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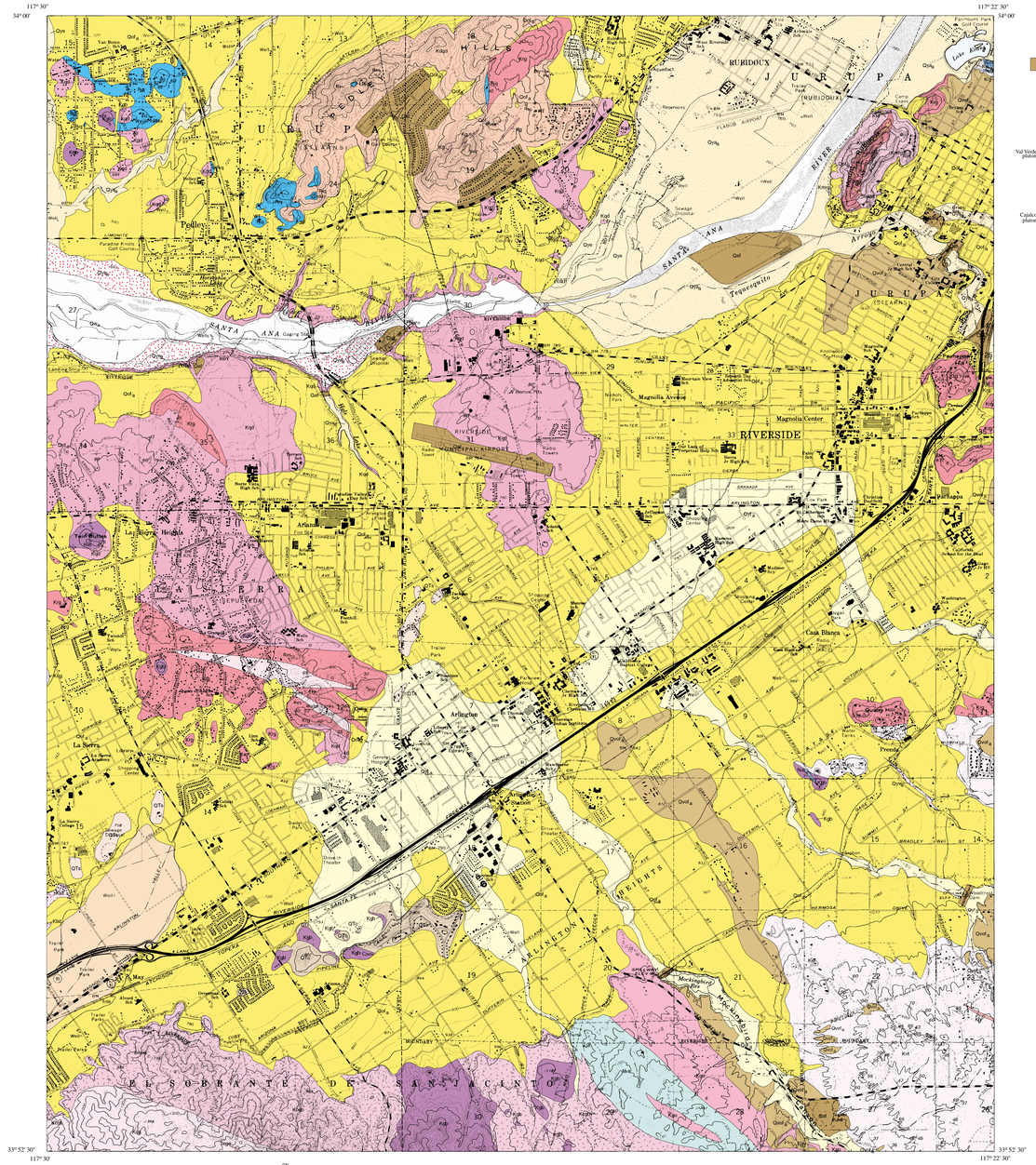

GEOLOGIC MAP OF THE RIVERSIDE WEST 7.5' QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA

Version 1.0

By

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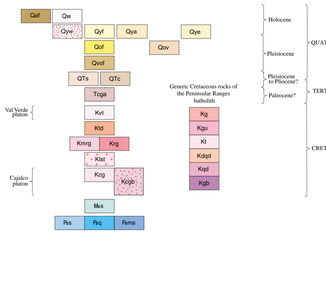
CORRELATION OF MAP UNITS



On some SCAMP geologic map plots, including the Riverside West 7.5' quadrangle, characteristic grain size information is displayed using subscripted map unit symbol suffix characters (e.g. Qyf_g, Qvo_{cl}), 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

Strike and dip of igneous foliation

70 **Inclined**

Vertical

Strike and dip of metamorphic foliation

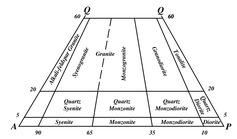
70 **Inclined**

Vertical

Bearing and plunge of linear features

70 **Igneous**

SURROUNDING 7.5' QUADRANGLES



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

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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:

Qaf **Artificial fill (late Holocene)**—Deposits of fill resulting from human construction or mining activities. Largest areas are in north-central part of quadrangle related to grading associated with residential development and airport runway construction

Qw **Very young wash deposits (late Holocene)**—Deposits of active alluvium; confined to main channel of Santa Ana River. Consists mostly of unconsolidated sand and lesser gravel in ephemeral river channel. Sediment subject to localized reworking mainly during winter months

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:

Qye **Young wash deposits (Holocene and latest Pleistocene)**—Unconsolidated cobble to sandy alluvium of inactive parts of Santa Ana River channel. Forms terraces slightly elevated above main channel. Mostly gray and poorly sorted

Qyf **Young alluvial fan deposits (Holocene and late Pleistocene)**—Gray-brown, unconsolidated sand and pebble- to gravel-sand deposits derived from lithicly diverse sedimentary units. Arkosic sand derived from varied metamorphic and granitic lithologies of Peninsular Ranges. All deposits are located south of Santa Ana River

Qya **Young axial channel deposits (Holocene and late Pleistocene)**—Gray, unconsolidated alluvium consisting of coarse- to fine-grained sand and lesser gravel and silt flanking Santa Ana River channel and its tributaries in northeastern part of quadrangle. Forms terraces slightly elevated above main Santa Ana River channel

Qye **Young colian deposits (Holocene and late Pleistocene)**—Sand dune deposits, inactive except for very minor amount of sediment movement during Santa Ana wind storms. Restricted to two areas on east and southeast sides of Pedley Hills. Chiefly unconsolidated, moderately well sorted fine to medium grained sand

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_{CM} 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, to slightly indurated, sandy, alluvial fan deposits. Covers extensive areas north and south of Santa Ana River. Most of unit is slightly to moderately dissected and reddish-brown. Locally includes thin, discontinuous surface layer of Holocene alluvial fan material

Qov **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. Locally capped by thin, discontinuous alluvial deposits of Holocene age. Restricted to single, broad, poorly defined channel south of La Sierra in southwestern 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_{CM} 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 5/8)

Qvof **Very old alluvial fan deposits (early Pleistocene)**—Mostly well-dissected, well-indurated, reddish-brown sand deposits. Commonly contains duripans and locally silcretes. Forms several isolated areas of exposure in eastern half of quadrangle. Deposits flanking bedrock slopes typically have well developed, dissected surfaces

QTs **Unnamed sedimentary rocks in Riverside and Corona areas (early Pleistocene to late Pliocene?)**—In Riverside area, sandstone and conglomerate containing clasts derived from San Bernardino Mountains; nonmarine. Forms several limited outcrops west of Arlington. Southeast of Riverside, in Riverside East quadrangle, unit contains locally derived clasts

QTc **Conglomeratic sedimentary rocks of Riverside West 7.5' quadrangle (early Pleistocene to late Pliocene?)**—Nonmarine conglomerate. Upper part contains boulders derived from Peninsular Ranges; lower part contains cobbles derived from San Bernardino Mountains

