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EXPLANATORY DATA
LOS ANGELES SHEET
GEOLOGIC MAP OF CALIFORNIA
OLAF P. JENKINS EDITION

Compiled by Charles W. Jennings and Rudolph G. Strand, 1969

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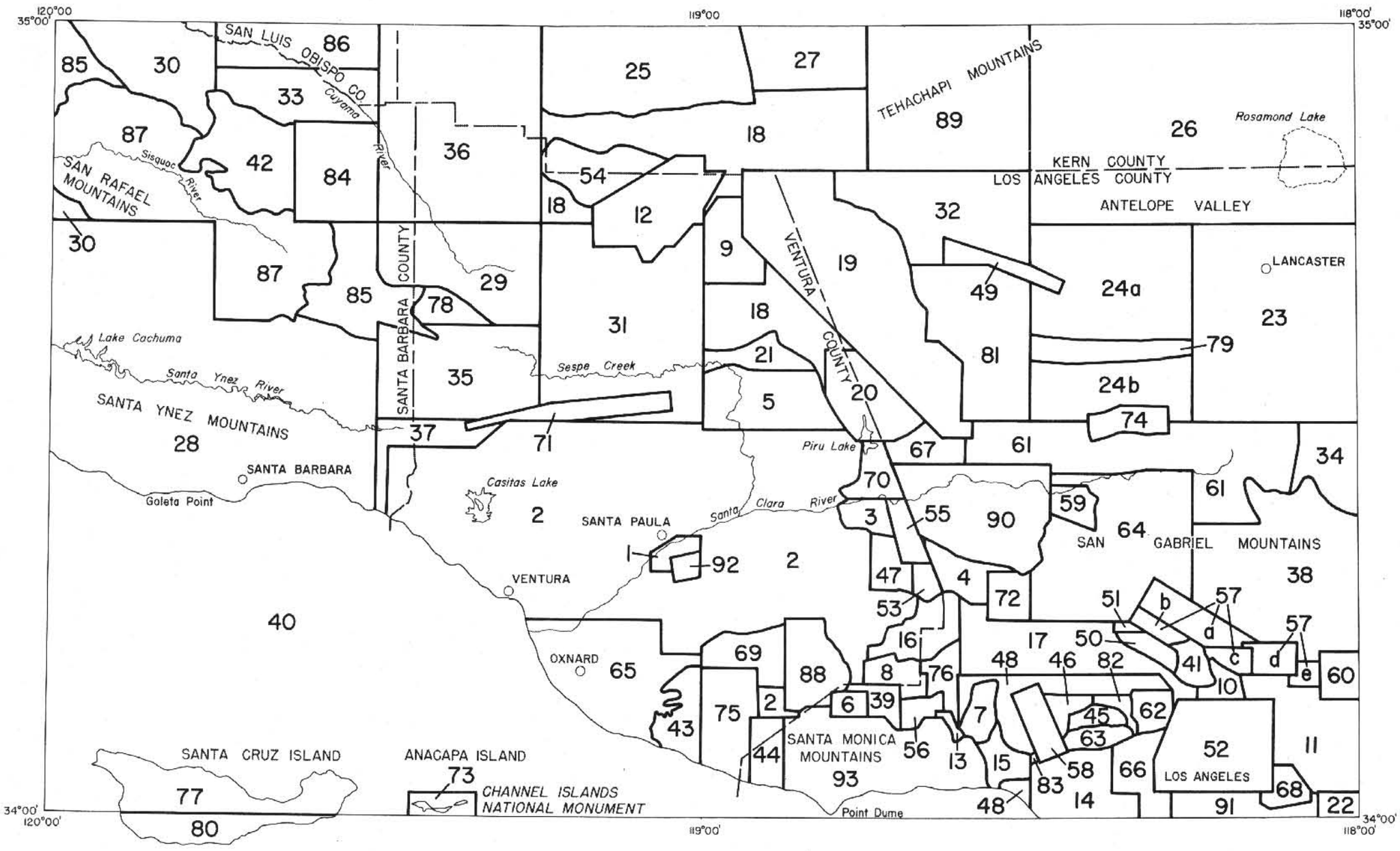
USED IN THE COMPILATION OF THE LOS ANGELES SHEET



