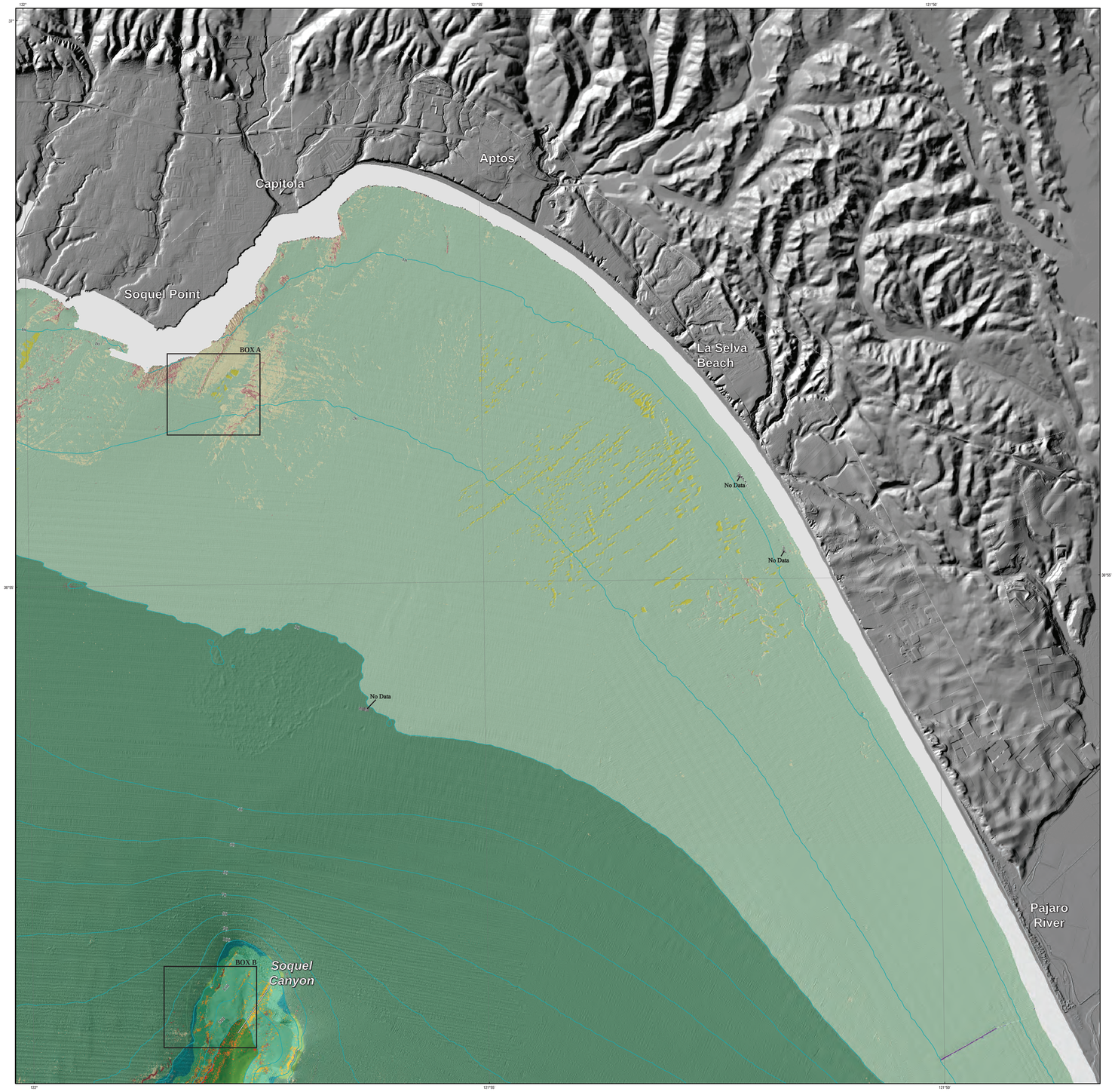
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2016–1025
Sheet 5 of 10
Pamphlet accompanies map



Onshore elevation data from National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management's Digital Coast (available at http://www.csc.noaa.gov/digitalcoast/data/coastallidar/) and from U.S. Geological Survey's National Elevation Dataset (available at http://ned.usgs.gov/). Offshore shaded-relief bathymetry from map on sheet 2, this report

