DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

TO ACCOMPANY MAP MF-1719

MAPS SHOWING LOCATIONS OF SELECTED PRE-QUATERNARY ROCK SAMPLES FROM 34° 30' NORTH LATITUDE to 42° NORTH LATITUDE, CALIFORNIA CONTINENTAL MARGIN

by

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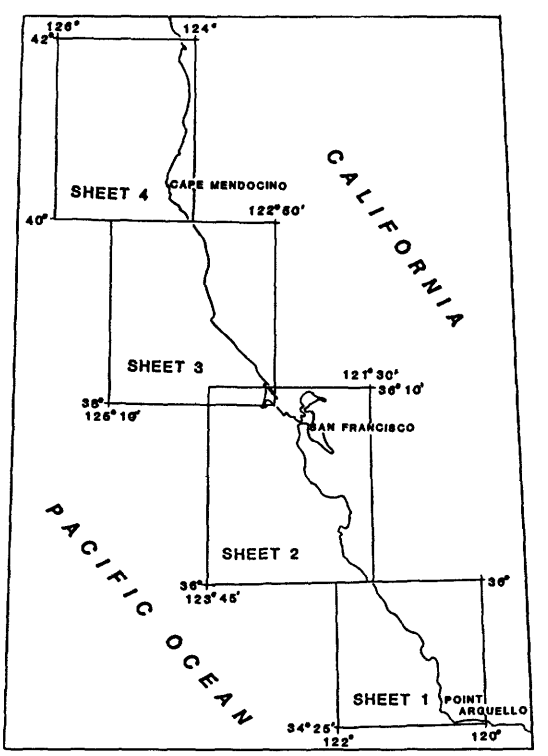
This report is comprised of four map sheets on which are shown the locations of rocks recovered from the central and northern California continental shelf and slope. Bottom samples reported on those sheets have been selected to include those from cruises that attempted to recover rocks of pre-Quaternary age. Rocks or unconsolidated sediment of Quaternary age are noted where recovered, although cruises dedicated to sampling Quaternary strata are not shown.

This pamphlet includes a table for each map sheet that lists the sample sites in order of increasing latitude, and at a given latitude, in order of increasing longitude. The table also gives, when determined (N.D., not determined), the location, water depth, lithologic description, age, sample identification number, and sampling device used. Sample locations were obtained by a variety of navigation techniques (radar, electronic range-range, loran). Precision and accuracy of the locations are unknown. Disagreements between reported sampling depths and those indicated by the bathymetry shown on the map sheets may result from errors in navigation, errors in soundings taken by the sampling vessel, or errors in the bathymetric chart. Lithologic descriptions were extracted from the most detailed reports available; they range from on-deck hand-specimen identification to thin section and x-ray diffraction analysis. The statements used in the tables are quoted directly from the source(s) cited and may not necessarily conform with stratigraphic nomenclature and age assignments adopted by the U.S. Geological Survey. Insertions are indicated by brackets, and omissions by dots. Statements such as 'like rocks recovered' are the judgement of the original author. Some authors have made inferences regarding age and equivalent onshore rocks or formations based on sample lithology. These inferred ages or correlations are included in the lithologic descriptions to distinguish them from listed age determinations that are based solely on fossils. Sample identifications are those given on various cruises, and the type of sampling device (dredge, core, grab) is listed with the identification. Core samples were recovered with a gravity-driven dart core. The location of the start and finish of the dredge hauls are given.

An explanation on each sheet lists the sample symbols, identifies the cruise, and gives the appropriate reference. A complete reference list follows the tables in the pamphlet.

Columnar sections of offshore test wells drilled in the early 1960's and an 1978 Outer Continental Shelf deep stratigraphic test well (OCS-CAL 78-164, No. 1) are shown as inset figures, and drill sites are located on the maps by well number.



N LAT.	W LONG.	UN-CORRECT-ED DEPTH (meters)	DESCRIPTION	AGE	SAMPLE NUMBER
34° 28'56.6"	120° 47'00"	435.2	The Point Conception well penetrated 8,005 ft of predominantly fine-grained clastic strata of Neogene age (Holocene to early middle Miocene). This is underlain by 265 ft of calcareous marine SANDSTONE and PEBBLE CONGLOMERATE containing undiagnostic pelecypod shells (questionably early Miocene). The lower Miocene sediment unconformably overlies 836 ft of SANDY SILTSTONE and MUDSTONE containing marine microfossils of Early Cretaceous to Late Jurassic age. The only conspicuous depositional break or faunal hiatus is the regional unconformity at the base of the apparently continuous Neogene section.	Well bottomed in late Jurassic to Early Cretaceous sediment dated by marine microfossils. 265 ft of ambiguously dated sediment overlies unconformity. Early middle Miocene to Holocene sediment follows (3,005 ft)	OCS-CAL 78-164, No.1
34° 33.5'	121° 17.5'	--	A few PHOSPHORITE nodules and a few small pieces of glauconitic SILTSTONE.	N.D.	VE-D7 (dredge)
34° 36.7'	121° 12'	--	A few PHOSPHORITE nodules and a few small pieces of glauconitic SILTSTONE.	N.D.	VE-D6 (dredge)
34° 36.7'	121° 47.0'				
34° 38.0'	121° 42.0'	2900	Laumontite-bearing feldspathic GRAYWACKE.	N.D.	ANTI-1- 1D (dredge)
34° 44.9'	121° 41.0'				
34° 44.9'	121° 38.7'	1323-1242	Soft granitic SANDSTONE was the dominant rock type. The size and angularity of the granitic sandstone indicate that it was in place. Individual grains are angular to subangular, implying rapid deposition with little reworking. Quartz and feldspar commonly show undulatory extinction, and the micas are deformed, suggesting that the rock has undergone a significant shearing or flattening deformation. The sandstone is similar to that found within the Franciscan assemblage, which also is quartz rich, angular to subangular, and internally sheared.	N.D.	KZ-73-D7 (dredge)
34° 49.2'	121° 14.7'	450	Well-rounded boulders and cobbles indicative of significant transport prior to deposition and also some rock fragments assumed to be local bedrock. The most abundant transported boulders were metaconglomerate, metasandstone, argillite, and mafic volcanic rocks. In-place rocks included pholad-bored granitic SANDSTONE and CALCARENITE, CHERT, and one piece of actinolite SCHIST. The schist was very angular and easily broken and probably could not have survived appreciable transportation.	N.D.	KZ-73-D5 (dredge)

34° 58.5'	121° 55.3'				
34° 58.5'	121° 51.4'	3250-2520	Volcanic boulders and manganese encrusted volcanic boulders. Probably BASALT.	N.D.	KZ-73-D6 (dredge)
35° 04.0'	121° 29.6'	504	Fine black SAND, crushes easily, slightly greenish inside, slightly magnetic.	N.D.	ANT-1-2DC (core)
35° 04.0'	121° 29.6'	400	Rock and sand, appears much like Monterey SHALE; siliceous; light colored with black CHERT lenses.	N.D.	ANT-1-5DC (core)
35° 04.5'	121° 27.9'	414	Small rock chips plus greenish sandy MUD.	N.D.	ANT-1-4DC (core)
30° 04.5'	121° 28.0'	417	Rock.	N.D.	ANT-1-3DC (core)
35° 08'00"	120° 48'57"	57	SILTSTONE, olive-gray.	Holocene foraminifers; barren of nannofossils.	NCAL-75-1G (core)
35° 08'09"	120° 48'48"	51	SANDSTONE, dark-gray, coarse, poorly cemented.	Barren of nannofossils.	NCAL-75-1I (core)
35° 08'25"	120° 48'38"	44	SANDSTONE, dark-gray, coarse, poorly cemented.	Barren of nannofossils.	NCAL-75-1K (core)
35° 08'30"	120° 44'30"	--	GRAYWACKE. Same as AQ-4 but here lithic volcanic clasts, an intermediate type (andesitic), are prominent mode.	N.D.	AQ-118 (core)
35° 08'36"	120° 48'27"	42	SANDSTONE, dark-gray, medium-grained, recent shells.	Barren of nannofossils.	NCAL-75-1L (core)
35° 08'43"	120° 48'15"	38	SANDSTONE, dark-gray, medium-grained; red organic coating on fractured surface; rock seems to be more fractured than other samples.	Barren of nannofossils.	NCAL-75-1M (core)
35° 08'55"	120° 48'05"	32	SANDSTONE, dark-gray with red organic coating.	Holocene foraminifers; barren of nannofossils.	NCAL-75-1Q (core)
35° 09'17"	120° 50'47"	62	Green CLAY and SILTSTONE with worm borings; olive-gray, very hard LIMESTONE or DOLOMITE. Monterey-type lithology.	Holocene foraminifers; barren of nannofossils.	NCAL-75-2Q (core)
35° 09'27"	120° 50'30"	58	Three inches of modern, [Holocene] SAND on top of 1 in. of dark-brown SHALE.	Barren of nannofossils.	NCAL-75-2'O' (core)
35° 09'32"	120° 50'07"	49	SILTSTONE or SHALE, dark-brown, weathered.	Barren of nannofossils.	NCAL-75-2M (core)
35° 09'37"	120° 50'00"	48	Eight inches of green MUD on top of 1 in. of brown-weathered SHALE.	Barren of nannofossils.	NCAL-75-2K (core)
35° 09'47"	120° 51'52"	76	SILTSTONE, dark-brown. Miocene-type lithology.	Barren of nannofossils.	NCAL-75-3N (core)

(Sheet 1--Cont.)

35° 09'58"	120° 49'57"	34	SANDSTONE, brown, fine-grained, some laminated; MUDSTONE or SHALE, brown; TAR clasts.	Miocene foraminifers, middle (?) Miocene (very questionable call); barren of nannofossils.	NCAL-75-2H (core)
35° 10'00"	120° 49'44"	33	Brown TUFF or SANDSTONE, medium-grained, laminated; brown SHALE.	Middle Miocene, foraminifers probably Luisian; contains Relizian restricted forams; may be reworked; middle Miocene coccoliths [in sandstone].	NCAL-75-2B (core)
35° 10'2"	120° 51'32"	68	SILTSTONE, chocolate-brown. Looks like Miocene chert.	Barren of nannofossils, Holocene foraminifers.	NCAL-75-3L
35° 10'03"	120° 49'49"	33	SANDSTONE, brown, layered, tuffaceous; SILTSTONE, light-olive-gray, laminated.	Middle Miocene, undifferentiated; foraminifers possibly Relizian; early-middle Miocene coccoliths [in sandstone].	NCAL-75-2C (core)
35° 10'03"	120° 49'49"	33	Silt-size particles; SILTSTONE; brownish-black SHALE.	Miocene foraminifers, [possibly] middle Miocene (questionable because few species); early-middle Miocene coccoliths [in shale].	NCAL-75-2D
35° 10'08"	120° 49'27"	29	SANDSTONE or TUFF; brownish-gray laminated SILTSTONE.	Middle Miocene Luisian foraminifers; early to middle Miocene coccoliths [in sandstone or tuff].	NCAL-75-2A (core)
35° 10'08"	120° 51'26"	65	SILTSTONE or SHALE, dark-brown.	Barren of nannofossils.	NCAL-75-3K (core)
35° 10'13"	120° 51'16"	56	SILTSTONE, chocolate-brown, hard, bored.	Holocene foraminifers; barren of nannofossils.	NCAL-75-3J (core)
35° 10'21"	120° 51'09"	53	Siliceous SHALE, laminated.	Holocene foraminifers.	NCAL-75-3I (core)
35° 10'25"	120° 51'03"	47	SHALE, dark-brown, silty.	Holocene foraminifers; barren of nannofossils.	NCAL-75-3E (core)
35° 10'44"	120° 50'46"	39	SILTSTONE or TUFF, medium-brown, laminated, weathered.	Holocene foraminifers mostly; there are also some poorly preserved foraminifers that are likely to be Miocene but impossible to identify [in siltstone or tuff].	NCAL-75-3A (core)
35° 11'05"	120° 52'32"	68	Four inches of green sandy MUD on top of 1 in.of brown MUDSTONE.	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-4P (core)

