

Figure 11 (left). USGS-OSU high-resolution minisparker profile NSAF-145 (collected

in 2012 on survey B-04-12-NC), which crosses Spanish Canyon and shelf subparal-

inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level

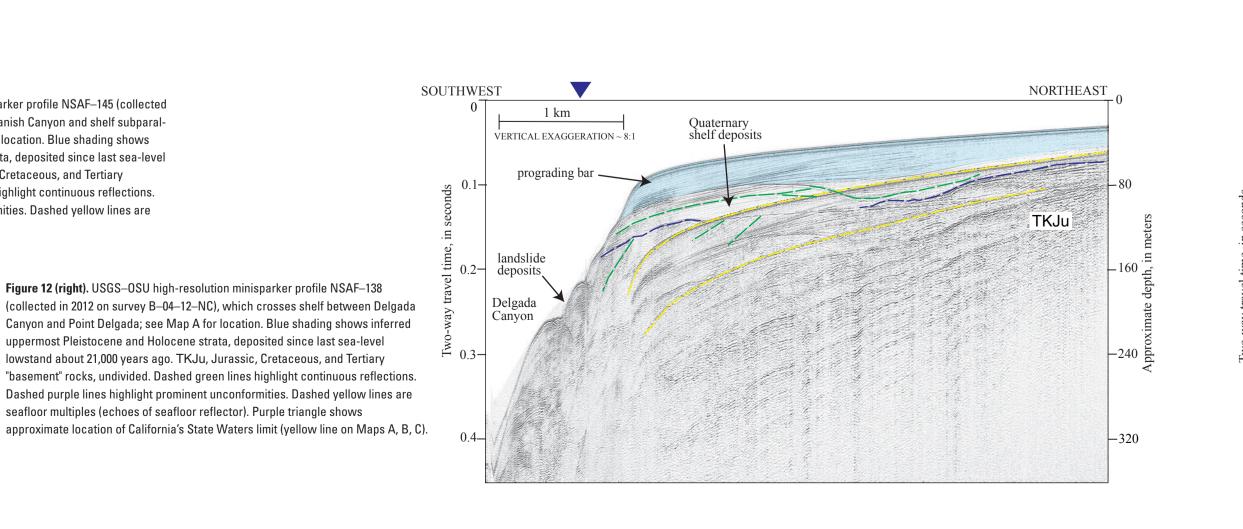
"basement" rocks, undivided. Dashed green lines highlight continuous reflections.

Dashed purple lines highlight prominent unconformities. Dashed yellow lines are

lel to coast, offshore of King Range; see Map A for location. Blue shading shows

lowstand about 21,000 years ago. TKJu, Jurassic, Cretaceous, and Tertiary

seafloor multiples (echoes of seafloor reflector).



mouth of Big Flat Creek, about 2 km northwest of Delgada Canyon; see Map A for location. Dashed red lines show faults. Blue shading

shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. TKJu,

reflector). Purple triangle shows approximate location of California's State Waters limit (yellow line on Maps A, B, C).

Jurassic, Cretaceous, and Tertiary "basement" rocks, undivided. Dashed purple lines highlight unconformities. Dashed green lines highlight

continuous reflections (not intended to show correlations across faults). Dashed yellow lines are seafloor multiples (echoes of seafloor

Figure 6. USGS-OSU high-resolution minisparker profile NSAF-123 (collected in 2012 on survey B-04-12-NC), which crosses shelf

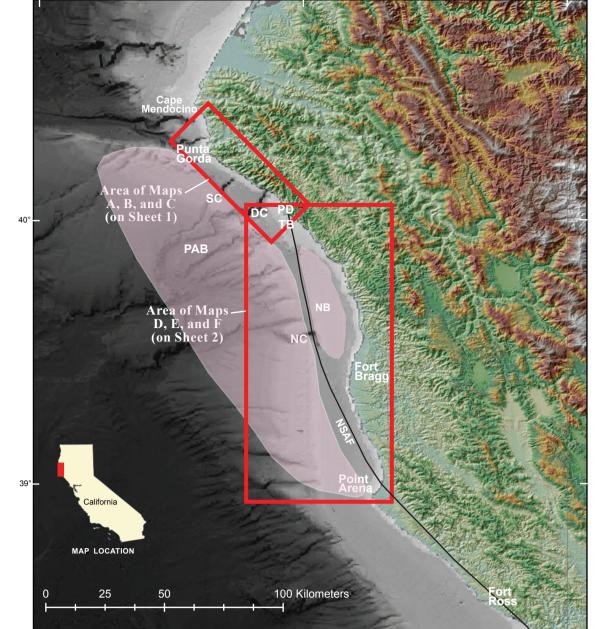
offshore of mouth of Big Creek, southeast of Spanish Canyon; see Map A for location. Blue shading shows inferred uppermost Pleistocene

