DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY
WRIR 83-4116-D

MAP SHOWING OUTCROPS OF GRANITIC ROCKS AND SILICIC, SHALLOW-INTRUSIVE ROCKS, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA

Compiled by F. Allan Hills

INTRODUCTION

This map report is one of a series of geologic and hydrologic maps covering all or parts of States within the Basin and Range province of the western United States. Other map reports in this series contain data about: ground-water hydrology, ground-water quality, surface distribution of selected rock types, tectonic conditions, areal geophysics, Pleistocene lakes and marshes, and mineral and energy resources. This work is a part of the U.S. Geological Survey's program for geologic and hydrologic evaluation of the province to identify prospective regions for further study relative to isolation of high-level nuclear waste (Bedinger, Sargent, and Reed, 1984).

This map report was prepared from published geologic maps and reports utilizing the project guidelines defined in Sargent and Bedinger (1984). The map shows the known occurrences of granitic rocks and silicic, shallow-intrusive rocks. The Description of Map Units includes the geologic and, if available, radiometric age, the lithology, and sources of data for the units in outlined and numbered areas within the counties of the study area. The nomenclature of the geologic units is from published reports and does not necessarily conform to U.S. Geological Survey usage. Listed radiometric ages do not necessarily represent the entire age range of a unit.

Because the classification of plutonic igneous rocks has changed since publication of many reports used in this study, the author has attempted to convert the rock terminology in the original reports to that adopted by the International Union of Geologic Sciences (IUGS), as reported by Streckeisen (1976). Where changes have been made, the author's or authors' original term is enclosed by brackets following the IUGS term (i.e., mongogranite [quartz monzonite]). Where no term is shown in brackets, either the original rock terminology conforms with the IUGS classification, or the published data are insufficient to determine the appropriate IUGS rock name. The lithologic designation as part of a formal or informal geologic name has not been modified to conform to IUGS terminology. The terminology of the silicic shallow-intrusive rocks is that of the original author or authors.

DESCRIPTION OF MAP UNITS

[Radiometric ages determined by one of the following methods: (1) Rb-Sr whole-rock, (2) U-Pb zircon, (3) K-Ar mica, (4) K-Ar hornblende, (5) K-Ar feldspar, (6) Lead-alpha. To convert feet (ft) to meters, multiply by 0.3048; to convert miles (mi) to kilometers, multiply by 1.609; to convert square miles (mi^2) to square kilometers, multiply by 2.590; mm, millimeter]

County-area number	Map symbol	Pluton and geologic unit	Geologic and radiometric age in millions of years (m.y.)	Lithology and comments	References for county area
			IMPERIAL COUNTY (IM)		
IM-1	Th		Tertiary	Undescribed shallow-intrusive rocks.	Jennings, 1967
IM-2	Tmg	Quartz monzonite of Mount Barrow	Tertiary	Coarsely porphyritic, hornblende-biotite monzogranite [quartz monzonite] with rapakivi-type feldspars. Contains minor aplitic biotite granite (Mesozoic?) locally.	Dillon, 1975
IM-3	Ta, Th		Tertiary	Mostly andesitic shallow-intrusive rocks; Th, undescribed.	Jennings, 1967
IM-4	Mzu		Mesozoic	Undescribed granitic rocks.	Jennings, 1967
IM-5	Jsg		Jurassic 145 m.y.(2)	Biotite syenogranite [granite].	Dillon, 1975; Henshaw, 1942
	Mzmg		Mesozoic	Biotite-hornblende monzogranite [quartz monzonite].	
	Xqd		Early Proterozoic	Biotite-hornblende quartz diorite to diorite.	
IM-6	Mzu		Mesozoic	Undifferentiated granitic rocks.	Jennings, 1967; Rogers, 1965; Strand, 1962
			INYO COUNTY (IN)		
IN-1	Kmg	Quartz monzonite of Redding Canyon	Cretaceous	Alaskitic coarse-grained, porphyritic monzogranite [quartz monzonite]. Intrusive into Cambrian sedimentary rocks.	Bateman, 1965; Nelson, 1966b
		Birch Creek pluton; quartz monzonite and granodiorite of Birch Creek	Cretaceous	Medium- to coarse-grained monzogranite [quartz monzonite] grading to granodiorite; porphyritic near contacts. Well foliated. Cut by three minor faults. Eastern outcrop.	
IN-2	Jmg	Quartz monzonite of Beer Creek	Jurassic 151 to 163 m.y.(3) and 170 m.y.(2)	Medium- to coarse-grained, porphyritic quartz monzonite containing large diorite inclusions. Possibly continuous in subsurface with monzogranite of county area MO-3.	McKee 1968; McKee and Nelson, 1967
IN-3	Jm	Monzonite of Joshua Flat and diorite of Marble Canyon	Jurassic 171 and 184 m.y.(3)	Medium-grained hornblende-augite monzonite including minor monzogranite [quartz monzonite], granodiorite, quartz diorite, and medium-grained hornblende diorite; also, augite diorite including minor syenodiorite, monzonite, and granodiorite. Cut by several steeply dipping faults.	Nelson, 1971

IN-4	Jgd	Tinemaha Granodiorite	Jurassic 155 m.y.(2)	Medium-grained, porphyritic, generally epidotized, hornblende-biotite granodiorite. Contains numerous, small, mafic inclusions, which together with planar orientation of biotite and hornblende, define a foliation. Crossed by many mafic dikes. Deeply weathered.	Bateman, 1965; Nelson, 1966a; Stern and others, 1981
IN-5	Kmg	Papoose Flat pluton	Cretaceous 81 and 75 m.y.(3)	Strongly porphyritic and foliated biotite-muscovite monzogranite [quartz monzonite] to monzodiorite. Contains traces of hornblende and other dark minerals totaling 6 modal percent. Faults abundant along southwestern edge of pluton; shearing and foliation prominent locally. Greisen-like veins containing muscovite and fluorite common north of Side Hill Spring.	Langenheim and others, 1982; Nelson, 1966a, 1971; Nelson and others, 1978; Ross, 1965, 1967; Sylvester and others, 1978
IN-6	Jgd	Santa Rita Flat pluton, Tinemaha Granodiorite	Jurassic 123 m.y.(3); 155 and 160 m.y.(2)	Medium-grained, generally equigranular, hornblende-biotite granodiorite ranging to quartz monzonite; inclusions of diorite. Locally large K-feldspar phenocrysts. Accessories include magnetite, apatite, zircon, allanite, and abundant large crystals of sphene. Plagioclase generally andesine but grades to sodic labradorite. Biotite extensively altered, and epidote common in small veins and as irregular patches. Pronounced north-trending faults and dikes. Quaternary sediments cover west side of pluton, but pluton may extend at shallow depth under Owens Valley.	Langenheim and others, 1982; Ross, 1965; Stern and others, 1981
IN-7	Jmg	Paiute Monument pluton, Paiute Monument Quartz Monzonite	Jurassic 156 and 157 m.y.(3); 170 and 190 m.y.(2)	Coarse-grained, seriate, and porphyritic, biotite monzogranite [quartz monzonite]; traces of hornblende, sphene, zircon, apatite, allanite, and metallic opaque minerals. Appears to intrude Hunter Mountain Quartz Monzonite. Faults abundant along western edge of pluton but less common elsewhere.	Langenheim and others, 1982; Ross, 1965, 1967, 1969
		Pat Keyes pluton, Hunter Mountain Quartz Monzonite	Jurassic 160 to 180 m.y.	Weakly porphyritic to equigranular hornblende-biotite monzogranite [quartz monzonite] and granodiorite, ranging locally to hornblende-pyroxene diorite. Contains conspicuous pale-red to purple K-feldspar, magnetite, sphene, apatite, zircon, and allanite. Faults common near western margin but not abundant elsewhere. Possibly continuous at shallow depth with Hunter Mountain Quartz Monzonite of area IN-23.	
IN-8	Jmg	Hunter Mountain Quartz Monzonite	Jurassic 160 to 180 m.y.	Medium- to coarse-grained hornblende monzogranite [quartz monzonite], ranging to monzonite, syenite, and granite. Feldspars highly altered, probably as result of weathering. Accessory minerals include sphene and magnetite. Similar to border facies of Hunter Mountain Quartz Monzonite of area IN-13.	Burchfiel, 1969; Ross, 1969