35° 11'10"	120° 52'20"	61	MUDSTONE, dark-brown, siliceous, dense, compact. SILTSTONE, yellowish-gray to olive-black. Tan CHERT with foraminifers broken along the fractures of the chert.	Miocene, foraminifers probably middle or late Miocene; barren of nannofossils.	NCAL-75-4'O' (core)
35° 11'15"	120° 52'25"	---	Argillaceous CARBONATE; dark, muddy carbonate, very fine-grained. Carbonate may be in part authigenic. Probably Monterey Formation or equivalent of Miocene age.	Barren of foraminifers and nannofossils.	AQ-34 (core)
35° 11'39"	123° 54'27"	87	Hard rock found in green clay MUD. SANDSTONE and SILTSTONE, olive-gray, very fine-grained.	Indeterminate diatoms.	NCAL-75-5A (core)
35° 11'41"	120° 54'44"	95	Four inches of micaceous SILTSTONE (feldspathic?).	Holocene foraminifers; barren of nannofossils.	NCAL-75-5D(core)
35° 24.4'	121° 42.7'				
35° 12.9'	121° 33.2'	1258-1036	Cloth bag of rocks plus jar of biological material; GRAYWACKE (Upper Cretaceous or lower Tertiary?); TAR.	Miocene (?) foraminifers.	ANTI-1-7D (dredge)
35° 16'45"	120° 55'38"	--	Fine-grained ARGILLITES; dark, micaceous, faintly laminated argillaceous material with common detrital quartz and feldspar. Some possible microfossils. No authigenic quartz, but chlorite and carbonate possibly are. Probably Monterey Formation or equivalent of Miocene age.	Barren of foraminifers and nannofossils.	AQ-113 (core)
35° 16'50"	120° 55'33'	---	Same as AQ-113.	N.D.	AQ-115 (core)
35° 17'53"	120° 55'42"	58	MUDSTONE, 2 in, dark-brown, fissile, slightly sandy.	Barren of nannofossils.	NCAL-75-8T (core)
35° 18'01"	120° 55'29"	57	MUDSTONE, few very angular fragments, well-indurated, silicified, dark-brown, conchoidal fracture.	Barren of nannofossils.	NCAL-75-8S (core)
35° 18'11"	120° 55'28"	58	MUDSTONE, dark-brown, partially silicified; CHERT, light-tan with leached forams.	Middle (?) Miocene foraminifers (foram outlines indicate a possible Middle Miocene assemblage, but this is very questionable). Barren of nannofossils.	NCAL-75-8Q (core)
35° 18'23"	120° 55'23"	60	Two inches of brown CLAY (mostly shale fragments) on top of 2 in. of compact brown SHALE.	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-8'O' (core)

(Sheet 1--Cont.)

35° 18'25"	120° 55'28"	---	Same as AQ-113.	N.D.	AQ-24 (core)
35° 18'41"	120° 54'58"	55	Three inches of brown SHALE (looks like Miocene chert).	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-8I (core)
35° 18'48"	120° 54'49"	53	MUDSTONE, 2 in, brown-gray.	Barren of nannofossils.	NCAL-75-8H (core)
35° 18'50"	120° 55'40"	---	Silty ARGILLITES; same as fine-grained argillites [see AQ-113 above] but proportion of detrital quartz and feldspar is higher.	N.D.	AQ-111 (core)
35° 18'53"	120° 54'37"	51	CLAY, green-brown, hard, grading to soft; SILT, brownish-black, semiconsolidated.	No foraminifers; Miocene (?) diatoms.	NCAL-75-8G (core)
35° 18'55"	120° 57'49"	92	Three inches of brown SILTSTONE with "seaweed" growing on top. Top of sample harder than bottom though lithology is similar.	Barren of nannofossils.	NCAL-75-9P (core)
35° 19'03"	120° 56'18"	74	CLAY, greenish, sandy. SHALE or SILTSTONE, brown.	Middle to late (?) Miocene foraminifers probably Relizian to Mohnian; barren of nannofossils.	NCAL-75-9I (core)
35° 19'03"	120° 56'45"	78	Three inches of pebbly, clayey SAND with shell fragments and abundant forams on top of 4 in. of brown MUDSTONE.	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-9K (core)
35° 19'03"	120° 57'11"	89	Fourteen inches of pebbly clayey SAND with shell fragments; organic (modern), on top of 2 in. of brown brittle siliceous (?) MUDSTONE.	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-9N (core)
35° 19'08"	120° 55'20"	62	MUDSTONE, brown.	Barren of nannofossils.	NCAL-75-9B (core)
35° 19'13"	120° 55'34"	?	CLAY, 2 in, brown, sandy, on top of in of hard brown MUDSTONE.	Barren of nannofossils.	NCAL-75-9C (core)
35° 19'17"	120° 54'01"	42	MUDSTONE, dark-brown, dense; SILTSTONE, olive-black; SILICEOUS SHALE. Miocene lithology.	Barren of foraminifers and nannofossils.	NCAL-75-8C (core)
35° 19'25"	120° 55'10"	---	Same as AQ-113 [see above].	Barren of foraminifers and nannofossils.	AQ-110 (core)

35° 20'25"	120° 54'50"	--	Same as AQ-113 [see above].	Foraminifers very rare and probably surface contamination; not from formation lithology. Barren of nannofossils.	AQ-108 (core)
35° 20'59"	120° 58'58"	72	Two inches of brown SHALE or SILTSTONE, soft to firm, moderately indurated.	Holocene foraminifers; barren of nannofossils.	NCAL-75-10F (core)
35° 20'37"	121° 00'00"	---	Same as AQ-111 [see above]. Possible glauconite grain. Probably Monterey Formation or equivalent of Miocene age.	Foraminifers very rare and probably surface contamination; not from formation lithology.	AQ-103 (core)
35° 21'00"	120° 58'42"	90	One inch of green silty CLAY on top of 3 in. of brownish-green to light-brown hard laminated SILTSTONE.	Indeterminate foraminifers; Quaternary coccoliths.	NCAL-75-10E (core)
35° 21'10"	120° 00'05"	---	Same as AQ-111 [see above]. Bedding is present; prominent quartz silt layering in ARGILLITE.	N.D.	AQ-104 (core)
35° 23'25"	120° 56'40"	---	ULTRAMAFIC rock. Plagioclase cumulate with equant subhedra and euhedra of enstatite and feldspar surrounded interstitially by serpentine, after olivine (probably). Chloritic rims on plagioclase. Abundant exsolution lamellae in enstatite. Cracks in cumulate grains possibly related to expansion of serpentine.	N.D.	AQ-101 (core)
35° 24'35"	120° 59'00"	78	Two inches of soft clayey pebbly green SAND on top of 2 in of firm green-gray to black sandy CLAY with clasts(?) of black, hard rock up to 3/4 in diameter (black CHERT?).	Quaternary coccoliths.	NCAL-75-12F (core)
35° 25.0'	121° 45.5'	1271-1005	Several rounded cobbles of QUARTZ MONZONITE and QUARTZ DIORITE. Most common rock recovered was granitic SANDSTONE, with lesser amounts of pholad-bored PHOSPHORITE, some SILTSTONE, and MAFIC VOLCANIC rock. Sandstone, siltstone, and phosphorite were most probably in place. The granitic cobbles were transported an unknown distance.	N.D.	KZ-73-D4 (dredge)

(Sheet 1--Cont.)

35° 25'45"	120° 57'45"	---	GRAYWACKE: Predominantly angular quartz, feldspar, and lithic grains in micaceous matrix. Detrital biotite altered to chlorite in part.	N.D.	AQ-4 (core)
			Little or no pressolution or recrystallization but compaction deformation is very evident in mica grains and argillite clasts. Quartz: clear angular grains with inclusion trains and grains of polygonized metamorphic type. Lithic: argillites, felsic volcanics, cherty grains. Plagioclase (K-spar unknown). Biotite: detrital grains and matrix. Chlorite, muscovite, epidote, opaques.		
35° 27'47"	121° 05'19"	98	SILTSTONE, olive-gray.	Late late Miocene or early Pliocene diatoms and silicoflagellates.	NCAL-75-17C (core)
35° 29'29"	121° 05'30"	64	Two inches of brown SHALE or clayey SANDSTONE, as in NCAL-75-18E [see below].	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-18G (core)
35° 29'43"	121° 05'38"	58	Four inches of fractured brown-gray SANDSTONE (as in NCAL 75-18E) and SHALE. Shale is well indurated. Heavy mineral bedding present in sandstone.	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-18F (core)
35° 30'21"	121° 05'52"	53	Four inches of medium-gray (unoxidized) to yellow-brown (oxidized) moderately indurated dirty, fine-grained, poorly sorted, well-rounded SANDSTONE. Uppermost 1/2 is coated with Holocene shell sand; heavy mineral layering noted.	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-18E (core)
35° 30'35"	121° 06'08"	56	One inch of gray soft clayey SAND with abundant shells, on top of 2 in.of gray to brown firm clayey SAND, on top of 1 in. of dark-brown hard SHALE (somewhat fissile).	Indeterminate foraminifers; barren of nannofossils.	NCAL-75-18A (core)
35° 32'29"	121° 16'38"	318	Eighteen inches of green, very firm CLAY with water-worn pebbles at top of core. Pebbles look like Franciscan type.	Late Miocene or early Pliocene diatoms and silicoflagellates.	NCAL-75-23A (core)
35° 36'10"	121° 12'20"	53	Three and one half inches of chocolate-brown SILTSTONE, moderately well indurated, with some very thin white veinlets. Some clay present in this rock.	Middle Miocene foraminifers, poorly preserved, possibly Relizian; barren of nannofossils.	NCAL-75-25A (core)

35° 36'26"	121° 12'15"	38	Brown-weathered SILTSTONE with rock fragments at bottom and top of core (K?); much silty clay in core; possibly colluvium (8-in. long core).	Poorly preserved middle Miocene foraminifers, possibly Relizian; barren of nannofossils.	NCAL-75-25E
35° 36'30"	121° 12'05"	38	Rock fragments same as NCAL-75-25E, [see above] in clay matrix. Clay matrix yellow brown; appears more weathered than 25E. Microfossil sample taken about 2 in. from bottom of 8-inch-long core.	Middle Miocene, Luisian foraminifers; middle Miocene coccoliths.	NCAL-75-25F (core)

N LAT.	W LONG.	UN-CORRECT-ED DEPTH (meters)	DESCRIPTION	AGE	SAMPLE NUMBER
36° 04.2'	122° 11.8'				
36° 03.3'	122° 10.8'	1849-2150	Soft MUDSTONE or SHALE, forams.	N.D.	ANTI-1-10D (dredge)
36° 19.2'	121° 56.9'				
36° 19.1'	121° 56.2'	60-45	GRAVEL, few pebbles of angular to subrounded granite, red chert, and shale(?). Shelf here is probably bedrock with a thin cover of sand and gravel.	N.D.	LS-8 (dredge)
36° 22.4'	122° 15.8'				
36° 22.7'	122° 19.8'	1190-825	DOLOMITE (80%): many large, subrounded boulders of fine-grained, gray-brown, highly perforated dolomite. Some boulders may have pholad borings. All boulders phosphatically coated; most sides covered with bryozoans, calcareous worm tubes, and other marine growth. No fresh surfaces. Lithologically similar to . . . interbeds and concretions in the Monterey. SANDSTONE (20%): several small subangular, well-indurated, medium-grained, yellowish-brown, sandstone boulders. Clasts appear to be composed predominantly of quartz, lithic, and metamorphic rock fragments. No fresh surfaces. GRANITE: a few well-rounded pebbles of granitic rock.	Barren of microfossils.	MF-1 (dredge)
36° 22.20"	121° 58'10"				
36° 22.20"	121° 58'40"	---	Fragments of CLAYSTONE and SHALE (62%): tough to moderately tough and well- indurated, angular to subrounded, covered with worm holes, some pholad borings; fresh surfaces, light-yellow to medium-gray; weathered surfaces, dark-brownish to blackish-gray; mineral grains of silt-sized quartz and feldspar (5%), marine microfossils (5-15%). Unidentified centric diatoms, radiolarians, and sponge spicules. The association of abundant diatoms, somewhat laminated microstructure of the sediment . . . . together with the benthic foraminiferal fauna. . . strongly suggest this rock was derived from the Miocene Monterey Shale.	Late middle Miocene (Luisian) foraminifers.	LS-7 (dredge)
36° 24'40"	121° 58'00"				
36° 34'50"	121° 57'25"	---	Muddy SANDSTONE and silty MUDSTONE, moderately tough and indurated, subangular to subrounded, some pholad borings; medium-gray. Mineral grains of quartz, K-feldspar,	N. D.	LS-6 (dredge)

