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Yosemite National Park

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Yosemite National Park

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Geologic Resources Inventory Map Document for Yosemite National Park

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Geologic Resources Inventory Map Document

Yosemite National Park, California

Document to Accompany Digital Geologic-GIS Data

yose_geology.pdf

Version: 4/19/2021

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Yosemite National Park, California (YOSE).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.

2) **GRI Digital Maps and Source Citations** – A listing of all GRI digital geologic-GIS maps produced for this project along with sources used in their completion. In addition, a brief explanation of how each source map was used is provided.

3) **Map Unit List** – A listing of all geologic map units present on maps for this project, generally listed from youngest to oldest.

4) **Map Unit Descriptions** – Descriptions for all geologic map units. If a unit is present on multiple source maps the unit is listed with its source geologic unit symbol, unit name and unit age followed by the unit's description for each source map.

5) **Geologic Cross Sections** – Geologic cross section graphics with source geologic cross section abbreviations.

6) **Ancillary Source Map Information** – Additional source map information presented by source map. For each source map this may include a stratigraphic column, index map, map legend and/or map notes.

7) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

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About the NPS Geologic Resources Inventory Program

Background

The Geologic Resources Inventory (GRI) provides geologic map data and pertinent geologic information to support resource management and science-informed decision making in more than 270 natural resource parks throughout the National Park System. Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The GRI is one of 12 inventories funded by the National Park Service (NPS) Inventory and Monitoring Program. The Geologic Resources Division of the NPS Natural Resource Stewardship and Science Directorate administers the GRI. The NPS Geologic Resources Division partners with the Colorado State University Department of Geosciences to produce GRI products. Many additional partners participate in the GRI process by contributing source maps or reviewing products.

The GRI team undertakes three tasks for each park in the Inventory and Monitoring program: (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a geographic information system (GIS) format, and (3) provide a GRI report. These products are designed and written for nongeoscientists.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: https://www.nps.gov/articles/gri-geodatabase-model.htm

Geologic Reports: GRI reports synthesize discussions from the original scoping meeting, follow up conference call(s), and subsequent research. Chapters of each report discuss the geologic setting of the park, distinctive geologic features and processes within the park, highlight geologic issues facing resource managers, and describe the geologic history leading to the present-day landscape. Each report also includes a poster illustrating these GRI digital geologic-GIS data.

For a complete listing of GRI products visit the GRI publications webpage: https://go.nps.gov/gripubs. GRI digital geologic-GIS data is also available online at the NPS Data Store: https://irma.nps.gov/DataStore/Search/Quick. To find GRI data for a specific park or parks select the appropriate park(s), enter “GRI” as a Search Text term, and then select the Search button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: https://www.nps.gov/subjects/geology/gri.htm. At the bottom of that webpage is a "Contact Us" link if you need additional information. You may also directly contact the program coordinator:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division. Learn more about I&M and the 12 baseline inventories at the I&M webpage: https://www.nps.gov/im/inventories.htm.

GRI Digital Maps and Source Map Citations

The GRI digital geologic-GIS maps for Yosemite National Park, California (YOSE) include a compiled park and vicinity map, as well as component maps that collectively comprise the compiled map.

Digital Geologic-GIS Map of Yosemite National Park and Vicinity, California (*GRI MapCode YOSE*)

The above map was compiled from the individual component GRI digital geologic-GIS maps listed below. The source map for each component map is also presented with each component map.

Digital Geologic-GIS Map of the Bass Lake Quadrangle, California (*GRI MapCode BALA*)

Bateman, P.C., 1989, Geologic Map of the Bass Lake Quadrangle, West-Central Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1656, scale 1:62,500 (Bass Lake 15' Quadrangle). (*GRI Source Map ID 1371*).

Digital Geologic-GIS Map of the Dardanelles Cone Quadrangle, California (*GRI MapCode DACO*)

Huber, N.K., 1983, Preliminary Geologic Map of the Dardanelles Cone Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Miscellaneous Field Studies MF-1436, scale 1:62,500 (Dardanelles Cone 15' Quadrangle). (*GRI Source Map ID 1366*).

Digital Geologic-GIS Map of the Devils Postpile Quadrangle, California (*GRI MapCode DVPO*)

Huber, N.K., and Rinehart, C.D., 1965, Geologic Map of the Devils Postpile Quadrangle, Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-437, scale 1:62,500 (Devils Postpile 15' Quadrangle). (*GRI Source Map ID 1370*).

Digital Geologic-GIS Map of the El Portal Quadrangle, California (*GRI MapCode ELPT*)

Bateman, P.C., and Krauskopf, K.B., 1987, Geologic Map of the El Portal Quadrangle, West-Central Sierra Nevada, California: U.S. Geological Survey, Miscellaneous Field Studies MF-1998, scale 1:62,500 (El Portal 15' Quadrangle). (*GRI Source Map ID 1372*).

Digital Geologic-GIS Map of the Hetch Hetchy Reservoir Quadrangle, California (*GRI MapCode HEHR*)

Kistler, R.W., 1973, Geologic Map of the Hetch Hetchy Reservoir Quadrangle, Yosemite National Park, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1112, scale 1:62,500 (Hetch Hetchy Reservoir 15' Quadrangle). (*GRI Source Map ID 1357*).

Digital Geologic-GIS Map of the Kaiser Peak Quadrangle, California (*GRI MapCode KAPE*)

Bateman, P.C., Lockwood, J.P., and Lydon, P.A., 1971, Geologic Map of the Kaiser Peak Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-894, scale 1:62,500 (Kaiser Peak 15' Quadrangle). (*GRI Source Map ID 1373*).

Digital Geologic-GIS Map of the Lake Eleanor Quadrangle, California (*GRI MapCode LAEL*)

Dodge, F.C.W., and Calk, L.C, 1987, Geologic Map of the Lake Eleanor Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1639, scale 1:62,500 (

Lake Eleanor 15' Quadrangle). (*GRI Source Map ID 1363*).

Digital Geologic-GIS Map of the Mariposa Quadrangle, California (*GRI MapCode MARP*)

Krauskopf, K.B., 1985, Geologic Map of the Mariposa Quadrangle, Mariposa and Madera Counties, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1586, scale 1:62,500 (Mariposa 15' Quadrangle). (*GRI Source Map ID 1359*).

Digital Geologic-GIS Map of the Matterhorn Peak Quadrangle, California (*GRI MapCode MATP*)

Chesterman, Charles W., 1975, Geology of the Matterhorn Peak 15-minute Quadrangle, Mono and Tuolumne Counties, California: California Geological Survey, Map Sheet MS-22, scale 1:48,000 (Matterhorn Peak 15' Quadrangle). (*GRI Source Map ID 4641*).

Digital Geologic-GIS Map of the Mono Craters Quadrangle, California (*GRI MapCode MCRA*)

Kistler, R.W., 1966, Geologic Map of the Mono Craters Quadrangle, Mono and Tuolumne Counties, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-462, scale 1:62,500 (Mono Craters 15' Quadrangle). (*GRI Source Map ID 1358*).

Digital Geologic-GIS Map of the Merced Peak Quadrangle, California (*GRI MapCode MERP*)

Peck, D.L., 1980, Geologic Map of the Merced Peak Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1531, scale 1:62,500 (Merced Peak 15' Quadrangle).
(*GRI Source Map ID 1360*).

Digital Geologic-GIS Map of the Pinecrest Quadrangle, California (*GRI MapCode PINC*)

Huber, N.K., 1983, Preliminary Geologic Map of the Pinecrest Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Miscellaneous Field Studies MF-1437, scale 1:62,500 (Pinecrest 15' Quadrangle). (*GRI Source Map ID 1367*).

Digital Geologic-GIS Map of the Shuteye Peak Quadrangle, California (*GRI MapCode SHUP*)

Huber, N.K., 1968, Geologic Map of the Shuteye Peak Quadrangle, Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-728, scale 1:62,500 (Shuteye Peak 15' Quadrangle).
(*GRI Source Map ID 1369*).

Digital Geologic-GIS Map of the Tower Peak Quadrangle, California (*GRI MapCode TOWP*)

Wahrhaftig, Clyde, 2000, Geologic Map of the Tower Peak Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Investigation Series Map I-2697, scale 1:62,500 (Tower Peak 15' Quadrangle). (*GRI Source Map ID 1355*).

Digital Geologic-GIS Map of the Tuolumne Meadows Quadrangle, California (*GRI MapCode TUME*)

Bateman, P.C., Kistler, R.W., Peck, D.L., and Busacca, Alan, 1983, Geologic Map of the Tuolumne Meadows Quadrangle: Yosemite National Park, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1570, scale 1:62,500 (Tuolumne Meadows 15' Quadrangle). (*GRI Source Map ID 1361*).

Digital Geologic-GIS Map of the Yosemite Quadrangle, California (*GRI MapCode YOSM*)

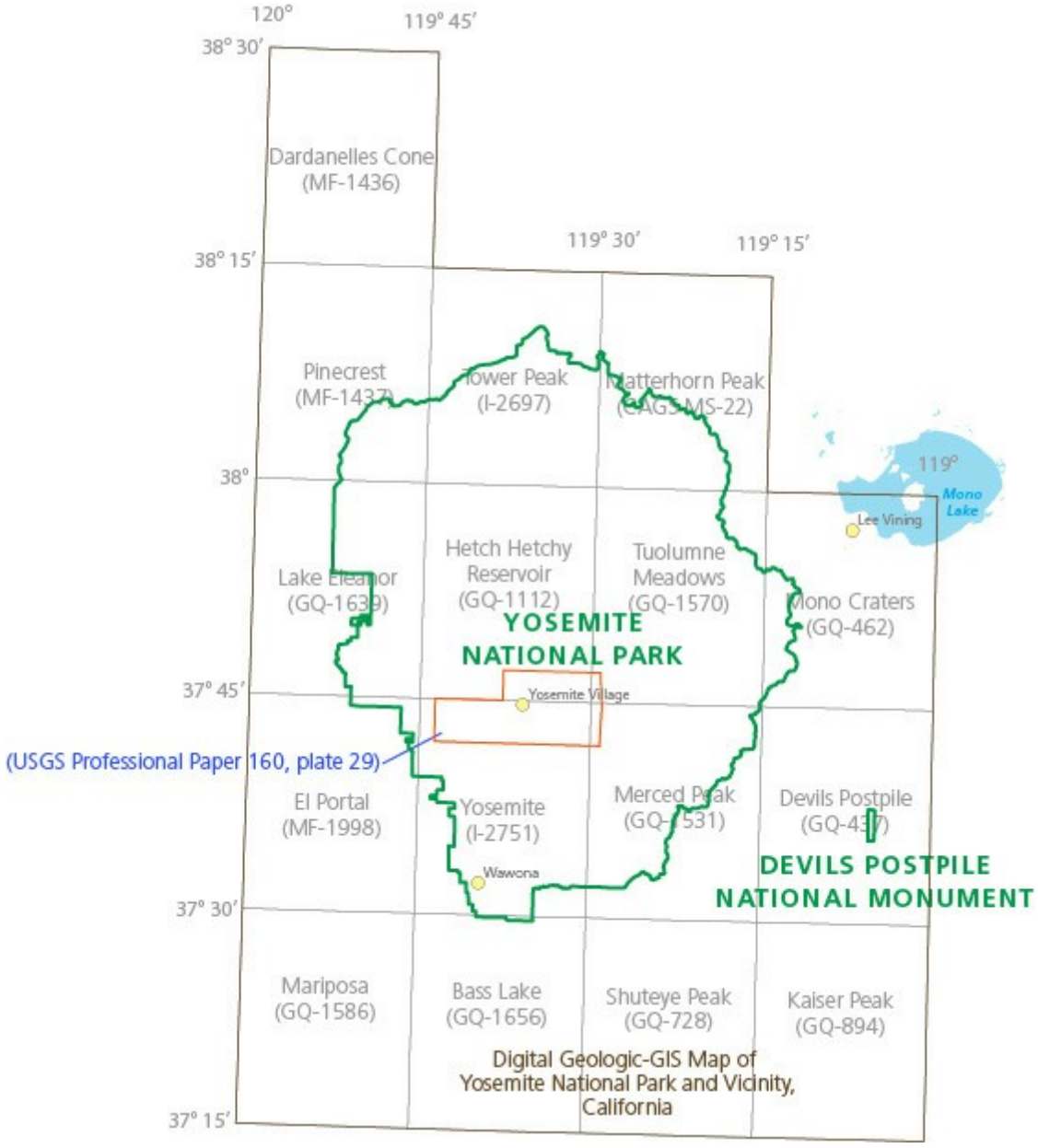
Peck, Dallas L., 2002, Geologic Map of the Yosemite Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Investigation Series Map I-2751, scale 1:62,500 (Yosemite 15' Quadrangle). (*GRI Source Map ID 864*).

The GRI used the full extent of the source maps presented above, and captured all geologic features within their extents.

Additional information pertaining to each source map is also presented in the GRI Source Map Information (YOSEMAP) table included with the GRI geologic-GIS data.

Index Map

The following index map displays the extents of the GRI digital geologic-GIS maps produced for Yosemite National Park (YOSE). The boundary for Yosemite National Park (as of March 2021) is outlined in green. Gray lines represent the extent of the sixteen 15' quadrangle-extent component maps. The source map series number is presented for each component map (e.g., GQ-1656). The extent denoted by the the blue lines is the extent of the Yosemite Valley glacial and post-glacial GRI digital geologic-GIS map. This map is not a component map, but its own map with its own ancillary map information document.



Index Map by Jake Suri (Colorado State University)

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Yosemite National Park, California (YOSE) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qafl - Artificial fill). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (YOSEUNIT) table included with the GRI geologic-GIS data. Some source unit symbols, names and/or ages may have been changed in this document and in the GRI digital geologic-GIS data. This was done if a unit was considered to be the same unit as one or more units on other source maps used for this project, and these unit symbols, names and/or ages differed. In this case a single unit symbol and name, and the unit's now recognized age, was adopted. Unit symbols, names and/or ages in a unit descriptions, or on a correlation of map units or other source map figure were not edited. If a unit symbol, name or age was changed by the GRI the unit's source map symbol, name and/or age appears with the unit's source map description.

Cenozoic Era

Quaternary Period

dam - dam
Qafl - Artificial fill
Qct - Calcareous tufa
Qp - Rhyolitic pumice
Qal - Alluvium
Qtl - Talus
Qls - Landslide deposits
Qng - Neoglacial and perigalcial deposits
Qs - Surficial deposits, undivided
Qts - Talus and slopewash
Qrg - Rock glacier
Qm - Cirque moraine
Qr - Rhyolite and Rhyolite domes
Qrf - Obsidian flows
Qro - Older rhyolite domes
Qbr - Basalt of Red Cones
Qoq - Olivine-bearing quartz latite
Qco - Colluvium
Qmyw - Moraine younger than Wisconsin Stage of Matthews (1930)
Qg - Glacial deposits
Qb - Olivine basalt
Qan - Andesite, youngest
Qti - Till of Tioga Glaciation
Qte - Till of Tenaya Glaciation
Ql - Lake beds
Qbj - Basalt of June Lake Junction
Qta - Till of Tahoe Glaciation
Qtao - Older till of Tahoe Glaciation
Qmb - Till of Mono Basin Glaciation
Qgdw - Glacial deposits of Wisconsin Stage of Matthews (1930)
Qam - Andesite of Mono Craters
Qbt - Bishop Tuff
Qsg - Till of Sherwin Glaciation
Qto - Old till, probably of Sherwin Glaciation
Qap - Andesite of Pumice Butte

Qqm - Quartz latite of Mammoth Mountain
Qad - Andesite of Devils Postpile
Qtr - Rhyolitic tuff of Reds Meadow
Qta - Andesite, younger

Tertiary Period
Tan - Trachyandesite flows
Ta - Andesitic crystal lithic tuff
Tqt - Quartz latite of Two Teats
Tda - Hypabyssal rocks, undifferentiated
Tad - Andesite, older
Ttb - Trachybasalt
Ttc - Trachyandesite and Trachyte Cinder Cones
Tmp - Mafic phonolite
Tmpp - Mafic phonolite, ultrapotassic lava
Tadp - Andesite of Deadman Pass
Tmt - Mehrten Formation, trachyandesite
Tmf - Mehrten Formation, volcanic mud flows
Tdp - Disaster Peak Formation
Trd - Rhyodacite
Tob - Olivine basalt, older
Tanb - Hornblende andesite and basalt
Tha - Hornblende andesite
Tsda - Dardanelles Formation
Tsevt - Eureka Valley Tuff
Tsevtt - Eureka Valley Tuff, Tollhouse Flat Member
Tstml - Eureka Valley Tuff, Table Mountain Latite
Trp - Relief Peak Formation
Trpba - Relief Peak Formation, basalt flows and andesite
Tbb - Basalt of Brown Bear Pass
Ttbp - Trachybasalt plug
Thb - Volcanic rocks of Hunewill Hills, basalt
Thd - Volcanic rocks of Hunewill Hills, dacite
Thah - Volcanic rocks of Hunewill Hills, andesite
Tht - Volcanic rocks of Hunewill Hills, tuff breccia
Twa - Andesite of Walker River
Tt - Pyroclastic rocks of Hanna Mountain
Tvs - Valley Springs Formation
Tcl - Indurated conglomerate

Mesozoic Era

Cretaceous Period
Kgu - Granitic rocks, undifferentiated
Kblg - Granodiorite of Boundary Lake
Ktz - Granodiorite of Topaz Lake
Kfgr - Felsic granitic rocks
Kkl - Granodiorite of Kinney Lakes
Krcl - Quartz monzonite of Rock Creek Lake
Kle - Granodiorite of Lake Edison
Kqm - Fine- to medium-grained quartz monzonite and granodiorite
Kapp - Aplite and pegmatite dikes

Kjp - Johnson Granite Porphyry
Kcp - Cathedral Peak Granodiorite
Kcm - Granodiorite of Cow Meadow
Kmgp - Mount Givens Granodiorite, porphyritic
Kmg - Mount Givens Granodiorite
Kmgq - Mount Givens Granodiorite, quartz mass
Klv - Granodiorite of Lake Vernon
Kfl - Granodiorite of Fremont Lake
Khd - Half Dome Granodiorite
Khdp - Half Dome Granodiorite, porphyritic facies
Khde - Half Dome Granodiorite, equigranular facies
Khqm - Half Dome Quartz Monzonite
Kglp - Granodiorite of Glacier Point
Kgla - Tonalite of Glen Aulin
Kma - Granite of Marie Lakes
Kgrl - Granodiorite of Grayling Lake
Kkc - Granodiorite of Kuna Crest
Kcc - Granite porphyry of Cony Crags
Ks - Sentinel Granodiorite
Kab - Quartz monzonite of Aeolian Buttes
Kel - Quartz monzonite of Ellery Creek
Ksg - Sheared granodiorite of Koip Crest
Kwc - Wheeler Crest Quartz Monzonite
KJawb - Alaskite of Williams Butte
KJml - Quartz monzonite of Mono Lake
Kbl - Quartz monzonite of Billy Lake
Klga - Garnet-bearing aplite
Krc - Granodiorite of Rush Creek
Klvc - Quartz Monzonite of Lee Vining Canyon
Kmd - Granodiorite of Mono Dome
Kti - Granodiorite of Tioga Lake
Kyc - Yosemite Creek Granodiorite
Kcl - Granite of Chilnualna Lakes
Kbv - Bridalveil Granodiorite
Kbvi - Bridalveil Granodiorite, abundant inclusions
Kbu - Granodiorite of Bearup Lake
Kloc - Granodiorite of Long Canyon
Kagm - Alaskite of Grace Meadow
Kgi - Quartz diorite of Mount Gibson
Kgic - Quartz diorite of Mount Gibson, coarse-grained facies
Kgif - Quartz diorite of Mount Gibson, fine-grained facies
Kut - Granite of Upper Twin Lake
Kpm - Granite of Piute Mountain
Kabl - Aplite mass north of Bernice Lake
Ktp - Granodiorite of North Tuolumne Peak
Ktl - Granite of Turner Lake
Ktnl - Leucogranite of Ten Lakes
Krd - Granodiorite of Red Devil Lake
Ksl - Quartz monzonite of Shellenbarger Lake
Kfd - Felsic dikes and masses
Ktk - Leucogranite of Timber Knob
Kn - Leucogranite of Norris Creek
Kmp - Complex of Mahan Peak

Khrr - Granodiorite of Horse Ridge
Kbz - Granodiorite of Breeze Lake
Kol - Granodiorite of Ostrander Lake
Koli - Granodiorite of Ostrander Lake, abundant inclusions
Kdm - Mafic dikes and masses
Kjla - Granodiorite of Jackass Lakes, Anne Lake phase
Kjl - Granodiorite of Jackass Lake
Kjls - Granodiorite of Jackass Lakes, Sadler Peak phase
Kic - Granodiorite of Illilouette Creek
Kici - Granodiorite of Illilouette Creek, abundant inclusions
Klt - Leaning Tower Granite
Kid - Intrusive quartz diorite
Ktr - Granodiorite of Turner Ridge
Ktg - Taft Granite
Kbc - Granite of Big Creek
Krp - Leucogranite porphyry of Red Peak
Kpp - Leucogranite porphyry of Post Peak
Khc - Granodiorite porphyry of Horsethief Canyon
Kwr - Granodiorite of Whiskey Creek
Kdc - Granodiorite of Camino Creek
Kgc - Granodiorite of Grizzly Creek
Khr - Granodiorite of Hodgdon Ranch
Kncc - Tonalite of North Crane Creek
Knccb - Tonalite of North Crane Creek, contact breccia zone
Ktc - Tonalite of Tamarack Creek
Kav - Quartz Diorite of Aspen Valley
Kavf - Quartz Diorite of Aspen Valley, fine-grained hornblende-biotite quartz diorite facies
Ktmc - Quartz diorite of Tamarack Creek
Katnl - Alaskite of Ten Lakes
Krm - Granite of Rancheria Mountain
Kbam - Granite of Bald Mountain
Kswl - Granite of Swamp Lake
Kcr - Microgabbro of the Clark Range
Kec - El Capitan Granite
Ktf - Granodiorite of Tueeulala Falls
Kcf - Granodiorite of Crane Flat
Ksm - Granodiorite of Sawmill Mountain
Ktpv - Tonalite of Poopenaut Valley
Kpvp - Tonalite of Poopenaut Valley, porphyric hornblende-biotite granodiorite facies
Khg - Granodiorite of Hazel Green Ranch
Khgm - Granodiorite of Hazel Green Ranch, mafic marginal facies
Keca - El Capitan Granite, granodiorite facies
Kecb - El Capitan Granite, quartz monzonite facies
Kecc - El Capitan Granite, quartz-rich granodiorite facies
Kecd - El Capitan Granite, quartz-rich quartz monzonite facies
Kbm - Granodiorite of Beasore Meadows
Ksp - Granite of Shuteye Peak
Kqmsp - Quartz monzonite of Shuteye Peak
Ksc - Granite of Stovepipe Campground
Kal - Alaskite
Koh - Tonalite of Oakhurst
Knc - Granodiorite of Niagara Creek
Kla - Granodiorite of Lake Alpine

Kg - Granodiorite
Kep - Ebbetts Pass Granodiorite of Wilshire (1957)
Ksma - Stanislaus Meadow Adamellite of Parker (1961)
Klp - Lookout Peak Tonalite of Parker (1961)
Kbf - Granodiorite of Bummers Flat
Kgpv - Granodiorite of Poopenaut Valley
Kt - Tonalite
Kap - Aplite
Kar - Granodiorite of Arch Rock
Kccm - Granodiorite of Chowchilla Mountain
Khm - Granite of Hogan Mountain
Kgp - Granite of Gray Peak
Kst - Granite porphyry of Star Lakes
Kirc - Granodiorite of Iron Creek
Kwmt - Ward Mountain Trondhjemite
Ktgm - Granites of Thornberry and Goat Mountains
Kblt - Bass Lake Tonalite
Kblti - Bass Lake Tonalite, abundant inclusions
Kww - Granodiorite of Wawona
Ksw - Tonalite of South Wawona
Kela - Leucotonalite north of Eastman Lake
Kwm - Leucotonalite of Ward Mountain
Ktbm - Tonalite of Blue Canyon, main facies
Kbmt - Tonalite of Blue Canyon, microtonalite facies
Kbtm - Tonalite of Blue Canyon, mafic tonalite facies
Kbmm - Tonalite of Blue Canyon, mafic microtonalite facies
Kdr - Granodiorite of Double Rock
Kmh - Granodiorite of Mount Hoffman
Kil - Granite of Ireland Lake
Kgl - Leuocgranite of Gallison Lake
Kdp - Dacite porphyry
Kft - Felsic tuff
Kph - Pelitic hornfels
Kmft - Interstratified mafic and felsic tuffs
KJqdg - Quartz diorite, diorite and gabbro
Km - Meta-andesite and metarhyodacite
Kmrp - Metarhyodacite porphyry
Kmv - Metavolcanic rocks
Kbop - Granite of Bond Pass
Kavl - Granite of Avonelle Lake
Kdl - Granite of Dorothy Lake
Klh - Granite of Lake Harriet
Kmc - Leucogranite of Mount Clark
Klg - Leucogranite
Kqd - Quartz diorite and tonalite
Klc - Quartz Diorite of Long Creek
Kmva - Undifferentiated metavolcanic rocks
Kmq - Quartzofeldspathic gneiss
Kmr - Metarhyolite, younger
Kslpg - Granodiorite of Soldier Lake Pluton
Kbp - Rocks of Buckeye Creek Pluton, porphyritic quartz monzonite
Kbn - Rocks of Buckeye Creek Pluton, nonporphyritic quartz monzonite
Kbd - Rocks of Buckeye Creek Pluton, quartz diorite

Cretaceous and Jurassic Periods
KJf - Granodiorite of King and Fish Creeks
KJd - Diorite, younger
KJgb - Gabbro, older
KJr - Metarhyolite tuff
KJmb - Mafic metatuff and metatuff breccia
KJma - Mafic intrusive rocks
KJgm - Granitic gneisses of the Mokelumne Peak Roof Pendant
KJsc - Quartz monzonite of Sheepthief Creek
KJg - Alaskite of Graveyard Peak
KJs - Sheared and lineated quartz monzonite
KJm - Granodiorite of Margaret Lakes
KJqm - Biotite quartz monzonite and granodiorite
KJdcp - Granodiorite of Dinkey Creek, porphyritic
KJdc - Granodiorite of Dinkey Creek, equigranular and generally foliated
KJdmp - Quartz diorite and other mafic plutonic rocks
KJfg - Fine-grained quartz monzonite
KJdg - Dark granodiorite and other mafic plutonic rocks

Pre- Cretaceous Period
pKt - Tactite, older
pKsq - Schist and metaquartzite
pKmvb - Basaltic metavolcanic rocks
pKmvr - Rhyolitic metavolcanic rocks
pKms - Metasedimentary rocks, undivided
pKmsq - Metasedimentary rocks, quartzite
pKmsm - Metasedimentary rocks, marble
pKmsh - Metasedimentary rocks, hornfels
pKmsmf - Metasedimentary rocks east of Melones Fault
pKml - Metalimestone and mica schist
pKmv - Metavolcanic rocks east of Melones Fault
pKmu - Metamorphosed ultramafic rocks east of Melones Fault
pKcs - Calc-silicate hornfels, quartzite and schist
pKq - Massive quartzite
pKs - Quartz-biotite-plagioclase schist
pKh - Hornfels, granofels and amphibolite

Jurassic Period
Jmg - Metagabbro
Jum - Serpentinized ultramafic rocks
Jmv - Mafic metavolcanic rocks
Jwr - Granite of Woods Ridge
Jgc - Tonalite of Granite Creek
Jgcm - Tonalite of Granite Creek, mafic marginal facies
Jmaf - Mariposa Formation
Jbu - Greenstone of Bullion Mountain
Jmsmf - Metasedimentary rocks west of Melones Fault
Jmvmf - Metavolcanic rocks west of Melones Fault
Jmu - Metamorphosed ultramafic rocks west of Melones Fault
Jlb - Tuffaceous lake beds
Jmgd - Microgranodiorite
Jrt - Rhyolite ash-flow tuff

Jmvil - Metavolcanic rocks south of Ireland Lake
Jmsil - Metasedimentary rocks west of Ireland Lake
Jmsv - Undifferentiated metasedimentary and metavolcanic rocks North of Hooper Peak
Jcc - Granite of Cottonwood Creek
Jm - Undifferentiated metasedimentary rocks
Jmt - Tactite, younger
Jmq - Quartz-pebble conglomerate
Jmm - Marble, youngest
Jqtr - Quartz Diorite of South Fork of Tuolumne River
Jdio - Diorite, older
Jp - Quartz porphyry
Jsp - Serpentinite
Jgn - Granite gneiss
Jas - Rocks of Virginia Lakes sequence, amphibolite and biotite-hornblende schist
Jrs - Rocks of Virginia Lakes sequence, quartz sericite and phyllonite
Jrtp - Rocks of Virginia Lakes sequence, quartz sericite and phyllonite, highly sheared
Jvmb - Rocks of Virginia Lakes sequence, metabasalt
Jhm - Rocks of Virginia Lakes sequence, marble
Jqhm - Rocks of Virginia Lakes sequence, quartzofeldspathic hornfels, calc-silicate hornfels, metaconglomerate and marble
Jhcgl - Rocks of Virginia Lakes sequence, metaconglomerate
Jqhg - Rocks of Virginia Lakes sequence, quartzofeldspathic hornfels and metasiltstone
Jdi - Diabase of Reversed Creek
Kdwl - Diorite or Waugh Lake
Kdbc - Diorite of Bloody Canyon
Kgb - Gabbro, younger
Jx - Graywackes, volcanic tuffs and flows, crossbedded sandstone
Js - Marble and calc-silicate hornfels
Jt - Volcanic tuffs and flows, lapilli-tuff, shale and calc-silicate hornfels
Jc - Jurassic local basal conglomerate
Jtmb - Volcanic rocks near Twin Island Lakes, metabasalt
Jma - Volcanic rocks near Twin Island Lakes, metaandesite and metabasalt
Jms - Volcanic rocks near Twin Island Lakes, metasedimentary rocks
Jmbr - Volcanic rocks of the Ritter Range, undifferentiated metavolcanic rocks
Jmts - Volcanic rocks of the Ritter Range, tuffaceous metasandstone and metasiltstone
Jmdf - Volcanic rocks of the Ritter Range, metadacite flow
Jmab - Volcanic rocks of the Ritter Range, metaandesite and metabasalt
Jmeg - Volcanic rocks of the Ritter Range, epidote garnet metarock

Jurassic and Triassic Periods
JTRu - Volcanic rocks of Shadow Creek and Mammoth Crest, undifferentiated metavolcanic rocks
JTRa - Volcanic rocks of Shadow Creek and Mammoth Crest, metaandesite and metabasalt
JTRx - Volcanic rocks of Shadow Creek and Mammoth Crest, crystal metatuff
JTRc - Volcanic rocks of Shadow Creek and Mammoth Crest, calcareous metasedimentary rocks
JTRss - Volcanic rocks of Shadow Creek and Mammoth Crest, metasandstone, metasiltstone and slate
JTRd - Volcanic rocks of Shadow Creek and Mammoth Crest, metadacite and metaandesite
JTRpz - Volcanic rocks of Shadow Creek and Mammoth Crest, piedmontite-bearing zone
JTRqa - Volcanic rocks of Shadow Creek and Mammoth Crest, quartz-andalusite-corundum rock
JTrvsc - Volcanic rocks of Silver Creek
JTRv - Volcanic rocks
JTRt - Metatuff and metatuff breccia
JTRr - Metarhyolite, older

Triassic Period
pJs - Metasedimentary rocks
TRsp - Slate and phyllite
TRpb - Phyllite of Briceburg
TRpbls - Phyllite of Briceburg, limestone olistoliths
TRh - Phyllite and chert of Hites Cove
TRht - Phyllite and chert of Hites Cove, talc schist and minor serpentinite
TRmi - Mafic hypabyssal intrusive rocks
TRso - Monzonite of Saddlebag and Odell Lakes
TRft - Mafic flows and tuff
TRrt - Rhyolite ash-flow tuff
TRsc - Tuffaceous sandstone, siltstone and conglomerate
TRrh - Rhyolite tuff

Paleozoic Era and Triassic Period
TRPZqz - Quartzite
TRPZphq - Schist and hornfels
TRPZm - Marble, younger
TRPZch - Calc-hornfels

Paleozoic Era

Permian Period
PZpr - Quartzite of Pilot Ridge
PZpgz - Quartzite and Schist of Pilot Ridge, quartzite
PZps - Quartzite and Schist of Pilot Ridge, schist and marble
PZpt - Quartzite and Schist of Pilot Ridge, tactite and hornfels
PZqs - Quartzite and phyllite
PZms - Metasedimentary strata, undifferentiated
PZmsq - Metamorphosed sedimentary and volcanic rocks, quartz-mica schist and quartzite
PZmr - Metamorphosed sedimentary and volcanic rocks, marble
PZmdr - Metamorphosed sedimentary and volcanic rocks, metamorphosed dacites and rhyodacites
Ph - Quartzofeldspathic hornfels, calc-silicate hornfels, and volcanic flows
Pa - Andesite flows and breccias, local graywacke and sandstone lenses
Pt - Felsic volcanic tuffs, volcanic flows and local graywackes
Pc - Permian local basal conglomerate

Pennsylvanian and Permian Periods
PPNh - Calc-silicate and quartzofeldspathic hornfels and marble
PPNpsh - Fine-grained pelitic and siliceous hornfels
PPNmtp - Marble, oldest
PPNqtp - Quartzite and quartzofeldspathic hornfels
PPNq - Calc-silicate hornfels, quartzite, and quartzofeldspathic hornfels
PPNc - Permian and Pennsylvanian marble and calc-silicate hornfels

Silurian and Ordovician Periods
SOm - Silurian and Ordovician marble and calc-silicate hornfels
SOq - Biotite-bearing quartzite
SOa - Older sedimentary rocks, hornfels and marbles
Sox - Older sedimentary rocks, calcareous quartzite
Soc - Marble, calc-silicate hornfels, and quartzite

SOh - Quartzofeldspathic hornfels
SOs - Marble and calc-silicate hornfels, older
SOhm - Dense hornfels and silicated marble
Soma - Silicated marble

Age Unknown
cmp - Carbonaceous metapelite
md - Mafic dike
fd - Felsic dikes
mba - Metabasalt

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

dam - Dam (Recent)

No additional description provided on source map: Lake Eleanor 15' Quadrangle

Qafl - Artificial fill (Recent)

af - Artificial fill (Recent)
No additional description provided on source map: Kaiser Peak 15' Quadrangle

Qct - Calcareous tufa (Holocene)

Qct - Calcareous tufa (Holocene)
Hot Spring deposits near Mono Hot Springs. Description from source map: Kaiser Peak 15' Quadrangle

Qp - Rhyolitic pumice (Holocene)

Qp - Rhyolitic pumice (Recent)
Subangular, light-gray, rhyolitic pumice fragments and volcanic ash. Mapped only where it constitutes a blanket up to several tens of feet in thickness in the rather broad, flat area in the northeastern part of the quadrangle. Elsewhere it is locally a major constituent of units mapped as Qal or Qts. Although much of the pumice is of Recent age (related to Qr domes), much is probably older (e.g., related to Qqm). Description from source map: Devils Postpile 15' Quadrangle

Qal - Alluvium (Holocene)

Qal - Alluvium (Holocene)
Gravel, sand, and silt in stream and lake deposits. Description from source map: Yosemite 15' Quadrangle

Qal - Alluvium (Holocene)
Chiefly sand and gravel underlying meadows. Description from source map: Tower Peak 15' Quadrangle

Qal - Alluvial deposits (Holocene)
Valley fill underlying meadows. Locally includes minor talus. Description from source map: Bass Lake 15' Quadrangle

Qal - Alluvium (Holocene)
Chiefly fluvial and lacustrine deposits underlying meadows. Description from source map: Lake Eleanor 15' Quadrangle

Qal - Alluvial deposits (Quaternary)
Gravels along the Merced River near El Portal. Includes alluvial fan deposits and colluvium. Description from source map: El Portal 15' Quadrangle

Qal - Alluvium (Holocene)
Chiefly sand and gravel underlying meadows. Description from source map: Tuolumne Meadows 15' Quadrangle

Qal - Alluvium (Holocene)
Primarily stream deposits underlying upland meadows. Description from source map: Dardanelles Cone 15' Quadrangle

Qal - Alluvium (Holocene)
Primarily stream deposits underlying meadows. Description from source map: Pinecrest 15' Quadrangle

Qal - Alluvium (Holocene)
Chiefly lake and stream deposits underlying meadows. Description from source map: Merced Peak 15' Quadrangle

Qal - Alluvium (Holocene)
Poorly to moderately sorted deposits of sand, gravel, and rare thin layers of interbedded silt. Description from source map: Matterhorn Peak 15' Quadrangle

Qal - Alluvium (Quaternary)
No additional description provided on source map. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Qal - Alluvial deposits (Holocene)
Chiefly alluvium underlying meadows. Description from source map: Kaiser Peak 15' Quadrangle

Qal - Alluvial deposits (Recent)
No additional description provided on source map. Description from source map: Shuteye Peak 15' Quadrangle

Qal - alluvium and pumice (Recent)
No additional description provided on source map. Description from source map: Mono Craters 15' Quadrangle

Qal - valley fill (Recent)
Includes both gravel and finer materials, deposited largely as valley fill. Locally contains appreciable pumice of nonalluvial origin, especially in the northeast quadrant of the map. Description from source map: Devils Postpile 15' Quadrangle

Qtl - Talus (Holocene)

Qtl - Talus (Holocene)
Rock waste shed from cliffs. Description from source map: Yosemite 15' Quadrangle

Qtl - Talus (Holocene)
Rock waste derived from cliffs. Only especially extensive areas shown. Description from source map: Tower Peak 15' Quadrangle

Qtl - Talus and Slopewash (Holocene)
Miscellaneous debris mantling gentle to steep slopes. Locally contains appreciable pumice, especially in the northeast quadrant of the map. Locally also includes minor glacial materials. Locally includes minor talus. Description from source map: Bass Lake 15' Quadrangle

Qtl - Talus (Holocene)
No additional description provided on source map: Lake Eleanor 15' Quadrangle

Qtl - Talus (Holocene)
Rock glaciers shown diagrammatically by curved lines. Description from source map: Tuolumne Meadows 15' Quadrangle

Qtl - Surficial Deposits, Undivided (Holocene)
Talus, slopewash and reworked till. Shown only south of Lightning Mountain and west of Iceberg Peak in northeast corner of quadrangle. Includes mine tailings at Juniper Mine west of Red Rock Meadow. Description from source map: Dardanelles Cone 15' Quadrangle

Qtl - Talus (Holocene)
Includes young glacial deposits and protalus ramparts; crest of morainal ridges shown by dashed lines. Description from source map: Merced Peak 15' Quadrangle

Qtl - Talus and Slopewash (Quaternary)
Undifferentiated talus, glacial deposits, reworked glacial deposits, and some alluvium. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Qtl - Talus (Holocene)
No additional description provided on source map: Kaiser Peak 15' Quadrangle

Qtl - Talus (Recent)
Rock debris, mapped only in small area in north west corner of quadrangle where it obscures bedrock geologic relations. Description from source map: Shuteye Peak 15' Quadrangle

Qtl - Talus and Slopewash (Recent)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qtl - talus (Recent)
Rock debris, largely angular, mapped chiefly at the foot of steep cliffs at higher elevations in the quadrangle. Description from source map: Devils Postpile 15' Quadrangle

Qls - Landslide deposits (Holocene)

Qls - Landslide deposits (Holocene)
Unsorted debris deposits resulting from mass movement. Description from source map: Tower Peak 15' Quadrangle

Qls - Landslide deposit (Quaternary)
No additional description provided on source map. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Qsl - landslide or inactive rock glacier (Recent)
Landslide or inactive rock glacier. Description from source map: Mono Craters 15' Quadrangle

Qng - Neoglacial and perigalcial deposits (Holocene)

Qng - Neoglacial and perigalcial deposits (Holocene)
Includes cirque moraines and rock glaciers. Description from source map: Tower Peak 15' Quadrangle

Qng - Cirque Moraine (Holocene)
Rock glaciers, active talus, and protalus ramparts; consisting essentially of fresh, highly angular rock fragments ranging from sand-sized particles to cobbles and boulders ten feet or more across, Probably of post-Wisconsin age. Description from source map: Matterhorn Peak 15' Quadrangle

Qng - Cirque Moraine (Holocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qng - Cirque Moraine (Holocene)
Small moraines in cirques, probably of post Wisconsin age. Description from source map: Devils Postpile 15' Quadrangle

Qs - Surficial deposits, undivided (Holocene)

Qs - Surficial deposits, undivided (Holocene)
Talus, slopewash and reworked till. Shown only south of Lightning Mountain and west of Iceberg Peak in northeast corner of quadrangle. Includes mine tailings at Juniper Mine west of Red Rock Meadow. Description from source map: Dardanelles Cone 15' Quadrangle

Qts - Talus and slopewash (Quaternary)

Qts - Talus and slopewash (Quaternary)
Undifferentiated talus, glacial deposits, reworked glacial deposits, and some alluvium. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Qts - talus and slopewash (Recent)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qts - talus and slopewash (Quaternary)
Rock debris, largely angular, mapped chiefly at the foot of steep cliffs at higher elevations in the quadrangle. Description from source map: Devils Postpile 15' Quadrangle

Qrg - Rock glacier (Holocene)

Qrg - rock glacier (Recent)
No additional description provided on source map. Description from source map: Mono Craters 15' Quadrangle

Qm - Cirque moraine (Holocene)

Qm - Cirque moraine (Holocene)
Rock glaciers, active talus, and protalus ramparts; consisting essentially of fresh, highly angular rock

fragments ranging from sand-sized particles to cobbles and boulders ten feet or more across, Probably of post-Wisconsin age. Description from source map: Matterhorn Peak 15' Quadrangle

Qm - cirque moraine (Recent)
No additional description provided on source map. Description from source map: Mono Craters 15' Quadrangle

Qm - Cirque moraine (Recent)
Small moraines in cirques, probably of post Wisconsin age. Description from source map: Devils Postpile 15' Quadrangle

Qr - Rhyolite and Rhyolite domes (Holocene)

Qr - Rhyolite of Mono Craters, rhyolite domes (Recent)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qr - Rhyolite (Recent)
Obsidian and other dominantly glassy rocks with varied percentage of quartz; plagioclase, sanidine, and biotite phenocrysts. Occurs as a series of domes alined north-south considered to be a southern extension of the Mono Craters rhyolitic domes. Description from source map: Devils Postpile 15' Quadrangle

Qrf - Obsidian flows (Holocene)

Qrf - Rhyolite of Mono Craters, obsidian flows (Recent)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qro - Older rhyolite domes (Pleistocene)

Qro - Rhyolite of Mono Craters, older rhyolite domes (Pleistocene(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

Qbr - Basalt of Red Cones (Holocene)

Qbr - Basalt of Red Cones (Recent)
Occurs as cinders in the Red Cones and as a flow extending from the base of the southernmost cone. Typically scoriaceous with prominent phenocrysts of plagioclase and olivine. Description from source map: Devils Postpile 15' Quadrangle

Qoq - Olivine-bearing quartz latite (Holocene or Pleistocene)

Qoq - Olivine-bearing quartz latite (Pleistocene or Recent)
Flow of dark-gray rock with aphanitic to glassy matrix and abundant plagioclase and sanidine phenocrysts. Description from source map: Devils Postpile 15' Quadrangle

Qco - Colluvium (Quaternary)

no Unit Symbol - Colluvium (Quaternary?)
Chiefly slopewash. Shown only in western part of quadrangle to indicate lack of outcrop on ridges chiefly underlain by lahars. In these areas the colluvium commonly contains abundant volcanic-rock clast representing a lag deposit derived by weathering of the lahar matrix. The presence of such clast, together with an absence of clasts of granitic rock, permits mapping the approximate areal distribution of lahars where outcrops are lacking. Shown as a stippled overprint. Description from source map: Pinecrest 15' Quadrangle

Qmyw - Moraine younger than Wisconsin Stage of Matthews (1930) (Quaternary)

Qm - Moraine younger than Wisconsin Stage of Matthews (1930) (Quaternary)
No additional description provided on source map: Hetch Hetchy Reservoir 15' Quadrangle

Qg - Glacial deposits (Pleistocene)

Qg - Glacial deposits (Pleistocene)
Glacial till and outwash deposits. Crest of morainal ridges shown by dotted lines. Description from source map: Yosemite 15' Quadrangle

Qg - Glacial deposits (late Pleistocene)
Chiefly morainal deposits from Tioga-age glaciation, but includes some probably Tahoe age in southwestern corner of quadrangle. Description from source map: Tower Peak 15' Quadrangle

Qg - Glacial deposits (Pleistocene)
Ground and lateral moraine peripheral to White Chief Mountain. Crest of morainal ridges are shown by dot pattern. Description from source map: Bass Lake 15' Quadrangle

Qg - Glacial deposits (Pleistocene)
Glacial moraine, fill and outwash, and slopewash deposits derived from moraine. Moraine crest shown by dotted lines. Description from source map: Lake Eleanor 15' Quadrangle

Qg - Glacial deposits (Pleistocene)
Crest of morainal ridges shown by dot pattern. Description from source map: Tuolumne Meadows 15' Quadrangle

Qg - Glacial deposits (Pleistocene)
Predominantly moraines of late Pleistocene age. Description from source map: Dardanelles Cone 15' Quadrangle

Qg - Glacial deposits with morainal form (Holocene)
Predominantly lateral moraines of late Pleistocene age. Description from source map: Pinecrest 15' Quadrangle

Qg - Glacial deposits (Pleistocene)
Crest of morainal ridges shown by dashed lines. Description from source map: Merced Peak 15' Quadrangle

Qg - Glacial deposits (Pleistocene)
Crest of morainal ridges shown by dot pattern. Description from source map: Kaiser Peak 15' Quadrangle

Qg - Glacial deposits (Pleistocene)
Glacial till, mapped only where extensive or where it exhibits morainal form. Not differentiated as to age but deposits mapped are probably mostly of Wisconsin age. Description from source map: Shuteye Peak 15' Quadrangle

Qg - Glacial deposits (Pleistocene)
Chiefly formless till but includes some moraine; largely of Wisconsin age. Description from source map: Devils Postpile 15' Quadrangle

Qb - Olivine basalt (Pleistocene(?))

Qb - Olivine basalt (Pleistocene)
Flow near Pigeon Flat has K-Ar age of 150,000 years. Description from source map: Dardanelles Cone 15' Quadrangle

Qb - Basalt (Pleistocene(?))
Small volcanic neck of olivine basalt and associated scoria east of Cooper Pocket; columnar-jointed flow and associated intrusive breccia southwest of Cooper Pocket. Description from source map: Pinecrest 15' Quadrangle

Qan - Andesite, youngest (Pleistocene)

Qa - Andesite (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qa - Andesite (Pleistocene)
Medium-gray aphanitic rock, locally containing plagioclase and pyroxene phenocrysts; exposed only in extreme northeast corner of quadrangle. Description from source map: Devils Postpile 15' Quadrangle

Qti - Till of Tioga Glaciation (Pleistocene)

Qti - Till of Tioga Glaciation (Pleistocene)
Forms sharp, hard breached moraines with free-standing crest. All materials, including granitic, volcanic, and metamorphic rocks, are relatively fresh. Description from source map: Matterhorn Peak 15' Quadrangle

Qti - Till of Tioga Glaciation (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qte - Till of Tenaya Glaciation (Pleistocene)

Qte - Till of Tenaya Glaciation (Pleistocene)
Forms sharp-crested, slightly eroded moraines containing fresh boulders of metamorphic and volcanic

rocks and moderately weathered granitic boulders. Description from source map: Matterhorn Peak 15' Quadrangle

Ql - Lake beds (Pleistocene)

Ql - Lake beds (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qbj - Basalt of June Lake Junction (Pleistocene)

Qb - Basalt of June Lake Junction (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qta - Till of Tahoe Glaciation (Pleistocene)

Qta - Andesite (Pliocene or Pleistocene)
Medium-gray aphanitic rock, locally containing plagioclase and pyroxene phenocrysts; exposed only in extreme northeast corner of quadrangle. Description from source map: Devils Postpile 15' Quadrangle

Qtao - Older till of Tahoe Glaciation (Pleistocene)

Qtao - Older till of Tahoe Glaciation (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qmb - Till of Mono Basin Glaciation (Pleistocene)

Qmb - Till of Mono Basin Glaciation (Pleistocene)
Forms indistinct moraines with continuous crests; deeply weathered granitic boulders are common. Boulders of fine-grained metamorphic and volcanic rocks are fresh. Description from source map: Matterhorn Peak 15' Quadrangle

Qgdw - Glacial deposits of Wisconsin Stage of Matthews (1930) (Pleistocene)

Qw - Glacial deposits of Wisconsin Stage of Matthews (1930) (Quaternary)
Moraine crest shown by dotted pattern. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Qam - Andesite of Mono Craters (Pleistocene)

Qam - Andesite of Mono Craters (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qbt - Bishop Tuff (Pleistocene)

Qbt - Bishop Tuff (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qsg - Till of Sherwin Glaciation (Pleistocene)

Qsh - Till of Sherwin Glaciation (Pleistocene)
Forms smooth, soil-covered moraines and other glacial deposits, which lack conspicuous depositional form. Granitic boulders in soil are deeply weathered and exfoliated, whereas boulders of fine-grained volcanic and metamorphic rocks are less weathered. Description from source map: Matterhorn Peak 15' Quadrangle

Qe - Glacial deposits of El Portal Glaciation (Quaternary)
Moraine crest shown by dotted pattern. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Qsh - till of Sherwin Glaciation (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qto - Old till, probably of Sherwin Glaciation (Pleistocene)

Qto - old till, probably of Sherwin Glaciation (Pleistocene)
No additional description provided on source map: Mono Craters 15' Quadrangle

Qap - Andesite of Pumice Butte (Pleistocene)

Qap - Andesite of Pumice Butte (Pleistocene)
Cinder cones and associated flows. Rock typically scoriaceous; nonporphyritic. Contacts only approximate; partly distinguished from older andesite in area by aerial photo interpretation. Unit includes dacite that forms two knobs in northwest part of outcrop area, which may be older than the andesite. Description from source map: Devils Postpile 15' Quadrangle

Qqm - Quartz latite of Mammoth Mountain (Pleistocene)

Qqm - Quartz latite of Mammoth Mountain (Pleistocene)
Rock dominantly glassy with varied percentage of plagioclase and biotite phenocrysts. Light-gray; nearly black in glassier phases. Commonly flow-banded. Previously designated as Pliocene(?). Description from source map: Devils Postpile 15' Quadrangle

Qad - Andesite of Devils Postpile (Pleistocene)

Qad - Andesite of Devils Postpile (Pleistocene)
Rock is light to dark gray, commonly porphyritic with phenocrysts of plagioclase and olivine; rarely vesicular. Platy and columnar jointing well developed locally. Description from source map: Devils Postpile 15' Quadrangle

Qtr - Rhyolitic tuff of Reds Meadow (Pleistocene)

Qtr - Rhyolitic tuff of Reds Meadow (Pleistocene)
Crystal-vitric tuff with phenocrysts of quartz and sanidine in nearly equal amounts. Welded in part, with two distinct zones of dense welding, indicating a compound flow unit. Eutaxitic structure prominent in welded portions. Base consists of unconsolidated pumice, ash, and exotic fragments. Description from source map: Devils Postpile 15' Quadrangle

Qta - Andesite, younger (Pleistocene or Pliocene)

Qta - Andesite (Pliocene or Pleistocene)
Medium-gray aphanitic rock, locally containing plagioclase and pyroxene phenocrysts; exposed only in extreme northeast corner of quadrangle. Description from source map: Devils Postpile 15' Quadrangle

Tan - Trachyandesite flows (Tertiary)

Ta - Trachyandesite flows (Tertiary)
Potassic lava flows that contain as much as 8 percent. Description from source map: Bass Lake 15' Quadrangle

Ta - Andesitic crystal lithic tuff (Tertiary)

Ta - andesitic crystal lithic tuff (Tertiary)
No additional description provided on source map: Mono Craters 15' Quadrangle

Tqt - Quartz latite of Two Teats (Tertiary)

Tqt - quartz latite of Two Teats (Tertiary)
No additional description provided on source map: Mono Craters 15' Quadrangle

Tqt - Quartz latite of Two Teats (Pliocene)
Light-gray to dark- or purplish-gray, glassy to microcrystalline rock with abundant plagioclase and lesser biotite and amphibole phenocrysts. Flow structures common; locally fragmental. Description from source map: Devils Postpile 15' Quadrangle

Tda - Hypabyssal rocks, undifferentiated (Tertiary)

Tda - hypabyssal rocks, undifferentiated (Tertiary)
No additional description provided on source map: Mono Craters 15' Quadrangle

Tad - Andesite, older (Pliocene(?))

Tad - Andesite (Pliocene(?))
Small plug and dikes in Highland lakes-Airola Peak area. Dikes shown by short, solid lines. Description from source map: Dardanelles Cone 15' Quadrangle

Ttb - Trachybasalt (Pliocene)

Tt - Trachybasalt (Pliocene)
Massive olivine-bearing flows of basaltic aspect along the forks of Granite Creek and less abundant platy flows of trachyandesite and trachyte. Description from source map: Merced Peak 15' Quadrangle

Tt - Trachybasalt (Pliocene)
Includes olivine trachyandesite and olivine latite. Probably represents basalt magma contaminated by assimilated granitic rock. Chiefly flows, but a neck outcrops east of Pin cushion Peak, and dikes occur northeast of Saddle mountain. K-Ar age 3.5 +/- 0.2 m.y. Description from source map: Kaiser Peak 15' Quadrangle

Tt - Trachybasalt (Pliocene)
Generally light-gray but locally dark-gray, fine-grained rock with abundant olivine phenocrysts. The basalt is distinctly alkalic, as is the trachybasalt described from Black Point just south of the quadrangle (Hamilton and Neuerburg, 1956), and is a member of the alkalic-calcic suite of late Cenozoic volcanic rocks in the central Sierra Nevada (Huber and Rinehart, 1966, 1967). K-feldspar (sanidine?) is abundant in the matrix of some samples (for example, No. SP-173-C in table of chemical analyses). Although the trachybasalt was more extensive prior to erosion, its present distribution is in part related to eruption from scattered local vents now visible as volcanic necks, the most conspicuous of which are the knob south of Squaw Dome and Brown Cone in the adjacent Kaiser Peak quadrangle. Trachybasalt of probably similar age has been dated by the potassium-argon method at 3.3 and 3.5 million years in the Devils Postpile quadrangle and 3.8 million years in the Kaiser Peak quadrangle (Dalrymple, 1964). In the Devils Postpile quadrangle the trachybasalt was included within the map unit designated as andesite of Deadman Pass (Tadp) (Huber and Rinehart, 1965; 1966; 1967). Description from source map: Shuteye Peak 15' Quadrangle

Ttc - Trachyandesite and Trachyte Cinder Cones (Pliocene)

Ttc - Trachyandesite and Trachyte Cinder Cones (Pliocene)
Near Post Peak and Chetwood Creek. Description from source map: Merced Peak 15' Quadrangle

Tmp - Mafic phonolite (Pliocene)

Tp - Mafic phonolite (Pliocene)
Massive to platy flows near Merced Pass and along Grizzly Creek and the West Fork of Granite Creek. Ultrapotassic lava containing phenocryst of phlogopite and olivine in a groundmass rich in sanidine and leucite. Description from source map: Merced Peak 15' Quadrangle

Tmpp - Mafic phonolite, ultrapotassic lava (Pliocene)

Tpp - Mafic phonolite, ultrapotassic lava (Pliocene)
Ultrapotassic lava in a volcanic neck near the junction of Madera Creek and the West Fork of Granite Creek and a small volcanic pipe near Cold Springs Meadow. Description from source map: Merced Peak 15' Quadrangle

Tadp - Andesite of Deadman Pass (Pliocene)

Tad - Andesite of Deadman Pass (Pliocene)
Series of interbedded andesitic flows, cinders, and rubble. Flow rock commonly vesicular; essentially non porphyritic. Map unit includes scattered remnants of andesitic rock not necessarily from the same source, but of approximately the same age. Description from source map: Devils Postpile 15' Quadrangle

Tmt - Mehrten Formation, trachyandesite (Pliocene and Miocene)

Tmt - Mehrten Formation, trachyandesite (Pliocene and Miocene)
Dense, strongly jointed, black. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Tmf - Mehrten Formation, volcanic mud flows (Pliocene and Miocene)

Tmf - Mehrten Formation, volcanic mud flows (Pliocene and Miocene)
Brown with rounded cobbles and pebbles of principally andesitic volcanic rocks in a matrix of sand-size particles of volcanic origin. Large boulders of granitic rock also occur in this mud flow - Dense, strongly jointed, black. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Tdp - Disaster Peak Formation (Pliocene(?) and Miocene)

Tdp - Disaster Peak Formation (Pliocene? and Miocene)
Andesitic mudflow deposits. Medium to light gray with rounded to angular pebbles of chiefly andesitic and basaltic volcanic rocks set in a matrix of volcanic sand-sized particles. Contains clasts of plagioclase- and biotite-bearing welded Eureka Valley Tuff. Description from source map: Lake Eleanor 15' Quadrangle

Tdp - Disaster Peak Formation (Miocene)
Andesitic lahars with local interbedded stream deposits. Lahars characterized by abundant clast of hornblende andesite. Description from source map: Dardanelles Cone 15' Quadrangle

Tdp - Disaster Peak Formation (Pliocene(?) and Miocene)
Andesitic lahars with local interbedded stream deposits. The lahars are characterized by abundant clasts of andesite with conspicuous hornblende laths singly and in clots; clasts of the Table Mountain Latite (Tsgtm) and the Eureka Valley Tuff (Tsgev) are uncommon, but diagnostic indicators of this formation relative to the similar Relief Peak Formation. The Disaster Peak Formation, as named and defined by Slemmons (1966), is here adopted. Description from source map: Pinecrest 15' Quadrangle

Trd - Rhyodacite (Miocene)

Trd - Rhyodacite (Miocene)
Intrusive plugs of rhyodacite near Highland lakes, Lookout Peak, and Henry Peak. K-Ar age is about 6.3 m.y. Description from source map: Dardanelles Cone 15' Quadrangle

Tob - Olivine basalt, older (Miocene)

Tob - Olivine basalt (Miocene)
Scattered plugs, dikes, and flows. Description from source map: Dardanelles Cone 15' Quadrangle

Tb - Olivine basalt (Miocene)
Dark-gray to brownish-black, hard, dense, fresh olivine basalt with microphenocrysts of olivine and sodic bytownite (An 70-74) set in a microcrystalline, intersertal ground mass of plagioclase laths, augite grains, and magnetite. Occurs as flows and dikes. Description from source map: Matterhorn Peak 15' Quadrangle

Tanb - Hornblende andesite and basalt (Miocene)

Ta - Hornblende andesite and basalt (Miocene)
Dark gray andesite, with conspicuous hornblende needles, and basalt; occurs as dikes, sills, and irregular masses intrusive into and probably related to the Relief Peak Formation. Description from source map: Tower Peak 15' Quadrangle

Tha - Hornblende andesite (Miocene)

Ta - Hornblende andesite (Miocene)
Scattered plugs and dikes; flow on Bald Peak. Dike east of The Three Chimneys has K-Ar age of about 6 m.y. (R. W. Kistler, written commun., 1980). Includes intrusive dacite in Bald Peak area and biotite-hornblende andesite at Hiram Peak. Description from source map: Dardanelles Cone 15' Quadrangle

Tsda - Dardanelles Formation (Miocene)

Tsd - Dardanelles Formation (Miocene)
Dark-gray to black latite flows with sparse tabular plagioclase phenocryst. K-Ar age is about 9.3 m.y. (Dalrymple, 1964). Description from source map: Dardanelles Cone 15' Quadrangle

Tsevt - Eureka Valley Tuff (Miocene)

Tse - Eureka Valley Tuff (Miocene)
Biotite-bearing welded latite tuff. K-Ar age is about 9.3 m.y.(Nobel and others, 1974). Description from source map: Dardanelles Cone 15' Quadrangle

Tsevtt - Eureka Valley Tuff, Tollhouse Flat Member (Miocene)

Tset - Eureka Valley Tuff, Tollhouse Flat Member (Miocene)
Biotite-bearing, latite tuff. Two cooling units are exposed in Pinecrest quadrangle; lower unit densely to moderately welded, upper unit poorly welded to nonwelded. Upper unit is present (or exposed) only locally; major exposures are present only on the south side of Dodge Ridge and south and east of Coyote Meadows. Potassium-argon age is about 9.5 m.y. (Noble and others, 1974). Description from source map: Pinecrest 15' Quadrangle

Tstml - Eureka Valley Tuff, Table Mountain Latite (Miocene)

Tst - Table Mountain Latite (Miocene)
Dark-gray to black porphyritic latite flows characterized by platy plagioclase phenocrysts as much as 1 cm or more in long dimension. Near Bald Peak includes stream deposits containing clast of Table Mountain Latite. Description from source map: Dardanelles Cone 15' Quadrangle

Tst - Eureka Valley Tuff, Table Mountain Latite (Miocene)
Dark-gray to black porphyritic latite with platy plagioclase phenocrysts, up to 1 cm or more, in an aphanitic matrix. Phenocrysts usually have strong tabular orientation. Potassium-argon age is about 9.2 m.y. (Dalrymple, 1964). Exposed only on ridge crest northeast of Cooper Pocket. Description from source map: Pinecrest 15' Quadrangle

Trp - Relief Peak Formation (Miocene)

Trp - Relief Peak Formation (Miocene)
Mainly lahars with porphyritic hornblende andesite clasts and some lava flows. Includes interbedded stream deposits. In quadrangles to the west and northwest, unit underlies Table Mountain Latite, whose K-Ar age is about 9.5 Ma (Dalrymple, 1964). Description from source map: Tower Peak 15' Quadrangle

Trp - Relief Peak Formation (Miocene)
Andesitic mudflow deposits. Brown to medium gray with clast of chiefly andesitic and basaltic volcanic rocks and granitic rocks set in a matrix of volcanic sand-sized particles. Description from source map: Lake Eleanor 15' Quadrangle

Trp - Relief Peak Formation (Miocene)
Andesitic lahars with local interbedded stream deposits. Porphyritic hornblende-andesite clasts common in uppermost lahar flow units, but otherwise less common than in the Disaster Peak Formation. In the northeast part of the quadrangle the lahars are extensively altered (propylitized; see Wilshire, 1957). Trpba; basalt flows at Dardanelles and andesite near Bull Run Rock, southwest corner of quadrangle. Description from source map: Dardanelles Cone 15' Quadrangle

Trp - Relief Peak Formation (Miocene)
Andesitic lahars with local interbedded stream deposits. Porphyritic hornblende-andesite clasts common in uppermost lahar flow units west and southwest of East Flange Rock, but otherwise less common than in the Disaster Peak Formation. Deposits in southeast part of quadrangle are questionably assigned to the Relief Peak Formation rather than the Disaster Peak because of exposures of the Relief Peak in Hetch Hetchy Reservoir quadrangle to southeast and in Lake Eleanor quadrangle to south. The Relief Peak Formation, as named and defined by Slemmons (1966), is here adopted. Description from source map: Pinecrest 15' Quadrangle

Trpba - Relief Peak Formation, basalt flows and andesite (Miocene)

Trpb - Relief Peak Formation, basalt flows and andesite (Miocene)
Basalt flows at Dardanelles and andesite near Bull Run Rock, southwest corner of quadrangle. Description from source map: Dardanelles Cone 15' Quadrangle

Tbb - Basalt of Brown Bear Pass (Miocene)

Tbb - Basalt of Brown Bear Pass (Miocene)
Light- to dark-gray, massive basalt with vertical columnar jointing. Highly vesicular facies and purplish autobrecciated facies also present. Overlies Valley Springs Formation (Tvs), but relationship to Relief Peak Formation (Trp) is unclear. Unit has K-Ar ages of 19 to 20 Ma (Robinson and Kistler, 1986). Description from source map: Tower Peak 15' Quadrangle

Ttbp - Trachybasalt plug (Miocene)

Ttb - Trachybasalt plug (Miocene)
Fission-track age on sphene and apatite: 9.4 m.y. Description from source map: Tuolumne Meadows 15' Quadrangle

Thb - Volcanic rocks of Hunewill Hills, basalt (Miocene)

Thb - Volcanic rocks of Hunewill Hills, basalt (Miocene)
Brownish-black to dark-brownish, slightly vesicular, porphyritic basalt with phenocrysts of olivine enclosed -in a fine-grained dense groundmass of labradorite, pyroxene, and olivine. Occurs as flows. Description from source map: Matterhorn Peak 15' Quadrangle

Thd - Volcanic rocks of Hunewill Hills, dacite (Miocene)

Thd - Volcanic rocks of Hunewill Hills, dacite (Miocene)
Dull pinkish-gray, weakly mottled, porphyritic dacite with phenocrysts of andesine, quartz, dark green pyroxene, and black biotite set in a fine grained groundmass. Occurs as flows. Description from source map: Matterhorn Peak 15' Quadrangle

Thah - Volcanic rocks of Hunewill Hills, andesite (Miocene)

Tha - Volcanic rocks of Hunewill Hills, andesite (Miocene)
Light- to dark-gray, locally brownish, dense, porphyritic andesite with phenocrysts of black hornblende and glassy white andesine set in a fine-grained groundmass of the same minerals and some devitrified glass. Includes also interflow layers of tuff breccia (Tht) of andesitic composition. Description from source map: Matterhorn Peak 15' Quadrangle

Tht - Volcanic rocks of Hunewill Hills, tuff breccia (Miocene)

Tht - Volcanic rocks of Hunewill Hills, tuff breccia (Miocene)
Included also interflow layers in (Thah) of tuff breccia of andesitic composition. Description from source map: Matterhorn Peak 15' Quadrangle

Twa - Andesite of Walker River (Miocene)

Twa - Andesite of Walker River (Miocene)
Light- to medium-gray and pinkish-gray, platy, and well-banded porphyritic andesite ranging from hornblende-rich to biotite-rich with phenocrysts of hornblende and biotite set in a fine-grained groundmass of andesine, hornblende, and biotite. Correlated with Walker River andesite of Halsey (1953, p. 62). Description from source map: Matterhorn Peak 15' Quadrangle

Tt - Pyroclastic rocks of Hanna Mountain (Miocene)

Tt - Pyroclastic rocks of Hanna Mountain (Miocene)
Massive, light- to dark-gray and locally buff-colored, usually well-indurated, poorly layered tuff and tuff breccia, which contain much andesitic and some basaltic debris set in a fine-grained matrix of volcanic ash and mineral and lithic fragments. May be correlated with the Relief Peak Formation of Slemmons (1966, p. 203). Description from source map: Matterhorn Peak 15' Quadrangle

Tvs - Valley Springs Formation (Miocene and Oligocene)

Tvs - Valley Springs Formation (Miocene to Oligocene)
Rhyolite tuff, partly to densely welded, and bedded ash deposits. Locally includes rhyolitic sedimentary deposits. Unit has K-Ar ages of 24 to 27 Ma in Dardanelles Cone quadrangle to northwest (Robinson and Kistler, 1986). Description from source map: Tower Peak 15' Quadrangle

Tvs - Valley Springs Formation (Miocene and Oligocene)
Rhyolite tuff, partly to densely welded. Locally intrudes rhyolitic sedimentary rocks. K-Ar ages determined for samples from Eagle Creek are 23.3 m.y (sanidine) and 26.1 m.y (biotite) (Dalrymple, 1964). Description from source map: Dardanelles Cone 15' Quadrangle

Tcl - Indurated conglomerate (Eocene(?))

