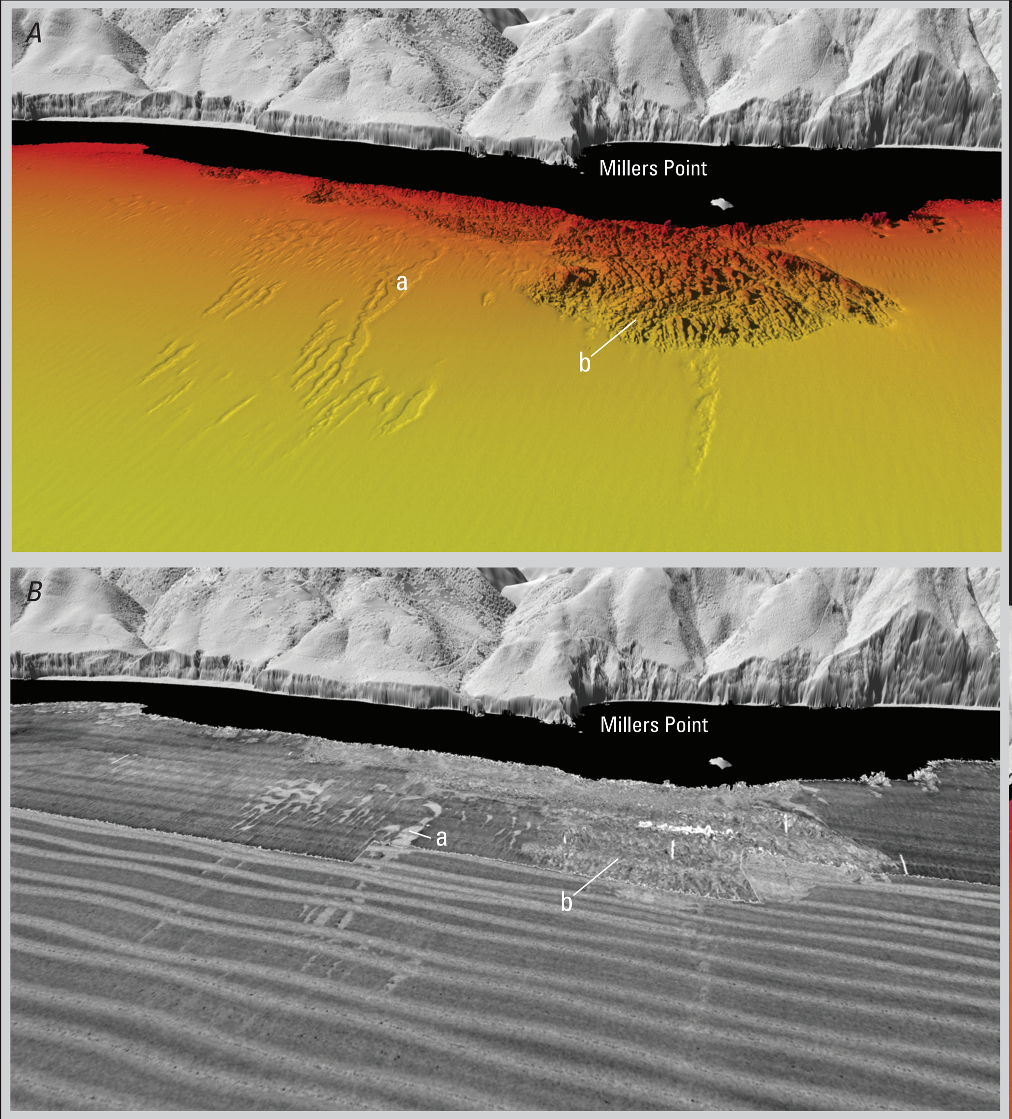


Figure 1. Perspective views to northeast over area offshore of Millers Point, showing colored shaded-relief bathymetry (*A*) and acoustic-backscatter imagery (*B*). In acoustic-backscatter imagery, lighter tones indicate stronger backscatter intensity, suggesting rock or coarser grained sediments, whereas darker tones indicate weaker backscatter intensity, suggesting finer grained sediments; linear features of high backscatter that roughly parallel coastline are data-collection artifacts; bright white linear features perpendicular to coastline are gaps in data. Colored shaded-relief bathymetry highlights shallow depressions on seafloor (a), which are common along California coast; these features generally have coarser grained sediment than surrounding seafloor and contain larger rippled bedforms and increased shell material (see sheet 10 of this report), creating very high backscatter intensities, even higher than some rocky outcrops (b). Vertical exaggeration, 2x; distance across bottom of both images, about 1.5 km.

