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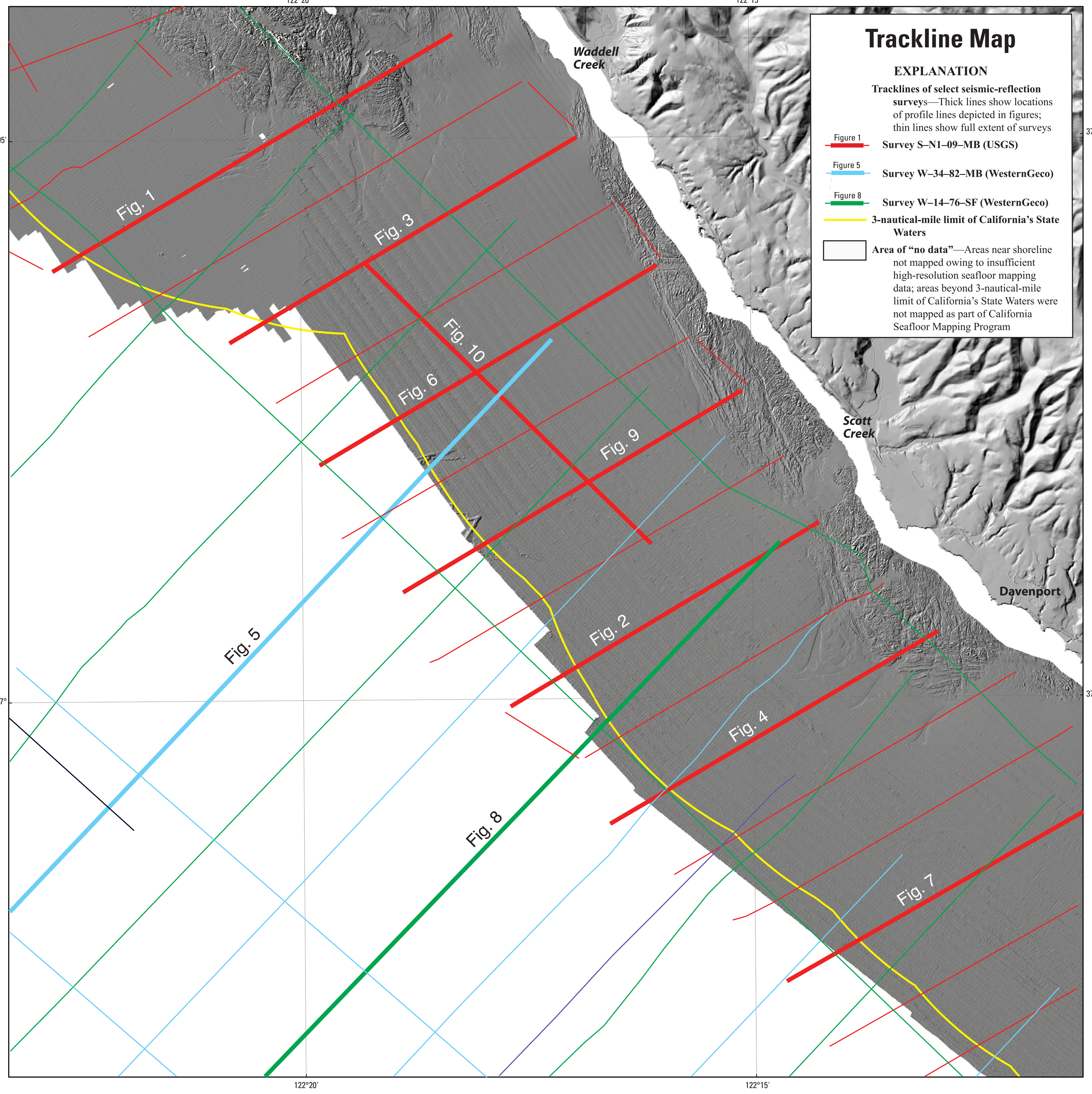
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2015–1191
Sheet 8 of 10
Pamphlet accompanies map



Onshore elevation data from California Coastal Conservancy (available from National Oceanic and Atmospheric Administration [NOAA] Coastal Service Center's Digital Coast 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

