U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

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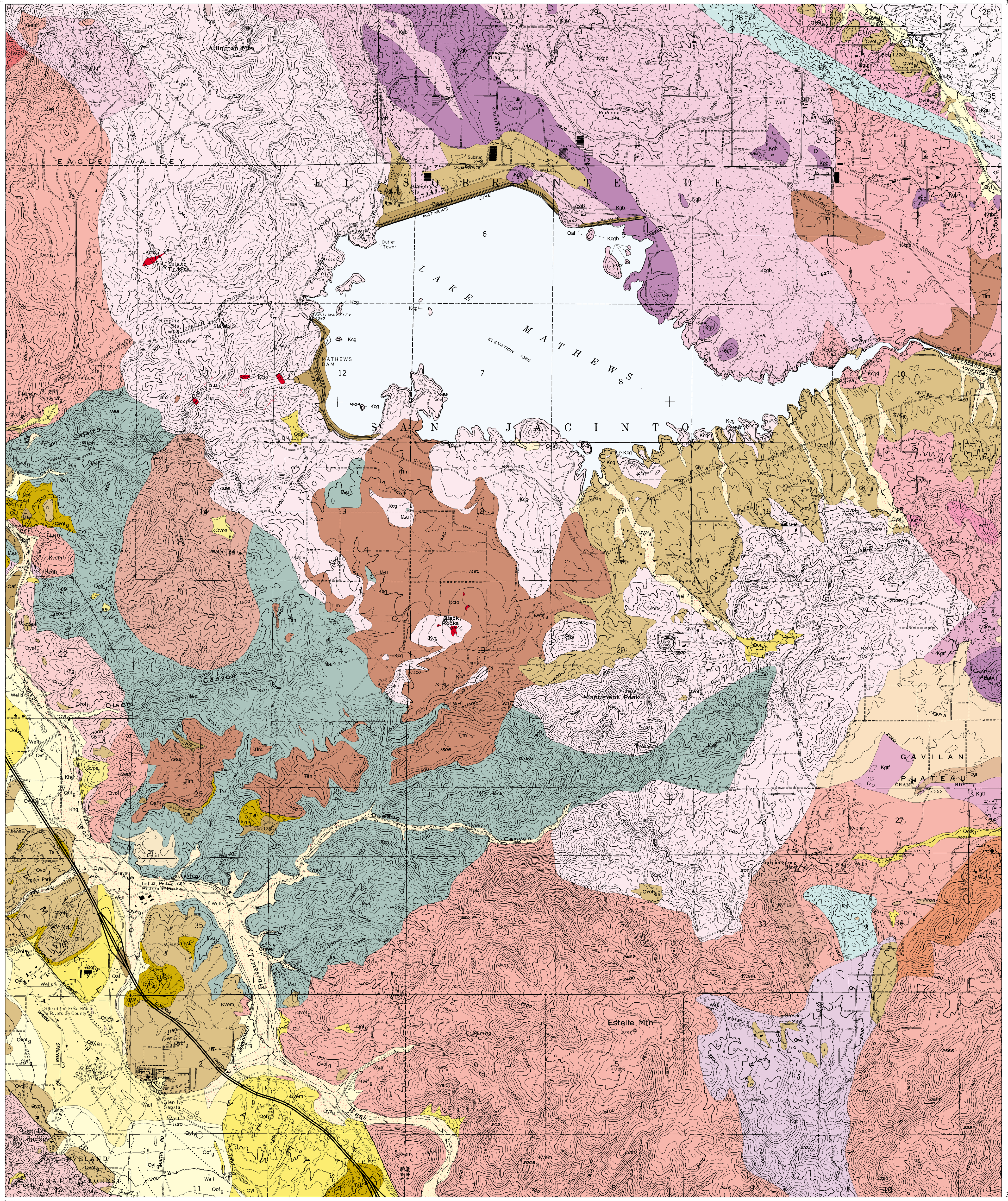
CALIFORNIA DIVISION OF MINES AND GEOLOGY

