DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

West of Soquel Creek

Qtl **Colluvium (Holocene)**—Unconsolidated, heterogeneous deposits of moderately to poorly sorted silt, sand, and gravel. Deposited by slope wash and mass movement. Minor fluvial reworking. Locally includes numerous landslide deposits and small alluvial fans. Contacts generally gradational. Locally grades into fluvial deposits. Generally more than 5 ft thick

Qal **Alluvial deposits, undifferentiated (Holocene)**—Unconsolidated, heterogeneous, moderately sorted silt and sand containing discontinuous lenses of clay and silty clay. Locally includes large amounts of gravel. May include deposits equivalent to both younger (Qyf) and older (Qof) flood-plain deposits in areas where these were not differentiated. Thickness highly variable; may be more than 100 ft thick near coast

Qb **Basin deposits (Holocene)**—Unconsolidated, plastic, silty clay and clay rich in organic material. Locally contain interbedded thin layers of silt and silty sand. Deposited in a variety of environments including estuaries, lagoons, marsh-filled sloughs, flood basins, and lakes. Thickness highly variable; may be as much as 90 ft thick underlying some sloughs

Qbs **Beach sand (Holocene)**—Unconsolidated well-sorted sand. Local layers of pebbles and cobbles. Thin discontinuous lenses of silt relatively common in back-beach areas. Thickness variable, in part due to seasonal changes in wave energy; commonly less than 20 ft thick. May interfinger with either well-sorted dune sand or, where adjacent to coastal cliff, poorly-sorted colluvial deposits. Iron and magnesium-rich heavy minerals locally from placers as much as 2 ft thick

Qt **Terrace deposits, undifferentiated (Pleistocene)**—Weakly consolidated to semiconsolidated heterogeneous deposits of moderately to poorly sorted silt, silty clay, sand, and gravel. Mostly deposited in a fluvial environment. Thickness highly variable; locally as much as 60 ft thick. Some of the deposits are relatively well indurated in upper 10 ft of weathered zone

Qes **Eolian deposits of Sunset Beach (Pleistocene)**—Weakly consolidated, well-sorted, fine- to medium-grained sand. Forms an extensive coastal dune field. Thickness ranges from 5 to 80 ft

Qcl **Lowest emergent coastal terrace deposits (Pleistocene)**—Semiconsolidated, generally well-sorted sand with a few thin, relatively continuous layers of gravel. Deposited in nearshore high-energy marine environment. Grades upward into eolian deposits of Manresa Beach in southern part of county. Thickness variable; maximum approximately 40 ft. Unit thins to north where it ranges from 5 to 20 ft thick. Weathered zone ranges from 5 to 20 ft thick. As mapped, locally includes many small areas of fluvial and colluvial silt, sand, and gravel, especially at or near old wave-cut cliffs

Qcu **Coastal terrace deposits, undifferentiated (Pleistocene)**—Semiconsolidated, moderately well sorted marine sand with thin, discontinuous gravel-rich layers. May be overlain by poorly sorted fluvial and colluvial silt, sand, and gravel. Thickness variable; generally less than 20 ft thick. May be relatively well indurated in upper part of weathered zone

East of Soquel Creek

Qtl **Colluvium (Holocene)**—For description, see column West of Soquel Creek

Qal **Alluvial deposits, undifferentiated (Holocene)**—For description, see column West of Soquel Creek

Qyf **Younger flood-plain deposits (Holocene)**—Unconsolidated, fine-grained, heterogeneous deposits of sand and silt, commonly containing relatively thin, discontinuous layers of clay. Gravel content increases toward the Santa Cruz Mountains and is locally abundant within channel and lower point-bar deposits in natural levees and channels of meandering streams. Thickness generally less than 20 ft

Qof **Older flood-plain deposits (Holocene)**—Unconsolidated, fine-grained sand, silt, and clay. More than 200 ft thick beneath parts of the Pajaro and San Lorenzo River flood plain. Lower parts of these thick fluvial aggradational deposits include large amounts of gravel, and serve a major ground-water aquifer beneath Pajaro Valley

