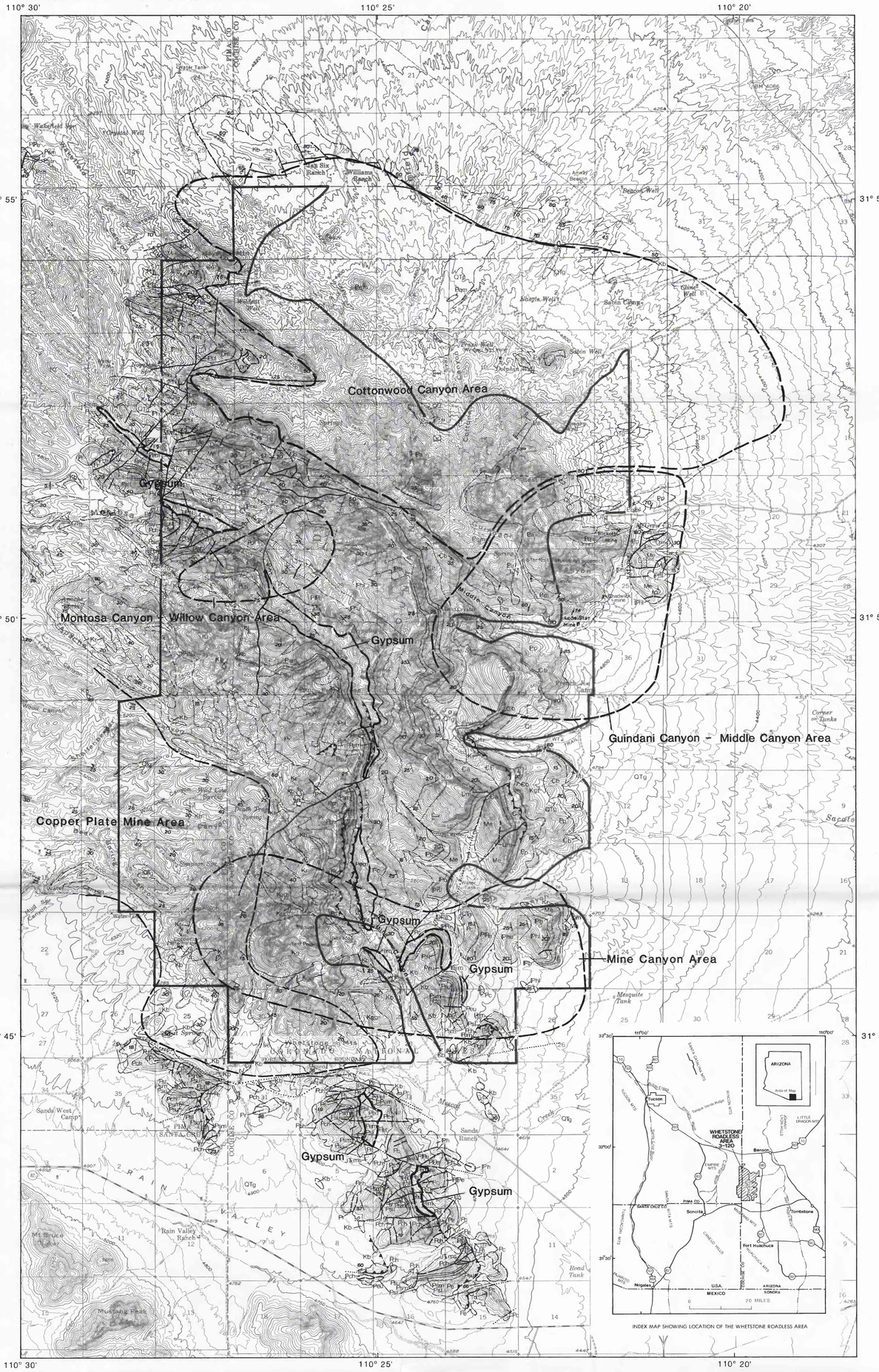

INDEX MAP SHOWING LOCATION OF THE WHETSTONE ROADLESS AREA

Base from U.S. Geological Survey 1:62,500, Benson, 1958; Fort Huachuca, 1958

APPROXIMATE MEAN DECLINATION, 1983

SCALE 1:48 000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology modified slightly from Creasey (1967) and Hayes and Raup (1968)