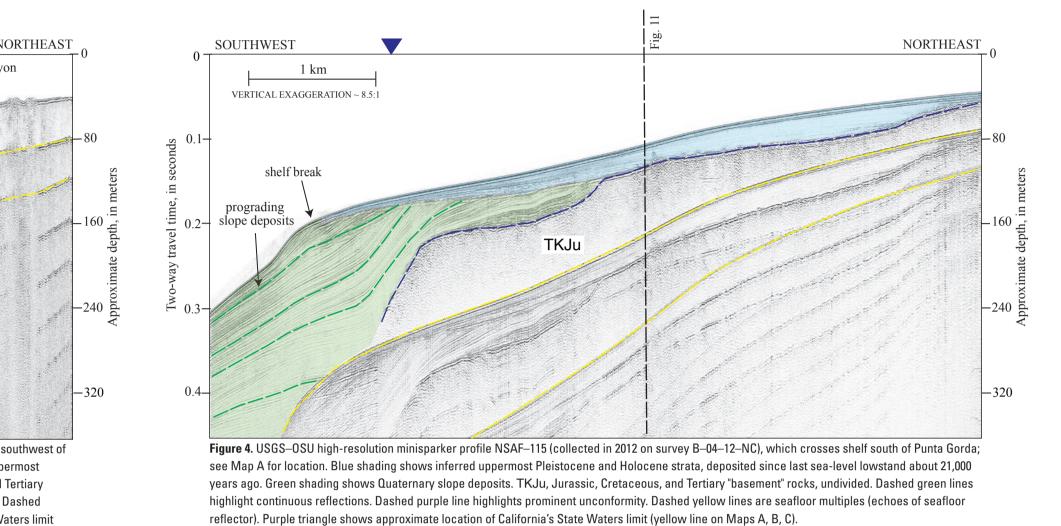
and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. TKJu, Jurassic, Cretaceous, and Tertiary "basement"

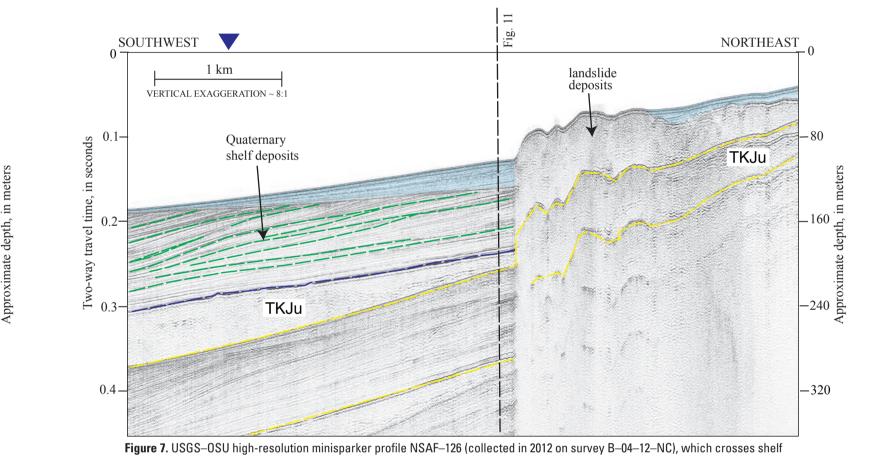
rocks, undivided. Dashed purple line highlights prominent unconformity. Dashed green lines highlight continuous reflections. Dashed yellow

lines are seafloor multiples (echoes of seafloor reflector). Purple triangle shows location of California's State Waters limit (yellow line on

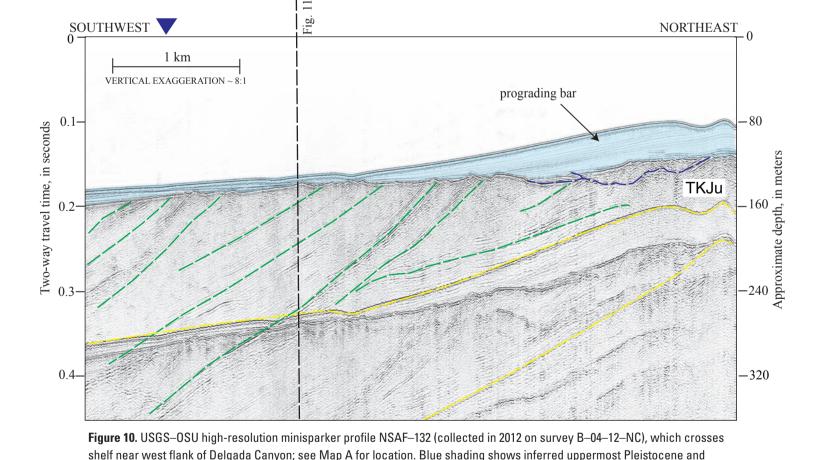
Colored shaded-relief index map of part of northern California, showing locations of selected geographic features mentioned in this report. Also shown are locations of Maps A. B. and C on this sheet and Maps D, E, and F on sheet 2 (red boxes). Black line shows fault (NSAF, northern San Andreas Fault). Pink shading shows offshore sedimentary basins (NB, Noyo Basin; PAB, Point Arena Basin). Other abbreviations: DC, Delgada Canyon; NC, Noyo Canyon; PD, Point Delgado; SC, Spanish Canyon; TB, Tolo bank.







