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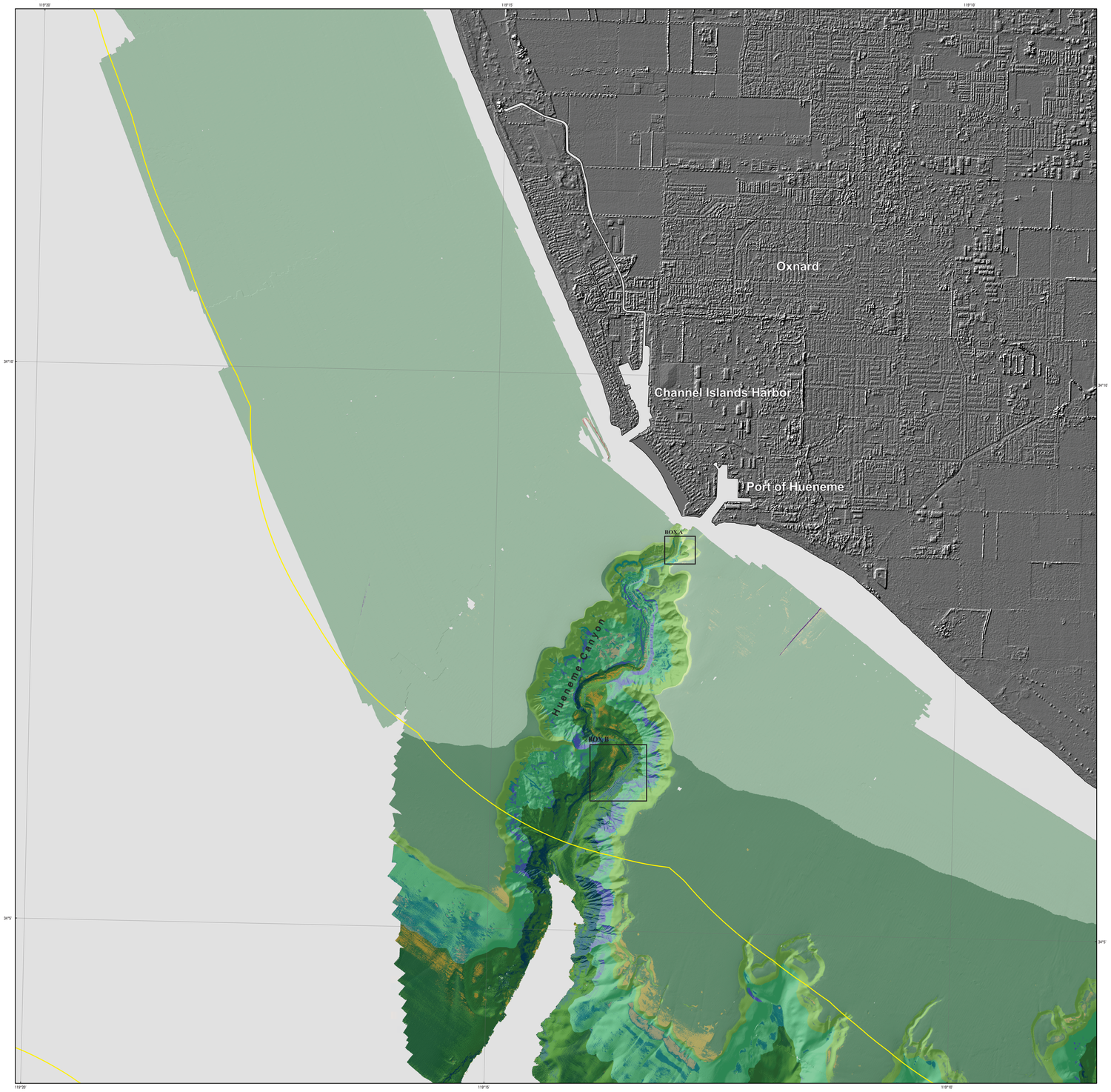
U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3225
Sheet 5 of 12
Pamphlet accompanies map



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). Offshore shaded-relief bathymetry from map on sheet 2, this report. 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

ONE MILE = 0.869 NAUTICAL MILES

ONE KILOMETER = 0.539 NAUTICAL MILES

MAP LOCATION

Seafloor character mapped in 2011
GIS database and digital cartography by Nadine E. Golden and Eleyne L. Phillips
Edited by Taryn A. Lindquist
Manuscript approved for publication July 25, 2012

Seafloor Character, Hueneme Canyon and Vicinity, California

By
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2012

DESCRIPTION OF MAP UNITS

DEPTH ZONE 2—INTERTIDAL TO 30 METERS WATER DEPTH

SLOPE CLASS 1—0 TO 5 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobble, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulder and rugose bedrock
- **Anthropogenic material**—Related to development by humans

SLOPE CLASS 2—5 TO 30 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobble, and bedrock