Explanatory pamphlet accompanies map

MINERAL RESOURCE POTENTIAL MAP OF THE WHETSTONE ROADLESS AREA, COCHISE AND PIMA COUNTIES, ARIZONA

By

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1983

EXPLANATION

AREA OF MINERAL RESOURCE POTENTIAL

Copper Plate Mine Area--Low potential for copper and silver

Cottonwood Canyon Area--Moderate potential for uranium

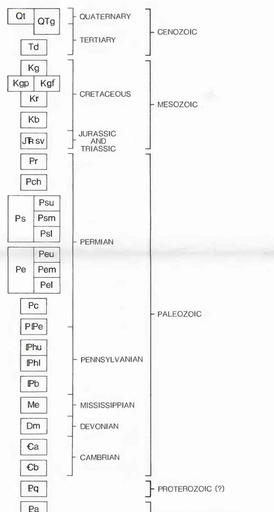
Guindani Canyon-Middle Canyon Area--Moderate potential for tungsten and uranium; low potential for fluorite, gold, mercury, and quartz

Gypsum--High potential for Gypsum

Mine Canyon Area--High potential for copper and molybdenum in porphyry-type deposit; moderate potential for copper, gold, lead, and silver in vein deposits

Montosa Canyon--Willow Canyon Area--Low potential for mercury

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qt TALUS (QUATERNARY)--Blocky rubble

QTg GRAVEL DEPOSITS (QUATERNARY AND TERTIARY)--Pebble and cobble alluvium

Td ALKALI DIORITE (TERTIARY)--Augite diorite dike

Kg GRANODIORITE (CRETACEOUS)--Medium- to coarse-grained granodiorite

Kgp PORPHYRITIC GRANODIORITE (CRETACEOUS)--Medium-grained porphyritic granodiorite

Kgf FINE-GRAINED GRANODIORITE (CRETACEOUS)--Fine-grained granodiorite in sill

Kr RHYODACITE (CRETACEOUS)--Fine-grained rhyodacite in sills

JTR sv SEDIMENTARY AND VOLCANIC ROCKS (JURASSIC AND TRIASSIC)--Consists of conglomerate, sandstone, siltstone, and silicic volcanic rocks. About 600 ft thick

Kb BISBEE GROUP, UNDIVIDED (CRETACEOUS)--In this area, consists of (in descending order): Turney Ranch Formation--sandstone interbedded with siltstone and shale, at least 3,200 ft thick; Shellenberger Canyon Formation--shale, siltstone, sandstone, and limestone, about 4,000 ft thick; Apache Canyon Formation--shale, siltstone, and sandstone in upper part, limestone in lower part, thickness 550-740 ft; Willow Canyon Formation--sandstone, siltstone, shale and limestone, up to 570 ft thick; Glance Conglomerate--limestone pebbles and cobbles, up to 300 ft thick

Pr RAINVALLEY FORMATION (PERMIAN)--Limestone, dolomite, and sandstone, about 200 ft thick. Age of unit in this area is Late Permian

Pch CONCHA LIMESTONE (PERMIAN)--Limestone and cherty, limestone, about 600 ft thick. Age of unit in this area is Early and Late(?) Permian

Ps SCHURRER FORMATION, UNDIVIDED (PERMIAN)--Age of unit in this area is Early(?) Permian. Divided into:

Psu Upper member--Sandstone, 81-146 ft thick

Psm Middle member--Limestone and dolomite, about 140 ft thick

Psl Lower member--Sandstone, about 350 ft thick

Pe EPITAPH FORMATION, UNDIVIDED (PERMIAN)--Age of unit is Early Permian. Divided into:

Peu Upper member--Limestone and dolomite, 200-371 ft thick

Pem Middle member--Limestone, dolomite, marl, sandstone, and gypsum, 655-858 ft thick

Pel Lower member--Dolomite and minor marl and sandstone, up to 133 ft thick

Pc COLINA LIMESTONE (PERMIAN)--Limestone and subordinate dolomite, 180-630 ft thick. Age of unit is Early Permian

PPe EARP FORMATION (PERMIAN AND PENNSYLVANIAN)--Calcareous sandstone, siltstone, and shale interlayered with limestone. Chert pebble conglomerate in middle part of unit. Maximum thickness 724 ft to possibly 1,115 ft. Age of unit is Late Pennsylvanian and Early Permian

HORQUILLA LIMESTONE (PENNSYLVANIAN)--Age of unit is Middle and Late Pennsylvanian. Divided into:

Phu Upper member--Limestone, siltstone, and sandstone, 531 ft thick

Phl Lower member--Limestone and minor shale and siltstone, about 420 ft thick

Pb BLACK PRINCE LIMESTONE (PENNSYLVANIAN)--Bioclastic limestone with chert-pebble conglomerate and siltstone at base. Thickness 85-135 ft. Age of unit in this area is Early Pennsylvanian

Me ESCABROSA LIMESTONE (MISSISSIPPIAN)--Massive-appearing limestone, 712 ft thick. Age of unit is Early and Late(?) Mississippian

Dm MARTIN FORMATION (DEVONIAN)--Limestone, dolomite, sandstone, and dolomitic sandstone, about 330 ft thick. Age of unit in this area is Middle(?) and Late Devonian

Ca ABRIGO LIMESTONE (CAMBRIAN)--Interbedded sandy limestone and subordinate sandy dolomite and dolomitic sandstone in upper 145 ft of unit, limestone in middle 406 ft, shale, limestone, and siltstone in lower 315 ft. Age of unit is Middle and Late Cambrian

Cb BOLSA QUARTZITE (CAMBRIAN)--Quartzite and subordinate sandstone, 455 ft thick. Age of unit is Middle Cambrian

Pq QUARTZ (PROTEROZOIC?)--Massive bull quartz in large vein

Pa ALASKITE (MIDDLE PROTEROZOIC)--Medium- to coarse-grained alaskite composed of quartz, plagioclase, potassium feldspar, and white mica

Pqm QUARTZ MONZONITE (MIDDLE PROTEROZOIC)--Porphyritic quartz monzonite composed of quartz, plagioclase, potassium feldspar, biotite, and white mica

Pp PINAL SCHIST (EARLY PROTEROZOIC)--Muscovite-quartz schist, cordierite-andalusite-muscovite schist, and cordierite-muscovite-chlorite-quartz schist

CONTACT--Dashed where approximately located

FAULT--Long dashed where approximately located, short dashed where inferred, dotted where concealed

THRUST FAULT--Dashed where approximately located, saw teeth on upper plate

35 STRIKE AND DIP OF INCLINED BEDDING

STRIKE AND DIP OF FOLIATION

48 Inclined

Vertical

SHAFT

ADIT

OPEN PIT MINE

PROSPECT

APPROXIMATE BOUNDARY OF WHETSTONE ROADLESS AREA

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 resource potential survey of the Whetstone Roadless Area in the Coronado National Forest, Cochise and Pima Counties, Arizona. Whetstone Roadless Area (3-120) was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The Whetstone Roadless Area has resources of copper, silver, tungsten, gypsum, and quartz, and potential for resources of fluorite, uranium, lead, gold, molybdenum, gypsum, and mercury. All areas of mineral resource potential are shown on the map.

No evidence of a potential for resources of fossil fuels was found in this study.

INTRODUCTION

The U.S. Bureau of Mines and the U.S. Geological Survey conducted field investigations in the spring and fall of 1980 to evaluate the mineral resource potential of the Whetstone Roadless Area, which comprises 36,610 acres of in Coronado National Forest in southeastern Arizona. Field investigations included geologic mapping, geochemical sampling, aeromagnetic and gravity surveys, and examinations of known mines, prospects, and mineralized areas.

Mining Activity

The Whetstone Roadless Area has been prospected since about 1870, when small copper-gold-silver-lead deposits were discovered in Mine Canyon just east of the roadless area. Mining, prospecting, and exploration have continued intermittently since that time.

Mineral production from the roadless area has been limited to copper, silver, and quartz sandstone at the Copper Plate mine, and tungsten at the James mine. Mining outside, but near the roadless area boundary has been conducted for copper, gold, silver, and lead in the Mine Canyon area, and for fluorite, quartz, tungsten, and uranium in the Guindani Canyon-Middle Canyon area, mostly during the 1950's and earlier.

Exploration for uranium took place in the Cottonwood Canyon area and in the Guindani Canyon-Middle Canyon area in the 1950's and in the middle-1970's through 1981. Only two properties have produced ore, and both are outside of the roadless area.

In 1982, leases for oil and gas had been issued by the Bureau of Land Management for all public land in the Whetstone Roadless Area. No drilling has taken place.

