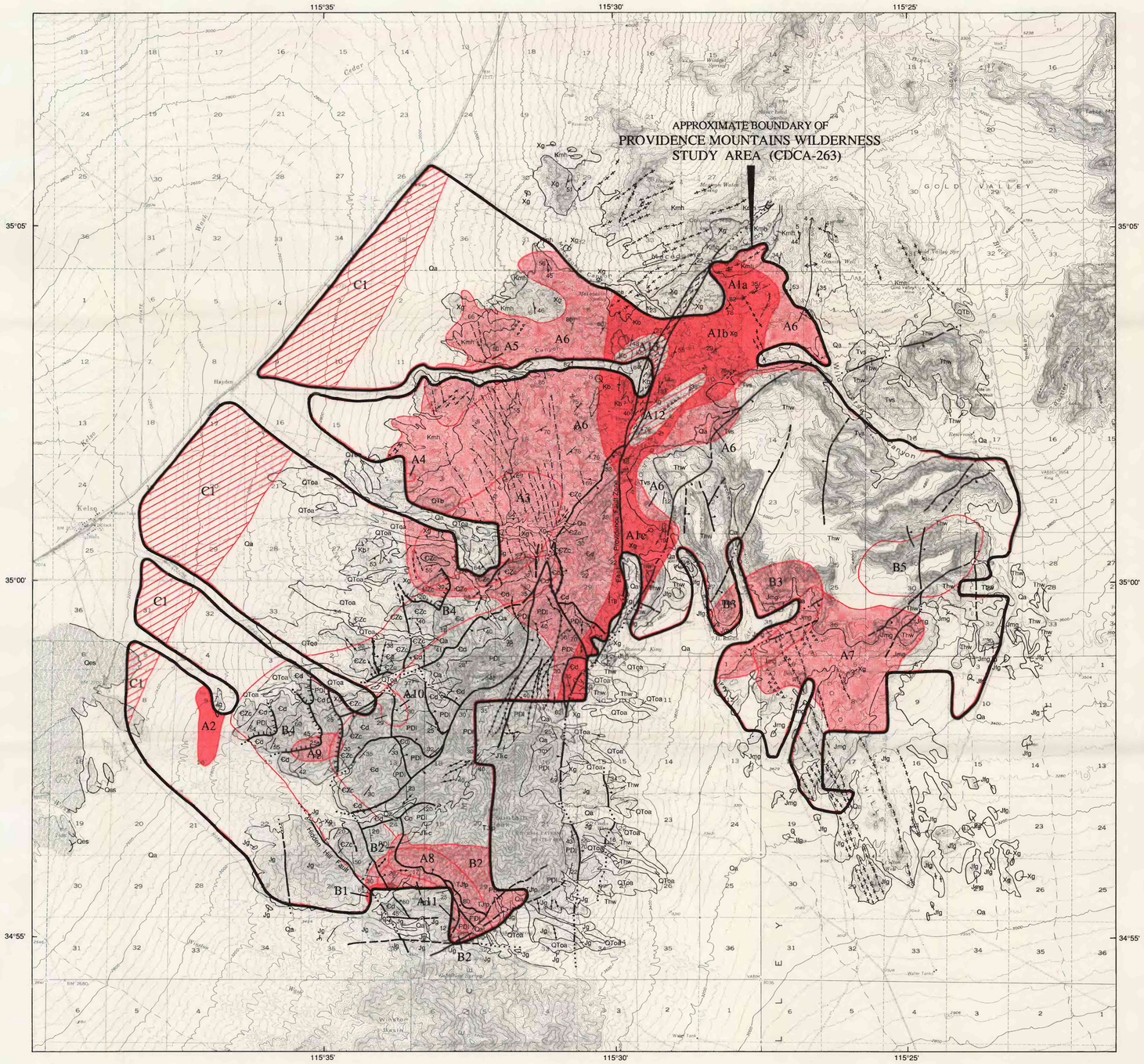


Base from U.S. Geological Survey 1:62,500:
Kelso and Mid Hills, 1955; Colton Well and Flynn, 1956

Geology mapped by D.M. Miller, L.K. Fox, and L.L. Glick, 1983, and D.M. Miller and Paul Stone, 1984; assisted by S.L. Garwin, S.L. Gusa, and M.M. Kelly.