Tcga **Conglomerate at Arlington Mountain (Paleocene?)**—Cobble conglomerate; composed of exotic welded tuff clasts. Forms single, 100-m-long exposure at southern edge of quadrangle

Rocks of Peninsular Ranges batholith

Kvt **Val Verde pluton (Cretaceous)**—Relatively uniform pluton composed of biotite-hornblende tonalite, but subdivided into three distinct units in quadrangle to southwest. 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_{ip}. $^{40}Ar/^{39}Ar$ age of hornblende is 100 Ma, biotite 95 Ma and potassium feldspar 88.5 Ma. Within Riverside West quadrangle, represented only by:

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. In central part of pluton, tonalite is mostly massive, and contains scattered segregational masses of mesocratic to melanocratic tonalite. Elliptical- to puncake-shaped, mesocratic to melanocratic inclusions are common

Kld **Tonalite dikes of Mount Rubidoux (Cretaceous)**—Light gray, fine- to medium-grained, massive to foliated, hornblende-clinopyroxene-hypersthene-biotite tonalite. Contains discoidal mafic inclusions

Kmrg **Granite of Mount Rubidoux (Cretaceous)**—Massive granite characterized by coarse grain size and presence of hypersthene and fayalitic olivine. Area of exposure limited to Mount Rubidoux. Termed "coarse leucogranite of Rubidoux Mountain" by Larsen (1948). Inequigranular; average grain size 5 mm; Potassium feldspar crystals are up to 12 mm in length. Biotite and hornblende aggregate about 5 percent and hypersthene and olivine are sparser constituents. Most of granite is devoid of inclusions. Zircon ages are 109 Ma_{ip} and 107.3 Ma_{ip} and $^{40}Ar/^{39}Ar$ age of biotite is 98 Ma and potassium feldspar 93 Ma

Krg **Granite of the Riverside area (Cretaceous)**—Medium- to coarse-grained, massive to faintly foliated, leucocratic biotite granite. Contains about 1 to 3 percent biotite. Inclusions are sparse or absent except locally in western part of body, where rock contains 2 to 8 percent biotite and sparse to abundant inclusions of quartz diorite, granodiorite, and fine-grained mafic rock. At Mount Rubidoux, west of quadrangle, rocks contain sparse hypersthene and fayalitic olivine and moderately abundant equant inclusions of dark-gray fine-grained rock. At Mount Rubidoux rock was included in "fine leucogranite of Rubidoux Mountain" by Larsen (1948)

Klst **La Sierra Tonalite (Cretaceous)**—Massive biotite tonalite. Restricted to small area south of La Sierra, but much more extensive in quadrangle to west. Fairly dark-colored compared to other units in region containing no hornblende, but alteration found in much of rock tends to darken it. Medium- to coarse-grained; structureless. Much of tonalite is altered to secondary minerals, especially epidote and chlorite, and contains localized zones that are thoroughly altered to epidote, quartz, and chlorite; some highly altered rocks contain tourmaline and sulfide minerals. Named by Larsen (1948) for exposures in vicinity of La Sierra

Kcg **Cajalco pluton (Cretaceous)**—Mostly biotite and biotite-hornblende monzogranite and granodiorite. Informally named for exposures in Cajalco area, Lake Mathews 7.5' quadrangle (Morton, 1999). Rocks of Cajalco pluton were included within Cajalco quartz monzonite by Dudley (1935) and within Woodson Mountain granodiorite by Larsen (1948). Body 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. South of quadrangle, upper part of pluton contains very prominent halo of highly tourmalinized rock. Zircon ages are 109.5 Ma_{ip} and 112.6 Ma_{ip}. Within quadrangle includes:

Monzogranite—Medium-grained, equigranular, hypautomorphic-granular to subporphyritic monzogranite and subordinate granodiorite; in northern and northeastern part of pluton, including Riverside West quadrangle, stoped masses of hornblende gabbro are abundant. Unit includes relatively fine-grained leucogranite. Westward, includes irregularly variable amounts of angular inclusions mostly, if not entirely, derived from stoping of Cretaceous Estelle Mountain volcanics

