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U.S. Geological Survey

Open-File Report 2014–1214
Sheet 4 of 10
Pamphlet accompanies map

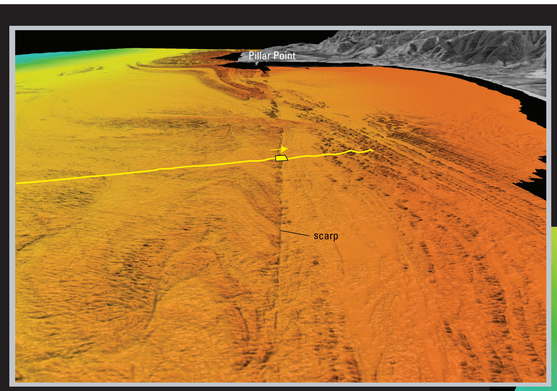


Figure 1. Perspective view to northwest over southern part of Half Moon Bay, showing lower relief areas of outcrop and also linear scarp possibly formed by east strand of San Gregorio Fault. Scarp has offset of 1 to 1.5 m, with west side higher than east side. Thin yellow line shows path of camera sled, towed 1 to 2 m over seafloor, that captured video and photographs; yellow arrow shows tow direction. Yellow rectangle shows location of video mosaic (fig. 3) generated from video captured over scarp. Vertical exaggeration, 2x; distance across bottom of image, about 600 m.

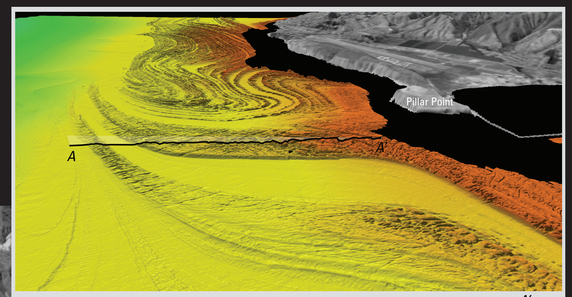


Figure 2. Perspective view to northwest toward Mavericks surf break offshore of Pillar Point, showing spectacular folds exposed in bedrock west of Pillar Point. Bathymetric profile *A–A′* shows shallowing "ramp" under surf break. Water depths range from about 35 m at west (left) end of profile to less than 5 m at east (right) end of profile. Long-period swells initiated from North Pacific storms interact with ramp, along with deeper channel to south, to generate one of largest surfing waves in world. Vertical exaggeration of perspective view, 2x; distance across bottom of image, about 1.6 km; vertical exaggeration of profile *A–A′*, 10x.

