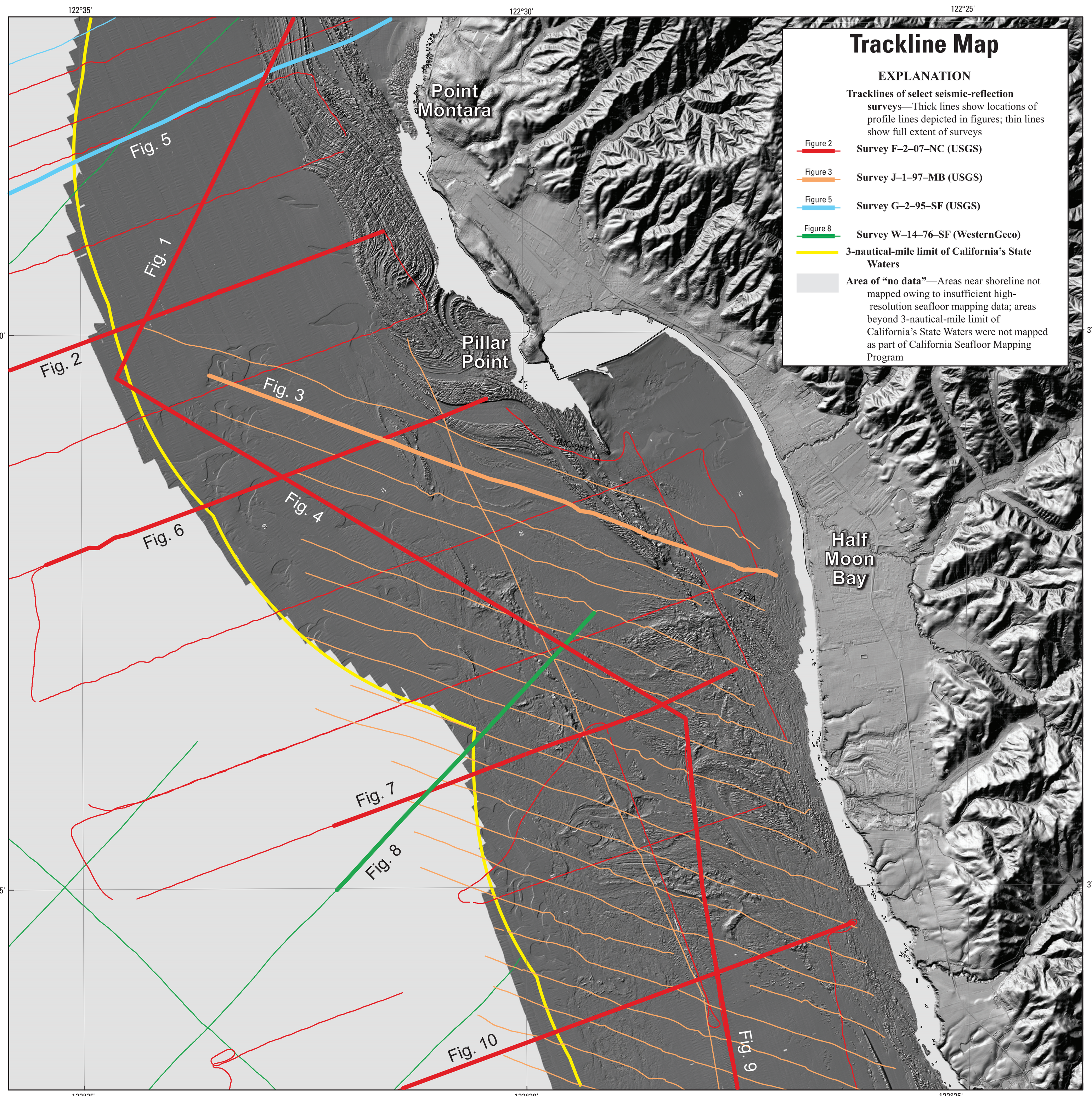
Open-File Report 2014–1214
Sheet 8 of 10
Pamphlet accompanies map



Onshore elevation data collected by Photoscience in 2005 for U.S. Geological Survey and County of San Mateo. Offshore shaded-relief bathymetry from map on sheet 2, this report. California's State Waters limit from NOAA Office of Coast Survey