Qyfo **Alluvial fan deposits (Holocene)**—Unconsolidated, moderately to poorly sorted sand, silt, and gravel, with layers of silty clay. Generally coarsest nearest the mountain front. Thickness uncertain, but may locally be greater than 50 ft

Qb **Basin deposits (Holocene)**—For description, see column West of Soquel Creek

Qds **Dune sand (Holocene)**—Unconsolidated, well-sorted, fine- to medium-grained sand. Deposited as linear strip of coastal dunes. May be as much as 80 ft thick

Qbs **Beach sand (Holocene)**—For description, see column West of Soquel Creek

Qcf **Abandoned channel fill deposits (Holocene)**—Unconsolidated, plastic, poorly sorted clay, silty clay, and silt. Deposited within channels on younger and older flood-plain deposits. Thickness generally less than 10 ft

Qt **Terrace deposits, undifferentiated (Pleistocene)**—For description, see column West of Soquel Creek

Qes **Eolian deposits of Sunset Beach (Pleistocene)**—For description, see column West of Soquel Creek

Qem **Eolian deposits of Manresa Beach (Pleistocene)**—Weakly to moderately consolidated, moderately well sorted silt and sand. Deposited in extensive coastal dune field. Overlies fluvial terrace deposits (Qwf). Locally grades conformably into underlying coastal terrace deposits (Qcu). Upper 10 to 20 ft is partially indurated owing to clay and iron oxide cementation in weathered zone. Moderate permeability and porosity except in soil zones, where generally low

Terrace deposits of Watsonville

Qwf **Fluvial facies (Pleistocene)**—Semiconsolidated, moderately to poorly sorted silt, sand, silty clay, and gravel. May be more than 200 ft thick. Gravel, approximately 50 ft thick, is generally present 50 ft below surface of deposit and is both a local aquifer and significant source of gravel. Upper 5 to 15 ft of unit is moderately indurated owing to clay and iron oxide cementation in weathered zone

Qof **Alluvial fan facies (Pleistocene)**—Semiconsolidated, moderately to poorly sorted,discontinuous layers of silty clay, silt, sand, and gravel. Deposited by streams, sheet flow, and debris flow on alluvial fans adjacent to Santa Cruz Mountains. Thickness variable; locally may be more than 50 ft thick

Qcu **Coastal terrace deposits. undifferentiated (Pleistocene)**—For description, see column West of Soquel Creek

Qce **Eolian facies**—Semiconsolidated, moderately well sorted eolian sand. Deposited conformably on top of coastal terrace deposits; undifferentiated, in western part of county. Thickness as much as 40 ft

Qcl **Lowest emergent coastal terrace deposits**—For description, see column West of Soquel Creek

Qar **Aromas Sand, undivided (Pleistocene)**—Heterogeneous sequence of mainly eolian and fluvial sand, silt, clay, and gravel. Several angular unconformities present in unit, with older deposits more complexly jointed, folded, and faulted than younger deposits. Total thickness may be more than 800 ft. Locally divided into:

Qae **Eolian lithofacies**—Moderately well sorted eolian sand. Highly variable degree of consolidation owing to differential weathering. May be as much as 200 ft thick without intervening fluvial deposits. Several sequences may be present, separated by paleosols. Upper 10 to 20 ft of each dune sequence is oxidized and relatively indurated, with all primary structures destroyed by weathering. Lower part of each dune sequence below weathering zone may be essentially unconsolidated

Qaf **Fluvial lithofacies**—Semiconsolidated, heterogeneous, moderately to poorly sorted silty, clay, silt, sand, and gravel. Deposited by meandering and braided streams. Includes beds of relatively well sorted gravel ranging from 10 to 20 ft thick. Clay and silty clay layers, locally as much as 2 ft thick, occur in unit. Locally includes buried soils, high in expansive clays, as much as 14 ft thick