OPEN-FILE REPORT 01-479



Base from U.S. Geological Survey
7.5' Lake Mathews quadrangle, 1967
Polyconic projection

SCALE 1:24,000

CONTOUR INTERVAL 40 FEET

Geology mapped by F.H. Weber, 1976,
and D.M. Morton, 1993-5

GEOLOGIC MAP OF THE LAKE MATHEWS 7.5' QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA

Version 1.0

By

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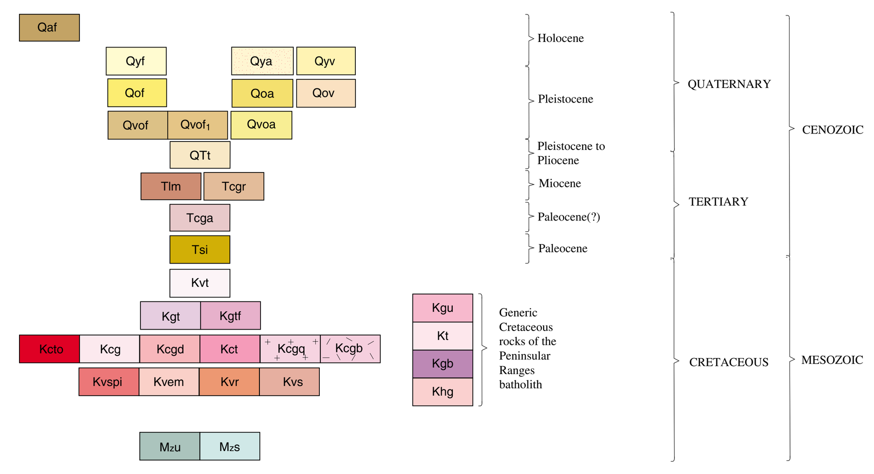
CORRELATION OF MAP UNITS



On some SCAMP geologic map plots, including the Lake Mathews 7.5' quadrangle, characteristic grain size information is displayed using subscripted alpha characters (e.g. Qyf_g, Qov_a), where the characters conform to the following definitions:

a - arenaceous (very coarse sand through very fine sand)
b - boulder gravel (25mm)
g - gravel (cobble through granule gravel)
s - silty
c - clayey
m- marl
p - peat

In the **Description of Map Units**, the Ma following U/Pb ages has an attached subscript; Ma_{id} for isotope dilution analyses, and Ma_{ip} for ion probe analyses.

Contact—Generally located within ±15 meters

Fault—High angle. Strike-slip component on all faults is right-lateral; dip-slip component is unknown, but probably reflects vally-highland relations. Dashed where located within ±30 meters; dotted where concealed

Kcto - Zones of tourmalinized monzogranite and granodiorite.

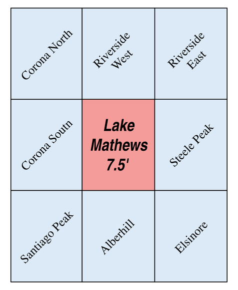
Strike and dip of metamorphic foliation

Inclined

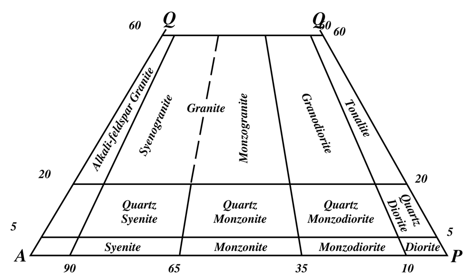
Strike and dip of igneous foliation

Inclined

Vertical



SURROUNDING 7.5' QUADRANGLES



Classification of plutonic rock types (from IUGA, 1973, and Streckeisen, 1973). A, alkali feldspar; P, plagioclase feldspar; Q, quartz.

