UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GEOLOGIC MAP OF THE MONTARA MOUNTAIN QUADRANGLE, SAN MATEO COUNTY, CALIFORNIA

by

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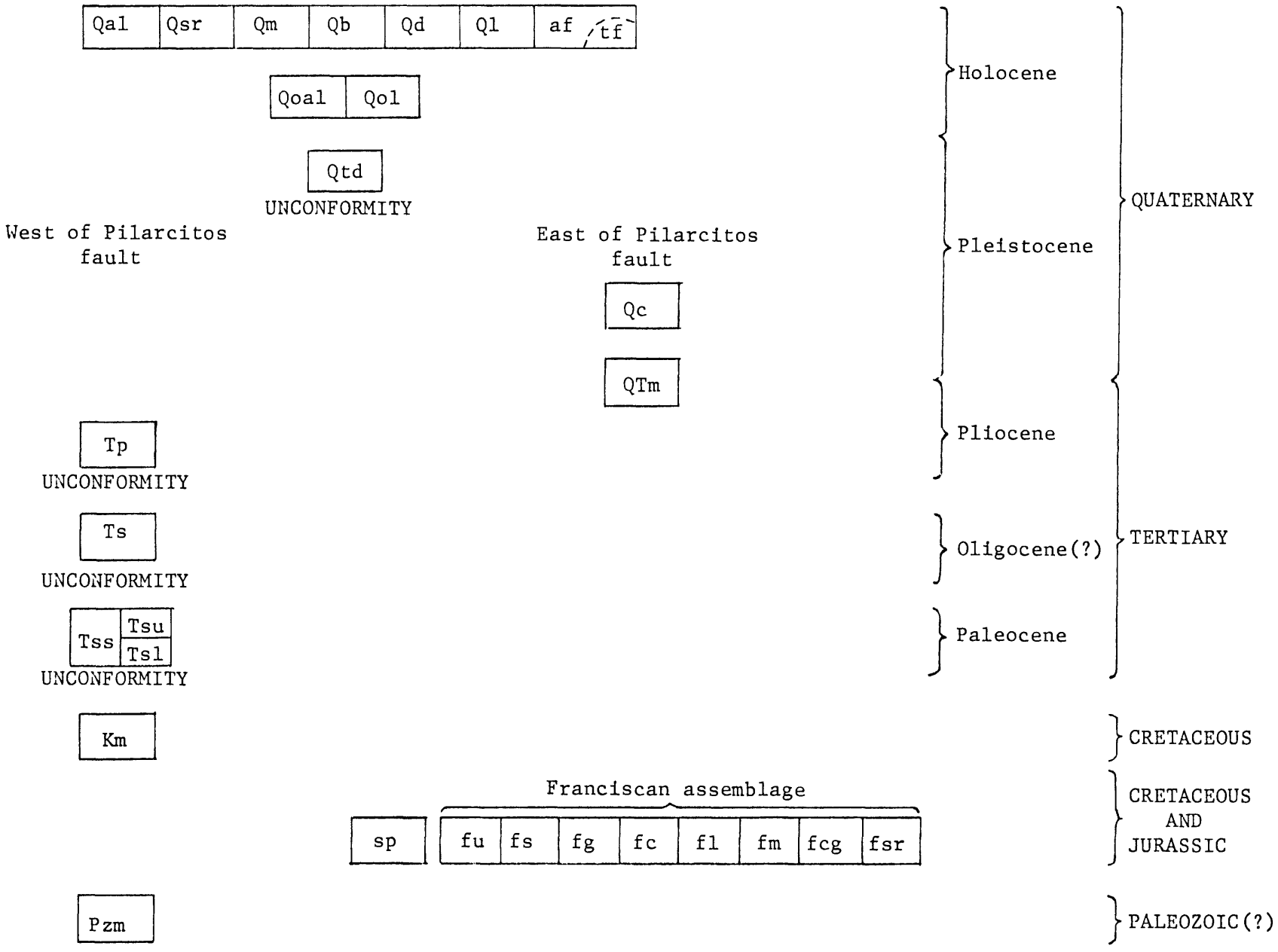
Open-File Report 81-451

1981


Qal
Qsr
Qm
Qb
Qd
Ql
af
tf
Qoal
Qol
Qtd
UNCONFORMITY
West of Pilarcitos fault
East of Pilarcitos fault
Qc
QTm
Tp
UNCONFORMITY
Ts
UNCONFORMITY
Tss
Tsu
Tsl
UNCONFORMITY
Km
Franciscan assemblage
sp
fu
fs
fg
fc
fl
fm
fcg
fsr
Pzm
Holocene
Pleistocene
Pliocene
Oligocene(?)
Paleocene
QUATERNARY
TERTIARY
CRETACEOUS
CRETACEOUS AND JURASSIC
PALEOZOIC(?)

