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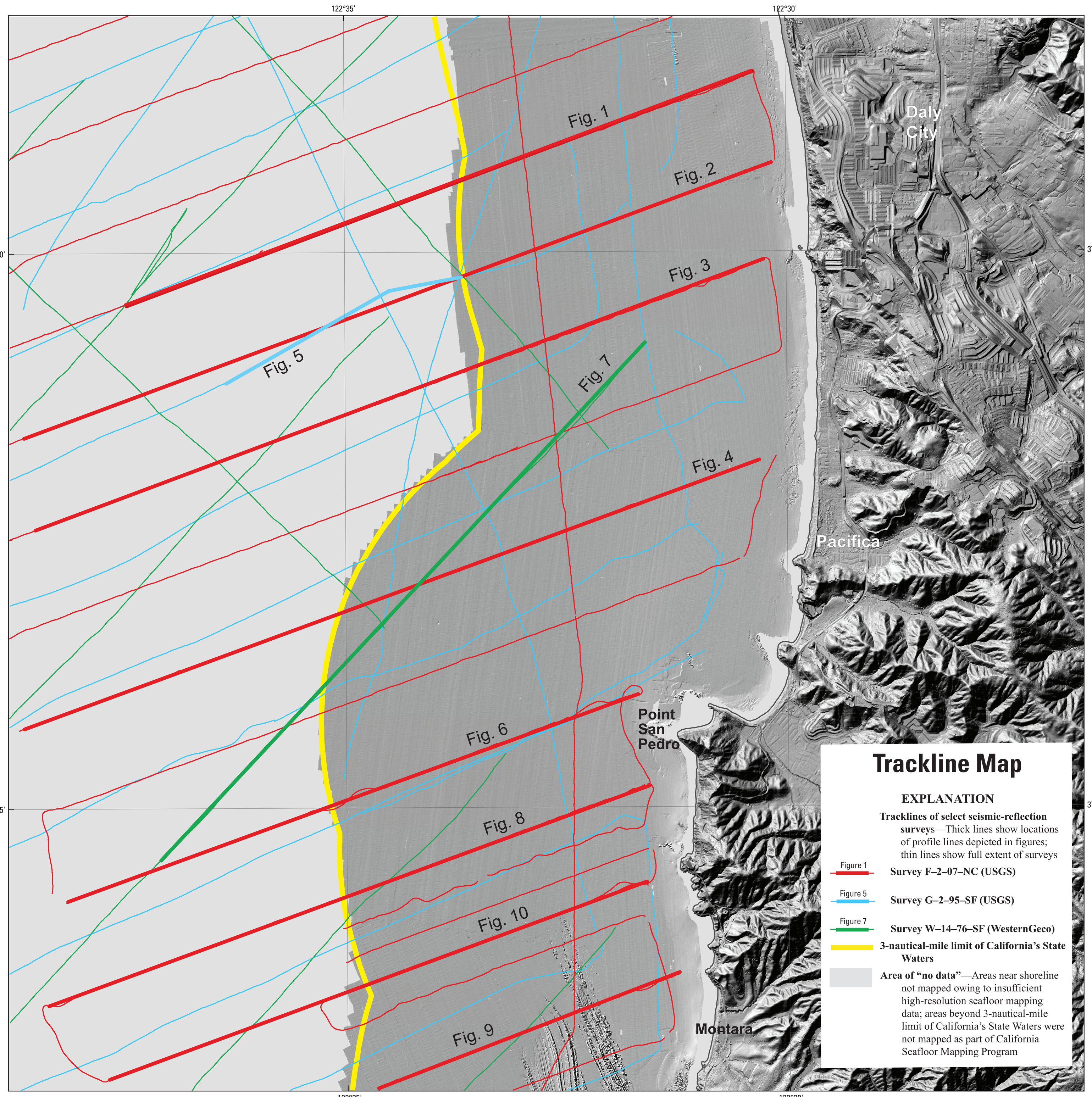
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2014–1260
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

APPROXIMATE MEAN DECLINATION, 2014

SCALE 1:50 000
ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

GIS database and digital cartography by Eleyne L. Phillips and Florence L. Wong
Manuscript approved for publication December 22, 2014

