DIVISION OF MINES AND GEOLOGY
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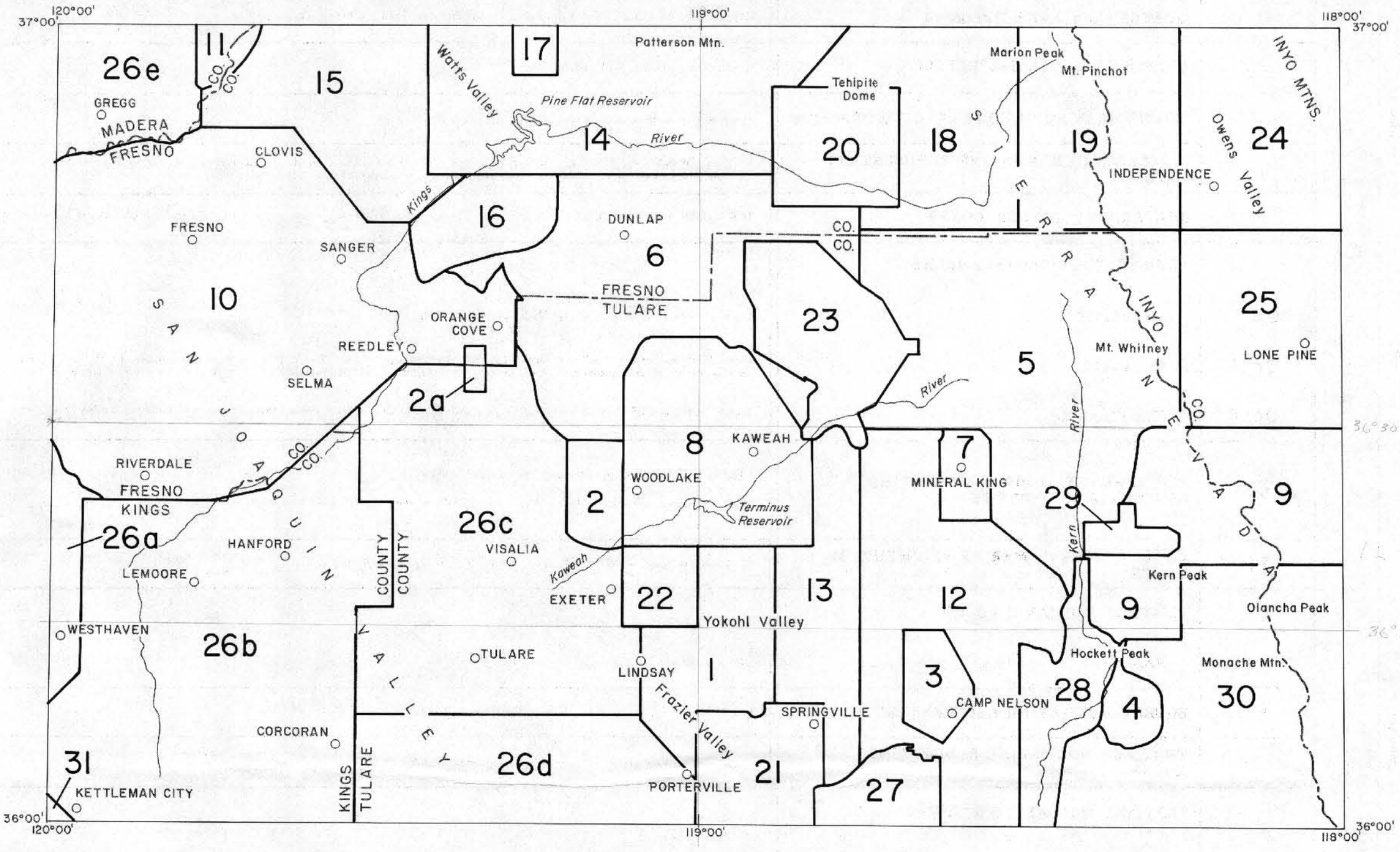
EXPLANATORY DATA
FRESNO SHEET
GEOLOGIC MAP OF CALIFORNIA
OLAF P. JENKINS EDITION

Compiled by Robert A. Matthews and John L. Burnett, 1965

INDEX TO GEOLOGIC MAPPING
USED IN THE COMPILATION OF THE FRESNO SHEET



1. Alfors, John T., and Putman, George W., Reconnaissance geologic map of parts of the Porterville, Lindsay, and Frazier Valley quadrangles, scale 1:24,000, and part of the Kaweah quadrangle, scale 1:62,500, California Div. Mines and Geology, reconnaissance mapping for the State Geologic Map, 1964.