Tcl - Indurated conglomerate (Eocene(?))
No additional description provided on source map: Tuolumne Meadows 15' Quadrangle

Tcl - indurated conglomerate (Tertiary)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kgu - Granitic rocks, undifferentiated (Cretaceous)

Kgu - Granitic rocks, undifferentiated (Cretaceous)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kblg - Granodiorite of Boundary Lake (Cretaceous)

Kbl - Granodiorite of Boundary Lake (Cretaceous)
Light-colored, medium-grained biotite granodiorite and granite characterized by discrete anhedral quartz grains. Locally porphyritic with varying proportions of plagioclase and small tabular K feldspar phenocrysts. Description from source map: Tower Peak 15' Quadrangle

Kbl - Granodiorite of Boundary Lake (Late Cretaceous)
Light-colored medium-grained biotite granodiorite and granite characterized by discrete anhedral quartz grains. Locally porphyritic with varying proportions of K-feldspar and plagioclase phenocrysts. Average color index about 6. Description from source map: Pinecrest 15' Quadrangle

Ktz - Granodiorite of Topaz Lake (Cretaceous)

Ktl - Granodiorite of Topaz Lake (Cretaceous)
Light-gray, coarse-grained biotite granodiorite and granite with roughly equant, well-formed microcline phenocrysts as much as 10 cm long making up 2 to 10 percent of the rock. Quartz typically occurs in 1/2-cm clots. Mafic mineral content about 10 percent. Asymmetric schlieren locally abundant. Description from source map: Tower Peak 15' Quadrangle

Ktl - Granodiorite of Topaz Lake (Cretaceous)
Porphyritic biotite granodiorite with K-feldspar phenocrysts commonly averaging about 2 cm in length. Average color index about 10. Rock is very similar to granodiorite of Topaz Lake. Preliminary Rb-Sr data indicate an age of about 101 m.y. (A.C. Robinson, oral commun., 1982). Description from source maps: Dardanelles Cone 15' Quadrangle, Pinecrest 15' Quadrangle

Kfgr - Felsic granitic rocks (Cretaceous)

Kgr - Felsic granitic rocks (Cretaceous)
Biotite leucogranite and aplite. Includes Trondhjemite in east- and south-central parts of quadrangle. Description from source map: Lake Eleanor 15' Quadrangle

Kkl - Granodiorite of Kinney Lakes (Cretaceous)

Kkl - Granodiorite of Kinney Lakes (Cretaceous)
Medium- to coarse-grained biotite-hornblende granodiorite. Color index ranges from 10 to 25, the average decreasing from southwest to northeast. Flattened mafic inclusions are abundant in the southern and western parts, but sparse east of Bull Run Peak and north of Hiram Meadow. The granodiorite of Kinney Lakes, named for exposures in the Markleeville quadrangle adjacent to the north (Armin and others, 1981), is probably equivalent to the granodiorite of Fremont Lake in the Pinecrest quadrangle adjacent to the south (Huber, 1982). Preliminary Rb-Sr data indicate an age of about 87 m.y. (A.C. Robinson, oral commun., 1982). Description from source map: Dardanelles Cone 15' Quadrangle

Kkl - Granodiorite of Kinney Lakes (Late Cretaceous)
Equigranular hornblende-biotite granodiorite. Where hornblende-rich, contains abundant lenticular mafic inclusions. Preliminary Rb-Sr data indicates that the granodiorite of Kinney Lakes is younger than the granodiorite of Poopenaut Valley, Kpv (A.C. Robinson, oral commun., 1982), but the contact between the two units bas not been mapped and is shown arbitrarily. Description from source map: Pinecrest 15' Quadrangle

Krcl - Quartz monzonite of Rock Creek Lake (Cretaceous)

Krc - Quartz monzonite of Rock Creek Lake (Cretaceous)
Intrudes granodiorite of Lake Edison. Description from source map: Kaiser Peak 15' Quadrangle

Kle - Granodiorite of Lake Edison (Cretaceous)

Kle - Granodiorite of Lake Edison (Cretaceous)
Equigranular, medium-grained, foliated in margins but structureless in core. Typically contains abundant sphene. Intrudes Mount Givens Granodiorite, granodiorite of Margaret Lakes, and alaskite of Graveyard Peak. Age relative to granodiorite of Cow Meadow and to fine- to medium-grained quartz monzonite and granodiorite is unknown. Description from source map: Kaiser Peak 15' Quadrangle

Kqm - Fine- to medium-grained quartz monzonite and granodiorite (Cretaceous)

Kqm - Fine- to medium-grained quartz monzonite and granodiorite (Cretaceous)
Small masses intrusive into the Mount Givens Granodiorite. Generally fine grained but medium grained southwest of Lake Edison. Description from source map: Kaiser Peak 15' Quadrangle

Kapp - Aplite and pegmatite dikes (Late Cretaceous)

Kap - Aplite and pegmatite dikes and small masses (Late Cretaceous)
Mostly late differentiates of the Tuolumne Intrusive Suite. Description from source map: Tuolumne Meadows 15' Quadrangle

Ka - Aplite (Upper Cretaceous)
Quartz monzonite, fine grained, white: occurs as dikes and sills in the Half Dome Quartz Monzonite. Minor widely dispersed euhedral crystals of biotite and hornblende characterize the rock. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kap - Aplite dikes (Cretaceous)
Probably offshoots from the Mount Givens Granodiorite. Age relative to granodiorite of Cow Meadow and fine- to medium-grained quartz monzonite and granodiorite is unknown. Description from source map: Kaiser Peak 15' Quadrangle

Kjp - Johnson Granite Porphyry (Late Cretaceous)

Kjp - Johnson Granite Porphyry (Late Cretaceous)
Fine-grained equigranular granite that locally contains K-feldspar phenocrysts and miarolitic cavities. Consists of a large mass that forms the core of the Tuolumne Intrusive Suite and thin dikes marginal to the central mass. Description from source map: Tuolumne Meadows 15' Quadrangle

Kcp - Cathedral Peak Granodiorite (Cretaceous)

Kcp - Cathedral Peak Granodiorite (Cretaceous)
Medium- to coarse-grained, hornblende-biotite granodiorite that contains conspicuous blocky phenocrysts of microcline as much as 10 cm long. The phenocrysts commonly occur in aligned swarms and asymmetric schlieren are locally abundant. Description from source map: Tower Peak 15' Quadrangle

Kcp - Cathedral Peak Granodiorite (Late Cretaceous)
Medium-grained hornblende-biotite granodiorite that contains conspicuous blocky megacrysts of K-feldspar 2 to 5 cm across. Megacrysts are largest and most abundant in the margins of the body and are progressively less abundant and smaller inward. Foliation is generally weak. U-Pb zircon age: 88 ± 2 my. Description from source map: Tuolumne Meadows 15' Quadrangle

Kcp - Cathedral Peak Granodiorite (Upper Cretaceous)
Medium-grained coarsely porphyritic hornblende-biotite granodiorite that contains phenocrysts of potassium feldspar as long as 10 cm. The south end of a large pluton centered on Tuolumne Meadows, is exposed along the north edge of the quadrangle northeast of Merced Lake. Description from source map: Merced Peak 15' Quadrangle

Kc - Rocks similar to Cathedral Peak Granite (Cretaceous)
Rocks are essentially quartz monzonite. Massive, well-jointed, light-gray porphyritic and nonporphyritic phases with phenocrysts of microcline perthite up to several inches in maximum dimension set in a coarse-grained ground mass of quartz, biotite, zoned calcic oligoclase, and microcline. K-Ar determinations on biotite from this unit yield ages of about 81 million years (Evernden and Kistler, 1970, p. 10J). Description from source map: Matterhorn Peak 15' Quadrangle

Kcp - Rocks similar to Cathedral Peak Granite (Cretaceous)
Rocks range in composition from granodiorite to alaskite with average composition of mafic quartz monzonite (average of 56 modes: 26 percent quartz; 27 percent K-feldspar; 41 percent plagioclase; 6 percent mafics, chiefly biotite). Rock generally coarse grained and commonly porphyritic with blocky phenocrysts of K-feldspar up to 5 cm in length. Alaskite phase (Kcpa) limited to Fish Creek-Silver Divide area and is indicated by pattern on map. Kcp intrudes Kmg. K-Ar determinations on biotite from this unit yield ages of about 85 million years. (Broderson, R.A., 1962,). Description from source map: Devils Postpile 15' Quadrangle

Kcm - Granodiorite of Cow Meadow (Cretaceous)

Kcm - Granodiorite of Cow Meadow (Cretaceous)
Fine- to medium-grained rock in dike like mass intrusive into the Mount Givens Granodiorite. Age relative to granodiorite of Lake Edison is unknown. Description from source map: Kaiser Peak 15' Quadrangle

Kmgp - Mount Givens Granodiorite, porphyritic (Cretaceous)

Kmgp - Mount Givens Granodiorite, porphyritic (Cretaceous)
Equigranular and foliated; includes porphyritic phase (Kmgp). Purple dots indicate extraordinary abundance of subangular mafic inclusions (Kmgi). Intrudes granodiorite of Dinkey Creek. Radiometric (K-Ar) age 82-87 m.y. Description from source map: Kaiser Peak 15' Quadrangle

Kmg - Mount Givens Granodiorite (Upper Cretaceous)

Kmg - Mount Givens Granodiorite (Upper Cretaceous)
Biotite-hornblende granodiorite and porphyritic biotite granodiorite along the southern edge of the quadrangle. Forms the northern margin of one of the largest plutons in the Sierra Nevada Batholith. Description from source map: Merced Peak 15' Quadrangle

Kmg - Mount Givens Granodiorite, equigranular and foliated (Cretaceous)
Equigranular and foliated; includes porphyritic phase (Kmgp). Purple dots indicate extraordinary abundance of subangular mafic inclusions (Kmgi). Intrudes granodiorite of Dinkey Creek. Radiometric (K-Ar) age 82-87 m.y. Description from source map: Kaiser Peak 15' Quadrangle

Kmg - Mount Givens Granodiorite (Cretaceous)
Medium- to coarse-grained hornblende-biotite granodiorite and quartz monzonite. The portion of the pluton of Mount Givens Granodiorite that lies within the Shuteye Peak quadrangle has a cyclic, semi-concentric zoning expressed by texture, composition, and specific gravity. The nonporphyritic phase is predominantly granodiorite with an average color index of 14. The porphyritic phase has a composition field straddling the granodiorite-quartz monzonite boundary, has an average color index of about 8, and is characterized by K-feldspar phenocrysts commonly as much as 2 cm long. In both phases the plagioclase is predominantly andesine. The K feldspar shows occasional grid structure, and the plagioclase is commonly but not prominently zoned. The hornblende is characteristically euhedral. Sphene is an abundant accessory mineral. A third, more restricted, phase is a fine- to medium-grained aplitic rock exposed in the vicinity of Jackass Rock which constitutes the core of the concentric zonal structure. This phase has an average color index of 1.5 and the plagioclase is oligoclase. Mount Givens Granodiorite intrudes granodiorite of Beasore Meadow and quartz monzonite of Shuteye Peak. East of the Shuteye Peak quadrangle the age of the Mount Givens Granodiorite has been established at about 87 million years by the potassium-argon method (Kistler, Bateman, and Brannock, 1965). Coarse pattern indicates porphyritic phase (Kmgp); fine pattern aplitic phase (Kmga), q indicates quartz mass (Kmgq). Description from source map: Shuteye Peak 15' Quadrangle

Kmg - Mount Givens Granodiorite (Cretaceous)
Medium-grained rocks range in composition from granodiorite to quartz monzonite with average composition of felsic granodiorite (average of 57 modes: 24 percent quartz; 18 percent K-feldspar; 43 percent plagioclase; 15 percent. mafics, chiefly biotite and hornblende). Overprint in southwest corner of quadrangle indicates area of somewhat more porphyritic and more felsic rocks than average. Unit probably continuous with Mount Givens Granodiorite to south.(Bateman and others, 1963) K-Ar determinations on biotite and hornblende from this unit south of the Devils Postpile quadrangle yield ages of about 85 million years. (Kistler and others, 1965). Pattern indicates porphyritic phase. Description from source map: Devils Postpile 15' Quadrangle

Kmgq - Mount Givens Granodiorite, quartz mass (Cretaceous)

q - Mount Givens Granodiorite, quartz mass (Cretaceous)
Medium- to coarse-grained hornblende-biotite granodiorite and quartz monzonite. The portion of the pluton of Mount Givens Granodiorite that lies within the Shuteye Peak quadrangle has a cyclic, semiconcentric zoning expressed by texture, composition, and specific gravity. The nonporphyritic phase is predominantly granodiorite with an average color index of 14. The porphyritic phase has a composition field straddling the granodiorite-quartz monzonite boundary, has an average color index of about 8, and is characterized by K-feldspar phenocrysts commonly as much as 2 cm long. In both phases the plagioclase is predominantly andesine. The K feldspar shows occasional grid structure, and the plagioclase is commonly but not prominently zoned. The hornblende is characteristically euhedral. Sphene is an abundant accessory mineral. A third, more restricted, phase is a fine- to medium-grained

aplitic rock exposed in the vicinity of Jackass Rock which constitutes the core of the con-centric zonal structure. This phase has an average color index of 1.5 and the plagioclase is oligoclase. Mount Givens Granodiorite intrudes granodiorite of Beasore Meadow and quartz monzonite of Shuteye Peak. East of the Shuteye Peak quadrangle the age of the Mount Givens Granodiorite has been established at about 87 million years by the potassium-argon method (Kistler, Bateman, and Brannock, 1965). Coarse pattern indicates porphyritic phase (Kmgp); fine pattern aplitic phase (Kmga), q indicates quartz mass (Kmgq). Description from source map: Shuteye Peak 15' Quadrangle

Klv - Granodiorite of Lake Vernon (Cretaceous)

Klv - Granodiorite of Lake Vernon (Cretaceous)
Hornblende-biotite granodiorite characterized by bimodal grain-size distribution of mafic minerals, with scattered grains 5 mm to 1 cm in size, and abundant grains 1 mm in size and smaller, giving the rock a "spotted" appearance. Contains numerous flattened mafic inclusions. Equivalent to granodiorite of Tueeulala Falls (Ktf) of Dodge and Calk (1987), part of granodiorite of Boundary Lake (Kblg) of Huber (1983), and part of the quartz diorite of Mount Gibson (Kgi) of Kistler (1973). Description from source map: Tower Peak 15' Quadrangle

Kfl - Granodiorite of Fremont Lake (Cretaceous)

Kfl - Granodiorite of Fremont Lake (Cretaceous)
Medium-dark-gray, medium-grained, hornblende-biotite granodiorite. Where hornblende-rich, contains abundant lenticular or elongate mafic inclusions, commonly uniformly distributed, but locally in clusters. In the southwest part of its occurrence in this quadrangle, it is largely mafic free, lacking in inclusions, and tending toward granitic composition. Map unit is named for exposures near Fremont Lake where it was mapped by Giusso (1981) in the Sonora Pass quadrangle to the north. The unit extends west into the Pinecrest quadrangle where it has been called the granodiorite of Kinney Lakes (Huber, 1983). Description from source map: Tower Peak 15' Quadrangle

Khd - Half Dome Granodiorite (Late Cretaceous)

Khd - Half Dome Granodiorite (Late Cretaceous)
Light-colored, medium-grained, equigranular sodic granodiorite and granite, typically containing 8 to 12 percent euhedral crystals of biotite, hornblende, and titanite (sphene) 5 to 10 mm across. Northeastern corner of the quadrangle. Age about 88 Ma. Description from source map: Yosemite 15' Quadrangle

Khd - Half Dome Granodiorite (Cretaceous)
Medium- to coarse-grained, equigranular hornblende-biotite granodiorite with abundant elongate or flattened mafic inclusions. Characterized by euhedral hornblende prisms as much as 1 cm long, biotite books as much as 1 cm across, and conspicuous sphene. Near Tilden Lake it is mafic-poor and has large microcline phenocrysts. Description from source map: Tower Peak 15' Quadrangle

Khd - Half Dome Granodiorite (Upper Cretaceous)
Medium-grained hornblende-biotite granodiorite and less abundant granite. Typically contains about 10 percent conspicuous euhedral crystals of biotite, hornblende, and sphene 0.5 to 1.0 mm long. Dot pattern indicates porphyritic phase containing abundant phenocrysts of potassium feldspar 2 to 3 cm across. Description from source map: Merced Peak 15' Quadrangle

Khdp - Half Dome Granodiorite, porphyritic facies (Late Cretaceous)

Khdp - Half Dome Granodiorite, porphyritic facies (Late Cretaceous)
Medium-grained porphyritic hornblende-biotite granodiorite with a seriate texture. Biotite and hornblende commonly in euhedral. Abundance of K-feldspar megacrysts increases inward toward contact with Cathedral Peak Granodiorite. Megacrysts are generally smaller than those in the Cathedral Peak Granodiorite, are tabular rather than equant, and commonly are a little more than 1 cm across and 2 to 3 cm long. Description from source map: Tuolumne Meadows 15' Quadrangle

Khde - Half Dome Granodiorite, equigranular facies (Late Cretaceous)

Khd - Half Dome Granodiorite, equigranular facies (Cretaceous)
No additional description provided on source map: Tuolumne Meadows 15' Quadrangle

Khqm - Half Dome Quartz Monzonite (Cretaceous)

Kh - Half Dome Quartz Monzonite (Cretaceous)
Coarse-grained, medium-gray, massive, with local schlieren; porphyritic at contacts with quartz monzonite of Cathedral Peak Granite; Composed of zoned calcic andesine (An-30-40), microcline perthite phenocrysts, quartz, biotite, and hornblende. Description from source map: Matterhorn Peak 15' Quadrangle

Kh - Half Dome Quartz Monzonite (Upper Cretaceous)
Biotite-hornblende quartz monzonite, coarse-grained, light-gray. Color index about 10. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kglp - Granodiorite of Glacier Point (Late Cretaceous)

Kgp - Granodiorite of Glacier Point (Late Cretaceous)
Dark, medium-grained, equigranular well-foliated mafic granodiorite, tonalite, and quartz diorite containing abundant small dark inclusions. Forms a band west of the Half Dome Granodiorite. Typically contains 15 to 25 percent subequal biotite and hornblende, in anhedral grains and clusters 1 to 5 mm across. Some of the grains contain cores of augite. Equivalent to part of the Sentinel Granodiorite by Calkins (Calkins, 1930, 1985) and with the granodiorite of Kuna Crest by Huber and others (1989) and by Bateman (1992b). Bateman (1992a) and Fleck and others (1996) refer to it as the tonalite of Glacier Point. Age of a sample from Washburn Point about 92 Ma (K-Ar, Rb-Sr). Description from source map: Yosemite 15' Quadrangle

Kgla - Tonalite of Glen Aulin (Late Cretaceous)

Kga - Tonalite of Glen Aulin (Late Cretaceous)
Dark-colored rock of variable composition ranging from fine-grained quartz diorite in the west to medium-grained granodiorite at the east contact with Half Dome Granodiorite and Cathedral Peak Granodiorite. U-Pb zircon age: 86 ± 2 m.y. Description from source map: Tuolumne Meadows 15' Quadrangle

Kma - Granite of Marie Lakes (Upper Cretaceous)

Kma - Granite of Marie Lakes (Upper Cretaceous)
Light-gray fine-grained biotite granite in dikes near Marie Lakes and on the south slopes of Mounts Lyell and MacClure. May be correlative with Half Dome Granodiorite. Description from source map: Merced Peak 15' Quadrangle

Kgrl - Granodiorite of Grayling Lake (Early Cretaceous)

Kgr - Granodiorite of Grayling Lake (Upper Cretaceous)
Fine- to medium-grained, well-foliated mafic biotite-hornblende granodiorite along the west side of the Clark Range. Contains 20 to 25 percent small anhedral grains of subequal biotite and hornblende and relatively abundant sphene. Description from source map: Merced Peak 15' Quadrangle

Kkc - Granodiorite of Kuna Crest (Late Cretaceous)

Kk - Granodiorite of Kuna Crest (Late Cretaceous)
Dark-colored medium-grained hornblende-biotite granodiorite. Generally coarser grained than the tonalite of Glen Aulin on the opposite side of the Tuolumne Intrusive Suite, but, nevertheless, considered to be its approximate equivalent. Description from source map: Tuolumne Meadows 15' Quadrangle

Kk - Granodiorite of Kuna Crest (Upper Cretaceous)
Medium-grained. hornblende-biotite quartz monzodiorite near Mount Lyell. At the northeast corner of the quadrangle, the southern margin of a large pluton, where it consists of medium- to light-gray equigranular quartz monzodiorite containing 20 to 25 percent anhedral biotite and hornblende. On the southern slopes of Mounts Lyell and MacClure and on the western slopes of Rodger Peak and Electra Peak, dikes and small intrusive masses of distinctive medium-gray quartz monzodiorite containing abundant dark euhedral phenocrysts of plagioclase and finer grains of biotite. Description from source map: Merced Peak 15' Quadrangle

Kk - Granodiorite of Kuna Crest (Cretaceous)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kk - Granodiorite of Kuna Crest (Cretaceous)
Rock dominantly granodiorite but of variable composition and texture. In Rush Creek area, contains zones of numerous mafic inclusions and stringers of mafic mineral segregation. Unit names for exposures on Kuna Crest, Mono Craters quadrangle. Description from source map: Devils Postpile 15' Quadrangle

Kcc - Granite porphyry of Cony Crags (Lower Cretaceous)

Kcc - Granite porphyry of Cony Crags (Lower Cretaceous)
Biotite granite porphyry in the core of a disrupted compound pluton at the headwaters of the Merced River. Contains sparse phenocrysts of plagioclase, quartz, and potassium feldspar in a fine-grained groundmass. Description from source map: Merced Peak 15' Quadrangle

Ks - Sentinel Granodiorite (Late Cretaceous)

Ks - Sentinel Granodiorite (Late Cretaceous)
Light-colored, medium-grained, equigranular granodiorite and less abundant tonalite, quartz diorite, and granite containing 10 to 20 percent discrete crystals and crystal aggregates of hornblende, biotite, and titanite 2 to 5 mm across. Main mass crosses Yosemite Valley near Sentinel Rock. Age about 94 Ma. Description from source map: Yosemite 15' Quadrangle

Ks - Sentinel Granodiorite (Cretaceous)
Medium-grained tonalite. Characterized by euhedral biotite and hornblende and abundant sphene. Color index about 15. Description from source map: Lake Eleanor 15' Quadrangle

Ks - Sentinel Granodiorite (Upper Cretaceous)
Biotite-hornblende granodiorite, coarse-grained, dark-gray, locally sheared. Color index averages about 15. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kab - Quartz monzonite of Aeolian Buttes (Cretaceous)

Ka - Quartz monzonite of Aeolian Buttes (Cretaceous)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kel - Quartz monzonite of Ellery Creek (Cretaceous)

Ke - Quartz monzonite of Ellery Creek (Cretaceous)
No additional description provided on source map: Mono Craters 15' Quadrangle

Ksg - Sheared granodiorite of Koip Crest (Cretaceous)

Ks - Sheared granodiorite of Koip Crest (Cretaceous)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kwc - Wheeler Crest Quartz Monzonite (Cretaceous)

Kwc - Wheeler Crest Quartz Monzonite (Cretaceous)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kwc - Wheeler Crest Quartz Monzonite (Cretaceous)
Medium-grained, commonly porphyritic with phenocrysts of K-feldspar 1 cm in average length. Biotite and hornblende chief mafic minerals. Unit correlated with Wheeler Crest Quartz Monzonite to southeast: (Bateman, 1961; Bateman and others, 1963; and Rinehart and Ross, 1964) K-Ar determinations on hornblende from this unit in the Mount Tom quadrangle to the southeast yield ages of about 100 million years. (Kistler and others, 1965). Description from source map: Devils Postpile 15' Quadrangle

KJawb - Alaskite of Williams Butte (Cretaceous)

KJa - Alaskite of Williams Butte (Jurassic or Cretaceous)
No additional description provided on source map: Mono Craters 15' Quadrangle

KJml - Quartz monzonite of Mono Lake (Cretaceous)

KJm - Quartz monzonite of Mono Lake (Jurassic or Cretaceous)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kbl - Quartz monzonite of Billy Lake (Cretaceous)

Jb - Quartz monzonite of Billy Lake (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Klga - Garnet-bearing aplite (Cretaceous)

Jla - Garnet-bearing aplite (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Krc - Granodiorite of Rush Creek (Cretaceous)

Jr - Granodiorite of Rush Creek (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Jr - Granodiorite of Rush Creek (Jurassic(?))
Medium-grained, ranging in composition from granodiorite to diorite; generally exhibits a pronounced linear structure and less pronounced foliation. Description from source map: Devils Postpile 15' Quadrangle

Klvc - Quartz Monzonite of Lee Vining Canyon (Cretaceous)

Jl - Quartz monzonite of Lee Vining Canyon (Jurassic)
Locally unit divided into autolith zone. Description from source map: Mono Craters 15' Quadrangle

Jl - Quartz Monzonite of Lee Vining Canyon (Jurassic(?))
Medium-grained with varied texture. Unit contains appreciable dense, fine-grained felsic rock, commonly porphyritic, locally banded, possibly younger. Numerous dikes and sills, not shown, probably related to this unit, cut the metamorphic rocks exposed in the San Joaquin Mountain ridge. Unit correlated with quartz monzonite exposed in Lee Vining Canyon and elsewhere in Mono Craters quadrangle. (Kistler, 1960; Rose, 1957) Rb-Sr whole-rock determinations from this unit in the Mono Craters quadrangle yielded an age of about 190 million years.(Kistler and others, 1965). Description from source map: Devils Postpile 15' Quadrangle

Kmd - Granodiorite of Mono Dome (Late Cretaceous)

Km - Granodiorite of Mono Dome (Late Cretaceous)
Medium-grained equigranular granodiorite and quartz diorite. Contains pyroxene as discrete crystals and as cores in hornblende. Rb-Sr whole-rock age: 93 ± 6 m.y. (Late Cretaceous). Previously considered Jurassic by Kistler (1966). Description from source map: Tuolumne Meadows 15' Quadrangle

Kmg - Granodiorite of Mono Dome (Cretaceous)
Light- to medium-gray, medium to coarse-grained biotite-hornblende granodiorite; grades locally into biotite granite. K-Ar determinations on hornblende in samples collected from this unit in the Mono Craters quadrangle yield ages of about 85 million years (Evernden and Kistler, 1970, p. 10). Description from source map: Matterhorn Peak 15' Quadrangle

Jm - Granodiorite of Mono Dome (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kti - Granodiorite of Tioga Lake (Late Cretaceous)

Kti - Granodiorite of Tioga Lake (Late Cretaceous)
Medium-grained dark-gray rock. Angular plagioclase and ragged, partly chloritized amphibole crystals are set in a matrix of fine-grained K-feldspar, quartz, plagioclase, and biotite. Description from source map: Tuolumne Meadows 15' Quadrangle

Kyc - Yosemite Creek Granodiorite (Late Cretaceous)

Ky - Granodiorite of Yosemite Creek (Late Cretaceous)
Strongly foliated granodiorite containing abundant parallel tabular phenocrysts of plagioclase 5 mm long and about 15 percent biotite, hornblende, and titanite. Crops out in a thin band between the Sentinel Granodiorite and the granodiorite of Glacier Point southeast of Illilouette Ridge. Description from source map: Yosemite 15' Quadrangle

Kyc - Granodiorite of Yosemite Creek (Cretaceous)
Medium-grained hornblende-biotite granodiorite and tonalite. Hornblende commonly euhedral. Color index averages about 20 but ranges from about 10 to over 30. Description from source map: Lake Eleanor 15' Quadrangle

Ky - Yosemite Creek Granodiorite of Rose (1957) (Early Cretaceous)
Predominantly coarse-grained, dark-gray biotite-hornblende tonalite; grades to granodiorite. Locally is porphyritic and contains plagioclase phenocrysts. Description from source map: Tuolumne Meadows 15' Quadrangle

Ky - Yosemite Creek Granodiorite of Rose (1957) (Upper Cretaceous)
Predominantly biotite-hornblende quartz diorite, coarse-grained, dark-gray; grades to granodiorite. Locally, this rock is porphyritic with white phenocrysts of plagioclase. The stippled area to the north of Mount Hoffmann marks a zone of inclusions(Kyca) of alaskite of Ten Lakes and granodiorite of Mount Hoffmann in a myriad of dikes of Yosemite Creek Granodiorite and aplite Average color index about 15 but ranges from 7 to 35. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kcl - Granite of Chilnualna Lakes (Middle Cretaceous)

Kc - Granite of Chilnualna Lakes (Middle Cretaceous)
Light-colored, fine-grained, equigranular granodiorite containing 5 to 10 percent biotite. Forms a small pluton northwest of Buena Vista Peak. Referred to by Bateman (1992a,b) and Huber and others (1989) as the granite of Chilnualna Lakes. Description from source map: Yosemite 15' Quadrangle

Kbv - Bridalveil Granodiorite (Middle Cretaceous)

Kb - Bridalveil Granodiorite (Middle Cretaceous)
Bluish-gray, "salt-and-pepper" granodiorite forming dikes and gently dipping sheets in the southern wall of Yosemite Valley and several larger bodies farther south. Named the Bridalveil Granite by Calkins (1930). Typically sodic granodiorite containing about 5 percent biotite in fine shreds, but near external contacts includes calcic granodiorite containing about 10 percent biotite and less abundant hornblende. Includes a zone of abundant inclusions (Kbvi). Description from source map: Yosemite 15' Quadrangle

Kbvi - Bridalveil Granodiorite, abundant inclusions (Middle Cretaceous)

Kb - Bridalveil Granodiorite, abundant inclusions (Middle Cretaceous)
No additional description provided on source map: Yosemite 15' Quadrangle

Kbu - Granodiorite of Bearup Lake (Cretaceous)

Kbu - Granodiorite of Bearup Lake (Cretaceous)
Even-grained granodiorite characterized by euhedral hornblende and biotite crystals and with a wide range in mafic mineral content. Equivalent to part of quartz diorite of Mount Gibson and part of granodiorite of Double Rock of Kistler (1973). Description from source map: Tower Peak 15' Quadrangle

Kloc - Granodiorite of Long Canyon (Cretaceous)

Klc - Granodiorite of Long Canyon (Cretaceous)
Dark hornblende-biotite granodiorite and quartz-diorite with mafic mineral content of about 30 percent and with abundant mafic inclusions. Description from source map: Tower Peak 15' Quadrangle

Kagm - Alaskite of Grace Meadow (Cretaceous)

Kgm - Alaskite of Grace Meadow (Cretaceous)
Sugary, medium- to fine-grained, light-pink to white alaskite with rare dark minerals. Contains abundant inclusions of diorite, gabbro, quartzite, biotite schist, and marble. Description from source map: Tower Peak 15' Quadrangle

Kgi - Quartz diorite of Mount Gibson (Upper Cretaceous)

Km - Quartz diorite of Mount Gibson (Upper Cretaceous)
Hornblende-biotite quartz diorite, coarse-grained, dark-gray to black, pyroxene-bearing. Color index varies from about 20 to 85. Contact breccia zone shown with stippled pattern. Potassium-argon age of biotite is 88.2± 2.1 and of hornblende is 81.5 ± 2.3 m.y. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kmgc - Quartz diorite of Mount Gibson, coarse-grained facies (Cretaceous) and **Kmgf - Quartz diorite of Mount Gibson, fine-grained facies (Cretaceous)**
Dark-gray, pyroxene bearing quartz diorite, commonly with large poikilitic biotite crystals and locally with rare orbicules. Composed of two facies. The contact between the facies is sharp, with the coarse-grained facies intruding the fine-grained facies. Description from source map: Tower Peak 15' Quadrangle

Kgic - Quartz diorite of Mount Gibson, coarse-grained facies (Cretaceous)

Kmgc - Quartz diorite of Mount Gibson, coarse-grained facies (Cretaceous)
No additional description provided on source map: Tower Peak 15' Quadrangle

Kgif - Quartz diorite of Mount Gibson, fine-grained facies (Cretaceous)

Kmgf - Quartz diorite of Mount Gibson, fine-grained facies (Cretaceous)
No additional description provided on source map: Tower Peak 15' Quadrangle

Kut - Granite of Upper Twin Lake (Cretaceous)

Kut - Granite of Upper Twin Lake (Cretaceous)
Coarse, equigranular, pink biotite granite. Locally has a very strong vertical lineation, probably of metamorphic origin. Description from source map: Tower Peak 15' Quadrangle

Kpm - Granite of Piute Mountain (Cretaceous)

Kpm - Granite of Piute Mountain (Cretaceous)
Light-pink to orange, medium- to coarse-grained granite containing abundant, closely packed, tabular microcline crystals. Description from source map: Tower Peak 15' Quadrangle

Kabl - Aplite mass north of Bernice Lake (Early Cretaceous)

Ka - Aplite mass north of Bernice Lake (Early Cretaceous)
No additional description provided on source map: Tuolumne Meadows 15' Quadrangle

Ktp - Granodiorite of North Tuolumne Peak (Early Cretaceous)

Ktp - Granodiorite of North Tuolumne Peak (Early Cretaceous)
Small masses and dikes of hornblende-biotite granodiorite. Description from source map: Tuolumne Meadows 15' Quadrangle

Ktl - Granite of Turner Lake (Early Cretaceous)

Ktl - Granite of Turner Lake (Early Cretaceous)
Porphyritic biotite granite and felsic granodiorite. Contains abundant phenocrysts of potassium feldspar in a medium-grained groundmass. Description from source map: Tuolumne Meadows 15' Quadrangle

Ktl - Porphyritic granite of Turner Lake (Lower Cretaceous)
Biotite granite and felsic granodiorite containing abundant tabular 1- to 2-mm phenocrysts of potassium feldspar in a medium-grained groundmass. Description from source map: Merced Peak 15' Quadrangle

Ktnl - Leucogranite of Ten Lakes (Cretaceous)

Kt - Leucogranite of Ten Lakes (Cretaceous)
White, coarse-grained leucogranite mottled by gray anhedral quartz crystals. Quartz, microcline, and plagioclase in equal proportions; mafic mineral content about 4 percent. Description from source map: Tower Peak 15' Quadrangle

Kt - Leuocgranite of Ten Lakes (Early Cretaceous)
Coarse-grained white mottled to gray anhedral quartz crystals. Rb-Sr whole-rock age: 98 ± 4 m.y. Previously called alaskite of Ten Lakes and considered Jurassic by Kistler (1973). Description from source map: Tuolumne Meadows 15' Quadrangle

Krd - Granodiorite of Red Devil Lake (Early Cretaceous)

Krd - Granodiorite of Red Devil Lake (Early Cretaceous)
Equigranular granodiorite and granite forming the outer unit of the intrusive suite of Washburn Lake. Zoned from inclusion-rich mafic biotite-hornblende granodiorite at the outer margin to biotite granite at the inner contact with the granite of Turner Lake. South of Gallison Lake, the granodiorite is strongly sheared. U-Pb zircon age: 98±2 my. Description from source map: Tuolumne Meadows 15' Quadrangle

Kr - Granodiorite of Red Devil Lake (Lower Cretaceous)
Equigranular granodiorite and granite forming the outer unit of a compound pluton. Zoned from inclusion-rich mafic hornblende-biotite granodiorite at the outer margin to biotite granite at the inner contact with the porphyritic granite of Turner Lake (Ktl). Zone of abundant inclusion (Krdi). Description from source map: Merced Peak 15' Quadrangle

KJr - Granodiorite of Red Devil Lake (Jurassic and Cretaceous)
Medium-grained, equigranular. Unit exposed only in small area at west edge of quadrangle and named for more extensive exposures in the Merced Peak quadrangle (Peck, 1964). Age of unit and granodiorite of Jackass Lakes (Kjl) relative to other granitic rocks in quadrangle unknown. Description from source map: Devils Postpile 15' Quadrangle

Ksl - Quartz monzonite of Shellenbarger Lake (Cretaceous)

KJs - Quartz monzonite of Shellenbarger Lake (Jurassic and Cretaceous)
Fine- to medium grained, commonly porphyritic with micrographic groundmass and 2 to 5 mm albite phenocrysts of possible replacement origin. Description from source map: Devils Postpile 15' Quadrangle

Kfd - Felsic dikes and masses (Cretaceous)

KJfd - Felsic dikes and masses (Jurassic and Cretaceous)
Fine-grained, rhyolitic, commonly with flow banding. Most dikes occur as a swarm in and near the granodiorite near King Creek (KJf) and are shown somewhat generalized on the map. Description from source map: Devils Postpile 15' Quadrangle

Ktk - Leucogranite of Timber Knob (Lower Cretaceous)

Ktk - Leucogranite of Timber Knob (Lower Cretaceous)
White to very light gray, fine-grained equigranular biotite leucogranite in a stock and dikes near Timber Knob and in the Strawberry Tungsten Mine area. Description from source map: Merced Peak 15' Quadrangle

Kn - Leucogranite of Norris Creek (Lower Cretaceous)

Kn - Leucogranite of Norris Creek (Lower Cretaceous)
Very fine to medium-grained white leucogranite and aplite forming a plexus of dikes near Jackass Meadow. Description from source map: Merced Peak 15' Quadrangle

Kmp - Complex of Mahan Peak (Cretaceous)

Kmp - Complex of Mahan Peak (Cretaceous)
Strongly foliated and migmatitic complex of fine-grained leucogranite with abundant diorite inclusions and cut by unfoliated, fine-grained granitic dikes and irregular masses. Equivalent to part of granodiorite of Double Rock of Kistler (1973). Description from source map: Tower Peak 15' Quadrangle

Khrr - Granodiorite of Horse Ridge (Middle Cretaceous)

Khr - Granodiorite of Horse Ridge (Middle Cretaceous)
Fine-grained, equigranular, calcic granodiorite forming an envelope around the lighter colored granodiorite of Chilnualna Lakes (Kcl). Typically contains 10 to 15 percent fine flakes of biotite and about 10 percent poikilitic grains of potassium feldspar. Description from source map: Yosemite 15' Quadrangle

Kbz - Granodiorite of Breeze Lake (Lower Cretaceous)

Kb - Granodiorite of Breeze Lake (Lower Cretaceous)
Light-gray seriate-textured biotite granodiorite forming an elongate stock near Breeze Lake and Chain Lakes. Abundant plagioclase phenocrysts, 0.5 to 8 mm in length, are set in a fine-grained groundmass. Potassium feldspar ranges in different samples from fine interstitial grains to poikilitic crystals as much as 1 cm across. Description from source map: Merced Peak 15' Quadrangle

Kol - Granodiorite of Ostrander Lake (Middle Cretaceous)

Ko - Granodiorite of Ostrander Lake (Middle Cretaceous)
Mostly medium-grained equigranular biotite-hornblende granodiorite and biotite granite, but includes porphyritic biotite granodiorite containing poikilitic tablets of potassium feldspar 5 to 10 mm long near the center of the pluton and mafic granodiorite and tonalite on the southern and western margins of the body. Contains about 10 percent mafic minerals, predominantly biotite in poorly formed grains 1 to 3 mm across. Forms a large pluton in the eastern part of the quadrangle. Discordant U-Pb ages of 107 and 112 Ma of a sample near Ostrander Lake are probably too old by 10 to 15 Ma. Includes zone of abundant inclusions (Koli). Description from source map: Yosemite 15' Quadrangle

Ko - Granodiorite of Ostrander Lake (Lower Cretaceous)
Medium-grained equigranular hornblende-biotite granodiorite and biotite granite forming the eastern half of a large pluton that extends westward to Ostrander Lake in the Yosemite quadrangle. Typically contains 6 to 10 percent anhedral biotite and hornblende. Locally contains subhedral 5- to 10-mm tablets of potassium feldspar. Description from source map: Merced Peak 15' Quadrangle

Koli - Granodiorite of Ostrander Lake, abundant inclusions (Middle Cretaceous)

Ko - Granodiorite of Ostrander Lake, abundant inclusions (Middle Cretaceous)
Mostly medium-grained equigranular biotite-hornblende granodiorite and biotite granite, but includes porphyritic biotite granodiorite containing poikilitic tablets of potassium feldspar 5 to 10 mm long near the center of the pluton and mafic granodiorite and tonalite on the southern and western margins of the body. Contains about 10 percent mafic minerals, predominantly biotite in poorly formed grains 1 to 3 mm across. Forms a large pluton in the eastern part of the quadrangle. Discordant U-Pb ages of 107 and 112 Ma of a sample near Ostrander Lake are probably too old by 10 to 15 Ma. Includes zone of abundant inclusions (Koli). Description from source map: Yosemite 15' Quadrangle

Kdm - Mafic dikes and masses (Cretaceous)

KJmd - Mafic dikes and masses (Jurassic and Cretaceous)
Fine- to medium-grained, occasionally porphyritic or amygdaloidal. Shown somewhat diagrammatically and only in areas where numerous, as in upper North Fork basin and in vicinity of Deadhorse Lake. Dike and two small masses south of Iron Mountain are magnetite-rich hornblendite. Description from source map: Devils Postpile 15' Quadrangle

Kjl - Granodiorite of Jackass Lake (Lower Cretaceous)

Kj - Granodiorite of Jackass Lakes (Lower Cretaceous)
Large pluton of biotite granodiorite underlying much of the southeastern half of the quadrangle and containing many screens and inclusions of older metamorphic and plutonic rocks. Typically consists of very light gray, medium-grained granodiorite containing about 10 percent biotite and subordinate hornblende in subhedral grains and aggregates; but may range from tonalite and quartz diorite to porphyritic leucogranite containing abundant phenocrysts of potassium feldspar. Description from source map: Merced Peak 15' Quadrangle

KJj - Granodiorite of Jackass Lakes (Jurassic and Cretaceous)
Medium-grained, equigranular. Unit exposed only in small area at west edge of quadrangle and named for more extensive exposures in the Merced Peak quadrangle (Peck, 1964). Description from source map: Devils Postpile 15' Quadrangle

Kjls - Granodiorite of Jackass Lakes, Sadler Peak phase (Lower Cretaceous)

Kjs - Granodiorite of Jackass Lakes, Sadler Peak phase (Lower Cretaceous)
Light-gray equigranular to vaguely porphyritic biotite granite and leucogranite, which is very similar to felsic varieties of the granodiorite of Jackass Lakes; forms a small stock and dike between Sadler Peak and Long Mountain. Description from source map: Merced Peak 15' Quadrangle

Kjla - Granodiorite of Jackass Lakes, Anne Lake phase (Lower Cretaceous)

Kja - Granodiorite of Jackass Lakes, Anne Lake phase (Lower Cretaceous)
Equigranular hornblende-biotite granodiorite very similar to, but slightly more mafic than the granodiorite of Jackass Lakes; forms an elongate stock having sharp contacts near the West Fork of Granite Creek. Description from source map: Merced Peak 15' Quadrangle

Kic - Granodiorite of Illilouette Creek (Middle Cretaceous)

Ki - Granodiorite of Illilouette Creek (Middle Cretaceous)
Medium-grained, equigranular, biotite-hornblende granodiorite and much less abundant granite and tonalite in masses flanking Horse Ridge and extending northwest through Bridalveil Creek Campground. Contains 10 to 20 percent biotite and hornblende, largely in subhedral grains 1 to 3 mm across, but including sparse to abundant stout prisms of hornblende as long as 1 cm. Mafic inclusions and schlieren typically define a foliation. Includes zone of inclusions (Kici). Description from source map: Yosemite 15' Quadrangle

Ki - Granodiorite of Illilouette Creek (Lower Cretaceous)
Medium-grained equigranular mafic hornblende-biotite granodiorite and hornblende tonalite forming the marginal unit of a large compound pluton that extends westward to Bridalveil Creek. Typically contains 15 to 20 percent biotite and hornblende; sparse to abundant euhedral hornblende crystals may be 5 to 10 mm long. Includes zone of inclusions (Kici). Description from source map: Merced Peak 15' Quadrangle

KJic - Granodiorite of Illilouette Creek (Jurassic or Cretaceous)
Medium -grained hornblende-biotite granodiorite with abundant sphene. Unit derives its name from a creek in the Merced Peak quadrangle adjacent to the north (Peck, 1964). Description from source map: Shuteye Peak 15' Quadrangle

Kici - Granodiorite of Illilouette Creek, abundant inclusions (Middle Cretaceous)

Ki - Granodiorite of Illilouette Creek, abundant inclusions (Middle Cretaceous)
No additional description provided on source map: Yosemite 15' Quadrangle

Klt - Leaning Tower Granite (Middle Cretaceous)

Kl - Leaning Tower Granite (Middle Cretaceous)
Biotite-hornblende granite and granodiorite in three small bodies exposed on the walls of Yosemite Valley. Contains about 10 percent biotite and less abundant hornblende in small anhedral grains and in clusters as large as 5 mm of fine biotite after hornblende. Senate textured to sparsely porphyritic with subhedral potassium feldspar tablets as large as 5 mm. Description from source map: Yosemite 15' Quadrangle

Kid - Intrusive quartz diorite (Cretaceous)

Kid - Intrusive quartz diorite (Cretaceous)
Dark rock in dikes cutting El Capitan Granite and Taft Granite on the northern wall of Yosemite Valley. The dike rock is fine- to medium-grained, contains about 20 percent biotite and hornblende, and ranges in composition from hornblende quartz diorite to biotite tonalite and mafic biotite granodiorite. Dikes on the face of El Capitan resemble a map of North America. Description from source map: Yosemite 15' Quadrangle

Ktr - Granodiorite of Turner Ridge (Cretaceous)

Ktr - Granodiorite of Turner Ridge (Cretaceous)
Distinctive dark porphyritic granodiorite and tonalite in a small pluton and in dikes that extend discontinuously from near Bridalveil Creek Campground to the South Fork of the Merced River. Contains 10 to 30 percent conspicuous, corroded, equant phenocrysts of quartz and tablets of plagioclase as large as 1 cm and about 15 percent subhedral grains of biotite and hornblende in a fine- to very fine grained groundmass. Description from source map: Yosemite 15' Quadrangle

Ktg - Taft Granite (Early Cretaceous)

Kt - Taft Granite (Early Cretaceous)
Light-colored, medium-grained, equigranular leucogranite in several small masses cutting the El Capitan Granite, which extend south from El Capitan and Taft Point. The granite weathers yellowish gray, and contains 1 to 5 percent biotite flakes and opaque grains less than 1 mm across. Grades locally into biotite granodiorite and biotite tonalite against contacts with El Capitan Granite. A discordant U-Pb age

of 96 Ma of a sample from Taft Point is probably too young. Description from source map: Yosemite 15' Quadrangle

Kbc - Granite of Big Creek (Early Cretaceous)

Kbc - Granite of Big Creek (Early Cretaceous)
Light-colored, medium-grained, equigranular biotite granite and leucogranite, similar to Taft Granite (Ktg), forming a small pluton intrusive into Bass Lake Tonalite at the southern margin of the quadrangle. Contains about 5 percent biotite and opaque minerals in 1 to 2 mm grains. Description from source map: Yosemite 15' Quadrangle

Krp - Leucogranite porphyry of Red Peak (Lower Cretaceous)

Krp - Leucogranite porphyry of Red Peak (Lower Cretaceous)
Biotite leucogranite porphyry containing sparse to abundant (10 to 50 percent) phenocrysts of plagioclase and quartz in a fine-grained sugary-textured groundmass. Very light gray where fresh, but mostly weathered to shades of red and yellow because of alteration of disseminated pyrite. A few calcic cores of plagioclase are typically replaced by potassium feldspar. Contains sparse miarolitic cavities. Zone of abundant inclusions (Krpi). Description from source map: Merced Peak 15' Quadrangle

Kpp - Leucogranite porphyry of Post Peak (Lower Cretaceous)

Kpp - Leucogranite porphyry of Post Peak (Lower Cretaceous)
Fine-grained biotite leucogranite porphyry in small masses near Triple Divide Peak and Post Peak and in the drainage basin of the West Fork of Granite Creek. Similar to the leucogranite porphyry of Red Peak but lacks miarolitic cavities and pyrite; weathers very light gray. The eastern masses typically contain very abundant round to slabby mafic inclusions that weather flush with the enclosing porphyry on outcrops. Zone of abundant inclusions (Kppi). Description from source map: Merced Peak 15' Quadrangle

Khc - Granodiorite porphyry of Horsethief Canyon (Lower Cretaceous)

Khc - Granodiorite porphyry of Horsethief Canyon (Lower Cretaceous)
Medium-light-gray hornblende-biotite granodiorite porphyry in a small mass along the South Fork of the Merced River east of Moraine Meadow. Contains very abundant phenocrysts, predominantly plagioclase, in a fine-grained sugary-textured groundmass. Description from source map: Merced Peak 15' Quadrangle

Kwr - Granodiorite of Whiskey Creek (Cretaceous)

KJwr - Granodiorite of Whiskey Creek (Jurassic or Cretaceous)
Medium-grained hornblende-biotite granodiorite and quartz diorite with an average color index of 18. The body in the southern part of the quadrangle is zoned, with generally more mafic rock near its margins. The eastern, hook-shaped extension of this pluton is also relatively mafic, although quite variable. Plagioclase is commonly quite strongly zoned and is predominantly andesine and sodic labradorite. The rock is locally porphyritic with extremely poikilitic K-feldspar phenocrysts. Hornblende is typically

euhedral. The rock is quite similar to the nonporphyritic phase of the Mount Givens Granodiorite, but is distinguished by a higher average color index and lesser content of sphene. Granodiorite of Whisky Ridge intrudes quartz monzonite of Shuteye Peak and granodiorite of Dinkey Creek. Relations between it and the Mount Givens Granodiorite are uncertain. Description from source map: Shuteye Peak 15' Quadrangle

Kdc - Granodiorite of Camino Creek (Cretaceous)

KJcc - Granodiorite of Camino Creek (Jurassic or Cretaceous)
Fine- to medium-grained unit is extremely variable, with composition ranging from quartz diorite to quartz monzonite and an average composition of granodiorite. Color index ranges from 10 to 30. Plagioclase is pre-dominantly andesine and sodic labradorite; mafic content is predominantly biotite with lesser hornblende. This unit commonly contains abundant inclusions of metamorphic rocks, locally in advanced stages of assimilation. Granodiorite of Camino Creek intrudes quartz monzonite of Shuteye Peak and granodiorite of Beasore Meadow. Description from source map: Shuteye Peak 15' Quadrangle

Kgc - Granodiorite of Grizzly Creek (Cretaceous)

Kgc - Granodiorite of Grizzly Creek (Cretaceous)
Medium-grained hornblende-biotite granodiorite and tonalite that resembles the Bass Lake Tonalite, but which contains rounded quartz phenocrysts with an average diameter of about 5 mm. Description from source map: Bass Lake 15' Quadrangle

Kgc - Granite of Grizzly Creek (Lower Cretaceous)
Distinctive mafic hornblende-biotite granodiorite and tonalite west of Quartz Mountain; forms the north end of an elongate northeast-trending pluton cutting the leucogranite of Shuteye Peak. Contains abundant tabular phenocrysts of plagioclase and conspicuous corroded equant phenocrysts of quartz. Description from source map: Merced Peak 15' Quadrangle

KJgc - Granodiorite of Grizzly Creek (Jurassic or Cretaceous)
Medium-grained hornblende-biotite granodiorite. Color index variable within range 10-30. Unit is characterized by abundant phenocrysts of quartz averaging about 5 mm and locally as much as 1 cm in maximum dimension. Plagioclase is andesine. Quartz diorite of Grizzly Creek intrudes quartz monzonite of Shuteye Peak. Description from source map: Shuteye Peak 15' Quadrangle

Khr - Granodiorite of Hodgdon Ranch (Cretaceous)

Khr - Granodiorite of Hodgdon Ranch (Cretaceous)
Fine- to medium-grained hornblende-biotite granodiorite. Coarse poikilitic potassium feldspar. Subhedral mafic minerals. Color index about 10. Description from source map: Lake Eleanor 15' Quadrangle

Kncc - Tonalite of North Crane Creek (Cretaceous)

Kcc - Tonalite of North Crane Creek (Cretaceous)
Medium-grained, senate, biotite-hornblende tonalite. Subhedral mafic minerals. Color index about 20. Includes: Contact-breccia zone (Kccb) contains abundant variable-sized inclusions of the tonalite of Poopenaut Valley (Kpv). Description from source map: Lake Eleanor 15' Quadrangle

Knccb - Tonalite of North Crane Creek, contact breccia zone (Cretaceous)

Kccb - Tonalite of North Crane Creek, contact breccia zone (Cretaceous)
No additional description provided on source map: Lake Eleanor 15' Quadrangle

Ktc - Tonalite of Tamarack Creek (Cretaceous)

Ktc - Tonalite of Tamarack Creek (Cretaceous)
Medium-grained, senate, biotite-hornblende tonalite. Subhedral mafic minerals. Color index about 20. Includes: Contact-breccia zone (Kccb) contains abundant variable-sized inclusions of the tonalite of Poopenaut Valley (Kpv). Description from source map: Lake Eleanor 15' Quadrangle

Kav - Quartz Diorite of Aspen Valley (Cretaceous)

Kav - Quartz Diorite of Aspen Valley (Cretaceous)
Medium-grained biotite-hornblende tonalite to quartz diorite. Contains subhedral to euhedral mafic minerals. Color index about 25. Locally sheared, and where sheared more felsic than elsewhere. Probably correlative with the tonalite of Poopenaut Valley. Continuous with the quartz diorite of South Fork of Tuolumne River in Hetch Hetchy Reservoir quadrangle (Kistler, 1973). Locally divided into: Fine-grained hornblende-biotite quartz diorite facies (Kavt). Description from source map: Lake Eleanor 15' Quadrangle

Kavf - Quartz Diorite of Aspen Valley, fine-grained hornblende-biotite quartz diorite facies (Cretaceous)

Kavf - Quartz Diorite of Aspen Valley, fine-grained hornblende-biotite quartz diorite facies (Cretaceous)
No additional description provided on source map: Lake Eleanor 15' Quadrangle

Ktmc - Quartz diorite of Tamarack Creek (Lower Cretaceous)

Kt - Quartz diorite of Tamarack Creek (Lower Cretaceous)
Biotite-hornblende quartz diorite, coarse-grained, dark-gray. Color index about 20. Locally foliated; hornb1ende crystals, normally short and stubby, more than half an inch long in some places. Potassium-argon age of biotite is 89.4+/-2.6 m.y. and of hornblende 95.9 +/- 3.0 m.y. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Katnl - Alaskite of Ten Lakes (Cretaceous)

Jt - Alaskite of Ten Lakes (Jurassic)
Occurs as two separate bodies. Quartz monzonite, coarse-grained, white, mottled by gray irregular crystals of quartz. quartz, microcline, and plagioclase are in equal proportions. Color index about 4. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Krm - Granite of Rancheria Mountain (Cretaceous)

Krm - Granite of Rancheria Mountain (Cretaceous)
Coarse-grained biotite granite. Commonly contains blocky phenocrysts of potassium feldspar. Evenly disseminated, fine- to medium-grained, anhedral biotite flakes. Color index about 4. Probably correlative with the Taft Granite of Yosemite Valley (Calkins, 1930). Description from source map: Lake Eleanor 15' Quadrangle

Jr - Granodiorite of Rancheria Mountain (Jurassic)
Biotite granodiorite and quartz monzonite, coarse-grained. The eastern part is predominantly granodiorite but locally grades to alaskite. Quartz monzonite predominates in the western part of the unit, where phenocrysts of microcline are locally abundant. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kbam - Granite of Bald Mountain (Cretaceous)

Kbm - Granite of Bald Mountain (Cretaceous)
Medium- to coarse-grained granite, similar to the granite of Rancheria Mountain. Color index about 7. Locally highly sheared. Description from source map: Lake Eleanor 15' Quadrangle

Kswl - Granite of Swamp Lake (Cretaceous)

Ksl - Granite of Swamp Lake (Cretaceous)
Medium- to coarse-grained granite and granodiorite, similar to the granite of Rancheria Mountain. Color index about 7. Description from source map: Lake Eleanor 15' Quadrangle

Kcr - Microgabbro of the Clark Range (Lower Cretaceous)

Kcr - Microgabbro of the Clark Range (Lower Cretaceous)
Medium-gray microgabbro forming a 2- to 8-m-wide dike that extends from the east flank of Mount Clark to the Red Peak Fork of the Merced River. Contains sparse tabular phenocrysts of plagioclase and clots of hornblende in a fine-grained groundmass. Description from source map: Merced Peak 15' Quadrangle

Kec - El Capitan Granite (Early Cretaceous)

Ke - El Capitan Granite (Early Cretaceous)
Light-colored, coarse-grained biotite granodiorite and granite forming bold, coarsely jointed rock masses. Weathered granodiorite and granite are yellowish gray to pinkish gray, and coarse quartz and potassium feldspar crystals stand out on the surface. Typically the rock is senate to porphyritic in texture, and contains dark quartz in coarse, equant to lensoid grains as large as 1 cm and potassium feldspar either in 1 by 2 cm tablets or in fine interstitial grains. The mafic minerals are in subhedral grains as large as 2 mm and form 5 to 10 percent of the rock. Biotite predominates, but a few distinctive reddish grains of allanite can be seen in each thin section of most samples. Hornblende is absent or present only in trace amounts except in more mafic samples from the southern part of the area. Age of a sample from Turtleback Dome is 103 Ma (U-Pb). Description from source map: Yosemite 15' Quadrangle

Kec - El Capitan Granite (Early Cretaceous)
Medium-grained, equigranular to weakly porphyritic biotite granite present in a small protrusion into the northern part of the map area. Description from source map: Bass Lake 15' Quadrangle

Kec - El Capitan Granite (Cretaceous)
Coarse-grained biotite granodiorite with blocky phenocrysts of potassium feldspar. Disseminated, medium-grained, anhedral biotite flakes. Color index 9. Description from source map: Lake Eleanor 15' Quadrangle

Kec - El Capitan Granite (Cretaceous)
Medium-grained, equigranular to weakly porphyritic biotite granite and granodiorite. Description from source map: El Portal 15' Quadrangle

Kec - El Capitan Granite (Cretaceous)
Granitic rock, in part porphyritic, coarse-grained, white to light-gray; weathers to buff or reddish brown; occurs in four facies differing in their relative proportions of plagioclase, microcline, quartz, and biotite; Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Ke - El Capitan Granite (Lower Cretaceous)
Coarse-grained biotite granite along the South Fork of the Merced River at the western boundary of the quadrangle. Forms the southeast end of a very large pluton that extends to Yosemite Valley. Contains conspicuous subhedral grains of quartz, plagioclase, and potassium feldspar as large as 1 cm across. Description from source map: Merced Peak 15' Quadrangle

Keca - El Capitan Granite, granodiorite facies (Early Cretaceous)

Jea - El Capitan Granite, granodiorite facies (Jurassic)
Granodiorite facies with plagioclase about four times as abundant as microcline. Color index about 7. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kecb - El Capitan Granite, quartz monzonite facies (Early Cretaceous)

Jeb - El Capitan Granite, quartz monzonite facies (Jurassic)
Quartz monzonite facies with quartz, plagioclase, and microcline in equal abundance. Color index about 8. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kecc - El Capitan Granite, quartz-rich granodiorite facies (Early Cretaceous)

Jec - El Capitan Granite, quartz-rich granodiorite facies (Jurassic)
With same feldspar proportions and color index as granodiorite facies but with an average of 40 percent quartz. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kecd - El Capitan Granite, quartz-rich quartz monzonite facies (Early Cretaceous)

Jed - El Capitan Granite, quartz-rich quartz monzonite facies (Jurassic)
With slightly more plagioclase than microcline color index of 5, and about 40 percent quartz. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Ktf - Granodiorite of Tueeulala Falls (Cretaceous)

Ktf - Granodiorite of Tueeulala Falls (Cretaceous)
Medium-grained hornblende-biotite granodiorite. Subhedral mafic minerals. Color index about 15. U-Pb age of 108.7 Ma. Description from source map: Lake Eleanor 15' Quadrangle

Ktf - Granodiorite of Tueeulala Falls (Late Cretaceous)
Biotite-hornblende granodiorite. Several poorly exposed masses of heterogeneous mafic rock in the southeast corner of the quadrangle are tentatively correlated with rock mapped in the adjacent Lake Eleanor quadrangle (F. C. W. Dodge and L. C. Calk, written commun., 1980). Description from source map: Pinecrest 15' Quadrangle

Kcf - Granodiorite of Crane Flat (Cretaceous)

Kcf - Granodiorite of Crane Flat (Cretaceous)
Medium-grained biotite granodiorite. Contains evenly disseminated subhedral to anhedral biotite. Color index about 10. May be correlative with the biotite granite of Arch Rock in Yosemite Valley (Calkins, 1930). Description from source map: Lake Eleanor 15' Quadrangle

Ksm - Granodiorite of Sawmill Mountain (Cretaceous)

Ksm - Granodiorite of Sawmill Mountain (Cretaceous)
Medium to coarse grained; highly variable composition that ranges from biotite leucogranite to hornblende-biotite trondhjemite. Color index variable, but averages about 10. Very similar in appearance to the El Capitan Granite. U-Pb age 116.1 Ma. Description from source map: Lake Eleanor 15' Quadrangle

Ktpv - Tonalite of Poopenaut Valley (Cretaceous)

Kpv - Tonalite of Poopenaut Valley (Cretaceous)
Medium-grained biotite-hornblende tonalite. Ranges locally from granodiorite to quartz diorite, but generally is uniform texturally. Contains subhedral to euhedral mafic minerals. Color index ranges widely from about 7 to nearly 30 but generally averages 20. Locally sheared, and where sheared generally more felsic than elsewhere. Probably correlative with the granodiorite of The Gateway in Yosemite Valley (Calkins, 1930) and the tonalite of Blue Canyon further south. Locally divided into porphyritic facies. Description from source map: Lake Eleanor 15' Quadrangle

Kpvp - Tonalite of Poopenaut Valley, porphyric hornblende-biotite granodiorite facies (Cretaceous)

Kpvp - Tonalite of Poopenaut Valley, porphyric hornblende-biotite granodiorite facies (Cretaceous)
No additional description provided on source map: Lake Eleanor 15' Quadrangle

Khg - Granodiorite of Hazel Green Ranch (Cretaceous)

Khg - Granodiorite of Hazel Green Ranch (Cretaceous)
Medium-grained hornblende-biotite granodiorite and tonalite. Generally more felsic than the tonalite of Poopenaut Valley but otherwise similar. Color index about 15. Locally divided into mafic marginal facies. Description from source map: Lake Eleanor 15' Quadrangle

Khgm - Granodiorite of Hazel Green Ranch, mafic marginal facies (Cretaceous)

Khgm - Granodiorite of Hazel Green Ranch, mafic marginal facies (Cretaceous)
No additional description provided on source map: Lake Eleanor 15' Quadrangle

Kbm - Granodiorite of Beasore Meadows (Cretaceous)

KJbm - Granodiorite of Beasore Meadows (Jurassic or Cretaceous)
Medium-grained hornblende-biotite granodiorite. Color index variable but generally in range 15-30 with a probable average of 20-25. Plagioclase is commonly zoned and is predominantly sodic labradorite and calcic andesine. Locally contains large swarms of abundant mafic inclusions. Granodiorite of Beasore Meadow intrudes quartz monzonite of Shuteye Peak. Description from source map: Shuteye Peak 15' Quadrangle

Ksp - Granite of Shuteye Peak (Early Cretaceous)

Ksp - Granite of Shuteye Peak (Early Cretaceous)
Light-colored porphyritic granite and leucogranite in the southeastern corner of the quadrangle. Forms the northern end of a large pluton that extends 50 km to the south. Weathers yellowish gray, and contains abundant flat, tabular phenocrysts of potassium feldspar 5 to 10 mm long and 4 to 10 percent mafic minerals, primarily biotite in small, poorly formed books. Age about 102 Ma (U-Pb). Description from source map: Yosemite 15' Quadrangle

Ksp - Granite of Shuteye Peak (Early Cretaceous)
Massive, medium-to coarse-grained, locally porphyritic biotite granite and granodiorite. Description from source map: Bass Lake 15' Quadrangle

Ksp - Leucogranite of Shuteye Peak (Lower Cretaceous)
Very light gray leucogranite and biotite granite containing sparse to abundant tabular phenocrysts of potassium feldspar as long as 1 cm. Much of the rock is strongly sheared. Forms the north end of a large pluton near the southwest comer of the quadrangle. Description from source map: Merced Peak 15' Quadrangle

