DIVISION OF MINES AND GEOLOGY
Ian Campbell, *State Geologist*

STATE OF CALIFORNIA
Ronald Reagan, *Governor*
THE RESOURCES AGENCY
Norman B. Livermore, Jr., *Secretary*

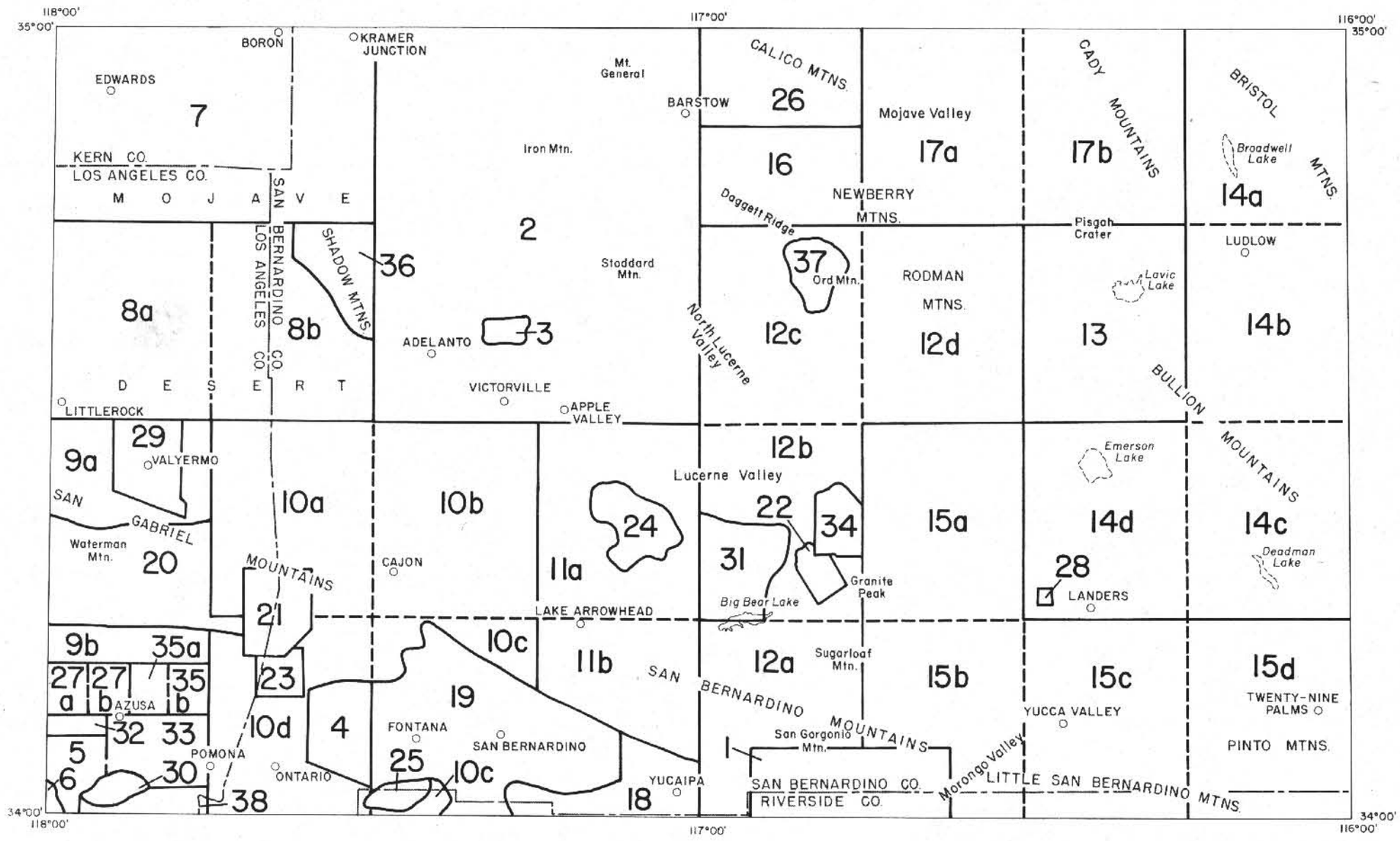
DEPARTMENT OF CONSERVATION
James G. Stearns, *Director*

# EXPLANATORY DATA
# SAN BERNARDINO SHEET
## GEOLOGIC MAP OF CALIFORNIA
### OLAF P. JENKINS EDITION

Compiled by Thomas H. Rogers, 1967

Second printing, 1975

# INDEX TO GEOLOGIC MAPPING
## USED IN THE COMPILATION OF THE SAN BERNARDINO SHEET




†*1. Allen, C. R., 1957, San Andreas fault zone in San Gorgonio Pass, southern California: Geol. Soc. America Bull., vol. 68, no. 3, pp. 315–350, Pl. 1, scale 1:63,360. Also *in* Geology of Southern California: California Div. Mines Bull. 170, 1954, map sheet 20: Geology of the north side of San Gorgonio Pass, scale 1:62,500.

†2. Bowen, O. E., Jr., 1954, Geology and mineral deposits of Barstow quadrangle, San Bernardino County, California: California Div. Mines Bull. 165, Pl. 1, scale 1:125,000.

Dibblee, T. W., Jr., 1960, Geologic maps of the Barstow and Hawes quadrangles, San Bernardino County, California: U. S. Geol. Survey Mineral Investigations Field Studies Maps (Barstow MF-233, Hawes MF-226) scale 1:62,500; Preliminary geologic maps of the Victorville and Apple Valley quadrangles, California: U. S. Geol. Survey Mineral Investigations Field Studies Maps (Victorville MF-229, Apple Valley MF-232) scale 1:62,500. Local additions west of Sidewinder Mountain by W. D. Stone, Geology of the Black Mountain area, Apple Valley quadrangle, California, scale 1″ = 660′, University California, Riverside, unpublished M.A. thesis, 1964. Fault in alluvium west of Hinkley from California Dept. Water Resources, 1960, Bull. 91–3, Fig. 2, scale 1:62,500.

