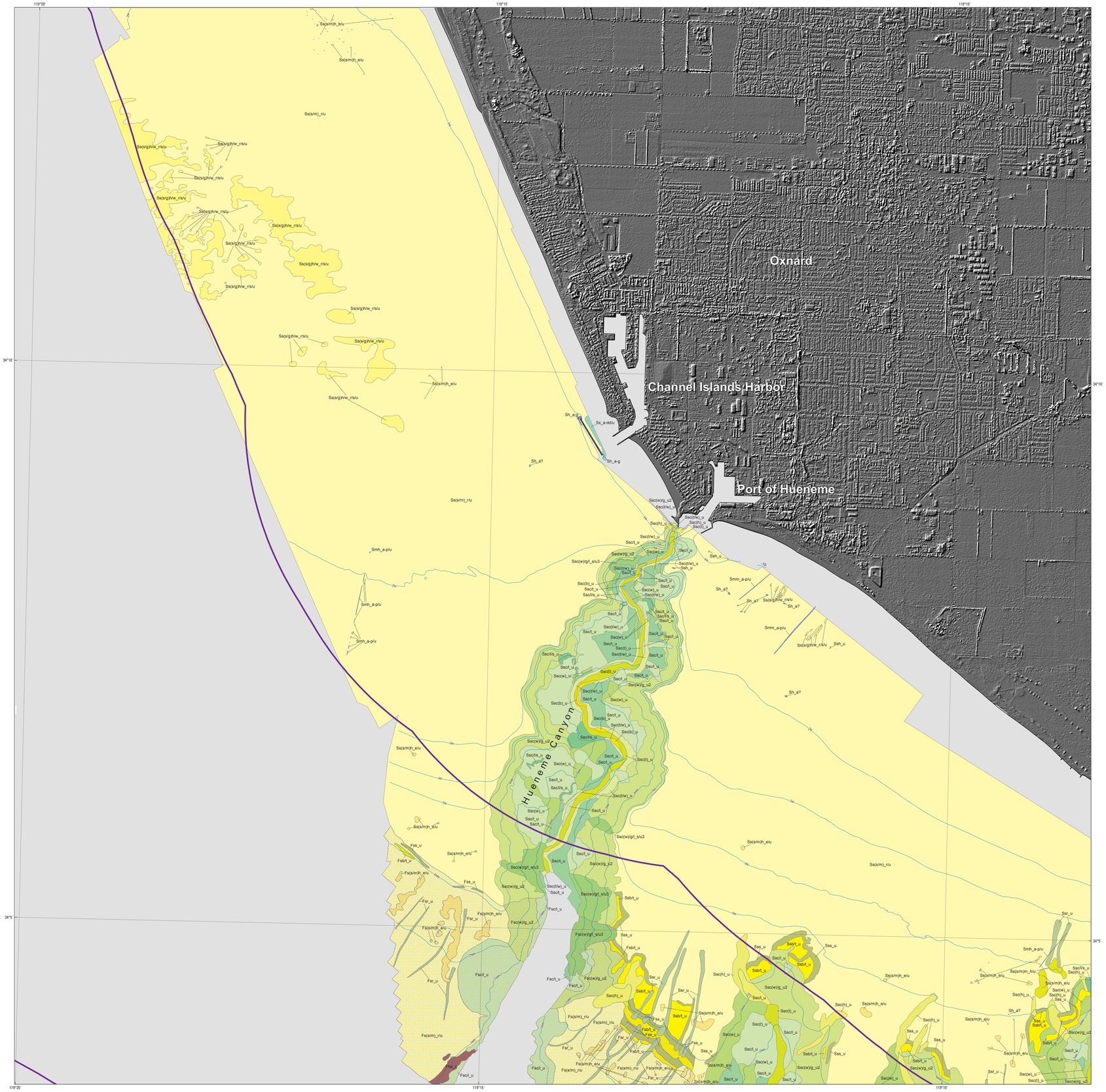
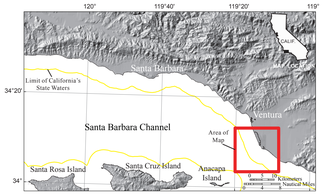
U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3225
Sheet 7 of 12
Pamphlet accompanies map





