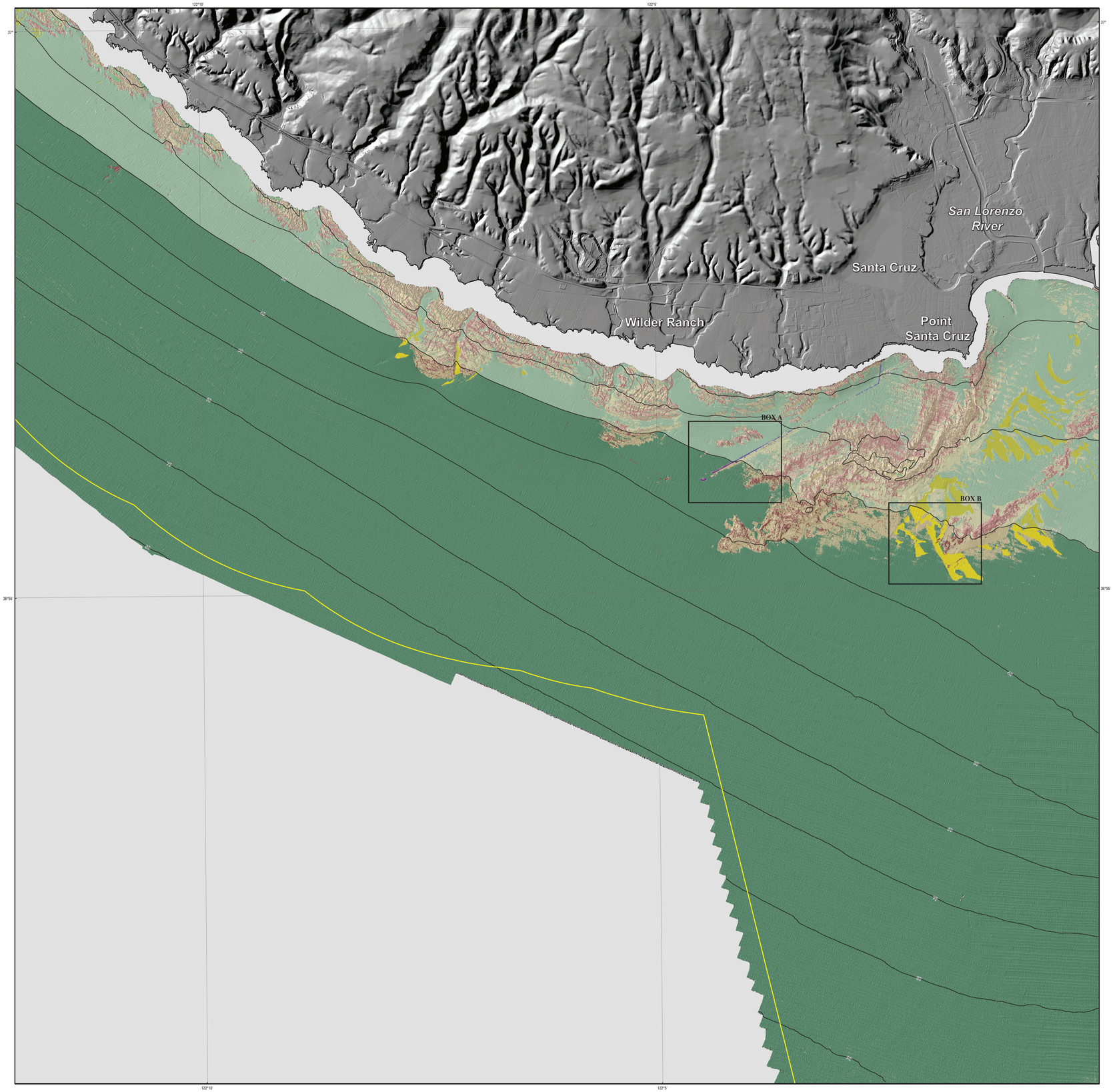
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2016–1024
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. California's State Waters limit from NOAA Office of Coast Survey.

