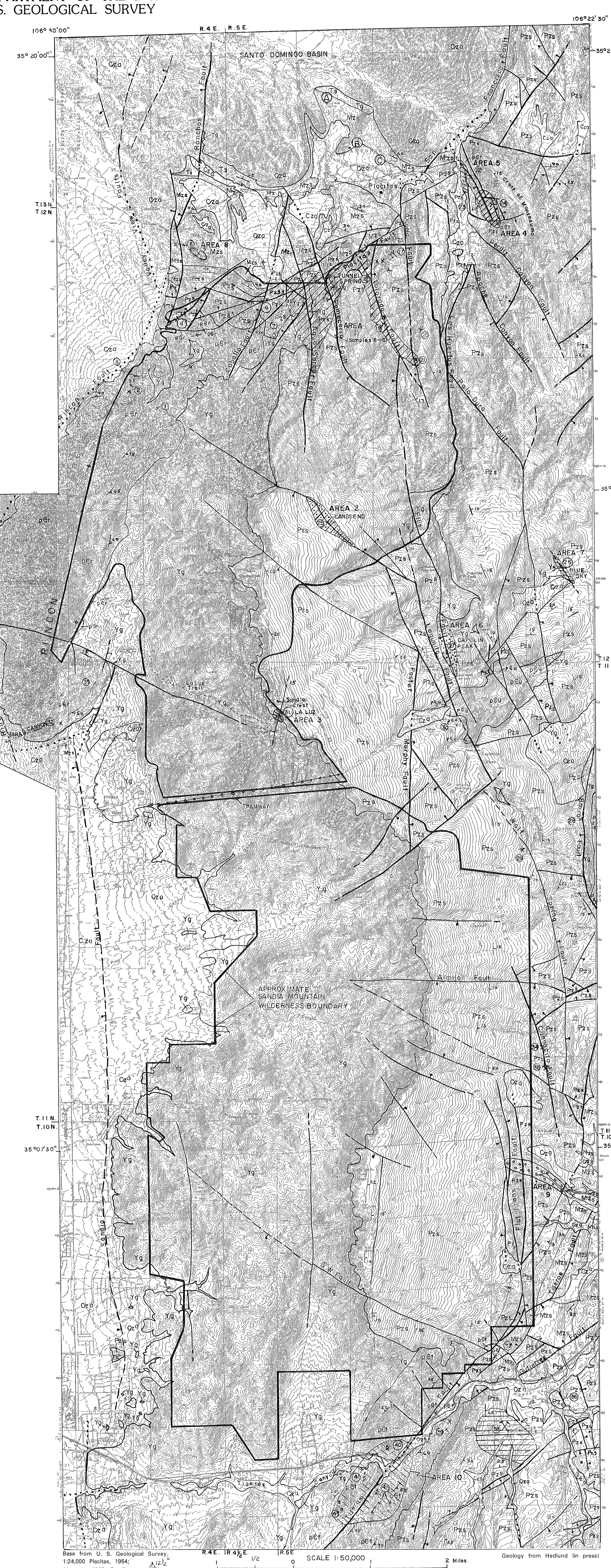
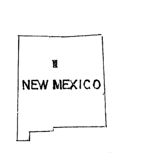
DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

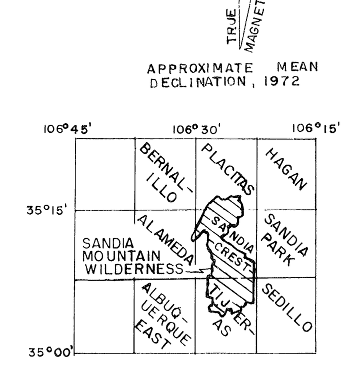
MISCELLANEOUS FIELD STUDIES
MAP MF-1631-A
PAMPHLET ACCOMPANIES MAP



Base from U. S. Geological Survey, 1:24,000 Placitas, 1954; Alameda, 1960; Sandia Crest, Tijeras, 1961

Geology from Hedlund (in press)


MAP LOCATION



Index showing quadrangles used in this study

EXPLANATION

MINERAL RESOURCE POTENTIAL--Number corresponds to locality described in pamphlet; letters A, B, and C correspond to occurrences of coal in the Mesaverde Formation

