DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Geologic Map of the Southern Part of the Dale Lake 15-minute Quadrangle, San Bernardino and Riverside Counties, California

by

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This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purpose only and does not imply endorsement by the U.S.G.S.

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INTRODUCTION

The area of this map covers eastern parts of the Pinto Mountains, the south tip of the Sheep Hole Mountains, and a small part of the Coxcomb Mountains. Previous geologic studies within the area include those by Harder and Rich (1910), Moyle (1961), Kupfer and Basset (1962), Hope (1966, 1969), Silver and others (1977), Powell (1981), John (1981), Calzia and others (1983), and Howard and John (1984). Simpson and others (1984) presented gravity and aeromagnetic information, and Kilburn and others (1983) reported geochemical data on stream samples in the area.

Much of the area is underlain by the intermediate-composition Jurassic-age plutonic, hypabyssal, and volcanic rocks of the eastern Pinto Mountains; textural similarities and gradational relations suggest that these rocks are coeval and comagmatic. Older rocks are represented only by a small outcrop of marble (unit m) and by unmapped inclusions of schist and leucogranite gneiss in the easternmost Pinto Mountains. Younger mafic dikes are present in the Pinto Mountains. Jurassic or Cretaceous pink granite (KJg) and the Cretaceous granodiorite of Clarks Pass (Kcp) are present in the Sheep Hole Mountains, and the Cretaceous porphyritic granodiorite unit (Kgp) is present in the Coxcomb Mountains. Alluvial fans within the map area record a sequence of four mapped units ranging in age from Pliocene(?) to Holocene. Windblown sand covers large areas.

Faults of Neogene and possibly older age underlie linear valleys and range fronts. Left-lateral offset is indicated for the east-striking fault system that bisects the map area, based on separation of Jurassic units (Hope, 1966) and aeromagnetic anomalies (Calzia and others, 1983; Simpson and others, 1983). Quaternary-age faulting is demonstrated by the linearity of east-striking Pinto Mountains range fronts and of an east-striking outcrop ridge of alluvium (QTa1?) in the northwest corner of the area. The east-striking faults of the Pinto Mountains do not continue into the Sheep Hole and Coxcomb Mountains, but instead truncate eastward against the buried Sheep Hole fault between the ranges (Hope, 1966, 1969). The presence of the quartz monzodiorite unit (Jqd) on both sides of the Sheep Hole fault suggests that the fault offset is limited.

The Dale mining district in the Pinto Mountains has produced gold ore valued at more than $1,000,000, with associated silver and lead, from steep, dominantly north-trending quartz veins along faults in the plutonic, hypabyssal, and volcanic rocks of the eastern Pinto Mountains (Wright and others, 1953; Calzia and others, 1983). Much of the mineralization appears to be associated with alteration of Jurassic hypabyssal rocks. Iron has been produced from skarn-related(?) hematite-magnetite deposits at the Iron Age and Snowflake mines, also associated with Jurassic hypabyssal rocks (Harder and Rich, 1910; Wright and others, 1953).

DESCRIPTION OF UNITS

Alluvium (Quaternary and Tertiary?)--Locally derived stream-wash and alluvial-fan deposits composed of poorly sorted, angular to sub-angular sandy gravel. Divided into:

Qa4 **Unit 4 (Holocene)**--Loose detritus in modern and recently abandoned washes

Qa3 **Unit 3 (Holocene)**--Forms bar and swale topography on alluvial fans and low terraces. Age may be in part Pleistocene

Qa2 **Unit 2 (Pleistocene)**--Forms dark desert-pavement surfaces of varnished stones on alluvial fans and terraces. Contains small angular quartzite cobbles near the southwest corner of the map area. Moderately dissected locally; gradational with unit 1

QTa1 **Unit 1 (Pleistocene and Pliocene?)**--Forms highly dissected ridges that locally are capped by dark desert-pavement remnants

Qs **Windblown sand (Quaternary)**--Dune crests are indicated by dot-dash lines

Kgp **Porphyritic granodiorite (Late Cretaceous)**--In the Coxcomb Mountains. Medium-grained biotite granodiorite having coarse-grained (1-2 cm) alkali-feldspar phenocrysts. Color index

5 to 10. Described by Calzia and others (1983) as part of the Coxcomb Granodiorite of Miller (1944). Included by John (1981) as part of the Cadiz Valley batholith