DESCRIPTION OF MAP UNITS

UNCONSOLIDATED CONTINENTAL SHELF SEDIMENTS

Ss(s/g)h/w_r/s/u	Soft, mobile sediment window that has hummocky unconsolidated and rippled sediment waves overlying scoured lag pavement of sand and gravel
Ss(s/m)_r/u	Soft, unconsolidated rippled sediment (sand and mud)
Ss(s/m)h_e/u	Pockmarks or depressions in soft unconsolidated sediment (sand and mud)
Ss(s/m)m_h/u	Hummocky mound in soft, unconsolidated sediment (sand and mud)
Ssb/t_u	Terrace representing relict beach; composed of soft, unconsolidated sediment
Ssh_u	Depression in soft, unconsolidated sediment
Ssr_u	Rill in soft, unconsolidated sediment
Sss_u	Scarp; composed of soft, unconsolidated sediment

UNCONSOLIDATED CONTINENTAL SHELF AND CANYON SEDIMENTS

Ssc(b)_u	Bar within canyon thalweg; composed of soft, unconsolidated sediment
Ssc(h)_u	Canyon head; composed of soft, unconsolidated sediment
Ssc(t)_u	Canyon thalweg; composed of soft, unconsolidated sediment
Ssc(t/w)_u	Wall adjacent to canyon thalweg; composed of soft, unconsolidated sediment
Ssc(w)/g/f_s/u3	Canyon wall and gullies, predominantly landslide scoured and steeply sloping; composed of soft, unconsolidated sediment
Ssc(w)/g_u2	Canyon wall and gullies, moderately sloping; composed of soft, unconsolidated sediment
Ssc(w)_u	Canyon wall; composed of soft, unconsolidated sediment
Sscf/s_u	Landslide scarp; composed of soft, unconsolidated sediment
Sscf_u	Landslide deposits; composed of soft, unconsolidated sediment
Ssc/f_u	Terrace; composed of soft, unconsolidated sediment

UNCONSOLIDATED CONTINENTAL SLOPE SEDIMENTS

Fs(s/m)_r/u	Soft, unconsolidated rippled sediment (sand and mud)
Fs(s/m)h_e/u	Pockmarks or depression in soft, unconsolidated sediment (sand and mud)
Fsb/t_u	Terrace representing relict beach; composed of soft, unconsolidated sediment
Fsr_u	Rill in soft, unconsolidated sediment
Fss_u	Scarp; composed of soft, unconsolidated sediment

UNCONSOLIDATED CONTINENTAL SLOPE AND CANYON SEDIMENTS

Fsc(w)/g/f_s/u3	Canyon wall and gullies, predominantly landslide scoured and steeply sloping; composed of soft, unconsolidated sediment
Fsc(w)/g_u2	Canyon wall and gullies, moderately sloping; composed of soft, unconsolidated sediment
Fscf_u	
Fscf_u	Terrace; composed of soft, unconsolidated sediment

HARD SUBSTRATE

Fhe_c	Hard, indurated, consolidated sedimentary bedrock

ANTHROPOGENIC FEATURES

Ss_a-dd/u	Anthropogenic disturbance (dredge scours) in soft, unconsolidated sediment near harbor entrance
Smm_a-p/u	Mound of soft, unconsolidated sediment overlying hard anthropogenic feature (pipeline)
Smh_a-p/u	Linear depression in soft, unconsolidated sediment overlying hard anthropogenic feature (pipeline)
Sh_a-g	Hard anthropogenic feature (breakwater)
Sh_a?	Hard unidentified feature, possibly anthropogenic

EXPLANATION OF MAP SYMBOLS

Contact

Area of "no data"—No shipboard acoustic-backscatter data was collected in areas from shoreline (defined as Mean Higher High Water) out to about 10-m water depth owing to ship navigation safety; 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—Line in southwest corner of map area is limit surrounding Anacapa Island (outside of map area)

Bathymetric contour (in meters)—Derived from modified 10-m-resolution bathymetry grids. Contour intervals: 1–50 m water depth, 10 m; 50–100 m water depth, 50 m; >100 m water depth, 100 m

DISCUSSION

This map shows "potential" marine benthic habitats in the Hueneme Canyon and vicinity 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 (sheets 10, 11) with information depicted on several other thematic maps of the Hueneme Canyon and vicinity map area: high-resolution bathymetry (sheets 1, 2); backscatter (sheet 3); ground-truthing information (sheet 6); and seafloor character (sheet 8). This map also uses information from usSEABED 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-truthing" using in situ observations, video, and (or) photographic documentation.

