Figure 3. Video mosaic generated from seafloor video captured over transition from sediment-covered seafloor to rocky outcrop (mapped as Purisima Formation, sheet 10) with patches of sand and cobbles (see fig. 1 for location). Camera-sled tow direction is from bottom to top. Geologic transition likely is cause of sharp boundary seen in backscatter imagery, with sands creating lower backscatter and rock outcrop generating higher backscatter. Mosaic is made up of about 41 seconds of video as camera sled traveled above seafloor. Video mosaic created using software developed by Dr. Yuri Rzhanov, Center for Coastal and Ocean Mapping, University of New Hampshire, through joint U.S. Geological Survey–University of New Hampshire cooperative agreement.

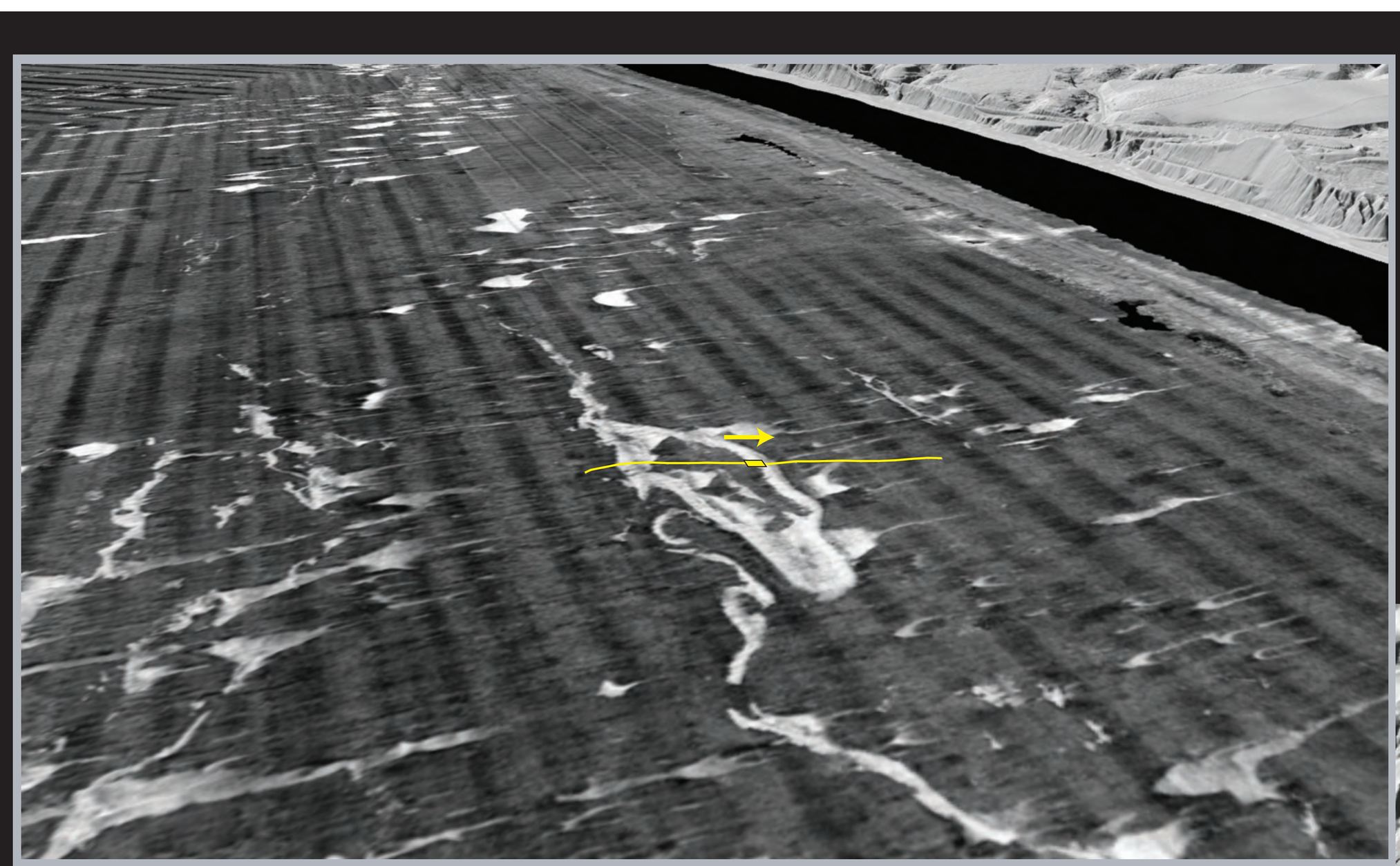


Figure 1. Perspective view to north over nearshore area showing acoustic-backscatter imagery draped over shaded-relief bathymetry. In acoustic-backscatter imagery, lighter tones indicate stronger backscatter intensity, suggesting rock or coarser grained sediment, whereas darker tones indicate weaker backscatter intensity, suggesting finer grained sediment. Nearshore region has complicated patterns of low and high backscatter intensity. Higher backscatter intensities likely are caused by patches of rock, gravel, and coarser sand in shallow scour depressions (see fig. 6). Thin yellow line shows path of camera sled, towed 1 to 2 m above seafloor, that captured video and photographs; yellow arrow shows tow direction. Yellow rectangle shows location of video mosaic (fig. 3) generated from video captured above transition from low to high backscatter. Vertical exaggeration of perspective view, 2x; distance across bottom of image, about 860 m.