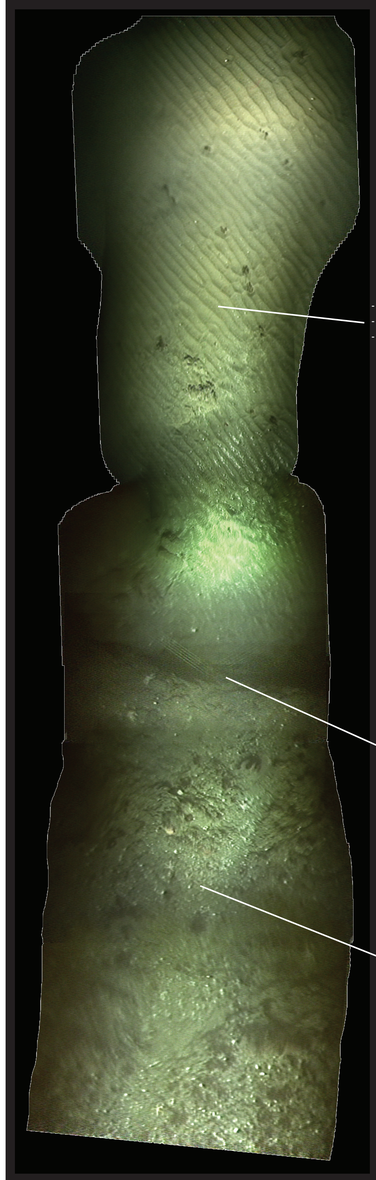
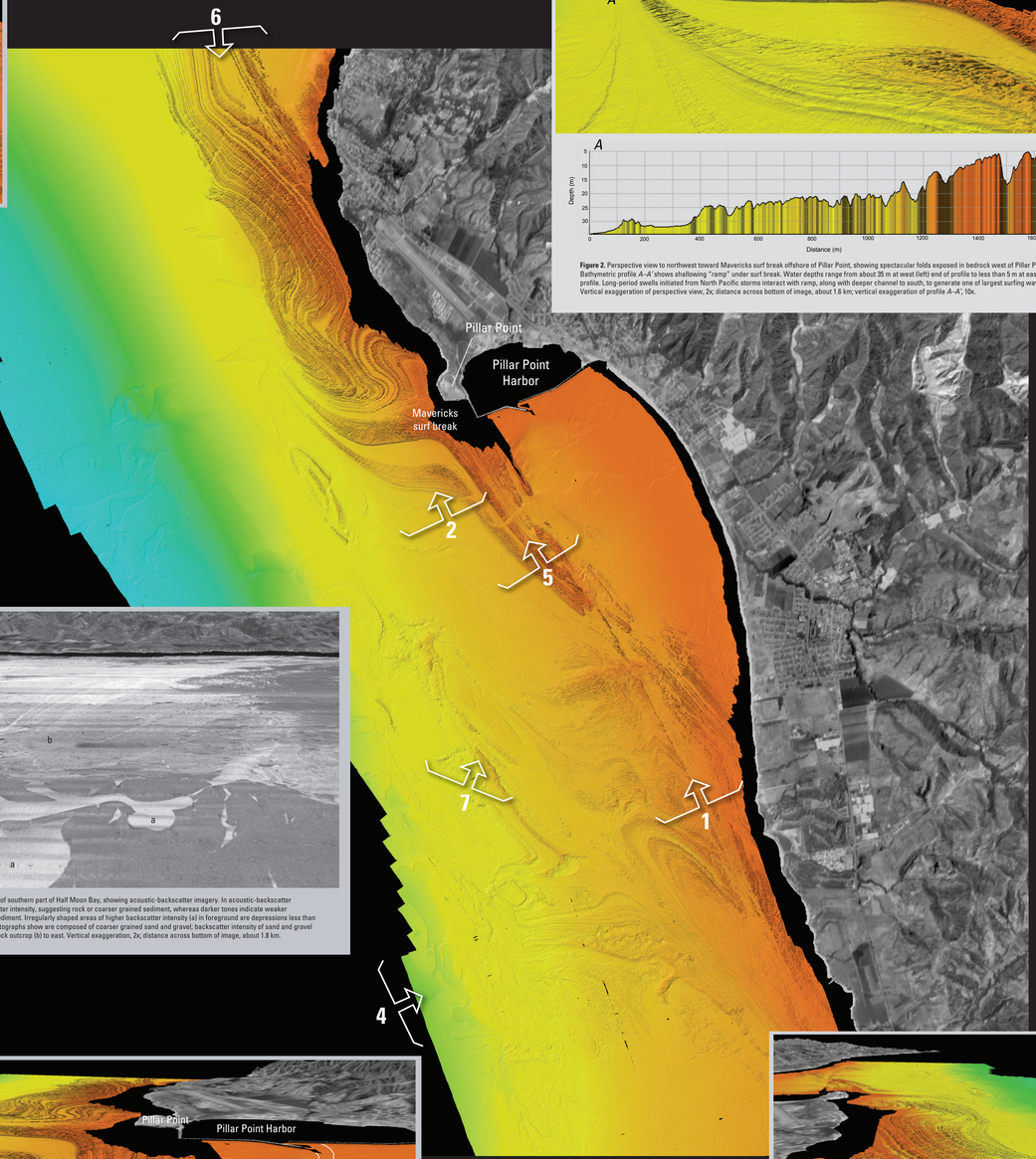