DESCRIPTION OF MAP UNITS

VERY YOUNG SURFICIAL DEPOSITS—Sediment recently transported and deposited in channels and washes, on surfaces of alluvial fans and alluvial plains, and on hillslopes. Soil-profile development is non-existant. Includes:

Qaf **Artificial fill (late Holocene)—**Deposits of fill resulting from human construction or mining activities

YOUNG SURFICIAL DEPOSITS—Sedimentary units that are slightly consolidated to cemented and slightly to moderately dissected. Alluvial fan deposits (Qyf series) typically have high coarse:fine clast ratios. Younger surficial units have upper surfaces that are capped by slight to moderately developed pedogenic-soil profiles (A/C to $A/AC/B_{cambric}C_{ox}$ profiles). Includes:

Qyf **Young alluvial fan deposits (Holocene and late Pleistocene)—**Gray-hued sand and cobble- and gravel-sand deposits derived from lithicly diverse sedimentary units in the Temescal Valley. In Mockingbird Canyon derived mainly from granitic rock

Qya **Young axial channel deposits (Holocene and late Pleistocene)—**Gray, unconsolidated alluvium consisting of fine-grained sand and silt. Occurs in Temescal Valley and channels in dissected very old alluvial fan deposits on the south side of Lake Mathews

Qyv **Young alluvial valley deposits (Holocene and late Pleistocene)—**Silty to sandy alluvium on valley floors; gray, unconsolidated

OLD SURFICIAL DEPOSITS—Sedimentary units that are moderately consolidated and slightly to moderately dissected. Older surficial deposits have upper surfaces that are capped by moderately to well-developed pedogenic soils ($A/AB/B/C_{ox}$ profiles and Bt horizons as much as 1 to 2 m thick and maximum hues in the range of 10YR 5/4 and 6/4 through 7.5YR 6/4 to 4/4 and mature Bt horizons reaching 5YR 5/6). Includes:

Qof **Old alluvial fan deposits (late to middle Pleistocene)—**Indurated, sandy and gravely alluvial fan deposits in Temescal Valley. Slightly to moderately dissected; reddish-brown. Some deposits include thin, discontinuous surface layer of Holocene alluvial fan material

Qoa **Old axial channel deposits (late to middle Pleistocene)—**Alluvial deposits consisting mainly of sand, but containing minor gravel and silt. Gray to reddish-brown, unconsolidated to indurated. Generally slightly dissected. Restricted to several isolated occurrances south of Lake Mathews

Qov **Old alluvial valley deposits (late to middle Pleistocene)—**Fluvial deposits along valley floors. Consists of moderately indurated, slightlydissected, sandy alluvium, containing lesser silt, and clay-bearingalluvium. Some deposits include thin alluvial deposits of Holocene age. Restricted to Gavilan Plateau area in eastern part of quadrangle

VERY OLD SURFICIAL DEPOSITS—Sediments that are slightly to well consolidated to indurated, and moderately to well dissected. Upper surfaces are capped by moderate to well developed pedogenic soils ($A/AB/B/C_{ox}$ profiles having Bt horizons as much as 2 to 3 m thick and maximum hues in the range 7.5YR 6/4 and 4/4 to 2.5YR 5/6)

Qvof **Very old alluvial fan deposits (early Pleistocene)—**Mostly well-dissected, well-indurated, reddish-brown sand deposits, containing minor gravel. Commonly contains duripans and locally silcretes. Primarily occurs in Temescal Valley and on the south side of Lake Mathews

$Qvof_1$ **Very old alluvial fan deposits, Unit 1 (early Pleistocene)—**Well-dissected, well-indurated, reddish-brown sand deposits, containing minor gravel. Commonly contains duripans and locally silcretes. Restricted to two small areas on west side of Temescal Valley

Qvoa **Very old axial channel deposits (early Pleistocene)—**Gravel, sand, and silt; reddish-brown, well-indurated, surfaces well-dissected

QTt **Conglomerate of Temescal Wash—**Boulder conglomerate, sand and gravel matrix. Fairly well indurated. Brown. Probably deposited on weathered Paleocene surface

Tlm **Lake Mathews Formation (Miocene)—**Mudstone, conglomerate, and poorly bedded sandstone; massively bedded, nonmarine

Tcgr **Rhyolite-clast conglomerate of Lake Mathews area (Miocene?)—**Cobble conglomerate; coarse-grained sandstone matrix, massive bedded, indurated. Cobble clasts include exotic red rhyolite