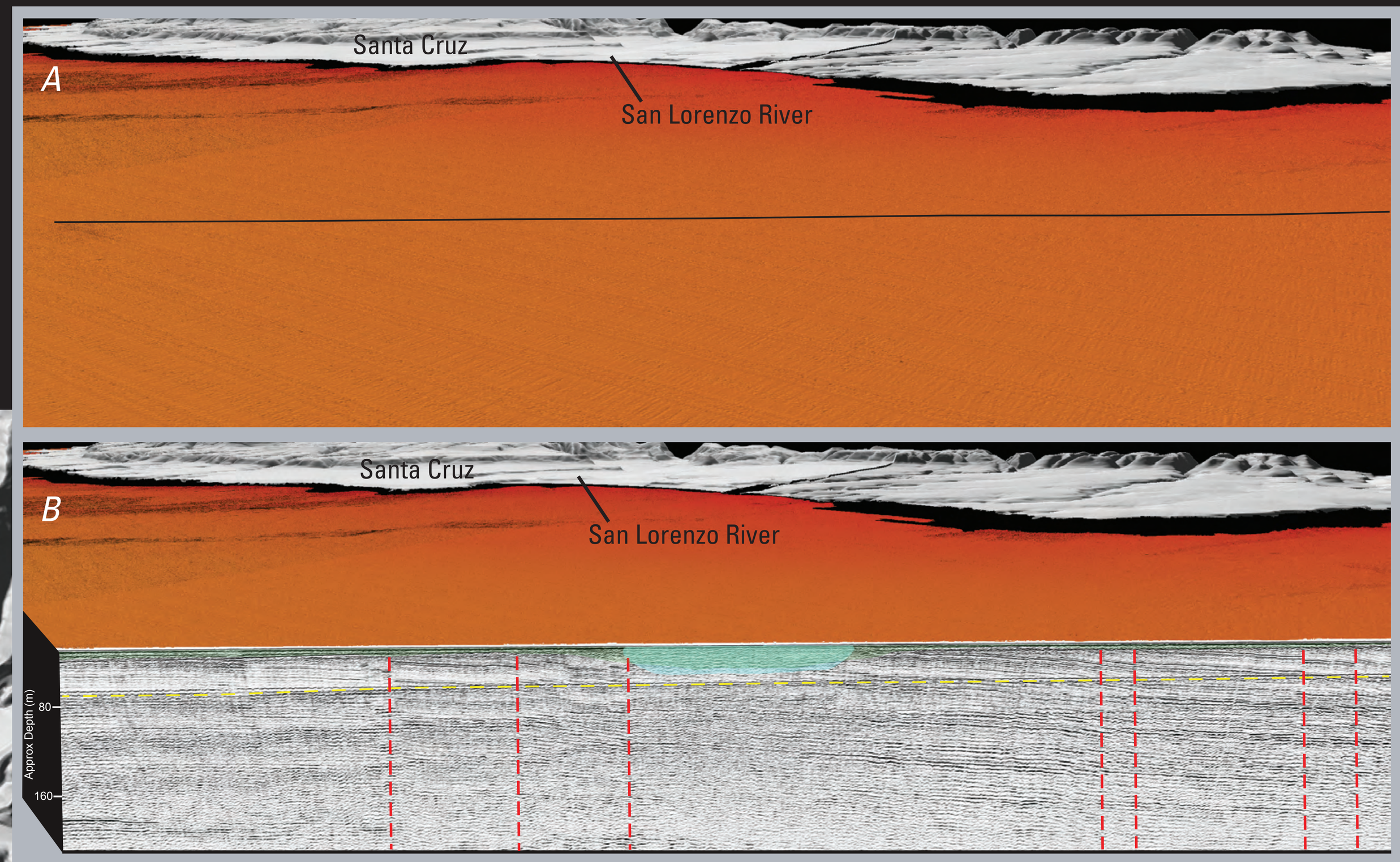