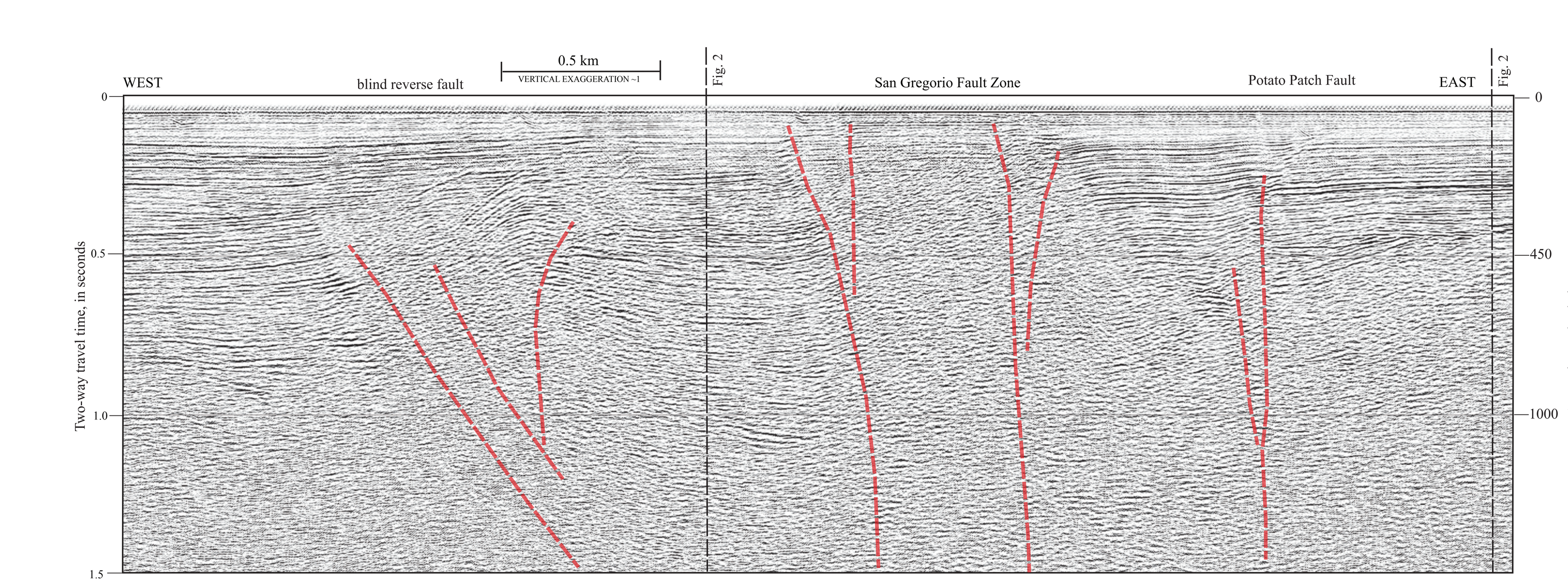


Figure 5. USGS migrated, multichannel seismic-reflection profile G111 (collected in 1995 on survey G–2–95–SF), which crosses shelf west-southwest of Daly City; see trackline map for location. Dashed red lines show faults. San Gregorio Fault Zone is imaged as two primary strands, less than 0.5 km apart. West (to left) of San Gregorio Fault Zone, folds are imaged above blind (that is, it does not reach surface) reverse fault zone; fault is probably inactive because seafloor and shallow sediments above fault are flat lying.