between mouths of Big Creek and Big Flat Creek; see Map A for location. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. TKJu, Jurassic, Cretaceous, and Tertiary "basement" rocks, undivided. Dashed purple line highlights unconformity. Dashed green lines highlight continuous reflections. Dashed yellow lines are seafloor multiples (echoes of seafloor reflector). Purple triangle shows approximate location of California's State Waters limit (yellow line on Maps A, B, C).



shelf near west flank of Delgada Canyon; see Map A for location. Blue shading shows inferred uppermost Pleistocene and Holocene strata, deposited since last sea-level lowstand about 21,000 years ago. TKJu, Jurassic, Cretaceous, and Tertiary 'basement" rocks, undivided. Dashed green lines highlight continuous reflections. Dashed purple lines highlight unconformities. Dashed yellow lines are seafloor multiples (echoes of seafloor reflector). Purple triangle shows approximate location of California's State Waters limit (yellow line on Maps A, B, C).

¹Fugro USA Marine, Inc.; ² U.S. Geological Survey

This publication consists of two map sheets that display shallow geologic structure, along with sediment distribution and thickness, for an approximately 150-km-long offshore section of the northern California coast between Punta Gorda and Point Arena. Each map sheet includes three maps, at scales of either 1:100,000 (sheet 1) or 1:200,000 (sheet 2), and together the sheets include 30 figures that contain representative high-resolution seismic-reflection profiles. The maps and seismic-reflection surveys cover most of the continental shelf in this region. In addition, the maps show the locations of the shelf break and the 3-nautical-mile limit of California's State Waters. The seismic-reflection data, which are the primary dataset used to develop the maps, were collected to support the California Seafloor Mapping Program (Johnson and others, 2017), U.S. Geological Survey Offshore Geologic Hazards projects, and National Oceanic and Atmospheric Administration's (NOAA's) Ocean Explorer program. In addition to the two map sheets, this publication includes geographic information system (GIS) data files of faults, sediment thicknesses, and depths-to-base of sediment.

Maps A and D, on map sheets 1 and 2, respectively, show tracklines for the three U.S. Geological Survey (USGS) a Oregon State University (OSU) seismic-reflection surveys that cover the Punta Gorda to Point Arena region. The surveys are (1) cruise C-1-10-NC, conducted in 2010; (2) cruise B-5-10-NC, conducted in 2010; and (3) cruise B-4-12-NC, conducted in 2012 (Beeson and others, 2016). These data were all collected using the SIG 2 Mille minisparker system, which used a 500-J high-voltage electrical discharge fired 1 to 2 times per second; at normal survey speeds of 4 to 4.5 nautical miles per hour, this gives a data trace every 1 to 2 m of lateral distance covered. The data were digitally recorded on a single-channel streamer in standard SEG-Y 32-bit floating-point format, using acquisition 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 (and, hence, are considered "high-resolution"), down to subbottom depths of as much as 400 m. The width of the continental shelf ranges from 12 to 17 km between Point Arena and Point Delgada, then it decreases to as little as about 7 km northwest of Point Delgada. In places, the continental shelf is crossed by submarine canyons: northwest of Point Delgada, the entire width of the shelf is incised by Spanish Canyon, and the midshelf to outer shelf area is cut by Delgada Canyon; between Point Delgada and Point Arena, the outer shelf is notched by Noyo Canyon. Ouaternary sediments and bedrock underlie the shelf. On the seismic-reflection profiles (figs. 1–30), we divide Quaternary shelf sediments into two units. The younger, upper unit (shaded blue on most seismic-reflection profiles) is generally characterized by low-amplitude, continuous to moderately continuous, diffuse, subparallel, generally flat reflections (terminology from Mitchum and others, 1977). In this upper unit, reflection apparent dip ranges from relatively flat $(1^{\circ}-3^{\circ})$ on most of the shelf to moderate (as much as $4^{\circ}-5^{\circ}$) within and at the front of prograding sediment bars (for example, figs. 6, 8, 9, 10). The lower contact of this upper unit is a transgressive surface of erosion, a commonly angular, wave-cut unconformity characterized by an upward change to lower amplitude, more diffuse reflections. On the basis of this lower contact, the upper unit is inferred to have been deposited on the shelf in the last about 21,000 years during the sea-level rise that followed the last major lowstand and the Last Glacial Maximum (LGM) (Stanford and others, 2011). Global sea level was about 120 to 130 m lower during the LGM, at which time most of the shelf between Punta Gorda and Point Arena (above these water depths) was emergent. The post-LGM sea-level rise was rapid (about 9 to 11 m per

thousand years) until about 7,000 years ago, when it slowed considerably to about 1 m per thousand years (Stanford and The lower, older Quaternary (pre-LGM) unit of shelf deposits is found below the post-LGM transgressive surfac erosion on many profiles, and it overlies an erosional unconformity (imaged on some but not all profiles) at the top of Neogene or older basement rocks (Hoskins and Griffiths, 1971; McLaughlin and others, 1994). This unit is characterize by low- to moderate-amplitude, low- to high-frequency, parallel to subparallel reflections, and it contains numerous internal unconformities that are inferred to result from wave erosion during multiple, previous Quaternary sea-level transgressions (Waelbroeck and others, 2002). The pre-LGM Quaternary unit is notably thick in the Noyo Basin (figs. 19, 20, 21), located offshore east of the San Andreas Fault, between the mouths of Ten Mile River and Usal Creek (Bees