QTc **Continental deposits, undifferentiated (Pleistocene and Pliocene?)**—Semiconsolidated, fine-grained, oxidized sand and silt. Generally underlie fluvial lithofacies of Aromas Sand (Qaf). May represent highly weathered eolian deposits formed on Purisima Formation. Thickness approximately 300 ft

SEDIMENTARY AND VOLCANIC ROCKS

West of San Andreas fault

Tp **Purisima Formation (Pliocene and upper Miocene)**—Very thick bedded yellowish-gray tuffaceous and diatomaceous siltstone containing thick interbeds of bluish-gray, semifriable, fine-grained andesitic sandstone. As shown, includes Santa Cruz Mudstone east of Scotts Valley and north of Santa Cruz. Thickness approximately 3,000 ft in the Corralitos Canyon area

Tps **Predominantly massive sandstone**

Tsc **Santa Cruz Mudstone (upper Miocene)**—Medium-to thick-bedded and faintly laminated, blocky-weathering, pale-yellowish-brown siliceous organic mudstone. As shown, includes Santa Margarita Sandstone along Glenwood syncline. Thickness at least 8,900 ft in the Texas Company Poletti well near Waddell Creek (Clark, 1981, p. 31)

Tsm **Santa Margarita Sandstone (upper Miocene)**—Very thick bedded to massive thickly crossbedded yellowish-gray to white friable granular medium-to fine-grained arkosic sandstone; locally calcareous and locally bituminous. Thickness 430 ft along Scotts Valley syncline (Clark, 1981, p. 25)

Tm **Monterey Formation (middle Miocene)**—Medium-to thick-bedded and laminated olive-gray to light-gray semisiliceous organic mudstone and sandy siltstone. Includes a few thick dolomite interbeds. Thickness about 2,675 ft on north limb of Scotts Valley syncline (Clark, 1981, p. 21)

Tlo **Lompico Sandstone (middle Miocene)**—Thick-bedded to massive yellowish-gray, medium- to fine-grained calcareous arkosic sandstone; locally friable. Maximum thickness 720 ft along Majors Creek (Clark, 1981, p. 18)

Tla **Lambert Shale (lower Miocene)**—Thin- to medium-bedded and faintly laminated olive-gray to dusky-yellowish-brown organic mudstone containing phosphatic laminae and lenses in lower part. Thickness about 1,500 ft along Mountain Charlie Gulch (Clark, 1981, p. 16)

Tvq **Vaqueros Sandstone (lower Miocene and Oligocene)**—Thick-bedded to massive yellowish-gray arkosic sandstone containing interbeds of olive-gray shale and mudstone. Thickness 4,500 ft along Bear Creek (Burchfiel, 1958)

Tbs **Basalt (lower Miocene)**—Spheroidal-weathering pillow basalt flows. Thickness as much as 200 ft along Zayante Road (Clark, 1981, p. 15)

Tz **Zayante Sandstone (Oligocene)**—Thick- to very thick-bedded, yellowish-orange arkosic sandstone containing thin interbeds of greenish and reddish siltstone and lenses and thick interbeds of pebble and cobble conglomerate. Thickness 1,800 ft along Lompico Creek (Clark, 1981, p. 14)

Tsl **San Lorenzo Formation, undivided (Oligocene and Eocene)**

Tsr **Rices Mudstone Member (Oligocene and Eocene)**—Olive-gray mudstone and massive medium light-gray, very fine- to fine-grained arkosic sandstone; thick bed of glauconitic sandstone at base. Thickness 1,700 ft along Bear Creek (Brabb, 1964, p. 675)

Tst **Twobar Shale Member (Eocene)**—Very thin bedded and laminated olive-gray shale. Thickness 790 ft along Kings Creek (Brabb, 1964, p. 671).