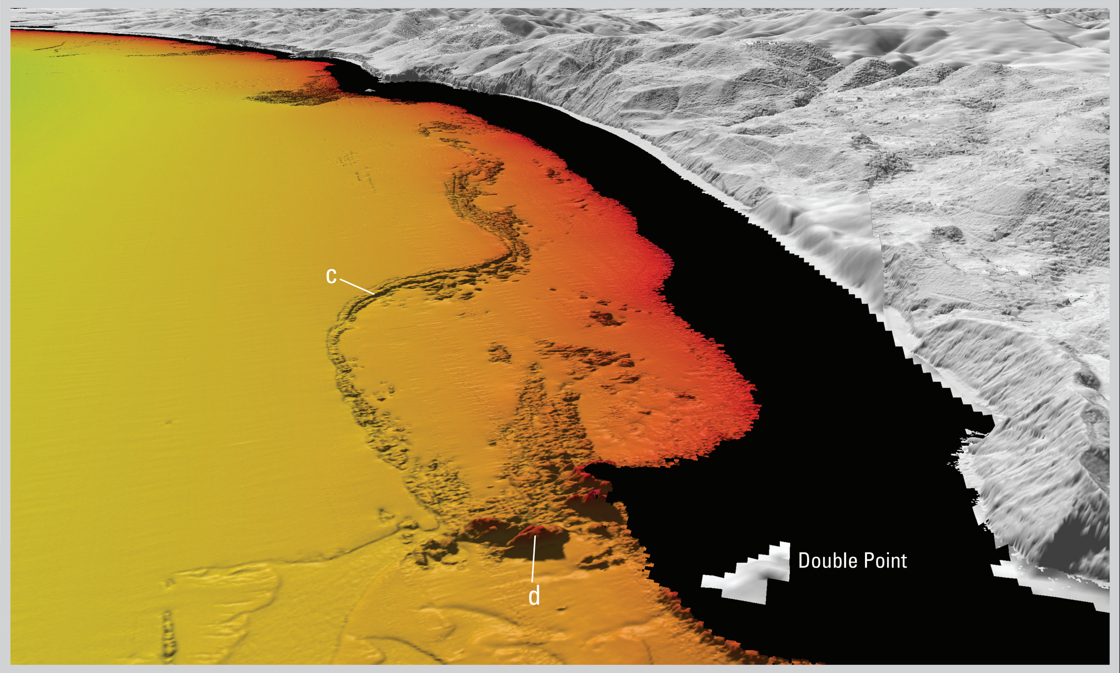