IN-9	Mzs		Mesozoic(?)	Equigranular to prophyritic, generally trachytoid, syenite to nepheline syenite, containing biotite, aegirine-augite, melanite, magnetite, and sphene. Grades locally to aegirine-augite monzonite and monzodiorite. Dikes, sills, and chonoliths.	McAllister, 1952; Streitz and Stinson, 1974
	Mzu		Mesozoic(?)	Undescribed granitic rocks.	
IN-10	Kg		Cretaceous(?)	Coarse, light-colored granite containing traces of biotite. Feldspar predominantly microperthite. Accessory minerals include sphene, magnetite, and zircon. Intrusive into andesite and rhyolite. Weathers to spheroidal boulders and pedestal rocks.	Knopf, 1918
IN-11	Kmg, Kg		Cretaceous(?)	Hornblende-biotite monzogranite [quartz monzonite] generally without foliation, and granite similar to that of area IN-10.	Knopf, 1918; Merriam, 1963
IN-12	Mzu		Mesozoic(?)	Generally, undifferentiated granitic rock, but southern masses are monzogranite [quartz monzonite].	Merriam, 1963; Ross, 1967
IN-13	Jmg	Hunter Mountain Quartz Monzonite	Jurassic 180 m.y.(3)	Primarily biotite-hornblende quartz monzonite and less abundant leucocratic monzogranite [quartz monzonite] locally porphyritic. Biotite-hornblende quartz monzonite generally contains less than 15 percent quartz and some magnetite, sphene, apatite, and zircon. Syenitic and monzonitic border facies.	Hall, 1971; Hall and MacKevett, 1962; Hall and Stephens, 1963; McAllister, 1956; Ross, 1969
IN-14	Jmg	Hunter Mountain(?) Quartz Monzonite	Jurassic	Similar to granitic rocks of area IN-13 and possibly continuous with those rocks in subsurface.	Hall and MacKevett, 1962; Hall and Stephens, 1963; Ross, 1969
IN-15	Tmg	Granite at Skiddco	Tertiary	Biotite monzogranite [quartz monzonite], locally porphyritic and gneissic. Appears to intrude along normal and thrust faults. Interpreted as floored intrusive or laccolith. As much as 2,000 ft thick near Skiddoo.	Hunt and Mabey, 1966
IN-16	Mzmg		Mesozoic	Pink to gray, equigranular to porphyritic, hornblende-biotite monzogranite [quartz monzonite] and light-colored monzogranite [quartz monzonite]. Accessory sphene, magnetite, apatite, and tourmaline. Similar to Hunter Mountain Quartz Monzonite of area IN-13. Cut by abundant north-northwest-trending faults near Darwin.	Hall and MacKevett, 1962; Stern and others, 1981; Stinson, 1977a, 1977b; Streitz and Stinson, 1974

	Mzu		Mesozoic	Undifferentiated granitic rocks, but principally light-gray, medium- to coarse-grained, equigranular to porphyritic, biotite monzogranite [quartz monzonite]; contains hornblende locally and accessory sphene, magnetite, zircon, and apatite. Encloses masses of older, dark-green to dark-greenish-gray, fine- to coarse-grained gabbro and hornblende gabbro, ranging from a few inches to nearly a square mile in area. Locally, some gray-white to tan, coarse-grained alaskite granite containing traces of biotite. No description of rocks near Little Lake.	
IN-17	Jmg	Hunter Mountain(?) Quartz Monzonite and quartz monzonite of Maturango Peak	Jurassic(?) 166 m.y.(3) and 169 m.y.(4), Jurassic(?) 132 m.y.(3) and 165 m.y.(4)	Undifferentiated, Mesozoic granitic rocks. Mostly biotite-hornblende monzogranite [quartz monzonite] and leucocratic monzogranite [quartz monzonite]. Intruded by swarms of northwest-trending dikes of fine-grained to microcrystalline diorite, diorite porphyry, and granite porphyry. No detailed maps available.	Moore, 1976; Moore and Harakal, 1976; Smith, 1962; Von Huene, 1960
IN-18	Kgd	Hall Canyon pluton	Cretaceous	Medium-grained, leucocratic, muscovite-bearing granodiorite containing traces of biotite and garnet. Locally is granite. Landslide deposits, along western margin. Intrudes metasedimentary rocks of Pahrump Group (Proterozoic).	Albee and others, 1981; Labotka and others, 1980
IN-19	Tg	Little Chief stock, Little Chief Granite	Late Tertiary 12 m.y.(5)	Composite, hypabyssal stock of hornblende-biotite granite and biotite granite containing phenocrysts (1 to 10 mm long) of strongly zoned plagioclase and unzoned sanidine in groundmass (0.5 mm) of quartz, alkali-feldspar and rare plagioclase. Stock may have dome-shaped top and flat bottom, and rests on metamorphosed Precambrian rocks. Original thickness of stock about 12,000 ft; as much as 8,000 to 9,000 ft remain.	Albee and others, 1981; Hunt and Mabey, 1966; Labotka and others, 1980; McDowell, 1974; Stern and others, 1966
IN-20	Tmg		Tertiary 30±10 m.y.(2)	Light- to medium-gray, coarse-grained porphyritic, biotite monzogranite [quartz monzonite]. Accessory magnetite, sphene, apatite, and zircon. Widely spaced joints; few lamprophyre dikes and inclusions. Surface area about 20 mi², including areas concealed by thin cover of alluvium.	Drewes, 1963
	Tu		Tertiary 45 m.y.(6)	Mostly pinkish-gray, fine- to medium-grained monzogranite [quartz monzonite], latite, granodiorite, and granite. Variable proportions of sodic plagioclase, potassium feldspar, quartz, and minor biotite. Accessory amphibole, magnetite, apatite, sphene, and zircon. Outcrops adjacent to Greenwater Valley include more monzonitic rocks and porphyritic quartz latite. Intrudes red, porphyritic rhyolite and rhyodacite of Tertiary age.	

	p€d		Precambrian	Medium-dark-gray to dark-greenish-gray, generally massive to slightly foliated, amphibolitic metadiorite, containing andesine or oligoclase, hornblende, and minor biotite. Accessory sphene, titaniferous magnetite, apatite, and rare quartz and pyroxene.	
IN-21	Mzu		Mesozoic(?)	Undescribed granitic rocks.	Jennings, 1977; Streitz and Stinson, 1974
IN-22	TRgd	Granodiorite of Redlands Canyon	Triassic(?)	Dark-colored, commonly greenish, medium-grained, biotite granodiorite. Traces of augite, hornblende, sphene, apatite, and magnetite. Augite partially replaced by hornblende. Secondary chlorite, epidote, sericite, albite, and microcline. Apparently intruded along pre-existing fault. Outcrop sheared and brecciated by Panamint Valley fault.	Johnson, 1957
IN-23	Jmg	Quartz monzonite of Manly Peak	Jurassic(?) 137 m.y. and 145 m.y. (3)	Massive, directionless, porphyritic, biotite monzogranite [quartz monzonite] containing 8- to 10-mm-long pink phenocrysts of microcline and traces of hornblende. Accessory sphene, apatite, magnetite, and zircon. Secondary calcite and penninite. Eastern contact of pluton may be along Tertiary fault, but no shearing or brecciation within pluton.	Armstrong and Suppe, 1973; Johnson, 1957
IN-24	Jmg		Jurassic	Light- to medium-gray, coarse- to medium-grained, equigranular, biotite monzogranite, locally ranging to monzonite, diorite, and syenogranite. Locally, includes light and dark granitic rocks in nearly flat-lying sheets from tens to hundreds of feet thick. Area cut by faults.	Smith and others, 1968
IN-25	Mzu		Mesozoic	Undescribed granitic rocks.	Jennings and others, 1962
IN-26	Kgd	Mostly Round Valley Peak Granodiorite, but includes Lamarck Granodiorite, granodiorite of Mono Recesses, granodiorite of Lake Edison, granodiorite of Chickenfoot Lake, granodiorite of Red Mountain, and granodiorite of Coyote Flats	Cretaceous 89, 90, and 93 m.y. (2)	Homogeneous dark-gray, fine- to medium-grained biotite-hornblende granodiorite. Hornblende, trace to 5 percent; biotite as much as 14 percent. Accessory magnetite, apatite, sphene, and zircon. Dark inclusions common. Locally, mortar structure and decreased grain size revealed in thin sections. Locally, contaminated by assimilated hornblende gabbro, and cut by swarms of felsic dikes. Flattened inclusions produced foliation. Intrudes metamorphosed Jurassic or Triassic volcanic rocks and metamorphosed Pennsylvanian and Permian sedimentary rocks. Contacts abrupt and discordant.	Bateman, 1965; DuBray, 1981; Langenheim and others, 1982; Rinehart and Ross, 1957, 1964; Sherlock and Hamilton, 1958; Stern and others, 1981