Butano Sandstone (Eocene)

Tbu **Upper sandstone member**—Thin-bedded to very thick-bedded medium-gray, fine-to medium-grained arkosic sandstone containing thin interbeds of medium-gray siltstone. Thickness about 3,200 ft (Clark, 1981, p. 8)

Tbm **Middle siltstone member**—Thin- to medium-bedded, nodular, olive-gray pyritic siltstone. Thickness about 700 ft (Clark, 1981, p. 8)

Tbl **Lower sandstone member**—Very thick-bedded to massive, yellowish-gray, granular, medium- to coarse-grained arkosic sandstone. Thickness as much as 5,000 ft (Clark, 1981, p. 11)

Tblc **Conglomerate**—Thick to very thick interbeds of sandy pebble conglomerate in lower part of lower sandstone member

Tl **Locatelli Formation** (Paleocene)—Nodular, olive-gray to pale yellowish-brown micaceous siltstone. Thickness 800-900 ft (Clark, 1981, p. 7)

Tlss **Sandstone**—Massive medium-gray, fine-to medium-grained arkosic sandstone locally at base. Maximum thickness 80 ft ;Clark, 1981, p. 7)

SEDIMENTARY ROCKS

East of San Andreas fault

Ts **Siltstone and sandstone (Pliocene and upper Miocene)**—Very thick-bedded siltstone, sandstone, and minor conglomerate. Referred to the Etchegoin Formation by Dibblee and Brabb (1978) and to the Purisima Formation by Allen (1946), who indicated that it is nearly 10,000 ft thick. Only about 1,000 ft is exposed in Santa Cruz County

Tmp **Shale of Mount Pajaro area (Miocene and Oligocene)**—Medium- to thick-bedded, laminated, olive-gray to brownish-black semisiliceous shale, mudstone, and less abundant medium-bedded, very pale orange sandstone, tuffaceous sandstone, limestone, and conglomerate. Minimum thickness 4,300 ft (Osbun, 1975, p. 1 75)

Tmm **Sandstone of Mount Madonna area (Eocene?)**—Mostly massive very pale-orange arkosic sandstone containing lesser amounts of brownish-black siliceous shale and mudstone. Thickness 1,300-2,250 ft (Simon), 1974, p. 45)

Tms **Mudstone of Maymens Flat area (Eocene and Paleocene)**—Massive dusky yellow-green and moderate red mudstone containing abundant planktonic foraminifers. In places, mudstone is glauconitic and sandy. Thickness 200-960 ft (Simoni), 1974, p. 36)

Kgs **Shale and sandstone of Nibbs Knob area (Upper Cretaceous)**—Medium- to thin-bedded and rhythmically interbedded, olive-black shale and olive-gray sandstone (graywacke). Minor thin conglomerate lenses. Thickness 1,100-1,900 ft (Simoni, 1974, p. 31)

Kcg **Conglomerate (Upper Cretaceous)**—Consists predominately of well-rounded pebbles and cobbles of porphyritic volcanic rocks. Thickness 150-1,120 ft (Simoni, 1974, p. 25)

INTRUSIVE AND METAMORPHIC ROCKS

qd **Quartz diorite (Cretaceous)**—Grades to granodiorite south and east of Ben Lomond Mountain

ga **Granite and adamellite (Cretaceous)**

gd **Gneissic granodiorite (Cretaceous)**

hcg **Hornblende-cummingtonite gabbro (Cretaceous)**

sch **Metasedimentary rocks (Mesozoic or Paleozoic)**—Mainly pelitic schist and quartzite

m **Marble (Mesozoic or Paleozoic)**—Locally contains interbedded schist and calc-silicate rocks

db **Diabase**—Age and stratigraphic relations unknown. Structurally within shale of Mount Pajaro area

REFERENCES CITED

Allen, J.E., 1946, Geology of the San Juan Bautista Quadrangle, California: California Division of Mines, Bulletin 133, scale 1:62,500.

Brabb, E.E., 1960, Geology of the Big Basin area, Santa Cruz Mountains, California: Stanford, Calif., Stanford University, Ph.D. dissertation, scale 1:24,000.

