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Open-File Report 2016–1024
Sheet 4 of 10
Pamphlet accompanies map

Figure 3. Video mosaic generated from seafloor video captured over ridge of rocky outcrop southwest of Point Santa Cruz (see fig. 1 for location). Outcrop in this area consists of mixed environment of boulders, cobbles, and gravels. Camera-sled tow direction is from bottom to top; mosaic is made up of about 50 seconds of video as camera sled travels over 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.

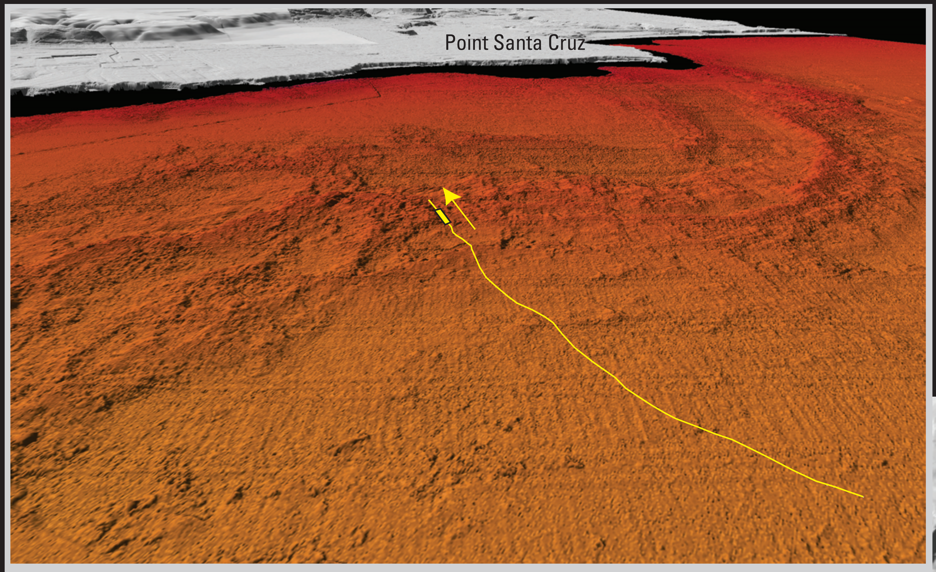


Figure 1. Perspective view to north over seafloor south of Santa Cruz, showing southwest-to-northeast-trending ridge of rocky outcrop that has as much as 5 m of local relief and curves northward to meet Point Santa Cruz (see also, fig. 2). Thin yellow line shows path of camera sled, towed 1 to 2 m above seafloor, that captured video and photographs; yellow arrow shows tow direction. Yellow rectangle shows location of video mosaic (fig. 3) generated from video captured near top of ridge. Vertical exaggeration, 2x; distance across bottom of image, about 750 m.

