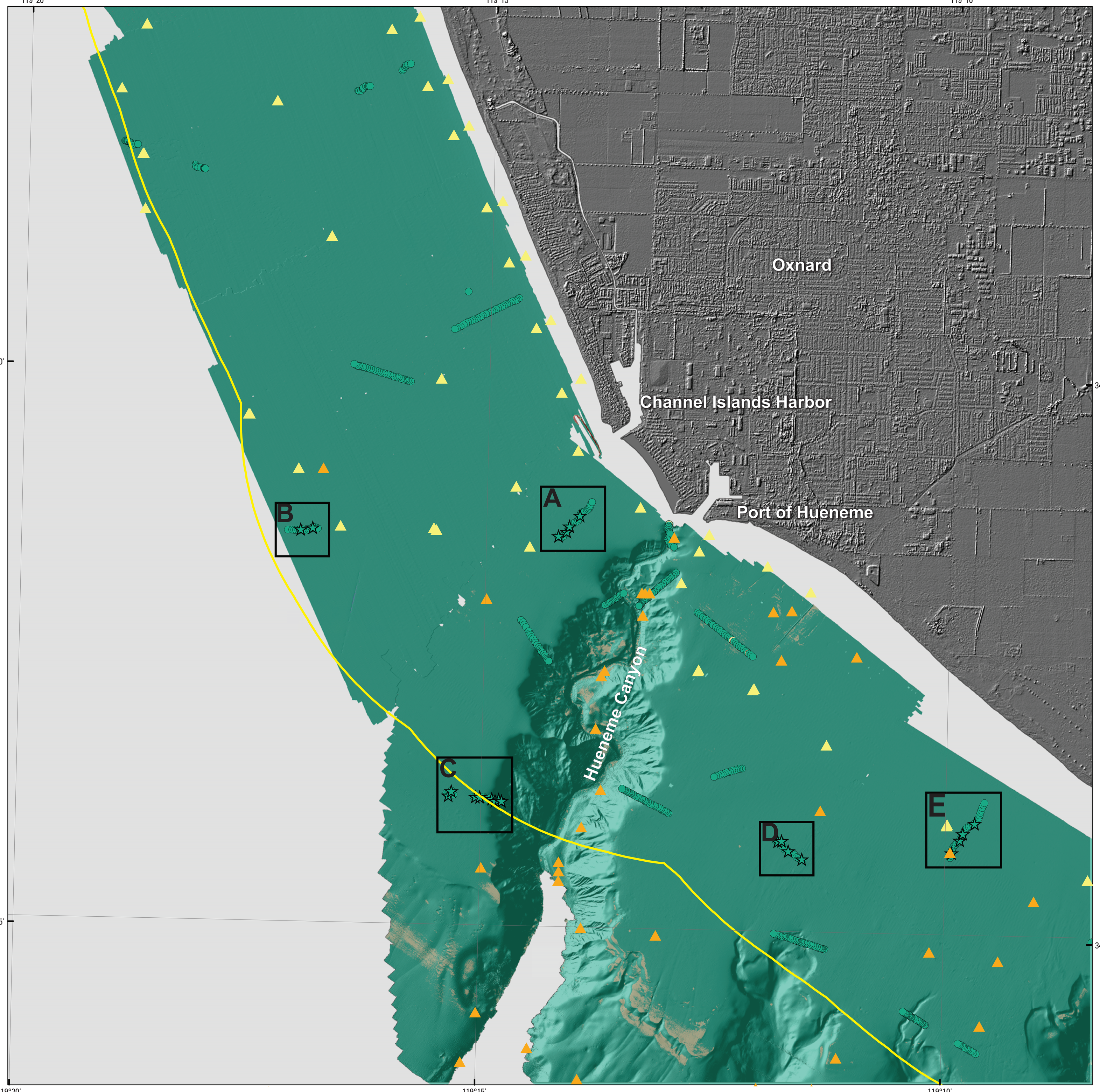


Onshore elevation data from NOAA Coastal Services Center (data collected by EarthData International in 2002-2003) and from U.S. Army Corps of Engineers (data collected by Fugro Pelagos in 2009). Offshore shaded-relief bathymetry from map on sheet 2, this report. California's State Waters limit from NOAA Office of Coast Survey

