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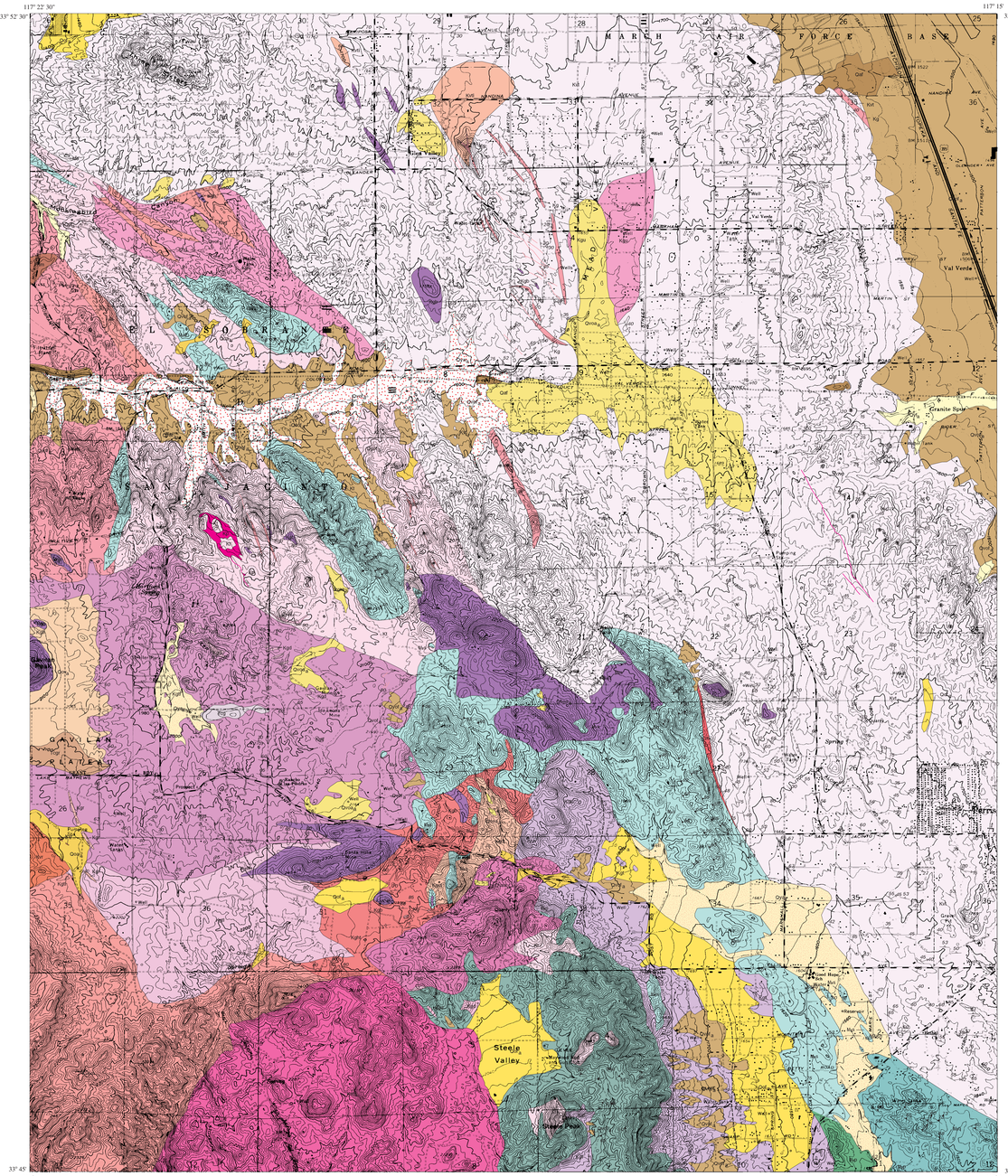
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 01-449



Base from U.S. Geological Survey
7.5' Steele Peak quadrangle, 1967
Polyconic projection

Geology mapped by D.M. Morton, 1991, 1995-6

SCALE 1:24,000

1 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET

GEOLOGIC MAP OF THE STEELE PEAK 7.5' QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA

Version 1.0

By

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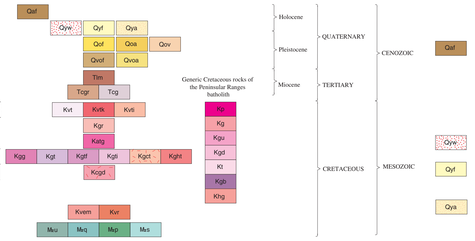
CORRELATION OF MAP UNITS



On some SCAMP geologic map plots, including the Steele Peak 7.5' quadrangle, characteristic grain size information is displayed using subscripted alpha characters (e.g. Qya_g, Qoa_s), 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_{sr} for ion probe analyses.