Kcp **Granodiorite of Clarks Pass (Late Cretaceous)**--In the Sheep Hole Mountains and 2 km SE of Clarks Pass. Medium-grained hornblende-bearing sphene-biotite granodiorite containing alkali-feldspar phenocrysts about 1 cm across. Color index 5 to 15. Described by Howard and John (1984) and John (1981) as part of the Cadiz Valley batholith

KJg **Pink granite (Cretaceous or Jurassic)**--In the Sheep Hole Mountains. Pale pink-weathering, medium-grained leucomonzogranite. Cut by the granodiorite of Clarks Pass (Kcp); cuts the quartz monzodiorite unit (Jqd). Described by Howard and John (1984)

Mafic dikes (Jurassic?)--In the Pinto Mountains. Dikes greater than 1m thick. Dark, fine-grained to aphanitic microdiorite, in places containing hornblende micro-phenocrysts or irregular xenocrystic(?) quartz. Associated with quartz veins (which have been prospected). Cut by unmapped quartz-phyric aplite and granite dikes less than 1 m thick

Plutonic, hypabyssal, and volcanic rocks of the eastern Pinto Mountains (Jurassic)--Probably correlative with the Kitt Peak-Trigo Peaks super unit of Tosdal and others (in press). Modal mineralogy and chemical analyses of representative samples are shown in Figure 1 and Table 1, respectively. Divided into:

-x-x- **Intermediate and felsic dikes**--Fine-grained, commonly porphyrytic. Phenocrysts present in felsic dikes include zoned lavender alkali-feldspar (as wide as 8 cm), quartz, plagioclase, and biotite. Phenocrysts present in intermediate-composition dikes include plagioclase, hornblende, altered biotite, and pyroxene(?) replaced by epidote. Dacite dike 3 km northeast of the Iron Age mine has calcite-filled vugs, and possibly is Tertiary

Jpg **Porphyritic granite**--Medium-grained hornblende-biotite monzogranite and quartz monzonite containing subequant lavender alkali-feldspar phenocrysts (in places rimmed by plagioclase) 1 to 2 cm across. Color index 7 to 15. Mafic minerals are recrystallized and clotted in the eastern Pinto Mountains. Contains euhedral plaigoclase, phenocrysts of alkali feldspar that contain zonal inclusions of all other phases near the rims, and interstitial graphic intergrowths of quartz and alkali feldspar. Plagioclase is generally saussaritized and greenish. Contains abundant rounded fine-grained mafic enclaves 1 to 20 cm across that locally are mantled by granophyric rims consisting of outward-branching intergrowths of alkali feldspar (65%) and quartz (35%). Chemically analyzed samples of this unit in nearby areas (K.A. Howard and S.E. Shaw, unpublished data) contain 64 to 68 percent SiO_2. Through decrease in phenocryst content, grades into the quartz monzodiorite unit (Jqd) and parts of the quartz monzonite unit (Jqm). Locally where in sharp contact against the poikilitic-biotite-bearing rocks of the quartz monzonite unit, the porphyritic granite unit has a fine-grained groundmass suggesting that it is a chilled, younger intrusion

Jqd **Quartz monzodiorite**--In the easternmost Pinto Mountains, the Sheep Hole Mountains, and east of the map area in the western Coxcomb Mountains. Dark-greenish-gray, medium-grained equigranular rock containing biotite ± hornblende. Color index 9 to 32. The SiO_2 content of a sample from the Pinto Mountains is 62 percent, and that of a sample from the Sheep Hole Mountains is 59 percent (Table 1). The unit is generally recrystallized, and becomes foliated to gneissic in all three ranges (Sheep Hole, Coxcomb, and Pinto Mountains) in proximity to Late Cretaceous granitoid rocks (Kcp and Kgp) of the Cadiz Valley batholith (John, 1981; Calzia and others, 1983). Foliations in the unit sub-parallel the steep contact of the Late Cretaceous rocks and lineations plunge steeply. The most recrystallized rocks in the map area are metamorphosed to prograde assemblages of green hornblende + epidote + albitic(?) plagioclase. Fine-grained equigranular enclaves are common in the unit and are similar mineralogically to the host rock but contain a higher percentage of mafic minerals. The unit may be a recrystallized and slightly more mafic variant of the quartz monzonite unit (Jqm); their mutual contact was not visited in the field