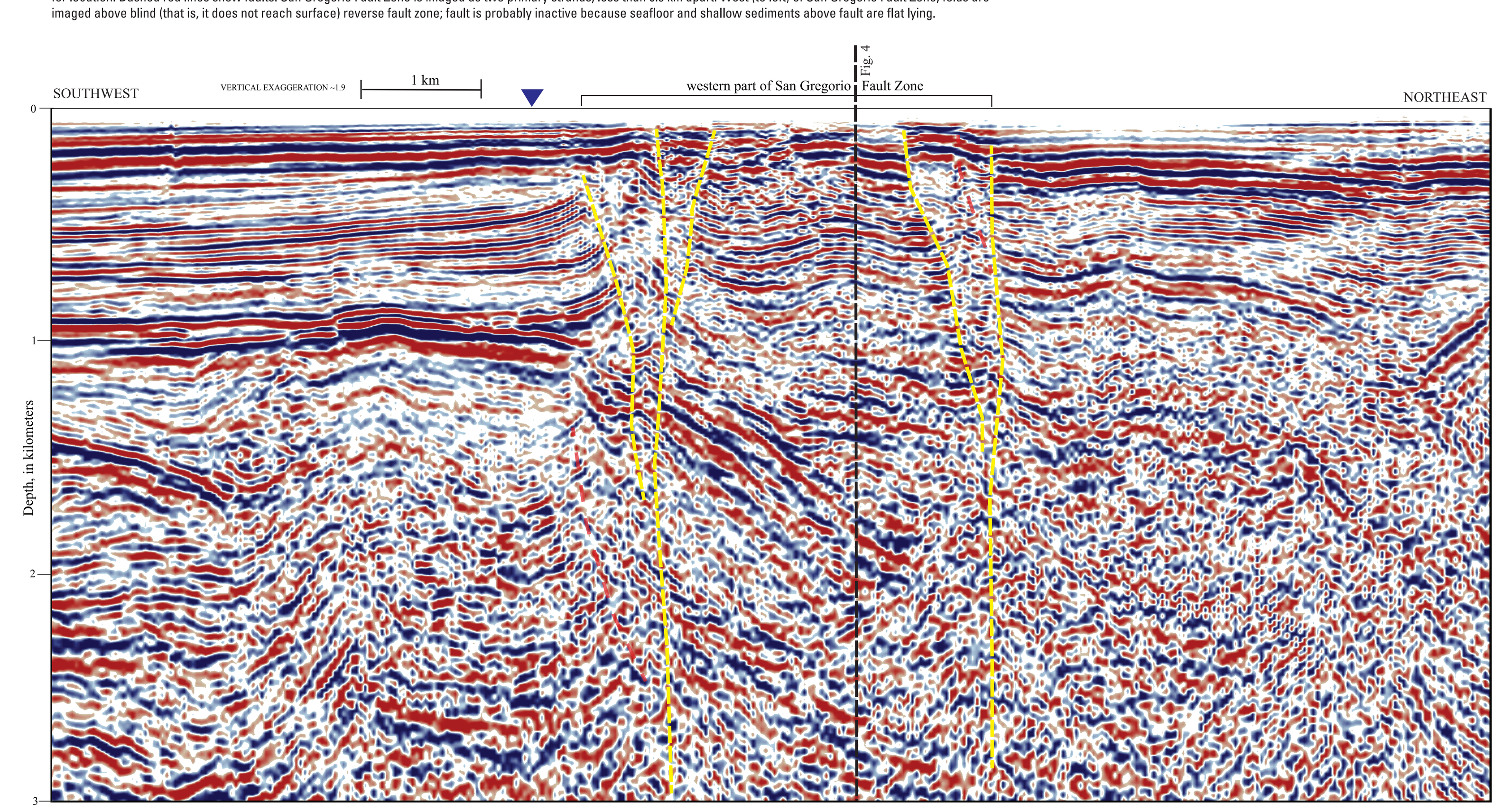


Figure 7. Migrated and depth-converted, deep-penetration, multichannel seismic-reflection profile WSF–062 (collected in 1976 on WesternGeco survey W–14–76–SF; from USGS National Archive of Marine Seismic Surveys [U.S. Geological Survey, 2009]), which crosses shelf offshore of Pacifica; see trackline map for location. Dashed yellow lines show western part of San Gregorio Fault Zone, which is imaged as two complex positive flower structures. Depth conversion performed using rock-velocity model derived from stacking velocities; vertical exaggeration, about 1.9:1. Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

Figure 1. USGS high-resolution minisparker seismic-reflection profile HMS–21A (collected in 2007 on survey F–2–07–NC), which crosses shelf west of Daly City; see trackline map for location. Dashed red lines show faults. San Andreas Fault is imaged on east end of profile. Potato Patch Fault lies about 1 km east of complex San Gregorio Fault Zone. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Upper unit unconformably overlies older sequence, which continues to base of profile, that is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections. 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).