______1964, Subdivision of San Lorenzo Formation (Eocene-Oligocene), West-Central California: American Association of Petroleum Geologists Bulletin v. 48, no. 5. p. 670-697.

Brabb, E.E., 1989, Geologic map of Santa Cruz County, California, U.S. Geological Survey Miscellaneous Investigations Series Map I-1905, scale 1:62,500.

Brabb, E.E., and Dibblee, T.W., Jr., 1979, Preliminary geologic map of the Castle Rock Ridge Quadrangle, Santa Cruz and Santa Clara Counties, California: U.S. Geological Survey Open-File Report 79-659, scale 1:24,000.

Burchfiel, B.C., 1958, Geology of the Two Bar Creek area, Boulder Creek, California: Stanford, Calif., Stanford University, MS thesis, scale 1:12,000.

Clark, J.C., 1981, Stratigraphy, paleontology, and geology of the central Santa Cruz Mountains, California Coast Ranges: U.S. Geological Survey Professional Paper 1168, 51 p., map scale 1:24,000.

Cooper-Clark and Associates, 1975, Preliminary map of landslide deposits in Santa Cruz County, California, in Seismic safety element, an element of the Santa Cruz County General Plan: Santa Cruz County Planning Department, California, scale 1:62,500.

Cummings, J.C., Touring, R.M., and Brabb, E.E., 1962, Geology of the northern Santa Cruz Mountains, California: California Division of Mines and Geology Bulletin 181, p. 179-220.

Dibblee, T.W., Jr., 1966, Geology of the Palo Alto Quadrangle, Santa Clara and San Mateo Counties, California: California Division of Mines and Geology Map 8, scale 1:62,500.

______1973, Preliminary geologic map of the Mt. Madonna Quadrangle, Santa Clara and Santa Cruz Counties, California: U.S. Geological Survey Open-File Report, scale 1:24,000.

Dibblee, T.W., Jr., and Brabb, E.E., 1978, Preliminary geologic maps of the Chittenden, Los Gatos, and Watsonville East Quadrangles, California: U.S. Geological Survey Open-File Report 78-453, scale 1:24,000.

______1980, Preliminary geologic map of the Loma-Prieta Quadrangle, Santa Cruz and Santa Clara Counties, California: U.S. Geological Survey Open-File Report 80-944, scale 1:24,000.

Dibblee, T.W., Jr., Brabb, E.E., and Clark, J.C., 1978, Preliminary geologic map of the Laurel Quadrangle, Santa Cruz and Santa Clara Counties, California: U.S. Geological Survey Open-File Report 78-84, scale 1:24,000.

Dupré W.R., 1975, Maps showing geology and liquefaction potential of Quaternary deposits in Santa Cruz County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-648, 2 sheets, scale 1:62,500.

Greene, H.G., 1977, Geology of the Monterey Bay region: U.S. Geological Survey Open-File Report 77-718, 347 p., 9 sheets.

Greene, H.G., Lee, W.H.K., McCulloch, D.S., and Brabb, E.E., 1973, Faults and earthquakes in the Monterey Bay region, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-518, 4 sheets, scale 1:200,000.

Hall, N.T., Sarna-Wojcicki, A.M., and Dupré, W.R., 1974, Faults and their potential hazards in Santa Cruz County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-626, scale 1:62,500.

Hector, S.T., 1976, Environmental geology of the Castle Rock Ridge area, Santa Cruz and Santa Clara Counties, California: Davis, California, University of California at Davis, MS thesis, 98 p., scale 1:24,000.

Hoskins, E.G., and Griffiths, J.R., 1971, Hydrocarbon potential of northern and central California offshore, in Cram, I.H., ed., Future petroleum provinces of the United States—their geology and potential: American Association of Petroleum Geologists Memoir 15, v.1, p. 212-228.

Leo, G.W., 1961, The plutonic and metamorphic rocks of Ben Lomond Mountain, Santa Cruz County, California: Stanford, Calif., Stanford University, Ph.D. dissertation, 194 p.