Tcga **Conglomerate of Arlington Mountain (Paleocene?)—**Cobble conglomerate composed of exotic welded tuff clasts with minor clasts of exotic quartzite. Found in two small areas north of Arlington Mountain in northwestern part of quadrangle

Tsi **Silverado Formation (Paleocene)—**Nonmarine and marine sandstone, and siltstone thinly overlying thick basal conglomerate. Basal conglomerate is thoroughly weathered, pale gray to reddish-brown, pebble conglomerate, very locally is a boulder conglomerate. Occurs in Temescal Valley

Rocks of Peninsular Ranges batholith

Val Verde pluton (Cretaceous)—Relatively uniform pluton composed of biotite-hornblende tonalite. Termed Perris quartz diorite by Dudley (1935), Val Verde tonalite by Osborn (1939), and included within Bonsall tonalite by Larsen (1948). Name Val Verde adopted by Morton (1999) based on detailed study of Osborn (1939) near Val Verde, a former settlement and railway siding midway between Perris and Riverside. Apparently steep-walled Val Verde pluton is eroded to mid-pluton level. Emplacement age of pluton 105.7 Ma_{id}. $^{40}Ar/^{39}Ar$ age of hornblende is 100 Ma, biotite 95 Ma and potassium feldspar 88.5 Ma (Snee, pers comm., 1999). Includes:

Kvt **Val Verde tonalite—**Gray-weathering, relatively homogenous, massive-to well-foliated, medium- to coarse-grained, hypautomorphic-granular biotite-hornblende tonalite; principal rock type of Val Verde pluton. Contains subequal biotite and hornblende, quartz and plagioclase. Potassium feldspar generally less than two percent of rock. Where present, foliation typically strikes northwest and dips moderately to steeply northeast. Nothern part of pluton contains younger, intermittently developed, northeast-striking foliation. In central part of pluton, tonalite is mostly massive, and contains few segregational masses of mesocratic to melanocratic tonalite. Elliptical- to pancake-shaped, meso- to melonocratic inclusions are common

Gavilan ring complex (Cretaceous)—Composite ring structure consisting of a variety of granitic rocks that range from monzogranite to tonalite. Informally named here for exposures in Gavilan Plateau area, Steele Peak and Lake Mathews 7.5' quadrangles. Western part of complex was termed Estelle quartz diorite and eastern part included in Perris quartz diorite by Dudley (1935). Western part of complex was termed Estelle tonalite and eastern part was included within Bonsall tonlaite by Larsen (1948). Hypersthene is a characteristic mineral of many rocks in complex. Based on texture, depth of erosion is greater in eastern part of compex than in western part. Rocks on west side of the complex commonly have hypabyssal texture and appear to grade into volcanic textrured rock. Several gold mines (e.g., Good Hope, Gavilan, and Santa Rosa mines), which constituted Pinacate mining district (Sampson, 1935), are located within complex. Gold apparently occurrs in arsenopyrite bearing quartz veins. Located in center of ring complex, but not part of it, is near-circular Arroyo del Toro pluton. Includes:

Kgt **Massive textured tonalite—**Brown weathering, massive, relatively heterogenous, hypershtene-bearing biotite-hornblende tonalite. Most abundant rock type in complex. Equant-shaped mesocratic to melanocratic inclusions are common. Zircon age is 112.9 Ma_{id} and 113.6 Ma_{ip}

Kgtf **Foliated tonalite—**Gray, medium-grained, foliated biotite-hornblende tonalite containing discoidal mafic inclusions. Most of tonalite lacks hypersthene. Unit restricted to northern part of complex

Cajalco pluton (Cretaceous)—Mostly biotite and biotite-hornblende monzogranite and granodiorite. Informally named here for extensive exposures in Cajalco area, Lake Mathews 7.5' quadrangle. Rocks of Cajalco pluton were included within Cajalco quartz monzonite by Dudley(1935) and within Woodson Mountain granodiorite by Larsen (1948). Unit is a shallow-level pluton emplaced by magmatic stoping within largely volcanic and volcanoclastic rocks. It is tilted eastward and eroded to progressively greater depths from west to east. Upper part of pluton contains a very prominent halo of tourmalinized rock. Zircon ages are 109.5 Ma_{id} and 112.6Ma_{ip} (Premo, pers. comm., 1999). Includes:

Kcto **Tourmalinized monzogranite and granodiorite—**Tourmalinized monzogranite and granodiorite that includes some tourmalinized vocanic rock in western part of pluton. Tourmaline is extremely fine-grained to aphanitic. Only rock that is essentially all tourmaline is mapped as Kcto. Tourmalinized rock is very resistant to erosion and stands out as small, bold, black hills, locally termed tourmaline 'blow-outs'

Kcg **Monzogranite—**Most of western part of pluton is medium-grained, equigranular, hypautomorphic-granular to subporphyritic monzogranite and subordinate granodiorite. Includes variable amounts of angular inclusions of volcanic rock

Kcgd **Granodiorite—**Most of eastern part of pluton is medium-grained, equigranular, hypautomorphic granular granodiorite and subordinate monzogranite. Granodiorite includes variable amounts of angular inclusions

Kct **Tonalite—**Masses of mafic biotite-hornblende tonalite. Represents deepest part of pluton

Kcgq **Granodiorite and quartz latite, undifferentiated—**Nearly equal amounts of putonic and volcanic rock; in some areas, unit is mostly quartz latite. Found near intrusive contacts with Mesozoic volcanic rocks

Kcgb **Granodiorite and gabbro, undifferentiated—**Mixed granodiorite and gabbro. In northern and northeastern part of pluton granitic rock contains high concentrations of stoped hornblende gabbro. In some areas granite and gabbro are intimately intermixed producing very heterogneous rock

Generic Cretaceous granitic rocks of the Peninsular Ranges batholith

Kgu **Granite, undifferentiated (Cretaceous)—**Leucocratic fine-to-coarse-grained massive granite and biotite monzongranite. Most is equigranular and consists of quartz and alkali feldspars. In leucocraitc granite, biotite is a widespread varietal mineral. Muscovite-bearing granite occurs at Bell Mountain, Romoland 7.5' quadrangle

Kt **Tonalite, undifferentiated (Cretaceous)—**Gray, medium-grained biotite-hornblende tonalite, typically foliated

Kgb **Gabbro (Cretaceous)—**Mainly hornblende gabbro. Includes Virginia quartz-norite and gabbro of Dudley (1935), and San Marcos gabbro of Larsen (1948). Typically brown-weathering, medium-to very coarse-grained hornblende gabbro; very large poikilitic hornblende crystals are common, and very locally gabbro is pegmatitic. Much of unit is quite heterogeneous in composition and texture

Khg **Heterogenous granitic rocks (Cretaceous)—**A wide variety of heterogenous granititc rocks occur in the Santa Ana Quadrangle. Some heterogneous assemblages include large proportions of schist and gneiss. Rocks in the Santa Ana Mountains include a mixture of monzogranite, granodiorite, tonalite, and gabbro. Tonalite composition rock is the most abundant rock type

End of rocks of the Peninsular Ranges batholith

Kvspi **Intrusive rocks associated with Santiago Peak Volcanics (Cretaceous)—**Shallow porphyritic intrusive rocks principally of intermediate composition. Composed of plagioclase, clinopyroxene and altered orthopyroxene. Silicic porphyries composed of plagioclase, quartz, and altered pyroxene and biotite (Herzig, 1991)

Kvem **Estelle Mountain volcanics of Herzig (1991) (Cretaceous)—**Heterogenous mixture of rhyolite and latite flows, shallow intrusive rocks, and volcaniclastic rocks; andesite is rare. Informally named by Herzig (1991) for exposures in vicinity of Estelle Mountain

Kvr **Rhyolite of Estelle Mountain volcanics of Herzig (1991) (Cretaceous)—**Rhyolite; relatively uniform and homogenous