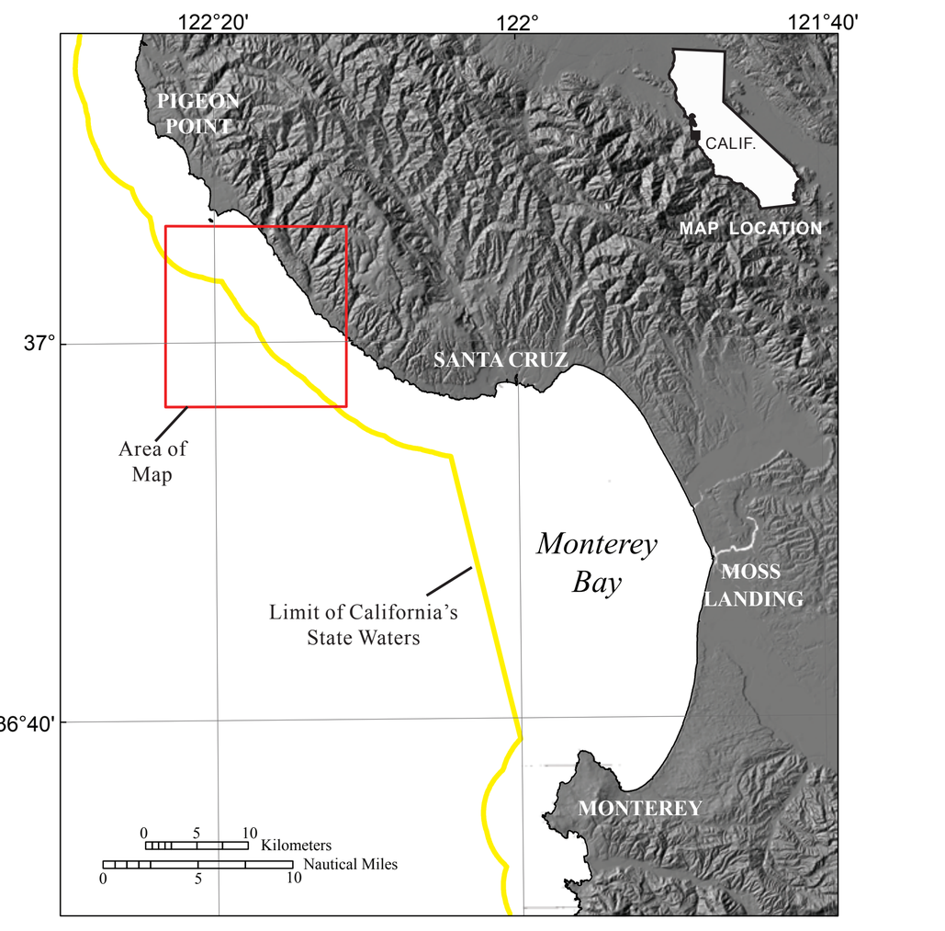
TRUE NORTH, MAGNETIC NORTH, 13½°
APPROXIMATE MEAN DECLINATION, 2015

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

MAP LOCATION

GIS database and digital cartography by Peter Dartnell and Stephen R. Hartwell

Manuscript approved for publication September 30, 2015



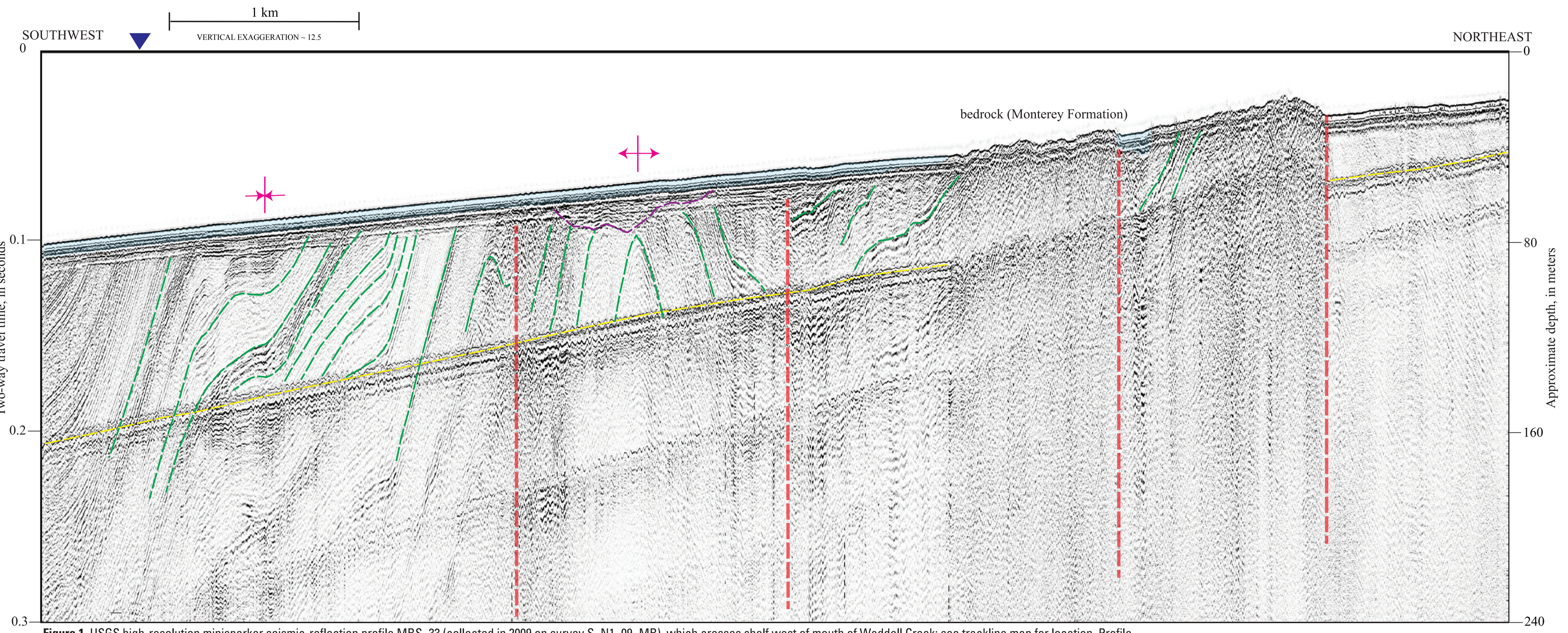


Figure 1. USGS high-resolution minisparker seismic-reflection profile MBS–33 (collected in 2009 on survey S–N1–09–MB), which crosses shelf west of mouth of Waddell Creek; see trackline map for location. Profile highlights faulted and folded strata beneath continental shelf, west of San Gregorio Fault Zone. Dashed red lines show faults. Magenta symbols show fold axes (diverging arrows, anticline; converging arrows, syncline). Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Underlying reflectors image deformed Neogene strata. Dashed purple line shows unconformity. Dashed green lines highlight some 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).