2. Alfors, John T., and Putman, George W., Reconnaissance geologic map of parts of the Exeter and Ivanhoe quadrangles, scale 1:24,000, California Div. Mines and Geology, reconnaissance mapping for the State Geologic Map, 1964. (Quaternary deposits from R. E. Storie et al., 1942, Soil survey of the Visalia area, California: U. S. Dept. Agriculture Series 1935, no. 16.)

2a. Alfors, John T., and Putman, George W., Reconnaissance geologic map of part of the Orange Cove South quadrangle, scale 1:24,000, California Div. Mines and Geology, reconnaissance geologic mapping for the State Geologic Map, 1964.

3. Barosh, Patrick J., Geologic map of the northern part of the Camp Nelson quadrangle, scale 1:24,000, unpublished report 1959. (Parts modified by C. W. Jennings, T. E. Gay, Jr., and O. E. Bowen, California Div. Mines and Geology, unpublished mapping, 1963.)

4. Burnett, John L., Reconnaissance geologic map of part of the Hockett Peak quadrangle, scale 1:62,500, California Div. Mines and Geology, reconnaissance mapping for the State Geologic Map, 1963.

†5. Burnett, John L., and Matthews, Robert A., Reconnaissance geologic map of the Mt. Whitney, Triple Divide Peak, and parts of the Kern Peak and Mineral King quadrangles, scale 1:62,500, California Div. Mines and Geology, reconnaissance mapping for the State Geologic Map, 1960-65.

†6. Burnett, John L., and Matthews, Robert A., Reconnaissance geologic map of parts of the Dunlap, Patterson Mtn., Tehipite Dome, and Giant Forest quadrangles, scale 1:62,500, California Div. Mines and Geology, reconnaissance mapping for the State Geologic Map, 1959-64. (Minor modifications in the Dunlap quadrangle by J. T. Collier, Southern Pac. Co., 1958.)

7. Christensen, Mark N., 1963, Structure of metamorphic rocks of Mineral King, California: Univ. California Pubs. Geol. Sci., vol. 42, no. 4, pp. 159–198, Map: Geologic map of the Mineral King area, scale 1:22,600.

8. Durrell, Cordell, 1943, Geology of the Sierra Nevada northeast of Visalia, Tulare County, California: California Jour. Mines and Geology, vol. 39, no. 2, pp. 153–168, Pl. III: Geologic map of the region about Lemon Cove and Three Rivers, Tulare County, scale 1:125,000. Map also published in Cordell Durrell, 1941, Metamorphism in the southern Sierra Nevada northeast of Visalia, California: University of California Pubs., Bull. Dept. Geol. Sci., vol. 25, no. 1, pp. 1–117, Map I: Geologic map of part of the southern Sierra Nevada northeast of Visalia, California, scale 1:125,000.

*9. Gray, C. H., Jr., Morton, P. K., Saul, R. B., Reconnaissance geologic map of parts of the Olancha, Kern Peak, and Hockett Peak quadrangles, scale 1:62,500, California Div. Mines and Geology, reconnaissance mapping for the State Geologic Map, 1961.

Bateman, P. C., and Merriam, C. W., 1954, Geology of the Owens Valley region, Inyo County *in* California Div. Mines Bull. 170, Map Sheet II, scale 1:250,000.

Knopf, Adolph, 1918, A geologic reconnaissance of the Inyo Range and the eastern slope of the southern Sierra Nevada, California: U. S. Geological Survey Prof. Paper 110, 130 pp.: Geologic reconnaissance map of the Mount Whitney quadrangle and parts of the Olancha and Ballarat quadrangles, California, scale 1:125,000.

10. Huntington, Gordon L., Soil association map, eastern Fresno County, scale approx. 1:300,000, Univ. of California, Davis, Dept. of Soils and Plant Nutrition, map and report in preparation, 1965.

11. Janda, Richard, Preliminary geologic map of parts of the Friant and Lanes Bridge quadrangles, scale 1:24,000, Univ. of California Ph.D. thesis in progress, 1965.