3. Bowen, O. E., Jr., and Ver Planck, W. E., 1965, Stratigraphy, structure, and mineral deposits in the Oro Grande Series near Victorville, California: California Div. Mines and Geology Special Report 84, Pl. 1, scale 1:24,000.

4. Burnham, W. L., The geology and ground water conditions of the Etiwanda-Fontana area, California, scale 1:31,680, Pomona College, unpublished M.A. thesis, 1953.

5. California Dept. Water Resources, 1966, Planned utilization of ground water basins—San Gabriel Valley, Appendix A, Geohydrology, Plate 9A, scale 1:125,000.

6. Daviess, S. N. and Woodford, A. O., 1949, Geology of the northwestern Puente Hills, Los Angeles County, California: U. S. Geol. Survey Oil and Gas Preliminary Map 83, sheet 1 of 2, scale 1″ = 1000′.

Stark, H. E., Geology and paleontology of the northern Whittier Hills, California, Pomona College, unpublished M.A. thesis, 1949.

†7. Dibblee, T. W., Jr., 1960, Geology of the Rogers Dry Lake and Kramer quadrangles, California: U. S. Geol. Survey Bull. 1089-B, Pl. 8, scale 1:62,500.

†8a. Dibblee, T. W., Jr., 1959, Geologic map of the Alpine Butte quadrangle, California: U. S. Geol. Survey Mineral Investigations Field Studies Map MF-222, scale 1:62,500.

†8b. Dibblee, T. W., Jr., 1960, Preliminary geologic map of the Shadow Mountains quadrangle, Los Angeles and San Bernardino Counties, California: U. S. Geol. Survey Mineral Investigations Field Studies Map MF-227, scale 1:62,500.

†9. Dibblee, T. W., Jr., Geologic maps of the Valyermo and Pomona quadrangles, scale 1:62,500, U. S. Geol. Survey, unpublished, 1955–1958, 1967, 1968:
a) Valyermo quadrangle.
b) Pomona quadrangle.

10. Dibblee, T. W., Jr., Geologic maps of the San Antonio, Hesperia, Ontario, and San Bernardino quadrangles, scale 1:62,500, U. S. Geol. Survey, unpublished, 1953–1958, and 1963:
a) San Antonio quadrangle (local additions from P. L. Ehlig, unpublished, reference no. 20).
b) Hesperia quadrangle (local additions from California Dept. Water Resources, Geologic Map of the Cedar Springs Reservoir-San Bernardino Tunnel area, scale 1″ = 1000′, unpublished, 1967; and A. Smith, Structural petrology, Crestmore, California, scale 1 inch = ¼ mile, California Institute Technology, unpublished PhD thesis, 1947).
c) San Bernardino quadrangle (local additions as in b) above and from D. M. Morton, Geologic mapping in the central part of the Cucamonga Peak 7½′ quadrangle, California Div. Mines and Geology, 1968).
d) Ontario quadrangle (local additions from California Div. Water Resources, 1934, Geology and ground water storage capacity of valley fill—South Coastal Basin Investigation, Bull. 45, Pl. C, scale 1 inch=approx. 2 miles; R. Streitz, Preliminary geologic map of the SW¼ Mt. Baldy 7½′ quadrangle, California Div. Mines and Geology, work in progress, 1967; and D. M. Morton, Preliminary geologic map of the Devore 7½′ quadrangle, California Div. Mines and Geology, work in progress, 1968).

†11. Dibblee, T. W., Jr., Geologic maps of the Lake Arrowhead and Redlands quadrangles, scale 1:62,500, U. S. Geol. Survey, unpublished, 1957, 1958, 1967:
a) Lake Arrowhead quadrangle (local faults near Mohave River from U. S. Army Corps of Engineers, Mohave River Forks Reservoir—Geology and foundation exploration plan, Appendix 1, Pls. 1 and 2, scale 1″ = 100′, unpublished, 1966).
b) Redlands quadrangle.

†12. Dibblee, T. W., Jr., 1964, Geologic maps of the San Gorgonio Mountain, Lucerne Valley, Ord Mountains and Rodman Mountains quadrangles, scale 1:62,500, U. S. Geol. Survey Misc. Geol. Investigations Maps:
a) San Gorgonio Mountain quadrangle, I-431 (glacial deposits from R. P. Sharp, C. R. Allen, and M. F. Meier, 1959, Pleistocene glaciers on southern California mountains: American Jour. Science, vol. 257, pp. 81–94, Fig. 5, scale 1″ = approx. 2000′).
b) Lucerne Valley quadrangle, I-426.
c) Ord Mountains quadrangle, I-427.
d) Rodman Mountains quadrangle, I-430.

†13. Dibblee, T. W., Jr., 1966, Geologic map of the Lavic quadrangle, San Bernardino County, California: U. S. Geol. Survey Misc. Geol. Investigations Map I-472, scale 1:62,500 (local faults from W. S. Wise, University California, Santa Barbara, written communication, 5/12/67).

†14. Dibblee, T. W., Jr., 1967, Geologic maps of the Broadwell Lake, Ludlow, Deadman Lake, and Emerson Lake quadrangles, scale 1:62,500, U. S. Geol. Survey Misc. Geol. Investigations Maps:
a) Broadwell Lake quadrangle, I-478.
b) Ludlow quadrangle, I-477.
c) Deadman Lake quadrangle, I-488.
d) Emerson Lake quadrangle, I-490.

†15. Dibblee, T. W., Jr., Geologic maps of the Old Woman Springs, Morongo Valley, Joshua Tree, and Twentynine Palms quadrangles, scale 1:62,500, U. S. Geol. Survey Misc. Geol. Investigations Maps:
a) Old Woman Springs quadrangle, I-518.
b) Morongo Valley quad., I-517, 1967.(local additions from R. J. Proctor, Geology of the Desert Hot Springs-Upper Coachella Valley area, California Div. Mines and Geology Special Report 94, in press, 1967).
c) Joshua Tree quadrangle, I-516.
d) Twentynine Palms quadrangle, in press.

