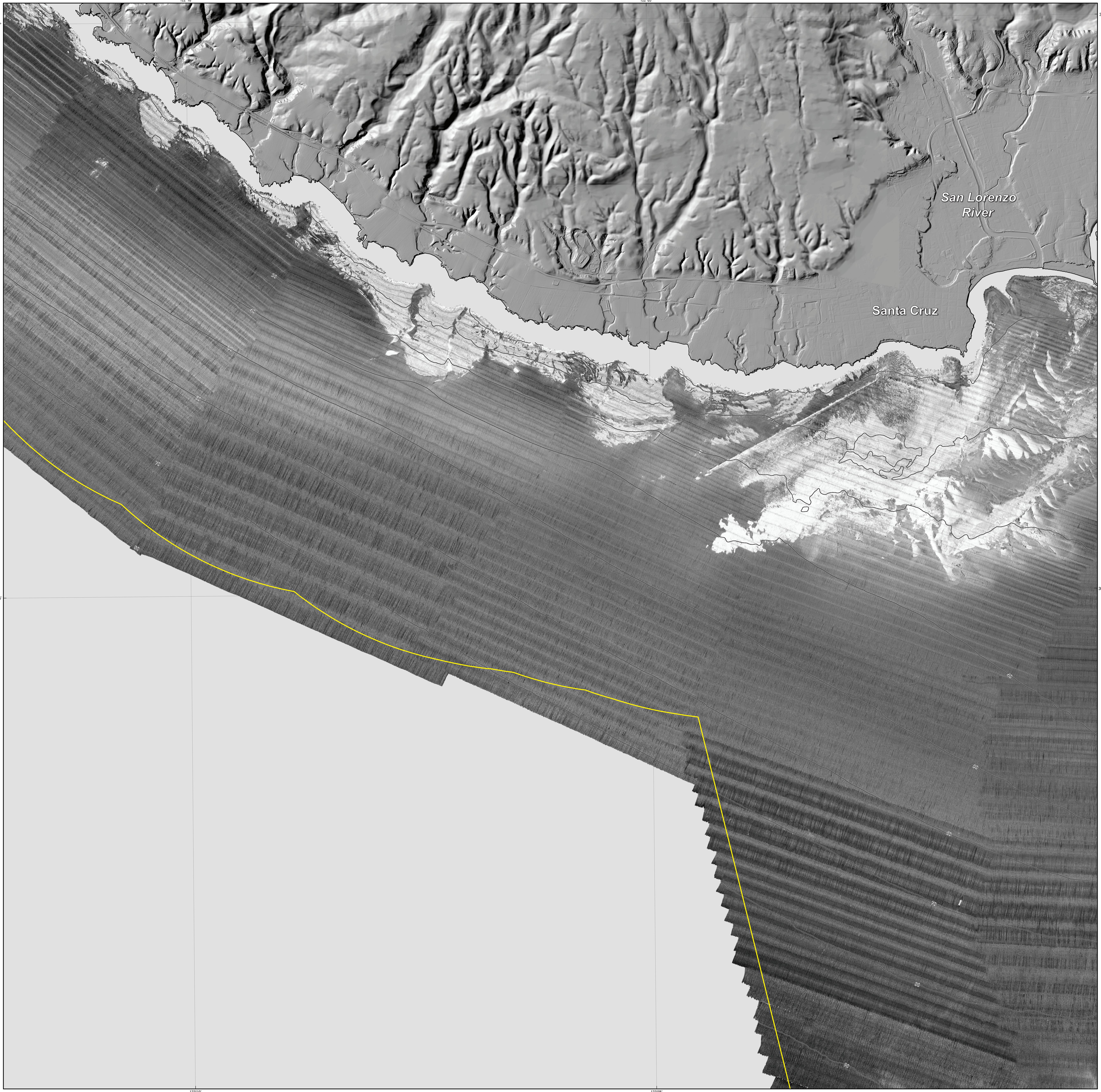
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2016–1024
Sheet 3 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/). California's State Waters limit from NOAA Office of Coast Survey

Universal Transverse Mercator projection, Zone 10N

NOT INTENDED FOR NAVIGATIONAL USE

APPROXIMATE MEAN DECLINATION, 2016

SCALE 1:24 000

BATHYMETRIC CONTOUR INTERVAL 10 METERS

ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Acoustic-backscatter imagery by Peter Dartnell, 2014 (data collected by U.S. Geological Survey in 2009). Bathymetric contours by Mercedes D. Erdey, 2014

