

DISCUSSION

This acoustic-backscatter map of the Offshore of Scott Creek map area in central California was generated from acoustic-backscatter data collected by California State University, Monterey Bay (CSUMB), by Fugro Pelagos, and by the U.S. Geological Survey (USGS) (fig. 1). Mapping was completed between 2006 and 2009, using a combination of 400-kHz Reson 7125 and 244-kHz Reson 8101 multibeam echosounders, as well as a 234-kHz SWATHplus bathymetric sidescan-sonar system. 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 CSUMB and Fugro Pelagos multibeam mapping missions, an Applanix POS MV (Position and Orientation System for Marine Vessels) was used to accurately position the vessels 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, $\pm 0.02^\circ$; heave accuracy, $\pm 5\%$, or 5 cm). To account for tidal-cycle fluctuations, Fugro Pelagos used Starfix HP and XP real-time kinematic (RTK) GPS receivers, and CSUMB used a NovCom 2050 receiver; 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 (tide) using vertical-position data from the RTK receivers. The multibeam backscatter data were postprocessed using Geocoder, within which the backscatter 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. After the lines were corrected, they were mosaicked into 1- or 2-m-resolution images. Overlap between parallel lines was resolved using a priority table whose values were based on the distance of each sample from the ship track, with the samples that were closest to and furthest from the ship track being given the lowest priority. An anti-aliasing algorithm was also applied. The mosaics were then exported as georeferenced TIFF images, imported into a geographic information system (GIS), and converted to GRIDs at 2-m resolution.

During the USGS 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 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 GeoTIFFs 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 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 differences in backscatter intensity that are apparent in some areas of the map are due to the different frequencies of the mapping systems, as well as to different processing techniques. 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 sheets 1 and 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 California Coastal Conservancy (available from National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center's Digital Coast 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

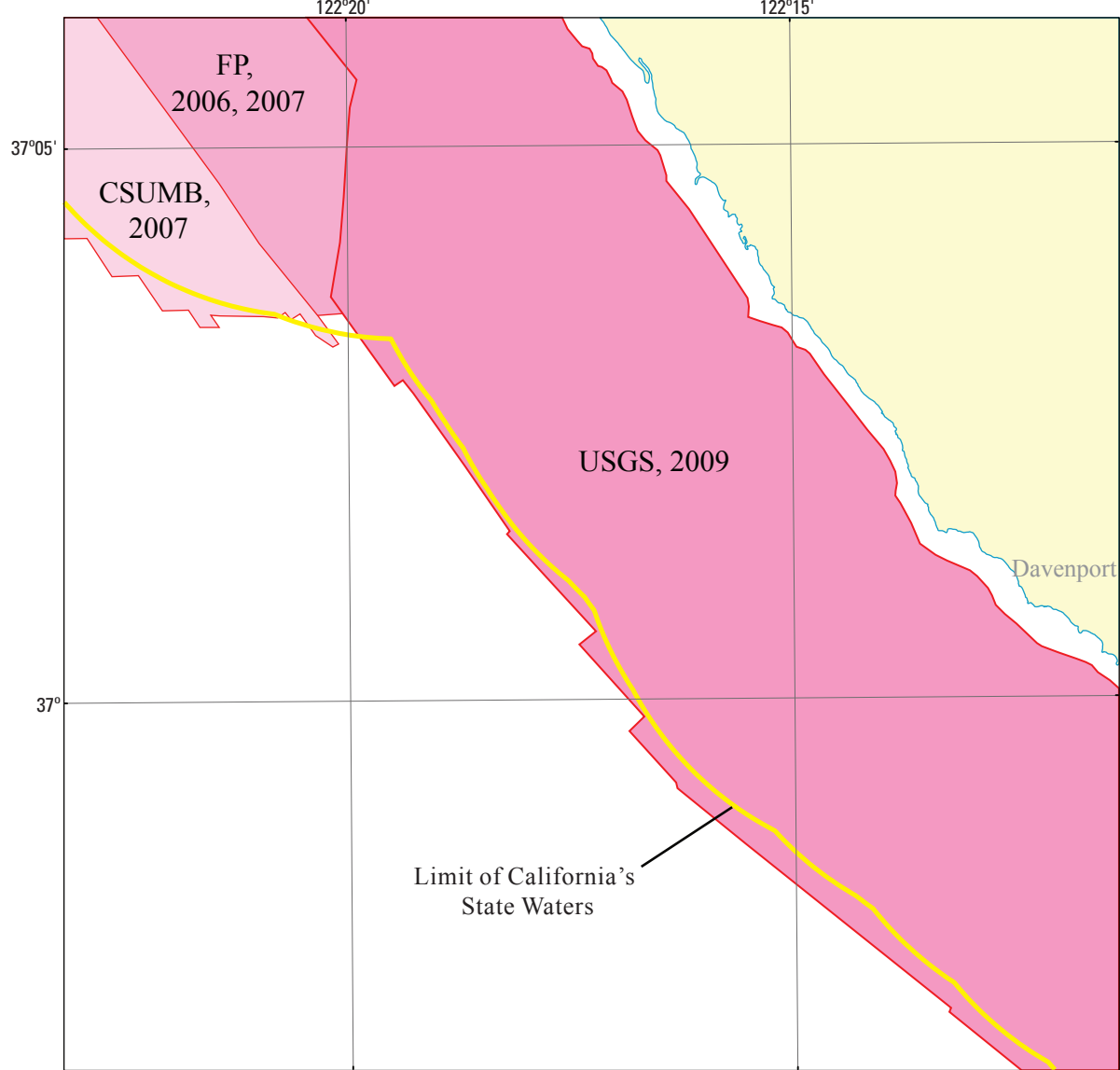
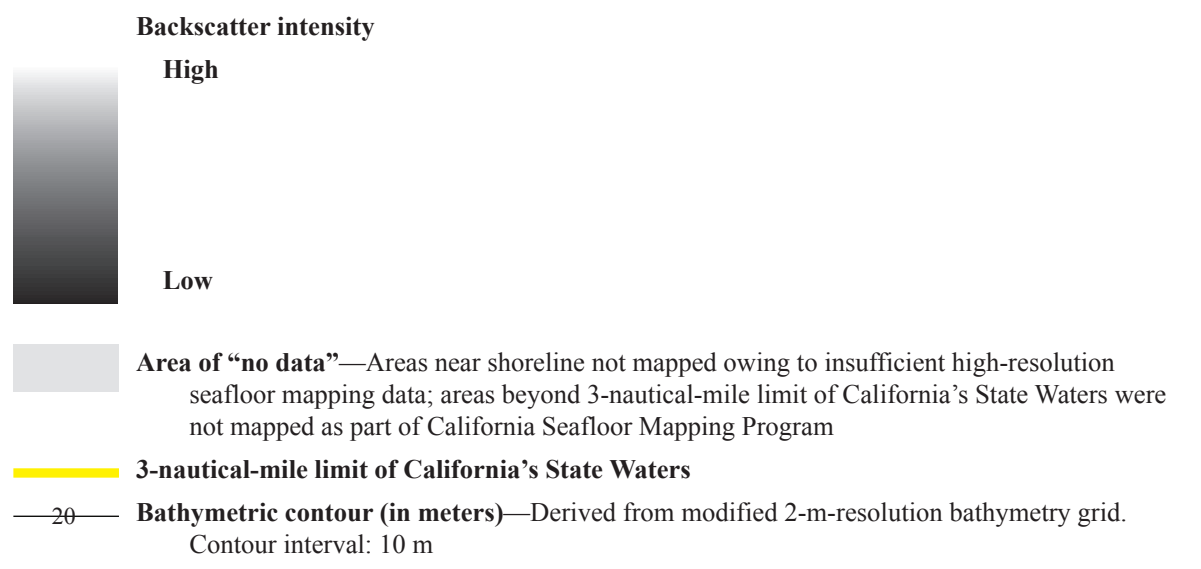