Universal Transverse Mercator projection, Zone 10N

NOT INTENDED FOR NAVIGATIONAL USE

13½°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2016

SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

BATHYMETRIC CONTOUR INTERVAL 10 METERS

ONE MILE = 0.869 NAUTICAL MILES

CALIF.
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 18, 2016

Seafloor Character, Offshore of Santa Cruz 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
- **Hard anthropogenic material**—High backscatter, low 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
- **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
- **Hard anthropogenic material**—High backscatter, low rugosity; related to development by humans

EXPLANATION OF MAP SYMBOLS

Area of "no data"—Areas near shoreline not mapped owing to insufficient high-resolution seafloor mapping data; areas beyond limit of California's State Waters were not mapped as part of California Seafloor Mapping Program

Limit of California's State Waters

10 **Bathymetric contour (in meters)**—Derived from modified 2-m-resolution bathymetry grid. Contour interval: 10 m

DISCUSSION

This seafloor-character map of the Offshore of Santa Cruz 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), and Depth Zone 3 (30 to 100 m). 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); and Slope Class 2, 5° to 30° (sloping). Depth Zone 1 (intertidal), Depth Zones 4 and 5 (greater than 100 m), and Slope Classes 3 to 5, greater than 30° (steeply sloping to overhang), are not present in this map area.

Fine- to medium-grained smooth sediment (sand and mud) makes up 89.5 percent (133.9 km^2) of the map area: 12.3 km^2 is in Depth Zone 2, and 115.6 km^2 is in Depth Zone 3. Mixed smooth sediment (sand and gravel) and rock (sediment typically forming a veneer over bedrock, or rock outcrops having little to no relief) make up 5.5 percent (8.3 km^2) of the map area: 5.8 km^2 is in Depth Zone 2, and 2.4 km^2 is in Depth Zone 3. Rock and boulder, rugose (rock outcrops and boulder fields having high surficial complexity) makes up 3.8 percent (5.7 km^2) of the map area: 5.2 km^2 is in Depth Zone 2, and 0.5 km^2 is in Depth Zone 3. Medium- to coarse-grained sediment (in scour depressions consisting of material that is coarser than the surrounding seafloor) makes up 1.1 percent (1.6 km^2) of the map area: 1.1 km^2 is in Depth Zone 2, and 0.6 km^2 is in Depth Zone 3. Rugged, hard anthropogenic material makes up less than 0.1 percent (0.1 km^2) of the map area: less than 0.1 km^2 is in Depth Zone 2, and less than 0.1 km^2 is in Depth Zone 3 (table 1).

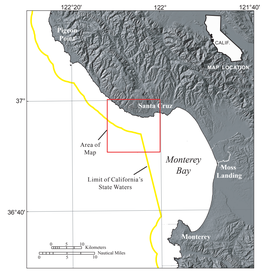

Table 1. Coverage of classified seafloor, in square kilometers (sq km) and percent of total area, broken into California Marine Life Protection Act Depth Zones 2 and 3.

	Total		Depth Zone 2 (water depth 0–30 m)		Depth Zone 3 (water depth 30–100 m)	
	percent	sq km	percent of total	sq km	percent of total	sq km
Fine- to medium-grained smooth sediment	89.5	133.9	8.2	12.3	77.3	115.6
Mixed smooth sediment and rock	5.5	8.3	3.9	5.8	1.6	2.4
Rock and boulder, rugose	3.8	5.7	3.5	5.2	0.3	0.5
Medium- to coarse-grained sediment	1.1	1.6	0.7	1.1	0.4	0.6
Rugged, hard anthropogenic (pipe)	<0.1	0.1	<0.1	<0.1	<0.1	<0.1

BOX A

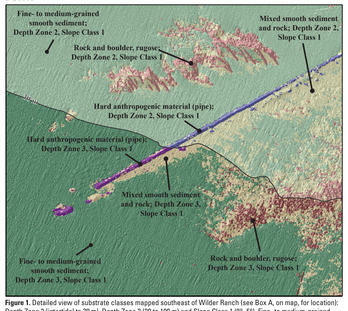

Figure 1. Detailed view of substrate classes mapped southeast of Wilder Ranch (see Box A, on map, for location): Depth Zone 2 (intertidal to 30 m), Depth Zone 3 (30 to 100 m) and Slope Class 1 (0°–5°). Fine- to medium-grained smooth sediment is shown in shades of green; mixed smooth sediment and rock is shown in shades of tan; rock is shown in shades of pink; and anthropogenic material is shown in shades of purple. Bathymetric contour (30 m) shown for depth reference.