Trauger, Frederick D., Geologic map of an area near Friant, scale 1:31,680 and 1:62,500, unpublished 1936–41.

12. Jennings, Charles W., and Gay, Thomas E., Jr., Reconnaissance geologic map of parts of the Mineral King, Kern Peak, Camp Nelson, and Hockett Peak quadrangles, scale 1:62,500, California Div. Mines and Geology, reconnaissance mapping for the State Geologic Map, 1962–63.

13. Jennings, Charles W., and Strand, Rudolph G., Reconnaissance geologic map of parts of the Springville and Kaweah quadrangles, scale 1:62,500, California Div. Mines and Geology, reconnaissance geologic mapping for the State Geologic Map, 1963.

14. Krauskopf, Konrad B., 1953, Tungsten deposits of Madera, Fresno, and Tulare Counties, California: California Div. Mines Special Rept. 35, 83 pp., Pl. 1: Reconnaissance geologic map of parts of the Kaiser, Dinuba, Tehipite, and Mount Goddard 30′ quadrangles, Fresno County, California, scale 1:125,000. (Modified in part by R. A. Matthews, Geologic map of the Patterson Mtn. quadrangle, scale 1:48,000, California Div. Mines and Geology work in progress, 1964–65.) Photointerpretation of glacial deposits in the northern part of the Tehipite Dome quadrangle by R. A. Matthews, 1965.

†15. Macdonald, Gordon A., 1941, Geology of the western Sierra Nevada between the Kings and San Joaquin Rivers, California: Univ. California Pubs., Bull. Dept. Geol. Sci., vol. 26, no. 2, pp. 215–286, Map 1: Geologic map of the western part of the Sierra Nevada between the Kings and San Joaquin Rivers, California, scale 1:62,500. (Minor modifications in the southeastern part by R. A. Matthews, California Div. Mines and Geology, 1963.)

16. Matthews, Robert A., and Burnett, John L., Reconnaissance geologic map of parts of the Watts Valley and Patterson Mtn. 15′ quadrangles and the Wahtoke and Orange Cove North 7½′ quadrangles, scales 1:62,500 and 1:24,000, California Div. Mines and Geology, reconnaissance geologic mapping for the State Geologic Map, 1960–64.

17. Matthews, Robert A., and Alfors, John T., Geology of the sanbornite deposits in the Patterson Mtn. and Watts Valley quadrangles, scale 1:1320, California Div. Mines and Geology report in preparation, 1962–65.

18. Moore, James G., Geologic map of parts of the Tehipite Dome and Marion Peak quadrangles, scales 1:62,500 and 1:48,000, U. S. Geol. Survey, work in progress, 1965.

19. Moore, James G., 1963, Geology of the Mount Pinchot quadrangle, southern Sierra Nevada, California: U. S. Geol. Survey Bull. 1130, 152 pp., Pl. 1, scale 1:62,500.

20. Moore, James G., and Dodge, F. C., 1962, Mesozoic age of metamorphic rocks in the Kings River area, southern Sierra Nevada, California: U. S. Geol. Survey Prof. Paper 450-B, pp. B-19 to B-21, Fig. 7.1, scale approx. 1:250,000. (Additional information in the northeastern part of the area from unpublished mapping by J. G. Moore and F. C. Dodge, scale approx. 1:125,000, 1961.)

21. Plafker, George, Geology of the southwest part of the Kaweah 30′ quadrangle, California, enlarged scale 1:62,500, Univ. of California, unpublished M.S. thesis, 1956. (Minor modifications by C. W. Jennings, R. G. Strand, and A. R. Smith, California Div. Mines and Geology, 1963 and 1964, and J. T. Collier, Southern Pacific Co., 1958.)

22. Putman, George W., and Alfors, John T., Geologic map of part of the Rocky Hill quadrangle, scale 1:24,000, California Div. Mines and Geology, unpublished 1964.

Putman, George W., and Alfors, John T., 1965, Depth of intrusion and age of the Rocky Hill stock, Tulare County, California: Geol. Soc. Amer. Bull., vol. 76, pp. 357–364, Fig. 1, scale 1 inch equals approx. 2000 feet.

23. Ross, Donald C., 1958, Igneous and metamorphic rocks of parts of Sequoia and Kings Canyon National Parks, California: California Div. Mines and Geology Special Rept. 53, 24 pp., Pl. 1, scale 1:62,500. (Glacial deposits from Joseph H. Birman, Glaciation of parts of Sequoia and Kings Canyon National Parks, preliminary unpublished report and map, scale 1:24,000, prepared for the National Park Service, San Francisco, California, 1962.)