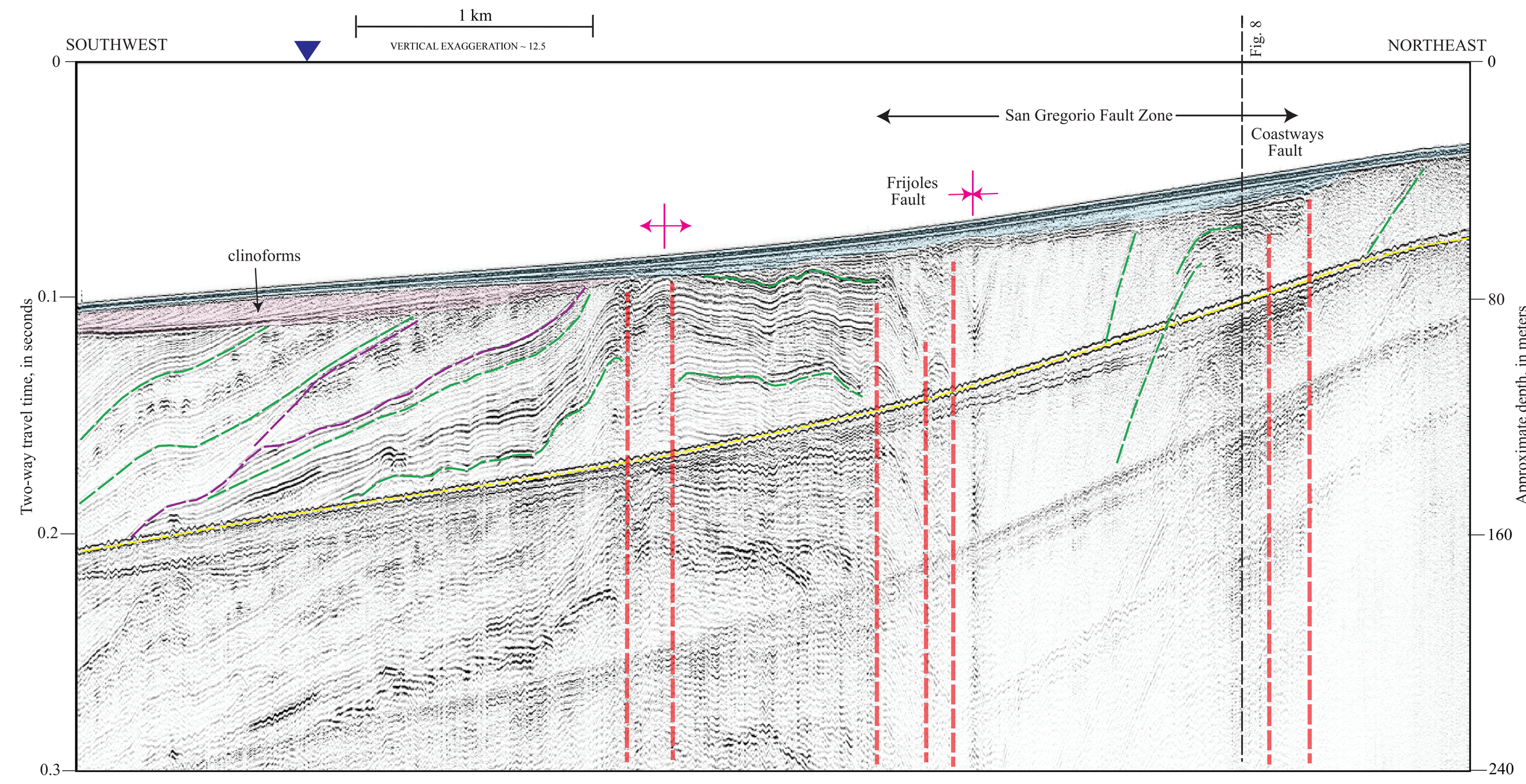


Figure 2. USGS high-resolution minisparker seismic-reflection profile MBS–30 (collected in 2009 on survey S–N1–09–MB), which crosses shelf west of mouth of Scott Creek; see trackline map for location. Profile highlights faulted and folded strata beneath continental shelf, including San Gregorio Fault Zone. Dashed red lines show faults. Magenta symbols show fold axes (diverging arrows, anticline; converging arrows, syncline). Blue and pink shading shows two units of inferred uppermost Pleistocene and Holocene strata, deposited in last about 30,000 years during final stages of sea-level fall and subsequent sea-level rise. Underlying reflectors are of inferred Neogene age. Dashed green lines highlight some continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed purple lines show unconformities. 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).

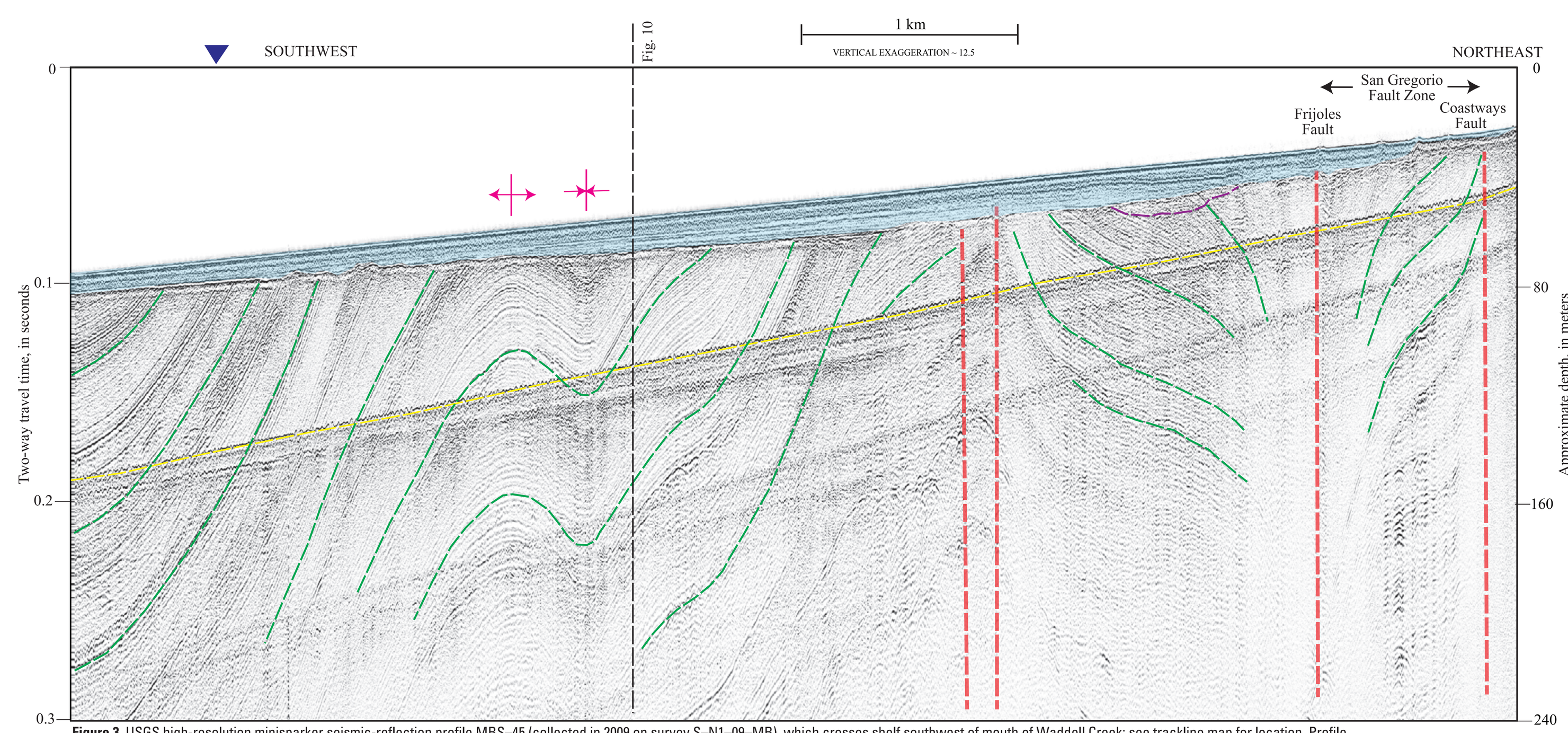


Figure 3. USGS high-resolution minisparker seismic-reflection profile MBS–45 (collected in 2009 on survey S–N1–09–MB), which crosses shelf southwest of mouth of Waddell Creek; see trackline map for location. Profile highlights faulted and folded strata beneath continental shelf, including San Gregorio Fault Zone. Dashed red lines show faults. Magenta symbols show fold axes (diverging arrows, anticline; converging arrows, syncline). Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Underlying reflectors are of inferred Neogene age. Dashed purple line shows unconformity. Dashed green lines highlight some 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).