DESCRIPTION OF MAP UNITS

Qal — ALLUVIUM (Holocene)--Unconsolidated gravel, sand, silt clay, and organic matter in various proportions and combinations. Bedding is lenticular and poorly developed; interfingers laterally with colluvial deposits (Qsr). Maximum thickness probably less than 75 ft (23 m). Includes marshy ground west of Princeton and on the north side of Mori Point

Qsr — SLOPE WASH, RAVINE FILL, AND COLLUVIUM (Holocene)--Unconsolidated to moderately consolidated deposits of sand, silt, clay, and rock fragments accumulated by slow downslope movement of weathered rock debris and soil. Composition dependent upon underlying rocks. Commonly unsorted and unbedded, but locally crudely layered by downslope movements. Mapped where thickness presumed to exceed 5 ft (1.5m); maximum thickness as much as 20 ft (6 m). Maximum accumulations commonly develop near bases of slopes underlain by sheared rocks of the Franciscan assemblage (fsr). Deposits interfinger with alluvial deposits (Qal) at bases of slopes. Numerous small shallow landslides occur in this unit on the west-facing flank of Montara Mountain

Qm — BAY MUD (Holocene)--Very poorly to well consolidated blue-gray to black silty clay with interspersed layers of sand, gravel, peat, and shell fragments. Soft and plastic when wet and firm when dry. Bedding ranges from distinct to indistinct. May be as much as 100 ft (30 m) thick near the San Francisco airport

Qb — BEACH DEPOSITS (Holocene)--Loose clastic deposits composed of sand- to cobble-sized fragments, usually located in the tidal zone, that are moderately well sorted by wave action. Along the exposed coast thickness varies with the seasons; maximum thickness probably less than 50 ft (15 m) adjacent to the El Granada breakwater in Half Moon Bay

Qd — DUNE SAND (Holocene)--Loose fine- to medium-grained well-sorted wind-blown sand. Present along the coast northeast of Shelter Cove and northeast of Mori Point. May be as much as 30 ft (9 m) thick

Ql — LANDSLIDE DEPOSITS (Holocene)--Unconsolidated to moderately consolidated deposits whose composition and structure depends upon the geologic unit involved and the type of landslide. Considered to be active and (or) unstable. Other active landslide deposits may be present

af — ARTIFICIAL FILL (Holocene)--Poorly to well consolidated gravel, sand, silt, and rock fragments in various combinations used in a variety of applications including riprap, highway-, railroad-, and airport runway-fills, earthfill dams, reservoir embankments, and building-site grades. Thickness

dependent upon type of application and site. Many small fills not shown because of scale limitations. Includes organic and man-made debris in sanitary landfills

tf — TOPOGRAPHIC FILL--Urban area presumed to be underlain by artificial fill, based on changes in topographic contours between 1949 and 1956 editions of the Montara Mountain 7.5-minute quadrangle

Qoal — OLDER ALLUVIUM (Holocene)--Unconsolidated to moderately consolidated gravel, sand, silt, and clay in various proportions and combinations. Chiefly older alluvial fan deposits. Distribution and extent largely inferred from drainage patterns on historic maps, as natural exposures are concealed by urban development

Qol — OLDER LANDSLIDE DEPOSITS (Holocene)--Moderately consolidated deposits whose composition and structure depends upon the geologic unit involved and the type of landslide. Assumed to be inactive and (or) stabilized, as no evidence of recent movement observed; susceptible to being reactivated by improper grading procedures and (or) accelerated erosional processes. Other inactive landslides may be present