Kqmsp - Quartz monzonite of Shuteye Peak (Cretaceous)

KJsp - Quartz monzonite of Shuteye Peak (Jurassic or Cretaceous)
Medium-grained light-colored quartz monzonite and minor granodiorite with average color index about 5. Generally equigranular but locally slightly porphyritic with equant K-feldspar phenocrysts as much as 1 cm in average length. Plagioclase is predominantly oligoclase and is commonly strongly zoned, sericitized, and generally ratty looking. K-feldspar commonly has grid structure. Mortar structure is not uncommon. Mafic minerals are biotite and lesser amounts of granular, fine-grained, opaque material (probably mostly magnetite). In the summit area of Chiquito Ridge, rocks of this unit exhibit spectacular exfoliation sheet jointing. Description from source map: Shuteye Peak 15' Quadrangle

Ksc - Granite of Stovepipe Campground (Early Cretaceous)

Ksc - Granite of Stovepipe Campground (Early Cretaceous)
Light-colored porphyritic granite forming a small pluton in the southwestern corner of the quadrangle. Medium-grained biotite granite containing abundant tabular phenocrysts of potassium feldspar 5 to 10 mm long and 2 to 9 percent mafic minerals, primarily biotite. Similar in composition and texture to the granite of Shuteye Peak and possibly correlative. Description from source map: Yosemite 15' Quadrangle

Kal - Alaskite (Early Cretaceous)

Kal - Alaskite (Early Cretaceous)
Light-colored, fine- to medium-grained leucogranite in the southwestern corner of the quadrangle containing 1 to 2 percent small grains of biotite and red garnet. Description from source map: Yosemite 15' Quadrangle

Koh - Tonalite of Oakhurst (Cretaceous)

Ko - Tonalite of Oakhurst (Cretaceous)
Medium-grained, light-colored hornblende-biotite-tonalite, with faint planar foliation defined by orientation of mafic minerals and, locally, of small lenticular mafic intrusions. Indistinguishable in outcrop from the tonalite of Blue Canyon. U-Pb isotopic age (from Bass Lake quadrangle) about 105 m.y. Description from source map: Mariposa 15' Quadrangle

Knc - Granodiorite of Niagara Creek (Cretaceous)

Knc - Granodiorite of Niagara Creek (Cretaceous)
Medium-grained biotite-hornblende granodiorite with poikilitic K-feldspar. Average color index about 15. Preliminary Rb-Sr data indicate an age of about 90 m.y. (A.C. Robinson, oral commun., 1982). Description from source map: Dardanelles Cone 15' Quadrangle

Kla - Granodiorite of Lake Alpine (Cretaceous)

Kla - Granodiorite of Lake Alpine (Cretaceous)
Medium- to coarse-grained hornblende-biotite granodiorite. Average color index about 13. Abundant

sphene. K-Ar age of about 92 m.y. (Evernden and Kistler, 1970). Description from source map: Dardanelles Cone 15' Quadrangle

Kg - Granodiorite (Cretaceous)

Kg - Granodiorite (Cretaceous)
Fine-grained, porphyritic biotite-hornblende granodiorite containing small (<1 cm) K-feldspar phenocrysts. Color index about 10. Small isolated mass in northwest corner of quadrangle. Description from source map: Dardanelles Cone 15' Quadrangle

Kep - Ebbetts Pass Granodiorite of Wilshire (1957) (Cretaceous)

Kep - Ebbetts Pass Granodiorite of Wilshire (1957) (Cretaceous)
Medium-grained hornblende-biotite granodiorite. Average color index about 10. Texture is locally subporphyritic with abundant small (<1 cm) K-feldspar phenocrysts. K-Ar age of about 95 m.y. in the Markleeville quadrangle (Armin and others, 1981). Description from source map: Dardanelles Cone 15' Quadrangle

Ksma - Stanislaus Meadow Adamellite of Parker (1961) (Cretaceous)

Ksm - Stanislaus Meadow Adamellite of Parker (1961) (Cretaceous)
Medium- to coarse-grained porphyritic biotite granite, contains as much as 25 percent K-feldspar phenocrysts 1 to 4 cm long. Average color index about 7. Description from source map: Dardanelles Cone 15' Quadrangle

Klp - Lookout Peak Tonalite of Parker (1961) (Cretaceous)

Klp - Lookout Peak Tonalite of Parker (1961) (Cretaceous)
Medium- to coarse-grained hornblende-biotite tonalite. Average color index about 20. Well foliated, with abundant flattened mafic inclusions. Description from source map: Dardanelles Cone 15' Quadrangle

Kbf - Granodiorite of Bummers Flat (Cretaceous)

Kbf - Granodiorite of Bummers Flat (Cretaceous)
Kbf - Granodiorite of Bummers Flat (Early Cretaceous)
Porphyritic biotite granodiorite with K-feldspar phenocrysts commonly averaging about 2 cm in length. Average color index about 10. Rock is very similar to granodiorite of Topaz Lake. Preliminary Rb-Sr data indicate an age of about 101 m.y. (A.C. Robinson, oral commun., 1982). Description from source maps: Dardanelles Cone 15' Quadrangle, Pinecrest 15' Quadrangle

Kgpv - Granodiorite of Poopenaut Valley (Cretaceous)

Kpv - Granodiorite of Poopenaut Valley (Cretaceous)
Medium- to coarse-grained, biotite-hornblende granodiorite. K-feldspar commonly occurs as very

poikilitic phenocrysts up to 2 cm long. Average color index is about 12. Description from source map: Dardanelles Cone 15' Quadrangle

Kpv - Granodiorite of Poopenaut Valley (Early Cretaceous)
Generally medium-grained biotite-hornblende granodiorite, but extremely variable in composition. Locally has moderately well-developed foliation and streaky appearance. Probably includes more than one intrusive unit. Description from source map: Pinecrest 15' Quadrangle

Kt - Tonalite (Cretaceous)

Kt - Tonalite (Cretaceous)
Biotite-hornblende tonalite. Generally medium- to coarse-grained, but extremely variable in texture and color index (c. i. average about 25). Rock commonly is foliated as defined by preferred orientation of mafic minerals. Occurs in a zone between granodiorites of Bummers Flat and Poopenaut Valley. Description from source map: Dardanelles Cone 15' Quadrangle

Kap - Aplite (Early Cretaceous)

Kap - Aplite (Early Cretaceous)
Light-colored, fine-grained leucogranite in a mineralized dike near Star Lakes. Contains about 5 percent phenocrysts of plagioclase and quartz in an aphanitic groundmass. Description from source map: Yosemite 15' Quadrangle

ap - Aplite (Cretaceous)
In granodiorite of Bond Pass (Kbop) occurs as dike-like bodies of aplite or fine-grained sugary alaskite containing tourmaline rosettes. Includes aplitic border facies of granodiorite of Lake Harriet (Klh) mapped along the northeastern margin of that pluton. Description from source map: Tower Peak 15' Quadrangle

Kap - Aplite (Early Cretaceous)
Dikes in the Coarsegold roof pendant and north of Bass Lake are typical fine-grained equigranular aplite. Dike at southeast end of Bass Lake is also fine grained. but contains dark clots as much as 1 cm across composed of micas, chlorite, and opaque material. Description from source map: Bass Lake 15' Quadrangle

Kap - Aplite (Cretaceous)
Dikes and irregular masses of sugary-textured, light-colored aplite, grading locally into alaskite and pegmatite. Small red garnets and black tourmaline locally. Only the larger dikes are shown (generally more than 3 m thick and more than 300 m long). Much of the aplite, especially in the southern part of the quadrangle, may represent dikes of the leucotonalite north of Eastman Lake. Description from source map: Mariposa 15' Quadrangle

Ka - Aplite (Cretaceous)
Fine-grained granodiorite with average color index about 6. Occurs as isolated mass south of Union Reservoir. Description from source map: Dardanelles Cone 15' Quadrangle

Kar - Granodiorite of Arch Rock (Early Cretaceous)

Ka - Granodiorite of Arch Rock (Early Cretaceous)
Biotite granodiorite forming a small pluton in the Bass Lake Tonalite (Kblt) near the Arch Rock Entrance

Station. Predominantly medium-grained, equigranular granodiorite containing 6 to 8 percent mafic minerals, mostly subhedral biotite, but the unit includes calcic granodiorite containing subhedral hornblende and titanite as well as biotite. Typically contains potassium feldspar in poikilitic grains as large as 1 cm. Similar in appearance to adjacent Bass Lake Tonalite, but contains coarser and better formed biotite grains. Description from source map: Yosemite 15' Quadrangle

Kar - Granodiorite of Arch Rock (Cretaceous)
Medium-grained, equigranular, hornblende-biotite granodiorite. Description from source map: El Portal 15' Quadrangle

Kccm - Granodiorite of Chowchilla Mountain (Early Cretaceous)

Kcm - Granodiorite of Chowchilla Mountain (Early Cretaceous)
Biotite granodiorite forming a small body in the southwestern part of the quadrangle. Medium-grained, sedate-textured granodiorite containing about 8 percent fine, poorly formed mafic minerals, predominantly biotite but including less abundant hornblende. Description from source map: Yosemite 15' Quadrangle

Khm - Granite of Hogan Mountain (Early Cretaceous)

Khm - Granite of Hogan Mountain (Early Cretaceous)
Fine- to medium-grained leucocratic granite forming the north end of a shallow pluton, most of which is in the Bass Lake quadrangle, and a small pluton centered on Mt. Savage, and dikes cutting Bass Lake Tonalite. Contains 2 to 4 percent small grains of opaque minerals and flakes of biotite. Description from source map: Yosemite 15' Quadrangle

Khm - Granite of Hogan Mountain (Early Cretaceous)
Ductilely deformed biotite granite. Description from source map: Bass Lake 15' Quadrangle

Kgp - Granite of Gray Peak (Lower Cretaceous)

Kgp - Granite of Gray Peak (Lower Cretaceous)
Hornblende-biotite granite underlying the north slope of Gray Peak in the Clark Range. Contains prominent tabular phenocryst of potassium feldspar as long as 3 cm in a coarse-grained groundmass. Much of the rock is strongly sheared. Description from source map: Merced Peak 15' Quadrangle

Kst - Granite porphyry of Star Lakes (Early Cretaceous)

Ksl - Granite porphyry of Star Lakes (Early Cretaceous)
Light-colored granite porphyry and sedate to porphyritic granite, quartz monzonite, and sodic granodiorite. Contains subhedral phenocrysts of plagioclase, about 8 percent biotite, and in some samples less abundant quartz and hornblende, in a fine-grained to aphanitic groundmass. Some samples contain miarolitic cavities and abundant fine-grained potassium feldspar. Crops out near Star Lakes and Raymond Mountain, where it grades eastward into the granodiorite of Iron Creek. Also crops out along the bluffs north of the South Fork of the Merced River along the northern margin of the El Capitan Granite pluton. Age about 108 Ma (Rb-Sr). Description from source map: Yosemite 15' Quadrangle

Ksl - Granite porphyry of Star Lakes (Early Cretaceous)
Within the quadrangle is medium-grained, equigranular, hornblende-biotite granodiorite. Description from source map: Bass Lake 15' Quadrangle

Ksl - Granite porphyry of Star Lakes (Lower Cretaceous)
Hornblende granodiorite, granodiorite porphyry, and biotite granite porphyry forming the eastern margin of a pluton that extends from the South Fork of the Merced River to Raymond Mountain and Star Lakes in the Yosemite quadrangle. Typically contains abundant 2- to 5-mm phenocrysts of plagioclase in a medium- to fine-grained sugary-textured ground mass. Description from source map: Merced Peak 15' Quadrangle

Kirc - Granodiorite of Iron Creek (Early Cretaceous)

Kic - Granodiorite of Iron Creek (Early Cretaceous)
Medium-grained, equigranular to porphyritic granodiorite and less abundant granite in the southeastern corner of the quadrangle. Contains 15 to 20 percent hornblende and biotite. Many samples flooded with fine-grained potassium feldspar. Age about 110 Ma (Rb-Sr). Description from source map: Yosemite 15' Quadrangle

Kwmt - Ward Mountain Trondhjemite (Early Cretaceous)

Kw - Ward Mountain Trondhjemite (Early Cretaceous)
Light-colored, generally gneissic plagioclase-rich rock with an average biotite content of about 6 percent. Present in the southwest corner of the quadrangle. Description from source map: Bass Lake 15' Quadrangle

Ktgm - Granites of Thornberry and Goat Mountains (Early Cretaceous)

Ktg - Granites of Thornberry and Goat Mountains (Early Cretaceous)
Medium-grained, equigranular rocks of variable composition, fabric, and grain size. Composition ranges from granodiorite to quartz diorite. Locally is contaminated with partly assimilated fragments of the Bass Lake Tonalite and in places contains a weak gneissic foliation. Description from source map: Bass Lake 15' Quadrangle

Kblt - Bass Lake Tonalite (Early Cretaceous)

Kbl - Bass Lake Tonalite (Early Cretaceous)
Tonalite, granodiorite, and quartz diorite underlying much of the western part of the quadrangle. Called the granodiorite of the Gateway by Calkins (Calkins, 1930, 1985) and Huber and others (1989). Typically consists of well-foliated, medium-grained, equigranular tonalite and calcic granodiorite containing abundant mafic inclusions. Mafic minerals consist mostly of subhedral crystals of equally abundant biotite and hornblende 1 to 2 mm across and less abundant titanite. Quartz is typically smaller and more irregularly shaped than in El Capitan Granite. U-Pb ages range from 124 to 105 Ma, including an age of 117 Ma of a sample from Henness Ridge. Includes a zone of abundant inclusions. Description from source map: Yosemite 15' Quadrangle

Kbl - Bass Lake Tonalite (Early Cretaceous)
Medium-grained, equigranular rock, generally foliated. Potassium feldspar is sparse and commonly interstitial to quartz and plagioclase but is enriched locally in irregular and poorly defined zones with gradational boundaries. Gneissic foliation and lineation are present in the southwest corner of the quadrangle adjacent to the Ward Mountain Trondhjemite and in the northwest quarter peripheral to the granite of Hogan Mountain. Description from source map: Bass Lake 15' Quadrangle

Kbl - Bass Lake Tonalite (Cretaceous)
Medium-grained, equigranular hornblende-biotite tonalite and granodiorite, generally foliated and containing lens-shaped mafic inclusions. Description from source map: El Portal 15' Quadrangle

Kblti - Bass Lake Tonalite, abundant inclusions (Early Cretaceous)

Kbl - Bass Lake Tonalite, abundant inclusions (Early Cretaceous)
No additional description provided on source map: Yosemite 15' Quadrangle

Kww - Granodiorite of Wawona (Early Cretaceous)

Kw - Granodiorite of Wawona (Early Cretaceous)
Light-colored, calcic granodiorite forming a small pluton near Wawona. The granodiorite contains 15 percent mafic minerals with biotite more abundant than hornblende. Less mafic and less well-foliated than Bass Lake Tonalite, and contains coarser, more equant quartz in grains as large as 5 mm. Description from source map: Yosemite 15' Quadrangle

Ksw - Tonalite of South Wawona (Early Cretaceous)

Ksw - Tonalite of South Wawona (Early Cretaceous)
Distinctive hornblende-biotite tonalite containing 30 to 40 percent coarse euhedral phenocrysts of hornblende as long as 1 cm and less abundant biotite in a very light gray groundmass. Forms a band 1000 ft wide between the granodiorite of Wawona and El Capitan Granite. Description from source map: Yosemite 15' Quadrangle

Kela - Leucotonalite north of Eastman Lake (Cretaceous)

Kel - Leucotonalite north of Eastman Lake (Cretaceous)
Fine-grained, light-colored granitic rock with biotite and muscovite. resembling aplite over much of the area. Locally sparse poikilitic K-feldspar phenocrysts as much as 1 cm in diameter. Foliation faint or absent. May be cogenetic with the granodiorite of Knowles in the Raymond quadrangle, which has an isotopic age of 111 m.y. Description from source map: Mariposa 15' Quadrangle

Kwm - Leucotonalite of Ward Mountain (Cretaceous)

Kwm - Leucotonalite of Ward Mountain (Cretaceous)
Medium-grained, light-colored biotite leucotonalite with minor muscovite. Locally abundant crescent-shaped aggregates a few centimeters long of small biotite flakes. In most places shows strong cataclastic foliation defined by rough alignment of crushed material and biotite aggregates. U-Pb isotopic

age (from Millerton Lake quadrangle) about 114 m.y. Description from source map: Mariposa 15' Quadrangle

Ktbm - Tonalite of Blue Canyon, main facies (Cretaceous)

Kbm - Tonalite of Blue Canyon, main facies (Cretaceous)
Medium-grained. light-colored granitic rocks, chiefly hornblende-biotite tonalite but grading locally into diorite, quartz diorite, granodiorite, and granite. Mostly equigranular. but in places has K-feldspar phenocrysts as much as 2 cm long, biotite flakes as much as 1 cm. and hornblende prisms as much as 1.5 cm. Planar foliation conspicuous in some areas but commonly faint and locally absent: defined by orientation of mafic minerals and lenticular mafic inclusions. Lineation conspicuous only in a few places. In many areas cut by numerous small dikes, mostly less than 2 m thick, of aplite-pegmatite, microtonalite, and microdiorite with a variety of textures: lamprophyre dikes scarce and small. Quartz veins not common but abundant locally. U-Pb isotopic age (on specimens from this and adjoining quadrangles) about 114 m.y. Divided into main facies, microtonalite facies (Kbmt), mafic tonalite facies (Kbtm), and the mafic microtonalite facies (Kbmm). Description from source map: Mariposa 15' Quadrangle

Kbmt - Tonalite of Blue Canyon, microtonalite facies (Cretaceous)

Kbmt - Tonalite of Blue Canyon, microtonalite facies (Cretaceous)
Fine-grained, light-colored granitic rocks with biotite as the only mafic mineral. A few small dark inclusions. Foliation faint or absent. Divided into main facies (Kbm), microtonalite facies, mafic tonalite facies (Kbtm), and the mafic microtonalite facies. Description from source map: Mariposa 15' Quadrangle

Kbtm - Tonalite of Blue Canyon, mafic tonalite facies (Cretaceous)

Kbtm - Tonalite of Blue Canyon, mafic tonalite facies (Cretaceous)
Medium- to fine-grained granitic rocks darker than the main facies of tonalite. Texture and composition variable, but hornblende generally abundant and in excess of biotite. Foliation faint or absent. Divided into main facies (Kbm), microtonalite facies (Kbmt), mafic tonalite facies, and the mafic microtonalite facies. Description from source map: Mariposa 15' Quadrangle

Kbmm - Tonalite of Blue Canyon, mafic microtonalite facies (Cretaceous)

Kbmm - Tonalite of Blue Canyon, mafic microtonalite facies (Cretaceous)
Fine-grained gray tonalite with a higher proportion of mafic minerals than the main-facies unit. Variable in composition and texture, much of it resembling the mafic inclusions and dikes of microtonalite and microdiorite in the main-facies unit. Commonly contains angular fragments and blocks of the main-facies tonalite; cut by many aplite dikes. Divided into main facies (Kbm), microtonalite facies (Kbtm), mafic tonalite facies (Kbtm), and the mafic microtonalite facies. Description from source map: Mariposa 15' Quadrangle

Kdr - Granodiorite of Double Rock (Early Cretaceous)

Kd - Granodiorite of Double Rock (Early Cretaceous)
Coarse-grained porphyritic granodiorite. Locally abundant lensoid mafic inclusions accompanied by alined tabular K-feldspar phenocrysts give the rock a streaked appearance. Previously considered Jurassic by Kistler. Description from source map: Tuolumne Meadows 15' Quadrangle

Jd - Granodiorite of Double Rock (Jurassic)
Biotite granodiorite, coarse-grained, porphyritic, gray, weathers buff or reddish brown; locally varies to quartz monzonite. Characterized by a foliated and streaky appearance manifested by locally abundant autoliths and, in many plates, by parallel alinement of microcline phenocrysts. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kmh - Granodiorite of Mount Hoffman (Early Cretaceous)

Kh - Granodiorite of Mount Hoffman (Early Cretaceous)
Coarse-grained locally porphyritic biotite granodiorite and granite. Southeast margin of pluton in west side of quadrangle (Mount Hoffman pluton) is locally sheared. Rb-Sr whole-rock age: 98±4 m.y. Previously considered Jurassic by Kistler (1973). Description from source map: Tuolumne Meadows 15' Quadrangle

Jh - Granodiorite of Mount Hoffman (Jurassic)
Biotite granodiorite, coarse-grained, locally porphyritic, light-gray; weathers buff or reddish brown. Locally varies to quartz monzonite. Southeastern border of pluton is alaskite that is locally sheared. Color index of the granodiorite is about 10, that of the alaskite about 3. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Kil - Granite of Ireland Lake (Early Cretaceous)

Kil - Granite of Ireland Lake (Early Cretaceous)
Medium- to coarse-grained porphyritic granite, much of it strongly sheared. Description from source map: Tuolumne Meadows 15' Quadrangle

Kgl - Leuocgranite of Gallison Lake (Early Cretaceous)

Kgl - Leuocgranite of Gallison Lake (Early Cretaceous)
Fine-grained felsic granite. Description from source map: Tuolumne Meadows 15' Quadrangle

Kdp - Dacite porphyry (Early Cretaceous)

Kdp - Dacite porphyry (Early Cretaceous)
Fine-grained gray rock composed of plagioclase phenocrysts in a matrix of plagioclase, quartz, and opaque minerals. Description from source map: Tuolumne Meadows 15' Quadrangle

Kft - Felsic tuff (Early Cretaceous)

Kft - Felsic tuff (Early Cretaceous)
Quartz and feldspar crystals abundant, and collapsed pumice fragments present locally. Includes thinly laminated calc-silicate rock composed of quartz, feldspar, epidote, and opaque minerals. Description from source map: Tuolumne Meadows 15' Quadrangle

Kph - Pelitic hornfels (Early Cretaceous)

Kph - Pelitic hornfels (Early Cretaceous)
Thin-bedded fine-grained metasiltstone composed of tiny grains of plagioclase, muscovite, quartz, and opaque minerals. Larger plagioclase grains are present locally. Crossbeds occur in some places. Description from source map: Tuolumne Meadows 15' Quadrangle

Kmft - Interstratified mafic and felsic tuffs (Early Cretaceous)

Kmft - Interstratified mafic and felsic tuffs (Early Cretaceous)
Includes a lens of pebble conglomerate. Tuffs are composed chiefly of quartz, biotite, plagioclase, and opaque minerals. Description from source map: Tuolumne Meadows 15' Quadrangle

KJqdg - Quartz diorite, diorite and gabbro (Cretaceous and/or Jurassic)

KJd - Diorite (Jurassic or Early Cretaceous)
Small masses of quartz diorite and less abundant diorite, gabbro, and tonalite. The masses are predominantly dark, medium grained, equigranular hornblende-biotite quartz diorite containing 20 to 40 percent mafic minerals, but the rocks range in texture from fine grained to coarsely porphyritic, and in composition from biotite tonalite to hornblende diorite, pyroxene diorite, and hornblende gabbro. The dioritic masses are older than the surrounding rocks, but include dikes of younger quartz diorite and tonalite similar to the dikes of intrusive diorite mapped separately on the northern wall of Yosemite Valley. Description from source map: Yosemite 15' Quadrangle

Kjdg - Diorite and gabbro (Cretaceous or Jurassic)
Dark rocks of variable composition and texture. Description from source map: Bass Lake 15' Quadrangle

KJdg - Quartz diorite, diorite and gabbro (Cretaceous or Jurassic)
Medium- to coarse-grained dark-colored rocks. Description from source map: El Portal 15' Quadrangle

KJgb - Gabbro and diorite (Cretaceous or Jurassic)
Dark-colored hornblende-plagioclase rocks, conspicuously variable in texture and composition. Mostly medium to coarse grained, locally fine grained. Biotite generally present, locally in excess of hornblende. Some varieties have monoclinic and (or) orthorhombic pyroxene, commonly as cores of hornblende crystals. Foliation faint or absent. Description from source map: Mariposa 15' Quadrangle

KJqd - Quartz diorite, diorite and gabbro (Cretaceous or Jurassic)
Mafic plutonic rocks ranging greatly in composition, grain size, and texture. Probably includes rocks of different ages. Description from source map: Tuolumne Meadows 15' Quadrangle

dg - Diorite and gabbro (age unknown)
In scattered masses that are extremely variable in grain size, texture, and composition. Some masses

intrude the granodiorite of Bummers Flat (Kbf) but most appear to be xenoliths. Description from source map: Pinecrest 15' Quadrangle

KJd - Diorite and gabbro (Jurassic and Cretaceous)
Fine- to coarse-grained, occurs as scattered masses not necessarily of same age. Gabbro limited chiefly to central part of mass south of Iron Creek, and masses north of Stevenson Meadow, south of Island Pass, and northeast of Davis Lakes. Description from source map: Devils Postpile 15' Quadrangle

Km - Meta-andesite and metarhyodacite (Early Cretaceous)

Km - Meta-andesite and metarhyodacite (Early Cretaceous)
Slightly metamorphosed flows and tuff forming small outcrops on the flanks of Raymond Mountain. The meta-andesite is in well-jointed flows of gray porphyritic andesite that contains euhedral tabular phenocrysts of plagioclase as long as 5 mm and less abundant hornblende (partly altered to biotite) in a felted groundmass. The metarhyodacite is a gray tuff containing abundant broken crystals of plagioclase as large as 5 mm and less abundant quartz and hornblende (partly altered to biotite) in a fine-grained matrix. Description from source map: Yosemite 15' Quadrangle

Kmrp - Metarhyodacite porphyry (Early Cretaceous)

Kmr - Metarhyodacite porphyry (Early Cretaceous)
Dark, slightly metamorphosed rhyodacite porphyry forming a 30-ft-wide dike near Star Lakes. The porphyry contains nearly 50 percent light-colored, rounded and embayed phenocrysts of plagioclase and much less abundant quartz and amphibole in a dark, very fine grained groundmass. Age about 108 Ma (Rb-Sr). Description from source map: Yosemite 15' Quadrangle

Kmv - Metavolcanic rocks (Early Cretaceous)

Kmv - Metavolcanic rocks (Early Cretaceous?)
Basaltic and andesitic metavolcanic rocks derived from lava flows and tuffs. Includes associated dark metasedimentary rocks. Description from source map: Yosemite 15' Quadrangle

Kbop - Granite of Bond Pass (Cretaceous)

Kbp - Granite of Bond Pass (Cretaceous)
Gray, moderately foliated, hornblende-biotite granite and granodiorite with moderately large, slightly pinkish, K-feldspar phenocrysts. Locally intensely sheared. Includes bodies of aplite or fine-grained sugary alaskite containing tourmaline rosettes and mapped separately. Description from source map: Tower Peak 15' Quadrangle

Kavl - Granite of Avonelle Lake (Cretaceous)

Kal - Granite of Avonelle Lake (Cretaceous)
Coarse-grained biotite granite, commonly with abundant tabular phenocrysts of microcline as much as 3 cm in maximum dimension. Equivalent to granodiorite of Rancheria Mountain and part of granodiorite of Double Rock of Kistler (1973). Description from source map: Tower Peak 15' Quadrangle

Kdl - Granite of Dorothy Lake (Cretaceous)

Kdl - Granite of Dorothy Lake (Cretaceous)
Light-pink, fine- to coarse grained tourmaline-bearing granite. Contains rare miarolitic cavities. Locally intensely sheared, with tourmaline on shear surfaces. Description from source map: Tower Peak 15' Quadrangle

Klh - Granite of Lake Harriet (Cretaceous)

Klh - Granodiorite of Lake Harriet (Cretaceous)
Dark-gray, moderately foliated granodiorite characterized by shreddy clots of biotite and hornblende. Aplitic border facies along northeastern margin mapped separately. Description from source map: Tower Peak 15' Quadrangle

Kmc - Leucogranite of Mount Clark (Lower Cretaceous)

Kmc - Leucogranite of Mount Clark (Lower Cretaceous)
Very light gray, medium-grained, equigranular hornblende biotite leucogranite. Description from source map: Merced Peak 15' Quadrangle

Klg - Leucogranite (Lower Cretaceous)

Klg - Leucogranite (Lower Cretaceous)
Fine- to medium-grained equigranular biotite leucogranite forming small angular blocks in the granodiorite of Jackass Lakes on the south flank of Long Mountain; and small strongly sheared masses along the South Fork of the Merced River east of Moraine Meadow and on the southwest flank of Quartz Mountain. Description from source map: Merced Peak 15' Quadrangle

Kqd - Quartz diorite and tonalite (Lower Cretaceous)

Kqd - Quartz diorite and tonalite (Lower Cretaceous)
Fine- to medium-grained equigranular quartz diorite and tonalite in small masses within the granitic rocks and along contacts and in dikes within the metamorphic rocks. Medium-gray to medium-light-gray rocks containing sparse phenocrysts of plagioclase and 20 to 40 percent subequal amounts of biotite and hornblende. Description from source map: Merced Peak 15' Quadrangle

Klc - Quartz Diorite of Long Creek (Lower Cretaceous)

Klc - Quartz Diorite of Long Creek (Lower Cretaceous)
Light-gray, medium-grained quartz diorite containing 15 to 20 percent equally abundant biotite and hornblende. Forms several small masses and dikes in metavolcanic rocks in Bench Canyon and in the drainage basin of Long Creek Includes a zone of abundant inclusions. Description from source map: Merced Peak 15' Quadrangle

Kmva - Undifferentiated metavolcanic rocks (Lower Cretaceous)

Km - Undifferentiated metavolcanic rocks (Lower Cretaceous)
Quartzofeldspathic hornfels, epidote-amphibolite hornfels, and less abundant schist and gneiss derived from pyroclastic rocks, lava flows, volcanic intrusive rocks, and volcanogenic sedimentary rocks ranging in composition from basalt to rhyolite. Predominantly medium- to light-gray, massive to weakly foliated rocks having well-preserved relict textures derived from massive rhyodacitic vitric and vitric-crystal tuff, lapil1i tuff, and tuff breccia. Along the eastern edge of the quadrangle, the metavolcanic rocks are more varied and include dark-gray flows of porphyritic metabasalt and meta-andesite and well-bedded volcanogenic siltstone, sandstone, and conglomerate. In the southwest comer of the quadrangle, the rocks are predominantly medium- to dark-gray massive tuff and tuff breccia of andesitic and dacitic composition. Description from source map: Merced Peak 15' Quadrangle

Kmq - Quartzofeldspathic gneiss (Lower Cretaceous)

Kmq - Quartzofeldspathic gneiss (Lower Cretaceous)
Very light gray, fine-grained, weakly foliated rocks near Jackass Meadow, derived from silicic tuff or volcanic intrusive rocks of granitic composition. Description from source map: Merced Peak 15' Quadrangle

Kmr - Metarhyolite, younger (Lower Cretaceous)

Kmr - Metarhyolite (Lower Cretaceous)
Light-gray quartzofeldspathic hornfels derived from crystal-vitric tuff, breccia, and flow rock of rhyolitic composition. Forms a 20-m-thick layer near Cold Springs Meadow. Description from source map: Merced Peak 15' Quadrangle

Kslpg - Granodiorite of Soldier Lake Pluton (Lower Cretaceous)

Ksg - Granodiorite of Soldier Lake Pluton (Cretaceous)
Fine-grained, light-gray, massive, well-jointed, strongly foliated granodiorite; contains zoned calcic andesine (An35-45), quartz, biotite, hornblende, and alkali feldspar as interstitial grains and rims on the plagioclase. Description from source map: Matterhorn Peak 15' Quadrangle

Kbp - Rocks of Buckeye Creek Pluton, porphyritic quartz monzonite (Cretaceous)

Kbp - Rocks of Buckeye Creek Pluton, porphyritic quartz monzonite (Cretaceous)
Massive, porphyritic (Kbp), and nonporphyritic (Kbn), light- to medium-gray and locally pinkish quartz monzonite composed of quartz, orthoclase, calcic oligoclase, biotite, and hornblende; phyritic with phenocrysts of alkali feldspar in a medium-grab ground mass. Grades locally into dark medium-grained hornblende-biotite quartz diorite (Kbd). Description from source map: Matterhorn Peak 15' Quadrangle

Kbn - Rocks of Buckeye Creek Pluton, nonporphyritic quartz monzonite (Cretaceous)

Kbn - Rocks of Buckeye Creek Pluton, nonporphyritic quartz monzonite (Cretaceous)
Massive, porphyritic (Kbp), and nonporphyritic (Kbn), light- to medium-gray and locally pinkish quartz monzonite composed of quartz, orthoclase, calcic oligoclase, biotite, and hornblende; phyritic with phenocrysts of alkali feldspar in a medium-grab ground mass. Grades locally into dark medium-grained hornblende-biotite quartz diorite (Kbd). Description from source map: Matterhorn Peak 15' Quadrangle

Kbd - Rocks of Buckeye Creek Pluton, quartz diorite (Cretaceous)

Kbd - Rocks of Buckeye Creek Pluton, quartz diorite (Cretaceous)
Massive, porphyritic (Kbp), and nonporphyritic (Kbn), light- to medium-gray and locally pinkish quartz monzonite composed of quartz, orthoclase, calcic oligoclase, biotite, and hornblende; phyritic with phenocrysts of alkali feldspar in a medium-grab ground mass. Grades locally into dark medium-grained hornblende-biotite quartz diorite (Kbd). Description from source map: Matterhorn Peak 15' Quadrangle

KJf - Granodiorite of King and Fish Creeks (Cretaceous and Jurassic)

KJf - Granodiorite of King and Fish Creeks (Jurassic and Cretaceous)
Fine- to coarse-grained, varied composition and texture with average composition of granodiorite. Both King Creek and Fish Creek masses are highly contaminated and contain numerous metavolcanic inclusions, including large masses of part to nearly completely assimilated material. King Creek are also cut by numerous mafic and rhyolitic dikes (only rhyolitic dikes shown on map). KJf intruded by Kcp and Kmg. Description from source map: Devils Postpile 15' Quadrangle

KJd - Diorite, younger (Cretaceous or older)

di - Diorite (Cretaceous or older)
Occurs as generally small, irregularly shaped bodies throughout the map area. Extremely variable in grain size, texture, and composition. Some bodies are older and some younger than the plutonic rocks with which they are in contact, but most appear to be xenoliths. Two larger bodies of coarse-grained hornblende gabbro (Kgb), near the center of the quadrangle, intrude the metasedimentary sequence and in turn also have been metamorphosed. This coarse-grained gabbro has a U/Pb zircon age of about 148 Ma (Lahren and others, 1990). Description from source map: Tower Peak 15' Quadrangle

KJgb - Gabbro, older (Cretaceous or older)

gb - Gabbro (Cretaceous or older)
Occurs as generally small, irregularly shaped bodies throughout the map area. Extremely variable in grain size, texture, and composition. Some bodies are older and some younger than the plutonic rocks with which they are in contact, but most appear to be xenoliths. Two larger bodies of coarse-grained hornblende gabbro (Kgb), near the center of the quadrangle, intrude the metasedimentary sequence and in turn also have been metamorphosed. This coarse-grained gabbro has a U/Pb zircon age of about 148 Ma (Lahren and others, 1990). Description from source map: Tower Peak 15' Quadrangle

KJr - Metarhyolite tuff (Cretaceous or Jurassic)

Kjr - Metarhyolite tuff (Cretaceous or Jurassic)
Chiefly light-gray crystallithic metatuff. Includes metatuff breccia and flow-banded rhyolite. In northeast corner of quadrangle. Description from source map: Bass Lake 15' Quadrangle

KJmb - Mafic metatuff and metatuff breccia (Cretaceous or Jurassic)

KJm - Mafic metatuff and metatuff breccia (Cretaceous or Jurassic)
Medium to dark gray metamorphosed pyroclastic rocks. Description from source map: Bass Lake 15' Quadrangle

KJma - Mafic intrusive rocks (Cretaceous or Jurassic)

KJm - Mafic intrusive rocks (Cretaceous or Jurassic)
Most commonly medium- to coarse grained hornblende gabbro, hornblendite, and pyroxenite; includes some fine- to medium-grained diorite. Description from source map: Lake Eleanor 15' Quadrangle

KJgm - Granitic gneisses of the Mokelumne Peak Roof Pendant (Cretaceous(?) and Jurassic(?))

KJgm - Granitic gneisses of the Mokelumne Peak Roof Pendant (Cretaceous(?) and Jurassic(?))
Heterogeneous unit containing fine- to medium-grained biotite-granodiorite gneiss; medium- to coarse-grained biotite-hornblende granodiorite gneiss that locally contains small porphyroblastic feldspar augen; fine-grained gneissic aplite; and abundant small outcrops of metamorphic rocks. This unit extends northwesterly into the Mokelumne Wilderness where it was named the Mokelumne Peak roof pendant by McKee and Howe (1981). K-Ar dating by McKee and Howe indicates that the pendant has undergone reheating by the Sierra Nevada batholith about 98 m.y. ago and thus the primary age of the pendant is unknown. Previously called the granodiorite of Silver Creek by Armin and others (1981) in the Markleeville quadrangle. Protoliths for this unit are probably pre-Cretaceous in age. Description from source map: Dardanelles Cone 15' Quadrangle

KJsc - Quartz monzonite of Sheepthief Creek (Cretaceous or Jurassic)

KJsc - Quartz monzonite of Sheepthief Creek (Jurassic or Cretaceous)
Southwest corner of quadrangle. Medium-grained, locally porphyritic. Intrudes granodiorite of Dinkey Creek; relation to Mount Givens Granodiorite unknown. Description from source map: Kaiser Peak 15' Quadrangle

KJg - Alaskite of Graveyard Peak (Cretaceous or Jurassic)

KJg - Alaskite of Graveyard Peak (Jurassic or Cretaceous)
Very light colored, medium-grained, equigranular. Intrudes granodiorite of Margaret Lakes. Description from source map: Kaiser Peak 15' Quadrangle

KJs - Sheared and lineated quartz monzonite (Cretaceous or Jurassic)

KJs - Sheared and lineated quartz monzonite (Jurassic or Cretaceous)
Dikes in north margin of granodiorite of Dinkey Creek. Description from source map: Kaiser Peak 15' Quadrangle

KJm - Granodiorite of Margaret Lakes (Cretaceous or Jurassic)

KJm - Granodiorite of Margaret Lakes (Jurassic or Cretaceous)
Fine- to medium-grained biotite granodiorite; generally sheared. Description from source map: Kaiser Peak 15' Quadrangle

KJqm - Biotite quartz monzonite and granodiorite (Cretaceous or Jurassic)

KJqm - Biotite quartz monzonite and granodiorite (Jurassic or Cretaceous)
Medium-grained biotite quartz monzonite and granodiorite; color index averages about 8. Rock is locally porphyritic with K-feldspar phenocrysts about 1 cm in average length. Plagioclase is predominantly andesine. Sphene is an abundant accessory mineral; hornblende is minor. A finer grained phase occurs in the central part of the unit. This unit intrudes granodiorite of Dinkey Creek. Description from source map: Shuteye Peak 15' Quadrangle

KJdcp - Granodiorite of Dinkey Creek, porphyritic (Cretaceous or Jurassic)

KJdcp - Granodiorite of Dinkey Creek, porphyritic (Jurassic or Cretaceous)
K-feldspar phenocrysts are generally tabular, but large conspicuous equant phenocrysts are present in northwest part. Description from source map: Kaiser Peak 15' Quadrangle

KJdc - Granodiorite of Dinkey Creek, equigranular and generally foliated (Cretaceous or Jurassic)

KJdc - Granodiorite of Dinkey Creek, equigranular and generally foliated (Jurassic or Cretaceous)
Equigranular and generally foliated, but a coarse-grained felsic facies in the east-central part is unfoliated. Description from source map: Kaiser Peak 15' Quadrangle

KJdc - Granodiorite of Dinkey Creek (Jurassic or Cretaceous)
Hornblende-biotite granodiorite and quartz monzonite with average color index of about 10. Generally moderately to strongly porphyritic with tabular K-feldspar phenocrysts commonly as much as 2 cm in average length and rarely as much as 4 or 5 cm long. Plagioclase is predominantly calcic oligoclase and sodic andesine. The porphyritic rock, which predominates in this unit within the Shuteye Peak quadrangle and to the east on Kaiser Ridge, has been shown by mapping in the adjacent Kaiser Peak and Huntington Lake quadrangles (P.C. Bateman, oral commun., 1966) to grade laterally near Huntington Lake into medium-grained dark granodiorite more typical of the main mass of granodiorite of Dinkey Creek to the southeast in the Huntington Lake quadrangle. The granodiorite of Dinkey Creek is intruded by the Mount Givens Granodiorite in the Blackcap Mountain quadrangle (Bateman, 1965). Description from source map: Shuteye Peak 15' Quadrangle

KJdmp - Quartz diorite and other mafic plutonic rocks (Cretaceous or Jurassic)

KJd - Quartz diorite and other mafic plutonic rocks (Jurassic or Cretaceous)
Mostly recrystallized mafic volcanic rocks, especially in northeast corner of quad. Orbicular diorite 1.5 miles southeast of Big Margaret Lake. Description from source map: Kaiser Peak 15' Quadrangle

KJfg - Fine-grained quartz monzonite (Cretaceous or Jurassic)

KJfg - Fine-grained quartz monzonite (Jurassic or Cretaceous)
Fine-grained aplitic quartz monzonite occurs as a small mass and associated dikes at the north edge of the quadrangle, It is intrusive into the adjacent small mass of hornblende-biotite granodiorite. Description from source map: Shuteye Peak 15' Quadrangle

KJdg - Dark granodiorite and other mafic plutonic rocks (Cretaceous or Jurassic)

KJd - Dark granodiorite and other mafic plutonic rocks (Jurassic or Cretaceous)
Unit includes various small bodies of mafic intrusive rock of uncertain ages relative to most of the other intrusive rocks. Dark medium-grained hornblende-biotite granodiorite north of Muglers Meadow and north of Iron Lakes; dark medium-grained hornblende-biotite granodiorite and quartz diorite on Kaiser Ridge; diorite and gabbro west of Little Shuteye Pass. Body north of Muglers Meadow is intruded by the Mount Givens Granodiorite. Description from source map: Shuteye Peak 15' Quadrangle

pKt - Tactite, older (pre-Cretaceous)

pKt - Tactite (pre-Cretaceous)
Metasedimentary rocks near the southeastern corner of the quadrangle and in small inclusions and screens elsewhere in the area. pKsq, dark biotite schist, gray metaquartzite, and less abundant rusty weathering argillite and tactite pKt, tactite layer, composed mostly of epidote, pyroxene, garnet, and magnetite. Description from source map: Yosemite 15' Quadrangle

pKsq - Schist and metaquartzite (pre-Cretaceous)

pKsq - Schist and metaquartzite (pre-Cretaceous)
Metasedimentary rocks near the southeastern corner of the quadrangle and in small inclusions and screens elsewhere in the area. pKsq, dark biotite schist, gray metaquartzite, and less abundant rusty weathering argillite and tactite pKt, tactite layer, composed mostly of epidote, pyroxene, garnet, and magnetite. Description from source map: Yosemite 15' Quadrangle

pKmvb - Basaltic metavolcanic rocks (pre-Cretaceous)

mvb - Basaltic metavolcanic rocks (Cretaceous or older)
Basaltic and andesitic metavolcanic rocks derived from lava flows and tuffs. Includes associated dark metasedimentary rocks. Description from source map: Tower Peak 15' Quadrangle

pKmvr - Rhyolitic metavolcanic rocks (pre-Cretaceous)

mvr - Rhyolitic metavolcanic rocks (Cretaceous or older)
Rhyolitic and dacitic metavolcanic rocks derived from tuffs, some probably ignimbrites. Includes metarhyolite breccia and possibly some metamorphosed intrusive rocks. Description from source map: Tower Peak 15' Quadrangle

pKms - Metasedimentary rocks, undivided (pre-Cretaceous)

ms - Metasedimentary rocks (pre-Cretaceous)
Includes quartzite, marble, biotite-andalusite schist, meta-conglomerate, and calc-silicate hornfels. Predominate rock type indicated in local areas: pKmsq, commonly pure, white, crossbedded quartzite; pKmsm, white to gray, medium- to coarse-grained marble; pKmsh, fine-grained calc-silicate hornfels. Description from source map: Tower Peak 15' Quadrangle

pKm - Metasedimentary rocks, undivided (pre-Cretaceous)
Pendant on Highway 4 east of Lake Alpine consists of biotite hornfels, garnet-quartz-biotite schist, calc granofels, biotite-hornblende amphibolite, quartz-biotite-feldspar metatuff, metatuff-breccia, and garnet-clinopyroxene-epidote skarn. Protoliths for this unit are pre-Cretaceous in age. Description from source map: Dardanelles Cone 15' Quadrangle

pKmsq - Metasedimentary rocks, quartzite (pre-Cretaceous)

msq - Metasedimentary rocks, quartzite (pre-Cretaceous)
Includes quartzite, marble, biotite-andalusite schist, meta-conglomerate, and calc-silicate hornfels. Predominate rock type indicated in local areas: pKmsq, commonly pure, white, crossbedded quartzite; pKmsm, white to gray, medium- to coarse-grained marble; pKmsh, fine-grained calc-silicate hornfels. Description from source map: Tower Peak 15' Quadrangle

pKmsm - Metasedimentary rocks, marble (pre-Cretaceous)

msm - Metasedimentary rocks, marble (pre-Cretaceous)
Includes quartzite, marble, biotite-andalusite schist, meta-conglomerate, and calc-silicate hornfels. Predominate rock type indicated in local areas: pKmsq, commonly pure, white, crossbedded quartzite; pKmsm, white to gray, medium- to coarse-grained marble; pKmsh, fine-grained calc-silicate hornfels. Description from source map: Tower Peak 15' Quadrangle

pKmsh - Metasedimentary rocks, hornfels (pre-Cretaceous)

msh - Metasedimentary rocks, hornfels (pre-Cretaceous)
Includes quartzite, marble, biotite-andalusite schist, meta-conglomerate, and calc-silicate hornfels. Predominate rock type indicated in local areas: pKmsq, commonly pure, white, crossbedded quartzite; pKmsm, white to gray, medium- to coarse-grained marble; pKmsh, fine-grained calc-silicate hornfels. Description from source map: Tower Peak 15' Quadrangle

pKmsmf - Metasedimentary rocks east of Melones Fault (pre-Cretaceous)

pKms - Metasedimentary rocks east of Melones Fault (pre-Cretaceous)
Slate, phyllite, mica schist, hornfels, quartzite, and metaconglomerate. Metamorphic equivalents of clastic sedimentary rocks: most commonly gray to black slates and phyllites, but near intrusive contacts altered to hornfels and (or) coarse mica schist. Quartzite more abundant than in rocks west of Melones fault, especially in northeast quarter of quadrangle. Planar cleavage generally prominent, lineation conspicuous locally. Bedding commonly parallel to cleavage, locally at high angles; generally not discernible in fine-grained rocks. Gradational bedding prominent in a few places. Abundant pyrite locally, coloring weathered outcrops yellow to red-brown. Age uncertain: at least as old as Jurassic, and part or all may be Paleozoic. Outcrops continuous with rocks assigned to the Calaveras Complex of Schweickert and others (1977) in adjoining quadrangles. Description from source map: Mariposa 15' Quadrangle

pKml - Metalimestone and mica schist (pre-Cretaceous)

pKml - Metalimestone and mica schist (pre-Cretaceous)
Coarse calcite marble, calcite-garnet rock, calcite-wollastonite rock, garnet-pyroxene rock, and quartz-pyroxene hornfels, interlayered with mica schist: metalimestone bodies too small and erratic to be mapped separately. Description from source map: Mariposa 15' Quadrangle

pKmv - Metavolcanic rocks east of Melones Fault (pre-Cretaceous)

pKmv - Metavolcanic rocks east of Melones Fault (pre-Cretaceous)
Chlorite schist and hornfels, chlorite-muscovite schist. hornblende schist, and amphibolite. Chiefly metamorphic equivalents of basalt and andesite in the form lava flows, tuff beds, volcanic breccias, and small intrusive bodies; metadacite and metarhyolite locally. Chloritized mafic phenocrysts locally, as much as 1 cm diameter. Mostly strongly foliated, in some places massive. Locally intimately interbedded with metasedimentary rocks: locally intruded by small bodies of ultramafic rocks. Metavolcanic rocks north and east of Mariposa are probably Jurassic because a late Oxfordian ammonite has been reported in rocks continuous with them a few kilometers northwest; metavolcanic rocks elsewhere are known only to be older than the Cretaceous granitic rocks that intrude them. Description from source map: Mariposa 15' Quadrangle

pKmu - Metamorphosed ultramafic rocks east of Melones Fault (pre-Cretaceous)

pKmu - Metamorphosed ultramafic rocks east of Melones Fault (pre-Cretaceous)
Mostly light- to dark-green and black serpentinite, conspicuously reddish on weathered surfaces, with many slickensides and patches of soft whitish talc schist; partly schistose and partly massive with conspicuous mesh structure and bastite metacrysts. Locally metamorphosed to coarse aggregates of talc and olivine plus anthophyllite and (or) actinolite. Commonly associated with aplite and vein quartz; locally silicified to a magenta-colored rock resembling quartzite. Description from source map: Mariposa 15' Quadrangle

pKcs - Calc-silicate hornfels, quartzite and schist (pre-Cretaceous)

pKcs - Calc-silicate hornfels, quartzite and schist (pre-Cretaceous)
In pendants and septa between Glen Aulin and May Lake. Description from source map: Tuolumne Meadows 15' Quadrangle

pKq - Massive quartzite (pre-Cretaceous)

pKq - Massive quartzite (pre-Cretaceous)
Associated with other metasedimentary rocks in metamorphic remnants between Glen Aulin and May Lake. Description from source map: Tuolumne Meadows 15' Quadrangle

pKs - Quartz-biotite-plagioclase schist (pre-Cretaceous)

pKs - Quartz-biotite-plagioclase schist (pre-Cretaceous)
Fine- to medium-grained layered schist of probable metasedimentary origin. Protoliths for this unit are probably pre-Cretaceous in age. Description from source map: Pinecrest 15' Quadrangle

pKh - Hornfels, granofels and amphibolite (pre-Cretaceous)

pKh - Hornfels, granofels and amphibolite (pre-Cretaceous)
Four small pendants near Bull Run Lake consist mainly of biotite hornfels and quartz-pyroxene calc granofels with relatively minor biotite-hornblende amphibolite. Protoliths for this unit are pre-Cretaceous in age. Description from source map: Dardanelles Cone 15' Quadrangle

Jmg - Metagabbro (Jurassic)

Jmg - Metagabbro (Jurassic)
Dark, generally fine-grained, intrusive rocks presumed to be genetically related to associated mafic metavolcanic rocks. Description from source map: Bass Lake 15' Quadrangle

Jmgb - Metagabbro (Jurassic)
Fine-grained mafic rock that intrudes and was deformed with the enclosing stratified rocks. Description from source map: El Portal 15' Quadrangle

pKmg - Metagabbro (pre-Cretaceous)
Medium - to dark-green, coarse-grained rocks consisting chiefly of chloritized hornblende and saussuritized plagioclase, with abundant epidote both within the rocks and on joint surfaces. Fresher varieties not easily distinguishable from the gabbro and diorite unit (KJqdg). Age uncertain, presumably the same as that of the metavolcanic rocks east of Melones fault. Description from source map: Mariposa 15' Quadrangle

Jum - Serpentinized ultramafic rocks (Mesozoic or Paleozoic)

um - Serpentinized ultramafic rocks (Mesozoic or Paleozoic)
Confined to and define the approximate limits of the Melones fault zone. Description from source map: El Portal 15' Quadrangle

Jmv - Mafic metavolcanic rocks (Jurassic)

Jmv - Mafic metavolcanic rocks (Jurassic)
Chiefly amphibolite probably derived from basaltic and andesitic metatuff, metatuff breccia, and flows. Forms the core of the Coarsegold roof pendant and lenses (probably infolded or faulted) within the adjacent slate and phyllite. Description from source map: Bass Lake 15' Quadrangle

Jwr - Granite of Woods Ridge (Jurassic)

Jwr - Granite of Woods Ridge (Jurassic)
Fine- to medium-grained porphyritic biotite granite and granodiorite. Characteristically contains coarse-grained phenocrysts of tabular to blocky subhedral potassium feldspar and fine-grained anhedral biotite flakes. Contaminated with mafic material near contacts with other rock units. Color index variable, from 5 to nearly 15. Designated as the granite and granodiorite of Cottonwood Creek by Huber (1983), and Stern and others (1981), respectively. U-Pb age of 150.9 Ma. Description from source map: Lake Eleanor 15' Quadrangle

Jgc - Tonalite of Granite Creek (Jurassic)

Jgc - Tonalite of Granite Creek (Jurassic)
Medium grained hornblende-biotite tonalite and granodiorite. Commonly strongly foliated; subhedral to euhedral mafic minerals; interstitial potassium feldspar. Color index about 25. U-Pb ages of 165.7 and 162.6 Ma. Description from source map: Lake Eleanor 15' Quadrangle

Jgcm - Tonalite of Granite Creek, mafic marginal facies (Jurassic)

Jgcm - Tonalite of Granite Creek, mafic marginal facies (Jurassic)
Medium-grained hornblende-biotite gabbro. Description from source map: Lake Eleanor 15' Quadrangle

Jmaf - Mariposa Formation (Jurassic)

Jm - Mariposa Formation (Jurassic)
Mostly slate, but locally includes quartzite and conglomerate. Altered to hornfels near contacts with plutonic rock. Occurs as slivers in the Melones fault zone. Description from source map: El Portal 15' Quadrangle

Jbu - Greenstone of Bullion Mountain (Jurassic)

Jbu - Greenstone of Bullion Mountain (Jurassic)
Chiefly andesitic and basaltic metatuff and metatuff breccia, but includes lava flows. Description from source map: El Portal 15' Quadrangle

Jmsmf - Metasedimentary rocks west of Melones Fault (Jurassic)

Jms - Metasedimentary rocks west of Melones Fault (Jurassic)
Slate, phyllite, mica schist, hornfels, quartzite, and metaconglomerate. Metamorphic equivalents of clastic sedimentary rocks: most commonly gray to black slates and phyllites, but near intrusive contacts altered to hornfels and (or) coarse mica schist. Abundant andalusite in some places, locally in crystals many centimeters long: purple garnet and sillimanite conspicuous in a few places. Planar cleavage generally prominent, lineation conspicuous locally. Bedding generally not discernible; when present, commonly parallel to cleavage but locally at high angles. Gradational bedding prominent in a few places. Stretched pebbles common in metaconglomerate, with elongations as much as 10:1. Abundant pyrite locally, coloring weathered outcrops yellow to red-brown. Age probably Late Jurassic (late Oxfordian to early Kimmeridgian), based on probable continuity of outcrops with the Mariposa Formation farther to the northwest. Description from source map: Mariposa 15' Quadrangle

Jmvmf - Metavolcanic rocks west of Melones Fault (Jurassic)

Jmv - Metavolcanic rocks west of Melones Fault (Jurassic)
Chiefly, gray-green chlorite schist and hornfels, metamorphic equivalents of tuff beds, lava flows, volcanic breccias, and small intrusive bodies; probable metadacites near west edge of quadrangle. Chloritized mafic phenocrysts locally, as much as 1 cm diameter. Purple garnet locally. Mostly strongly foliated, in some places massive. Locally intimately interbedded with metasedimentary rocks; locally intruded by small bodies of ultramafic rocks. Age probably Late Jurassic, based on close association with metasedimentary rocks correlative with the Mariposa Formation. Description from source map: Mariposa 15' Quadrangle

Jmu - Metamorphosed ultramafic rocks west of Melones Fault (Jurassic)

Jmu - Metamorphosed ultramafic rocks west of Melones Fault (Jurassic)
Light- to dark-green and black serpentinite, reddish on weathered surfaces. Partly schistose and partly massive with conspicuous mesh structure and bastite metacrysts. Description from source map: Mariposa 15' Quadrangle

Jlb - Tuffaceous lake beds (Jurassic)

Jlb - Tuffaceous lake beds (Jurassic)
Thinly bedded and fine grained; composed chiefly of volcanogenic sediment. Common minerals include plagioclase, quartz, biotite, hornblende, and opaque minerals. Calcareous layers contain calcite, diopside, hornblende, epidote, and trace amounts of scheelite. Description from source map: Tuolumne Meadows 15' Quadrangle

Jmgd - Microgranodiorite (Jurassic)

Jmgd - Micro granodiorite (Jurassic)
Hypabyssal intrusive rock east of Vogelsang Lake. Ranges in composition and texture from microgranodiorite to granite porphyry and intrusive rhyolite. Description from source map: Tuolumne Meadows 15' Quadrangle

Jrt - Rhyolite ash-flow tuff (Jurassic)

Jrt - Rhyolite ash-flow tuff (Jurassic)
Light-gray tuff with a few flattened pumice fragments. Phenocrysts of quartz and plagioclase are in a fine-grained matrix. Rb-Sr whole-rock age about 185 m.y. Description from source map: Tuolumne Meadows 15' Quadrangle

Jmvil - Metavolcanic rocks south of Ireland Lake (Jurassic)

Jmv - Metavolcanic rocks south of Ireland Lake (Jurassic)
Also includes septum 2 km northwest of Hooper Peak in the northwest corner of the quadrangle and a small mass 2½ km west of Babcock Lake in the south-central part. Predominantly tuff-breccia of intermediate composition containing angular to rounded fragments that average 2 to 10 cm across but are as large as 75 cm. Description from source map: Tuolumne Meadows 15' Quadrangle

Jmsil - Metasedimentary rocks west of Ireland Lake (Jurassic)

Jms - Metasedimentary rocks west of Ireland Lake (Jurassic)
Thinly laminated calc-silicate hornfels and quartz-biotite schist with epidote layers and "eyes." Locally interbedded with volcanic conglomerate. Description from source map: Tuolumne Meadows 15' Quadrangle

Jmsv - Undifferentiated metasedimentary and metavolcanic rocks North of Hooper Peak (Jurassic)

Jm - Undifferentiated metasedimentary and metavolcanic rocks North of Hooper Peak (Jurassic)
Pattern indicates abundant dikes of the adjacent plutonic rocks. Description from source map: Tuolumne Meadows 15' Quadrangle

Jcc - Granite of Cottonwood Creek (Jurassic)

Jcc - Granite of Cottonwood Creek (Jurassic)
Chiefly biotite granodiorite in Pinecrest quadrangle, locally porphyritic with centimeter-size K-feldspar phenocrysts. Grades southward into porphyritic biotite granite in Lake Eleanor quadrangle (F.C.W. Dodge and L.C. Calk, written commun., 1980). U-Pb isotopic ages of 148 m.y. and 151 m.y. have been obtained from this unit (Stern and others, 1981). Description from source map: Pinecrest 15' Quadrangle

Jm - Undifferentiated metasedimentary rocks (Lower Jurassic?)

Jm - Undifferentiated metasedimentary rocks (Lower Jurassic?)
Predominantly medium-gray, fine-grained, thinly bedded micaceous metaquartzite, but includes less abundant gray quartz-biotite hornfels and schist, red-weathering quartz-plagioclase hornfels, tactite, and marble. Description from source map: Merced Peak 15' Quadrangle

Jmt - Tactite, younger (Lower Jurassic?)

Jmt - Tactite (Lower Jurassic?)
Mostly epidote-pyroxene-garnet-magnetite rock. Description from source map: Merced Peak 15' Quadrangle

Jmq - Quartz-pebble conglomerate (Lower Jurassic?)

Jmq - Quartz-pebble conglomerate (Lower Jurassic?)
Near Cold Springs Meadow. Description from source map: Merced Peak 15' Quadrangle

Jmm - Marble, youngest (Lower Jurassic?)

Jmm - Marble (Lower Jurassic?)
Medium-gray cherty marble east of Chiquito Lake and west of Gray Peak. Description from source map: Merced Peak 15' Quadrangle

Jqtr - Quartz Diorite of South Fork of Tuolumne River (Jurassic)

Jq - Quartz Diorite of South Fork of Tuolumne River (Jurassic)
Biotite-hornblende quartz diorite, coarse-grained, dark-gray, foliated. Color index varies from 15 to 30. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Jdio - Diorite, older (Jurassic)

Jd - Diorite (Jurassic)
Fine-grained, massive, well-jointed, dark greenish-gray diorite composed of dark-green hornblende, pale greenish-brown biotite, calcic oligoclase, pale greenish diopsidic augite, and minor quartz. Locally weakly sheared. Description from source map: Matterhorn Peak 15' Quadrangle

di - Diorite (Jurassic)
Diorite, fine-grained, dark-gray to black; contains biotite and hornblende in variable proportions. Diorite occurs as inclusions in granitic rocks of Jurassic age and may be mostly chemically reconstituted metamorphic rocks. Description from source map: Hetch Hetchy Reservoir 15' Quadrangle

Jp - Quartz porphyry (Jurassic)

Jp - Quartz porphyry (Jurassic)
Light-gray, dense, weakly lineated, and foliated quartz porphyry with phenocrysts of clear quartz and dull white sodic oligoclase enclosed in a fine-grained groundmass of quartz, white feldspar, and black biotite. Description from source map: Matterhorn Peak 15' Quadrangle

Jsp - Serpentinite (Jurassic)

Jsp - Serpentinite (Jurassic)
Dark, mottled green and brown, highly sheared serpentinite, which was derived in part from pyroxenite and from andesitic lavas. Contains veins of chrysotile, conspicuous magnetite, and considerable anthophyllite at contacts with small granite dikes. Description from source map: Matterhorn Peak 15' Quadrangle

Jgn - Granite gneiss (Jurassic)

Jgn - Granite gneiss (Jurassic)
Foliated, lineated, light to dark gray, massive, well jointed granite gneiss with porphyroblasts of clear quartz in a gneissic matrix of quartz, potash feldspar, plagioclase, and biotite. Description from source map: Matterhorn Peak 15' Quadrangle

Jas - Rocks of Virginia Lakes sequence, amphibolite and biotite-hornblende schist (Jurassic)

Ja - Rocks of Virginia Lakes sequence, amphibolite and biotite-hornblende schist (Jurassic)
Dark- to light-green, gray, and purplish sheared lavas and pyroclastic deposits of andesitic and dacitic compositions; all completely metamorphosed into amphibolites and biotite-hornblende schist. Tuff is locally sheared to slate. Description from source map: Matterhorn Peak 15' Quadrangle

Jrs - Rocks of Virginia Lakes sequence, quartz sericite and phyllonite (Jurassic)

Jr - Rocks of Virginia Lakes sequence, quartz sericite and phyllonite (Jurassic)
Highly sheared, foliated, locally silicified and mineralized with pyrite. Derived principally from lavas of rhyolitic composition. Description from source map: Matterhorn Peak 15' Quadrangle

Jrtp - Rocks of Virginia Lakes sequence, quartz sericite and phyllonite, highly sheared (Jurassic)

Jrt - Rocks of Virginia Lakes sequence, quartz sericite and phyllonite (Jurassic)
Highly sheared, creamy-white to light-gray, locally stained brown by limonite, fine-grained tuffs and tuff breccias of rhyolitic and dacitic composition metamorphosed into quartz-sericite schist and phyllonite. Locally silicified and mineralized with pyrite. Description from source map: Matterhorn Peak 15' Quadrangle

Jvmb - Rocks of Virginia Lakes sequence, metabasalt (Jurassic)

Jb - Rocks of Virginia Lakes sequence, metabasalt (Jurassic)
Dark-gray to dark greenish - brown, dense, fined-grained, well-jointed, and locally weakly sheared metabasalt with relict phenocrysts of intermediate labradorite (An 50-55) set in a fine-grained groundmass of pale bluish-green hornblende, pale brown biotite, and pale green chlorite. Description from source map: Matterhorn Peak 15' Quadrangle

Jhm - Rocks of Virginia Lakes sequence, marble (Jurassic)

Jhm - Rocks of Virginia Lakes sequence, marble (Jurassic)
Medium- to fine-grained, streaked light-gray and white, poorly layered, massive marble, which locally contains white wollastonite and pale orange-brown garnet. Description from source map: Matterhorn Peak 15' Quadrangle

Jqhm - Rocks of Virginia Lakes sequence, quartzofeldspathic hornfels, calc-silicate hornfels, metaconglomerate and marble (Jurassic)

Jh - Rocks of Virginia Lakes sequence, quartzofeldspathic hornfels, calc-silicate hornfels, metaconglomerate and marble (Jurassic)
Well-bedded, banded, dark-gray to dark-brown quartzofeldspathic hornfels, locally andalusite-bearing; calc-silicate hornfels, metaconglomerate (Jqhmc) and thin, gray marble beds. Description from source map: Matterhorn Peak 15' Quadrangle

Jhcgl - Rocks of Virginia Lakes sequence, metaconglomerate (Jurassic)

cgl - Rocks of Virginia Lakes sequence, metaconglomerate (Jurassic)
No additional description provided on source map. Description from source map: Matterhorn Peak 15' Quadrangle

Jqhg - Rocks of Virginia Lakes sequence, quartzofeldspathic hornfels and metasiltstone (Jurassic)

Jq - Rocks of Virginia Lakes sequence, quartzofeldspathic hornfels and metasiltstone (Jurassic)
Bedded, banded, light-gray, brown to dark-gray siltstone, sandstone, chert, and minor conglomerate; all metamorphosed to quartzofeldspathic hornfels, calc-silicate hornfels, quartzite, metachert, and metaconglomerate. Description from source map: Matterhorn Peak 15' Quadrangle

Jdi - Diabase of Reversed Creek (Jurassic)

Jdi - Diabase of Reversed Creek (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kdwl - Diorite or Waugh Lake (Jurassic)

Jw - Diorite of Waugh Lake (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kdbc - Diorite of Bloody Canyon (Jurassic)

Jd - Diorite of Bloody Canyon (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Kgb - Gabbro, younger (Jurassic)

Jg - Gabbro (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Jx - Graywackes, volcanic tuffs and flows, crossbedded sandstone (Jurassic)

Jx - Graywackes, volcanic tuffs and flows, crossbedded sandstone (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Js - Marble and calc-silicate hornfels (Jurassic)

Js - Marble and calc-silicate hornfels (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Jt - Volcanic tuffs and flows, lapilli-tuff, shale and calc-silicate hornfels (Jurassic)

Jt - Volcanic tuffs and flows, lapilli-tuff, shale and calc-silicate hornfels (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Jc - Jurassic local basal conglomerate (Jurassic)

Jc - Local basal conglomerate (Jurassic)
No additional description provided on source map: Mono Craters 15' Quadrangle

Jtmb - Volcanic rocks near Twin Island Lakes, metabasalt (Jurassic)

Jb - basalt (Jurassic)
Thick flows; medium dark-gray to dark-gray, massive, finely porphyritic with labradorite laths ranging from a fraction of a millimeter to 5 mm in length, set in a dense matrix of plagioclase, biotite, chlorite, and hornblende. Description from source map: Devils Postpile 15' Quadrangle

Jma - Volcanic rocks near Twin Island Lakes, metaandesite and metabasalt (Jurassic)

Ja - andesite and basalt (Jurassic)
Lenticular sequence of thin to thick flows, commonly interlayered with thinly laminated to thin-bedded tuffaceous rocks; medium dark-gray to dark-gray; typically porphyritic with tabular phenocrysts of plagioclase (andesine to labradorite) as large as 2 cm in maximum dimension; locally contains quartz amygdules; bears striking megascopic resemblance to Jab and JTRa. Description from source map: Devils Postpile 15' Quadrangle

Jms - Volcanic rocks near Twin Island Lakes, metasedimentary rocks (Jurassic)

Js - sedimentary rocks (Jurassic)
A generally well-bedded sequence of sedimentary rocks, tuffaceous in part, in the northwestern part of the quadrangle. Composed chiefly of siltstone and fine-grained sandstone but includes tremolite-bearing carbonaceous marble, pelitic hornfels and slate, both typically carbonaceous, and granule conglomerate. Locally includes several feet of graded, rhythmically bedded siltstone in layers ranging from 1 mm to 3 cm. Description from source map: Devils Postpile 15' Quadrangle

Jmbr - Volcanic rocks of the Ritter Range, undifferentiated metavolcanic rocks (Jurassic)

Jbr - undifferentiated volcanic rocks, chiefly breccia (Jurassic)
Highly varied unit that includes nearly all lithologic types of metavolcanic rocks found in the metavolcanic sequence but consists chiefly of tuff breccia, somewhat lesser amount crystal tuff and crystal-lithic tuff, and a much smaller flows, hypabyssal intrusives, and bedded tuff. Composition ranges from rhyolite to basalt but averages near dacite or rhyodacite. Rocks are typically structureless, at most, weakly foliated; primary texture generally dominates. Lithic fragments range in maximum dimension from a few mm to more than a foot; fragments are typically volcanic but locally are sedimentary or granitoid. Overprinted pattern indicates area of extensive migmatization south of Bench Canyon at west, edge of quadrangle. Description from source map: Devils Postpile 15' Quadrangle

Jmts - Volcanic rocks of the Ritter Range, tuffaceous metasandstone and metasiltstone (Jurassic)

ts - tuffaceous sandstone and siltstone (Jurassic)
South of Bench Canyon. Description from source map: Devils Postpile 15' Quadrangle

Jmdf - Volcanic rocks of the Ritter Range, metadacite flow (Jurassic)

df - dacite flow (Jurassic)
Medium dark-gray to dark-gray thin dacite flow or hypabyssal intrusive in structureless pyroclastic rocks north of Twin Island Lakes. Description from source map: Devils Postpile 15' Quadrangle

Jmab - Volcanic rocks of the Ritter Range, metaandesite and metabasalt (Jurassic)

Jab - andesite and basalt (Jurassic)
Thin to thick flows locally interlayered with bedded tuffaceous rocks; medium dark-gray to dark-gray; fine-grained to conspicuously porphyritic, containing tabular plagioclase (oligoclase to labradorite) phenocrysts a few mm to as much as 3 cm in maximum dimension. In several places the unit is breccia with irregular-shaped fragments of coarsely porphyritic rock in a fine grained matrix. Porphyritic phases bear striking megascopic resemblance to Jma and JTRa. Fragments of Jab are found in overlying volcanic breccia. Description from source map: Devils Postpile 15' Quadrangle

Jmeg - Volcanic rocks of the Ritter Range, epidote garnet metarock (Jurassic)

eg - epidote garnet metarock (Jurassic)
Narrow belt of epidote-garnet rock, at southeastern limit of unit, interpreted as metamorphosed limestone. Description from source map: Devils Postpile 15' Quadrangle

JTRu - Volcanic rocks of Shadow Creek and Mammoth Crest, undifferentiated metavolcanic rocks (Jurassic and Triassic(?))