†16. Dibblee, T. W., Jr., Geologic map of the Daggett quadrangle, scale 1:62,500, U. S. Geol. Survey Misc. Geol. Investigations Map in press (additional faults west of Daggett from G. A. Miller, Ground water investigations in the Daggett area, scale 1:62,500, U.S. Geol. Survey, unpublished, 1967).

†17. Dibblee, T. W., Jr. and Bassett, A. M., 1966, Geologic maps of the Newberry and Cady Mountains quadrangles, scale 1:62,500, U. S. Geol. Survey Misc. Investigations Maps:
a) Newberry quadrangle, I-461.
b) Cady Mountains quadrangle, I-467 (local faults from W. S. Wise, University California, Santa Barbara, written communication, 5/12/67).

*18. Dutcher, L. C. and Burnham, W. L., 1959, Geology and ground water hydrology of the Mill Creek area, San Bernardino County, California: U. S. Geol. Survey open file report, scale 1:24,000.

Dutcher, L. C. and Burnham, W. L., 1960, Geology and ground water hydrology of the Redlands-Beaumont area, California, with special reference to ground water outflow: U. S. Geol. Survey open file report scale 1:24,000.

*19. Dutcher, L. C. and Garrett, A. A., 1963, Geologic and hydrologic features of the San Bernardino area, California—with special reference to underflow across the San Jacinto fault: U. S. Geol. Survey Water Supply Paper 1419, Pl. 1, scale 1:31,680. Additional faults from the following reports: L. C. Dutcher and W. L. Burnham, 1960, reference no. 18; W. L. Burnham, reference no. 4; A. W. Gosling, 1966, The patterns of subsurface flow in the Bloomington-Colton area, upper Santa Ana Valley, California: U. S. Geol. Survey open file report, scale 1:24,000; and J. J. French, 1966, Progress report on proposed ground water studies in the Lytle Creek-San Sevaine area, Upper Santa Ana Valley, California: U. S. Geol. Survey open file report, Fig. 2, scale 1:24,000.

20. Ehlig, P. L., Geologic map of a part of the eastern San Gabriel Mountains, compiled on 1:250,000 scale by P. L. Ehlig from original field maps, unpublished work in progress, 1967, California State College at Los Angeles.

Dibblee, T. W., Jr., Geologic maps of the Valyermo and Pomona quadrangles, reference no. 9.

Crowder, D. F., 1967, Mineral resources of the Devil Canyon-Bear Canyon primitive area, California: U. S. Geol. Survey Bull. 1230-G, Pl. 1, scale 1:62,500.

*21. Ehlig, P. L., The geology of the Mount Baldy region of the San Gabriel Mountains, California, scale 1:16,000, University California, Los Angeles, unpublished PhD thesis, 1958.

*22. Guillou, R. B., 1953, Geology of the Johnston Grade area, San Bernardino County, California: California Div. Mines Special Report 31, Pl. 1, scale 1″ = 1000′ (additions from F. Miller, Geology of Cushenbury Canyon, scale 1:12,000, University California, Riverside, unpublished senior thesis, 1961).

*23. Hsu, K. J., 1955, Granulites and mylonites of the region about Cucamonga and San Antonio Canyons, San Gabriel Mountains, California: University California Publications in Geol. Sciences, vol. 30, no. 4, pp. 223–324, map 1, scale 1″ = approx. 2000′.

*24. MacColl, R. S., 1964, Geochemical and structural studies in batholithic rocks of southern California: Part 1, Structural geology of Rattlesnake Mountain pluton: Geol. Soc. America Bull. vol. 75, no. 9, pp. 805–822, Pl. 1, scale 1 inch = approx. 0.6 mile.

25. MacKevett, E. M., 1951, Geology of the Jurupa Mountains, San Bernardino and Riverside Counties, California: California Div. Mines Special Report 5, Pl. 1, scale 1:15,840.

†*26. McCulloh, T. H., 1965, Geologic map of the Nebo and Yermo quadrangles, San Bernardino County, California: U. S. Geol. Survey open file report, scale 1:24,000.

27. Morton, D. M., Preliminary geologic maps of a) SW¼ Azusa, and b) SE¼ Azusa quadrangles, Los Angeles County, California, scale 1:9600, California Div. Mines and Geology, work in progress, 1967. (Available on open file at California Div. Mines and Geology offices in San Francisco and Los Angeles.) Local older alluvium and concealed faults in alluvium from J. S. Shelton, 1946, 1955, references no. 32 and 33, and California Dept. Water Resources, 1966, reference no. 5.

28. Moxham, R. M., Walker, G. W., and Baumgardner, L. R., 1955, Geologic and airborne radioactivity studies in the Rock Corral area, San Bernardino County, California: U. S. Geol. Survey Bull. 1021-C, pp. 109–125, Pl. 16, scale 1″ = 1000′.

†*29. Noble, L. F., 1954, Geology of the Valyermo quadrangle and vicinity, California: U. S. Geol. Survey Geologic Quadrangle Maps of the United States GQ-50, scale 1:24,000.

30. Olmsted, F. H., 1950, Geology and oil prospects of western San Jose Hills, Los Angeles County, California: California Journal of Mines and Geology, vol. 46, no. 2, pp. 191–213, Pl. 23, scale 1:24,000.

†*31. Richmond, J. F., 1960, Geology of the San Bernardino Mountains north of Big Bear Lake, California: California Div. Mines Special Report 65, Pl. 1, scale 1:31,680.

32. Shelton, J. S., 1946, Geologic map of the northeast margin of the San Gabriel basin, Los Angeles County, California: U. S. Geol. Survey Oil and Gas Investigations Preliminary Map 63, scale 1:24,000.

33. Shelton, J. S., 1955, Glendora volcanic rocks, Los Angeles basin, California: Geol. Soc. America Bull. vol. 66, no. 1, pp. 45–90, Pl. 1, scale 1:24,000 (local additions from California Dept. Water Resources, 1966, reference no. 5, and California Div. Water Resources, 1934, see under reference no. 10).