Contact—Generally located within ±15 meters.

Fault inferred—High angle. Dip-slip component is unknown, but probably reflects valley- highland relations. Dashed where located within ±30 m.

Kp — pegmatite dike.

Kg — granite dike.

Strike and dip of bedding

70 **Inclined**

Vertical

Horizontal

Strike and dip of igneous foliation

70 **Inclined**

Vertical

Strike and dip of metamorphic foliation

70 **Inclined**

Vertical

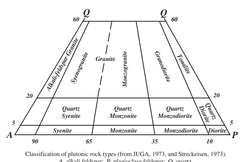
Bearing and plunge of linear features

Minor fold axis

70 **Igneous**

70 **Metamorphic**

SURROUNDING 7.5' QUADRANGLES



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

LOCATION MAP

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, firm, or product names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

This map was printed on an electronic plotter directly from digital files. Dimensional calibration may vary between electronic plotters and between X and Y directions on the same plotter, and paper may change size due to atmospheric conditions; therefore, scale and proportions may not be true on plots of this map.

Digital files available on World Wide Web at http://geopubs.wr.usgs.gov

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:

Artificial fill (late Holocene)—Deposits of fill resulting from human construction; restricted to construction activities on March Air Force Base in northeastern part of quadrangle and Colorado River aqueduct construction near Cajalco Road.

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:

Young alluvial wash deposits (Holocene and late Pleistocene)—Sand and gravelly sand deposits; unconsolidated. Restricted to drainage roughly followed by Cajalco Road

Young alluvial fan deposits (Holocene and late Pleistocene)—Gray-hued arkosic, sandy and gravel-sand deposits derived from local Peninsular Ranges batholith granitic bedrock. Limited distribution along eastern and western edges of quadrangle

Young axial channel deposits (Holocene and late Pleistocene)—Gray, unconsolidated alluvium consisting of medium- to fine-grained sand and lesser gravel and silt. Found 2 km southwest of Perris, and in western part of quadrangle, east of Gavilan Road

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/BC$_{ox}$ 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:

Old alluvial fan deposits (late to middle Pleistocene)—Indurated, sandy alluvial fan deposits, locally contains matrix supported gravel. Widely distributed in southern part of quadrangle. Most of unit is slightly to moderately dissected and reddish-brown. Some Qof includes thin, discontinuous surface layer of Holocene alluvial fan material

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.

Old alluvial valley deposits (late to middle Pleistocene)—Fluvial deposits along valley floors. Consists of moderately indurated, slightly dissected, sandy alluvium, containing lesser silt, and clay-bearing alluvium. In some areas, unit includes thin alluvial deposits of Holocene age. Restricted to Gavilan Plateau area in western 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/BC$_{ox}$ 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)

Very old alluvial fan deposits (early Pleistocene)—Mostly well-dissected, well-indurated, reddish-brown sand deposits. Commonly contains duripans and locally silcretes. Covers large areas adjacent to U.S. Highway 215 in northeastern part of quadrangle and flanking drainage followed by Cajalco Road

Very old axial channel deposits (early Pleistocene)—Gravel, sand, and silt; reddish-brown, well-indurated, surfaces well-dissected. Extensively developed in and south of Mead Valley

Lake Mathews Formation (Miocene)—Mudstone, minor conglomerate, and poorly bedded sandstone; massively bedded, nonmarine. Restricted to small area along Mockingbird Canyon Road along western edge of quadrangle

Rhyolite-clast conglomerate of Lake Mathews area (Miocene?)—Cobble conglomerate; coarse-grained sandstone matrix, massively bedded, indurated. Cobble clasts are exotic red rhyolite. Exposed over small area near Lake Mathews Drive along western edge of quadrangle

