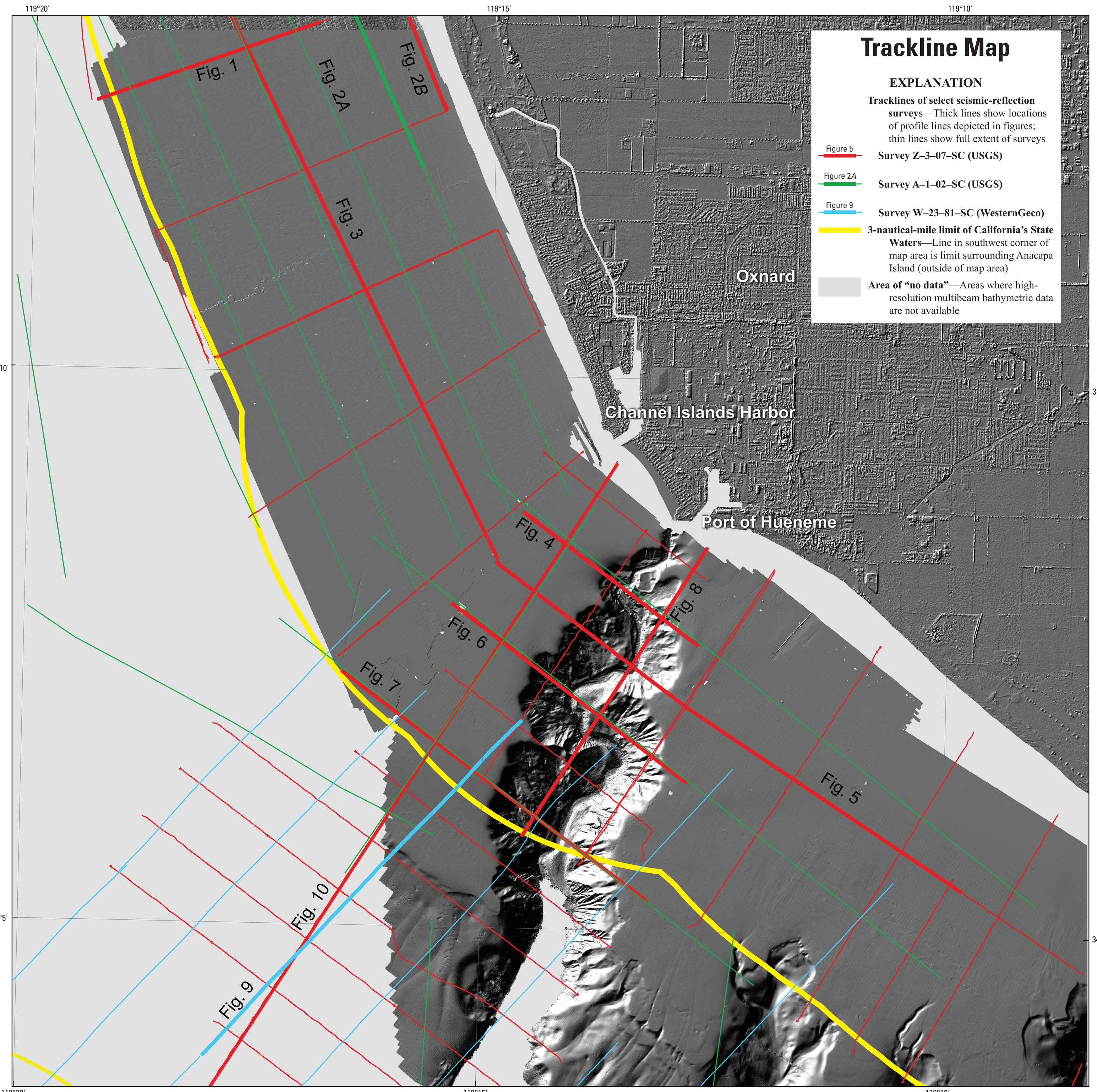

SCALE 1:50 000

ONE MILE = 0.869 NAUTICAL MILES

NOT INTENDED FOR NAVIGATIONAL USE

GIS database and digital cartography by Eleyne L. Phillips and Florence L. Wong

Edited by Taryn A. Lindquist

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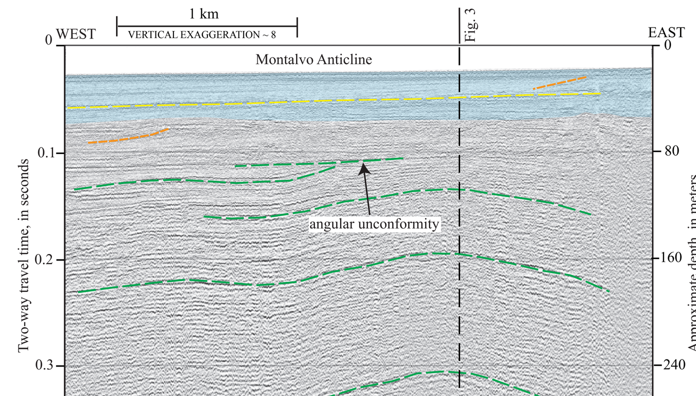


