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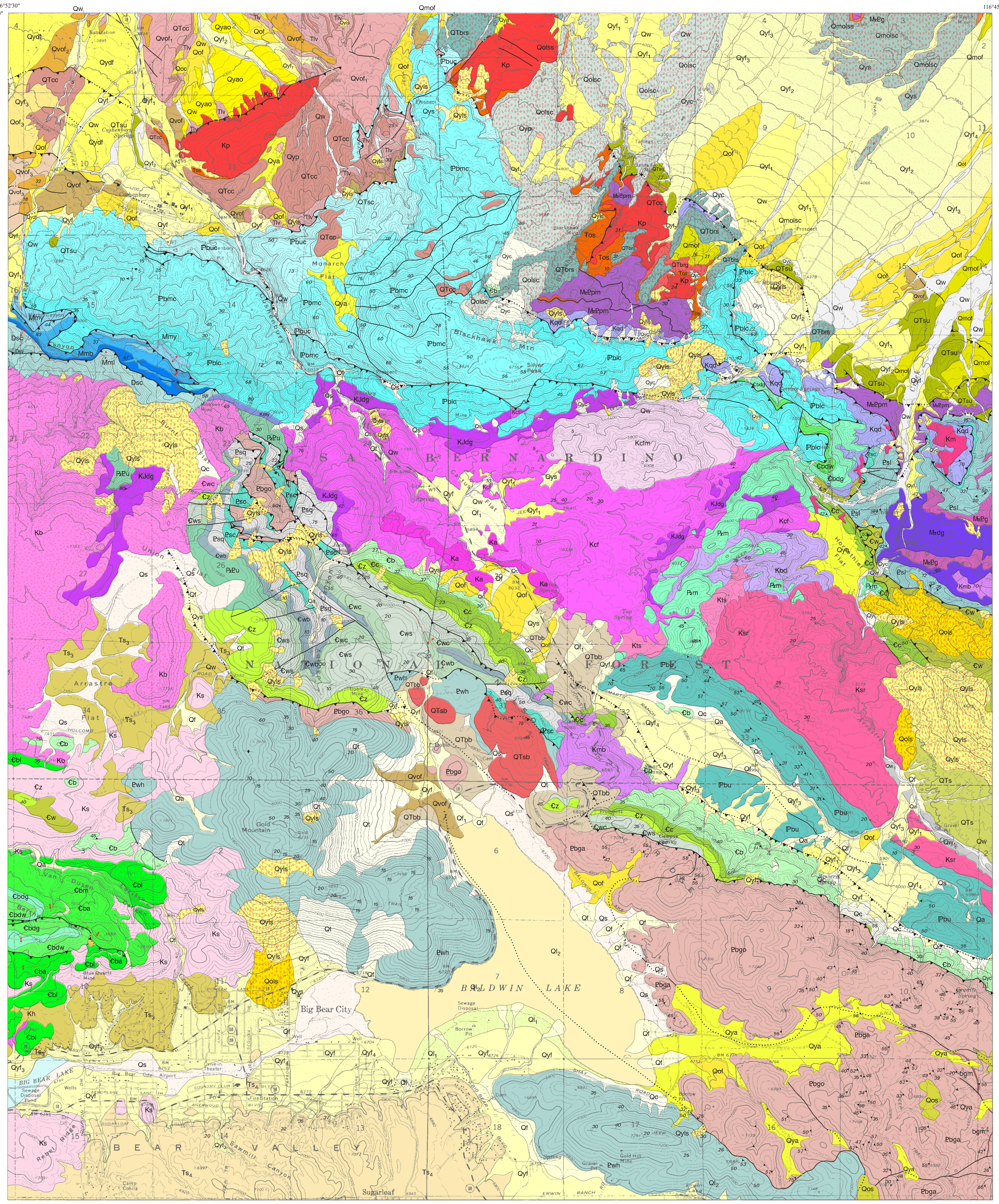
CALIFORNIA GEOLOGICAL SURVEY




Base from U.S. Geological Survey
7.5' Big Bear City quadrangle, 1971

Polyconic projection

SCALE 1:24,000

1 MILE

1 KILOMETER

CONTOUR INTERVAL 40 FEET

Geology mapped by F.K. Miller, 1975-1976, 1995-1996, 2001;
J.C. Matti, 1991-1996; R.E. Powell, 1977