Conglomerate in the Lake Mathews area (Miocene?)—Cobble conglomerate; coarse-grained sandstone matrix, massively bedded, indurated. Lacks red rhyolite clasts of Tcgr. Restricted to small area east of Gavilan Road in western part of quadrangle

Rocks of the 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 the pluton is 105.7 Ma_{id}. $^{40}Ar/^{39}Ar$ age of hornblende is 100 Ma, biotite 95 Ma and potassium feldspar 88.5 Ma. Includes:

Val Verde tonalite—Gray-weathering, relatively homogeneous, 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. Northern 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 melanocratic inclusions are common

Potassium feldspar-bearing tonalite—Biotite-hornblende tonalite; contains small amounts of potassium feldspar, heterogeneous, occurs as a selvage along part of the western contact.

Inclusion-rich tonalite—Tonalite; contains abundant melanocratic inclusions, most with compositionally gradational borders. Forms medium- and small-size masses in Val Verde tonalite in northern part of quadrangle

Granophyre (Cretaceous)—Gray, aphanitic to very fine-grained, granophyric textured granitic rock. Composed of granophyric intergrowths of quartz and alkali feldspars. Contains some fine-grained pyrite which oxidizes to give rock rusty appearance. Restricted to small dike-form bodies in southern part of Gavilan Plateau

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 tonalite by Larsen (1948). Hypersthene is characteristic mineral of many rocks in complex. Based on texture, depth of erosion is greater in eastern part of complex than in western part. Rocks on west side of the complex commonly have hypabyssal texture and appear to grade into volcanic textured 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 occurs in arsenopyrite bearing quartz veins. Located in center of ring complex, but not part of it, is near-circular Arroyo del Toro pluton. Includes:

Hypersthene monzogranite—Massive hypersthene monzogranite; nearly black where fresh, dark-brown-weathering. Contains biotite, hornblende, hypersthene, and clinopyroxene as mafic phases. Rock has sparse small mesocratic inclusions, which are commonly lighter colored than monzogranite. Quarried as "black granite"building stone in past. Zircon age is 109 Ma_{id} and 106 Ma_{sr}. $^{40}Ar/^{39}Ar$ age of biotite is 104.5 Ma and potassium feldspar 99.3 Ma

Massive textured tonalite—Brown-weathering, massive, relatively heterogeneous, hypersthene-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_{sr}

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

Tonalite containing abundant mesocratic inclusions—Moderately fine-grained tonalite containing abundant, small, platy mesocratic inclusions. Tonalite lacks hypersthene, which is common to most rocks of complex. Forms large mass southeast of Gavilan Plateau. Zircon age is 108.6 Ma_{id} and 109.1 Ma_{sr}. $^{40}Ar/^{39}Ar$ age of hornblende is 106 Ma, biotite 103 Ma and potassium feldspar 98.5 Ma

Coarse-grained biotite-hornblende tonalite—Massive to foliated, relatively light colored, coarse-grained tonalite that weathers to form very large boulders of disintegration. Restricted to two small masses east of Santa Rosa Mine

Heterogeneous tonalite—Medium-grained, foliated biotite-hornblende tonalite, containing moderately abundant to abundant, small, biotite-hornblende granodiorite intrusions. Rock contains moderately abundant elliptical- to pancake-shaped, mesocratic to melanocratic inclusions. Restricted to single irregular-shaped mass east of Santa Rosa Mine

Granodiorite of Arroyo del Toro pluton (Cretaceous)—Light gray, medium-grained, massive, very homogeneous, and inclusion-free biotite-hornblende granodiorite. Some of the rock in the western part of the pluton is slightly porphyritic. Informally named here for Arroyo del Toro, located in center part of pluton. Termed Steele Valley granodiorite by Dudley(1935) and included by Larsen(1948) within Woodson Mountain granodiorite. Near circular Arroyo del Toro is located in center of Gavilan ring complex, but based on compositional differences, apparently is not part of complex. Zircon ages of the pluton are 108.6 Ma_{id} and 111 Ma_{sr}. $^{40}Ar/^{39}Ar$ biotite age is 104.3 Ma and potassium feldspar 98.5 Ma.

