SACRAMENTO VALLEY

CENOZOIC — QUATERNARY

Holocene

Q — Qa, Qb

Qa—NATURAL LEVEE AND CHANNEL DEPOSITS
Deposits of active stream channels and their natural levees as well as adjacent broad alluvial fans.

Qb—BASIN DEPOSITS
Fine-grained deposits of silt and clay in flood basins between modern water courses. (Locally includes marsh deposits.)

ALLUVIUM
Poorly sorted stream and basin deposits; clay to boulder size.(Also includes older channel deposits along the Feather River west of Oroville.)

t — DREDGE OR MINE TAILINGS

Qls — LANDSLIDE DEPOSITS
Shown where practicable; arrows indicate direction of movement.

Pleistocene

Qm — Qm—MODESTO FORMATION
(Youngest Pleistocene alluvial terraces and fans.)

Qr — Qr—RIVERBANK FORMATION
(Distinguished from Modesto by degree of soil formation and by its geomorphic position as terraces above the Modesto.)

MODESTO-RIVERBANK FORMATIONS
Alluvial deposits of gravel, sand, silt, and clay.

Qv — PLEISTOCENE VOLCANIC ROCKS
Qv^b—Olivine basalt flows.
(At Promontory Point, Cohasset quadrangle.)

CENOZOIC — TERTIARY

Pliocene

QPs — QPl

VOLCANIC SEDIMENTS OF SUTTER BUTTES
QPs—Volcanic fluviatile sediments and lahars derived from local sources at Sutter Buttes. [Rampart beds of Williams and Curtis (1977).]
QPl—Volcanic lake beds in center of Sutter Buttes.

QPv — QPv^a, QPv′, Major Pelean domes

VOLCANIC ROCKS OF SUTTER BUTTES
QPv′–Rhyolite and conspicuous white rhyodacite domes.
QPv^a–Hornblende-biotite andesite.

QPto — Pnt

TUFFS OF OROVILLE OF LINDGREN (1911)
Interbedded volcaniclastic deposits of gravel, sand, and tuff.
Pnt-NOMLAKI TUFF

Qrb — **RED BLUFF FORMATION**
Coarse red gravel; minor interbedded sand and silt. [Also includes overlying Ash of Mount Maidu in the Richardson Springs NW quadrangle (Harwood and others, 1981).]

Pl — **LAGUNA FORMATION**
Interbedded alluvial gravel, sand, and silt.

Ptu — Pnt — **TUSCAN FORMATION**
Interbedded lahars, volcanic conglomerate, volcanic sandstone, siltstone, and pumiceous tuff.
Pnt-NOMLAKI TUFF

Pv — PLIOCENE VOLCANIC ROCKS
Pv^b—Basalt. [Includes olivine basalt of Paradise and Cohasset Ridge (Harwood and others, 1981).]

Miocene

MPs — **SUTTER FORMATION**
Volcanic sediments of andesitic and rhyolitic composition at Sutter Buttes. Derived from Sierran volcanic deposits. Nonmarine. (Some thin lenses of ash near the base of the formation, equivalent to Oligocene-Miocene Valley Springs Formation.)

MPc — **MIOCENE-PLIOCENE CHANNEL DEPOSITS**
Interbedded fluvial conglomerates and sandstone. [Also includes New Era Formation of Creely (1965).]

Mlb — **LOVEJOY BASALT**
Black, fine-grained olivine basalt; highly fractured.

MPv — **MIOCENE-PLIOCENE VOLCANIC ROCKS**
MPv^{sp}—Andesite mudflow breccia; tuffaceous sandstone and conglomerate derived from andesitic sources. [Also includes Mehrten Formation and Reeds Creek Andesite of Clark and Anderson (1938).]

Oligocene

Eocene

Ec — **CAPAY FORMATION**
Buff sands and glauconitic shales at Sutter Buttes. Shallow marine. (Also includes overlying Ione Formation and Butte Gravels.)

El — **IONE FORMATION**
Quartzose sandstone, claystone, and conglomerate. Mostly nonmarine. [Also includes Wheatland Formation of Clark and Anderson (1938), along Dry Creek.]

CENOZOIC — MESOZOIC — CRETACEOUS

Ku — **UPPER CRETACEOUS ROCKS**
Shale and sandstone of the Forbes Formation and Kione Sand exposed at Sutter Buttes. Marine.