Figure 1. Map showing areas of multibeam-echosounder and bathymetric-sidescan surveys (pink shading) and onshore topographic-lidar surveys (yellow shading). Also shown are data-collecting agencies (CSUMB, California State University, Monterey Bay, Seafloor Mapping Lab; FP, Fugro Pelagos; USGS, U.S. Geological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

Onshore elevation data from California Coastal Conservancy (available from National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center's Digital Coast 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
DETERMINATION, 2010

SCALE 1:24 000
1 1/2 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 2 KILOMETER
BATHYMETRIC CONTOUR INTERVAL: 10 METERS
ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Acoustic backscatter imagery by Peter Dartnell, 2014 data collected by Fugro Pelagos in 2006-2007, by California State University, Monterey Bay, Seafloor Mapping Lab in 2007, and by U.S. Geological Survey in 2009. Bathymetric contours by Mercedes D. Erdes, 2014.
GIS database and digital cartography by Nadine E. Golden
Manuscript approved for publication September 20, 2015



Acoustic Backscatter, Offshore of Scott Creek Map Area, California

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1528-2021-1228 (online)
<http://dx.doi.org/10.3133/ofr1501191>

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Suggested Citation: Dartnell, P., Ritchie, A.C., Finlayson, D.P., and Kvitck, R.G., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 3 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 2 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 1 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 4 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 5 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 6 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 7 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 8 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 9 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 10 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 11 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 12 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 13 of 10, by Peter Dartnell, P. Dartnell, J. 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Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 21 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 22 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 23 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 24 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 25 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 26 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 27 of 10, by Peter Dartnell, P. Dartnell, J. 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Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 35 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 36 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 37 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 38 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 39 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 40 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 41 of 10, by Peter Dartnell, P. Dartnell, J. 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Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 84 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 85 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 86 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 87 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 88 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 89 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 90 of 10, by Peter Dartnell, P. Dartnell, J. 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Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 98 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 99 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 100 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 101 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 102 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 103 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 104 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 105 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 106 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 107 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 108 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 109 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 110 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 111 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 112 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 113 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 114 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 115 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 116 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 117 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 118 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 119 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 120 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 121 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 122 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 123 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 124 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 125 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 126 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 127 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 128 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 129 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 130 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 131 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 132 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 133 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 134 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 135 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 136 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 137 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 138 of 10, by Peter Dartnell, P. Dartnell, J. Johnson, R.D., 2015, Acoustic backscatter, Offshore of Scott Creek map area, California, sheet 139 of 10, by Peter Dartnell, P. Dartnell, J. 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