SLOPE CLASS 3—30 TO 60 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed

DEPTH ZONE 3—30 TO 100 METERS WATER DEPTH

SLOPE CLASS 1—0 TO 5 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobble, and bedrock

SLOPE CLASS 2—5 TO 30 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobble, and bedrock

SLOPE CLASS 3—30 TO 60 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed

SLOPE CLASS 4—60 TO 90 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed

DEPTH ZONE 4—100 TO 200 METERS WATER DEPTH

SLOPE CLASS 1—0 TO 5 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobble, and bedrock

SLOPE CLASS 2—5 TO 30 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobble, and bedrock

SLOPE CLASS 3—30 TO 60 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed

SLOPE CLASS 4—60 TO 90 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed

DEPTH ZONE 5—GREATER THAN 200 METERS WATER DEPTH

SLOPE CLASS 1—0 TO 5 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobble, and bedrock

SLOPE CLASS 2—5 TO 30 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobble, and bedrock

SLOPE CLASS 3—30 TO 60 DEGREES

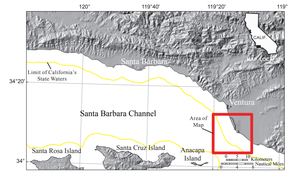
- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed

SLOPE CLASS 4—60 TO 90 DEGREES

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed

EXPLANATION OF MAP SYMBOLS

- **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)



DISCUSSION

This seafloor-character map of Hueneme Canyon and vicinity in southern California was produced using video-supervised, maximum-likelihood classification of the bathymetry and backscatter (intensity of return) signals from sonar systems (a summary of the video data collected for the purpose of supervising the classification is shown on sheet 6). Rugosity (a GIS-derived characterization of roughness) and backscatter intensity were used as variants in the classification. The interpreted classifications were then draped over shaded-relief bathymetry (see sheet 2).

The substrate classes mapped in this area have been divided into the following California Marine Life Protection Act depth zones: Depth Zone 2 (intertidal to 30 m); Depth Zone 3 (30 to 100 m); Depth Zone 4 (100 to 200 m); and Depth Zone 5 (greater than 200 m). Depth Zone 1 (intertidal) is not present in this map area. In addition, the following slope classes are represented on this map (Coastal and Marine Ecological Classification Standard slope zones are shown in parentheses): Slope Class 1, 0° to 5° (flat); Slope Class 2, 5° to 30° (sloping); Slope Class 3, 30° to 60° (steeply sloping); and Slope Class 4, 60° to 90° (vertical).

Fine- to medium-grained smooth sediment makes up 99.0 percent of the map area (139.8 km^2): 83.5 km^2 is in Depth Zone 2; 34.9 km^2 is in Depth Zone 3; 12.0 km^2 is in Depth Zone 4; and 9.5 km^2 is in Depth Zone 5. Mixed smooth sediment and rock (sediment typically forming a veneer over bedrock, or rock outcrops having little to no relief) makes up 1.0 percent of the map area (1.5 km^2): 0.1 km^2 is in Depth Zone 2; 0.5 km^2 is in Depth Zone 3; 0.4 km^2 is in Depth Zone 4; and 0.5 km^2 is in Depth Zone 5. Rock and boulder, rugose (rock and boulder outcrops having high surficial complexity), which makes up less than 0.1 percent (<0.1 km^2) of the map area, is present only in Depth Zone 2. Anthropogenic material (a pipe), which makes up less than 0.1 percent (<0.1 km^2) of the map area, is present only in Depth Zone 2 (table 1).

Table 1. Coverage of classified seafloor, in square kilometers (sq km) and percent of total area, broken into California Marine Life Protection Act Depth Zones 2, 3, 4, and 5.

	Total		Depth Zone 2 (water depth 0–30 m)		Depth Zone 3 (water depth 30–100 m)		Depth Zone 4 (water depth 100–200 m)		Depth Zone 5 (water depth >200 m)	
	percent	sq km	percent of total	sq km	percent of total	sq km	percent of total	sq km	percent of total	sq km
Fine- to medium-grained smooth sediment	99.0	139.8	59.1	83.5	24.7	34.9	8.5	12.0	6.7	9.5
Mixed smooth sediment and rock	1.0	1.5	0.1	0.1	0.4	0.5	0.3	0.4	0.3	0.5
Rock and boulder, rugose	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.0
Anthropogenic (pipe)	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.0

BOX A

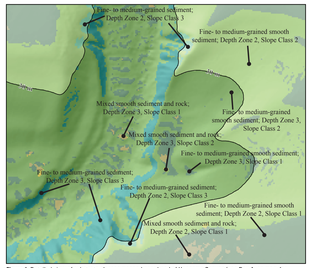


Figure 1. Detailed view of substrate classes mapped near head of Hueneme Canyon (see Box A, on map, for location): Depth Zone 2 (intertidal to 30 m); Depth Zone 3 (30 to 100 m); Slope Class 1 (0°–5°); Slope Class 2 (5°–30°); and Slope Class 3 (30°–60°). Light-green areas are fine- to medium-grained smooth sediment; tan areas are mixed smooth sediment and rock. Bathymetric contour (30 m) added for depth reference.