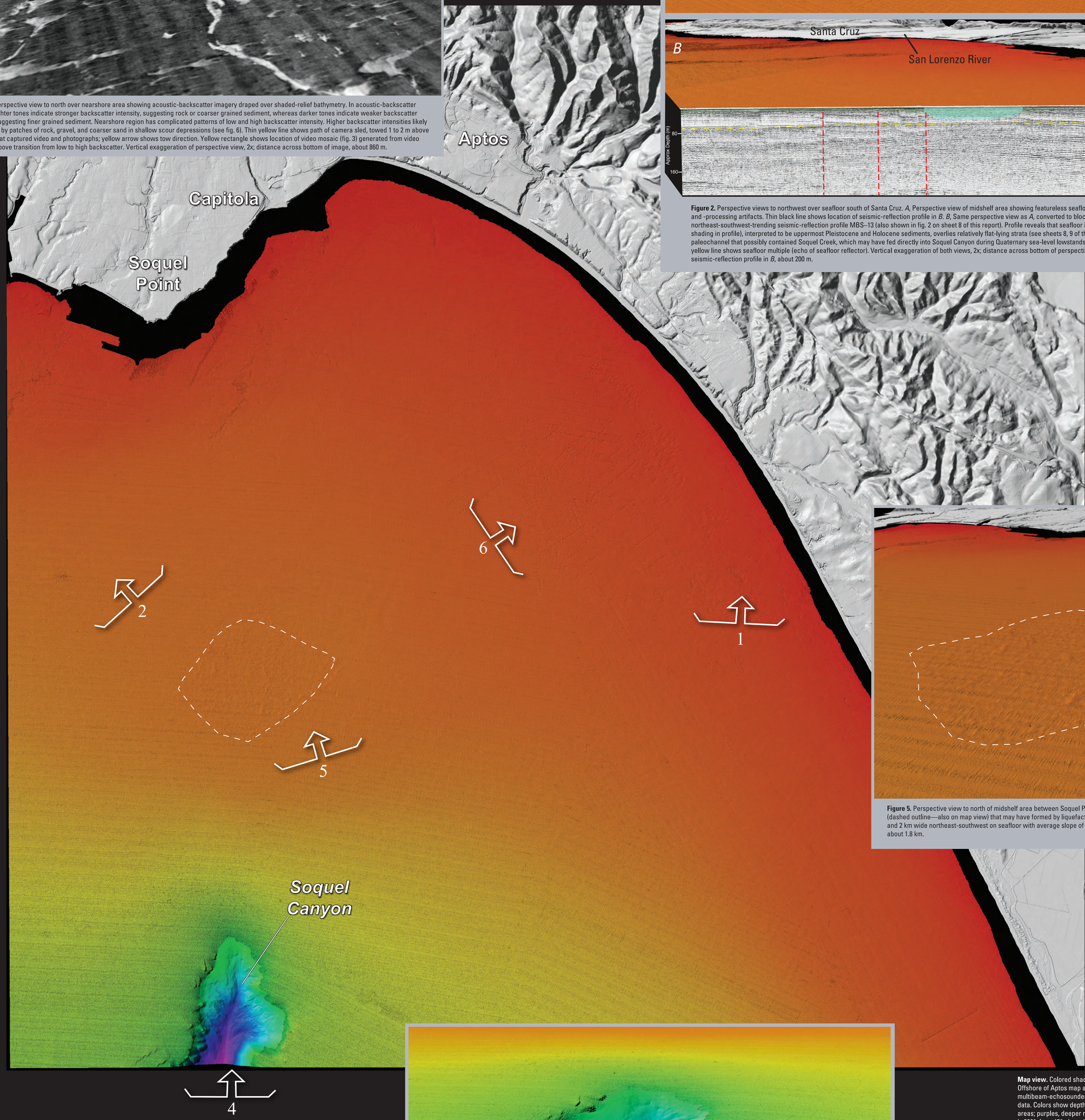