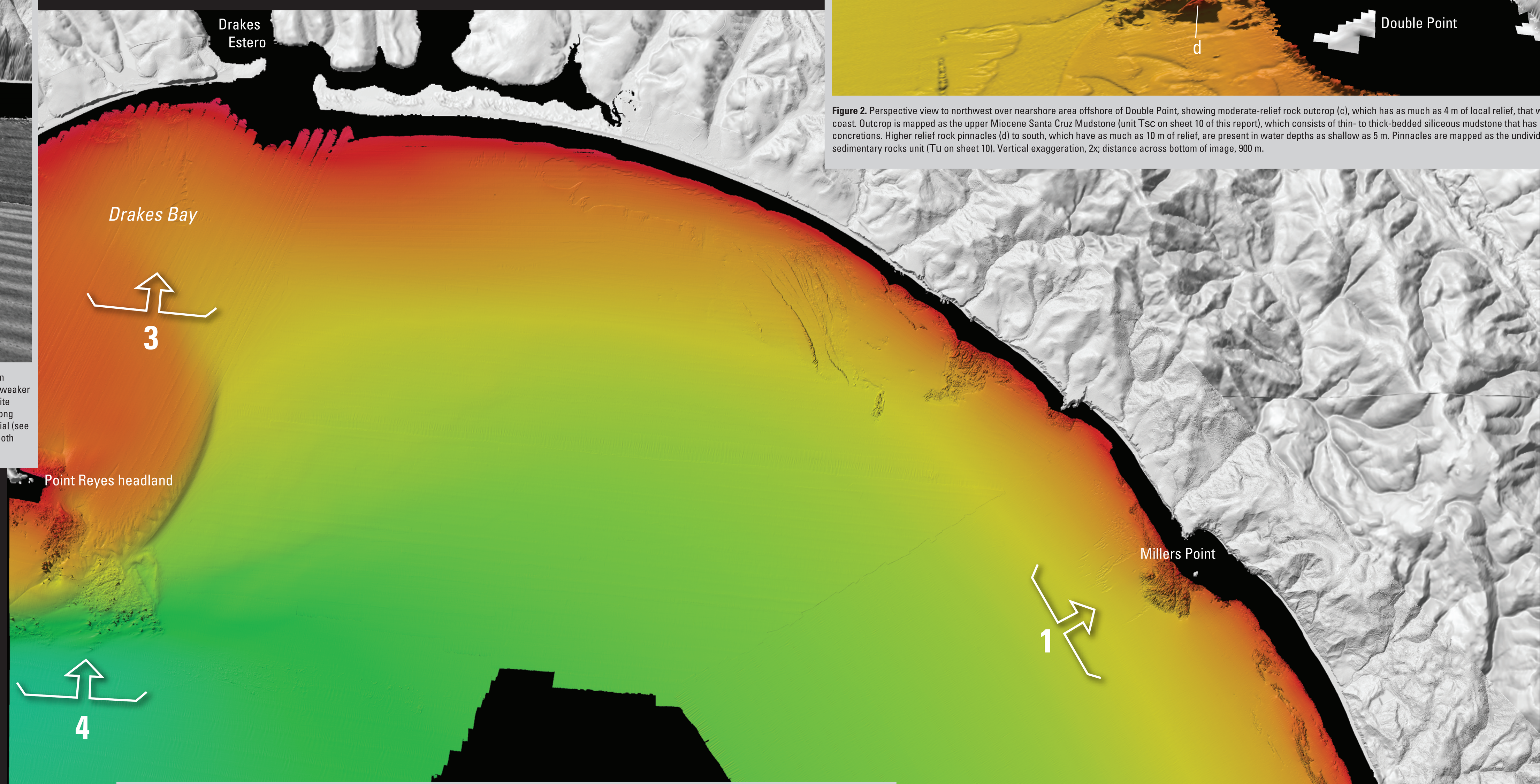