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STRATIGRAPHIC NOMENCLATURE—LOS ANGELES SHEET

AGE	STATE MAP SYMBOL	STATE MAP UNIT State Map Units listed here are not necessarily in stratigraphic sequence; the sequence used has been standardized for all sheets of the Geologic Map of California	STRATIGRAPHIC UNITS AND CHARACTERISTIC LITHOLOGIES Formally named formations grouped in sequence (separated by semicolons) are listed from youngest to oldest.
CENOZOIC – QUATERNARY – Recent	Qs	**RECENT DUNE SAND**	Wind-blown sand and beach deposits along coast, desert dune sand and bars of wave-deposited sand around Rosamond Dry Lake.
	Ql	**QUATERNARY LAKE DEPOSITS**	Playa clay and silt of Rosamond Dry Lake.
	Qal	**RECENT ALLUVIUM**	"Younger" alluvium consisting of Recent clay, silt, sand and gravel, unconsolidated, poorly stratified to well statified, includes alluvial fan, flood-plain, and streambed deposits. In some desert areas includes mixture of playa clay and wind-blown sand.
	Qf	**RECENT ALLUVIAL FAN DEPOSITS IN THE GREAT VALLEY**	Alluvial fan deposits at the southern end of the San Joaquin Valley.
	Qt	**QUATERNARY NONMARINE TERRACE DEPOSITS**	Alluvial terrace deposits, in places along the coast overlies thin marine terrace deposits. Locally includes fanglomerate and "older" alluvial debris at higher levels.
Pleistocene	Qc	**PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	Casitas Formation—*red to greenish clay, silt, sand and conglomerate* (Carpinteria area). Frazier Mountain Formation—*conglomerate, fanglomerate and landslide breccia of local derivation* (Lockwood Valley). Pacoima Formation—*dark-brown breccia and fanglomerate, locally folded.* Nadeau Gravel—*gravel and interbedded sand of prevailingly dark color* (Pearland quadrangle). Harold Formation—*interbedded gravel, sand, silt, and gypsiferous clay.* "Older" alluvium consisting of gravel, sand, clay, and silt; dissected alluvial fan deposits. "Ancient" alluvium, commonly with soil formation on surface (San Gabriel Valley).
	Qm	**PLEISTOCENE MARINE DEPOSITS AND MARINE TERRACE DEPOSITS**	San Pedro Formation—*sand, silt, and marl, highly fossiliferous* (Los Angeles basin). Marine and some stream terrace deposits along the coast and on Santa Cruz Island. Qm-Pu: Santa Barbara Formation[1]—*buff to yellow sand, silt and calcareous sediments.*
Pliocene	QP	**PLIOCENE-PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	Paso Robles Formation[2]—*interbedded gray to brown clay, sandstone, and conglomerate* (Cuyama area and Santa Ynez Mountains). Saugus Formation—*sandstone, conglomerate and siltstone, mainly fluviatile but locally brackish water deposits.* Tulare Formation[2]—*gravel, clay and conglomerate* (south end San Joaquin Valley).
	Puc	**UNDIVIDED UPPER PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Hungry Valley Formation—*brown conglomerate, white conglomeratic sandstone, and brown mudstone.*
	Pc	**UNDIVIDED PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Morales Formation[3]—*gray, poorly bedded stream-laid gravel and sand;* Quatal Formation—*orange to buff, pebbly, arkosic sandstone and light-red clays, gypsiferous siltstone, and gypsum;* Lockwood Clay of Carman, 1964—*pale-tan to gray montmorillonitic clay and interbedded fine-grained sandstone.* Peace Valley Formation—*brown siltstone, buff sandstone, some conglomerate and sedimentary breccia.* Meeke Mine Formation—*pebble gravel, sand, and lacustrine clay shale;* may be early Pleistocene in age (Tehachapi Mountains area).
	Pu	**UPPER PLIOCENE MARINE SEDIMENTARY ROCKS**	Sunshine Ranch Member of Saugus Formation—*continental and brackish-water greenish sandstone and mudstone, red conglomerate beds, and thin limestone beds* (San Fernando Reservoir area); upper member of the Fernando Formation (includes rocks commonly called Pico Formation)[4]—*sandy siltstone, conglomerate and sandstone* (Los Angeles basin). Pico Formation[4]—*siltstone, sandstone and conglomerate* (Ventura basin). Careaga Sandstone—*poorly consolidated, fine- to medium-grained sandstone* (Santa Ynez Mtns.). Unnamed marine Pliocene-Pleistocene (?) silt and sand in the Baldwin Hills area.
	Pmlc	**MIDDLE AND/OR LOWER PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Anaverde Formation—*gray shale, arkosic sandstone, red conglomerate, dark-gray dioritic breccia; plant fossils of early to middle Pliocene age* (in San Andreas fault zone). Ridge Route Formation—*sandstone with conglomerate, shale, and siltstone interbeds.* Chanac Formation—*sandstone, claystone and conglomerate.*