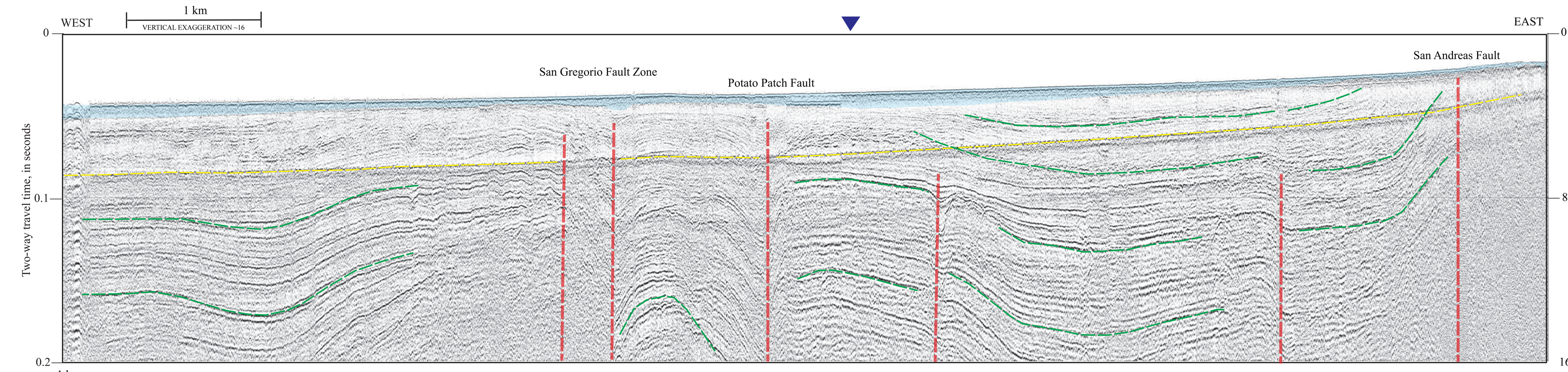


Figure 2. USGS high-resolution minisparker seismic-reflection profile HMS–020 (collected in 2007 on survey F–2–07–NC), which crosses shelf west-southwest of Daly City; see trackline map for location. Dashed red lines show faults. San Gregorio Fault Zone is less than 1 km wide. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Upper unit unconformably overlies older sequence, which continues to base of profile, that is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections. 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).

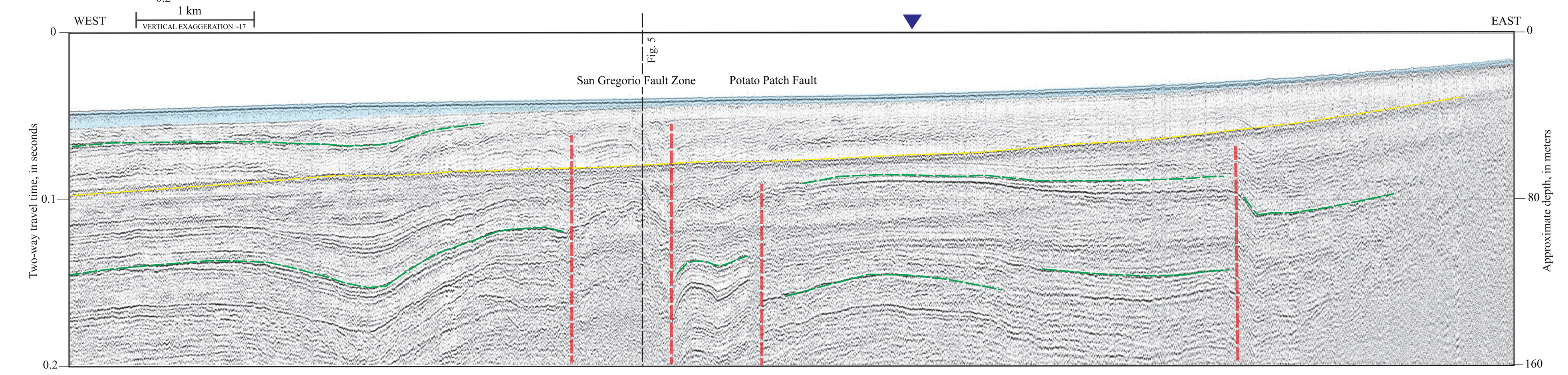


Figure 3. USGS high-resolution minisparker seismic-reflection profile HMS–019 (collected in 2007 on survey F–2–07–NC), which crosses shelf southwest of Daly City; see trackline map for location. Dashed red lines show faults. San Gregorio Fault Zone is characterized by two main strands, about 1 km apart. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Upper unit unconformably overlies older sequence, which continues to base of profile, that is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections. 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).

