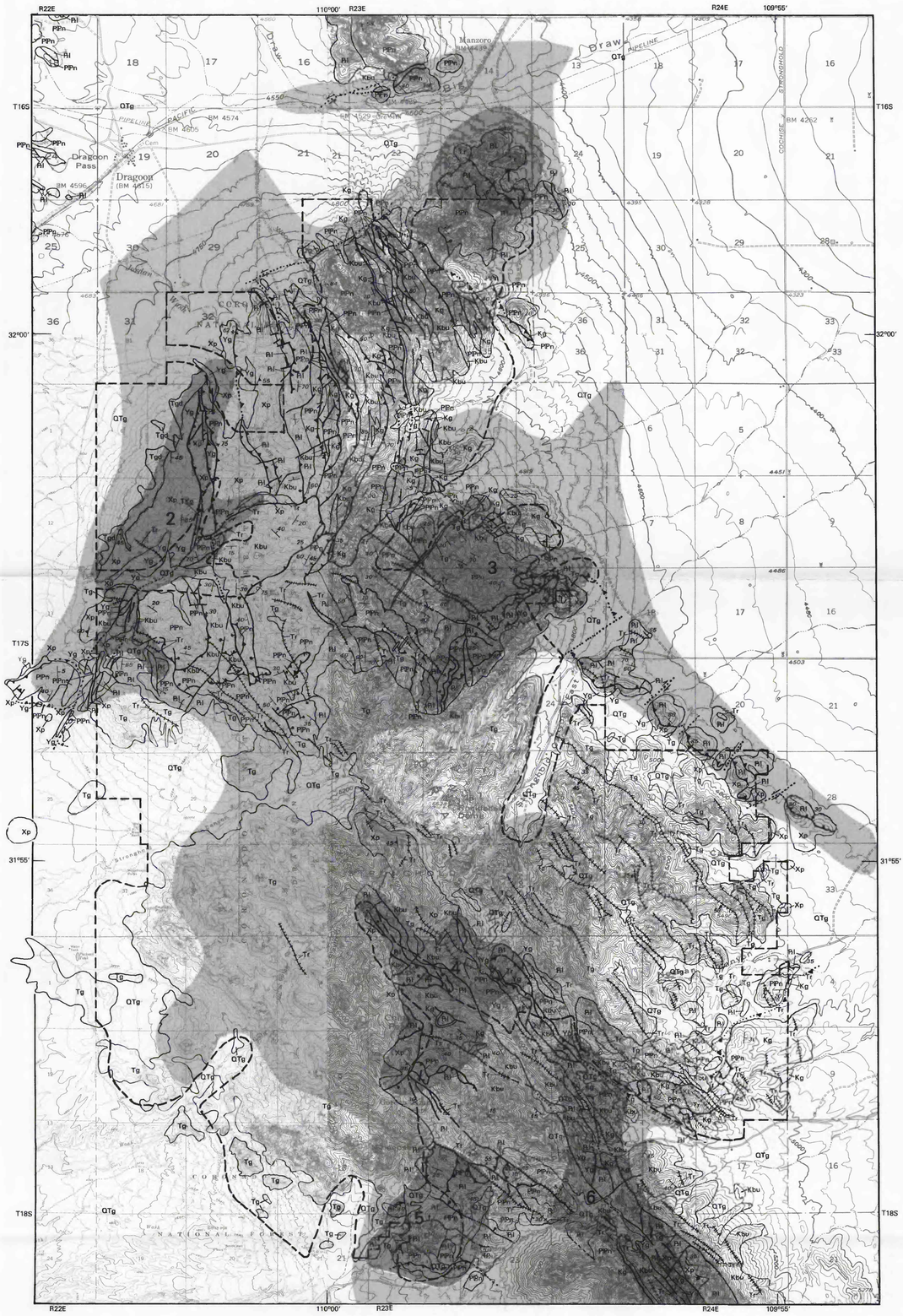
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



MINERAL RESOURCE POTENTIAL CLASSIFICATION

4 Moderate potential--Numbers indicate areas referred to in text
Low potential

EXPLANATION FOR GEOLOGIC BASE

(Note: The following correlation, list of map units, and explanation are for the geologic base map shown in gray)

CORRELATION OF MAP UNITS

QTg	QUATERNARY AND TERTIARY
Tr	
Tg	TERTIARY
Tgd	
Kbu	CRETACEOUS
Kg	
PPn	PERMIAN AND PENNSYLVANIAN
Pzl	PALEOZOIC
Yg	PROTEROZOIC Y
Xp	PROTEROZOIC X