			plagioclase, authigenic chlorite, pyrite, and rock fragments. Distinct bedding 1-4 cm thick. Samples studied contained two distinct grain-size populations mixed together. Biogenic material is sparse, consisting of radiolaria, sponge spicules, fish bones, and fecal pellets. These appear similar to Purisima siltstone and mudstone found elsewhere in Monterey Bay, but are mapped as Tertiary-Quaternary undifferentiated in the absence of definitive age data.		
36° 25'50"	121° 57'25"				
36° 25'45"	121° 58'35"	---	Highly altered METASEDIMENTARY ROCK; moderately tough, angular, hackly, uneven surfaces, some worm holes; orange-brown to black; mineral grains of pyrite, calcite, and at least 6 unidentified minerals, extreme alteration; highly weathered throughout. May have undergone little transport.	N.D.	LS-5 (dredge)
36° 26'30"	121° 55'50"				
36° 26'30"	121° 56'25"	---	Muddy SANDSTONE and silty MUDSTONE; same as LS-6 [see above].	N.D.	LS-4 (dredge)
36° 27'15"	121° 57'25"				
36° 27'30"	121° 57'50"	---	Sandy SILTSTONE (81%): brittle and friable, subrounded to rounded, some worm holes, many pholad borings; light-greenish-gray, mineral grains of quartz, K-feldspar, glauconite, chlorite, pyrite, rock fragments. Distinct bedding approximately 2 cm thick. Limey, very fine grained SANDSTONE (19%): moderately tough and fairly well indurated, very angular, very rough, hackly, and uneven surface; dark-gray (fresh surfaces) to orange-brown (weathered surfaces); mineral grains of quartz, plagioclase, microcline, biotite, chlorite, rock fragments. Biogenic material similar to LS-6 [see above].	N.D.	LS-3 (dredge)
36° 28'35"	121° 58'10"				
36° 28'45"	121° 57'30"	---	Sandy SILTSTONE similar to LS-3. Pebble CONGLOMERATE, angular to subangular, .05-1 mm grain size, yellow-orange-brown. Rock fragments up to 5 cm; granodiorite, silty mudstone, chert, quartz, glauconite, biotite. Matrix is 25-35% calcite spar cemented sand. Biogenic material similar to LS-6 [see above].	N.D.	LS-1 (dredge)
36° 30.2'	121° 59.4'				
36° 30.5"	121° 59.3'	400-200	GRANODIORITE (10%): several angular boulders of medium-gray porphyritic biotite granodiorite, similar in modal composition to intrusive rocks exposed on the Monterey Peninsula;	Barren of fossils.	CB-5 (dredge)

(Sheet 2--Cont.)

			some fresh surfaces. MUDSTONE (65%): Large boulders, angular, well-indurated, silty, light- to medium-greenish- gray; clasts of quartz, K-feldspar, plagioclase, chlorite, biotite. PEBBLE CONGLOMERATE (25%): subangular to subrounded, moderately indurated, lightly perforated by pholad borings. Gray-green pebbles of quartz, chert, lithic fragments, and granitic and metamorphic rock fragments in a coarse sand matrix cemented by sparry calcite. Biogenic material similar to LS-6 [see above].		
36° 30.7' 36° 30.8'	121° 58.7' 121° 59.6'	450-120	GRANITE (99%): ten rounded to subangular pebbles (largest is 7x3x2 cm and average size is 3.5 x 2 x 1 cm), yellowish-gray (5Y7/2) fine- to medium-grained granitic rocks. Some rocks are perforated and some have freshly fractured surfaces indicating they may have been broken off larger rocks. Very little marine growth. In thin section appears to be a quartz diorite. SILTSTONE (1%): one small (2x2x2 cm) angular yellowish-gray (5Y7/2) perforated pebble. One side appears freshly fractured and other sides coated with phosphorite. Biogenic material similar to LS-6 [see above].	N.D.	CB-3 (dredge)
Same as CB-3		150-100	GRANITE: angular to well-rounded boulders, no fresh surfaces; a granodiorite. Silty MUDSTONE: tough and well indurated, subangular to subrounded, many more worm holes; some pholad borings; medium-gray. Poorly sorted LITHIC ARKOSE; the sandstone appears in thin section to consist of angular fragments of siltstone, quartz, and plagioclase feldspar. Most of the siltstone fragments are fractured and sheared, suggesting derivation from a fault zone. Also present are glauconite, pyrite, hornblende, a few fish bones, and radiolaria. Pronounced orientation of grains parallel to bedding planes. Pebble CONGLOMERATE: the conglomerate clasts are principally rounded quartz, chert, lithic fragments, and granitic rock pebbles in a coarse sand matrix cemented by sparry calcite. Also present: glauconite, biotite. Younger than silty mudstone or granodiorite. Biogenic material similar to LS-6 [see above].	Barren of fossils.	CB-4 (dredge)
36° 32.75' 36° 32.25'	122° 01.67' 122° 00.7'	449.7-365.6	LIMESTONE, in place.	Diatoms within the limestone indicate middle Miocene age.	C-5 (dredge)
36° 32.83' 36° 32.85'	121° 57.56' 121° 57.90'	182.8-137.1	GRANODIORITE, transported, but probably not far from outcrop.	N.D.	C-2 (dredge)
36° 34.4' 36° 33.25'	122° 01.3' 122° 01.3'	621.5-402.2	GRANODIORITE, slickinsides present; fault gouge. Sample probably taken from fault zone or very close to a fault zone.	N.D.	C-3 (dredge)

36° 35.05'	122° 02.45'				
36° 35.6'	122° 00.65'	915-175	GRANITE (99%): very angular cobbles and pebbles from 13x7x5 cm to less than 2x2x2 cm. Some have freshly fractured faces. Most are phosphatically coated and several are partially covered with calcareous worm tubes, bryozoans, and corals. One cobble is rounded and is about 4x3x2 cm. In thin section rock appears to be a granodiorite. CHERT: one angular pebble (6x3x3 cm in size) of red chert with fine calcitic veins. GNEISS: one small (4x3x2 cm in size) subrounded cobble. No unconsolidated rocks.	N.D.	CB-2 (dredge)
36° 36.67'	122° 04'				
36° 37.17'	122° 03.58'	1389.3-822.6	Angular fragments of dark- to light-brown banded siliceous SILTSTONE that contain radiolarians and diatoms characteristic of the Monterey Formation.	Middle Miocene diatoms.	C-11 (dredge)
36° 37.67'	122° 03.28'				
36° 38.0'	122° 01.58'	1096.8-310.8	GRANODIORITE and FELSITE, phenocrysts present. Rock probably in place.	N.D.	C-4 (dredge)
36° 37.5'	121° 53.7'				
36° 37.8'	121° 53.7'	35-55	GRANITE (5%): four boulder-sized angular chunks of porphyritic biotite granodiorite, very similar in modal composition to CB-5, with some marine growth and distinct fresh fractures on one boulder. Unconsolidated SAND (95%): gray-green, poorly sorted, fossiliferous (abundant shell fragments), silty sand.	Middle Miocene.	MB-26 (dredge)
36° 37.4'	121° 52.85'	40.5	Vibracore penetration depth: 3.35 m. Total core length: 3.3 m. Core consists of principally MUD and well-sorted SAND. Lower 0.6 m of core composed of olive-green MUD with chips of CHERT. Upper 2.4 m of core composed of very clean, well-sorted, medium-grained, greenish-white arkosic SAND that grades upward into greenish-gray fine-grained SAND. Several angular, freshly broken chunks of chert caught in core catcher suggest that this is the Monterey Formation.	Middle Miocene.	MBC-9 (core)
36° 37.55'	122° 00.75'				
36° 38.25'	122° 01.5'	1005-175	GRANITE (20%): very angular granitic boulders, cobbles, and pebbles ranging in size from 12x12x7 cm to less than 1x1x1 cm with an average size of approximately 4x5x2 cm. Many boulders exhibit fresh fractures; exposed sides are generally phosphatically coated and covered with bryozoans, calcareous worm tubes, and barnacles. Five of the granitic cobbles are well-rounded and range in size from 14x8x6 cm to 5x4x3 cm. In thin section rock is a biotite granodiorite. SILTSTONE (<1%): one very well rounded, broken and perforated, siltstone cobble, 6x6x5 cm in size, and one siltstone "rod" 10 cm long and 2 cm in diameter, perforated with small diameter worm burrows. "Rod" could be cast of larger diameter worm burrow. Bryozoans attached to both rocks, and both were greenish-gray.	N.D.	CB-1 (dredge)
36° 40.2'	122° 06.5'				
36° 38.75'	122° 0'4.37'	1608.6-1371	Same as C-11 [see above].	Middle Miocene diatoms.	M-31 (dredge)

(Sheet 2--Cont.)

36° 40.'33 36° 38.72'	122° 0'5.67 122° 00.33'	1169.9-365.6	SANDSTONE (90%): fossiliferous. LIMESTONE (10%): sample not in place; probably transported down Carmel Canyon.	N.D.	M-29 (dredge)
36° 40.25' 36° 40.67'	122° 07.5' 122° 07.58'	1261.3-1096.8	CHERT and SILTSTONE: probably not in place. Siltstone is probably dominant lithology beneath mud cover.	N.D.	M-22 (dredge)
36° 41.4' 36° 40.55'	122° 01.75' 122° 00.5"	915-230	GRANITE (70%): very angular granitic rocks from 18x12x3 cm to less than 2x2x2 cm; average of 5x4x3 cm. Some have fresh fractures indicating that they were broken from the outcrop during the dredging operation. Not much growth on surfaces, and where present only on one side. SILTSTONE (10%): two very large boulders, 30x32x25 cm and 25x25x10 cm of sandy and pebbly, highly fossiliferous siltstone, moderate-yellowish-brown (10YR5/4) to light-brown (5YR5/6) on weathered surfaces and dark-greenish-gray (5G4/1) on fresh surfaces. Surfaces of boulders are severely bored and burrowed and are subrounded in shape. Surfaces covered with phosphate and calcareous worm tubes, bryozoans, corals, and siliceous sponges. Small pebbles less than 1 cm in diameter consist of chert, slate, and other lithic fragments, well-rounded and scattered sparsely throughout mud matrix. Probably transported from outcrop upslope. In thin section the siltstone appears to be Purisima, based on its heavy mineral suite and volcanic rock fragments. However, grains within the rock are too fine grained to identify. MUD (20%): dark-greenish-gray mudstone (5GY4/1). This sample was dredged from or near its place of outcrop. . . suggesting that this area has undergone subsidence since late Pliocene time.	This small assemblage is of Pliocene age in terms of the Pacific Coast megainvertabrate sequence. . . These molluscs are of common occurrence in the shallower facies of the Purisima Formation of the Santa Cruz Mountains. The association of molluscs suggests a shallow-water environment - inner sublittoral (neritic) zone, possibly between 27 to 55 m.	MB-2 (dredge)
36° 42.0' 36° 41.17'	122° 01.08' 122° 00.75'	1425.8-438.7	GRANODIORITE, not porphyritic, in place.	N.D.	M-27 (dredge)
36° 42.53' 36° 42.5'	122° 01.0' 121° 57.75'	1005.4-365.6	GRANODIORITE, not porphyritic, in place.	N.D.	M-25 (dredge)
36° 43.0' 36° 42.58'	122° 02.5' 122° 01.83'	945-895.7	SILTSTONE, in place. Resembles Pliocene Purisima Formation.	N.D.	M-16 (dredge)
36° 44.83' 36° 45.05'	122° 01.03' 122° 04.25'	972.5-914	SILTSTONE (95%): may have been in place. GRANODIORITE (5%): probably not in place.	N.D.	M-14 (dredge)