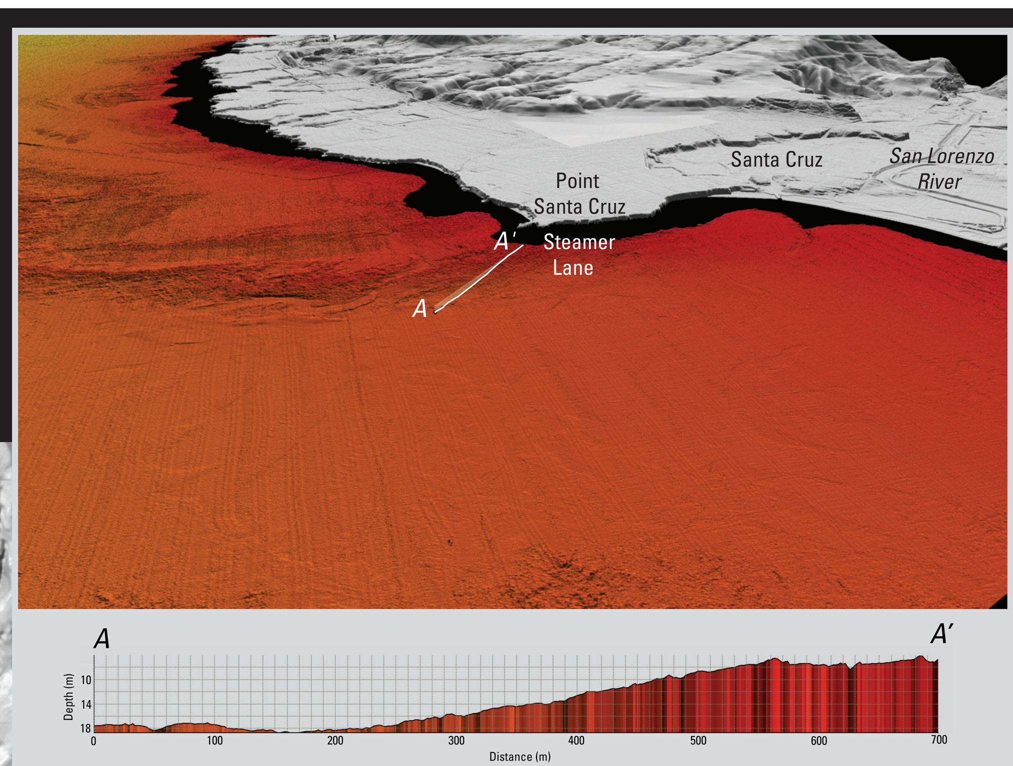
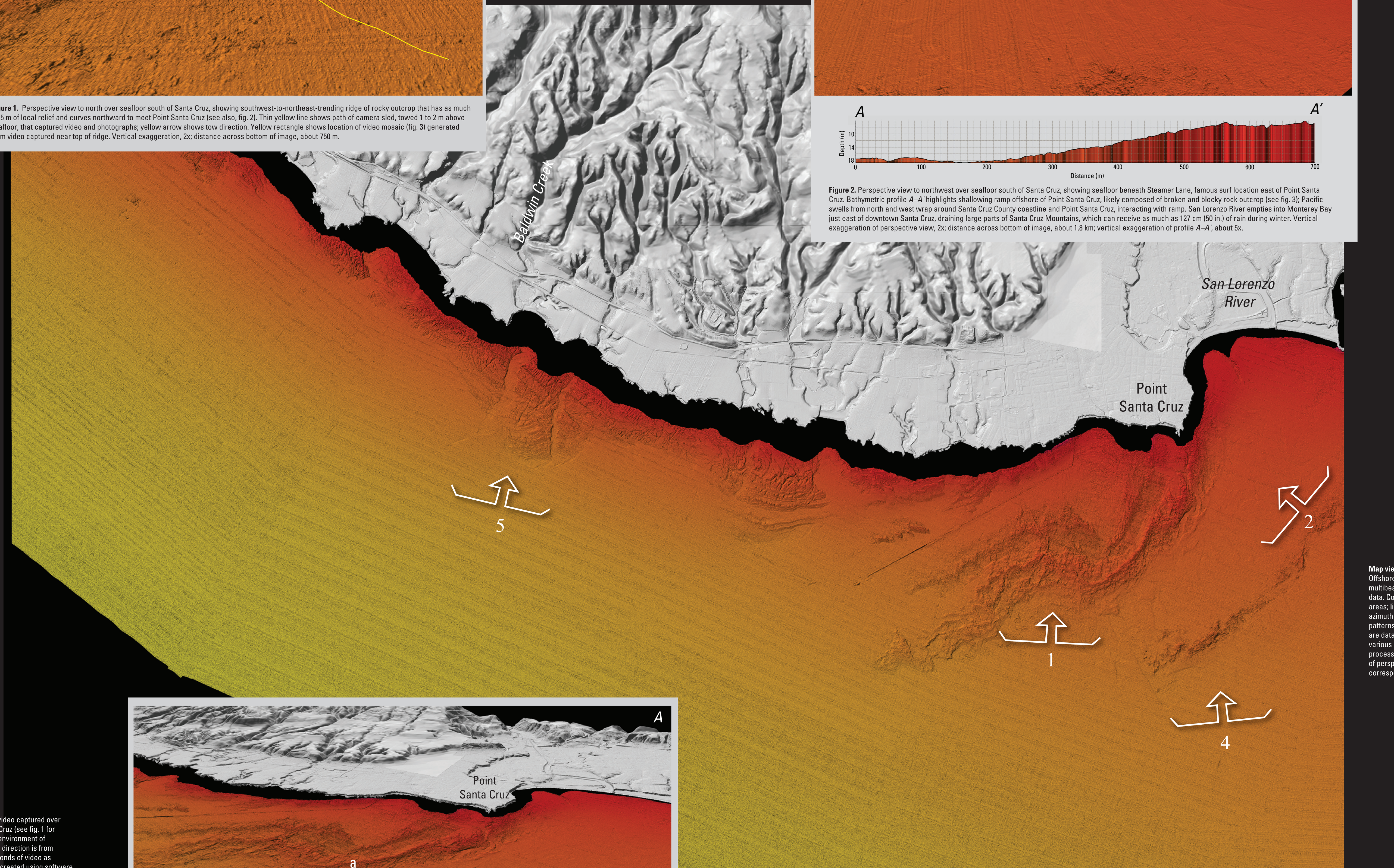