Quaternary upper slope deposits (shaded green on figs. 4, 5, 15, 16, 17, 22) are also present on many profiles. The deposits mainly form sedimentary wedges represented by a mix of parallel, lenticular, and hummocky, offshore-dipping reflections, consistent with deposition by processes ranging from dilute sediment gravity flows to submarine landslides. These slope deposits contain numerous internal erosional surfaces and disconformities, and they are inferred to have formed as the shelf prograded seaward during Quaternary sea-level regressions and lowstands (Waelbroeck and others,

The undivided Neogene bedrock unit (Tu), which is mapped beneath Quaternary deposits and also beneath a promi-

nent erosional surface on the shelf in the southern part of the map area (see, for example, figs. 28, 29, 30), consists of sedimentary rocks of inferred Miocene to Pliocene age. This unit likely consists of marine deposits of varied lithol and thicknesses that are similar to those described in the offshore Point Arena Basin (Hoskins and Griffiths, 1971; Blake and others, 1985; McCulloch, 1987). On seismic-reflection profiles, this unit is characterized by low-amplitude, highfrequency reflections that are commonly folded. Where these units are exposed on the seafloor, the multibeam imagery has a "ribbed" texture that we interpret as resulting from differential erosion of layered strata (for example, Beeson and others, 2017, their fig. 11). Outcrops of older (pre-Neogene) rocks form rough, irregular, hummocky, and highly jointed and fractured seafloor outcrops on high-resolution bathymetric imagery (for example, Beeson and others, 2017, their fig. 17)). Northeast of the San Andreas Fault, these undivided "basement rocks" (unit TKJu) probably include the Upper Cretaceous to upper Eocene rocks of the Coastal Belt terrane and the lower Paleogene to middle Miocene units of the King Range terrane (McLaughlin and others, 1994). The King Range terrane, which consists of pillow basalt, sandstone, argillite, and minor

Brown, R.D., Jr., and Wolfe, E.W., 1972, Map showing recently active breaks along the San Andreas Fault between Point conglomerate, was divided by McLaughlin and others (1994) into two separate subterranes (the King Peak and Point Delgada subterranes) on the basis of structural continuity, lithology, and age. The Coastal Belt terrane is largely composed

others, 1985). Southwest of the San Andreas Fault, the undivided basement rocks (unit TKJu) underlying the Point Arena

interbedded minor siltstone and conglomerate (Hoskins and Griffiths, 1971; McCulloch, 1987). These basement rocks are

Basin may largely consist of Jurassic metasediment, Cretaceous silty shale and sandstone, and Eocene sandstone with

to no resolvable stratigraphy or structure. Faults shown on the seismic-reflection profiles are identified on the basis of the abrupt offset, 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 right-lateral San Andreas Fault (Maps A, D, on sheets 1, 2) is the dominant geologic structure in the map area and is the primary structure in the widely distributed plate boundary between the Pacific Plate and the Sierra Nevada–Great Valley Microplate (Williams and others, 2006). The

Johnson, S.Y., and Beeson, J.W., 2019, Shallow structure and geomorphology along the offshore northern San Andreas San Andreas Fault extends for 1,100 km from the Salton Sea to the Mendocino Triple Junction, marking the southern boundary of the Cascadia convergent margin (Dickinson and Snyder, 1979; Prentice, 1999; Williams and others, 2006). Estimates of cumulative right-slip on the San Andreas Fault range from about 300 to 450 km along the southern and northern segments of the San Andreas Fault "system" (the group of distributed strike-slip faults along the plate boundary),

respectively (James and others, 1993; Wesnousky, 2005). The map area includes the northernmost section of the San Andreas Fault (Maps A–F), which in the map area extends

