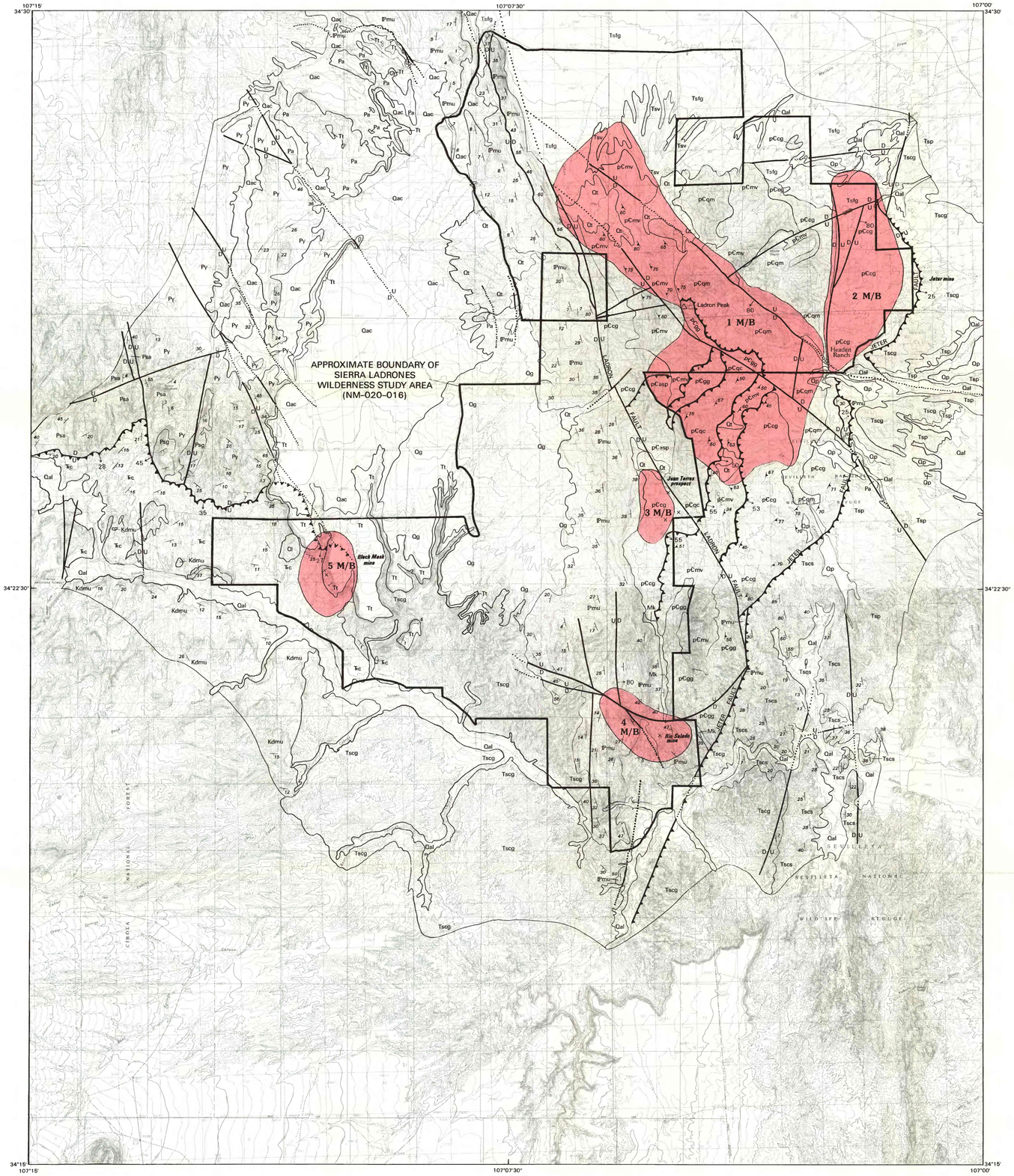
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

BULLETIN 1734–F
PLATE 1



MAP SHOWING MINERAL RESOURCE POTENTIAL, GEOLOGY, AND SELECTED AREAS OF CLAIM ACTIVITY OF THE SIERRA LADRONES WILDERNESS STUDY AREA, SOCORRO COUNTY, NEW MEXICO

EXPLANATION OF MINERAL RESOURCE POTENTIAL

[Entire study area has low mineral resource potential for all metals (except as noted below) and geothermal energy, at certainty level B, and for coal, uranium, and oil and gas, at certainty level C]

M/B **Geologic terrane having moderate mineral resource potential for the commodities listed below, with certainty level B**