GEOLOGY

The rocks of the Whetstone Mountains consist of Proterozoic igneous and metamorphic rocks, Paleozoic and Mesozoic sedimentary strata, and Cretaceous granitic rocks. The Proterozoic rocks crop out in the northern part of the mountains. Paleozoic strata are exposed in a northwest-southeast-trending band across the middle of the area and in a faulted block at the southern end of the mountains. Mesozoic strata crop out mainly on the west side of the area. Published geologic maps of the roadless area are by Creasey (1967) and Hayes and Raup (1968).

The oldest rocks are chlorite-, cordierite-, and andalusite-bearing muscovite-biotite-quartz schists intruded by quartz monzonite and alaskite. The schists belong to the Pinal Schist, which in the Whetstone Mountains formed from shales and silty shales thought to have been metamorphosed about 1,625 to 1,680 m.y. ago. The quartz monzonite is part of a pluton that probably was emplaced about 1,400 to 1,450 m.y. ago (Silver, 1978). Alaskite bodies in the area may be related to the quartz monzonite.

The Paleozoic sedimentary section consists of rocks that range in age from Cambrian through Permian, although the Ordovician and Silurian are not represented. Rocks of Middle Cambrian age are sandstone and quartzite, but most of the higher parts of the section consist of carbonate rocks. Strata of Late Cambrian to Late Pennsylvanian age were deposited in an open marine environment, whereas overlying rocks of late Pennsylvanian to Late Permian age accumulated under tidal, supratidal, and open ocean conditions. The Paleozoic rocks have an aggregate thickness of about 8,000 ft.

Sedimentary and volcanic rocks of Jurassic and Triassic age crop out in a small area near the southern end of the Whetstone Mountains.

Sedimentary rocks of Early Cretaceous age were deposited unconformably on Paleozoic rocks with considerable local relief. The Mesozoic rocks were deposited in a marine to nonmarine prograding deltaic environment near the margin of a shallow sea. These rocks are about 8,800 ft thick.

The youngest Mesozoic rocks in the area are intrusive bodies cutting the Paleozoic and Cretaceous strata. These are a granodiorite pluton and sill-like masses in the southern and central parts of the area, and intrusive rhyodacite in irregular sill-like masses in the western part of the area. The granodiorite pluton is 76 m.y. old (Marsh and others, 1978), approximately the age of widespread silicic volcanism (Hayes, 1970) and of porphyry copper mineralization in southeastern Arizona (Creasey, 1980). The central part of the pluton locally is partly altered to sericite and potassium feldspar.

Cenozoic units consist of a single dacite dike and extensive accumulations of gravel, principally around the base of the mountains.

The structural geology of the Whetstone Mountains is dominated by the southwesterly dipping homocline formed by the Paleozoic and Cretaceous strata. Steeply dipping normal faults and a few thrust faults cut the stratified rocks but do not appear to offset them more than a few hundred feet. The faults do not significantly disturb the homoclinal pattern of the strata, although the strata have been warped into a few east-west-trending folds in the northern part of the area. The tilting, faulting, and folding probably took place during the Laramide orogeny of latest Cretaceous and early Tertiary age.

Most of the mineral deposits in the area are spatially and probably genetically related to the Proterozoic and Cretaceous igneous rocks. Uranium, fluorspar, tungsten, and possibly quartz deposits in the northern and northeastern parts of the area probably originated during consolidation of the Proterozoic quartz monzonite and alaskite. Copper deposits with silver, gold, molybdenum, and lead in the southern part of the area formed in and near the Cretaceous granodiorite. The mercury mineralization is not correlated to any known geologic event, but almost certainly is Late Cretaceous or younger. Gypsum deposits in the Permian formations are of sedimentary origin.

GEOCHEMISTRY

Geochemical data obtained from stream sediment, nonmagnetic fractions of heavy-mineral concentrates, rock samples, and water (Werschky and others, 1983) show that uranium, fluorine, beryllium, yttrium, niobium, tin, tungsten, and molybdenum form a suite of elements associated with the Proterozoic quartz monzonite and alaskite. Anomalous concentrations of copper, lead, molybdenum, tin, and tungsten in heavy-mineral concentrates from stream sediments, and silver, gold, and lead from rock samples, are interpreted to result from weak porphyry copper-type mineralization associated with emplacement of the Cretaceous granodiorite pluton. Antimony and arsenic found in stream sediments in low concentrations around the granodiorite may be part of this elemental suite. Anomalous mercury concentrations in stream sediment samples and cinnabar in heavy mineral concentrates from Middle Canyon and the Montosa Canyon-Willow Canyon area indicate mercury mineralization.