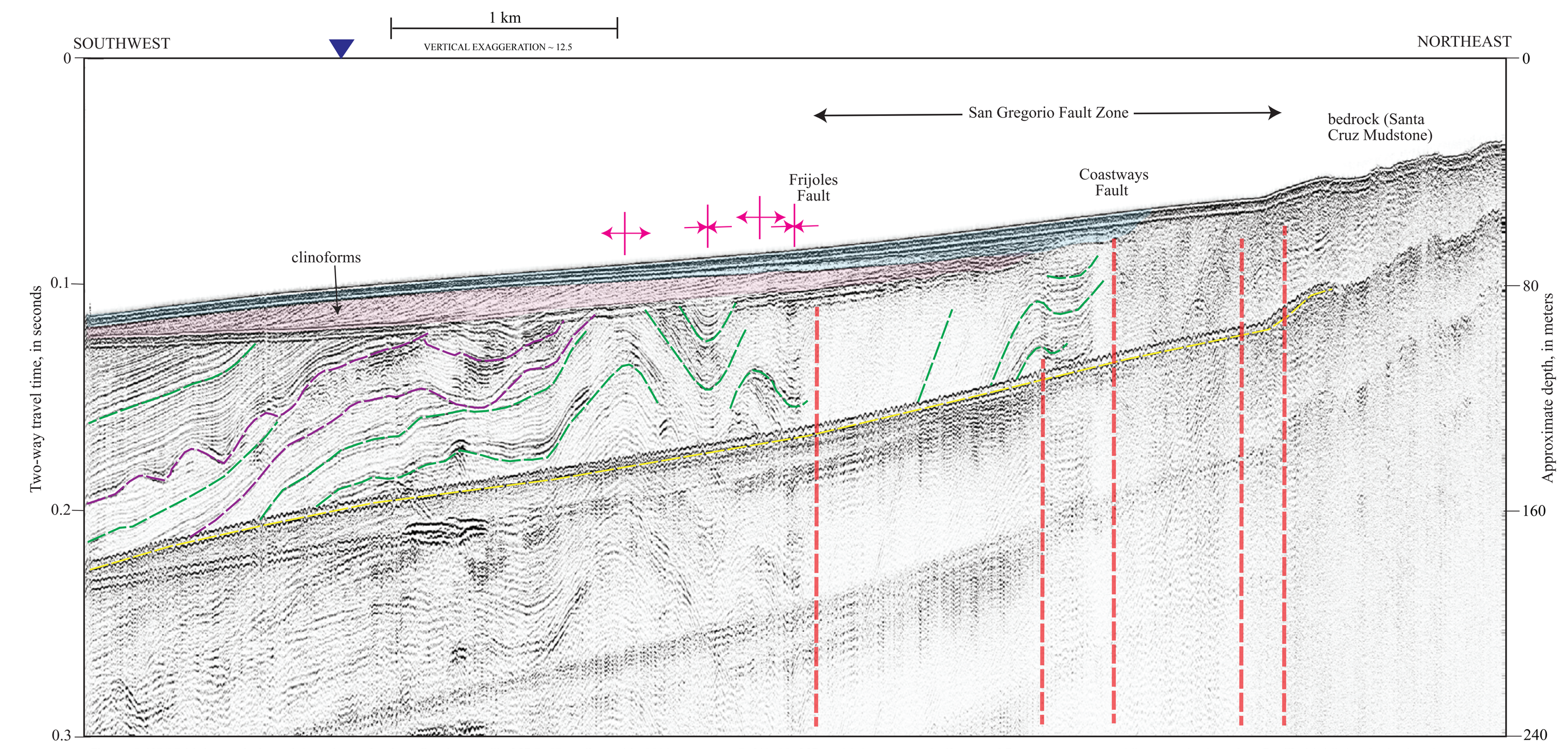


Figure 4. USGS high-resolution minisparker seismic-reflection profile MBS–25 (collected in 2009 on survey S–N1–09–MB), which crosses shelf west of Davenport; see trackline map for location. Profile highlights faulted and folded strata beneath continental shelf, including San Gregorio Fault Zone. Dashed red lines show faults. Magenta symbols show fold axes (diverging arrows, anticlines; converging arrows, synclines). Blue and pink shading shows inferred uppermost Pleistocene and Holocene strata, deposited in last about 30,000 years during final stages of sea-level fall and subsequent sea-level rise. Underlying reflectors are of inferred Neogene age. Dashed green lines highlight some continuous reflections that reveal structure (not distinctive stratigraphic markers). Dashed purple lines shows unconformities. 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).

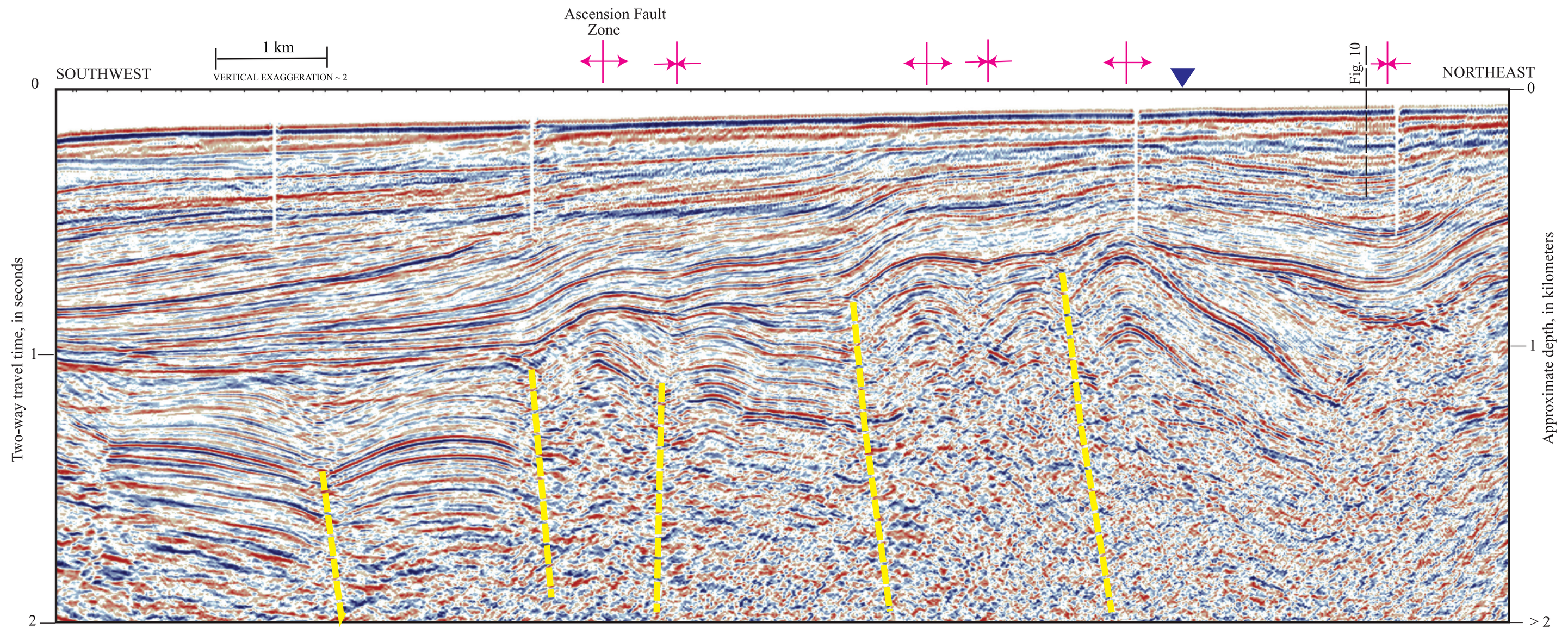


Figure 5. Migrated, deep-penetration industry, 2-D, multichannel air-gun seismic-reflection profile WS82–600 (collected in 1982 on survey W–34–82–MB; from USGS National Archive of Marine Seismic Surveys [U.S. Geological Survey, 2009]), which crosses shelf west-southwest of mouth of Scott Creek; see trackline map for location. Note that vertical scale and exaggeration are significantly different than that of high-resolution seismic-reflection profiles shown in figures 1, 2, 3, 4, 6, 7, 9, and 10. Dashed yellow lines show faults. Magenta symbols show fold axes (diverging arrows, anticlines; converging arrows, synclines). Profile highlights faults and folds beneath continental shelf west of nearby San Gregorio Fault Zone, including Ascension Fault Zone. Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