# Preliminary Geologic Map of the Big Bear City 7.5' Quadrangle, San Bernardino County, California

**Version 1.0**

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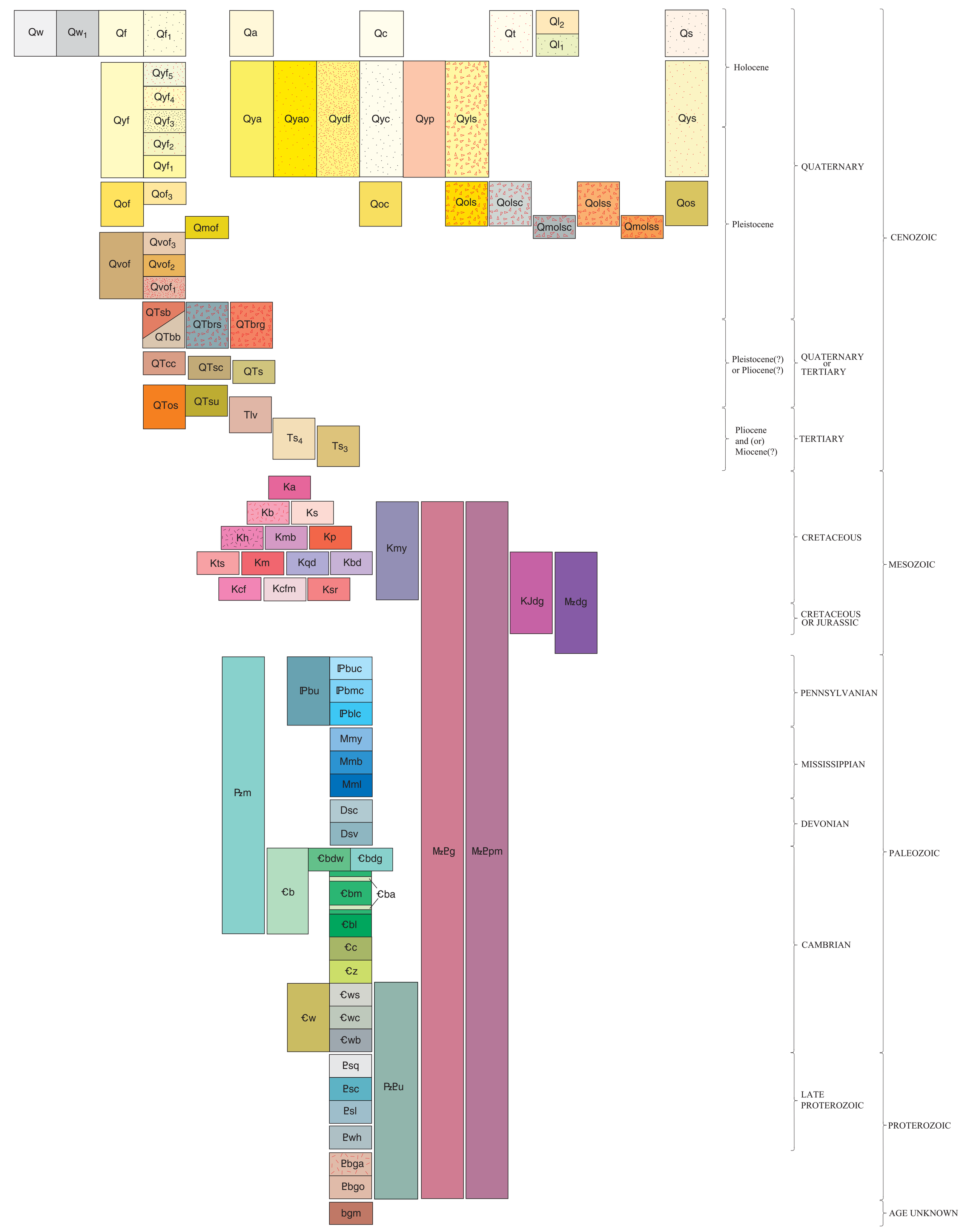
**Note:**

**In this version (1.0) of the "Preliminary Geologic Map of the Big Bear City 7.5' Quadrangle, San Bernardino County, California", identification and correlation of some Quaternary and late Tertiary units on the north side of the San Bernardino Mountains has not been reconciled with more recent and detailed work on Quaternary and late Tertiary units to the north in the Cougar Buttes 7.5' quadrangle (Powell and Matti, 2000). The extent of necessary reconciliation is not known at the time of this Open-File release, but necessary corrections, possibly involving the results of additional field studies, will be made in a later version of this map.**

## CORRELATION OF MAP UNITS




## DESCRIPTION OF MAP UNITS

Qw — **Very young wash deposits (late Holocene)**—Thin, unconsolidated to locally cemented sand and gravel deposits in active washes; cemented only where carbonate rock detritus present. Typically shows fresh flood scours and channel-and-bar morphology. Locally includes small areas of older surficial deposits

Qw$_1$ — **Very young wash deposits, Unit 1**—Unconsolidated to locally cemented sand and gravel deposits in, and bordering, active washes; cemented only where carbonate rock detritus present. Typically shows fresh or muted flood scours and channel-and-bar morphology. Forms terrace risers bordering active washes

Qf — **Very young alluvial-fan deposits (late Holocene)**—Unconsolidated to locally cemented, undissected deposits of gravel and sand that form active or recently active parts of alluvial fans. Essentially no pedogenic soil development

Qf$_1$ — **Very young alluvial-fan deposits, Unit 1**—Unconsolidated to locally cemented, deposits of gravel and sand that form recently active parts of alluvial fans; cemented only where carbonate rock detritus present. Underlies deposits of active fans and cut by channels carrying active fan sediments

Qa — **Very young alluvial-valley deposits (late Holocene)**—Unconsolidated to locally cemented sand and gravel deposits in valley bottoms

Qc — **Very young colluvial deposits (late Holocene)**—Unconsolidated sandy and pebbly deposits of hillslopes and bases of slopes. May include some slightly older stablized colluvial deposits. No pedogenic soil development

Qt — **Very young talus deposits (late Holocene)**—Unconsolidated to slightly consolidated deposits of angular and subangular pebble-, cobble-, and boulder-size material that form scree and rubble on hillslopes and base of steep slopes

**Very young lacustrine deposits (late Holocene)**—Active and recently active lacustrine deposits. Restricted to Baldwin and Erwin Lakes areas

Ql$_2$ — **Very young lacustrine deposits, Unit 2**—Silt and clayey silt, containing scattered sand grains. Pale tan to brownish gray. Relatively coherent when dry. Irregularly capped by fine-grained evaporite mineral(s). Large and small quartzite blocks from Gold Mountain may be present in lake sediments at depth

Ql$_1$ — **Very young lacustrine deposits, Unit 1**—Lake sediments similar to very young lacustrine deposits, Unit 2 (Ql$_2$), but mixed with fine-grained fluvial sediment reworked by wind-driven wave action during periods of high water. Probably underlies and may interfinger with Ql$_2$ sediments

Qs — **Very young surficial deposits, undifferentiated (late Holocene)**—Sand and pebble to small cobble gravel not assigned to any specific surficial materials unit. Unconsolidated to moderately consolidated. Includes wash, fan, colluvium, and alluvial-valley deposits

Qyf — **Young alluvial-fan deposits (Holocene and late Pleistocene)**—Slightly consolidated to cemented, undissected to slightly dissected deposits of unsorted boulders, cobbles, gravel, and sand that form inactive parts of alluvial fans. Sand in all Qyf units ranges from fine to coarse grained. Many fans have unsorted clast and matrix-supported debris-flow fabrics. Subunits of Qyf generally form a nested series of thin fills that include from younger to older:

Qyf$_5$ — **Young alluvial-fan deposits, Unit 5 (late Holocene)**—Sand and pebble-boulder gravel. Unconsolidated to slightly consolidated; sand is fine to coarse grained. Occupies topographically highest position relative to other Qyf units