Kc — **CHICO FORMATION**
Sandstone, conglomerate, and siltstone. Marine.

MESOZOIC — JURASSIC

Jmc — **MONTE de ORO FORMATION**
Sandstone, conglomerate, slate, and siltstone; minor volcanic rocks. Marine. [Also includes part of Pentz Sandstone of Creely (1965).]

Jv — **JURASSIC VOLCANIC ROCKS**
Metamorphosed mafic to felsic pyroclastic rocks, flows, and volcaniclastic rocks; some meta-argillite and graywacke. [Also includes Oregon City Formation of Creely (1965) and Bloomer Hill Formation of Hietanen (1977).] (Probably correlative with Copper Hill Volcanics.)

SIERRAN FOOTHILLS

Q — **ALLUVIUM**
Undivided alluvial deposits of unconsolidated gravel, sand, and silt. Locally may include fan deposits, colluvium, and older alluvium.

t — DREDGE OR MINE TAILINGS

af — **ARTIFICIAL FILL**
(At Oroville Dam.)

Ql — **LAKE DEPOSITS**

Qls — **LANDSLIDE DEPOSITS**
Shown where practicable; arrows indicate direction of movement.

Qg — **GLACIAL DEPOSITS**
Undivided glacial till, moraine, and outwash deposits.

Qv — **PLEISTOCENE VOLCANIC ROCKS**
Qv^b–Olivine basalt flows. (At Bald Mountain, north of Allegheny.)

Pv — **PLIOCENE VOLCANIC ROCKS**
Pv^b—Basalt.
Pv^a—Andesite; primarily flows, sometimes platy.

MPv — **MIOCENE-PLIOCENE VOLCANIC ROCKS**
MPv^{sp}—Andesite mudflow breccia; tuffs, volcanic sediments, and conglomerate. Locally includes flows and intrusive rocks of andesitic composition. (Includes Mehrten, Bonta, and Penman Formations.)

Mlb — **LOVEJOY BASALT**
Black, fine-grained olivine basalt; highly fractured.

ϕMv — **OLIGOCENE-MIOCENE VOLCANIC ROCKS**
ϕMv′–Rhyolite, welded and non-welded tuffs; sandstone, siltstone, claystone, and conglomerate. (Includes Valley Springs and Delleker Formations).

Tg — **"AURIFEROUS GRAVEL"**
River channel deposits; pebbles, cobbles, and boulders of pre-Tertiary basement rock types, in places predominately quartzose gravels and sand. Mostly Eocene, but may include older and younger deposits.

CRETACEOUS-JURASSIC PLUTONIC ROCKS
- **KJgr** — GRANITE, GRANODIORITE
- **KJqd** — QUARTZ DIORITE, TONALITE, TRONDHJEMITE, QUARTZ MONZONITE
- **KJdi** — DIORITE
- **KJgb** — GABBRO

JURASSIC PLUTONIC ROCKS
- **Jgr** — GRANITE, GRANODIORITE
- **Jqd** — QUARTZ DIORITE, TRONDHJEMITE
- **Jdi** — DIORITE
- **Jgb** — GABBRO

CENTRAL BELT

PALEOZOIC AND MESOZOIC ROCKS

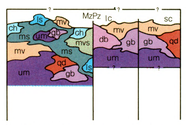
Jm — **MARIPOSA FORMATION**
Slate, sandstone, conglomerate, and sedimentary breccia. Marine.

Jlr — **LOGTOWN RIDGE FORMATION**
Metamorphosed mafic flows, breccias, pyroclastic, and volcaniclastic rocks.

A structurally complex assemblage of diverse rock types, Paleozoic and/or Mesozoic in age, and variably metamorphosed at low or medium grade. Tectonic and pseudostratigraphic relationships indicate this belt consists of ophiolitic melange [Horseshoe Bend Formation of Hietanen (1977)]; an extensive chert-argillite terrane [Clipper Gap formation of Edelman (1986)]; and volcanic-plutonic arc complexes [Slate Creek complex of Edelman (1986); Lake Combie complex of Tuminas (1983); Franklin Canyon Formation of Hietanen (1973).]

sc—SLATE CREEK COMPLEX-An Early Jurassic sequence of serpentinite-matrix melange, plutonic, and volcanic rocks.

lc—LAKE COMBIE COMPLEX-A pre-Late Jurassic (?) sequence of ultramafic tectonite, plutonic, volcanic and volcaniclastic rocks.