Qtd_1 — TERRACE DEPOSITS (Upper Pleistocene)--Moderately consolidated to moderately indurated marine deposits of sand, silt, gravel, and clay in various proportions and combinations, in indistinct to distinct lenses and beds. Lower part of a single terrace unit commonly is finer-grained, moderately well indurated and forms near-vertical cliffs along the exposed coast; upper part of a terrace unit is coarser-grained, moderately consolidated, poorly indurated, and forms rounded or subdued topography. Up to 60 ft (18 m) thick between El Granada and Princeton and 75 ft (23 m) thick at Montara (Jack, 1969). Locally includes some stream terrace deposits, alluvium, and older eolian sands. Subscript refers to different terrace levels in local areas. The first marine terrace, Qtd_1 (Half Moon Bay terrace of Smith (1960): 120,000 years old (Weber and Lajoie (1977)), is well-developed between Princeton and Moss Beach and extends from well south of the map area north almost continuously as far as Martini Creek. The second marine terrace, Qtd_2 (Miramar terrace of Smith (1960); 200,000 years old (Weber and Lajoie (1977)) is well developed between the Half Moon Bay airport and Montara. Remnants of older terraces at altitudes up to 750 feet and higher also exist in the map area. The Seal Cove Bluffs, west of the Half Moon Bay airport, are capped by deposits of Qtd_1 and the difference in altitude is caused by offset on the Seal Cove fault

Qc — COLMA FORMATION (Pleistocene)--Weakly consolidated yellowish-gray and tan sandy clay and silty sand and friable light- to reddish-brown poorly to well sorted sand and gravel. Thin- to thick-bedded with cross bedding commonly present in the

friable sands. Silty sand beds commonly contain zones of scattered well-rounded and polished chert pebbles. Total thickness unknown but probably exceeds 100 feet (30 m). Appears to underlie the San Francisco Bay flood plain, between the historic bay margin on the east and the base of the hills on the west. Probably a shallow water marine deposit

QTm — MERCED FORMATION (Pleistocene and Pliocene)--Moderately consolidated but commonly friable yellowish- to grayish-orange where weathered and bluish-gray where fresh thick-bedded to massive fine sandstone, siltstone and clayey sandstone. Bedding in the sandstone is indistinct but in places is defined by layers containing abundant marine shells; locally the fossiliferous layers are moderately cemented and hard

Tp — PURISIMA FORMATION (Middle Pliocene)--Highly fractured well-indurated soft to medium hard mudstone, siltstone, and sandstone in indistinct to distinct thin beds. Bedding is easily distinguished in the modern wave-cut platform exposed at low tide but not readily apparent in weathered exposures. Rests unconformably upon the Montara Quartz Diorite (Km) and unconformably overlain by marine terrace deposits (Qtd). At Moss Beach locally derived boulder- to pebble-conglomerate beds are present at the base, in the Moss Beach syncline; at the south end of Montara Beach a few feet of well-rounded chert-pebble conglomerate and bituminous sandstone rest on the quartz diorite. Total thickness as exposed in the wave-cut platform and adjacent sea cliff obscured by lack of marker beds and presence of faults; thought to be at least a few hundred feet thick. Mapped as the Merced Formation by Lawson (1914), and as the "Merced" Formation by Glen (1959) who correlated it with the Purisima Formation to the southeast across the Seal Cove fault

Ts — SANDSTONE (Oligocene?)--Well indurated hard medium-gray fine- to medium-grained feldspathic sandstone (wacke) containing abundant mafic clasts and cut by quartz and calcite veinlets. Poorly exposed in the southeast corner of the quadrangle but appears to extend southward into an area of unquestioned Mindego Basalt

Tss — SANDSTONE, SHALE, AND CONGLOMERATE (Paleocene)--As mapped, divided into:

Tsu — Sandstone and conglomerate--Well-consolidated soft to medium hard light-gray to brown fine- to coarse-grained sandstone and pebble to cobble conglomerate, with lesser amounts of conglomeratic sandstone, siltstone and claystone, all containing granitic debris, in distinct beds ranging from thin to massive. In the roadcut north of Devils Slide, where Highway 1 swings east, a boulder conglomerate containing granitic clasts up to 5 ft (1.5 m) on a side

crops out at the base of this map unit. The pebble to cobbble conglomerates on San Pedro Mountain appear to form the lower part of the map unit and may represent the same stratigraphic horizon as the boulder conglomerate. The conglomerate section appears to thin northward from possibly 300 ft (91 m) on San Pedro Mountain to about 4 ft (1.2 m) at Point San Pedro. Total thickness of this map unit estimated by Darrow (1963) to be 1300 ft (396 m)