Commodities

1. **Tungsten, bismuth, molybdenum, and lead**
2. **Silver and gold**
3. **Fluorite and tungsten**
4. **Manganese, cobalt, nickel, tungsten, and molybdenum**
5. **Manganese, cobalt, nickel, and molybdenum**

CORRELATION OF MAP UNITS

Qal, Ql	Holocene	QUATERNARY
Qac, Qt	Holocene and Pleistocene	QUATERNARY
Qp	Pleistocene	QUATERNARY
Qg	Pleistocene	QUATERNARY
Tt	Pliocene	QUATERNARY
Tscg, Tsv, Tsp, Tscs	Pliocene to Middle Miocene	TERTIARY
Unconformity		
Kdmu	Upper Cretaceous	CRETACEOUS
Unconformity		
Trc	Upper Triassic	TRIASSIC
Unconformity		
Psa, Psg, Py, Pa	Lower Permian	PERMIAN
IPmu		PENNSYLVANIAN
Mk		MISSISSIPPIAN
Unconformity		
pCqm, pCcg, pCgg		PRECAMBRIAN
Unconformity		
pCasp, pCmv, pCqc, pCg		PRECAMBRIAN

DESCRIPTION OF MAP UNITS

[in., inch; ft, foot]

Qal **Alluvial deposits (Holocene)**—Light-gray to light-brown sand and silt and intercalated gravel deposited in the Rio Salado and its major tributaries, and in the major valleys along the eastern slopes of the Sierra Ladrones; unit locally includes colluvium

Ql **Landslide deposits (Holocene and Pleistocene)**—Jumbled, angular travertine blocks in a matrix of crushed travertine and conglomerate of the Santa Fe Group (Tscg). Deposits occur along undercut cliffs of travertine (Tt) north of the Rio Salado

Qt **Talus deposits (Holocene and Pleistocene)**—Angular blocks of all the Precambrian rocks and Pennsylvanian limestone that underlie the western part of the Sierra Ladrones occur as major talus deposits along the northeast, north, and west slopes of the Sierra Ladrones

Qac **Alluvial and colluvial deposits (Holocene and Pleistocene)**—Unsorted pebbles and cobbles of Precambrian and Paleozoic rocks in an unbedded or crudely bedded, light-brown to light-red sand and silt; unit locally includes talus and eolian deposits. Mantles the travertine (Tt), and Yeso Formation (Py), Abo Formation (Pa), and Pennsylvanian limestone of the Magdalena Group (IPmu) in small valley in western part of the area

Qp **Piedmont slope deposits (Pleistocene)**—Light-gray to light-brown, moderately well sorted to poorly sorted, angular to subangular sand, silt, and gravel deposited on terraces cut on Pliocene and Miocene sedimentary rocks and Precambrian granite gneiss (pCcg) along the eastern margin of the eastern slopes of the Sierra Ladrones

Qg **Gravel deposits (Pleistocene)**—Poorly sorted, unbedded angular to subangular fragments of Precambrian and Paleozoic rocks from the higher elevations of the Sierra Ladrones that are deposited on a terrace cut on the Pliocene travertine and the Pliocene conglomerate of the Santa Fe Group in the southwestern part of the study area

Tt **Travertine (Pliocene)**—White, light-yellow, light-red, and tan dense limestone beds that locally show concretionary structures and leaf imprints and enclose chert and limestone pebbles. Unit was deposited on an erosional surface cut on Lower Permian Abo Formation, Yeso Formation, Upper Triassic Chinle Formation, and the Pliocene conglomerate (Tscg) of the Santa Fe Group. Unit is 0–110 ft thick

Santa Fe Group (Pliocene to Middle Miocene)

Tscg **Conglomerate (Pliocene)**—Composed chiefly of subangular to subrounded fragments (1/4 in. to 2 in. across) of Precambrian granitic metasediments, metavolcanics, and Paleozoic limestone in a sand and silt matrix. Unit is crudely bedded and light reddish gray. Unit was deposited unconformably on older Tertiary, Mesozoic, Paleozoic, and Precambrian rock units and downfaulted against older Tertiary rocks along the flanks of the Sierra Ladrones

Tsfg **Fanglomerate (Pliocene)**—Unsorted, unbedded, angular to subangular and subrounded boulders and cobbles of Precambrian metavolcanics, metasediments, granite gneiss, and quartz monzonite. Unit deposited along northern lower slopes on metavolcanic quartz monzonite (pCqm) and siliceous metavolcanics (pCmv). Unit is overlain by conglomerate of Santa Fe Group (Tscg)

Tsv **Volcanic conglomerate (Pliocene)**—Composed of well-rounded dark-red cobbles and pebbles of porphyritic andesite in a matrix of granules and sand-sized dark-red andesite. Unit occurs in faulted blocks in the headwaters of Cañon del Alamito in the northeastern part of the study area

