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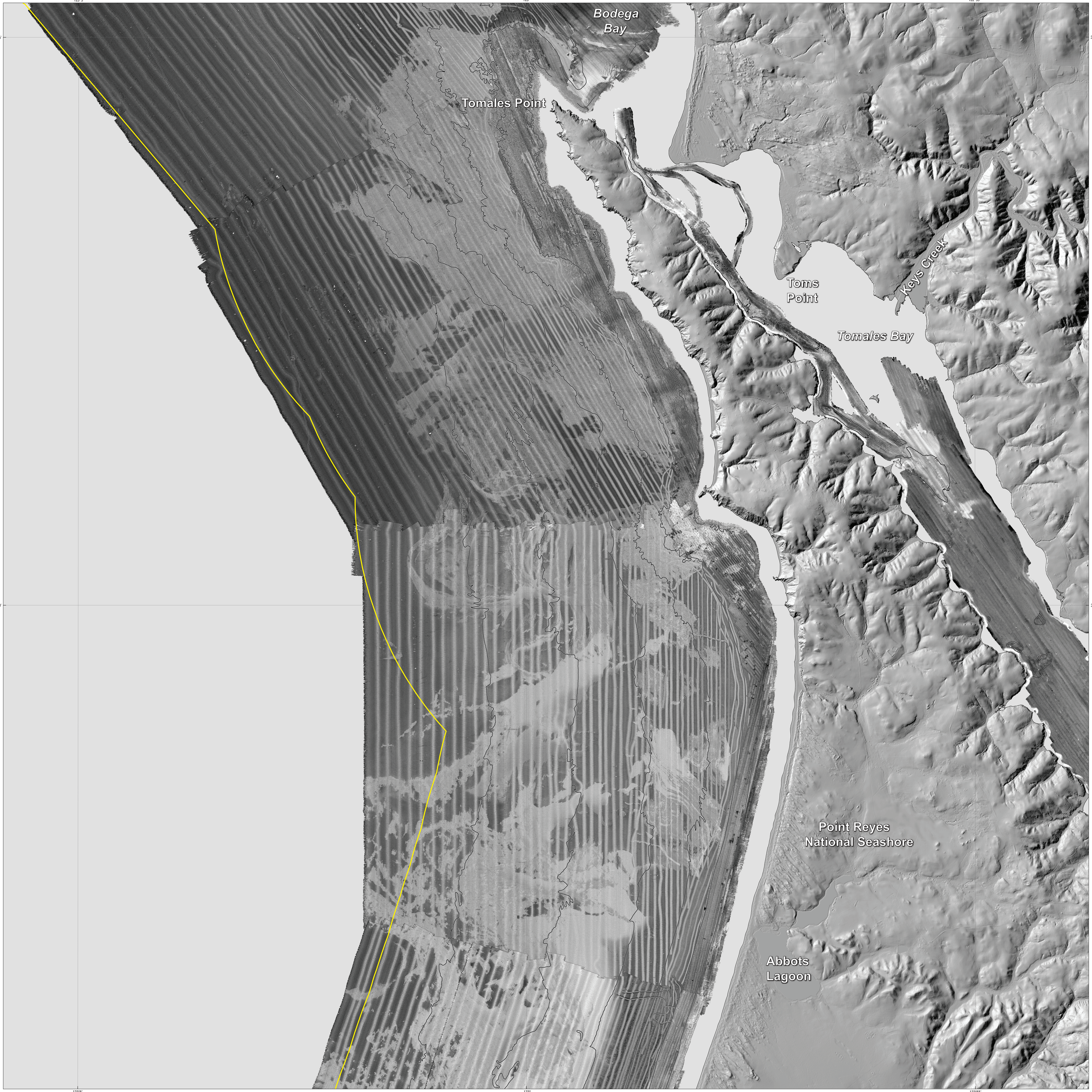
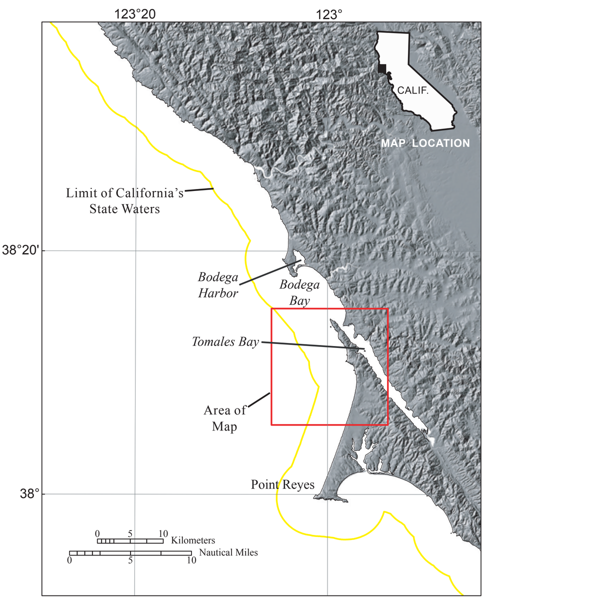
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2015–1088
Sheet 3 of 10
Pamphlet accompanies map