Qyf$_4$ — **Young alluvial-fan deposits, Unit 4 (late Holocene)**—Sand and pebble-boulder gravel. Unconsolidated to slightly consolidated. Differs from Qyf$_5$ and from Qyf$_3$ by relative topographic position and overlap relations

Qyf$_3$ — **Young alluvial-fan deposits, Unit 3 (late and middle Holocene)**—Sand and pebble-boulder gravel. Unconsolidated to slightly consolidated. Differs from Qyf$_4$ and from Qyf$_2$ by relative topographic position

Qyf$_2$ — **Young alluvial-fan deposits, Unit 2 (early Holocene)**—Sand, silty sand, and granule-pebble gravel. Slightly to moderately consolidated. Differs from Qyf$_3$ by relative topographic position, overlap relations, degree of consolidation, and average grain size, and from Qyf$_1$ by relative topographic position and slight differences in average grain size

Qyf$_1$ — **Young alluvial-fan deposits, Unit 1 (early Holocene and late Pleistocene)**—Sand and pebble-boulder gravel. Slightly to moderately consolidated; sand is fine to coarse grained. Differs from Qyf$_2$ by relative topographic position and slight difference in average grainsize

Qya — **Young alluvial-valley deposits**—Unconsolidated alluvial sand and gravel; restricted to small perched valleys

Qyao — **Young alluvial and slope wash deposits, oxidized (Holocene and late Pleistocene)**—Arkosic sand and pebbly to cobbly sand forming an apron on north flank of San Bernardino Mountains. Surface characterized by oxidized grains of potassium feldspar; deposits appear orange on color aerial photographs. Unit contains one or more buried soil horizons

Qydf — **Young debris-flow fan deposits, oxidized (Holocene and late Pleistocene)**—Unsorted bouldery debris flows containing boulders of biotite monzogranite as large as 2 m in diameter. Surface morphology is hummocky and debris flow levees are common

Qyc — **Young colluvial deposits (Holocene and late Pleistocene)**—Silt, sand, and pebble deposits of hillslopes and base of slopes. Inactive, slightly dissected, slightly consolidated

Qyp — **Young playa deposits (Holocene and late Pleistocene)**—Clay, silt, and sand ponded in small, closed depressions

Qyls — **Young landslide deposits (Holocene and late Pleistocene)**—Slope-failure deposits of displaced bedrock blocks and (or) chaotically mixed rubble. Deposits are probably inactive under current climatic conditions and under moderate to strong ground-shaking conditions

Qys — **Young surficial deposits, undifferentiated (Holocene and late Pleistocene)**—Slightly dissected, slightly consolidated deposits not assigned to any specific surficial unit. Includes wash, fan, and colluvium deposits

Qof — **Old alluvial-fan deposits (late to middle Pleistocene)**—Fluvial and debris-flow fan deposits. Sand to boulder; clast types reflect up-canyon bedrock units. Moderately to well consolidated and dissected. Includes:

Qof$_3$ — **Old alluvial-fan deposits, Unit 3 (late Pleistocene)**—Sand to granule-boulder gravel. Moderately dissected fluvial and debris-flow alluvial fan deposits

Qoc — **Old colluvial deposits (late to middle Pleistocene)**—Moderately dissected, slightly to moderately consolidated, stabilized deposits of sediment, rock fragments, and soil material deposited by rain wash or slow continuous downslope creep

Qols — **Old landslide deposits (late to middle Pleistocene)**—Slope-failure deposits consisting of displaced bedrock blocks and chaotically mixed rubble

**Old landslide breccia (late or middle Pleistocene)**—Rock avalanche breccia that constitutes the Blackhawk landslide. Breccia is derived chiefly from metamorphosed Paleozoic carbonate strata and subordinately from Pliocene conglomeratic sandstone and granitic rocks. Includes:

Qolsc — **Old landslide breccia, carbonate rocks (Pleistocene)**—Rock avalanche breccia derived from metamorphosed Paleozoic carbonate strata

Qolss — **Old landslide breccia, strata of Blackhawk Canyon (Pleistocene)**—Rock avalanche breccia derived from sandstone and conglomeratic sandstone

Qos — **Old surficial deposits, undifferentiated (late to middle Pleistocene)**—Moderately dissected, moderately consolidated deposits not assigned to any specific surficial unit

Qmof — **Moderately old alluvial-fan deposits (Pleistocene)**—Sand and gravel, cemented. Western fans are mainly carbonate rock clasts; eastern fans are mixed carbonate rocks, granitic rocks, quartzite, and gneiss clasts. Somewhat deformed in upper piedmont folds. May include some very-old alluvial fan deposits

Qmolsc — **Moderately old landslide breccia, carbonate rocks (early Pleistocene)**—Blocks and fragmented carbonate rock resulting from mega-landslide processes

Qmolss — **Moderately old landslide breccia, strata of Blackhawk Canyon (early Pleistocene)**—Shattered and fragmented granitoid rock emplaced by mega-landslide processes. Some highly broken blocks probably moved almost intact

Qvof — **Very old alluvial fan-deposits (middle to early Pleistocene)**—Alluvial fans having mainly carbonate rock clasts; moderately consolidated and moderately to well dissected. Includes from younger to older:

Qvof$_3$ — **Very old alluvial-fan deposits, Unit 3 (early Pleistocene)**—Moderately dissected. Sandy pebble-cobble deposits incised into uplifted parts of Qvof$_2$

Qvof$_2$ — **Very old alluvial fan-deposits, Unit 2 (early Pleistocene)**—Well dissected, moderately consolidated to indurated, sandy, pebble-boulder gravel west of Cushenbury Canyon. Eastward, unit is well cemented pebbly to cobbly fluvial fanglomerate; subrounded to well rounded clasts. Forms resistant ledges. Moderately deformed in upper piedmont folds

Qvof$_1$ — **Very old alluvial fan-deposits, Unit 1 (early Pleistocene)**—East of Cushenberry Canyon, unit is sand, cobble, and boulder fanglomerate made up of interbedded fluvial and debris flow deposits. Clasts are predominately marble in well cemented sandy matrix. Well-dissected surfaces characterized by etched and pitted limestone clasts; forms resistant ledges. Intensely deformed in upper piedmont folds