- Low to moderate resource potential for barite in veins; low to moderate resource potential for silver and gold in veins
- Low to moderate resource potential for barite and low resource potential for fluorite in veins
- Low resource potential for fluorite in veins
- Low to moderate resource potential for silver in veins and low resource potential for fluorite in veins
- Low resource potential for gold in veins
- Low resource potential for molybdenite in veins as delineated by geochemical anomaly
- High resource potential for limestone of cement clinker quality. Quarry site contains identified limestone resource

PROSPECT
- Pit
- Shaft
- Adit or tunnel
- Quarry
- Drill hole site

CORRELATION OF MAP UNITS

Unit		
Cza	Upper Cenozoic	CENOZOIC
Tg	Tertiary	CENOZOIC
Mzs		MESOZOIC
Pzs		PALEOZOIC
Yg		PROTEROZOIC Y
p€r		PROTEROZOIC Y AND X
p€u		PROTEROZOIC Y AND X
p€t		PROTEROZOIC X?

DESCRIPTION OF MAP UNITS

- **Cza** ALLUVIUM, AND ALLUVIAL-FAN AND BASIN-FILL DEPOSITS (UPPER CENOZOIC)
- **Tg** GALISTEO FORMATION (EARLY TERTIARY)--Sandstone, mudstone, and minor conglomerate
- **Mzs** SEDIMENTARY ROCKS (MESOZOIC)--Sandstone, shale, and mudstone of Mesaverde, Mancos, Dakota Formations (Cretaceous); Morrison, Todilto, Entrada Formations (Jurassic); and Chinle, Santa Rosa Formations (Triassic)
- **Pzs** SEDIMENTARY ROCKS (PALEOZOIC)--Red beds, sandstone, limestone, and minor gypsum of the San Andres, Yeso, and Abo Formations (Permian); chiefly limestone and minor shale and sandstone of the Madera Group (Permian and Pennsylvanian) and Sandia Formation (Pennsylvanian); and Arroyo Penasco Group (Mississippian)
- **Yg** SANDIA GRANITE OF KELLEY AND NORTHROP (1975) (PROTEROZOIC Y)
- **p€r** GNEISS AND SCHIST OF RINCON (PROTEROZOIC Y and X)
- **p€u** UNDIFFERENTIATED GNEISS AND GRANITE (PROTEROZOIC Y and X)
- **p€t** TIJERAS GREENSTONE OF KELLEY AND NORTHROP (1975) (PROTEROZOIC X?)

- CONTACT
- FAULT--Dashed where inferred or approximately located; dotted where concealed. Bar and ball on downthrown side
- ANTICLINE--Showing direction of plunge
- SYNCLINE--Showing direction of plunge
- 30 STRIKE AND DIP OF BEDS--Inclined
- STRIKE AND DIP OF FOLIATION IN PRECAMBRIAN ROCKS
  - 80 Inclined
  - Vertical

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of the Sandia Mountain Wilderness, Cibola National Forest, Bernalillo and Sandoval Counties, New Mexico. The Sandia Mountain Wilderness was established by Public Law 95-237, February 24, 1978.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The Sandia Mountain Wilderness has areas of low to moderate resource potential for barite in vein and bedded replacement deposits, low resource potential for fluorite in vein deposits, low to moderate resource potential for silver and gold in vein deposits, and low resource potential for molybdenum in vein deposits.

There is little or no indication that oil, gas, coal, or geothermal energy resources are present, although parts of the Santo Domingo basin that adjoin the wilderness to the north may have some oil and (or) gas potential. Coal-bearing beds, which are present in the Mesaverde Formation near the study area, do not occur in the wilderness.

Localities where limestone and shale of the Wild Cow Formation, Madera Group, are present within the wilderness have a high resource potential for cement clinker.

INTRODUCTION

During 1981 and 1982 the U.S. Geological Survey and the U.S. Bureau of Mines conducted field investigations to evaluate the mineral resource potential of the Sandia Mountain Wilderness, Bernalillo and Sandoval Counties, N. Mex. The wilderness encompasses 61 mi^2 (37,232 acres) within the Cibola National Forest, but the map area is about 145 mi^2 and includes areas adjacent to the wilderness boundary.

The Sandia Mountains are a part of an eastward-tilted fault block that is about 18 mi long and 8-10 mi wide and that is continuous with the Manzanita-Manzano Mountain fault blocks to the south of Tijeras Canyon (fig. 1). The westward-facing Sandia range front of Precambrian crystalline rocks is capped by about 2,500 ft of Pennsylvanian and Permian limestone, sandstone, and siltstone strata that dip 15°-20° eastward to form the dip slope of the tilted fault block.