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

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

Generic Cretaceous granitic rocks of the Peninsular Ranges batholith

Granitic Pegmatite dikes (Cretaceous)—Leucocratic, mostly tabular, pegmatitic-textured granitic dikes. Most dikes range in thickness from a few centimeters to over a meter. Larger dikes are typically zoned compositionally and texturally, having a border and wall zone consisting of coarse-grained biotite, quartz, and alkali feldspars. Intermediate zone consists of large to giant crystals of quartz and alkali feldspars, and commonly contain muscovite, schorl, and garnet. Core zone consists of quartz and alkali feldspars. Line-rock layering is rare.

Granitic dikes, (Cretaceous)—Includes texturally diverse group of leucocratic granitic dikes composed mainly of quartz and alkali feldspars. Dikes range in thickness from few centimeters to over a meter and are up to several hundred meters in length. Most are tabular; some are texturally and compositionally unzoned, irregular-shaped bodies. Some dike rock has a foliated or gneissoid fabric. Textures are mostly coarse grained and equigranular granitic but range from aplitic to pegmatitic. Accessory minerals include biotite, muscovite, and garnet

Undifferentiated granite (Cretaceous)—Leucocratic fine-to coarse-grained massive granite and biotite monzogranite. Most is equigranular and consists of quartz and alkali feldspars. In leucocratic granite, biotite is a widespread varietal mineral. Forms large masses between Mockingbird Canyon and Cajalco Road, and east of Mead Valley

Granodiorite, undifferentiated (Cretaceous)—Biotite and hornblende-biotite granodiorite, undifferentiated. Most is massive and medium grained. Forms numerous small bodies in foliated tonalite unit (Kgtf) of Gavilan ring complex, and in Mesozoic metasedimentary rocks, undifferentiated unit (Mzu)

Tonalite, undifferentiated (Cretaceous)—Gray, medium-grained biotite-hornblende tonalite, typically foliated. Forms large masses in mountains north and south of Cajalco Road. Differs from Val Verde tonalite by generally finer grain size, from Gavilan tonalite by lack of hypersthene, and from both by greater heterogenity

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 locally gabbro is pegmatitic. Much of unit is quite heterogeneous with respect to composition and texture. Includes noritic and dioritic composition rocks. Forms large mass in mountains 2 km east of Gavilan Mine, and another at Santa Rosa Mine; several small bodies throughout quadrangle

Heterogeneous granitic rocks (Cretaceous)—Heterogeneous mixture of monzogranite, granodiorite, tonalite, gabbro, schist and gneiss; tonalite composition rock is most abundant. Forms elongate bodies in undifferentiated granite unit (Kgu)

End of rocks of the Peninsular Ranges batholith

Estelle Mountain volcanics of Herzig (1991) (Cretaceous)—Heterogeneous 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, Lake Mathews 7.5' quadrangle. These rocks were termed Temescal dacite-porphyry by Dudley (1935) and Temescal Wash quartz latite porphyry by Larsen (1948). Zircon age of rock from unit collected west of Lake Mathews, Lake Mathews 7.5' quadrangle, is 125.8 Ma (Anderson, 1991)

Rhyolite of Estelle Mountains volcanics of Herzig (1991) (Cretaceous)—Rhyolite; relatively uniform and homogeneous. Exposed in foothills south of Gavilan Plateau along west edge of quadrangle

Mesozoic metasedimentary rocks, undifferentiated (Mesozoic)—Wide variety of low-to high-metamorphic-grade rocks, most of which include abundant biotite schist. Forms large mass surrounding most of Steele Valley in southern part of quadrangle

Quartz-rich rocks (Mesozoic)—Quartzite and quartz-rich metasandstone. Forms large northwest-striking mass in southeastern corner of quadrangle

Phyllite (Mesozoic)—Fissile black phyllite, typically having sheen produced by very fine-grained white mica on s-surface; locally contains small elongate prisms of fine-grained white mica, which may be pseudomorphs after chiastolite. Forms small mass west of quartz-rich rocks unit (Mzq) in southeastern corner of quadrangle

Schist (Mesozoic)—Biotite schist, in part gradational with phyllite unit (Mzp). 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. Forms wide-spread belt striking northwest diagonally across most of quadrangle

GEOLOGIC SUMMARY

The Steele Peak quadrangle is located in the northern part of the Peninsular Ranges Province within the central part of the Perris block, a relatively stable, rectangular in plan area located between the Elsinore and San Jacinto fault zones.