Tsp **Popotosa Formation (Miocene)**—Light-gray and light-greenish-gray to medium-reddish-brown and purple, thin- to medium-bedded, fine-grained silty and argillaceous sandstone; contains lenses of pebbles and numerous white to light-red volcanic ash beds 6 in. to 10 ft thick. Formation is unconformably overlain by conglomerate of Santa Fe Group (Tscg)

Tscs **Conglomerate and sandstone (Miocene)**—Crudely bedded fanglomerate and sandstone. Fanglomerate is crudely bedded, light gray to light brown, and composed of subrounded pebbles and cobbles of Precambrian schist, gneiss, quartzite, granitic rocks, and upper Paleozoic rocks in an indurated sand- to pebble-sized matrix. The interbedded sandstones are light gray and moderately well bedded and contain 1- to 3-in.-thick lenses of well-rounded pebbles of Precambrian and Paleozoic rocks. Unit is a faulted block between the northeast-trending Jeter fault and an unnamed north-trending fault in the southeastern part of the study area

Kdmu **Upper Cretaceous rocks, undivided**—From oldest to youngest: Gallup Sandstone, D-Cross shale tongue of the Mancos, Tres Hermanos Formation, Rio Salado shale tongue of the Mancos, and the basal Dakota Sandstone which unconformably overlies the Upper Triassic Chinle formation (Trc). Swarms of late Oligocene monzonite dikes intrude Cretaceous and Triassic rocks in the southwestern part of the map area. The dikes trend N. 7° W. to N. 10° E. and are intruded into near-vertical faults and fractures and form low ridges. Dikes weather to a light brownish yellow and brownish gray

Trc **Chinle Formation (Upper Triassic)**—Red to purplish-red siltstone, silty shale, and mudstone interbedded with a few lenses and interbeds of reddish-brown pebble and granule conglomerate; pebbles are poorly sorted, subrounded to rounded quartz, feldspar, and minor limestone. Formation is unconformably overlain by Dakota Sandstone; basal contact not exposed. The formation is thrust northeastward over Yeso Formation (Py), Glorieta Sandstone (Psg), and San Andres Limestone (Psa). Only the upper 350–450 ft of formation crops out in the study area. Swarms of late Oligocene monzonite dikes (described above under Kdmu) intrude the formation in the southwestern part of the map area

Psa **San Andres Limestone (Lower Permian)**—Dark-gray, thin- to medium-bedded, fine- to medium-grained limestone interbedded with a few lithe-gray to light-yellow sandstone and gypsum beds

Psg **Glorieta Sandstone (Lower Permian)**—White, light-yellow, and light-gray, medium- to coarse-grained, crossbedded sandstone, which forms tors and cliffs in the southwestern part of the study area. Basal beds are intercalated with upper beds of Yeso Formation (Py). Unit is about 150–170 ft thick

Py **Yeso Formation (Lower Permian)**—Interbedded buff, reddish-orange, and yellowish-gray siltstone and sandstone, white to light-yellow gypsum, gypsiferous siltstone, and medium-gray limestone. Basal contact not exposed

Pa **Abo Formation (Lower Permian)**—Chiefly medium-red siltstone and fine-grained sandstone and a few beds of granule and pebble conglomerate, medium-red sandstone, and light-gray to light-yellowish-gray limestone. Upper and lower contacts of formation not exposed in the map area

IPmu **Magdalena Group (Pennsylvanian), undivided**—Composed mostly of medium- to thick-bedded, light- to medium-gray limestone with interbedded sets of medium- to thick-bedded, light-yellowish-gray, medium- to coarse-grained sandstone, granule sandstone, and conglomeratic sandstone. Lower part of unit forms massive hogbacks and flatirons along the western escarpment of the Sierra Ladrones. Lenticular thrust slices of Pennsylvanian limestone occur along the southern part of the Jeter thrust fault at the base of the eastern escarpment of the Sierra Ladrones. Upper contact of unit not exposed in the study area. Lowermost limestone beds of unit disconformably overlie Mississippian Kelly Formation along the middle and lower parts of Mule Canyon in the southern part of the study area