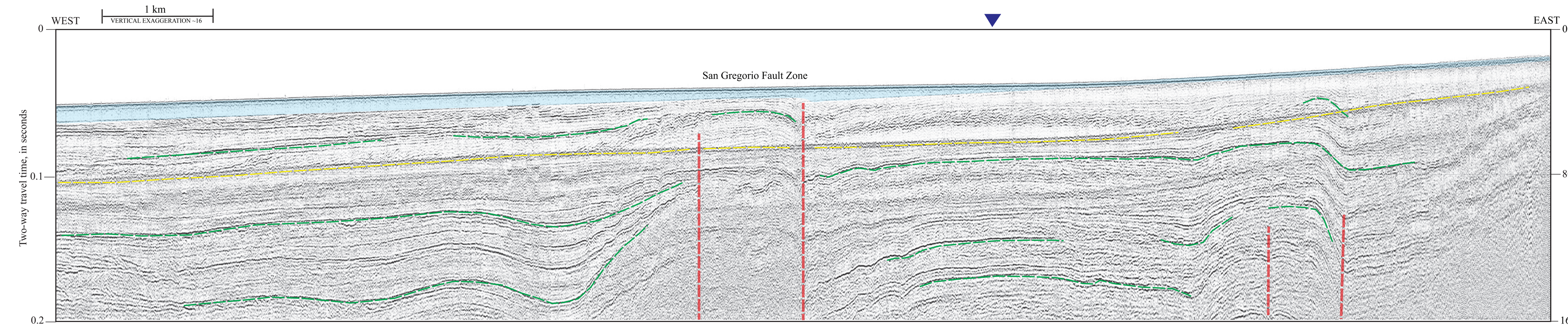


Figure 4. USGS high-resolution minisparker seismic-reflection profile HMS–017 (collected in 2007 on survey F–2–07–NC), which crosses shelf west of Pacifica; see trackline map for location. Dashed red lines show faults. San Gregorio Fault Zone is characterized by two main strands, about 2 km apart. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Upper unit unconformably overlies older sequence, which continues to base of profile, that is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections. 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).

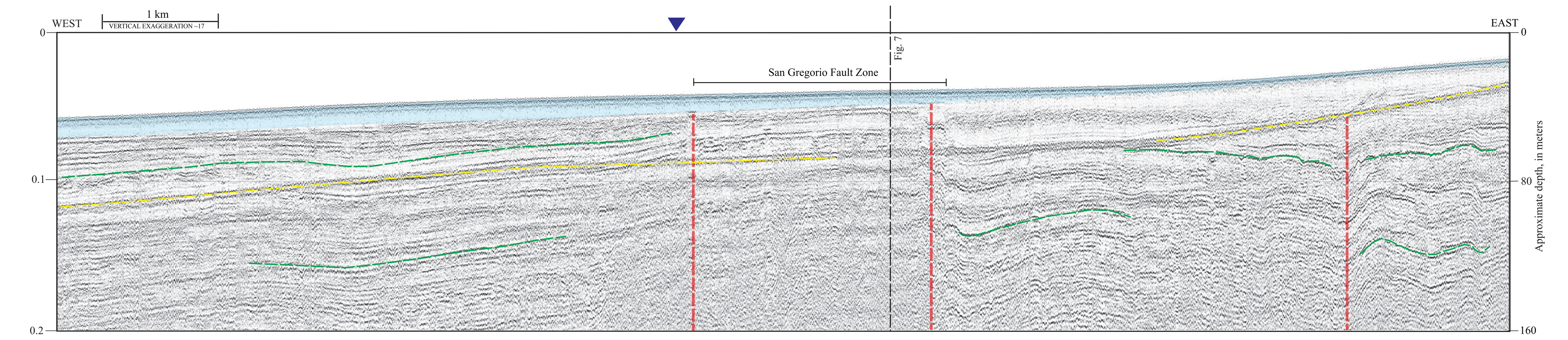


Figure 6. USGS high-resolution minisparker seismic-reflection profile HMS–015 (collected in 2007 on survey F–2–07–NC), which crosses shelf west of Point San Pedro; see trackline map for location. Dashed red lines show faults. San Gregorio Fault Zone is characterized by two main strands, about 1.8 km apart. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Upper unit unconformably overlies older sequence, which continues to base of profile, that is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections. 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).