	TRmg	Tungsten Hills Quartz Monzonite	Triassic 203 m.y. (2)	Porphyritic to fine-grained, biotite monzogranite [quartz monzonite] containing minor hornblende and perthitic K-feldspar. Crops out around Mount Tom in southern part of area. Generally structureless. Accessory magnetite, ilmenite, sphene, apatite, allanite, zircon, and zirconlike minerals (possibly monazite and thorite). Secondary epidote, locally, fine sericite in plagioclase, chlorite after biotite, and hematite or limonite after magnetite. Fine, granoblastic mortar structure between grains, and undulatory extinction and granoblastic structure in quartz. Tungsten mineralization common along, but not confined to, contact of monzogranite with calcic metasedimentary rocks. Conspicuous widely spaced, nearly vertical joints produce rectilinear pattern on weathered outcrops.	
		Wheeler Crest Quartz Monzonite	Triassic 207 m.y. (3)	Seriate to porphyritic, white to gray, medium- to coarse-grained biotite monzogranite [quartz monzonite]; locally mortar structure, shredded biotite, bent twin lamellae in plagioclase, and other characteristics of cataclasis. Accessory apatite, magnetite, zircon, and sphene. Inclusions small and uncommon. Forms arcuate mass north of Tungsten Hills Quartz Monzonite. Generally foliated as result of alignment of feldspar phenocrysts, ovoid clots of mafic minerals, and lenticular mafic inclusions. Locally intrudes and encloses large, amoeboid masses of diorite and hornblende gabbro. Deeply weathered. Includes small quantity of light-gray, medium-grained granite, albite granite of McGee Mountain, Cretaceous(?), containing plagioclase (albite) and potassium feldspar in about equal quantities.	
IN-27	Kg		Cretaceous	Incompletely described, fine-grained monzogranite [quartz monzonite]; considered youngest granitic rock in area; crops out throughout about 2.5 mi^2 in eastern part area.	Bateman, 1965; Bateman and Moore, 1965; Elliot and McKee, 1982; Stern and others, 1981
		Leucogranite of Rawson Creek	Cretaceous 95 m.y. (2)	Medium-grained alaskite granite to monzogranite; generally less than 3 percent biotite and dark minerals. Has widely spaced joints.	
	Kgd	Lamarck Granodiorite and granodiorite of Coyote Flats	Cretaceous 89 m.y. (2)	Light-gray, medium-grained biotite-hornblende granodiorite; foliated margins.	
	Jg	Granite west of Warren Lake	Jurassic 167 m.y.	Light-gray, medium-grained, biotite-hornblende monzogranite [quartz monzonite].	

	Ѣmg	Tungsten Hills Quartz Monzonite	Triassic 203 m.y.(2)	Light-gray, medium-grained, biotite-hornblende monzogranite [quartz monzonite] similar to that of area IN-26. Generally structureless and unfoliated except for widely spaced joints. Intruded by large dikes and masses of felsic aplite, pegmatite, and alaskite, and locally by mafic dikes. Encloses large mass of diorite to gabbro and many smaller masses of calc-hornfels, some containing sheelite mineralization. Includes masses of equigranular, fine- to medium-grained, hornblende-biotite granodiorite of Deep Canyon and some alaskite. Also, included in Tungsten Hills Quartz Monzonite are the oldest plutonic rocks in the area, which are small masses of hornblende-biotite gabbro, diorite, and quartz diorite. Also, incorporated in granitic rocks of area are metamorphic rocks west of Rawson Creek, and north of Big Pine Creek, mainly micaceous quartzite, marble, metachert, and pelitic and calcic hornfels.	
IN-28	Kgd	Lamarck Granodiorite	Cretaceous 89 m.y.(2)	See IN-27 for description.	Bateman, 1965; Bateman, and Moore, 1965; DuBray, 1981; Moore, 1963
	Kg	Leucogranite of Rawson Creek	Cretaceous 95 m.y.(2)	See IN-27 for description.	
	KJd		Cretaceous or Jurassic	Diorite or gabbro.	
	Jgd	Tinemaha Granodiorite, Inconsolable Granodiorite, and other rocks of Palisades Crest granitoid sequence	Jurassic 155 m.y.(2)	All granitic units similar to Tinemaha Granodiorite, as described in areas IN-4 and IN-6.	
	Jmg	Red Mountain Creek pluton	Jurassic	Equigranular, medium-grained, alaskitic, biotite monzogranite.	
IN-29	Kmg	Bullfrog pluton	Cretaceous	Medium-grained, alaskitic, biotite monzogranite cut by aplite and pegmatite dikes.	Bateman, 1965; DuBray, 1981; Moore, 1963
	Kgd	Spook pluton, Dragon pluton, Granodiorite of Mount Whitney	Cretaceous	Gray, variably textured, hornblende-biotite granodiorite. Dark inclusions abundant. Granodiorite of Mount Whitney, south of Lone Pine Creek, contains euhedral, potassium-feldspar megacrysts.	
	KJu		Cretaceous and Jurassic	Layers of granodiorite, alaskitic monzogranite, and diorite or gabbro as much as 2 mi thick. Includes some older metavolcanic rocks.	
	Jgd	Tinemaha Granodiorite	Jurassic	See IN-4 and IN-6 for description. DuBray (1981) gives modal compositions of granitic rocks of area.	

IN-30	Kmg	Cretaceous(?)	Medium- to coarse-grained, biotite-hornblende monzogranite [quartz monzonite], generally without foliation. Accessory magnetite, sphene, apatite, and zircon. Also, porphyritic, hornblende-biotite granodiorite to monzogranite [quartz monzonite]. Contains accessory magnetite, sphene, apatite, and zircon, and generally, large phenocrysts of potassium feldspar scattered in matrix of plagioclase, quartz, and dark minerals.	Knopf, 1918;
IN-31	Mzu	Mesozoic(?)	Monzogranite, granodiorite, diorite, hornblende gabbro, syenogranite, and aplite; not differentiated on published maps.	Jennings and others, 1962; Stinson, 1977a
		KERN COUNTY (KE)		
KE-1	Mzgd	Mesozoic	Primarily biotite granodiorite and monzogranite [quartz monzonite]. Minor leucocratic granite, biotite-hornblende quartz diorite, commonly gneissic and hornblende diorite and gabbro, locally gneissic.	Dibblee, 1954
KE-2	Mzu	Mesozoic	Undifferentiated granitic rocks.	Miller and Webb, 1940; Smith, A. R., 1964
KE-3	Jqd, Jg	Jurassic	Fine- to medium-grained, faintly gneissoid, biotite-quartz diorite intruded by coarser, biotite-quartz diorite. Accessory sphene, apatite, zircon, and iron oxide minerals. Quartz diorite in contact with light-colored, medium- to coarse-grained, biotite granite. Relative ages of these rocks unknown.	Crowell, 1952; Dibblee, 1959a, 1961, 1963; Dibblee and Louke, 1970; Jennings and Strand, 1969; Samsel, 1962; Wiese, 1950
	Mzmg	Mesozoic	Generally light-colored, massive, medium-grained and equigranular, biotite monzogranite [quartz monzonite] containing traces of muscovite. Accessory sphene, apatite, hematite, and magnetite. Grades to granodiorite, and to a facies containing pink orthoclase and little biotite. Weathers to rounded topography of generally low relief. Hydrothermally altered locally west of Lone Tree Canyon.	
	Mzgd	Mesozoic	Coarse- to medium-grained, equigranular to porphyritic, biotite granodiorite and biotite granite. Locally intruded by dike swarm of Tertiary felsite.	
	Mzqd	Mesozoic	Light- to medium-gray, faintly gneissoid to massive, medium-grained, equigranular, hornblende-biotite quartz diorite. Accessory sphene, zircon, and iron oxides. Undulatory extinction in quartz and bent-mica plates in rocks of area indicate widespread, minor cataclasis. All rocks in area deeply weathered and generally form rounded hills. Garlock fault crosses area.	

KE-4	Trqd	Quartz diorite of Last Chance Canyon	Triassic	Gray-white, medium-grained, equigranular, massive, biotite-quartz diorite, containing minor hornblende. Weathers to rounded geomorphic features.	Dibblee, 1952; John, 1981
		Quartz diorite of Schmidt Camp area	Triassic	Dark-gray, medium-grained, equigranular, hornblende quartz diorite; includes minor biotite. Strongly foliated, buff-weathering, muscovite-biotite granite underlies about 2 mi^2 along margins of quartz diorite body at northeast and southwest ends of area. Also, small quantity of granophyre along contact with enclosing Precambrian schist.	
KE-5	Mzmg	Quartz monzonite of Rand Mountains, Atolia Quartz Monzonite	Mesozoic	Mostly gray-white, massive, medium- to coarse-grained, even-textured, biotite monzogranite [quartz monzonite]. Locally contains hornblende or muscovite. Locally porphyritic. Accessory apatite and sphene. Generally, closely jointed. In northern part of area encloses large, irregular masses of structureless, pink, even-textured, medium- to fine-grained, muscovite granite, locally contains biotite. Monzogranite cut by numerous, pegmatite and aplite dikes, and by numerous faults. In southern outcrops monzogranite intruded by pinkish-white, medium-grained, muscovite-biotite granite. Weathers to rounded, smooth topography.	Dibblee, 1952, 1958a, 1958b; 1959a, 1960f, 1963; Hulin, 1925; John, 1981