GEOPHYSICS

Aeromagnetic and gravity surveys were made for this study. Aeromagnetic data from a survey flown at 1,000 ft terrane clearance show a prominent high over a Cretaceous granodiorite pluton in the southern part of the area, well-defined positive and negative anomalies over a Cretaceous granodiorite sill, and high aeromagnetic values associated with the Proterozoic quartz monzonite. A modeled magnetic profile indicates that an east-trending nose of the aeromagnetic high associated with the granodiorite pluton may be an east-dipping, sill-like projection of the intrusive rock unit. Gravity data (Bankey and Kleinkopf, 1982) show high values over the granodiorite, the associated intrusive rhyodacite, and Paleozoic carbonate rocks, and relatively low values associated with Proterozoic intrusive rocks.

MINING DISTRICTS AND MINERALIZED AREAS

All of the Whetstone Mountains are in the Whetstone mining district. Mining activity is known in four parts of the district--the Mine Canyon area, the Copper Plate mine area, the Guindani Canyon-Middle Canyon area, and the Cottonwood Canyon area. A fifth area in Montosa Canyon and Willow Canyon shows signs of having been mineralized. These areas are outlined on the map. Principal data on the major mines and mineralized areas are summarized in table 1.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The Whetstone Roadless Area has resource potential for copper, gold, silver, molybdenum, lead, gypsum, quartz, tungsten, uranium, and mercury. These resources are found in five areas outlined on this map and discussed below. The resource potential of mineralized areas in the Whetstone Mountains is ranked in this report using the following classification:

Low potential.--The available information defines a geologic environment that is permissive for mineral resources, but there is little evidence to indicate that geologic processes acted to produce a mineral resource.

Moderate potential.--The available information defines a geologic environment that is favorable for mineral resources, and there is evidence to support the interpretation that geologic processes could have resulted in a mineral resource.

High potential.--The available information defines a geologic environment that is favorable for mineral resources, and there is sufficient evidence to support the interpretation that geologic processes resulted in a mineral resource.

Mine Canyon area

Copper, lead, and silver sulfides and gold occur in veins in granitic rocks and skarn, and as disseminations and replacement bodies in skarn in the contact zone of the granodiorite pluton exposed in Mine Canyon. The mineralized rock is mostly in the pluton, and is exposed for a distance of about 1 mi, but does not extend into the Whetstone Roadless Area. Records for the Whetstone mining district for the period 1918-29 are thought to represent production from Mine Canyon. These data, combined with data from files of the U.S. Bureau of Mines for the period 1935-61, show production of 136,248 lbs of copper, 900,000 lbs of lead, 8 oz of gold, and 830,000 in silver. An estimated indicated resource of 32 million tons (29 million t) of 0.28 percent copper and 0.01 percent molybdenum has been made from drill-core data from holes drilled in the central part of the granodiorite (DeRuyter, 1979). The Mine Canyon area has moderate potential for copper, silver, gold, and lead resources in vein deposits, and a high potential for copper and molybdenum in porphyry-type deposits inside and outside the roadless area. The copper-molybdenum resources are thought to extend into the roadless area, and geophysical data suggest that the pluton projects into that area at depth.

Commodity in the Mine Canyon Area	Location inside or outside the roadless area	Deposit type	Mineral resource potential	Criteria used to define resource potential
Copper, lead, silver and gold	Inside(?) and outside	Vein and replacement	Moderate	(a) Mines that have had production (b) High geochemical and assay concentrations of copper, lead, silver, and gold (c) Veins and replacement deposits (d) Visible sulfide minerals
Copper and molybdenum	Inside(?) and outsided	Possible porphyry copper	High	(a) Porphyritic granitic rock of Late Createceous age (b) Sericite and secondary potassium feldspar (c) High assay concentrations of copper and molybdenum (d) Copper and molybdenum minerals in drill core

Copper Plate mine area

This area is in the southwest corner of the Whetstone Roadless Area and contains the Copper Plate mine, a small open pit in Cretaceous sandstone. The copper ore, consisting of copper carbonate disseminated in sandstone in a fault zone, was used as smelter flux. A sample from the mine contains 0.68 percent copper and 0.6 oz silver. An indicated resource of 2,000-4,000 tons of low grade copper ore was measured at the mine (McColly and Scott, 1982). Few indications of copper were found in the Copper Plate mine outside of the Copper Plate mine. The Copper Plate mine area is considered to have a low potential for copper resources.