JTRu - undifferentiated volcanic rocks (Triassic(?) and Jurassic)
Highly varied unit that contains nearly all the rock types of the entire metavolcanic sequence but consists chiefly of crystal-lithic tuff. Composed of discontinuous lenticular, dominantly pyroclastic units, rhyolitic to basaltic in composition but average near dacite or rhyodacite. Rock types in order of decreasing abundance are crystal-lithic tuff; tuff breccia; tuffaceous sandstone and siltstone; flows and hypabyssal intrusives, mostly mafic. Fragments of underlying formations occur locally at or near the base. Rocks in the stratigraphic interval between the base and roughly the easternmost JTRx unit are characteristically more schistose than most other rocks in the metavolcanic sequence, and primary structures are sparse. Elsewhere in the sequence, primary textures and structures are generally well preserved south of Garnet Lake; from Garnet Lake north, preservation becomes progressively poorer with accompanying increase in dominance of metamorphic fabric. Hornfelses, schists, and gneisses predominate in the Rush creek area, and are included with JTRu although the high degree of metamorphic recrystallization and associated anomalous structural trends makes their equivalence uncertain and the location of the contact with Jbr tentative. Based on lithologic similarities, rocks in the Mammoth Crest area are probably equivalent to those in the stratigraphic interval between Agnew Meadows and Shadow Lake. Description from source map: Devils Postpile 15' Quadrangle

JTRa - Volcanic rocks of Shadow Creek and Mammoth Crest, metaandesite and metabasalt (Jurassic and Triassic(?))

JTRa - andesite and basalt (Triassic(?) and Jurassic)
Thin to thick flows and hypabyssal intrusives; medium dark-gray to dark-gray; aphanitic to porphyritic with plagioclase (albite to andesine) phenocrysts as much as 3 cm in length; locally with quartz amygdules up to 1 cm in maximum dimension; coarsely porphyritic phases bear striking megascopic resemblance to Jab and Jma. Locally extensively replaced by epidote, particularly on Volcanic Ridge. Description from source map: Devils Postpile 15' Quadrangle

JTRx - Volcanic rocks of Shadow Creek and Mammoth Crest, crystal metatuff (Jurassic and Triassic(?))

JTRx - crystal tuff (Triassic(?) and Jurassic)
Light- to medium-gray; lithic fragments common but sparse; typically massive or weakly foliated parallel to regional strike; rhyolitic to quartz latitic in composition; white and pink feldspar commonly distinguishable in outcrops as are small wispy dark patches, bent around crystals or lithic fragments giving the rock an aspect reminiscent of the eutaxitic structure of welded tuff; most of these layers probably originated as ash flows. Description from source map: Devils Postpile 15' Quadrangle

JTRc - Volcanic rocks of Shadow Creek and Mammoth Crest, calcareous metasedimentary rocks (Jurassic and Triassic(?))

JTRc - calcareous sedimentary rocks (Triassic(?) and Jurassic)
Typically thin-bedded tuffaceous sandstone and siltstone, commonly calcareous; minor amounts of marble, slate, and conglomerate; gross sedimentary features preserved but microscopic granoblastic fabric; well foliated in places. Unit contains sporadic occurrences of garnet, pyroxene, tremolite and (or) actinolite, and plagioclase. Rocks composing the sedimentary lentil near Minaret Summit contain a much smaller proportion of volcanic material than most sedimentary rocks in the metavolcanic sequence. Fossils were recovered from calcareous sandstone at three localities, identified on the map – A, north of Thousand Island Lake; B north of Garnet Lake; and C, south of Minaret Mine. Locality B yielded pectinoid pelecypods determined as Early Jurassic in age, A yielded fragments of similar fossils, and C yielded several indeterminate ammonites. (Rhinehart and others, 1959). Description from source map: Devils Postpile 15' Quadrangle

JTRss - Volcanic rocks of Shadow Creek and Mammoth Crest, metasandstone, metasiltstone and slate (Jurassic and Triassic(?))

JTRss - sandstone, siltstone; and slate (Triassic(?) and Jurassic)
North of Thousand Island Lake: siltstone and slate (latter locally contains andalusite and garnet); medium- to dark-gray, aphanitic to fine-grained, thinly laminated or massive; locally contains thin laminations composed of quartz, plagioclase and amphibole; primary texture generally well preserved but locally phyllitic. North of Davis Lakes: siltstone and fine- to medium-grained tuffaceous sandstone; dark-gray to medium light-gray, thinly laminated to thin-bedded; beds locally graded. Description from source map: Devils Postpile 15' Quadrangle

JTRd - Volcanic rocks of Shadow Creek and Mammoth Crest, metadacite and metaandesite (Jurassic and Triassic(?))

JTRd - dacite and andesite (Triassic(?) and Jurassic)
Medium- to dark-gray, massive porphyritic flows and hypabyssal intrusive rocks, locally amygdaloidal with quartz or calcite fillings; grades into breccia in a few places; original texture generally well preserved. Includes a coarsely porphyritic, medium-gray, quartz latitic flow or hypabyssal intrusive, locally amygdaloidal, west of Weber Lake. Description from source map: Devils Postpile 15' Quadrangle

JTRpz - Volcanic rocks of Shadow Creek and Mammoth Crest, piedmontite-bearing zone (Jurassic and Triassic(?))

pz - piedmontite-bearing zone (Triassic(?) and Jurassic)
No additional description provided on source map: Devils Postpile 15' Quadrangle

JTRqa - Volcanic rocks of Shadow Creek and Mammoth Crest, quartz-andalusite-corundum rock (Jurassic and Triassic(?))

qa - quartz-andalusite-corundum rock (Triassic(?) and Jurassic)
Interpreted as a metamorphosed previously kaolinite-bearing alteration zone. Description from source map: Devils Postpile 15' Quadrangle

JTrvsc - Volcanic rocks of Silver Creek (Jurassic and Triassic(?))

JTRv - Volcanic rocks of Silver Creek (Triassic(?) and Jurassic)
Rocks of dominantly intermediate composition so extensively recrystallized that primary textures and structures are obscure or absent and correlation with units exposed in the Ritter Range Pendant is uncertain. Rocks bearing some similarities to JTRx were tentatively recognized in a few outcrops. Well-developed foliation is the dominant structure with schist and gneiss the most common rock. Crystal-lithic tuff was probably the chief parent rock type; a few mafic flows and calcareous epiclastic rocks formed a quantitatively minor part of the sequence. Description from source map: Devils Postpile 15' Quadrangle

JTRv - Volcanic rocks (Jurassic or Triassic)

JTRv - Volcanic rocks (Triassic or Jurassic)
Along contact between granodiorite of Lake Edison and alaskite of Graveyard Peak in northeast corner of quadrangle and a mile north of Lake Edison. Chiefly andesite tuff, but includes dacite and rhyolite tuff. [may correlate with JTRsc in the Devils Postpile quadrangle]. Description from source map: Kaiser Peak 15' Quadrangle

JTRt - Metatuff and metatuff breccia (Jurassic or Triassic)

JTRt - Metatuff and metatuff breccia (Triassic or Jurassic)
Medium- to dark-gray crystal-lithic metatuff and metatuff breccia with generally well preserved primary textures. There exist all gradations from fine-grained massive metatuff to metatuff breccia with lithic fragments as much as one-half meter long; no fragments of nonvolcanic rock appear to be present. Bedding is generally obscure to absent. Rock is typically a quartz-feldspar-mica hornfels with amphibole locally abundant. Refractive index of fused glass beads indicates composition equivalent to rhyodacite. Description from source map: Shuteye Peak 15' Quadrangle

JTRr - Metarhyolite, older (Jurassic or Triassic)

JTRr - Metarhyolite (Triassic or Jurassic)
Light-gray, rhyolitic crystal-lithic metatuff, meta-tuff breccia, and flow-banded metarhyolite. The rhyolitic and rhyodacitic metatuff and metatuff breccia are similar except for color and composition; and the rhyolitic breccia is generally not as coarse. Banding in the flow-banded metarhyolite is often intricately contorted and evidence of autobrecciation is common. Rock is a quartz-feldspar-mica hornfels; rhyolitic composition indicated by refractive index of fused glass beads. Description from source map: Shuteye Peak 15' Quadrangle

pJs - Metasedimentary rocks (pre-Jurassic)

pJs - Metasedimentary rocks (pre-Jurassic)
Quartz-mica schist, quartzite, calc-silicate hornfels, and tactite. Light- to dark-gray quart z-mica schist and quartzite predominate in all areas of metasedimentary rock in the quadrangle except for the small masses in the vicinity of Fish Creek, where calc-silicate hornfels and tactite predominate. On Kaiser Ridge, white to buff quartzite locally show s conspicuous crossbedding. Tungsten mineralization is present locally in tactite in the Fish Creek area; the deposits have been described by Krauskopf (1953). Description from source map: Shuteye Peak 15' Quadrangle

TRsp - Slate and phyllite (Triassic)

TRsp - Slate and phyllite (Triassic)
Includes quartzite and probably some chert. Forms the outer parts of the Coarsegold roof pendant. Description from source map: Bass Lake 15' Quadrangle

TRpb - Phyllite of Briceburg (Triassic)

TRb - Phyllite of Briceburg (Triassic)
Chiefly phyllite, but includes quartzite, chert, graywacke, and limestone olistoliths (TRpbls) that contain Early Triassic conodonts. Description from source map: El Portal 15' Quadrangle

TRpbls - Phyllite of Briceburg, limestone olistoliths (Triassic)

TRb - Phyllite of Briceburg, limestone olistoliths (Triassic)
Chiefly phyllite, but includes quartzite, chert, graywacke, and limestone olistoliths (TRpbls) that contain Early Triassic conodonts. Description from source map: El Portal 15' Quadrangle

TRh - Phyllite and chert of Hites Cove (Triassic)

TRh - Phyllite and Chert of Hites Cove (Triassic)
Rhythmically bedded, light-colored chert sequences interbedded with dull-gray phyllite. Includes Talc schist (TRht) and minor serpentinite of metasedimentary origin. Description from source map: Lake Eleanor 15' Quadrangle

TRh - Phyllite and chert of Hites Cove (Triassic)
Sequences of rhythmically banded chert in a matrix of phyllite. A few limestone lenses (TRhls) are present, some of which may be olistoliths. An interstratified bed in the central part of this unit has yielded fossil conodonts indicating an Early Triassic age. Locally contains metabasalt (TRhmba). Description from source map: El Portal 15' Quadrangle

TRht - Phyllite and chert of Hites Cove, talc schist and minor serpentinite (Triassic)

TRht - Phyllite and Chert of Hites Cove, talc schist and minor serpentinite (Triassic)
No additional description provided on source map: Lake Eleanor 15' Quadrangle

TRmi - Mafic hypabyssal intrusive rocks (Triassic)

TRmi - Mafic hypabyssal intrusive rocks (Triassic)
Probably of andesitic composition. Mass northeast of Dore Cliff is porphyritic. Description from source map: Tuolumne Meadows 15' Quadrangle

TRso - Monzonite of Saddlebag and Odell Lakes (Triassic)

TRso - Monzonite of Saddlebag and Odell Lakes (Triassic)
Altered biotite-hornblende monzonite. Probably hypabyssal and cogenetic with Triassic volcanic rocks. Rb-Sr whole-rock age: about 220 m.y. Description from source map: Tuolumne Meadows 15' Quadrangle

TRft - Mafic flows and tuff (Triassic)

TRft - Mafic flows and tuff (Triassic)
Pebble conglomerate at base of unit is overlain by tuffaceous beds of intermediate composition. Mafic flows at top of unit. Rb-Sr whole-rock age: 224 ± 14 m.y. Description from source map: Tuolumne Meadows 15' Quadrangle

TRrt - Rhyolite ash-flow tuff (Triassic)

TRrt - Rhyolite ash-flow tuff (Triassic)
Light-gray tuff with many flattened pumice fragments generally 1 to 5 cm long. Phenocrysts of quartz and plagioclase are embedded in a fine-grained matrix. Description from source map: Tuolumne Meadows 15' Quadrangle

TRsc - Tuffaceous sandstone, siltstone and conglomerate (Triassic)

TRsc - Tuffaceous sandstone, siltstone and conglomerate (Triassic)
Lenses of rhyolite tuff are present in a few places. Conglomerate lenses apparently were deposited in stream channels. Flattened pebbles are identical with rock in Paleozoic strata down section to the east. Description from source map: Tuolumne Meadows 15' Quadrangle

TRrh - Rhyolite tuff (Triassic)

TRrh - Rhyolite tuff (Triassic)
Mostly bedded. Description from source map: Tuolumne Meadows 15' Quadrangle

TRPZqz - Quartzite (Triassic or Paleozoic)

qz - Quartzite (Paleozoic or Triassic)
No additional description provided on source map. Description from source map: Kaiser Peak 15' Quadrangle

TRPZphq - Schist and hornfels (Triassic or Paleozoic)

phq - Schist and hornfels (Paleozoic or Triassic)
No additional description provided on source map: Kaiser Peak 15' Quadrangle

TRPZm - Marble, younger (Triassic or Paleozoic)

m - Marble (Paleozoic or Triassic)
No additional description provided on source map: Kaiser Peak 15' Quadrangle

TRPZch - Calc-hornfels (Triassic or Paleozoic)

ch - Calc-hornfels (Paleozoic or Triassic)
No additional description provided on source map: Kaiser Peak 15' Quadrangle

PZpr - Quartzite of Pilot Ridge (early Paleozoic)

Pzp - Quartzite of Pilot Ridge (early Paleozoic)
Metaquartzite, quartz mica schist, phyllite, and argillite along the western edge of the quadrangle. Metaquartzite and quartz mica schist are light colored, massive to finely laminated rock composed of quartz and subordinate sericite and biotite. Some of the metaquartzite stands out as massive, light-colored, unvegetated outcrops. Equally abundant are darker colored, massive to slatey phyllite and argillite that weather to ocherous colors. Dashed line shows the trace of an inferred stratigraphic horizon based on aerial photographs. Description from source map: Yosemite 15' Quadrangle

Pzp - Quartzite of Pilot Ridge (Paleozoic?)
Sequences of massive quartzite interbedded with phyllite and schist. Siliceous marble and skarn occur locally. Locally ls indicates a limestone unit. Description from source map: El Portal 15' Quadrangle

PZpgz - Quartzite and Schist of Pilot Ridge, quartzite (Paleozoic)

PZpq - Quartzite and Schist of Pilot Ridge, quartzite (Paleozoic)
No additional description provided on source map: Lake Eleanor 15' Quadrangle

PZps - Quartzite and Schist of Pilot Ridge, schist and marble (Paleozoic)

PZps - Quartzite and Schist of Pilot Ridge, schist and marble (Paleozoic)
Quartz-mica schist with minor graphitic schist and marble. Description from source map: Lake Eleanor 15' Quadrangle

PZpt - Quartzite and Schist of Pilot Ridge, tactite and hornfels (Paleozoic)

PZpt - Quartzite and Schist of Pilot Ridge, tactite and hornfels (Paleozoic)
Garnet-epidote tactite and calc-hornfels. Description from source map: Lake Eleanor 15' Quadrangle

PZqs - Quartzite and phyllite (Paleozoic)

Pzqs - Quartzite and phyllite (Paleozoic)
Characterized by massive quartzite beds. Description from source map: Bass Lake 15' Quadrangle

PZms - Metasedimentary strata, undifferentiated (Paleozoic)

Pzms - Metasedimentary strata, undifferentiated (Paleozoic)
Quartzofeldspathic hornfels, calc-silicate hornfels, and carbonaceous marble in the northeast corner of the quadrangle. Description from source map: Tuolumne Meadows 15' Quadrangle

PZmsq - Metamorphosed sedimentary and volcanic rocks, quartz-mica schist and quartzite (Paleozoic(?))

ms - Metamorphosed sedimentary and volcanic rocks, quartz-mica schist and quartzite (Paleozoic(?))
No additional description provided on source map: Hetch Hetchy Reservoir 15' Quadrangle

PZmr - Metamorphosed sedimentary and volcanic rocks, marble (Paleozoic(?))

m - Metamorphosed sedimentary and volcanic rocks, marble (Paleozoic(?))
No additional description provided on source map: Hetch Hetchy Reservoir 15' Quadrangle

PZmdr - Metamorphosed sedimentary and volcanic rocks, metamorphosed dacites and rhyodacites (Paleozoic(?))

mv - Metamorphosed sedimentary and volcanic rocks, metamorphosed dacites and rhyodacites (Paleozoic(?))
No additional description provided on source map: Hetch Hetchy Reservoir 15' Quadrangle

Ph - Quartzofeldspathic hornfels, calc-silicate hornfels, and volcanic flows (Permian)

Ph - Quartzofeldspathic hornfels, calc-silicate hornfels, and volcanic flows (Permian)
No additional description provided on source map: Mono Craters 15' Quadrangle

Pa - Andesite flows and breccias, local graywacke and sandstone lenses (Permian)

Pa - Andesite flows and breccias, local graywacke and sandstone lenses (Permian)
No additional description provided on source map: Mono Craters 15' Quadrangle

Pt - Felsic volcanic tuffs, volcanic flows and local graywackes (Permian)

Pt - Felsic volcanic tuffs, volcanic flows, local graywackes (Permian)
No additional description provided on source map: Mono Craters 15' Quadrangle

Pc - Permian local basal conglomerate (Permian)

Pc - Local basal conglomerate (Permian)
No additional description provided on source map: Mono Craters 15' Quadrangle

PPNh - Calc-silicate and quartzofeldspathic hornfels and marble (Permian(?) and Pennsylvanian(?))

PPNh - Rocks of Twin Peaks sequence, calc-silicate and quartzofeldspathic hornfels and marble (Pennsylvanian(?) and Permian(?))
Mottled brown, green, greenish-gray, and gray, locally poorly layered quartzofeldspathic hornfels, calc-silicate hornfels, biotite schist, and marble. Description from source map: Matterhorn Peak 15' Quadrangle

PPNh - Quartzofeldspathic hornfels, calc-silicate hornfels, and carbonaceous marbles (Pennsylvanian(?) and Permian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

PPNpsh - Fine-grained pelitic and siliceous hornfels (Permian(?) and Pennsylvanian)

PPNh - fine-grained pelitic and siliceous hornfels (Pennsylvanian and Permian(?))
Moderately well-bedded dark siliceous hornfels and small amounts of interbedded pelitic hornfels, slate, and quartzite; several large irregular areas of massive light-colored cherty or silicified rock northeast of Agnew Meadows; minor interlayering with metavolcanic rocks at the top of the unit may possibly be primary but appears more likely to be of tectonic origin. Parent rocks were chiefly shale and siltstone. Description from source map: Devils Postpile 15' Quadrangle

PPNmtp - Marble, oldest (Permian(?) and Pennsylvanian(?))

PPNm - Rocks of Twin Peaks sequence, marble (Pennsylvanian(?) and Permian(?))
Massive, poorly bedded, light-gray and buff-colored, fine- to medium-grained crystalline marble. Locally contains garnet, epidote, and wollastonite. Description from source map: Matterhorn Peak 15' Quadrangle

PPNm - Carbonaceous marble (Pennsylvanian(?) and Permian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

PPNm - marble (Pennsylvanian and Permian(?))
In two small outcrops north of Minaret Summit is lithologically similar to the Mount Baldwin Marble in the Mount Morrison quadrangle; (Rinehart and Ross, 1964) medium-gray to medium dark-gray, thinly laminated to massive, crinoidal in part, clean, typically too sheared and deformed to determine regional trend. The two outcrops are separated by massive tuffaceous conglomerate containing many marble fragments. Description from source map: Devils Postpile 15' Quadrangle

PPNqtp - Quartzite and quartzofeldspathic hornfels (Permian(?) and Pennsylvanian(?))

PPNq - Rocks of Twin Peaks sequence, quartzite and quartzofeldspathic hornfels (Pennsylvanian(?) and Permian(?))
Massive, layered, light- to medium-gray and brown quartzite, quartzofeldspathic hornfels, and metaconglomerate. Description from source map: Matterhorn Peak 15' Quadrangle

PPNq - Calc-silicate hornfels, quartzite, and quartzofeldspathic hornfels (Permian(?) and Pennsylvanian(?))

PPNq - Calc-silicate hornfels, quartzite, and quartzofeldspathic hornfels (Pennsylvanian(?) and Permian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

PPNc - Permian and Pennsylvanian marble and calc-silicate hornfels (Permian(?) and Pennsylvanian(?))

PPNc - Marble and calc-silicate hornfels (Pennsylvanian(?) and Permian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

SOm - Silurian and Ordovician marble and calc-silicate hornfels (Silurian(?) and Ordovician(?))

SOm - Marble and calc-silicate hornfels (Ordovician(?) and Silurian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

SOq - Biotite-bearing quartzite (Silurian(?) and Ordovician(?))

SOq - Biotite-bearing quartzite (Ordovician(?) and Silurian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

SOa - Older sedimentary rocks, hornfels and marbles (Silurian(?) and Ordovician(?))

SOa - Older sedimentary rocks, andalusite hornfels, quartzofeldspathic hornfels with thin carbonaceous marbles (Ordovician(?) and Silurian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

Sox - Older sedimentary rocks, calcareous quartzite (Silurian(?) and Ordovician(?))

Sox - Older sedimentary rocks, crossbedded calcareous quartzite (Ordovician(?) and Silurian (?))
No additional description provided on source map: Mono Craters 15' Quadrangle

Soc - Marble, calc-silicate hornfels, and quartzite (Silurian(?) and Ordovician(?))

Soc - Marble, calc-silicate hornfels, and quartzite (Ordovician(?) and Silurian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

SOh - Quartzofeldspathic hornfels (Silurian(?) and Ordovician(?))

SOh - Quartzofeldspathic hornfels (Ordovician(?) and Silurian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

SOs - Marble and calc-silicate hornfels, older (Silurian(?) and Ordovician(?))

SOs - Marble and calc-silicate hornfels (Ordovician(?) and Silurian(?))
No additional description provided on source map: Mono Craters 15' Quadrangle

SOhm - Dense hornfels and silicated marble (Silurian(?) and Ordovician(?))

SOhm - dense hornfels and silicated marble (Ordovician(?) and Silurian(?))
Chiefly bedded to massive dark-colored pelitic and siliceous hornfels; locally abundant thin to thick beds of silicated marble and thin beds of calc-hornfels, both containing plagioclase, tremolite, diopside, and wollastonite as common minerals; minor amounts of fine- to medium-grained quartzite. Parent rocks were shale, siltstone, marly siltstone, and quartz-bearing limestone. Description from source map: Devils Postpile 15' Quadrangle

Soma - Silicated marble (Silurian(?) and Ordovician(?))

Soma - silicated marble (Ordovician(?) and Silurian(?))
In beds generally poorly layered or massive. Description from source map: Devils Postpile 15' Quadrangle

cmp - Carbonaceous metapelite (age unknown)

cmp - Carbonaceous metapelite (age unknown)
Locally contains small masses of metabasalt (cmpmba), metagabbro (cmpmgb), limestone (cmpls), quartzite (cmpqtz), and other lithologies. May he a tectonic rather than a stratigraphic unit and coincident with the Calaveras-Shoo Fly thrust. Description from source map: El Portal 15' Quadrangle

md - Mafic dike (age unknown)

mafic dike - mafic dikes (age unknown)
Traces of mafic dikes. Description from source map: Lake Eleanor 15' Quadrangle

fd - Felsic dikes (age unknown)

felsic dikes - felsic dikes (age unknown)
Zone of abundant felsic dikes. Description from source map: Lake Eleanor 15' Quadrangle

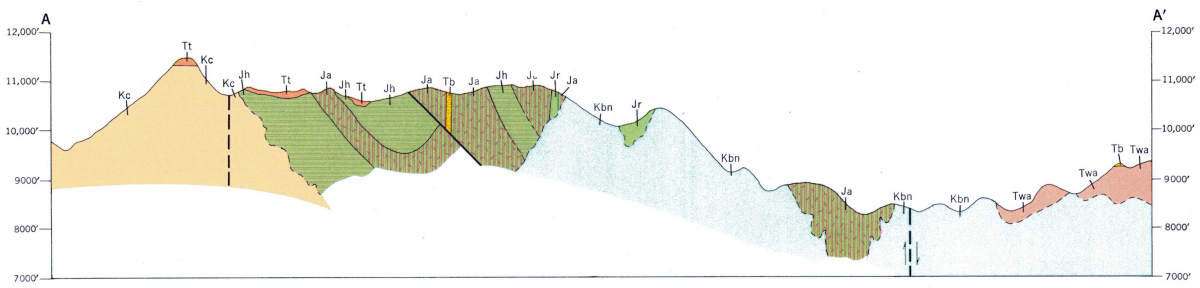
mba - Metabasalt (age unknown)

No additional description provided on source map: El Portal 15' Quadrangle

Geologic Cross Sections

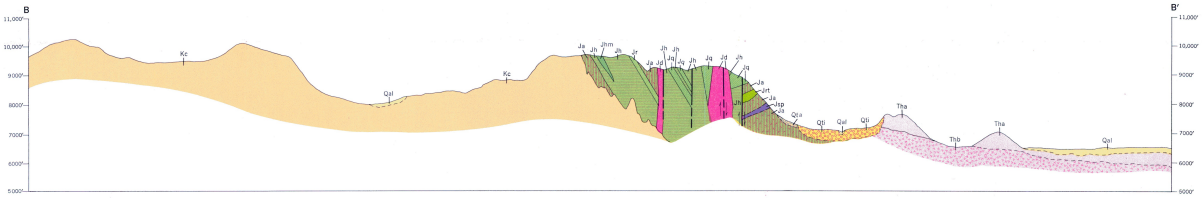
The geologic cross sections present in the GRI digital geologic-GIS data produced for Yosemite National Park, California (YOSE) are presented below. Note that some cross section abbreviations (e.g., A - A') may have been changed from their source map abbreviation in the GRI data so that each cross section abbreviation in the GRI data is unique. Cross section graphics were scanned at a high resolution and can be viewed in more detail by zooming in (if viewing the digital format of this document).

Cross Section A-A'



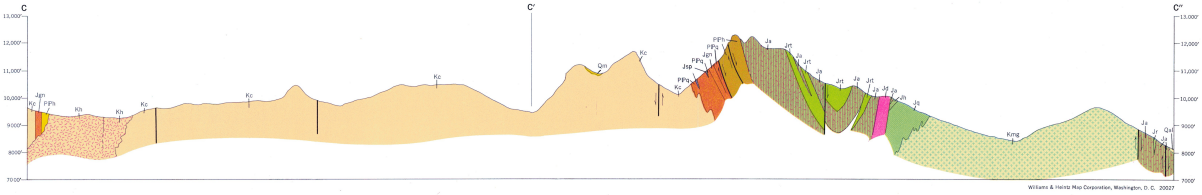
Graphic from source map: (Matterhorn Peak 15' Quadrangle). No vertical exaggeration denoted on source map.

Cross Section B-B'



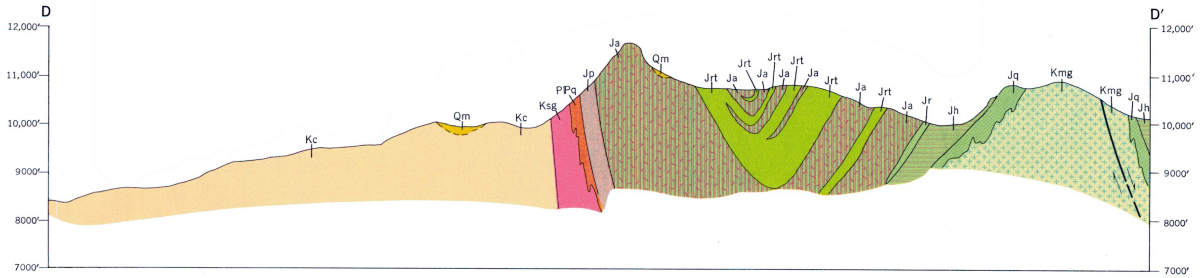
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Cross Section C-C'



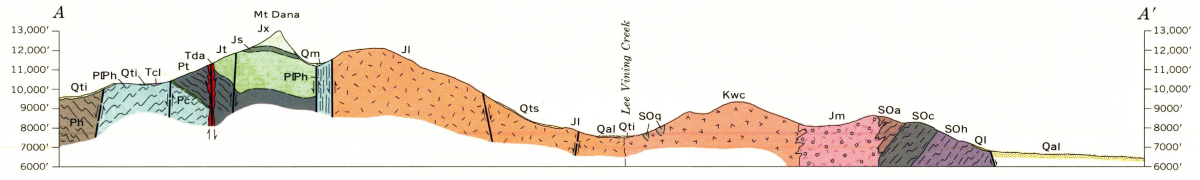
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Cross Section D-D'



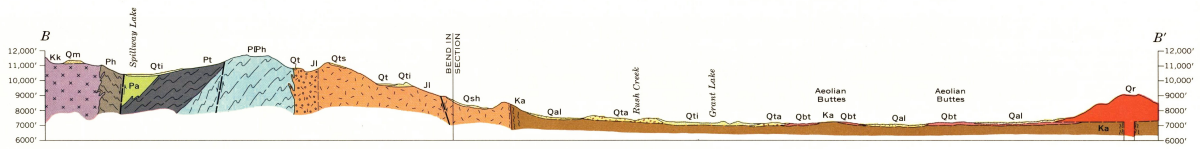
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Cross Section E-E'



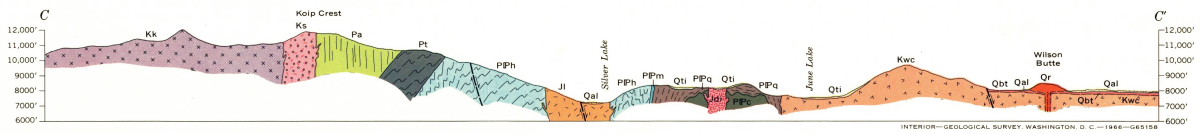
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Cross Section F-F'



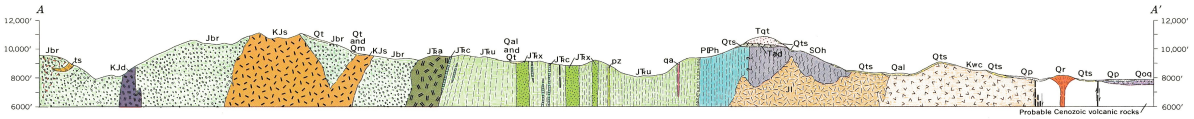
Graphic from source map: (Mono Craters 15' Quadrangle). Cross section B-B' on source map. No vertical exaggeration denoted on source map.

Cross Section G-G'



Graphic from source map: (Mono Craters 15' Quadrangle). Cross section C-C' on source map. No vertical exaggeration denoted on source map.

Cross Section H-H'



Graphic from source map: (Devils Postpile 15' Quadrangle). Cross section A-A' on source map. No vertical exaggeration denoted on source map.

Ancillary Source Map Information

The following sections present ancillary source map information associated with sources used for this project.

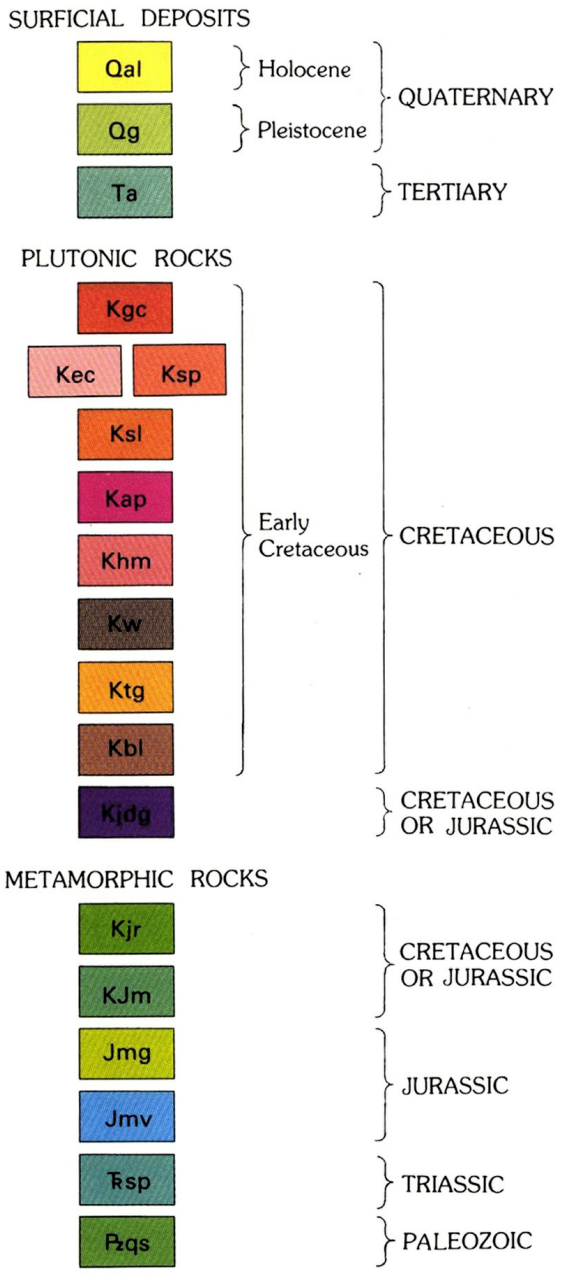
Bass Lake 15' Quadrangle

The formal citation for this source.

Bateman, P.C., 1989, Geologic Map of the Bass Lake Quadrangle, West-Central Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1656, scale 1:62,500 (*GRI Source Map ID 1371*).

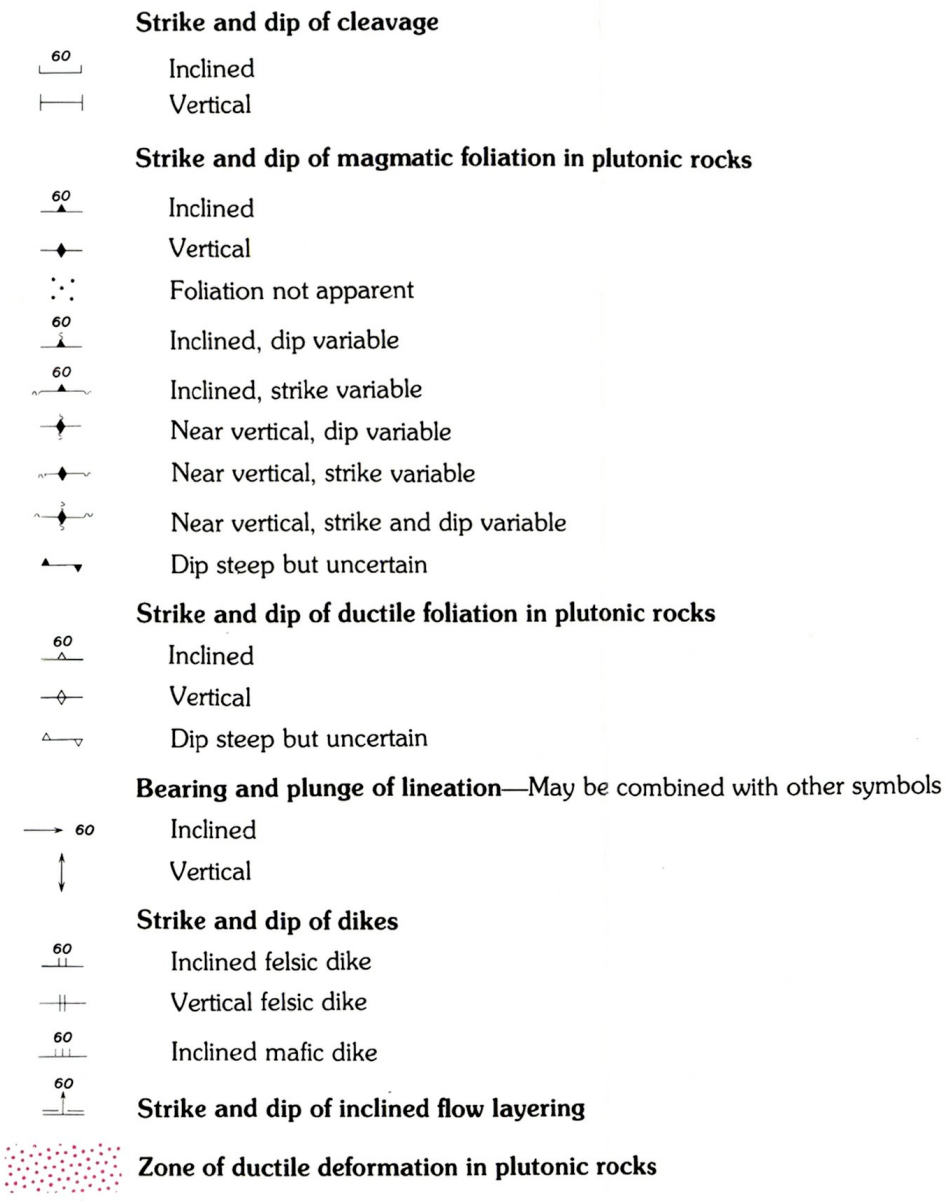
Prominent graphics and text associated with this source.

Correlation of Map Units



Graphic from source map: Bass Lake 15' Quadrangle

Map Legend



Graphic from source map: Bass Lake 15' Quadrangle

Summary of Geology

The Bass Lake 15 minute quadrangle occupies part of the west slope of the central Sierra Nevada. California State Highway 41, which extends north from Fresno to Yosemite National Park, crosses the center of the quadrangle, and numerous branching roads provide access to all parts of the quadrangle. The area within the quadrangle slopes generally toward the southwest, but the Coarsegold roof pendant in the southwestern part is composed of metamorphic rocks that are resistant to erosion and stand relatively high; consequently, the lowest large area within the quadrangle is Fresno Flats, just

northeast of the Coarsegold roof pendant. The communities of Oakhurst and Ahwahnee are in this area; other population centers are at Coarsegold, near the south edge of the quadrangle, at Fish Camp near the north boundary, and along the shores of Bass Lake. The highest point is White Chief Mountain in the northeast corner, at 8,676 ft (2,644 m), and the lowest point is where the Fresno River crosses the west side of the quadrangle at a little below 2,000 ft (about 600 m). Most of the east half of the quadrangle lies within the Sierra National Forest and is heavily forested, but the west half is privately owned and mainly used for grazing. Yosemite National Park lies immediately to the north and includes a narrow strip along the central part of the north boundary of the quadrangle.

Text from source map: Bass Lake 15' Quadrangle

Metamorphosed Sedimentary and Volcanic Rocks

Remnants of Paleozoic and Mesozoic metamorphosed sedimentary and volcanic rocks underlie about 25 percent of the quadrangle. No fossils have been found within the quadrangle, and the ages of these rocks are inferred from correlations with similar strata farther north in the western metamorphic belt of the Sierra Nevada. The strata have been repeatedly deformed and dip steeply. In most places they strike northwest parallel with the long axis of the Sierra Nevada. Where bedding and cleavage can be identified in the same outcrop, they generally are parallel, but in some places cleavage clearly cuts across bedding. The Nevadan orogeny, which occurred about 155 m.y. ago (Schweickert and others, 1984) is the best known of the deformational events that produced the steep dips and the cleavage, but deformation occurred at other times as well.

The Coarsegold roof pendant (units Jmv and TRsp), by far the largest mass of metamorphic rocks in the quadrangle, forms a crescent that is open to the east and extends from the north end of Goat Mountain southwest and west through Thornberry Mountain, northwest through Potter Ridge across the west boundary into the adjoining Mariposa quadrangle (Krauskopf, 1986), then northeast, reentering the Bass Lake quadrangle at Miami Mountain. The pendant has a core of mafic metavolcanic rocks (unit Jmv), much of it amphibolite, which is flanked by slate and phyllite interbedded with lesser quartzite and chert(?) (unit TRsp). Similarity of the slate and phyllite on the two sides of the pendant and tongues of metavolcanic rock in the metasedimentary rocks that form the west flank of the pendant suggest folding or faulting, but neither has been identified with certainty. The metavolcanic rocks were derived from basaltic and andesitic tuff, breccia, and probably from flows. Similar rocks northwest of the quadrangle, at the south end of the western metamorphic belt, have yielded a Late Jurassic ammonite and an Early Jurassic Rb Sr isochron (Bateman and others, 1985). The flanking metasedimentary rocks (unit TRsp) were derived from mud, sand, and chert. Similar strata farther north along the Merced River have yielded Early Triassic conodonts (Bateman and others, 1985). Both the metavolcanic and metasedimentary strata were deposited in a marine environment, possibly on the landward side of a volcanic island arc.

Metasedimentary rocks at Goat Mountain and remnants of metasedimentary rocks in the north half of the quadrangle (unit Pzqs) are composed chiefly of quartzite, phyllite, and argillite. These rocks are lithologically similar to rocks farther north along the Merced River, which have been tentatively correlated with the early Paleozoic Shoo Fly Complex of Schweickert (1981) of the northern Sierra Nevada.

The metamorphosed volcanic rocks near White Chief Mountain, in the northeast corner of the quadrangle, are the youngest of the stratified rocks and probably are of Early Cretaceous age. Two units have been mapped. The most widespread unit is composed of mafic andesitic and dacitic metatuff and metatuff breccia (unit KJm), and a second less extensive unit is composed of metarhyolite tuff, metarhyolite tuff breccia, and flow banded metarhyolite (unit KJr). The environment in which these rocks were erupted has not been determined, but they probably were deposited on dry land.

The remnants of metasedimentary rock that extend eastward from Miami Mountain to the large mass south and west of Chipmunk Meadow are roof pendants and before erosion probably were continuous with one another and with the Coarsegold roof pendant at a level that may have been only a few hundred meters above the present surface.

Text from source map: Bass Lake 15' Quadrangle

Granitic Rocks

After the strata were squeezed and tilted, they were invaded by granitic magmas that reheated and recrystallized them, and caused additional deformation. Small bodies of dark gabbro and diorite (unit KJdg) have been considered the earliest intrusions, but their ages have not been determined, and some of these bodies may have been intruded later or possibly at several different times. The Bass Lake Tonalite (Bateman, 1988), which underlies about 70 percent of the quadrangle, is the next oldest rock. U Pb dating indicates its age is about 114 m.y. (Stem and others, 1981). This rock was intruded upward unevenly into the overlying metamorphic rocks. The largest upward protrusion occupies the elliptical area between the Coarsegold roof pendant and the remnants of metamorphic rock that extend eastward across the quadrangle from Miami Mountain. The Ward Mountain Trondhjemite (Bateman, 1988), which has an optimum U Pb age of 112 m.y., and probably also the granite of Hogan Mountain, were intruded shortly after the Bass Lake Tonalite and are genetically related to it.

In the northeast corner of the quadrangle, the granitic rock associated with metamorphic rocks is the granite porphyry of Star Lakes (Peck, 1980). It is a dark medium grained rock of variable composition and texture. The rock exposed within the Bass lake quadrangle is medium gray, medium grained, and superficially resembles the Bass Lake Tonalite, but D.L. Peck (written commun., 1982) reports that it becomes more leucocratic and porphyritic northward in the Yosemite quadrangle. R.W. Kistler (written commun., 1984) has determined a rubidium strontium isotopic age of 108 ± 3.6 m.y. on samples collected within the Yosemite quadrangle.

The El Capitan Granite and the granite of Shuteye Peak were emplaced about 102 m.y. ago (Stern and others, 1981). The granite of Shuteye Peak crops out in the east side of the quadrangle and forms Fresno Dome. The El Capitan Granite, which underlies extensive areas to the north, extends only into a small area along the north edge of the quadrangle.

The youngest granitic rock is the granodiorite of Grizzly Creek, which crops out in the northeastern part of the quadrangle, north and northeast of Fresno Dome, where it lies between the granite of Shuteye Peak on the south and metamorphic rocks on the north. It is characterized by conspicuous rounded quartz phenocrysts 3 to 6 mm across. The contact between the west end of the granodiorite of Grizzly Creek and the Bass Lake Tonalite was not located accurately because of soil cover and slope wash, and its placement is approximate. Nevertheless, a contact must exist because the granodiorite of Grizzly Creek intrudes the granite of Shuteye Peak, and the granite of Shuteye Peak intrudes the Bass Lake Tonalite.

It is possible that some of the magmas rose high enough to erupt at the ancestral surface, but a genetic relation between the remnants of metavolcanic rocks and the granitic rocks has not been established. Modal and chemical analysis of the plutonic rocks and a discussion of ductile structures in the rocks are given in Bateman (1988).

Text from source map: Bass Lake 15' Quadrangle

Development of Modern Landscape

Intrusion of the granitic rocks almost certainly was closely followed by uplift of the area, which led to rapid erosion. Most of the cover of metamorphic rocks was stripped away, and the underlying granitic plutons were exposed. During Eocene time, approximately 50 m.y. ago, the relief in the Sierra Nevada region was gentle. Thornberry, Buckeye, and Miami Mountains, and Deadwood Peak stood above the general level because the metamorphic rocks that underlie them were resistant to erosion.

The modern Sierra Nevada was formed later by westward tilting and dissection of a huge block

of the earth's crust (Huber, 1981). Tilting probably began about 50 m.y. ago and was significantly accelerated about 25 m.y. ago; about two thirds of the height of the Sierran crest has been attained since then. According to Huber (1981) tilting continues to accelerate, and the Sierran crest is now being uplifted more rapidly than ever before. The tilting raised the northeast corner of the quadrangle high enough for glaciers to form during the ice ages of the Pleistocene epoch and to cause the main west flowing streams to cut the deep canyons in which they now flow.

Text from source map: Bass Lake 15' Quadrangle

Mineral Deposits

Both the Fresno River and Coarse Gold Creek have been the sites of extensive placer operations for gold, and old diggings are common in the metamorphic rocks, especially in the Coarsegold roof pendant. However, the only lode mine with a significant record of gold production is the Texas Flat Mine, a short distance northwest of Coarsegold, which was located in 1866 and was operated discontinuously until 1927 (Ireland, 1888; McLaughlin and Bradley, 1915; Laisure, 1928). Records of the total production are not available, but McLaughlin and Bradley (1915) report that gold produced between 1903 and 1915 brought about $185,000, representing about 9,000 fine ounces. The mine exploits a quartz vein that strikes northeast, dips about 30° southeast, and has an average width of about 4 ft. The vein, which contains both sulfides and free gold, lies parallel with the sedimentary strata of the Coarsegold roof pendant at the west end of an elongate pluton of Bass Lake Tonalite. Extensive workings consist of a 1,400 ft adit along the vein and inclined shafts, winzes, and stopes that extend 170 ft below the adit.

Text from source map: Bass Lake 15' Quadrangle

Selected References (Annotated)

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References from source map: Bass Lake 15' Quadrangle

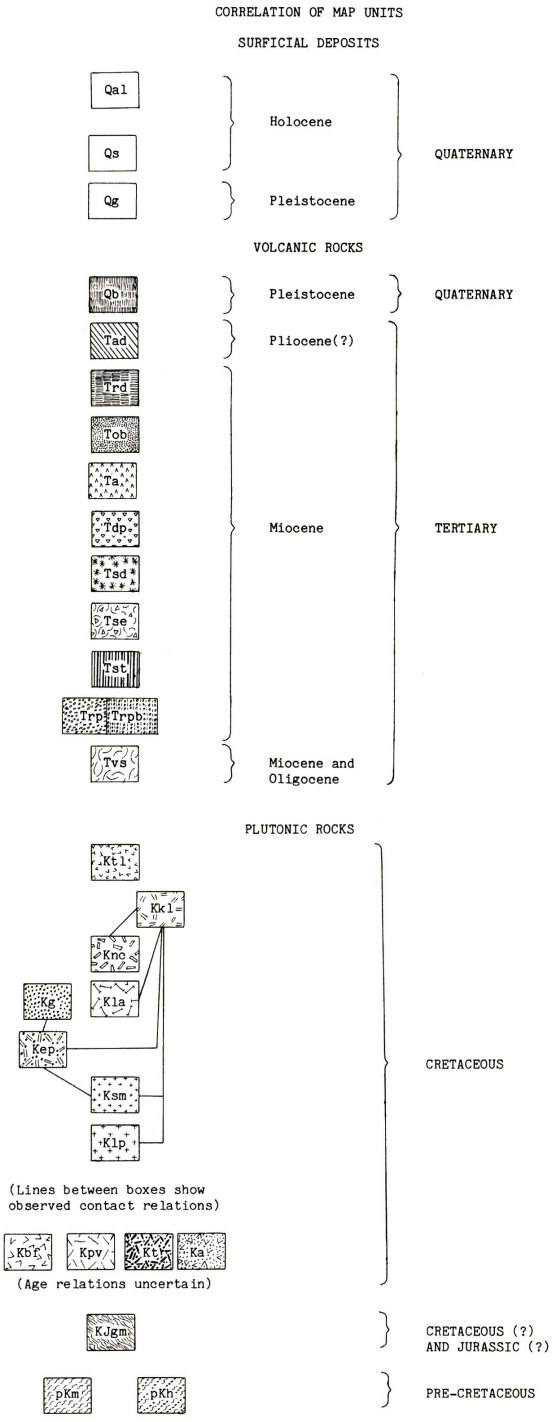
Dardanelles Cone 15' Quadrangle

The formal citation for this source.

Huber, N.K., 1983, Preliminary Geologic Map of the Dardanelles Cone Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Miscellaneous Field Studies MF-1436, scale 1:62,500 (*GRI Source Map ID 1366*).

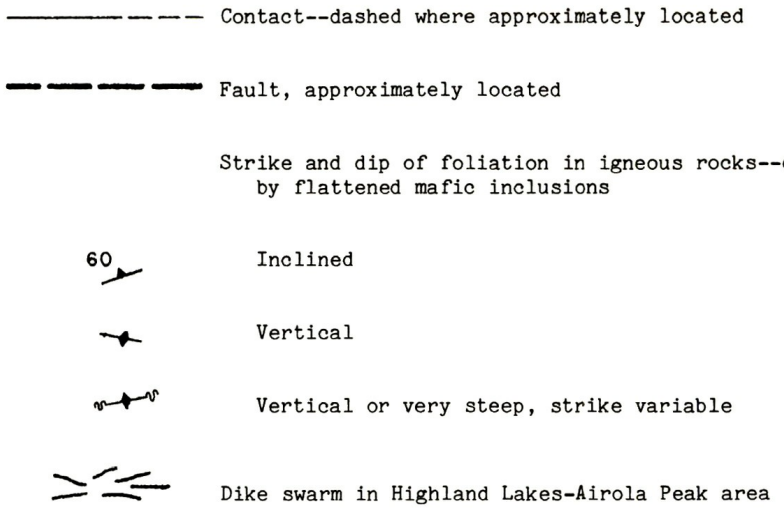
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Correlation of Map Units



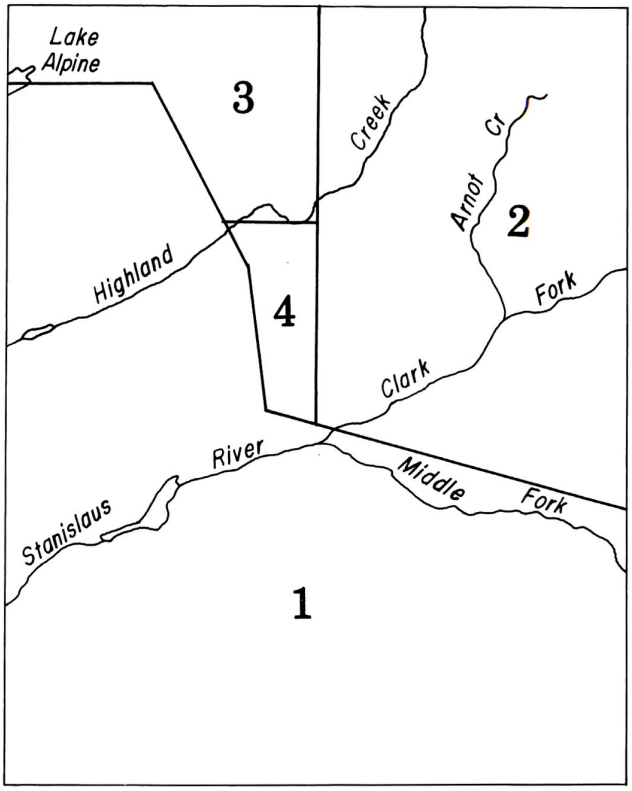
Graphic from source map: Dardanelles Cone 15' Quadrangle

Map Legend



Graphic from source map: Dardanelles Cone 15' Quadrangle

Index to Sources of Geologic Data



INDEX TO SOURCES OF GEOLOGIC DATA

1. D. B. Slemmons, unpublished mapping, 1953-1962; E. Boudreau, unpublished mapping, 1962; N. K. Huber and J. D. Schneyer, field revisions and additions, 1980.

2. D. B. Slemmons, unpublished mapping, 1953-1962; G. W. Bergantz, J. R. Giusso, W. J. Keith, and P. F. Ostendorf, Jr., field revisions and additions, 1980.

3. R. A. Armin and D. A. John, unpublished mapping, 1981.

4. D. B. Slemmons, unpublished mapping, 1953-1962; N. K. Huber, minor photo-revisions, 1980.

Graphic from source map: Dardanelles Cone 15' Quadrangle

Geologic Summary

Bedrock in the Dardanelles Cone quadrangle mainly consists of two rock groups: Mesozoic granitic rocks of the Sierra Nevada batholith, and overlying Tertiary rocks, chiefly of volcaniclastic origin. The batholith was intruded as a group of plutons that in the Dardanelles Cone quadrangle are probably all of Cretaceous age and are predominantly granodiorite in composition. Metamorphic rocks, which are widespread as septa and roof pendants within much of the batholith, are of very limited extent in the Dardanelles Cone quadrangle.

The granodiorite of Topaz Lake, the youngest plutonic unit in the quadrangle, is the only one for which we have reasonably reliable K-Ar age determinations; all older units are suspected of having reset K-Ar ages. Plutons comprising the Topaz Lake unit are considered to belong to the Late Cretaceous Cathedral Range intrusive epoch of Evernden and Kistler (1970). The granodiorite of Kinney Lakes

appears to bear a peripheral relationship to the granodiorite of Topaz Lake similar to that between the Half Dome Granodiorite and the Cathedral Peak Granodiorite in eastern Yosemite National Park. The Kinney Lakes and Topaz Lake are probably two units (there may be more) of an intrusive suite similar to the Tuolumne suite within which the Half Dome and Cathedral Peak are two of several units. The Tuolumne suite was previously called a "series" by Bateman and Chappel (1979) and a "sequence" by Stern and others (1981).

The biotite-hornblende granodiorite of Poopenaut Valley is continuous with similar rocks in the Pinecrest (Huber, 1983) and Lake Eleanor (F.C.W. Dodge and L.C. Calk, written commun., 1980) quadrangles to the south. Rocks thus mapped probably consist of multiple plutons, but they appear to be part of a belt of biotite-hornblende granodiorites and tonalites that extends at least as far south as the Millerton Lake quadrangle (more than 100 km). They would then be part of the Fine Gold granitoid suite of Stern and others (1981), which has an average U-Pb isotopic age of about 112 m.y. (Early Cretaceous).

By the middle Tertiary, the batholith had been unroofed and deeply eroded, and the Tertiary volcanic rocks were erupted onto a terrain with considerable relief. These rocks were erupted mostly from sources near the present Sierra crest and were dispersed westward down the slope of the ancestral Sierra toward the Central Valley and eastward into what is now Nevada. The earliest of these volcanic units, rhyolitic tuff of the Valley Springs Formation, flowed down ancient stream channels cut into the underlying granitic bedrock. One such channel can be traced almost continuously from the southeast corner of the quadrangle to near the west edge of the quadrangle. Subsequent units of the Tertiary volcanic sequence, including extensive lahars and a welded tuff, cap many of the ridges throughout the quadrangle. Uplift and westward tilting of the Sierra Nevada was occurring throughout the period of volcanic activity and indeed continues today (Huber, 1981) Erosion, particularly stream incision during periods of volcanic quiescence, was accelerated by this uplift and produced widespread unconformities within and between volcanic units. These unconformities are commonly marked by fluvial gravels.

The present distribution of volcanic rocks is largely the result of topographic inversion, post volcanic streams finding it easier to incise the adjacent or underlying weathered granite once the volcanic rocks were breached than to remove the tough, cohesive volcanic rocks themselves. An exception to this inversion can be seen at Pigeon Flat, where a relatively young interglacial basalt occurs in the bottom of the canyon of the Middle Fork of the Stanislaus River. The age of this basalt is about 150,000 years (Dalrymple, 1964b).

The present drainage pattern was well established by the Pleistocene and served to channel glaciers, particularly in the eastern half of the quadrangle. Major interfluves, such as the higher parts of the Dardanelles Cone and The Three Chimneys, remained above the level of even the most widespread glaciation.