Figure 2. Perspective view to northwest over seafloor south of Santa Cruz, showing seafloor beneath Steamer Lane, famous surf location east of Point Santa Cruz. Bathymetric profile *A–A′* highlights shallowing ramp offshore of Point Santa Cruz, likely composed of broken and blocky rock outcrop (see fig. 3). Pacific swells from north and west wrap around Santa Cruz County coastline and Point Santa Cruz, interacting with ramp. San Lorenzo River empties into Monterey Bay just east of downtown Santa Cruz, draining large parts of Santa Cruz Mountains, which can receive as much as 127 cm (50 in.) of rain during winter. Vertical exaggeration of perspective view, 2x; distance across bottom of image, about 1.8 km; vertical exaggeration of profile *A–A′*, about 5x.



Map view. Colored shaded-relief bathymetry map of Offshore of Santa Cruz map area, generated from multibeam-echosounder and bathymetric-sidescan data. Colors show depth: reds indicate shallower areas; light greens, deeper areas. Illumination azimuth is 300°, from 45° above horizon. Ripple patterns and parallel lines apparent within map area are data-collection and -processing artifacts. These various artifacts are made obvious by hillshading process. Numbered arrows show viewing directions of perspective views shown on this sheet; numbers correspond to figure numbers of views.

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 Santa Cruz map area.

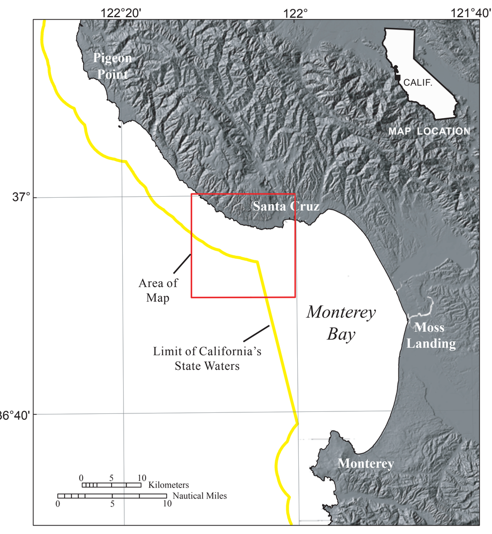
The map view in the center of the sheet is similar to the colored shaded-relief bathymetry map of the Offshore of Santa Cruz map area (see sheet 1 of this report). Numbered arrows show viewing directions of the perspective views on this sheet; the numbers indicate the figure number of the perspective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

The perspective views and bathymetric profiles in figures 1, 2, 4, 5, and 6 show the colored shaded-relief bathymetry of the Offshore of Santa Cruz map area, as viewed from different directions. These views highlight the diverse seafloor environments in this map area, which include extensive areas of featureless, sedimented seafloor, as well as layered, folded, and fractured bedrock.

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 (fig. 4) 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. 6), 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.