Universal Transverse Mercator projection, Zone 10N

NOT INTENDED FOR NAVIGATIONAL USE

APPROXIMATE MEAN DECLINATION, 2016

SCALE 1:24 000

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

BATHYMETRIC CONTOUR INTERVALS 10 METERS AND 50 METERS

ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Seafloor character mapped by Mercedes D. Erdey, 2013.
Bathymetric contours by Mercedes D. Erdey, 2014
GIS database and digital cartography by Mercedes D. Erdey
Manuscript approved for publication February 19, 2016

Seafloor Character, Offshore of Aptos Map Area, California

By
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2016

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, cobbles, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock
- **Medium- to coarse-grained sediment**—Very high backscatter, low rugosity; typically medium- to coarse-grained sediment, with varying amounts of shell hash; in scour depressions
- **Rugged anthropogenic material**—High backscatter, high rugosity; 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, cobbles, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock

DEPTH ZONE 3—30 METERS 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, cobbles, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose 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, cobbles, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock

DEPTH ZONE 4—100 METRES 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, cobbles, 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, cobbles, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock

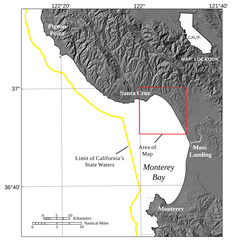
DEPTH ZONE 5—100 METRES TO 200 METERS WATER DEPTH

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, cobbles, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock

EXPLANATION OF MAP SYMBOLS

- **Area of "no data"**—Areas near shoreline not mapped owing to insufficient high-resolution seafloor mapping data
- **Bathymetric contour (in meters)**—Derived from modified 2-m- and 3-m-resolution bathymetry grids. Contour intervals: 1–100 m water depth, 10 m; >100 m water depth, 50 m



DISCUSSION

This seafloor-character map of the Offshore of Aptos map area in central 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). In addition, the following slope classes are represented on this map (Coastal and Marine Ecological Classification Standard slope zone is shown in parentheses): Slope Class 1, 0° to 5° (flat), Slope Class 2, 5° to 30° (sloping), and Slope Class 3, 30° to 60° (steeply sloping). Depth Zone 1 (intertidal), and Slope Classes 4 to 5, greater than 60° (vertical to overhang), are not present in this map area.

Fine- to medium-grained smooth sediment (sand and mud) makes up 97.2 percent (177.5 km²) of the map area: 55.2 percent (100.9 km²) is in Depth Zone 2, 40.3 percent (73.6 km²) is in Depth Zone 3, 1.4 percent (2.5 km²) is in Depth Zone 4, and 0.3 percent (0.5 km²) is in Depth Zone 5. Mixed smooth sediment (sand and gravel) and rock (that is, sediment typically forming a veneer over bedrock, or rock outcrops with little to no relief) make up 1.8 percent (3.4 km²) of the map area: 1.6 percent (3.0 km²) is in Depth Zone 2, less than 0.1 percent (0.1 km²) is in Depth Zone 3, 0.1 percent (0.2 km²) is in Depth Zone 4, and less than 0.1 percent (0.1 km²) is in Depth Zone 5. Rock and boulder, rugose (rock outcrops and boulder fields having high surficial complexity) makes up 0.4 percent (0.7 km²) of the map area: 0.3 percent (0.6 km²) is in Depth Zone 2, less than 0.1 percent (<0.1 km²) is in Depth Zone 3, less than 0.1 percent (<0.1 km²) is in Depth Zone 4, and less than 0.1 percent (<0.1 km²) is in Depth Zone 5. Medium- to coarse-grained sediment (in scour depressions consisting of material that is coarser than the surrounding seafloor), which makes up 0.6 percent (1.0 km²) of the map area, is present only in Depth Zone 2. Rugged, anthropogenic material (a pipe), which makes up less than 0.1 percent (<0.1 km²) 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	97.2	177.5	55.2	100.9	40.3	73.6	1.4	2.5	0.3	0.5
Mixed smooth sediment and rock	1.8	3.4	1.6	3.0	<0.1	0.1	0.1	0.2	<0.1	0.1
Rock and boulder, rugose	0.4	0.7	0.3	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Medium- to coarse-grained sediment	0.6	1.0	0.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Anthropogenic material, rugged (pipe)	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.0