Figure 2. Perspective views to northwest over seafloor south of Santa Cruz. *A*, Perspective view of midshelf area showing featureless seafloor. Ripple patterns and parallel lines are data-collection and -processing artifacts. Thin black line shows location of seismic-reflection profile in *B*. *B*, Same perspective view as *A*, converted to block diagram that combines bathymetry with northeast-southwest-trending seismic-reflection profile MBS–13 (also shown in fig. 2 on sheet 8 of this report). Profile reveals that seafloor is featureless because thin layer of sediment (blue shading in profile), interpreted to be uppermost Pleistocene and Holocene sediments, overlies relatively flat-lying strata (see sheets 8, 9 of this report). Blue shading also highlights buried paleochannel that possibly contained Soquel Creek, which may have fed directly into Soquel Canyon during Quaternary sea-level lowstands. Dashed red lines show interpreted faults. Dashed yellow line shows seafloor multiple (echo of seafloor reflector). Vertical exaggeration of both views, 2x; distance across bottom of perspective view in *A*, about 1.4 km; depth of base of seismic-reflection profile in *B*, about 200 m.



Map view. Colored shaded-relief bathymetry map of Offshore of Aptos map area, generated from multibeam-echosounder and bathymetric-sidescan data. Colors show depths: reds indicate shallower areas; purples, deeper regions. Illumination azimuth is 300°, from 45° above horizon. Ripple patterns and parallel lines apparent within map area are data-collection and -processing artifacts, made obvious by the hillshading process. The difference in resolution of shaded-relief bathymetry at the head of Soquel Canyon reveals boundary between multibeam and bathymetric-sidescan data. Numbered arrows show viewing directions of perspective views shown on this sheet; numbers correspond to figure numbers of views.