*24. Ross, Donald C., 1965, Geology of the Independence quadrangle, Inyo County, California: U. S. Geol. Survey Bull. 1181-O, 64 pp., Pl. 1, scale 1:62,500.

*25. Ross, Donald C., Geologic compilation of the Inyo Mountain region, scale 1:125,000, U. S. Geol. Survey, unpublished 1965. (Modified in part by R. A. Matthews and J. L. Burnett, California Div. Mines and Geology.) Earthquake fault and related faults from Paul C. Bateman, 1961, Willard B. Johnson and the strike slip component of fault movement in Owens Valley, California earthquake of 1872: Bull. Seismol. Soc. Amer., vol. 51, no. 4, pp. 483–493, Fig. 2, scale 1:125,000.

Bateman, P. C., and Merriam, C. W., 1954, Geology of the Owens Valley region, Inyo County *in* California Div. Mines Bull. 170, Map Sheet II, scale 1:250,000.

Knopf, Adolph, 1918, A geologic reconnaissance of the Inyo Range and the eastern slope of the southern Sierra Nevada, California: U. S. Geol. Survey Prof. Paper 110, 130 pp.: Geologic reconnaissance map of the Mount Whitney quadrangle and parts of the Olancha and Ballarat quadrangles, California, scale 1:125,000.

26. U. S. Dept. Agriculture Soil Surveys: a) Coalinga area, 1952, by F. F. Harridine et al., Series 1944, no. 1; b) Kings County, 1946, by J. L. Retzer et al., Series 1938, no. 9; c) Visalia area, 1940, by R. E. Storie et al., Series 1935, no. 16; d) Pixley area, 1942, by R. E. Storie et al., Series 1935, no. 23; e) Madera area, 1962, by L. K. Stromberg et al., Series 1951, no. 11.

27. Waterman, Lucius W., Soils association map of the Tule River Indian Reservation, eastern Tulare Soil Survey, scale 1:62,500, U. S. Dept. Agriculture Soil Conservation Service, work in progress, 1964–65.

Jennings, Charles W., and Gay, Thomas E., Jr., Reconnaissance geologic map of part of the Camp Nelson quadrangle, scale 1:62,500, California Div. Mines and Geology reconnaissance mapping for the State Geologic Map, 1963–64.

†28. Webb, Robert W., 1946, Geomorphology of the middle Kern River Basin, southern Sierra Nevada, California: Geol. Soc. Amer. Bull., vol. 57, no. 4, pp. 355–382, Pl. 7: Geologic map of the middle Kern Basin, southern Sierra Nevada of California, scale 1:125,000 [Pliocene age of volcanics (3.5 m.y. ± 0.1 m.y.) from G. B. Dalrymple, 1963, Potassium-argon dates of some Cenozoic volcanic rocks of the Sierra Nevada: Geol. Soc. Amer. Bull., vol. 74, pp. 379–390.]

†29. Webb, Robert W., 1950, Volcanic geology of Toowa Valley, southern Sierra Nevada, California: Geol. Soc. Amer. Bull., vol. 61, no. 4, pp. 349–357, Pl. 1: Geologic map of Toowa Valley, scale 1:60,000. (Minor additions and adjustments to fit newer topographic maps by geologists of California Div. Mines and Geology, 1961–62.)

*30. Weber, F. H., Jr., Saul, R. B., Morton, P. K., and Gray, C. H., Jr., Reconnaissance geologic map of the Monache Mtn. quadrangle and parts of the Hockett Peak and Olancha quadrangles, scale 1:62,500, California Div. Mines and Geology, reconnaissance mapping for the State Geologic Map, 1960.

31. Woodring, W. P., Stewart, Ralph, and Richards, R. W., 1940, Geology of the Kettleman Hills oil field, California: U. S. Geol. Survey Prof. Paper 195, 170 pp., Pl. 3: Geologic map of the Kettleman Hills, scale 1:31,680.

† Minor modifications by C. A. Wahrhaftig, University of California, Berkeley, faculty research, personal communication, 1965.