Universal Transverse Mercator projection, Zone 11N

NOT INTENDED FOR NAVIGATIONAL USE

13°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2012

SCALE 1:50 000
2 1 0 2 MILES
7000 3500 0 7000 FEET
1 0.5 0 1 KILOMETER
ONE MILE = 0.869 NAUTICAL MILES

CALIF.
MAP LOCATION

Seafloor-character map generalized from map on sheet 5, this report. Video observations recorded and digital still photographs taken in 2007-2008. Sample localities from usSEABED (Reid and others, 2006) and from Barnard and others (2009)

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

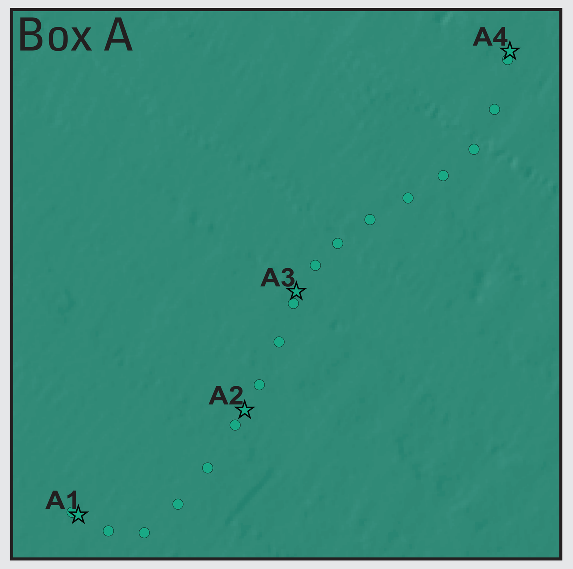


Figure 1A. Detailed view of seafloor character mapped north of Hueneme Canyon, approximately 1 km offshore of Port of Hueneme (see Box A, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 1B–1E) from camera line CAM37, cruise S1C08SC.

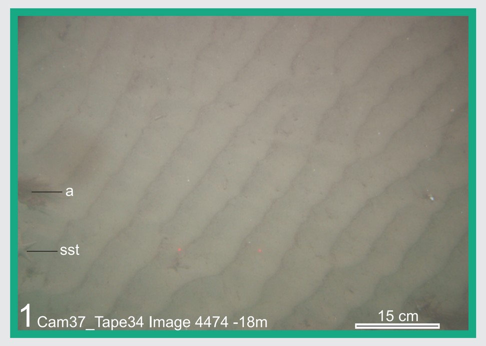


Figure 1B. Digital still photograph no. A1 (see fig. 1A for location). Fine sand with sharp-crested, symmetrical wave ripples (18 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes algae (a) and sea star (sst). Distance between lasers (red dots) is 15 cm.

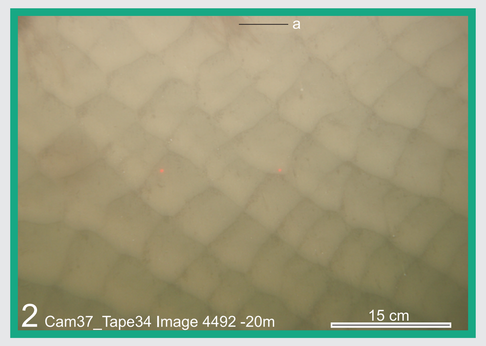


Figure 1C. Digital still photograph no. A2 (see fig. 1A for location). Fine sand with sharp-crested interference ripples, which indicate bottom currents of different orientations (20 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes algae (a). Distance between lasers (red dots) is 15 cm.

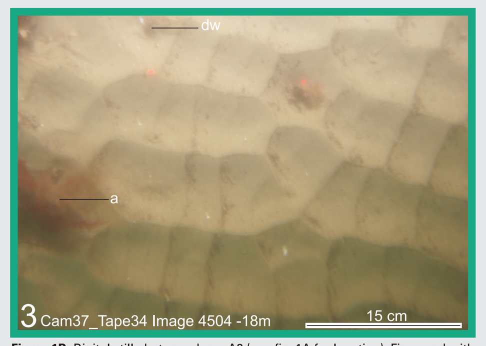


Figure 1D. Digital still photograph no. A3 (see fig. 1A for location). Fine sand with sharp-crested wave and interference ripples (18 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes algae (a) and drift weed (dw). Distance between lasers (red dots) is 15 cm.