Lawson, A.C., 1908, The California earthquake of April 18, 1906: Carnegie Institute of Washington, Report of the State offshore from Point Arena in the south to Point Delgada and Shelter Cove in the north (Beeson and others, 2017). Relative to the vector of plate convergence (~329°; UNAVCO, 2018), most of this section of the fault strikes distinctly more northward (~330°–353°; Johnson and Beeson, 2019). The most northward-striking (~353°) part of the San Andreas Fault in this area is located offshore between the mouths of Ten Mile River and Usal Creek, where fault-related transtension has resulted in development of the Quaternary-age Noyo Basin (figs. 18, 19, 20, 21; see also, Beeson and others, 2017). At its north end near Point Delgada, the San Andreas Fault bends about 8° more to the northwest (from 353° to 345°), forcing uplift and exposure of the basement rocks of unit TKJu on the seafloor, on Tolo bank (Beeson and others, 2017). The San Andreas Fault comes onshore at Shelter Cove (Lawson, 1908; Brown and Wolfe, 1972; Prentice and others, 1999), where it transitions into a complex contractional structural zone in or on the southwestern margin of the rapidly uplifting King Range (Merritts and Bull, 1989; Merritts, 1996; McLaughlin and others, 2000). We were unable to document in our seismic-reflection profiles any significant late Quaternary faulting or folding in the offshore southwest of the central and eastern King Range (figs. 4–13), and, hence, we believe that this complex structural zone is located north of our profiles, either onshore or possibly in the nearshore. Such a nearshore structure (the queried fault shown on Maps A, Merritts, D., 1996, The Mendocino triple junction—Active faults, episodic coastal emergence, and rapid uplift: Journal of B, and C) would have a strike similar to that of the San Andreas Fault in the Santa Cruz Mountains (Johnson and Beeson, 2019). The northwest-striking Mattole Canyon Fault, mapped on the southwest flank of Punta Gorda at the northwest end

Merritts, D., and Bull, W.B., 1989, Interpreting Quaternary uplift rates at the Mendocino triple junction, northern of our seismic-reflection survey (figs. 1-3), may represent the southern margin of the complex King Range structural zone and (or) a continuation of the queried fault zone in the nearshore. We were only able to map the Mattole Canyon Fault a

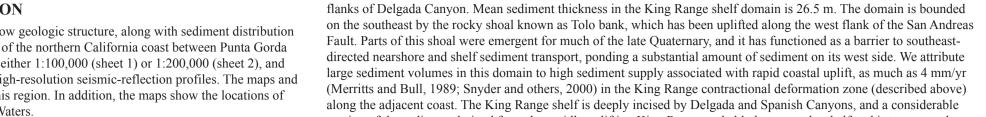
Mitchum, R.M., Jr., Vail, P.R., and Sangree, J.B., 1977, Seismic stratigraphy and global changes of sea level, part 6 short distance, given the geographic limits of our geophysical survey; more data is needed to clearly define this complex transitional zone between Punta Gorda and the Mendocino Triple Junction.

On sheets 1 and 2, Maps B and E show the thickness of the post-LGM depositional unit (blue shading on figs. 1–30), and Maps C and F show the depth to the base of the unit. To make these maps, water bottom and depth to base of the uppermost Pleistocene and Holocene sediment layer were mapped from seismic-reflection profiles. The difference between the two horizons was exported for every shot point as XY coordinates (UTM zone 10) and two-way travel time (TWT). The thickness of the uppermost Pleistocene and Holocene unit (Maps B and E) was determined by applying a sound velocity of 1,600 m/sec (following the method of Sommerfield and others, 2009) to the TWT. The thickness points were interpolated to a preliminary continuous surface, overlaid with zero-thickness bedrock outcrops, and contoured, following the methodology of Wong and others (2012). The data points from seismic-reflection profiles are dense along tracklines (about 1–2 m apart) and sparse between tracklines (typically 800–1,000 m apart), resulting in contouring artifacts. Contours were therefore manually edited in a few areas to incorporate the effect of faults, to remove irregularities from interpolation, and to reflect other geologic information and complexity. Contour modifications and regridding were repeated a few times to produce the final maps. Data for the depth to base of the uppermost Pleistocene and Holocene unit (Maps C and F) were generated by adding the thickness data to water depths determined from bathymetric mapping (Maps A and D). The area covered in Maps B, C, E, and F extends from the eastern extent of the seismic tracklines (typically the inner shelf, at water depths of 10 to 15 m) to either the western extent of trackline coverage (generally the outer shelf) or to the shelf break. Within this about 120-km-long region of open coast, five different "domains" of shelf sediment are delineated on the

basis of coastal geomorphology and sediment thickness (Maps B and E, on sheets 1 and 2). Coastal relief and sediment supply are variable across this region; however, all sediment domains are exposed to the wave-dominated, open Pacific coast, the highest wave energy being focused at coastal promontories. Table 1 summarizes the size, mean sediment thickness, and sediment volume of each domain. (1) The Punta Gorda bank shelf domain lies on the shelf (~7 to 9 km wide) southwest of Punta Gorda and includes a Canyon Fault forms the northeastern margin of Punta Gorda bank (fig. 2), whereas the southwestern margin of Punta Gorda bank is not obviously structurally controlled. Mean sediment thickness in the Punta Gorda bank shelf domain is 3.1 m; the maximum thickness (~17 m) is found in a northwest-trending trough on the northwest flank of the Mattole Canyon Williams, T.B., Kelsey, H.M., and Freymueller, J.T., 2006, GPS-derived strain in northwestern California—Termination of Fault (fig. 2). The Punta Gorda bank shelf domain extends to the northwest boundary of our seismic-survey area: the southeast boundary of the domain is approximately where sediment thickness increases substantially as part of the King Range shelf domain (Map B).