* The concealed faults in Owens Valley are from L. C. Pakiser, M. F. Kane, and W. H. Jackson, 1964, Structural geology and volcanism of Owens Valley region, California, a geophysical study: U. S. Geol. Survey Prof. Paper 438, 69 pp., Pl. 1, sheet 3, scale 1:96,000.

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—FRESNO 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 (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**	Loose sand deposits very low in organic matter, northwest of Fresno and near Dinuba (Delhi soil series).
	Qal	**RECENT ALLUVIUM**	Stream alluvium including some dissected fans on the margins of the Great Valley. Coarse granitic fanglomerate along the eastern front of the Sierra Nevada. Talus and slope wash. Alluvial fill in upland meadows. Recent calcareous tufa deposits in Kern Peak and Camp Nelson quadrangles.
	Qsc	**RECENT RIVER AND MAJOR STREAM CHANNEL DEPOSITS IN THE GREAT VALLEY**	Sediments along river channels and major streams including adjacent natural levees.
	Qf	**RECENT ALLUVIAL FAN DEPOSITS IN THE GREAT VALLEY**	Sediments deposited from streams emerging from highlands surrounding the Great Valley. Modesto Formation—*granitic sand and silt.*
	Qb	**RECENT BASIN DEPOSITS IN THE GREAT VALLEY**	Sediments deposited during flood stages of major streams in the area between natural stream levees and fans.
	Ql	**QUATERNARY LAKE DEPOSITS**	Fine sand, silt, and clay of Tulare Lake. Lacustrine and fluviatile deposits of Owens Valley.
— QUATERNARY — Pleistocene	Qg	**QUATERNARY GLACIAL DEPOSITS**	Glacial till and moraine. Rock glaciers.
	Qt	**QUATERNARY NONMARINE TERRACE DEPOSITS**	Stream terraces of unconsolidated sand, silt, clay and gravel.
	Qc	**PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	Riverbank Formation—*granitic sand, silt, and clay.* Older alluvium and dissected fan deposits in the San Joaquin Valley. So-called sand dune in Sand Meadows (southwest of Mineral King) composed of stream deposited sand, gravel, and cobbles.
	✳	**QUATERNARY CINDER CONES**	Basaltic cinder cones in the Golden Trout Creek area ("Toowa Valley") and on the west side of Owens Valley north of Independence.
		PLEISTOCENE VOLCANIC ROCKS:	
	Qpv^r	**RHYOLITIC**	Rhyodacite flow (may be late Tertiary; Marion Peak quadrangle).
	Qpv^b	**BASALTIC**	"Olivine basalt west of Aberdeen" and "Olivine basalt of Sawmill Canyon" (Mt. Pinchot quadrangle); "Olivine basalt of Oak Creek" (may be Pliocene; Mt. Pinchot quadrangle). Basalt in the Golden Trout Creek area of probable Pleistocene age and other unnamed basalt elsewhere.
	Qpv^p	**PYROCLASTIC**	Basaltic cinders west of Aberdeen (Mt. Pinchot quadrangle) and basaltic ash and cinders (Independence quadrangle and Golden Trout Creek area).
— Pleistocene, Pliocene —	QP	**PLIOCENE-PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	[1] Turlock Lake Formation—*granitic sand, silt, clay, and cobbles.* [1] Tulare Formation—*continental beds of poorly consolidated sandstone, siltstone, and conglomerate.*
— Pliocene —	Pu	**UPPER PLIOCENE MARINE SEDIMENTARY ROCKS**	San Joaquin Formation—*fine-grained silty sandstone, silt and clay, nonmarine in part.*
		PLIOCENE VOLCANIC ROCKS:	
	Pv^b	**BASALTIC**	Olivine basalt (Kern River area).
TERTIARY — Eocene	Ec	**EOCENE NONMARINE SEDIMENTARY ROCKS**	Ione Formation—*well indurated sandstone and conglomerate* (Lanes Bridge and Friant quadrangles).
— Undivided	Tc	**TERTIARY NONMARINE SEDIMENTARY ROCKS**	Tuffaceous "sand and gravel" of Janda (Lanes Bridge and Friant quadrangles).
		TERTIARY VOLCANIC ROCKS:	
	Tv^r	**RHYOLITIC**	Rhyolite— rhyodacite (Black Kaweah peak, Triple Divide Peak quadrangle).