Figure 2. Perspective view to northwest over nearshore area offshore of Double Point, showing moderate-relief rock outcrop (c), which has as much as 4 m of local relief, that winds along coast. Outcrop is mapped as the upper Miocene Santa Cruz Mudstone (unit Tsc on sheet 10 of this report), which consists of thin- to thick-bedded siliceous mudstone that has carbonate concretions. Higher relief rock pinnacles (d) to south, which have as much as 10 m of relief, are present in water depths as shallow as 5 m. Pinnacles are mapped as the undivided sedimentary rocks unit (Tu on sheet 10). Vertical exaggeration, 2x; distance across bottom of image, 900 m.



Map view. Colored shaded-relief bathymetry map of Drakes Bay and Vicinity map area, generated from multibeam-echosounder and bathymetric-sidescan data. Colors show depth: reds and oranges indicate shallower areas; greens, 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.

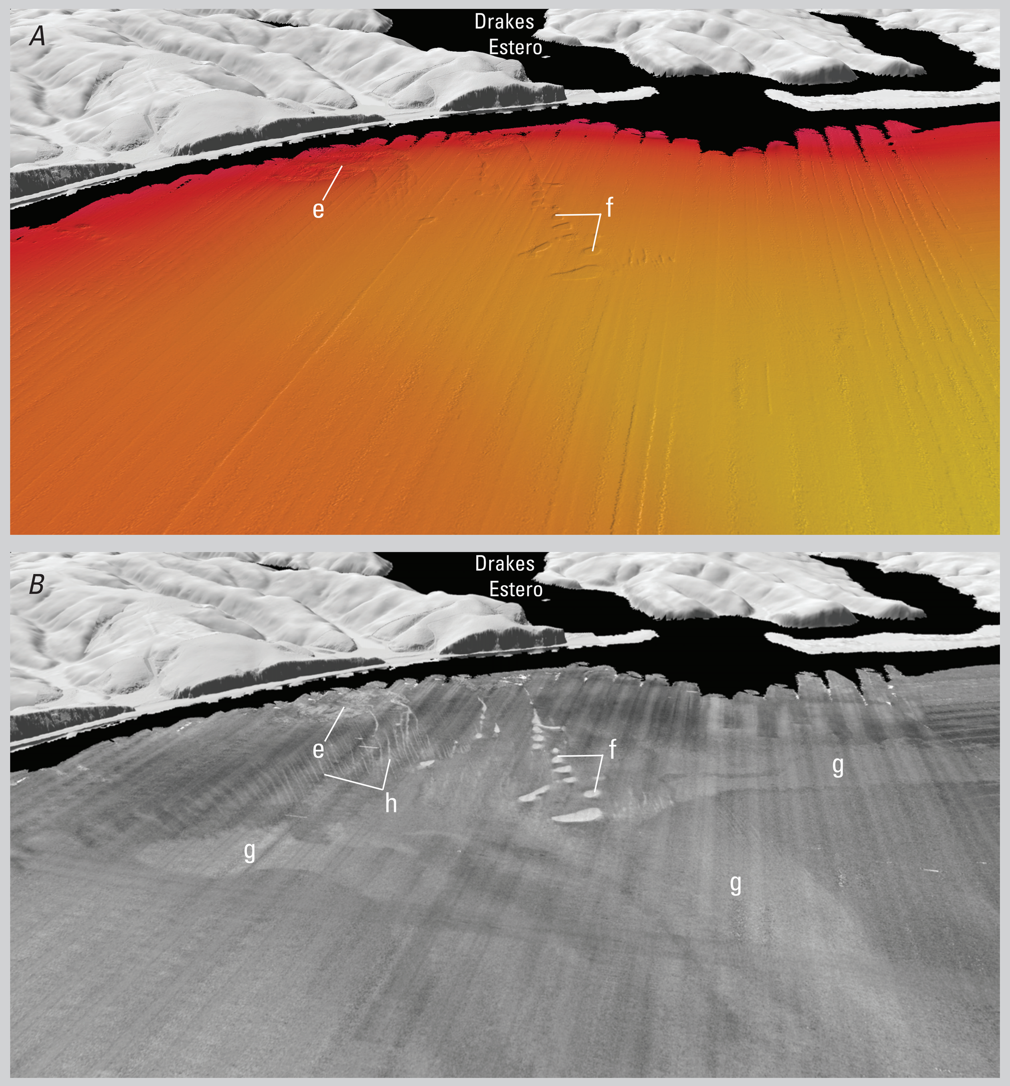


Figure 3. Perspective views to north over nearshore area just offshore of Drakes Estero, showing colored shaded-relief bathymetry (*A*) and acoustic-backscatter imagery (*B*). Colored shaded-relief bathymetry shows little seafloor relief and only small patch (e) of rougher, rocky seafloor (mapped as the upper Miocene and Pliocene Purisima Formation [unit Tp] on sheet 10 of this report). Also shown are series of shallow depressions (f) that have less than 1 m of relief; these depressions have much higher backscatter intensity, suggesting that they contain sediment that is coarser grained than that of surrounding seafloor. Although sediment-covered seafloor contains little relief, backscatter imagery shows areas of slightly higher backscatter (g), suggesting that local variations in grain size exist. Such grain-size variations also are suggested by striped pattern of higher and lower backscatter (h), perpendicular to shoreline, that are offshore of rocky outcrops (e). Linear, north-south-trending features in both bathymetry and backscatter data are data-collection artifacts. Vertical exaggeration, 2x; distance across bottom of both images, about 2.4 km.