	Pml	**MIDDLE AND/OR LOWER PLIOCENE MARINE SEDIMENTARY ROCKS**	Lower member of the Fernando Formation (includes rocks commonly called Repetto Formation)[5]—*siltstone, conglomerate and fine sandstone.* Etchegoin Formation—*buff, fine, fossiliferous sand* (SW San Joaquin Valley). Unnamed siliceous mudstone in the Bitterwater Creek area (may be late Miocene in age). Towsley Formation—*siltstone, mudstone, sandstone and conglomerate* (late Miocene and early Pliocene age; Santa Susanna Mountains).
Miocene	Mc	**UNDIVIDED MIOCENE NONMARINE SEDIMENTARY ROCKS**	Fiss Fanglomerate—*fanglomerates of brown volcanic detritus and gray granitic detritus* (Miocene age uncertain; Willow Springs and Rosamond quadrangles). Punchbowl Formation—*white, buff to pink sandstone, gray to red siltstone and clay shale, and gray to red conglomerate* (middle and late Miocene and early Pliocene age; Valyermo area). Mint Canyon Formation—*grayish-green or light-brown siltstone and mudstone, light-brown, gray or reddish sandstone and conglomerate; some tuff beds* (late Miocene and early Pliocene age; Mint Canyon area). Oso Canyon Formation—*fanglomerate, gray-white to red sandstone, and red to green siltstone,* grades laterally west into Quail Lake Formation (late Miocene age; west end Antelope Valley). Bissell Formation—*dolomite, limestone and shale with magnesite layers, sandstones and conglomerates* (Miocene or Pliocene age; Bissell Hills, Rosamond quadrangle). Unnamed gray fanglomerate sand and clay that grades northward into marine sandstone and shale of middle and late Miocene age (southern San Joaquin Valley).
	Mu	**UPPER MIOCENE MARINE SEDIMENTARY ROCKS**	Tequepis Sandstone[6]—*gray-white, massive to thick-bedded, compact, semifriable sandstone* (Santa Ynez Mtns.). Sisquoc Formation[6]—*soft, fissile to massive diatomite in part tuffaceous, shale and siltstone* (Santa Ynez Mtns.). Santa Margarita Formation—*sandstone, siltstone, some conglomerate* (Cuyama Valley and Pine Mtn. areas). Modelo Formation—*siliceous and diatomaceous shale, sandstone, siltstone and some conglomerate* (in part middle Miocene; Santa Monica Mtns.). Upper part of Monterey Shale on Pt. Dume. Castaic Formation—*shale with interbedded sandstone and beds of pebble conglomerate* (considered to be same as the Modelo Formation by some geologists). Puente Formation—*siltstone, siliceous shale, diatomaceous shale, sandstone and conglomerate,* including Sycamore Canyon Member—*conglomerate and siltstone* (Los Angeles area). Quail Lake Formation—*buff sandstone and brown shale* (west end Antelope Valley).
	Mmc	**MIDDLE MIOCENE NONMARINE SEDIMENTARY ROCKS**	Tick Canyon Formation—*siltstone, sandstone, conglomerate,* probably early Miocene. Unnamed nonmarine sandstone, mudstone and conglomerate (lateral equivalent to part of lower Topanga Formation of Durrell, 1954, Santa Monica Mtns.). Unnamed cobble conglomerate and red beds (southern San Joaquin Valley).
	Mm	**MIDDLE MIOCENE MARINE SEDIMENTARY ROCKS**	Monterey Shale[7]—*brown, soft, fissile, punky, organic shale, hard porcellaneous shale and chert, bituminous silty siliceous shale, locally includes thin limestone beds, siliceous clay siltstone and sandstone; south of Malibu Coast fault includes shale, sandstone, dolomite, and chert.* Unnamed sandstone, mudstone, sedimentary breccia and some volcanic rocks (south of Malibu Coast fault). San Onofre Breccia—*sandstone and breccia of schist fragments including slabs and blocks of glaucophane schist* (along coast, western Santa Monica Mtns.). Topanga Formation—*shale, sandstone, some conglomerate, arkose* (Santa Monica Mtns.).
		MIOCENE VOLCANIC ROCKS:	
	Mv	**UNDIFFERENTIATED**	Interbedded agglomerate, flow breccias, flows, tuffs, and volcanic sandstone (central Santa Monica Mtns.). Andesite and basalt flows in the Topanga Formation(?), Verdugo Mtns. and Pacoima Hills.
	Mv^a	**ANDESITIC**	Conejo Volcanics—*hypersthene andesite* (Santa Monica Mtns.).
	Mv^b	**BASALTIC**	Conejo Volcanics—*basalt flows and breccia, some andesite, arkose and tuff* (Santa Monica Mtns.). Vesicular and porphyritic extrusive basaltic flows and pyroclastic rocks (Conejo Volcanics?; Santa Cruz and Anacapa Islands). Basalt flows in the Gem Hill Formation (Miocene age uncertain; Rosamond quadrangle). Vesicular amygdaloidal basalt flows, with interbedded tuff breccia and agglomerate (Sunland area).