Kcgb **Granodiorite and gabbro, undifferentiated—**Mixed granodiorite and gabbro. Restricted to southern part of quadrangle, where granitic rock contains high concentrations of stoped hornblende gabbro. In some areas, including Riverside West quadrangle, granite and gabbro are intimately intermixed producing very heterogeneous rock

Generic Cretaceous granitic rocks of the Peninsular Ranges batholith

Kg **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 rocks have 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

Kgu **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 mass at southern edge of quadrangle; Intrudes Mesozoic schist (**Mzs**)

Ki **Tonalite, undifferentiated (Cretaceous)—**Mainly biotite-hornblende tonalite not associated with specific plutons. Gray, medium-grained, typically foliated. Occurs as dike-form body west of Arlington

Kdqd **Diorite and quartz diorite, undifferentiated (Cretaceous)—**Dark gray, medium-to coarse-grained mixtures of hornblende diorite and biotite and biotite-hornblende quartz diorite. Underlies most of Pedley Hills

Kqd **Quartz diorite (Cretaceous)—**Medium- to coarse-grained biotite-hornblende quartz diorite. Most is slightly to well foliated and contains discoidal to pancake-shaped melanocratic inclusions in foliation plane. Grades into diorite and biotite-hornblende tonalite. Exposed extensively in La Sierra Heights area and around Riverside airport

Kgb **Gabbro (Cretaceous)—**Mainly hornblende gabbro. 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 higly heterogeneous with respect to composition and texture. Includes noritic and dioritic composition rocks. Largest exposures along south edge of quadrangle, but smaller bodies found throughout quadrangle

End rocks of the Peninsular Ranges batholith

Mks **Schist (Mesozoic)—**Biotite schist; locally grades to 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

Pss **Biotite Schist (Paleozoic?)—**Medium-to dark-gray, fine-grained biotite schist and biotite-quartz-feldspar schist. Locally contains sillimanite and cordierite. Commonly includes minor amounts of quartzite and calc-silicate hornfels. Limited to single exposure south of Quarry Hill

Psq **Impure quartzite (Paleozoic?)—**Quartzite; impure, light-gray to light-greenish-gray, fine-to medium-grained, layered to massive. Limited exposures west of Pedley Hills

Pzms **Marble and schist, undifferentiated (Paleozoic?)—**Intermixed marble, calc-silicate rock, and biotite schist. Restricted to small hill south of Lake Evans in northeast corner of quadrangle

GEOLOGIC SUMMARY

The Riverside West quadrangle is located in the northern part of 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.

Most of the quadrangle is covered by a variable thickness of Quaternary alluvial material deposited on Cretaceous and older basement rocks. In the southern part of the quadrangle, northwest trending amphibolite grade biotite-bearing schist of Mesozoic or older age separates massive textured granitic rocks to the west from foliated and layered granitic rocks to the east. In the northern part of the quadrangle, scattered exposures of amphibolite grade biotite schist, impure quartzite, marble, calc-silicate rock, and skarn are probably Paleozoic. In the northeast corner of the quadrangle probable Paleozoic marble, which was quarried for local use, is intruded by tonalite, producing pyroxene-hornfels grade garnet-pyroxene skarn.

The wide variety of mafic to silicic Cretaceous plutonic rocks in the quadrangle, are part of the composite Peninsular Ranges batholith. Hornblende and pyroxene gabbro, oldest of the plutonic rocks, occurs as a number of scattered small bodies. The relatively large gabbro body located at the south edge of the quadrangle extends for some distance south into the Lake Mathews quadrangle. On both sides of this body, the granodiorite of the Cajalco pluton contains numerous stoped masses of gabbro. Most of the granitic rock in the quadrangle is tonalitic with a faint to pronounced planar fabric produced by oriented biotite and hornblende. This planar structure in the northern two-thirds of the quadrangle typically strikes east, distinct from the northwest strike of planar structures common to most of the Peninsular Ranges batholith. The northwest part of the extensive, relatively uniform medium- to coarse-grained biotite-hornblende tonalite the Val Verde pluton underlies the southeast corner of the quadrangle. Relatively mafic hornblende and biotite-hornblende quartz diorite occurs in the central part of the quadrangle, and heterogeneous tonalite underlies most of the Pedley Hills in the north part of the quadrangle. In the southwestern part of the quadrangle, the northeastern extent of the Cajalco pluton consists of biotite monzogranite and granodiorite and

