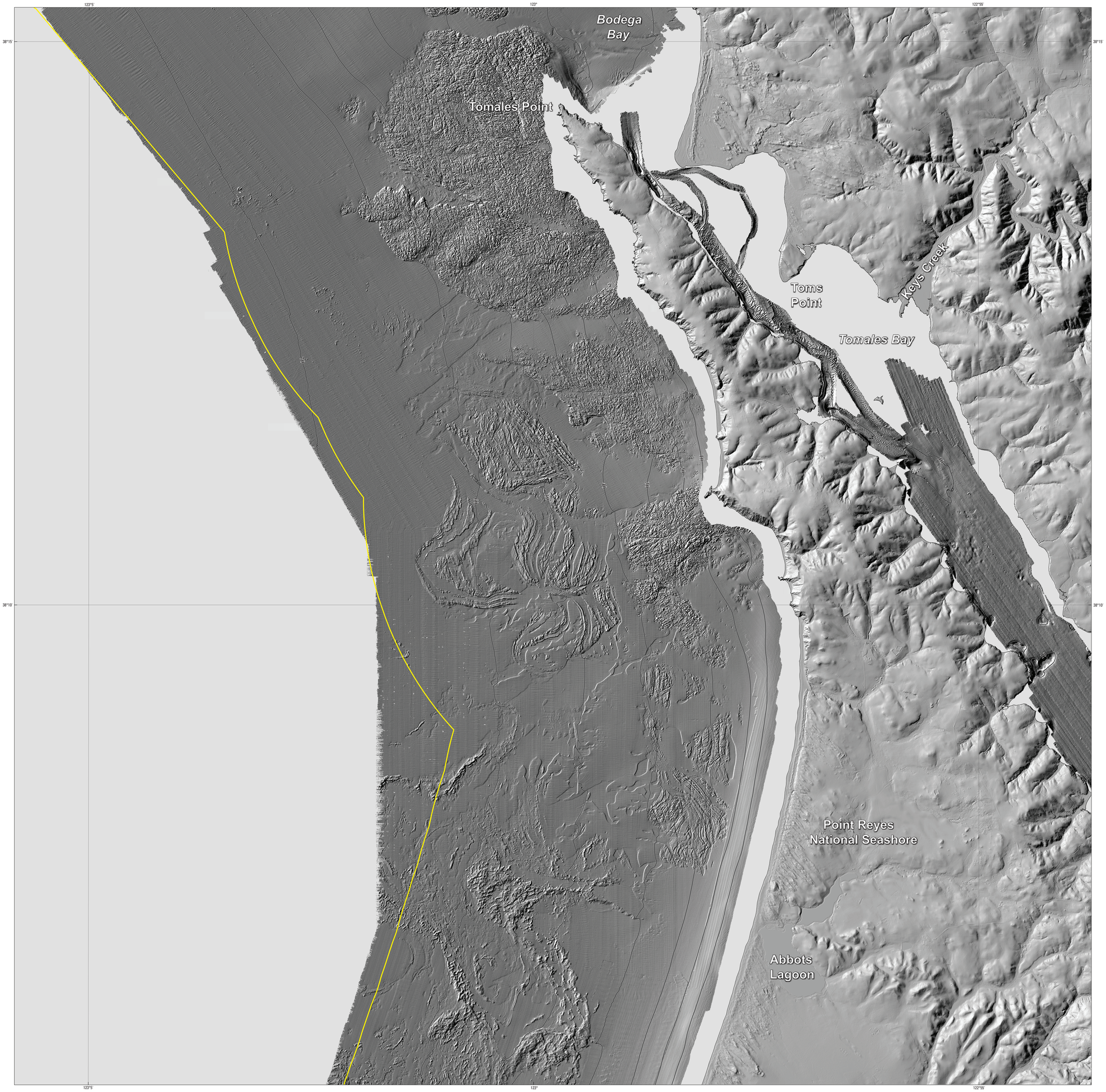
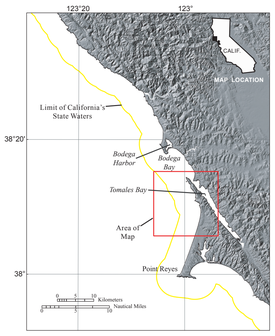
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2015–1088
Sheet 2 of 10
Pamphlet accompanies map





DISCUSSION

This shaded-relief bathymetry map of the Offshore of Tomales Point map area in northern California was generated from bathymetry 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 bathymetry 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.

For the USGS mapping missions within Tomales Bay (Anima and others, 2008), differential GPS (DGPS) data 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 the raw samples that discriminate the seafloor returns (soundings) from unintended targets in the water column.

Processed soundings were exported from the acquisition and processing software as XYZ files and bathymetric surface models. Once all of the surface models were transformed to a common projection and datum, they were merged together into one overall 2-m resolution bathymetric-surface model and clipped to the boundary of the map area. An illumination having an azimuth of 300° and from 45° above the horizon was then applied to the bathymetric surface to create the shaded-relief imagery. Note that the ripple patterns and parallel lines that are apparent within the map area are data-collection and processing artifacts. In addition, lines at the borders of some surveys are the result of slight differences in depth as measured by different mapping systems in different years. These various artifacts are made obvious by the hillshading process.

Bathymetric contours were generated at 10-m intervals from a modified 2-m-resolution bathymetric surface. 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 the same illumination (azimuth of 300° and from 45° above the horizon) to 2- and 3-m-resolution topographic-lidar data available from 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

Amount of illumination

Illuminated (facing false sun)

In shadow (facing away from false sun)

Direction of illumination from false sun—Position of false sun is at 300° azimuth, 45° above horizon [arrow included in explanation for illustration purposes only; not shown on map]

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

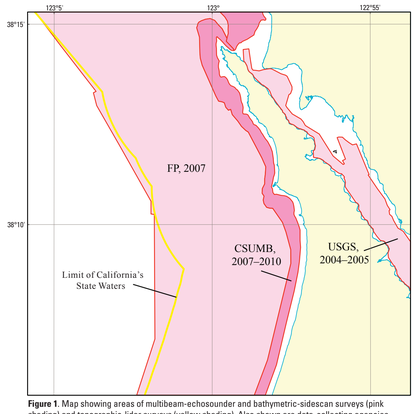


Figure 1. Map showing areas of multibeam-echosounder and bathymetric-sidescan surveys (pink shading) and topographic-lidar surveys (yellow shading). Also shown are data-collecting agencies (CSUMB, California State University, Monterey Bay, Seafloor Mapping Lab; FP, Fugro Pelagos; USGS, U.S. Geological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

APPROXIMATE MEAN DECLINATION, 2015

SCALE 1:24 000

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

BATHYMETRIC CONTOUR INTERVAL 10 METERS
ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Shaded-relief bathymetry by Peter Dartnell, 2013 (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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Shaded-Relief Bathymetry, Offshore of Tomales Point Map Area, California

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2015

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