Figure 1. USGS minisparker seismic-reflection profile SB–58 (survey Z–3–07–SC; Sliter and others, 2008), which obliquely crosses Montalvo Anticline (Greene and others, 1978; Fisher and others, 2005); see trackline map for location. Blue shading shows inferred uppermost Pleistocene and Holocene deltaic and shelf deposits. Dashed green lines highlight dipping beds and angular unconformity. Dashed orange lines highlight areas of reflections that have offshore-dipping clinoforms. Dashed yellow line is seafloor multiple.

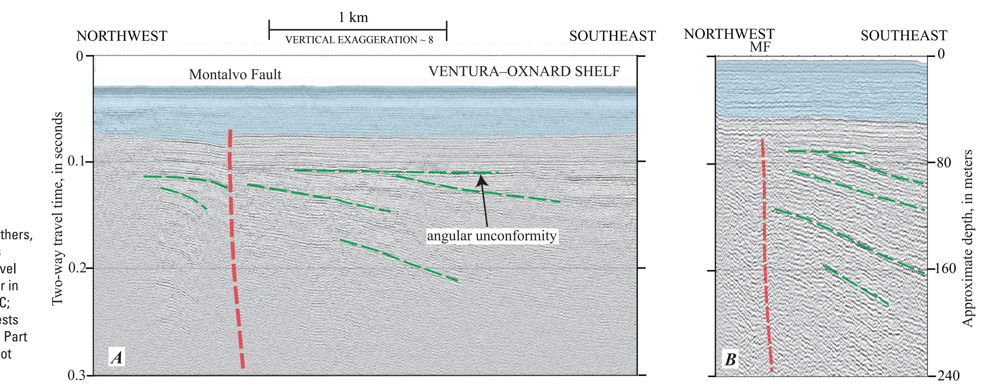


Figure 2. Two USGS seismic-reflection profiles that cross Montalvo Fault (dashed red lines) (Greene and others, 1978; Yeats and others, 1988; Fisher and others, 2005); see trackline map for locations. Blue shading shows inferred upper Pleistocene and Holocene strata (as much as about 40 m thick), deposited since last sea-level lowstand about 21,000 years ago. Dashed green lines show dipping strata and angular unconformity earlier in Pleistocene(?) section. *A*, Huntec minisparker seismic-reflection-profile HC–1850 (USGS survey A–1–02–SC; note that survey extends 330 m farther to northwest, beyond north edge of map area). Interpretation suggests that Montalvo Fault has as much as 7 m of south-side-up vertical offset or warping above unconformity. *B*, Part of minisparker seismic- reflection profile SB–57 (survey Z–3–07–SC; Sliter and others, 2008). Profile does not obviously show similar displacement along Montalvo Fault (MF).

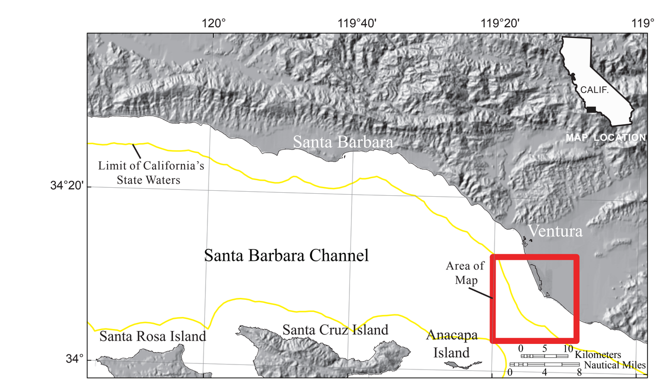
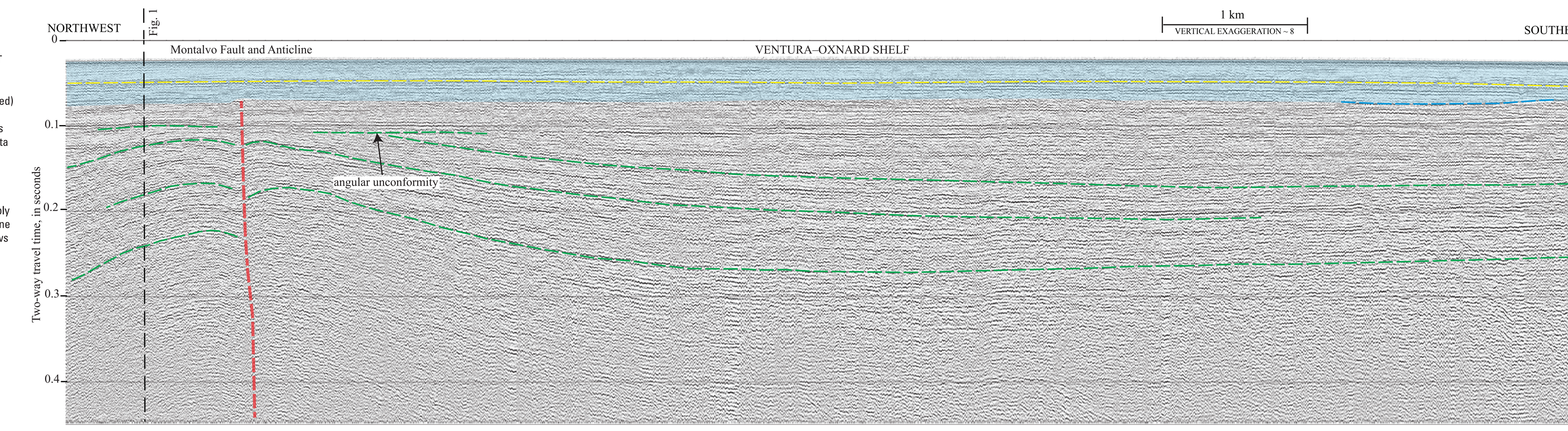