LIST OF MAP UNITS

QTg GRAVEL AND SAND (QUATERNARY AND TERTIARY)--Alluvium of terrace, pediment, and basin-fill deposits

Tr RHYOLITE (TERTIARY)--Porphyritic and nonporphyritic dikes and plugs

Tg GRANITE (TERTIARY)--Stronghold stock, alkali granite, and some aplite; fluorite-bearing

Tgd GRANITE (TERTIARY)--Stock of granite to granodiorite

Kbu SEDIMENTARY ROCK (CRETACEOUS)--Chiefly upper part of the Bisbee Group; shale and sandstone, some limestone and conglomerate

Kg SEDIMENTARY ROCK (CRETACEOUS)--Lower part of the Bisbee Group; conglomerate

P PPn SEDIMENTARY ROCK (PERMIAN AND PENNSYLVANIAN)--Mainly limestone and some dolomite, shale, and sandstone

Pzl SEDIMENTARY ROCK (MISSISSIPPIAN TO CAMBRIAN)--Limestone, dolomite, shale, and quartzite. Includes the Abrigo and Martin Formations

Yg GRANODIORITE (PROTEROZOIC Y)--Includes aplite and granodiorite porphyry

Xp METAMORPHIC ROCK (PROTEROZOIC X)--Mainly Pinal Schist; includes phyllite, quartzite, arkose, sedimentary breccia and conglomerate, and intruding the Pinal, some amphibolite

APPROXIMATE BOUNDARY OF ROADLESS AREA

CONTACT

FAULT--Showing dip. Dotted where concealed

Normal fault--Bar and ball on downthrown side

Thrust fault--Teeth on upper plate

Strike-slip fault--Arrows show relative movement

Fault intruded by rhyolite dike (unit Tr)

STRIKE AND DIP OF BEDS

70 Inclined

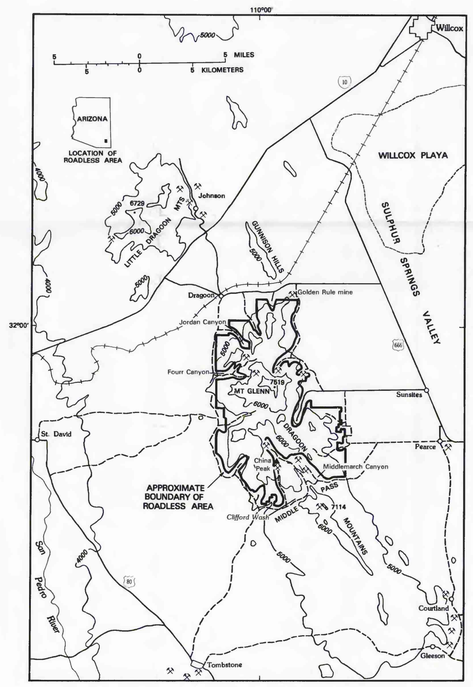
Vertical

80 Overturned

STRIKE AND DIP OF FOLIATION

65 Inclined

Vertical



INDEX MAP SHOWING LOCATION OF THE DRAGOON MOUNTAINS ROADLESS AREA (03201)

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 Dragoon Mountains Roadless Area in the Coronado National Forest, Cochise County, Arizona. The Dragoon Mountains Roadless Area (03201) 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.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The Dragoon Mountains Roadless Area lies in the northern part of the Dragoon Mountains, near the southeast corner of Arizona. The roadless area lies between the village of Dragoon on the main line of the Southern Pacific Railroad to the north and a Cochise County road through Middle Pass to the south, and between the valley of the San Pedro River to the west and the Sulfur Springs Valley to the east.

Six areas, about 10 percent of the roadless area, have a moderate mineral resource potential; the remainder of the area has a low mineral resource potential. The roadless area could contain metamorphic skarn-type deposits of copper, lead, molybdenum, and zinc, and some of these could contain silver and gold. Less probably, the roadless area could also contain stockwork molybdenum deposits and replacement or vein deposits containing beryllium, fluorite, thorium, tin, and tungsten. The possibility for the presence of industrial rock material of value is moderate, and for gas or oil is low.

INTRODUCTION

The Dragoon Mountains Roadless Area lies in the northern end of the Dragoon Mountains near the center of Cochise County in southeastern Arizona. It covers an area of about 100 mi^2 (250 km^2), lying between the village of Dragoon on the Southern Pacific Railroad to the north and the county road through Middle Pass to the south, and between the San Pedro River valley to the west and Sulfur Springs valley to the east. It lies about midway between Willcox and Tombstone.