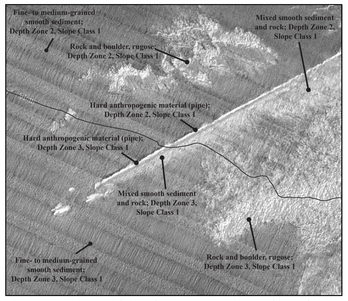

Figure 2. Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 1 (Box A on map). Brighter areas indicate coarse-grained, rough, or hard seafloor; darker areas indicate unconsolidated (loosely packed) sediment. Interpreted substrate classes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

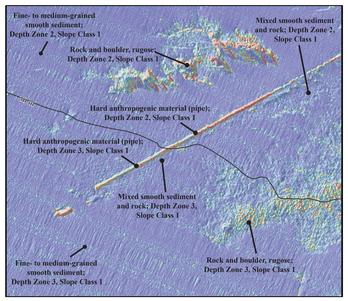

Figure 3. Rugosity (characterization of roughness derived from bathymetry) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 1 (Box A on map). Rugosity values are displayed in muted "rainbow" color spectrum that ranges from purple (low rugosity) through green (medium rugosity)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

BOX B

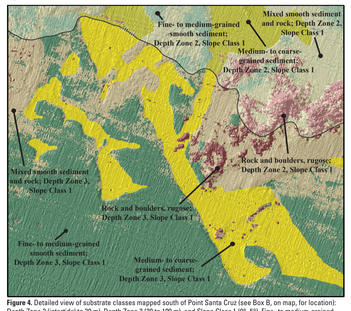

Figure 4. Detailed view of substrate classes mapped south of Point Santa Cruz (see Box B, on map, for location): Depth Zone 2 (intertidal to 30 m), Depth Zone 3 (30 to 100 m), and Slope Class 1 (0°–5°). Fine- to medium-grained smooth sediment is shown in shades of green; mixed smooth sediment and rock is shown in shades of tan; rock is shown in shades of pink; and medium- to coarse-grained sediment is shown in yellow. Bathymetric contour (30 m) shown for depth reference.

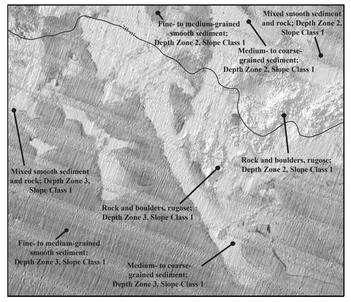

Figure 5. Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 4 (Box B on map). Brighter areas indicate coarse-grained, rough, or hard seafloor; darker areas indicate unconsolidated (loosely packed) sediment. Interpreted substrate classes from figure 4 included for comparison. Bathymetric contour (30 m) shown for depth reference.

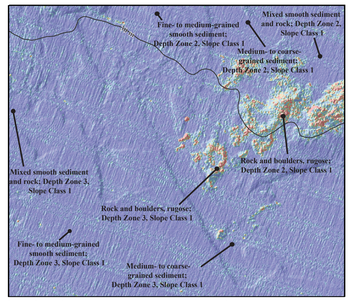

Figure 6. Rugosity (characterization of roughness derived from bathymetry) draped over shaded-relief bathymetry (see sheet 2) for same area as figure 4 (Box B on map). Rugosity values are displayed in muted "rainbow" color spectrum that ranges from purple (low rugosity) through green (medium rugosity) to red (high rugosity). Interpreted substrate classes from figure 4 included for comparison. Bathymetric contour (30 m) shown for depth reference.

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