Tsl — Shale and sandstone--Predominantly laminated to rhythmically bedded soft to medium hard brown fine- to coarse-grained arkosic sandstone and black shale, well exposed in Highway 1 roadcuts north of Devils Slide. Thickness estimated to be 2500 ft (762 m) by Darrow (1963)

Km — MONTARA QUARTZ DIORITE (Cretaceous)--Pervasively fractured medium-to coarsely-crystalline granitic rock, largely quartz diorite but locally grading into granite and granodiorite. Includes dikes and small masses of aplite, alaskite, and pegmatite. Foliation in the rock is indicated by preferred orientation of biotite and tabular dioritic inclusions and, in places, aplite and pegmatite dikes. Hard unfractured rock is rare, and commonly the rock is weathered to depths of 100 ft (30 m). The southwest flank of Montara Mountain is pockmarked by numerous small shallow landslides in the weathered rock or in the colluvium developed on the weathered rock. Jointing is common and is best exposed in the sea cliffs; alteration to epidote occurs along some of the joint surfaces. According to Curtis and others (1958) a K-Ar age determination of the Montara Quartz Diorite gave 91.6 m.y. A recalculation of the basic data by Compton (1966), using 1965 decay-rate values, gave an age of 87.4 m.y., and subsequently 89.6 m.y. using the new standard values described by Dalrymple (1979)

sp — SERPENTINE--Soft sheared serpentine enclosing blocks of hard gray to greenish-gray unsheared serpentine and ultramafic rock. Present in the Franciscan terrane northeast of the Pilarcitos fault. West of the San Andreas fault occurs as near-vertical tabular bodies in or along faults or shear zones; east of the San Andreas fault occurs in near-vertical tabular bodies and flat-lying sheets

fu — FRANCISCAN ASSEMBLAGE (Jurassic and Cretaceous) divided into:

fs — Graywacke--Medium- to coarse-grained poorly sorted dirty sandstone (lithic graywacke) with interbedded siltstone and shale. The rock is very well consolidated hard, and dark greenish gray where fresh to poorly consolidated soft, and grayish orange where weathered. Fresh natural exposures are rare as the rock is deeply weathered in a few places, however, the graywacke stands up in bold outcrop owing to a higher degree of induration or cementation. In some places the graywacke is

tuffaceous. West of the San Andreas fault the bulk of the graywacke occurs in a crudely layered sequence with other Franciscan Assemblage rock types; east of the San Andreas fault the graywacke occurs as tectonic inclusions in a matrix of sheared rocks (fsr). In places may include sheared rocks (fsr)

fg — Greenstone--Dark green to red altered basaltic volcanic rocks, including flows, pillow lavas, breccias, tuffs, and minor related intrusive rocks. Locally altered to pumpellyite rock or clay minerals. Friable to hard and dense depending upon rock type and degree of weathering. West of the San Andreas fault the bulk of the greenstone occurs in discrete lenticular (?) units interlayered with graywacke; east of the San Andreas fault the greenstone occurs mainly as rounded tectonic inclusions in a matrix of sheared rocks (fsr)

fc — Chert--Massive to rhythmically thin-bedded white, green, red, and brown hard brittle chert, commonly with thin interlayers of reddish-brown shale. Some massive exposures are recrystallized chert and are cut by crystalline quartz veins. West of the San Andreas fault the chert occurs as lenses interlayered in graywacke and greenstone; east of the San Andreas fault the chert occurs as tectonic inclusions in sheared rocks (fsr)

fl — Limestone--Light-gray hard dense finely crystalline limestone locally containing thin interbeds of black chert. Natural exposures range from large bold outcroppings to scattered small fragments in colluvium; artificial exposures show the limestone to be fractured or sheared throughout. The limestone occurs as discontinuous lenses and equidimensional bodies between the San Andreas and Pilarcitos faults except for one outcrop of pale red limestone in Mills Creek in Burlingame. Includes the Calera Limestone Member and other limestones of Lawson's (1914) Cahil Sandstone