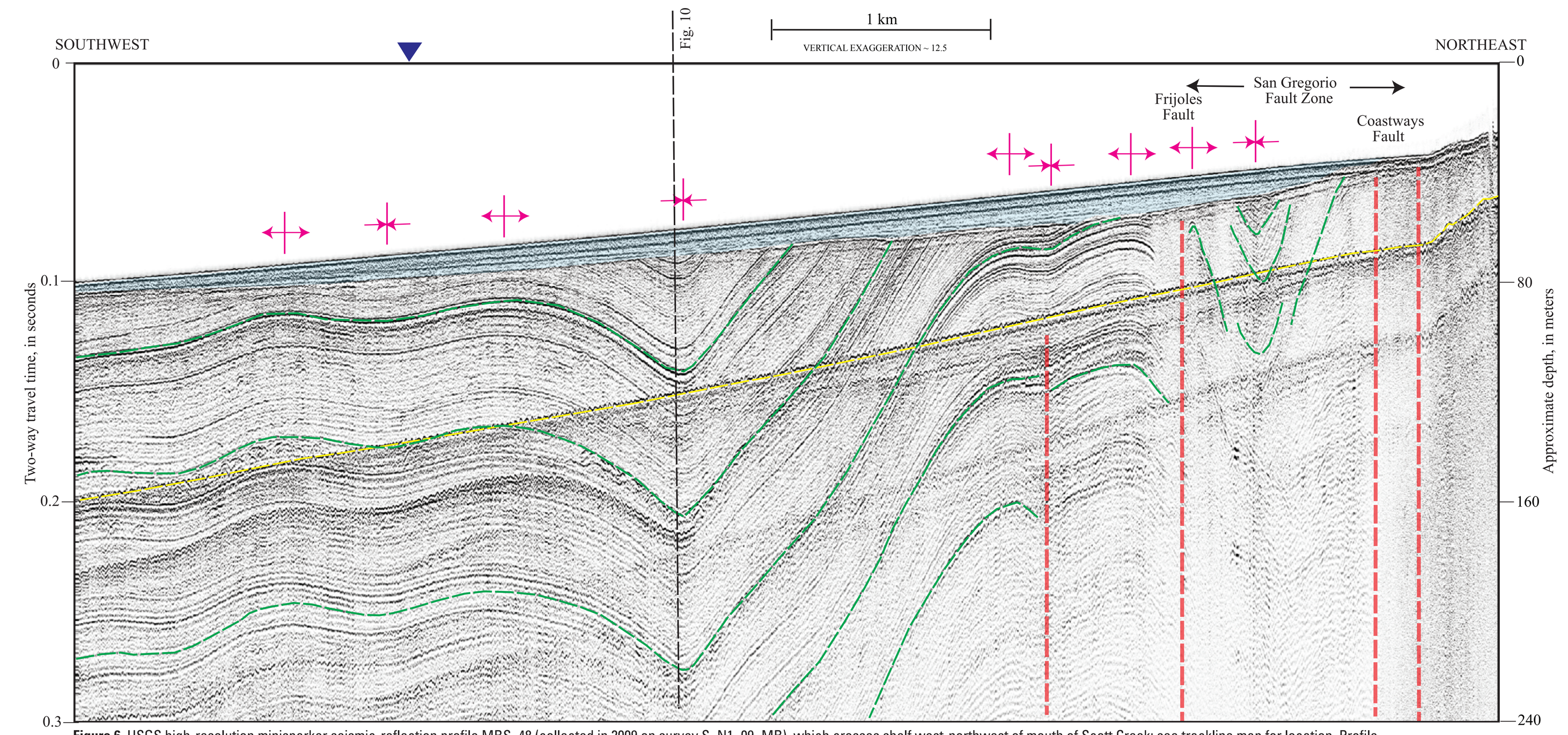


Figure 6. USGS high-resolution minisparker seismic-reflection profile MBS–48 (collected in 2009 on survey S–N1–09–MB), which crosses shelf west-northwest of mouth of Scott Creek; see trackline map for location. Profile highlights faulted and folded strata beneath continental shelf, including San Gregorio Fault Zone. Dashed red lines show faults. 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. Underlying reflectors are of inferred Neogene age. Dashed green lines highlight some 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).