Text from source map: Dardanelles Cone 15' Quadrangle

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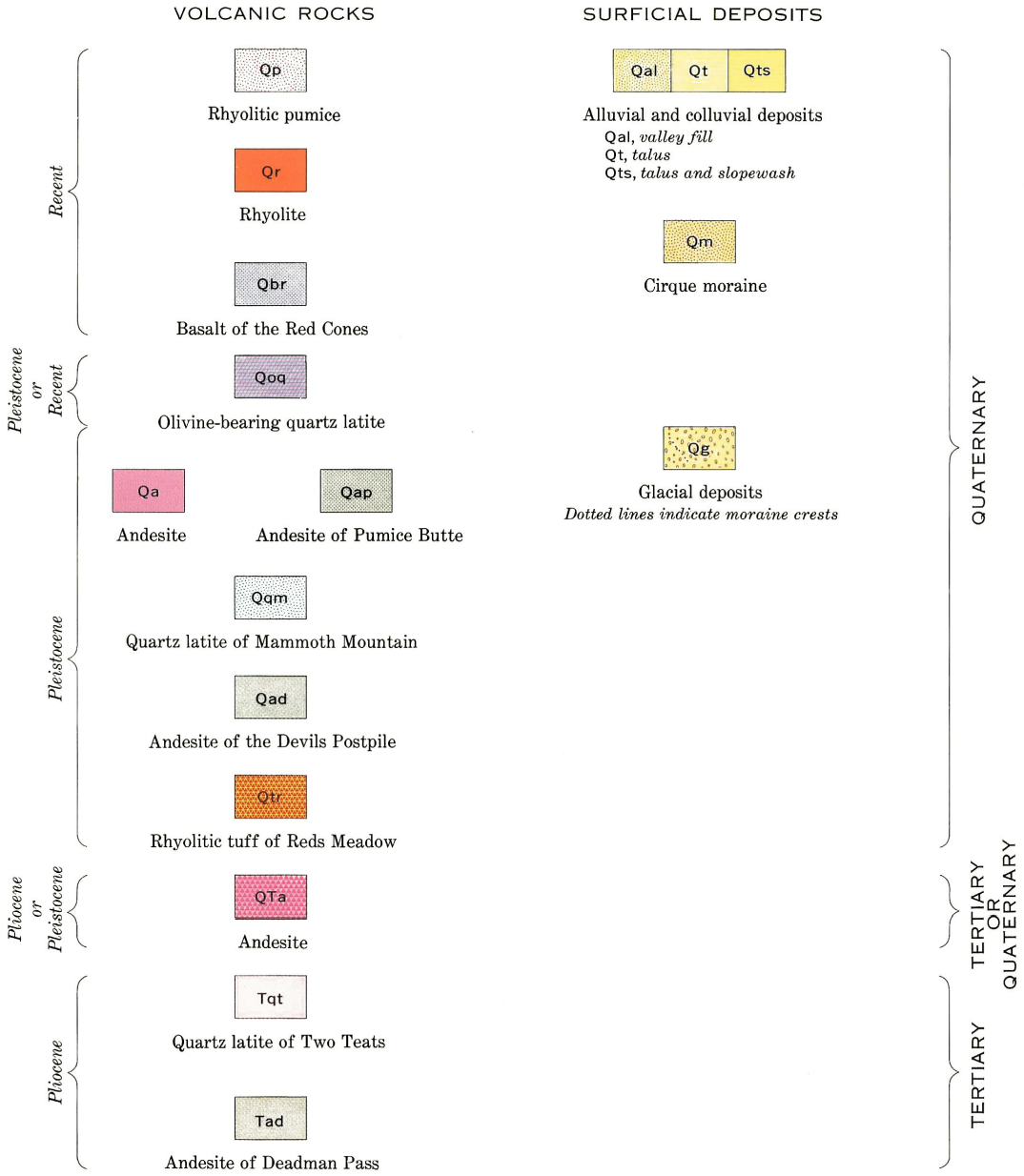
Devils Postpile 15' Quadrangle

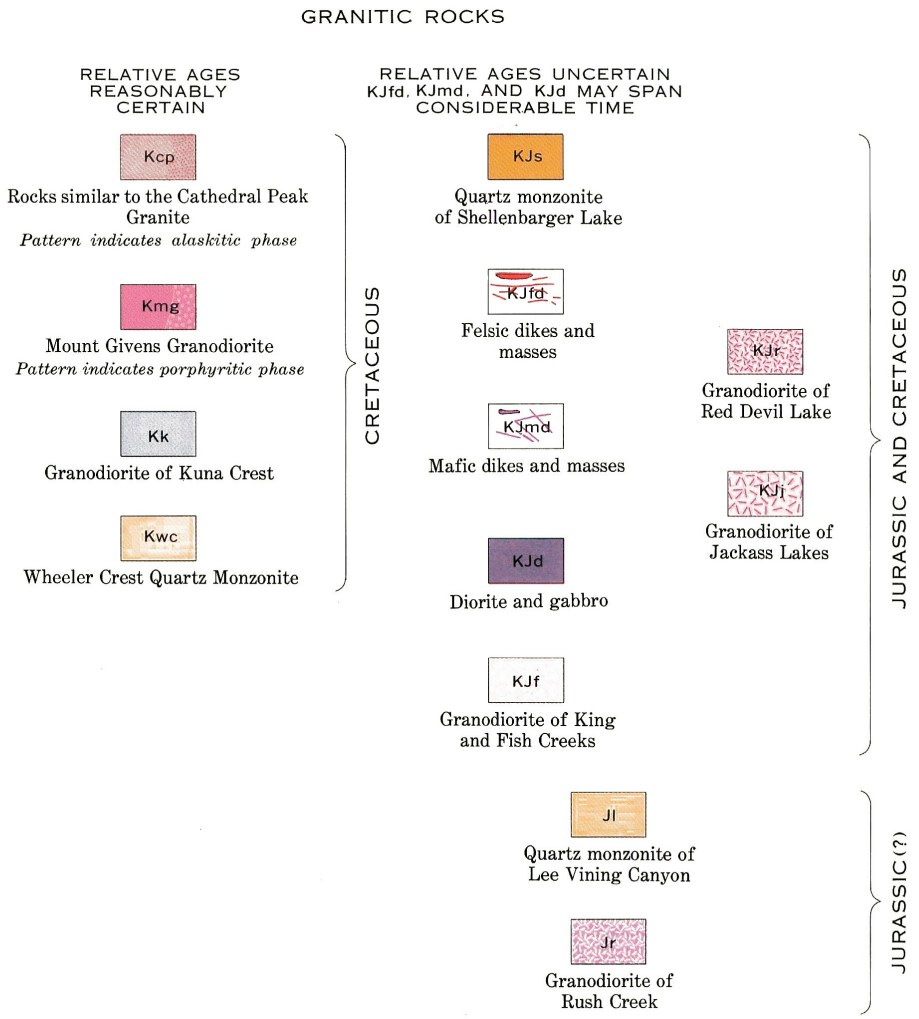
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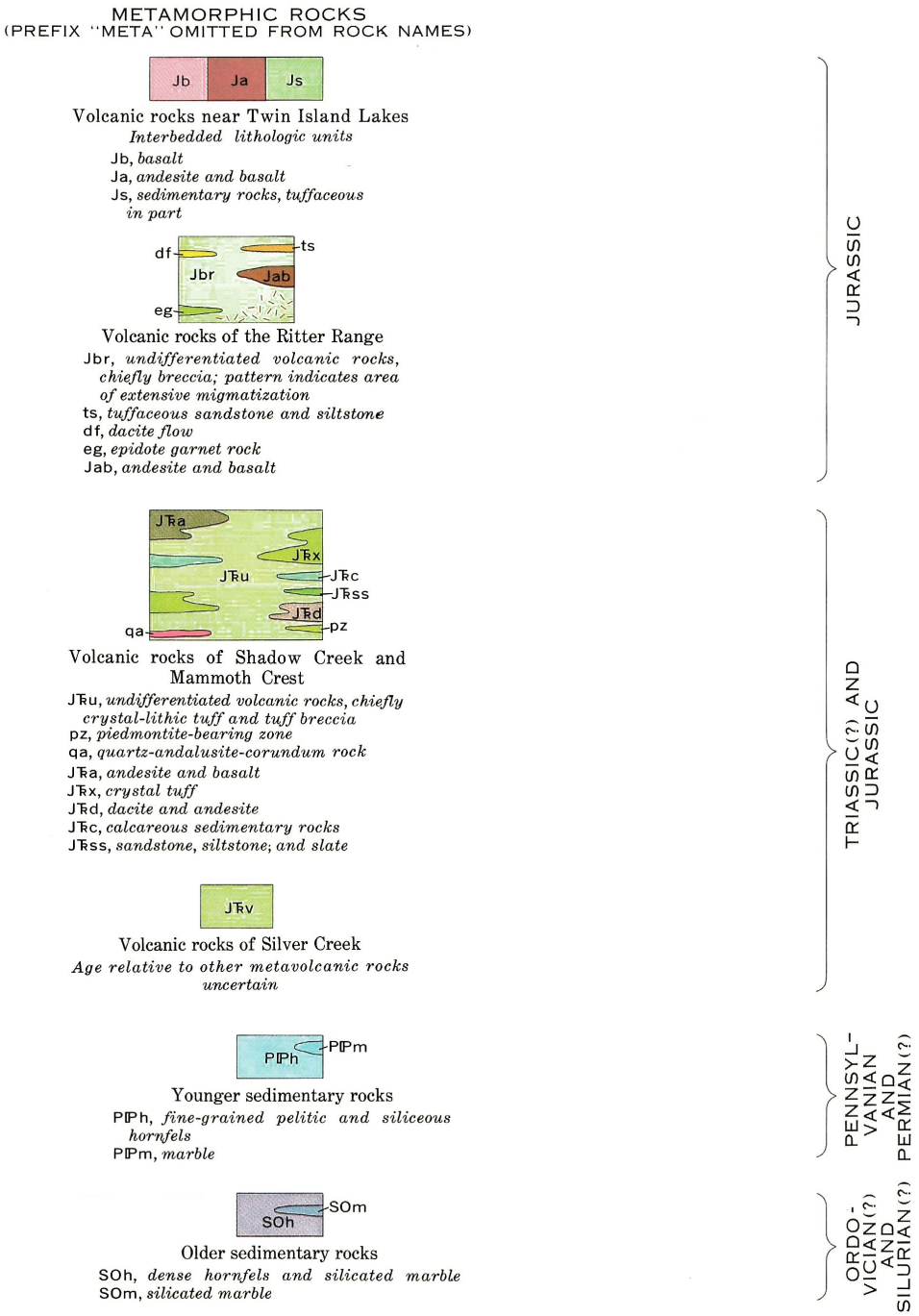
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Correlation of Map Units

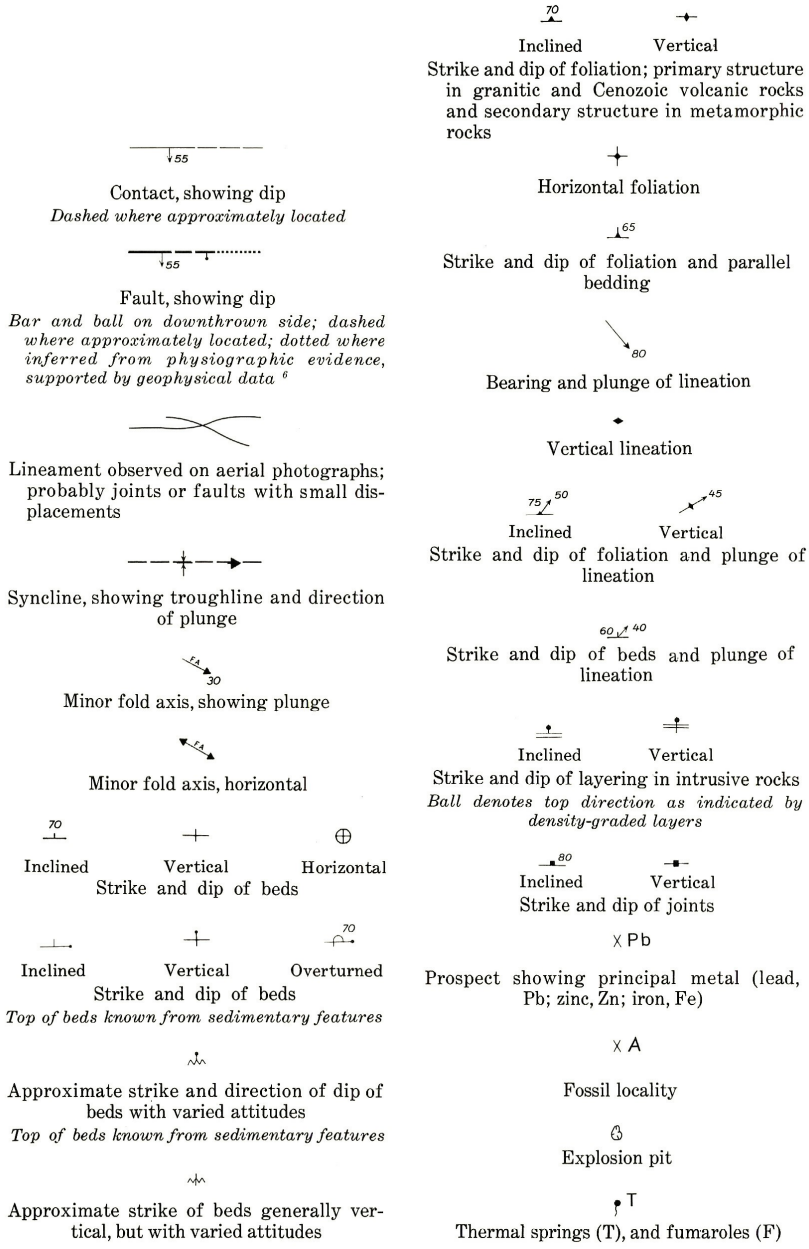



GRANITIC ROCKS
RELATIVE AGES REASONABLY CERTAIN
RELATIVE AGES UNCERTAIN KJfd, KJmd, AND KJd MAY SPAN CONSIDERABLE TIME
Kcp
Rocks similar to the Cathedral Peak Granite
Pattern indicates alaskitic phase
Kmg
Mount Givens Granodiorite
Pattern indicates porphyritic phase
Kk
Granodiorite of Kuna Crest
Kwc
Wheeler Crest Quartz Monzonite
CRETACEOUS
KJs
Quartz monzonite of Shellenbarger Lake
KJfd
Felsic dikes and masses
KJmd
Mafic dikes and masses
KJd
Diorite and gabbro
KJf
Granodiorite of King and Fish Creeks
KJr
Granodiorite of Red Devil Lake
KJj
Granodiorite of Jackass Lakes
JURASSIC AND CRETACEOUS
Jl
Quartz monzonite of Lee Vining Canyon
Jr
Granodiorite of Rush Creek
JURASSIC (?)



Graphics from source map: Devils Postpile 15' Quadrangle

Map Legend



Graphic from source map: Devils Postpile 15' Quadrangle

Footnotes (for description of map units)

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Footnotes from source map: Devils Postpile 15' Quadrangle

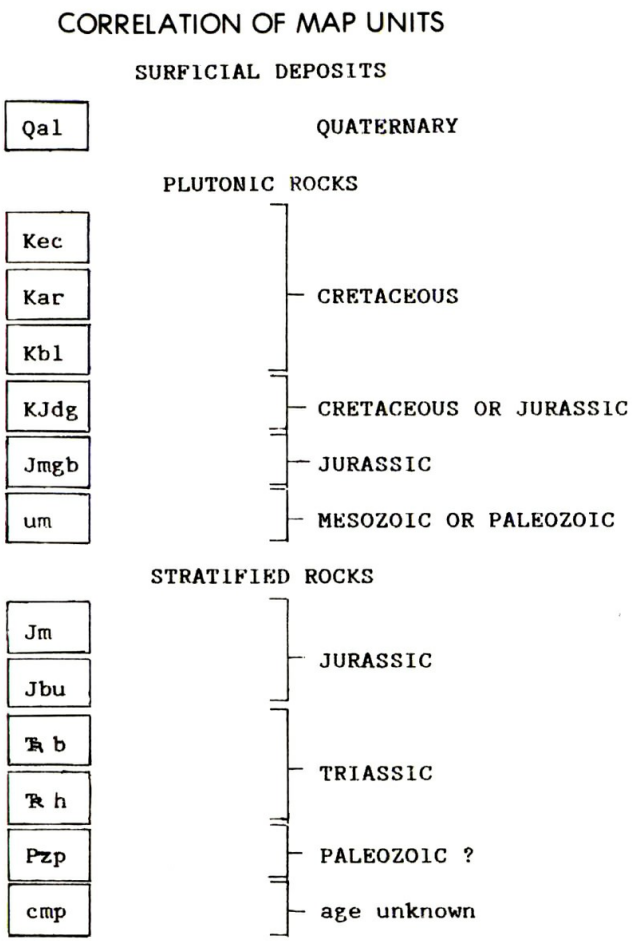
El Portal 15' Quadrangle

The formal citation for this source.

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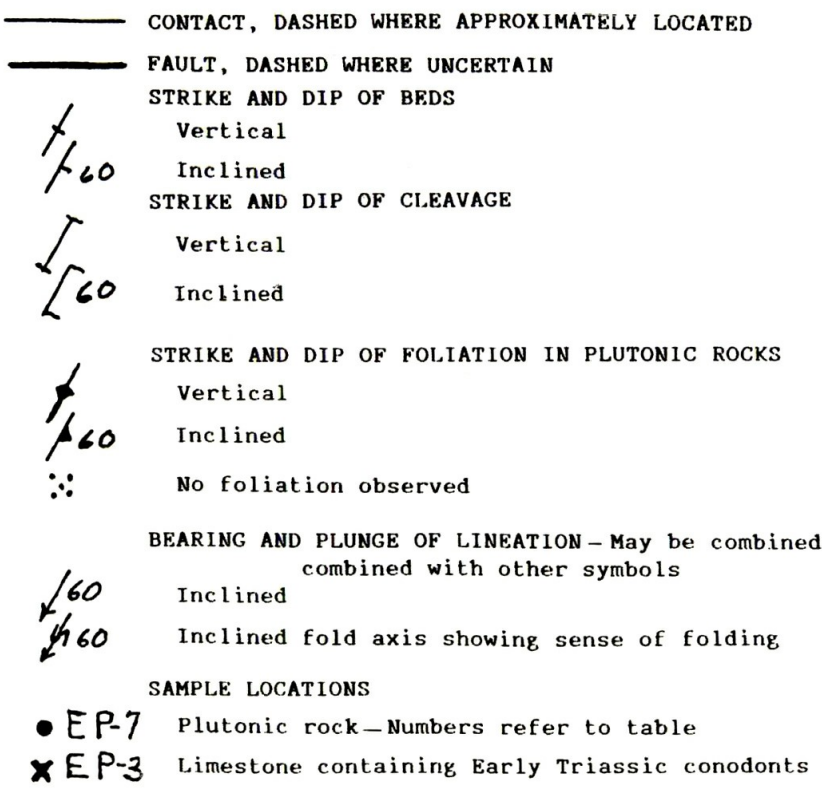
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Correlation of Map Units



Graphic from source map: El Portal 15' Quadrangle

Map Legend



Graphic from source map: El Portal 15' Quadrangle

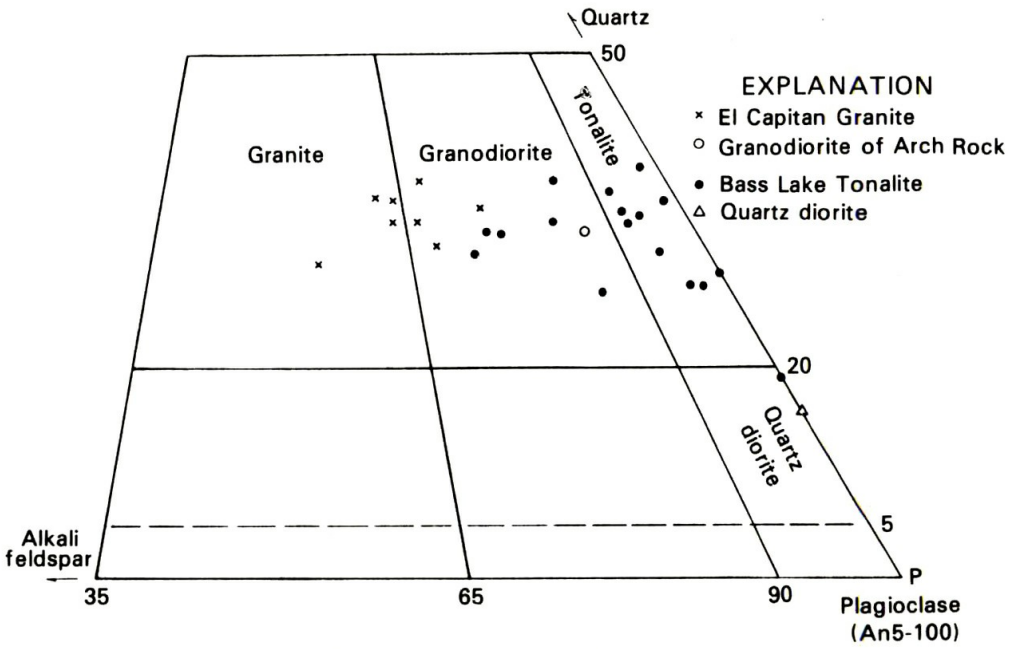
Modes and Specific Gravity of Plutonic Rocks

Modes and specific gravity of plutonic rocks

Sample Number	Mode (volume percent) Quartz	Alkali feldspar	Plagio-clase	Mafic Minerals	Specific Gravity
Quartz diorite near El Portal (KJdg)					
EP-126	11	tr	58	31	----
Bass Lake Tonalite (Kbl)					
EPb-2	28	4	44	23	----
EPc-1	35	8	49	8	2.62
EPc-2	21	0	52	27	2.77
EPc-3	23	3	49	25	2.77
EPc-4	22	3	46	29	2.77
EPd-1	27	14	41	17	2.71
EPd-2	15	0	63	22	2.81
EPd-4	29	1	44	26	2.80
EPd-5	21	2	51	26	2.82
EPd-6	26	1	45	28	2.81
EPd-7	27	4	46	22	2.75
EPd-8	14	tr	61	24	2.82
EP-51	26	13	40	20	----
EP-52	26	8	42	25	----
EP-104	24	2	59	16	----
EP-119	31	1	55	12	----
Bass Lake Tonalite (con.)					
EP-132	27	16	43	14	----
EP-134	27	3	48	22	----
EP-140	27	1	48	24	----
EP-142	21	8	48	23	----
EP-148	26	4	46	24	----
Granodiorite of Arch Rock (Kar)					
EP-105	28	8	50	13	----
El Capitan Granite (Kec)					
EP-6	33	21	38	8	----
EP-13	32	22	39	6	----
EP-23	32	15	44	8	----
EP-27	32	20	41	8	----
EP-29	28	29	35	8	----
EP-45	28	19	41	11	----
EP-46	32	22	39	6	----
EP-48	35	18	39	8	----
EP-50	34	23	37	6	----
EP-100	28	24	37	11	----

Graphic from source map: El Portal 15' Quadrangle

Plot of Modes of Plutonic Rocks



Plot of modes of plutonic rocks
(Classification modified slightly from Streckeisen (1973)

Graphic from source map: El Portal 15' Quadrangle

Summary of Geology

The El Portal quadrangle is in the western foothills of the Sierra Nevada, just west of Yosemite National Park. California State Highway 140, the Yosemite All-Year Highway, meets the Merced River at Briceburg in the western part of the quadrangle and follows it across the quadrangle and into Yosemite Valley. Deep dissection by the Merced River and its tributaries has produced rugged topography. Altitudes are progressively higher toward the northeast. The lowest point in the quadrangle is at about 1100 ft (335 m) where the Merced River crosses the west edge, and the highest point is 6915 ft (2107 m) at the north end of Chowchilla Mountains (near the south boundary of the quadrangle).

The quadrangle is underlain predominantly by strongly deformed but weakly metamorphosed sedimentary and volcanic rocks of Paleozoic(?) and early Mesozoic age, which, except for small slivers of Mariposa Formation, traditionally have been assigned to the Calaveras Formation or Complex. Because the Calaveras has never been defined precisely, and because the name has been used in some published reports to include all of the strata within this quadrangle east of the Melones fault zone and in other published reports to include only selected units, we have given informal names to the strata previously included in the Calaveras (Bateman and others, 1985; Bateman, in press). These rocks are intruded by plutonic rocks of Cretaceous age. The well-known Melones fault zone crosses the southwest corner of the quadrangle, and the Calaveras-Shoo Fly thrust, although not firmly established, probably extends N. 30° W. across the quadrangle from the southeast corner, within a complex zone composed of discontinuous lenses of metabasalt, metagabbro, limestone, quartzite, and olistostromes in a matrix of carbonaceous metapelite. Poor exposures, steep brush-covered hillsides, and obscure and apparently complex structures make for many uncertainties in interpreting the geology of the quadrangle.

Text from source map: El Portal 15' Quadrangle

Stratified Rocks

The stratified rocks form a series of units that trend about N. 30° W. across the quadrangle. Sparse fossils, an isotopic age determination, and relations projected from the north indicate that these units are younger toward the southwest (Bateman and others, 1985). Whether this westward younging succession of units reflects original stratigraphy or subsequent tectonism has not been established. Beds generally strike parallel with the units and dip steeply, but locally they are complexly folded. The most common lithology is phyllite, which is notably incompetent; quartzite, chert, limestone, basaltic andesite, and diamictite also are present. Most of the strata are in the greenschist metamorphic facies, but adjacent to plutonic rocks they are in the hornblende-hornfels facies. The strata are strongly cleaved; however, bedding is readily discernible in quartzite, chert, and some limestone. In most places bedding and cleavage are parallel, but cleavage that cuts across beds is apparent in many places, indicating the presence of obscure and probably complex structures.

The most northeasterly stratified unit, the quartzite of Pilot Ridge, is tentatively correlated with the early Paleozoic Shoo Fly Complex of Schweickert (1981), which is an important unit in the northern Sierra Nevada. However, the quartzite of Pilot Ridge has yielded no fossils. It consists chiefly of quartzite and schist or phyllite, and contains sparse silicated marble and chert. On the southeast side, the quartzite of Pilot Ridge is separated from the phyllite and chert of Hite Cove by a complex zone dominated by carbonaceous metapelite and which may contain the Calaveras-Shoo Fly thrust (Schweickert, 1981).

West of the metapelite zone is the phyllite and chert of Hite Cove, a unit characterized by rhythmically handed chert interlayered with phyllite. The unit also contains limestone lenses. An extensive limestone bed in the central part of the quadrangle has yielded Early Triassic conodonts (Bateman and others, 1985), and a collection made many years ago from a lens near Hite Cove in the eastern part is reported to have contained foraminifers of Pennsylvanian or Permian age (Turner, 1893; Clark, 1964)). Unfortunately the collection from near Hite Cove has been lost, and collections made later from the same locality have yielded no fossils.

The next unit to the west, the phyllite of Briceburg, is gradational with the phyllite and chert of Hite Cove, and the contact between the two units is arbitrarily drawn along a line that separates abundant chert to the east from sparse chert to the west. Limestone olistoliths contain conodonts of the same age as those in the conodont-bearing limestone in the phyllite and chert of Hite Cove, indicating that the unit is either of the same age or younger than the phyllite and chert of Hite Cove. Masses of fine-grained metagabbro that were intruded into the phyllite and involved in the deformation of the strata probably are of the same age as the adjacent Jurassic greenstone of Bullion Mountain. The presence of these masses suggests that the phyllite of Briceburg is older than the greenstone of Bullion Mountain; the phyllite probably is of Triassic age. North of the Merced River, steeply dipping bedding and cleavage strike N. 30° W., on the average, in the eastern part of the phyllite of Briceburg and N. 85° W. in the western part. A fault may separate these domains, as shown on the map, but it is also possible that these divergent structured may mark a sharp flexure.

The contact of the phyllite of Briceburg with the greenstone of Bullion Mountain is disturbed in some places, but does not appear to he a major fault zone. The greenstone is composed mostly of andesitic and basaltic tuff and tuff breccia, but pillow lava is exposed along Highway 140 a few hundred meters north of its junction with the Trahucco Creek road, and thin layers that may he flows are present along the Merced River. Samples from the east side of the greenstone have yielded a Rb-Sr isochron that indicates an Early Jurassic age (189.3 + 10.2 m.y.), whereas an ammonite collected from the west side of the greenstone, just west of the quadrangle, indicates a Late Jurassic age (Bateman and others, 1985; Clark, 1964).

The Melones fault zone, a wide zone marked by the presence of lenses of serpentinite, separates the greenstone of Bullion Mountain from the Late Jurassic Mariposa Formation to the west. Within the quadrangle the Mariposa occurs only as slivers within the fault zone.

Text from source map: El Portal 15' Quadrangle

Plutonic Rocks

The plutonic rocks include lens-shaped bodies of serpentinite that are confined to the Melones fault zone, small bodies of diorite and gabbro, the Bass Lake Tonalite, the granodiorite of Arch Rock, and the El Capitan Granite. The ages of the diorite and gabbro are unknown, but most of the masses appear to be older than the Bass Lake Tonalite, which has been dated isotopically at about 114 m.y. (Stern and others, 1981). Rocks now assigned to the Bass Lake Tonalite were called formerly the tonalite of Blue Canyon in the Mariposa quadrangle to the south and granodiorite of Hazel Green Ranch in the Lake Eleanor quadrangle to the north (Krauskopf, 1985; Dodge and Calk, in press). Because the name Blue Canyon has been preempted for another rock unit and because Hazel Green applies only to the rock in the pluton that extends across the boundary between the Lake Eleanor and El Portal quadrangles, neither name was suitable for a formal named unit. Because of these and other problems Bateman (in press) selected the name Bass Lake Tonalite for this rock (Bateman, in press).

Typical Bass Lake Tonalite is equigranular, medium dark gray, and contains lens-shaped dark-colored inclusions. Locally it is cut by dark-colored dikes. This rock forms one of the most extensive intrusions in the Sierra Nevada, but is present within the quadrangle only along the southern margin and in isolated plutons farther north. The presence of the plutons within the area of stratified rocks suggests strongly that the Bass Lake Tonalite underlies the stratified rocks at shallow depths and that the plutons are upward protrusions from the main mass of tonalite. The next younger granodiorite of Arch Rock, a medium-gray medium-grained rock present in the northeastern part of the quadrangle, is thought to be cogenetic with the Bass Lake Tonalite and only slightly younger.

The El Capitan Granite, which locally projects into the east side of the quadrangle from the Yosemite quadrangle to the east, is a light-gray rock that commonly contains blocky megacrysts of alkali feldspar 1 to 2 cm across. It has a U-Pb isotopic age of 102 m.y. and thus is significantly younger than the Bass Lake Tonalite and the granodiorite of Arch Rock (Stern and others, 1981). The locations of samples collected from the plutonic rocks are shown on the map, and the modes of the samples are given in the accompanying table and diagram. None of these samples has been analyzed chemically, but analyses of samples of the same rocks collected in the Lake Eleanor quadrangle to the north and in the Mariposa quadrangle to the south can be consulted (Krauskopf, 1984, 1985; Dodge, 1986; in press).

Text from source map: El Portal 15' Quadrangle

Mineral Deposits

Placer operations along the Merced River and its tributaries probably have yielded the bulk of the gold that has been recovered from the El Portal quadrangle. Although the Mother Lode crosses the southwest corner of the quadrangle (coincident with the Melones fault zone), no large lode deposits occur along the span that lies within the quadrangle. However, quartz veins that lie east of the Mother Lode have been exploited and yielded significant amounts of gold plus minor amounts of silver, copper, and lead.

Limestone from the quarry north of the Merced River at Miller Gulch was used in making cement from 1927 to 1944 when service on the Yosemite Valley Railroad was discontinued, and barite was mined near El Portal, north of the Merced River just east of Rancheria Flat, between 1910 and 1948. The barite occurs in vein-like masses interstratified with quartzite, phyllite, and schist. According to Bowen and Gray (1957) approximately 2,430,843 tons of limestone and 398,613 tons of barite were shipped.

Excellent descriptions of the gold deposits within the quadrangle are given in Bowen and Gray (1957), and the following remarks are mostly abstracted from that publication. Except for the Colorado Mine, which Kampf and Keller (1982) report is still yielding fine specimens of crystalline gold, none of the gold mines was in production in 1986. The lode gold mines with the largest recorded production are along the north side of the Merced River at Clearing House, and along the South Fork, 2 miles southeast at Hite Cove. Both mines lie close to the west boundary of the carbonaceous metapelite. Other mines with recorded gold production are scattered throughout the quadrangle.

The Hite Cove mine was discovered in 1862 and was operated intermittently until 1912. During this period it yielded 130,000-150,000 oz of gold plus substantial amounts of silver. The deposit consists of a principal and two subsidiary veins, which are enclosed in slate, dark carbonaceous schist, and quartzite. The principal vein varies in thickness from a few feet to as much 12 ft; it strikes N. 50° - 70° W. over most of its length but bends to N. 50° W. near the south end, and dips 75° to 80° N. Ore has been stoped in a zone that extends about 600 ft horizontally and about 700 ft vertically.

The Clearing House mine consists of two sulfide-bearing quartz veins, one on either side of a dike-like intrusion of tonalite. The sulfides include arsenopyrite, galena, and sphalerite. The western vein was discovered in 1860 and worked until 1880, and the eastern vein was located in 1908 and mined between 1911 and 1937. These veins yielded about 350,000 oz of gold and substantial amounts of silver, copper, and lead. Both veins strike east of north, but the eastern vein dips steeply east whereas the western vein dips steeply west. Both veins are in metamorphosed sedimentary rocks at the surface, but the eastern vein passes downward at a depth of about 400 ft into tonalite.

Text from source map: El Portal 15' Quadrangle

Acknowledgements

Several years before we began study of the El Portal quadrangle O.E. Bowen generously supplied Bateman with a copy of his unpublished map of the El Portal and Coulterville quadrangles. His map outlines the principal units and was of great help to us, especially in the early stages of our study. The swarm of limestone olistoliths east of Briceburg is largely from Bowen's map. We are grateful to R. A. Schweickert, C.M. Merguerian, O.T. Tobisch, S.R. Paterson, and Tapas Bhattacharyya, who are carrying on studies within and adjacent to the El Portal quadrangle and freely exchanged data and ideas with us. N.K. Huber collected samples and traced some contacts in the northeast corner of the quadrangle. D.L. Peck mapped some contacts along the east side of the quadrangle in connection with his mapping of the adjacent Yosemite quadrangle.

Text from source map: El Portal 15' Quadrangle

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References from source map: El Portal 15' Quadrangle

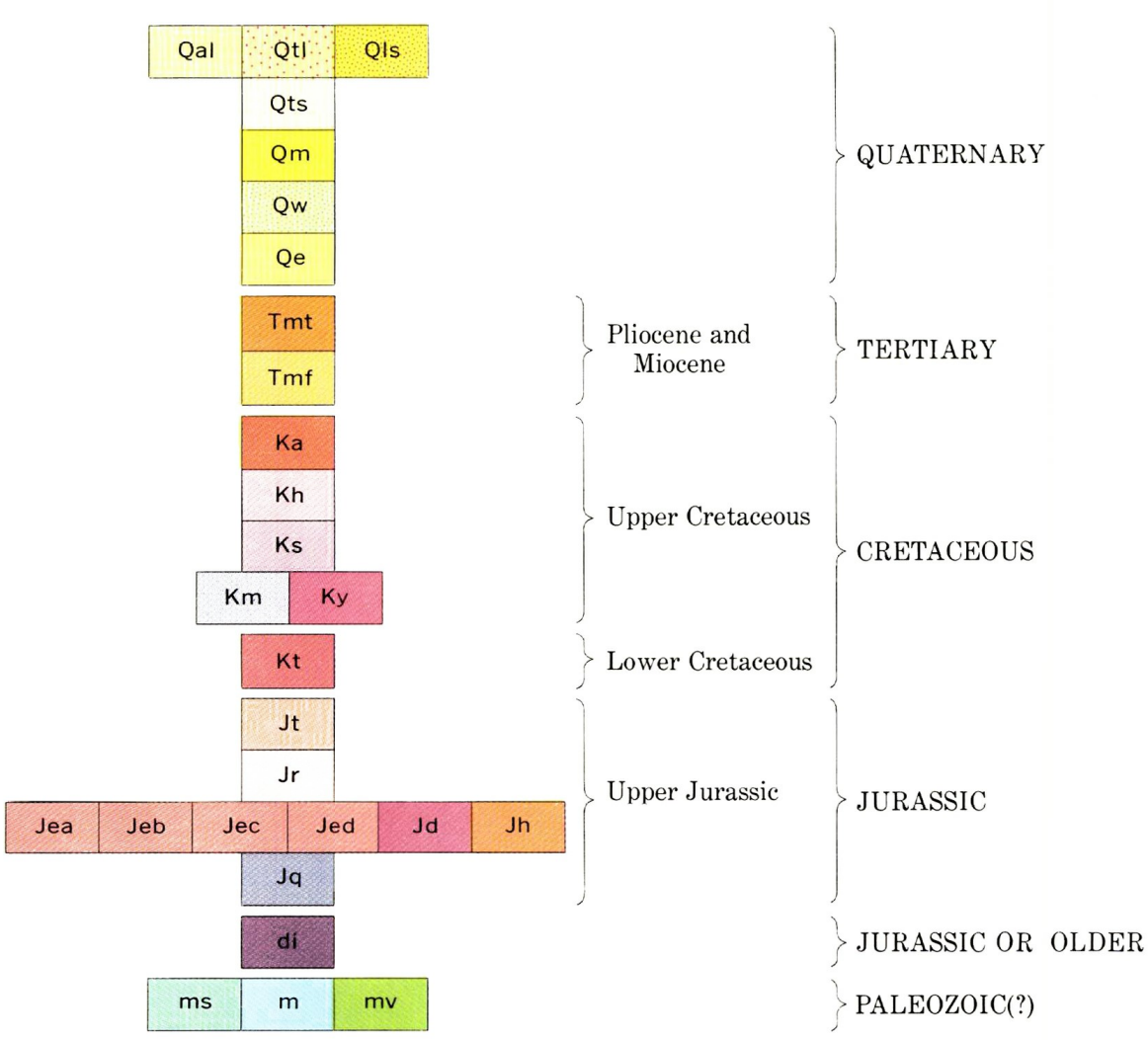
Hetch Hetchy Reservoir 15' Quadrangle

The formal citation for this source.

Kistler, R.W., 1973, Geologic Map of the Hetch Hetchy Reservoir Quadrangle, Yosemite National Park, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1112, scale 1:62,500 (*GRI Source Map ID 1357*).

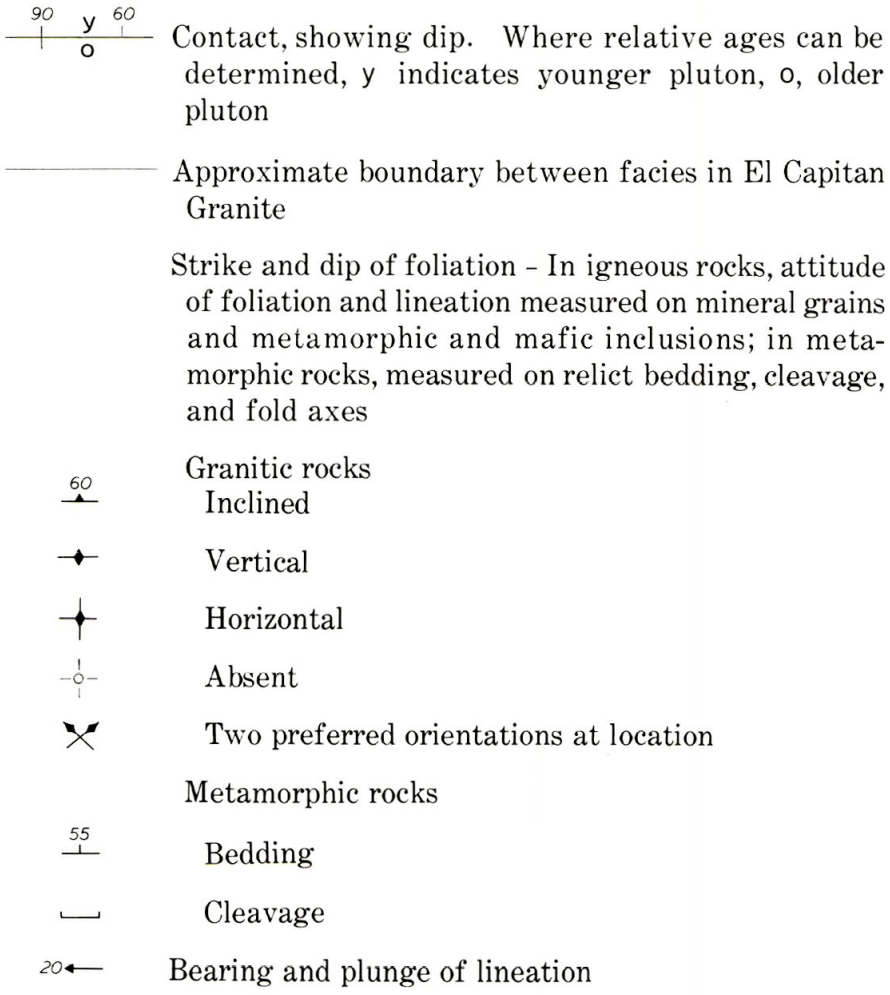
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Correlation of Map Units



Graphic from source map: Hetch Hetchy Reservoir 15' Quadrangle

Map Legend



Graphic from source map: Hetch Hetchy Reservoir 15' Quadrangle

Selected References

Matthes, F.E., 1930, Geologic history of Yosemite Valley: U.S. Geological Survey Prof. Paper 160, 137p.

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References from source map: Hetch Hetchy Reservoir 15' Quadrangle

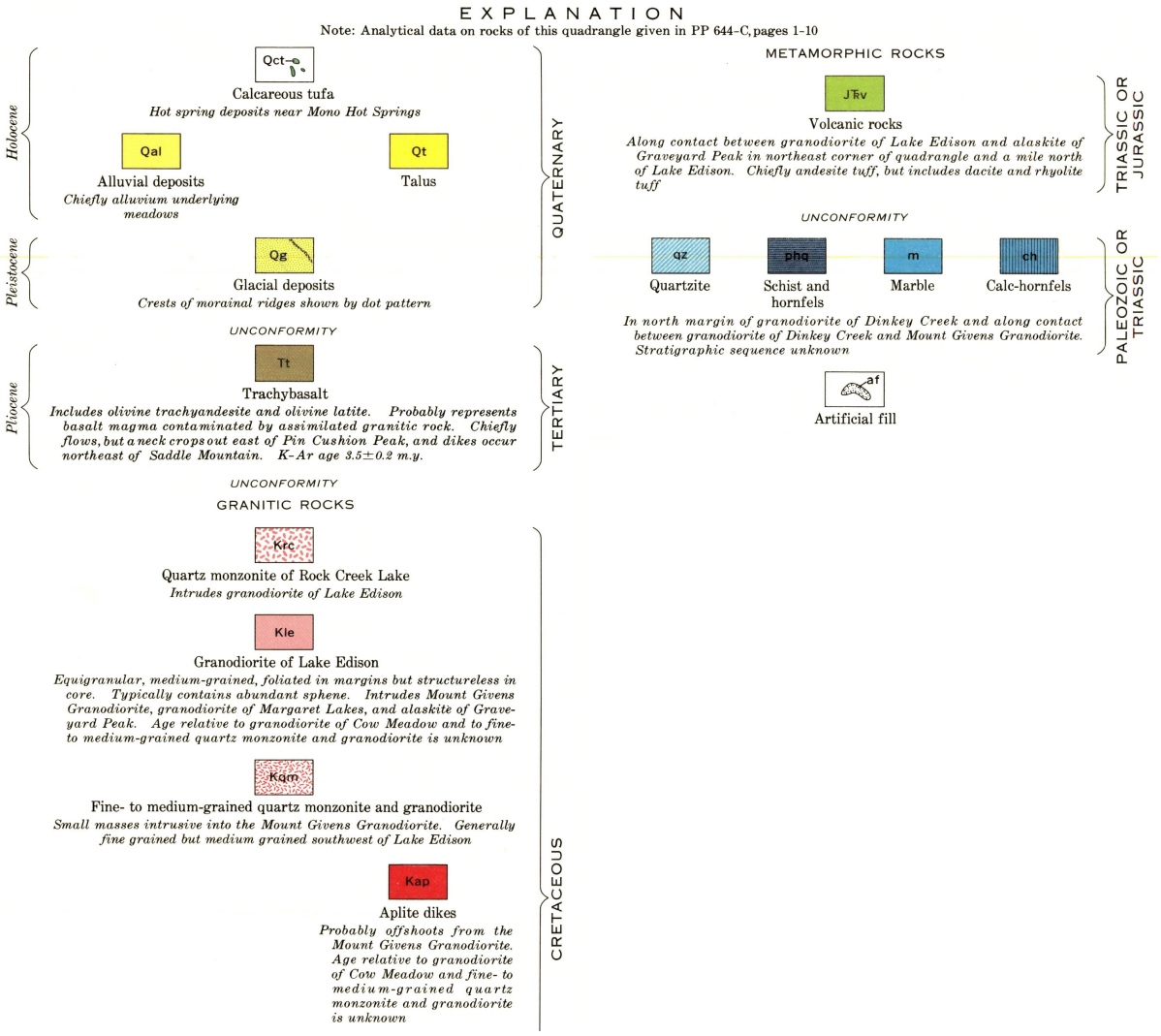
Kaiser Peak 15' Quadrangle

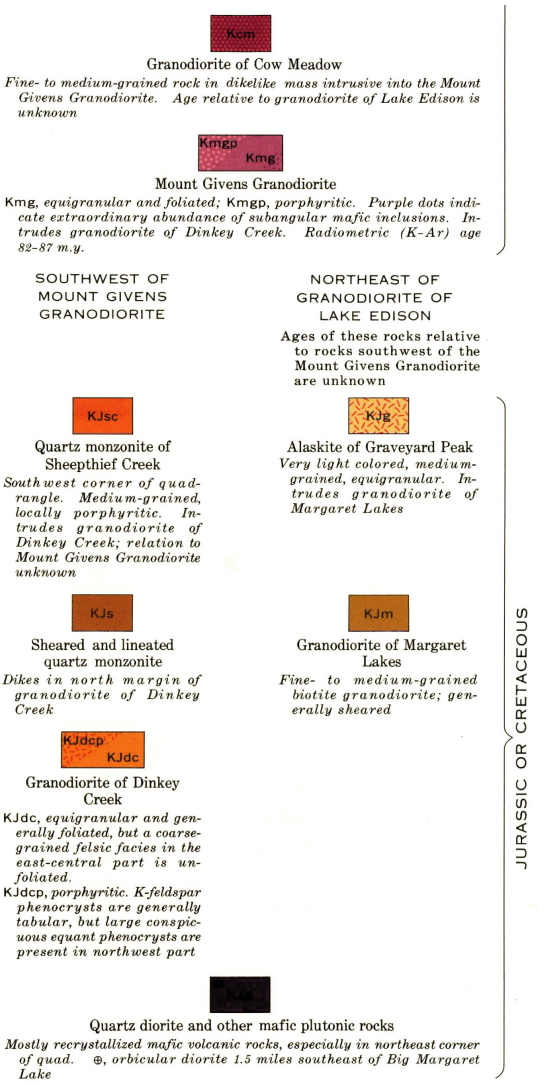
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Bateman, P.C., Lockwood, J.P., and Lydon, P.A., 1971, Geologic Map of the Kaiser Peak Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-894, scale 1:62,500 (*GRI Source Map ID 1373*).

Prominent graphics associated with this source.

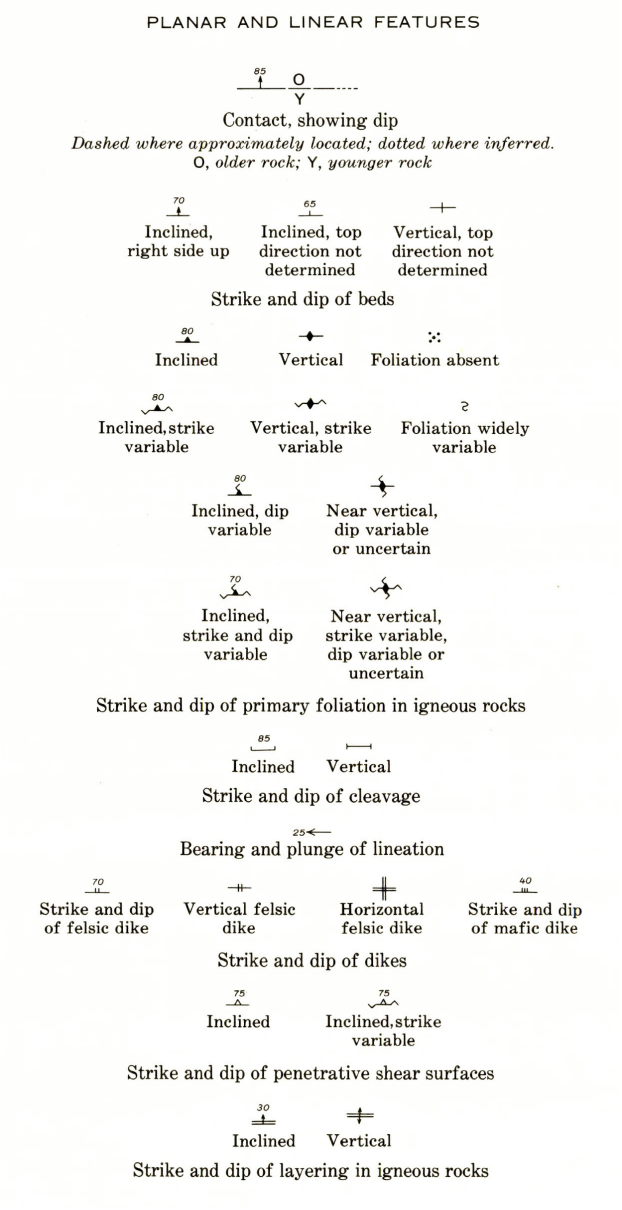
Correlation of Map Units





Graphic from source map: Kaiser Peak 15' Quadrangle

Map Legend



Graphic from source map: Kaiser Peak 15' Quadrangle

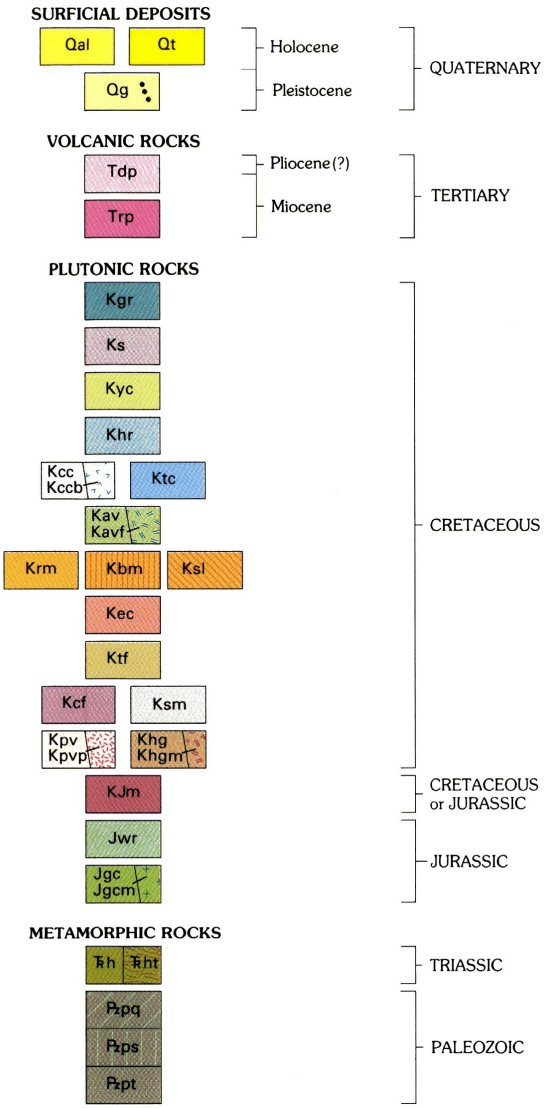
Lake Eleanor 15' Quadrangle

The formal citation for this source.

Dodge, F.C.W., and Calk, L.C, 1987, Geologic Map of the Lake Eleanor Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1639, scale 1:62,500 (*GRI Source Map ID 1363*).

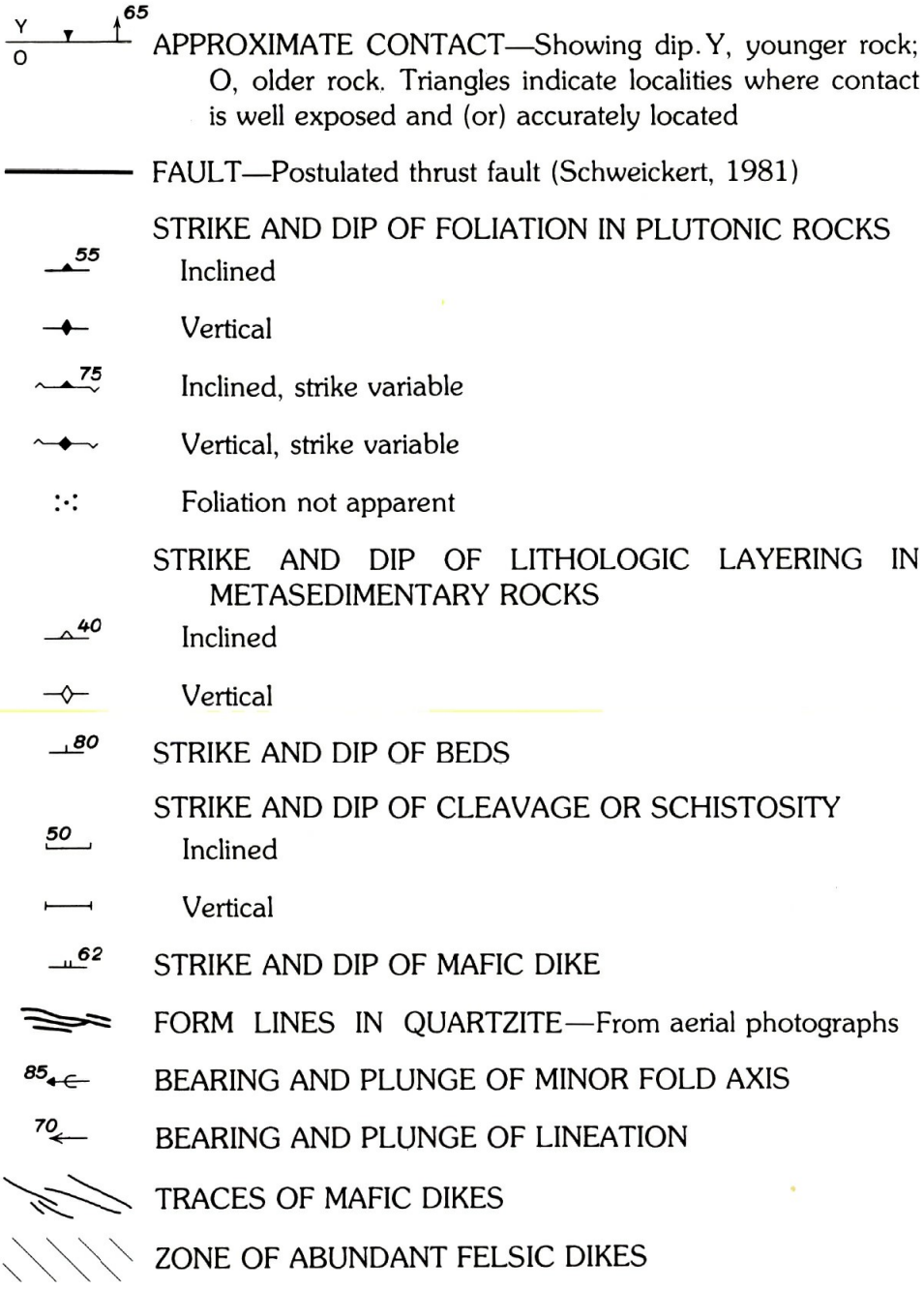
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Correlation of Map Units



Graphic from source map: Lake Eleanor 15' Quadrangle

Map Legend



Note: Symbols may be combined; intersection of symbols is point of observation.

Graphic from source map: Lake Eleanor 15' Quadrangle

Highlights of Geology

The Lake Eleanor quadrangle is located on the western slope of the central Sierra Nevada, northwest of Yosemite Valley. The eastern third of the quadrangle is within Yosemite National Park, the western two-thirds are within Stanislaus National Forest. All but the south edge, which is within Mariposa County, is within Tuolumne County. Elevations range from 2,000 ft (610 m) in the Tuolumne River canyon at the west edge of the quadrangle to 7,261 ft (2,213 m) at the summit of Bald Mountain near the east margin. Dense vegetation comprises pine and fir forests at higher elevations and nearly impenetrable chaparral at lower elevations coupled with deep soils, slopewash, and glacial debris restricts outcrops of fresh bedrock to artificial cuts and stream and river canyons in much of the map area.

The quadrangle lies near and along the west margin of the Sierra Nevada batholith. Geologic mapping of the Lake Eleanor quadrangle is part of a continuing program to study the geology of a section across the batholith between lat 37° and 38° N. Within this section, the adjacent Hetch Hetchy Reservoir quadrangle has been completed and geologic mapping is nearing completion in the Yosemite and El Portal quadrangles.

Analytical data for the plutonic, metamorphic, and volcanic rocks of the Lake Eleanor quadrangle, including chemical and modal analyses, specific gravities, and isotopic age determinations that are mentioned in this report are from Dodge and Calk (1986).

Text from source map: Lake Eleanor 15' Quadrangle

Metamorphic Rocks

Although the quadrangle is underlain chiefly by various kinds of granitic rocks, its south edge is underlain by metasedimentary rocks belonging to a belt, the western metamorphic belt, of stratified rocks 350 km long and averaging 70 km wide along the northern half of the west side of the Sierra Nevada. In addition, metasedimentary rocks are present as scattered inclusions as much as 4 km across within plutonic rock bodies in the western half of the quadrangle.

Metamorphic rocks in the western foothills belt east of the Melones fault zone, a well-known fault zone 30 km west of the Lake Eleanor quadrangle, previously assumed to be of Paleozoic age on the basis of sparse evidence were assigned to the Calaveras Formation; however, recent studies suggest that diverse ages are represented. Because of the present uncertainty of assigning these rocks to the Calaveras Formation, the metasedimentary rocks in the quadrangle are assigned to two informal units with local names.

The quartzite and schist of Pilot Ridge consists dominantly of quartz-mica schist derived from pelitic sediments and quartzite, originally quartz sandstone; however, slate, graphitic schist, marble, and tactite are present. Although extensive recrystallization has generally obliterated many original features, sedimentary textures such as well-rounded grains in quartzite are rarely present. Lithologic layering, which likely mimics bedding, is common, generally dips steeply, and locally is strongly contorted. Linear trends, particularly in the massive kilometer-thick quartzite that makes up Pilot Ridge, are believed to reflect traces of original bedding. These trends are visible in aerial photographs and are defined by vegetation lines or by aligned outcrops. Isotopic ages determined on orthogneisses found in sills and stocks within the quartzite and schist unit indicate a probable early Paleozoic age for the strata.

The phyllite and chert of Hite Cove consists of rhythmically bedded chert sequences interbedded with phyllite. A band of talc schist and minor associated serpentinite in the unit represents the metamorphic derivative of dolomitic limestone. A Pennsylvanian or Permian age was reported on large

foraminifer fossils collected nearly 100 years ago from the eastern part of the phyllite and chert of Hites Cove near Hites Cove, 10 km south of the Lake Eleanor quadrangle. Unfortunately, the collection has been lost, and efforts to recollect identifiable material have been unsuccessful. Recently, Early Triassic conodont fossils have been discovered in samples from this unit collected south of the quadrangle along the Merced River.

The contact between the phyllite and chert of Hite Cove and the quartzite and schist of Pilot Ridge trends N. 50° W. along the west margin of the westernmost quartzite band within the quartzite and schist unit. The postulated Shoo Fly thrust fault (Schweickert, 1981) approximately coincides with this contact on the west side of Pilot Ridge. Although no exposed and not necessarily a thrust fault, presence of a major fault suggested by abrupt lithologic change at this contact, the large age difference across the contact, and the termination of the talc schist against the contact. A zone of mixed rocks is present between quartzite and phyllite to the south; however, it is not exposed in the Lake Eleanor quadrangle.

The metamorphic rocks are intruded by younger plutonic rocks although immediate contact effects are barely discernible. A metasedimentary-tonalite contact is particularly well displayed in a row cut on the east side of Big Creek.

Text from source map: Lake Eleanor 15' Quadrangle

Plutonic Rocks

Plutonic rocks of the Sierra Nevada batholith make up three-quarter of the bedrock in the quadrangle and occur in several intrusive units of various ages. The plutonic rocks have been classified and named according to their quantitative (modal) mineral content. Major intrusive units consist largely of granitoids ranging in composition from tonalite to granite; gabbroids comprise a minor part (less than five percent) of the plutonic rocks in the quadrangle. A combination of relative and absolute ages was used to establish a succession of intrusive units. In spite of poor exposures, relative ages of some of the units have been determined at a few localities in the quadrangle—younger units contain inclusions of older units, structures in older units are truncated at contacts with younger units, and rarely, dikes of younger units cut older units. Absolute ages have been determined by radiometric methods, including potassium argon analyses of hornblende and biotite, lead-uranium analyses of zircon, and whole-rock rubidium-strontium analyses. The radiometric ages, along with others from nearby quadrangles, indicate the plutonic rocks originated during several magmatic episodes in late Mesozoic time.

The oldest granitoid in the quadrangle, the tonalite of Granite Creek, is present in two masses with ages of 166 and 163 Ma, respectively. This unit, along with isolated plutons to the west, has been assigned to the Jurassic Jawbone intrusive sequence. The presence of this sequence on the west side of the Sierra Nevada and of contemporaneous granitoids on the east side indicates that Jurassic intrusions followed a general N. 40° W. trend in this region, whereas Cretaceous intrusions, which probably displaced the previously more widespread Jurassic granitoids in the central part of the batholith, have a general N. 20° W. trend, parallel in the present-day Sierran crest. The tonalite is invariably strongly foliate, and in some samples original igneous crystal shapes are lost, grain size is reduced, compositional zoning of mineral grains is obliterated, an, larger crystals are bordered by granoblastic mortar, indicating the tonalite has been subjected to intense post-magmatic deformation. This deformation is attributed to the widely recognized Nevadan orogeny. The western-most mass of tonalite has been intruded by the undeformed, porphyritic granite of Woods Ridge. The granite has an age of 151 ME thus bracketing the time of the Nevadan orogeny within the 12 M interval between 163 and 151 Ma in the Late Jurassic.

Granitoids mapped as the tonalite of Poopenaut Valley are the mop widespread rocks in the quadrangle. They are mostly hornblende-biotite tonalite; however, their composition is variable. The granitoids may be present in multiple intrusive bodies, but generally poor exposure prevent division into definitive subunits; a porphyritic granodiorite facies was mapped around the dam at the south end of Lake Eleanor. The tonalite forms the northern part of a nearly 150-km-long belt of Early Cretaceous granodiorites and tonalites that extends north beyond Pinecrest and south at least as far as Millerton Lake and includes the granodiorite of The Gateway in Yosemite Valley and the tonalite of Blue Canyon further to the south.

The granodiorite of Sawmill Mountain, named after one of the most prominent features in the quadrangle, is a light-colored rock of variable composition. It is typified by discrete, conspicuous, anhedral quart crystals and evenly disseminated, medium to fine subhedral biotite grain and commonly is vaguely porphyritic with stubby phenocrysts of alkali feldspar. The granodiorite closely resembles the El Capitan Granite on the north side of Yosemite Valley to the southeast. This similarity of distinctive nearby units suggest a consanguineous relationship; however, the difference precludes consanguinity. The granodiorite of Sawmill Mountain has an age of 116 Ma, whereas the El Capitan Granite is approximately 100 Ma (there is uncertainty about the granite's true age because U-Pb ages indicate 97, 102, and 103 Ma on individual samples, but 107 Ma is suggested by a five-point whole-rock Rb-Sr isochron).

The remaining younger Cretaceous granitoids in the eastern half of the quadrangle are present as small bodies that are generally correlative with rocks mapped to the southeast such as the granites of Bald Mountain and Swamp Lake. Both these granites are believed to be comagmatic with the Taft Granite of Yosemite Valley or are small parts of larger units such as the Sentinel Granodiorite and granodiorite of Yosemite Creek, which make up the outer shell of the Tuolumne Intrusive Suite.

Text from source map: Lake Eleanor 15' Quadrangle

Volcanic Rocks

Scattered erosional remnants of a once continuous andesitic mudflow extend to the southwest across the quadrangle and indicate the position of an ancestral channel of the Tuolumne River; a channel that is crossed by the present-day Tuolumne River near North Mountain. A rubbly outcrop of volcanic debris north of Ackerson Meadow apparently resulted from the mudflow back-filling a tributary that flowed to the northwest and entered the main river at Abernathy Meadow 5 km to the northwest. The present-day Middle Fork of the Tuolumne River follows this ancient channel for some distance, but was blocked from the main river by a glacial moraine. A volcanic mudflow of the Disaster Peak Formation present in the northwest corner of the quadrangle surficially resembles a mudflow of the Relief Peak Formation in the central part of the quadrangle, but the former mudflow is younger, and contains fragments of an intermediate-age rock unit, the Eureka Valley Tuff. The source of all the volcanic mudflows was far to the east, near the present Sierra crest.

Text from source map: Lake Eleanor 15' Quadrangle

Glacial Deposits

Glaciers extended into the quadrangle from the northeast at least three times during the Pleistocene. The tongues of ice generally followed present-day drainages; the largest occupied the Tuolumne River canyon, and smaller tongues occurred in Cherry and Eleanor Creeks. Configuration of the Tuolumne River canyon suggests that during the latest glaciation ice extended downstream to below

Joes Point at a present-day elevation of 2,500 ft (Clyde Wahrhaftig, written commun., 1985).

Although three glacial advances, the Tioga and Tahoe glaciations and a glaciation of pre-Tahoe age, are recognized in the northeastern quarter of the quadrangle, the glacial deposits have not been subdivided and include unconsolidated glacio-fluvial debris and colluvium derived from glacial till as well as morainal remnants. Crests of morainal ridges are commonly conspicuous on aerial photographs.

Text from source map: Lake Eleanor 15' Quadrangle

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References from source map: Lake Eleanor 15' Quadrangle

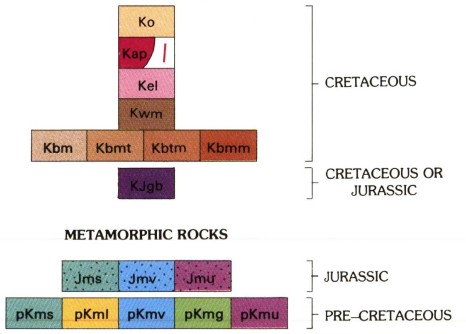
Mariposa 15' Quadrangle

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Krauskopf, K.B., 1985, Geologic Map of the Mariposa Quadrangle, Mariposa and Madera Counties, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1586, scale 1:62,500 (*GRI Source Map ID 1359*).

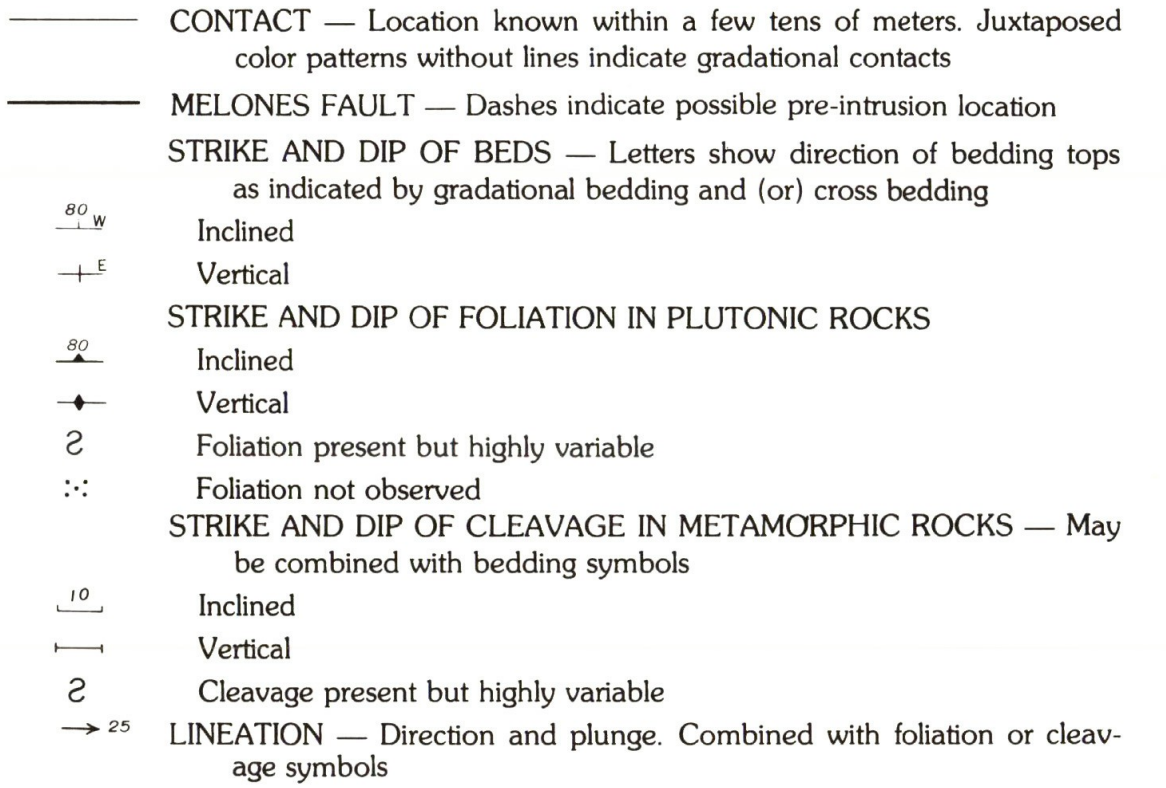
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Correlation of Map Units



Graphic from source map: Mariposa 15' Quadrangle

Map Legend



Graphic from source map: Mariposa 15' Quadrangle

Principal Geologic Features

The Mariposa 15-minute quadrangle is in the western foothills of the central Sierra Nevada. about 50 km southwest of Yosemite Valley and 60 km northeast of Merced. Mariposa, county seat of Mariposa County. is near the northwest corner. Altitudes range from less than 200 m above sea level at the southern border to more than 1,600 m near the northeast corner. but most of the quadrangle lies between 500 and 1,000 m. The southwest half is mostly open oak- and pine-covered grassland with local relief less than 150 m: the northeast half has greater relief, and dense stands of pine. oak. and chaparral are more common. The Chowchilla River and its many tributaries drain the central part: the northwest corner is drained by Mariposa Creek and the southeast corner by the Fresno River.