34. Shreve, R. L., The Blackhawk landslide: Geol. Soc. America Special Paper (in press), Pl. 1, 1:24,000.

35. Streitz, R., Preliminary geologic maps of the a) SW¼ Glendora, and b) SE¼ Glendora quadrangles, Los Angeles County, California, scale 1:9600, California Div. Mines and Geology, work in progress, 1967. (Available on open file at California Div. Mines and Geology offices in San Francisco and Los Angeles.) Local faults in valley alluvium and Tertiary volcanics from J. S. Shelton, 1955, reference no. 33, and California Dept. Water Resources, reference no. 5.

†36. Troxel, B. W., Geologic map of the Shadow Mountains quadrangle, scale 1:24,000, California Div. Mines and Geology, work in progress, 1967. In part published *in* Geology of Southern California: California Div. Mines Bull. 170, 1954, map sheet 15: Geologic map of part of the Shadow Mountains, western San Bernardino County, California, scale 1:21,120.

†37. Weber, F. H., Jr., 1963, Geology and mineral deposits of the Ord Mountain district, San Bernardino County, California: California Div. Mines and Geology Special Report 77, Pl. 1, scale 1:24,000.

38. Woodford, A. O., Shelton, J. S., and Moran, T. G., 1944, Geology and oil possibilities of the Puente and San Jose Hills, California: U. S. Geol. Survey Oil and Gas Investigations Preliminary Map 23, scale 1:62,500.

* Additional mapping by T. W. Dibblee, Jr.

† Part of this area is also covered by geologic maps of the Southern Pacific Co., Land Dept., Regional geologic mapping program, scale 1: 24,000, unpublished, 1956–1960. For information concerning these maps contact Manager—Land Dept., Southern Pacific Co., 65 Market St., San Francisco, California 94105.