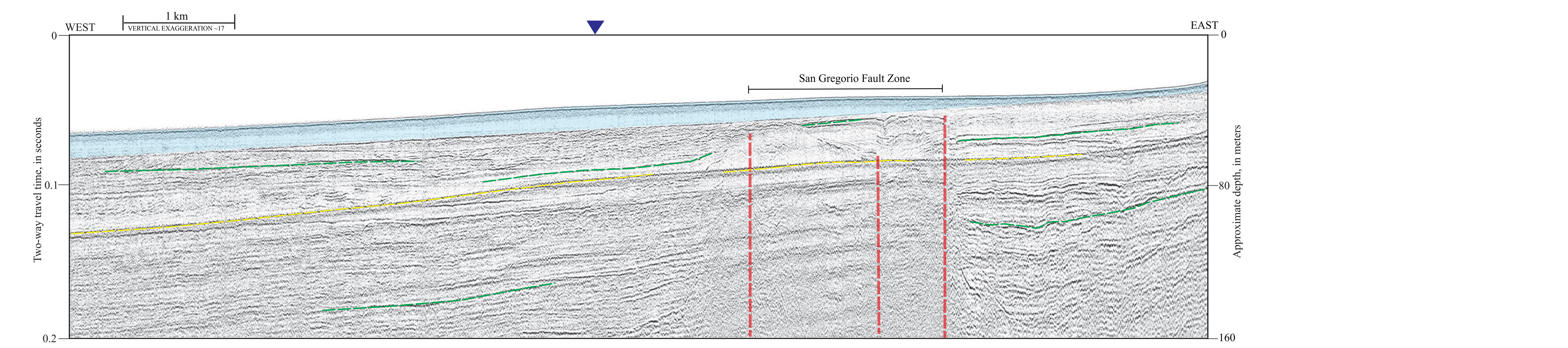


Figure 8. USGS high-resolution minisparker seismic-reflection profile HMS–014 (collected in 2007 on survey F–2–07–NC), which crosses shelf southwest of Point San Pedro; see trackline map for location. Dashed red lines show faults. San Gregorio Fault Zone is characterized by two main strands, about 1.8 km apart. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Upper unit unconformably overlies older sequence, which continues to base of profile, that is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections. 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).