SCALE 1:62 500

1 ½ 0 1 2 3 4 5 MILES
1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

14° TRUE NORTH MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1987

CALIF
AREA OF MAP

MINERAL RESOURCE POTENTIAL MAP OF THE PROVIDENCE MOUNTAINS WILDERNESS STUDY AREA, SAN BERNARDINO COUNTY, CALIFORNIA

EXPLANATION

- Area with high mineral resource potential
- Area with moderate mineral resource potential
- Area with low mineral resource potential
- Area with unknown mineral resource potential

Map area	Mineral resource potential and commodities	Certainty level	Deposit type
A1			
A1a	High: Ag, Cu, Pb, Zn, W Moderate: Au	D	Quartz vein and silicified shear zones
A1b	High: Au, Ag, Cu, Pb, Zn	D	
A1c	High: Ag, Cu, Pb, Zn Moderate: Au	D	Quartz vein and carbonate replacement
A2	High: Au, Ag	D	Quartz vein
A3	Moderate: Au, Ag Low: Cu, Pb, Zn	D	Quartz vein and carbonate replacement
A4	Moderate: Au, Ag Low: Cu, Pb, Zn	D	Quartz vein
A5	Moderate: Au, Ag Low: Cu, Pb, Zn	D	Quartz vein and silicified shear zones
A6	Moderate: Au, Ag Low: Cu, Pb, Zn	C	Quartz vein and carbonate replacement
A7	Moderate: Au, Ag Low: Cu, Pb, Zn	C	Quartz veins
A8	Moderate: Au, Cu Low: Ag, Pb, Zn	C	Quartz veins, silicified shear zones, and carbonate replacement
A9	Moderate: Au, Ag	B	Quartz vein and carbonate replacement
A10	Low: Ag, Cu, Pb	C	
A11	Low: Au, Ag, Cu	C	Quartz vein and carbonate replacement
A12	Unknown: Au, Ag	--	Disseminated
A13	Unknown: Mo	--	Porphyry
B1	High: Fe	D	Skarn
B2	Moderate: Fe (Area B2 encompasses areas A8 and A11)	D	Skarn
B3	Moderate: Fe	C	Skarn
B4	Low: Fe	B	Skarn
B5	Low: Fe	B	Skarn
C1	Unknown: Oil and gas		
Respective map units (see text)	Low: Au	C	Placer
	Low: U	C	Pegmatite
	Low: Industrial limestone, dolomite, and quartzite	C	Bulk
	Low: Sand, gravel, and crushed stone	C	Voluminous deposits
	Low: Geothermal energy	C	Localized high heat flow

[Au, gold; Ag, silver; Cu, copper; Mo, molybdenum; Pb, lead; U, uranium; W, tungsten; Zn, zinc]

LEVELS OF RESOURCE POTENTIAL

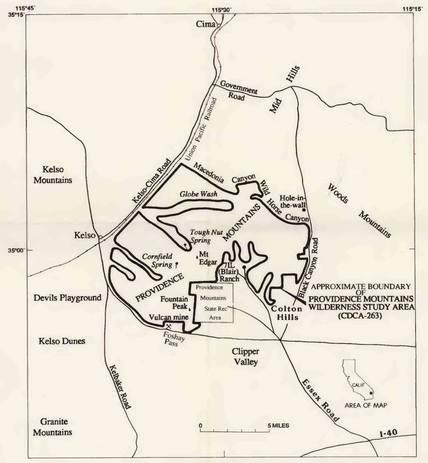
- H High mineral resource potential
- M Moderate mineral resource potential
- L Low mineral resource potential
- U Unknown mineral resource potential

LEVELS OF CERTAINTY

- A Available data not adequate
- B Data indicate geologic environment, and suggest level of resource potential
- C Data indicate geologic environment, indicate resource potential, but do not establish activity of resource-forming processes
- D Data define geologic environment and level of resource potential and indicate activity of resource-forming processes in all or part of area

LEVEL OF RESOURCE POTENTIAL	A	B	C	D
U/A	H/B HIGH POTENTIAL	H/C HIGH POTENTIAL	H/D HIGH POTENTIAL	
UNKNOWN POTENTIAL	M/B MODERATE POTENTIAL	M/C MODERATE POTENTIAL	M/D MODERATE POTENTIAL	
	L/B LOW POTENTIAL	L/C LOW POTENTIAL	L/D LOW POTENTIAL	
			N/D NO POTENTIAL	

LEVEL OF CERTAINTY



INDEX MAP

CORRELATION OF MAP UNITS

Qa	Qes	QUATERNARY	CENOZOIC
QToa	QTb	QUATERNARY AND TERTIARY	
Thw		TERTIARY	
Tvs			
TJfp		TERTIARY AND (OR) JURASSIC	CENOZOIC AND (OR) MESOZOIC
Kb		CRETACEOUS	MESOZOIC
Kmh			
Ji		JURASSIC	
Jfg			
Jg	Jmg		
JRc		TRIASSIC	
PDl		PERMIAN THROUGH DEVONIAN	
€d		CAMBRIAN	PALEOZOIC
€Zc			
			LATE PROTEROZOIC
Xg			EARLY PROTEROZOIC