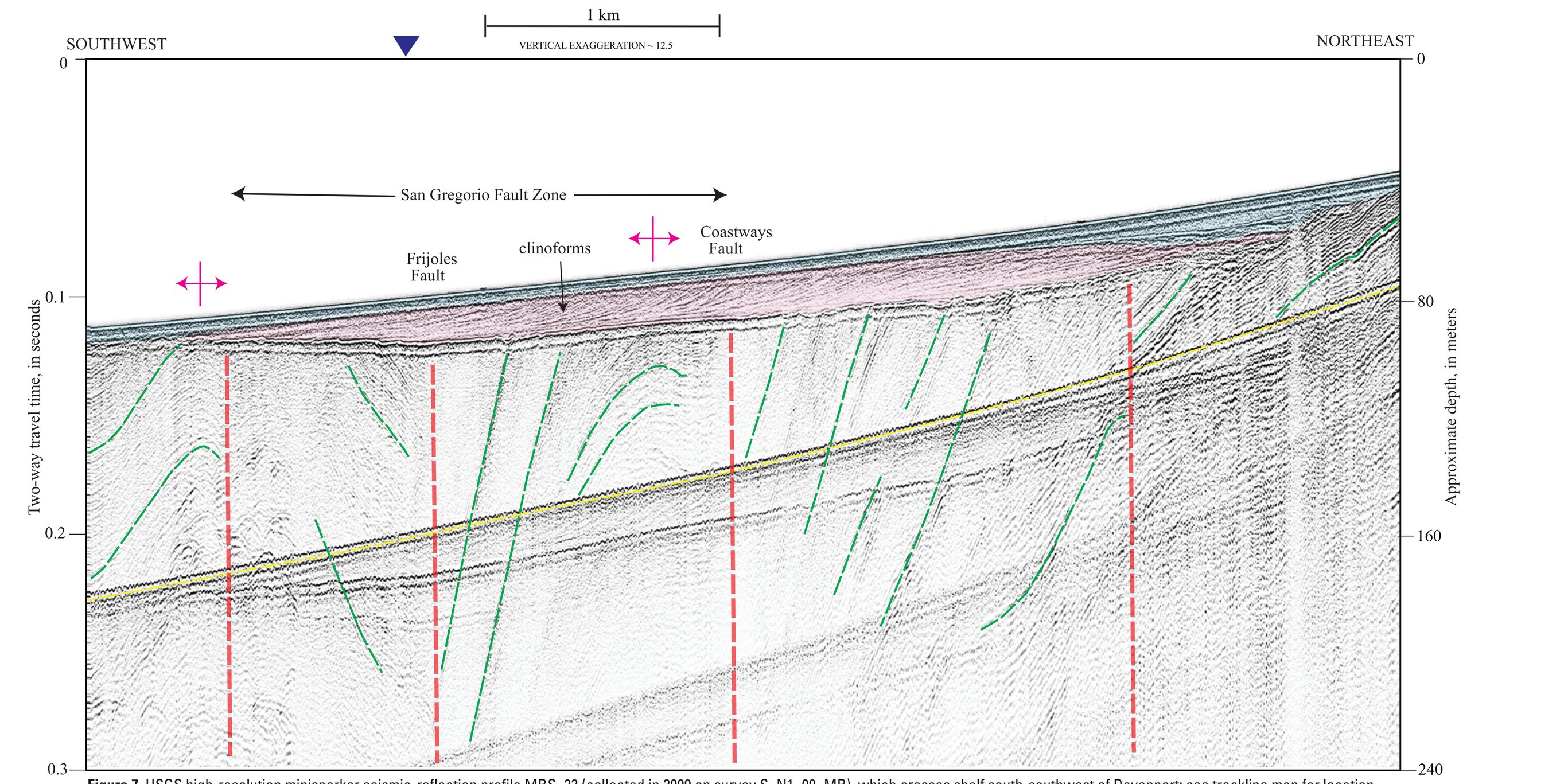


Figure 7. USGS high-resolution minisparker seismic-reflection profile MBS–22 (collected in 2009 on survey S–N1–09–MB), which crosses shelf south-southwest of Davenport; see trackline map for location. Profile highlights faulted and folded strata beneath continental shelf, including San Gregorio Fault Zone. Dashed red lines show faults. Magenta symbols show anticline axes. Blue and pink shading shows inferred uppermost Pleistocene and Holocene strata, deposited in last about 30,000 years during final stages of sea-level fall and subsequent sea-level rise. Underlying reflectors are of inferred Neogene age. Dashed green lines highlight some 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).

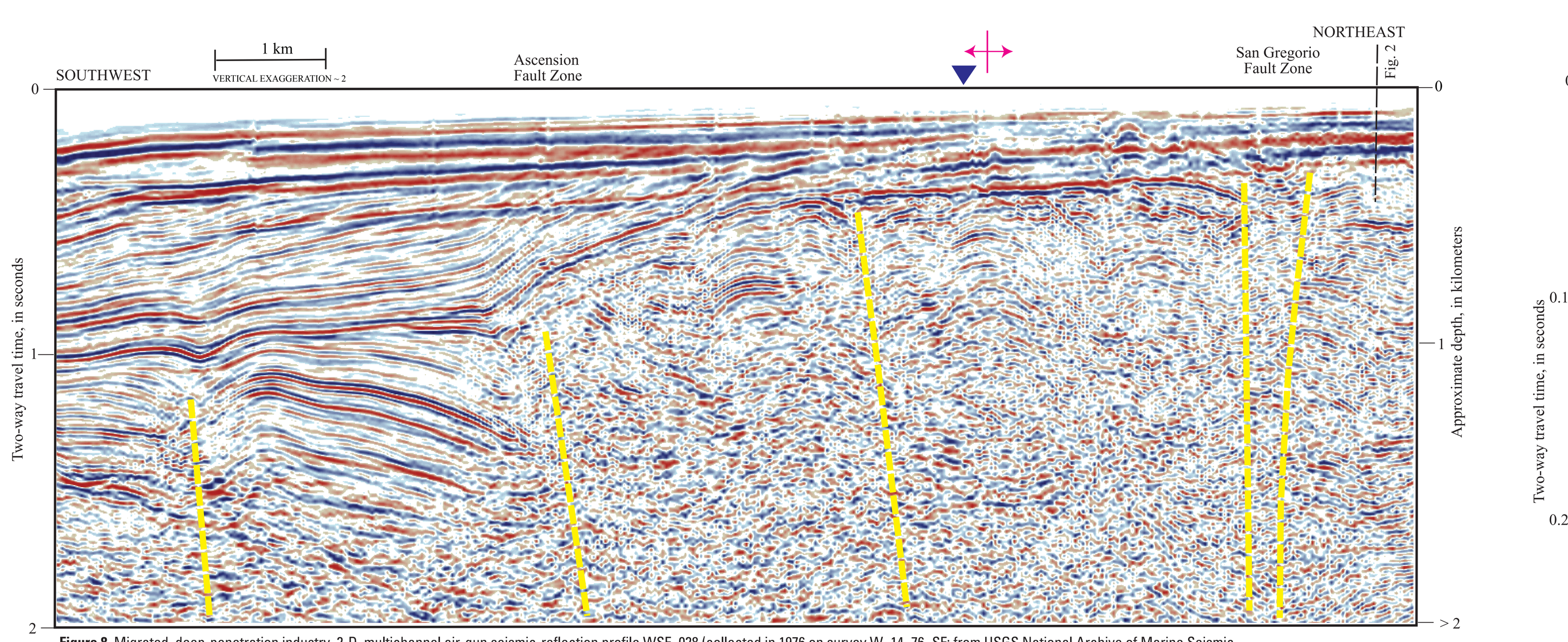


Figure 8. Migrated, deep-penetration industry, 2-D, multichannel air-gun seismic-reflection profile WSF–028 (collected in 1976 on survey W–14–76–SF; from USGS National Archive of Marine Seismic Surveys [U.S. Geological Survey, 2009]), which crosses shelf west-southwest of Davenport; see trackline map for location. Note that vertical scale and exaggeration are significantly different than that of high-resolution profiles shown in figures 1, 2, 3, 4, 6, 7, 9, and 10. Dashed yellow lines show faults. Magenta symbol shows anticline axis. Profile highlights faults and fold beneath continental shelf west of San Gregorio Fault Zone, including Ascension Fault Zone. Purple triangle shows location of California's State Waters limit (yellow line on trackline map).