DISCUSSION

This acoustic-backscatter map of the Offshore of Tomales Point map area in northern California was generated from backscatter data collected by Fugro Pelagos, by California State University, Monterey Bay (CSUMB), and by the U.S. Geological Survey (USGS) (fig. 1). Mapping was completed between 2004 and 2010, using a combination of 200-kHz and 400-kHz Reson 7125 and 244-kHz Reson 8101 multibeam echosounders, as well as 234-kHz and 468-kHz SEA SWATHplus bathymetric sidescan-sonar systems. 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 Fugro Pelagos and CSUMB 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). KGPS altitude data (Fugro Pelagos, StarFix HP & XP units; CSUMB, NavCom 2050) were used to account for tidal-cycle fluctuations, and 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 KGPS receivers. Backscatter data were postprocessed using 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 types. 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. Individual GeoBaRs were mosaicked into 1- or 2-m resolution images. Overlap between parallel lines was resolved using a priority table based on the distance of each sample from the ship track, with samples closest to- and furthest from- the ship track given the lowest priority. An anti-aliasing algorithm was also applied. The mosaics were then exported from CARIS as georeferenced TIFF images, imported into a geographic information system (GIS), and converted to GRIDs at 2-m resolution.

For the USGS mapping missions within Tomales Bay (Anima and others, 2008), differential GPS (DGPS) data were combined with measurements of vessels 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) 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 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 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 that 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 modified 2-m-resolution bathymetric surface (see sheet 1 of this report). The original surface was smoothed using the Focal Mean tool in ArcGIS and a circular neighborhood with a radius of 20 to 30 m (depending on the area). The contours were generated from this smoothed surface using the ArcGIS Spatial Analyst Contour tool. The most continuous contour segments were preserved; smaller segments and isolated island polygons were excluded from the final output.

The onshore-area image was generated by applying an illumination having an azimuth of 300° and from 45° above the horizon to 2- and 3-m-resolution topographic-lidar data available from National Oceanic and Atmospheric Administration (NOAA) Coastal Service Center's Digital Coast and the U.S. Geological Survey, National Elevation Dataset (available at http://ned.usgs.gov/).

REFERENCE CITED

Anima, R.J., Chin, J.L., Finlayson, D.P., McGann, M.L., and Wong, F.L., 2008, Interferometric sidescan bathymetry, sediment and foraminiferal analyses; a new look at Tomales Bay, California: U.S. Geological Survey Open-File Report 2008–1237, 33 p., available at http://pubs.usgs.gov/of/2008/1237/.

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

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

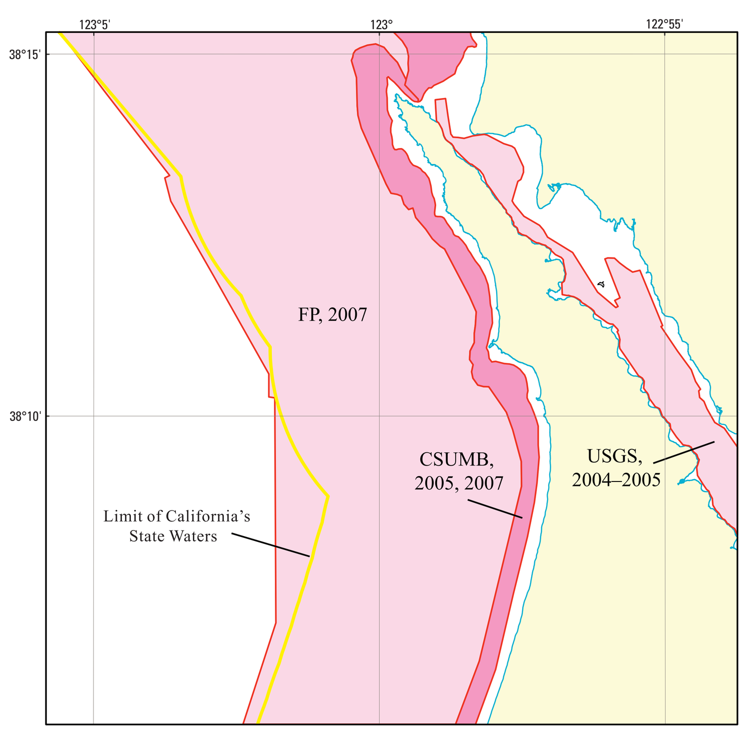


Figure 1. Map showing areas of multibeam-echosounder and bathymetric-sidescan surveys (pink shading) and topographic-lidar surveys (yellow shading). Also shown are data-collecting agencies (CSUMB, California State University, Monterey Bay, Seafloor Mapping Lab; FP, Fugro Pelagos; USGS, U.S. Geological Survey) and dates of surveys. Yellow line shows limit of California's State Waters.

Onshore elevation data from California Coastal Conservancy, available at http://www.csc.noaa.gov/digitalcoast/data/coastallidar/, and from U.S. Geological Survey, 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

14°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2015

SCALE 1:24 000
1 1/2 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

Acoustic-backscatter data collected by Fugro Pelagos in 2007, by California State University, Monterey Bay, Seafloor Mapping Lab in 2007–2010, and by U.S. Geological Survey in 2004–2005. Bathymetric contours by Mercedes D. Erdey, 2013

GIS database and digital cartography by Nadine E. Golden

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Acoustic Backscatter, Offshore of Tomales Point Map Area, California

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