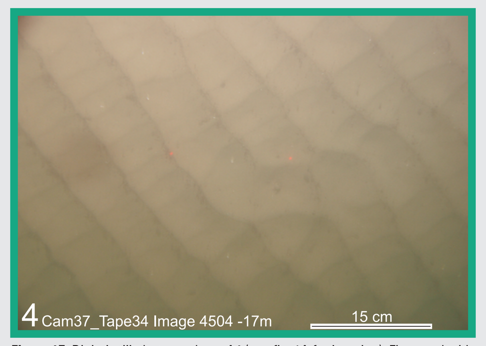


Figure 1E. Digital still photograph no. A4 (see fig. 1A for location). Fine sand with sharp-crested, symmetrical interference ripples (17 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Distance between lasers (red dots) is 15 cm.

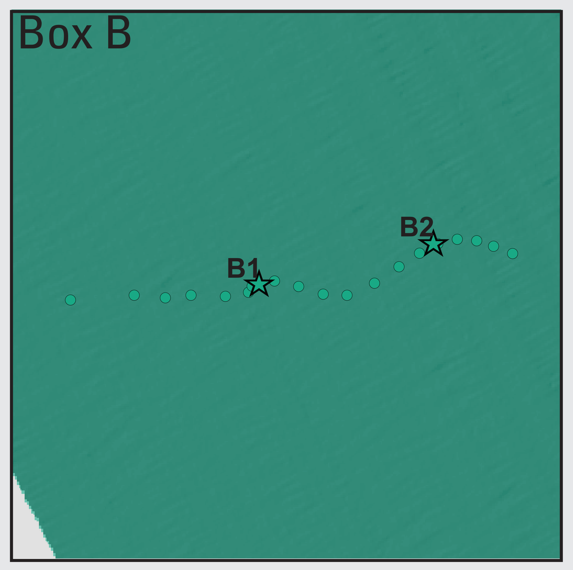


Figure 2A. Detailed view of seafloor character mapped northwest of Hueneme Canyon, approximately 6 km offshore of Port of Hueneme (see Box B, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 2B,2C) from camera line CAM35, cruise S1C08SC.

Figure 2B. Digital still photograph no. B1 (see fig. 2A for location). Fine- to medium-grained sand with mostly sharp-crested, symmetrical wave ripples (19 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Distance between lasers (red dots) is 15 cm.

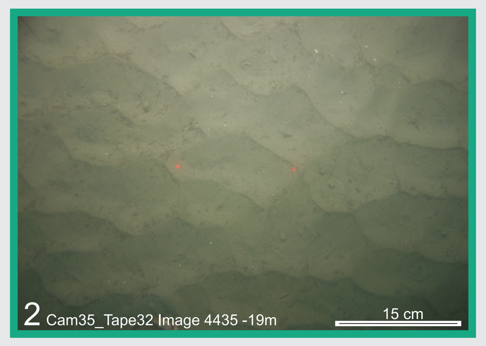


Figure 2C. Digital still photograph no. B2 (see fig. 2A for location). Fine- to medium-grained sand with sharp-crested, asymmetrical interference ripples in a confused pattern (19 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Distance between lasers (red dots) is 15 cm.

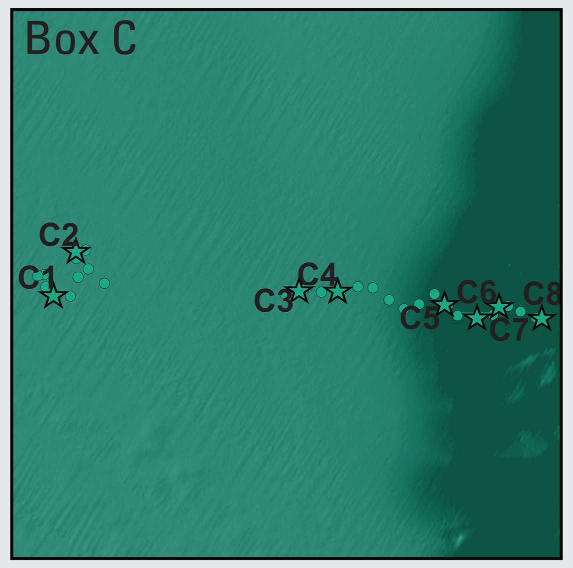


Figure 3A. Detailed view of seafloor character mapped west of Hueneme Canyon, approximately 6 km offshore of Port of Hueneme (see Box C, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 3B–3I) from camera line CAM34, cruise S1C08SC.