reflections. Dashed purple lines highlight prominent unconformities. Dashed yellow lines are seafloor multiples (echoes of seafloor reflector). Purple triangle shows approximate location of California's State Waters limit (yellow

(2) The King Range shelf domain is located on the about 6- to 11-km-wide shelf northwest of Tolo bank, on the southwest flank of the King Range. Maximum sediment thickness (~64 m) is found in large, prograding offshore bars (figs. 8, 9, 10, 12, 13) adjacent to the mouths of Big Flat Creek and Telegraph Creek, on the northwest and southeast



(Merritts and Bull, 1989; Snyder and others, 2000) in the King Range contractional deformation zone (described above) along the adjacent coast. The King Range shelf is deeply incised by Delgada and Spanish Canyons, and a considerable portion of the sediment derived from the rapidly uplifting King Range probably bypasses the shelf and is transported through these canyons to the deep sea. (3) The Tolo bank shelf domain is found on the shelf (~12 to 16 km wide) south of Shelter Cove, coinciding closely with the seafloor bedrock exposures of Tolo bank. This domain (and Tolo bank) is bound on the east by the San Andreas Fault Zone, and the maximum sediment thickness in this domain is located in a small sag basin within and adjacent to the

fault zone (fig. 16). Mean sediment thickness in the Tolo bank shelf domain is 1.2 m. Tolo bank restricts southeastirected littoral and shelf sediment transport in this region and is an important control on sediment distribution. (4) The Noyo Basin shelf domain is located on the about 15- to 19-km-wide shelf east and south of Tolo bank. The southern limit of the domain extends west into the offshore between Fort Bragg and the mouth of Ten Mile River, and it lies a few kilometers south of the head of Noyo Canyon. Mean sediment thickness in this domain is 8.4 m, but there is significant variation. Maximum sediment thickness (~46 m) in the Noyo Basin shelf domain is found in a nearshore-bar depocenter east of the south edge of Tolo bank (figs. 16, 17). Nearshore bars offshore of Usal Creek and smaller coastal watersheds to the south contain sediment 10 to 30 m thick (figs. 18, 19, 20, 21). Thinner (3.5–7 m) sediment cover characterizes most of the midshelf area in this domain, and minimal sediment (0.25–3.5 m) is present on the midshelf to

outer shelf areas west of the San Andreas Fault (figs. 18, 19). (5) The Point Arena shelf domain mainly occupies the inner to middle parts of the about 11- to 20-km-wide shelf, xtending from the south boundary of the Noyo Basin shelf domain to the south end of our seismic surveys (Map D). Mean sediment thickness in the Point Arena shelf domain is 6.0 m. Thickest sediment (as much as ~26 m) is found in a series of discontinuous inner shelf bars (figs. 25, 26, 27, 28, 29, 30) that receive sediment from several variably sized coastal watersheds, which include Noyo River, Big River, Little River, Albion River, and Navarro River. Sediment generally thins westward on the midshelf, and minimal sediment (mostly 0.25–3.5 m) is present west of the San Andreas Fault, north of the mouth of the Navarro River (figs. 24, 25, 26). Because of increasing proximity to the coast, thicker sediment (as much as 10.5–14 m) is present west of the San Andreas Fault, south of the Navarro River (figs. 27, 28, 29,

Mean sediment thickness for the entire shelf area covered by our seismic surveys between Point Arena and Punta Gorda is 8.9 m, and total post-LGM sediment volume is 12,824×106 m³. Mean sediment thickness for the shelf area within California's State Waters between Point Arena and Punta Gorda is 12.4 m, and total sediment volume is 9,473×106 m³. Sediment distribution and thickness varies substantially in both regions, largely in response to variations in sediment

supply and both local and regional tectonics. Table 1. Area, sediment-thickness, and sediment-volume data for the five regional shelf-sediment domains between Punta Gorda

			Mean sediment	Sediment volume	
	Domain	Area (km²)	thickness	(10 ⁶ m ³)	
(1) Pur	nta Gorda bank shelf	72.0	3.1	224	
Punta	Gorda bank shelf, within California's State Waters	61.2	2.7	168	
(2) Kin	g Range shelf	186.6	26.5	4,958	
King I	Range shelf, within California's State Waters	135.1	31.4	4,241	
(3) Tol	o bank shelf	153.2	1.2	179	
Tolo b	ank shelf, within California's State Waters	46.1	0.9	43	
(4) No	yo Basin shelf	550.7	8.4	4,643	
Noyo :	Basin shelf, within California's State Waters	209.8	13.5	2,847	
(5) Poi	nt Arena shelf	481.5	6.0	2,891	
Point A	Arena shelf, within California's State Waters	306.9	7.1	2,174	
Entir	re Punta Gorda to Point Arena region	1,425.6	8.9	12,824	
Enti	re Punta Gorda to Point Arena region, within	761.4	12.4	9,473	