LOS ANGELES COUNTY (LA)

LA-1	Mzmg		Mesozoic(?)	Biotite monzogranite [quartz monzonite] similar to rock in area KE-5.	Dibblee, 1963
LA-2	Jmg		Jurassic(?)	Gray-white and pink, medium-grained, biotite monzogranite [quartz monzonite] containing traces of hornblende; foliated locally. Accessory sphene, zircon, and magnetite. Jointed and brecciated. Few deeply weathered outcrops on low, rounded, slopes strewn with small residual boulders mostly of aplite. San Andreas fault system crosses area.	Dibblee, 1960g, 1961; Jennings and Strand, 1969; Wiese, 1950
LA-3	Mzmg	Holcomb Quartz Monzonite	Mesozoic	Gray-white, medium-grained, directionless, biotite monzogranite [quartz monzonite]; traces of hornblende or muscovite locally. Accessory sphene, apatite, zircon, and iron oxides. Locally includes older, nearly white, massive to gneissic, fine- to medium-grained, aplitic monzogranite [quartz monzonite], containing biotite, muscovite, and hornblende; accessory apatite, zircon, and iron oxides.	Dibblee, 1959b, 1967h; Noble, 1954
	Mzs		Mesozoic or older	Light-brown to light-gray, unfoliated, medium-grained, equigranular, ferruginous syenite.	

	Mzgd	Pinyon Ridge Granodiorite	Jurassic(?)	Grades from gray-white granodiorite through quartz diorite to medium-gray diorite. Generally, hornblende and biotite are present and locally hornblende constitutes 40 percent of rock. Generally slightly to moderately gneissic.	
	Mzd		Mesozoic or older	Dark-gray to black, medium- to coarse-grained, hornblende diorite and hornblende metagabbro. Commonly contains biotite. San Andreas fault crosses area.	

MONO COUNTY (MO)

MO-1	Jg	Granite of Casa Diablo Mountain	Jurassic, 161 m.y.(2)	Coarse-grained, unfoliated, slightly porphyritic, biotite-albite granite. Magnetite is only accessory mineral. Altered locally. Uncommon aplite dikes and masses, of probable Jurassic age, cut the granodiorite and pre-Jurassic rocks. Also, cut by lamprophyre dikes locally.	Crowder and others, 1972, 1973; Crowder and Sheridan, 1972; Donahoe and others, 1983; Evernden and Kistler, 1970; Krauskopf, 1971; Krauskopf and Bateman, 1977; McKee and Donahoe, 1981; Rinehart and Ross, 1957; Stern and others, 1981
	℞gd	Granodiorite of the Benton Range	Triassic 208 and 214 m.y.(2), 210 m.y.(3,4)	Generally porphyritic, medium-grained, hornblende granodiorite, locally having faint foliation. Megacrysts of K-feldspar and subhedral to euhedral hornblende. Accessory magnetite, allanite, sphene, zircon, and apatite. Inclusions of more mafic rock, schlieren, dikes, and patches of aplite and conspicuous locally. Diorite and gabbro of probable Triassic age occur in numerous small outcrops within several square miles but are not shown on map.	
	Mzmg	Quartz monzonite of Deer Spring	Jurassic or Triassic	Biotite monzogranite [quartz monzonite]; minor hornblende, apatite, magnetite and allanite. Intrudes diorite and gabbro which underlie about one-half the area. Conspicuous north-northwest-trending faults with minor offset.	
MO-2	Jg	Granite of Casa Diablo Mountain	Jurassic 161 m.y.(2)	Published reports containing lithologic description cover only eastern tip of mass south of Cowtrack Mountain. Krauskopf and Bateman (1977) assign granite of that area to granite of Casa Diablo Mountain.	Krauskopf and Bateman, 1977; Stern and others, 1981
	℞gd	Granodiorite of the Benton Range	Triassic 214 m.y.(2)	Stern and others (1981) correlate major part of granite in area with granodiorite of Benton Range. (See descriptions under area MO-1).	

MO-3	Kmg	Adamellite and granite of Pellisier Flats	Late Cretaceous 90 m.y.(2)	Hornblende-biotite monzogranite [adamellite] and syenogranite [granite] characterized by ubiquitous small inclusions, generally less than 100 mm wide, of dark-gray diorite. Locally porphyritic. Leucocratic phase in dikes and irregular masses that grades into monzogranite and syenogranite.	Crowder and others, 1972; Crowder and Sheridan, 1972; Emerson, 1966; Evernden and Kistler, 1970; Krauskopf, 1971; McKee, 1968; McKee and Nash, 1967; McKee and Nelson, 1967; Miller, 1978; Nelson, 1966b, 1971; Stern and others, 1981; Stewart and others, 1974
		Adamellite of Boundary Peak	Cretaceous	Leucocratic, medium-grained, biotite monzogranite [adamellite]. Correlated with quartz monzonite of McAfee Creek and Indian Garden Creek. Adamellite and granite of Pellisier Flats highly sheared by westward dipping White Mountain fault zone along western edge of area. Adamellite of Boundary Peak appears to intrude the fault zone.	
	KJu	Quartz monzonite of McAfee Creek	Cretaceous 83 m.y.(3)	Coarse-grained, felsic, quartz-rich, biotite monzogranite [quartz monzonite]. Partly equivalent to Aiken facies of McAfee adamellite of Emerson (1966). Intrudes granodiorite of Cabin Creek and granodiorite of Mount Bancroft.	
		Quartz monzonite of Indian Garden Creek	Cretaceous 93 m.y.(3)	Fine- to medium-grained, felsic, biotite monzogranite [quartz monzonite]. Approximately equivalent to Garden facies of McAfee adamellite of Emerson (1966).	
		Quartz monzonite of Leidy Creek	Cretaceous(?)	Medium-grained, felsic monzonite [quartz monzonite] (Leidy adamellite of Emerson, 1966); intrudes granodiorite of Cabin Creek.	
		Granodiorite of Cabin Creek	Jurassic(?)	Medium-grained, locally porphyritic, locally foliated, biotite-hornblende granodiorite. Comprises most of the area of KJu rocks. Also called Cabin granodiorite by Emerson (1966).	
	Jgd	Granodiorite of Mount Barcroft	Jurassic 161 m.y.(2)	Dark-gray, medium-grained, quartz-poor, biotite-hornblende granodiorite (Barcroft granodiorite of Emerson, 1966).	
	Jmg	Quartz monzonite of Beer Creek	Jurassic, 161 m.y.(3) and 170 m.y.(2)	Porphyritic, medium-grained, hornblende-biotite monzogranite [quartz monzonite] (Cottonwood adamellite of Emerson, 1966). Northeast-trending faults common in the southern outcrops.	
	Jm	Monzonite of Joshua Flat	Jurassic, 171 to 184 m.y.(3); and 167 m.y.(2)	Medium-grained, hornblende-, biotite-, and, locally, augite-bearing monzonite to monzogranite [quartz monzonite].	
		Monzonite of Eureka Valley	Jurassic, 163 to 171 m.y.(3)	Medium-grained, augite- and olivine-bearing monzonite containing small masses of diabase.	
MO-4	Kmg	Sage Hen Flat pluton, quartz monzonite of Sage Hen Flat	Cretaceous 130 to 138 m.y.(3)	Medium-grained monzogranite to quartz monzonite [quartz-poor quartz monzonite], apparently unfoliated; steeply dipping north-trending joints common. Two minor faults in southeastern part.	Krauskopf, 1971; McKee and Nash, 1967; Nelson, 1966b

MO-5	Kg	Granitic rocks of Rattlesnake Gulch	Cretaceous(?) 93 m.y.(3)	Coarse-grained, porphyritic, biotite syenogranite [granite] grading locally to monzogranite [quartz monzonite] and finer grained granodiorite.	Chesterman, 1975; Chesterman and Gray, 1975; Evernden and Kistler, 1970; Kistler, 1966; Stern and others, 1981
	Kgd	Granodiorite of Kuna Crest	Cretaceous 91 m.y.(2)	Biotite-hornblende granodiorite. Includes small areas of diorite, granodiorite, and quartz monzonite of Jurassic(?) age.	
	TRgd	Granodiorite of Mono Dome	Triassic	Light- to medium-gray, medium- to coarse-grained, biotite-hornblende granodiorite; part of Lee Vining intrusive epoch of Evernden and Kistler (1970). Locally grades to biotite granite.	
	TRmg	Quartz monzonite of Mono Lake	Triassic(?)	Gray, medium- to coarse-grained, hornblende-biotite monzogranite [quartz monzonite].	
		Quartz monzonite of Lee Vining Canyon	Triassic 206±20 m.y.(1)	Biotite monzogranite [quartz monzonite] containing traces of hornblende.	
		Wheeler Crest Quartz Monzonite	Triassic	Biotite-hornblende monzogranite [quartz monzonite]. See Kistler (1966) for modal analyses of rocks exposed in area.	