The area is moderately rugged, and locally, in the Coronado Stronghold area, is very rugged. Scrubby forests cover the high terrain, and grass, shrubs, and cactus cover the lower country. Surface water is scarce; springs are few and watercourses ephemeral. Access is by ranch or U.S. Forest Service roads from the highways in the adjacent intermontane valleys, and some of these roads extend well into the roadless or mapped area. The area is in the Coronado National Forest.

Base and precious metals were mined from several sites in and near the roadless area (Kreidler, in press). These deposits are skarn-type alteration of mixed limestone and shale near granite. Most production was probably lead, zinc, silver, and possibly a little gold and tungsten.

GEOLOGY

The roadless area is underlain by a wide variety of rocks that are stongly faulted and intruded by several stocks and many dikes (Gilluly, 1956; Drewes, 1982, pl. 2; Drewes and Meyer, in press). The Precambrian basement is made up of schist, arkose, quartzite, sedimentary breccia, metavolcanic rock, and amphibolite, all intruded by granodiorite stocks. These are unconformably overlain by Paleozoic and Mesozoic sedimentary sequences. The Paleozoic rocks are mainly limestone but include some clastic rocks near the base and top; the Mesozoic sequence is largely of clastic rocks. Mineral deposits in the area are mostly associated with the Abrigo and Martin Formations, of mixed limestone, dolomite, shale, and sandstone, low in the Paleozoic sequence. These formations are not separately mappable at the scale of the geologic map.

The basement rocks and sedimentary sequences are intruded by two granitic stocks, two rhyolite porphyry plugs, and a swarm of rhyolite dikes and some andesite dikes. A small Oligocene stock lies along the northwest flank of the mountains. The large Miocene to Oligocene Stronghold stock lies in the center of the mountains and extends beyond their west flank. The plugs are of Tertiary or Cretaceous age and are near the Golden Rule mine in the northeastern tip of the range. Most dikes are also Miocene, and typically trend northwest across stock and host rock alike. Gravel deposits lap against the flanks of the range and west of the Stronghold stock they lie upon a pediment.

Few mountain ranges in southeastern Arizona are as abundantly faulted as are the Dragoon Mountains (Gilluly, 1956; Cooper, 1960; Drewes, 1980, 1981). Many faults are steep northwest- or north-trending stuctures; others are gently inclined. Many of the faults are thrust faults formed under compressive deformation. A few tight folds or truncated folds are found associated with the thrust faults. Nearly all of these structural features are cut by the granitic stocks and thus were available as conduits for fluids dispersing from the stocks and plugs, some of which probably carried metals.

The stocks, pluge, and dikes are structural features whose local configuration also is germane to this study. Not only are contact metamorphic zones broader next to the more gently outward-dipping intrusive contact, but in places geophysical data (Klein, in press) or surface observation suggest the subsurface site of shoulders or cupolas on the flanks of a stock. Indeed, the two rhyolite porphyry plugs may be tips of a larger intrusive body not quite exposed.

MINING DISTRICTS AND MINERALIZATION

Ores, chiefly of base metals and silver, have been produced from several mines and mining camps near the Dragoon Mountains Roadless Area. At Johnson, 2-2.5 mi (3-4 km) north of Dragoon, production of such ores from a geologic setting much like that of the roadless area probably exceeded a value of $10 million. At Pearce, 4-5 mi (7-8 km) southeast of the roadless area, similarly large values of silver were produced from rocks having a volcanic setting unlike that of the roadless area. At Black Diamond, a mining camp 2 mi (3 km) south of Middle Pass, about $0.5 million of copper and a little silver were produced from replacement deposits which appear to have a geologic setting resembling some parts of the roadless area.