	Tv^a	**ANDESITIC**	Latite (?) of Monache and Templeton Mountains (Monache Mtn. and Olancha quadrangles).
	Tv^b	**BASALTIC**	Olivine basalt and some hornblende andesite flows.
JURASSIC — CRETACEOUS — Undivided		**MESOZOIC GRANITIC ROCKS**	
	gr	**UNDIFFERENTIATED,**	Granitic rocks ranging in composition from granite to gabbro.
	gr^a	**GRANITE AND ADAMELLITE (QUARTZ MONZONITE)**	Quartz monzonite, alaskite, alaskitic quartz monzonite, muscovite granite, and biotite hornblende granite. Hunter Mountain Quartz Monzonite—*in part granodiorite;* quartz monzonite in Independence quadrangle, Lodgepole Granite, Pear Lake Quartz Monzonite, Cactus Point Granite, Big Baldy Granite, Weaver Lake Quartz Monzonite (all of Sequoia-Kings Canyon area).
	gr^g	**GRANODIORITE**	Granodiorite, including hornblende biotite granodiorite. Tinemaha Granodiorite—*includes some quartz monzonite;* granodiorite in the Independence and Mount Pinchot quadrangles. Isabella Granodiorite—*ranging to quartz diorite* (Kern River Basin), Tokapah Porphyritic Granodiorite, Clover Creek Granodiorite, Cow Creek Granodiorite (Sequoia and Kings Canyon area). Lamarck Granodiorite (Mount Pinchot area).
	gr^t	**TONALITE (QUARTZ DIORITE) AND DIORITE**	Quartz diorite, pyroxene quartz diorite (near Academy), and hornblende diorite. Sacatar Quartz Diorite—*ranges from gabbro to granodiorite* (Kern River Basin). Potwisha Quartz Diorite (Sequoia area).
	bi	**MESOZOIC BASIC INTRUSIVE ROCKS**	Hornblende gabbro, pyroxene-hornblende gabbro, clinopyroxene anorthosite (Mount Pinchot quadrangle), and other mafic plutonic rocks including some diorite. Summit Gabbro—*hornblende gabbro* (Kern River Basin). Elk Creek Gabbro (Sequoia area). Olivine gabbro near Orosi.
MESOZOIC — TRIASSIC—JURASSIC	ub	**MESOZOIC ULTRABASIC INTRUSIVE ROCKS**	Serpentine, peridotite, harzburgite, pyroxenite, and dunite; locally includes talc schist and actinolite schist.
	$J\bar{R}v$	**JURASSIC AND/OR TRIASSIC METAVOLCANIC ROCKS**	Metavolcanic rock including metamorphosed rhyolitic to basaltic tuffs and flows. Fossils near Boyden Cave, Kings River area, are Triassic or Jurassic.
	$\bar{T}R$	**TRIASSIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Metamorphosed sandstone and hornfels interbedded with marble; contains Triassic fossils (Mineral King area).
	gr-m	**PRE-CENOZOIC GRANITIC AND METAMORPHIC ROCKS**	Mixed granitic and metamorphic rocks (areas that are mainly granitic but contain abundant inclusions of metamorphic rocks). Ash Mountain mafic complex—*primarily a dark fine-grained rock of quartz diorite composition intruded by a lighter gray fine-grained rock of quartz diorite composition; possibly altered metamorphic rocks* (Sequoia Park area).
— UNDIVIDED		**PRE-CRETACEOUS METAMORPHIC METAVOLCANIC ROCKS**	
	m	**UNDIFFERENTIATED**	Kernville "Series"—*Undifferentiated phyllite, quartzite, schist, marble, gneiss and metavolcanic rocks* in the Kern River area. "Kaweah Series"[2]—*complex of metasedimentary and metavolcanic rocks including mica schist, phyllite, amphibolite, metachert, quartzite, marble, and metamorphosed rhyolitic and basaltic flows and tuffs.* Metagabbro within the serpentine belt along the western margin of the Sierra Nevada. Unnamed metamorphic rocks elsewhere.
	ls	**ls = LIMESTONE AND/OR DOLOMITE**	Metamorphosed limestone, including calc-silicate rocks.
	ms	**PRE-CRETACEOUS METASEDIMENTARY ROCKS**	Unnamed metamorphic rocks composed predominantly of schist, metachert, phyllite, quartzite, hornfels, tactite, slate, and marble.
	mv	**PRE-CRETACEOUS METAVOLCANIC ROCKS**	Unnamed amphibolite, mica schist, metarhyolite, and other metamorphosed tuffs and flows.