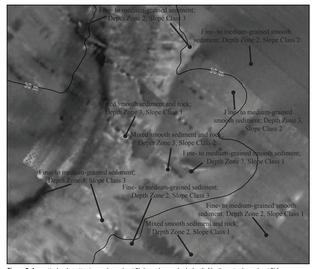


Figure 2. Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 1 (Box A on map). Brighter areas indicate coarse-grained, rough, or hard seafloor; darker areas indicate unconsolidated (loosely packed) sediment. Interpreted substrate classes from figure 1 included for comparison. Bathymetric contour (30 m) added for depth reference.

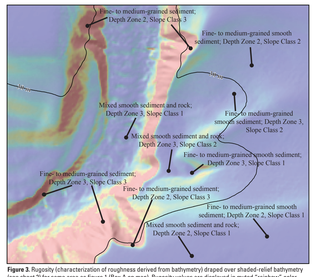


Figure 3. Rugosity (characterization of roughness derived from bathymetry) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 1 (Box A on map). Rugosity values are displayed in muted "rainbow" color spectrum that ranges from purple (low rugosity) through green (medium rugosity) to red (high rugosity). Areas of high slope are indicated by high-rugosity values (red); areas of low slope, by medium- to low-rugosity values (green to purple). Interpreted substrate classes from figure 1 included for comparison. Bathymetric contour (30 m) added for depth reference.

BOX B

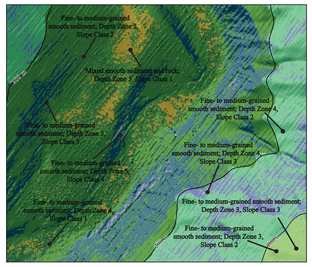


Figure 4. Detailed view of substrate classes mapped in a deeper part of Hueneme Canyon (see Box B, on map, for location): Depth Zone 3 (30 to 100 m); Depth Zone 4 (100 to 200 m); Depth Zone 5 (greater than 200 m); Slope Class 1 (0°–5°); Slope Class 2 (5°–30°); Slope Class 3 (30°–60°); and Slope Class 4 (60°–90°). Fine- to medium-grained smooth sediment is shown in shades of green and blue; mixed smooth sediment and rock is shown in shades of orange. Northeast-southwest-trending texture is artifact of data collection. Bathymetric contours (100 m and 200 m) added for depth reference.

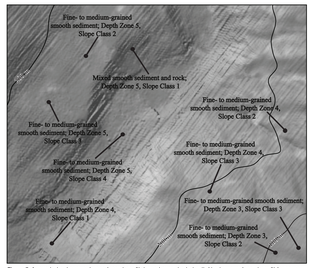


Figure 5. Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 4 (Box B on map). Brighter areas indicate coarse-grained, rough, or hard seafloor; darker areas indicate unconsolidated (loosely packed) sediment. Interpreted substrate classes from figure 4 included for comparison. Northeast-southwest-trending texture is artifact of data collection. Bathymetric contours (100 m and 200 m) added for depth reference.

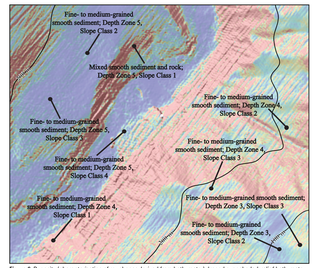


Figure 6. Rugosity (characterization of roughness derived from bathymetry) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 4 (Box B on map). Rugosity values are displayed in muted "rainbow" color spectrum that ranges from purple (low rugosity) through green (medium rugosity) to red (high rugosity). Areas of high slope are indicated by high-rugosity values (red); areas of low slope, by medium- to low-rugosity values (green to purple). Interpreted substrate classes from figure 4 included for comparison. Northeast-southwest-trending texture is artifact of data collection. Bathymetric contours (100 m and 200 m) added for depth reference.

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Suggested Citation: Phillips, E.L., and Cochrane, G.R., 2012, Seafloor character, Hueneme Canyon and vicinity, California, sheet 5 in Scientific Investigations Map 3225, pamphlet 41 p., 12 sheets, scale 1:24 000, doi:10.3133/sim3225. (Kvitek, R.G., Iampietro, P.J., Lam, P., Cochrane, G.R., Clahan, K.B., Dieter, B.W., Wong, S.L., Nabesh, M.M., and Normark, W.R. (U.S. Johnson, ed.), California State Waters Map Series—Hueneme Canyon and vicinity, California: U.S. Geological Survey Scientific Investigations Map 3225, pamphlet 41 p., 12 sheets, available at http://pubs.usgs.gov/sim/3225/.)