

**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 depression

**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
- Medium- to coarse-grained sediment—Very high backscatter, low rugosity; typically medium- to coarse-grained sediment, with varying amounts of shell hash, in scour depression

**DEPTH ZONE 3—30 METERS TO 100 METERS WATER DEPTH**

**SLOPE CLASS 1—0 TO 5 DEGREES**

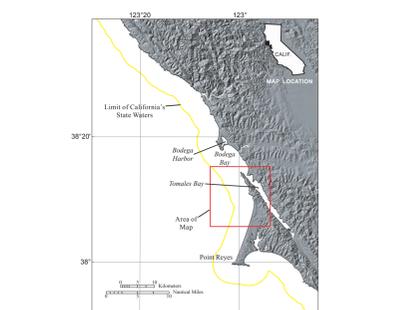
- Fine- to medium-grained smooth sediment—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- Mixed smooth sediment and rock—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobbles, and bedrock
- Rock and boulder,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

**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
- Medium- to coarse-grained sediment—Very high backscatter, low rugosity; typically medium- to coarse-grained sediment, with varying amounts of shell hash, in scour depression

**EXPLANATION OF MAP SYMBOLS**

- 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



rugose (rock outcrops and boulder fields having high surficial complexity) makes up 14.4 percent (18.2 km<sup>2</sup>) of the map area. 8.7 km<sup>2</sup> is in Depth Zone 2, and 9.5 km<sup>2</sup> is in Depth Zone 3. Medium- to coarse-grained sediment in scour depressions makes up 2.2 percent (6.8 km<sup>2</sup>) of the map area. 1.0 km<sup>2</sup> is in Depth Zone 2 and 5.6 km<sup>2</sup> 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.**

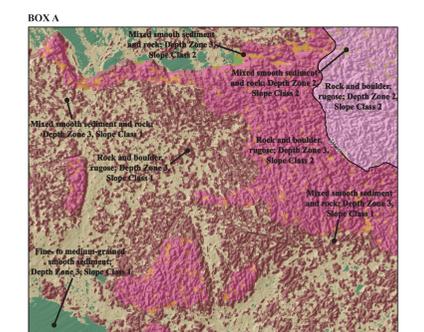
	Total		Depth Zone 2 (water depth 0–30 m)		Depth Zone 3 (water depth 30–100 m)	
	percent	sq km	percent of total	sq km	percent of total	sq km
Fine- to medium-grained smooth sediment	56.5	71.7	14.3	18.2	42.2	53.5
Mixed smooth sediment and rock	23.9	30.2	4.2	5.3	19.7	24.9
Rock and boulder, rugose	14.4	18.2	6.9	8.7	7.5	9.5
Medium- to coarse-grained sediment	5.2	6.6	0.8	1.0	4.4	5.6

**DISCUSSION**

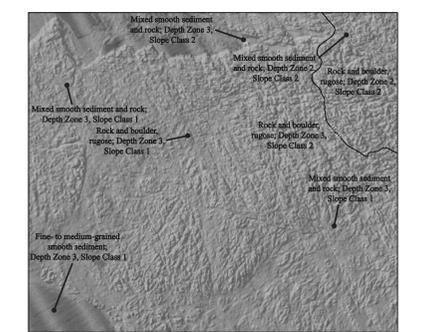
This seafloor-character map of the Offshore of Tomales Point map area in northern California was produced using video-supported, maximum likelihood classification of the bathymetry and backscatter (intensity of return) signals from sonar systems (a summary of the video data collected for the purpose 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° (steep)). Depth Zone 1 (intertidal), Depth Zones 4 and 5 (greater than 100 m), and Slope Classes 3 and 4, greater than 30° (steeply sloping to vertical) are not present in this map area.