Lithologies of the belt are denoted as follows:

ms—metasedimentary rocks; argillite, phyllite, chert, conglomerate, and breccia; some quartzite and volcaniclastic rocks; includes argillite-matrix melange.

mv—metavolcanic rocks; mafic to felsic flows, tuffs, breccias, and volcaniclastic rocks.

mvs—volcaniclastic sediments; mixed metavolcanic and metasedimentary rocks.

ch— chert, bedded and massive; chert breccia.

ls— limestone and marble.

db—massive diabase, some dikes; locally includes diorite and gabbro.

qd—metadiorite, primarily quartz diorite, tonalite, and trondhjemite; locally includes diabase.

gb—gabbro; locally includes diorite and related rocks.

um—ultramafic rocks; peridotite, serpentinite and metaserpentinite; includes serpentinite-matrix melange and locally talc and chlorite schists.

Pzcc — ls, Pzcv — **CALAVERAS COMPLEX**
Chert, argillite, slate.
Pzcv—Metavolcanic and related hypabyssal rocks.
ls—crystalline limestone.

FEATHER RIVER PERIDOTITE BELT

PzMz — mv — **METAMORPHIC ROCKS OF UNKNOWN AGE**
Schistose metasedimentary and metavolcanic rocks; includes quartz, mica, and hornblende schists.
mv-blueschist bearing metavolcanic rocks.

Pza — **PALEOZOIC AMPHIBOLITE**
Metamorphosed igneous rocks; includes hornblendites, mafic schists, and quartzites of amphibolite grade.

Pzp — Pzgb — **PERIDOTITE OF MELONES FAULT ZONE**
Partially to completely serpentinized ultramafic rocks; locally includes talc schist and gabbro. (Includes Feather River peridotite; Pzgb-Gabbro.

Melones Fault Zone of Clark (1960)

SIERRA NEVADA

Q — **ALLUVIUM**
Undivided alluvial deposits of unconsolidated gravel, sand, and silt. Locally may include fan deposits, colluvium, and older alluvium.

Qf — **FAN DEPOSITS**
Gravel, sand, and silt.

Ql — **LAKE DEPOSITS**
(Also includes Mohawk Lake Beds.)

t — DREDGE OR MINE TAILINGS

Qv — Cinder cone or volcano — **PLEISTOCENE VOLCANIC ROCKS**
Qv^a—Olivine basalt and latite flows.
Qv^{cp}—Cinder cone deposits, scoria, and tuff.

Qg — **GLACIAL DEPOSITS**
Undivided glacial till, moraine, and outwash deposits.

Qls — **LANDSLIDE DEPOSTS**
Shown where practicable; arrows indicate direction of movement.

af — **ARTIFICIAL FILL**
(At Prosser Creek and Martis Creek Dams.)

Qt — **TERRACE DEPOSITS**
Locally may include fan deposits and colluvium.

Qos — **PLEISTOCENE NONMARINE SEDIMENTARY ROCKS**
Fluvial and lacustrine deposits of gravel, sand, silt, and clay.

Pv — Cinder cone or volcano — **PLIOCENE VOLCANIC ROCKS**
Pv^a—Andesite; primarily flows, sometimes platy.
Pv^b—Basalt, latite, and basaltic andesite flows. (Includes basaltic tuff at Ladybug Peak.) [Also includes Warner Basalt of Durrell (1959, 1966).]

Pi — **PLIOCENE INTRUSIVE ROCKS**
Pi^a–Andesite.
Pi^b–Basalt.

MPv — Not necessarily in stratigraphic sequence. — **MDCENE-PLIOCENE VOLCANIC ROCKS**
(Includes Meerten, Ingalls, Bonta, and Penman Formations.)
MPv^b—Basalt.
MPv^a—Andesite undivided.
MPv^{sp}—Andesite flows. Locally includes interbedded lahars;
MPv^{sp}—Andesitic pyroclastic rocks, including mudflow breccia; tuffs and tuff breccia; volcanic sediments and conglomerate. Locally includes flows and intrusive rocks of andesitic composition.
MPv^t—Dacitic tuff breccia and pumiceous tuff.