RIVERSIDE COUNTY (RI)

RI-1	Kmg	White Tank Quartz Monzonite	Cretaceous	Youngest unit in area is pinkish-gray, very coarse grained, porphyritic, biotite monzogranite; locally has rapakivi texture. Called polka-dot granite locally where it contains cordierite-bearing, spherical, bluish-gray patches of quartz, biotite, and muscovite. Weathers to grus, and outcrops characteristically are rounded hills. Apparently includes Fargo quartz monzonite of Hope (1966, 1969) and porphyritic part of White Tank quartz monzonite of Rogers (1961) and Dibblee (1967f and 1968b).	Dibblee, 1967f, 1968b; Ehlert and Ehlig, 1977; Hope, 1966, 1969; Powell, 1981, 1982; Rogers, 1961
	Kgd		Cretaceous	Light-gray, buff-weathering, fine- to medium-grained, hornblende-biotite granodiorite; accessory apatite, zircon, sphene, opaque minerals, and allanite. Locally, pervasively lineated, and in Little San Bernardino Mountains, intensely cataclasized. Comprises much of batholith that extends 35 mi in a south-easterly direction from town of Joshua Tree to Cottonwood Mountains.	
	Kt		Cretaceous	Hornblende-biotite tonalite, perhaps a facies of biotite-hornblende granodiorite. Tonalite and other lithologies, on the southwestern flank of Little San Bernardino Mountains strongly sheared; increasingly cataclasized toward the southwest in proximity to San Andreas fault.	

	Ku		Cretaceous	Undifferentiated granitic rocks.	
	KJu		Cretaceous or Jurassic	Undifferentiated granitic rocks. May include Jurassic batholithic rocks (Powell, 1981).	
RI-2	Xgd	Soledad Granodiorite and augen gneiss	Early Proterozoic 1,650 m.y.(2)	Dark, medium-grained, porphyritic, biotite granodiorite to monzogranite, commonly has rapakivi texture. Grades to augen gneiss and locally to mylonite.	Powell, 1981;
RI-3	KJu		Cretaceous or Jurassic	Undifferentiated granitic rocks.	Powell, 1981, 1982
	Jmg		Jurassic	Hornblende-biotite monzogranite. Accessory sphene, biotite, apatite, allanite, and opaque minerals. Equigranular quartz monzonite and hypabyssal quartz-monzonite porphyry intermingled with monzogranite near roof of pluton. Also includes leucrocratic monzogranite and quartz porphyry of uncertain age relationship to the monzogranite. Jurassic rocks generally more fractured than Cretaceous batholithic rocks of area RI-1.	
	Jgb		Jurassic	Hornblende gabbro, hornblende diorite, and monzodiorite [gabbro-diorites], locally shows layering interpreted as indicating crystal accumulation. Biotite and 1 to 2 percent potassium feldspar indicate alkalic affinity. Hornblende in excess of 25 percent; traces of clinopyroxene and olivine in hornblende crystals. Intruded by Jurassic monzogranite.	
	Xg	Joshua Tree Granite or Granite Gneiss	Early Proterozoic	Porphyritic biotite leucogranite, but is leucogranite gneiss where undeformed as on Pinto Mountain. Capped by aluminous schist of aluminosilicates, muscovite, and quartz, interpreted as metamorphosed ancient weathered zone.	
RI-4	KJu		Cretaceous or Jurassic	Undescribed granitic rocks.	Powell, 1982
	Yam		Middle Proterozoic	Undifferentiated granulitic gneiss and anorthosite-mangerite rocks consisting of anorthosite, mangerite, jotunite, syenite, and norite. Anorthosite-mangerite rocks probably about 1,200 m.y. old, and gneiss probably metamorphosed about 1,400 m.y. ago.	
RI-5	Kmg	White Tank Quartz Monzonite	Cretaceous	Medium- to coarse-grained, pinkish-gray, nonporphyritic, biotite monzogranite.	Powell, 1981, 1982
	Kgd		Cretaceous	Fine- to medium-grained hornblende-biotite granodiorite.	
	Jmg		Jurassic	Coarse- to very coarse grained, porphyritic hornblende-biotite monzogranite, characterized by lavender phenocrysts of potassium feldspar. Ranges compositionally to monzonite.	

	Yam		Middle Proterozoic	Rusty brown-weathering, extensively fractured, syenite, mangerite, and jotunite. Contains hornblende, biotite, and relict hypersthene.	
	Xgn	Joshua Tree Granite or Granite Gneiss	Early Proterozoic 1,650 m.y.(2)	Leucocratic augen-gneiss of monzogranitic composition. Apparently formed by shearing of Joshua Tree Granite. Mantled by aluminous schist as described in area RI-3.	
RI-6	KJg		Cretaceous and Jurassic 101 m.y.(3)	Biotite granodiorite and monzogranite.	Armstrong and Suppe, 1973; Carr and Dickey, 1980; K. A. Howard, U.S. Geological Survey, written commun., 1980; Lyle, 1982
RI-7	Tmg	Little Maria pluton	Tertiary	Mainly leucocratic monzogranite [adamellite] and some syenogranite and pegmatite. Postdates major deformation; no tectonic foliation.	Bishop, 1963; Emerson, 1982; Lafferty, 1981
	Kg	Northern and Southern Midlands plutons	Late Cretaceous	Granodiorite, monzogranite [adamellite], granite aplite, and pegmatite. Commonly, well-developed tectonic foliation; unit ranges from augen gneiss to schist. Stocks, dikes, and sills of dioritic composition in northern part of area.	
	p€u		Precambrian	Undifferentiated granitic rocks; generally foliated.	
RI-8	Jgn		Jurassic 50 to 159 m.y.(3) and 160 m.y.(2)	Highly sheared and recrystallized granodiorite, adamellite, and alaskite. Recrystallized to greenschist facies. Most K-Ar ages between 50 and 80 m.y.	Hamilton, 1964, 1982; Martin and others, 1982
	Ygn		Middle Proterozoic 1,400 m.y.(2)	Highly sheared, potassic granite gneiss containing porphyroblasts or relict phenocrysts of K-feldspar. No primary mafic minerals.	
RI-9	Jg		Jurassic 160 m.y.	Granodiorite, adamellite, and alaskite.	Hamilton, 1982; Martin and others, 1982; Miller, 1944b
	Yg		Middle Proterozoic 1,400 m.y.	Potassic, porphyritic granite. All rocks in area highly sheared locally and generally recrystallized to greenschist facies; included in Chuckwalla Complex of Miller (1944b).	
RI-10	Mzu, Ju, p€u		Mesozoic, Jurassic, and Precambrian	Undescribed granitic rocks mostly assigned to Mesozoic but some areas assigned by John (1981) to Jurassic and Precambrian.	Jennings, 1967; John, 1981
RI-11	Ku		Cretaceous	Undescribed granitic rocks of Cretaceous batholithic suite.	Powell, 1982
	₹Pu		Triassic or Permian	Poorly described syenodiorite to granodiorite.	

	Yam		Middle Proterozoic	Syenite, mangerite, and jotunite of anorthosite-mangerite suite.	
	Xgd		Early Proterozoic	Biotite-granodiorite porphyry to monzogranite porphyry and equivalent gneiss and augen gneiss. Tentatively correlated with Soledad Granodiorite of area RI-2.	
RI-12	p€u	Chuckwalla Complex	Precambrian	Mixture of dark-gray, hornblende-rich diorite or quartz-diorite and pinkish-gray to light-gray granite. Diorite commonly foliated and intruded lit-par-lit by granite.	Miller, 1944b
RI-13	Mzqd		Mesozoic	Biotite-rich quartz diorite to diorite. Variably tectonized, locally mylonitized. Occurs between north branch of San Andreas fault and Banning fault, and cut by south branch of San Andreas fault.	Dibblee, 1982a; 1982b
RI-14	Kqd	Bonsall Tonalite	Cretaceous(?)	Mostly homogenous, light-gray, medium- to coarse-grained, hornblende-biotite quartz diorite and minor granodiorite containing abundant accessory sphene. Locally, inclusion-rich quartz diorite, heterogeneous leucocratic granitoid rocks, and mixed granitoid rocks. Extensively mylonitized in vicinity of Palm Canyon.	Dibblee, 1982a, 1982b, 1982c; Morton and others, 1980
RI-15	Mzgd	Bradley Granodiorite	Mesozoic	Medium-gray, medium- to coarse-grained, foliated, biotite-hornblende granodiorite, quartz monzodiorite, and monzogranite, similar to rocks in area RI-14.	Miller, 1944b; Rogers, 1965
	Mzu		Mesozoic	Undifferentiated granitic rocks.	
RI-16	Mzqd		Mesozoic, Cretaceous(?)	Biotite-rich quartz diorite ranging to granodiorite. Massive to faintly gneissoid. Similar to rocks of area RI-14.	Dibblee, 1982c