36° 45.33'	122° 01.75'				
36° 44.83'	122° 00.25'	1065.7-974.3	SANDSTONE (50%) and SILTSTONE (50%), transported?	N.D.	M-19 (dredge)
36° 45.05'	121° 58.85'				
36° 45.3'	121° 58'	830-370	Burrowed, semi- to fairly well consolidated SILTSTONE. Color ranges from yellowish gray (5Y7/2) on weathered surfaces to greenish gray (5GY6/1) on fresh surfaces. Largest piece is 18x15x6 cm. Little marine growth. Some phosphatic coating. In thin section is very fine grained. Large clasts consist of subangular quartz and other lithic rock fragments. Largest grain is about .06 mm in size. Rock is lithologically similar to Purisima. MUD (60%): grayish-olive-green (5GY3/2).	Indeterminate; undiagnostic fauna.	MB-8 (dredge)
36° 46.0'	121° 59.17'				
36° 45.3'	121° 59.2'	882.9-292.5	SANDSTONE, probably in place.	N.D.	M-17 (dredge)
36° 46.3'	121° 55.5'				
36° 45.45'	121° 55.85'	400-135	SILTSTONE (35%): large (largest is 18x10x7 cm), angular, well-consolidated, sandy siltstone; grayish-orange (10YR7/4) on weathered surfaces, greenish-gray (5GY7/1) on fresh surfaces. Highly fossiliferous; some pieces are severely burrowed. Many rocks are partially covered with bryozoans, calcareous worm tubes, and barnacles; some have phosphatic coating. One rounded concretionary rock present. In thin section siltstone appears to be coarser grained than other siltstones collected in the canyon. The larger grains (some ranging up to .06 mm in size) are composed primarily of subangular quartz (about 10% of the coarse-grained material), plagioclase feldspar, biotite, chlorite, and some lithic rock fragments. Appears similar to Purisima lithology. SANDSTONE (1<%): two large angular boulders (24x16x11 cm and 35x25x20 cm) and several smaller cobbles of fine-grained, highly fossiliferous and perforated sandstone; dusky-yellow (5Y6/4) to yellowish-gray (5Y7/2) on weathered surfaces and pale-greenish-yellow (10Y8/2) on fresh surfaces. Many pholad-type borings found on surface of sandstone. Some samples, especially the fossiliferous ones, contain fine-grained gravel with chert and volcanic, granitic, and other lithic fragments. Fossils consist mainly of pelecypods. In thin section the sandstone is fine grained and appears similar to MB-4, but is finer grained. The predominant clasts are quartz and silicic, volcanic, and granitic rock fragments. Could be basal sand to Monterey Formation.	Middle Pliocene foraminifers similar to Purisima Formation. Micro- fauna suggests deposition at upper bathyal depths of 200 to 600 m. The shallow water Pliocene macrofauna assemblage can be correlated, with confidence, with the upper part of the Purisima Formation of the Santa Cruz Mountains (San Gregorio Sandstone Member?), the lower part of the type Merced Formation of the northern part of the San Francisco Peninsula, and exposures in the upper part of the Merced(?) Formation of Sonoma County. All of these onshore occurrences are of late Pliocene age.	MB-12 (dredge)

(Sheet 2--Cont.)

			GRANITE (<1%): three well-rounded granitic cobbles; the largest is 5x4x3 cm. In thin section looks like a granodiorite. MUD (65%): unconsolidated sandy silt to mud, fossiliferous, contains many well-rounded pebbles of chert, quartzite, and other lithic fragments; pebbles are generally less than 3 cm in size.		
36° 45.5' 36° 47.25"	122° 08.0' 122° 08.25'	1096.8- 292.5	SILTSTONE. Not in place. Possibly from subcrop higher up on canyon wall.	N.D.	M-18 (dredge)
36° 46.1' 36° 45.7'	121° 56.0' 121° 56.1'	300	SILTSTONE and SANDSTONE: gray, consolidated, perforated siltstone and fossiliferous sandstone; several cobble-sized pieces freshly broken off from outcrop. The perforated "siltstone" has remains of siliceous sponges attached. Presumably the burrows are those of a worm or crustacean; they are not pholad or mytilid (e.g., *Lithophaga)* mollusk borings which would indicate relatively shallow water.	Pelecypod restricted to the Pliocene epoch as used by West Coast molluskan paleontologists. Range within Purisima Formation.	N-2 (grab)
36° 46.83' 36° 45.87'	121° 57.62' 121° 56.47'	329- 274.2	SILTSTONE (45%). SANDSTONE (45%). LIMESTONE (7%). GRANODIORITE. Most varied lithology of all dredgings. Limestone and granodiorite not in place. Siltstone and sandstone probably in place, with siltstone the dominant lithology.	N.D.	M-9 (dredge)
36° 46.0' 36° 45.5'	121° 53.45' 121° 54.0'	230-110	CONGLOMERATE (90%): subangular, highly fossiliferous (pelecypods and gastropods) boulders (over 20 boulders) with very pale orange (10YR8/2), well-rounded, pebble-sized clasts of chert. Other clasts are composed of lithic and volcanic(?) rocks. A fine-grained sand matrix. Color varies from grayish-orange (10YR7/4) to moderate yellowish brown (10YR5/4) on weathered surfaces to light bluish gray (5B7/1) on fresh surfaces. Cement is calcareous, well indurated. Surfaces of boulders are well burrowed with marine growth, calcareous worm tubes, bryozoans, corals, barnacles, small rock scallops, and some siliceous sponges. Sizes of the boulders range from 20x17x13 cm to 4x4x4 cm. SANDSTONE (10%): subrounded to subangular sandstone boulders with same appearance and characteristics as sandy matrix of conglomerate, and probably represents a sandy facies of the conglomerate. Fairly friable. No muds or unconsolidated material.	Pliocene foraminifers similar to the Purisima Formation. Miocene or Pliocene mollusks.	MB-18 (dredge)

36° 47.6'	121° 54.35'				
36° 45.3'	121° 54.25'	350-110	SANDSTONE (5%): light-olive-gray (5Y5/2), consolidated to semiconsolidated, fossiliferous, arkosic sandstone. Samples are perforated with U-shaped worm tubes; many pelecypod shell fragments included. Samples consist of many small friable angular fragments with only three pieces larger than 3 cm in diameter; largest piece measures 5x19x13 cm. One subrounded pebble of sandstone, 3x3x2 cm in size, is well lithified and contains inclusions of opaque mineral grains. No marine growth present. SILTSTONE (20%): one tabular chunk of siltstone measuring 6x6x3.5 cm, perforated with worm tubes and coated with phosphorite and limonite. No marine growth or fresh surfaces. Many angular fragments or chips of siltstone. In thin section appears lithologically similar to siltstone sample MB-12. Matrix too fine-grained to identify minerals. Coarser grains consist of quartz, plagioclase, feldspar, biotite, and lithic and volcanic(?) rock fragments. Also contains foraminifers, diatoms, radiolaria, sponge spicules, glauconite. Largest grain is about .07 mm in size. Looks lithologically similar to Purisima. GRANITE (<1%): one well-rounded pebble of granodiorite. No marine growth. MUD (70-75%): olive-green to blue-gray.	Middle(?) Pliocene foraminifers, similar to typical Purisima Formation. Microfauna suggests an upper bathyal or lower neritic (depths of 200 to 75 m) depositional environment.	MB-16 (dredge)
36° 45.87'	122° 01.25'				
36° 47.7'	122° 03.45'	872-201.1	SILTSTONE, probably in place.	N.D.	M-12 (dredge)
36° 46.55'	121° 56.33'				
36° 48.05'	121° 56.3'	521-182.8	SILTSTONE. May be in place, similar to other dredge samples on canyon. May be Pliocene Purisima Formation.	N.D.	M-8 (dredge)
36° 47.03'	122° 05.45'				
36° 47.55'	122° 06.05'	460-275	SILTSTONE (1%): two well-rounded cobbles of well-indurated siltstone with some phosphatic coating. Also contains foraminifers, diatoms, radiolaria, sponge spicules, glauconite. MUD (99%): grayish olive green (5GY8/1) wet, greenish-gray (5GY6/1) dry, mud with silt interfingers and a few fossil fragments. In thin section the siltstone is coarse grained with fine-grained sand scattered throughout; largest grain is about .06 mm. About 30% subangular quartz with average size of about .05 mm. Approximately 5% volcanic(?) and lithic rock fragments and about 5% chlorite. The remainder of the grains too fine-grained to disseminate. Lithologically appears like Purisima.	Pliocene foraminifers: middle (?) Purisima Formation; fauna suggests an upper bathyal environment at depths of between 200 and 600 m.	MB-1 (dredge)

(Sheet 2--Cont.)

36° 47.6'	122° 04.5'				
36° 48.1'	122° 04.05"	600-145	SILTSTONE (40%): semi-consolidated, subrounded to subangular boulders, cobbles, and pebbles of fossiliferous siltstone. Largest boulder is 13x11x4 cm and average size is 4x4x6 cm. Color ranges from yellowish gray (5Y7/2) on weathered surfaces to light greenish gray (5G8/1) on fresh surfaces. Very little marine growth. Few fragments of molluskan fossil shells. Some chunks of siltstone are well bored and burrowed; one large calcareous worm tube 9 cm long and 1 cm in diameter. One whole pelecypod shell, rare radiolarians. In thin section the sample is similar to MB-1 with about 30% subangular quartz grains, average size about .07 mm; few shards of volcanic (?) fragments and lithic rock fragments totaling about 10% of sample. Lithologically appears like Purisima. GRANITE (<1%): one angular cobble (8x5x3 cm) of porphyritic biotite granodiorite with K-feldspar phenocrysts similar in modal composition to CB-5. UNCONSOLIDATED SAND AND MUD (60%): Grayish-olive-green (5GY3/2) wet MUD with a few rounded pebbles.	Pliocene foraminifers indicative of lower to middle (?) Purisima Formation.	MB-3 (dredge)
36° 47.5'	121° 55.5'				
36° 48.25'	121° 55.3'	500-110	SILTSTONE (60%): several small boulders and cobbles (average size 8x8x5 cm, largest size 13x10x8 cm) of subangular, semiconsolidated, sandy siltstone. Some samples are well bored and burrowed and a few are phosphatically coated. Color ranges from dusky yellow (5Y6/4) and yellowish grey (5Y7/2) on weathered surfaces to light bluish-gray (5B7/1) on fresh surfaces. Two chunks partially covered with calcareous worm tubes, bryozoans, and corals. Some limonitic staining. A few fossil fragments. Also contains foraminifers, diatoms, radiolarians, and glauconite. UNCONSOLIDATED SILT AND CLAY (40%): grayish-olive (10Y4/2) mud.	Pliocene foraminifers possibly from middle Purisima Formation; faunas suggest deposition at upper bathyal environments at depths ranging from 200 to 600 m.	MB-13 (dredge)

36° 47.8'	121° 49.1'				
36° 48.5'	121° 49.1'	150-40	SILTSTONE (35%): fossiliferous angular chunks of semi-consolidated greenish-gray (5GY6/1) siltstone or mudstone. Largest piece is 14x9x6 cm in size ; no marine growth. Some burrows, but very few. About 10 chunks recovered. Also contains foraminifers, diatoms, sponge spicules, fragments of pelecypod shells. This sample is thought to have been transported. The color and general appearance of the siltstone suggest that these samples may be from the Lobitos and Tunitas Members of the Purisima Formation. UNCONSOLIDATED SILT (65%): light-olive-gray silt with some mud and fine-grained sand.	Pliocene foraminifers indicative of parts of upper to middle Purisima Formation; faunas suggest outer shelf neritic to upper bathyal enviroments at depths ranging from 200 to 74 m.	MP-21 (dredge)
36° 47.5'	122° 15.7'				
36° 49.3'	122° 17.8'	750-1500	Neogene sedimentary rocks that appear to be equivalents of Pliocene Purisima Formation.	N.D.	CA3-A19 (dredge).
36° 48.0'	122° 15.3'				
36° 48.7'	122° 17.7'	750-1500	Same as CA3-A19 [see above].	N.D.	CA2-A18 (dredge).
36° 48.6'	122° 13.4'				
36° 49.0'	122° 13.8'	660-900	Same as CA3-A19.	N.D.	CA1-A17 (dredge).
36° 48.8'	122° 11.0'				
36° 49.0'	122° 10.2'	450-350	Same as CA3-A19.	N.D.	CA2-A35 (dredge)
36° 49.0'	122° 11.9'				
36° 49.9'	122° 13.0'	800-730	Same as CA3-A19.	N.D.	CA1-A34 (dredge)
36° 48.98'	121° 59.48'				
36° 49.55'	122° 00.5'	493.6-310.8	ARKOSIC SANDSTONE: consisting mostly of quartz and orthoclase, with a minor amount of plagioclase, poorly cemented by a clay matrix. Could be from the Santa Margarita Sandstone or from the basal sandstone of the Monterey Formation.	N.D.	S-2 (dredge)