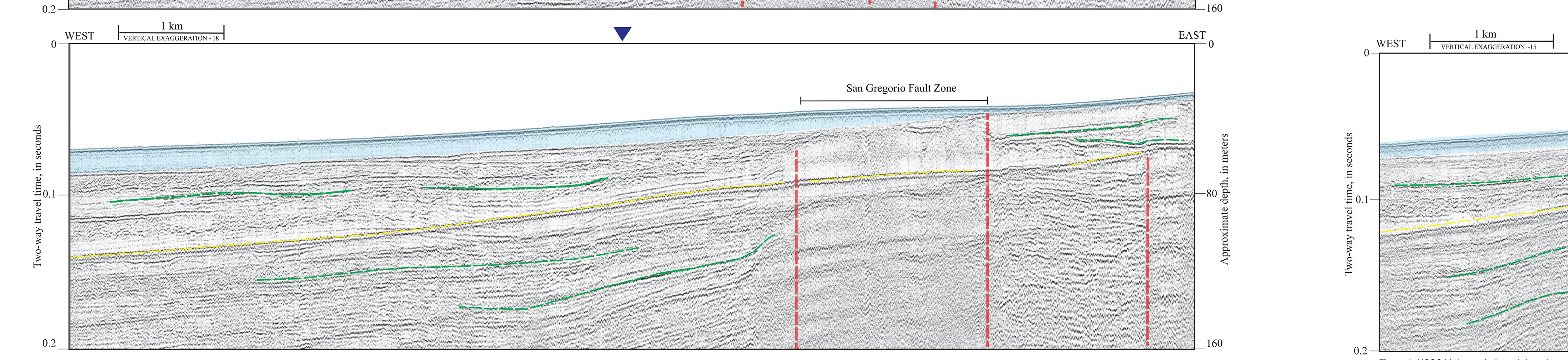
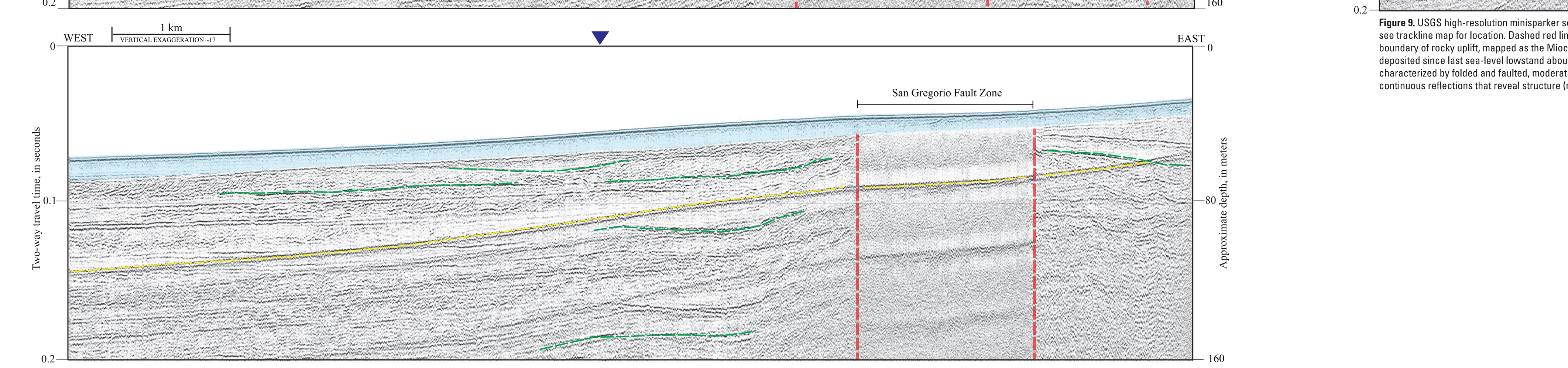


Figure 10. USGS high-resolution minisparker seismic-reflection profile HMS–013 (collected in 2007 on survey F–2–07–NC), which crosses shelf northwest of Montara; see trackline map for location. Dashed red lines show faults. San Gregorio Fault Zone is characterized by two main strands, about 1.5 km apart. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Upper unit unconformably overlies older sequence, which continues to base of profile, that is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections. 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).



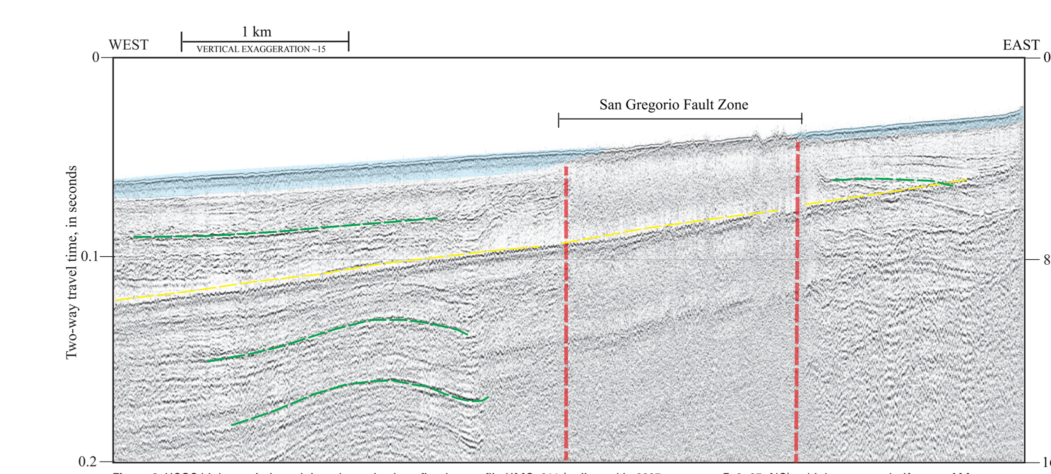
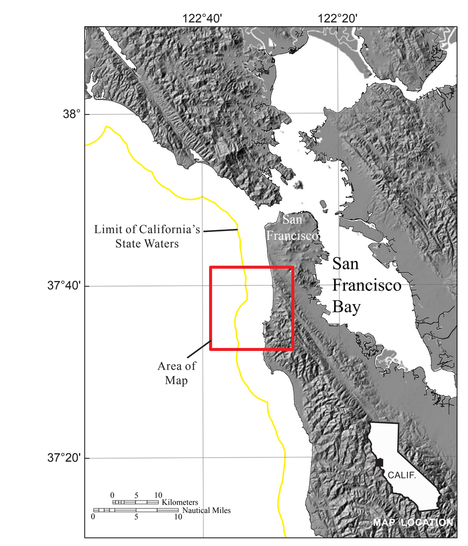