Plutonic rocks, principally the somber plagioclase-rich granitoid called tonalite, underlie about 80 percent of the quadrangle forming a broad band running north-south down its center. Metamorphic rocks occupy areas of irregular shape on the east and west sides. In the mass of metamorphic rocks in the northwest corner is the southern end of the Mother Lode, the famous belt of gold-bearing quartz veins that extends northwestward along the Sierra Nevada foothills for some 200 km. The southernmost of the large Mother Lode mines. the Mariposa mine, was in the present town of Mariposa. The typical Mother Lode rocks and structures that are continuous to the northwest are cut off abruptly by tonalite about 3 km southeast of the town. Farther to the southeast are patches of similar rocks with local small showings of gold-bearing quartz, but the continuity of structure and the large quartz veins characteristic of the Mother Lode are lacking.

The geologic history that can be read from the rocks of the quadrangle is a record of ancient sedimentation and volcanic activity. followed by deep burial. strong deformation, and mild metamorphism of the rock layers, then the intrusion of large masses of molten magma that further metamorphosed the sedimentary and volcanic material and ultimately solidified into a variety of granitic rocks. Finally regional uplift occurred, accompanied by deep erosion that uncovered the metamorphic and igneous rocks and that is continuing today. The character of the metamorphosed sedimentary and volcanic rocks suggests original deposition on the sea floor near a chain of islands (an island arc) with numerous volcanoes. The kind of deformation and igneous activity suggests crumpling of rock layers and partial melting of deep rock material when the ancient sea floor was pushed against the continent and was in part carried down into the mantle by movement of the oceanic plate (subduction). The plausibility of such a reconstruction rests on broad regional studies. however. and could not be established from evidence in this quadrangle alone.

Text from source map: Mariposa 15' Quadrangle

Metamorphic Rocks

The large area of metamorphic rocks on the west side of the quadrangle is near the south end of the western metamorphic belt of the Sierra foothills. which extends northwestward for more than 350 km along the west side of the Sierra Nevada batholith and includes the Mother Lode. The metamorphic rocks on the east side are part of the Coarsegold septum, which occupies a large area in the adjoining Bass Lake quadrangle: many small outliers of this septum are surrounded by granitic rocks toward the center of the Mariposa quadrangle. The small V-shaped patch near the northeast corner is a southward projection of a large mass of metamorphic rocks in the El Portal quadrangle to the north.

Relations among the metamorphic rocks are complicated by uncertainty as to the location of the Melones fault in this quadrangle. To the northwest along the Sierra foothills, this prominent fault splits the western metamorphic belt longitudinally. Traditionally, rocks west of the fault have been regarded as predominantly Mesozoic. those east of the fault as Paleozoic: the fault is widely thought to mark the juncture of two terranes that originated in different environments and at different times. This view is difficult to substantiate for the southern part of the fault because of complex structures, similarity of rocks on the two sides, and scarcity of fossils. An alternative hypothesis has been suggested recently that the southern part of the fault is not a major tectonic feature but simply a displacement separating two belts of related Jurassic rocks (Schweickert and others, 1982). Whichever view is correct, the fault must enter the northwest corner of the Mariposa quadrangle and is cut off by the tonalite of Blue Canyon. The problem is to locate the fault in the prong of metamorphic rocks in the northwest corner and to seek possible evidence for its one-time continuation southeastward across the quadrangle.

Rocks in the northwest prong are extensively sheared, especially at contacts of the ultramafic bands, and the fault could reasonably be placed at any one of several prominent shear surfaces. Or a mass of metamorphic rocks 6 or 7 km thick could be regarded as the fault zone. with the shears representing different strands in a diffuse zone of dislocation. It seems most likely that the principal plane of movement, as shown on the map, is the contact between the large mass of metasedimentary rocks to the west and the metavolcanic rocks to the east. a contact that is followed for some distance by one of the large ultramafic bodies. The belts of sheared serpentinite roughly parallel to this contact would then represent subsidiary planes of slippage. The fault so mapped, together with rocks on either side, is strongly curved. apparently by forceful intrusion of the tonalite mass immediately to the south.

The fault presumably once extended farther southeastward before it was invaded and largely obliterated by the tonalite magma. One might expect to find some evidence of the fault in the metamorphic rocks of the southeast corner, but no clear hint of its location is preserved. Bateman and

others (1983) speculate that the sheared tongue of the leucotonalite of Ward Mountain may follow the ancient trace of the fault zone, a trace preserved in rocks underlying the tonalite of Blue Canyon and providing a locus for later intrusion and for some continued movement after the tonalite was emplaced.

Locating the Melones fault zone at least tentatively is important in assigning ages to the metamorphic rocks. No fossils were found in this quadrangle, no radiometric dates for the metamorphic rocks are available, and no lithologic differences among either the metasedimentary or metavolcanic rocks are sufficiently striking to justify assigning different parts to different formations. But the relations of these rocks to those in adjacent quadrangles indicate that rocks of at least two different ages, or two different terranes, must be represented. The Melones fault zone, because it clearly separates rocks of different ages farther to the northwest, seems a plausible place for a division. Metasedimentary rocks west of the fault are continuous with the Mariposa Formation to the north, so they can be confidently correlated with this Upper Jurassic sequence. Metasedimentary rocks east of the fault can be similarly correlated, although with somewhat less assurance, with the Calaveras Formation (or Calaveras Complex of Schweickert and others, 1977), simply because they are continuous with rocks that have previously been called Calaveras in quadrangles to the north and east. Since the age of this unit is currently in doubt, these rocks are mapped with no indication of age other than pre-Cretaceous.

It should be emphasized that this division of the metasedimentary rocks and the metavolcanic rocks interlayered with them into two divisions is purely arbitrary and justified only by relations outside of this quadrangle. The division is particularly uncertain in the southeast corner, where the Melones fault cannot be placed with any confidence: most rocks here are correlated with the Calaveras Complex simply for convenience. Farther north in the Coarsegold septum the correlation with this unit can be made more plausible on the grounds of greater abundance of quartzite and the local occurrence of limestone, but still the great bulk of these rocks is similar to the Mariposa Formation.

Metasedimentary rocks

The original sedimentary rocks were chiefly shales and siltstones with lesser amounts of sandstone and conglomerate, representing sediments deposited in a near-shore marine environment. These rocks have undergone two kinds of metamorphism: broad-scale regional metamorphism, converting them to slates, phyllites, and quartzite; and superimposed contact metamorphism near intrusive contacts that formed either coarse mica schist or hornfels. The principal changes in both kinds of alteration were the conversion of clay minerals in the sediments to micas and the recrystallization of quartz grains into an interlocking network: both mica flakes and quartz grains grew larger with increasing temperature toward intrusive contacts. Orientation of mica flakes by pervasive movement during metamorphism gives the rocks their characteristic parallel shiny surfaces (cleavage): in the few places where cleavage is weak or absent, the rocks either lacked the constituents needed to form mica (becoming quartzite) or were baked under conditions of little movement (becoming hornfels). The extent of movement and stretching of the rocks in some places is vividly illustrated by elongated pebbles in the metaconglomerates, some with length-to-thickness ratios as high as 10:1. Other metamorphic minerals are found locally but are not common: andalusite crystals that reach spectacular dimensions (as much as 20 cm long) in a north-south belt near Moore Hill and are present elsewhere as obscure spots in phyllite, purple garnets in schists near the gabbro body 2 km north of Green Mountain, and sillimanite in schist on Streeter Mountain.

Areas of metasedimentary rocks that include layers and lenses of metalimestone are distinguished on the map by a separate symbol: the individual bodies of metalimestone are too small to be shown at this scale. The larger metalimestone bodies are strongly deformed. so that their original shape is conjectural, but very likely they represent discontinuous reefs built up in shallow water.

Cleavage in the metasedimentary rocks is commonly steep or vertical. Where bedding is visible, it generally parallels the cleavage, but in a few places it is at sharp angles. Crosscutting relations of

bedding and cleavage are especially clear along and near the Raymond Road south of Knob Hill, where both structures are complexly deformed. Here and elsewhere the beds are probably tightly folded, but no well-defined fold axes could be distinguished. Graded bedding is conspicuous at a few places along the Raymond Road and at one outcrop south of Indian Hill: bedding tops, with a few exceptions, are toward the east. No well-defined marker beds were found that would permit subdivision of the metasedimentary rocks into stratigraphic units. The proportion of quartzite to phyllite is notably high in the northern part of the Coarsegold septum and in the triangular patch of metasedimentary rock near the northeast corner, a characteristic that helps to justify the correlation of these rocks with the Calaveras Complex.

Contacts of metasedimentary rocks with tonalite and leucotonalite are in some places sharp. in others gradational. At gradational contacts schist becomes coarse gneiss invaded by and interlayered with stringers of intrusive rock, so that the contact cannot be fixed within a distance of several tens of meters. Good examples of gradational contacts are found at several places along the tonalite margin east of Ben Hur and at the edges of the metasedimentary stringers around the north end of the leucotonalite tongue in the southeast corner of the quadrangle.

Metavolcanic rocks

The metavolcanic rocks consist in large part of fine-grained. greenish schistose varieties containing various mixtures of chlorite, actinolite. albite. and epidote. Much of this material is the metamorphic derivative of beds of volcanic ash (tuff): varieties containing quartz and mica probably represent mixtures of volcanic ash and fine-grained sediment. Less schistose varieties with poorly preserved phenocrysts of altered feldspar and pyroxene were presumably lava flows. and rocks with vague outlines of angular fragments were bed: of volcanic breccia. Where the rocks are more strongly metamorphosed. especially near intrusive contacts. they change to hornblende schist and locally to fairly coarse. poorly foliated amphibolite. Accompanying the varieties of obviously extrusive origin are coarser grained rocks. many with chloritized phenocrysts as much as or more than a centimeter in diameter: these probably represent small intrusive bodies. The largest bodies of coarser grained rocks, distinguished on the map as metagabbro. are probably the roots of some of the old volcanoes from which the ash, lava. and breccia were extruded. Two areas where volcanic activity was apparently concentrated are near the east edge of the quadrangle just north of the Twin Sisters and at the north edge near and north of Indian Mountain. A third area of probable volcanic activity is the cluster of steep hills north of Bailey Hats: here there are no metagabbro bodies big enough to map. but the hills consist largely of coarse volcanic breccia cut by many mafic dikes. The two small bodies of metavolcanic rocks near the southwest corner of the quadrangle, with which small copper deposits are associated, are probably also the roots of ancient volcanoes.

The compositions of most of the metavolcanic material suggest derivation from basalts or andesites, but local interbeds of lustrous sericite schist probably represent deposits of rhyolitic ash. Especially puzzling are the rocks mapped as metavolcanic rocks at the west edge of the quadrangle near Mariposa Creek: these consist of fine-grained aggregates of quart plagioclase, and nearly colorless actinolite, much of it in small rosettes. The composition suggests original dacitic tuffs and lavas. but alternatively the rocks could be interpreted as altered dikes from the Guadalupe Igneous Complex of Best (1963) in the adjacent Indian Gulch quadrangle.

Contacts between metavolcanic and metasedimentary rocks are generally gradational over a distance of meters or tens of meters, either because layers of the two rocks are interbedded or because the composition of the beds is mixed. Occasionally beds of metasedimentary rocks are found in the midst of a metavolcanic sequence far from a contact. and thin layers of chlorite schist are found in the midst of a metasedimentary sequence. Evidently the accumulation of sediment on an ancient sea floor alternated with periods of volcanic activity. and at times volcanic ash was deposited simultaneously with fine-grained sediment. The environment most closely analogous in the modern world would be the sea floor adjacent to a chain of volcanic islands. for example the island arcs rimming the northwest Pacific

Ocean.

Contacts of metavolcanic rocks against tonalite show less mixing than contacts of metasedimentary rocks, except in a few places. An especially striking gradational contact is the southern tip of the prong of metavolcanic rocks in the northwestern part of the quadrangle, where a complete transition can be followed from chlorite-actinolite schist into coarse amphibolite, hornblende gneiss. and hornblende-rich tonalite.

Metamorphosed ultramafic rocks

Metamorphic rocks derived from ultramafic intrusive rocks are abundant in the northwest corner of the quadrangle and appear in many small patches near the east edge. In composition they range from serpentinite accompanied by bands and lenses of talc schist to more strongly metamorphosed varieties containing olivine. anthophyllite, and actinolite. Most of this ultramafic material is intimately associated with metavolcanic rocks. but a few outcrops are surrounded by metasedimentary rocks and one (near the southeast corner) by tonalite. Such rocks are commonly thought to represent material from the underlying mantle that was intruded into near-surface rocks along zones of strong deformation.

Text from source map: Mariposa 15' Quadrangle

Plutonic Rocks

The plutonic rocks range in composition from hornblende gabbro to granite. By far the largest area, fully two-thirds of the quadrangle, is occupied by the tonalite of Blue Canyon. A very similar rock type. the tonalite of Oakhurst. extends into the eastern part as a projection of a large mass in the Bass Lake quadrangle. Two bodies of leucotonalite appear near the southwest and southeast corners. both of them parts of larger bodies in adjacent quadrangles. Gabbroic rocks are common in small masses, and two large bodies appear near the center of the quadrangle. Dikes with a variety of compositions, most of them too small to map. are abundant locally, intrusive into both metamorphic and plutonic rocks. The plutonic rocks commonly show steep or vertical foliation defined by the planar orientation of mafic minerals and lenticular inclusions. Contacts between plutonic bodies are for the most part sharp, but a few cannot be located precisely because of extensive mixing.

Tonalite of Blue Canyon

This large intrusive body extends far beyond the limits of the Mariposa quadrangle. The rock is light gray and medium grained, with a composition ranging from diorite to granite Generally both biotite and hornblende are present, with biotite in excess; hornblende exceeds biotite locally, and in some places it is entirely absent. Plagioclase is the most abundant light-colored mineral; K-feldspar is generally very minor and interstitial to other minerals, but locally forms small phenocrysts. Compositional and textural varieties are readily distinguished, but contacts between them are gradational and varieties are not indicated on the map except for two conspicuously more mafic types and a small isolated area of felsic microtonalite. The tonalite is a very common rock type in the western Sierra Nevada, one of the kinds that are often described simply as "Sierra granite."

Planar foliation is generally discernible in the tonalite, but over large areas it is very faint. The structure generally has steep to vertical dips, is parallel to most contacts, and follows broad sweeping curves with local swirling in the interior of the mass. Only at one place, the right-angled bend in the contact where it crosses Mariposa Creek, does the foliation at the immediate contact show conspicuously low dips, as if there the intrusive body was overriding the metasedimentary rocks. A larger area of moderate dips paralleling those in adjacent metasedimentary rocks appears near the southeast corner of the quadrangle.

Contacts with metamorphic rocks are generally sharp, but locally the two rocks are intimately mixed (migmatite) in bands as much as several tens of meters wide. Evidence for pronounced mechanical effects of the intrusion on its surroundings is lacking in most places, but the abrupt bending of greenstone and serpentine layers just west of Mormon Bar seems well explained by forceful intrusion of the tonalite, and the narrow tongue of metasedimentary rocks just south of Oakvale School could well have been caught up between two lobes of tonalite. The preservation of long thin bands of metasedimentary rocks far out in the tonalite, notably on Streeter Mountain and Butler Mountain, suggests passive intrusion of molten material, or possibly formation of molten material in place, rather than forceful injection.

The existence of such a large mass of tonalite, with much variation in texture and composition but without discernible internal contacts and with an overall uniformity of structure, seems best explained by the rise of individual pulses of magma in rapid succession. so that one succeeded another before the earlier one had solidified and so that none remained quietly in contact with cooler walls long enough for development of the concentric differentiation pattern so common in other Sierra Nevada intrusive bodies.

Leucotonalite

The two masses of leucotonalite, one in the southwest and one in the southeast corner, are similar in their light color, the absence of hornblende, and the presence of two micas. The body in the southwest is finer grained, almost aplitic, and has scattered small K-feldspar phenocrysts; the one in the southeast has strong cataclastic foliation and in many outcrops shows curious crescent-shaped aggregates a few centimeters long of tiny biotite flakes. The former is part of a mass that has been tentatively correlated with the granodiorite of Knowles in the Raymond quadrangle to the south (Bateman and others, 1981), and the latter is an extension of the leucotonalite of Ward Mountain which occupies a large area in the Millerton Lake quadrangle to the southeast (Bateman and Busacca, 1982).

Mafic intrusive bodies

The most common rock type in the numerous small mafic bodies is hornblende gabbro, typically showing a range in composition from nearly pure hornblendite to a biotite-bearing rock hard to distinguish from tonalite. The texture ranges from an aggregate of hornblende prisms a few centimeters across to a fine-grained rock resembling amphibolite.

Text from source map: Mariposa 15' Quadrangle

Structure

Major structures in both metamorphic and plutonic rocks, as well as most contacts between them, are almost uniformly vertical or nearly so. The only important exceptions are a small area of low dips at the intrusive contact near where Mariposa Creek crosses the west border of the quadrangle and a larger area southeast of Grub Gulch. The prevailing steep dips and the preservation of thin, elongated ships of metasedimentary rocks in the tonalite suggest slow vertical rise of partly molten tonalite magma into an area of already vertically oriented metamorphic rocks or possibly the partial melting nearly in place of some of the metamorphic rocks. Differences in composition of the tonalite from place to place suggest a number of intrusive pulses, or episodes of magma formation, the pulses following one another so closely that they mix while still molten and boundaries are obscured. Little mechanical effect of the intrusion on its surroundings is evident except at places along the contacts of the lobe southwest of Mormon Bar and around the mass of mafic tonalite that surrounds Oakvale School.

Pre-intrusive structures in the metamorphic rocks are puzzling. The wide strip of

metasedimentary and metavolcanic rocks in the western part of the quadrangle, with strike directions of cleavage (and probably of most bedding) ranging from N. 20° E. to N. 50° W. fits reasonably well into the general regional structure of the western Sierra Nevada. Isoclinal folding is doubtless present, as it is elsewhere in the western metamorphic belt, but definite fold axes could not be located. Similar rocks, with the addition of small patches of metalimestone, crop out in the eastern part of the quadrangle, but here the foliation and bedding deviate widely and erratically from regional trends. There seems no way to reconcile attitudes and stratigraphy in this part of the Coarsegold septum with any consistent structural pattern. The fragments of metamorphic rocks surrounded by tonalite adjacent to the pendant seem largely unrelated to nearby parts of the pendant. It looks as if the metamorphic rocks originally had a highly contorted structure, and the invading molten material simply plucked pieces loose at random and floated them out at various angles to their original moorings. Whether structures in the more coherent parts of the pendant were appreciably influenced by intrusion of the tonalites on either side or are simply the original structures produced during deformation and metamorphism is not clear from evidence in this quadrangle.

The leucotonalite of Ward Mountain in the southeast corner of the quadrangle belongs in the large zone affected by early Cretaceous deformation distinguished in the adjacent Raymond and Millerton Lake quadrangles by Bateman and others (1981) and Bateman and Busacca (1982). Like other rocks in this zone. the leucotonalite shows strong cataclastic deformation. Similar deformation is evident in a band a few tens of meters wide in adjacent rocks along the southwest side of the leucotonalite tongue, but otherwise rocks in the vicinity are not visibly affected. The parallelism of foliation in the leucotonalite and of its contacts to foliation in the surrounding tonalite of Blue Canyon, as well as to cleavage in nearby metamorphic rocks, suggests that intrusion of this tongue was guided by these earlier structures.

Perhaps, as suggested earlier. all these parallel structures reflect the one-time position of the Melones fault, preserved as a zone of dislocation in rocks under the plutonic bodies and still capable of movement after the granitic rocks were intruded.

Faults may play a larger role than is indicated by the map. but no clear offsetting of structures or beds was recognized.

Text from source map: Mariposa 15' Quadrangle

Economic Geology

No metal mines were active in the Mariposa quadrangle in 1982. but extensive exploratory work was underway at an old copper mine on Green Mountain in the southwest corner. Exploratory bulldozing was also in progress on an area of small quartz veins in greenstone near the top of Crook Mountain and on quartz veins in tonalite just west of the Fresno River near the south edge of the quadrangle. Old adits, small shafts, and dumps in many parts of the quadrangle testify to more active mining and exploration in the past.

Placer activity was intense along major streams of the quadrangle within a few months after the discovery of gold at Sutter's mill. The richest placers were those along Mariposa Creek and its tributaries. especially near Mormon Bar and the present town of Mariposa. The gravel deposits were shallow, however, and most placering ceased by 1870 except for a brief revival in the 1930's.

Lode mining for gold was also started in the summer of 1849 at the Mariposa mine, on the southern outskirts of the present town. The first stamp mill in California. albeit a primitive one, was set up here. This mine. the southernmost of the mines along the Mother Lode. is said to have been discovered by Kit Carson, and was one of several mines on the huge Las Mariposas Grant that had been

acquired by General John C. Fremont in 1847 It was less productive than other mines farther north in the grant, and its history is notable for extensive litigation and many changes of ownership. Total production is estimated to amount to $2,395,000, most of it dating from before 1915: the mine was reopened for a time in the 1930's and again briefly in 1955. The gold occurred in a branching quartz vein. the principal branch trending parallel to the regional structure (about N. 30' W.) and dipping steeply southwest—opposite to the dip of most Mother Lode veins. The gold was mostly free metal. but some was contained in sulfides (chiefly pyrite and arsenopyrite) that also yielded small amounts of silver and copper. Workings included an inclined shaft 500 m long (vertical depth about 400 m) and more than 3,000 m of drifts on eight levels (Laizure, 1982: Julihn and Horton, 1940: Clark, 1970).

Gold lodes were being worked as early as 1849 at several small mines in Grub Gulch, near the Ahwahnee road just south of Indian Hill. This area is at the northwest end of a 30-km-long belt including the Coarse Gold and Fine Gold districts. Mining was especially active from 1880 into the early 1900's. Maximum depth of workings is 250 m. and total production is estimated at about $960,000 (Clark, 1970).

The only other appreciable production of gold was from the Granite King mine about 1.6 km south of the old Yosemite highway at the west edge of the quadrangle. The mine is said to have been worked intermittently from the 1870's through the early 1900's and also from 1938 to 1941. Workings include a 15-m vertical shaft, a 10-m inclined shaft, and 70 m of drifts. During 1938-41 about 9,000 tons of gold ore was produced containing minor copper and lead. No figures are available on earlier production (Julihn and Horton, 1940).

Two small copper mines near the southwest corner of the quadrangle. Green Mountain and Lone Tree. were active at various times from 1863 into the early 1900's. These mines are near the southern end of the Foothill copper belt. a zone of copper occurrences stretching some 300 km along the lower Sierra foothills. The primary ore consists of sulfides (chalcopyrite, pyrite. pyrrhotite) in small quartz veins in shear zones cutting greenstone. but much of the ore recovered was enriched material from near the surface. Most of the oxidized ore was used for herbicides and insecticides: some metallic copper was recovered in a leaching and precipitating plant in Raymond. The sulfide ore is said to have been easily oxidized. so much so that the heat generated set a railroad car afire. The Green Mountain mine reportedly had 1,200 m of underground workings and produced "large quantities of high-grade oxide and carbonate ore,- but no production figures are available for either mine (Aubury, 1980: Laizure, 1928: Bowen and Gray. 1957). A recent drilling program by the Falconbridge Copper Corporation is said to have revealed a body of massive sulfide ore under Green Mountain that will be economically minable when the price of copper is higher (Sergio Pastor, oral commun. 1982).

Occurrences of copper ore have been noted at many places in the quadrangle, but the only other deposit from which a little production has been recorded is the Heiser mine about 3 km east of Mariposa. Some copper was also produced as a byproduct of gold mining at the Mariposa mine (Aubury, 1908).

Silver in small but unknown quantity was produced, mostly between 1930 and 1938, from two small mines about 6 km southeast of Mormon Bar (Silver Bar and Silver Lane). At both mines silver occurs as argentite, pyrargyrite, proustite, and native silver in quartz veins cutting tonalite. Both were developed by inclined shafts about 80 m long and a few hundred meters of drifts. A little silver was also recovered as a byproduct at the Mariposa mine (Bowen and Gray, 1957).

Sand and gravel for construction purposes have been obtained at various times from deposits along the major streams, but the only operation active in 1982 was on Mariposa Creek near Mormon Bar.

Text from source map: Mariposa 15' Quadrangle

Acknowledgements

Except for small areas of the Sierra National Forest in the northeast corner and a small area along Chowchilla Creek where it crosses the south border, the land in the quadrangle is privately owned. I am grateful to the owners for permitting access to their property and to many of them for help in other ways.

Text from source map: Mariposa 15' Quadrangle

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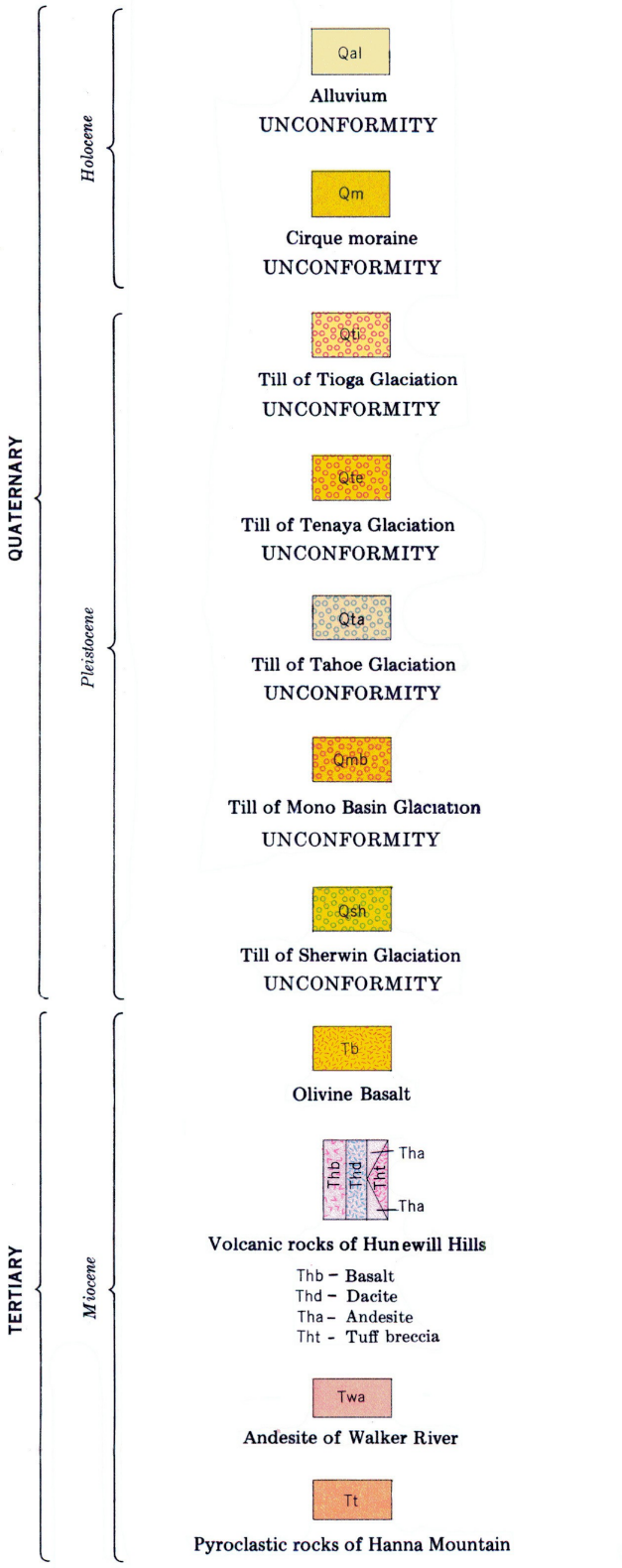
Matterhorn Peak 15' Quadrangle

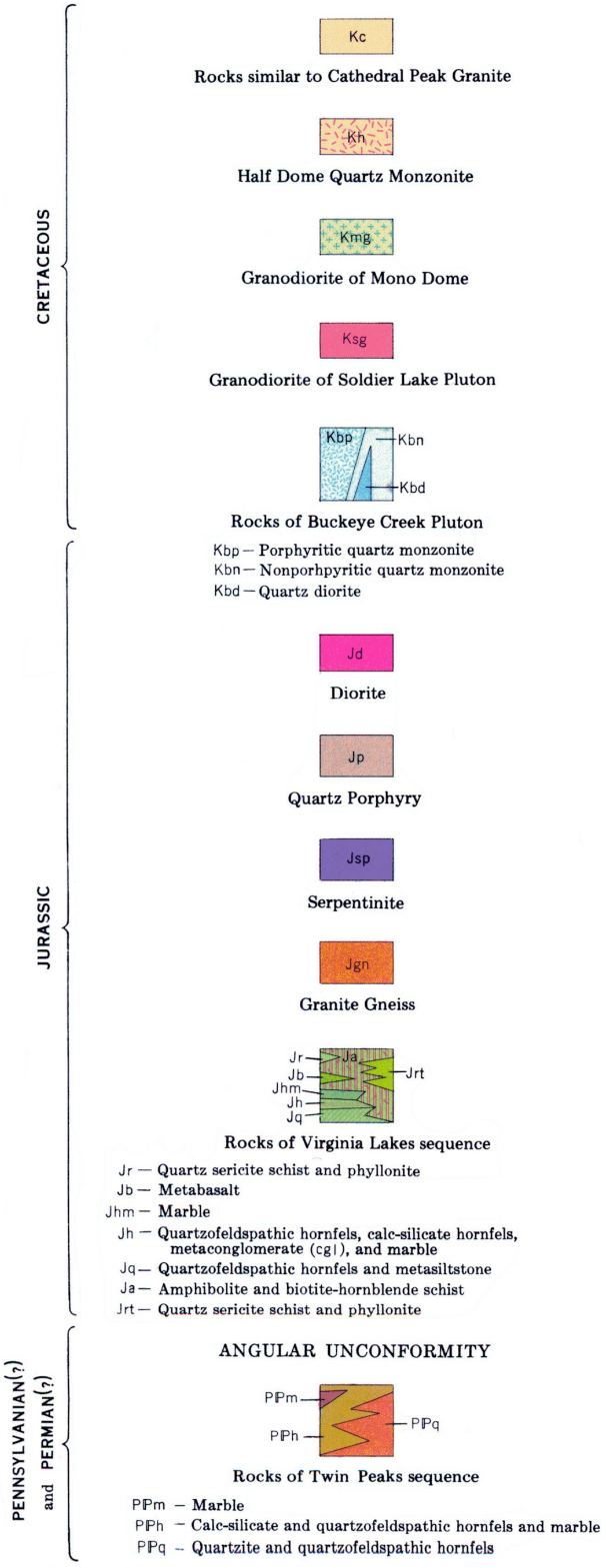
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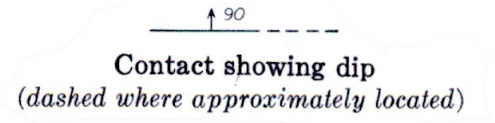
Correlation of Map Units



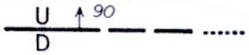


Graphic from source map: Matterhorn Peak 15' Quadrangle

Map Legend



Contact showing dip
(dashed where approximately located)



Fault showing dip
(dashed where approximately located; U, upthrown side; D, downthrown side dotted where concealed)



Lineament observed on aerial photographs
(probably joints or faults with small displacements)



Syncline showing troughline



Inclined Vertical
Strike and dip of beds



Inclined Vertical
Strike and dip of foliation
(primary structure in granitic and Cenozoic volcanic rock, flow banding and secondary structure in metamorphic rock)



Inclined Vertical
Strike and dip of joints



Prospect or mine
showing principal metal (gold, Au)

Graphic from source map: Matterhorn Peak 15' Quadrangle

Photograph 1



View east across Peeler Lake astride the crest of the Sierra Nevada, Mono County, California. Sawtooth Ridge in middle background. Rock is Cathedral Peak Granite.

Photograph from source map: Matterhorn Peak 15' Quadrangle

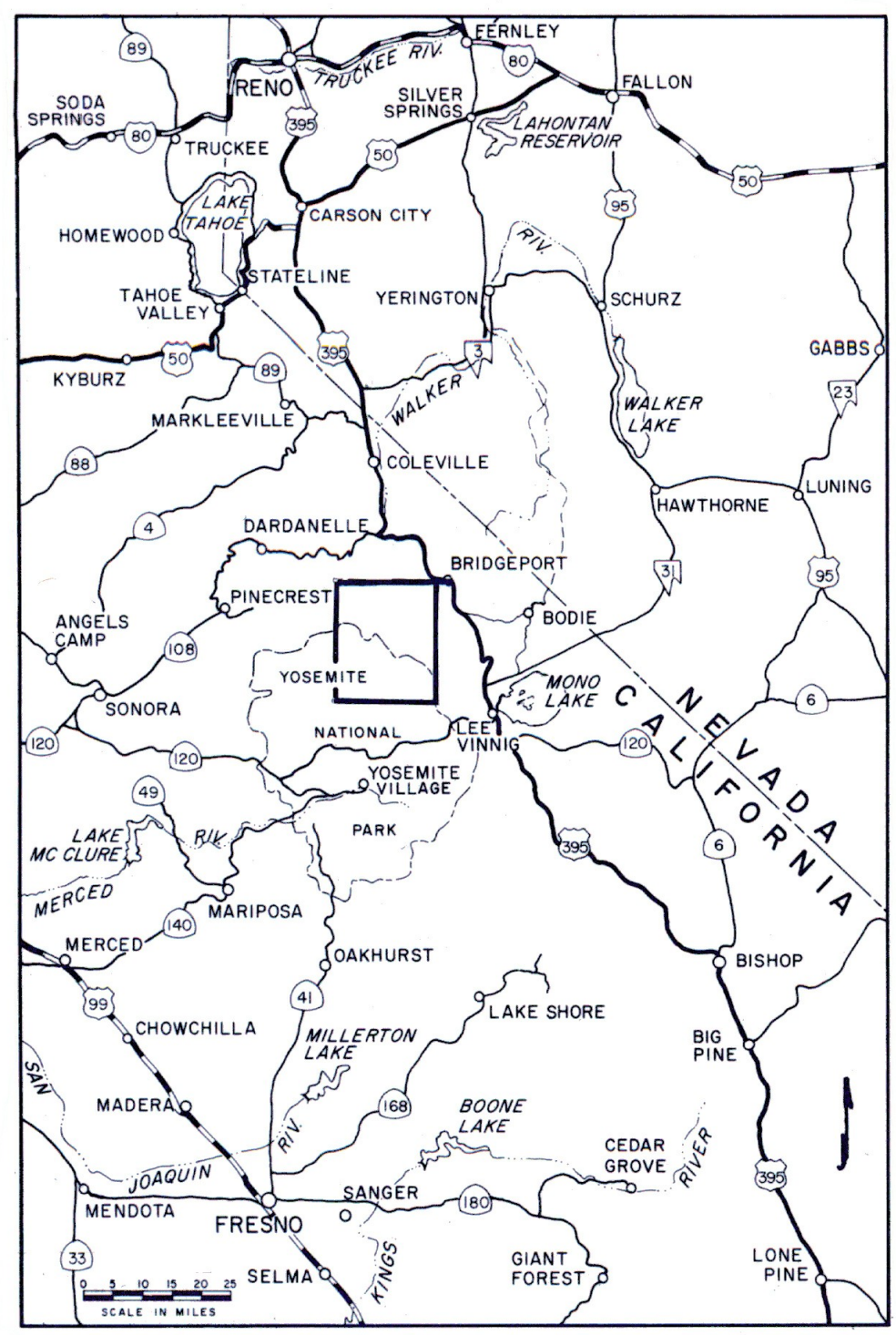
Photograph 2



View westward toward Virginia Lakes basin, Mono County, California. The rocks, consisting of metamorphosed interbedded volcanic and sedimentary, are members of the Virginia Lakes Sequence (Jurassic).

Photograph from source map: Matterhorn Peak 15' Quadrangle

Index to Geologic Mapping



Graphic from source map: Matterhorn Peak 15' Quadrangle

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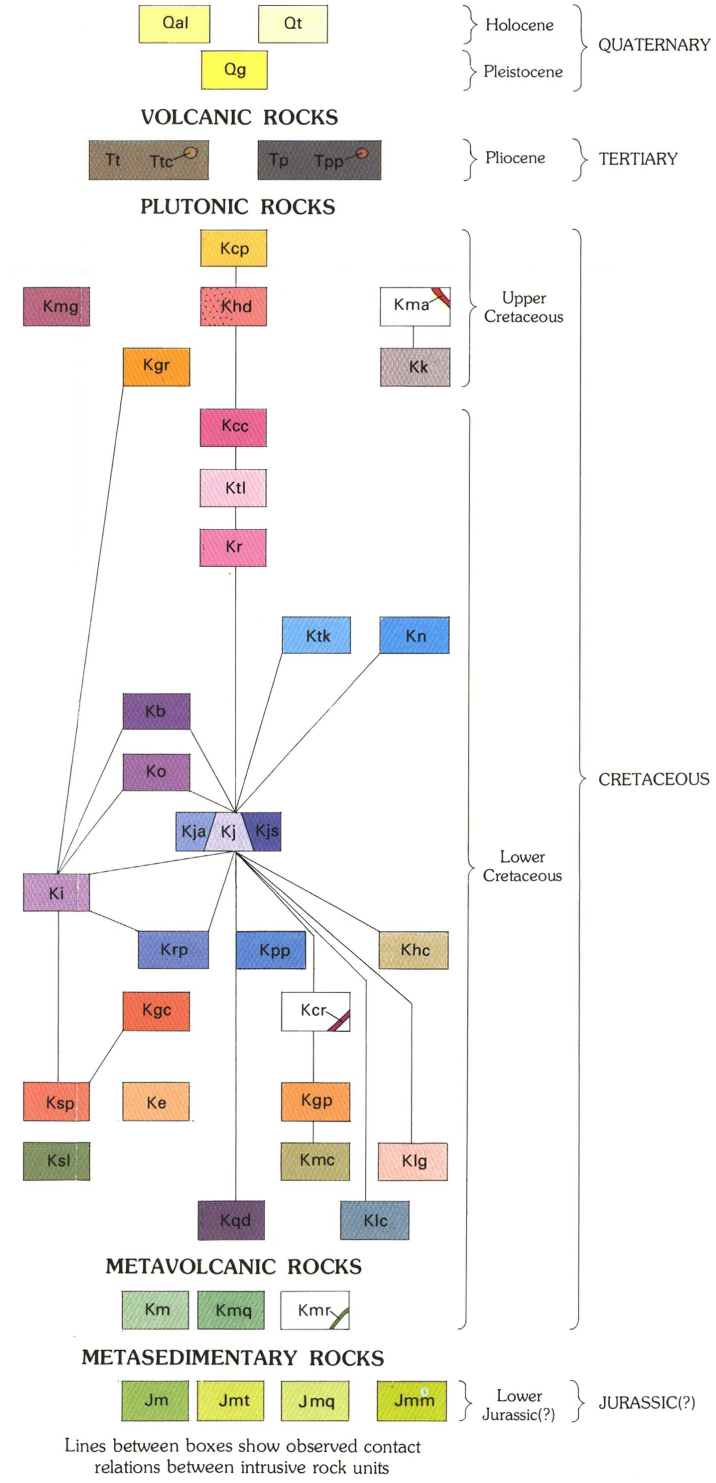
Merced Peak 15' Quadrangle

The formal citation for this source.

Peck, D.L., 1980, Geologic Map of the Merced Peak Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1531, scale 1:62,500 (*GRI Source Map ID 1360*).

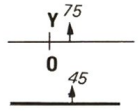
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Correlation of Map Units



Graphic from source map: Merced Peak 15' Quadrangle

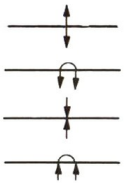
Map Legend



Contact showing dip—Approximately located. Where relative ages can be determined, Y indicates younger pluton, and O, older pluton

Fault showing dip—Bearing and plunge of slickensides also shown

Major folds—Showing direction of plunge; dashed where approximately located



Symmetric anticline

Overturned anticline

Symmetric syncline

Overturned syncline

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



Inclined



Horizontal

Vertical



Overturned

Inclined, strike variable

Strike and dip of foliation—Bearing and plunge of lineation indicated



Inclined

Vertical



Inclined, strike variable

Vertical, strike variable



No foliation apparent

Strike and dip of shear plane—Bearing and plunge of slickensides indicated



Inclined

Vertical



Inclined, strike variable

Vertical, strike variable

Strike and dip of aplite dikes



Inclined

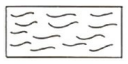
Vertical



Zone of abundant inclusions in plutonic rock



Zone of abundant dikes



Zone of pervasive shearing

Note: Symbols may be combined; intersection of symbols is point of observation.

Graphic from source map: Merced Peak 15' Quadrangle

Summary of Geology

The Merced Peak quadrangle is located on the western slope of the Sierra Nevada, east and southeast, of Yosemite Valley. It extends from the crest of the range at Mount Lyell in the northeast comer of the quadrangle to within 3 km of Half Dome at the northwest comer, and from Little Yosemite Valley on the north to Jackass Meadow on the south. All but the southern edge is within the Yosemite National Park and the Minarets Wilderness Area. The quadrangle includes the headwaters of the Merced River and the South Fork of the Merced River, as well as Granite Creek and other tributaries of the San Joaquin River. A major drainage divide extends diagonally across the quadrangle, separating the drainage of the Merced River on the northwest from that of the San Joaquin River on the southeast. Almost all of the area is above 7,000 ft (2,133 m) in altitude. Forests of pine and fir flourish at lower elevations, but much of the quadrangle is near or above timberline. Most of the area was scoured by Wisconsin-age glaciers, and fresh rock is widely exposed. Access is provided by a network of trails; one road to the Granite Creek Campground and Clover Meadow Ranger Station enters the southeast comer of the quadrangle.

The quadrangle is underlain by a variety of plutonic and metamorphic rocks which are covered locally by Tertiary lava flows and Pleistocene glacial deposits. It was mapped as part of a continuing study to determine the bedrock geology of a strip across the Sierra Nevada batholith, as described by Bateman and others (1963). Adjacent quadrangles have been mapped by Huber and Rinehart (Devils Postpile, 1965), Kistler (Mono Craters, 1966b), Huber (Shuteye Peak, 1968), Bateman and others (Kaiser Peak, 1971), and Kistler (Hetch Hetchy Reservoir, 1974), and geologic mapping of the remaining area---Tuolumne Meadows, Yosemite, and Bass Lake quadrangles---is in progress.

The Merced Peak quadrangle lies near the center of the Sierra Nevada batholith. It covers the western edge of the large Ritter pendant of metavolcanic rocks and the margins of three large plutonic sequences---the Tuolumne Intrusive Suite on the north, the Kaiser sequence (Mount Givens Granodiorite) on the south, and the Yosemite sequence (El Capitan Granite) on the west. Most of the quadrangle is underlain by three moderate-size plutonic sequences, each composed of several comagmatic units. Quartz diorite and metavolcanic rocks are more widely exposed here than in adjacent areas to the north and south. Indeed, metavolcanic and metasedimentary rocks that originally capped the batholith are widely preserved all across the batholith at this latitude, from the Wawona area on the west to the Mount Morrison pendant of Paleozoic metasedimentary rocks on the east, a distance of 70 km. Elsewhere in the Sierra, such rocks have been mostly eroded away and fragments of them are found in the Cretaceous and Cenozoic sedimentary rocks of the Great Valley and the California Coast Ranges (Dickinson and Rich, 1972).

Text from source map: Merced Peak 15' Quadrangle

Metamorphic Rocks

Marine sedimentary rocks of both Paleozoic and early Mesozoic age presumedly once covered all of the Merced Peak quadrangle, but few such rocks are preserved today. The most extensive localities are the Strawberry Tungsten Mine area, the south and west slopes of Sing Peak, Quartz Mountain, the ridge west of Cold Springs Meadow, and Quartzite Peak. Micaceous quartzite derived from shaley quartz sandstone is the dominant rock type, but a variety of different sedimentary rocks is represented, including quartz-pebble conglomerate, sandy siltstone, silty marl, and limestone. Original sedimentary textures, including graded bedding are locally well preserved. The beds dip steeply, and are locally strongly contorted. Near the Strawberry Tungsten Mine, where the stratigraphy and structure were studied in detail by W.J. Nokleberg (1970; in press), the beds show several generations of folds.

The metasedimentary rocks of the Strawberry Tungsten Mine area recently yielded a fossil clam tentatively identified by R.W. Imlay (oral commun., 1977) as Inoceramus pseudomytiloides of Early Jurassic age. The rocks, thus, are correlative with the quartz-rich metasedimentary rocks of the Boyden Cave pendant, which have yielded an Early Jurassic ammonite (Jones and Moore, 1973; Saleeby and others, 1978). Metasedimentary rocks of both pendants have been assigned to the Kings sequence by Bateman and Clark (1974) and by Nokleberg (in press). They may also be correlative with lithologically similar but unfossiliferous sections in the southwestern part of the Merced Peak quadrangle, in the Dinkey Creek pendant in the Huntington Lake quadrangle, and in the metasedimentary rocks in the adjacent Yosemite quadrangle. Apparently, the western slope of the central Sierra Nevada was covered by the Pacific Ocean or an inland sea during the Early Jurassic, about 200 m.y. ago, and was the site of deposition of quartzose sediments at the same time that volcanoes were erupting and plutons intruding only 20 to 40 km to the east.

Metavolcanic rocks are widely preserved in the Merced Peak quadrangle, particularly in the southeastern half of the area. The rocks are intimately associated with granitoid rocks of the Merced Peak sequence, particularly the granodiorite of Jackass Lakes, and are probably genetically related to them. The original composition and lithology of the metavolcanic rocks are widely indicated by relict crystals and textures. Most are derived from massive pyroclastic rocks, presumedly ashflows, that contained crystals of plagioclase, mafic minerals (probably pyroxene), and quartz in a more abundant matrix of ash or of ash and lapilli. The chemical composition of the original volcanic rocks over most of the area was predominantly rhyodacitic and rhyolitic, remarkably similar in major element composition to the granitoid rocks of the Merced Pass sequence that intrude them. The metavolcanic rocks along the eastern edge of the quadrangle, which constitute the western margin of the large Ritter pendant, are more varied in composition and include far more abundant flows of basalt and andesite. The age of the metavolcanic rocks in the central and eastern parts of the quadrangle has been determined to be late Early Cretaceous on the basis of several radiometric age determinations. Measurement by T.W. Stern of 238U/2O6Pb ratios in zircons in a sample of metarhyodacite tuff from the north flank of Ottoway Peak yielded and age of 100 +/-3 m.y. Measurements by R.W. Kistler of Rb/Sr isotopic ratios in suites of metavolcanic rocks from the Merced Peak and Strawberry Tungsten Mine area yielded an age of 95 +/-5 m.y. Similar ages were also determined by T.W. Stern by 238U/2O6Pb measurements on zircons from metavolcanic rocks from the Ritter pendant, 1 to 3 km east of the quadrangle boundary (R.S. Fiske, oral commun., 1977).

The metavolcanic rocks were strongly folded, mostly along northwest trends, after they were deposited but before emplacement of the granitoid rocks. Several fold axes were identified along the eastern edge of the quadrangle during the mapping but the structural relation of the metavolcanic rocks in the central and southern parts of the quadrangle was not determined because of the absence of marker beds and the paucity of recognizable original bedding. Vents and general source areas were not unequivocally identified in the study. However, the close spatial association of the metavolcanic rocks and the granitoid rocks of the Merced Peak sequence and their similar ages and chemical compositions suggest that the volcanic rocks were erupted from local vents that were subsequently engulfed by the leucogranite porphyry of Red Peak or Post Peak or by the granodiorite of Jackass Lake. The metavolcanic rocks (excluding those in the southwest comer of the quadrangle) and the granitoid rocks of the Merced Pass sequence may be the preserved lower part of a caldera that erupted volcanic ash now preserved in metavolcanic rocks not only in the Merced Peak quadrangle, but also in the upper coeval part of the Ritter pendant to the east. Whatever the details, the Merced Peak area was covered by a volcanic field in the late Early Cretaceous at about the same time that plutonic rocks were being emplaced at depth beneath the area.

Text from source map: Merced Peak 15' Quadrangle

Plutonic Rocks

More than 80 percent of the Merced Peak quadrangle is underlain by plutonic rocks, and of these more than 95 percent are granite and granodiorite in about equal abundance. In this report, the plutonic rocks are named in accordance with the classification recommended by the Subcommission on the Systematics of Igneous Rocks of the International Union of Geological Sciences (Streckeisen and others, 1973). According to this system, granite contains subequal amounts of plagioclase and potassium feldspar and more than 20 percent quartz; leucogranite is granite containing less than 5 percent mafic minerals such as biotite and hornblende. Granodiorite also contains more than 20 percent quartz, but plagioclase predominates. In tonalite and quartz diorite, more than 90 percent of the feldspar is plagioclase; tonalite contains more than 20 percent quartz, quartz diorite less than 20 percent. In the Merced Peak quadrangle, the abundant granite typically consists of medium- to fine-grained rocks containing 8 percent or less of mafic minerals, predominantly biotite. The texture of both granite and granodiorite is typically granitic, that is, some crystals of the essential minerals have well-developed crystal faces whereas others do not. Some of the granite and granodiorite is porphyritic, containing coarse rectangular phenocrysts of white to pink potassium feldspar. Others are granite porphyry, in which small phenocrysts of feldspar and quartz are set in a fine-grained groundmass. Granite and granite porphyry typically contain few diorite inclusions or schlieren (planar concentrations of mafic minerals). The equally abundant granodiorite is mostly medium grained. Mafic minerals, usually including some hornblende as well as biotite, are more abundant, forming 7 to 18 percent of the rock; dioritic inclusions and schlieren are usually conspicuous. Quartz diorite and tonalite are typically variable in grain size, even over a short distance; mafic minerals are more abundant (16-28 percent) and include subequal amounts of biotite and hornblende. All of the plutonic rocks contain a few percent or less of accessory minerals; these typically include magnetite, sphene, allanite, zircon, and apatite. Sulfide minerals are prominent in a few plutons, such as the granite porphyry of Red Peak, and garnet occurs in a few of the aplite dikes. All of the plutonic rocks are slightly altered. Plagioclase grains, particularly the calcic cores, are partly altered to a fine-grained mixture of albite, calcite, zoisite, and sericite. Biotite and hornblende are partly altered to chlorite and epidote.

The plutonic rocks occur in 30 separate units, each of which forms one or more intrusive bodies. Although many of the units are fairly similar in appearance, each can be distinguished by means of its texture, composition, or structure. The Half Dome Granodiorite, for example, is marked by coarse, well-formed mafic minerals including hornblende, biotite, and sphene; mafic minerals in the granodiorite of Illilouette Creek, in contrast, are generally poorly formed but typically include scattered large hornblende prisms.

The different plutonic bodies are separated by sharp contacts which are marked by many features that reflect the fluid or plastic nature of the masses when they were emplaced. Dikes of younger units cut older units, and the younger units contain inclusions of older units. Contacts cut across planar features of the older units and are marked in the younger units, by flattened dioritic inclusions and by mineral grains and schlieren oriented parallel to the contact. By observing such features along the contacts, the relative ages of the intrusive units shown in the map explanation was established. The absolute ages were determined by radiometric analysis of samples from the units; these include potassium-argon analyses of biotite and hornblende, lead-uranium analyses of zircon, and whole-rock rubidium-strontium analyses. The results, together with data on samples from adjacent areas, show that the plutonic rocks in the Merced Peak quadrangle range in age from 100 to 105 m. y. (Early Cretaceous) for the leucogranite of Shuteye Peak and the El Capitan Granite to 85 to 90 m.y. (Late Cretaceous) for the Half Dome and Cathedral Peak Granodiorites. Most of the plutonic and metavolcanic rocks are intermediate in age, 95 to 100 m.y.---a range in age not widely represented by plutonic rocks elsewhere in the central part of the Sierra Nevada batholith.

Most of the plutonic units listed in the explanation are grouped into four intrusive sequences from oldest to youngest they include the Buena Vista Crest, the Merced Peak, the Washburn Lake, and

the Tuolumne Intrusive Suite. Each sequence is composed of several units; the units change progressively in composition and texture in a characteristic way, show similarities in texture or composition, and have a close geographic association, indicating a common origin. Each sequence represents an igneous system that existed over several million years; the sequences may well have had additional members, both extrusive and intrusive, that have since been eroded or were emplaced only at greater or shallower depths than the present level of exposure.

The oldest plutonic rocks, small isolated masses of quartz diorite and tonalite, are shown in the explanation to belong to two units of the same age, but they probably include masses of several different ages. Units of the same or somewhat younger age than the masses of quartz diorite and tonalite include the leucogranite of Mount Clark, the granite porphyry of Star Lakes, and several small isolated masses of leucogranite. The leucogranite of Mount Clark is clearly cut by dikes of Half Dome Granodiorite and granodiorite of Red Devil Lake. Contact relations with the granite of Gray Peak are ambiguous, but layering in the Gray Peak near the contact suggests that the granite is younger. The coarse-grained granite of Gray Peak is questionably correlated with the lithologically similar leucogranite of Shuteye Peak and El Capitan Granite, both of which have yielded ages of 100 to 105 m.y. from nearby areas. These units are cut by mafic granodiorite and microgabbro that may represent the first phases of succeeding intrusive suites. The microgabbro of the Clark Range forms a dike that cuts the granite of Gray Peak and the leucogranite of Mount Clark but is truncated by the granodiorite of Jackass Lakes. The mafic granodiorite of Grizzly Creek, which contains distinctive equant phenocrysts of quartz, forms the southern body of a belt of dikes and small intrusive bodies of mafic granodiorite, tonalite, and quartz diorite that extends northwestward through the El Capitan pluton to the monolith of El Capitan at Yosemite Valley.

Intrusion of the El Capitan Granite and correlative units was followed by emplacement of the intrusive sequence of Buena Vista Crest, which forms a large compound pluton extending 30 km northwestward from the southern boundary of the quadrangle at Chiquito Creek to the vicinity of Bridalveil Creek Campground in the Yosemite quadrangle. The mafic outer unit of the sequence, the granodiorite of Illilouette Creek, intrudes the leucogranite of Shuteye Peak (and, in the Yosemite quadrangle, the El Capitan Granite) and also the leucogranite porphyry of Red Peak. The contact between the Illilouette and the next younger, inner unit of the sequence the granodiorite of Ostrander Lake, is well exposed from the west flank of Sing Peak to Moraine Mountain and displays well the schlieren so typical of the internal contacts of compound plutons. Fine-grained core units of the sequence, both granite and granodiorite, cut the center of the compound pluton near Buena Vista Peak in the Yosemite quadrangle. The granodiorite of Breeze Lake and the Bridalveil Granite of Yosemite Valley are tentatively correlated with the fine-grained granodioritic core unit because of the lithologic similarity. An age of 100 m.y. was determined using the uranium-lead method on zircon from the granodiorite of Illilouette Creek.

The intrusive sequence of Buena Vista Crest bordered on the east by the nearly contemporaneous intrusive sequence of Merced Peak. In contrast to typical intrusive sequences like the Tuolumne Intrusive Suite (Calkine, 1930), the oldest units of the sequence are not tonalite or mafic granodiorite but rather the leucogranite porphyry of Red Peak and Post Peak. The Post Peak porphyry cuts older quartz diorite (and is marked by abundant inclusions of quartz diorite) and dikes from the Red Peak porphyry cut the granite of Gray Peak. The two porphyry units appear to form the remnants of several stocks or domes that were intruded to shallow depths in the metavolcanic rocks and later partly engulfed by the granodiorite of Jackass Lakes. The granodiorite of Jackass Lakes forms a complex pluton that is divided into four separate lobes by screens of older metamorphic rocks and quartz diorite. Near Chain Lakes, the unit clearly cuts the outer mafic shell of the intrusive sequence of Buena Vista Crest, the granodiorite of Illilouette Creek, but it is in turn transected near East Merced Pass Lake by an arm of the inner unit of that intrusive sequence, the granodiorite of Ostrander Lake. The contact between the Jackass Lakes and the granodiorite of Illilouette Creek is nearly a straight line on the map from the east fork of Chiquito Creek to the flank of Merced Peak. For much of its length this line separates the eastern extent of metasedimentary rocks from the western extent of metavolcanic rocks, and it may

represent an ancient fault, perhaps the western boundary of the inferred Early Cretaceous caldera described above. Near Anne Lake and Sadler Peak the granodiorite of Jackass Lakes is intruded along sharp contacts by phases nearly identical to the granodiorite of Jackass Lakes. Near Timber Knob and Norris Creek, it is intruded by distinctly different and finer grained units of leucogranite that are questionably assigned to the sequence. The intrusive sequence of Merced Peak has yielded radiometric ages corresponding to the late Early Cretaceous, very near the boundary between Late and Early Cretaceous. An age of 98 m. y. was determined using the uranium-lead method on zircon from the granodiorite of Jackass Lakes, and it is in good agreement with ages determined using the same methods on the older metavolcanic rocks (100 m.y.) and on the younger granodiorite of Red Devil Lake (98 m.y.); an age of 95 m.y. was determined on hornblende from the granodiorite of Jackass Lakes using potassium-argon methods.

The intrusive sequence of Washburn Lake forms a nested compound pluton lying north of the intrusive sequence of Merced Peak. Several units of the Merced Peak, as well as older metavolcanic and plutonic rocks are cut by dikes of the outer shell of the Washburn, the granodiorite of Red Devil Lake, and by the large inner unit, the granite of Turner Lake, which has broached the outer shell at the southern end of the pluton. This sequence displays clearly many of the features of nested compound plutons of the Sierra Nevada batholith. The outer shell grades smoothly inward from strongly foliated mafic granodiorite containing many mafic inclusions to felsic granodiorite and granite containing few mafic inclusions. This unit is cut by a younger, inner unit of porphyritic granite and granodiorite containing tabular phenocrysts of potassium feldspar. The contact between the two is marked by an abrupt change in lithology and schlieren layers, but few or no dikes or inclusions. This inner unit, in turn, is cut by a core unit of granite porphyry.

Two dike-like projections of granodiorite of Red Devil Lake, extend southeastward across the divide near Electra Peak, roughly parallel to the foliation of the surrounding metavolcanic rocks. At Bench Canyon these intrude the granodiorite of Jackass Lakes and are bordered by migmatitic gneiss formed from the metavolcanic rocks. All of the rocks are strongly sheared within a zone that extends northwestward across the comer of the quadrangle. The shears trend parallel to the zone and dip steeply northeast and southeast, and lineations in the shear planes trend northeast. Similar shear zones cut rocks of the Buena Vista Crest and Merced Peak intrusive sequences, as well as the El Capitan Granite, the granite of Gray Peak, and the leucogranite of Shuteye Peak. Younger plutonic rocks of the Tuolumne Intrusive Suite, however, are not sheared, and, the shear zone of Electra Peak is truncated by Half Dome Granodiorite near Bernice Lake. The shear zones apparently record northeast-southwest compression during an episode of middle Cretaceous deformation about 95 m.y. ago.

Several units of the Tuolumne Intrusive Suite underlie the northern part of the Merced Peak quadrangle, where they form the southwestern margin of a large compound pluton that extends more than 30 km to the north. One of the outer mafic units of the Tuolumne, the granodiorite of Kuna Crest, underlies the extreme northeast corner of the quadrangle and also forms dikes and small intrusive rocks of distinctive biotite quartz monzodiorite cutting the granodiorite of Red Devil Lake on the southern flanks of Mounts MacClure and Lyell. The granodiorite of Grayling Lake, which underlies the lower, western flank of Red Peak is assumed to be correlative. It intrudes the leucogranite porphyry of Red Peak and also forms dikes cutting the granodiorite of Illilouette Creek which are well exposed along the Creek. Half Dome Granodiorite is the most widely exposed unit of the Tuolumne Intrusive Suite. It underlies the northwest part of the quadrangle and forms a dike-like mass 2 to 3 km wide that extends 12 km to the southeast, bisecting the compound pluton of the intrusive sequence of Washburn Lake. The contact at the southwest margin of this mass is well exposed from Quartzite Peak to the Triple Peak Fork of the Merced River and displays many typical features of external plutonic contacts, including dikes, inclusions, sharp angular changes in the attitude of the contact, marginal schlieren, and abundant aplite dikes. Dikes of fine-grained biotite granite, the granite of Marie Lakes, cut the granodiorite of Red Devil Lake, dikes of the granodiorite of Kuna Crest, and metavolcanic rocks near Mount Lyell, and extend eastward into the Devils Postpile quadrangle. These are assumed to be approximately contemporaneous

with the Half Dome Granodiorite. The youngest unit of the Tuolumne Intrusive Suite, the Johnson Granite Porphyry lies north of the quadrangle, but the southern tip of the next younger unit, the very, coarsely porphyritic Cathedral Peak Granodiorite, extends across the quadrangle boundary northeast of Merced Lake and is the youngest plutonic rock in the area. An age of 85 to 90 m.y., for the Tuolumne in the adjacent Tuolumne Meadows quadrangle has been determined by many potassium-argon analyses of biotite and hornblende and by several uranium-lead analyses of zircon (T.W. Stern, written commun., 1978).

Text from source map: Merced Peak 15' Quadrangle

Late Cretaceous and Tertiary Uplift and Erosion

Emplacement of the Tuolumne Intrusive Suite was followed by a cessation of igneous activity for 80 m.y. During this time the rocks were strongly jointed, uplifted, and deeply eroded. Joint cracks formed after solidification of the plutons, probably as a result of both thermal contraction during cooling and regional stresses. The cracks, which are vertical or nearly so, are in two major sets, a dominant north-trending set and a less well developed west- to northwest-trending set. The joints cut both plutonic and metamorphic rocks and cross contacts without change in attitude. Joint cracks are well displayed in the higher altitudes of the quadrangle, where they are marked by stream courses, ponds, and abundant trees.

Intrusion of the plutonic rocks was accompanied and followed by uplift and erosion that stripped most of the cover of metavolcanic rocks, related shallow plutonic rocks, and the upper parts of the plutons. The debris was carried westward by streams and was deposited on the floor of the Pacific Ocean in the area of the present Great Valley and Coast Ranges, forming the Cretaceous "Great Valley sequence" of sandstone, shale, and conglomerate. The progressive unroofing of the Sierra plutons in the Late Cretaceous is recorded in the sequence by the decreasing abundance of volcanic fragments upwards from the base of the Upper Cretaceous and by the increasing abundance of quartz, feldspar, and mica. By the early Tertiary, 65 m.y. ago, the Sierra was an area of low, rolling hills and broad valleys.

Erosion in the Merced Peak quadrangle was strongly affected by the lithology of the rocks. Metamorphic rocks, fine-grained granite, and granite porphyry are the most resistant to erosion. They underlie almost all of the divide that extends from Mount Lyell to Madera Peak and the Clark Range that extends from Merced Peak to Quartzite Peak. Granite and felsic granodiorite of Ostrander Lake underlie the Buena Vista Crest. Quartz diorite, tonalite, and mafic granodiorite are the least resistant rocks. The courses of Illilouette and Madera Creeks, for example, appear to reflect the distribution of mafic granodiorite and quartz diorite, and the upper course of the Merced River coincides with the southeast-trending prong of Half Dome Granodiorite. The distribution and orientation of joint cracks was also an important factor in the pattern of erosion. The effect of the strong northwest -trending set of joint cracks is shown, for example, by the orientation of several forks at the headwaters of the Merced River and by the upper course of the South Fork of the Merced River.

Text from source map: Merced Peak 15' Quadrangle

Upper Tertiary Volcanic Rocks

During the early Tertiary, the Sierra was relatively stable, but igneous activity resumed about 30 m.y. ago when volcanic eruptions flooded large areas of the northern Sierra with rhyolitic ash. In the late Miocene, about 9 to 10 m.y. ago, eruptions of andesitic lava in the northern Sierra and basaltic lava in

the central Sierra was accompanied by renewed uplift of the range and erosion of more deeply incised valleys; these events constitute the mountain-valley stage of Matthes (1930).

During the Pliocene Epoch, between 3.6 and about 3.0 my. ago, igneous activity in the quadrangle resumed with the extrusion of flows of trachybasalt and less abundant ultrapotassic phonolite. Flows if trachybasalt and less abundant trachyandesite and trachyte similar to lavas described by Hamilton and Neuerburg (1956) from elsewhere in the Sierra form lava fields near Clover Meadow Ranger station and Cora Lakes in the southeastern part of the quadrangle; they also form small flows and cones near Post Peak and along Madera Creek. The flows have not been dated radiometrically but are presumed to be contemporaneous with similar flows dated by Dalrymple (1963, p. 387; 1964, p. 26) at 2.9 to 3.6 m.y. in the surrounding Devils Postpile, Kaiser Peak and Mount Abbott quadrangles. Far less widespread flows and volcanic necks and pipes near Grizzly Creek, Madera Creek, and Merced Pass are an unusual volcanic rock type ultrapotassic mafic phonolite. These rocks contain phenocrysts of phlogopite, olivine, or both, in a groundmass containing abundant sanidine, leucite, and apatite. Compared to other volcanic rocks of similar silica content, they are rich in potassium, sodium, and phosphorus, and poor in alumina. All of these lava bodies, and particularly the volcanic neck near the junction of Madera Creek and the West Fork of Granite Creek, contain abundant light-colored inclusions of granitic rock. The inclusions were partially melted; the melt was then expanded into a froth owing to the release of water from biotite and hornblende and was quenched to glass. The flows along Grizzly Creek and near Merced Pass have been dated by Dalrymple at 3.6 m.y. using potassium-argon determinations on phlogopite and sanidine.