GIS database and digital cartography by Nadine E. Golden

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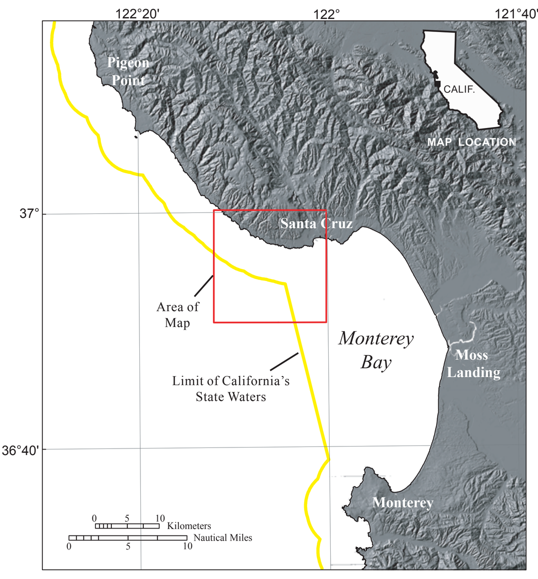

DISCUSSION

This acoustic-backscatter map of the Offshore of Santa Cruz map area in central California was generated from acoustic-backscatter data collected by the U.S. Geological Survey (USGS) (fig. 1). Mapping was completed in 2009, using a 234-kHz SWATHplus bathymetric sidescan-sonar system. The mapping mission collected backscatter data from about the 10-m isobath to beyond the limit of California's State Waters (note that the California's State Waters limit, which generally is 3 nautical miles [5.6 km] from shore, extends farther offshore south of Santa Cruz, so that it encompasses all of Monterey Bay).

During the mapping mission, GPS with real-time-kinematic corrections 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 (Ritchie and others, 2010). 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.

The individual grids, which cover different areas, were displayed in a GIS to create this map, on which 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 an indication of seafloor texture and composition. 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). Note that the ripple patterns and parallel lines of higher backscatter intensity throughout the map area are data-collection and -processing artifacts.

Bathymetric contours were generated at 10-m intervals from a merged 2-m-resolution bathymetric surface (see sheets 1, 2 of this report). The merged surface was smoothed using the Focal Mean tool in ArcGIS and a circular neighborhood that has a radius of between 20 and 30 m (depending on the location). The contours were generated from this smoothed surface using the Spatial Analyst Contour tool in ArcGIS. The most continuous contour segments were preserved; smaller segments and isolated island polygons were excluded from the final output. The contours were then clipped to the boundary of the map area.

The onshore-area image was generated by applying an illumination having an azimuth of 300° and from 45° above the horizon to 2-m-resolution topographic-lidar 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 to 10-m-resolution topographic-lidar data from the U.S. Geological Survey's National Elevation Dataset (available at http://ned.usgs.gov/).

REFERENCE CITED

Ritchie, A.C., Finlayson, D.P., and Logan, J.B., 2010, Swath bathymetry surveys of the Monterey Bay area from Point Año Nuevo to Moss Landing, San Mateo, Santa Cruz, and Monterey Counties, California: U.S. Geological Survey Data Series 514, available at http://pubs.usgs.gov/ds/514/.

EXPLANATION

Backscatter Intensity

High

Low

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

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

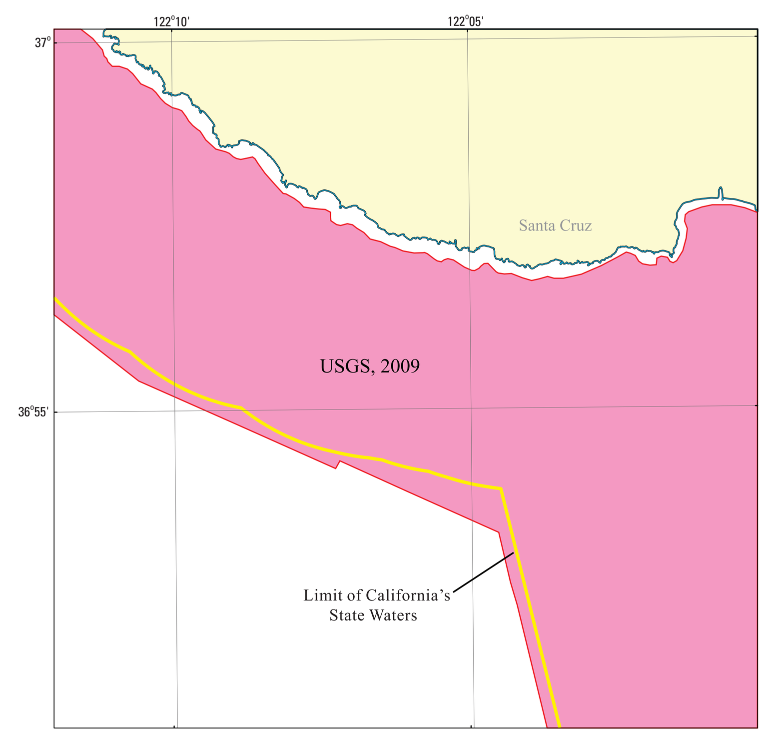

Figure 1. Map showing areas of multibeam-echosounder and bathymetric-sidescan surveys (pink shading) and onshore topographic-lidar surveys (yellow shading). Also shown are data-collecting agencies (USGS, U.S. Geological Survey) and dates of surveys if known. Yellow line shows limit of California's State Waters.

Acoustic Backscatter, Offshore of Santa Cruz Map Area, California

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