EXPLANATION

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

Shallow

0
15
30
45
60
75
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]

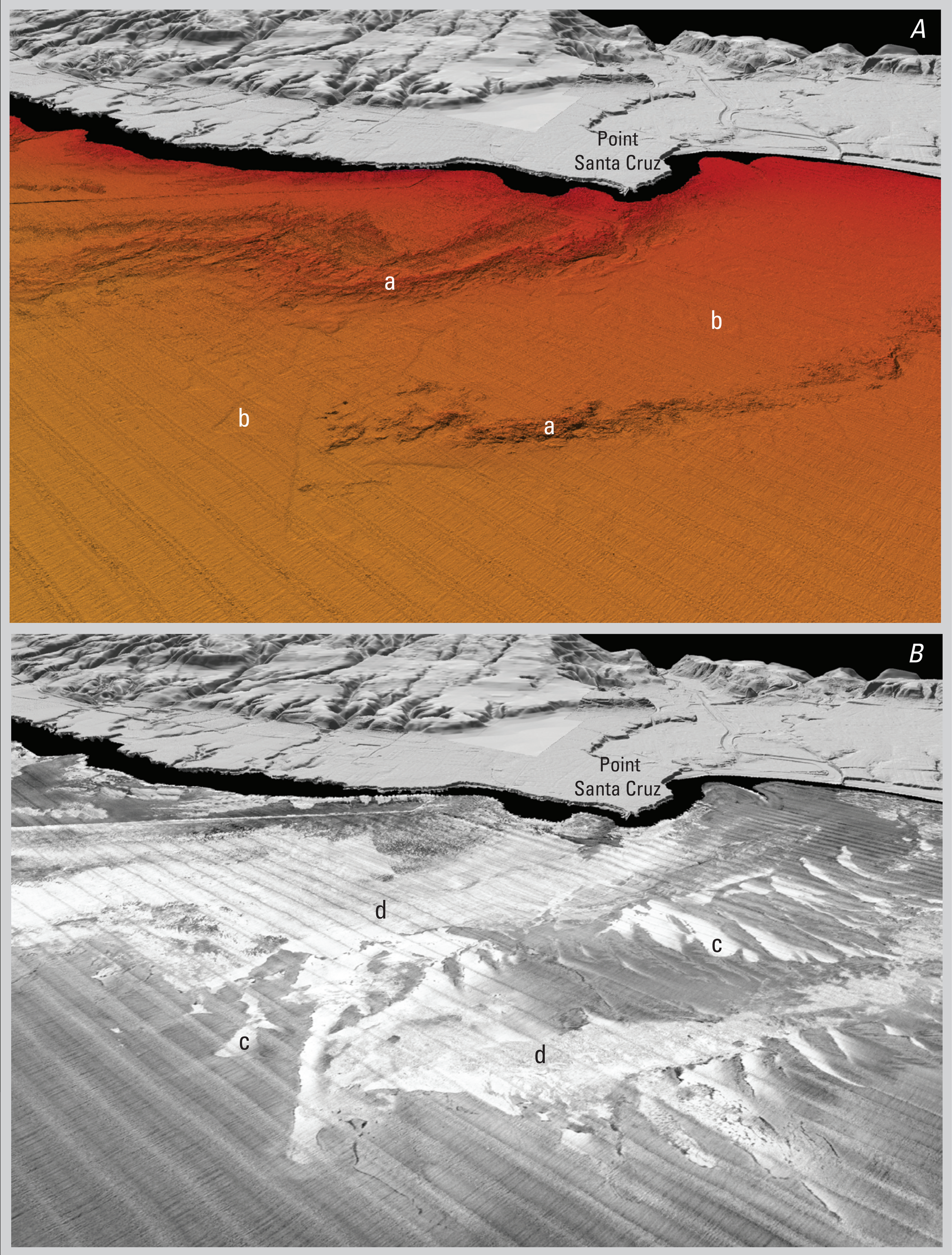


Figure 4. Perspective views to north over seafloor south of Santa Cruz, showing colored shaded-relief bathymetry (*A*) and acoustic-backscatter imagery (*B*). In acoustic-backscatter imagery, lighter tones indicate stronger backscatter intensity, suggesting rock or coarser grained sediment, whereas darker tones indicate weaker backscatter intensity, suggesting finer grained sediment. Bathymetry shows ridges of rocky outcrop (a) exposed offshore of Point Santa Cruz and almost featureless seafloor surrounding ridges. Shallow depressions (b) are barely visible in bathymetry data (see also, sheets 1, 2). Acoustic-backscatter imagery reveals featureless seafloor actually has complicated pattern of lower and higher backscatter intensity. Higher backscatter is contained mainly within shallow