SAN BERNARDINO COUNTY (SB)

SB-1	Tu		Tertiary	Undescribed granitic rocks.	Jennings and others, 1962
SB-2	Tmg	Monzonite of Kingston Range	Tertiary	Biotite-monzogranite(?) porphyry [monzonite porphyry]. Phenocrysts of white orthoclase, 3 to 8 mm long in very fine grained groundmass mainly of quartz, oligoclase, and biotite. Accessory magnetite, sphene, and zircon. Contacts of Kingston Peak stock with surrounding, faulted Precambrian sedimentary rocks dip steeply to northeast and east.	Hewett, 1956
SB-3	Mzg		Mesozoic	Light-gray, medium- to coarse-grained syenogranite or monzogranite. Bounded by low-angle and high-angle faults; some of these appear to be splays of nearby Garlock fault.	Smith and others, 1968

SB-4	Mzu		Mesozoic	Undescribed granitic rocks.	Jennings and others, 1962
SB-5	Mzu		Mesozoic	Undescribed granitic rocks.	Jennings and others, 1962
SB-6	Jmg, Mzmg		Jurassic and Mesozoic	Gray, medium- to coarse-grained, hornblende-biotite monzogranite (quartz monzonite) and granodiorite containing small areas of syeno-granite, quartz diorite, and diorite. North- to northwest-trending dike swarm of fine-grained to microcrystalline diorite, diorite porphyry, and granite porphyry that intrudes granitic rocks. Smith (1962) infers that areas SB-6 and SB-7 originally were contiguous but have been offset by movement on Garlock fault. John (1981) assigns Jurassic age to some granitic rocks of area, but classifies others as undifferentiated Mesozoic plutonic rocks.	John, 1981; Miller, 1978; Smith, G. I., 1962
SB-7	Jmg, Mzmg	Atolia Quartz Monzonite and unnamed granitic rocks	Jurassic and Mesozoic	Gray, hornblende-biotite monzogranite [quartz monzonite] and granodiorite, and locally syenogranite, and diorite. Fine-grained, crushed, epidotized, hypabyssal monzogranite northeast of Spangler. Plutonic rocks intruded by north- to northwest-trending dike swarm of fine-grained to microcrystalline diorite, diorite porphyry, and granite porphyry.	Hulin, 1925; John, 1981; Smith, G. I., 1962, 1964; Von Huene, 1960
SB-8	Tu	Red Mountain Andesite of Hulin (1925), Almond Mountain Volcanics	Pliocene	Shallow-intrusive pipes, dikes, and masses associated with extrusion of volcanic rocks.	Hulin, 1925; Smith, G. I., 1964
SB-9	Tu		Tertiary	See description under SB-8.	Dibblee, 1966; John, 1981; Smith, G. I., 1964
	Jg, Mzu		Jurassic and Mesozoic	Mostly undescribed granitic rocks. Partly assigned to Atolia Quartz Monzonite (Smith, G. I., 1964), and partly assigned to Jurassic age (John, 1981).	
SB-10	KJmg		Cretaceous and Jurassic	Mostly grayish white, massive, medium- to coarse-grained, biotite monzogranite [quartz monzonite] containing traces of muscovite and hornblende. Accessory magnetite, sphene, apatite, and zircon. Forms rounded geomorphic features of low relief. Biotite monzogranite intrudes dark-gray, medium-grained, equigranular quartz diorite. May be continuous with similar rocks in areas SB-9, SB-12, and SB-21 as part of very large batholith.	Dibblee, 1968a
SB-11	Tu		Tertiary	Undifferentiated intrusive volcanic rocks and very fine grained plutonic rocks.	Jennings and others, 1962

SB-12	Mzmg	Jack Spring quartz monzonite of McCulloh (1960)	Mesozoic	Light-colored, medium-grained, locally porphyritic, biotite monzogranite [quartz monzonite] to biotite granodiorite containing minor hornblende. Accessory apatite and opaque oxides. Rocks generally erode to rounded knolls of low relief. Part of large batholith covering areas SB-9, SB-10, and SB-21.	Byers, 1960; Dibblee, 1968a; McCulloh, 1960
	Mzd	Larrea Complex	Mesozoic	Diorite-gabbro of Larrea Complex of McCulloh (1960); not described.	
SB-13	Jg		Jurassic	Gray to dark-gray, granitic rocks ranging from hornblende syenogranite through hornblende-biotite monzogranite to hornblende-biotite granodiorite. Erode to rounded topographic forms. Densely faulted locally; intruded and overlain by Tertiary Alvord Peak Basalt.	Byers, 1960; John, 1981
SB-14	Mzu		Mesozoic	Undescribed granitic rocks.	Jennings and others, 1962
SB-15	Tu		Tertiary	Undifferentiated shallow-intrusive rocks and very fine grained plutonic rocks.	Grose, 1959; Jennings and others, 1962
	KJmg	Teutonia Quartz Monzonite	Cretaceous and Jurassic	Pink, mostly medium-grained, massive, directionless, hornblende-biotite monzogranite [quartz monzonite]. Accessory magnetite, sphene, and epidote. Gradational into older, dark-gray, fine- to medium-grained, massive, and directionless quartz diorite. Both rock types cut by northwest-trending dikes of light-colored, coarse-grained, quartz syenite containing traces of penninite (after biotite) and magnetite.	
SB-16	Mzgd, Mzqd, Mzsg		Mesozoic(?)	Intimately mixed granitic rocks consisting of abundant dark-gray, medium-grained, massive quartz diorite (Mzqd) and granodiorite (Mzgd) and less abundant light-gray, coarse-grained, massive syenogranite (Mzsg).	Grose, 1959
SB-17	Kg, Ku, Ju	Teutonia batholith, Teutonia Quartz Monzonite	Cretaceous and Jurassic 54 to 168 m.y.(3)	Composite of at least six noncomagmatic suites that range from hornblende gabbro through quartz diorite, quartz monzodiorite, granodiorite, monzogranite [adamellite], to syenogranite. All plutons are subalkalic and calc-alkalic, are predominantly along metaluminous-peraluminous boundary, and are magnetite bearing. Ilmenite found in only one pluton of monzogranitic composition. Radiometric ages range from 54 to 168 m.y., but cluster between about 73 and 105 m.y. Minor zones of mylonite locally. Batholith appears to postdate major thrust faulting and mylonitization.	Barca, 1966; Beckerman and others, 1982; Evans, 1971
SB-18	p€gn	Clark Mountain Granite Gneiss	Precambrian	Coarse-grained granitic gneiss containing many pegmatite dikes. South part of area undifferentiated lower Precambrian gneiss, schist, and granite (Jennings, 1961) and called injection gneiss or foliated granite by Hewett (1956).	Clary, 1967; Hewett, 1956; Jennings, 1961

SB-19	Kmg	Teutonia Quartz Monzonite	Cretaceous	Light-gray to light-brown, medium-grained, porphyritic, biotite-muscovite monzogranite. Locally phenocrysts of K-feldspar as much as 75 mm long. Apparently intruded Precambrian crystalline rocks along pre-existing thrust fault. Weathers to low, rounded hills.	Bishop, 1963; Hewett, 1956; John, 1981
SB-20	p€gu	Needles Complex	Precambrian	Foliated diorite and metadiorite injected by foliated granite, and at Homer Mountain is mostly foliated, porphyritic gneiss.	Miller, 1944a
SB-21	Mzmg	Atolia Quartz Monzonite	Mesozoic	Mostly gray-white, massive, medium- to coarse-grained, biotite and biotite-hornblende monzogranite [quartz monzonite], containing traces of muscovite and hornblende. Accessory magnetite, sphene, apatite, and zircon. Forms rounded, low geomorphic features. Near Fremont Peak, some lighter colored and finer grained, leucocratic monzogranite containing little or no biotite. Outcrops probably part of single pluton mantled by thin layer of alluvium.	Dibblee, 1958a, 1968a; Hulin, 1925; John, 1981
	Mzqd		Mesozoic	Dark-gray, medium-grained, equigranular, slightly foliated, biotite-hornblende quartz diorite which is older than monzogranite. Weathers to low, rounded hills.	
SB-22	Mzmg, Kmg		Mesozoic, probably Cretaceous	Gray-white, buff-weathering, generally massive, medium- to coarse-grained, biotite monzogranite [quartz monzonite]. Locally intruded by swarms of pegmatite and aplite dikes. Weathers to coarse grus and forms rounded topography. Massive, pinkish-white, medium-grained, muscovite-biotite granite in small plugs and irregular masses in monzogranite. Small masses of hornblende diorite, remnants of an older plutonic complex, occur locally. Part of monzogranite is Cretaceous in age, but age of remainder undetermined (John, 1981).	Dibblee, 1959b, 1960d, 1960e, 1960f, 1963; John, 1981; Troxel and Gunderson, 1970
	Mzh		Mesozoic	Slightly metamorphosed hypabyssal to volcanic latitic rocks. See area SB-23.	
SB-23	Kmg		Cretaceous	Gray-white, massive, equigranular, medium-grained, biotite monzogranite [quartz monzonite]. Accessory sphene, sphene, magnetite, apatite, and zircon.	Bowen, 1954; Dibblee, 1960c, 1960d, 1964a, 1964b, 1964c, 1964d, 1967b, 1967c, 1968a; Gardner, 1940; John, 1981
	Jmg		Jurassic	Gray, medium- to coarse-grained, porphyritic, biotite monzogranite.	
	Mzmg, ₮mg		Mesozoic, in part Triassic	Massive to slightly gneissic, granitic rocks, ranging from quartz diorite to monzogranite; form bulk of the plutonic rocks of area. Biotite partly altered to iron oxide, traces of hornblende, and accessory magnetite, sphene, apatite, and zircon.	