Universal Transverse Mercator projection, Zone 10N

NOT INTENDED FOR NAVIGATIONAL USE

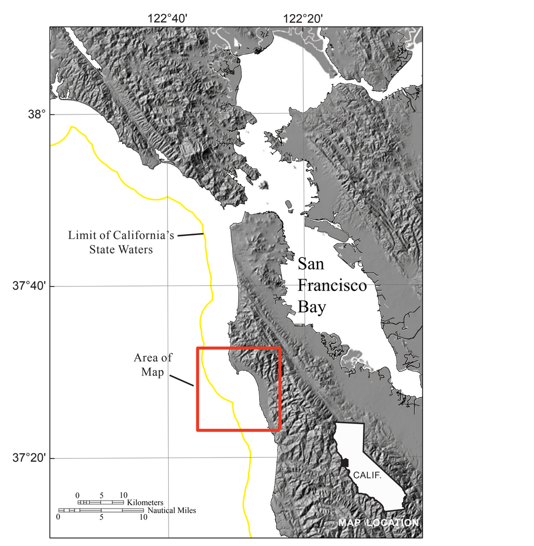
TRUE NORTH
MAGNETIC NORTH
14°
APPROXIMATE MEAN DECLINATION, 2014

SCALE 1:50 000
2 1 0 2 MILES
7000 3500 0 7000 FEET
1 0.5 0 1 KILOMETER
ONE MILE = 0.869 NAUTICAL MILES

CALIF.
MAP LOCATION

GIS database and digital cartography by Eleyne L. Phillips, Florence L. Wong, and Stephen R. Hartwell

Manuscript approved for publication October 2, 2014



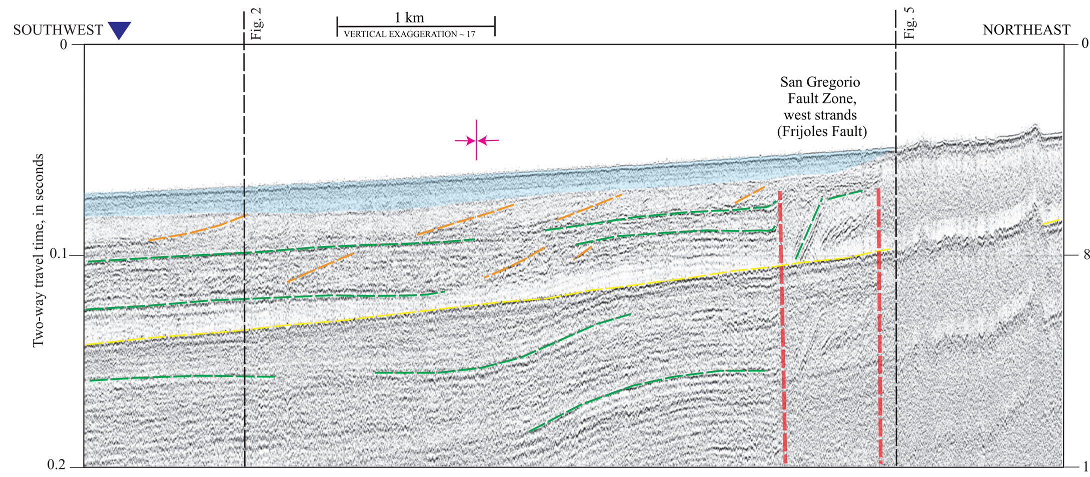


Figure 1. USGS high-resolution minisparker seismic-reflection profile HMS–036C (collected in 2007 on survey F–2–07–NC), which crosses shelf west-southwest of Point Montara; see trackline map for location. Dashed red lines show faults, including west strands (Frijoles Fault) of San Gregorio Fault Zone. Magenta symbol shows syncline axis. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Dashed orange lines highlight zone of reflections that show offshore-dipping clinoforms. Dashed green lines highlight continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed yellow line is seafloor multiple (echo of seafloor reflector). Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