36° 49.45'	121° 59.5'				
36° 49.95'	122° 00.0'	360-90	SILTSTONE (40%): subangular to well-rounded (most subangular) small boulders and cobbles. All very thoroughly bored and burrowed with very little marine growth on surfaces; some corals and siliceous sponges attached to one side of a few cobbles. Color ranges from grayish orange (10YR7/4) to yellowish gray (5Y7/2) on weathered surfaces and from yellowish gray (5Y8/1) to light bluish gray (5B7/1) on fresh. Size of largest boulder is 19x16x10 cm; rocks generally average 8x7x5 cm in size. One boulder is well-rounded, probably concretionary, sandy siltstone 17x9x6 cm in size. A few samples appear to be well cemented with a calcareous cement. Some fossil fragments. In thin section, sample is very fine grained, too fine grained to identify all minerals. Quartz is predominant large-grained mineral with the largest being about 06 mm in size. A small amount of volcanic and lithic rock fragment is present. Most larger-grained minerals have secondary calcite growth. Also contains foraminifers, diatoms, sponge spicules, and glauconite. Lithologically similar to Purisima. GRANITE OR METAMORPHIC (<1%): one well-rounded gneiss cobble. UNCONSOLIDATED SAND (60%): sandy grayish-olive-green (5GY3/2) wet mud with a few rounded pebbles. Sample was collected at depths much shallower than those suggested by the foraminiferal assemblages, apparently suggesting late Pliocene to Pleistocene uplift.	Pliocene foraminifers indicative of upper to middle Purisima Formation; faunas represent deposition at middle bathyal depths ranging from 1500 to 600 m.	MB-5 (dredge)
36° 49.75'	121° 58.5"				
36° 50.45'	121° 59.05'	210-105	SILTSTONE (70%): semi- to well-consolidated, subangular to subrounded pebbles to small boulders of siltstone that are thoroughly bored and burrowed. Color varies from yellowish gray (5Y7/2) on weathered surface to light greenish gray (5GY8/1) on fresh surfaces. Very little marine growth. Largest boulder size is 13x9x4 cm and average size is 6x5x2 cm. About 30 large boulders total. In thin section rock is fine grained; difficult to identify all minerals. Larger-grained minerals consist of subangular to subrounded quartz (about 30%), biotite (about 2%), chlorite (about 3%), and a few volcanic and lithic rock fragments. Largest grain is about .35 mm. Also contains foraminifers, radiolarians, sponge spicules, and glauconite. Sample appears lithologically similar to Purisima. MUD (30%): grayish-olive-green (5GY3/2) mud with angular pebbles of siltstone. Sample was collected at depths much shallower than those suggested by the foraminiferal assemblages, apparently suggesting late Pliocene to Pleistocene uplift.	Pliocene foraminifers indicative of lower and middle Purisima Formation; faunas represent deposition at upper bathyal depths ranging from 600 to 200 m. Fauna similar to MB-12; appears similar to shallow-water facies of Purisima Formation exposed near Capitola.	MB-7 (dredge)
36° 50.2'	122° 18.4'				
36° 51.4'	122° 20.0'	1270- 900	Same as CA3-A19.	N.D.	CA51-A7 (dredge)

36° 50.77'	121° 57.5'				
36° 50.3'	121° 57.75"	243.1-195.6	SANDSTONE (75%). SILTSTONE (25%). Sample in place. Siltstone resembles Pliocene Purisima Formation.	.N.D.	S-1 (dredge)
36° 51.25'	121° 58.05'				
36° 51.45'	121° 58.6'	110-80	SILTSTONE (50%): semi- to fairly consolidated subangular cobbles; largest is 5.5x7x2.5 cm, severely burrowed and bored. Color ranges from yellowish gray (5Y7/2) on exposed surfaces to light greenish gray (5GY3/2) on fresh surfaces. Very little marine growth. Little phosphatic coating. In thin section this rock is too fine grained to identify all minerals. Predominant coarser grained minerals are composed of quartz and some feldspars and volcanic and rock fragments. Largest grain is about 1 mm in size. Appears to be lithologically similar to Purisima. MUD (50%): grayish-olive-green (5GY3/2) wet mud with silt stringers. Sample was collected at depths much shallower than those suggested by the foraminiferal assemblages, apparently suggesting late Pliocene to Pleistocene uplift.	Pliocene foraminifers indicative of lower to middle (?) Purisima Formation.	MB-9 (dredge)
36° 51.3'	122° 21.0'				
36° 53.0'	122° 19.0'	750-800	Same as CA3-A19.	N.D.	CA2-A23 (dredge)
36° 51.3'	122° 22.7'				
36° 52.5'	122° 22.4'	907-1367	Mafic volcanic rock, highly fractured; breaks into small pieces.	N.D.	ANTI-1-21D (dredge)
36° 51.4'	122° 12.6'				
36° 51.9'	122° 12.0'	750-400	Same as CA3-A19.	N.D.	CA4-A20 (dredge)
36° 52.0'	122° 13.0'				
36° 52.4'	122° 12.5'	600-350	Same as CA3-A19.	N.D.	CA3-A36 (dredge)
36° 52.0'	122° 14.2'				
36° 55.0'	122° 14.7'	600-400	N.D.	Barren of age-diagnostic fossils.	SC-1 (dredge)
36° 52.6'	122° 21.0'				
36° 52.8'	122° 22.0	600-850	Same as CA3-A19.	N.D.	CA17-A33 (dredge)
36° 52.8'	122° 17.7'				
36° 53.9'	122° 19.0'	1000-400	Same as CA3-A19.	N.D.	CA5-A21 (dredge)
36° 54.0'	122° 17.5'	675	Same as CA3-A19.	N.D.	CA52-A8 (dredge)

(Sheet 2--Cont.)

36° 54.2'	122° 24.9'				
36° 54.5'	122° 25.5	1100-850	Fresh angular pieces of spilitic BASALT that may be similar to other small pieces of mafic volcanic rock previously recovered from this area.	N.D.	CA48-A4 (dredge)
36° 54.9'	122° 24.3'				
36° 56.8'	122° 23.2'	1000- 500	Same as CA3-A19.	N.D.	CA6-A22 (dredge)
36° 55.2'	122° 28.1'				
36° 55.7'	122° 28.4	1250- 950	Same as CA3-A19.	N.D.	CA45-A1 (dredge)
36° 55.7'	122° 23.4'				
36° 55.8'	122° 22.8'	800-550	Same as CA3-A19.	N.D.	CA49-A5 (dredge)
36° 56.36'	121° 58.95'	17	Vibra-core penetration depth: .6 meters. Total Core Length: .3 meters. Description: Core consists of dark-gray MUD. No sedimentary structures visible. Fragments of consolidated, friable, fine-grained SANDSTONE and MUD caught in core catcher. Core appears to have bottomed in Purisima Formation.	N.D.	MBC-2 (core)
36° 58.0'	122° 26.2'				
36° 58.2'	122° 25.4'	650-500	Same as CA3-A19.	N.D.	CA46-A2 (dredge)
36° 58.2'	122° 22.2'	275	Same as CA3-A19.	N.D.	CA50-A6 (dredge)
36° 59.4'	122° 25.3'				
36° 59.6'	122° 26.1'	400-150	Same as CA3-A19.	N.D.	CA47-A3 (dredge)
36° 59.23'	123° 21.82'	2000-1730	Alkali BASALT.	N.D.	S4-78-NC2a (dredge)
37° 00.20'	123° 20.00'	2300-1960	Glassy aphyric BASALT and one SANDSTONE with Mn-crust (10 samples). From Guide Seamount.	N.D.	S4-78-NC2 (dredge)
37° 01.98'	123° 20.58'	1712-1645	Alkali BASALT with one altered BRECCIA fragment. Basalt types include: 1. Porphyritic basalt with large feldspar phenocrysts +- xenocrysts and glassy groundmass; 2. Olivine plagioclase phyric basalt with glassy groundmass containing 15-20% clay; 3. Flow-banded basalt with patchy distribution of glass and clay in groundmass; and 4. Highly altered vesicular basalt; abundant clay and zeolites in vesicles (25 samples).	N.D.	S5-79-NC(12) (dredge)

37° 02.32'	123° 20.58'	4327	Alkali BASALT.	N.D.	S5-79-NC 12 (dredge)
37° 04'30"	123° 04'30"	1097-731	PHOSPHORITE: Most of the phosphorite specimens are either dark chocolate brown or brownish gray in color. They all contain angular and rounded mineral grains. Some grains are glassy, others dull, but a majority of them are well rounded, especially the dull ones. Rock fragments, too, are present in limited amounts. Grain size is quite small, and they contain, in addition to quartz and feldspar, angular fragments of andesite and tests of diatoms and foraminifers which, too, have been largely phosphatized. Microscopically, the phosphorites and phosphatized siltstones vary considerably in mineralogical composition and texture. Oolites and pellets are somewhat widely separated. Some of the pellets and oolites have nuclei of phosphatic material or a grain of quartz or feldspar. Wherever a concentric structure exists, it is usually confined to the exterior of the oolite. In a few places the chamoisite surrounds and partly fills cavities in some of the pellets of phosphorite. The phosphatic material is largely collophane with a refractive index of 1.610. It is isotropic and ranges in color from yellowish to yellow brown.	Early Mohnian (Miocene) foraminifers in shale.	MUL-49-45 (dredge)
37° 17.3'	123° 04.7'	722	Volcanic rock.	N.D.	ANTI-1-11DC (core)
37° 21.0'	123° 25.8'	804-987	BASALT: In hand specimen the basalt is vesicular, black to grayish black in color, fine granular, and porphyritic. The feldspar phenocrysts are dark and glassy while the olivine phenocrysts are dark green and the augite black. The vesicles are either filled or empty. The filling is chalcedony, chloropal, and calcite. The original color was black but some large pieces have been altered and all or nearly all of the original mineral has been replaced. A specimen of basalt [from this station] is phosphatic to a depth of 1/8 in. The interior of the same specimen is slightly phosphatic, but not anywhere as much as the rim. Some of the replacement, perhaps most is a phosphatic mineral and the color is changed to a light brown. Some very large pieces of siliceous sponges were attached to the blocks of basalt. Under the microscope the basalts have a porphyritic and sub-ophitic texture in which phenocrysts of feldspar are enclosed in a groundmass of lath-shaped feldspar and intersertal augite. Basic glass is rare, though often very dark blue due to the presence of dusty magnetite. The essential minerals are basic plagioclase and augite. The plagioclase ranges in composition from intermediate to basic labrodorite (An60 to An70). The feldspar phenocrysts are more basic than the feldspar in the groundmass. Both carlsbad and albite twinning are common, and zonal structures are found, especially in the euhedral phenocrysts. Inclusions of dark-brown glass are common. Few of the crystals are altered to calcite and kaolin. The phenocrysts are much more altered than the groundmass laths. The clinopyroxene is augite. In all cases, however, the augite is in the form of euhedral and subhedral crystals, both occurring as phenocrysts and as intersertal grains between the feldspar laths. It is colorless, and has	N.D.	MUL-49-29 (dredge)

(Sheet 2--Cont.)

been altered partly to chlorite and almost colorless serpentine. Olivine is not present in all basalts. When present, however, it is more or less completely altered to pale-green serpentine and golden-yellow iddingsite. The unaltered olivine occurs in euhedral crystals showing prismatic faces and pyramidal terminations. Few of them have corroded borders. Inclusions of chromite are common, especially in the serpentinized crystals. In addition to plagioclase and augite as groundmass constituents, there is also some dark-brown glass which derives its color from black, dusty particles of magnetites. Secondary minerals include: serpentine, iddingsite, chlorite, calcite, kaolin, limonite, chalcedony, and chloropal.

Phosphatized BASIC TUFF: This is a fragmental rock with a mottled grayish-brown color. On the weathered surface it is light brown in color. It contains angular fragments of pumice, minerals, and basalt held in a fine-grained dark-brown groundmass. The mineral fragments range in size from 1 mm to 8 mm. The rock fragments are somewhat larger.