	Mzh	Ord Mountain Group of Gardner (1940); Sidewinder Volcanic Series of Bowen (1954)	Mesozoic	Slightly to moderately metamorphosed hypabyssal to volcanic rocks. Porphyritic, and has aphanitic to fine-grained groundmass. Mostly latitic but ranges from siliceous felsite to basalt. Estimated thickness about 2,000 ft locally. Numerous northwest-trending normal faults.	
	p€gn		Precambrian	Primarily granite gneiss and smaller quantities of quartz-diorite gneiss. Granite gneiss is light gray, fine to medium grained, and composed of about equal quantities of quartz, potassic feldspar, and sodic plagioclase. Generally contains less than 5 percent biotite and muscovite, but these minerals abundant in darker layers. Quartz-diorite gneiss is gray, fine to medium grained, and composed of quartz, sodic plagioclase, and minor potassic feldspar, biotite, and hornblende. Dark-gray bands or laminae, abundant in biotite or hornblende, alternate with gray-white laminae enriched with quartz and feldspar, and with gray laminae of intermediate composition. Thick, dike-like masses of black, massive, medium- to coarse-grained, hornblende diorite or gabbro intrude Precambrian rocks and are thought to be of Mesozoic age (not shown on map).	
SB-24	Th	Volcanic intrusive rocks of Calico Mountains and other volcanic rocks	Pliocene, Miocene, or Oligocene	Complex mixture of intrusive andesite, andesite porphyry, and andesitic breccia, agglomerate, and tuff breccia in Calico Mountains. Ranges compositionally to dacite. Cut by Calico fault and by several small faults. Small plugs of light-pinkish-gray, massive to flow-laminated, porphyritic dacite with very fine grained groundmass north of Barstow.	Dibblee, 1960a, 1960b, 1970; McCulloh, 1960
	Mzmg		Mesozoic or older	At least seven types of intermixed plutonic igneous rocks intertongue with structurally complex metasedimentary and metavolcanic rocks. No large homogeneous masses. Most common igneous rock is gray-white, massive, homogeneous, equigranular, medium-grained, biotite monogranite [quartz monzonite] containing accessory magnetite, apatite, and sphene. North of Barstow, some light-gray, medium- to fine-grained, biotite-hornblende granodiorite; accessory magnetite, apatite, sphene, chlorite, and rutile. Small quantities of quartz diorite, granodiorite porphyry, granite, and aplite throughout area.	
	Mzgb	Larrea Complex of McCulloh (1960)	Mesozoic	Diorite-gabbro. Mostly undescribed. Dark-gray, massive, medium- to coarse-grained, hornblende-diorite-gabbro on Iron Mountain where intruded by monzogranite.	

SB-25	Mzg		Mesozoic	Mainly pink to pinkish-gray-white, biotite granite and biotite monzogranite [quartz monzonite], enclosing large masses of coarse-grained, hornblende diorite and gabbro. Cut by northwest-trending Camp Rock fault.	Dibblee, 1970
SB-26	Th		Probably Miocene or older	Intrusive volcanic rocks forming plugs, pods, and dikes. Mainly andesitic in composition, but also includes quartz latite, dacite, and basalt. Microcrystalline but contains phenocrysts of biotite and basaltic hornblende.	Dibblee, 1970; Dibblee and Bassett, 1966a, 1966b
SB-27	Ta		Miocene and Oligocene	Massive to flow-laminated, andesite to dacite porphyry.	Dibblee, 1964b, 1964c, 1966, 1967c, 1967d; John, 1981
	Kmg		Cretaceous	Gray-white, massive, equigranular, medium-grained, biotite monzogranite [quartz monzonite]. Accessory sphene, magnetite, apatite, and zircon. Intrudes Jurassic monzogranite.	
	Mzmg	Quartz monzogranite of Emerson Lake area	Mesozoic	Gray-white, medium-grained monzogranite [quartz monzonite] containing a small quantity of biotite and traces of muscovite, sphene, and iron oxides; intrudes Jurassic monzogranite.	
	Jmg		Jurassic	Biotite monzogranite [quartz monzonite] is gray, medium to coarse grained, commonly porphyritic, massive, and contains biotite, hornblende, and accessory magnetite, sphene, apatite, and zircon. Locally sheared or hydrothermally altered.	
	Mzh		Mesozoic	Hypabyssal porphyries; intrusive into Jurassic monzogranite (see description in area SB-23).	
	Mzgb		Mesozoic(?)	Small to large masses of biotite diorite and hornblende-biotite diorite and gabbro; enclosed by monzogranites.	
SB-28	Ta		Miocene to Oligocene	Intrusive, greenish to pink and brownish-gray, massive to flow-laminated andesite porphyry, dacite porphyry, and quartz-latite prophyry. Contains abundant phenocrysts of plagioclase and commonly plates of biotite. Partly hydrothermally leached. Encloses large, nearly planar masses of monzogranite; intruded by dike swarm of Tertiary andesite. Cut by Calico and Bullion faults and other faults.	Dibblee, 1964a, 1966, 1967b; Dibblee and Bassett, 1966b
SB-29	Jg		Jurassic	Hard, massive, gray, fine- to medium-grained biotite granite. Accessory sphene, magnetite, apatite, and zircon. Biotite altered to iron oxides. Cut by several minor faults.	Dibblee and Bassett, 1966b; Jennings and others, 1962; John, 1981
	Mzu		Mesozoic	Undifferentiated granitic rocks.	

SB-30	Kg, Mzg		Cretaceous 115 m.y.(6), Mesozoic	Light-gray and buff to white, massive, medium- to coarse-grained biotite monzogranite [biotite granite to biotite quartz monzonite] containing muscovite and accessory magnetite, sphene, apatite, and zircon. Less abundant dark-gray, medium- to fine-grained, massive to gneissoid, biotite quartz diorite, which locally, occurs as elongate inclusions engulfed in monzogranite. Area cut by northeast- and northwest-trending faults. Cretaceous age assigned by John (1981) to granite at east end of area; remaining outcrops undifferentiated Mesozoic.	Dibblee, 1967a; Dibblee and Bassett, 1966b; John, 1981
SB-31	Jsg,	Sands Granite	Jurassic(?)	Mostly light-gray, equigranular, leucocratic, biotite-muscovite syenogranite. Typically 60 percent orthoclase, 10 percent albite, 25 percent quartz, 2 percent muscovite, 2 percent biotite, and trace of sphene. Cut by several faults. Syenite reported in southern part of area by Southern Pacific Company geologists (Keith Howard, U.S. Geological Survey, written commun., 1980). Some medium-grained quartz monzonite or quartz syenite. Typically, composed of 45 percent albite, 40 percent orthoclase, 12 percent quartz, and 3 percent biotite. Intrudes Cambrian to Devonian carbonate rocks; cut by numerous andesite dikes probably of Tertiary age.	Barca, 1966; Hewett, 1956
SB-32	Ku, Ju, Mzu		Cretaceous, Jurassic, Mesozoic	Undescribed granitic rocks of several different areas.	Bishop, 1963; John, 1981
SB-33	Ju,		Jurassic 165 m.y.(2)	Undifferentiated granitic rocks.	Bishop, 1963; John, 1981; Silver and McKinney, 1963
	Yu		Middle Proterozoic	Generally foliated granitic rocks.	
SB-34	Tr	Fountain Peak Rhyolite	Tertiary	Hypabyssal plug of biotite rhyolite.	Bishop, 1963; Hazzard, 1954
	p€gu		Precambrian	Generally foliated granitic rocks.	
SB-35	Tr		Tertiary	Rhyolite plug.	Bishop, 1963
SB-36	Kg, Kgd	Old Woman-Painted Rock pluton and other small plutons	Cretaceous 79 m.y.(1)	Composite batholith consisting of several plutons, the largest exposed mass, the Old Woman-Painted Rock pluton, has core of garnet two-mica granite (Kg) surrounded by biotite granodiorite (Kgd). Intrudes Precambrian gneisses. Plutons intruded thrust faults and generally are unaffected by metamorphism and deformation.	Miller and others, 1982
SB-37	Kgd	Stepladder pluton	Cretaceous 72 m.y.(3)	Light-colored, porphyritic, biotite granodiorite containing pink K-feldspar phenocrysts 10 to 20 mm long.	Armstrong and Suppe, 1973; Calzia and Morton, 1980; Howard and others, 1982b