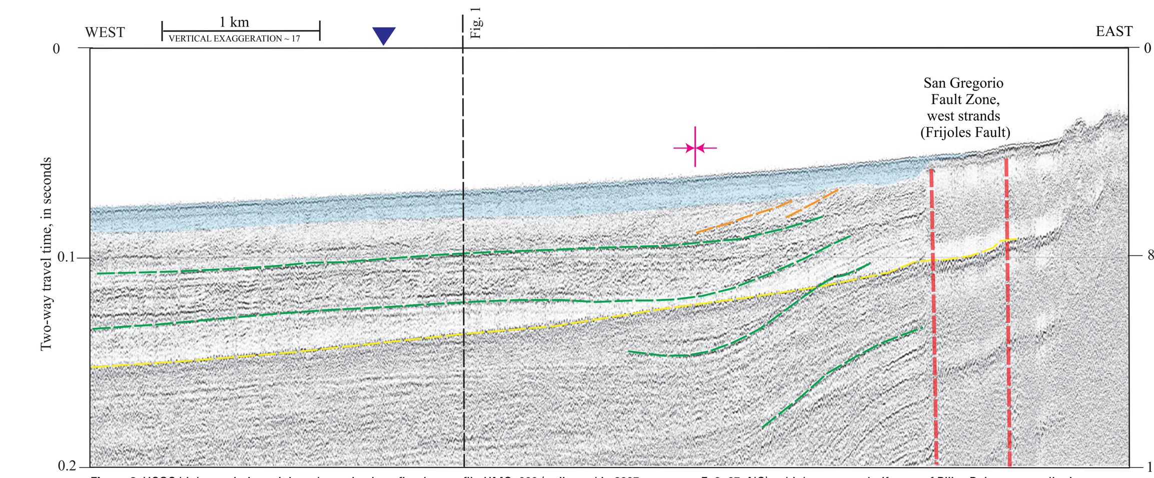


Figure 2. USGS high-resolution minisparker seismic-reflection profile HMS–008 (collected in 2007 on survey F–2–07–NC), which crosses shelf west of Pillar Point, perpendicular to shoreline; see trackline map for location. Dashed red lines show faults, including west strands (Frijoles Fault) of San Gregorio Fault Zone. Magenta symbol shows syncline axis. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. In underlying unit, dashed orange lines highlight reflections that show offshore-dipping clinoform. Dashed green lines highlight continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed yellow line is seafloor multiple (echo of seafloor reflector). Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

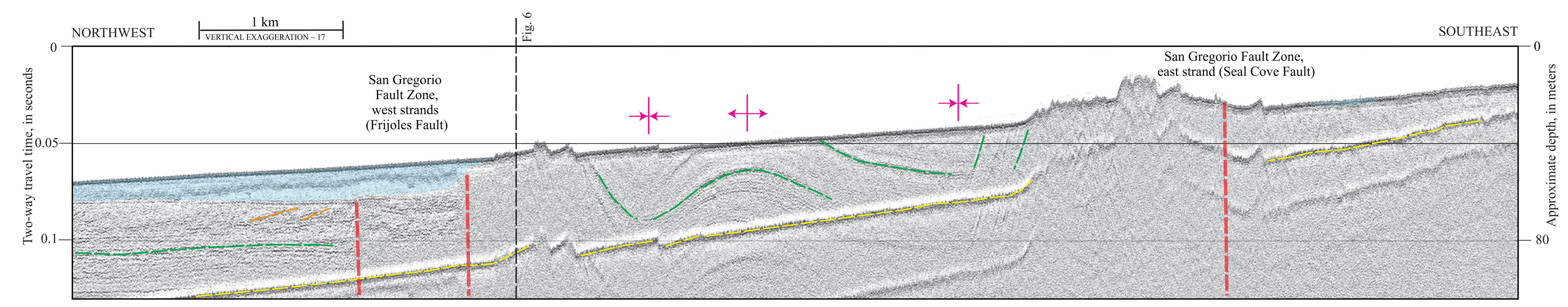


Figure 3. USGS high-resolution geopulse seismic-reflection profile 714 (collected in 1997 on survey J–1–97–MB), which crosses shelf west and south of Pillar Point; see trackline map for location. Dashed red lines show faults, including west (Frijoles Fault) and east (Seal Cove Fault) strands of San Gregorio Fault Zone. Location of east strand is based primarily on prominent lineament in multibeam bathymetry (see sheets 1, 2). Magenta symbols show fold axes (diverging arrows, anticline; converging arrows, synclines). Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Dashed orange lines highlight zone of reflections that show offshore-dipping clinoforms. Dashed green lines highlight continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed yellow line is seafloor multiple (echo of seafloor reflector).