fcg — Conglomerate--Well consolidated medium hard moderate brown deeply weathered pebble to cobble conglomerate. Clasts are well rounded and composed of medium to coarse grained granitic rocks, fine grained to aphanitic volcanic rocks, and graywacke, and lesser amounts of chert, shale, and shist all in a matrix of micaceous graywacke. The conglomerate is exposed along the north slope of San Pedro Valley near the Sanchez Adobe where it is at least 10 ft (3 m) thick and is surrounded by graywacke (fs) and sheared rocks (fsr)

fm — Metamorphic rocks--Dusky blue to brownish-gray and grayish-green hard dense rounded blocks of metamorphic rocks of the blueschist facies. Largely glaucophane schist and gneiss but included a wide variety of metamorphic rock

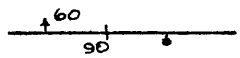
types, many bodies of which are too small to show. Mainly confined to the area east of the San Andreas fault where they occur as tectonic inclusions in sheared rocks (fsr)

fsr — Sheared rocks--Predominantly soft light- to dark-gray sheared shale, siltstone, and graywacke of the Franciscan Assemblage containing various sized tectonic inclusions of Franciscan rock types. Weathers to grayish-yellow clayey and silty sand and in places is eroded to form badlands topography. The thickness is unknown but is a least several hundreds of feet. An unstable material, especially when wet. Equivalent to Franciscan melange of the California Coast Ranges

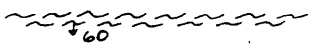
Pzm — METASEDIMENTARY ROCKS--White to light brownish gray finely to coarsely crystalline marble and graphitic marble in the southeast corner of the quadrangle, and quartz-mica hornfels and related metamorphosed sedimentary rocks at El Granada. The marble is fresh and hard; the hornfels is weathered and soft. These rocks occur as pendants 600 ft (183 m) or more long and 100 ft (30 m) thick in the Montara Quartz Diorite. Other pendants of pre-granitic rock may be present. The marble is the Gavilan Limestone of Lawson (1914)

Contact--Long-dashed where approximately located; short-dashed where inferred; dotted where concealed

Fault--Long -dashed where aproximately located; short-dashed where inferred; dotted where concealed queried where existence or extension is questionable



Fault, showing dip--Bar and ball on downthrown side

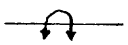


Shear zone, showing dip

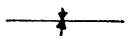
Photo-lineament--In the sea cliffs controlled by jointing; elsewhere probably controlled by faulting

Folds, approximately located

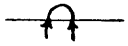
Anticline



Overturned anticline



Syncline



Overturned syncline

Strike and dip of beds--Ball indicates top of beds known from sedimentary structures

Inclined

Vertical

Horizontal

Overturned

Approximate

Component of dip

Strike and dip of jointing

Inclined

Vertical

Strike and dip of foliation

Inclined

Vertical

Multiple attitudes at one site

Qtd
Km

Abbreviated columnar section

Landslide, showing approximate direction of movement--Boundary dashed where approximately located; queried where questionable

o

Shallow landslide, commonly in surficial materials--Generally less than 10 ft (3 m) thick and less than

100 ft (30 m) in diameter. Visible on 1968 aerial photos. Many more exist than are shown