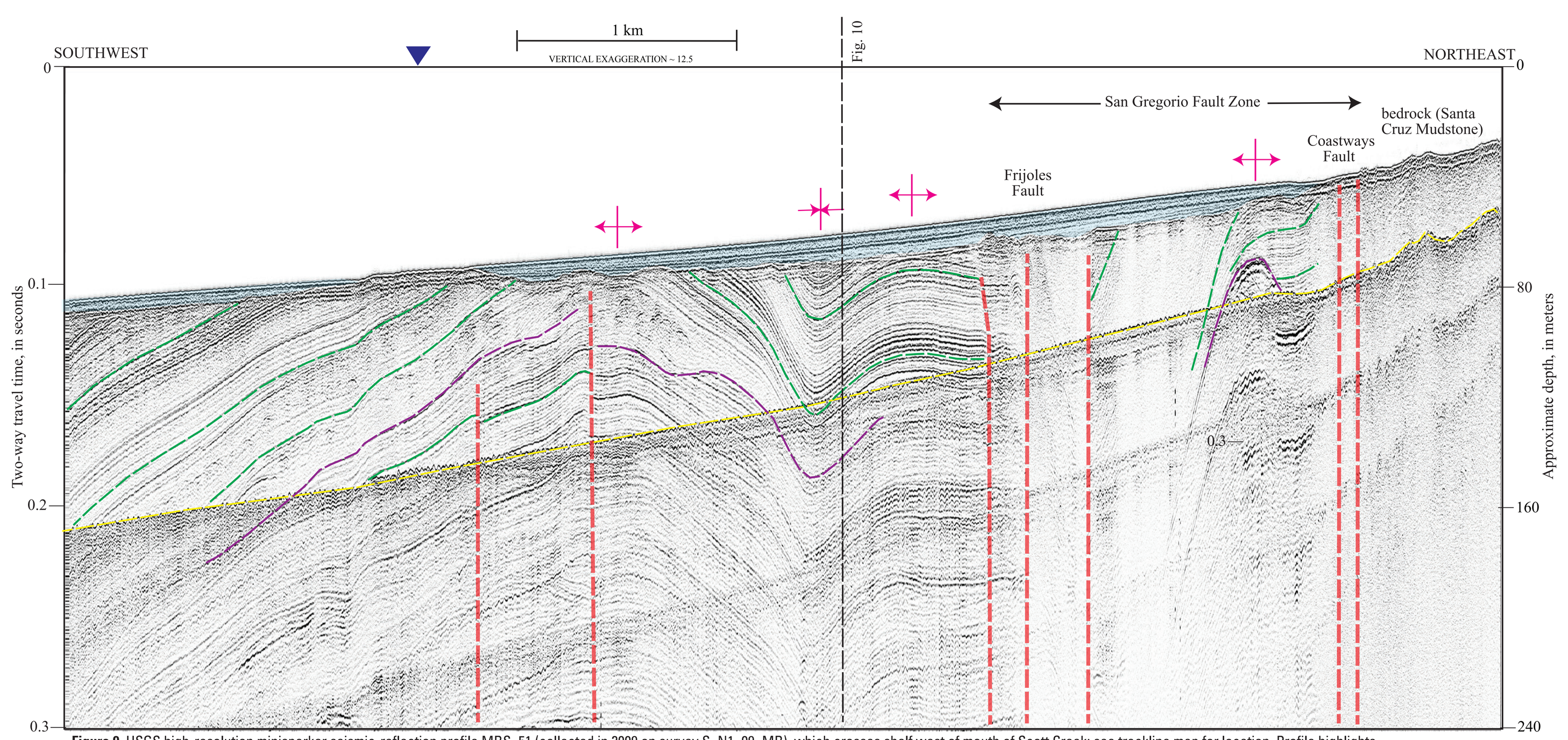


Figure 9. USGS high-resolution minisparker seismic-reflection profile MBS–51 (collected in 2009 on survey S–N1–09–MB), which crosses shelf west of mouth of Scott Creek; see trackline map for location. Profile highlights faulted and folded strata beneath continental shelf, including San Gregorio Fault Zone. Dashed red lines show faults. Magenta symbols show fold axes (diverging arrows, anticlines; converging arrows, syncline). Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. Underlying reflectors are of inferred Neogene age. Dashed purple lines show unconformities. Dashed green lines highlight some 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).