Marine benthic habitats are classified using the Benthic Marine Potential Habitat Classification Scheme, a mapping-attribute code 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 chapter 6 in 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-sonar data, converted to bathymetric depth grids (seafloor digital elevation models; sheets 1, 2), are essential to development of the habitat map. Shaded-relief imagery (sheet 4) 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 scours and depressions, as well as depositional features such as dunes, mounds, or sand waves. Low backscatter, indicative of a "soft" bottom, also significantly aids identification and classification of sedimentary habitats.

The Hueneme Canyon and vicinity map area includes the western part of the Hueneme–Mugu Canyon system (Greene and others, 1978), which, in the map area, consists of Hueneme Canyon and parts of three smaller, unnamed headless canyons incised into the shelf on its east flank. The areas between the canyons consist of gently offshore-sloping continental-shelf habitats. The 29 potential marine benthic habitat types delineated in the map area include 21 types found on, or incised into, the continental shelf ("Shelf" megahabitat) and 8 types identified on the continental slope ("Flank" megahabitat). The meso- and macrohabitats include canyon walls, scarps, channels (thalwegs), gullies, and terraces, as well as dynamic features such as landslides and channel bars within the canyons. Other habitats include rills, pockmarks, depressions, mobile sand sheets, and anthropogenic features on the flat continental shelf. Backscatter data show that most of the area is underlain by "soft" materials, consistent with the interpretation that unconsolidated sediments dominate habitat in the map area.

Although much of the map area is flat and appears fairly homogeneous, sedimentary processes are inferred to be quite active and, thus, habitats are highly dynamic. Sediment generally moves as a "sheet" on the shelf; mass transport is primarily to the southeast. In addition, erosion through shelf sediments down to a coarser lag has produced "ripple scour depressions" on the shelf in the northwestern part of the map area.

The head of Hueneme Canyon is virtually at the shoreline, and it intercepts large volumes of sediment that are being transported southeastward in the littoral zone and on the shelf. Thus, Hueneme Canyon serves as the main conduit for moving sediment from the Santa Barbara littoral cell offshore into the deep Santa Monica Basin (Greene and others, 1978; Normark and others, 2009; Romans and others, 2009). Within the canyon, lateral sediment fill derived from the shelf incises canyon walls and accumulates on midwall locations that are prone to landslides. Sediment entering the canyon from its nearshore head moves rapidly downcanyon on the canyon floor, forming bars and dunes and commonly undercutting canyon walls, further promoting landslides. Habitats, therefore, are created, modified, destroyed, and recreated regularly in this dynamic environment.

Of the 138.1 km^2 in the map area, 128.3 km^2 (92.9 percent) is classified as Shelf megahabitat, and 9.8 km^2 (7.1 percent) is classified as Flank (slope) megahabitat; although most of the Shelf megahabitat is flat and homogenous, 3.2 km^2 (2.4 percent of the map area) consists of ripple scour depressions. Landslide scarps and landslide deposits, which are found in both Shelf and Flank megahabitats, cover 1.3 km^2 (0.9 percent) and 5.7 km^2 (4.1 percent) of the map area, respectively. The thalweg habitat, which is restricted to Hueneme Canyon, covers 1.5 km^2 (1.1 percent) of the map area.

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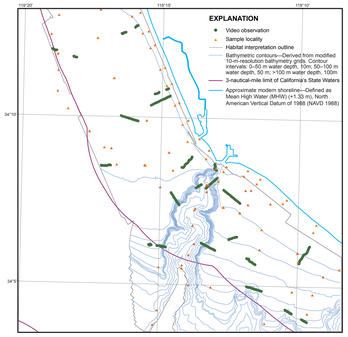

Figure 1. Map showing video-observation locations and sample localities for Hueneme Canyon and vicinity map area.

Onshore elevation data from NOAA Coastal Services Center (data collected by EarthData International in 2002-2003) and from U.S. Army Corps of Engineers (data collected by Fugro Pelagos in 2009).
California's State Waters limit from NOAA Office of Coast Survey
Universal Transverse Mercator projection, Zone 11N

NOT INTENDED FOR NAVIGATIONAL USE

APPROXIMATE MEAN DECLINATION, 2012

SCALE 1:24 000

1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 KILOMETER

BATHYMETRIC CONTOUR INTERVALS 10 METERS, 50 METERS, AND 100 METERS
ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Potential marine benthic habitats mapped by Charles A. Endris and H. Gary Greene, 2011. Bathymetric contours by Andrew C. Ritchie, 2011
GIS database and digital cartography by Nadine E. Golden, Elwyne L. Phillips, and Charles A. Endris
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Potential Marine Benthic Habitats, Hueneme Canyon and Vicinity, California

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