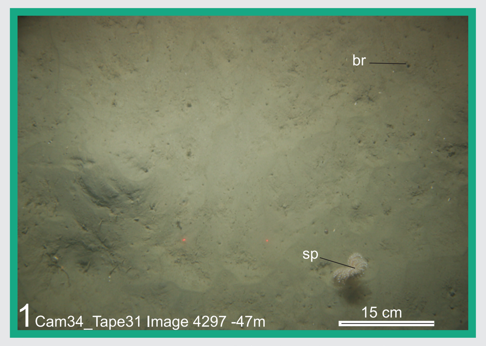


Figure 3B. Digital still photograph no. C1 (see fig. 3A for location). Fine sand with degraded wave ripples in a confused pattern (47 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes small burrows (br) and sea pen (sp). Distance between lasers (red dots) is 15 cm.

Figure 3C. Digital still photograph no. C2 (see fig. 3A for location). Fine sand with degraded wave ripples (44 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sea hare (sh), flatfish (ff), and brittle star (bs). Distance between lasers (red dots) is 15 cm.

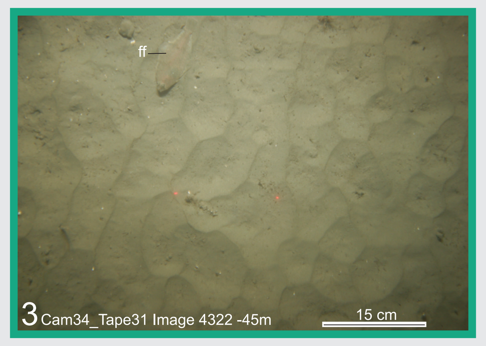


Figure 3D. Digital still photograph no. C3 (see fig. 3A for location). Fine- to medium-grained sand with sharp-crested interference ripples (45 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes flatfish (ff). Distance between lasers (red dots) is 15 cm.

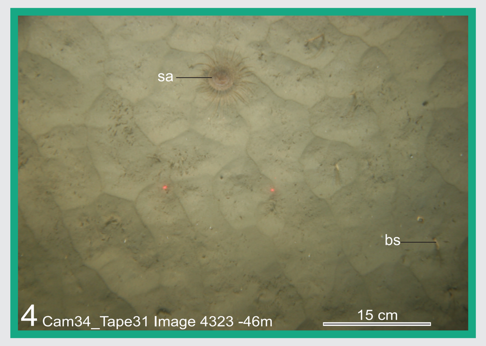


Figure 3E. Digital still photograph no. C4 (see fig. 3A for location). Fine sand with sharp-crested interference ripples (46 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sea anemone (sa) and brittle star (bs). Distance between lasers (red dots) is 15 cm.

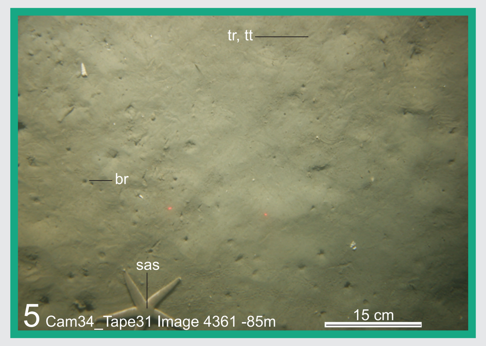


Figure 3F. Digital still photograph no. C5 (see fig. 3A for location). Mud and sand (85 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes burrows (br), tracks (tr), trails (tt), and sand star (sas). Distance between lasers (red dots) is 15 cm.

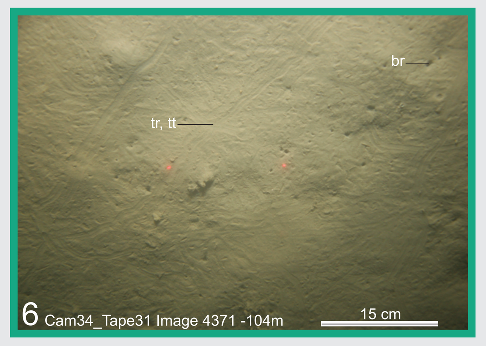


Figure 3G. Digital still photograph no. C6 (see fig. 3A for location). Mud and sand (104 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes burrows (br), tracks (tr), and trails (tt). Distance between lasers (red dots) is 15 cm.

Figure 3H. Digital still photograph no. C7 (see fig. 3A for location). Mud and sand (133 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes burrows (br), crab (c), flatfish (ff), tracks (tr), and trails (tt). Distance between lasers (red dots) is 15 cm.