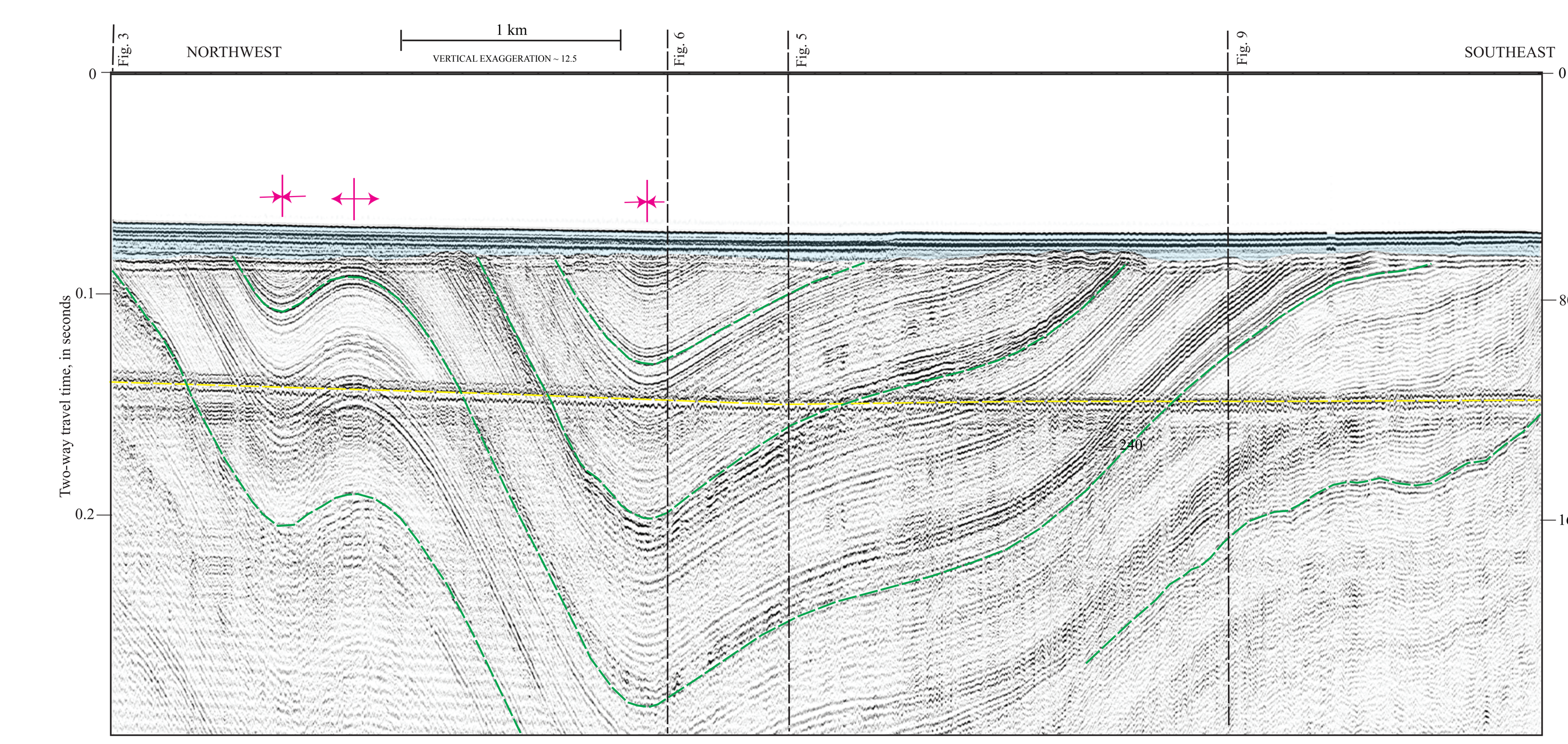


Figure 10. USGS high-resolution minisparker seismic-reflection profile MBS–28A (collected in 2009 on survey S–N1–09–MB), which crosses shelf roughly parallel to coastline, between mouths of Waddell and Scott Creeks; see trackline map for location. Profile highlights folded strata beneath continental shelf, west of San Gregorio Fault Zone. 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. Underlying reflectors are of inferred Neogene age. Dashed green lines highlight some 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 Scott Creek map area, providing imagery of the subsurface geology. The offshore part of the map area consists of gently (about 0.6° to 0.8°) offshore-dipping nearshore, inner shelf, and midshelf areas, extending to water depths of about 70 m at the limit of California's State Waters. Most of the shelf is underlain by flat, sandy and muddy sediment; bedrock forms moderate-relief outcrops that locally extend from the shoreline out to water depths of as much as 45 m (see sheet 10). The seismic-reflection profiles provide the data for interpreting subbottom stratigraphy, sediment thickness, and geologic structure (see sheets 9, 10).

Most profiles displayed on this sheet (figs. 1, 2, 3, 4, 6, 7, 9, 10) were collected in 2009 on U.S. Geological Survey (USGS) cruise S–N1–09–MB. The single-channel seismic-reflection data were acquired using a SIG 2Mille minisparker that used a 500-J high-voltage electrical discharge fired 2 times per second, which, at normal survey speeds of 4 to 4.5 nautical miles per hour, gives a data trace every 1.0 to 1.5 m of lateral distance covered. 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 algorithm was applied to the data, along with a 160- to 1,200-Hz bandpass filter and a heave correction that uses an automatic seafloor-detection window (averaged over 30 m of lateral distance covered). These data can resolve geologic features a few meters thick (hence, are considered "high-resolution"), down to subbottom depths of as much as 400 m.

Figures 5 and 8 show migrated, deep-penetration, multichannel seismic-reflection profiles collected in 1976 and 1982 by WesternGeco on cruises W–14–76–SF and W–34–82–MB, respectively. These profiles 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 using 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.

The Offshore of Scott Creek map area straddles the right-lateral San Gregorio Fault Zone, an important structure in the distributed transform boundary between the North American and Pacific plates (see, for example, Dickinson and others, 2005). This fault zone is part of a fault system that is present predominantly in the offshore for about 400 km from Point Conception in the south (where it is known as the Hosgri Fault; Johnson and Watt, 2012) to Bolinas and Point Reyes in the north (Bruns and others, 2002; Ryan and others, 2008). The San Gregorio Fault Zone in the map area is part of a 90-km-long offshore segment that extends northward from Point Sur (about 75 km south of the map area), across outer Monterey Bay to Point Año Nuevo (1 km north of the map area) (see sheet 9; see also, Weber and Lajoie, 1980; Brabb and others, 1998; Wagner and others, 2002). Offshore parts of this fault zone are identified in 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 amplitude, frequency, geometry, continuity, and vertical sequence. In this map area, the San Gregorio Fault forms a distributed shear zone about 2 km wide that includes two main fault strands (figs. 2, 3, 4, 6, 7, 9; see also, sheet 10). The nearshore east strand, known as the Coastways Fault, partly coincides with a prominent bathymetric lineament on the outer flank of nearshore bedrock outcrops present between Davenport and the mouth of Waddell Creek (see sheets 1, 2). The west strand, known as the Frijoles Fault, cuts across the flat, sediment-covered shelf. Cumulative lateral slip on the San Gregorio Fault Zone is thought to range from 4 to 10 mm/yr, on the basis of field observations at Point Año Nuevo (Weber, 1994; U.S. Geological Survey and California Geological Survey, 2010).

The high-resolution seismic-reflection profiles (figs. 1, 2, 3, 4, 6, 7, 9, 10) show a lower unit of deformed Neogene bedrock and one or two upper units (pink and blue shading) that consist of upper Quaternary sediments. Bedrock is characterized by folded and faulted, moderate- to high-amplitude, variably continuous, parallel to subparallel reflections (terminology from Mitchum and others, 1977). Underlying strata east of the Coastways Fault consist of the upper Miocene Santa Cruz Mudstone; west of the fault, underlying strata are inferred to consist of a mix of Neogene rocks that include the Monterey Formation (middle and upper Miocene), the Purisima Formation (upper Miocene and Pliocene; Powell and others, 2007), and possibly the Santa Cruz Mudstone (upper Miocene).

Throughout the map area, the contact between the Neogene bedrock and the overlying upper Quaternary sediments is an angular unconformity. Two upper Quaternary units are recognized in the profiles. The lower unit (pink shading; figs. 2, 4, 7), which is present only in the south half of the map area, notably consists of low-amplitude, low-angle (1° to 3°), offshore-dipping clinoforms (Catuneanu, 2006) that are as thick as 15 m. The upper unit (blue shading; figs. 1, 2, 3, 4, 6, 7, 9, 10) typically is characterized by low-amplitude, continuous to moderately continuous, diffuse, subparallel reflections, and it has a maximum thickness of about 12 m.

Our preferred hypothesis is that the clinoforms in the lower (pink shading in profiles) of the two upper Quaternary units represent a progradational shoreface that formed between about 30,000 and 21,000 years ago during the sea-level regression of marine-isotope stage 2 (Waelbroeck and others, 2002). The overlying upper unit (blue shading in profiles) represents shelf deposits that formed during the sea-level transgression of the last about 21,000 years. In this interpretation, the surface at the base of the upper unit throughout the map area is a transgressive surface of erosion that formed as the shoreface migrated landward. Alternatively, Grossman and others (2006) suggested that both of these units were deposited in the last about 21,000 years, during the latest Pleistocene and Holocene sea-level rise.

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Seismic-Reflection Profiles, Offshore of Scott Creek Map Area, California

by

Samuel Y. Johnson, Stephen R. Hartwell, and Ray W. Sliter

2015

For sale by U.S. Geological Survey, Information Services, Box 25286, Federal Center, Denver, CO 80225, 1–888–ASK–USGS

Digital files available at http://dx.doi.org/10.3133/ofr20151191

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