Quarry

Borrow pit

Spring

Water well

Upper edge of cut slope or natural scarp--Hachures on low side

Conglomerate beds

Closed depression

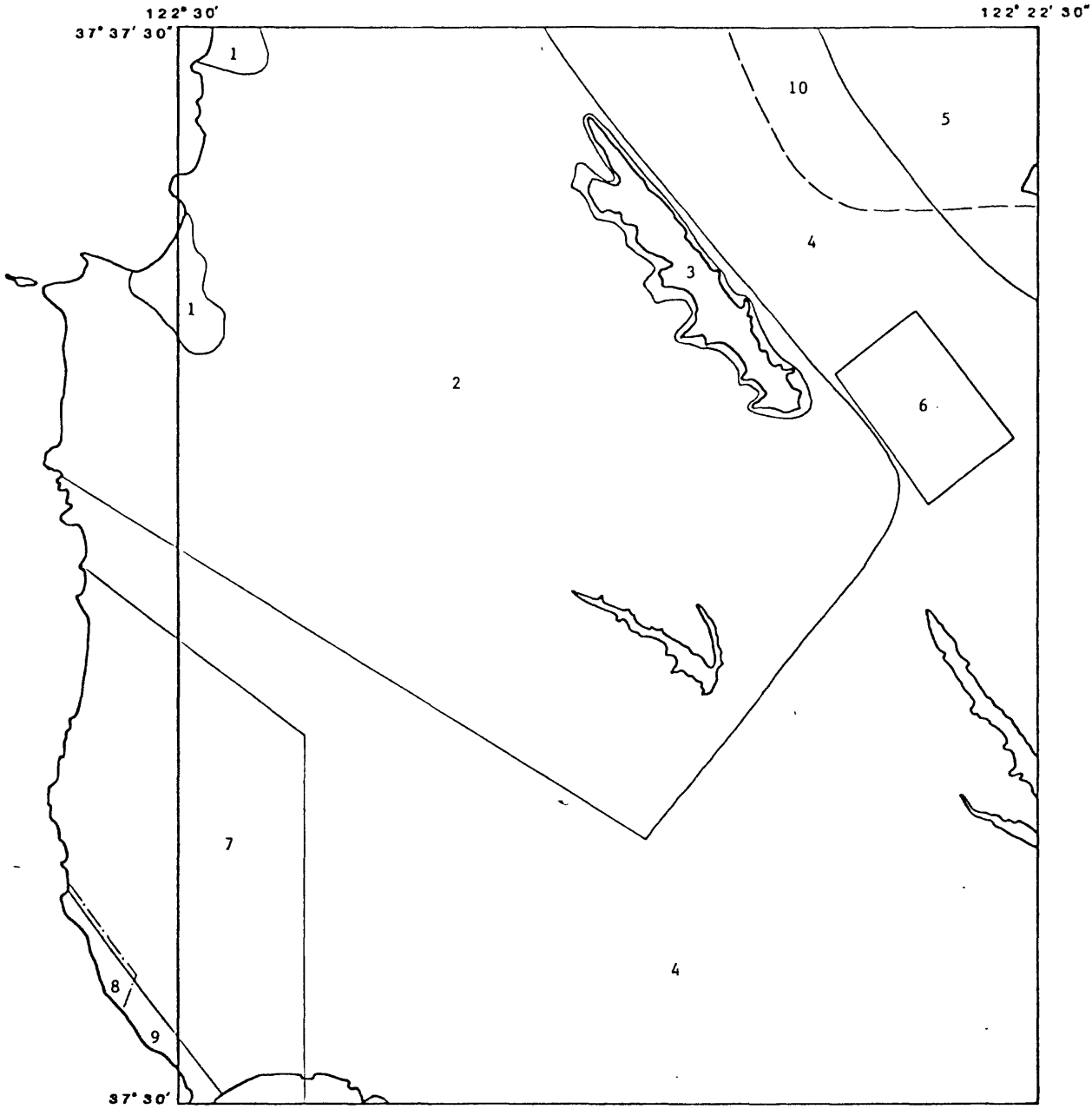
Fossil locality

SEIC △ State Earthquake Investigation Commission monument (Lawson, 1908, p. 152)

Historic shoreline and extent of marsh lands from U. S. Coast Survey maps

-175' Borehole, showing altitude of basement rock--Datum is mean sea level

-200' Borehole, showing altitude of bottom of hole--Datum is mean sea level



SOURCES OF DATA

SOURCES OF DATA

1. Historic shoreline data from U. S. Coast Survey (1853).

2. Darrow (1963), with extensive modifications north of San Pedro Valley.

3. Pampeyan (1975).

4. Lawson (1914), with numerous modifications and additions; some data on marine terraces and faulting from Smith (1960).