______1967, The plutonic and metamorphic rocks of the Ben Lomond Mountain area, Santa Cruz County, California: California Division of Mines and Geology Special Report 91, p. 27-43

McCrory, P.A., Greene, H.G., and Lajoie, K.R., 1977, Map showing earthquake intensity zonation and distribution of Quaternary deposits, San Mateo, Santa Cruz, and Monterey Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-903, scale 1:250,000.

McCulloch, D.S., Clarke, S.H., Jr., Field, M.E., Scott, E.W., and Utter, P.M., 1977, A summary report on the regional geology, petroleum potential, and environmental geology of the southern proposed Lease Sale 53, central and northern California outer continental shelf: U.S. Geological Survey Open-File Report 77-593, 59 p.

McJunkin, R.D., 1984, Geology of Big Basin Redwoods State Park, Santa Cruz County, California: California Division of Mines and Geology Open-File Report 84-6 SAC, 72 p., map scale 1:24,000.

McLaughlin, R.J., 1971, Geologic map of the Sargent fault zone in the vicinity of Mount Madonna, Santa Clara County, California: U.S. Geological Survey Open-File Report, scale 1:12,000.

______1973, Geology of the Sargent fault zone in the vicinity of Mount Madonna, Santa Clara and Santa Cruz Counties, Caiifornia: San Jose, California, San Jose State University, MS thesis, 131 p.

McLaughlin, R.J., Simoni, T.R., Osbun, E.D., and Bauer, P.G., 1971, Geologic map of the Loma Prieta-Mount Madonna area, Santa Clara and Santa Cruz Counties, California: U.S. Geological Survey Open-File Report, scale 1:24,000.

Osbun, E.D., 1975, Geology of the Sveadal area, southern Santa Cruz Mountains, California: San Jose, California, San Jose State University, MS thesis, 156 p.

Phillips, R.L., 1983, Late Miocene tidal shelf sedimentation, Santa Cruz Mountains, California, in La Rue, D.K., and Steel, R.J., eds., Society of Economic Paleontologists and Mineralogists, Pacific Section, Proceedings, p. 45-61.

______1984a, Late Miocene (Santa Margarita Sandstone) shallow marine clastics: Society of Economic Paleontologists and Mineralogists Annual Meeting, San Jose, California, Field Trip Guidebook, 46 p.

______1984b, Depositional features of late Miocene marine cross-bedded conglomerates, California, in Koster, E.H., and Steel, R.J., eds., Sedimentology of gravels and conglomerates: Canadian Society of Petroleum Geologists Memoir 10, p. 345-358.

Ross, D.C., 1970, Quartz gabbro and anorthositic gabbro, markers of offset along the San Andreas Fault in the California Coast Ranges: Geological Society of America Bulletin, v. 81, no. 12, p. 3647-3661.

Ross, D.C., and Brabb, E.E., 1973, Petrography and structural relations of granitic basement rocks in the Monterey Bay area, California: U.S. Geological Survey Journal of Research, v. 1, no. 3, p. 273-282.

Sarna-Wojcicki, A.M., Pampeyan, E.H., and Hall, N.T., 1975, Map showing recently active breaks along the San Andreas fault between the central Santa Cruz Mountains and the northern Gabilan Range, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-650, scale 1:24,000.

Simoni, T.R., Jr., 1974, Geology of the Loma Prieta area, Santa Clara and Santa Cruz Counties, California: San Jose, California, San Jose State University, MS thesis, 75 p.

Stanley, R.G., 1984, Middle Tertiary sedimentation and tectonics of the La Honda basin, central California: Santa Cruz, California, University of California at Santa Cruz, Ph.D. dissertation, 471 p.

Stanley, R.G., and McCaffrey, Robert, 1983, Extent and offset history of the Ben Lomond fault, Santa Cruz County, California, in Andersen, D.W., and Rymer, M.J., eds., Tectonics and sedimentation along faults of the San Andreas system: Society of Economic Paleontologists and Mineralogists, Pacific Section Publication 30, p. 79-90.