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

# STRATIGRAPHIC NOMENCLATURE—SAN BERNARDINO SHEET

| AGE | STATE MAP SYMBOL | STATE MAP UNIT<br>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<br>(The formally named formations grouped within an individual State Map Unit, are listed in stratigraphic sequence from youngest to oldest.) |
|---|---|---|---|
| CENOZOIC – QUATERNARY – Recent | Qs | **RECENT DUNE SAND** | Windblown sand, local dunes. Wave-deposited sandbars at north end of Rogers Dry Lake. |
| | Qal | **RECENT ALLUVIUM** | Stream, river channel, and alluvial fan deposits. Alluvial deposits in Mojave Desert of Pleistocene to Recent age shown as Qal-Qc. Playa clay and windblown sand near Rogers Dry Lake. |
| | | **RECENT VOLCANIC ROCKS:** | |
| | $Qrv^b$ | **BASALTIC** | Black vesicular basalt flows from Pisgah Crater (may be Pleistocene). |
| | Ql | **QUATERNARY LAKE DEPOSITS** | Manix Lake Beds—*light-gray, green, and buff sand, interbedded silt, clay and gravel* east of Manix (contain late Pleistocene vertebrate fossils). Unnamed clay, silt, and marl, local alkaline efflorescences, and windblown sand (Mojave Desert). |
| | Qt | **QUATERNARY NONMARINE TERRACE DEPOSITS** | Stream and river terrace deposits. |
| | Qg | **QUATERNARY GLACIAL DEPOSITS** | Glacial till on north flank of San Gorgonio Mountain. |
| Pleistocene | Qc | **PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS** | Qc: dissected, undeformed or slightly deformed alluvial fan deposits locally cemented by caliche: Burnt Canyon Breccia and Heights Fanglomerate south of San Gorgonio Mountain. San Dimas Formation along south flank of San Gabriel Mountains (includes local terrace remnants). Unnamed silt, sand, and gravel elsewhere.<br>$Qc_o$ (older than Qc): folded, faulted, and dissected alluvial fan deposits locally cemented by caliche: Cabezon Fanglomerate and deformed gravels of Whitewater River south of San Gorgonio Mountain. Shoemaker Gravel and Harold Formation (includes interbedded brown to green shale and white marly clay) along north flank of San Gabriel Mountains. Cushenbury Springs Formation—*fanglomerate and landslide breccia* on north flank of San Bernardino Mountains. Unnamed gray, brown, and red-brown fanglomerate and conglomerate elsewhere (possibly in part late Pliocene east of Barstow). |
| | | **PLEISTOCENE VOLCANIC ROCKS:** | |
| | $Qpv^b$ | **BASALTIC** | Black vesicular basalt flows from Sunshine and Malpais Craters. Black massive basalt flow on Broadwell Mesa. |
| | $Qpv^p$ | **PYROCLASTIC** | Gray, white, and buff massive tuff south of Lavic Lake. |
| | ✳ | **QUATERNARY CINDER CONES** | Black and brown-black basaltic pumice of Pisgah Crater (Recent) and Sunshine Crater (Pleistocene). |
| Pliocene | | **PLIOCENE VOLCANIC ROCKS:** | |
| | $Pv^r$ | **RHYOLITIC** | Gray to light-brown massive fine-grained felsite and dacite (may be in part Pleistocene). Red rhyolitic to dacitic flow breccia in Ord Mountains. |
| | $Pv^b$ | **BASALTIC** | Black massive vesicular and nonvesicular basalt (may be in part Pleistocene). |
| | $Pv^p$ | **PYROCLASTIC** | Light-gray massive rhyolitic tuff and tuff breccia (may be in part Pleistocene). |
| | Pu | **UPPER PLIOCENE MARINE SEDIMENTARY ROCKS** | Upper Member of the Fernando Formation (includes rocks commonly called Pico Formation)[1]—*sandy siltstone, conglomerate, and sandstone* (southwest of Azusa). |
| | Pml | **MIDDLE AND/OR LOWER PLIOCENE MARINE SEDIMENTARY ROCKS** | Lower Member of the Fernando Formation (includes rocks commonly called Repetto Formation)[2]—*siltstone, conglomerate, and fine sandstone* (southwest of Azusa). |
| | Pmlc | **MIDDLE AND/OR LOWER PLIOCENE NONMARINE SEDIMENTARY ROCKS** | Anaverde Formation—*yellow and white arkosic sandstone and conglomerate, interbedded gray gypsiferous shale and red to green siltstone* (south of Little Rock on the north flank of the San Gabriel Mountains). Potato Sandstone—*red, gray, and white massive conglomerate, buff arkosic sandstone and siltstone, green to gray rhythmically-bedded shale and pebbly sandstone, minor gray limestone* (according to D. I. Axelrod, in R. E. Smith,[3] upper part of this formation contains an early Pliocene flora; lower part of formation may be Miocene; north of Redlands). |
| | Pc | **UNDIVIDED PLIOCENE NONMARINE SEDIMENTARY ROCKS** | Duarte Conglomerate[4]—*light-gray massive conglomerate and local sandstone* (south flank San Gabriel Mountains). Crowder Formation[4]—*gray fanglomerate, conglomerate, and sandstone* (Cajon Pass area). San Timoteo Formation—*gray, yellow, and brown semi-consolidated gravel, sand, silt, and clay* (contains a late Blancan vertebrate fauna now regarded as early Pleistocene according to R. H. Tedford, written communication 6/12/67). Santa Ana Sandstone[4]—*buff to gray, friable, arkosic sandstone, minor micaceous siltstone and pebble conglomerate, local black basalt* (San Bernardino Mountains). Unnamed brown, gray, and white sandstone, fanglomerate and marl in Mojave Desert[4]. |