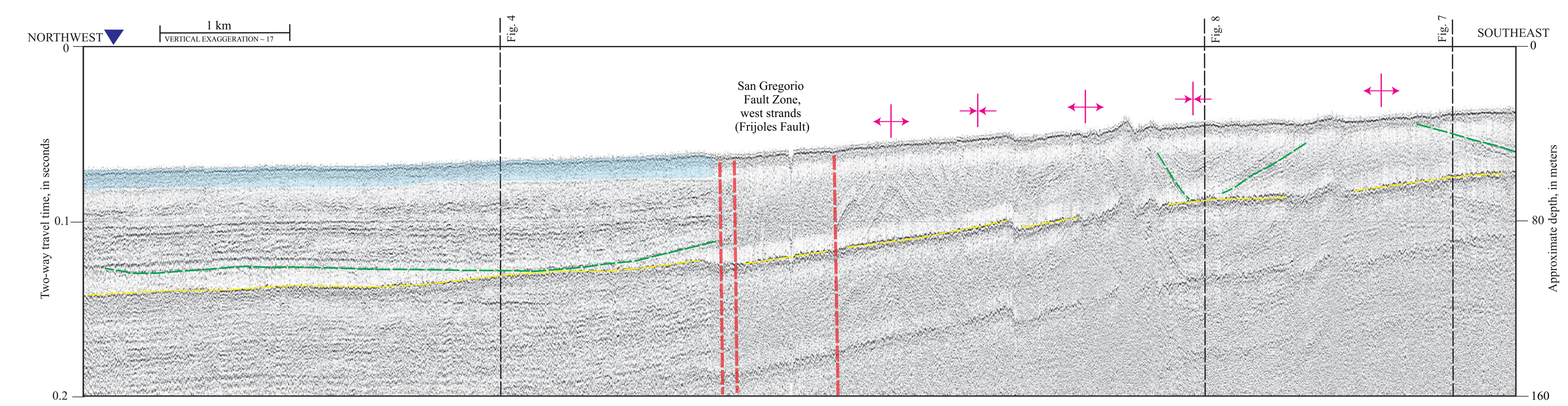


Figure 4. USGS high-resolution minisparker seismic-reflection profile HMS–036D (collected in 2007 on survey F–2–07–NC), which crosses shelf west and south of Pillar Point; see trackline map for location. Dashed red lines show faults, including west strand (Frijoles Fault) of San Gregorio Fault Zone. Magenta symbols show fold axes (diverging arrows, anticlines; converging arrows, synclines). Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Dashed green lines highlight continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed yellow line is seafloor multiple (echo of seafloor reflector). Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

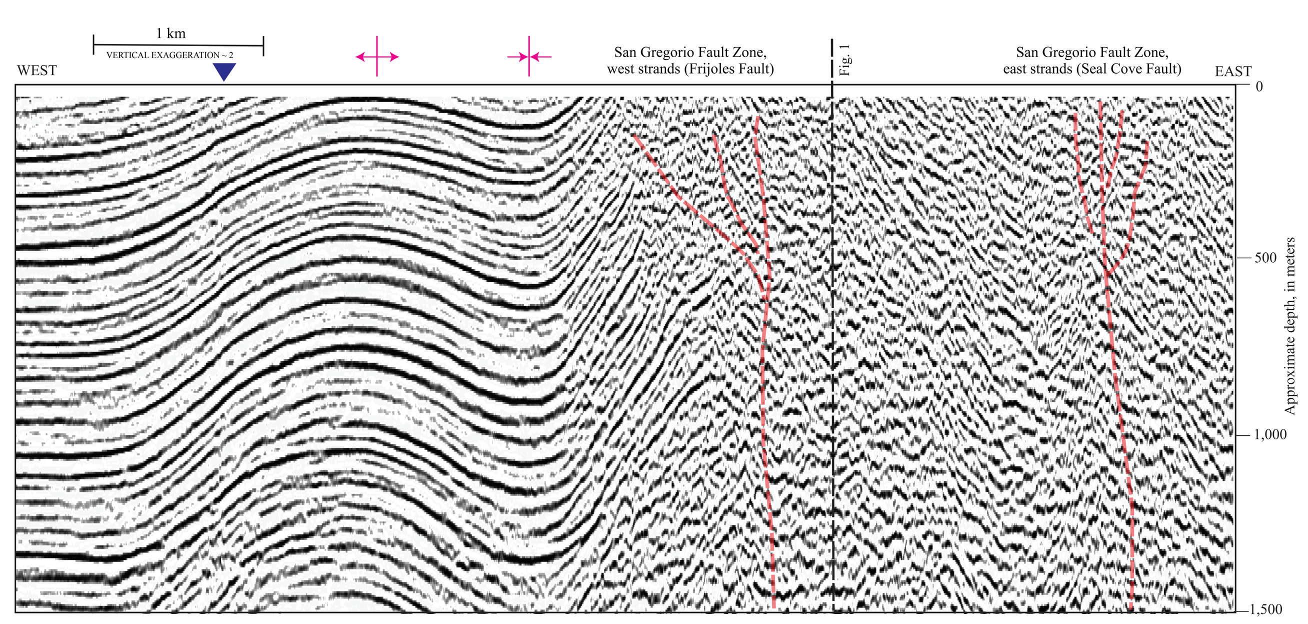


Figure 5. USGS migrated and depth-converted, multichannel seismic-reflection profile 128 (collected in 1995 on survey G–2–95–SF), which crosses shelf west of Point Montara, showing San Gregorio Fault Zone offshore of Point Montara (modified from Bruns and others, 2002); see trackline map for location. Dashed red lines show faults, including west (Frijoles Fault) and east (Seal Cove Fault) strands of San Gregorio Fault Zone. Both west (Frijoles Fault) and east (Seal Cove Fault) strands of fault system form positive flower structures with multiple splays. East strand (Seal Cove Fault) is also imaged as prominent lineation in high-resolution bathymetric data (see sheets 1, 2). Magenta symbols show fold axes (diverging arrows, anticline; converging arrows, syncline). Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