depressions (c), common along California coast, that are filled with coarser sands and have backscatter intensities that are similar to rock (d). Ripple patterns and parallel lines in both bathymetry and backscatter data are data-collection and -processing artifacts. Vertical exaggeration of perspective views, 2x; distance across bottom of both views, about 2.7 km.

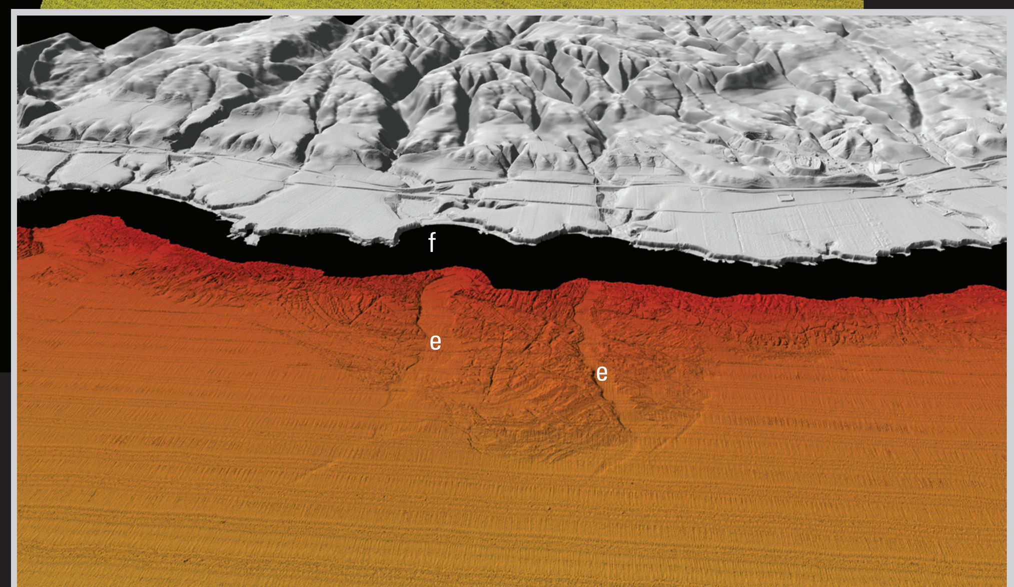


Figure 5. Perspective view to north over nearshore area west of Santa Cruz, showing layered, folded, and fractured bedrock that dominates nearshore along this stretch of coast. Bedrock outcrop is mapped as the upper Miocene Santa Cruz Mudstone, which is composed of thin- to thick-bedded siliceous mudstone (see sheet 10 of this report). Narrow channels (e) cut into bedrock are likely pathways for modern sediment flowing out of onshore watersheds, including Baldwin Creek (f), to shelf offshore. Vertical exaggeration, 2x; distance across bottom of image, about 3.2 km.