QTsb — **Slide breccia (Pleistocene? or Pliocene?)**—Breccia and large brecciated blocks of Proterozoic quartzite of Wildhorse Meadows (Ᵽwh). Unit is monolithologic. Largest part appears to have originated as single slide block from east side of Gold Mountain near Baldwin Lake, but may include smaller masses from north side of mountain. Includes:

QTbb — **Basal breccia (Pleistocene? or Pliocene?)**—Breccia, matrix and clast supported. Almost all clasts are angular white quartzite. Matrix is orangish brown clayey silt, sand, and fine lithic material. Appears to be basal brecciated material related to major slide block(s) of Proterozoic quartzite of Wildhorse Meadows (Ᵽwh) from east and north sides of Gold Mountain near Baldwin Lake

**Breccia (Pleistocene? or Pliocene?)**—Rock avalanche? breccia. Breccia is derived chiefly from metamorphosed Paleozoic carbonate strata and subordinately from Pliocene conglomeratic sandstone and granitic rocks. Includes:

QTbrs — **Breccia, carbonate rock**—Rock avalanche? breccia derived from metamorphosed Paleozoic carbonate strata. Includes breccia derived from conglomeratic sandstone of Old Woman Sandstone (Tos). Sedimentary strata are disorganized and bedding is rarely discernable

QTbrg — **Breccia, granitic rocks**—Rock avalanche? breccia derived from Cretaceous granitic rocks

QTcc — **Conglomerate of Cushenberry Springs (Pleistocene? or Pliocene?)**—Consolidated to cemented, very thick to indistinctly bedded, pebble to boulder conglomerate; most abundant clast type is medium to coarse grained marble

QTsc — **Sandstone and conglomerate (Pleistocene? or Pliocene?)**—Consolidated pebble to boulder, marble- and granitic-clast conglomerate interbedded with lesser medium to very coarse grained lithic arkose; sediment source from south

QTs — **Sedimentary rocks of Lone Valley area (Pleistocene? or Pliocene?)**—Clayey siltstone and sparse conglomeratic arkose interbeds. Siltstone is unconsolidated to moderately consolidated; arkosic beds carbonate-cemented. Siltstone is light brown to greenish brown, arkose is pale tan. Bedding in siltstone is indistinct. Unit may represent lacustrine deposit containing small, thin deltaic interbeds

Tos — **Old Woman Sandstone (Pleistocene? and Pliocene?)**—Fluvial arkosic sandstone, conglomeratic sandstone, and conglomerate; medium- to coarse-grained; predominantly reddish, subordinately pale yellowish brown or gray. Contains pebbles to boulders of quartzite, lineated granitic gneiss, amphibolite, granite, basalt, and rare limestone. Thin-bedded to massive, well-developed cross-bedding; sediment source from north. Includes:

QTsu — **Old Woman Sandstone, sandstone member**—Lithic, arkosic sandstone interbedded with conglomeratic sandstone and conglomerate; volcanic clasts predominate, but also has abundant marble; sediment source from north

Tlv — **Sedimentary strata of Lucerne Valley (Pliocene)**—Brown lacustrine clay and silty clay interbedded with fluvio-lacustrine greenish gray and brown silt and fine sand. Overlies Old Woman Sandstone (Tos) with angular unconformity. Contains late Pliocene vertebrate fossils (May and Repenning, 1982). Unit may include early Pleistocene strata. Part of unit probably equivalent to part of Old Woman Sandstone

Ts$_4$ — **Sedimentary rocks south of Big Bear Lake (Miocene?)**—Siltstone, fine- to coarse sandstone, pebbly sandstone, and minor greenish mudstone. Unit is moderately well consolidated, thin to thick bedded, locally indistinct stratification. White, pale-brown, and brownish-gray

Ts$_3$ — **Sedimentary rocks south of Bertha Ridge and John Bull Mountain (Miocene?)**—Two distinct lithologies: (1) Limestone-clast conglomerate. Consolidated to cemented; medium- to thick-bedded; light- to medium-gray, (2) Siltstone, fine- to coarse-grained sandstone, and pebbly sandstone;white, brownish-gray, and greenish-gray

Ka — **Garnetiferous alaskite (Cretaceous)**—Alaskite; only mafic minerals are small, rare, widely scattered, biotite grains. Consists chiefly of albite, quartz, potassium feldspar, and muscovite. Small, red garnets found irregularly throughout unit, but concentration is highly variable. Medium grained and fine grained, variable on outcrop scale. Unlike Cretaceous monzogranite of Cactus Flat (Kcf), which it intrudes, alaskite has no penetrative fabric

Kb — **Monzogranite of John Bull Flat (Cretaceous)**—Medium-grained biotite monzogranite. Distinguished by uniform grain size (except near borders), abundant potassium feldspar, low color index, and fine-grained rock in outer part. Color index averages about 7; biotite is only mafic mineral. Nonporphyritic; has no directional or penetrative fabric. May be related to monzogranite of Stanfield Cutoff

Ks — **Monzogranite of Stanfield Cutoff (Cretaceous)**—Biotite monzogranite. Distinguished by consistent medium to fine grain size, seriate texture, and absence of other distinctive characteristics. Color index ranges fron 3 to 9. Biotite is only mafic mineral; forms thin crystals in much of unit. Has very fine-grained chilled border, which in places contains bipyramidal quartz. Locally has sparse 1.5-cm-long orthoclase phenocrysts. Texture is hypidiomorphic-granular; rock has no directional fabric

Kmy — **Mylonite (Cretaceous)**—Mylonite and intensely mylonitized, fine-grained, leucocratic monzogranite. About 40 m thick; extent unknown

MzⱣg — **Granitic orthogneiss (Mesozoic or Proterozoic)**—Foliated, lineated, leucocratic biotite granite gneiss. Porphyroblastic; fine to coarse grained

MzⱣpm — **Mixed plutonic and metasedimentary rocks (Mesozoic to Proterozoic)**—Gneissose metaplutonic rocks, predominantly intermediate in composition and containing dioritic and paragneissic inclusions