BOX A

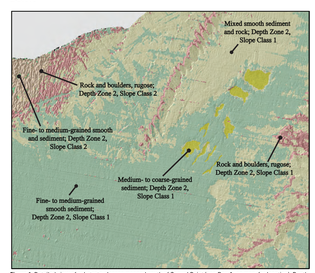


Figure 1. Detailed view of substrate classes mapped south of Soquel Point (see Box A, on map, for location): Depth Zone 2 (intertidal to 30 m), and Slope Classes 1 and 2 (0°–30°). Fine- to medium-grained smooth sediment is shown in shades of green; mixed smooth sediment and rock is shown in shades of tan; rock and boulder, rugose is shown in shades of pink and brown; and medium- to coarse-grained sediment is shown in shades of yellow.

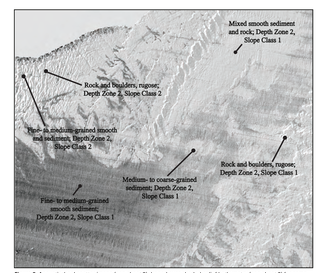


Figure 2. Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 1 (Box A on map). Brighter areas indicate coarse-grained, rough, or hard seafloor; darker areas indicate unconsolidated (loosely packed) sediment. Parallel light and dark lines are data-processing artifacts. Interpreted substrate classes from figure 1 included for comparison.

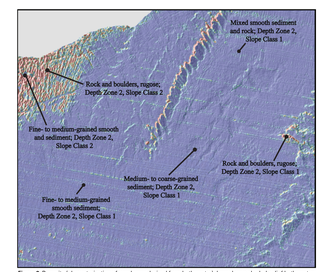


Figure 3. Rugosity (characterization of roughness derived from bathymetry) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 1 (Box A on map). Rugosity values are displayed in muted "rainbow" color spectrum that ranges from purple (low rugosity) through green (medium rugosity) to red (high rugosity). Parallel lines of medium rugosity (green) are data-processing artifacts. Interpreted substrate classes from figure 1 included for comparison.

BOX B

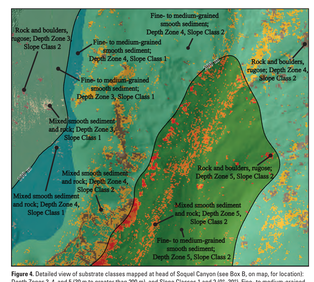


Figure 4. Detailed view of substrate classes mapped at head of Soquel Canyon (see Box B, on map, for location): Depth Zones 3, 4, and 5 (30 m to greater than 200 m), and Slope Classes 1 and 2 (0°–30°). Fine- to medium-grained smooth sediment is shown in shades of green; mixed smooth sediment and rock is shown in shades of tan and orange; and rock and boulder, rugose is shown in shades of red and brown. Bathymetric contours (100 m and 200 m) shown for depth reference.

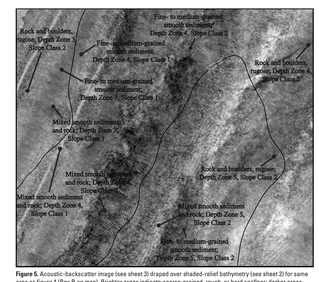


Figure 5. Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 4 (Box B on map). Brighter areas indicate coarse-grained, rough, or hard seafloor; darker areas indicate unconsolidated (loosely packed) sediment. Parallel light-gray lines are data-processing artifacts. Interpreted substrate classes from figure 4 included for comparison. Bathymetric contours (100 m and 200 m) shown for depth reference.

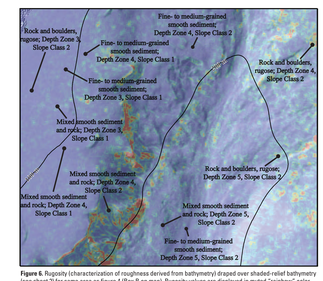


Figure 6. Rugosity (characterization of roughness derived from bathymetry) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 4 (Box B on map). Rugosity values are displayed in muted "rainbow" color spectrum that ranges from purple (low rugosity) through green (medium rugosity) to red (high rugosity). Interpreted substrate classes from figure 4 included for comparison. Bathymetric contours (100 m and 200 m) shown for depth reference.

For sale by U.S. Geological Survey, Information Services, Box 25286, Federal Center, Denver, CO 80225, 1-888-ASK-USGS

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