Microscopal characteristics: under the microscope, the rock is decidedly fragmental, and is composed of angular fragments of plagioclase, augite, and basalt firmly held in a groundmass of phosphatized basic glass. The plagioclase ranges in composition from basic andesine (An45) to acid labradorite (An50), and occurs in partly altered, rounded, and angular grains. Both carlsbad and albite twinning are common. Augite is another common mineral. It is either colorless or pale pink and occurs in rounded or subhedral grains. Alteration to chlorite is rare. However, one can find several angular and rounded grains surrounded by a narrow rim of dark-brown phosphatic material. In addition, an occasional feldspar grain and even small fragments of basalt have rims of phosphatic material. The degree of phosphatization was probably more intense in the case of this tuff than in some of the siltstones. Not only are the basalt fragments surrounded by a phosphatic rim, but the process went so far as to destroy the glassy groundmass in the basalt. Besides the phosphatic material, there are several round grains of emerald-green chamoisite enclosing cubes and octahedra of magnetite.

37° 21.51'	123° 26.02'	830	Alkali BASALT	N.D.	S5-7?-NC13 (dredge)
37° 22.4'	122° 37.6'	81	SANDSTONE, gray, poorly indurated.	Oligocene(?) diatoms and coccoliths.	KZ-J-19b (core)
37° 22.4'	122° 37.6'	81	Short stiff core; gray at base, overlain by olive sand.	Oligocene(?) diatoms and coccoliths.	KZ-J-19c (core)
37° 22.4'	122° 34.4'	74	Bent core barrel on first try. Chalky brown pholad-bored rocks.	N.D.	KZ-J-14b (core)
37° 22.8'	123° 25.0'	877-822	About 100 pounds of rocks was obtained. These rocks are mostly volcanic, some being highly altered, presumably by submarine weathering. In the cavities of some of the lavas there is a brilliant blue deposit, probably a phosphate mineral.	N.D.	MUL-49-25 (dredge)

BASALT similar to MUL-49-29. Contains titaniferous augite violet in color and exhibits very strong dispersion. Although usually quite fresh in most rocks and sections, several sections showed it as having been altered in part to pale-green chlorite with separation of magnetite [for example, one figure in report shows an euhedral crystal of titaniferous augite rimmed with pale-green chlorite speckled with cubes and octahedra of magnetite].

Slightly tuffaceous SILTSTONE, similar to MUL-49-51 [see above].

Phosphatized BASIC TUFF similar to MUL-49-29. [A photomicrograph of this sample is illustrated in Chesterman. A] . . . dark border of phosphatic material surrounds euhedral crystals of augite and angular grains of feldspar. Groundmass is largely phosphatized basic glass. Magnification 70X, plain light.

RHYOLITE TUFF BRECCIA: This is a dense, fairly hard, fine-grained fragmental block. It is dark gray in color and consists of angular fragments of quartz, feldspar, pumice, and rhyolite firmly cemented in a dense dark-greenish-gray fine-grained groundmass. The mineral grains range in size from .5 mm to 2 mm.

Microscopal characteristics: under the microscope one can easily recognize the fragmental nature of the rock. It contains angular grains of orthoclase, plagioclase, quartz, pumice, and rhyolite firmly held in a groundmass of devitrified glass. The orthoclase is more or less altered to kaolin. It shows a well-developed carlsbad twin in those grains which are incompletely altered. The plagioclase, too, is very highly altered to kaolin, but still one can make out the albite and carlsbad twinning. Although no definite composition can be assigned to the plagioclase, it appears to lie near intermediate oligoclase. Quartz is glassy and occurs as angular and rounded grains and as granular intergrowths with feldspar. The groundmass is a fine-grained devitrified glass which contains angular fragments of pumice and rhyolite. Flow banding may still be seen in those places where devitrification is less complete. Among the secondary minerals, chlorite and kaolin are very common. The chlorite is pale green in color and exhibits beautiful ultra-blue and violet interference colors.

Biotite-QUARTZ DIORITE: The biotite-quartz diorite is typically coarse-grained, equigranular, massive, and slightly gneissoid. Few of the specimens showed minor amounts of brecciation. On the weathered surface, the rock is unequally colored with limonite. Quartz and plagioclase are the essential minerals. Biotite is present in all specimens, whereas hornblende occurs only sporadically. The quartz is glassy and the feldspar is dull white.

Microscopal characteristics: under the microscope the biotite-quartz diorite has a hypidiomorphic-granular texture. The grain size ranges from 1 to 5 mm for plagioclase; 1 to 2 mm for quartz; and up to 3 mm for biotite. The plagioclase ranges in composition from basic orthoclase (An25) to acid andesine (An35). It occurs in subhedral crystals and irregularly shaped grains showing well-developed albite and carlsbad twinning and poorly developed pericline twinning. Zoning is not common, though present in the quartz diorite from this station. Alteration to kaolin and calcite is common, more so at the interior of the crystals than the exterior. Both orthoclase and microcline are present in limited amounts, especially in the form of anhedral crystals which have been more or less altered to kaolin and sericite.

			Quartz, on the other hand, generally appears as glassy and slightly clouded anhedra. In a few specimens it shows strain shadows and contains numerous curving hairlines of submicroscopic black inclusions. Although both biotite and hornblende are present, biotite is the commonest ferromagnesian mineral in the rock. It usually occurs in dark-brown pleochroic plates and irregular crystals. Alteration to dark-green chlorite is common, especially at this station. Hornblende is in dark-green pleochroic subhedral crystals. They are also partly altered to chlorite. Sphene, zircon, apatite, and magnetite occur sporadically as inclusions in the other minerals. In so far as mineral composition is concerned, the biotite-quartz-diorite contains, on the average, the following: Plagioclase; 40-60%; quartz; 35-50%; biotite; 5-10%.		
37° 23.4'	122° 39.4'	75	SAND and angular PEBBLES.	N.D.	ANTI-1-17DC (core)
37° 23'42"	122° 53'25"	---	Unfossiliferous SILTSTONE . . . slightly tuffaceous and contain small fragments of pumice and glass.	N.D.	HA-7453 (dredge)
37° 23.8'	123° 23.2'	----	Vesicular alkali BASALT and a BRECCIA fragment with a glassy clast. Degree of alteration ranges from slightly altered fine-grained holocrystalline basalt (clays <5%) to very altered basalt with abundant yellow clay and zeolites in vesicles. Some samples contain phenocrysts of clinopyroxene+- amphibole +- plagioclase +- olivine; xenocrysts of plagioclase and amphibole are common (16 samples). From Pioneer Seamount.	N.D.	S4-78-NC8 (dredge)
37° 24.4'	123° 23.5'	1280-914	BASALT similar to MUL-49-29. About 25 pounds of dense black basalt was obtained here. Some pieces were 10 in. across. An altered zone about an inch deep covers each piece.	N.D.	MUL-49-27 (dredge)
37° 25.0'	123° 00'	329-146	SILTSTONE: In general the siltstones are very fine-grained buff to blue-gray colored rocks. Bedding is visible on one or two specimens. They all contain circular conical holes caused by marine-boring organisms. All of the siltstones sectioned are hard and firmly cemented with silica and calcium carbonate. Some of them are fossiliferous and contain tests of diatoms and foraminifera, are slightly tuffaceous, and contain small angular fragments of pumice as well as glass shards. Under the microscope, the siltstones appear to range from massive siliceous shales to ordinary siltstones. They are all very fine grained and appear to consist of angular grains of quartz, orthoclase, oligoclase, biotite, and pumice fragments enclosed in a much finer grained groundmass of silica, calcite, and clay particles. Scattered indiscriminately throughout the rocks are ovoid-shaped bodies of emerald-green mineral which resembles glauconite, but owing to its much weaker pleochroisms it is tentatively called chamoisite; in these green bodies are black cubic crystals of magnetite.	N.D.	MUL-49-51 (dredge)

			An occasional plate of pale-green chlorite can be found. The pumice fragments and the glass shards have been largely devitrified and now present a characteristic salt- and-pepper effect. Specimens . . show . . phosphatic material yellowish to deep yellow-brown in color, isotropic, traversed by numerous conchoidal fractures, localized in irregular patches where it acts somewhat as a cementing material for the detrital grains. In a few of the sections, there occurs a narrow dark-brown rim immediately surrounding the mineral grain which is enclosed in the phosphatic material. Also, in the tuffaceous siltstone, the pumice fragments are more or less completely changed over to the phosphatic material. Scattered throughout the siltstone are tests of diatoms and foraminifers. The foraminifer tests are composed largely of calcite, while the diatoms are chalcedony. Some of the foraminifers have been partly phosphatized. The groundmass, for the most part, is a mixture of chalcedony, calcite, and clay. Several of them contain more calcite than others, while some are rich in clay and chalcedony.		
37° 25.3'	122° 27.4'	21.5	Partially indurated, dark-olive-green SAND at base.	Miocene to Pleistocene diatoms and silicoflagellates.	KZ-I-1 (core)
37° 25.3'	122° 28.0'	27	SANDSTONE, partially indurated, dark-gray.	Middle or late Miocene diatoms and silicoflagellates.	KZ-I-2 (core)
37° 26.5'	123° 28.7'	1828-1280	BASALT similar to MUL 49-25. About 300 pounds of dense black vesicular basalt.	N.D.	MUL-49-32 (dredge)
37° 26.5'	123° 28.7'	1463-1261	BASALT similar to MUL-49-25.	N.D.	MUL-49-38 (dredge)
37° 31.9'	123° 02.8'	585-457	Recovered about 100 pounds of friable, dark-gray siltstone.	N.D.	MUL-49-34 (dredge)
37° 33.0'	123° 15.0'	2011-1828	A few pieces of friable, light-gray, silty SHALE. Fossiliferous siltstone [similar to MUL-49-51, see above] . . . showing diatoms enclosed in a fine-grained matrix of clay, chalcedony, and calcite . . . minor amounts of quartz and feldspar . . .contains no pumice or glass shards.	N.D.	MUL-49-64 (dredge)
37° 40'30"	123° 03'50"	82-100	SILTSTONE: Same as MUL-49-64 [see above]. A few small pieces of biotite-QUARTZ DIORITE: similar to MUL-49-25. These are unlike the granitic rocks of the Farallon Islands but are insufficient to be diagnostic.	N.D.	MUL-49-54 (dredge)
37° 42'30"	123° 23.0'	2103-1828	Slightly tuffaceous SILTSTONE similar to MUL-49-51 [see above]. Contains abundant diatoms and foraminifers. PHOSPHORITE, similar to MUL-49-45 [see above]; contains 50% or more phosphatic material.	Miocene diatoms and foraminifers in gray silty shale.	MUL-49-62 (dredge)

(Sheet 2--Cont.)

37° 42'55"	123° 04'40"	---	Biotite-QUARTZ DIORITE: Highly brecciated and contains slickinsides.	N.D.	HA-7422 (dredge)
37° 44.0'	123° 08.6'	126	Siliceous CHERT, very greatly bored by worms, was recovered. This material, inside of the altered surface layer resembles much of the Miocene chert of the continental areas.	N.D.	MUL-49-67 (dredge)
37° 46.0'	123° 07.55'	---	Biotite-QUARTZ DIORITE, equigranular, massive, and slightly gneissoid. Under the microscope, the . . . specimens have a hypidiomorphic-granular texture. The plagioclase ranges from oligoclase to andesine, and occurs in subhedral to irregular grains having well-developed albite and carlsbad twinning. Most of the plagioclase crystals are altered to kaolinite (?) and calcite. The quartz present shows strained extinction. Green hornblende is the commonest ferromagnesian mineral.	N.D.	HA-7421 (dredge)
37° 46.4'	123° 00.0'	146-118	A few small pieces of light-gray SEDIMENTARY ROCK were obtained. These contained fossil foraminifers, very well preserved. With them there were several rounded pieces of GRANITE. In addition, the haul included friable dark-gray silty mud; firm enough so that it is believed to be older than Recent sediment but no fossils were found in it.	N.D.	MUL-49-36 (dredge)
37° 48'40"	123° 23.0'	731	One hundred pounds of soft silty fossiliferous SAND containing many foraminifers and sponge spicules. The presence of a species of *Siphogeneroides* indicates that the age is Miocene, probably a part of the Monterey Formation.	N.D.	MUL-49-22 (dredge)
37° 49.7'	123° 10.2'	85	GRAYWACKE.	N.D.	KZ-Q-2c (core)
37° 50'18"	123° 14.0'	---	SANDSTONE, firmly cemented; composed of angular grains of quartz, dark-brown biotite, and muscovite set in a silica matrix.	N.D.	HA-7420 (dredge)