Kh — **Granodiorite of Hanna Flat (Cretaceous)**—Coarse-grained hornblende-biotite granodiorite. Irregularly porphyritic; has 2-cm-long, crude, scattered phenocrysts. Average color index 15 in eastern part, grading to 10 in western part; concentration of hornblende and sphene decreases from east to west also. $^{40}Ar/^{39}Ar$ incremental age on hornblende is 76.5 Ma (R.J. Fleck, written commun., 1996)

Kmb — **Monzogranite, undifferentiated (Cretaceous)**—Biotite monzogranite. Generic unit; rocks may represent more than one pluton. Most are medium- to coarse-grained, relatively leucocratic biotite monzogranite ranging to granodiorite

Kp — **Porphyritic monzogranite (Cretaceous)**—Biotite monzogranite. Medium-grained groundmass containing abundant to sparse phenocrysts of potassium feldspar, typically 1 to 4 cm long. Color index about 10; weathered outcrops are typically oxidized to light orangish brown. Locally contains abundant inclusions of dioritic rock

Kts — **Monzogranite of Top Spring (Cretaceous)**—Biotite monzogranite, possibly ranging to granodiorite. Contains about 2 percent primary? muscovite. Color index about 7. Has subtle, but distinct foliation, which could be incipient ductile deformation or partially recrystallized well-developed ductile foliation. Fine grained. May be related to Cretaceous monzogranite of Cactus Flat (Kcf)

Km — **Muscovite-biotite monzogranite (Cretaceous)**—Coarse-grained muscovite-biotite monzogranite. Fairly leucocratic; muscovite is abundant and conspicuous. Ductilely deformed

Kqd — **Quartz diorite (Cretaceous)**—Biotite-hornblende quartz diorite to tonalite, medium-grained, dark greenish gray to black, hydrothermally altered

KJdg — **Mixed mafic diorite and gabbro (Cretaceous or Jurassic)**—Biotite-hornblende diorite and quartz diorite, and hornblende-biotite diorite and quartz monzodiorite. Fine- to coarse-grained. Appears to have some spatial relation to Paleozoic carbonate rocks and intermediate composition Mesozoic plutons. Rocks of this unit have wide compositional and textural range, but are distinguished from other units by their very high color index. Average color index 45. Unit may include rocks of more than one period of intrusion

Mzdg — **Diorite and gabbro (Cretaceous)**—Intermingled mafic and intermediate rocks of varied composition and texture. Color index ranges from 50 to 95. Includes coarse- to very coarse-grained hornblendite and hornblende gabbro, medium- to coarse-grained biotite-hornblende diorite, fine-grained, dark-colored diorite to quartz diorite, medium-grained diorite and quartz diorite, and coarse- to extremely coarse-grained gabbro-dioritic pegmatite

Kbd — **Biotite quartz diorite (Cretaceous)**—Quartz diorite; biotite is only mafic mineral. Medium to fine grained, even grained to slightly foliated; has granoblastic looking texture. Quartz is about 10 percent, color index averages about 25. Contains sparse sphene. Texture and composition relatively uniform throughout body. Intrusive relations with other plutons are ambiguous. Conspicuous absence of well developed fabric found in adjacent plutons suggests biotite quartz diorite is younger or is an older metamorphosed body

Kcf — **Monzogranite of Cactus Flat (Cretaceous)**—Biotite monzogranite. Contains 1 to 2 percent primary muscovite. Medium to coarse grained, and locally has poorly formed, 1-cm-long feldspar phenocrysts. Average color index is 10. Rock is characterized by pervasive ductile-brittle fabric; very obvious in thin section, but not apparent in most outcrops. Locally rock is noticably to highly lineated. All quartz is ductilely deformed, having elongations between 3 and 10 times width. Feldspars are broken and tectonically shaped, and typically show considerable grain-size reduction. Micas are disaggregated and many wrap around felsic grains. Muscovite-bearing variety mapped separately:

Kcfm — **Monzogranite of Cactus Flat, muscovite-bearing unit (Cretaceous)**—Muscovite-biotite monzogranite. Similar to monzogranite of Cactus Flat (Kcf) in all respects, except consistantly carries 3 to 5 percent muscovite

Ksr — **Monzogranite of Smarts Ranch Road (Cretaceous)**—Muscovite-biotite monzogranite and biotite monzogranite. Coarse to very coarse grained. Characterized by well developed, pervasive lineation defined by elongation of both mafic and felsic minerals and disaggregated trains of minerals. Color index averages 10; muscovite averages about 3 percent. Pale purple garnet irregularly distributed through unit; locally abundant, more commonly absent. Is intensely deformed, and recrystallized. All fine grained feldspar produced by milling is recrystallized as are sutured boundaries and elongate grains of ductilely deformed quartz. Recrystallization contrasts strongly with unmodified fabric of monzogranite of Cactus Flat (Kcf)

Pzm — **Marble, undifferentiated (Paleozoic)**—Limestone and dolomitic marble. Near white to medium-dark gray; most is light to medium gray. Coarse to very coarse grained. Much is probably derived from Cambrian Bonanza King Formation (Ꞓb), but other Paleozoic carbonate units may be represented

ℙbu — **Bird Spring Formation, undifferentiated (Pennsylvanian)**—Upper part of Furnace Limestone of Vaughan (1922) as mapped by Guillou (1953), Richmond (1960), Dibblee (1964), and Sadler (1981); correlated with Bird Spring Formation of southern Great Basin by Cameron (1981) and Brown (1984, 1987, 1991). Three members recognized in quadrangle:

ℙbuc — **Upper Carbonate Member**—Generally light-colored, medium- to thick-bedded, medium to coarsely crystalline calcite marble; locally is pelmatozoan bearing. Typical lithologies include white, gray, or mottled marble and cherty, silicified marble that are interstratified in packages as much as 12 m thick. Yellowish- to brownish-gray phyllite is subordinate

ℙbmc — **Middle Carbonate Member**—Medium- to thick-bedded, generally medium- to dark-gray, chert-bearing calcite marble containing lenses and thin layers of quartz, silt, and fine sand. Locally pelmatozoan-bearing