| Miocene | Mc | **UNDIVIDED MIOCENE NONMARINE SEDIMENTARY ROCKS** | Tropico Group—*undifferentiated sandstone, chert, clay shale, granitic breccia, limestone or dolomite, and local rhyolitic tuff* (may be in part Pliocene; Rogers Dry Lake-Kramer Hills area). Bissell Formation (of Tropico Group)—*limestone and/or dolomite.* Punchbowl Formation—*buff, massive, conglomeratic sandstone and siltstone, interbedded red, green, and brown siltstone and shale, local brown and gray gypsiferous shale and coarse conglomerate west of San Andreas fault* (contains a late Miocene and a middle Miocene vertebrate fauna east of San Andreas fault and an early Pliocene vertebrate fauna west of San Andreas fault: R. H. Tedford and T. Downs, 1965, Geol. Soc. America, Spec. Paper 87, p. 234; Cajon Pass-Valyermo area). Unnamed nonmarine sediments east of Barstow including light-colored locally tuffaceous sand, variegated locally-opaline shale, varicolored claystone and siltstone, light-colored limestone, dolomite, and magnesite, minor conglomerate, fanglomerate, sedimentary breccia, chert, celestite beds, rhyolitic tuff, olivine basalt, and dacite mudflow breccia (unnamed sediments contain a middle and a late Miocene vertebrate fauna in the northern Cady Mountains and a middle Miocene fauna at Daggett Ridge: D. P. Whistler, written communication, 5/17/67; correlation of fossiliferous strata with similar unnamed sediments elsewhere in map area is uncertain; may be in part Oligocene elsewhere). |
| | Muc | **UPPER MIOCENE NONMARINE SEDIMENTARY ROCKS** | Barstow Formation—*fluvatile and lacustrine sandstone and shale, locally silicified* (contains a late Miocene and a late middle Miocene vertebrate fauna in the Calico Mountains according to D. P. Whistler, written communication, 5/17/67 and R. H. Tedford, written communication, 6/12/67). Coachella Fanglomerate—*red-brown massive conglomerate and sandstone* (south of Morongo Valley). |
| | Mmc | **MIDDLE MIOCENE NONMARINE SEDIMENTARY ROCKS** | Unnamed lacustrine limestone, sandstone, shale, conglomerate, sedimentary breccia, and interbedded olivine basalt flows (Calico Mountains). Biotite dacite mudflow breccia of the Pickhandle Formation (Calico Mountains). |
| | | **MIOCENE VOLCANIC ROCKS:** | |
| | Mv | **UNDIFFERENTIATED** | Glendora "Volcanics"—*undifferentiated massive andesite, basalt, dacite(?), and rhyolite, interbedded tuff and tuff breccia* (Azusa-Glendora area). |
| | $Mv^r$ | **RHYOLITIC** | Dacite vitrophyre and dacite of the Tropico Group (Rogers Dry Lake-Kramer Hills area). Rhyolitic felsite and dacite porphyry east of Ludlow. Dacite and rhyolite of the Glendora "Volcanics" (Azusa area). |
| | $Mv^a$ | **ANDESITIC** | Brown, red, green, and gray porphyritic andesite flows and breccia of the Glendora "Volcanics" (Azusa area). Andesite associated with the Barstow Formation (Calico Mountains). Unnamed andesite flow breccia, andesite-dacite breccia, and hornblende andesite elsewhere (contains early Miocene vertebrate fauna in the southern Cady Mountains according to D. P. Whistler, written communication, 5/17/67). |
| | $Mv^b$ | **BASALTIC** | Red Buttes Quartz Basalt (of Tropico Group)—*black quartz-bearing volcanic rocks* (referred to as quartz basalt by T. W. Dibblee, Jr., 1960, ref. no. 7, and quartz andesite by O. E. Bowen, 1954, ref. no. 2; may be in part Pliocene). Olivine basalt flows of Tropico Group (may be in part Pliocene). Basalt porphyry, pillow lava, associated palagonite tuff of the Glendora "Volcanics" (Azusa area). Unnamed black massive vesicular and nonvesicular basalt and basalt breccia elsewhere. |
| | $Mv^p$ | **PYROCLASTIC** | Gem Hill Formation (of Tropico Group)—*rhyolitic tuff* (Rogers Dry Lake-Kramer Hills area). Pickhandle Formation—*undifferentiated tuff, tuff-breccia, agglomerate, and tuffaceous sandstone* (Calico Mountains). Andesitic tuff, tuff breccia, and tuffaceous sediments of the Glendora "Volcanics" (Azusa area). Unnamed varicolored tuff, tuff breccia, and agglomerate elsewhere. |
| | Mu | **UPPER MIOCENE MARINE SEDIMENTARY ROCKS** | Puente Formation—*white and tan, well-bedded siltstone, shale, siliceous shale, and conglomerate, minor feldspathic sandstone and tuff* (south of Azusa). |
| | Mm | **MIDDLE MIOCENE MARINE SEDIMENTARY ROCKS** | Topanga Formation—*buff conglomerate, sandstone, siltstone, and shale, interbedded vesicular basalt flows* (Azusa area). Volcanic conglomerate and reworked tuffs associated with Glendora "Volcanics" (San Jose Hills). |
| | Ml | **LOWER MIOCENE MARINE SEDIMENTARY ROCKS** | Vaqueros Formation—*fossiliferous arkosic sandstone and conglomerate* (near Cajon Canyon). |
| Oligocene | ϕc | **OLIGOCENE NONMARINE SEDIMENTARY ROCKS** | Vasquez Formation—*conglomerate, arkosic sandstone, and siltstone, associated andesitic and basaltic volcanic rocks* (northwest of Valyermo). |
| Paleocene | Ep | **PALEOCENE MARINE SEDIMENTARY ROCKS** | San Francisquito Formation—*dark gray to black shale, coarse conglomerate, tan to gray sandstone, abundant thin lignite seams and limestone lenses* (formerly mapped as "Martinez Formation"; Cajon Pass-Valyermo area). |

