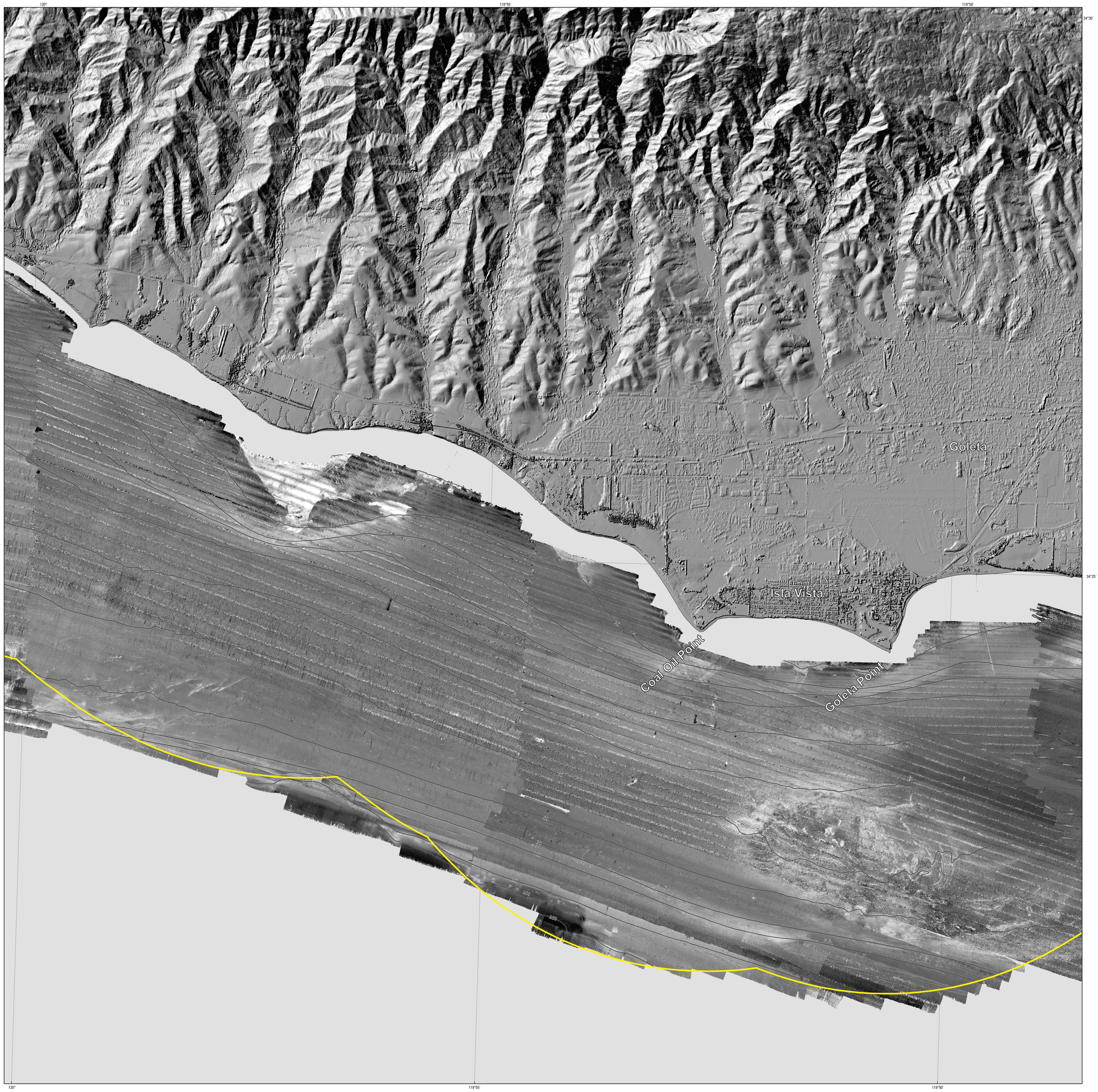
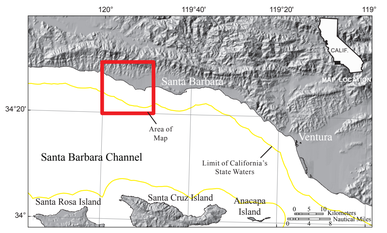
U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3302
Sheet 3 of 12
Pamphlet accompanies map