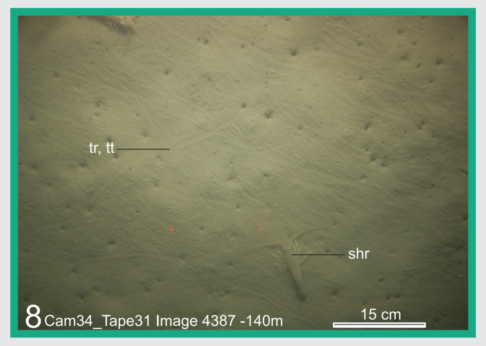


Figure 3I. Digital still photograph no. C8 (see fig. 3A for location). Mud and sand (140 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes shrimp (shr), tracks (tr), and trails (tt). Distance between lasers (red dots) is 15 cm

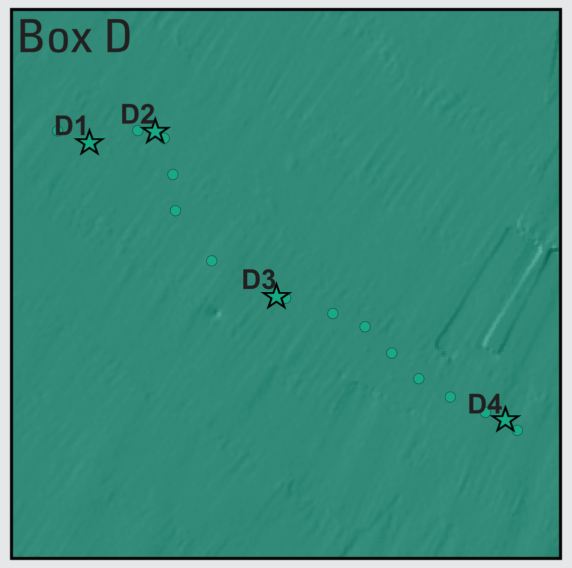


Figure 4A. Detailed view of seafloor character mapped southeast of Hueneme Canyon, approximately 4 km offshore of Port of Hueneme (see Box D, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 4B–4E) from camera line CAM41, cruise S1C08SC.

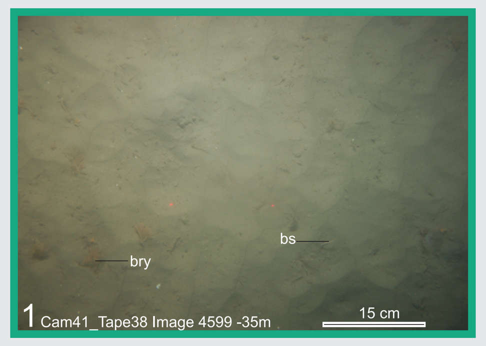


Figure 4B. Digital still photograph no. D1 (see fig. 4A for location). Fine sand with degraded ripples in a confused pattern (35 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes bryozoan (bry) and brittle star (bs). Distance between lasers (red dots) is 15 cm.Distance between lasers (red dots) is 15 cm.

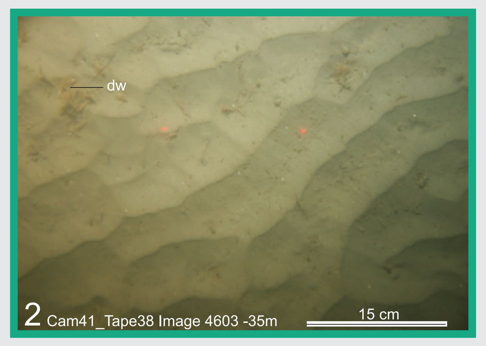


Figure 4C. Digital still photograph no. D2 (see fig. 4A for location). Fine sand with sharp-crested ripples in a confused pattern (35 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes drift weed (dw). Distance between lasers (red dots) is 15 cm.

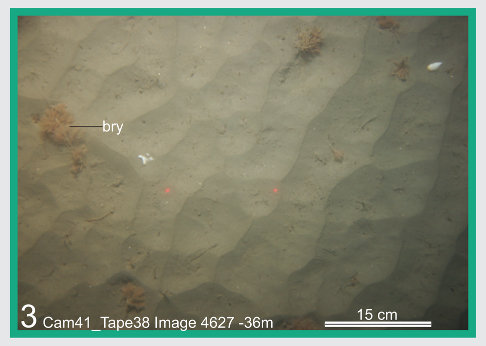


Figure 4D. Digital still photograph no. D3 (see fig. 4A for location). Fine sand with sharp-crested ripples in a confused pattern (36 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes bryozoan (bry). Distance between lasers (red dots) is 15 cm.