# STRATIGRAPHIC NOMENCLATURE—Continued

| AGE | STATE MAP SYMBOL | STATE MAP UNIT<br>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<br>(The formally named formations grouped within an individual State Map Unit, are listed in stratigraphic sequence from youngest to oldest.) |
|---|---|---|---|
| CENOZOIC – TERTIARY – UNDIVIDED | Tc | **TERTIARY NONMARINE SEDIMENTARY ROCKS** | Old Woman Sandstone—*buff to pink massive arkosic sandstone, interbedded conglomerate, siltstone, and mudstone* (probably late Tertiary; north flank San Bernardino Mountains). |
| | Tl | **TERTIARY LAKE DEPOSITS** | Unnamed red-brown and green massive claystone, white vuggy limestone, interbedded white bentonitic tuff (west of Pisgah Crater; altered tuff marketed as "hectorite"). |
| | | **TERTIARY INTRUSIVE (HYPABYSSAL) ROCKS:** | |
| | Ti | **UNDIFFERENTIATED** | Felsite east of the Rodman Mountains. Stoddard Canyon Quartz Monzonite[5]—*light-gray quartz monzonite porphyry forming stocks and dikes, local chilled border phases resembling quartz latite and dacite* (San Gabriel Mtns.). |
| | $Ti^r$ | **RHYOLITIC** | Mountain Meadows Dacite Porphyry[6]—*buff, gray, or green massive biotite dacite porphyry* (San Gabriel Mountains). Unnamed intrusive dacite, rhyolitic and dacitic breccia, dacite porphyry, and perlite breccia in the Mojave Desert (locally extrusive in Barstow area). |
| | $Ti^a$ | **ANDESITIC** | Intrusive andesite, andesite breccia, and andesite porphyry in the Mojave Desert. |
| | $Ti^b$ | **BASALTIC** | Intrusive basalt, diabase, and olivine diabase in the Mojave Desert (may be Pleistocene). |
| MESOZOIC – CRETACEOUS – UNDIVIDED | | **MESOZOIC GRANITIC ROCKS** | |
| | gr | **UNDIFFERENTIATED** | Quartz monzonite, granodiorite, quartz diorite, and monzonite. An intrusive complex of quartz monzonite porphyry, latite porphyry, and porphyritic felsite near Stoddard Well. Mount Lowe Granodiorite[7]—*light-colored, foliated, quartz-poor granitic rock of monzonitic to dioritic composition* (Permian-Triassic; San Gabriel Mountains). |
| | $gr^a$ | **GRANITE AND ADAMELLITE (QUARTZ MONZONITE)** | White Tank Quartz Monzonite and Palms "Granite"—*white to gray biotite quartz monzonite* (Twentynine Palms area). Cactus Quartz Monzonite—*gray-buff biotite quartz monzonite* (San Bernardino Mountains). Holcomb Quartz Monzonite—*gray to pink quartz monzonite* (Valyermo area). Unnamed light-colored unfoliated or slightly foliated, biotite and biotite-hornblende quartz monzonite, hornblende quartz monzonite, hornblende granite, granite porphyry, aplite, and pegmatite. |
| | $gr^g$ | **GRANODIORITE** | Woodson Mountain Granodiorite—*light-colored granodiorite, scattered small dark inclusions* (Jurupa Mountains). Unnamed biotite granodiorite and biotite granodiorite porphyry. |
| | $gr^t$ | **TONALITE (QUARTZ DIORITE) AND DIORITE** | Bonsall Tonalite—*light- to dark-gray tonalite containing abundant, large, oriented inclusions* (Jurupa Mountains). Unnamed hornblende-biotite quartz diorite, quartz diorite porphyry, dark-colored locally foliated diorite, local thin cataclastic and mylonitic zones. |
| | bi | **MESOZOIC BASIC INTRUSIVE ROCKS** | San Marcos Gabbro—*dark-gray and white, mottled hornblende gabbro* (Jurupa Mountains). Gold Park Gabbro-Diorite—*highly variable hornblende gabbro and diorite* (near Twentynine Palms; possibly Precambrian re. W. J. Miller, 1938, Geol. Soc. America Bull., p. 438). Unnamed black, massive, hornblende gabbro and diorite-gabbro. |
| MESOZOIC – TRIASSIC–JURASSIC | JTRv | **JURASSIC AND/OR TRIASSIC METAVOLCANIC ROCKS** | Sidewinder Volcanic "Series"—*highly variable, locally metamorphosed pyroclastic, volcanic, and some hypabyssal intrusive rocks including light-colored dacitic and rhyolitic tuff and vitrophyre, dark-colored andesitic tuff, latitic agglomerate, lark-gray andesite, latite, and basalt, brown and white rhyolite and dacite, blue-gray massive keratophyre, and dark-gray basalt porphyry and diorite porphyry, local piemontite* (may range from Late Permian to Jurassic in age). Ord Mountain Group—*andesitic flows, tuff, and breccia, hypabyssal porphyritic andesite and monzonite.* |
| PALEOZOIC – PERMIAN | Pm | **PERMIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS** | Fairview Valley Formation—*dark-gray massive limestone conglomerate, thin-bedded gray-green silty and sandy limestone (metamorphosed locally to hornfels), minor thin-bedded calcareous siltstone and shale* (contains Permian fossils in limestone clasts; may be in part Triassic). |
| PALEOZOIC – CARBONIFEROUS | C | **UNDIVIDED CARBONIFEROUS MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS** | Oro Grande "Series"—*blue-gray and white, massive, calcite and dolomite marble, dark-colored quartz-mica schist and argillite, quartz-biotite hornfels, green thin-bedded calc-silicate hornfels, pink to white quartzite, local quartzite breccia, dolomite marble breccia, and metasiltstone* (possibly in part older than Carboniferous). Furnace Limestone—*white and blue gray, massive and thin-bedded, calcite and dolomite marble, minor pink calc-silicate hornfels, dark-gray micaceous phyllite, and gray to white quartzite.* |
| PALEOZOIC – UNDIVIDED | ℙ | **PALEOZOIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS** | Saragossa Quartzite—*light-gray to white, massive, cross-bedded, vitreous quartzite, dark-gray phyllite, and dark-gray fine-grained schist.* Chicopee Canyon Formation—*white, cross-bedded and ripple-marked, thin-bedded, micaceous quartzite and calc-silicate hornfels* (mapped as part of Saragossa Quartzite by T. W. Dibblee, Jr., ref. no. 12b). Unnamed gray, white, and pink quartzite, gray-brown massive metaconglomerate, pink to green hornfels, and black fine-grained schist in Mojave Desert. |
| | ls | **LIMESTONE AND/OR DOLOMITE** | White calcite and dolomite marble, green to red-brown tactite, minor graphitic and micaceous schist. |
| ? | gr-m | **PRE-CENOZOIC GRANITIC AND METAMORPHIC ROCKS** | Injection gneiss, granitic gneiss intruded by pegmatite and aplite, and gneissic hornblende diorite in Barstow area (possibly Paleozoic). Migmatites of biotite quartz monzonite south of Lucerne Valley (probably Mesozoic). Granite-migmatite complex near Broadwell Lake (probably Mesozoic, possibly older). |
| ? | mv | **PRE-CRETACEOUS METAVOLCANIC ROCKS** | Hodge Volcanic Formation—*dark-colored quartz latite and dacite, light-colored, commonly schistose, tuffaceous metasedimentary and metavolcanic rocks including gray biotite schist, red-brown massive metatuff, and white to pink quartzite* (older than the Sidewinder Volcanic "Series" according to O. E. Bowen (ref. no. 2)). Unnamed gray massive metavolcanic rocks in Cady Mountains. |
| ? | ms | **PRE-CRETACEOUS METASEDIMENTARY ROCKS** | San Antonio Canyon Group—*quartzite, thin-bedded graphitic schists, dark-colored gneiss, and light-colored migmatite* (San Gabriel Mountains). Unnamed quartzitic schist, quartz-biotite hornfels, calc-silicate hornfels, and calcite marble. |
| ? | m | **PRE-CRETACEOUS METAMORPHIC ROCKS, UNDIFFERENTIATED** | Pelona Schist—*gray and green feldspar-quartz-mica schist, massive amphibolite, minor thin quartzite, and piemontite-bearing metachert* (age uncertain and in dispute; believed to be Mesozoic by some geologists and as old as Precambrian by others). Light-colored schistose to gneissic granitic rocks near Victorville. Mylonite, mylonite gneiss, mylonite schist, granite cataclasite, flaser gneiss, cataclastic quartz diorite gneiss, and cataclastic metasediments in San Gabriel and San Bernardino Mountains. |
| ? | ls | **LIMESTONE AND/OR DOLOMITE** | Light-colored marble, associated tactite and skarn. |
| PRECAMBRIAN | p€c | **PRECAMBRIAN IGNEOUS AND METAMORPHIC ROCK COMPLEX:** | San Gabriel Complex[8]—*hornblende, biotite, quartz, feldspar gneiss-migmatite complex, transected by dikes of amphibolite, aplite, pegmatite, and semi-concordant bodies of quartz diorite.* San Gorgonio Igneous-Metamorphic Complex[8]—*migmatite-gneiss, flaser gneiss, piemontite-bearing gneiss, and greenschist, pervasively intruded by quartz monzonite and associated pegmatite.* Cucamonga Complex[8]—*quartz diorite gneiss, paragneiss, graphitic marble, quartz monzonite mylonite, pegmatite.* Unnamed gray banded gneiss cut by abundant granitic rocks and locally sheared and folded[8] (Little San Bernardino Mountains and Mojave Desert). |
| | | **UNDIVIDED PRECAMBRIAN METAMORPHIC ROCKS:** | |
| | p€ | **UNDIFFERENTIATED** | Tan to gray vitreous quartzite[8] in Mill Creek Canyon. |
| | p€s | **SCHIST** | Gray, black, and green, fine- to medium-grained schist in the Mojave Desert (age uncertain). |
| | p€g | **GNEISS** | Pinto Gneiss[8]—*dark-colored, strongly foliated, quartz-biotite gneiss* (Twentynine Palms area). Baldwin Gneiss[8]—*fine-grained gneiss and schist, augen gneiss, and granitic gneiss.* Waterman Gneiss[8]—*dark-colored hornblende-feldspar-mica gneiss, local diorite and pegmatite dikes, marble, and quartzite* (rocks shown as pCg? in the Barstow area may be Paleozoic). Unnamed dark-gray, banded, quartz diorite gneiss and augen gneiss, light-gray granitic gneiss, minor gray and green schist, amphibolite, and marble, local thin cataclastic zones, tight folds, and intrusive granitic rocks[8]. |

## NOTES

[1] The type locality of the Pico Formation is in the Ventura Basin; upper Pliocene strata in the Los Angeles basin commonly are assigned to the Pico Formation on the basis of foraminiferal correlation; the U. S. Geological Survey has abandoned the name Pico, and for the Los Angeles basin assigns these rocks to the Upper Member of the Fernando Formation (Durham, D. L. and Yerkes, R. F., 1964. Geology and oil resources of the eastern Puente Hills area: U. S. Geol. Survey Prof. Paper 420-B).