	Mv^p	**PYROCLASTIC**	Gem Hill Formation—*mainly tuff, tuff breccia, and tuffaceous sandstone* (Miocene age uncertain) and Bobtail Quartz Latite Member—*felsite breccia* (Rosamond-Willow Springs area). Conejo Volcanics—*agglomerate, pyroclastic and interbedded epiclastic rocks* (Santa Monica Mtns.). Rhyolite, andesite, and basalt breccia, agglomerate, scoriaceous flows, tuff, and tuff breccia (Santa Cruz Island).
	Ml	**LOWER MIOCENE MARINE SEDIMENTARY ROCKS**	"Temblor" Sandstone—*arkosic sandstone, pebbly in part, calcareous in part* (Santa Ynez River area); Rincon Shale—*blue-gray, silty, micaceous shale* (Santa Barbara-Ojai area); Vaqueros Formation—*sandstone, siltstone, some conglomerate;* in the Caliente Range divided into: Painted Rock Sandstone Member; Soda Lake Shale Member; Soda Lake Sandstone Member. Pleito Formation—*sandstone and interbedded clay shale* (in part Oligocene). Unnamed sandstone and conglomerate on Santa Cruz Island, including glaucophane schist-bearing breccias and conglomerates "San Onofre Breccia" of Rand, 1931, ref. no. 80 (similar breccias occur on Anacapa Island where shown as Mv^b). Unnamed brown to white sandstone, gray claystone and siltstone, in part middle Miocene (San Rafael Mtns. area).
Oligocene	ϕc	**OLIGOCENE NONMARINE SEDIMENTARY ROCKS**	Sespe Formation—*red to gray-green shale, sandstone, conglomerate, and breccias* (probably ranges in age from late Eocene to early Miocene). Vasquez Formation—*red to light-brown arkosic sandstone and conglomerate, some interbedded maroon siltstone and breccias* (Oligocene or early Miocene age). Simmler Formation (Plush Ranch Formation of Carman)—*red, green, and bluish-gray clay, arkosic sandstone, conglomerate, fanglomerate, and breccia* (Oligocene or early Miocene age; Cuyama-Lockwood Valley areas). Tecuya Formation—*red and green conglomerate sandstone and clay* (early Miocene and Oligocene(?) age; south end San Joaquin Valley). Unnamed, greenish-gray to red conglomerate sandstone and mudstone of Miocene or Oligocene age (San Rafael Mountains).
	ϕ	**OLIGOCENE MARINE SEDIMENTARY ROCKS**	Gaviota Formation—*massive to thick-bedded, buff-weathering arkosic sandstone.* "San Emigdio" Formation—*alternate beds of yellowish and grayish sandstones and shales* (San Emigdio Mtns.).
		OLIGOCENE VOLCANIC ROCKS:	
	ϕv	**UNDIFFERENTIATED**	Volcanic rocks of the Vasquez Formation, undifferentiated[8]—*black and reddish vesicular and amygdaloidal basalt and andesite, purplish breccia, minor beds of lithic tuff; associated with lacustrine strata in Tick Canyon containing borate beds.* Volcanic rocks in the Tecuya Formation—*olivine basalt, and andesite flows.*
	ϕv^r	**RHYOLITIC**	Neenach Volcanic Formation—*light-gray to pink rhyolitic felsite,* Oligocene(?) and early or possibly middle Miocene.
	ϕv^a	**ANDESITIC**	Volcanic rocks of the Vasquez Formation, andesitic[8]—*dark reddish-brown andesite flow breccias, including some greenish-white to buff tuff breccias.* Neenach Volcanic Formation—*dark-brown andesite,* Oligocene(?) and early or possibly middle Miocene.
	ϕv^b	**BASALTIC**	Volcanic rocks of the Vasquez Formation, basaltic[8]—*greenish-black basalts, commonly amygdaloidal.* Volcanic rocks of the Plush Ranch Formation—*black or red-brown hypersthene-augite-olivine basalt; some tuff and associated lacustrine strata that contain borate deposits.* (Carman, ref. 12.)
Eocene	E	**EOCENE MARINE SEDIMENTARY ROCKS**	"Coldwater" Sandstone—*arkosic sandstone, local oyster reefs, siltstone and shale;* Sacate Formation—*argillaceous to silty shale, some sandstone;* Cozy Dell Shale—*argillaceous to silty shale;* Matilija Sandstone—*arkosic sandstone;* Anita Shale—*shale and some sandstone;* Juncal Formation—*shale and arkosic sandstone;* Sierra Blanca Limestone—*massive, hard, organic limestone* (Santa Ynez, Topatopa and San Rafael Mtns.); Tejon Formation—*sandstone, siltstone, shale, some conglomerate* (San Emigdio-Tehachapi Mtns.). Llajas Formation—*conglomerate, sandstone, siltstone;* Santa Susana Formation—*concretionary shale, sandstone, conglomerate lenses* (Paleocene in part). Unnamed rocks of middle or late Eocene age in Elsmere Canyon. Unnamed Eocene siltstones, sandstones, shales and conglomerates in northern San Rafael Mountains, Santa Cruz Island, Piru Creek and Elizabeth Lake Canyon areas.