Mk **Kelly Formation (Mississippian)**—Upper part consists of Ladron Member (0–90 ft thick) which disconformably overlies the Calosa Member and is composed of medium-bedded, light-gray crinoidal limestone that contains abundant white to brown chert nodules. Caloso Member (0–40 ft thick) is composed of massively bedded, medium-gray, fine-grained dolomite and dolomitic limestone deposited unconformably on Precambrian granitic rocks. Both members wedge out against an erosional surface on Precambrian rocks northwest of Cerro Colorado in the southern part of the study area

pCqm **Quartz monzonite (Precambrian)**—The youngest Precambrian pluton of the map area underlies the northeastern part of the study area and intrudes the Precambrian granite gneiss (pCcg) and the metavolcanics (pCmv) in the northeastern and eastern parts of the area. The quartz monzonite is light orange to buff and coarse grained and even grained. It is composed of biotite and muscovite and about equal amounts of potassium feldspar, sodic plagioclase, and quartz. Accessory minerals are epidote, magnetite, and apatite. Contains xenoliths of quartzite, amphibolite, and metavolcanic rocks; weathers to knurled surfaces

pCcg **Granite gneiss (Precambrian)**—Ranges from fresh or nearly unaltered porphyritic granite gneiss to argillized porphyritic granite gneiss along the footwall of the Jeter thrust fault in the eastern and southeastern parts of the study area. The nearly unaltered facies that occurs south and southeast of Ladron Peak where it occurs in thrust slices is a medium- to coarse-grained, light-reddish-brown to light-brownish and reddish-orange, porphyritic gneissic rock composed of about 30–40 percent phenocrysts (2–10 mm across) in a fine- to medium-grained matrix of feldspar; the phenocrysts and matrix are composed of potassium feldspar, sodic plagioclase, muscovite, and quartz. The altered granite gneiss crops out within faulted and thrust-faulted blocks along the eastern and western slopes of the Sierra Ladrones. The altered facies is light gray to light orange; the potassium-feldspar and sodic-plagioclase phenocrysts and matrix are strongly argillized and silicified, and the muscovite is aligned along the foliation. These alteration zones parallel the Jeter thrust fault and other unnamed faults and grade laterally away from the faults through slightly altered to unaltered granite gneiss. Along the traces of these faults the granite gneiss is shattered and sheared

pCgg **Gneiss and granite (Precambrian)**—Unit ranges from coarse-grained granite to coarse-grained gneiss; locally it grades into gneissic granite and contains hornblende, muscovite, and biotite. Granitic gneiss is light reddish gray and light red and is composed of feldspar phenocrysts (1/8 to 1 in. across) in a matrix of feldspar, quartz, hornblende, muscovite, and biotite

pCasp **Amphibolite, schist, and phyllic (Precambrian)**—Interbedded amphibolite, quartz-muscovite schist, and phyllite with a few lenses and interbeds of quartzite. Aphibolite ranges from coarse-grained through fine-grained to foliated beds and is composed of about 60–80 percent blue-green hornblende, 20–30 percent plagioclase, and 5–10 percent quartz. Phyllite and schist are composed mostly of muscovite, quartz, feldspar, and minor biotite, magnetite, and epidote. Quartzite is white to light gray and foliated and contains fine muscovite laminae. Unit is intruded by granite gneiss (pCcg) and quartz monzonite (pCqm) at Ladron Peak

pCmv **Metavolcanic schist and gneiss (Precambrian)**—Metamorphosed pink to purple siliceous dacite and rhyolite flow, ash-flow tuff, and minor interbedded basalt flows. The siliceous flows and ash-flow gneisses and schists are composed of broken and sheared, elongated plagioclase crystals in a foliated, compacted matrix of feldspar, quartz, and ferromagnesium minerals. Unit is intruded by granite gneiss (pCcg), quartz monzonite (pCqm), and granitic gneiss (pCgg)

pCqc **Quartzite and conglomeratic quartzite (Precambrian)**—Massive white quartzite, schistose muscovite quartzite that contains numerous amphibolite inclusions, and conglomeratic quartzite

pCg **Granitic gneiss (Precambrian)**—Orange to reddish-orange, coarse- to medium-grained granitic gneiss; textures range from gneissic to massive. Unit underlies Cerro Colorado along the eastern boundary of the study area

MAP SYMBOLS

- Contact—Dotted where concealed
- Fault—Dotted where concealed; U, upthrown side; D, downthrown side; arrows show relative direction of movement
- Thrust fault—Dotted where concealed; angle of dip originally less than 45°. Dip of fault shown by barbed arrow. Sawteeth on upper plate
- 24 Strike and dip of beds
- 21 Strike and dip of foliation
- × Prospect pit
- Adit
- Caved adit

LEVEL OF RESOURCE POTENTIAL ↑ / LEVEL OF CERTAINTY →	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 →

LEVELS OF RESOURCE POTENTIAL

- H High mineral resource potential
- M Moderate mineral resource potential
- L Low mineral resource potential
- U Unknown mineral resource potential
- N No known 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, give good indication of level of resource potential, but do not establish activity of resource-forming processes
- D Data clearly define geologic environment and level of resource potential and indicate activity of resource-forming processes in all or part of the area

Diagram showing relationships between levels of mineral resource potential and levels of certainty. Shading shows levels that apply to this study area