Commodity in the Copper Plate mine area	Location inside or outside the roadless area	Deposit type	Mineral resource potential	Criteria used to define resource potential
Copper and silver	Inside	Disseminated	Low	(a) Mine that had production (b) High geochemical and assay values of copper and silver (c) Fault zone containing copper (d) Visible carbonate minerals

Guindani Canyon-Middle Canyon area

Tungsten, quartz, fluorite, gold, uranium, and possibly mercury resources occur in the Guindani Canyon-Middle Canyon area.

Tungsten has been produced from veins at the James mine, located inside the Whetstone Roadless Area, and from the Chadwick and other mines outside the roadless area. The exposed ore-grade rock was exhausted before 1960. Additional tungsten resources may exist at depth in the mine areas. The area around these mines is considered to have a moderate potential for tungsten resources. A low potential for tungsten resources outside the roadless area in the vicinity of French Joe Camp is based on anomalous geochemical values in a sample from that locality, and on an aeromagnetic high suggestive of a buried granitic mass.

A body of massive quartz mined at the Ricketts mine for smelter flux extends about 800 ft into the roadless area. It is estimated to contain 5,000 to 6,000 tons of indicated quartz resources for each vertical foot of quartz. The depth of the deposit is unknown. However, the Guindani Canyon-Middle Canyon area has a low potential for additional concealed quartz resources outside of the known deposit.

Fluorite has been produced from the Lone Star mine, believed to have been the largest producer of fluorite in Arizona. The mine is about 1,000 ft east of the roadless area. None of the ore extended into the roadless area. The potential for fluorite resources inside or outside the roadless area in the Guindani Canyon-Middle Canyon area is low.

Gold is known at the Gold Crystal prospect, situated in a faulted contact in the western part of Middle Canyon outside the roadless area. A grab sample from the prospect contained 0.02 oz/ton gold. The extent of the gold-bearing rock is unknown. The Guindani Canyon-Middle Canyon area has a low potential for additional gold resources of this type.

The Star No. 1 (Bluestone) prospect has produced 47 tons of low-grade uranium ore from fractures along mafic dikes in alaskite east of the roadless area. The distribution of high radioactivity values along the dike is irregular. The area containing the mafic dikes is considered to have a moderate potential for additional resources of uranium.

The distribution of mercury in Middle Canyon is poorly known. Middle Canyon has a low potential for mercury resources.

Commodity in the Guindani Canyon-Middle Canyon area	Location inside or outside the roadless area	Deposit type	Mineral resource potential	Criteria used to define resource potential
Tungsten	Inside and outside	Vein	Moderate	(a) Mine that had production (b) High geochemical concentrations of tungsten (c) Visible scheelite and wolframite (d) Aeromagnetic high near French Joe Camp
Quartz	Inside and outside	Massive vein	Low	(a) Measured dimensions of exposed quartz body (b) Mine that had production
Fluorite	Inside and outside	Vein	Low	(a) Mine that had production (b) Exposed fluorite vein
Gold	Outside	Disseminated in fault zone	Low	(a) Known gold values
Uranium	Outside	Vein	Moderate	(a) Mine that had production (b) High assay concentrations of uranium and high radioactivity counts
Mercury	Inside	Vein(?)	Low	(a) High geochemical concentration of mercury and identified cinnabar

Cottonwood Canyon area

The Cottonwood Canyon area has uranium resources as shown by high scintillometer readings and assay values of samples collected along fractures in quartz monzonite. The Windmill No. 1 mine north of the Whetstone Roadless Area has 110 lbs of uranium in rock averaging 0.11 percent uranium from other radioactive rocks of the Cottonwood Canyon area have 32 to 281 parts per million uranium. The Cottonwood Canyon area is classified as having a moderate potential for uranium in vein-type deposits. Most of the area of resource potential is outside the roadless area.

Commodity in the Cottonwood Canyon	Location inside or outside the roadless area	Deposit type	Mineral resource potential	Criteria used to define resource potential
Uranium	Inside and outside	Vein	Moderate	(a) Mine that had production (b) High assay and geochemical concentrations of uranium and high radioactivity counts

Montosa Canyon-Willow Canyon area

Mercury found during the geochemical study in this area, as in Middle Canyon, is suggestive of a mercury resource. However, the area has a low potential for mercury.