STRATIGRAPHIC NOMENCLATURE—Continued

AGE	STATE MAP SYMBOL	STATE MAP UNIT State Map Units listed here are not necessarily in stratigraphic sequence; the sequence used has been standardized for all sheets of the Geologic Map of California	STRATIGRAPHIC UNITS AND CHARACTERISTIC LITHOLOGIES Formally named formations grouped in sequence (separated by semicolons) are listed from youngest to oldest.
CENOZOIC – TERTIARY – Paleocene	Ep	**PALEOCENE MARINE SEDIMENTARY ROCKS**	Pattiway Formation—*siltstone, locally concretionary, sandstone, pebble-boulder conglomerate.* "Martinez" Formation—*sandstone, conglomerate, mudstone* (includes some rocks of Eocene age); Las Virgenes Sandstone—*gray sandstone* (Simi Hills); Simi Conglomerate—*well rounded pebbles and cobbles up to 1 foot diameter in matrix of coarse-grained arkosic sandstone; lenticular beds of sandstone.* Unnamed sandstone interbedded with thin shale and conglomerate (Paleocene; Santa Cruz Island, Santa Monica Mtns.). Unnamed conglomerates, sandstones, and siltstones (Paleocene and lower Eocene?; Castaic Creek-Elizabeth Canyon area). Ep-E: San Francisquito Formation—*arkosic sandstone, conglomerate and shale.* (Paleocene and possibly Eocene, stratigraphically above the unnamed conglomerates, etcetera, described above.)
CENOZOIC – TERTIARY – Undivided	Tc	**TERTIARY NONMARINE SEDIMENTARY ROCKS**	Caliente Formation—*calcareous, arkosic sandstone, red and gray mudstone, channel sand, and conglomerate; reddish-brown, thick-bedded, argillaceous, coarse-grained sandstone* (now dated as early Miocene to middle Pliocene). Violin Breccia—*rubble of gneiss blocks up to 6 feet in diameter in a mudstone matrix, accumulated as talus or alluvial debris at the base of the San Gabriel fault scarp; grades into finer grained Ridge Route Formation to the east.* (Miocene to Pliocene or Pleistocene age.)
CENOZOIC – TERTIARY – Undivided	Tm	**TERTIARY MARINE SEDIMENTARY ROCKS**	Unnamed shale and sandstone, some conglomerate, travertine, and tuff (except for travertine and arkose, has a marine aspect; age uncertain, may be Eocene, T. W. Dibblee, Jr., written communication, 1968; located at intersection of Big Pine and San Andreas faults).
CENOZOIC – TERTIARY – Undivided		**TERTIARY VOLCANIC ROCKS:**	
	Tv^b	**BASALTIC**	Basalt flows of the Caliente Formation—*multiple olivine basalt flows, highly vesicular in part, includes breccias on some flow tops* (Miocene age).
CENOZOIC – TERTIARY – Undivided		**TERTIARY INTRUSIVE (HYPABYSSAL) ROCKS:**	
	Ti	**UNDIFFERENTIATED**	Intrusive rocks ranging from olivine basalt to dacite; middle Miocene(?) age (Santa Monica Mtns.).
	Ti^r	**RHYOLITIC**	Bobtail Quartz Latite Member of Gem Hill Formation—*intrusive facies including felsite and porphyritic facies, porphyry and perlite;* Miocene(?) age; Rosamond-Willow Springs area. Rhyolite and obsidian plugs (Frazier Mountain area).
	Ti^a	**ANDESITIC**	Andesite porphyry of Miocene(?) or Oligocene(?) age (San Emigdio Mtns.). Hornblende andesite sill (South Mountain).
	Ti^b	**BASALTIC**	Intrusive basalt and diabase of middle Miocene(?) age (Santa Monica Mtns.).
MESOZOIC – CRETACEOUS	Ku	**UPPER CRETACEOUS MARINE SEDIMENTARY ROCKS**	Ku: Jalama Formation—*gray to black shale, hard, light-gray arkosic sandstone, and cobble conglomerate* (Santa Ynez Mtns.). "Chico" Formation—*sandstone, shale and conglomerate.* Unnamed light-gray sandstone, dark-gray siltstone and shale, and minor cobble conglomerate. Ku_c: Local lenses of presumably non-marine greenish- to reddish-gray conglomerate, sandstone, and mudstone (San Rafael and Santa Susana Mtns.).
MESOZOIC – CRETACEOUS	Kl	**LOWER CRETACEOUS MARINE SEDIMENTARY ROCKS**	Espada Formation—*dark olive-gray shale, siltstone, and thin sandstone beds* (San Rafael and Santa Ynez Mtns.).
MESOZOIC – CRETACEOUS	KJf	**FRANCISCAN FORMATION**	Franciscan Formation—*sheared and severely deformed, dark greenish-gray graywacke, black claystone and chert* (San Rafael and Santa Ynez Mtns.).
MESOZOIC – CRETACEOUS	KJfv	**FRANCISCAN VOLCANIC AND METAVOLCANIC ROCKS**	Greenstone of the Franciscan Formation and minor quantities of glaucophane schist (San Rafael and Santa Ynez Mtns.).
MESOZOIC – CRETACEOUS		**MESOZOIC GRANITIC ROCKS**	
	gr	**UNDIFFERENTIATED**	Granite and other quartz-bearing plutonic rocks (Soledad basin). Biotite granodiorite, quartz monzonite, and quartz diorite (Griffith Park). Areas of undivided, predominately granitic rocks; locally may grade into rocks of banded "gneissic" structure (gneissic granite) or may be complexly associated with gneiss (Sawmill Mountain and Bouquet Reservoir areas). Mount Lowe "Granodiorite" and Parker "Quartz Diorite"[9]—*light-colored, foliated, quartz-poor, feldspar-rich, porphyritic granitic rock of monzonitic to dioritic composition* (Permian-Triassic; San Gabriel Mtns.).