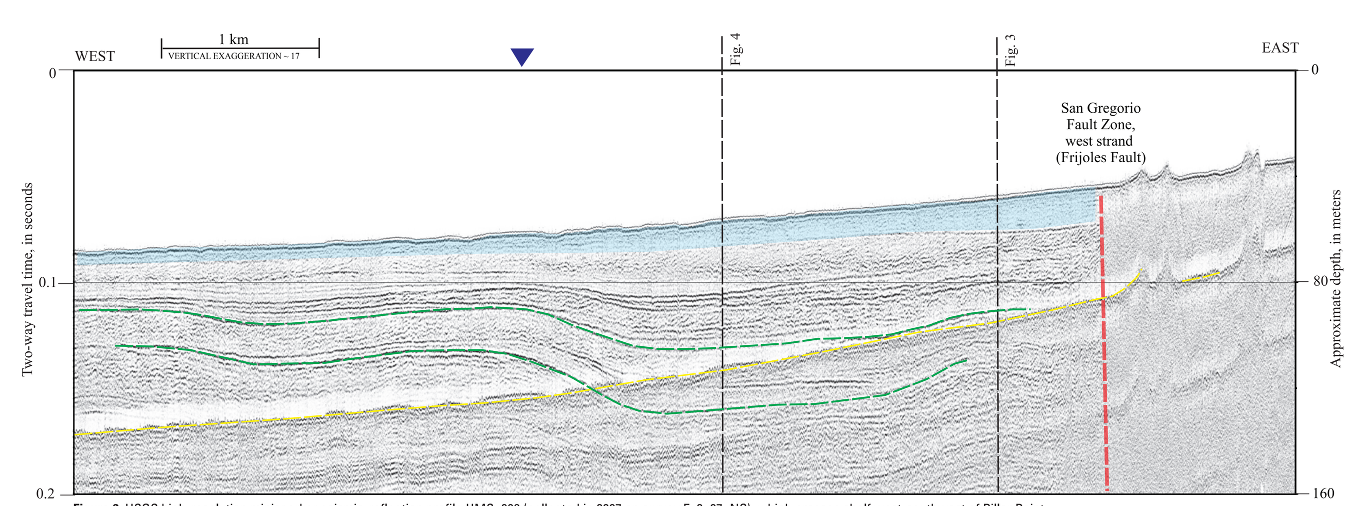


Figure 6. USGS high-resolution minisparker seismic-reflection profile HMS–006 (collected in 2007 on survey F–2–07–NC), which crosses shelf west-southwest of Pillar Point; see trackline map for location. Dashed red lines show faults, including west strand (Frijoles Fault) of San Gregorio Fault Zone. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Dashed green lines highlight continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed yellow line is seafloor multiple (echo of seafloor reflector). Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

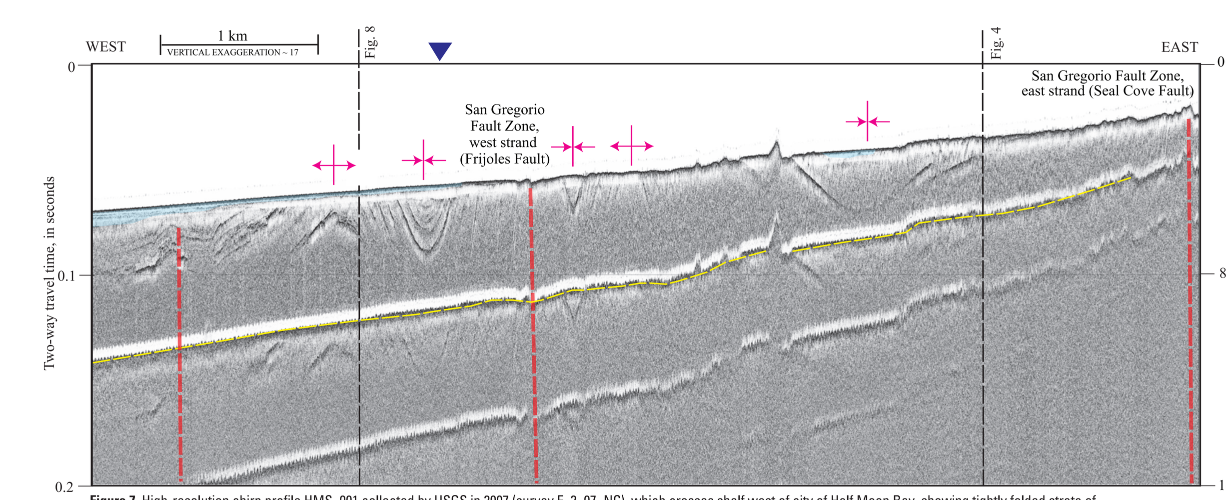


Figure 7. High-resolution chirp profile HMS–001 collected by USGS in 2007 (survey F–2–07–NC), which crosses shelf west of city of Half Moon Bay, showing tightly folded strata of Pliocene and upper Miocene Purisima Formation; see trackline map for location. Dashed red lines show faults, including west (Frijoles Fault) and east (Seal Cove Fault) strands of San Gregorio Fault Zone; faults are mapped primarily on basis of multibeam bathymetric data (see sheets 1, 2) but also by comparison with adjacent seismic-reflection profiles (see trackline map) on which more sediment is present. Magenta symbols show fold axes (diverging arrows, anticlines; converging arrows, synclines). Blue shading shows local, typically very thin sediment cover, inferred to represent uppermost Pleistocene and Holocene strata deposited since last sea-level lowstand about 21,000 years ago. Dashed yellow line is seafloor multiple (echo of seafloor reflector). Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