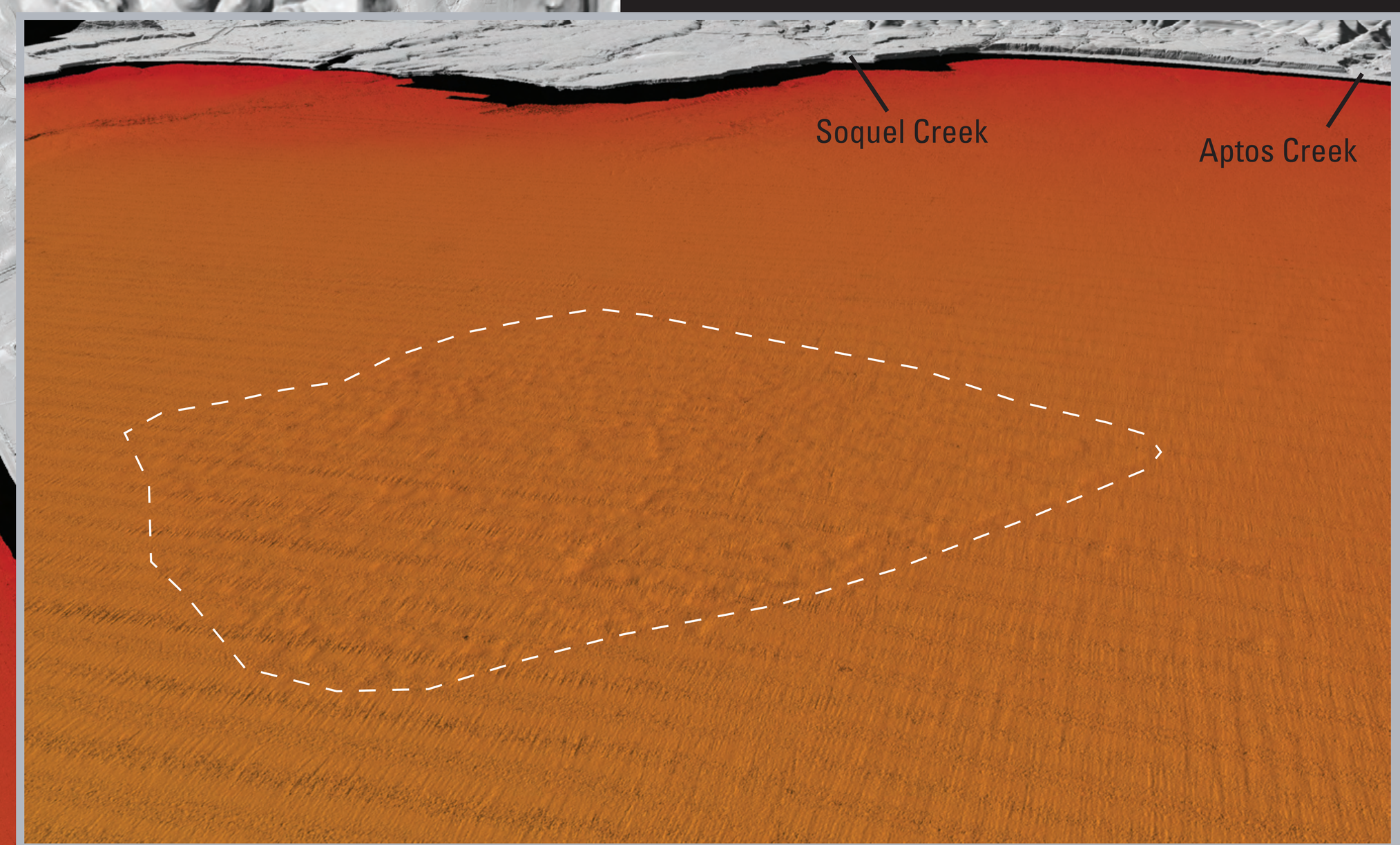


Figure 5. Perspective view to north of midshelf area between Soquel Point and submarine Soquel Canyon. View highlights very subtle hummocky seafloor (dashed outline—also on map view) that may have formed by liquefaction and slumping (sheet 10, this report). Deposit is about 1.9 km wide northwest-southeast and 2 km wide northeast-southwest on seafloor with average slope of 0.5° south. Vertical exaggeration of perspective view, 2x; distance across bottom of image, about 1.8 km.