DISCUSSION

This acoustic-backscatter map of the Offshore of Coal Oil Point map area in southern California was generated from backscatter data collected by the U.S. Geological Survey (USGS), by California State University, Monterey Bay (CSUMB), and by Fugro Pelagos (fig. 1). Most of the nearshore and shelf areas were mapped by the USGS in 2006, 2007, and 2008, using a combination of 117 kHz (2006, 2007) and 234.5-kHz (2008) SEA (AP) Ltd. SWATHplus-M phase-differencing sidescan sonars. A small area in the far-eastern nearshore and shelf was mapped by CSUMB in 2007, using a 244-kHz Reson 8101 multibeam echosounder. The outer shelf and slope were mapped by Fugro Pelagos in 2008, using a combination of 400-kHz Reson 7125, 240-kHz Reson 8101, and 100-kHz Reson 8111 multibeam echosounders. These mapping missions combined to collect acoustic-backscatter data from about the 10-m isobath to beyond the 3-nautical-mile limit of California's State Waters.

During the USGS mapping missions, differential GPS (DGPS) data (2006, 2007) and GPS data with real-time kinematic corrections (2008) were combined with measurements of vessel motion (heave, pitch, and roll) in a CodaOctopus F180 attitude-and-position system to produce a high-precision vessel-attitude packet. This packet was transmitted to the acquisition software in real time and combined with instantaneous sound-velocity measurements at the transducer head before each ping. The returned samples were projected to the seafloor using a ray-tracing algorithm that works with previously measured sound-velocity profiles. Statistical filters were applied to discriminate seafloor returns (soundings and backscatter intensity) from unintended targets in the water column. The backscatter data were postprocessed using USGS software (D.P. Finlayson, written commun., 2011) that normalizes for time-varying signal loss and beam-directivity differences. Thus, the raw 16-bit backscatter data were gain-normalized to enhance the backscatter of the SWATHplus system. The resulting normalized-amplitude values were rescaled to 16-bit and gridded into GeoJPEGS using GRID Processor Software, then imported into a geographic information system (GIS) and converted to GRIDs.

During both the CSUMB and the 2008 Fugro Pelagos multibeam mapping missions, an Applanix POS MV (Position and Orientation System for Marine Vessels) was used to accurately position the vessel during data collection, and it also accounted for vessel motion such as heave, pitch, and roll (position accuracy, ±2 m; pitch, roll, and heading accuracy, ±0.02°; heave accuracy, ±5%, or 5 cm). To account for tidal-cycle fluctuations, CSUMB used NavCom 2050 GPS receiver (CNAV) data, and Fugro Pelagos used KGPS data (GPS data with real-time kinematic corrections). In addition, sound-velocity profiles were collected with an Applied Microsystems (AM) SVPlus sound velocimeter. Soundings were corrected for vessel motion using the Applanix POS MV data, for variations in water-column sound velocity using the AM SVPlus data, and for variations in water height (tides) using vertical-position data from the CNAV receiver and also the KGPS data. Backscatter data were postprocessed using both Geocoder version 3.2 (Fugro Pelagos modified test release 16) and Geocoder within Caris HIPS and SIPS software. Georeferenced Backscatter Rasters (GeoBaRs) were created for each survey line using the beam average or time series data type. Intensities were radiometrically corrected (including despeckling and angle-varying gain adjustments), and the position of each acoustic sample was geometrically corrected for slant range on a line-by-line basis. The contrast and brightness of some GeoBaRs were adjusted to better match the surrounding GeoBaRs. Individual GeoBaRs were mosaicked together at 2-m resolution using the auto-seam method. The mosaics were then exported as georeferenced TIFF images, imported into a GIS, and converted to GRIDs.