Figure 3. USGS minisparker seismic-reflection profile SB–51T (survey Z–3–07–SC; Sliter and others, 2008), which crosses Ventura continental shelf in eastern Santa Barbara Channel; see trackline map for location. Red line (dashed where inferred) shows Montalvo Fault in core of Montalvo Anticline (Greene and others, 1978; Fisher and others, 2005). Dashed green lines highlight flat strata underlying much of shelf and dipping strata on anticlinal flanks, as well as angular unconformity lower in section; stratal thinning on southeast flank of anticline indicates that some deposition occurred during fold growth. Folded strata, which are inferred to be the Pliocene and Pleistocene Saugus Formation (upper part), are unconformably overlain by about 40 m of uppermost Pleistocene and Holocene shelf and deltaic strata (blue shading). Dashed blue line shows low-relief erosion surface at base of shelf and deltaic strata. Dashed yellow line is seafloor multiple.



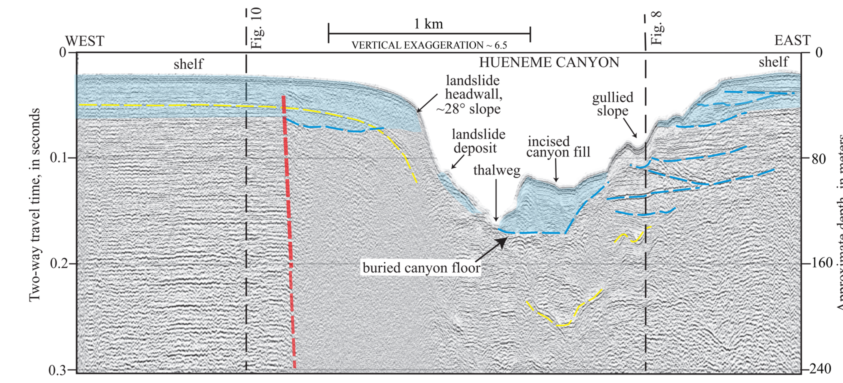
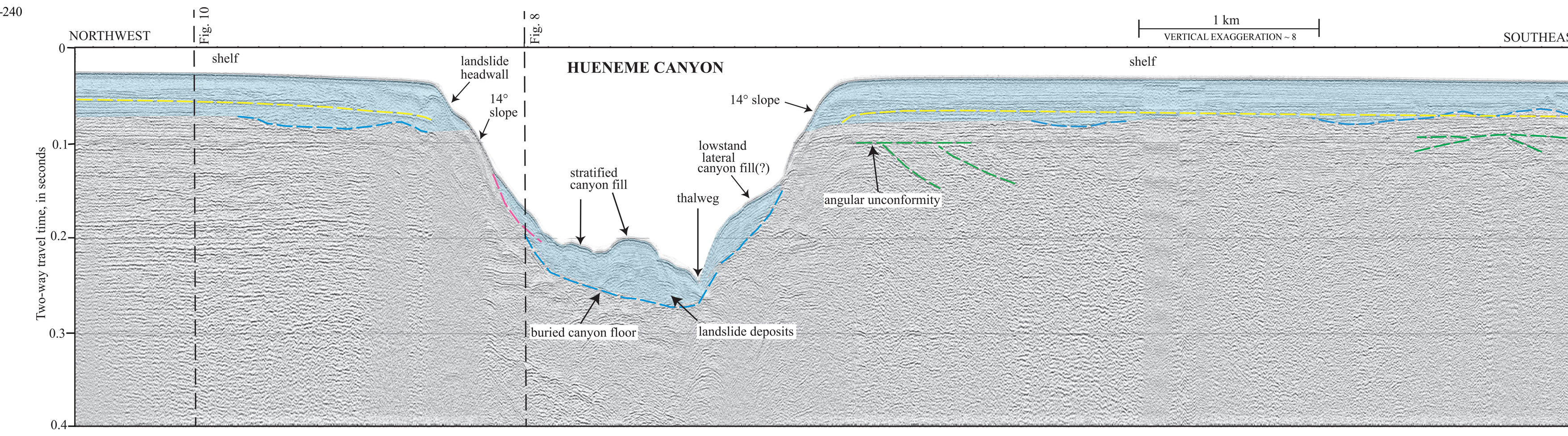