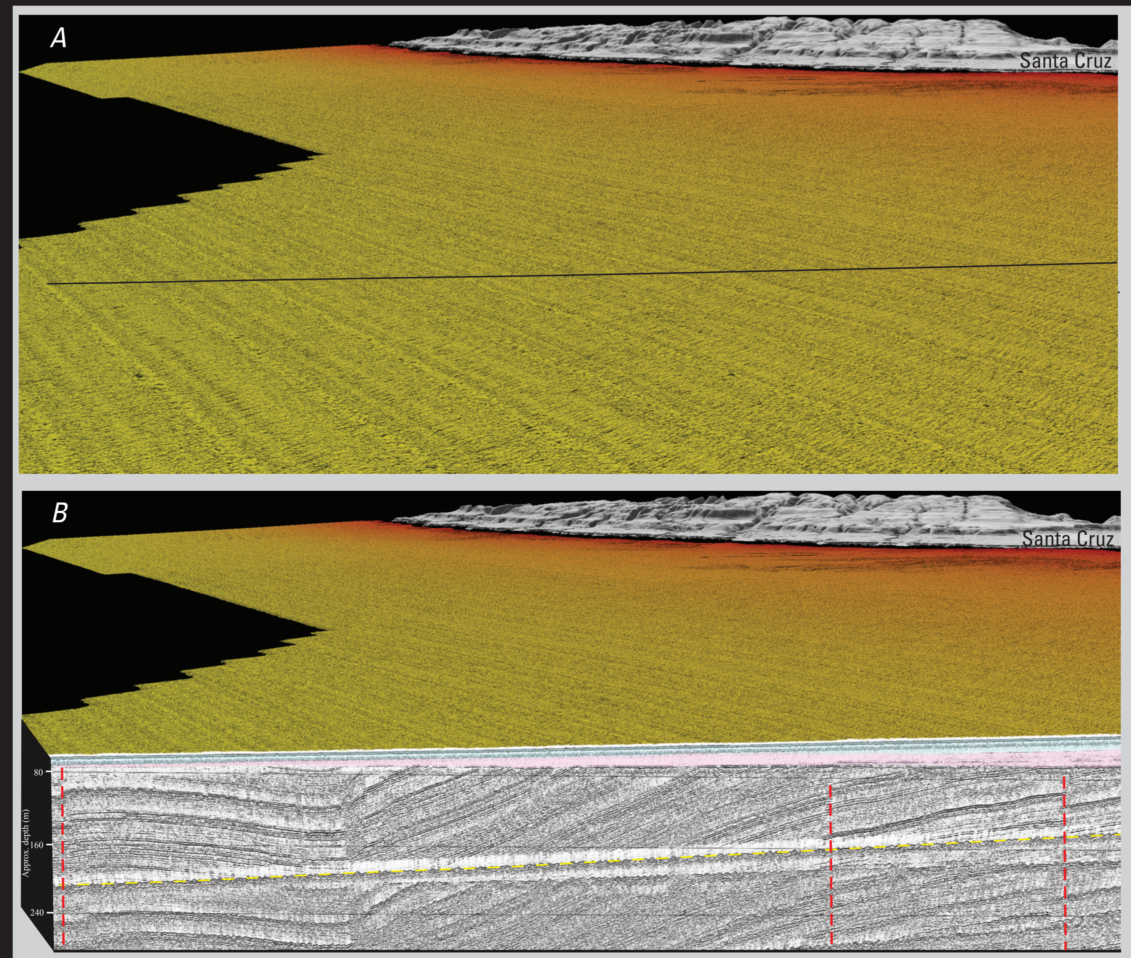


Figure 6. Perspective views to northwest over outer continental shelf south of Santa Cruz. *A*, Perspective view of shelf shows featureless seafloor. Ripple patterns and parallel lines are data-collection artifacts. Black line shows location of seismic-reflection profile in *B* below. *B*, Same perspective view as *A*, converted to block diagram that combines bathymetry with northeast-southwest-trending seismic-reflection profile MBS–15 (also shown in fig. 8 on sheet 8 of this report). Profile reveals that seafloor is featureless because more than 10 m of sediment (blue and pink shading in profile), interpreted to be uppermost Pleistocene and Holocene sediments, overlies folded and faulted strata (see sheets 8, 9 of this report). 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 *A*, about 2.2 km; depth of base of seismic-reflection profile in *B*, about 180 m.

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

Data Integration and Visualization, Offshore of Santa Cruz Map Area, California

By
Peter Dartnell
2016

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 figure 4 from map on sheet 3, this report. Bathymetric profile in figure 2 by Peter Dartnell, 2014. Seismic-reflection profile in figure 6 from sheet 8, this report
GIS database and digital cartography by Nadine E. Golden
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