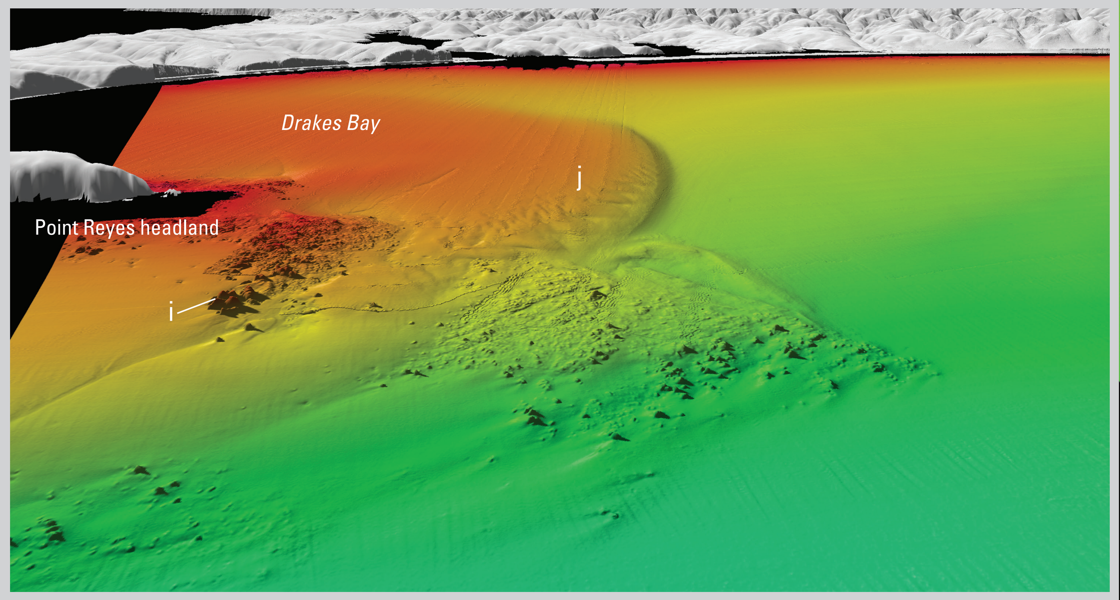


Figure 4. Perspective view to north, past east end of Point Reyes headland into Drakes Bay, showing low- to high-relief outcrop, which has as much as 11 m of local relief, east of headland (i). Outcrop is mapped as the Late Cretaceous porphyritic Point Reyes Granodiorite (unit Kgg on sheet 10 of this report). Large nearshore bar (j) that has sand waves on outer margin is found on wave-protected northeast flank of headland. Drakes Bay is named after European explorer Sir Francis Drake, who likely found shelter here to repair his ship during his 1577–80 circum-navigation of the globe; Drake, who called place where he landed "New Albion," was well received by local Native Americans (Aughton, 2007). Vertical exaggeration, 2x; distance across bottom of image, about 2 km.