Figure 3. Video mosaic of area offshore of southern part of Half Moon Bay (see fig. 1 for location), showing (west) to east, from bottom to top) bedrock outcrop, then sharp vertical offset, and then coarser sand, sand ripples, and some shell material. Vertical offset may be linear scarp shown in figure 1. 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 4. Perspective view to northeast offshore of southern part of Half Moon Bay, showing acoustic-backscatter imagery. 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. Irregularly shaped areas of higher backscatter intensity (a) in foreground are depressions less than 1 m deep that ground-truth–survey video and photographs show are composed of coarser grained sand and gravel; backscatter intensity of sand and gravel typically is higher than that of low-relief (0.5 m) rock outcrop (b) to east. Vertical exaggeration, 2x; distance across bottom of image, about 1.8 km.



Map view. Colored shaded-relief bathymetry map of Offshore of Half Moon Bay map area, generated from multibeam echosounder data. Colors show depth; reds and oranges indicate shallower areas; light blues, deeper areas. Illumination azimuth is 300°, from 45° above horizon. Numbered arrows show viewing directions of perspective views shown on this sheet; numbers correspond to figure numbers of views.

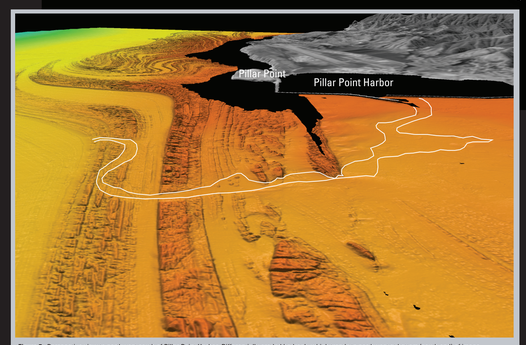
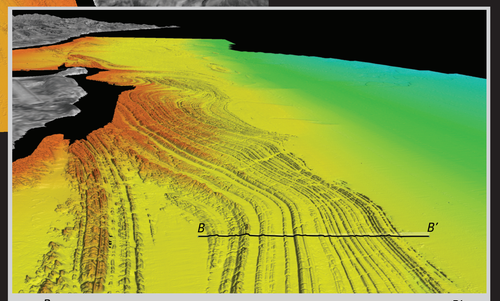


Figure 5. Perspective view to northwest south of Pillar Point Harbor. Differentially eroded bedrock, which trends to northwest at bottom (south end) of image, bends to west offshore of Pillar Point. White lines outline channel possibly cut by paleostream that flowed during times of lower sea level. Vertical exaggeration of perspective view, 2x; distance across bottom of image, about 900 meters.



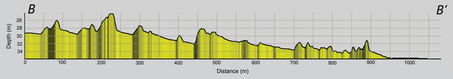


Figure 6. Perspective view to south along San Mateo County coast, showing differentially eroded bedrock that trends north-south then bends to southeast (to left) toward coastline. Bathymetric profile *B–B′* shows slight westward (to right) dip of bedrock; multibeam bathymetry and ground-truth–survey video and photographs confirm that bedrock protrudes between 1 and 4 m above sediment-filled troughs. Vertical exaggeration of perspective view, 2x; distance across bottom of image, about 1.8 km; vertical exaggeration of profile *B–B′*, about 10x.