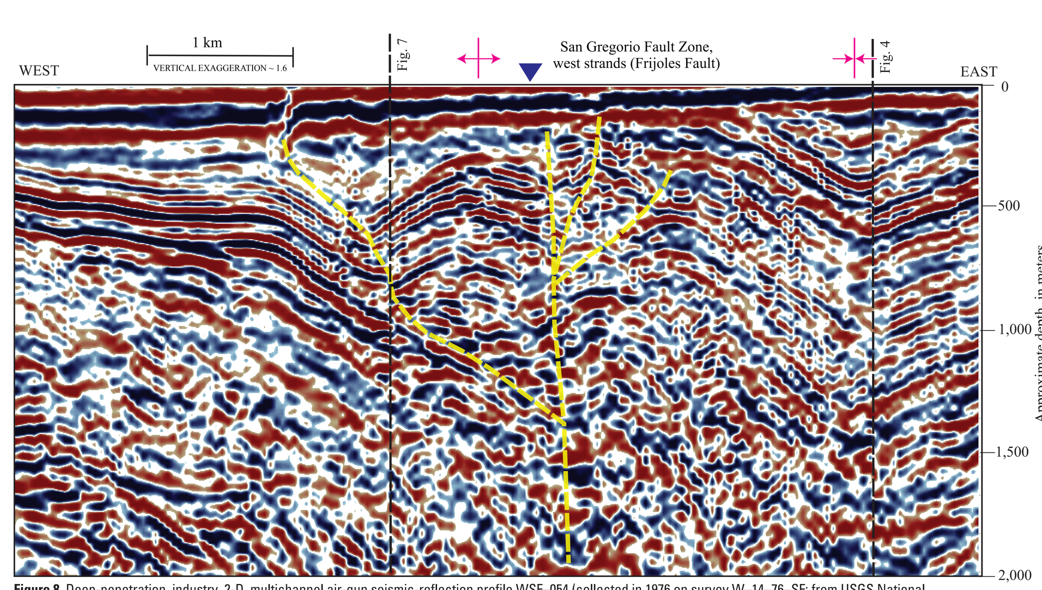


Figure 8. Deep-penetration, industry, 2-D, multichannel air-gun seismic-reflection profile WSF–054 (collected in 1976 on survey W–14–76–SF; from USGS National Archive of Marine Seismic Surveys [U.S. Geological Survey, 2009]), which crosses shelf west of city of Half Moon Bay; see trackline map for location. Dashed yellow lines show west strand (Frijoles Fault) of San Gregorio Fault Zone, imaged as complex positive flower structure. Magenta symbols show fold axes (diverging arrows, anticline; converging arrows, syncline). Local Tertiary sedimentary basin that contains at least 2 km of sediment is imaged east of fault zone. Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

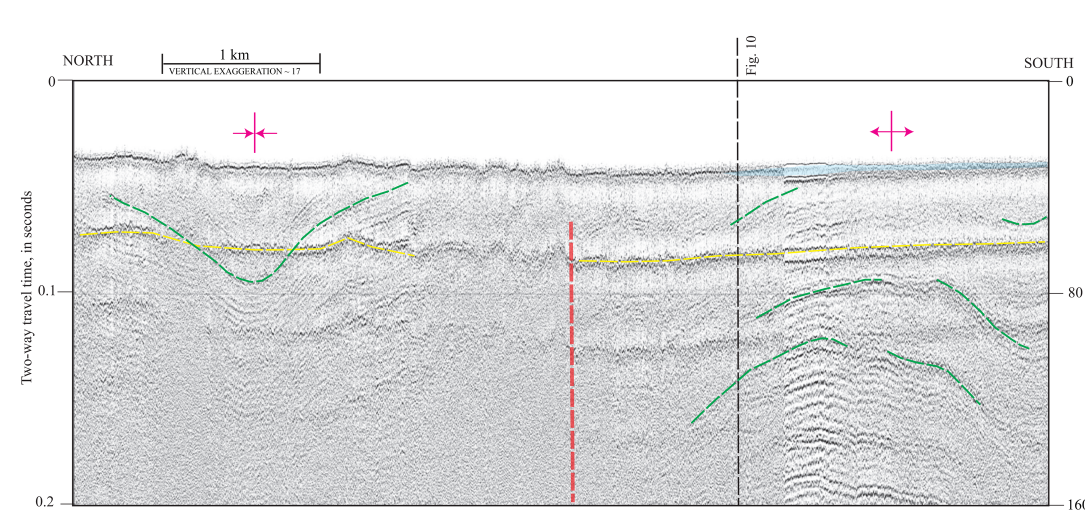


Figure 9. USGS high-resolution minisparker seismic-reflection profile HMS–036E (collected in 2007 on survey F–2–07–NC), which crosses shelf west and south of city of Half Moon Bay; see trackline map for location. Profile is subparallel to, and lies between, west (Frijoles Fault) and east (Seal Cove Fault) strands of San Gregorio Fault Zone. Dashed red line shows inferred fault. Magenta symbols show fold axes (diverging arrows, anticline; converging arrows, syncline). Blue shading shows local, very thin sediment cover, inferred to represent uppermost Pleistocene and Holocene strata deposited since last sea-level lowstand about 21,000 years ago. Dashed green lines highlight continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed yellow line is seafloor multiple (echo of seafloor reflector).