	gr^a	**ADAMELLITE (QUARTZ MONZONITE), GRANITE, ALASKITE**	Liebre Quartz Monzonite—*fractured, gray hornblende-biotite quartz monzonite, with dark inclusions and pegmatites.* Lebec Quartz Monzonite—*gray hornblende-biotite quartz monzonite.* Mt. Pinos Granite—*biotite granite and hornblende-biotite quartz diorite.* Tejon Lookout Granite—*biotite granite* (Tehachapi Mtns.). Unnamed granites and quartz monzonites (north of San Andreas fault).
	gr^g	**GRANODIORITE**	Unnamed granodiorite including some quartz diorite, quartz monzonite, and pink granite (San Gabriel Mtns.).
	gr^t	**TONALITE (QUARTZ DIORITE) AND DIORITE**	Vermont Quartz Diorite—*biotite quartz diorite* (Griffith Park). Lar Quartz Diorite—*biotite quartz diorite, commonly foliated* (Griffith Park). Unnamed quartz diorites and diorite (Tehachapi Mtns., San Gabriel-Verdugo Mtns., Piru Creek area, San Emigdio Mtns., Santa Cruz Island); includes migmatized metasedimentary rocks in Tehachapi Mtns.
MESOZOIC – CRETACEOUS	bi	**MESOZOIC BASIC INTRUSIVE ROCKS**	Hornblende diorite and gabbro (Tehachapi Mtns., Verdugo Mtns.).
MESOZOIC – CRETACEOUS	ub	**MESOZOIC ULTRABASIC INTRUSIVE ROCKS**	Serpentine (San Rafael Mtns.).
MESOZOIC – JURASSIC	Ju	**UPPER JURASSIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Ju-Tr: Santa Monica Slate—*highly foliated dark-gray to black slate, with minor amounts of mica schist, phyllite, and spotted cordierite slate* (Late Jurrasic pelecypods; formation probably Triassic in part, U.S. Geol. Survey Prof. Paper 420-A, p. 21–22).
MESOZOIC – JURASSIC		**PRE-CRETACEOUS METAMORPHIC ROCKS**	
	m	**UNDIFFERENTIATED**	Pelona Schist—*highly foliated mica-chlorite-albite-quartz schists, some biotite schist, actinolite schist and quartzite; probably derived from sedimentary and pyroclastic rocks* (age uncertain, generally considered to be Precambrian or Mesozoic). Diorite gneiss and some biotite schist (San Gabriel Mtns.). Unnamed phyllite, chlorite schist and greenstone (Santa Cruz Island).
	ls	**ls = LIMESTONE AND/OR DOLOMITE**	Thin strata of light blue-gray fine crystalline limestone in the Pelona Schist. Lenses of marble in granitic and metamorphic rocks (Tehachapi Mtns. and area north of Mt. Pinos and Frazier Mtn.).
MESOZOIC – JURASSIC	ms	**PRE-CRETACEOUS METASEDIMENTARY ROCKS**	Placerita Formation—*graphite, sillimanite, and biotite schists, quartzite, and some limestone and dolomite* (San Gabriel Mtns.). Hornfels, quartzite, gneiss, marble, and schist (San Emigdio Mtns.). Biotite gneiss, minor mica schist, quartzite, and hornfels (Tehachapi Mtns.).
MESOZOIC – JURASSIC	mv	**PRE-CRETACEOUS METAVOLCANIC ROCKS**	Metamorphosed quartz latite (Soledad Mtn., Rosamond quadrangle).
MESOZOIC – JURASSIC	gr-m	**PRE-CENOZOIC GRANITIC AND METAMORPHIC ROCKS**	Diorite gneiss injected by granodiorite (migmatite) and in places includes the Placerita Formation (San Fernando quadrangle). Undifferentiated gneisses and granitic rocks (Mesozoic(?) to Precambrian; Mint Canyon area).
PALEOZOIC – UNDIVIDED	ℙ	**PALEOZOIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Bean Canyon Formation—*dark-gray to black mica schist, phyllite, hornfels, and quartzite* (age uncertain, may be Mesozoic; formation in part volcanic—see ℙv; Tehachapi Mtns.).
PALEOZOIC – UNDIVIDED	ls	**ls = LIMESTONE AND/OR DOLOMITE**	Limestone, dolomite and marble of the Bean Canyon Formation.
PALEOZOIC – UNDIVIDED	ℙv	**PALEOZOIC METAVOLCANIC ROCKS**	Metabasalt and metafelsite flows or sills of the Bean Canyon Formation (age uncertain, may be Mesozoic; Tehachapi Mtns.).
PRECAMBRIAN	p€an	**PRECAMBRIAN ANORTHOSITE**	Anorthosite[10]—Medium- to very coarse-grained; includes anorthosite intruded by Mesozoic(?) granite (San Gabriel Mtns.).
PRECAMBRIAN	p€gr	**UNDIVIDED PRECAMBRIAN GRANITIC ROCKS**	Echo Granite—*orange to pinkish-gray, locally foliated, quartz-rich granitic rocks* (San Gabriel Mtns.). Syenite phase of San Gabriel anorthosite complex (Mint Canyon area). Gabbro[10]—gabbroic and noritic rocks; altered rocks bordering anorthosite; ilmenite-magnetite gabbro and massive ilmenite-magnetite (San Gabriel Mtns.).
PRECAMBRIAN		**UNDIVIDED PRECAMBRIAN METAMORPHIC ROCKS:**	
	p€g	**GNEISS**	Mendenhall Gneiss[10]—*quartz-plagioclase gneiss with ferromagnesian minerals* (San Gabriel Mtns.). Gneiss, veined gneiss, banded gneiss and migmatites (Frazier Mountain and Mt. Pinos areas). Coarse and fine augen gneisses, layered quartzo-feldspathic gneisses, minor amphibolites (Mint Canyon area). Banded amphibolite, hornfels, diorite and granite gneiss (Sawtooth Mtns.). Foliated gneiss containing some recrystallized limestone and quartzite, local migmatite (Verdugo Mtns.). For some of these rocks the attributed Precambrian age is uncertain. Complex of gneiss and lesser amounts of granitic rocks, locally includes migmatites and dark hornblende diorites (the granitic rocks are of magmatic origin or are recrystallized from gneiss and often grade into gneiss; age Mesozoic or older), Sawmill Mountain-Bouquet Reservoir area.
PRECAMBRIAN	ls	**ls = LIMESTONE AND/OR DOLOMITE**	White coarsely crystalline marble lenses in gneiss, probably Precambrian, but possibly Paleozoic or Mesozoic (Sawmill Mountain area).