Jqm **Quartz monzonite**--Medium-grained equigranular quartz monzonite, quartz monzodiorite, and monzogranite. Color index 10 to 32. Mafic phases are biotite, hornblende, local clinopyroxene (rimmed by hornblende), sphene, and opaques. The unit includes a northern facies that is gradational with the porphyritic granite unit (Jpg) and a southwestern facies that contains distinctive poikilitic biotite, locally contains clinopyroxene, and may be intruded by the porphyritic granite unit. Hornblende is pale-colored. Two analysed samples of the unit contain 61 and 62 percent SiO_2 (Table 1). Minerals tend to be euhedral or subhedral except for late-crystallizing alkali feldspar and interstitial quartz. Fine-grained mafic enclaves are present in places. Through decrease in grain size and increase in alteration grades into the hypabyssal rocks unit (Jh) in the southwestern part of the map area. Contains cross-cutting felsic veins where the unit intrudes the diorite unit (Jd)

Jh **Hypabyssal rocks**--Fine- to medium-grained , commonly porphyritic rocks considered to be hypabyssal equivalents of the quartz monzonite (Jqm) and porphyritic granite (Jpg) units. Includes porphyries and felsites with aphanitic groundmass. Color index variable. An analyzed sample that resembles the quartz monzonite unit contains 62 percent SiO_2 (Table 1). Phenocrysts include plagioclase (commonly lath-shaped), purplish alkali feldspar, quartz, bitotite, hornblende, and clinopyroxene (not all in the same rock). Hypabyssal equivalent of the porphyritic granite unit contains 1-cm alkali-feldspar phenocrysts and mafic clots, plagioclase phenocrysts, and granophyric interstitial graphic intergrowths of quartz and alkali feldspar. Unit contains unmapped intermediate and felsic dikes

Jha **Altered hypabyssal rocks**--Rocks equivelent to the hypabyssal unit, and locally to parts of the porphyritic granite and volcanic units, that are bleached and altered. Mafic minerals are commonly replaced or absent. Forms light-colored areas on aerial photographs

Jhv **Hypabyssal and volcanic rocks, undivided**

Jv **Volcanic rocks**--Porphyritic, aphanitic, and epiclastic rocks, including polymict volcanic breccias and tuffaceous sediments. Locally vuggy (containing silica-filled vugs) or laminated. Phenocrysts include plagioclase, chloritized biotite, chloritized hornblende, pyroxene (pseudomorphs), quartz, and alkali feldspar; the alkali feldspar phenocrysts are is generally purplish, subspherical, and indistinguishible from the alkali-feldspar phenocrysts in the porphyritic granite unit (Jgp). At one locality, porphyritic granite forming a sill or thick flow that contains these distinctive alkali-feldspar phenocrysts overlies upright, graded tuffaceous sandstone that contains identical1-cm alkali-feldspar crystals. This relation suggests that the plutonic, hypabyssal, and volcanic rocks of the eastern Pinto Mountains overlap in age. Analysed volcanic rocks contain from 64 to 66 percent SiO_2 (Table 1). K_2O values are high, apparently reflecting alkali metasomatism; the high K_2O is reflected by alkali-feldspar-rich groundmass, which typically stains yellow with cobaltinitrate in stained slabs

Jd **Diorite**--Small body of fine-grained diorite in the southwest part of the map area; intruded by the quartz monzonite unit

m **Marble (Jurassic or older)**--Siliceous marble that forms two 3-m-thick layers intruded by the altered hypabyssal rocks in the north-central part of the map area. Magnetite-hematite deposits at the Iron Age mine and elsewhere in the area are associated with actinolite and may be skarn type related to metasomatism and contact metamorphism of carbonate rock

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Figure 1. Modal mineralogy for plutonic and hypabyssal rocks (based on modal counts averaging 1000 points on stained slabs). Samples shown as unit Jh include unaltered samples from within rock unit Jha.