The results of the U.S. Geological Survey investigations include a geologic map (Hedlund, in press), an aeromagnetic map and interpretation (Cordell and Hedlund, in press), and a geochemical open-file report and map (Hendzel and others, 1983; Hendzel, in press). The U.S. Bureau of Mines reviewed past mining and prospecting activity, and the analytical results of the extensive sampling program were published by Kness (1982). During the period of this study no actual mining was observed within the wilderness, although the limestone quarry operations by Ideal Basic Industries near Tijeras were active.

GEOLOGY

About 40-50 percent of the rocks exposed in the Sandia Mountains are of Precambrian age and include an older group of greenstone, metarhyolite, quartzite, and gneiss that are intruded by the Sandia Granite (1,445 m.y.). Paleozoic strata, about 2,500 ft thick, comprise about 30 percent of the outcrop area and form an extensive dip slope on the tilted fault block. Mesozoic strata commonly occupy synclinal basins such as that near Placitas in the Santo Domingo basin. Tertiary strata are represented by the early Tertiary Galisteo Formation and the poorly consolidated basin-fill sediments of the Santa Fe Group.

The dominant structural element is the east-tilted Sandia fault block, which is bounded on the west by the Pliocene and Miocene Sandia and Rincon-Ranchos range-front faults. These faults have as much as 20,000-28,000 ft of throw. Numerous north-trending faults along the dip slope are considered coeval with the range-front faults and have had an important influence on the localization of barite-fluorite veins. The northeast- and east-northeast-striking Placitas-San Francisco, Tijeras, and Gutierrez faults are principally of Laramide age but probably had numerous periods of movement.

GEOCHEMISTRY

Geochemical sampling was done during 1982 (Hendzel and others, 1983; Hendzel, in press) and a total of 140 stream-sediment, panned-concentrate, rock, vein, and water samples were analyzed. Barium values of 10,000 parts per million (ppm) or greater were obtained from 22 panned concentrates along the drainages of the eastern dip slope. Associated with 13 of these concentrates were strontium values of 10,000 ppm, which suggests the probable presence of celestite in some veins. Anomalous values for Ag, Cu, Mo, Nb, Sn, V, W, and Zr were also noted in some of the barium-rich concentrates. Along the steep west-slope of the range, in an area of Precambrian rocks, anomalous amounts of La, Y, Th, W, and Zr were observed in analyzed panned concentrates from streams.

GEOPHYSICS

The aeromagnetic map (Cordell and Hedlund, in press) shows the magnetic expression of some of the major rock types but does not indicate the presence of any mineralized areas. The principal negative anomaly is over the Santo Domingo basin where a thick (9,000 ft) section of Paleozoic, Mesozoic, and Tertiary strata dips northward off of, and is faulted downward against, the Precambrian crystalline rocks of the Sandia fault block. Positive anomalies along the Sandia range front result from topography and variations in accessory magnetite content of the Precambrian crystalline rocks. The decreasing magnetic gradient off the Sandia Crest, along the dip slope to the east is locally interrupted by positive anomalies over fault slices of uplifted Precambrian rocks.

A regional gravity map (Suits and Cordell, 1981) does not indicate any significant mass-distribution anomalies within the study area.

MINERALIZATION

Barite vein and bedded replacement deposits typically occur along jasperized fault breccias within limestone beds of the Madera Group. Bedded replacement deposits of barite are not common but locally occur along veins of the Landsend deposit. Varying amounts of fluorite are commonly intergrown with the barite, and the high strontium values (10,000 ppm) in some veins suggest the probable presence of celestite.

Precious metal veins in the study area are of three main types: (1) argentiferous base-metal veins associated with barite and fluorite; (2) silver- and copper-bearing vein and fracture-filling deposits within red-bed strata of Permian and Triassic age; and (3) quartz-pyrite-gold veins in greenstone, quartzite, and gneiss of the Tijeras and Cibola Formations. Except for the La Luz deposit, most precious metal veins are outside the wilderness.

Ten mineralized areas have been defined in the map area: areas 1, 2, and 3 are within the wilderness; area 9 straddles the wilderness boundary and is based on a geochemical anomaly; and areas 4 through 8 and 10 are outside but near the wilderness area. The 10 mineralized areas are related to fault and fracture systems of diverse ages; the barite-fluorite veins are localized along faults of primarily Pliocene and Miocene age.