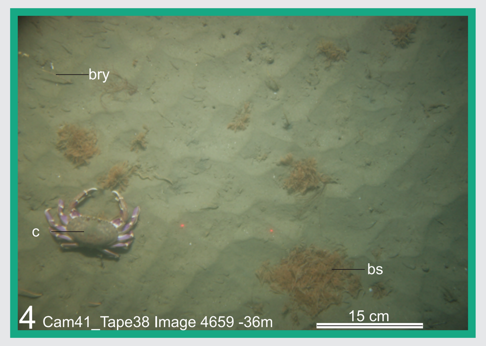


Figure 4E. Digital still photograph no. D4 (see fig. 4A for location). Fine sand with sharp-crested ripples in a confused pattern (36 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is moderate. Biocover includes bryozoan (bry), crab (c), and brittle star (bs). Distance between lasers (red dots) is 15 cm.

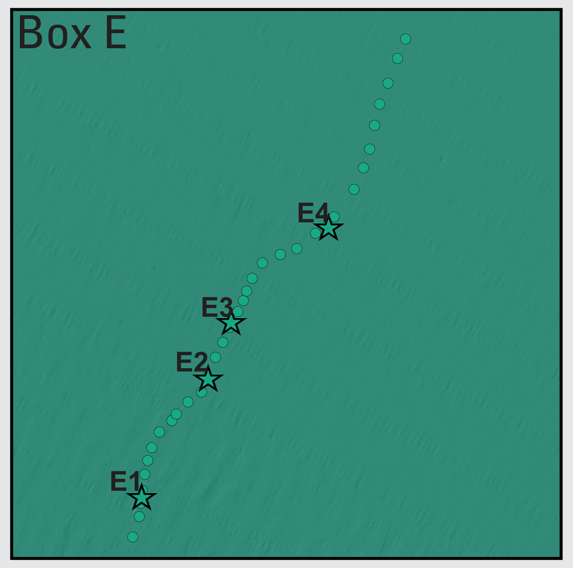


Figure 5A. Detailed view of seafloor character mapped east of Hueneme Canyon, approximately 1 km offshore of Port of Hueneme (see Box E, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 5B–5E) from camera line CAM38, cruise S1C08SC.

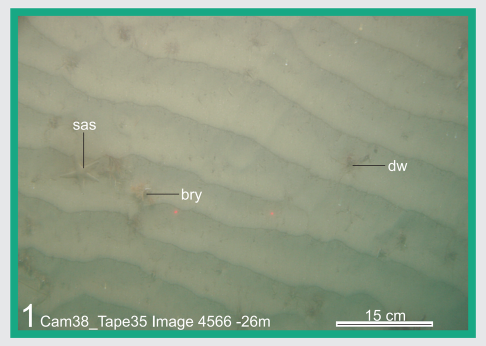


Figure 5B. Digital still photograph no. E1 (see fig. 5A for location). Fine sand with sharp-crested, symmetrical wave ripples (26 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes drift weed (dw), sand star (sas), and bryozoan (bry). Distance between lasers (red dots) is 15 cm.

Figure 5C. Digital still photograph no. E2 (see fig. 5A for location). Fine sand with sharp-crested, symmetrical wave ripples (22 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes algae (a), drift weed (dw), and crab (c). Distance between lasers (red dots) is 15 cm.

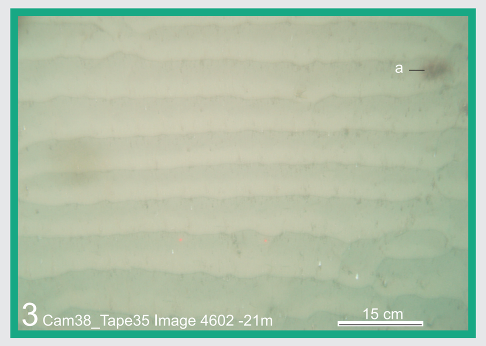


Figure 5D. Digital still photograph no. E3 (see fig. 5A for location). Fine sand with sharp-crested, oscillatory ripples (21 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes algae (a). Distance between lasers (red dots) is 15 cm.