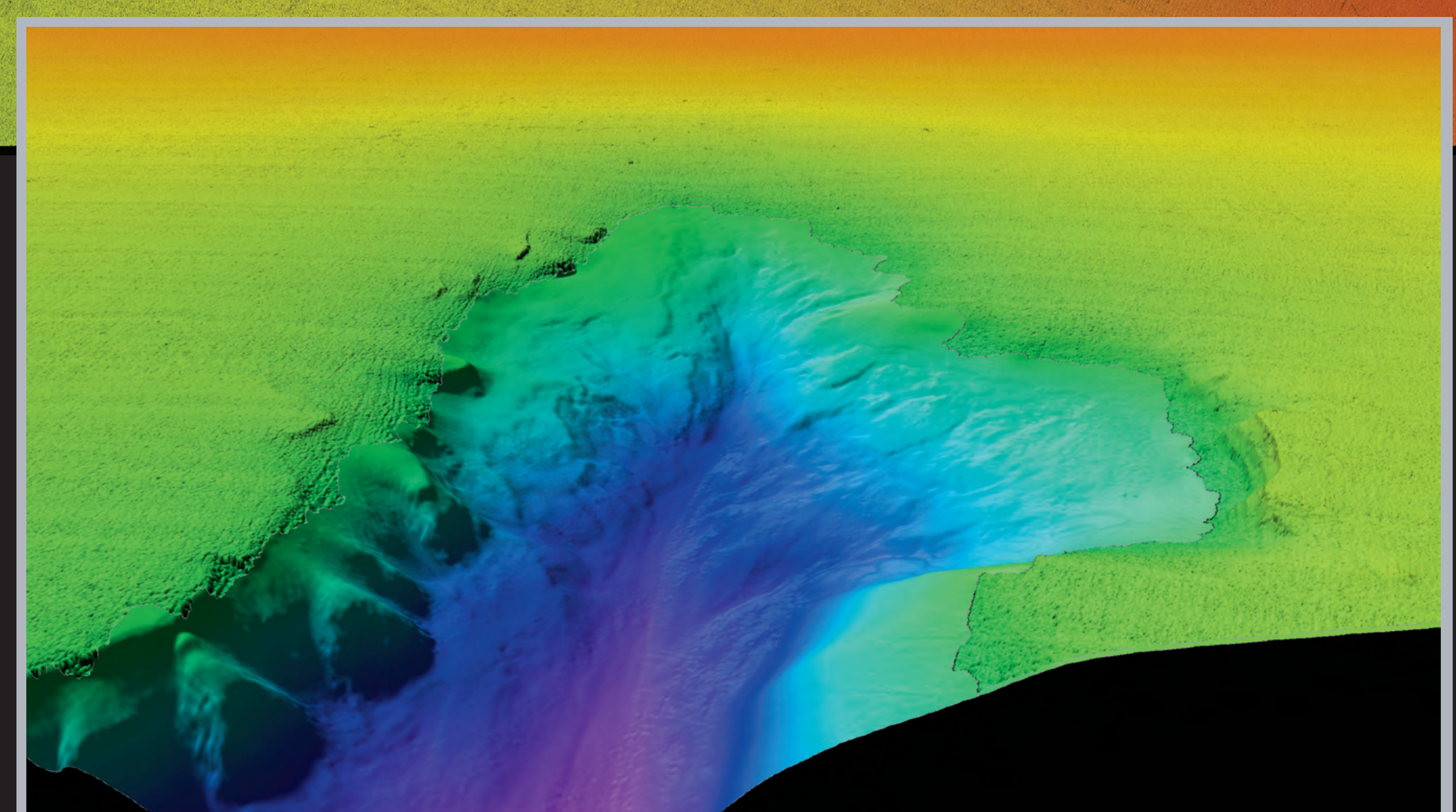


Figure 4. Perspective view to north at head of submarine Soquel Canyon. Canyon continues south in relatively straight manner until it merges with larger submarine Monterey Canyon to south, outside of map area. Soquel Canyon is cut off from coastal watersheds and is not considered an active conduit for coarse sediment into Monterey Canyon (Paull and others, 2011); however, Soquel Canyon was likely active during lower sea-level stands (see fig. 2, and sheet 9). Small gullies around canyon head may in part be associated with submarine landslides. Contrast in bathymetric data resolution at canyon head reveals boundary between multibeam and bathymetric sidescan datasets. Vertical exaggeration of perspective view, 2x; distance across bottom of image, about 1.7 km.