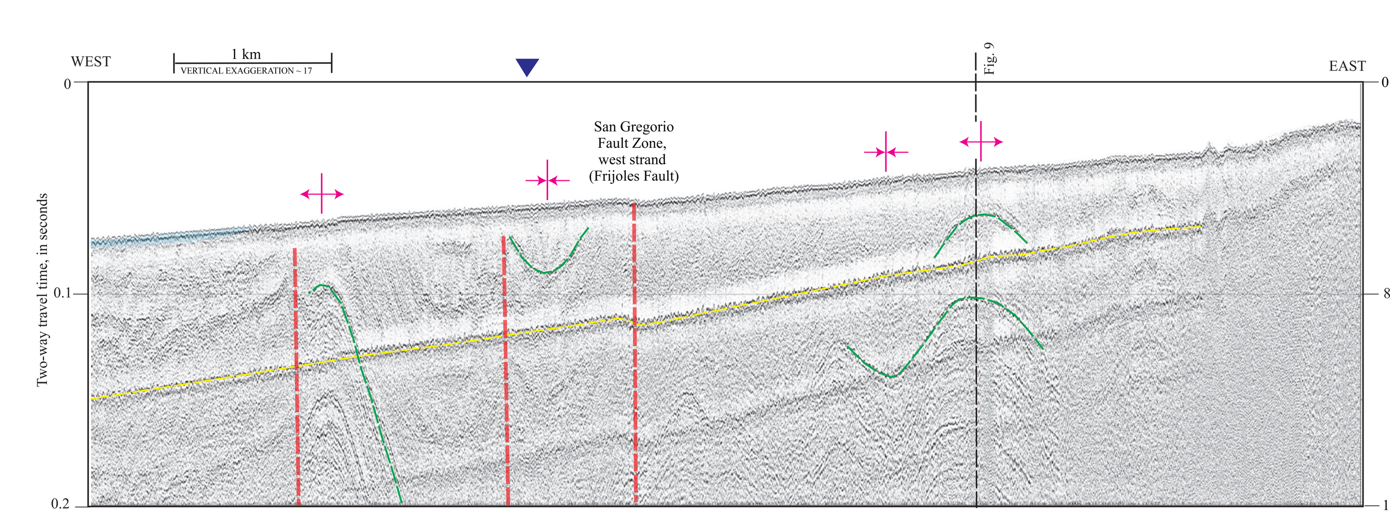


Figure 10. USGS high-resolution minisparker seismic-reflection profile HMS–034 (collected in 2007 on survey F–2–07–NC), which crosses shelf south-southwest of city of Half Moon Bay; see trackline map for location. Dashed red lines show faults, including west strand (Frijoles Fault) of San Gregorio Fault Zone. Magenta symbols show fold axes (diverging arrows, anticlines; converging arrows, synclines). Blue shading (west end of profile) shows local, very thin sediment cover, inferred to represent uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Dashed green lines highlight continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed yellow line is seafloor multiple (echo of seafloor reflector). Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

DISCUSSION

This map sheet shows seismic-reflection profiles from four different surveys of the Offshore of Half Moon Bay map area, providing imagery of the subsurface geology. This map area is largely characterized by a shallow (less than 50 m) bedrock platform that is overlain locally by thin sediment cover. The seismic-reflection profiles provide the data for interpreting subbottom stratigraphy, sediment thickness, and geologic structure (see sheets 9, 10 of this report).

The Offshore of Half Moon Bay map area straddles the right-lateral San Gregorio Fault, an important structure in the distributed transform boundary between the North American and Pacific plates (see, for example, Dickinson and others, 2005). This fault is part of a predominantly offshore, regional fault system that extends for about 400 km, from Point Conception in the south (where it is known as the Hosgri Fault) to Bolinas and Point Reyes in the north. The fault continues onland at coastal promontories such as Pillar Point (in this map area) and Pescadero Point (13 km south of the map area) (see sheet 9; see also, Weber and Lajoie, 1980; Brabb and others, 1998). Offshore parts of this fault system are identified on seismic-reflection profiles by the abrupt truncation or warping of reflections and (or) the juxtaposition of reflection panels that have differing seismic parameters, such as reflection presence, amplitude, frequency, geometry, continuity, and vertical sequence.