Commodity in the Montosa Canyon-Willow Canyon	Location inside or outside the roadless area	Deposit type	Mineral resource potential	Criteria used to define resource potential
Mercury	Inside	Vein(?)	Low	(a) High geochemical concentrations of mercury and identified cinnabar

Areas of gypsum resources

Good exposures of bedded gypsum are found in sedimentary strata south of the Whetstone Roadless Area, but few outcrops are known in the roadless area. The thickness and extent of gypsum deposits at most localities of gypsum-bearing formations is unknown. Gypsum is poorly exposed because it is easily eroded and covered. The roadless area has a high potential for gypsum resources.

Commodity	Location inside or outside the roadless area	Deposit type	Mineral resource potential	Criteria used to define resource potential
Gypsum	Inside and	Sedimentary	High	(a) Exposed sedimentary beds

As noted earlier, all public land in the Whetstone Mountains was under lease for oil and gas in 1982. However, no potential for resources of fossil fuels was identified in this study.

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Table 1.--Summary of information derived from U.S. Bureau of Mines examination of known mineral deposits in and near the Whetstone Roadless Area, Cochise and Pima Counties, Arizona

Deposit	Location	Commodity	Geologic control	Production and development
Nevada-Mascot mines	Mine Canyon area	Copper, gold, silver	Sulfide minerals are disseminated in fault zones and quartz veins in a grano-diorite stock.	Total production unknown (refer to text). Mascot adit 500 ft long, Nevada adit 250 ft long, shallow shafts, several prospect pits.
Two Peaks mine	Mine Canyon area	Copper, gold, silver	Sulfide minerals are disseminated in fault zones and quartz veins in a grano-diorite stock.	Production unknown. Adit 250 ft long, adit 40 ft long, shaft 40 ft deep, and several prospect pits.
Copper Plate mine	Copper Plate mine area	Copper, silver	Copper carbonates localized in fault zone cutting sandstone	1,600 tons of ore averaging 1.2 percent copper, 0.6 oz silver per ton produced in 1957-58 (Keith, 1974, p. 145). 70-ft-long, 30-ft-deep open pit.
Gold Crystal prospect	Guindani Canyon-Middle Canyon area	Gold	Gold occurs in gouge and breccia along a fault contact between limestone and quartzite.	Production unknown. Trench 200 ft long; caved adit.
James mine	Guindani Canyon-Middle Canyon area	Tungsten	Scheelite and wolframite occur disseminated in quartz veins in alaskite.	Several hundred pounds of concentrates produced from sorted ore assaying more than 2.0 percent tungsten trioxide (Dale and others, 1960, p. 55-56. Trench 75 ft long, several prospect pits.
Lone Star mine	Guindani Canyon-Middle Canyon area	Fluorite	Fluorite occurs in a vein in schist	20,000 tons of fluorite produced from 1946 to 1967 (Keith, 1973, p. 91). Caved shaft and several trenches on strike with vein, several prospect pits.
Star No. 1 (Bluestone) prospect	Guindani Canyon-Middle Canyon area	Uranium	Uranium occurs along mafic dikes in alaskite.	About 47 tons of low-grade uranium ore produced in 1958-60 (Keith, 1973, p. 91). Four short adits, scattered prospects pits.
Chadwick mine	Guindani Canyon-Middle Canyon area	Tungsten	Scheelite and wolframite occur disseminated in quartz veins in alaskite.	60-80 units (1,200-1,600 lbs.) of tungsten trioxide were produced (Wilson, 1950, p. 9-10). Trench 100 ft long; several prospect pits.
Ricketts mine	Guindani Canyon-Middle Canyon area	Silica	Quartz vein along contact between alaskite and quartz monzonite.	Several tens of thousands of tons of quartz mined from 1955 to 1959 (Keith, 1973). Several open pits, prospects.
Windmill No. 1 mine	Cottonwood Canyon area	Uranium	Uranium occurs in fault zones in quartz monzonite pluton.	Approximately 16 tons of ore averaging 0.11 percent uranium produced in the 1950's. Inclined shaft 107 ft deep, 90 ft of drifts, a 20-ft-deep raise, and a 38-ft-long adit.

[1]U.S. Geological Survey
[2]U.S. Bureau of Mines

Interior--Geological Survey, Reston, Va.--1983
For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225