Figure 4. USGS minisparker seismic-reflection profile HC–10 (survey Z–3–07–SC; Sliter and others, 2008), which extends across Hueneme Canyon; see trackline map for location. Note that apparent slopes of canyon walls are much greater than actual slopes, owing to vertical exaggeration; true slope values are indicated on figure. Dashed red line shows inferred fault. Blue shading shows inferred uppermost Pleistocene and Holocene shelf and deltaic strata, as thick as about 35 to 40 m beneath shelf, deposited during postglacial sea-level rise; strata beneath blue shading are inferred to be shallow-marine facies of upper part of the Pliocene and Pleistocene Saugus Formation (Greene and others, 1978). Dashed blue lines show channels and erosional unconformities, including buried canyon floor beneath canyon axis. Dashed yellow line is seafloor multiple. Note changes in depth and canyon morphology from that seen downcanyon in figures 5, 6, and 7.

Figure 5. USGS minisparker seismic-reflection profile HC–09T (survey Z–3–07–SC; Sliter and others, 2008), which extends across Hueneme Canyon; see trackline map for location. Note that apparent slopes of canyon walls are much greater than actual slopes, owing to vertical exaggeration; true slope values are indicated on figure. Blue shading shows inferred upper Pleistocene and Holocene shelf and deltaic strata, as thick as about 35 to 40 m, deposited during sea-level rise in last about 21,000 years; strata beneath blue shading are inferred to be shallow-marine facies of upper part of the Pliocene and Pleistocene Saugus Formation (Greene and others, 1978). Dashed green lines show dipping beds and angular unconformity. Dashed blue line shows channels and erosional surfaces, including buried channel floor beneath canyon axis. Dashed magenta line shows possible landslide failure plane. Dashed yellow line is seafloor multiple. Note changes in depth and canyon morphology from that seen upcanyon in figure 4 and downcanyon in figures 6 and 7.



