

DISCUSSION

This colored shaded-relief bathymetry map of the Offshore of Santa Cruz map area in central California was generated from bathymetry data collected by the U.S. Geological Survey (USGS) (Fig. 1). Mapping was completed in 2009, using a 234kHz SWATHplus bathymetric sidescan-sonar system. The mapping mission collected bathymetry 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 data 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) from unintended targets in the water column (Ritchie and others, 2010). Processed soundings were exported from the acquisition or processing software as XYZ files and bathymetric surfaces. All of the surfaces were then merged 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. In addition, a modified "rainbow" color ramp was applied to the bathymetry data, using reds to represent shallower depths, and light greens to represent greater depths (note that the Offshore of Santa Cruz map area requires only the shallower part of the full-rainbow color ramp used on some of the other maps in the California State Waters Map Series; see, for example, Kvitck and others, 2012). This colored bathymetry surface was draped over the shaded-relief imagery at 60-percent transparency to create this colored shaded-relief map. Note that the ripple patterns and parallel lines that are apparent within the map area are data-collection and -processing artifacts. These various artifacts are made obvious by the hillshading process. Bathymetric contours were generated at 10-m intervals from the merged 2-m-resolution bathymetric surface. 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 the same illumination (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/>).

REFERENCES CITED

Kvitck, R.G., Phillips, E.L., and Dartnell, P., 2012, Colored shaded-relief bathymetry, Huene Canyon and vicinity, California, *sheet 1* in Johnson, S.Y., Dartnell, P., Cochrane, G.R., Golden, N.E., Phillips, E.L., Ritchie, A.C., Kvitck, R.G., Greene, H.G., Krigman, L.M., Endre, C.A., Chuan, K.B., Sizer, R.W., Wong, F.L., Volkovich, M.M., and Normark, W.R. (S.Y. Johnson, ed.), California State Waters Map Series—Huene 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/>.
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

- Depth (in meters) and illumination (bright areas are illuminated, facing false sun; dark areas are in shadow, facing away from false sun)
- 0 Shallow
 - 10
 - 20
 - 30
 - 40
 - 50
 - 60
 - 70
 - 80
 - 90 Deep
- 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 limit of California's State Waters were not mapped as part of California Seafloor Mapping Program
 - Limit of California's State Waters
 - Bathymetric contour (in meters)—Derived from modified 2-m-resolution bathymetry grid. Contour interval: 10 m

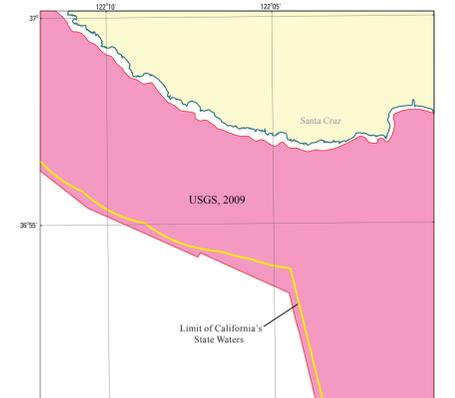


Figure 1. Map showing areas of multibeam-echosounder and bathymetric-sidescan surveys (pink shading) and onshore topographic-lidar surveys (yellow shading). Also shows the data-collecting agencies (USGS, U.S. Geological Survey) and dates of surveys if known. Yellow line shows limit of California's State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

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



Shaded-relief bathymetry by Peter Dartnell, 2014 (data collected by U.S. Geological Survey in 2009). Bathymetric contours by Mercedes D. Erbes, 2014. GIS database and digital cartography by Nadine E. Golden. Manuscript approved for publication February 18, 2016.



Colored Shaded-Relief Bathymetry, Offshore of Santa Cruz Map Area, California
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