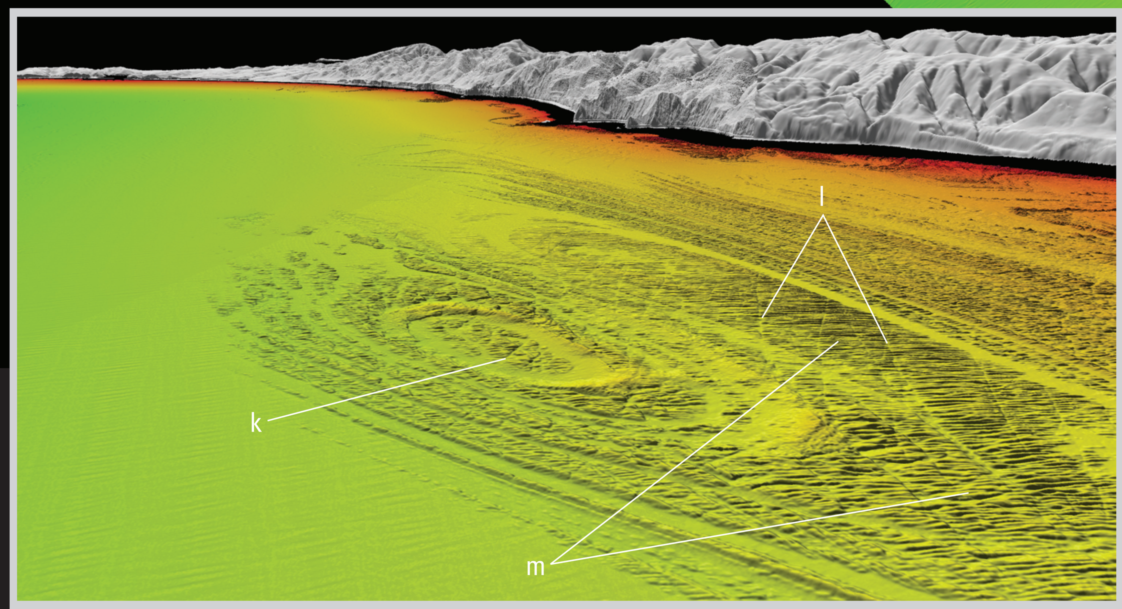


Figure 5. Perspective view to north over extensive area of low-relief, exposed bedrock. Elliptical structure (k) is surface expression of doubly plunging anticline in rocks inferred to be the Purisima Formation (mapped as unit Tp? on sheet 10 of this report). "Ribbed" character of outcrop reflects differential erosion of sedimentary-rock layers of variable lithologies; note that layers are cut by crosscutting series of widely spaced, north-south-trending linear fractures (l) and higher frequency, east-west-trending linear fractures (m). Vertical exaggeration, 2x; distance across bottom of image, about 1.3 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 Drakes Bay and Vicinity map area.

The map view in the center of the sheet is similar to the colored shaded-relief bathymetry map of the Drakes Bay and Vicinity 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 through 6 show the colored shaded-relief bathymetry of the Drakes Bay and Vicinity map area, as viewed from different directions. These views highlight the diverse seafloor environments in this map area, which include areas of featureless, sedimented seafloor interspersed with complex distributions of coarse-grained sediment, as well as extensive areas of folded and fractured bedrock.

Draping the acoustic-backscatter imagery (see sheet 3 of this report) over the bathymetry data (figs. 1, 3) highlights the relations between the backscatter intensity and the seafloor morphology, and it also aids in seafloor habitat and geology interpretations.

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.

REFERENCE CITED

Aughton, P., 2007, Francis Drake and the voyage of the Golden Hind, *in* Voyages that changed the world: London, Quercus, 208 p.

EXPLANATION

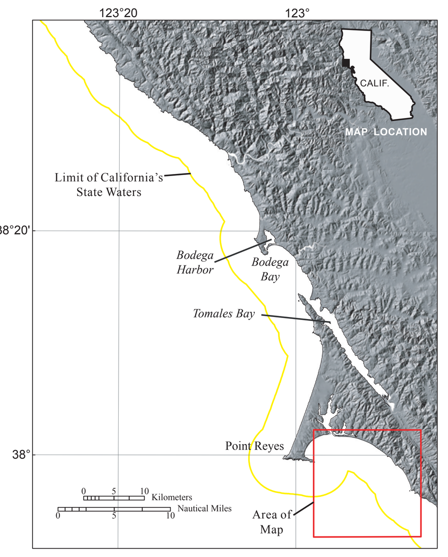
Depth (in meters) and illumination (bright areas are illuminated, facing false sun; dark areas are in shadow, facing away from false sun)

Shallow

10
20
30
40
50
60

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]