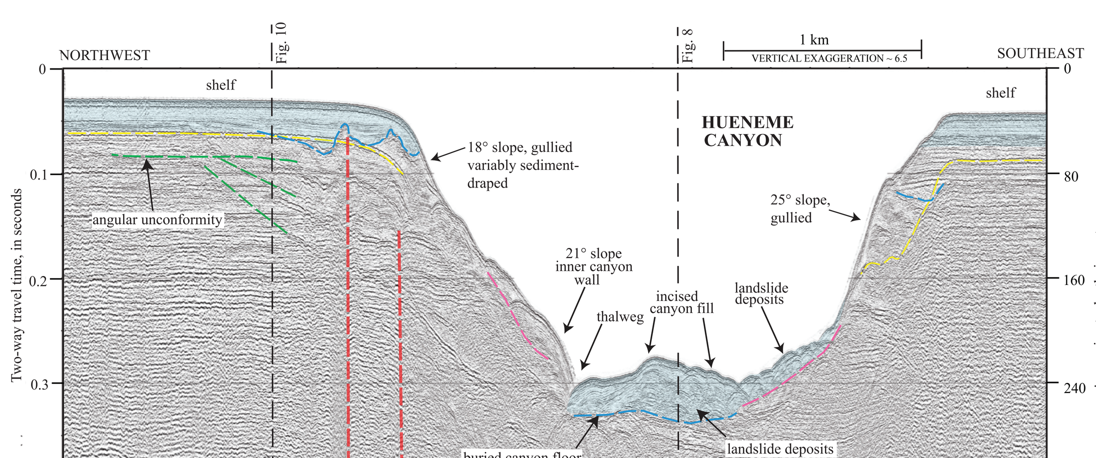
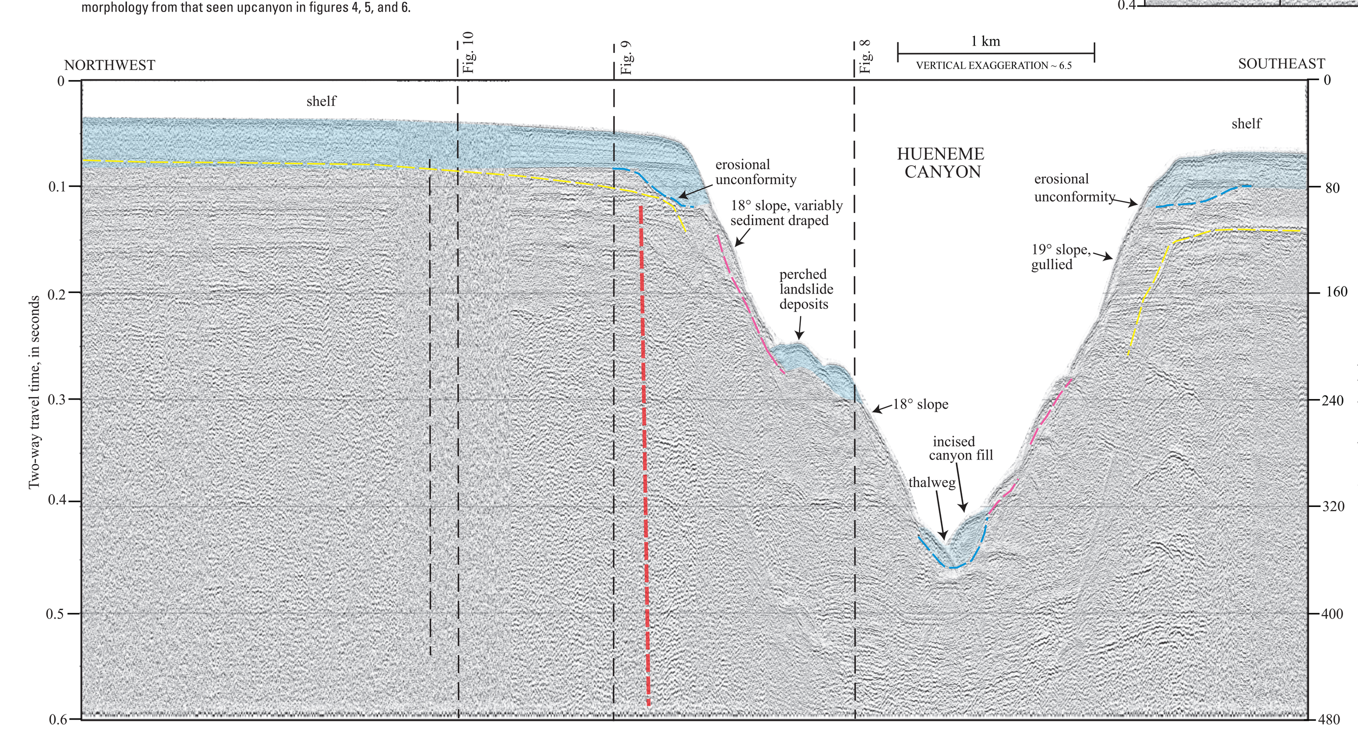


Figure 6. USGS minisparker seismic-reflection profile HC–20 (survey Z–3–07–SC; Sliter and others, 2008), which extends across Hueneme Canyon; see trackline map for location. Note that apparent slopes of canyon walls are much greater than actual slopes, owing to vertical exaggeration; true slope values are indicated on figure. Dashed red lines show inferred faults. Blue shading shows inferred upper Pleistocene and Holocene shelf and deltaic strata deposited during postglacial sea-level rise; strata beneath blue shading are inferred to be shallow-marine facies of upper part of the Pliocene and Pleistocene Saugus Formation (Greene and others, 1978). Dashed blue line shows channels and erosional surfaces at base of uppermost unit, within underlying Pleistocene(?) unit, and along buried channel floor beneath canyon axis. Dashed magenta lines show possible failure planes for deep-seated landslides. Dashed green lines show bedding dips, erosion surface, and angular unconformity in pre-Holocene strata. Dashed yellow line is seafloor multiple. Note changes in depth and canyon morphology from that seen upcanyon in figures 4 and 5 and downcanyon in figure 7.

Figure 7. USGS minisparker seismic-reflection profile HC–02 (survey Z–3–07–SC; Sliter and others, 2008), which extends across Hueneme Canyon; see trackline map for location. Note that apparent slopes of canyon walls are much greater than actual slopes, owing to vertical exaggeration; true slope values are indicated on figure. Dashed red line shows inferred fault. Blue shading shows inferred upper Pleistocene and Holocene shelf and deltaic strata deposited during sea-level rise in last about 21,000 years; strata are about 25 to 35 m thick beneath shelf and as thick as about 48 m in channel fills along canyon edge; strata beneath blue shading are inferred to be shallow-marine facies of the Pliocene and Pleistocene Saugus Formation (Greene and others, 1978). Dashed blue lines show erosional surfaces at base of blue-shaded unit (including beneath canyon axis). Dashed magenta lines show possible failure planes for landslides. Dashed yellow line is seafloor multiple. Note changes in depth and canyon morphology from that seen upcanyon in figures 4, 5, and 6.