Text from source map: Merced Peak 15' Quadrangle

Glaciation

Eruption of the volcanic rocks was followed by further uplift of the Sierra, the incision of deep canyons on the western slope, and repeated glaciations. Almost the entire area of the Merced Peak quadrangle was covered by glaciers two or more times during the Pleistocene. Unglaciated areas are limited to the crest from Mount Lyell to Madera Peak, the summit of the Clark Range, and a very few isolated summits such as Timber Knob and Quartz Mountain. The glaciers of late Wisconsin age can be readily traced because glacial features, both moraines and erosional features, are well preserved. During that time a glacier spilled down the Merced River canyon from a large ice field at the headwater of the river, and other glaciers filled the valleys of Illilouette Creek, Hoover Creek, the South Fork of the Merced River, the forks of Granite Creek, Long Creek, and Bench Canyon. Fresh and weathered rock was scoured from the higher altitudes of the quadrangle, leaving fresh exposures and such glacial features as chatter marks and glacial striae. Much of the rock debris was dumped in moraines at lower altitudes. Morainal ridges are well displayed along Illilouette Creek, at Chiquito Pass, and near Clover meadow Ranger Station. During the 10,000 yr. or so since the last major glaciation, the topography has changed little. Small pocket glaciers formed during thermal minima have further sculptured a few of the higher peaks; one glacier still blankets the north face of Mount Lyell. Blocks fallen from the cliffs have accumulated to form talus slopes, and some of the glacial lakes have been filled with alluvium to form alpine meadows.

Text from source map: Merced Peak 15' Quadrangle

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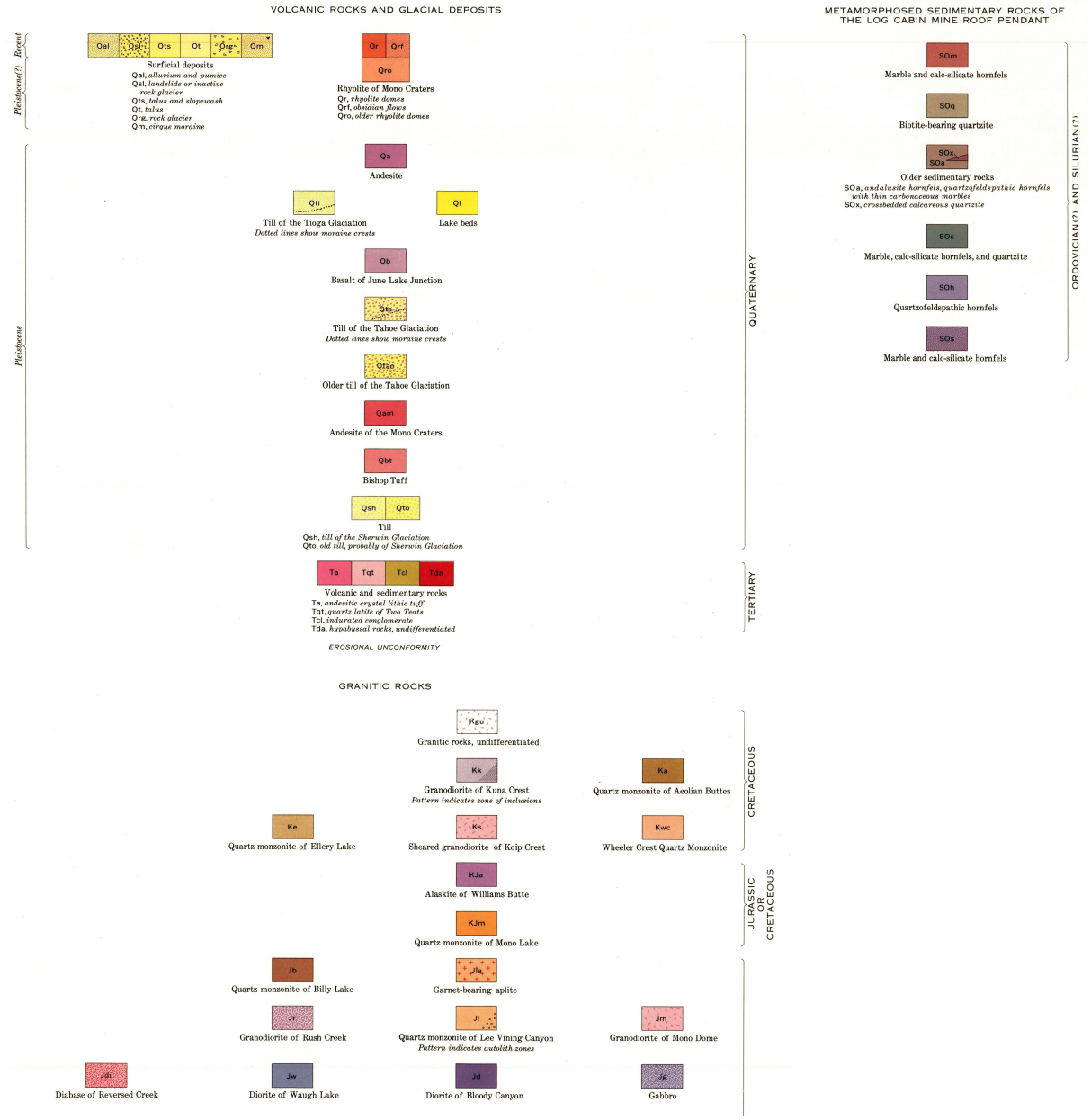
Mono Craters 15' Quadrangle

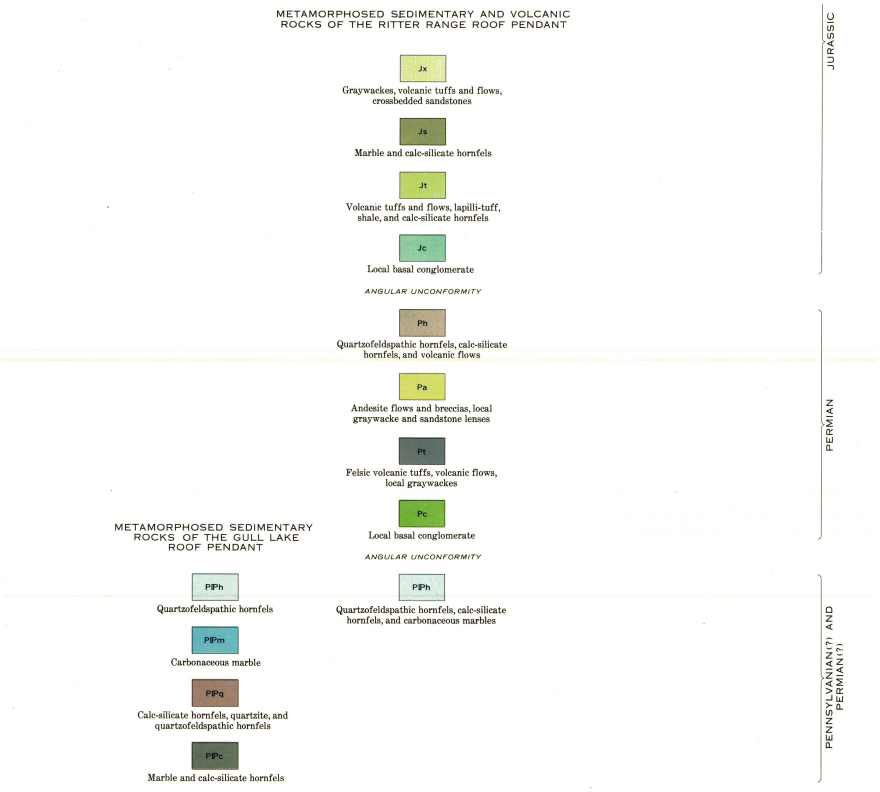
The formal citation for this source.

Kistler, R.W., 1966, Geologic Map of the Mono Craters Quadrangle, Mono and Tuolumne Counties, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-462, scale 1:62,500 (*GRI Source Map ID 1358*).

Prominent graphics and text associated with this source.

Correlation of Map Units





Graphic from source map: [Mono Craters 15' Quadrangle]

Map Legend

Contact
Dashed where approximately located; dotted where concealed



Fault
Bar and ball on downthrown block; dashed where approximately located; dotted where concealed



Mylonite zone



Anticline
Showing trace of axial plane and direction of plunge of fold axis. Dashed where approximately located



Overturned anticline
Showing trace of axial plane and direction of plunge of fold axis. Dashed where approximately located



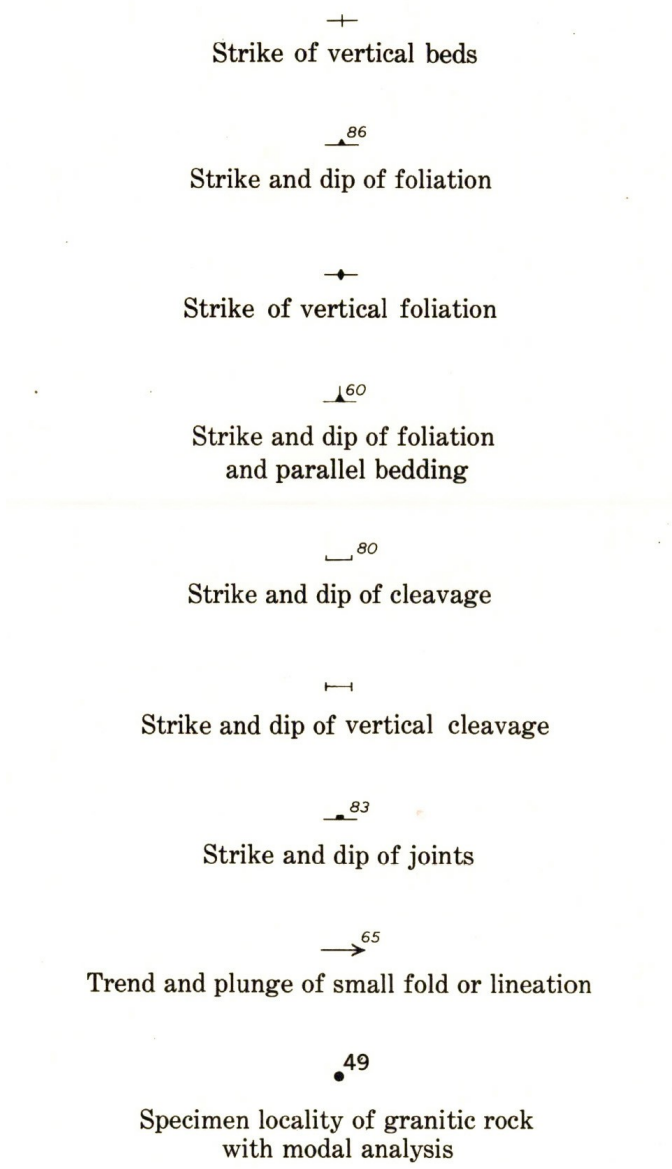
Syncline
Showing trace of axial plane and direction of plunge of fold axis. Dashed where approximately located



Strike and dip of beds



Strike and dip of overturned beds



Graphic from source map: Mono Craters 15' Quadrangle

Modal Analyses of Granitic Rocks

MODAL ANALYSES OF GRANITIC ROCKS

Specimen Number	Quartz	Plagioclase	K-Feldspar	Biotite	Hornblende	Accessories	Points counted	Percent anorthite in plagioclase
1	32.8	24.6	35.2	7.1	0.0	0.2	3000	37
2	18.6	44.4	33.4	2.43	0.16	0.8	3000	
3	35.5	35.7	27.4	3.45	0.15	0.45	2042	
4	27.9	32.9	32.6	5.1	0.3	1.2	3000	
5	34.8	25.3	37.5	2.0	0.0	0.7	1500	33 38
6	33.4	31.4	31.4	3.5	0.1	0.2	1000	24 22
7*	21.8	48.0	0.0	29.0	1.0	0.2	500	32 32
8	30.95	43.95	22.85	1.8	0.2	0.3	2000	
9	35.35	15.45	51.5	1.9	0.0	0.0	2080	35
10	31.2	32.8	32.5	3.6	0.0	0.0	1000	
11	23.9	58.9	12.3	4.2	0.1	0.6	1000	
12	31.9	35.4	26.15	6.2	0.0	0.45	2000	
13	34.1	33.7	29.9	2.1	0.0	0.4	1000	27
14	20.5	26.9	37.1	9.4	2.5	3.9	3000	27
15	15.45	61.9	6.85	10.45	1.7	3.8	2000	
16	24.6	28.1	42.1	5.0	0.29	0.62	2106	
17	34.0	28.0	27.0	8.0	1.0	2.0	2000	
18	18.0	42.0	23.0	12.0	4.0	1.0	2000	
19	21.0	33.0	37.0	5.0	1.0	3.0	2000	
20	11.0	54.0	22.0	5.0	6.0	2.0	2000	
21	15.77	51.4	26.5	7.5	1.6	1.5	3000	35 32 29
22	17.4	36.9	31.1	7.1	5.8	2.6	3000	36 34 32
23	14.8	52.2	20.0	6.2	5.65	2.2	2017	29 29
24	17.10	52.55	18.75	7.4	2.55	2.0	2000	35
25	20.7	45.3	28.7	2.6	1.7	1.0	1728	36
26	18.0	48.0	13.0	11.0	7.0	3.0	2000	
27	10.0	51.0	10.0	16.0	12.0	1.0	2000	
28	21.0	48.0	25.0	3.0	1.0	2.0	2000	
29	14.0	62.0	10.0	4.0	7.0	4.0	2000	
30	6.0	76.0	0.0	8.0	7.0	3.0	2000	
31	11.0	40.0	25.0	15.0	5.0	4.0	2000	
32	15.0	59.0	1.0	15.0	8.0	2.0	2000	
33	7.0	57.0	30.0	3.0	2.0	1.0	2000	
34	22.0	45.0	24.0	6.0	0.0	3.0	2000	
35	17.0	48.0	3.0	25.0	2.0	5.0	2000	
36	15.0	47.0	11.0	17.0	6.0	4.0	2000	
37	10.0	48.0	7.0	18.0	15.0	2.0	2000	
38	14.4	48.0	14.1	14.7	6.2	2.6	1810	
39	13.4	52.9	9.5	15.6	6.5	2.1	1855	
40	14.3	52.3	12.7	14.0	3.0	4.0	2500	
41	22.5	60.4	8.0	5.5	3.5	0.7	2000	34
42	22.3	47.1	7.15	15.5	5.8	2.3	2000	35
43	21.1	52.9	0.0	25.6	0.0	0.65	2000	
44	11.7	44.2	11.8	9.8	23.8	2.0	513	40
45	0.1	50.9	4.5	20.6	21.6	2.3	1000	45
46	0.1	49.4	4.1	21.8	22.3	2.4	2000	43 48
47	16.1	51.9	44.1	11.7	5.7	1.6	1010	33 54
48	14.75	53.7	4.0	17.9	0.2	9.55	2000	
49	11.4	51.45	12.8	18.3	6.75	2.05	2035	40
50	3.2	54.7	0.0	17.4	19.7	6.5	1015	
51	25.65	27.5	44.75	2.95	2.6	1.1	2089	31 31
52	16.5	39.75	19.65	11.6	9.95	2.85	2000	32 31
53	16.8	51.0	12.85	12.65	4.95	2.4	2000	
54	13.0	55.0	7.0	15.0	8.0	2.0	2000	
55	33.0	44.3	18.8	8.0	0.0	0.33	1502	

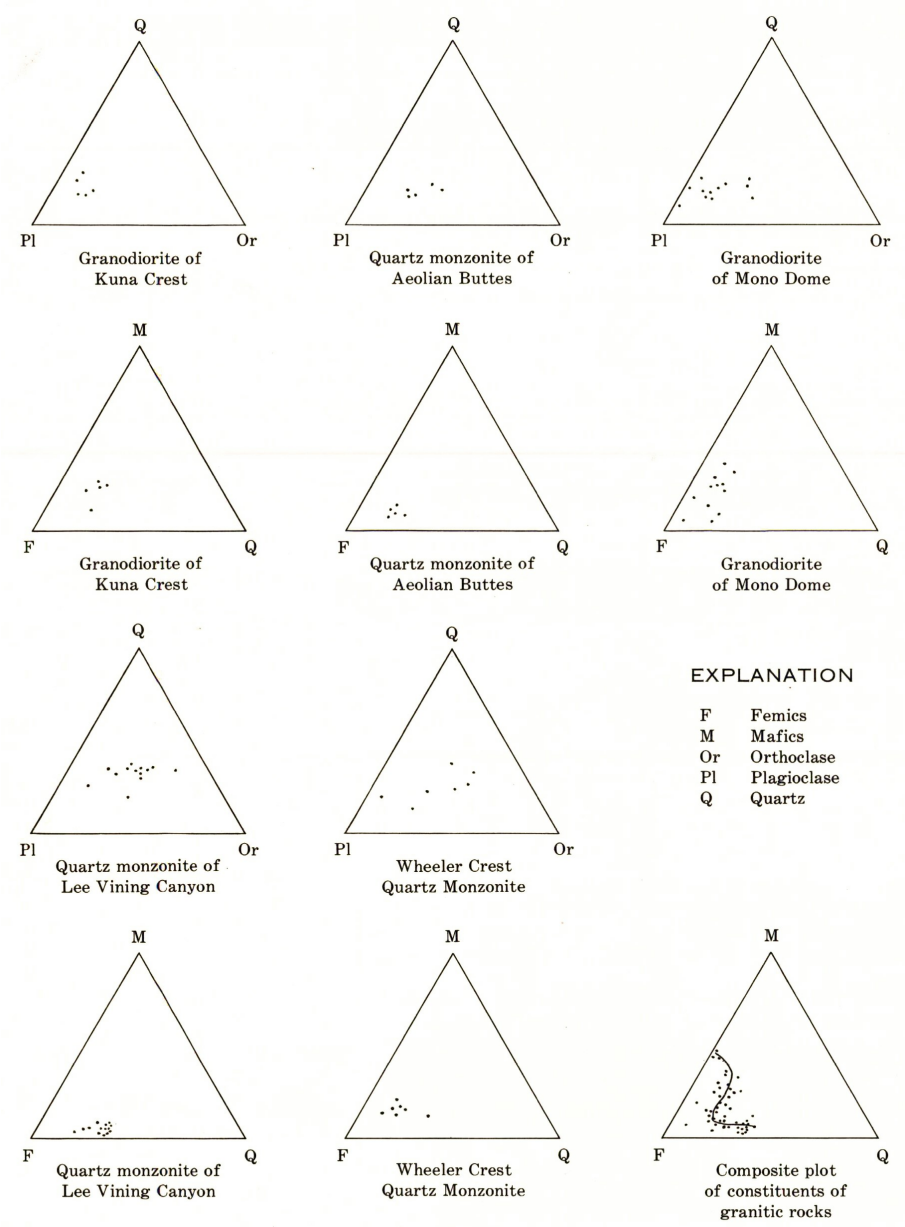
*Analysis is of an autolith in specimen 6

Specimen numbers	1–13	Quartz monzonite of Lee Vining Canyon
	14–20	Wheeler Crest Quartz Monzonite
	21–25	Quartz monzonite of Aeolian Buttes
	26–37	Granodiorite of Mono Dome
	38–42	Granodiorite of Kuna Crest
	43	Diorite of Bloody Canyon
	44–48	Diorite of Waugh Lake
	49–50	Granodiorite of Rush Creek
	51–52	Quartz monzonite of Billy Lake
	53–54	Granitic rocks, undifferentiated
	55	Quartz monzonite of Ellery Lake

Anorthite content of plagioclase is by U-stage techniques (Turner, 1947)

Graphic from source map: Mono Craters 15' Quadrangle

Ternary Diagrams



TERNARY DIAGRAMS OF MINERAL COMPOSITIONS OF THE MAJOR GRANITIC UNITS IN THE QUADRANGLE

Graphic from source map: Mono Craters 15' Quadrangle

References Cited

Turner, F.J., 1947, Determination of plagioclase with the four axis universal stage: Am. Mineralogist, v. 32, nos. 7-8, p. 389-410.

References from source map: Mono Craters 15' Quadrangle

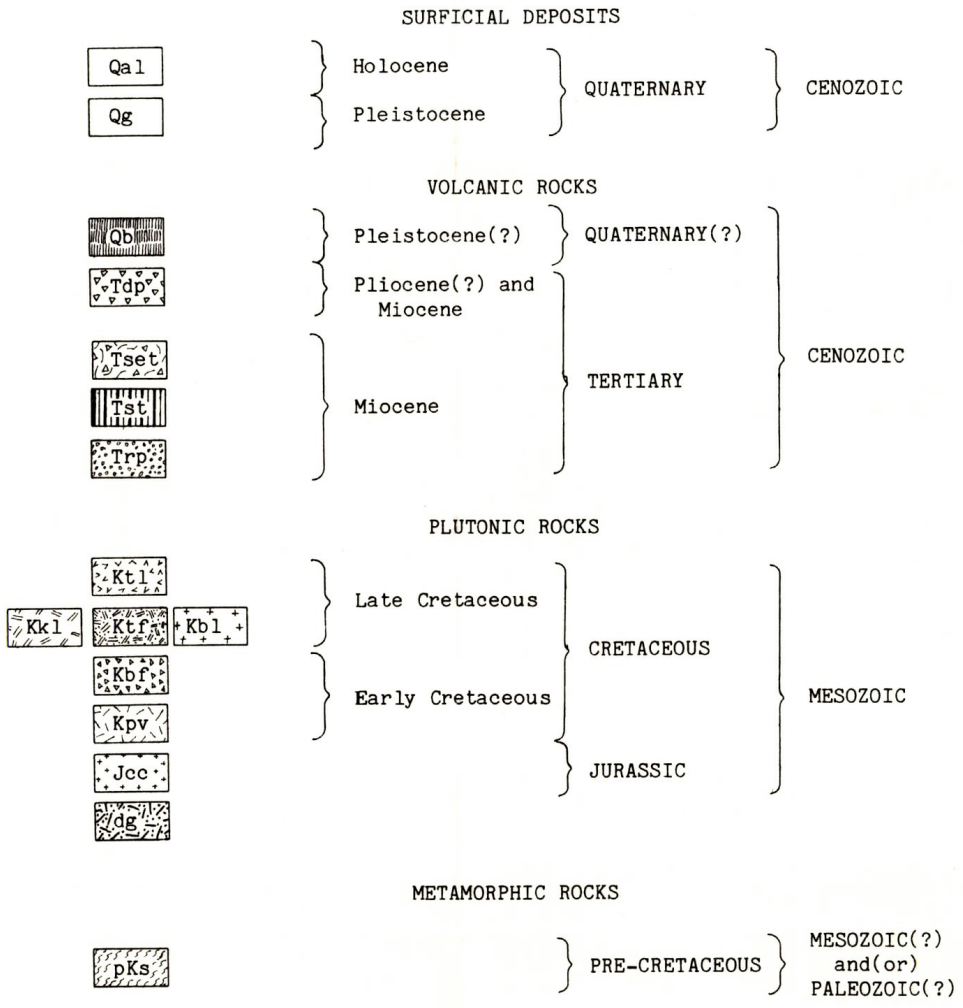
Pinecrest 15' Quadrangle

The formal citation for this source.

Huber, N.K., 1983, Preliminary Geologic Map of the Pinecrest Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Miscellaneous Field Studies MF-1437, scale 1:62,500 (*GRI Source Map ID 1367*).

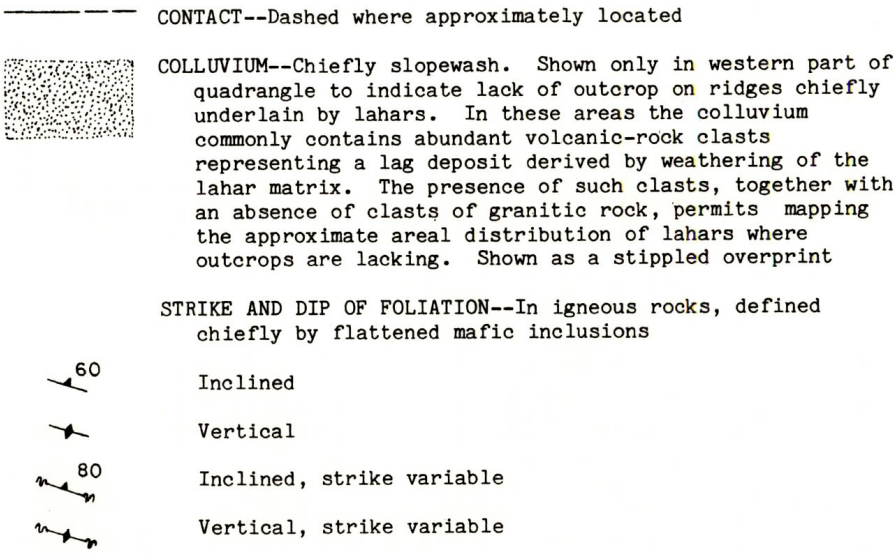
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Correlation of Map Units



Graphic from source map: Pinecrest 15' Quadrangle

Map Legend



Graphic from source map: Pinecrest 15' Quadrangle

Geologic Summary

Bedrock in the Pinecrest quadrangle mainly consists of two rock groups: Mesozoic granitic rocks of the Sierra Nevada batholith, and overlying Tertiary rocks, chiefly of volcaniclastic origin. The batholith was intruded as a group of plutons that in the Pinecrest quadrangle range in age from Jurassic to Late Cretaceous and are predominantly granodiorite in composition. Metamorphic rocks, which are widespread as septa and roof pendants within much of the batholith, are of very limited extent in the Pinecrest quadrangle.

The granodiorite of Topaz Lake, the youngest plutonic unit in the quadrangle, is the only one for which reasonably reliable K-Ar age determinations are available; all older units are suspected of having reset K-Ar ages. The granodiorite of Topaz Lake is considered to belong to the Late Cretaceous Cathedral Range intrusive epoch of Evernden and Kistler (1970). The granodiorite of Kinney Lakes appears to bear a peripheral relationship to the granodiorite of Topaz Lake similar to that between the Half Dome Granodiorite and the Cathedral Peak Granodiorite in eastern Yosemite National Park. The Kinney Lakes and Topaz Lake are probably two units (there may be more) of an intrusive suite similar to the Tuolumne suite within which the Half Dome and Cathedral Peak are two of several units. The Tuolumne suite was previously called a "series" by Bateman and Chappell (1979) and a "sequence" by Stern and others (1981).

Rocks here mapped as the granodiorite of Poopenaut Valley, although characterized as biotite-hornblende granodiorite, are quite variable and probably consist of multiple plutons; mapping has not been sufficiently detailed to establish subunits. These rocks appear to be part of a belt of biotite-hornblende granodiorites and tonalites that extends north into the Dardanelles Cone quadrangle, and at least as far south as the Millerton Lake quadrangle (more than 100 km). The Poopenaut Valley would then be part of the Fine Gold granitoid suite of Stern and others (1981), which has an average U-Pb isotopic age of about 112 m.y. (Early Cretaceous).

The granite of Cottonwood Creek is the only granitoid unit in the quadrangle for which a Jurassic age (about 150 m.y.) has been established (Stern and others, 1981). All granitoids for which no age data are available are assumed to be Cretaceous.

By the middle Tertiary, the batholith had been unroofed and deeply eroded, and the Tertiary volcanic rocks were erupted onto a terrain with considerable relief. These rocks were erupted mostly from sources near the present Sierra crest (Slemmons, 1966) and were dispersed westward down the slope of the ancestral Sierra toward the Central Valley and eastward into what is now Nevada. The earliest volcanic unit, rhyolitic tuff of the Valley Springs Formation, apparently did not reach the Pinecrest quadrangle, although it filled stream channels just a few kilometers to the north in the Dardanelles Cone quadrangle (Huber, 1983). Younger units of the Tertiary volcanic sequence, including extensive lahars and a welded tuff, do occur in the Pinecrest quadrangle and cap many of the ridges along the north margin and in the west half of the quadrangle. Uplift and westward tilting of the Sierra Nevada was occurring throughout the period of volcanic activity and indeed continues today. Erosion, particularly stream incision during periods of volcanic quiescence, was accelerated by this uplift and produced widespread unconformities within and between volcanic units. These unconformities are commonly marked by fluvial gravels.

The present distribution of volcanic rocks is largely the result of topographic inversion, post volcanic streams finding it easier to incise the underlying weathered granite, once the volcanic rocks were breached, than to remove the tough, cohesive volcanic rocks themselves. An exception to this inversion can be seen at Bell Meadow, an exhumed Tertiary valley, where the base of the Tertiary volcanic section is near the present level of Bell Creek, and granodiorite on the south side of the creek rises more than 350 m higher on Bell Mountain.

Two small erosional remnants of olivine basalt occur in the northeast corner of the quadrangle. This basalt appears to have resulted from local eruptions and was probably of limited original extent. Although it has been glaciated, its relation to present topography suggests that it is probably no older than middle Pleistocene.

The present drainage pattern was well established by the Pleistocene and served to channel glaciers, particularly in the east half of the quadrangle. Major interfluves, such as the higher parts of Dodge Ridge, remained above the level of even the most widespread glaciation. The Cherry Creek drainage basin, which has the largest catchment area feeding into the quadrangle, was extensively glaciated and a large tongue of ice extended down Cherry Creek into the Lake Eleanor quadrangle, the longest downslope extent of any glacier traversing the Pinecrest quadrangle. Similar but somewhat smaller tongues of ice extended down South Fork Stanislaus River and Kendrick-Eleanor Creek; much of the higher part of the west half of the quadrangle is unglaciated, and considerable residual colluvium is present on ridges and slopes.

Text from source map: Pinecrest 15' Quadrangle

References

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References from source map: Pinecrest 15' Quadrangle

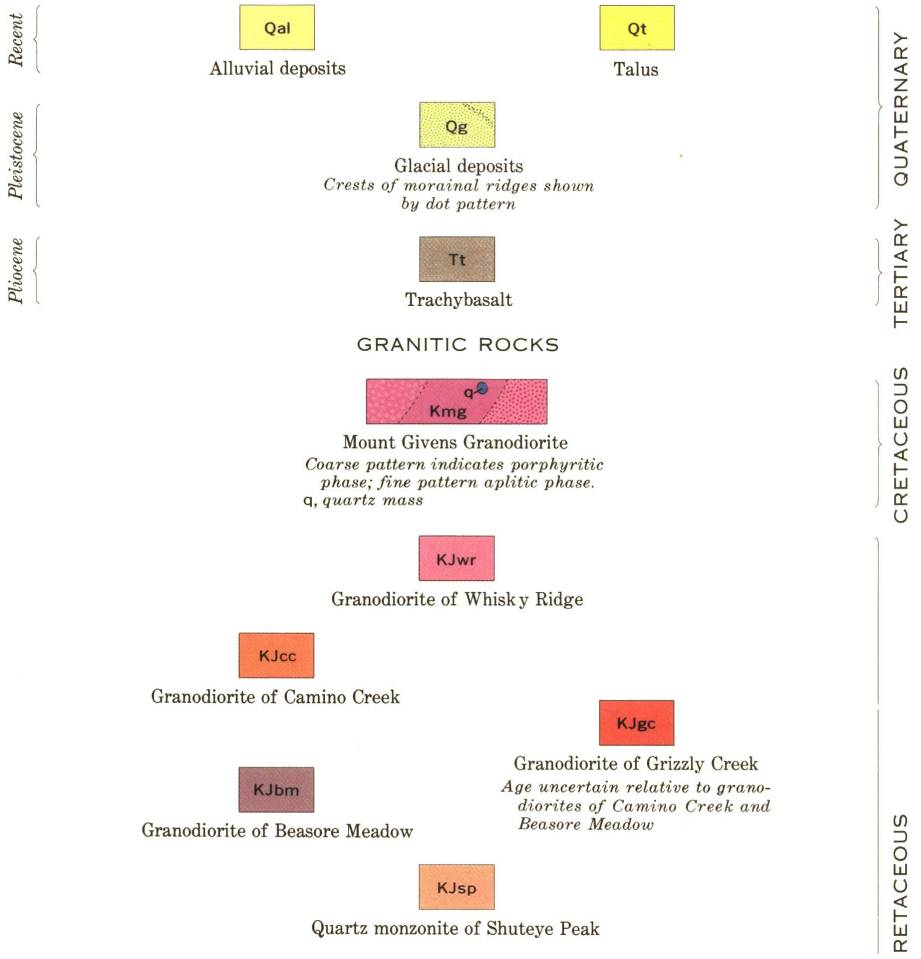
Shuteye Peak 15' Quadrangle

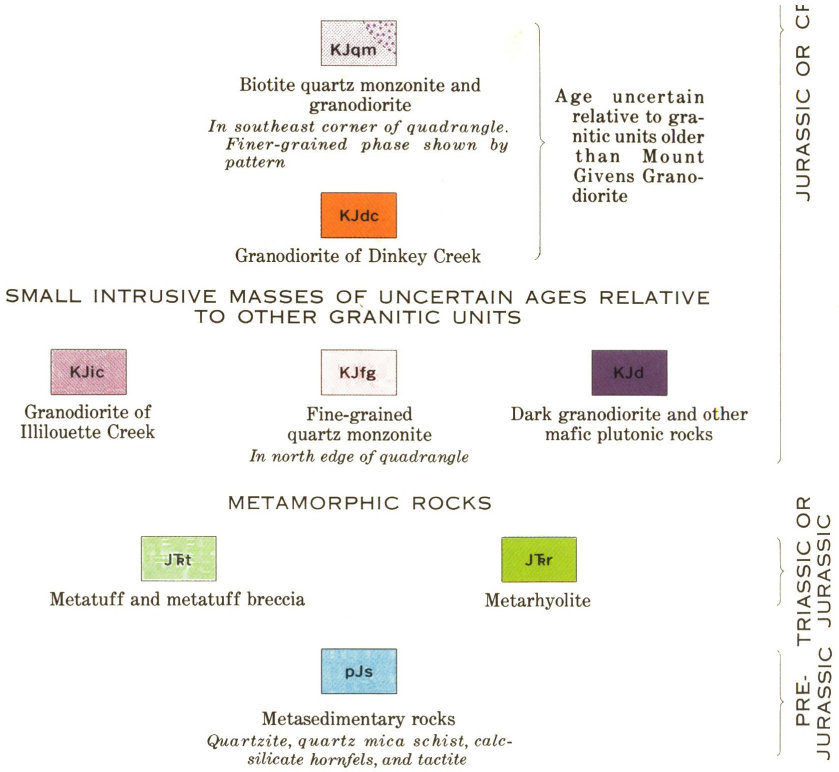
The formal citation for this source.

Huber, N.K., 1968, Geologic Map of the Shuteye Peak Quadrangle, Sierra Nevada, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-728, scale 1:62,500 (*GRI Source Map ID 1369*).

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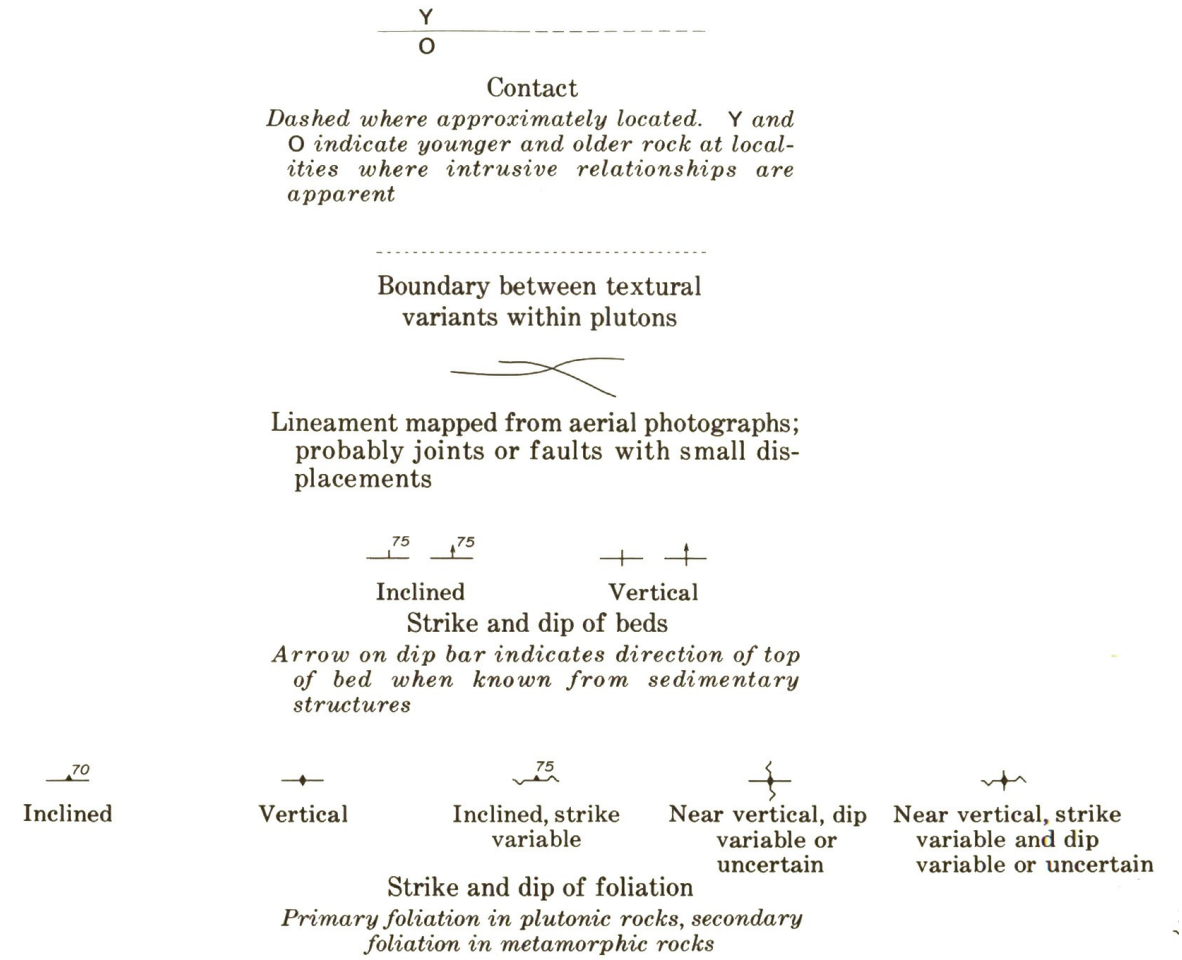
Correlation of Map Units





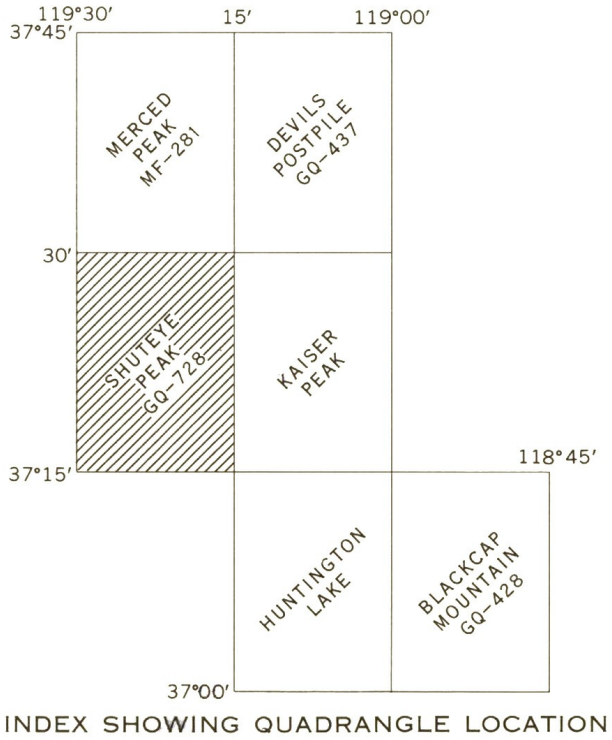
Graphic from source map: Shuteye Peak 15' Quadrangle

Map Legend



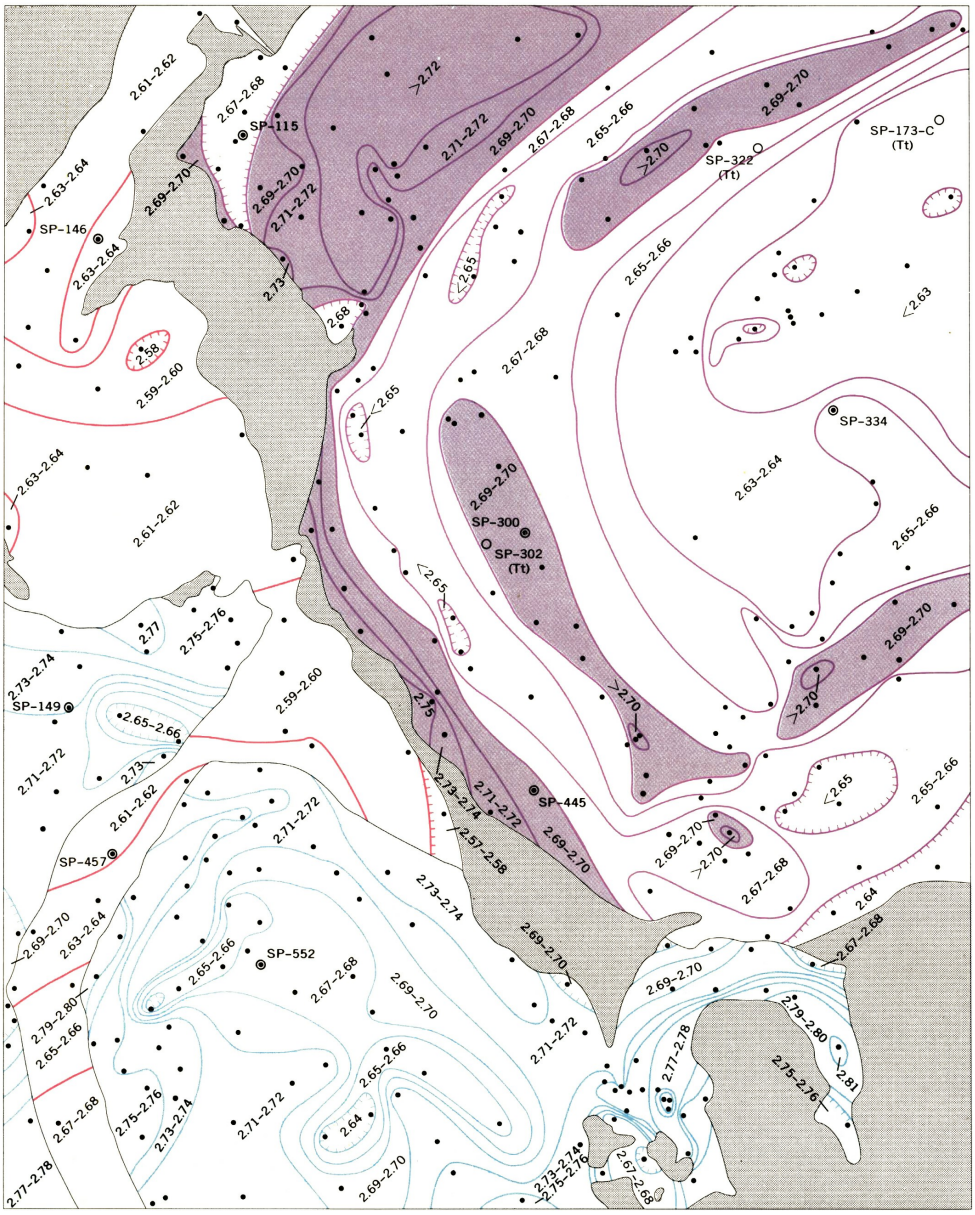
Graphic from source map: Shuteye Peak 15' Quadrangle

Index Showing Quadrangle Location



Graphic from source map: Shuteye Peak 15' Quadrangle

Specific Gravity Map



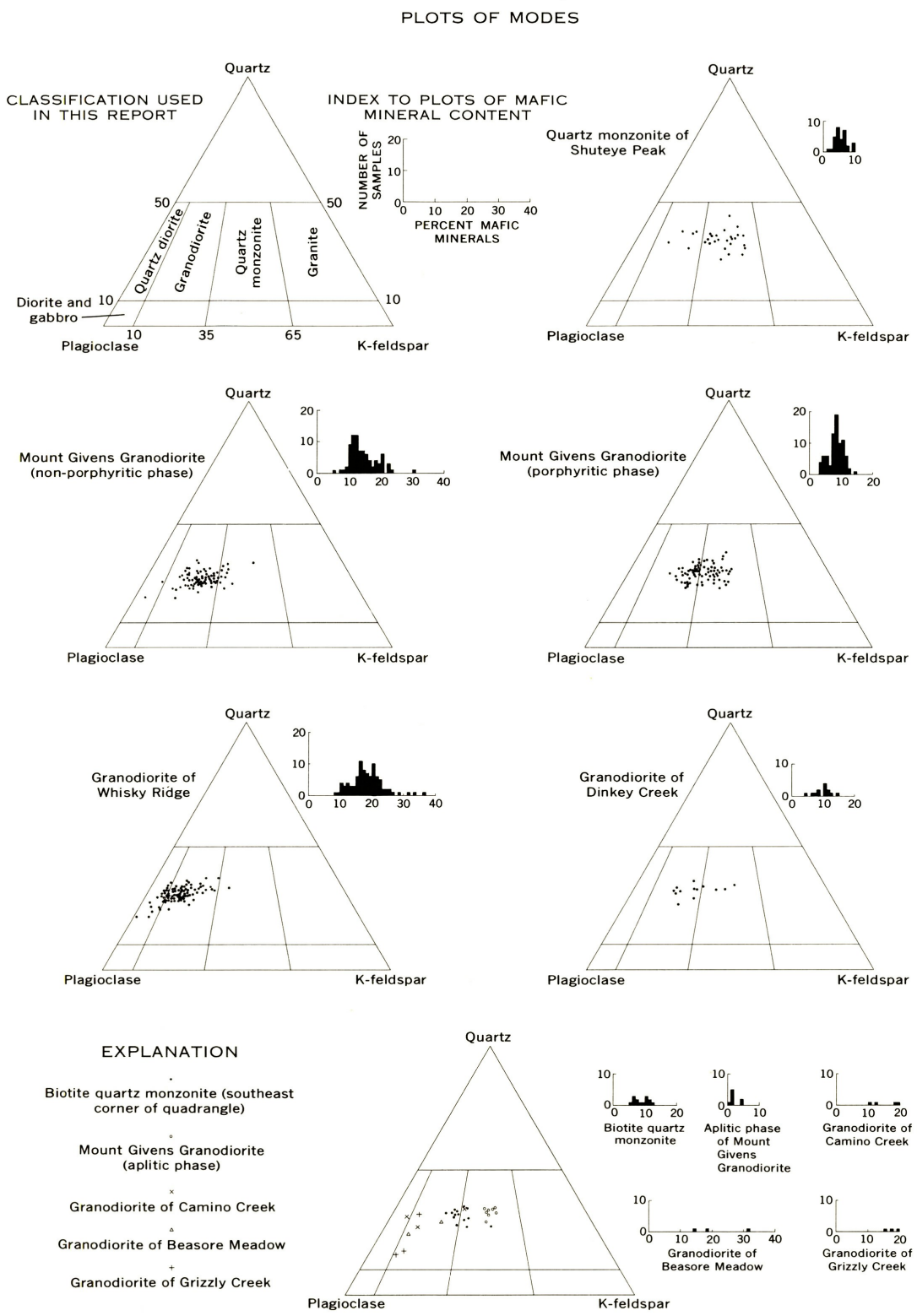
SPECIFIC GRAVITY MAP SHOWING VARIATION WITHIN MAJOR PLUTONIC UNITS AND LOCATION OF SAMPLES

Dots indicate locations of specific gravity determinations; open circles indicate locations of chemically analyzed samples, including trachybasalt (Tt). Specific gravity contour interval is 0.02. Purple contours lie within the Mount Givens Granodiorite, blue within the granodiorite of Whisky Ridge, and red within the quartz monzonite of Shuteye Peak.

Purple-colored areas emphasize trends of specific gravity highs that roughly coincide with the nonporphyritic phase of the Mount Givens Granodiorite. Blue-colored areas emphasize the generally higher specific gravity values near the margins of the granodiorite of Whisky Ridge.

Graphic from source map: Shuteye Peak 15' Quadrangle

Plots of Modes



Graphic from source map: Shuteye Peak 15' Quadrangle

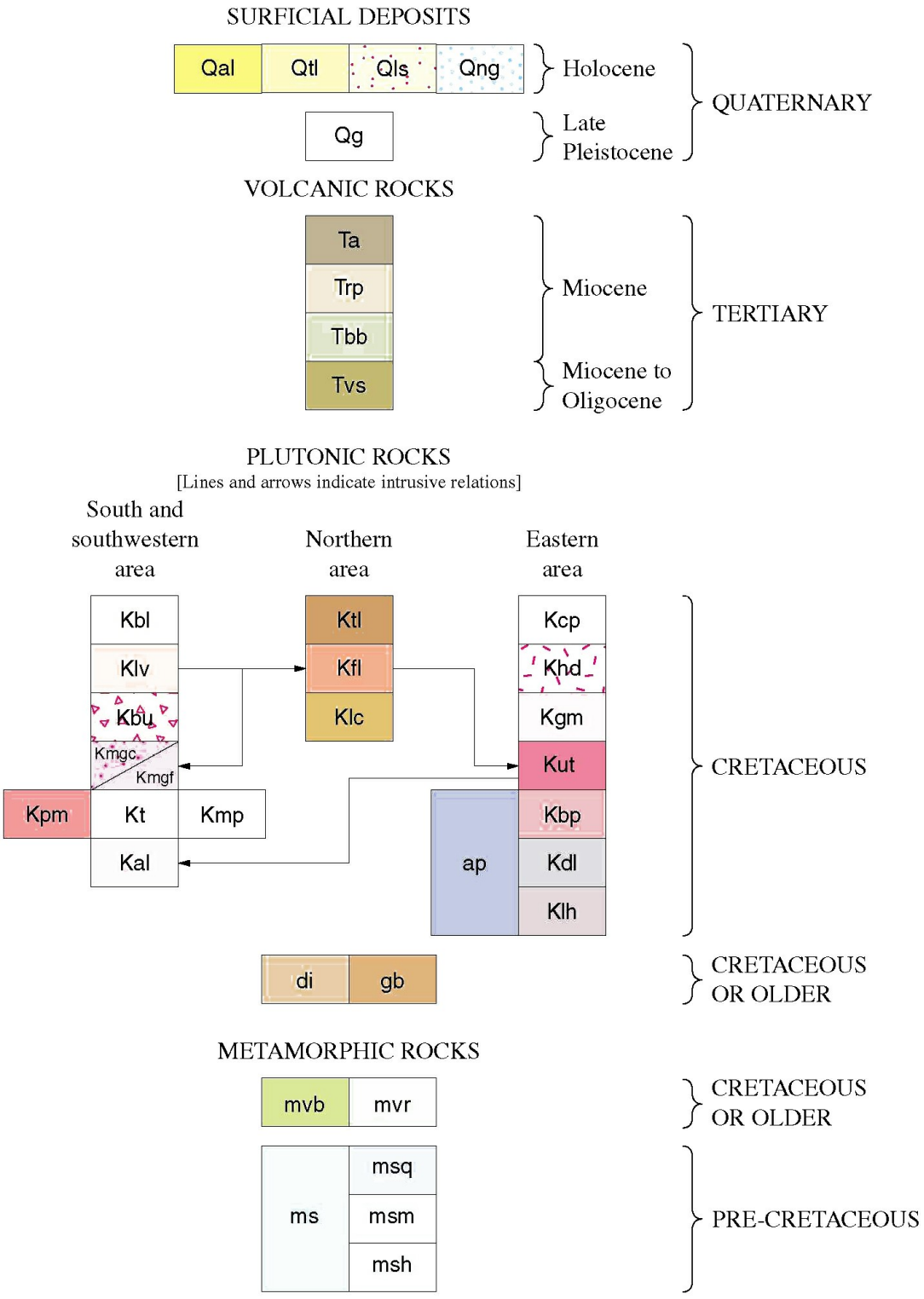
Tower Peak 15' Quadrangle

The formal citation for this source.

Wahrhaftig, Clyde, 2000, Geologic Map of the Tower Peak Quadrangle, Central Sierra Nevada, California: U.S. Geological Survey, Geologic Investigation Series Map I-2697, scale 1:62,500 (*GRI Source Map ID 1355*).

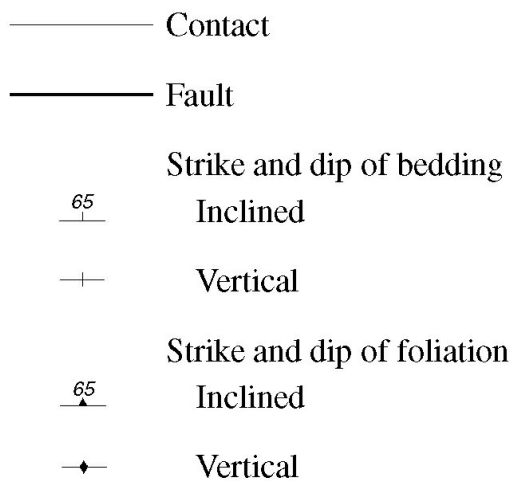
Prominent graphics and text associated with this source.

Correlation of Map Units



Graphic from source map: Tower Peak 15' Quadrangle

Map Legend



Graphic from source map: Tower Peak 15' Quadrangle

Preface

Clyde Wahrhaftig mapped the geology of the Tower Peak quadrangle in great detail (scale 1:24,000) over a period of many years from 1955 to 1980. For use in preparing a geologic map of Yosemite National Park (Huber and others, 1989), he reduced and generalized his geology to a scale of 1:48,000. Clyde died before he could complete a 1:62,500 version to match other published 15-minute geologic quadrangles in the park. Consequently, the present version was compiled by N. King Huber from materials left by Clyde and from geologic information from adjacent quadrangles. It is hoped that the result does not seriously compromise Clyde's interpretations. Publication of the map was supported by a contribution from the Clyde Wahrhaftig Trust.

Text from source map: Tower Peak 15' Quadrangle

Introduction

The following text is from a draft prepared by Wahrhaftig and all of the interpretations are his. It has been slightly rearranged and edited by N. King Huber.

The Tower Peak quadrangle, which includes northernmost Yosemite National Park, is located astride the glaciated crest of the central Sierra Nevada and covers an exceptionally well-exposed part of the Sierra Nevada batholith. Granitic plutonic rocks of the batholith dominate the geology of the Tower Peak quadrangle, and at least 18 separate pre-Tertiary intrusive events have been identified.

Pre-Cretaceous metamorphic rocks crop out in the quadrangle in isolated roof pendants and septa. Tertiary volcanic rocks cover granitic rocks in the northern part of the quadrangle, but are not considered in this brief summary. Potassium-argon (K-Ar) age determinations for plutonic rocks in the quadrangle range from 83 to 96 million years (Ma), including one of 86 Ma for the granodiorite of Lake Harriet (Robinson and Kistler, 1986). However, a rubidium-strontium whole-rock isochron age of 129 Ma has been obtained for the Lake Harriet pluton (Robinson and Kistler, 1986), which field evidence

indicates is the oldest plutonic body within the quadrangle. This suggests that some of the K-Ar ages record resetting during later thermal events and are too young. The evidence indicates that all the plutonic rocks are of Cretaceous age, with the youngest being the Cathedral Peak Granodiorite at about 83 Ma.

The pre-Tertiary rocks of the Tower Peak quadrangle fall into two groups: (1) an L-shaped area of older plutonic and metamorphic rocks, 3 to 10 km wide, that extends diagonally both northeast and southeast from near the center of the quadrangle; and (2) a younger group of large, probably composite intrusions that cover large areas in adjacent quadrangles and extend into the Tower Peak quadrangle from the east, north, and southwest.

Text from source map: Tower Peak 15' Quadrangle

Older Plutonic and Metamorphic Rocks

The L-shaped remnant of older plutonic and metamorphic rocks that extends northeast and southeast from the center of the quadrangle contains ten plutons with contiguous areas of at least 2.5 sq. km and several complexes of dikes and small irregular masses. These plutons and dikes intruded silicic and mafic metavolcanic rocks and miogeoclinal metasedimentary rocks. Mutual age relations between the plutonic rocks are incompletely determined, either because some of the rocks are not in geographically contiguous sequences or because the contacts have ambiguous age criteria. Structures in this remnant are generally steep, trend northwesterly, and are cut off sharply by the younger plutons. Lineations, foliations, and zones of recrystallization and shearing, all of supposed metamorphic or tectonic origin, are present in some plutons and suggest at least one period of dynamic metamorphism during or after the period of emplacement of these plutons. The metamorphic and early mafic rocks are described first below, followed by the plutonic rocks of the northeast arm of the "L", and then the rocks of the southeast arm.

Metamorphosed sedimentary rocks appear to be the oldest rocks. They include pure white orthoquartzite, in beds a few meters thick, that display thin partings bearing andalusite and biotite and common internal crossbedding. These are interbedded with thick (10 to 50 m) units of biotite-andalusite-sillimanite(?) schist, coarsely crystalline marble, and fine to coarse beds of pale-green, calc-silicate hornfels. These metasediments are complexly deformed. The southern body around Benson Lake is mainly quartzite, with some thick biotite-andalusite schist bodies near the top and marble at the base, folded into a large anticline with a horizontal crest and vertical limbs. The minimum stratigraphic thickness exposed in this body is 750 m. The northern body, around Bigelow and Snow Lakes, contains abundant marble bodies and about equal amounts of quartzite, biotite schist, and calc-silicate hornfels. It has been folded at least twice, the first time isoclinally. The latest deformation was into a flat-topped dome with nearly vertical flanks along the intrusive contacts. Small bodies and inclusions of metasedimentary rocks in several of the plutons indicate that this terrain was once more widespread. In the extreme northeast part of the quadrangle, metasedimentary rocks, which may be in depositional sequence with the metavolcanic rocks, include quartzite and stretched conglomerate.

[The metamorphic rocks in the Snow Lake region (Snow Lake pendant) have been extensively studied by Mary M. Lahren, who has correlated them with Precambrian to Triassic formations exposed in southeastern California (Lahren, 1989; 1991; Lahren and Schweickert, 1989). No attempt has been made here to reconcile Wahrhaftig's earlier mapping with her later interpretations.]

Bodies of diorite and hornblende-gabbro appear to be the oldest intrusions in the metasedimentary sequence. The gabbro contains bodies of pure hornblendite or hornblende-pyroxene rock as much as 300 m across. Hornblende crystals in these pods are as much as 3 cm across and are generally stubby or equant. Some of the gabbro in the large body near the center of the quadrangle

shows tilted but right side-up cumulate layering. All the mafic and ultramafic rocks have been metamorphosed.

Next younger seems to be a differentiated plutonic complex that includes the granodiorite of Lake Harriet, with an aplitic border facies, and the granite of Dorothy Lake. The Lake Harriet and its aplitic border facies intrude the metarhyolite, which is interpreted to be an ignimbrite because the outlines of flattened pumice fragments can be seen on weathered outcrops. The Dorothy Lake appears to be a siliceous core to the Lake Harriet pluton.

Intrusive into the Lake Harriet complex is the granite of Bond Pass, which was intruded in turn by the granite of Upper Twin Lake, and that by the alaskite of Grace Meadow. The Bond Pass is cut by northwest-trending, dike-like bodies of aplite that contain spherical rosette-like intergrowths of tourmaline, quartz, and feldspar. The granite of Upper Twin Lake has in places an intense vertical lineation expressed as a lengthening of quartz and feldspar grains, which is probably metamorphic in origin. The Grace Meadow lacks these metamorphic structures, at least on the mesoscopic scale. This implies a period of tectonism affected the above sequence just prior to the Grace Meadow intrusion.

The alaskite of Grace Meadow has the geographic pattern of a sheath enclosing the northwest end of the Half Dome Granodiorite pluton, suggesting that the Half Dome was emplaced by stoping the core of the Grace Meadow. The Grace Meadow has the peculiarity that although it is relatively uniformly leucocratic in color index, it contains abundant, irregularly distributed, large and small inclusions of gabbro, diorite, and metasedimentary rocks, many large enough to show on the geologic map. These inclusions appear to define belts through the Grace Meadow that before the intrusion might have been largely metasedimentary or largely mafic intrusive rocks. Although the contacts of the Grace Meadow with all older rocks are clearly intrusive, suggesting magmatic stoping, the impression given by the abundant inclusions is one of relatively passive emplacement with little large-scale fluid flow within the pluton. Perhaps the magma was injected initially as a dike complex along fractures in a shattered mafic and metamorphic complex, and the dikes simply widened out to form the present pluton as the fragments of older rocks drifted apart and downward. The inclusions also indicate that if the older plutons, such as the granite of Bond Pass and granite of Upper Twin Lake, were present where the Grace Meadow now is, they were completely dissolved in the new magma.

The granodiorite of Long Canyon, in the northeast corner of the quadrangle, is a mafic granodiorite that intrudes metavolcanic rocks and is intruded in turn by the granodiorite of Fremont Lake. Its geographic position suggests that it might be an early mafic member of the Fremont Lake-Topaz Lake intrusive sequence, but it appears to have been affected by a period of deformation that predates the intrusion of the Fremont Lake. This deformation has produced boudinage of dikes and mineral foliation at considerable angles to intrusive contacts. Hence the Long Canyon pluton may be much older than the above intrusive sequence.

The southeast branch of the L-shaped area of older rocks is dominated by the granite of Avonelle Lake, which contains abundant euhedral to subhedral, tabular-shaped K-feldspar phenocrysts as much as 3 cm in maximum dimension. The Avonelle Lake pluton extends south into the Hetch Hetchy Reservoir quadrangle, where it is probably equivalent to the granodiorite of Double Rock (Kistler, 1973). However, difficulties in matching contacts and lithologic descriptions across the quadrangle boundary make this correlation tentative and require a separate rock-unit name to avoid future confusion. The contact of the Avonelle Lake with the granite of Upper Twin Lake has given conflicting evidence for their relative ages, but there is a strong indication that the Upper Twin Lake is younger.

The granite of Avonelle Lake is intruded on the northeast by two relatively small plutons. The granite of Piute Mountain contains much more abundant, but smaller, flattened K-feldspar phenocrysts and has sharp intrusive contacts with a fine-grained gray selvage against the Avonelle Lake. The leucogranite of Ten Lakes (termed alaskite by Kistler, 1973, in the adjacent Hetch Hetchy Reservoir

quadrangle) is coarse grained and mottled by gray anhedral quartz crystals. Both of these latter plutons are intruded by rocks of the Tuolumne Intrusive Suite, part of the younger group of plutons.

On its southwest margin the granite of Avonelle Lake is intruded by a strongly foliated complex of leucogranite containing abundant diorite inclusions and cut by unfoliated, fine-grained granite dikes and irregular masses. This complex is mapped as the complex of Mahan Peak. It is continuous with the granodiorite of Rancheria Mountain of Kistler (1973). The complex is clearly intruded by the granodiorite of Lake Vernon (the "spotted rock"). Its contact relations with the quartz diorite of Mt. Gibson and the granodiorite of Bearup Lake are equivocal, but a locality near the trail from Jack Main Canyon (Paradise Valley) to Tiltill Mountain has inclusions of the Mahan Peak complex in the Mt. Gibson pluton. The simplest, but not completely satisfactory, explanation for the Mahan Peak complex is that it represents granite of Avonelle Lake together with contained diorite dikes that were remobilized and partly melted by the intrusion of the quartz diorite of Mt. Gibson, whose emplacement temperature would have been considerably higher than that of the granite of Avonelle Lake.

Text from source map: Tower Peak 15' Quadrangle

Younger Plutonic Rocks

The eastern composite intrusion of the younger group is the Tuolumne Intrusive Suite. In the Tower Peak quadrangle, the Tuolumne Suite includes (1) the northernmost and westernmost extent of the Cathedral Peak Granodiorite, which here has burst its shell of more mafic differentiates and intrudes older granitic and metamorphic rocks, and (2) the Half Dome Granodiorite, which is interpreted as an earlier, more mafic differentiate of the same magmatic pulse as that for the Cathedral Peak Granodiorite.

The northern composite intrusion of the younger group includes the granodiorite of Topaz Lake, a rock almost identical in appearance and age to the Cathedral Peak Granodiorite, but separated from the latter by a 6- to 7-km septum of older rocks. The Topaz Lake pluton is bordered on the south by the granodiorite of Fremont Lake. The Fremont Lake pluton appears to bear the same relationship to the granodiorite of Topaz Lake that the Half Dome Granodiorite does to the Cathedral Peak Granodiorite.

The southwestern composite intrusion of the younger group includes four large plutons in the southwest corner of the Tower Peak quadrangle and in adjacent quadrangles. These plutons show some evidence of being consanguineous, yet other evidence suggests a significant hiatus in the sequence. The complex includes, from oldest to youngest, the quartz diorite of Mt. Gibson, the granodiorite of Bearup Lake, the granodiorite of Lake Vernon, and the granodiorite of Boundary Lake. A swarm of fine-grained diorite dikes cuts the Mt. Gibson and Bearup Lake, but is apparently cut off by the granodiorite of Lake Vernon. This succession of events suggests a time break and interval of cooling. However, the granodiorite of Bearup Lake grades in color index from very near that of the Mt. Gibson where it is in intrusive contact with the Mt. Gibson to very near that of the Lake Vernon where the latter intrudes the Bearup Lake. This suggests a genetic relationship extending across the time gap.

Text from source map: Tower Peak 15' Quadrangle

Diorite Dikes

Sets of diorite dikes (not shown on the geologic map) with at least three orientations intrude the granite of Avonelle Lake, and at least one set also intrudes the quartz diorite of Mt. Gibson and granodiorite of Bearup Lake. These dikes are confined to the southwest part of the quadrangle and do not appear to occur in the northeastern part of the Avonelle Lake pluton. One set trends due north and is

about vertical, another set trends northwest and is about vertical, and the third strikes roughly east-west and dips 30° to 45° north. The first two sets appear to predate the formation of the Mahan Peak complex and the intrusion of the Mt. Gibson pluton because they are found as inclusions in the former. The diorite dikes probably represent periods of crustal extension, although it is not clear how extension alone would produce a dike-swarm dipping 30° north.