In the Offshore of Half Moon Bay map area, the San Gregorio Fault forms a distributed, 2- to 5-km-wide shear zone that narrows northward and includes two main fault strands (see sheets 9, 10). The nearshore east strand (figs. 3, 5), also known as the "Seal Cove Fault" or "Coastways Fault," forms a prominent bathymetric scarp (see sheets 1, 2). Weber (1990), Weber and others (1995), and Simpson and others (1997) suggested a dextral slip rate of 3.5 to 4.5 mm/yr for the onland part of the Seal Cove Fault on the basis of displacement of onshore marine-terrace shoreline angles and offset alluvial fan paleochannels. This estimated rate represents a minimum for the San Gregorio Fault system because the offshore west strand (also known as the "Frijoles Fault;" see figs. 1, 2, 3, 4, 5, 6, 7, 8, 10) also is active. Cumulative lateral slip on this fault zone is thought to range from 4 to 10 mm/yr in this area (U.S. Geological Survey and California Geological Survey, 2010).

Several high-resolution seismic profiles show an upper unit (blue shading in profiles; figs. 1, 2, 3, 4, 6, 9, 10) that is inferred to have been deposited in about the last about 21,000 years during the latest Pleistocene and Holocene post–Last Glacial Maximum sea-level rise. These deposits typically are characterized either by "acoustic transparency" or by parallel, low-amplitude, low- to high-frequency, continuous to moderately continuous, diffuse reflections (terminology from Mitchum and others, 1977); this seismic "facies" is attributable to the inferred uniform grain size caused by wave winnowing, which results in the general lack of acoustic-impedance contrasts needed to yield seismic reflections. This unit has its maximum thickness (about 12 m) in the northern part of the map area (figs. 1, 2; see also, sheet 9). The contact with underlying units is a commonly planar, transgressive surface of erosion that is marked by a distinct downward change to a section characterized by moderate- to high-amplitude, variably continuous, parallel to subparallel, folded and faulted reflections.

Except for the profiles in figures 3, 5, and 8, all profiles displayed on this map sheet were collected in 2007 on U.S. Geological Survey (USGS) cruise F–2–07–NC. Single-channel seismic-reflection data were acquired using two different sources, the SIG 2Mille minisparker (figs. 1, 2, 4, 6, 9, 10) and the EdgeTech 512 chirp (fig. 7). The SIG minisparker system used a 500-J high-voltage electrical discharge fired 1 to 4 times per second, which, at normal survey speed of 4 to 4.5 nautical miles per hour, gives a data trace every 0.5 to 2.0 meters. The data were digitally recorded in standard SEG-Y 32-bit floating-point format, using PC-based Triton Subbottom Logger (SBL) software that merges seismic-reflection data with differential GPS-navigation data. The EdgeTech 512 chirp subbottom-profiling system consists of a source transducer and an array of receiving hydrophones housed in a 500-lb fish towed at a depth of several meters below the sea surface. The swept-frequency chirp source signal was 500 to 4,500 Hz and 50 ms in length, and it was recorded by hydrophones located on the bottom of the fish. After the survey, a short-window (20 ms) automatic gain control algorithm was applied to both the chirp and minisparker data, and a 160- to 1,200-Hz bandpass filter was applied to the minisparker data.

Figure 3 shows a seismic-reflection profile collected in 1997 on USGS cruise J–1–97–MB, using a 0.40- to 5-kHz Geopulse system. Power was supplied by a double-plate, 910-J sound source fired at 0.5-second intervals. As with the minisparker and chirp systems, data were digitally recorded and merged with GPS navigation data.

Figure 5 shows a depth-converted, multichannel seismic-reflection profile collected in 1995 on USGS cruise G–2–95–SF (Childs and others, 2000; Bruns and others, 2002). Two 0.65-L air guns fired at 12.5-m intervals provided the seismic source, and data were digitally recorded on a 24-channel, 150-m-long streamer merged with GPS navigation data. Data-processing steps included deconvolution, automatic gain control, filtering at 50 to 160 Hz, stacking, and migration.

Figure 8 shows a deep-penetration, depth-converted, multichannel seismic-reflection profile collected in 1976 by WesternGeco on cruise W–14–76–SF. This profile and other similar data were collected in many areas offshore of California in the 1970s and 1980s when these areas were considered a frontier for oil and gas exploration. Much of these data have been publicly released and are now archived at the USGS National Archive of Marine Seismic Surveys (U.S. Geological Survey, 2009). These data were acquired with a large-volume air-gun source that has a frequency range of 3 to 40 Hz and recorded with a multichannel hydrophone streamer about 2 km long; shot spacing was about 30 m. These data can resolve geologic features that are 20 to 30 m thick, down to subbottom depths of about 4 km.

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Seismic-Reflection Profiles, Offshore of Half Moon Bay Map Area, California

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2014

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