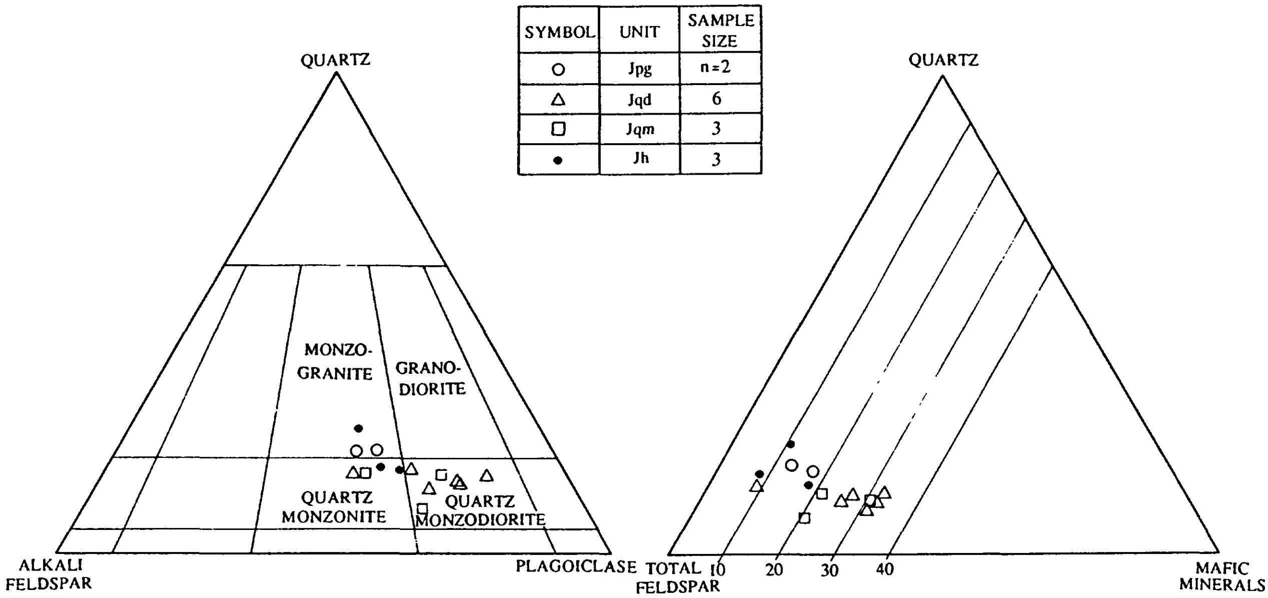


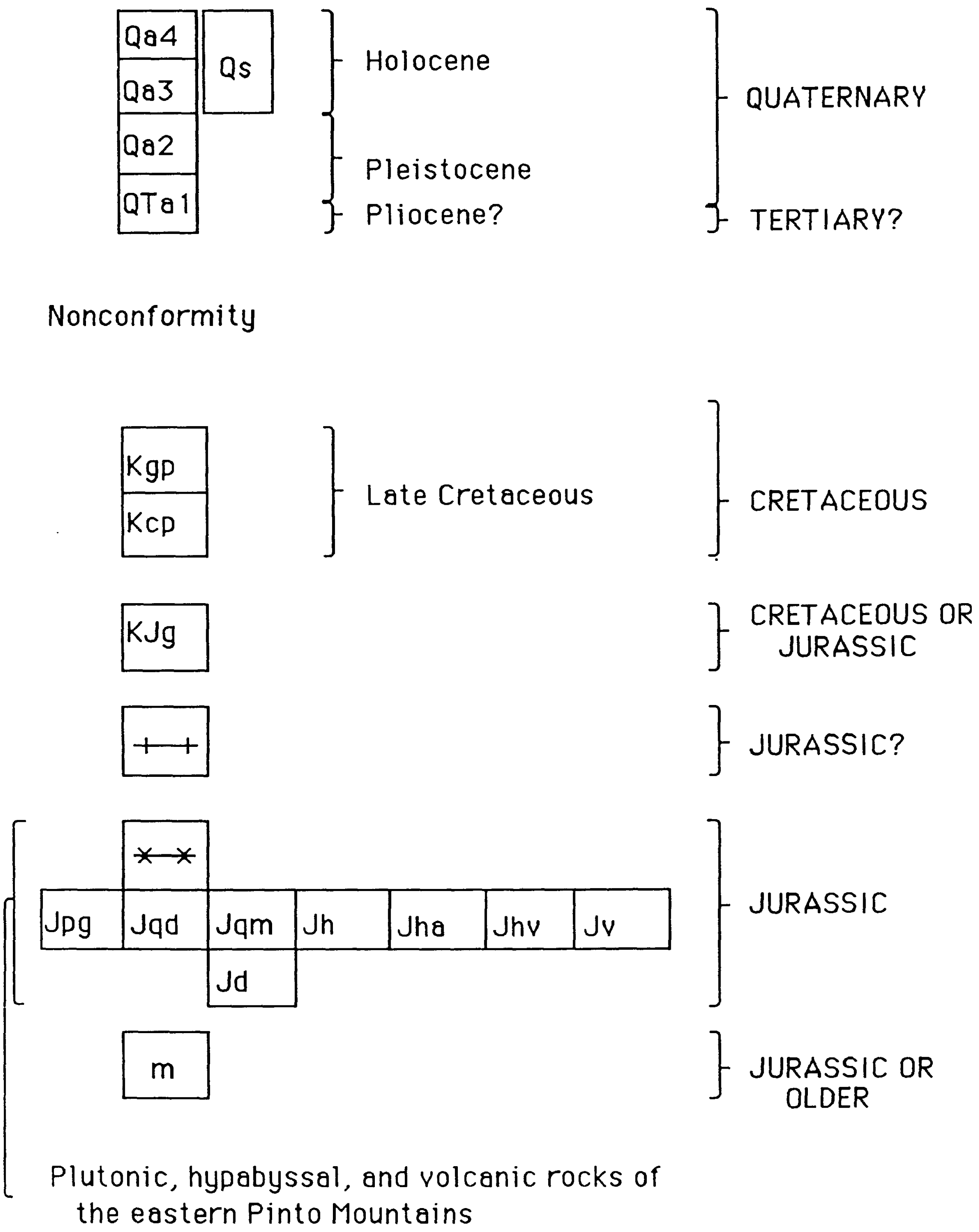
Table 1. Chemical analyses of rocks in the southern part of the Dale Lake 15-minute quadrangle (sample locations are shown on the map). LOI = loss on ignition at 900° C. FeTO3 is total iron calculated as Fe_2O_3. Analyses were performed by x-ray fluorescence in the U. S. Geological Survey laboratory in Lakewood, Colorado; analysts: A.J Bartel, K. Stewart, and J. Taggart.