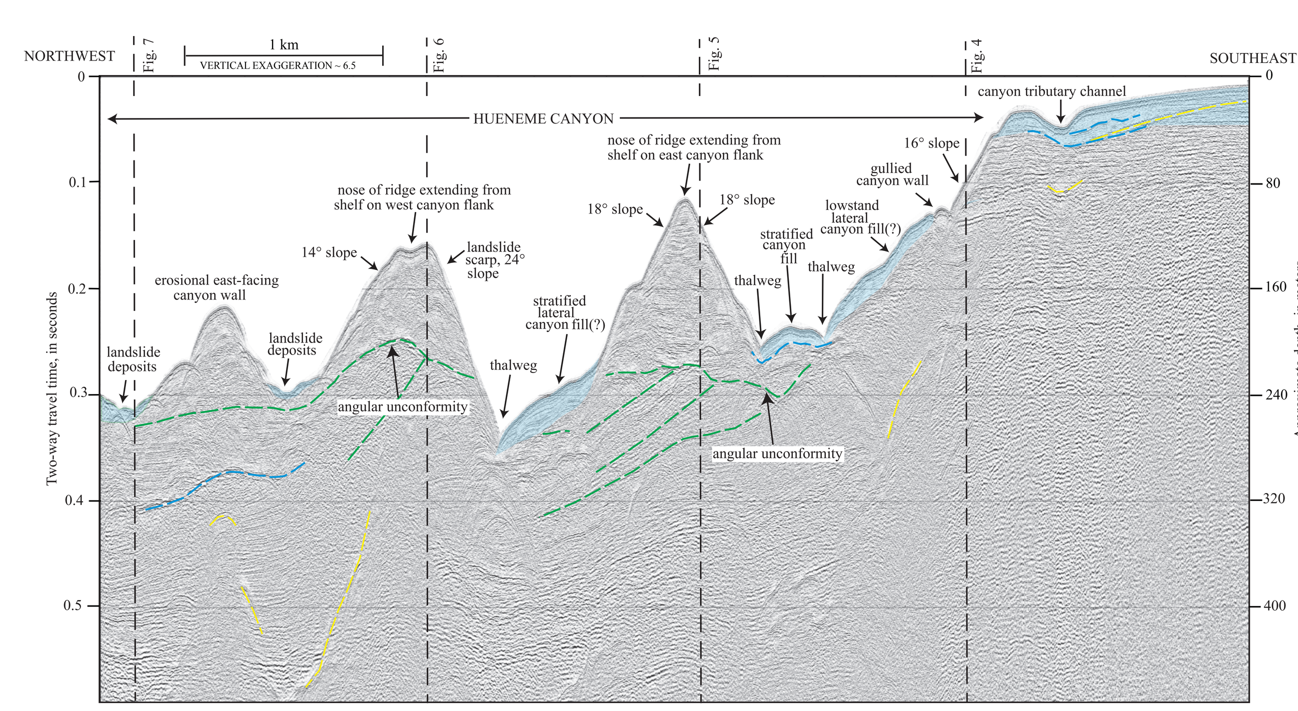


Figure 8. USGS minisparker seismic-reflection profile HC–21 (survey Z–3–07–SC; Sliter and others, 2008), which extends down Hueneme Canyon, obliquely crossing canyon axis and both canyon walls; see trackline map for location (note locations of crossing profile lines). Note that apparent slopes of canyon walls are much greater than actual slopes, owing to vertical exaggeration; true slope values are indicated on figure. Blue shading shows inferred upper Pleistocene and Holocene deposits, as thick as about 27 m on shelf but thinner within canyon; strata beneath blue shading are inferred to be shallow-marine facies of upper part of the Pliocene and Pleistocene Saugus Formation (Greene and others, 1978). Dashed blue lines show erosional channels within, and at base of, blue-shaded unit, as well as in underlying strata. Dashed green lines show south-dipping reflections and angular unconformity; strata beneath unconformity may be the Miocene “Topanga–Vaqueros undifferentiated unit” of Greene and others (1978). Dashed yellow line is seafloor multiple.