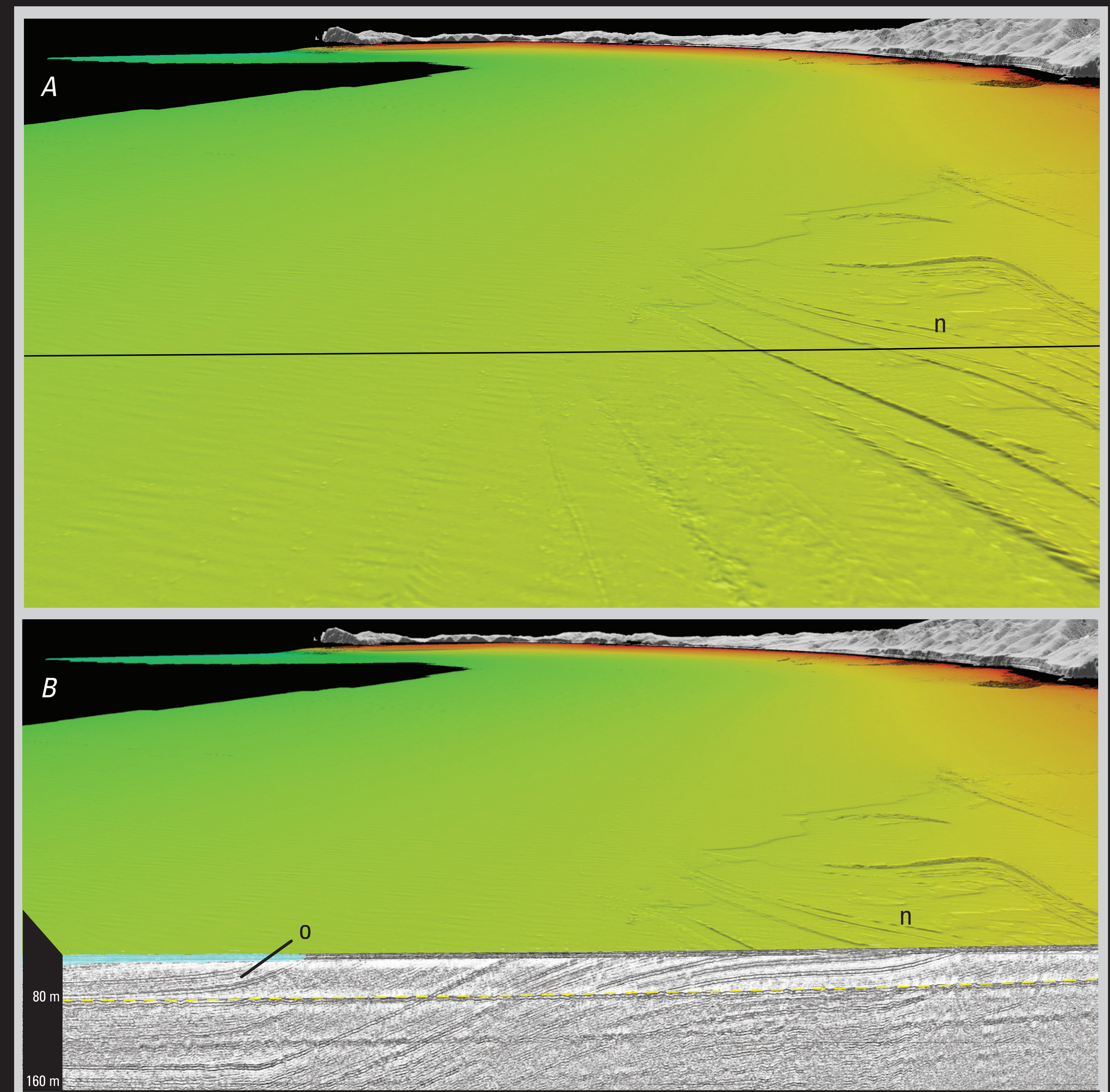


Figure 6. Perspective views to northwest over midshelf area south of Double Point. *A*, Perspective view of linear ridges of rock outcrop (n) exposed in nearshore (to right) and featureless seafloor southwest (to left) of them. Black line shows location of seismic-reflection profile in *B* below. *B*, Same view as *A*, converted to block diagram that combines bathymetry with northeast-southwest-trending seismic-reflection profile PR–31 (see fig. 2 on sheet 8, this report). Profile reveals southwest-dipping limb of anticline (o) below featureless seafloor that is covered with thin layer of uppermost Pleistocene and Holocene strata (blue shading). To northeast, steeply dipping beds exposed at seafloor are expressed as linear outcrop ridges (n); note that ridges do not have enough relief to show in seismic-reflection profile. Dashed yellow line is seafloor multiple (echo of seafloor reflector). Vertical exaggeration of perspective views, 2x; distance across bottom of perspective view in *A*, about 1 km; depth of base of seismic-reflection profile in *B*, about 160 m.

Onshore elevation data from NOAA Coastal Services Center's Digital Coast (available at http://csc.noaa.gov/digitalcoast/) and U.S. Geological Survey's National Elevation Dataset (available at http://ned.usgs.gov/). 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, 2013. Acoustic-backscatter imagery in figures 1 and 3 from map on sheet 3, this report. Seismic-reflection profile in figure 6 from sheet 8, this report

GIS database and digital cartography by Nadine E. Golden

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Data Integration and Visualization, Drakes Bay and Vicinity Map Area, California

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Peter Dartnell
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