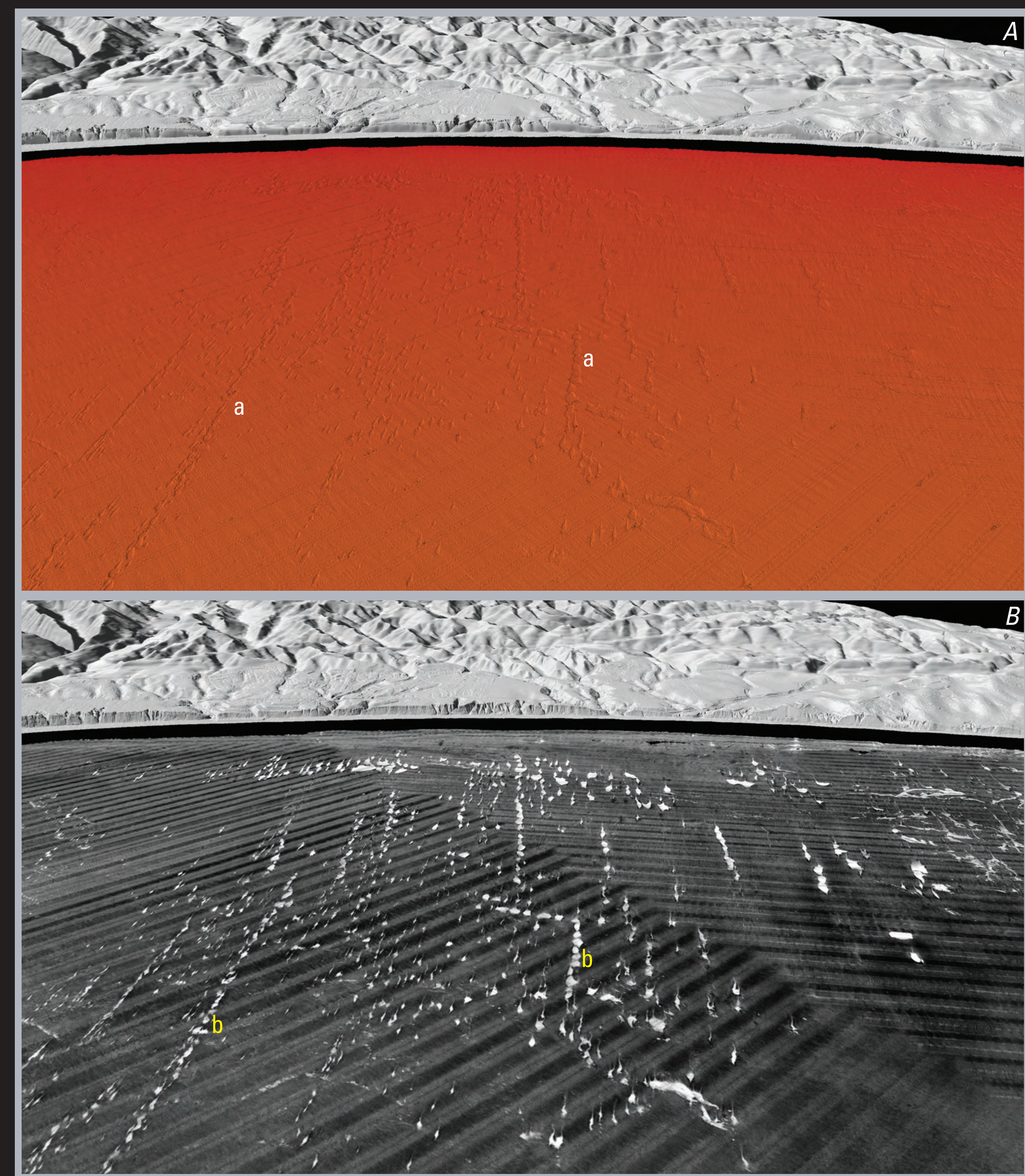


Figure 6. Perspective views to northeast over seafloor along Santa Cruz County coastline, showing colored shaded-relief bathymetry (*A*) and acoustic-backscatter imagery (*B*). Shallow depressions (a) with only 0.5 m of relief are spread throughout area, and some aligned groups of scour depressions extend more than 2 km perpendicular to shore. Acoustic-backscatter imagery reveals that depressions have very high backscatter intensities (b). These scour depressions (sheet 10 of this report) are filled with coarser sands and are common along California coast. Ripple patterns and parallel lines in both bathymetry and backscatter data are data-collection and -processing artifacts. Vertical exaggeration of both views, 2x; distance across bottom of both views, about 2.7 km.

DISCUSSION

Mapping California's State Waters has produced a vast amount of acoustic and visual data, including bathymetry, acoustic backscatter, seismic-reflection profiles, and seafloor video and photography. These data are used by researchers to develop maps, reports, and other tools to assist in the coastal and marine spatial-planning capability of coastal-zone managers and other stakeholders. Seafloor-character, habitat, and geologic maps may be used for fisheries management, for designation of Marine Protected Areas, for monitoring of environmental change such as sea-level-rise impacts, for prediction of sediment and contaminant budgets and transport, and for assessment of earthquake and tsunami hazards. To achieve these goals, it is helpful to integrate the different datasets and then view the results in three-dimensional representations such as those displayed on this data integration and visualization sheet for the Offshore of Aptos map area.

The map view in the center of the sheet is similar to the colored shaded-relief bathymetry map of the Offshore of Aptos map area (see sheet 1 of this report). Numbered arrows show viewing directions of the perspective views on this sheet; the numbers indicate the figure number of the perspective view.

The perspective views in figures 1, 2, 4, 5, and 6 show the colored shaded-relief bathymetry of the Offshore of Aptos map area, as viewed from different directions. These views highlight the seafloor morphology offshore of Aptos, which includes complex patterns of scour depressions, a seafloor slump, and the head of submarine Soquel Canyon.

Video-mosaic images created from seafloor digital video (fig. 3) display the geologic (rock, sand, mud) and biologic complexity of the seafloor. Whereas photographs capture high-quality snapshots of a small area of the seafloor (see sheet 6 of this report), video mosaics can capture larger areas and, thus, can show transitional zones between different seafloor environments.

Draping the acoustic-backscatter imagery (see sheet 3 of this report) over the bathymetry data (figs. 1 and 6) highlights the relations between the backscatter intensity and the seafloor morphology. It also aids in seafloor habitat and geology interpretations, as well as mapping sediment-transport pathways.