Kvs **Intermixed Estelle Mountain volcanics of Herzig (1991) and Cretaceous? sedimentary rocks (Cretaceous?)—**Complexly intermixed volcanic and sedimentary rocks, which appear to be coeval; sedimentary rocks predominate

Mzu **Mesozoic metasedimentary rocks, undifferentiated (Mesozoic)—**Wide variety of low metamorphic grade metamorphic rocks

Mzs **Schist (Mesozoic)—**Biotite schist, in part gradational with phyllite. In lower metamorphic-grade rocks, consists of andalusite-biotite schist. In higher metamorphic-grade rocks, includes cordierite biotite schist, and in highest metamorphic-grade rocks sillimanite schist, and less commonly garnet bearing schist

GEOLOGIC SUMMARY

All but the southeast corner of the Lake Mathews quadrangle is in the Perris block, a relatively stable, rectangular-in-plan area located between the Elsinore and San Jacinto fault zones in the northern Peninsular Ranges Province. In the southwest corner of the quadrangle, a small triangular-shaped area that is part of the Santa Ana Mountains structural block, is separated from the Perris block by a short segment of the Elsinore fault zone. The active Elsinore fault zone, a major component of the San Andreas fault system, consists of a series of en echelon northwest-striking right lateral faults located in a graben-like structure.

There is limited relief within the quadrangle because of the presence of two prominent erosion surfaces. The lower Perris surface (about 1,500 feet elevation) has low relief and dominates the physiography of the northern half of the quadrangle. This surface is discontinuously covered by coarse-grained, clastic, non-marine sedimentary rocks of the middle Miocene-age Lake Mathews Formation. A higher Gavilan-Lakeview surface (about 2,100 feet elevation) occurs in the eastern part of the quadrangle, and is locally covered by small exposures of fluvial conglomerate that contain exotic clasts of red rhyolite.

The Lake Mathews quadrangle is underlain almost entirely by Cretaceous and older basement rocks. Two different types of metamorphic rocks are exposed in the quadrangle. In the northeast is a northwest trending exposure of amphibolite grade biotite-bearing schist of probable Mesozoic age. This schist separates massive textured granitic rocks to the west from foliated and layered granitic rocks to the east. The large expanse of metamorphic rock between Temescal Wash and Lake Mathews is low metamorphic grade, typically siliceous, but highly variable in composition.

Cretaceous plutonic rocks in the quadrangle are part of the composite Peninsular Ranges batholith, and represent a wide variety of mafic to intermediate composition granitic rocks. Most are massive-textured with the exception of the crudely foliated biotite-hornblende tonalite of the Val Verde pluton in the northeast corner of the quadarangle. The Cajalco pluton, which consists of biotite monzogranite, granodiorite and lesser amounts of biotite-hornblende granodiorite, by far, accounts for most of the granitic rocks in the quadrangle. It is a shallow level pluton emplaced by magmatic stoping into largely intermediate composition volcanic and volcanoclasitic rocks and metamorphic rocks in its western and southern extent and into gabbroic rocks in its northern extent. The pluton appears to be tilted up to the northeast with the texture of the rock changing from subporphyritic rock containing beta-quartz-appearing phenocrysts in the southwestern part of the pluton to coarser-grained hypautomoprhic texture rock in the eastern part. Located in the upper part of the pluton and in overlying wall rock in the shallow western part of the pluton is widespread metasomatic tourmaline rock. Locally parts of the pluton have been completely replaced by tourmaline but more commonly tourmaline occurs in descrete thin zones, generally along joints. Some of the larger masses of tourmaline rock, locally termed tourmaline 'blowouts', contain cassiterite and sulfides. One large mass of cassiterite-bearing tourmaline rock supported a tin mining and smelting operation.

In the southeast corner of the quadrangle is the northwest part of the Gavilan ring complex. This shallow plutonic complex centered southeast of the quadrangle is predominantly tonalitic composition, characterized by the presence of hypersthene, which is rarely found in Peninsular Ranges batholithic rocks of intermediate composition.