[2] The "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, D. L. and Yerkes, R. F., 1964, U. S. Geol. Survey Prof. Paper 420-B).

[3] R. E. Smith, Geology of the Mill Creek area, San Bernardino County, California, University California, Los Angeles, unpublished M.A. thesis, 1959.

[4] No fossils have been reported from these rocks; Pliocene age is based on stratigraphic position.

[5] Radiometric age dates (K/A) of 17 ± 5 m.y. and 26 ± 3 m.y. are reported by K. J. Hsu (1963) Geol. Soc. America Bull., v. 74, pp. 507–512.

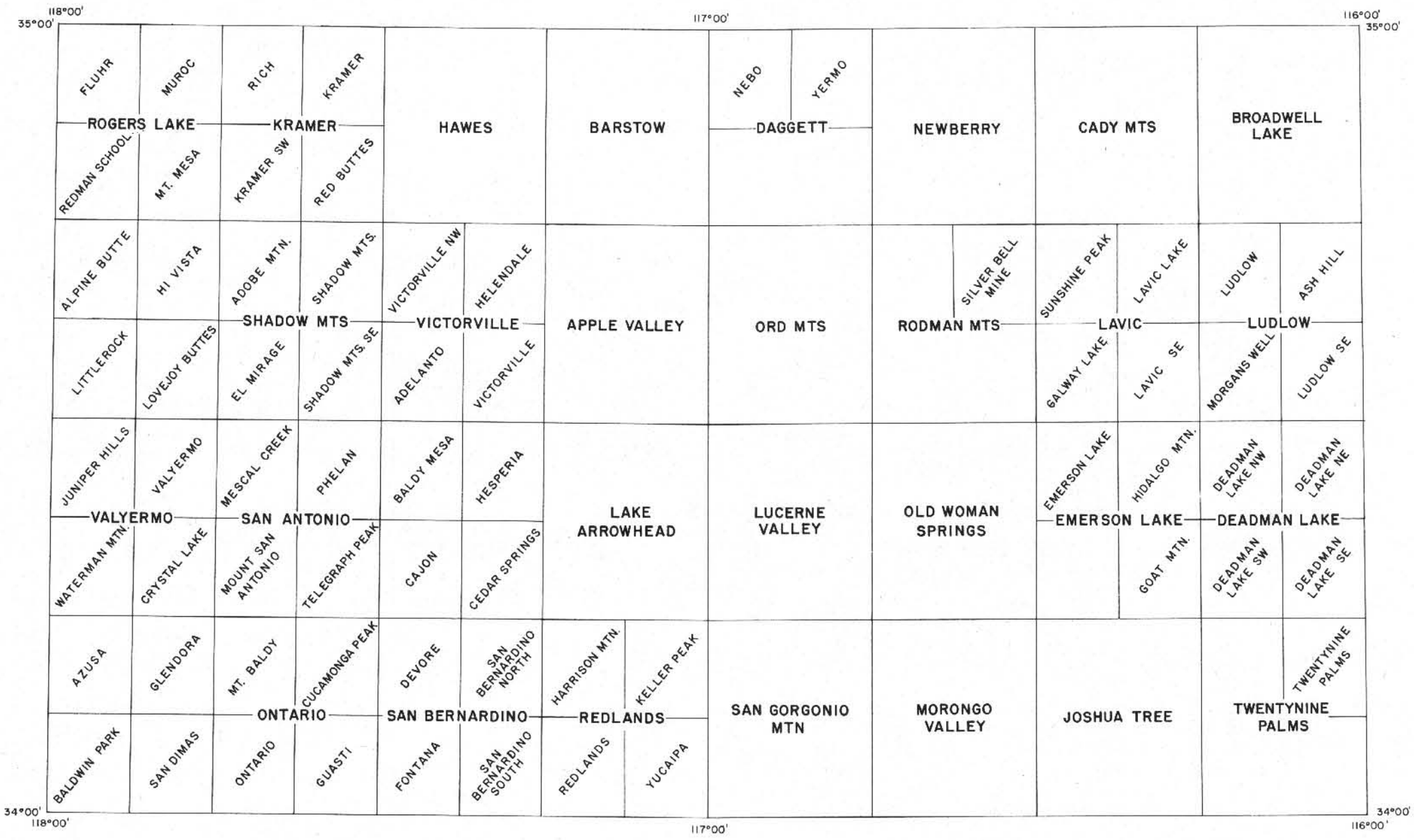
[6] Radiometric age date (K/A) of 27.5 ± 2.5 m.y. is reported by R. Streitz (1964), ref. no. 35.

[7] 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 (abstract), p. 201–202. Subsequent determinations indicate the age of these rocks is younger and may be Triassic—L. T. Silver, oral communication 5/1968.

[8] The age of some of these rocks is uncertain and actually may be younger than Precambrian.

# TOPOGRAPHIC QUADRANGLES

## AVAILABLE FROM THE U.S. GEOLOGICAL SURVEY
## FEDERAL CENTER, DENVER, COLORADO 80225
## 1968



View northwest along the San Bernardino mountain front toward the city of San Bernardino, Cajon Pass, and the snow-capped San Gabriel Mountains. The linear boundary between the dark orange groves of the valley and the lighter brushy foothills of the San Bernardino Mountains coincides with the South Branch of the San Andreas fault. The North Branch of the San Andreas fault occupies a trough (NB) in the foothills, at the base of the higher more rugged part of the San Bernardino Mountains. These two branches converge into a much narrower fault zone in the distance near Cajon Pass. The rocks between these faults consist of Mesozoic granitic rocks (light colored outcrops) and severely deformed Pliocene or Miocene nonmarine beds. The remainder of the San Bernardino Mountains and the San Gabriel Mountains consists of a granitic and metamorphic complex of Mesozoic, Paleozoic and Precambrian age. *Photo by R. C. Frampton, 1955*