37° 51.5'	122° 43.7'	---	Soft olive-colored sandy SILT; shell fragments, slightly lithified.	Miocene to Pleistocene diatoms and silicoflagellates.	KZ-E-1 (core)
37° 52.3'	122° 42.8'	---	SILTSTONE, soft, olive-colored pebble.	Middle or Late Miocene diatoms.	KZ-E-2 (core)
37° 52'20"	122° 19'53"	---	Same as HA-7422 [see above].	N.D.	HA-7447 (dredge)
37° 53'29"	123° 19'38"	---	Same as HA-7421 except that biotite is the commonest ferromagnesian mineral [see above].	N.D.	HA-7446 (dredge)
37° 54.0'	123° 25.7'	398-182	About 75 pounds of hard black banded CHERT (PHOSPHORITE, similar to MUL-49-62 [see above], except contains >50% phosphatic material) containing abundant cavities of fossil foraminifers. The dark color is due to petroleum residue. Such rocks are typical of the Monterey Miocene of California. In addition there was one large piece and some debris of a soft gray silty SHALE which contain abundant beautifully preserved foraminifers and diatoms.	N.D.	MUL-49-12 (dredge)
37° 55.0'	123° 26'58"	---	Finely laminated, diatomaceous MUDSTONE. PHOSPHORITE . . . most specimens are chocolate brown or brownish gray in color.	Late Luisian foraminifers in mudstone.	HA-7445 (dredge)
37° 55'15"	123° 24'05"	128	About 1000 pounds of cherty Miocene SHALE and a few fragments of GRANITIC ROCKS. CHERT is slightly silty and has been greatly bored to a depth of an inch by a species of worm which has not yet been identified. In addition there are numerous borings which were precisely like those made by shallow water mollusks such as *Pholadidea* . SILTSTONE (similar to MUL-49-64) [see above], very fine-grained, buff to gray, bedding poorly developed, and only visible in 1 or 2 specimens; contains circular conical holes caused by some unidentified marine boring organisms hard and firmly cemented with silica and calcium carbonate.	N.D.	MUL-49-19 (dredge)
37° 58'48"	123° 27.0'	---	Soft, poorly consolidated MUDSTONE. Calcareous SANDSTONE pipes about 10 cm long were also recovered . . . believed that they represent fossil worm or crab burrows.	Excellent early Pleistocene molluscan fauna.	HA-7443 (dredge)
37° 59.2'	123° 27.0'	135	Reports conflict as to what was recovered at this station. Chesterman (1952) infers that no plutonic rocks were recovered in the dredge, whereas Hanna (1952) describes granitic rocks.	N.D.	MUL-49-11 (dredge)

[Chesterman (1952) reports] SANDSTONE, gray in color and contains, besides quartz and feldspar, considerable dark-brown biotite. The grains range in size from .5 mm to 1 mm. Under the microscope the sandstone appears to be composed of rounded and angular grains of quartz, basic andesine, orthoclase, dark-brown biotite, and muscovite set in a silica matrix. The feldspar is partly altered to kaolin and sericite and the biotite to dark-green chlorite. The quartz occurs commonly in rounded and angular grains. Many of them are fractured and recemented with calcite and chalcedony.

[Hanna (1952) reports that] two dredge hauls were made at this station. In the first there were about 200 pounds of angular fragments of granitic rocks, deeply weathered but not rounded. A few pieces of schistose material were also obtained and some of these contain borings like those made by *Lithophaga*. The other haul contained about 100 pounds of nearly pure foraminifers .

N LAT.	W LONG.	UN-CORRECT-ED DEPTH (meters)	DESCRIPTION	AGE	SAMPLE NUMBER
38° 00.0'	123° 22.4'	128-104	This station furnished several hundred pounds of rocks, mostly large angular blocks of granodiorite broken off ledges. These, as well as smaller pieces, were encrusted with various organisms and showed evidence of fairly deep weathering. There were several pieces of pebble and boulder conglomerate and a large quantity of well-rounded pebbles and gravel probably derived from the same rock. Some of the boulders were six inches in diameter; most of them were a very hard dark metavolcanic rock which was not bored into by organisms and by hand lens examination showed little evidence of weathering. SANDSTONE: Brecciated, gray, hard, firmly cemented sandstone made up of angular grains of quartz and feldspar firmly held in a chalcedonic-silica cement. The grains range in size from .5 mm to 2 mm. Mineral composition: Quartz, 35-35%; Andesine, 25-30%; Orthoclase, 5-10%. RHYOLITE: Rhyolites were collected only at this station. In hand specimen, the ryholite is a dense hard fine-grained porphyritic rock varying in color from medium gray, through dark brownish gray to chocolate brown. Under the microscope they are porphyritic in which phenocrysts of quartz, orthoclase, and plagioclase are enclosed in a microcrystalline groundmass of partly devitrified glass. In several of the specimens showing less devitrification, fluidal banding and flow lines are distinctly visible. Sanidine is the potash feldspar. An occasional angular crystal or anorthoclase can be found. The sanidine normally occurs in euhedral and subhedral crystals with or without carlsbad twinning. Alteration to kaolin is common, especially along fractures. Some of the fractures in a few of the more altered phenocrysts are filled with an aggregate of small quartz grains, apparently secondary. Quartz is an abundant mineral, and occurs in the groundmass and as anhedral crystals and corroded grains. It is glassy in appearance and oftentimes shows strain shadows. The plagioclase varies in composition from acid to basic oligoclase (An15 to An25). It usually occurs in subhedral crystals showing both carlsbad and albite twinning. An occasional crystal showing pericline twinning is present. Alteration to kaolin is more pronounced in some rocks than others. Biotite is the only ferromagnesian mineral present in the rhyolites. It occurs in subhedral crystals which show, in some sections, considerable alteration. The unaltered biotite is dark-greenish-brown and strongly pleochroic. In several sections the biotite has been altered to pale-green chlorite. In the outer part of each altered biotite crystal one can find a narrow black zone of magnetite. For the most part, the groundmass is composed of a partly devitrified glass, dark to medium-brown in color. Flow banding and fluidal structures are still evident. In one section, the glass is completely devitrified and consists almost wholly of a microcrystalline aggregate of quartz and feldspar grains so arranged as to indicate the original flow banding.	N.D.	MUL-49-2 (dredge)

(Sheet 3--Cont.)

			ANDESITE: In hand specimen, they range in color from dark greenish gray to dark greenish brown. The andesite, in general, is a hard fine-grained porphyritic rock containing distinct crystals of dull white feldspar firmly held in a fine-grained semi-glassy groundmass. Ratio of groundmass to phenocrysts is approximately 10 to 1. The rock has a well-developed porphyritic texture which shows phenocrysts of plagioclase and orthoclase set in a semicrystalline groundmass. This specimen is somewhat fragmental and appears to be an andesitic breccia. The plagioclase is variable in composition, ranging from acid to intermediate andesine (An35 to An40). It generally occurs as euhedral crystals, occasionally as subhedral and anhedral crystals. Albite, carlsbad, and pericline twinning are common. Inclusions of glass, sphene, epidote, and even chlorite are present in the plagioclase. Calcite and kaolin are the two alteration products, but a few crystals of basic oligoclase were found partly altered to epidote. The groundmass plagioclase is usually in the form of untwinned microlitic laths scattered at random throughout the sections. Orthoclase, when present, is in the form of subhedral crystals partly altered to kaolin and sericite. Quartz is present and occurs in small amounts, usually in well-rounded grains and in fine-granular aggregates, especially in those areas where the groundmass glass has been most thoroughly devitrified. All ferromagnesian minerals, including hornblende and augite, have been completely altered to epidote and chlorite. For the most part, the groundmass consists essentially of more or less completely devitrified glass which still retains some of its original fluidal structures. Secondary minerals include: epidote, chlorite, calcite, limonite, kaolin, and sericite. Biotite-QUARTZ DIORITE: similar to MUL-49-25 [see above].		
38° 1.9'	123° 25.1'	---	The specimen is biotite GRANITE and has the following thin section mode (the thin section is strongly crackled and difficult to point count and the thin section is small. This mode should be considered only an approximate sample of the rock). Plagioclase, 29.5%; K-feldspar, 41.5%; Quartz, 24%; Biotite, 5%. Thin section notes: Plagioclase, in part subhedral, is thinly but weakly twinned, and somewhat sound. Sericitic alteration accentuates the zoning. Probably the plagioclase is oligoclase (An can't be determined from twinning in this thin section). K-feldspar is weakly to strongly grid twinned and myrmeckite is found locally between the two feldspars. Quartz, which tends to be interstitial, is only weakly strained (undulatory extinction). Anhedral, but discrete biotite crystals to 2 mm are scattered through the rock. Biotite is strongly pleochroic from dark brown to opaque. Subhedral to euhedral sphene crystals to 0.8 mm are present as are trace amounts of apatite and zircon. This specimen is quite different from the dredge samples described by Chesterman (1952). He described coarse-grained rocks composed dominantly of plagioclase and quartz with small amounts of K-feldspar and varying amounts of dark-brown biotite and dark-green hornblende. From this description I would guess that Chesterman's samples were correlative with the tonalite of Tomales Point. This specimen may be related to the alaskitic rocks that are associated with the granodiorite-granite of Inverness. No granite or alaskite similar to this specimen was seen on Southwest Farallon Island, the only one of the Farallon Islands where I examined and sampled the basement.	70-90 m.y. on Hb-Br isotopes.	812001
38° 02.2'	123° 24.8'	62	BIOTITE-QUARTZ DIORITE: similar to MUL-49-25. Most were heavily encrusted with organisms and contained borings up to 1 in. in diameter. These holes are very old and are ex-	N.D.	MUL-49-10 (dredge)

			actly like those made by mollusks such as *Pholadidea ovoidea* but in no case was there a trace of shell remaining. This, together with the presence of very old shells of *Mytilus californianus* in the same haul, indicates strongly that at no very distant date Cordell Bank was intertidal. There were a very few pebbles of dark-colored rocks which presumably were derived from nearby conglomerate.		
38° 03.3'	123° 31.2'	226-164	BIOTITE-QUARTZ DIORITE: similar to MUL-49-25 [see sheet #2]. Alteration to dark chlorite is common. ANDESITE: similar to MUL-49-2, but is not brecciated. SILTSTONE: similar to MUL-49-64.	N.D.	MUL-49-7 (dredge)
38° 03'50"	123° 33'30"	731-365	SILTSTONE: similar to MUL-49-64. PHOSPHORITE: similar to MUL-49-45.	N.D.	MUL-49-56 (dredge)
38° 04.7'	123° 27.7'	118	Stiff CLAY with layer of foraminiferal SAND; broken-off, angular granite pebble.	N.D.	KZ-73-DC6 (core)
38° 26.4	123° 36.4'	231	One half-inch [thick] cookie of indurated SHALE. Glauconite and large rock fragments which appear like siliceous Monterey Formation.	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-164 (core)
38° 26.7'	123° 34.9'	194	Stiff MUD, quite hard.	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-162 (core)
38° 27.0'	123° 35.4	187	Indurated SHALE fragments plus less-indurated stiff MUD. Corroded diatoms abundant; no foraminifers.	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-163 (core)
38° 32.4'	123° 41.9'	207	Green muddy SAND and 2- to 3- inch [thick] cookie of tan indurated SHALE.	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-165 (core)
38° 33.0'	123° 41.8'	187	Dark-green SAND over green-gray MUD with small chips of dark rock.	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-167 (core)
38° 40.2'	123° 49.5'	260	Large rock fragments; SAND; glauconite.	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-174 (core)
38° 40.2'	123° 49.6'	260	Dark-green muddy sand with various pebbles of SHALE, SANDSTONE, and GRANITE (rounded on one side).	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-176 (core)
38° 57.0'	123° 53.4'	123	Hard, compact SAND with pieces of rock. GRAYWACKE, SANDSTONE.	N.D.	ANTI-1-32DC (core)

(Sheet 3--Cont.)