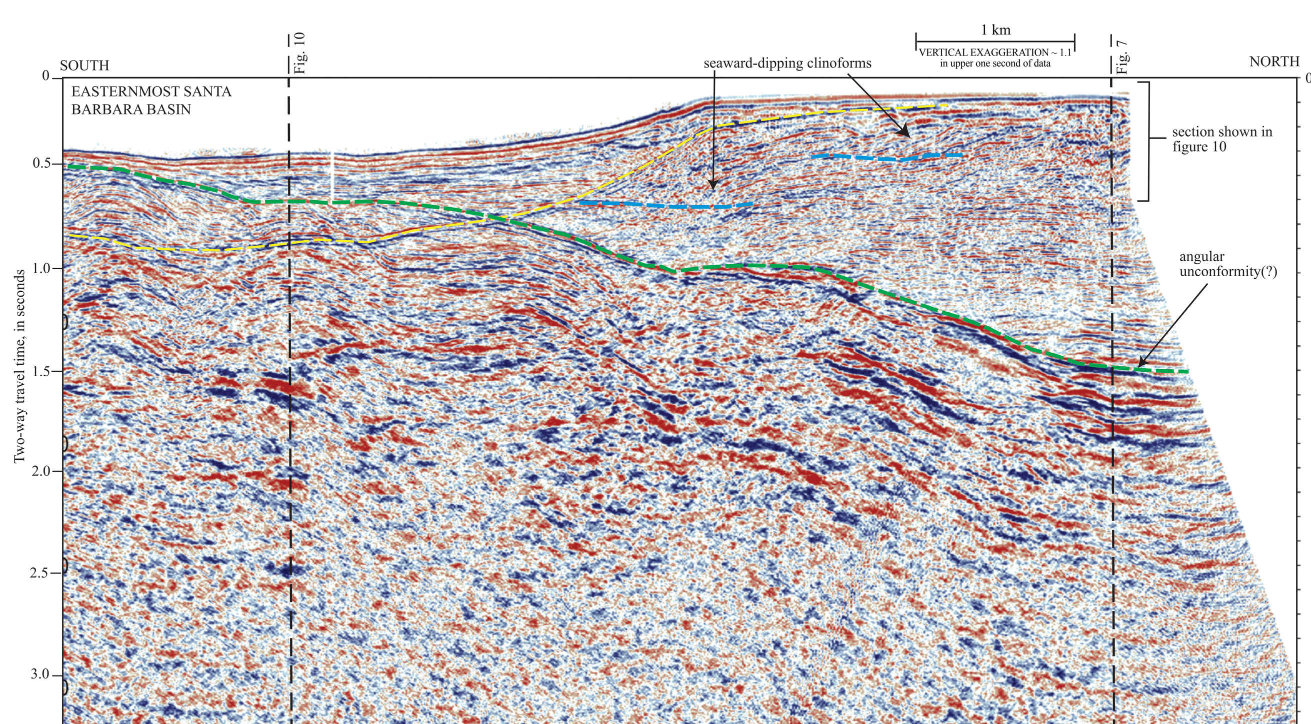


Figure 9. Industry 2-D migrated multichannel air-gun seismic-reflection profile WC81–614 (survey W–23–81–SC, collected in 1981), which extends south across Ventura continental shelf into eastern Santa Barbara Basin; see trackline map for location. Note that profile is aligned with southern part of subparallel high-resolution seismic-reflection profile shown in figure 10; however, this industry profile has much less vertical exaggeration (1.1:1 vs. 8:1). Note also that profile has not been depth converted and so no depth scale is shown, but it probably extends to depths of 4 to 5 km. Dashed blue lines show downlap surfaces of clinoforms that document Pleistocene progradation of shelf and subaqueous delta of Santa Clara River. Dashed green line highlights important continuous horizon for which two distinctly different interpretations have been made: (1) Huftile and Yeats (1995) and Sorlien and others (2000) suggested that strata imaged on this profile lie entirely within folded upper plate of steeply south-dipping Oak Ridge Fault; in this interpretation, horizon shown by dashed green line is prominent angular unconformity. (2) In contrast, Shaw and Suppe (1994) suggested that strata lie entirely within upper plate of north-dipping Pitas Point–Montalvo Thrust Fault system; in this interpretation, horizon marked by lower dashed green line is north-dipping, low-angle thrust fault. Greene and others (1978) assigned strata beneath this horizon to the Miocene Conejo Volcanics and Monterey Formation and strata above it to the Pliocene and Pleistocene Pico and Saugus Formations. Dashed yellow line is seafloor multiple.