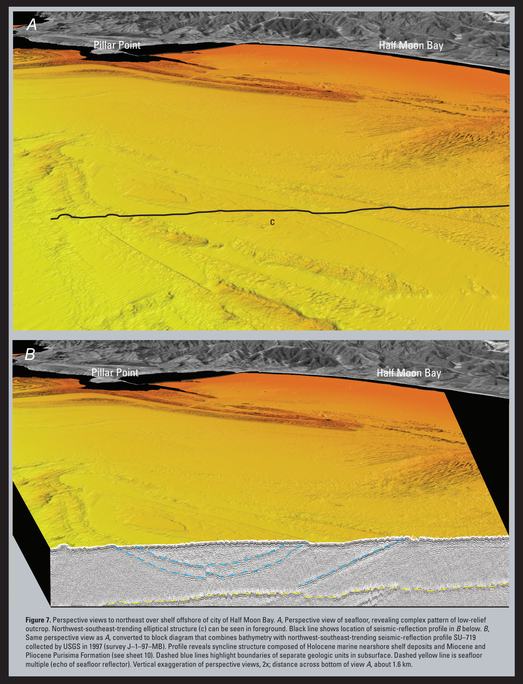


Figure 7. Perspective views to northeast over shelf offshore of city of Half Moon Bay. *A*, Perspective view of seafloor, revealing complex pattern of low-relief outcrop. Northwest-southeast-trending elliptical structure (c) can be seen in foreground. Black line shows location of seismic-reflection profile in *B* below. *B*, Same perspective view as *A*, converted to block diagram that combines bathymetry with northwest-southeast-trending seismic-reflection profile SU–719 collected by USGS in 1997 (survey J–1–97–MB). Profile reveals syncline structure composed of Holocene marine nearshore shelf deposits and Miocene and Pliocene Purisima Formation (see sheet 10). Dashed blue lines highlight boundaries of separate geologic units in subsurface. Dashed yellow line is seafloor multiple (echo of seafloor reflector). Vertical exaggeration of perspective views, 2x; distance across bottom of view *A*, about 1.6 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 Half Moon Bay map area.

The map view in the center of the sheet is similar to the colored shaded-relief bathymetry map of the Offshore of Half Moon Bay map area (see sheet 1 of this report). Numbered arrows show viewing directions of the perspective views on this sheet (figs. 1, 2, 4, 5, 6, 7); the numbers indicate the figure number of the perspective view.

The perspective views and bathymetric profiles in figures 1, 2, 5, 6, and 7 show the colored shaded-relief bathymetry of the Offshore of Half Moon Bay map area, as viewed from different directions. These views show a few examples of the complexity of the differentially eroded bedrock in the nearshore environment.

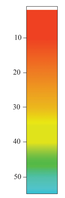
Video-mosaic images created from seafloor digital video (fig. 3) display the geologic (rock, sand, mud) and biologic complexity of the seafloor. Whereas photographs capture high-quality snapshots of a small area of the seafloor, video mosaics can capture larger areas and, thus, can show transitional 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, and it also aids in seafloor habitat and geology interpretations.

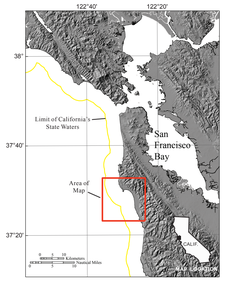
Block diagrams (fig. 7), which combine the bathymetry with seismic-reflection-profile data (see sheet 8 of this report), help reveal the stratigraphic and structural relations between the surface and subsurface.

EXPLANATION

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



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 imagery from digital orthophotographs available at Cal-Atlas Geospatial Clearinghouse, http://atlas.ca.gov/ (last accessed January 2013). Offshore shaded-relief bathymetry from map on sheet 1, this report

Universal Transverse Mercator projection, Zone 10N

NOT INTENDED FOR NAVIGATIONAL USE

Perspective views by Peter Dartnell, 2012. Bathymetric profiles in figures 2 and 6 by Peter Dartnell, 2012. Video-mosaic image in figure 3 by Peter Dartnell, 2012, 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. Seismic-reflection profile in figure 7 from sheet 8, this report

GIS database and digital cartography by Nadine Golden and Florence L. Wong

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