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 (The formally named formations grouped within an individual State Map Unit, are listed in stratigraphic sequence from youngest to oldest.)
PALEOZOIC	ℙ	**PALEOZOIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Calc-hornfels, biotite schist, and pelitic hornfels and quartzite (Mount Pinchot quadrangle; Paleozoic age uncertain).
	ℙ ls	ls = **LIMESTONE**	Massive, coarsely crystalline marble (Mount Pinchot quadrangle; Paleozoic age uncertain).
PERMIAN	ℙ	**PERMIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Owens Valley Formation—*pebble and cobble conglomerate* (Independence quadrangle).
CARBONIFEROUS	CP	**PENNSYLVANIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Keeler Canyon Formation—*thinly interbedded gray limestone, and dark gray hornfels with a zone of spheroidal black chert nodules near base* (Permian in part); Rest Spring Shale—*dark gray siltstone, shale, and mudstone, commonly metamorphosed to andalusite hornfels* (considered Pennsylvanian (?) in the type area east of this map sheet but is Upper Mississippian in part in the Independence quadrangle).
	CM	**MISSISSIPPIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Perdido Formation—*mixed metaclastic sequence of sandstone, conglomerate, calcarenite, and shale* (Independence quadrangle).
SILURIAN	S	**SILURIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Vaughn Gulch Limestone—*bioclastic limestone, thinly bedded limestone, and argillaceous limestone; rich in coral and sponge fragments;* Sunday Canyon Formation—*graptolitic limy shale, limy shale, and lesser amounts of limestone* (Independence quadrangle).
ORDOVICIAN	O	**ORDOVICIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Ely Springs Dolomite—*light- to dark-gray, thin- to thick-bedded dolomite containing abundant black chert;* Johnson Spring Formation—*mixed sequence of quartzite, dolomite, limestone (in part coral-bearing), and lesser amounts of siltstone and shale;* Barrel Spring Formation—*shale, mudstone, siltstone, limestone, and impure quartzite;* Badger Flat Limestone—*blue-gray silty limestone and calcarenite, and yellowish-gray siltstone (black chert, abundant in lower part);* Al Rose Formation—*siltstone, shale, and mudstone with subordinate limestone.*
CAMBRIAN	€	**CAMBRIAN MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Tamarack Canyon Dolomite—*thin-bedded dolomite with locally abundant black chert nodules;* Lead Gulch Formation—*thin-bedded interlayered sequence of limestone, siltstone, dolomite, chert, and shale;* Bonanza King Dolomite—*laminated to thick-bedded dolomite color banded in varied shades of gray with distinctive "zebra striping," and locally prominent black dolomite bands;* Monola Formation—*thin-bedded red-brown weathering siltstone and gray limestone;* Mule Spring Limestone—*white to gray thin-bedded limestone;* Saline Valley Formation—*intermixed sequence of gray limestone, brownish-gray shale, siltstone, argillaceous limestone, white quartzite, and calcareous quartz sandstone;* Harkless Formation—*red-brown stained quartzite, interbedded with siltstone and shale.*

NOTES

[1] Not necessarily in stratigraphic order.
[2] The "Kaweah Series" is subdivided more or less arbitrarily into four units with no sharp changes in lithology or unconformities (Durrell, 1941, p. 13).

Headwaters of Cliff Creek in Sequoia National Park with Sawtooth Peak, elevation, 12,343, on the skyline. Within this highly glaciated area are three small lakes perched on three immense glacial steps that were quarried in strongly jointed granite. The lowermost of these lakes is Spring Lake (S) in part underlain by ancient metavolcanic rocks. The upper two lakes, Columbine (C) and Cyclamen Lake (Cy), frozen during most of the year, are partly concealed by snow. Columbine Lake lies at the base of a well-developed cirque on the north face of Sawtooth Peak. *Photo by Mary Hill, July, 1963.*