MPi — **MIOCENE-PLIOCENE INTRUSIVE ROCKS**
MPi^a—Andesite. Locally includes dacite.
MPi^b—Basalt.

Ps — **PLDCENE NONMARINE SEDIMENTARY ROCKS**
Fluvial and lacustrine deposits of interbedded shale, sandstone, and siltstone; diatomaceous shale and ash; andesitic sand and gravel; minor conglomerate.

Mlb — **LOVEJOY BASALT**
Black, fine-grained olivine basalt; highly fractured.

ϕMv — **OLIGOCENEMIOCENE VOLCANIC ROCKS**
ϕMv′—Rhyolite welded and non-welded tuffs; sandstone, sitstone, claystone, and conglomerate. Loclly includes rhyolitic and perlitic intrusions. (Includes Valley Springs and DelleKerFormations.)

Tg — **"AUTIFEROUS GRAVEL"**
River channel deposits; pebble; cobbles, and boulders of pre-Tertiary basement rock types, in places predominately quartzose gravels and sand. Mostly Eocene, but may include older and younger deposits.

CRETACEOUS-JURASSIC PLUTONIC ROCKS
- **KJgr** — GRANITE, GRANODIORITE
- **KJqd** — QUARTZ DIORITE, QUARTZ MONZONITE
- **KJdi** — DIORITE
- **KJgb** — GABBRO

JURASSIC PLUTONIC ROCKS
- **Jqd** — QUARTZ DIORITE
- **Jdi** — DIORITE
- **Jgb** — GABBRO
- **Jum** — ULTRAMAFIC ROCKS
Peridotite, dunite, and pyroxenite; locally includes gabbro.

EASTERN BELT
(Northern Sierra Terrane)

Jms, Jmv, Jmv — **JURASSIC (?) METAMORPHIC ROCKS**
Jms—Metasedimentary rocks; slate, conglomerate,quartz arenite, hornfels, and schist. (Also includes Trail Fermation.)
Jmv—Metavolcanic rocks; mafic to felsicpyroclastic rocks, flows, breccias, and tuffaceous sediments.(Also ircludes Kettle Formation.)
Jmvs—Undivided metasedimentary and netavolcanic rocks.

Jsc, Jls — **SAILOR CANYON FORMATION**
Lithic graywacke, pyritic slate, and tuffaceous sediments. Marine. Jls-Limestone and marble.

TRms, TRls — **TRIASSIC METASEDIMENTARY ROCKS**
Phyllite, poly-mict conglomerate with interbedded quartz arenite; minor volcanic rocks. Marine. Trls-Limestone.

Ls, PTls — **PERMIAN AND TRIASSIC ROCKS**
Slate, phyllite, conglomerate, and greenstone; slate contains blocks of Permian and Triassic limestone. Marine. ls-limestone.

Rr — **REEVE FORMATION**
Andesitic breccia, flows, and tuffs; tuffaceous siltstone and conglomerate.

Hg — **GOODHUE FORMATION**
Andesitic and basaltic breccia, pillow lavas, and tuff.

Cp — **PEALE FORMATION**
Rhythmically bedded radiolarian chert (upper part); shale, pillow lavas, and tuff.

CPt — **TAYLOR FORMATION**
Andesitic breccia, tuff, minor flows, and tuffaceous slate.

Dsb — **SIERRA BUTTES FORMATION**
Rhyolitic to dacitic flows, and tuff breccia; black phosphatic chert, tuffaceous siltstone, and shale; also includes rhyolitic to andesitic hypabyssal intrusives. [Also includes Elwell Formation of Durrell and D'Allura (1977).]

Dg — **GRIZZLY FORMATION**
Conglomerate, quartzose sandstone, siliceous argillite and bedded chert. Marine.

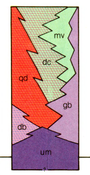
Dbt, Dbg — **BOWMAN LAKE BATHOLITH**
Dbt —Trondhjemite and tonalite.
Dbg—Granite and granodiorite.

Pzu — **PALEOZOIC ROCKS OF UNCERTAIN AGE AND CORRELATION**
Interbedded quartzite, pelite, and conglomerate; limestone and calc-silicate rocks; locally includes volcaniclastic sediments. Marine.