In area 4, the Las Huertas barite deposit occurs along a reverse fault on the west side of the Crest of Montezuma. The fault cannot be traced into the wilderness. At the Las Huertas mine the barite is in the form of a pod or lens 50 ft long and up to 10 ft wide and is localized in faulted sandstone and cherty limestone beds of the Sandia Formation (Kelley and Northrop, 1975, p. 106). The white, coarse-grained, tabular barite is intergrown with pale-green fluorite and minor amounts of galena. A sample taken by Williams and others (1964, p. 23) contained 71 percent barite, 9.8 percent fluorite, and 0.17 percent lead. Two chip samples taken by Kness (1982) contained 23.0 and 35.0 percent barium; the fluorine content was not determined, and lead values are 0.02 percent. The past production of barite from this deposit is unknown.

Area 5 includes the numerous workings of the Montezuma mine. Three shafts, a trench, small adits, and numerous prospect pits are located along the Las Huertas fault, which strikes N. 20° W., and a branch fault that strikes N. 15° E. The Las Huertas fault does not extend into the wilderness. The workings of the Montezuma mine are chiefly along drusy-quartz veins that contain pyrite, chalcopyrite, and argentiferous galena. Small shipments of ore in 1920 and 1926 contained as much as 11 oz of silver per ton (Elston, 1967, p. 29), but the analyses of unoxidized vein material from the present study indicates only 0.28 oz of silver per ton and 2-3 percent lead.

In area 6, small fluorspar deposits occur along the Ellis fault, which extends northward into the wilderness. At the Capulin Peak mine coarse, brecciated, purple and green fluorite, and colorless plates of barite occur along a vein about 120 ft long and up to 3 ft wide. The vein strikes N. 15° W. along the fault and is developed by a trench, shaft, and several prospect pits. Some vein samples contain as much as 2 percent lead. The past production of fluorspar was small, probably less than a hundred tons, with most of the production in the 1920's (Johnston, 1928, p. 118-119). No fluorspar deposits were discovered along the Ellis fault within the wilderness.

The Blue Sky (Arroyo Seco) silver deposit in area 7 is developed by an inclined adit along a N. 40-45° W.-striking fault that brought a small fault slice of Sandia Granite in contact with limestone of the Madera Group. The drusy-quartz veins contain abundant argentiferous galena, some fluorite, minor amounts of sphalerite, and chrysocolla. Analyses of unoxidized vein material indicate as much as 1.4 oz of silver per ton, 0.4-5.0 percent lead, and 11.5-24.0 percent fluorine.

Numerous bulldozer cuts within mudstone and sandstone red beds of the Chinle Formation in area 8 have revealed fracture fillings of secondary copper minerals, minor barite, and anomalous amounts of silver (5.7 oz/ton).

Valley and terrace gravel deposits have been prospected for gold placers about 1 mi east of Placitas along Las Huertas Canyon. The placer production is not known but was probably negligible.

About 0.5 mi southeast of Tijeras, azurite and malachite occur as fracture fillings within sandstone red beds of the Abo Formation. Four samples from the adit in this area contained 2.1-6 percent copper (Kness, 1982, p. 8).

At the south end of Rincon Ridge, near Jaral Canyon, numerous small prospects were developed along pegmatite dikes that follow a well-developed N. 60° W. joint direction in micaceous schist and gneiss. Most samples contain less than 0.005 oz of gold per ton, and the silver content of these dikes was less than 0.2 oz/ton. Some of the pegmatites contain minor amounts of beryl.

In the vicinity of Tijeras, the Wild Cow Formation, Madera Group, has been a source of cement clinker in the quarry operated by Ideal Basic Industries. Although the limestone and shale of the Wild Cow Formation are present within the wilderness, it is unlikely that these outcrops will be quarried when equal or better resources are available closer to the market and outside the wilderness.

Other small limestone quarries are just outside the wilderness and produced crushed stone aggregate for highway construction. Quarries are present along New Mexico Highway 44 near the Dry Camp picnic area, along the west side of the Tejano Canyon, and in the eastern suburbs of Albuquerque.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The Sandia Mountain Wilderness and adjacent areas contain small mineralized areas having low to moderate potential for barite resources in vein and bedded replacement deposits and for silver resources in veins; and low potential for fluorite resources in veins, for gold resources in veins, and for molybdenum resources in veins.