Where the diorite dikes intrude granite, they are bordered by thin, discontinuous selvages of fine-grained felsic rock, generally of granitic composition, but ranging toward diorite. In addition, the dikes are cut by thin, closely spaced, and exceedingly irregular veins of the same material, which are continuous with the selvages. The selvages are probably the product of melting of the granitic wall-rock by the diorite magma, which was probably intruded at a temperature well above the melting temperature of the more felsic rocks.

Text from source map: Tower Peak 15' Quadrangle

Mafic Inclusions

Most of the hornblende-bearing plutonic rocks have crudely lenticular or rod like inclusions, a few centimeters to a meter or more thick and as much as 5 meters long, of relatively fine-grained predominantly mafic minerals. These are distributed moderately uniformly through the plutons, although in a few localities the inclusions form clusters resembling schools of fish. In some plutons, especially the granodiorite of Fremont Lake and Half Dome Granodiorite, the concentration of inclusions varies greatly from place to place. The mafic inclusions are composed of the same minerals as the enclosing granitic rock, but in different proportions. Their origin remains an enigma. Current evidence favors most of the inclusions having originated as blobs of basaltic magma that were incorporated into the more felsic magma from which the granitic rocks crystallized (Bateman, 1992).

Text from source map: Tower Peak 15' Quadrangle

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References from source map: Tower Peak 15' Quadrangle

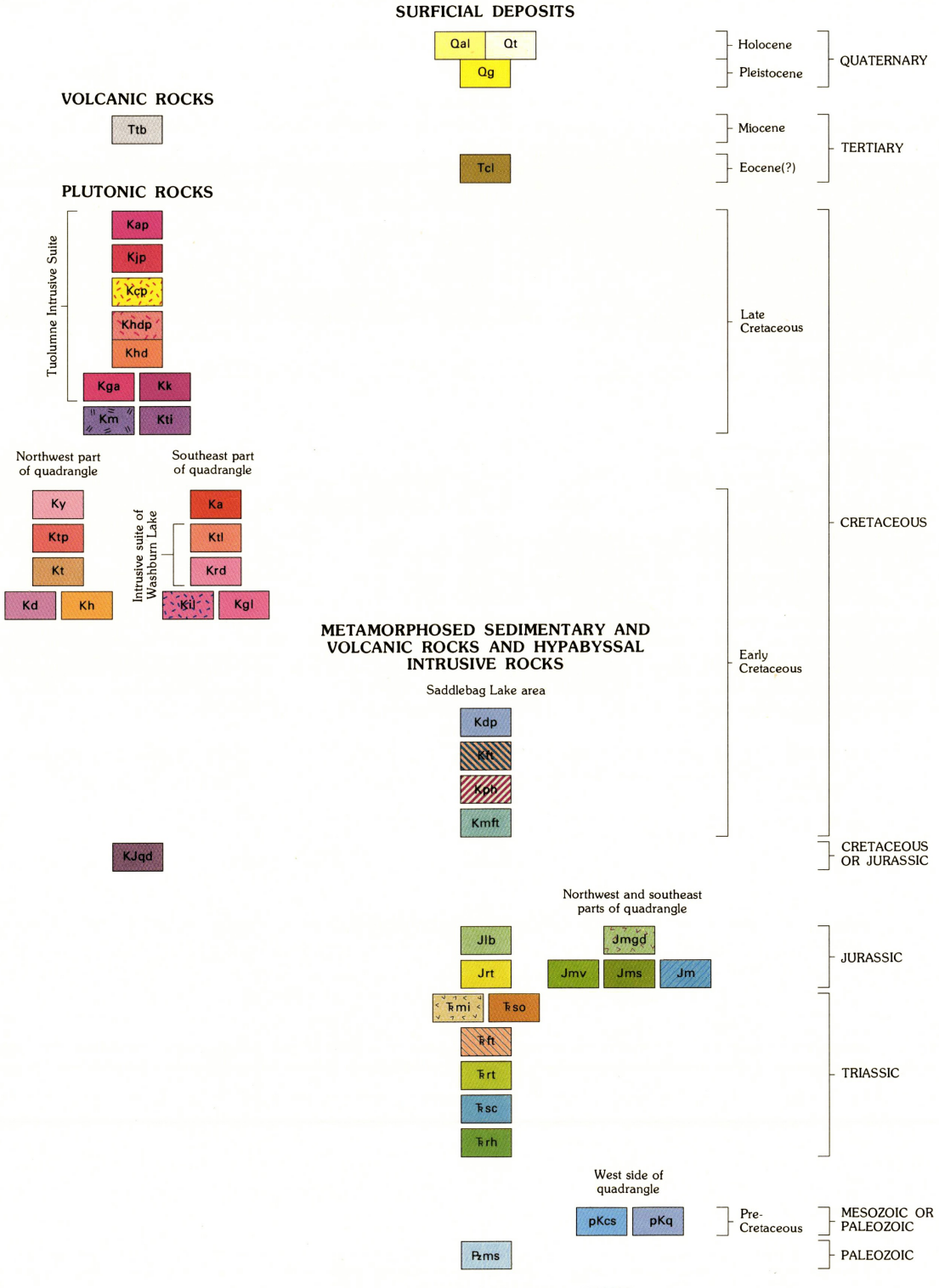
Tuolumne Meadows 15' Quadrangle

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Bateman, P.C., Kistler, R.W., Peck, D.L., and Busacca, Alan, 1983, Geologic Map of the Tuolumne Meadows Quadrangle: Yosemite National Park, California: U.S. Geological Survey, Geologic Quadrangle Map GQ-1570, scale 1:62,500 (*GRI Source Map ID 1361*).

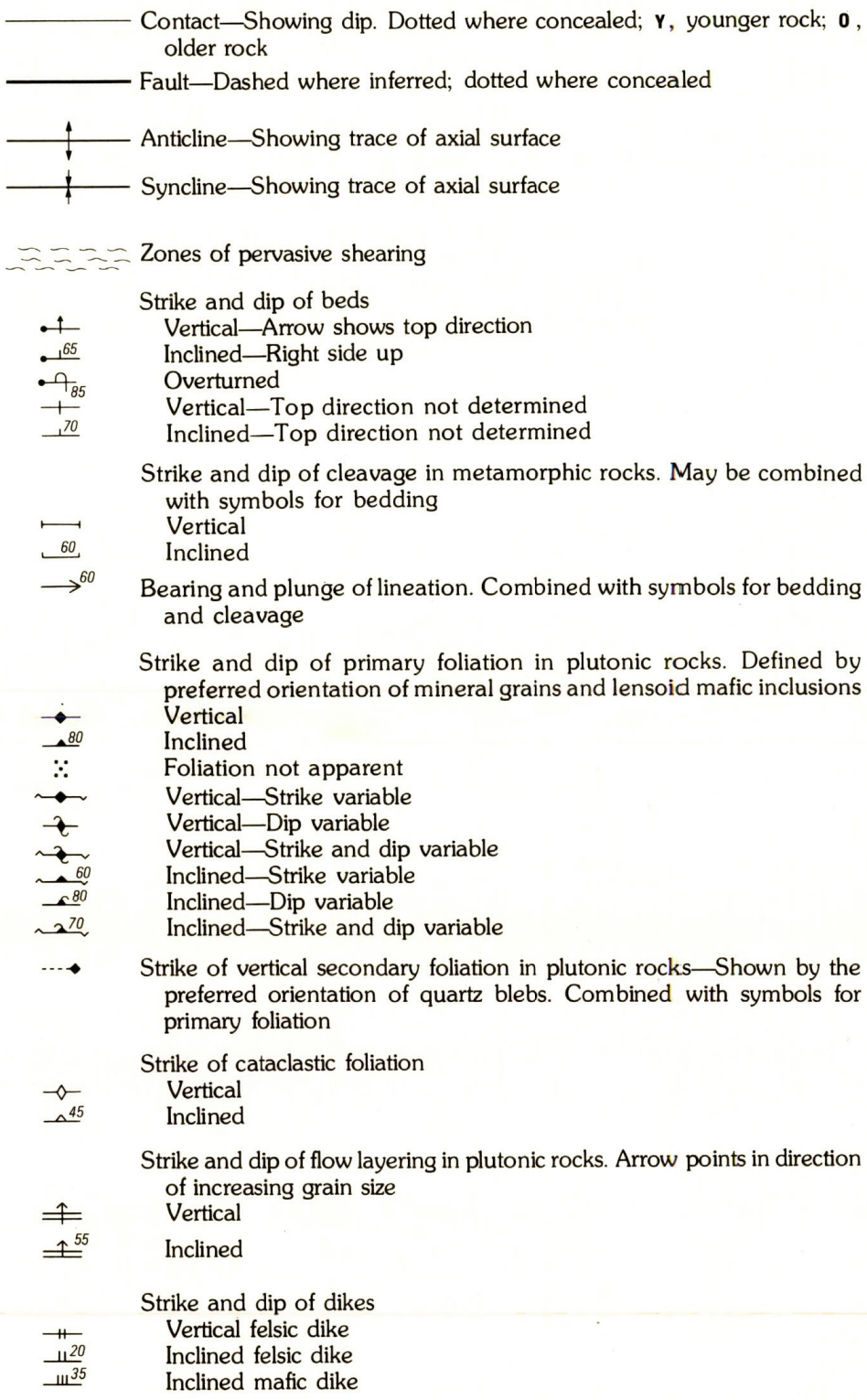
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Correlation of Map Units



Graphic from source map: Tuolumne Meadows 15' Quadrangle

Map Legend



Graphic from source map: Tuolumne Meadows 15' Quadrangle

Geologic Summary

The Tuolumne Meadows quadrangle lies mostly within Yosemite National Park where it occupies high glaciated country northeast of Yosemite Valley and just west of the Sierra Divide, but a small area of about 30 km2 in the northeast comer is in the Inyo National Forest. The Tioga Road (California Highway 120), a principal highway across the Sierra Nevada, bisects the quadrangle, and numerous trails from the Tioga Road lead into the back country. Altitudes range from 5,600 feet where the Tuolumne River crosses the west boundary of the quadrangle to 12,590 feet at Mount Conness, a peak along the Sierra Divide. Much of the quadrangle lies between 8,000 and 10,000 feet and is snowbound during the winter months. Granite domes and glacial features that were formed by processes that either operated in the recent past or are still operating are principal attractions of the area and are all well known. However, other geologic features that were produced in the distant past-hundreds of millions of years ago - are less well known but no less interesting. The most abundant rocks in the quadrangle are granitic, and the oldest rocks are remnants of metamorphosed sedimentary and volcanic rocks that were intruded by molten magmas that solidified to the granitic rocks. Much younger glacial deposits, talus, and alluvium locally mantle the older rocks.

Only scattered remnants of the old metamorphosed sedimentary and volcanic rocks now remain, but before the granitic magmas intruded and disrupted them, they covered the entire area. Metamorphic rocks occur in three parts of the quadrangle: the Saddlebag Lake area north of Tioga Pass in the northeast comer, south and west of Ireland Lake in the northwest-trending ridge that includes Parsons Peak, and small scattered masses in the west and north.

The only mass of metamorphic rocks large enough and coherent enough to allow reasonable interpretations of its structure and history is northeast of Tioga Pass. The oldest rocks, designated metasedimentary strata, undifferentiated, lie east of Saddlebag Lake along Tioga Crest. They include quartzofeldspathic hornfels, calc-silicate hornfels, pelitic hornfels, and conglomerate derived from sandstone; limestone, marl, sandy limestone, and calcareous quartzite; mudstone; and conglomerate. Most of these rocks were deposited in the margins of an ancient ocean, but the lenses of conglomerate may have been deposited in stream channels. The conglomerates are predominantly in the west part of the unit, which is probably the upper part, and they appear to reflect uplift, deformation, and erosion of the underlying strata as the period of marine deposition came to an end. The strata are folded into complex patterns that are the result of more than one episode of deformation; they show cleavage and dip steeply in most places. Because outcrops are poor and discontinuous, structures within this unit are not designated on the map. The age of these strata is not known exactly; poorly preserved molds of crinoid stems and distorted horn corals on the west side of Saddlebag Lake near its north end indicate a late Paleozoic age (360-240 m.y.).

Unconformably overlying these strata is a succession of nonmarine volcanic and associated sedimentary strata. These strata dip steeply to the west or are vertical in most places and are progressively younger to the west. Although the strata were tilted steeply to the west after they were deposited and before they were intruded by granitic rocks of the Cretaceous Tuolumne Intrusive Suite, presumably during the widespread Late Jurassic Nevadan orogeny, they are neither so strongly nor so complexly deformed as the underlying marine sedimentary strata. Folds were recognized only near the south end of the succession, north of Gaylor Lakes. Most of the units in the succession were deposited on land as pyroclastic and lava flows perhaps within or adjacent to a caldera, but the youngest and most westerly unit was deposited in a lake. Isotopic dating of whole rocks by the Rb-Sr method indicates that the lower part of the succession is Triassic (about 225 m.y.) and that the upper part is Jurassic (about 185 my).

A still younger group of volcanic and associated sedimentary strata are present in and around Gaylor Peak. These strata were down dropped against the adjacent strata along a curved bounding fault. The down dropped block continues to the southeast into the Mono Craters quadrangle where a wedge of

similar strata is in fault contact on both sides with late Paleozoic marine strata. Rb-Sr data indicate that the strata in the Mono Craters quadrangle are Early Cretaceous (140-100 my), and presumably the strata in the Tuolumne Meadows quadrangle are of the same age.

The strata in the ridge south and west of Ireland Lake, which includes Parsons Peak, in the southeast corner of that quadrangle, and north of Hooper Peak and at Rodgers Lake, in the northwest corner of the quadrangle, are also chiefly volcanic rocks and probably were deposited within the same general time span as the succession of metavolcanic rocks east of Saddlebag Lake in the northeast corner of the quadrangle. Quite different metamorphic rocks are present in small discontinuous remnants between May Lake and Glen Aulin. These rocks are composed of quartzite, calc-silicate hornfels, schist, and marble and, before metamorphism, were sand, marl, clay-shale, and limestone that were deposited in a marine environment. No fossils have been found in these strata, and their age is unknown. Similar appearing strata elsewhere in the Sierra Nevada are of early Paleozoic (500-400 m.y.) age and of Late Triassic and Early Jurassic age (225-175 m.y.).

Text from source map: Tuolumne Meadows 15' Quadrangle

Metamorphosed Sedimentary and Volcanic Rocks and Hypabyssal Intrusive Rocks

The Tuolumne Meadows quadrangle lies mostly within Yosemite National Park where it occupies high glaciated country northeast of Yosemite Valley and just west of the Sierra Divide, but a small area of about 30 km2 in the northeast comer is in the Inyo National Forest. The Tioga Road (California Highway 120), a principal highway across the Sierra Nevada, bisects the quadrangle, and numerous trails from the Tioga Road lead into the back country. Altitudes range from 5,600 feet where the Tuolumne River crosses the west boundary of the quadrangle to 12,590 feet at Mount Conness, a peak along the Sierra Divide. Much of the quadrangle lies between 8,000 and 10,000 feet and is snowbound during the winter months. Granite domes and glacial features that were formed by processes that either operated in the recent past or are still operating are principal attractions of the area and are all well known. However, other geologic features that were produced in the distant past-hundreds of millions of years ago - are less well known but no less interesting. The most abundant rocks in the quadrangle are granitic, and the oldest rocks are remnants of metamorphosed sedimentary and volcanic rocks that were intruded by molten magmas that solidified to the granitic rocks. Much younger glacial deposits, talus, and alluvium locally mantle the older rocks.

Only scattered remnants of the old metamorphosed sedimentary and volcanic rocks now remain, but before the granitic magmas intruded and disrupted them, they covered the entire area. Metamorphic rocks occur in three parts of the quadrangle: the Saddlebag Lake area north of Tioga Pass in the northeast comer, south and west of Ireland Lake in the northwest-trending ridge that includes Parsons Peak, and small scattered masses in the west and north.

The only mass of metamorphic rocks large enough and coherent enough to allow reasonable interpretations of its structure and history is northeast of Tioga Pass. The oldest rocks, designated metasedimentary strata, undifferentiated, lie east of Saddlebag Lake along Tioga Crest. They include quartzofeldspathic hornfels, calc-silicate hornfels, pelitic hornfels, and conglomerate derived from sandstone; limestone, marl, sandy limestone, and calcareous quartzite; mudstone; and conglomerate. Most of these rocks were deposited in the margins of an ancient ocean, but the lenses of conglomerate may have been deposited in stream channels. The conglomerates are predominantly in the west part of the unit, which is probably the upper part, and they appear to reflect uplift, deformation, and erosion of the underlying strata as the period of marine deposition came to an end. The strata are folded into complex patterns that are the result of more than one episode of deformation; they show cleavage and

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A still younger group of volcanic and associated sedimentary strata are present in and around Gaylor Peak. These strata were down dropped against the adjacent strata along a curved bounding fault. The down dropped block continues to the southeast into the Mono Craters quadrangle where a wedge of similar strata is in fault contact on both sides with late Paleozoic marine strata. Rb-Sr data indicate that the strata in the Mono Craters quadrangle are Early Cretaceous (140-100 my), and presumably the strata in the Tuolumne Meadows quadrangle are of the same age.

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Text from source map: Tuolumne Meadows 15' Quadrangle

Plutonic Rocks-Tuolumne Intrusive Suite

Granitic rocks underlie more than 90 percent of the quadrangle, but large areas are coveted by glacial deposits. The granitic rocks vary markedly in appearance: some are fine grained and some coarse grained, some are dark and some light colored, some are equigranular and some have large blocky megacrysts of feldspar that glisten in the sun, and some have black euhedral prisms of hornblende and books of biotite. The different granitic rocks are in different bodies (plutons) that were emplaced at different times and that meet along sharp contacts or are separated by thin septa (or screens) of metamorphic rock. The different bodies solidified from masses of molten magma, which were generated deep in the Earth's crust or upper mantle and rose into the upper crust, displacing the metamorphic and older granitic rocks with which they came in contact along the way. When the granitic rocks were emplaced, the present ground surface was deep in the Earth, buried under perhaps as much as 10 km of rock. Uplift and consequent removal of these overlying rocks by erosion created the surface we see today.

Although many different bodies of granitic rock are exposed within the quadrangle, the largest, youngest, and most interesting ones belong to the Tuolumne Intrusive Suite. Somewhat older granitic rocks are present in the northwest and southeast parts of the quadrangle, but the Tuolumne Intrusive Suite occupies most of the quadrangle. The formations that make up the Tuolumne Intrusive Suite are nested one within the other, the oldest at the margins and the youngest in the core of the suite. The tonalite of Glen Aulin and the granodiorite of Kuna Crest are the marginal formations on the west and east sides, respectively. Successively inward from them are the equigranular facies of the Half Dome Granodiorite, the porphyritic facies of the Half Dome Granodiorite, the Cathedral Peak Granodiorite, and the Johnson Granite Porphyry in the core of the suite. All of these rocks were emplaced about 87 m. y. ago, according to isotopic age determinations and were derived from a common parent source at depth. Nevertheless, they change progressively inward, becoming lighter colored and coarser gained except for the Johnson Granite Porphyry, which is fine grained.

The textural and compositional changes in the Tuolumne Intrusive Suite can be seen quite clearly by examining the rocks for about 3 km along the trail that runs north from May Lake, then stopping at road cuts along the Tioga Road between Olmstead Point, 2½ km southwest of Tenaya Lake, and the Visitor Center at Tuolumne Meadows. The rock along the trail between the parking area at the foot of the trail and May Lake is in the equigranular facies of the Half Dome Granodiorite, but at May Lake the trail enters a thin septum of quartzite and calc-silicate hornfels, which separates the Tuolumne Intrusive Suite from the granodiorite of Mount Hoffman to the west. North of May Lake, the trail passes across light-colored quartzite, but about a kilometer to the north, where it turns northeast to descend a steep slope, the quartzite is in sharp contact with the dark-gray, fine-grained tonalite of Glen Aulin. Farther down the trail, the rock becomes progressively lighter colored and coarser grained, and within a few hundred meters at the bottom of the steep slope, the rock is much like the rock exposed at Olmstead Point. It is the equigranular facies of the Half Dome Granodiorite, and the rocks at the three places look alike because they are all about equidistant from the west contact of the Tuolumne Intrusive Suite. The rock is characterized by black prisms of hornblende as much as 2 cm long, shiny flaky hexagonal books of biotite a centimeter across, and tiny yellow wedges of sphene.

Along the highway between Olmstead Point and Tenaya Lake, the appearance of the rocks changes very little, but east of the picnic ground at Murphy Creek, large rectangular feldspar crystals (called megacrysts) appear and increase in abundance toward the east end of the lake. This rock is the porphyritic facies of the Half Dome Granodiorite. In this span, many outcrops appear striped. The stripes are actually layers within the rock, which grade from fine grained and dark on one side to medium or coarse grained and light colored on the other. These layers were caused by different flow rates in the magma, which sorted the crystals according to size. The rate of flow was slower in the fine-grained, dark side of the layer and progressively faster toward the coarse-grained, light-colored side. The sorting was caused by differences in velocity across the layers. In the fine-grained dark side the difference in velocity was much greater across a width of a few millimeters than across the same width in the coarse-grained light-colored side. Velocity differences cause crystals to be dispersed to parts of the layer where the velocity differences are less, and large crystals are dispersed more effectively than small ones. The dark crystals are in the fine-grained part of the layer because they are small, and not because they are heavier. The boundary surfaces between layers mark sharp discontinuities in the rate of flow.

In most places, the contact between the porphyritic facies of the Half Dome Granodiorite and the Cathedral Park Granodiorite is sharp, but along Tioga Road it is gradational. East of Tenaya Lake, opposite the steep west face of Pywiack Dome, the tabular feldspar megacrysts of the Half Dome Granodiorite give way eastward through a mixed zone about 50 m wide to larger blocky megacrysts that characterize the Cathedral Peak Granodiorite. Eastward from Pywiack Dome along Tioga Road, the Cathedral Peak Granodiorite becomes progressively lighter colored because of decreasing amounts of dark-colored minerals, and the feldspar megacrysts become smaller and less abundant. The rock near Fairview Dome at the west edge of Tuolumne Meadows contains only small, sporadically distributed feldspar megacrysts.

At Tuolumne Meadows, the Cathedral Peak Granodiorite gives way abruptly to the fine-grained Johnson Granite Porphyry. This formation underlies a relatively small area about 2 km across from east to west and about 8 km long. A coherent central mass, but with very irregular boundaries, is bordered by dikes of similar rock that ramify adjacent parts of the Cathedral Peak Granodiorite. The Johnson Granite Porphyry is well exposed in outcrops north and across the road from the Visitor Center, and a sharp contact with the Cathedral Peak Granodiorite is exposed in a llat-lying outcrop a few tens of meters south of the Tuolumne River. Eastward to Tioga Pass, changes in the texture and composition of the rocks of the Tuolumne Intrusive Suite duplicate, in reverse order, the changes between May Lake and Tuolumne Meadows, but much of the area along the Tioga Road east of Tuolumne Meadows is covered with glacial moraine, and the granitic rocks are poorly and discontinuously exposed.

The changes from the margins inward in grain size, texture, and composition have attracted the attention of geologists, because an explanation would bear on the problem of the origin of the diversity of compositions and textures common to genetically related suites of granitoids the world over. The dark-colored marginal rocks are composed of assemblages of minerals that crystallized at high temperatures, and inward the rocks are composed of mineral assemblages that crystallized at progressively lower temperatures. The obvious inference is that the suite solidified from the margins inward with falling temperature. The sharp contacts between the different formations undoubtedly represent surges of magma from below which eroded the inward solidifying carapace and produced discontinuities. No evidence has been found to indicate that magma reached the surface in volcanic eruptions until the Johnson Granite Porphyry was emplaced, but the abrupt decrease in grain size in the Johnson and the presence of small vugs that reflect bubbles in the magma are best explained by loss of volatiles from the magma. Loss of volatiles causes a magma to crystallize at a higher temperature than it would if it had retained the volatiles. Undoubtedly the volatiles were lost upward to the surface, and there is a good possibility that they were lost in an eruption.

The underlying cause of the progressive inward compositional and textural changes is still uncertain. The more traditional view is that crystals separated from the melt as it cooled and either stuck to the walls or settled downward, thus progressively impoverishing the core magma of minerals that crystallize at high temperatures. Another possibility that is suggested by studies of isotopes of rubidium and strontium is that the composition of the parent magma at depth, rather than remaining constant, changed progressively as the result of incorporating parts of the lower crust that would melt at low temperatures, thus enriching the parent magma in low-temperature constituents. The relative importance of these two processes is yet to be determined.

Text from source map: Tuolumne Meadows 15' Quadrangle

Little Devils Postpile

Along the south side of the Tuolumne River, about 142 km southeast of Glen Aulin, is an irregularly shaped plug (or neck) of dark trachybasalt averaging about 100 m across, which intrudes the Cathedral Peak Granodiorite. This plug is locally called "Little Devils Postpile," but it resembles the well-known Devils Postpile, farther south in the Sierra Nevada along the upper San Joaquin River, only in that both are composed of dark volcanic rock. The Devils Postpile is a lava flow in which spectacular hexagonal columns developed during cooling, whereas Little Devils Postpile is an intrusive plug lacking conspicuous columns, which undoubtedly was the feeder for flows that have been entirely eroded away by ice and water. The plug has attracted the attention of geologists, because it has melted adjacent parts of the Cathedral Peak Granodiorite. The age of the plug has been inferred to be about 9.4±2 m.y. from counts of fission tracks in the minerals apatite and sphene which were extracted from the partly melted granodiorite. If this age is correct, the plug was intruded well before the beginning of the great ice age of the Pleistocene Epoch, which began about 2 m.y. ago.

Text from source map: Tuolumne Meadows 15' Quadrangle

Glacial Features

At the height of the last stage of the ice age of the Pleistocene, which peaked about 18,000 years ago and ended about 10,000 years ago, almost the entire area of the Tuolumne Meadows quadrangle was buried under the immense Tuolumne Ice Field, which was more than 300 m thick in places. Only the highest peaks such as Vogelsang, and Parsons Peak in the south, Cathedral and Unicorn Peaks near the center, and Mount Conness and North Peak in the northeast projected above the almost continuous ice field. Ice from this field flowed generally westward along the tributaries to the Merced and Tuolumne Rivers, but east of the Sierra Divide it flowed southeastward along Lee Vining Creek. As the great ice field dwindled because of warming summers and decreasing winter precipitation, small glaciers persisted in high cirque basins. However, the existing small glacier on the northeast side of Mount Conness is not a relict of the Tuolumne glacier-it dates from a shorter lived and less severe period called the Little Ice Age, which peaked 3,000 to 4,000 years ago.

This great ice field has left its mark indelibly on the landscape, shaping bedrock and leaving behind vast deposits of morainal till. Small tell-tale features are everywhere. Rock surfaces have been highly polished and grooved with fine striae by rocks that were dragged over bedrock surfaces by the moving ice. Accompanying the striated surfaces are chatter marks-curved fractures, shaped like the crescent moon, whose horns point in the direction the glacier was moving. They were caused by the moving rocks in the ice pressing against and fracturing the underlying bedrock. Glacial erratics are everywhere. These are boulders, some of enormous size, that were carried by the glacier from distant places, then dropped as the ice melted away.

But the largest glacial features are the glacial valleys and cirques cut by the plucking action of ice and moraines. Stream-cut valleys are V-shaped in cross section, with narrow bottoms and convex sides that flatten upward. As glaciers flowed along these stream-cut valleys, they widened the bottoms and steepened the walls of the valleys to form U-shaped canyons like those of Lyell Canyon and along Tenaya Creek. Smaller glaciers in upland regions widened and deepened the basins in which they formed to produce cirque basins that filled with lakes after the glaciers disappeared. Ireland Lake is a fine example of a lake-filled cirque, or tarn. Where one cirque is enlarged and encroaches on another, a knife-edge ridge, called an arete, is formed such as the one that lies between Vogelsang and Hanging Basket Lakes.

Moraines are collections of rocky material carried in and deposited by glaciers. Most of the morainal material within the Tuolumne Meadows quadrangle was deposited at the bottoms of glaciers as ground moraine, along their sides as lateral moraines, and within glaciers as medial moraines. Medial moraines lie within glaciers and extend downstream from the juncture of coalescing glaciers or from a rocky protuberance that supplies rock debris. Lateral and medial moraines are ridge-like, whereas bottom moraine is hummocky and marked by pits that formed where chunks of ice were left behind as the glacier wasted away. A fine display of lateral moraines can be seen on Moraine Flat northeast of Tuolumne Meadows; their crests are indicated on the map. Ground moraine is well displayed at Dana Meadows, near the east edge of the quadrangle southeast of Tioga Road.

Text from source map: Tuolumne Meadows 15' Quadrangle

Granite Domes

A magnificent display of granite domes is present between Tenaya Lake and Tuolumne Meadows-Pywiack Dome, Polly Dome, Medlicott Dome, Fairview Dome, and many others. Domes are

formed by exfoliation-the splitting off of rock slabs along curved surfaces that dip in the direction of the surface in which they occur, but a little less steeply. Thus sharp edges are gradually rounded off. If carried on long enough, exfoliation leads to rounded mound like forms that are covered with rock slabs. Exfoliation is caused by the release of pressure on the rocks because of erosion and is aided by the freezing and thawing of water that has seeped into minute cracks.

Although the domes of Yosemite are the best known in the Sierra Nevada because of their sparsely vegetated stark beauty, domes are also present in lower parts of the range, where they generally draw little attention because they are covered by forest or are in lowland areas. The formation of domes occurs only in massive rock and requires that steeply dipping joints are not open. Domes are absent along Tioga Road east of Tioga Pass where closely spaced, steeply dipping or vertical joints are present. The opening of the steeply dipping joints in this area probably results from the proximity to the eastern escarpment of the Sierra Nevada, which allows lateral movement toward the east and opening of the steep joints.

Text from source map: Tuolumne Meadows 15' Quadrangle

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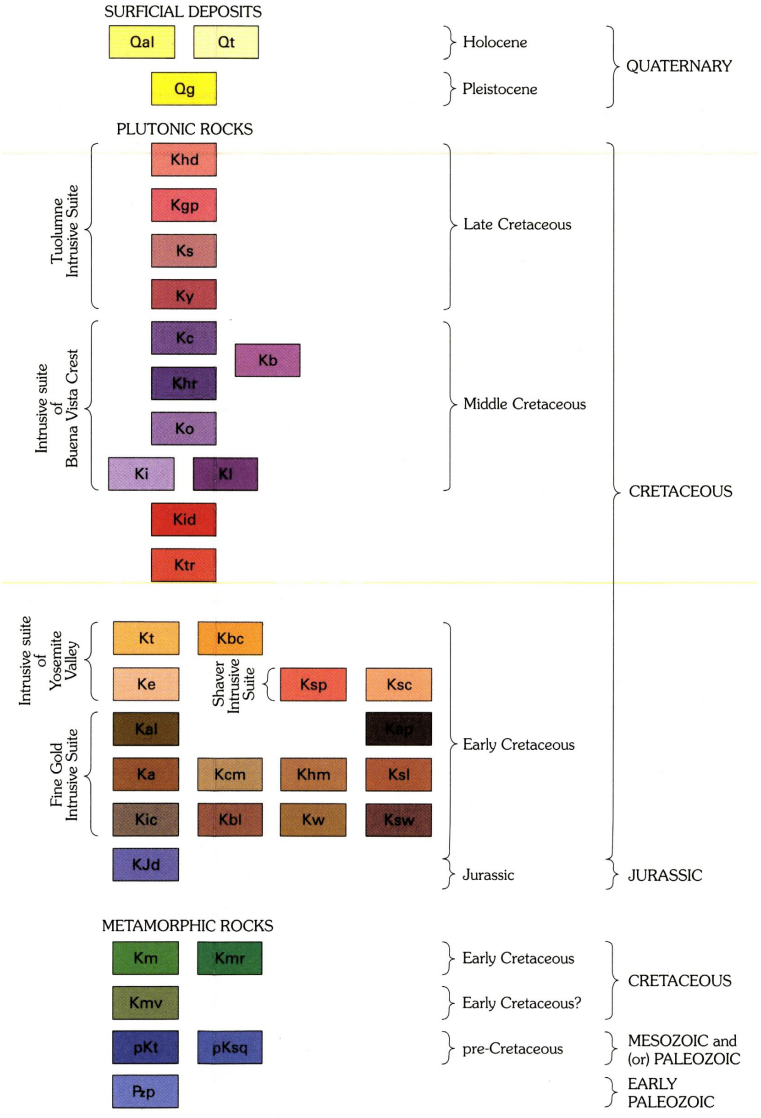
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Peck, Dallas L., 2002, Geologic Map of the Yosemite Quadrangle, Central Sierra Nevada, California: U. S. Geological Survey, Geologic Investigation Series Map I-2751, scale 1:62,500 (*GRI Source Map ID 864*).

Prominent graphics and text associated with this source.

Correlation of Map Units



Graphic from source map: Yosemite 15' Quadrangle

Map Legend



Approximate contact—Dashed where gradational or inferred. y, younger rock; o, older rock

Strike and dip of beds of metasedimentary rocks



Inclined

Vertical

Variable strike

Strike and dip of foliation in plutonic and metavolcanic rocks



Inclined



Variable strike

Vertical

Variable strike



Horizontal

No apparent foliation

Strike and dip of cataclastic foliation



Inclined



Variable strike

Vertical

Variable strike

Bearing and plunge of lineation

Strike and dip of dikes



Inclined felsic dike

Vertical felsic dike

Variable strike



Inclined mafic dike

Vertical mafic dike

Dike swarm—Shown diagrammatically



Inclined

Vertical



Zone of abundant inclusions in plutonic rock



Zone of pervasive shearing

Crest of a moraine

Graphic from source map: Yosemite 15' Quadrangle

Geologic Summary

The Yosemite 15-minute quadrangle is located on the western slope of the central Sierra Nevada, California. Most of the quadrangle is within Yosemite National Park, but part of the western margin and the southeastern corner are in the Sierra National Forest. The renowned Yosemite Valley and Merced River Gorge occupy the northern quarter of the quadrangle. The Wawona Road, the El Portal Road, the Big Oak Flat Road, and the Glacier Point Road provide ready access to the northern and

western parts of the area, but much of the eastern part is accessible only by foot or horseback. The area is drained by the Merced River, the South Fork of the Merced River, and their tributaries, and ranges in altitude from about 2500 ft in the canyon bottoms near the western edge of the quadrangle to above 9700 ft on Buena Vista Peak, near the eastern edge. Over much of the area bedrock geologic contacts are obscured by deep soil, slopewash, and glacial deposits, and by dense vegetation that changes from chaparral at lower elevations to pine and fir forests at higher elevations.

The quadrangle lies on the western edge of the Sierra Nevada batholith. The massive cliffs of Yosemite Valley and much of the quadrangle are underlain by Cretaceous plutonic rocks ranging in composition from quartz diorite to granite and in age from about 120 million years ago (Ma) to 88 Ma. Small masses of dioritic rocks of Cretaceous or Jurassic age are scattered across the quadrangle, and poorly dated metasedimentary and metavolcanic rocks of Paleozoic and Mesozoic age occupy the southwestern edge of the quadrangle and occur sparsely as screens and inclusions in the plutonic rocks.

The glacial and bedrock geology of Yosemite Valley in the northern part of the quadrangle and in an area to the north and east stretching to the crest of the Sierra Nevada was mapped in the classic study of Matthes and Calkins (Matthes, 1930; Calkins, 1930, 1985). The present study was conducted as part of a U.S. Geological Survey program led by Paul C. Bateman to map the geology of a section across the Sierra Nevada between latitudes 37° and 38° N. I mapped the Yosemite quadrangle primarily in 1967, 1974. and 1975. Additional short periods of time were devoted to the project between 1977 and 1997 when I was involved in management in the U.S. Geological Survey and later during retirement. Modal, chemical, and isotopic data for plutonic rocks from the quadrangle are presented in an accompanying report (Peck, 2001).

Text from source map: Yosemite 15' Quadrangle

Metamorphic Rocks

Sedimentary and volcanic rocks modified to metamorphic rocks by high pressures and temperatures were once above the granitic rocks of this quadrangle, but have largely been removed by erosion. They now underlie only the southwestern edge of the quadrangle and are found as small inclusions in the granitic rocks and as walls or screens between plutons here and there across the area. These metamorphic rocks range in age from early Paleozoic to Early Cretaceous. As summarized by Bateman (1992a), the metamorphic rocks were subjected to repeated deformations and episodic intrusions, mostly during the Jurassic and Cretaceous. Much of the metamorphism was regional, the result of elevated thermal gradients associated with the intrusions.

Metasedimentary rocks, including prominent massive beds of light-gray quartzite, are exposed along the western edge of the quadrangle southward from the South Fork of the Merced River, and can be seen in road cuts about 3 km northwest of Wawona. These rocks were previously assigned to the Calaveras Formation, but work by Schweickert (1981) and Bateman and others (1985) west of the Yosemite quadrangle has shown that the Calaveras is composed of several separate units of different ages. The easternmost unit, informally called the quartzite of Pilot Ridge (Pz p) and mapped in this quadrangle, has been tentatively correlated with the early Paleozoic Shoo Fly Complex of Schweickert (1981) of the northern Sierra Nevada on the basis of geologic mapping and isotopic U-Pb ages (275±10, 330±10, and 440±15 Ma) from orthogneiss derived from igneous rocks intruded into the complex (Sharp and others, 1982). The quartzite of Pilot Ridge consists partly of metaquartzite and quartz mica schist derived from quartz sandstone and siltstone, which are well exposed on Iron Mountain and Devil Peak in the southwestern part of the quadrangle, and partly of phyllite and argillite, which can be observed along the South Fork of the Merced River. Strongly dipping original sedimentary layering is prominent in some rocks, and a northwest-striking linear trend believed to reflect an original stratigraphic horizon is visible

on aerial photographs and is shown on the geologic map.

Pre-Cretaceous metasedimentary rocks are exposed in three localities near the southeastern corner of the quadrangle and in small remnants scattered across the area from Sentinel Dome south. These are predominantly biotite schist and metaquartzite (pKsq), but east of Iron Creek they include a layer of tactite (pKt) that is mapped separately. The rocks may well include remnants of both the early Paleozoic quartzite of Pilot Ridge and the Kings Plutonic rocks underlie most of the Yosemite quadrangle. The rocks range from diorite and gabbro to granite porphyry, but are predominantly light-colored sequence of Jurassic and (or) Early Triassic age (Bateman, 1992a).

Metavolcanic rocks (Kmv) occur in small discontinuous masses farther north near Deer Camp and Badger Pass and also form a belt extending southeast from Mariposa Grove. They are predominantly hornfels and schist derived from rhyodacite tuff that contain flattened lapilli and phenocrysts of plagioclase, quartz, and altered hornblende. The rocks are similar lithologically to metavolcanic rocks of Early Cretaceous age farther east in the Merced Peak quadrangle and are tentatively correlated with them.

Slightly metamorphosed andesite and rhyodacite (Km) crop out on the flanks of Raymond Mountain. The meta-andesite occurs in well-jointed lava flows exposed in a small mass on the eastern slope of Raymond Mountain. Metarhyodacite tuff crops out on the ridge west of Raymond Mountain, and is similar in composition to a metarhyodacite porphyry dike (Km r) near the Star Mine on Raymond Mountain. The meta-andesite flows and metarhyodacite tuff presumedly are derived from an extrusive center on Raymond Mountain associated with the granite porphyry of Star Lakes (Ks1). The metarhyodacite porphyry dike and the granite porphyry of Star Lakes have been dated at 108 Ma by using the whole rock rubidium-strontium method (R.W. Kistler, written commun., 1999).

Text from source map: Yosemite 15' Quadrangle

Plutonic Rocks

Plutonic Rocks underlie most of the Yosemite quadrangle. The rocks range from diorite and gabbro to granite porphyry, but are predominantly light-colored granodiorite, tonalite, and granite. Their compositional names reflect their mineral content, following the classification of Streckeisen and others (1973). Granite has subequal proportions of quartz. plagioclase feldspar, and potassium feldspar (orthoclase and microcline); in granodiorite, plagioclase feldspar predominates over potassium feldspar; and the series tonalite, quartz diorite, and diorite has less than 10 percent potassium feldspar and decreasingly abundant quartz. The plutonic rocks have been separated into 28 mapped units, each of which has a distinct appearance because of its mineral composition and texture. The oldest plutonic unit, diorite, is Jurassic or Cretaceous in age. All the other plutonic rocks are Cretaceous, ranging in age from Early to Late Cretaceous, from about 120 to about 88 Ma. Most of the plutonic rocks occur in suites of related units that show a certain family resemblance, again based on composition and texture. In most suites the individual plutons were intruded within a few million years of each other. Typically an intrusive suite ranges from an outer, darker, older unit through units intermediate in age and composition, to a younger more silicic unit at the center. The Tuolumne Intrusive Suite as mapped by Calkins (1930) is a classic example. The inner part consists of a core of Johnson Granite Porphyry flanked by Cathedral Peak Granodiorite, both exposed near Tuolumne Meadows, northeast of the Yosemite quadrangle. These are surrounded by a mass of Half Dome Granodiorite (K hd) and an outer margin formed by the granodiorites of Kuria Crest and Glacier Point (Kg p) and the tonalite of Glen Aulin. The suite was later expanded (Kistler, 1996) to include two western units, the Sentinel Granodiorite (Ks) and the granodiorite of Yosemite Creek (Ky).

Each suite was intruded as successive masses of hot viscous mush, beginning with the outer

unit. The surrounding and overlying country rocks probably were largely pushed outward and upward. Most of the plutons were emplaced at depths of 3 to 6 miles; these depths were estimated from the composition of the rocks and their component minerals. The youngest units of some suites, however, were apparently intruded at shallower depths or possibly fed volcanic eruptions, judging from the fine-grained texture of the rocks, the presence of small angular cavities (miarolitic cavities) formed from gas evolved from the magma, and the widespread potassic alteration. Examples of such shallow intrusives include the granite of Shellenbarger Lake near Mount Ritter in the Devils Postpile quadrangle; the leucogranite porphyries of Red Peak and Post Peak in the Merced Peak quadrangle; and the granite of Hogan Mountain (Khm), the granite porphyry of Star Lakes (Ksl), and the granodiorite of Turner Ridge (Ktr) in the Yosemite quadrangle. These shallow intrusives and related metavolcanic rocks are exposed in a northeast-trending belt that crosses the Sierra Nevada from Hogan Mountain to the Ritter Range.

The relative age of different plutonic units can by determined at a few localities by crosscutting relations, such as dikes of one unit cutting another unit, foliation in one unit cutting that in another along a contact, or one unit containing inclusions of another. Approximate ages for a number of plutonic units have been determined in the Yosemite quadrangle and in adjacent quadrangles by isotopic analyses of mineral separates and whole rocks. The plutonic rocks are described below, from oldest to youngest.

Text from source map: Yosemite 15' Quadrangle

Diorite

Quartz diorite and less abundant diorite, gabbro, and tonalite (KJd) form small masses, mostly in the central and northern parts of the quadrangle. The dioritic masses are intruded by all the surrounding granitic rocks. The dioritic masses have not been dated, but probably are Early Cretaceous or Jurassic in age. Some are cut by younger dioritic rocks similar in composition, and presumably in age, to the dikes of intrusive diorite (Kid) on the northern wall of Yosemite Valley.

Text from source map: Yosemite 15' Quadrangle

Fine Gold Intrusive Suite

The Fine Gold Intrusive Suite, which covers a broad area along the western margin of the central Sierra Nevada batholith, is the oldest intrusive suite in the quadrangle. It includes a number of units: the Bass Lake Tonalite (Kbi) and two similar units near Wawona, the granodiorite of Wawona (Kw) and the tonalite of South Wawona (Ksw); the granodiorite of Arch Rock (Ka) and several similar plutons, the granite of Hogan Mountain (Khm) and the granodiorite of Chowchilla Mountain (Kcm); two small masses of aplite (Kap) and alaskite (Kai); and the granite porphyry of Star Lakes (Ksl) and closely associated granodiorite of Iron Creek (Kic). These units are intruded by El Capitan Granite (Ke), and are dated isotopically as Early Cretaceous.

The Bass Lake Tonalite (Kbi) underlies much of the quadrangle west of a line extending from the northwestern corner to the southern boundary near Wawona Point. Calkins (1930) mapped this unit as the granodiorite of the Gateway. Later Calkins (1985) and Huber and others (1989) called it the tonalite of the Gateway. It was subsequently shown to be part of a large pluton that extends from north of lat 38° to south of lat 37°, and named the Bass Lake Tonalite (Bateman, 1992a). In the Yosemite quadrangle, the unit consists mostly of well-foliated tonalite and calcic granodiorite containing abundant mafic inclusions (dark masses composed largely of mafic minerals). The texture, composition of the rocks, and the relative abundance of biotite and hornblende vary systematically across the area. For example, the area north of Henness Ridge is underlain predominantly by biotite granodiorite, but the area along Strawberry

Creek is underlain by hornblende quartz diorite. More detailed mapping may show these to be separate plutons. Near Wawona a mass of light-colored biotite-hornblende granodiorite has been mapped separately as the granodiorite of Wawona (Kw), and a 1000-ft-wide band of distinctive hornblende biotite tonalite has been mapped as the tonalite of South Wawona (Ksw). The Bass Lake Tonalite is cut by dikes of El Capitan Granite near Arch Rock and near Wawona. Uranium-lead (U-Pb) ages of the Bass Lake Tonalite from the Yosemite and other quadrangles are summarized by Bateman (1992a) and range from 124 to 105 Ma. A sample from Henness Ridge yielded an age of 117 Ma.

The Bass Lake Tonalite is intruded by several small bodies of biotite granite and biotite granodiorite that make up some of the latest phases of the Fine Gold Intrusive Suite. The granodiorite of Arch Rock (Ka) forms a small pluton that is well exposed near the Arch Rock Entrance Station to Yosemite Valley. The pluton is mostly biotite granodiorite, but the margin is more mafic, consisting of calcic granodiorite similar to Bass Lake Tonalite and containing hornblende and titanite in addition to biotite. Three other small plutons described below are near the southwestern corner of the quadrangle. The granodiorite of Chowchilla Mountain (Kcm) is a seriate-textured granodiorite similar in appearance to the granite of Arch Rock but more sodic in composition. Dikes of the granodiorite of Chowchilla Mountain clearly cut the Bass Lake Tonalite. The granite of Hogan Mountain (Khm), which extends northward into the quadrangle from Hogan Mountain and also underlies Mount Savage, forms small leucocratic granite plutons and also dikes that cut the Bass Lake Tonalite. Other late phases of the Fine Gold Intrusive Suite are a body of alaskite (Kai) at the southwestern corner of the quadrangle and an aplite dike (Kap) near Star Lakes.

The granite porphyry of Star Lakes (Ksl) and the granodiorite of Iron Creek (Kic) underlie the southeastern corner of the quadrangle. These plutonic rocks, the metarhyodacite porphyry dike (Km r) near the top of Raymond Mountain, and the metavolcanic flows and tuff (Km) on the flanks of the mountain, may have evolved from the same body of magma. Twelve samples of the granite porphyry of Star Lakes and the metarhyodacite porphyry dike of Raymond Mountain have been dated at 108 Ma by using the whole rock rubidium-strontium method (R.W. Kistler, written commun., 1999). The granite porphyry of Star Lakes crops out both on Raymond Mountain and along the bluffs on the northern side of the South Fork of the Merced River, suggesting that the granite porphyry was split into two by a prong of the younger El Capitan Granite. The granite porphyry appears to grade eastward into the granodiorite of Iron Creek (Kic), a granodiorite similar in appearance to the Bass Lake Tonalite. Using the whole rock rubidium-strontium method on four samples, R.W. Kistler (written commun., 1999) dated the granodiorite of Iron Creek at 110 Ma. The granodiorite of Iron Creek extends south to White Chief Mountain in the adjacent Bass Lake quadrangle, and is separated from the Bass Lake Tonalite by a screen of metasedimentary and metavolcanic rocks.

Text from source map: Yosemite 15' Quadrangle

Intrusive Suite of Yosemite Valley

The intrusive suite of Yosemite Valley consists of the El Capitan Granite (Ke), the Taft Granite (Kt), the granite of Big Creek (Kbc), and several units (the granite of Rancheria Mountain and the leucogranite of Ten Lakes) that are exposed north of the quadrangle. The El Capitan Granite (Ke) forms a large pluton that extends from the northwestern boundary of the quadrangle to the southern and eastern boundaries. The pluton contains equally abundant granite and granodiorite, and the average composition of 137 samples is sodic granodiorite close to the classification boundary. The suite is intermediate in age between the Fine Gold Intrusive Suite and the intrusive suite of Buena Vista Crest, as shown by intrusive relations and by a concordant uranium-lead age of 103 Ma. The El Capitan Granite forms bold, coarsely jointed rock masses, including much of El Capitan. Subordinate fine-grained phases are locally present along the Big Oak Flat Road and near Chinquapin. As mapped by Calkins, the El Capitan Granite contains inclusions of Bass Lake Tonalite near the Arch Rock Entrance Station, and, near

Wawona, forms dikes that intrude the Bass Lake Tonalite. The eastern part of the pluton is widely disrupted by units of the intrusive suite of Buena Vista Crest and the Tuolumne Intrusive Suite, and the unit is cut by dikes of intrusive quartz diorite (Kid) on El Capitan.

The center of the El Capitan Granite pluton was intruded by masses and dikes of Taft Granite (Kt), which is similar in appearance to the El Capitan Granite but finer grained. Typically the Taft is light-colored leucogranite. However, near the margins of the bodies are darker, more mafic phases including biotite granodiorite and biotite tonalite. Along Big Creek, near the southern margin of the quadrangle, biotite granite and leucogranite (Kbc) form a small pluton that is perhaps correlative with the Taft Granite.

Text from source map: Yosemite 15' Quadrangle

Shaver Intrusive Suite

Exposed near the southeastern corner of the quadrangle is a small mass of the granite of Shuteye Peak (Ksp). The mass is an extension of a large pluton of the granite of Shuteye Peak, a unit of the Shaver Intrusive Suite, but is separated by a screen of metavolcanic rocks and by the younger granodiorite of Illilouette Creek (Ki). The granite is similar in appearance to the El Capitan Granite, but the composition is less calcic, and the potassium feldspar phenocrysts are smaller and more tabular in form. A concordant uranium-lead age of 102 Ma from a sample from the Shaver Lake quadrangle indicates that it is about the same age as the El Capitan Granite. A body of similar porphyritic biotite granite and leucogranite (Ksc) in the southwestern corner of the Yosemite quadrangle near Stovepipe Campground is tentatively correlated with the granite of Shuteye Peak.

Text from source map: Yosemite 15' Quadrangle

Granodiorite of Turner Ridge

The granodiorite of Turner Ridge (Ktr) forms a small piton on the ridge south of Bridalveil Creek Campground and also crops out as north-northwest-trending dikes cutting El Capitan Granite and Taft Granite that extend discontinuously from Turner Ridge to the South Fork of the Merced River. The unit consists of distinctive porphyritic granodiorite and tonalite containing abundant phenocrysts of quartz and feldspar. On the unnamed ridge between Turner Ridge and Turner Meadow the dikes appear to be gradational with El Capitan Granite but contain angular inclusions of the granite. Farther south, samples taken from thin dikes of the granodiorite have a fragmental appearance under the microscope, and contain broken tablets of plagioclase in a fine- to very fine grained groundmass. The granodiorite of Turner Ridge apparently intruded the solidified El Capitan and Taft plutons through brittle fractures at fairly shallow depth in the southern part of the quadrangle, and may have fed pyroclastic (ash) eruptions at the surface. The granodiorite is similar in composition, texture, and relative age to the granodiorite of Grizzly Creek exposed in the Merced Peak quadrangle and the Shuteye Peak quadrangle farther south.

Text from source map: Yosemite 15' Quadrangle

Intrusive Quartz Diorite

Dark-colored dikes that form the "Map of North America" on the face of El Capitan, described in many guidebooks such as Huber (1987), and other dikes in El Capitan Granite and Taft Granite on the northern wall of Yosemite Valley, are mapped as "intrusive quartz diorite" (Kid). Similar rocks form intrusive phases in diorite bodies south of the valley but were not mapped separately.

Text from source map: Yosemite 15' Quadrangle

Intrusive Suite of Buena Vista Crest

The intrusive suite of Buena Vista Crest is a nested sequence of plutons of Middle Cretaceous age that extend 30 km south from Yosemite Valley to the southeastern boundary of Yosemite National Park. The suite consists of six units that range from the granodiorite of Illilouette Creek (Ki), the Leaning Tower Granite (Kl), and the granodiorite of Ostrander Lake (Ko) at the margins of the suite to the finer grained biotite granodiorites of Chilnualna Lakes (Kc) and Horse Ridge (Khr) at the core of the suite near Buena Vista Peak, and the Bridalveil Granodiorite (Kb). The suite clearly intrudes El Capitan Granite and Taft Granite near the Bridalveil Creek Campground, but is, in turn, intruded by dikes of Sentinel Granodiorite (Ks) on Horizon Ridge. Farther east in the Merced Peak quadrangle, in the headwaters of the South Fork of the Merced River, the granodiorite of Illilouette Creek is intruded by the granodiorite of Jackass Lakes; however, that granodiorite is, in turn, intruded by the granodiorite of Ostrander Lake near Merced Peak. Thus the suite is both older and younger than the granodiorite of Jackass Lakes, which has yielded ages of 98 Ma by uranium-lead dating of zircons and 95 Ma by potassium-argon dating of hornblende. Two analyses of a sample from the granodiorite of Ostrander Lake from near Ostrander Lake yielded ages of 107 and 112 Ma. Both ages are probably too old, perhaps because the sample contains older relict zircons derived from the locally abundant dioritic inclusions.

The granodiorite of Illilouette Creek (Ki) occurs in two masses that form the northern and southern margins of the main body of the suite. On the southern side of Horse Ridge the southern mass is deformed by a broad shear zone trending westward from the Merced Peak quadrangle. Between Johnson Lake and Minnow Lake several different west-trending sharp discontinuities separate darker granodiorite on the south from lighter colored granodiorite on the north. It is not clear which discontinuity represents the contact between the granodiorite of Illilouette Creek (Ki) and the granodiorite of Ostrander Lake (Ko), and the one shown on the map was chosen arbitrarily.

The Leaning Tower Granite (Kl) was mapped by Calkins (1930, 1985) on the walls of Yosemite Valley. It forms a small intrusive body composing much of Leaning Tower, as well as dikes near Taft Point and Fireplace Bluffs. The Leaning Tower Granite is similar in age, texture, and composition to the granodiorite of Illilouette Creek, suggesting that the two may well be correlative.

The granodiorite of Ostrander Lake (Ko) forms much of the core of the intrusive suite of Buena Vista Crest, extending from the upper drainage basin of Bridalveil Creek eastward past the quadrangle boundary to the headwaters of the South Fork of the Merced River. It is predominantly granodiorite, but the center of the body along Horse Ridge is composed of biotite granite and porphyritic biotite granodiorite that contains poikilitic tablets of potassium feldspar. The southern and western parts of the body are composed of mafic granodiorite and tonalite.

Three fine-grained granodiorites form the younger units of the intrusive suite of Buena Vista Crest—the Bridalveil Granodiorite (Kb) and the granodiorites of Horse Ridge (Khr) and Chilnualna Lakes (Kc). The latter two form the core of the suite, and the Bridalveil Granodiorite forms small stocks, sheets, and dikes farther north. The granodiorite of Chilnualna Lakes is surrounded by and intrudes the granodiorite of Horse Ridge. The Bridalveil Granodiorite (Bridalveil Granite of Calkins, 1930) is well exposed on the southern wall of Yosemite Valley, forming the lip of Bridalveil Fall and prominent gently dipping sheets in the Cathedral Rocks. The Bridalveil Granodiorite (Kb) cuts all the other units in the lower valley walls and is presumed to be roughly equivalent to both the granodiorite of Chilnualna Lakes (Kc) and the granodiorite of Horse Ridge (Kh r) because of its similarity in appearance and composition to them.

Text from source map: Yosemite 15' Quadrangle

Tuolumne Intrusive Suite

The Tuolumne Intrusive Suite consists of two large masses—a younger nested sequence of granitic intrusives centered on Tuolumne Meadows and an older, western mass in the Hetch Hetchy Reservoir quadrangle that extends from near Mount Hoffman to the upper reaches of the Hetch Hetchy Reservoir. Units of the Tuolumne Intrusive Suite intrude all the surrounding granitic and metamorphic rocks, including units of the intrusive suites of Yosemite Valley and Buena Vista Crest in this quadrangle and the intrusive suites of Merced Peak and Washburn Lake in the adjoining Merced Peak quadrangle to the east.

The eastern mass ranges from Johnson Granite Porphyry at the core near Tuolumne Meadows through Cathedral Peak Granite and Half Dome Granodiorite (Khd) to mafic granodiorite and tonalite at the margins, including the granodiorite of Glacier Point. Granitic rocks of the suite form the massive walls of upper Yosemite Valley, including Half Dome, Glacier Point, Sentinel Rock, and Sentinel Dome. The eastern mass is separated from the western mass largely by a screen of metamorphic rocks and older plutonic rocks including El Capitan Granite. The western mass consists of two units—the Sentinel Granodiorite (Ks) (as used in a restricted sense as discussed below) and the granodiorite of Yosemite Creek (Ky). Isotopic ages based on uranium-lead and potassium-argon analyses of whole rock and mineral samples from the suite range from 94 Ma for a sample of Sentinel Granodiorite (Ks) from the Hetch Hetchy Reservoir quadrangle to 81 Ma for a sample of Johnson Granite Porphyry from near Tuolumne Meadows.

Calkins (1930) mapped two major units in the Yosemite quadrangle, the Sentinel Granodiorite and the Half Dome Quartz Monzonite. Because of the change in terminology for granitic rocks, the Half Dome Quartz Monzonite is now referred to as the Half Dome Granodiorite (Calkins, 1985). As a result of detailed mapping and sampling within the Yosemite and adjacent quadrangles, the Sentinel Granodiorite has been subdivided into three units: the Sentinel Granodiorite (as used in a more restrictive sense)), the granodiorite of Glacier Point, and the granodiorite of Yosemite Creek. Calkins (1930) described two phases of Sentinel Granodiorite: a light-colored western phase and a darker, streaky eastern phase, but they were not differentiated on his maps (Calkins, 1930, 1985). Mapping by Kistler (1973) in the Hetch Hetchy Reservoir quadrangle and by the author for this study indicates that these two phases comprise three separate units of the Tuolumne Intrusive Suite.

In this study, the Sentinel Granodiorite applies only to Calkins' western type, which forms Sentinel Rock. As such, the Sentinel Granodiorite is predominantly a light-colored granodiorite that contains discrete subhedral crystals of hornblende, biotite, and titanite. Some individual samples are similar to samples of Half Dome Granodiorite but the mafic minerals are less well formed. The Sentinel Granodiorite includes abundant inclusions of El Capitan Granite (Ke) and Taft Granite (Kt); near the contacts with these units, the Sentinel Granodiorite is more mafic and foliated. On Horizon Ridge, abundant, steeply dipping dikes of the Sentinel Granodiorite cut the granodiorite of Ostrander Lake (Ko); these are shown diagrammatically on the geologic map. A sample of the Sentinel Granodiorite from the upper basin of Yosemite Creek in the Hetch Hetchy Reservoir quadrangle has been dated at 94 Ma by using uranium-lead dating of titanite and potassium-argon dating of biotite and hornblende.

Near Mono Meadows the Sentinel Granodiorite intrudes a thin sliver of strongly foliated granodiorite containing abundant parallel phenocrysts of plagioclase. This latter unit is correlated with the granodiorite of Yosemite Creek (Ky), which forms the northern part of the western mass of the Tuolumne Intrusive Suite in the Hetch Hetchy Reservoir quadrangle north of Yosemite Valley. The granodiorite of Yosemite Creek has not been dated isotopically, but geologic relations in both the Yosemite and Hetch Hetchy Reservoir quadrangles show that it is older than the Sentinel Granodiorite.

Calkins' eastern phase of the Sentinel Granodiorite underlies Glacier Point, Illilouette Ridge, and

the unnamed ridge southeast of Mono Meadows, and in this report is called the granodiorite of Glacier Point. It forms the western margin of the eastern mass of the Tuolumne Intrusive Suite. The granodiorite of Glacier Point is darker colored than the Sentinel Granodiorite to the west, has more abundant and more anhedral mafic minerals, and contains more abundant dark inclusions that typically define a foliation. Samples range from calcic granodiorite to tonalite and quartz diorite and average very calcic granodiorite. Like the Sentinel Granodiorite, the granodiorite of Glacier Point contains abundant inclusions of El Capitan Granite and forms dikes that intrude El Capitan Granite. In individual exposures, however, the apparent relation between the two units can be misleading because the hot magmas of the granodiorite of Glacier Point partially melted the more silicic El Capitan Granite. A sample of the granodiorite of Glacier Point from Washburn Point has been dated at 92 Ma by using potassium-argon and rubidium-strontium isotopic techniques (Kistler and Dodge, 1966; R.W. Kistler, written commun., 1999). The granodiorite of Glacier Point appears to be approximately equivalent to the granodiorite of Kuna Crest and the tonalite of Glen Aulin in the Tuolumne Meadows quadrangle, and is shown as such by Huber and others (1989) and Bateman (1992b).

Along the eastern slope of Illilouette Ridge the dark-colored granodiorite of Glacier Point overlies the lighter colored Half Dome Granodiorite (Khd) along a contact that slopes steeply downward to the west. The sloping contact between the two units can be clearly seen from the meadow north of Curry Village.

The Half Dome Granodiorite is a very light colored, massive granitic rock that crops out in the northwestern corner of the quadrangle and constitutes the southwestern part of a large pluton that extends more than 25 km to the northeast. About one half of the samples from the Yosemite quadrangle that were studied are sodic granodiorite and one half granite. Mafic inclusions are sparse, and much of the rock is unfoliated. Abundant aplite dikes and sheets constitute a late phase of the body. Detailed studies of the Tuolumne Intrusive Suite by Bateman and Chappell (1979) and isotopic studies by Kistler and others (1986) indicate the Half Dome Granodiorite was intruded in several different pulses. On the basis of isotopic studies of samples collected in the Hoffman Creek basin north of Yosemite Valley, the age of the outer portion of the Half Dome Granodiorite exposed in this quadrangle is about 88 Ma. Dikes of the Half Dome Granodiorite intrude the older granodiorite below Glacier Point and behind the Church Bowl on the northern side of Yosemite Valley.

Text from source map: Yosemite 15' Quadrangle

Surficial Deposits

Sand, silt, and gravel deposited in geologically recent times by streams underlie the floor of Yosemite Valley, and coarse talus litters the base of the cliffs. Some of the higher parts of the quadrangle are blanketed by Pleistocene glacial deposits. These young surficial deposits formed in response to topographic uplift of the Sierra Nevada crest, erosion by both streams and glaciers, and deposition of detrital material. The development of the landscape was not the focus of this investigation, but has been studied and described by Matthes (1930) and Huber (1987).

The emplacement of the last phase of the granitic intrusives about 80 Ma was accompanied and followed by uplift and erosion of the area. The overlying metamorphic and volcanic rocks were largely eroded and reduced to sediments, and the resulting material was transported to the west, where it was deposited in the area of the present Great Valley. As a result the upper parts of the plutons were exposed. By Eocene time the area had been eroded to low relief. During the middle and late Cenozoic, topographic uplift of the Sierra crest and western tilting of the Yosemite region led to down cutting by western flowing streams such as the Merced River, forming deep canyons.

During the Pleistocene ice ages, beginning more than one million years ago, the area was subject to repeated glaciation. In the Yosemite quadrangle there is evidence for three glacial epochs, although there may have been more. The extent of glacial deposits was mapped in this study, and the crests of moraines shown by dotted lines.

The glacial moraines of different stages were not mapped separately, but they were mapped by Clyde Wahrhaftig (in Huber and others, 1989). During the early El Portal stage of Matthes (1930), considered to be equivalent to the Sherwin glaciation as defined on the eastern side of the Sierra, a glacier filled what is now Yosemite Valley and extended down the Merced River canyon to near El Portal. Glacial deposits of this stage are not exposed in Yosemite Valley, but Wahrhaftig has correlated the large subdued glacial deposit immediately east of Wawona on the South Fork of the Merced River with this stage. The Tahoe, a glacial stage about 130,000 years old, is well represented by moraine deposits on the eastern side of the Sierra Nevada crest but not in Yosemite Valley. However deposits of this stage, which are more deeply weathered than the later Tioga-stage deposits, are represented in the Yosemite quadrangle by moraines below Ostrander Lake and on the northeastern flank of Horizon Ridge, and also by moraines flanking the South Fork of the Merced River.

During the latest major glaciation, correlated with the Tioga stage of the eastern Sierra Nevada, a glacier extended down Yosemite Valley as far as the meadow below Bridalveil Fall; moraines are exposed at the head of the meadow and below Cathedral Rocks. The glacier did not completely fill the valley, but as reconstructed by Matthes (1930), its upper surface was only 1,500 feet above the current valley floor at Washington Column, at the head of the valley. As the glacier retreated, a lake was formed. Named Lake Yosemite by Matthes (1930), it was later filled with sand and silt, and forms the flat floor of the upper part of Yosemite Valley. Deposits of the Tahoe and Tioga stages are well represented along Illilouette Creek a short distance east of the Yosemite quadrangle.

Rock falls from the towering cliffs formed talus deposits flanking the valley walls both before and after the latest glaciation. One massive fall blocked Tenaya Creek, forming Mirror Lake. The rock falls continue, some triggered by earthquakes, rainstorms, snowmelt, and freeze-thaw effects, and others without a recognized triggering event (Wieczorek and others, 2000).

Text from source map: Yosemite 15' Quadrangle

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