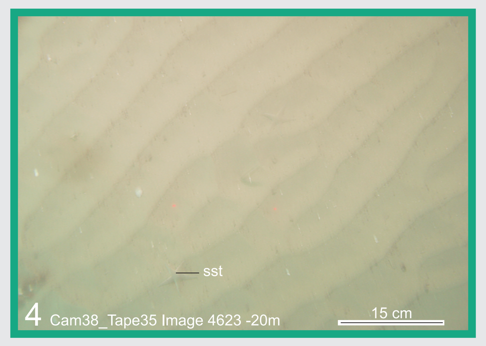
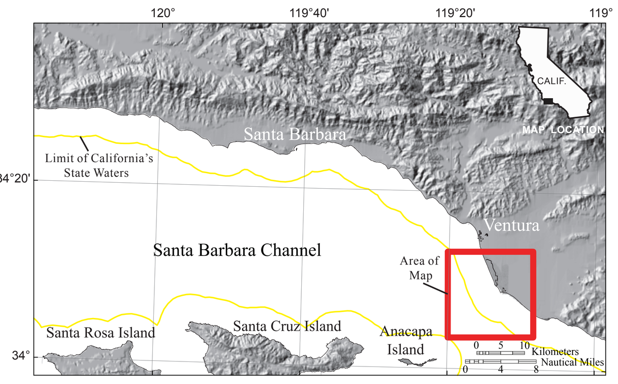


Figure 5E. Digital still photograph no. E4 (see fig. 5A for location). Fine sand with sharp-crested, oscillatory ripples (132 m water depth). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sand star (sst). Distance between lasers (red dots) is 15 cm.



DISCUSSION

Between 2006 and 2007, the seafloor in the Hueneme Canyon and vicinity map area in southern California was mapped by California State University, Monterey Bay (CSUMB), and the U.S. Geological Survey (USGS), using both multibeam echosounders and bathymetric sidescan-sonar units (see sheets 1–3). These mapping missions combined to collect bathymetry and acoustic-backscatter data from about the 10-m isobath to out beyond the 3-nautical-mile limit of California's State Waters. In order to characterize the bathymetry and acoustic-backscatter data into geologically and biologically useful information, the USGS ground-truth-surveyed the data by towing camera sleds (fig. 6) over specific locations throughout the map area.

The ground-truth-surveys occurred on two separate cruises over a two-year period. The camera sleds were towed 1 to 2 m over the seafloor, at speeds of between 1 and 2 nautical miles/hour. During the 2007 ground-truth cruise, a smaller USGS camera sled was used that housed two video cameras; one was forward looking, and the other was downward looking. The video was relayed in real time to the research vessel, where USGS and National Oceanic and Atmospheric (NOAA) scientists recorded both the geologic and biologic character of the seafloor once every minute, using programmable keypads. During the 2008 ground-truth cruise, a larger camera sled was used that housed two video cameras (one forward looking, the other downward looking), a high-definition video camera, and an 8-megapixel digital still camera, which captured a digital still photograph once every 30 seconds. The location and directions of the camera-sled tracklines were chosen in order to visually inspect areas thought to represent the full range of bottom hardness and rugosity in the map area.

In the context of marine-fisheries management, benthic-habitat complexity can be divided into abiotic (geologic) and biotic (biologic) components. Benthic-habitat complexity refers to the visual classification of local abiotic and biotic vertical relief and structure that may provide potential refuge for both juvenile and adult forms of various species. Only abiotic attributes were used in the production of the seafloor-character map on sheet 5. Of these abiotic attributes, two components (primary- and secondary-substrate composition) are shown as a series of colored dots. Classifications of primary and secondary substrate are based on the Wentworth scale of sediment grain-size categories, except that the granule and pebble sizes have been grouped together into a class called "gravel," and the clay and silt sizes have been grouped into a class called "mud." Primary and secondary substrate constitute greater than 50 and 20 percent of the seafloor during an observation, respectively. Only primary and secondary substrate are reported, although individual photographs may show more substrate types.

This sheet contains a smaller, generalized version of the seafloor-character map on sheet 5 that shows the camera-sled tracklines (indicated by aligned colored dots) used to ground-truth the sonar data. The map also shows the locations of the detailed views of seafloor character along some of the tracklines (Boxes A–E) that are highlighted on this sheet (figs. 1A–5A, respectively). Also shown are locations of samples (triangles) from usSEABED (Reid and others, 2006) and by Barnard and others (2009) that were used to supplement the ground-truth surveys. The seafloor-character map shows that this area is mostly covered with sediment, and its dominant feature is the large submarine Hueneme Canyon.

Each detailed view (figs. 1A–5A) shows the locations of camera-sled tracklines (aligned colored dots), as well as of the photographs (stars) taken along the tracklines. These photographs, which are representative of the seafloor, are displayed with a description of the observed seafloor characteristics recorded by USGS and NOAA scientists (figs. 1B–1E, 2B–2C, 3B–3I, 4B–4E, 5B–5E). Organisms, when present, are labeled on the photographs.