The potential for the occurrence of resources in areas 1, 2, 3, 9, and 10, within or marginal to the wilderness are assessed. The resource assessment is based on several factors or criteria:

1. A favorable geologic environment, such as the presence of numerous faults in favorable limestone or sandstone host rock
2. Evidence of mineralization in adjacent areas along similar structural trends and in favorable host rocks
3. Anomalous metal or other trace-element values in rock and vein samples, and in stream-sediment concentrates. For example, the presence of anomalous amounts of Ba (10,000 ppm and greater), Sr (10,000 ppm), Pb (5,000 ppm), and detrital fluorite in many panned concentrates along the Sandia Mountain dip slope is compatible with the proximity to vein and bedded-replacement deposits of barite.
4. Aeromagnetic anomalies. Extremely high and low gamma values in areas of broad magnetic gradients may indicate areas favorable for the discovery of mineral resources. The interrupted magnetic gradient off the Sandia Crest is related to fault slices of uplifted Precambrian rocks; some of these faults, such as the Ellis fault, are mineralized.
5. Alteration halos related to hydrothermal fluids, such as the formation of jasperized limestone and limonitic halos adjacent to the barite veins
6. Mineralized rock in or adjacent to the established wilderness boundary.

Area 1, near Tunnel Springs and along the Colorado fault, has a low to moderate potential for barite resources. The veins typically occur along north-striking, silicified faults such as the Agua Sarca, Pomecerro, and Colorado faults. The limestones are brecciated, jasperized, and stained by hematite and limonite and have locally been displaced against the Sandia Granite. Coarse barite, intergrown fluorite (commonly green to colorless), and local concentrations of galena as pods and disseminations fill the brecciated faults within the intervals as much as 60 ft long and 3 ft wide. The barite veins contain as much as 15 percent barium and 4.9 percent fluorine; the gold values are negligible but some of the more galena-rich veins contain as much as 0.8 oz of silver per ton. Many of the deposits have already been extensively mined and the lack of persistence of most veins has inhibited further exploration. An area of numerous small silver-gold veins of low resource potential is localized along the Placitas fault in the vicinity of Tunnel Springs. Some of the workings in this area have been filled or bulldozed away and were formerly included in the Kleinwort and San Jose group of claims (Ellis, 1922, p. 41). The silicified, brecciated, and hematitized Placitas fault is capped by sporadic gossans, especially at the intersections with the north-trending faults. The hypogene minerals are not readily identified but include pyrite, chalcopyrite, galena, barite, and fluorite. Kness (1982, p. 5) reported that of 51 samples analyzed in this area, the gold content was a trace or less and the silver content ranged from 0.2 to 0.8 oz/ton. These precious-metal veins are low grade; the geologic setting supports a low to moderate resource potential for silver and gold in this area.

Area 2, near the Landsend prospect, has a low to moderate resource potential for barite and a low resource potential for fluorite in vein and bedded replacement deposits. The barite-fluorite deposits have been extensively prospected by a series of bulldozer cuts and numerous pits over an area of about 2,000 by 50 ft. The veins, with some pinchouts, extend along the fault for as much as 450 ft and in places are as much as 6 ft wide. Some of the barite occurs in irregular layers 18-72 in. thick, approximately parallel to the bedding surfaces in the limestone. Minor galena and pale-yellow fluorite are also present, and the seven samples collected by Kness (1982) contained as much as 41 percent barium, 4.1 percent fluorine, and 0.1 percent lead. The property was probably developed in the late 1960's, but no production has been reported (Williams and others, 1964, p. 23).

Area 3, at the La Luz mine, has low to moderate resource potential for silver and low resource potential for fluorite in base-metal vein deposits. The fluorite veins have been identified and, like the associated silver deposits, the size and grade of the veins have not been fully evaluated. The mine workings consist of a lower adit, an upper collapsed adit, and numerous prospect pits that were developed along sheeted breccia zones in the Sandia Granite. In the upper workings, sandstone beds of the Sandia Formation are in fault contact with Sandia Granite. The veins strike N. 15° W. and N. 23° W., are about 3 ft wide, and contain appreciable amounts of argentiferous galena and purple fluorite and minor amounts of barite and manganese oxides. The four samples collected contained as much as 0.43 oz of silver per ton, 2 percent lead, and 0.15 percent barium; the gold content was less than 0.005 oz/ton. The mine, one of the oldest in the region, was chiefly worked between 1909 and 1921; the past production is not known.