DESCRIPTION OF MAP UNITS

Qa **Alluvium (Quaternary)**--Unconsolidated, poorly sorted silt, sand, and gravel in washes and in terraces covered with desert pavement

Qes **Eolian sand (Quaternary)**--Tan, poorly consolidated arkosic sand in sheets and dunes

QToa **Old alluvium (Quaternary and Tertiary)**--Partially consolidated to highly cemented alluvium typically capping high resistant terraces

QTb **Breccia (Quaternary and Tertiary)**--Consolidated to partially consolidated gravity-slide breccia consisting of angular, unsorted fragments of limestone in Tough Nut Spring area and tuff of Hole-in-the-Wall

Thw **Tuff of Hole-in-the-Wall of McCurry (1982) (Tertiary)**--Prominently layered sanidine rhyolite tuff consisting of welded and unwelded strata, some rich in lithic fragments. Includes overlying rhyolite flow locally

Tvs **Volcanic and sedimentary rocks (Tertiary)**--Lenticular strata consisting of, from top to bottom: lacustrine limestone and siltstone, rhyolite dome, aphyric basalt, biotite-sanidine welded rhyolite tuff, and conglomerate

TJfp **Fountain Peak Rhyolite of Hazzard (1954) (Tertiary and (or) Jurassic)**--Siliceous, generally aphyric, biotite rhyolite. May represent intrusion, dome, flows, and dikes

Kb **Breccia and leucocratic granite (Cretaceous)**--Intrusion breccia, leucocratic granite, and fault-brecciated felsite that is generally white, fine grained, and aphanitic

Kmh **Mid Hills Adamellite of Beckerman and others (1982) (Cretaceous)**--White, coarse-grained porphyritic biotite monzogranite containing aplite and pegmatite dikes

Ji **Ivanpah Granite of Beckerman and others (1982) (Jurassic)**--Brown, coarse-grained, subequigranular to porphyritic biotite syenogranite containing distinctive purple potassium feldspar

Jfg **Felsic granitoids of the Colton Hills (Jurassic)**--White, porphyritic, coarse-grained biotite monzogranite; light-gray, medium-grained, leucocratic granite; and yellow to pink, coarse-grained, quartz-rich biotite monzogranite

Jg **Quartz monzonite of Goldstone (Jurassic)**--Medium- to coarse-grained melanocratic subequigranular monzogranite, quartz monzonite, monzogranite, and quartz syenite. West of Foshay Pass unit locally includes hornblende-biotite monzogranite, foliated granitoid gneiss, and fine-grained quartz monzonite

Jmg **Mafic granitoids of the Colton Hills (Jurassic)**--Mesocratic to melanocratic granitoid rocks ranging from monzogranite to gabbro. Common rock types are biotite monzogranite and biotite-hornblende monzogranite and quartz monzonite; less common are biotite-hornblende diorite, olivine-augite gabbro, and biotite monzonite

JRc **Clastic and carbonate rocks (Jurassic and Triassic)**--Shale, sandstone, conglomerate, impure limestone, and tuff; lower part considered to be the Moenkopi Formation by Hazzard (1954)

PDl **Limestone (Permian through Devonian)**--Sandy, clean limestone of the Bird Spring Formation, locally cherty massive limestone of the Monte Cristo Limestone, and limestone and dolomite of the Sultan Limestone

€d **Dolomite (Cambrian)**--Buff and gray dolomite; corresponds to the Cambrian Nopah and Bonanza King Formations

€Zc **Clastic rocks (Cambrian and Late Proterozoic)**--Quartzite, shale, shaley limestone, and limestone. Corresponds to Cadiz Formation, Chambless Limestone, and Latham Shale of Hazzard (1954) and underlying Zabriskie Quartzite, Wood Canyon Formation, Stirling Quartzite, and Johnnie Formation

Xg **Gneiss (Early Proterozoic)**--Biotite monzogranite gneiss containing minor amphibole-rich gneiss, biotite schist, and pegmatite. Includes biotite-rich schistose augen gneiss in eastern Colton Hills

Contact--Dotted where concealed

60 Faults--Dashed where located approximately; dotted where concealed; dip indicated where known

High-angle--Bar and ball on downthrown side

Low-angle--Ticks on hanging wall

Fault filled by dike

Fault zone

Bedding

17 Inclined

23 Overturned

Foliation

11 Inclined

Vertical

Lineation

Breccia zone

Dikes

Dacite

Leucocratic granite

Fountain Peak Rhyolite