ℙblc — **Lower Carbonate Member**—Medium- to thick-bedded, light-gray to white, medium to coarsely crystalline, calcite marble. Has subordinate layers, up to 3 m thick, of brown-weathering dolomite marble and siliceous marble and thick- to very thick-bedded, medium- to dark-gray calcite marble

**Monte Cristo Limestone (Mississippian)**—Upper part of Furnace Limestone of Vaughan (1922) as mapped by Richmond (1960), Dibblee (1964), and Sadler (1981). Correlated with the Monte Cristo Limestone of the southern Great Basin by Cameron (1981), and Brown (1984, 1987, 1991). Three members recognized in quadrangle:

Mmy — **Yellowpine Member**—Heterogeneous, medium- to thick-bedded, interlayered, light- and dark-gray, calcite and dolomite marble

Mmb — **Bullion Member**—Thick- to very thick-bedded, light-gray to white, texturally massive, very pure bioclastic calcite marble. Grain size varies from fine to coarsely crystalline depending on metamorphism

Mml — **Lower Member**—Interlayered dark-gray and light-gray calcite marble that is thin to thick bedded, pelmatozoan bearing, texturally massive to mottled, and chert bearing

**Sultan Limestone (Devonian)**—Middle part of Furnace Limestone of Vaughan (1922) as mapped by Richmond (1960), Dibblee (1964), and Sadler (1981). Cameron (1981) and Brown (1984, 1987, 1991) correlated members with members of Sultan Limestone of Hewitt (1931) in southern Great Basin. Three members recognized in quadrangle:

Dsc — **Crystal Pass Member**—Thin- to thick-bedded, white calcite marble having intermittent thin intervals of dark-gray calcite and dolomite marble. Lower part of unit commonly is irregularly dolomitized and contains greater number of gray metalimestone layers. White marble layers locally are pyrite-bearing, and commonly have iron oxide stained surfaces

Dsv — **Valentine Member**—Thin- to very thick-bedded, light-gray, pale-yellowish-brown, and white, finely crystalline metadolomite that is laminated to texturally massive; some intervals contain lenticular to irregular nodules of white to pale-brown chert. Lithologically resembles Sevy Dolomite of Basin and Range Province, and is more dolomitic than type Valentine Limestone Member described by Hewett (1931)

**Bonanza King Formation (Cambrian)**—Lower part of Furnace Limestone of Vaughan (1922) as mapped by Guillou (1953), Richmond (1960), Dibblee (1964), and Sadler (1981). In Big Bear City quadrangle, Bonanza King is highly recrystallized; locally subdivided into informal members

Ꞓb — **Bonanza King Formation, undivided**—Dark and light dolomite marble lacking characteristics diagnostic of specific members

Ꞓbdg — **Bonanza King Formation, gray dolomite member**—Medium- to thick-bedded, medium-gray, texturally massive to mottled, fine- to medium-grained dolomite marble and calcareous metadolomite; interlayered with subordinate light-gray to white dolomite marble and calcareous metadolomite

Ꞓbdw — **Bonanza King Formation, white dolomite member**—Thin- to very thick-bedded, white to light gray, massive to laminated, fine-grained dolomite marble. Very similar to dolomite in Cambrian Nopah Formation in quadrangle to west; unit as mapped here probably includes some Nopah

Ꞓba, Ꞓbm — **Bonanza King Formation, middle Member**—Thin- to thick-bedded, light- to medium-gray, laminated to massive to mottled dolomite marble and calcareous metadolomite; grain size varies from fine to coarse. Member contains two or more 2- to 20-meters-thick intervals of greenish-brown and grayish-brown metasiltstone, argillite, hornfels, and impure limestone (Ꞓba); similar to Dunderberg Shale Member of Nopah Formation

Ꞓbl — **Bonanza King Formation, lower Member**—Thin- to thick-bedded limestone and calcite marble and subordinate dolomitic marble and metadolomite; textures vary from massive to mottled to laminated. Rocks are white, massive, and coarse grained near granitic rocks; elsewhere they are light to medium gray, well bedded, and finely laminated. South of Bertha Ridge lower member is texturally massive and light- to dark-gray. Where faulted, fractured, or tightly folded, rock is secondarily dolomitized and member is difficult to distinguish from other dolomitic members. Probably correlative with Papoose Lake Member of Bonanza King Formation as used by Barnes and Palmer (1961)

Ꞓc — **Carrara Formation (Cambrian)**—Heterogeneous unit of interbedded calcite marble, phyllite, calc-silicate rock, schist, and lesser quartzite. Upper part typically contains large proportion of carbonate rock; lower part is thinly bedded, and contains a large proportion of phyllite and quartzite. Carrara is equivalent to lower part of Furnace Limestone of Vaughan (1922) as mapped by Guillou (1953), Richmond (1960), Dibblee (1964), and Sadler's Furnace Limestone units F1-F3 (Sadler, 1981). Correlated with Carrara Formation of southern Great Basin by Stewart

Ꞓz — **Zabriskie Quartzite (Cambrian)**—Vitreous, quartz-cemented quartzite. Distinguished from quartzites of Cambrian Wood Canyon Formation and Late Proterozoic Stirling Quartzite by purity, lack of feldspar grains, whiteness, and massive structure. Uniformly white, but some fracture surfaces are stained yellow, orange or hematite-red by iron oxides. Very pure; quartz is almost only mineral in rock. Medium- to fine-grained, but contains scattered grains up to 5 mm across which are not aligned to define bedding. Thick bedded to massive; bedding unrecognizable in many exposures. Locally, unit contains bedding plane partings of phyllitic argillaceous rock Correlated with Zabriskie Quartzite of southern Great Basin by Stewart and Poole (1975). Average thickness as calculated from outcrop width is 400 m, but where exposed, upper and lower contacts are sheared

Ꞓw — **Wood Canyon Formation (Cambrian)**—Quartzite, quartzose phyllite, and minor calc-silicate rock. Most places in quadrangle subdivided into three subunits:

Ꞓws — **Wood Canyon Formation, siltite-quartzite unit**—Siltite and lesser interbedded quartzite. Siltite is argillaceous, dark gray to greenish gray. Well bedded, but bedding typically indistinct because of dark color of rocks. Bedding ranges from very thin to medium thick. Beds are relatively parallel to lensoidal. Quartzite is dark gray to light brownish gray. Medium to fine grained, in beds ranging from 0.5 cm to about 7 cm. Thinner beds are typically lensoidal on outcrop scale. Thickness uncertain, but probably greater than 40m

Ꞓwc — **Wood Canyon Formation, coarse-grained quartzite unit**—Quartzite, pebbly quartzite, and minor argillaceous siltite. Quartzite is thin to thick bedded, white, pale yellowish tan, and pale purple; much is feldspathic. Lower part contains numerous beds containg abundant, matrix- and clast-supported, 1-cm-wide, well-rounded quartzite pebbles. Pebble beds are separated by thick, medium- and coarse-grained beds of white quartzite containing widely scattered, slightly more angular quartzite pebbles. Middle part of unit is about 30 m of pale purple, black layered, prominently cross-bedded quartzite. Cross-bedded quartzite grades bed by bed upward into siltite-quartzite unit (Ꞓws) of Wood Canyon Formation. About 45-60 m thick

Ꞓwb — **Wood Canyon Formation, biotite schist unit**—Biotite schist. Black, indistinctly bedded, but massive-appearing. Composed mostly of very fine-grained biotite, and lesser amounts of quartz and albite. Almost all rocks also contain sparse, fine-grained metamorphic tourmaline. Grades bed by bed upward into coarse-grained quartzite unit (Ꞓwc). Contains locally abundant *Scolithus* and flaser-laminated zones. About 15-20 m thick.

**Stirling Quartzite (Late Proterozoic)**—Part of Saragossa Quartzite of Vaughan (1922) as mapped by Dibblee (1964). Lower part of Chicopee Formation as mapped by Guillou (1953); lower member of Chicopee Canyon Formation as mapped by Richmond (1960). Correlated with the Stirling Quartzite and Johnnie Formation of the southern Great Basin by Stewart and Poole (1975). Here subdivided into three informal members:

Ᵽsq — **Quartzite member**—Light-gray, yellow-gray, and white feldspathic quartzite and conglomeratic quartzite. Approximately lower two-thirds of member is medium- to thick-bedded, poorly sorted, fine- to coarse-grained feldspathic quartzite containing sparse matrix-supported pebbles up to 1 cm across. Upper third is medium- to thin-bedded, poorly to moderately well sorted, fine- to medium-grained feldspathic quartzite. Bedding upper part of member is parallel-planar, weathering slabby; current and oscillation ripple-marked surfaces are common. Thickness as calculated from outcrop width is approximately 120 m

Ᵽsc — **Carbonate member**—Wavy bedded, light-gray to light-tan-weathering limestone, limey dolomite, argillaceous limestone, and lesser quartzite. All carbonate rocks are fine- to coarse-grained marble and variable amounts of calcsilicate minerals, but almost everywhere sedimentary structures are preserved. Interbedded with (1) medium- and thick-bedded, medium-grained quartzite, (2) laminated to massive calcite marble, (3) quartz-sand-bearing marble, and (4) calc-silicate rock. Poorly and incompletely exposed, but dolomitic limestone and quartzite appear to dominate. About 120 m thick; base not exposed

Ᵽsl — **Lower quartzite member**—Quartzite. Massive to faintly layered; layering may or may not reflect bedding. White, highly recrystallized; no detrital grain shapes preserved. Considered possible Stirling Quartzite, but could be part of Proterozoic quartzite of Wildhorse Meadows (Ᵽwh). Mapped only in northeastern part of quadrangle; not contiguous with well-identified Sterling Quartzite units in central part of quadrangle

Ᵽwh — **Quartzite of Wildhorse Meadows (Late Proterozoic)**—Quartzite. Lower quarter of exposed formation is medium-to thick-bedded, medium-grained, white quartzite similar to quartzite member of Stirling Quartzite (Ᵽsq). About 40 cm of conglomeratic quartzite where unit is depositional on orthogneiss of Proterozoic Baldwin Gneiss (Ᵽbgo). Thick beds in lower quarter of exposed formation show indistinct internal bedding and some large scale cross-bedding; this part of unit forms angular outcrops. Grades upward into white, gray, and pinkish-gray, thick and massively bedded quartzite, which makes up rest of exposed formation. Rocks are micaceous, and weather into irregularly hematite-stained, rounded outcrops. Upper part contains well defined coarser-grained beds and a few dark, argillaceous quartzite beds. Quartzite of Wildhorse Meadows older than other Late Proterozoic and early Paleozoic units, but specific relations are not known

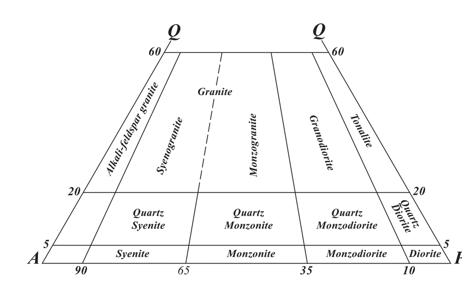
**Baldwin Gneiss (Proterozoic)**—Lineated orthogneiss and augen gneiss. Most is very coarse grained. Discordant U-Pb age on zircon is 1750±15 Ma (Silver, 1971). Includes:

Ᵽbga — **Baldwin Gneiss, augen gneiss**—Porphyroblastic biotite quartzofeldspathic gneiss. Similar to orthogneiss unit (Ᵽbgo), but contains potassium feldspar porphyroblasts up to 5 cm long, average size is about 2.5 cm. Concentration of porphyroblasts is highly variable, ranging from very sparse to rocks that are about 40 percent porphyroblasts by volume. North of Baldwin Lake, foliation and lineation in augen gneiss is not as well developed as it is in orthogneiss