Panned stream-sediment concentrates in an area about 1 mi northwest of Cedar Crest (SE1/4 sec. 3, T. 10 N., R. 5 E.) have yielded anomalous values for molybdenum (5,000 ppm) as well as anomalous amounts of Ba, Sr, Pb, V, Ag, and Cu. The source of this anomalous molybdenum was not discovered but may be veins along the Flat Irons fault just within the wilderness. Area 9 has a low resource potential for molybdenum in vein deposits.

Area 10, along the Tijeras fault, has a low resource potential for gold in vein deposits. This area contains numerous small quartz-pyrite-gold veins within fractured quartzites of the Cibola Gneiss and within the Tijeras Greenstone. These veins have been extensively prospected but the precious-metal production appears to have been small. Numerous samples analyzed by the U.S. Bureau of Mines from this area have yielded as much as 0.27 oz of gold per ton and 0.3-0.6 oz of silver per ton (Kness, 1982, p. 8).

There are no indications that oil, gas, coal, or geothermal energy resources occur within the wilderness, although parts of the Santo Domingo basin that adjoins the wilderness to the north, may have some oil and (or) gas potential. The coal-bearing beds of the Mesaverde Formation are outside the wilderness.

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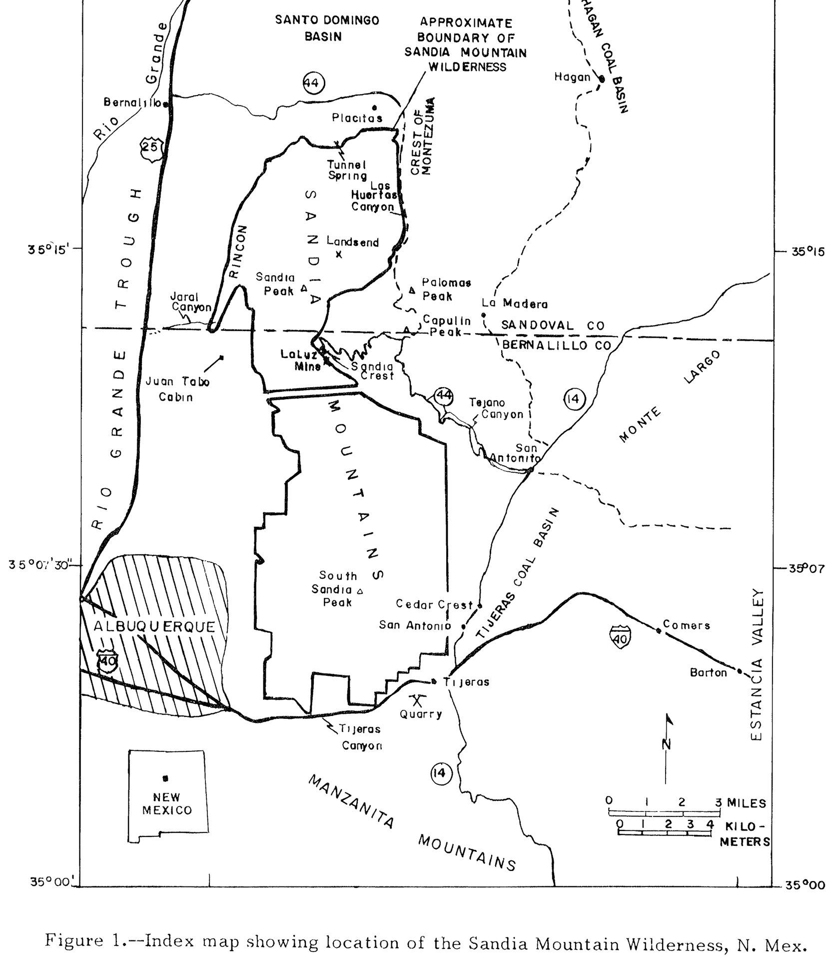

Figure 1.--Index map showing location of the Sandia Mountain Wilderness, N. Mex.

MINERAL RESOURCE POTENTIAL MAP OF THE SANDIA MOUNTAIN WILDERNESS, BERNALILLO AND SANDOVAL COUNTIES, NEW MEXICO

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