SB-38	Ymg		Proterozoic Y(?)	Dark, coarse-grained, gneissic, biotite-hornblende monzogranite. Probably about 1,400 m.y. old based on similarity to dated Proterozoic rocks elsewhere.	Carr and others, 1980; Howard and others, 1982b
SB-39	Tl	Latite of Eagle Peak	Miocene 21.6 m.y.(3)	Hypabyssal latite stock. Occurs in upper plate of low-angle detachment fault.	McClelland, 1982
SB-40	Ku, Kgn		Cretaceous 64 m.y.(3)	Ranges from metaluminous hornblende-biotite quartz diorite and quartz monzonite through hornblende-biotite granodiorite, biotite granodiorite, biotite monzogranite, muscovite-biotite granodiorite, and muscovite-biotite monzogranite, to peraluminous garnet-muscovite monzogranite. Accessory sphene and magnetite in all except garnet-muscovite monzogranite; allanite in all facies. Radiometric age (early Tertiary) from garnet-muscovite monzogranite interpreted as thermally reset. Locally mylonitic (Kgn), especially immediately below detachment faults.	John, 1981
SB-41	Kmg	Cactus Granite of Vaughan (1922)	Cretaceous	Principally gray-white, hard, massive, medium- to coarse-grained biotite monzogranite [quartz monzonite] containing traces of hornblende and accessory magnetite, sphene, apatite, and zircon. Locally fractured and sericitized. Foliated and porphyritic monzogranite north of Luna Mountain. Thin layers of biotite quartz diorite and hornblende diorite along sinuous contact zone between massive and foliated monzogranite.	Allen, 1957; Dibblee, 1964c, 1964d, 1965, 1967c, 1967d, 1967f, 1967g, 1971, 1974; John, 1981; Matti and others, 1982; Richmond, 1960; Vaughan, 1922
	JT mg		Jurassic(?) and Triassic(?)	Light-gray, generally massive, hornblende monzogranite. Intruded by Cretaceous monzogranite.	
	Mzgd		Mesozoic	Undescribed granodiorite. Well-developed, east-west foliation. May be comparable in age to Jurassic and Triassic monzogranite. Faults are abundant and San Andreas fault is just outside of area.	
	p€gn		Precambrian or Mesozoic or both	Light-gray, buff-weathering, heterogeneous, medium- to fine-grained granitic gneiss containing biotite and muscovite; biotite-rich zones faintly banded. Mylonitized locally.	
SB-42	Jqm		Jurassic	Mostly dark- to medium-gray, massive to porphyritic, biotite-hornblende quartz monzonite to monzogranite containing pink to gray phenocrysts of potassium feldspar. Accessory sphene, zircon, and iron oxides. Locally encloses large masses of hornblende diorite or gabbro. Intruded along east margin of area by small quantities of gray-white, massive, medium- to coarse-grained, porphyritic monzogranite of probable Cretaceous age. Similar to monzogranite in area SB-43.	Bishop, 1963; Dibblee, 1967b, 1967e, 1968b; K. A. Howard, U.S. Geological Survey, written commun., 1980; Howard and others, 1982a; John, 1981

SB-43		Cadiz Valley batholith		Includes at least four intrusive phases of Mesozoic age; small areas underlain by Precambrian meta-igneous rocks.	Armstrong and Suppe, 1973; Bishop, 1963; Calzia, 1982; John, 1981; Miller and others, 1981
	KJmg		Cretaceous and Late Jurassic 67 m.y.(3) and 145 m.y.(1)	Leucocratic, subequigranular, two-mica granite and monzogranite as irregular masses in central part of batholith. Probably youngest intrusive phase.	
	Jgd		Late Jurassic	Porphyritic, biotite granodiorite to monzogranite; accessory muscovite, sphene, and allanite. Also, older, gray, biotite-hornblende and biotite-sphene granodiorite.	
	Jgn		Late Jurassic	Mylonitic, porphyritic granodiorite and monzogranite.	
	Ju		Jurassic	Undifferentiated granitic rocks. At least partly equivalent to Jgd.	
	TRu		Triassic	Undescribed granitic rocks.	
	Mzu		Mesozoic	Undescribed granitic rocks.	
	pЄg		Precambrian	Undescribed granitic rocks.	
SB-44	Kg, Kgd	Arica, Castle Rock, and Turtle plutons	Cretaceous 72 m.y.(3), 101, and 106 m.y.(4)	Light-colored porphyritic, biotite granodiorite to monzogranite and hornblende-biotite granodiorite; contains muscovite locally.	K. A. Howard, U.S. Geological Survey, written commun., 1980; Howard and others, 1982b
	Jd		Jurassic(?) 167 m.y.(4)	Biotite-hornblende diorite. Minimum age is Jurassic, but may be Precambrian.	
	pЄgn		Precambrian	Porphyritic, biotite syenogranite, probably in Middle Proterozoic 1,400-m.y.-age group, and leucocratic monzogranite gneiss of possible Early Proterozoic age.	
SB-45	Ku		Late Cretaceous and older	Strongly mylonitized sills as much as 1,970 ft thick; some of peraluminous, two-mica monzogranite [adamellite], two-mica tonalite, and garnet two-mica granodiorite. Other sills of metaluminous, biotite granodiorite, and hornblende-biotite quartz diorite. Magnetite series. In part cut by Whipple detachment fault.	Anderson and Rowley, 1981; Davis and others, 1982; Thurn, 1982
SB-46	KJmg	Palms Quartz Monzonite and Gold Park Gabbro-Diorite	Cretaceous or Jurassic(?)	Light- to medium-gray, massive to gneissoid, medium-grained, commonly porphyritic, biotite monzogranite [quartz monzonite] to monzonite porphyry. Accessory sphene, hornblende, and iron oxides. Contains large masses of hornblende diorite or gabbro. Closely jointed. Similar to Cretaceous monzogranite of RI-1.	Dibblee, 1967f, 1968b; Rogers, 1954, 1961

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SD-1	Kt		Cretaceous	Primarily hornblende-biotite tonalite.	Theodore and Sharp, 1975; Weber, 1963

SD-2	Kt	Lakeview Mountain Tonalite	Cretaceous	Fine- to medium-grained, locally gneissic, hornblende-biotite tonalite. Accessory sphene, apatite, and zircon. Weathers to large residual boulders and grus. Joint systems well developed locally.	Merriam, 1958
SD-3	Kt	Bonsall Tonalite	Cretaceous	Mostly light-gray, medium-grained, gneissic-biotite hornblende tonalite. Accessory sphene, apatite, and zircon. Abundant, streaked or platy inclusions oriented parallel to contacts.	Merriam, 1958; Todd, 1977b
	Kmg	Quartz monzonite and granodiorite of Pine Valley	Cretaceous	White-weathering, coarse-grained, biotite-hornblende monzogranite [quartz monzonite] and granodiorite containing accessory sphene, allanite, and epidote.	
SD-4	Ku		Cretaceous	Probably tonalite.	Weber, 1963
SD-5				Principally tonalite; including tonalite of Las Bancas enclosing large masses of Cuyamaca Gabbro.	Miller, 1937; Todd, 1978, 1979
	Kt	Tonalite of Las Bancas	Cretaceous	Mostly pyroxene-biotite tonalite, but includes some mafic tonalite (gneissic hornblende-biotite tonalite), biotite tonalite, and quartz diorite. Weathers to low, bouldery outcrops.	
	Kgb	Cuyamaca Gabbro	Cretaceous	Olivine gabbro, hornblende gabbro, and peridotite. Occurs as two large masses and numerous small inclusions in tonalite.	
SD-6	Kt	Lakeview Mountain Tonalite	Cretaceous	Gray, hornblende tonalite. No detailed maps.	Weber, 1963
SD-7	Kt	La Posta Tonalite	Cretaceous	Homogenous, light-colored, foliated, biotite tonalite; minor acicular hornblende; accessory sphene, allanite, apatite, zircon, epidote, and opaque minerals. Inclusions and schlieren abundant near contacts with country rock. Fractured and hydrothermally altered locally.	Brooks and Roberts, 1954; Strand, 1962; Todd, 1977a
		Lakeview Mountain Tonalite	Cretaceous	Gray, hornblende tonalite with few inclusions; also called La Posta Quartz Diorite; crops out in southern part of area.	

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