Pzsf — **SHOO FLY COMPLEX**
- ss — Quartzose, feldspathic, and lithic sandstone; siltstone, slate, quartzite, phyllite, and argillite.
- v — Greenstone; mafic to intermediate volcanic flows, tuffs, and breccia.
- ch — Chert and chert breccia; minor amounts of argillite, siltstone and limestone.
- ls — Limestone, dolomite, and marbe; locally interlayered with chert, argillite, and sandstone.
- gb — Gabbro and diabase.
- um — Serpentinized ultramafic rock.
- m — Undivided melange; angular blocks of ultramafic rock, gabbro, basalt, limestone, chert, and sandstone in a chaotic matrix of sheared fine-grained sedimentary rocks.

MESOZOIC — JURASSIC

SMARTVILLE COMPLEX
Volcanic arc assemblage consisting of sedimentary, volcanic, hypabyssal, and plutonic rocks. Relationships between volcanic and plutonic rocks suggest rifting of a volcanic arc during Late Jurassic time.



mv—VOLCANIC ROCKS
Pyroclastic and volcaniclastic rocks; pillow lavas, breccias, and massive flows.

qd—QUARTZ DIORITE AND TONALITE
Locally includes plagiogranite.

dc—DIKE COMPLEX
Sheeted and unsheeted mafic and felsic dikes.

gb—GABBROIC ROCKS
Locally includes diorite and quartz diorite.

db—MASSIVE DIABASE
Locally includes diorite and gabbro.

um—ULTRAMAFIC ROCKS
Partly to completely serpentinized; locally includes pyroxenite and gabbroic rocks.

Big Bend - Wolf Creek Fault Zone

MESOZOIC — JURASSIC / TRIASSIC / PALEOZOIC — PERMIAN / CARBONIFEROUS / DEVONIAN / ORDOVICIAN-SILURIAN

REFERENCES CITED

Clark, L.D., 1960, Foothills fault system, western Sierra Nevada, California: Geological Society of America Bulletin, v. 71, n. 4, p. 483-496.
Clark, B.L., and Anderson, C.A., 1938, Wheatland Formation and its relation to early Tertiary andesites in the Sierra Nevada: Geological Society of America Bulletin, v. 49, n. 6, p. 931-956.
Creely, R.S., 1965, Geology of the Oroville quadrangle, California: California Division of Mines and Geology Bulletin 184, 86 p.
Durrell, C., 1959, Tertiary stratigraphy of the Blairsden quadrangle, Plumas County, California: University of California Publications in Geological Sciences, v. 34, n. 3, p. 161-192.
Durrell, C., 1966, Tertiary and Quaternary geology of the northern Sierra Nevada, *in* Bailey, E.H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 185-197.
Durrell, C., and D'Allura, J., 1977, Upper Paleozoic section in eastern Plumas and Sierra counties, northern Sierra Nevada, California: Geological Society of America Bulletin, v. 88, n. 6, p. 844-852.
Edelman, S.H., 1986, Structure across an ocean-continent suture zone in the northern Sierra Nevada, California, and its implications for ocean accretion processes and regional tectonics: University of California, Davis, Ph.D. dissertation, 311 p.
Harwood, D.S., Helley, E.J., and Doukas, M.P., 1981, Geologic map of the Chico monocline and northeastern part of the Sacramento Valley, California: U.S. Geological Survey Miscellaneous Investigations Series Map I-1238.
Hietanen, A., 1973, Geology of the Pulga and Bucks Lake quadrangles, Butte and Plumas counties, California: U.S. Geological Survey Professional Paper 731, 66 p.
Hietanen, A., 1977, Paleozoic-Mesozoic boundary in the Berry Creek quadrangle, northwestern Sierra Nevada, California: U.S. Geological Survey Professional Paper 1027, 22 p.
Lindgren, W., 1911, The Tertiary gravels of the Sierra Nevada of California: U.S. Geological Survey Professional Paper 73, 226 p.
Tuminas, A., 1983, Structural and stratigraphic relations in the Grass Valley-Colfax area of the northern Sierra Nevada foothills, California: University of California, Davis, Ph.D. dissertation, 415 p.
Williams, H., and Curtis, G.H., 1977, The Sutter Buttes of California; A study of Plio-Pleistocene volcanism: University of California Publications in Geological Sciences, v. 116, 56 p.

Graphics by Ross Martin

EXPLANATION FOR THE GEOLOGIC MAP OF THE CHICO QUADRANGLE, CALIFORNIA, 1992