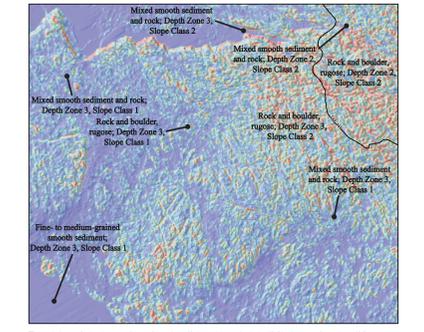
Fine- to medium-grained smooth sediment (sand and mud) makes up 56.5 percent (71.7 km<sup>2</sup>) of the map area. 18.2 km<sup>2</sup> is in Depth Zone 2, and 53.5 km<sup>2</sup> is in Depth Zone 3. Mixed smooth sediment (sand and gravel) and rock (that is, sediment typically forming a veneer over bedrock, or rock outcrops having little to no relief) makes up 23.9 percent (30.2 km<sup>2</sup>) of the map area. 5.3 km<sup>2</sup> is in Depth Zone 2, and 24.9 km<sup>2</sup> is in Depth Zone 3. Rock and boulder,



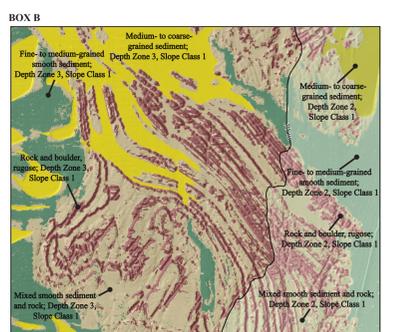
**Figure 1.** Detailed view of substrate classes mapped offshore of Tomales Point (see Box A, on map, for location). Depth Zone 2 (intertidal to 30 m), Depth Zone 3 (30 to 100 m), Slope Class 1 (0°–5°), and Slope Class 2 (5°–30°). Fine- to medium-grained smooth sediment is shown in shades of green; mixed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



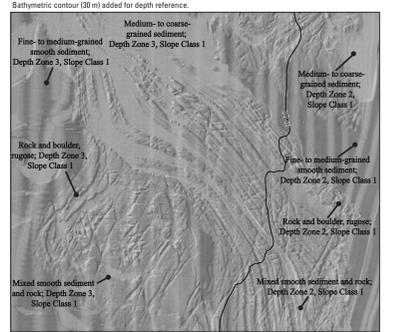
**Figure 2.** Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as Figure 1 (Box A on map). Brighter areas indicate coarse-grained, rough, or hard seafloor; darker areas indicate unconsolidated (loosely packed) sediment. Parallel light gray lines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



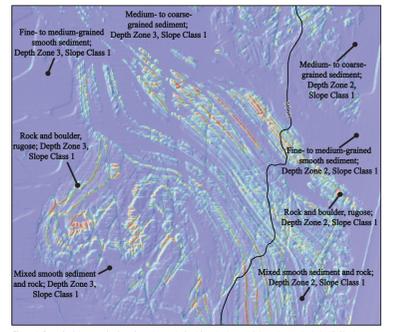
**Figure 3.** Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as Figure 1 (Box A on map). Rugosity values are displayed in muted "rainbow" color spectrum that ranges from purple (low rugosity) through green (medium rugosity) to red (high rugosity). Interpreted substrate classes from Figure 1 included for comparison.



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

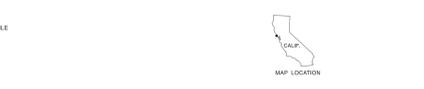
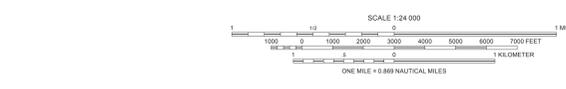


**Figure 5.** Acoustic-backscatter image (see sheet 3) draped over shaded-relief bathymetry (see sheet 2) for same area as Figure 4 (Box B on map). Brighter areas indicate coarse-grained, rough, or hard seafloor; darker areas indicate unconsolidated (loosely packed) sediment. Parallel light gray lines (in N to S and NW to SE direction) are data-processing artifacts. Interpreted substrate classes from Figure 4 included for comparison.



**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.

Shoreline elevation data from California Coastal Conservancy, available at <http://www.ccc.ca.gov/pubs/intermediate/coordinates/>, and from U.S. Geological Survey, National Elevation Dataset, available at <http://ned.srs.gov/>. California State Waters limit from NOAA Office of Coast Survey. Universal Transverse Mercator projection, Zone 10N. NOT INTENDED FOR NAVIGATIONAL USE.



Seafloor character mapped by Mercedes D. Erdey and Guy R. Cochrane, 2013. GIS database and digital cartography by Mercedes D. Erdey and Nadine E. Giddon. Manuscript approved for publication May 4, 2015.

**Seafloor Character, Offshore of Tomales Point Map Area, California**  
By Mercedes D. Erdey and Guy R. Cochrane 2015

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