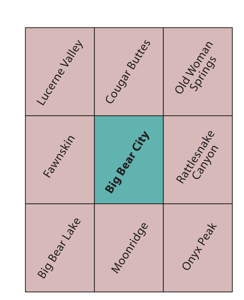
Ᵽbgo — **Baldwin Gneiss, orthogneiss**—Biotite quartzofeldspathic gneiss. North of Baldwin Lake, most, but not all rocks contain muscovite. Grain size highly variable, but typically coarse to very coarse. Rounded, 1-cm-long potassium feldspar grains are common. Quartz very abundant locally, making up about 50 percent of some rocks. Foliation defined mainly by irregular, discontinuous mica layers, but felsic and mafic minerals are poorly segregated into layers in much of unit. East of Baldwin Lake, gneiss has well-developed mineral lineation. Rock strongly recrystallized subsequent to development of foliation and lineation; large percentage of micas are oriented at high angles to both. Southeast of Baldwin Lake, blastomylonite (bgm) occurs along parts of contact between orthogneiss and augen gneiss units

PzⱣu — **Bedrock, undifferentiated (Paleozoic and Proterozoic)**—Quartzite, calc-silicate rock, marble, and lesser schist. Probably includes parts of Cararra Formation, Wood Canyon Formation, and Stirling Quartzite

bgm — **Mylonitic zones (age unknown)**—Thin mylonite zone, as thick as 20 m. Mylonite contains porphyroclasts of potassium feldspar in very fine-grained matrix. Separates orthogneiss and augen gneiss units of Baldwin Gneiss. Age and lateral extent is unknown




Classification of granitic rock types (from IUGS, 1976, and Streckeisen, 1976).
A, alkali-feldspar; P, plagioclase feldspar; Q, quatrz

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## EXPLANATION

**Contact**—Solid where located within ±15 meters; dashed where located within ±30 meters

**Fault**—High angle. Solid where located within ±15 meters; dashed where located within ±30 meters; dotted where concealed

**Thrust fault**—Older over younger. Solid where located within ±15 meters; dashed where located within ±30 meters; dotted where concealed.

**Anticline**

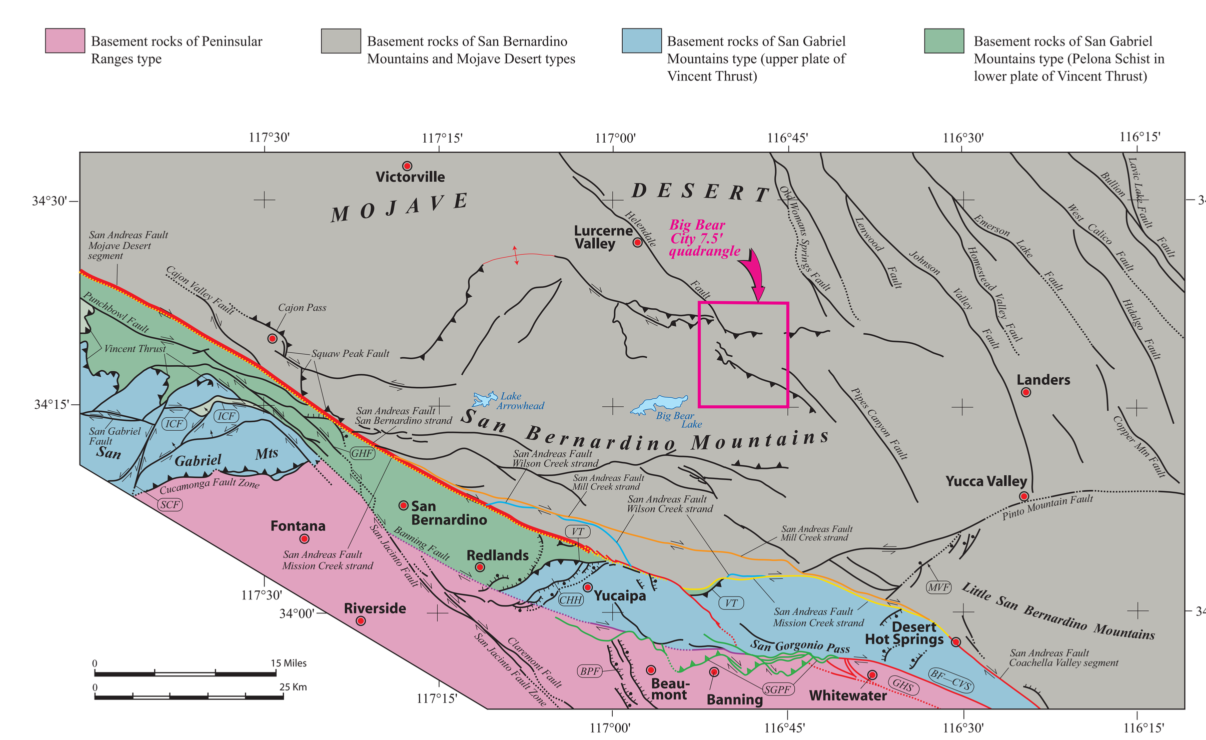
**Syncline**

**Strike and dip of beds**
- 70 **Inclined**
- **Vertical**
- 70 **Overturned**

**Strike and dip of metamorphic foliation**
- 70 **Inclined**
- **Vertical**

**Strike and dip of high strain foliation in granitic rocks**
- 70 **Inclined**

**Bearing and plunge of linear features**
- 70 **Minor fold axes**
- 70 **Strain-aligned minerals in granitic rocks**
- 70 **Strain-aligned minerals in gneissic rocks**




Map showing regional geologic framework and location of Big Bear City 7.5' quadrangle. Faults modified from Matti and others (1992), Matti and Morton (1993), and Rogers (1967). Faults shown in colors are strands of the San Andreas Fault; red indicates modern traces of the San Andreas Fault. *BF—CVS*, Banning Fault—Coachella Valley segment; *GHS*, San Andreas Fault—Garnet Hill strand; *BPF*, Beaumont Plain fault zone; *CHH*, Crafton Hills horst-and-graben complex; *GHF*, Glen Helen Fault; ICF, Icehouse Canyon Fault; *MVF*, Morongo Valley Fault; *SCF*, San Antonio Canyon Fault; *VT*, Vincent Thrust