lesser amounts of biotite-hornblende granodiorite. Common to this part of the Cajalco pluton are concentrated large and small stoped blocks of gabbro, most too small to be mapped at 1:24,000-scale. Numerous, massive to foliated, leucocratic biotite granite bodies are scattered thoughout the quadrangle. At Mount Rubidoux, very distinctive, dark colored, massive, coarse-grained granite contains hypersthene and fayalitic-olivine in addition to biotite and hornblende.

Located along the southwest boundary of the quadrangle is a very small occurrence of Paleocene? conglomerate that consists of exotic welded-tuff clasts and a few exotic bedded quartzite clasts. Several small areas of late Pliocene or early Pleistocene, slightly indurated fluvial sand, gravel, and cobbles occur in the Arlington area. Clasts in the deposits north of State Highway 91 consist entirely of San Bernardino Mountains lithologies. The deposits south of State Highway 91 consist of an upper section composed of slightly indurated bouldery gravel and sand derived from nearby Peninsular Ranges basement rocks and a lower section composed of clasts of San Bernardino Mountains lithologies. The patches of sediments containing San Bernardino Mountains lithologies are interpreted as being erosional remnants of paleo-Santa Ana River deposits, deposited when the river course was further south than its present day course.

Most of the lower elevation areas of the quadrangle are covered by Pleistocene alluvial fan deposits. These fans were graded to the location of the present day course of the Santa Ana River but at a slightly higher elevation than the elevation of the present day river grade.

The eastern part of the Santa Ana River includes a relatively broad young fluvial expanse and the western part is a relatively narrow alluvial channel incised into bedrock.

REFERENCES

Dudley, P.H., 1935, Geology of a portion of the Perris block, southern California: California Jour. of Mines and Geology. v. 31, no. 4, p. 487-506.

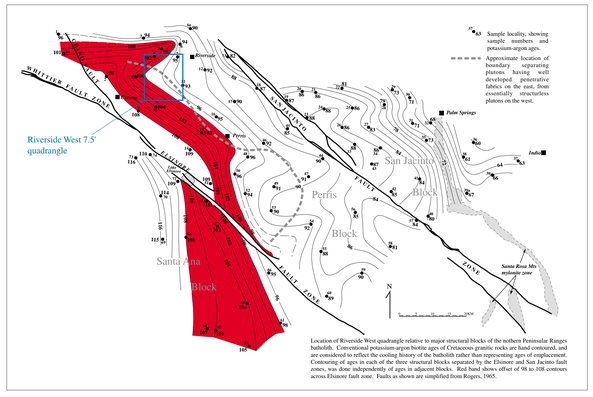
Larsen, E.S., 1948, Batholith and associated rocks of Corona, Elsinore, and San Luis Rey quadrangles, southern California: Geol. Soc. of America Mem. 29, 182 p.

Morton, D. M., 1999, Preliminary digital geologic map of the Santa Ana 30' X 60' quadrangle, southern California: U.S. Geological Survey Open-File Report 99-172, 61p., scale, 1:100,000.

Osborn, E.F., 1939, Structural petrology of the Val Verde Tonalite, southern California: Geol. Soc. America Bull. v. 50, p. 921-950.

Roger, T.H., 1965, Santa Ana California Division of Mines and Geology Geologic Map of California, scale, 1:250,000.

Streckeisen, A.L., 1973, Plutonic rocks—Classification and nomenclature recommended by the IUGA Subcommission on Systematics of Igneous Rocks: Geotimes, vol. 18, p. 26-30.



Location of Riverside West 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.