- Beeson, J.W., Johnson, S.Y., and Goldfinger, C., 2017, The transtensional offshore portion of the northern San Andreas fault—Fault zone geometry, late Pleistocene to Holocene sediment deposition, shallow deformation patterns, and asymmetric basin growth: Geosphere, v. 13, p. 1173–1206, https://doi.org/10.1130/GES01367.1. Beeson, J.W., Johnson, S.Y., Goldfinger, C., and Hartwell, S.R., 2016, Marine geophysical data—Point Arena to Cape Mendocino: U.S. Geological Survey data release, https://doi.org/10.5066/F7GT5K8R. Blake, M.C., Jr., Jayko, A.S., and McLaughlin, R.J., 1985, Tectonostratigraphic terranes of the northern Coast Ranges, California, in Howell, D.C., ed., Tectonostratigraphic terranes of the Circum-Pacific region: Earth Science Series, Circum-Pacific Council for Energy and Mineral Resources, v. 1, p. 159–171. Delgada and Bolinas Bay, California: U.S. Geological Survey Miscellaneous Geologic Investigations Map I–692,
- of Upper Cretaceous to upper Eocene arkosic sandstone, mudstone, and conglomerate (Evitt and Pierce, 1975; Blake and Dickinson, W.R., and Snyder, W.S., 1979, Geometry of triple junctions related to San Andreas Transform: Journal of Geophysical Research - Solid Earth, v. 84, p. 561–572. Evitt, W.R., and Pierce, S.T., 1975, Early Tertiary ages from the coastal belt of the Franciscan complex, northern commonly deformed, and they are imaged in the seismic profiles as reflection free (that is, massive) zones that have little

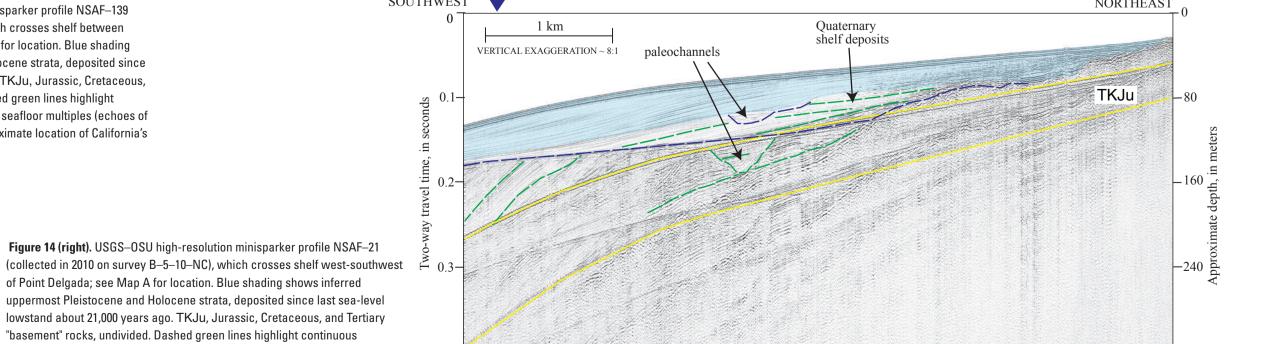
 Hoskins, E.G., and Griffiths, J.R., 1971, Hydrocarbon potential of northern and central California offshore, in Cram, I.H.,
 - ed., Future petroleum provinces of the United States—Their geology and potential: American Association of James, E.W., Kimbrough, D.L., and Mattinson, J.M., 1993, Evaluation of displacements of pre-Tertiary rocks on the northern San Andreas fault using U-Pb zircon dating, initial Sr, and common Pb isotopic ratios: Geological Society of America Memoir 178, p. 257–272.
 - Fault, Tomales Point to Fort Ross, California: Bulletin of the Seismological Society of America, v. 109, p. 833–854, Johnson, S.Y., Cochrane, G.R., Golden, N.E., Dartnell, P., Hartwell, S.R., Cochran, S.A., and Watt, J.T., 2017, The California Seafloor Mapping Program—Providing science and geospatial data for California's State Waters: Ocean and Coastal Management, v. 140, p. 88–104, https://doi.org/10.1016/j.ocecoaman.2017.02.004.
 - McCulloch, D.S., 1987, Regional geology and hydrocarbon potential of offshore Central California, in Scholl, D.W., Grantz, A., and Vedder, J.G., eds., Geology and resource potential of the continental margin of western North America and adjacent ocean basins—Beaufort Sea to Baja California: Circum-Pacific Council for Energy and Mineral Resources, Earth Science Series, v. 6, p. 353–401.
 - McLaughlin, R.J., Ellen, S.D., Blake, M.C., Jr., Jayko, A.S., Irwin, W.P., Aalto, K.R., Carver, G.A., and Clarke, S.H., Jr. 2000, Geology of the Cape Mendocino, Eureka, Garberville, and southwestern part of the Hayfork 30×60 minute quadrangles and adjacent offshore area, northern California: U.S. Geological Survey Miscellaneous Field Studies Map MF–2336, 6 sheets, scales 1:24,000 to 1,100,000, https://pubs.usgs.gov/mf/2000/2336/. McLaughlin, R.J., Sliter, W.V., Frederiksen, N.O., Harbert, W.P., and McCulloch, D.S., 1994, Plate motions recorded in
 - tectonostratigraphic terranes of the Franciscan complex and evolution of the Mendocino triple junction, northwestern California: U.S. Geological Survey Bulletin 1997, 60 p. Geophysical Research - Solid Earth, v. 101, p. 6051–6070.
 - California, from uplifted marine terraces: Geology, v. 17, p. 1020–1024. Stratigraphic interpretation of seismic reflection patterns in depositional sequences, in Payton, C.E., ed., Seismic stratigraphy—Applications to hydrocarbon exploration: American Association of Petroleum Geologists Memoir 26,
 - National Oceanic and Atmospheric Administration, 2017, National Oceanic and Atmospheric Administration Office for Coastal Management's Digital Coast, accessed March 2018 at https://coast.noaa.gov/digitalcoast/. Prentice, C.S., 1999, San Andreas fault—The 1906 earthquake and subsequent evolution of ideas, *in* Moores, E.M., Sloan, D., and Stout, D.L., eds., Classic Cordilleran concepts—A view from California: Geological Society of America
 - Prentice, C.S., Merritts, D.J., Beutner, E.C., Bodin, P., Schill, A., and Muller, J.R., 1999, Northern San Andreas fault near Shelter Cove, California: Geological Society of America Bulletin, v. 111, no. 4, p. 512–523. Snyder, N.P., Whipple, K.X., Tucker, G.E., and Merritts, D.J., 2000, Landscape response to tectonic forcing—Digital elevation model analysis of stream profiles in the Mendocino triple junction region, northern California: Geological Society of America Bulletin, v. 112, p. 1250–1263.
 - Sommerfield, C.K., Lee, H.J., and Normark, W.R., 2009, Postglacial sedimentary record of the Southern California continental shelf and slope, Point Conception to Dana Point, in Lee, H.J., and Normark, W.R., eds., Earth science in the urban ocean—The southern California continental borderland: Geological Society of America Special Paper 454, Stanford, J., Hemingway, R., Rohling, E., Challenor, P., Medina-Elizalde, M., and Lester, A., 2011, Sea-level probability
 - for the last deglaciation—A statistical analysis of far-field records: Global and Planetary Change, v. 79, p. 193–203. UNAVCO, 2018, Plate motion calculator: UNAVCO website, accessed July 24, 2018, at https://www.unavco.org/software/
- Waelbroeck, C., Labeyrie, L., Michel, E., Duplessy, J.C., McManus, J.F., Lambeck, K., Balbon, E., and Labracherie, M., 2002, Sea-level and deep water temperature changes derived from benthic foraminifera isotopic records: Quaternary Science Reviews, v. 21, p. 295–305. significant, ~2- to 3-km-wide area of exposed bedrock on the seafloor, here referred to as Punta Gorda bank. The Mattole