The quadrangle is underlain by Cretaceous and older basement rocks. Cretaceous plutonic rocks are part of the composite Peninsular Ranges batholith. A wide variety of mafic to intermediate composition granitic rocks occur in the quadrangle, and are mainly of tonalitic composition, but range from monzogranite to gabbro. Most rock units are faintly to intensely foliated, compositionally heterogenous, and contain varying amounts of meso-and melanocratic discoidal-shaped inclusions. Some rocks are composed almost wholly of inclusion material and some are migmatitic. Included within these granitic rocks are septa not shown on the geologic map of Paleozoic(?) schist of upper amphibolite metamorphic grade.

Metamorphic rocks of primarily Mesozoic age occur in a discontinuous belt extending from the southeast to the northwest corner of the quadrangle. Most of these rocks are well foliated biotite-bearing schist. Near the southern edge of the quadrangle phyllitic rocks dominate. Northwestward, metamorphism increases from greenschist or sub-greenschist grade near the south edge of the quadrangle to sillimanite-bearing schist of upper amphibolite grade in the vicinity of Cajalco Road.

Biotite-hornblende tonalite of the relatively large Val Verde pluton dominates the northeastern half of the quadrangle. In most places this tonalite has a northwest oriented crude to well developed planar fabric produced by oriented biotite and hornblende. Schlieren and massive clots of mafic tonalite locally occur. Discoidal-to pancake-shaped mafic inclusions are widespread and are oriented in the plane defined by the biotite and hornblende. This planar fabric typically dips moderately to the northeast, but locally shallows to a horizontal to subhorizontal planar fabric, or fades to an isotropic fabric.

West of the Val Verde pluton are a number of plutons having fabrics ranging from massive isotropic to foliated. Compositions of these plutons range from monzogranite to pyroxene gabbro. Most of these granitic rocks fall within the composition range from monzogranite to tonalite, and are part of the composite Gavilan ring complex. Hypersthene is a characteristic mineral of most of the rocks of this complex, which includes black hypersthene-bearing monzogranite that has been quarried as a source of 'black granite' building stone. Several inactive gold mines, e.g., Goodhope, Gavilan, and Santa Rosa mines that constituted the Pinacate mining district, are located in the Gavilan ring complex.

In the center of the Gavilan ring complex is the near circular Arroyo del Toro pluton, a massive-textured granodiorite essentially devoid of inclusions. Only the northern half of this pluton is located in the quadrangle. Some rock of this pluton was quarried for building stone. The southwestern corner of the quadrangle is underlain by siliceous volcanic and volcanoclastic rock considered to be coeval with the batholith and be the supra-part of the batholithic magmatism. Most of these volcanic rocks range in composition from rhyolite to andesite with latitic composition rocks predominating.

In the northeastern part of the quadrangle is the proximal parts of a Pleistocene alluvial fan complex.

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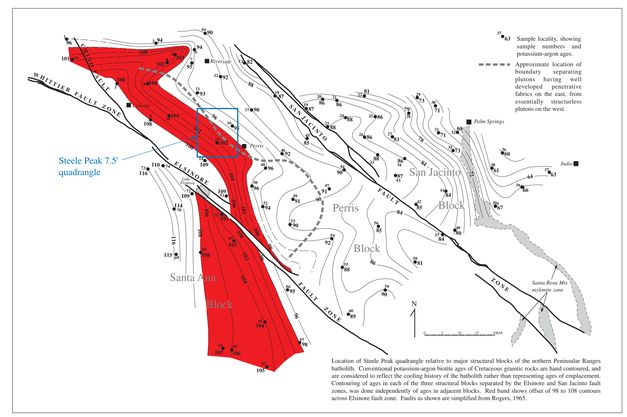

Location of Steele Peak quadrangle relative to major structural blocks of the nothern Peninsular Ranges batholith. Conventional potassium-argon biotite ages of Cretaceous granitic rocks are hand contoured, and are considered to reflect the cooling history of the batholith rather than representing ages 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.