Most of the southern part of the quadrangle is underlain by siliceous volcanic and volcanoclastic rocks considered to be coeval with the batholith and which are considered to represent the supra-part of the batholithic magmatism. These rocks generally range in composition from rhyolite to andesite, but latite is probably the predominant composition.

Paleocene continental rocks of the Silverado Formation occur within the Elsinore fault zone and nearby on the adjacent Perris block. Clay-rich parts of the Silveradro Formation have been mined for industrial clay. Near Arlington Mountain, in the northwest part of the quadrangle, are two very small occurrences of conglomerate that consist of exotic welded-tuff clasts and a few exotic bedded quartzite clasts. Extensive Quaternary alluvial deposits are found along the south side of Lake Mathews and in the Temescal Valley along the Elsinore fault zone.

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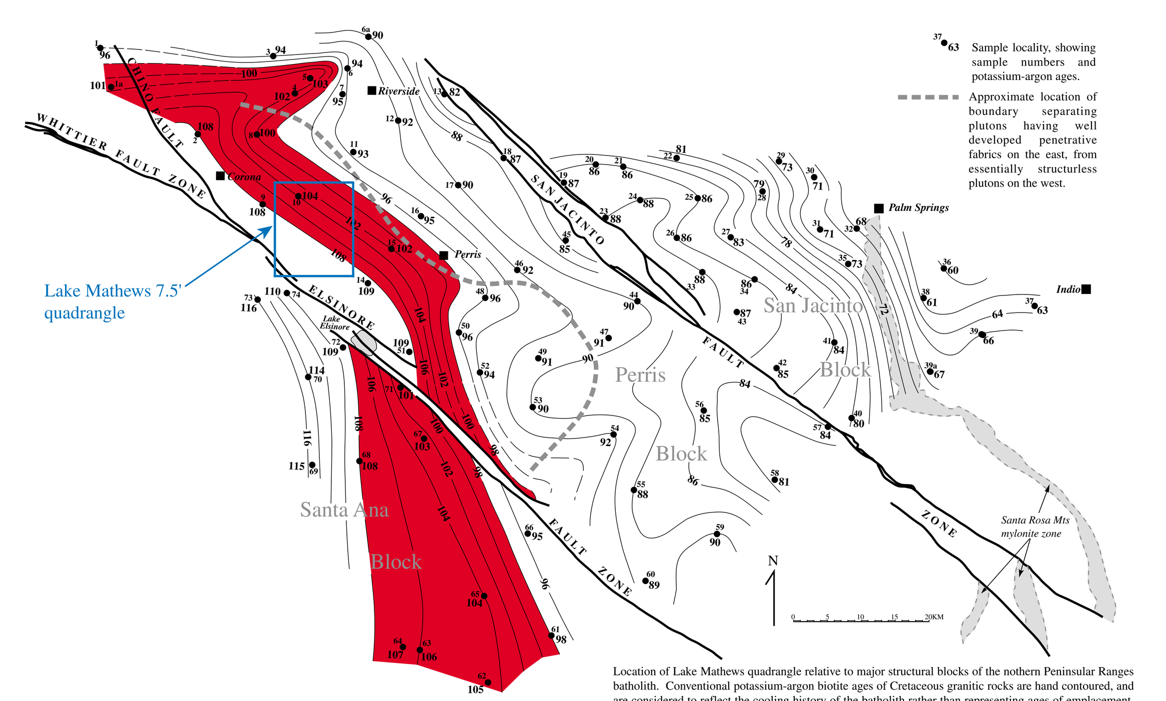

Location of Lake Mathews quadrangle relative to major structural blocks of the nothern Peninsular Ranges batholith. Conventional potassium-argon biotite ages of Cretaceous granitic rocks are hand contoured, and are considered to reflect the cooling history of the batholith rather than representing ages of emplacement. Contouring of ages in each of the three structural blocks separated by the Elsinore and San Jacinto fault zones, was done independently of ages in adjacent blocks. Red band shows offset of 98 to 108 contours across Elsinore fault zone. Faults as shown are simplified from Rogers, 1965.