 Wesnousky, S.G., 2005, The San Andreas and Walker Lane fault systems, western North America—Transpression, transfersion, cumulative slip and the structural evolution of a major transform plate boundary: Journal of Structural
 - Cascadia forearc contraction: Tectonophysics, v. 413, p. 171–184. Wong, F.L., Phillips, E.L., Johnson, S.Y., and Sliter, R.W., 2012, Modeling of depth to base of Last Glacial Maximum and seafloor sediment thickness for the California State Waters Map Series, eastern Santa Barbara Channel, California: U.S. Geological Survey Open-File Report 2012–1161, 16 p., https://pubs.usgs.gov/of/2012/1161/.









Offshore Shallow Structure and Sediment Distribution, Punta Gorda to Point Arena, Northern California Jeffrey W. Beeson¹ and Samuel Y. Johnson²

Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the This map or plate is offered as an online-only, digital publication. Users should be aware that, because of differences in rendering processes and pixel resolution, some slight distortion of scale may occur when viewing it on a computer screen or when printing i on an electronic plotter, even when it is viewed or printed at its intended publication scale

line on Maps A, B, C).

Figure 13 (left). USGS-OSU high-resolution minisparker profile NSAF-139

(collected in 2012 on survey B-04-12-NC), which crosses shelf between

Delgada Canyon and Point Delgada; see Map A for location. Blue shading

shows inferred uppermost Pleistocene and Holocene strata, deposited since

last sea-level lowstand about 21,000 years ago. TKJu, Jurassic, Cretaceous,

seafloor reflector). Purple triangle shows approximate location of California's

and Tertiary "basement" rocks, undivided. Dashed green lines highlight continuous reflections. Dashed yellow lines are seafloor multiples (echoes of

State Waters limit (yellow line on Maps A, B, C).