* Sample 4 is located 1.85 km south of the Dale Lake quadrangle: 0.46 km northeast of center, sec. 23, T. 2 S., R. 12E. (unsurveyed), Pinto Basin 15-minute quadrangle.

Sample 9 is a detrital clast in unit QTa1.

Map No.	1	2	3	4	5	6	7	8	9
Map unit	Jqd	Jqd	Jqm	Jqm *	Jh	Jv	Jv	Jv	Jv#
Field No.	CA82PN-11	CA82PN-38	CA82PN-58	H84PN-174	H84PN-172	CA82PN-54	CA82PN-16	CA82PN-60	CA82PN-10
SiO2	61.8	58.9	62.0	61.0	61.7	64.4	63.6	65.9	65.6
Al203	14.9	15.4	15.4	15.7	15.5	14.2	15.2	14.2	14.2
FeTO3	6.41	7.63	5.67	6.58	6.26	6.13	5.54	3.66	6.07
MgO	2.56	3.06	2.39	2.77	2.74	0.94	1.40	0.74	0.27
CaO	4.06	5.64	4.22	5.33	3.77	0.43	1.06	1.60	0.49
Na2O	2.76	2.87	2.73	3.07	3.96	0.87	2.07	2.76	1.45
K2O	3.97	3.49	5.03	3.52	3.09	10.5	7.98	7.09	9.55
TiO2	0.74	0.91	0.80	0.78	0.82	0.70	0.70	0.51	0.64
P2O5	0.25	0.37	0.25	0.26	0.25	0.25	0.26	0.17	0.22
MnO	0.13	0.11	0.05	0.10	0.07	0.05	0.04	<0.02	0.03
LOI	1.60	0.99	1.32	0.59	1.31	0.61	1.27	1.91	0.60
Total	99.18	99.37	99.86	99.7	99.47	98.78	99.12	98.54	99.12

CORRELATION OF MAP UNITS



SYMBOLS

d **Disturbed ground**--Mine tailings

Contact--Largely interpreted photogeologically

Fault--Showing direction and value where known of dip. Dotted where concealed. Arrows indicate sense of strike-slip displacement. Largely interpreted photogeologically

Trend and plunge of slickenside striae

Strike and dip of inclined bedding

Strike and dip of inclined foliation

Strike of vertical foliation

Trend and plunge of lineation

Sand dune--Showing crest line, mapped from air photos taken in 1972 and 1977

Geochemical sample locality--Data in Table 1