38° 57.2'	123° 59.3'	433	Stiff blue-gray SILT or SANDSTONE with sandy MUD; buff-colored surface sediments; glass shards. One foraminifer identified.	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-184 (core)
38° 57.3'	123° 59.7'	392	Dark-brown dry stiff sandy MUD. Slightly fissile; may be old.	Barren	7-TOW 9B-183 (core)
38° 57.9'	123° 58.6"	392	Brown and gray sandy MUD with chips and large pieces of laminated dark-brown SHALE (Miocene?).	Barren	7-TOW 9B-182 (core)
38° 58.2'	123° 59.4'	451	Dark-gray and buff muddy SAND with many chips of dark-gray to green rock. May be SILTSTONE or even volcanic(?) [Glauconite, diatoms, forams abundant].	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-181 (core)
38° 58.3'	123° 59.4'	451	Buff to gray, very stiff sandy CLAY. One small chip of SHALE.	Holocene(?) or Pliocene(?) foraminifers, probable contamination.	7-TOW 9B-180 (core)
38° 59.0'	123° 50.5'	104	Appears to be well-compacted SILT, consolidated SILTSTONE, shell covering.	Foraminifers present, no age determination.	ANTI-1-27DC (core)
39° 27.0'	124° 32.0'	Location approximate	Abundant GRAYWACKE. Rock weakly foliated to highly sheared in thin section and shows chlorite alteration of the groundmass.	Poorly fossiliferous but contains a few non-diagnostic mid-Eocene to Oligocene nannofossils.	ANTI-1-23D (dredge)

N LAT.	W LONG.	UNCORRECTED DEPTH* (meters)	DESCRIPTION	AGE	SAMPLE NUMBER
39° 57.71'	125° 27.12'	2927	Upper part (to 138 m) dominated by Pleistocene to upper Miocene grayish-green MUD with a few horizons of thinly bedded fine SAND. The bulk of the cored section (to 285 m) consists of pale-olive to greenish-olive DIATOMITE. The diatomite is underlain by 35 m of gray calcareous nannofossil OOZE which rests on ANDESITE (?).	Pliocene/Pleistocene boundary at 74 m based on radiolarians. Miocene/ Pliocene boundary at 129 m based upon foraminifers and radiolarians. Late Oligocene/early Miocene at 312 m based on calcareous nannofossils and silicoflagellates.	DSDP 173 (bore hole)
40° 15.9'	124° 35.8'	211	Green-gray SAND with calcareous concretionlike tubes or fillings and fragments of soft friable GRAYWACKE(?).	Foraminifers present, no extinct species	7-TOW 9B-161 (core)
40° 16.6'	124° 33.7'	192	Green-gray shelly foraminifer-rich muddy SAND with pebbles of calcareous material and manganese-coated GRAYWACKE(?).	Foraminifers present, no extinct species.	7-TOW 9B-160 (core)
40° 16.7'	124° 34.1'	286	Greenish-gray, slightly stiff MUD with mottles of foraminifer-rich SAND; some shell fragments.	Foraminifers present, no extinct species.	7-TOW 9B-159 (core)
40° 21.0'	124° 47.0'	1620	Stiff olive-gray silty CLAY.	Foraminifers present, no extinct species.	C-35 (dredge)
40° 22' 40° 19'	125° 38' 125° 44'	1820-2390	Cobbles and boulders of BASALT, altered basalt, CONGLOMERATES, CALCAREOUS OOZE, and SERPENTINE. Where fresh, the dark-gray basalt consists of 40% phenocrysts of equal amounts of labradorite and pigeonite, 0.1-1.2 mm. The groundmass consists of ore (10% of specimen) and somewhat more clinopyroxene than plagioclase. About 5% of chlorite was present in the specimen examined. Where altered, the basalt consists of oligoclase and chlorite (replacing labradorite) and relatively unaltered pigeonite. Chlorite (5%) often occurs in large blebs, especially where it replaces plagioclase. Thin veins, 0.05-0.2 mm across, pass through the specimen examined and consist of chlorite (with perhaps some serpentine), calcite, and albite. A boulder of clayey calcareous ooze consisted of 5-10% mineral grains, 0.05-0.1 mm, of which 20% was either glauconite or chlorite. A boulder of serpentine carried a polished, slickensided surface.	Abundant diatoms, predominantly modern assemblage.	FAN-BD-36 (dredge)

(Sheet 4–Cont.)

40° 30.0'	124° 42.5'	730	Very stiff, olive-gray, silty CLAY.	Pliocene to Holocene foraminifers. Lower bathyal fauna, indicating a much deeper environment than that from which it was collected.	W-94 (dredge)
40° 38.0'	124° 47.0'	2100	Olive-gray stiff sandy CLAY (sand/mud=0.16).	Foraminifers present, no extinct species.	C-3 (dredge)
40° 40.0'	123° 35.0'	490	Stiff silty CLAY and sandy MUD.	Foraminifers present, no extinct species.	C-2 (dredge?)
40° 56.0'	124° 44.0'	820	Olive-gray silty CLAY.	Foraminifers present, no extinct species.	C-4 (core)
40° 57.0'	124° 37.0'	465	One small angular rock; fine-grained. Fossiliferous DOLOMITE or LIMESTONE.	Miocene or younger, foraminifers possibly late Miocene or Pliocene in age. Suggested paleobathymetry is middle bathyal, 600 m +- 300 m.	C-5a (dredge)
40° 57.0'	124° 37.0'	465	Seven small boulders of fine-grained quartz-bearing LIMESTONE and DOLOMITIC LIMESTONE; buff-colored surface weathering.	Same as C-5a.	C-5b (dredge)
41° 01'	124° 39.0'	670	Green silty CLAY (sand/ mud=0.02); mollusk shells present. One well-rounded pebble of PUMICE . . .one subrounded pebble of indurated SILTSTONE.	Foraminifers present, no extinct species.	C-8 (dredge)
41° 24.0'	124° 25.0'	130	Stiff silty CLAY containing shell fragments and some pebbles.	Foraminifers present, no extinct species.	C-12 (core)
41° 28.0'	124° 51.0'	800	Two small boulders of fine-grained quartz-bearing DOLOMITE. Radiolarians, diatoms, and foraminifers present.	Two radiolarian species identified; both are long-ranging species, but were common in Miocene time.	W-90 (dredge)
41° 29.0'	124° 56.0'	640	Nine boulders of fine-grained quartz-bearing DOLOMITE. Radiolarians and diatoms present.	N.D.	W-91 (dredge)
41° 35.0'	124° 56.0'	1000	Hard CLAY below, medium SAND above. Black rock fragments and a yellow-white (sugary textured) mineral are prominent.	N.D.	W-82 (core)

41° 44.0'	124° 55.0'	730	One large pebble of iron-stained GRAYWACKE; fractures around grains. Several boulders of fine-grained quartz-bearing DOLOMITE (mineral identification by X-ray diffraction). Foraminifers, radiolarians, and quartz-bearing diatoms present.	N.D.	W-89 (dredge)
41° 47.0'	124° 26.0'	128	Olive-gray sandy MUD (required 4 attempts to obtain sample; probably a hard bottom).	N.D.	W-4 (grab)
41° 47.0'	124° 52.5'	860	Olive-gray silty CLAY.	Foraminifers present; no extinct species.	C-31 (core)
41° 47.0'	124° 55.0'	1000	Homogeneous olive-gray CLAY; faint mottling in upper half of core.	Foraminifers present; no extinct species.	C-32 (core)
41° 53.0'	124° 52.0'	690-740	Abundant PUMICE, several well-preserved volcanic bombs. Boulders of fine-grained quartz-bearing DOLOMITIC LIMESTONE; some boulders weathering to light gray on the surface. Minerals identified by x-ray diffraction.	Probably Miocene or younger; foraminifers possibly late Miocene or Pliocene. Paleobathymetry is mid-bathyal depths of 600 m +- 300 m.	C-21 (dredge)
41° 53.3'	124° 49.0'	660	Olive-green muddy SAND (sand/mud=1.2). Contains gastropod shells.	Foraminifers present; no extinct species.	C-28 (grab)
41° 54.0'	124° 50.0'	690	Olive-black silty SAND (sand/mud=5.5).	Foraminifers present; no extinct species.	C-27 (grab)
41° 54.0'	125° 00'	950	Stiff silty CLAY.	Foraminifers present; no extinct species.	C-29 (core)
41° 58.0'	125° 01.0'	1030	Fine-grained quartz-bearing LIMESTONE and stiff silty CLAY. Clay contains foraminifers, mineral identification by x-ray diffraction.	Foraminifers in limestone probably Miocene or younger; possibly late Miocene or Pliocene. Suggested paleobathymetry: upper abyssal, 1800 m +- 600 m.	C-23 (dredge)
41° 58.5'	124° 56.5'	970	Olive-gray silty CLAY.	Foraminifers present, no extinct species.	C-26 (core)
41° 59.5'	125° 07.5'	1500	Stiff olive-gray silty CLAY (sand/mud=0.07).	Foraminifers present; no extinct species.	C-24 (dredge)
42° 00.0'	124° 57.5'	920	Boulders of fine-grained quartz-bearing fossiliferous LIMESTONE and DOLOMITE and some stiff silty CLAY (sand/mud=0.003). Mineral identification by x-ray diffraction.	Foraminifers in dolomite probably Miocene or younger; foraminifers possibly late Miocene or Pliocene. Suggested paleobathymetry: middle bathyal depths of 600 +- 300 m.	C-22 (dredge)

REFERENCES CITED

Chesterman, C. W., 1952, Descriptive petrography of rocks dredged off the coast of central California: California Academy of Sciences Proceedings, Fourth Series, v. 27, no. 10, p. 359-374.

Cook, H. E., ed., 1979, Geologic studies of the Point Conception Deep Stratigraphic Test Well OCS-CAL 78-164, No. 1, Outer Continental Shelf, southern California: U.S. Geological Survey Open-File Report 79-1218, 148 p.

Earth Sciences Associates, 1974, Geology of the southern Coast Ranges and the adjoining continental margin of California, with special reference to the geology in the vicinity of the San Luis Range and Estero Bay, Final Safety Analysis Report for Diablo Canyon nuclear power plant, 2.5D, p. 3-98.

Greene, H. G., 1977, Geology of the Monterey Bay region (California): U.S. Geological Survey Open-File Report 77-718, 374 p.

Hanna, G. D., 1952, Geology of the continental slope off central California: California Academy of Sciences Proceedings, Fourth Series, v. 27, no.9, p. 325-328.

Isaacs, C. M., Keller, M. A., Gennai, V. A., Stewart, K. C., and Taggert, J. E., Jr., 1983, Preliminary evaluation of Miocene lithostratigraphy in the Point Conception Cost well OCS-CAL 78-164 No. 1, southern California, *in* Isaacs, C. M., and others, eds., Petroleum generation and occurrence in the Miocene Monterey Formation, California: Society of Economic Paleontologists and Mineralogists Pacific Section Special Publication, p. 99-110.

Krause, D. C., Menard, H. W., and Smith, S. M., 1964, Topography and lithology of the Mendocino Ridge: Journal of Marine Research, v. 22, no. 3, p. 236-249.

Kulm, L. D., von Huene, R., and others, 1973, Initial reports of the Deep Sea Drilling Project, v. 18, Washington D.C., (U.S. Government Printing Office), p. 40.

Mullins, H. T., and Nagel, D. K., 1981, Franciscan-type rocks off Monterey Bay, California: Implications for western boundary of Salinian Block: Geo-Marine Letters, v. 1, p. 135-139.

Silver, E. A., 1969, Structure of the continental margin off northern California, north of the Gorda Escarpment: U.S. Geological Survey Technical Report No. 2, contract no. 14-08-0001-11457, Scripps Institute of Oceanography, San Diego, California, 123 p.

_____, 1971, Transitional tectonics and Late Cenozoic structure of the continental margin off northernmost California: Geological Society of America Bulletin, v. 82, no. 1, p. 1-22.

Silver, E. A., Curray, J. R., and Cooper, A. K., 1971, Tectonic development of the continental margin off central California, *in* Lipps, J. H., and Moores, E. M., eds., Geologic guide to the northern Coast Ranges, Point Reyes, California: Geological Society of Sacramento, annual field trip guidebook, p. 1-10.

Uchupi, E., and Emery, K. O., 1963, The continental slope between San Francisco, California, and Cedros Island, Mexico: Deep-Sea Research, v. 10, p. 397-447.

Zieglar, D .L., and Cassell, J. K., 1978, Synthesis of OCS well information, offshore central and northern California, Oregon, and Washington, *in* Energy Exploration and Politics, Part II, Workshop on urban oil and gas development, 1978, Proceedings: State of California, Division of Oil and Gas, 27 p.