5. Historic shoreline data from U. S. Coast Survey (1867; 1868).

6. Faults located by geophysical methods from Donely, Wire, and Rowland (1975).

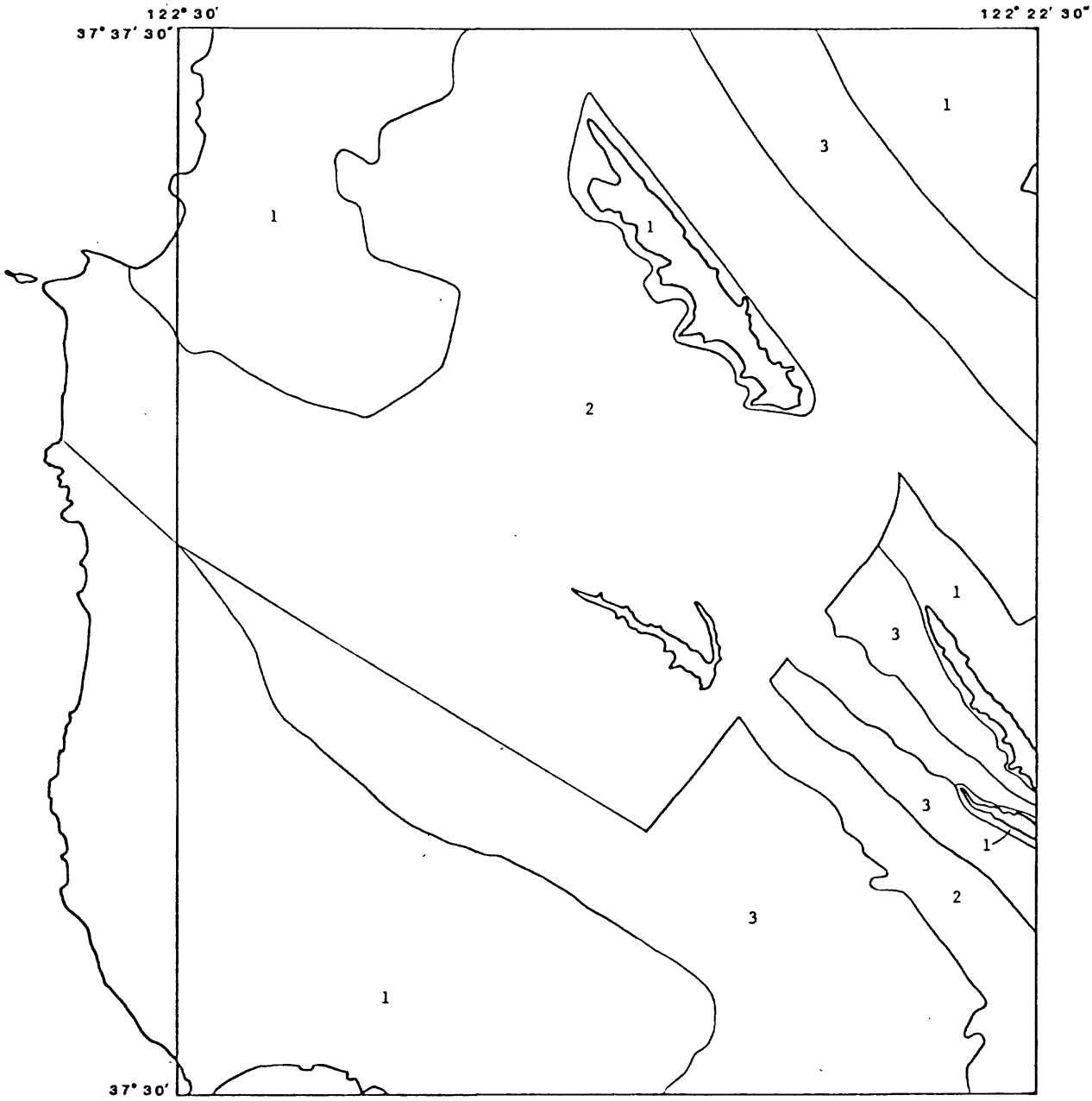
7. Some data on marine terraces and terrace deposits from Jack (1969).

8. Subsurface and some surface data from Leighton and Associates (1971)

9. Glen (1959), with modifications.

10. Basement depth data from Bonilla (1964), with additions.

The reader should be aware of maps by Brabb and Pampeyan (1972a, 1972b), Brabb, Pampeyan, and Bonilla (1972), Brown (1972), and Lajoie and others (1974), all of which include this map area and are based wholly or partly on this map.



RELIABILITY DIAGRAM

[1] Few additions or changes likely. [2] Some additions or changes likely.
[3] Many additions or changes likely.

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