NOTES

[1] Late Pliocene and early Pleistocene age, W. O. Addicott, 1965, U.S. Geol. Survey Prof. Paper 503-B, p. B-8. Radiometric dates (K-Ar) from ash layer(s) near base of Santa Barbara Formation range from 11.5 ± 2.4 m.y. to 7.8 ± 1.2 m.y. reported by Robert S. Yeats and W. A. McLaughlin, Geol. Soc. America Special Paper, in press, 1968.

[2] Probably Pleistocene, but may be late Pliocene in part.

[3] May be Pleistocene (see G. T. James, 1963, Paleontology and nonmarine stratigraphy of the Cuyama Valley Badlands, California: Univ. Calif. Dept. Geol. Sci. Bull., vol. 45).

[4] The Pico Formation includes rocks of early to late Pliocene age in the type locality in Ventura basin (Durham, D. L. and Yerkes, R. F., 1964, Geology and oil resources of the eastern Puente Hills area, southern California: U.S. Geol. Survey Prof. Paper 420-B, p. B 24–25); however, common usage in the L. A. basin restricts Pico to rocks of late Pliocene age. Modern U.S.G.S. usage assigns Pliocene marine rocks of the northeast L. A. basin to the upper member of the Fernando Formation.

[5] "Repetto" is defined and properly used only as a stage designation. The U.S. Geological Survey has abandoned the name "Repetto Formation" and assigns these rocks to the lower member of the Fernando Formation (Durham and Yerkes—see ref. footnote 4).

[6] Tequepis Sandstone and Sisquoc Formation are lateral equivalents; in part possibly of early Pliocene age in this map area.

[7] Also called Maricopa Shale in San Emidgio Mountains and Modelo Formation in Ventura basin. Ranges in age from middle Miocene (Relizian) to late Miocene (Mohnian). In Cuyama Valley area divided into Whiterock Bluff Shale Member, Saltos Shale Member and Branch Canyon Formation.

[8] Oligocene or early Miocene age.

[9] Radiometric age date (Pb^{206}/U^{238}) of 245 ± 10 m.y. determined by L. T. Silver, 1968, Preliminary history for the crystalline complex of the central Transverse Ranges, Los Angeles County, California: Geol. Soc. Amer. Spec. Paper no. 101 (Abstracts), p. 201–202. Also, oral communications from L. T. Silver, 1967 and 1968.

[10] "Isotopic age determinations (U-Th-Pb) on zircons from pegmatite and granophyre dikes in the western San Gabriel Mountains have yielded concordant ages of about 1200 million years. From structural and petrological relations, this is both a minimum and a probable age for the San Gabriel Mountains anorthosite complex. It is also a minimum age for the Mendenhall Gneiss . . . . . which has been intruded by the anorthosite complex." L. T. Silver, *et al.*, 1963, Precambrian age determinations in the western San Gabriel Mountains, California: Jour. Geology, vol. 71, no. 2, p. 196–214.