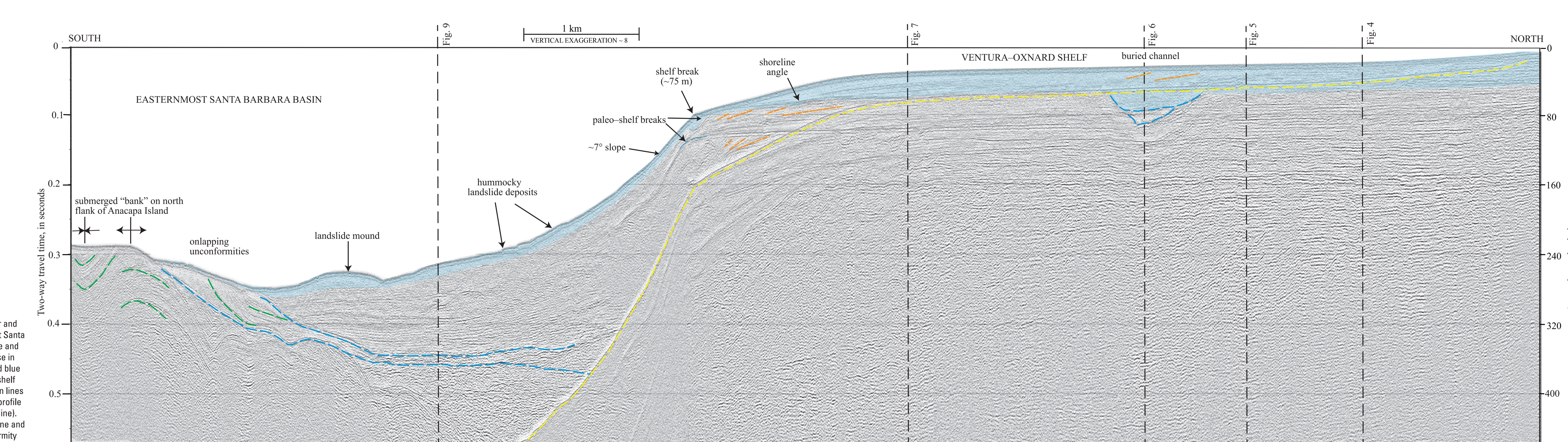


Figure 10. USGS minisparker seismic-reflection profile HC–12 (survey Z–3–07–SC; Sliter and others, 2008), which extends across Ventura–Oxnard shelf downslope into easternmost Santa Barbara Basin; see trackline map for location. Blue shading shows inferred Pleistocene and Holocene shelf and deltaic strata, as thick as about 50 m, deposited during sea-level rise in last about 21,000 years. Dashed orange lines show offshore-dipping clinoforms. Dashed blue lines show erosional unconformities, including buried channel under Ventura–Oxnard shelf and two onlapping unconformities on south flank of Santa Barbara Basin. Dashed green lines show dips of bedding in folded strata near unconformities; fold axes are shown above profile by symbols with outward-pointing arrows (anticline) and inward-pointing arrows (syncline). Upper Quaternary strata are inferred to be largely underlain by upper part of the Pliocene and Pleistocene Saugus Formation. Folded strata imaged beneath lower erosional unconformity on south end of profile are probably the Monterey Formation (Greene and others, 1978). Dashed yellow line is seafloor multiple.

DISCUSSION

This map shows seismic-reflection profiles from three different surveys of the Hueneme Canyon and vicinity map area, providing imagery of the subsurface geology. The dominant offshore physical features in the map area are the continental shelf and Hueneme Canyon. The seismic-reflection data reveal that the shelf is underlain by thick upper Pleistocene and Holocene deposits derived mainly from the nearby Santa Clara and Ventura Rivers and Calleguas Creek (Dahlen, 1992; Slater and others, 2002). Correlative strata in Hueneme Canyon, which bisects the shelf and serves as a major conduit of sediment to offshore basins, consist primarily of hummocky landslide deposits and incised canyon fill.

The Montalvo Fault and Anticline (Yeats and others, 1988; Fisher and others, 2005) system is the most important tectonic feature in the map area. Figure 2A shows fault offset of a horizon inferred to represent the base of a section that has been deposited over the last about 21,000 years, following the last major sea-level lowstand (see, for example, Fleming and others, 1998). Deeper, older faults and folds likely are present in the map area, but the limited amount of deeper seismic-reflection data in the map area (for example, fig. 9) preclude their mapping.

Data for most profiles displayed on this map sheet (figs. 1, 2B, 3, 4, 5, 6, 7, 8, 10) were collected in 2007 on USGS cruise Z–3–07–SC (Sliter and others, 2008). Single-channel seismic-reflection data were acquired using the SIG 2Mille minisparker. The SIG minisparker system used a 500-Joule, 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. After the survey, a short-window (20 ms) automatic gain control (AGC) algorithm and a 160- to 1,200-Hz bandpass filter was applied to the minisparker data.

Data for line 2 (fig. 2A) were collected in 2002 on USGS cruise A–1–02–SC. Profiles were collected using the 500-Joule sparker source from a Huntec deep-tow fish and a single-channel surface-towed streamer as the receiver. The source was towed at a minimum depth of about 5 m, well below boat-propeller wash. The sparker produced an effective frequency range of 1 to 6 kHz, with peak power at about 1 kHz. The data were recorded by a Delph recording system using a sampling frequency of 16 kHz. Additional information is available at http://walrus.wr.usgs.gov/infobank/a/a102sc/html/a-1-02-sc.seis.html.

Figure 9 shows a deep-penetration, migrated, multichannel seismic-reflection profile collected in 1981 by WesternGeco on cruise W–23–81–SC. This profile and other similar data were collected in many areas offshore of California in the 1970s and 1980s when the area was 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, Hueneme Canyon and Vicinity, California

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2012