Figure 9. USGS high-resolution minisparker seismic-reflection profile HMS–011 (collected in 2007 on survey F–2–07–NC), which crosses shelf west of Montara; see trackline map for location. Dashed red lines show faults. San Gregorio Fault Zone is characterized by two main strands, about 1.4 km apart; east strand forms boundary of rocky uplift, mapped as the Miocene and Pliocene Purisima Formation. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Upper unit unconformably overlies older sequence, which continues to base of profile, that is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections. Dashed green lines highlight continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed yellow line is seafloor multiple (echo of seafloor reflector).



DISCUSSION

This map sheet shows seismic-reflection profiles from three different surveys of the Offshore of Pacifica map area, providing imagery of the subsurface geology. This map area is largely characterized by a shallow (less than 40 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 Pacifica map area, which straddles the right-lateral transform boundary between the North American and Pacific plates, is cut by several active northwest-striking faults; these include the San Andreas Fault, two major strands of the San Gregorio Fault Zone, and the Potato Patch Fault (see Map E on sheet 9; see also, Bruns and others, 2002; Ryan and others, 2008). The offshore parts of these faults are identified on seismic-reflection profiles on the basis of 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.

The San Andreas Fault, which is the dominant plate-boundary structure, extends offshore near Mussel Rock, in the northern part of the map area. The San Andreas Fault in the map area has an estimated slip rate of 17 to 24 mm/yr (U.S. Geological Survey and California Geological Survey, 2010), and the devastating great 1906 California earthquake (M7.8) is thought to have nucleated on the San Andreas Fault offshore of San Francisco (Bolt, 1968; Lomax, 2005), a few kilometers north of the map area.

The San Gregorio Fault, another major strike-slip fault system within the distributed transform plate boundary, extends predominantly in the offshore 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 (Dickinson and others, 2005). Cumulative lateral slip on the San Gregorio Fault in this area is estimated to be about 4 to 10 mm/yr (U.S. Geological Survey and California Geological Survey, 2010). In the Offshore of Pacifica map area, the San Gregorio Fault forms a distributed shear zone in the offshore that includes two main faults, an east strand and a west strand, that are known onland to the south as the Seal Cove Fault and the Frijoles Fault, respectively (Weber and Lajoie, 1980; Brabb and others, 1998).

Several high-resolution seismic profiles show an upper unit (blue shading in profiles; figs. 1, 2, 3, 4, 6, 8, 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. The section generally is less than 13 m thick, and it generally thins from west to east (see 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.

Data for the seismic-reflection profiles shown in figures 1, 2, 3, 4, 6, 8, 9, and 10 were collected in 2007 on U.S. Geological Survey (USGS) cruise F–2–07–NC, using the SIG 2Mille minisparker system. The 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 Triton Subbottom Logger (SBL) software that merges seismic-reflection data with differential GPS-navigation data. After the survey, a short-window (20 ms) automatic gain control (AGC) algorithm and a 160- to 1,200-Hz bandpass filter were applied to the minisparker data.

Data for the seismic-reflection profile shown in figure 5 were 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, stacking, automatic gain control, filtering at 50 to 160 Hz, stacking, and migration.

Figure 7 shows a deep-penetration, migrated, 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 Pacifica Map Area, California

by

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2014

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