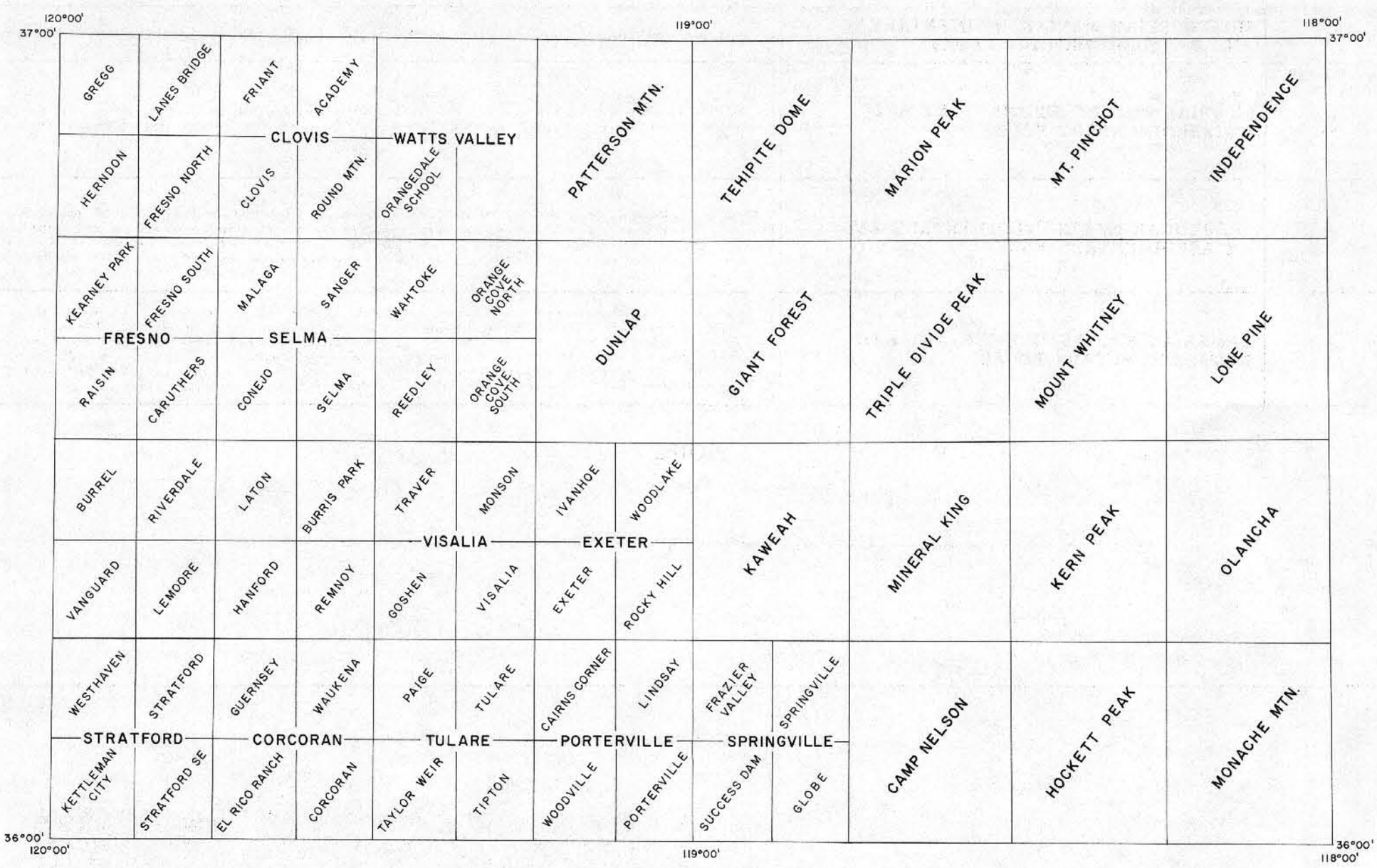
TOPOGRAPHIC QUADRANGLES

WITHIN THE FRESNO SHEET

AVAILABLE FROM THE U.S. GEOLOGICAL SURVEY

FEDERAL CENTER, DENVER, COLORADO 80225

1966



Aerial view from above Kaweah Basin southeastward over glacial cirques. These steep walled recesses are carved in granitic rocks on a 13,000 foot ridge in Sequoia National Park. The prominent amphitheater-like cirque in the foreground contains a tongue-like glacial moraine and is overridden by a small rock glacier. The rock glacier originates from the accumulation of granitic talus composed of angular blocks, some of which are more than 10 feet across. The broad relatively flat terrain in the near background is Boreal Plateau, an unglaciated remnant of an ancient erosional surface. *Photo by John L. Burnett, 1964.*