The acoustic-backscatter imagery from each different mapping system and processing method were merged into their own individual grids. These individual grids, which cover different areas, were displayed in a GIS to create this composite acoustic-backscatter map. On the map, brighter tones indicate higher backscatter intensity, and darker tones indicate lower backscatter intensity.The intensity represents a complex interaction between the acoustic pulse and the seafloor, as well as characteristics within the shallow subsurface, providing a general indication of seafloor texture and sediment type. Backscatter intensity depends on the acoustic source level; the frequency used to image the seafloor; the grazing angle; the composition and character of the seafloor, including grain size, water content, bulk density, and seafloor roughness; and some biological cover. Harder and rougher bottom types such as rocky outcrops or coarse sediment typically return stronger intensities (high backscatter, lighter tones), whereas softer bottom types such as fine sediment return weaker intensities (low backscatter, darker tones). The differences in backscatter intensity that are apparent in some areas of the map are due to the different frequencies of mapping systems, as well as different processing techniques. Note also that the straight lines of higher backscatter intensity that are visible throughout the map area are data-collection artifacts.

The onshore-area image was generated by applying an illumination having an azimuth of 300° and from 45° above the horizon to the coastal airborne topographic-lidar data, as well as to publicly available, 3-m-resolution, interferometric synthetic aperture radar (ifSAR) data, available from National Oceanic and Atmospheric Administration (NOAA) Coastal Service Center's Digital Coast, at http://csc-s-maps-q.csc.noaa.gov/dataviewer/viewer.html (last accessed April 5, 2011).

EXPLANATION

Backscatter intensity

High

Low

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

100 **Bathymetric contour (in meters)**—Derived from modified 10-m-resolution bathymetry grid. Contour intervals: 1–100 m water depth, 10 m; >100 m water depth, 50 m

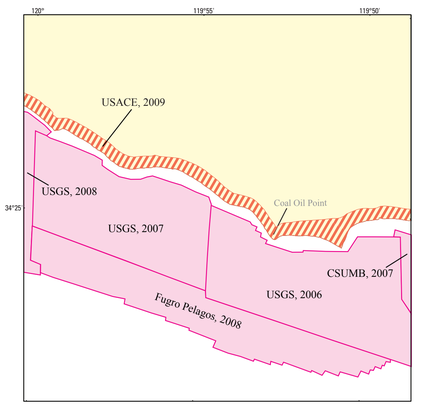


Figure 1. Map showing areas of multibeam-echosounder and bathymetric-sidescan surveys (pink shading), topographic-lidar surveys (orange diagonal lines), and publicly available interferometric synthetic aperture radar (ifSAR) topography (yellow shading). Also shown are data-collecting agencies (CSUMB, California State University, Monterey Bay, Seafloor Mapping Lab; FP, Fugro Pelagos; USACE, U.S. Army Corps of Engineers; USGS, U.S. Geological Survey) and dates of surveys if known.

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). California's State Waters limit from NDAA Office of Coast Survey

Universal Transverse Mercator projection, Zone 11N

NOT INTENDED FOR NAVIGATIONAL USE

APPROXIMATE MEAN DECLINATION, 2014

SCALE 1:24 000

1 0 1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 KILOMETER

BATHYMETRIC CONTOUR INTERVALS 10 and 50 METERS
ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Acoustic-backscatter imagery collected by U.S. Geological Survey in 2006, 2007, and 2008; by California State University, Monterey Bay, Seafloor Mapping Lab in 2007 (reprocessed by Peter Dartnell, 2010); and by Fugro Pelagos in 2008. Bathymetric contours by Andrew C. Ritchie, 2011

GIS database and digital cartography by Nadine E. Golden and Eleyne L. Phillips

Edited by Taryn A. Lindquist

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Acoustic Backscatter, Offshore of Coal Oil Point Map Area, California

By

Peter Dartnell,[1] Eleyne L. Phillips,[1] David P. Finlayson,[1] James E. Conrad,[1] and Rikk G. Kvitek[2]

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[1] U.S. Geological Survey;
[2] California State University, Monterey Bay, Seafloor Mapping Lab

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