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b) Verdugo Tunnel route, L-1079 (including mapping by M.W.D. 1964–66, and from Robert L. Beatie, see 57a).

c) Flintridge Tunnel route, B-20263 (including mapping by M.W.D. 1964, and from J. P. Buwalda, unpublished report on Raymond basin to City of Pasadena, 1940).

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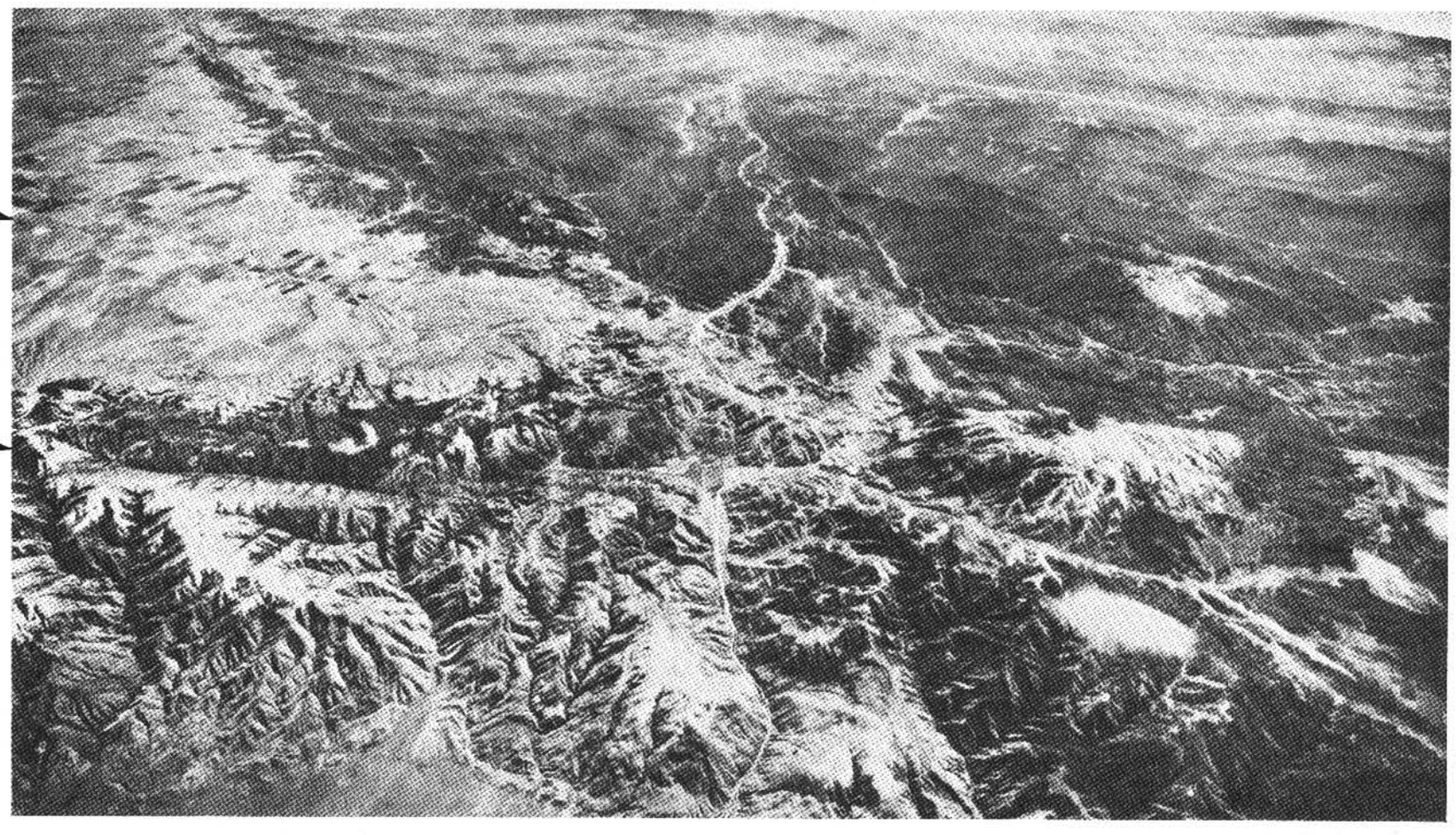
For a complete list of published geologic maps of this area see Division of Mines and Geology Special Reports 52, 52-A and 52-B.



The San Andreas, Garlock, and Big Pine faults and their intersections are the prominent features of this photo that portrays most of the eastern half of the Los Angeles Sheet area. View is southeasterly from approximately 65,000 feet above Interstate 5 near the northern edge of the map sheet area. *Photo of November, 1967, courtesy U. S. Geological Survey.*