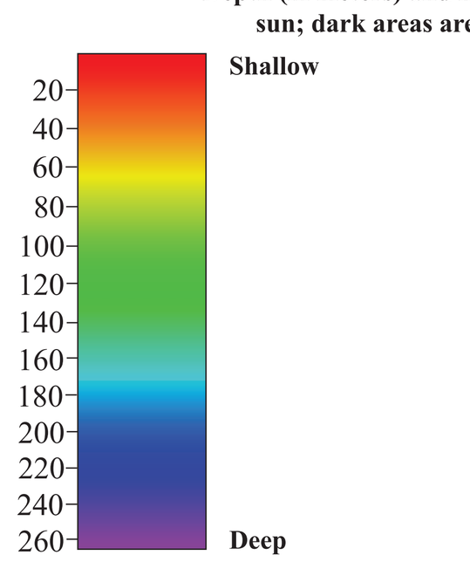
Block diagrams (fig. 2), which combine the bathymetry with seismic-reflection-profile data (see sheet 8 of this report), help reveal the stratigraphic and structural relations between the surface and subsurface.

REFERENCE CITED

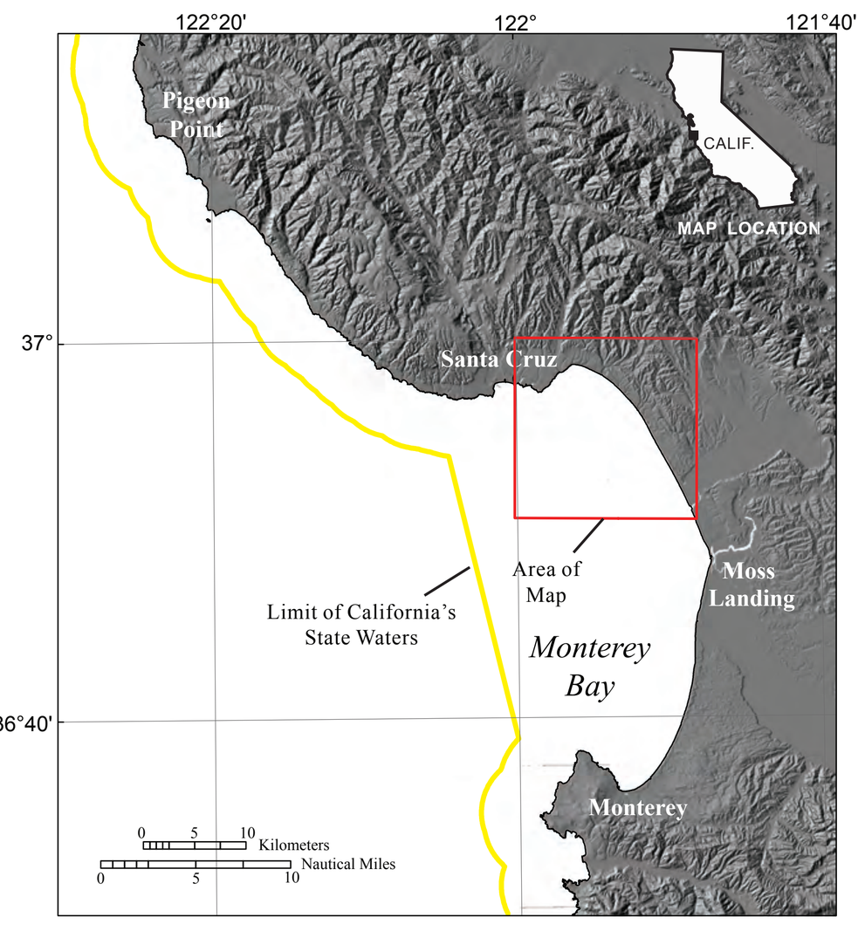
Paull, C.K., Caress, D.W., Ussler III, W., Lundsten, E., and Meiner-Johnson, M., 2011, High-resolution bathymetry and the axial channels within Monterey and Soquel submarine canyons, offshore central California: Geosphere, v. 7, p. 1,077–1,101.

EXPLANATION

Depth (in meters) and illumination (bright areas are illuminated, facing false sun; dark areas are 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]



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/)

Universal Transverse Mercator projection, Zone 10N

NOT INTENDED FOR NAVIGATIONAL USE

Perspective views by Peter Dartnell, 2014. Video-mosaic image in figure 3 by Peter Dartnell, 2014, using software developed by Dr. Yuri Rzhanov, Center for Coastal and Ocean Mapping, University of New Hampshire, through joint U.S. Geological Survey–University of New Hampshire cooperative agreement. Acoustic-backscatter imagery in figures 1 and 6 from map on sheet 3, this report. Seismic-reflection profile in figure 2 from sheet 8, this report

GIS database and digital cartography by Nadine E. Golden, 2014

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Data Integration and Visualization, Offshore of Aptos Map Area, California

By
Peter Dartnell
2016

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