Ground-truth surveys in the map area include approximately 18.39 trackline kilometers of video and 479 still photographs, in addition to 545 seafloor observations of abiotic and biotic attributes. A visual estimate of slope also was recorded.

GLOSSARY

Rugosity—A GIS-derived characterization of seafloor roughness, calculated as the ratio of the three-dimensional surface area of seafloor to the two-dimensional planar-base area, for each cell in the bathymetry grid.

Backscatter intensity—The amplitude of the reflected sonar signal (see sheet 3) used to infer the hardness of the bottom, determined after sonar-data processing has removed (as much as possible) the effects of water depth, angle of reflection, and bottom roughness.

Biocomplexity—The assessment of the presence or absence of biological structures that have the potential of providing shelter for fauna, determined by estimating the scale, the amount, and the morphology of biological relief (as described by Tissot and others, 2006).

Biocover—The visual estimate of the proportion of biologic cover by encrusting organisms: high, greater than 50 percent; moderate, between 50 percent and 10 percent; low, less than 10 percent.

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Tissot, B.N., Yoklavich, M.M., Love, M.S., York, K., and Amend, M., 2006, Benthic invertebrates that form habitat on deep banks off southern California, with special reference to deep sea coral: Fishery Bulletin, v. 104, p. 167–181.

EXPLANATION

Substrate class

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

Location of real-time video observation and interpreted substrate class of seafloor

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

Location of digital still photograph and interpreted substrate class of seafloor

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

Interpreted substrate class depicted in digital still photograph—Indicated by colored frame around photograph (not shown on map; shown in figures only)

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

Sample localities

From usSEABED (Reid and others, 2006)

From Barnard and others (2009)

Area of "no data"—Areas from shoreline (defined as Mean Higher High Water) out to 10-m water depth not mapped owing to difficulties in ship-based surveying caused by sea state (for example, waves, wind, or currents); 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

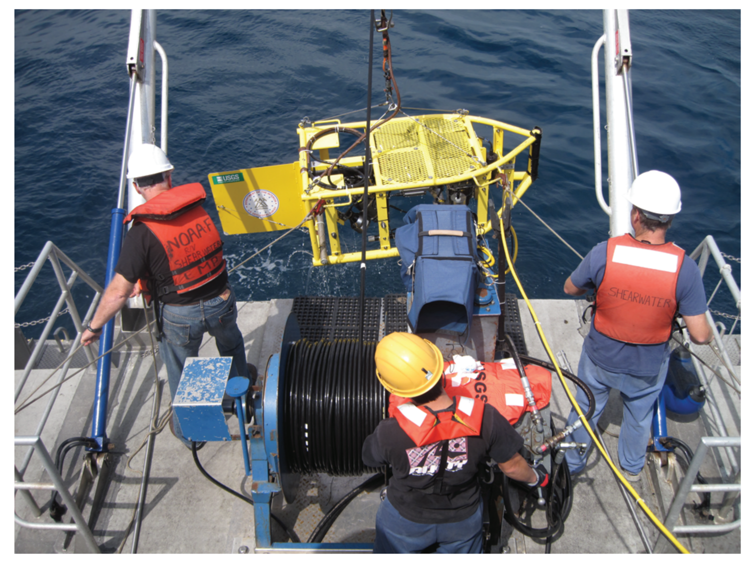

Figure 6. USGS-designed camera sled being launched off research vessel for ground-truth studies. Components onboard sled include four digital video camcorders, one 8-megapixel digital SLR camera, lasers for scale, and various strobe and video lights, as well as telemetry instrumentation that recorded depth, altitude, and compass heading.

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

Digital files available at http://pubs.usgs.gov/sim/3225/

Suggested Citation: Golden, N.E., Cochrane, G.R., Dartnell, P., and Krigsman, L.M., 2012, Ground-truth studies, Hueneme Canyon and vicinity, California, *sheet 6 in* Johnson, S.Y., Dartnell, P., Cochrane, G.R., Golden, N.E., Phillips, E.L., Ritchie, A.C., Kvitek, R.G., Greene, H.G., Krigsman, L.M., Endris, C.A., Clahan, K.B., Sliter, R.W., Wong, F.L., Yoklavich, M.M., and Normark, W.R. (S.Y. 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/.

Ground-Truth Studies, Hueneme Canyon and Vicinity, California

By
Nadine E. Golden,[1] Guy R. Cochrane,[1] Peter Dartnell,[1] and Lisa M. Krigsman[2]

[1]U.S. Geological Survey
[2]National Oceanic and Atmospheric Administration, National Marine Fisheries Service

2012