The Dragoon and Middle Pass mining districts lie, respectively, in and near the northeastern and the southern parts of the roadless area. In both districts the major production was from mines outside of the roadless area, although the districts themselves extend into the roadless area. Total production from the Dragoon mining district was about $340,000 (Keith, 1973), mainly in gold, silver, and lead; most of the production came from fissure veins in the Golden Rule mine. Aggregate production from the Middle Pass mining district was about $1.7 million (Keith, 1973), mainly from lead, zinc, copper, and lesser silver, gold, and tungsten mined from the Abril, San Juan, and Middle March mines. Typically these deposits were in mantos and chimneys of skarn-type replacement deposits in Paleozoic limestone and shale formations near the Stronghold stock.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The mineral potential of the roadless area is moderate for deposits like those of the nearby mining camps. Small ore bodies containing lead, zinc, copper, and silver are found as replacement bodies, fissure deposits, or skarn-type deposits, and can be expected to be present along certain segments of the stocks. The deposits could also contain gold, tungsten, tin, beryllium, and thorium, which are found in anomalous amounts in some of the mines and prospects of the roadless area. In addition, molybdenum stockwork deposits could be in the roadless area, based on geochemical anomalies of that metal and on comparison with known molybdenum in similar geologic settings. Areas of moderate potential lie near stocks where concealed extensions of the stocks are likely to be shallow and where the Abrigo and Martin Formations could be present, or where faults are particularly abundant.

About 10 percent of the roadless area has a moderate mineral resource potential, whereas the mineral resource potential in the remainder of the area is low. Additional exploration efforts are justified in those areas of moderate mineral resource potential. The exploration should be preceded by more detailed geologic, geochemical, and geophysical studies.

Six areas are believed to have a moderate mineral resource potential based on observations of geology (Drewes and Meyer, in press; Kreidler, in press), geochemistry (Watts and others, in press), and geophysics (Klein, in press).

Area 1 is around the Golden Rule mine, largely outside the northeast corner of the roadless area. The area is underlain by metamorphosed Paleozoic rocks, including the Abrigo and Martin Formations, intruded by rhyolite porphyry plugs. Mining records and analyses of mineralized rock on the dump show the presence of base metals, silver, and gold. Aeromagnetic and gravity anomalies, along with surface observations, suggest the presence of a concealed stock and of a strong northeast-trending fault at the northern flank of the range. The metamorphosed and locally mineralized formations dip southwest and are cut by the northeast-trending fault, as well as by bedding-plane thrust faults.

The presence of mineralized ground like that at the mine, would most probably be found downdip in the Abrigo and Martin Formations, along the fault, or beneath the gravels north of the range. This inferred mineralized rock would be skarn-type contact deposits like those at the surface.

Area 2, along the northwest flank of the range, is also believed to have a moderate mineral potential. This area is largely along the southeast wall of the Oligocene stock, where its roof is projected outward at a low angle. The area also extends south along a zone of steep faults and to an upwarped and up faulted, mineralized structural feature. Small mines and prospects lie along steeply inclined to vertical faults along which there are slivers of metamorphosed Paleozoic limestone. Geochemical anomalies appear to be more widespread than the known mineralized terrane. A geophysical anomaly at the stock has a configuration suggesting that the body has a shoulder to the southeast, where pods of aplite are along the fault zone containing the limestone slivers.

Additional mineralized ground may be found, most likely along fault zones and in formations typically altered to skarn minerals. Base metals and silver are most likely to be found. There is also a potential for stockwork molybdenum deposits or tungsten deposits.

At area 3, on the northeast side of the Stronghold stock, a probable mineral resource potential is inferred because the Abrigo and Martin Formations, and other units of the Paleozoic sequence, dip gently northeastward over a shoulder of the stock. The site has some prospects and small mines, containing concentrations of base metals and silver. The area also has favorable geochemical anomalies and a magnetic anomaly penetrating the area from the northeast.

There is a moderate potential at area 3 for small skarn-type deposits of base metals and silver downdip along the favored formations, and perhaps also some enrichment along intersections of faults and dikes at higher stratigraphic levels in the northern half of the area.

Area 4 lies largely outside the roadless area along a prong of sedimentary and metamorphic rocks between two lobes of the Stronghold stock. The Abril and San Juan mines lie in this area, along with many prospects. These mines are in skarn-type replacement deposits in faulted Paleozoic limestone along faults and near the stock. The mines are on a north-trending linear magnetic anomaly. A base metals-tungsten-silver geochemical anomaly trends northwest along the faulted sedimentary and metamorphic rocks, and a thorium-tin-beryllium geochemical anomaly trends northeast across the area, largely following the stock itself.

Possible other deposits of base metals and silver, and perhaps also of other metals in vein or replacement deposits may be present in area 4. Although most of the area is outside the Dragoon Mountains Roadless Area, some zones of faulted metamorphic and sedimentary rock near the stock have a similar potential.

Area 5 covers some of the southwestern part of the roadless area, near the Sala Ranch. It also lies along a gently outward dipping wall of the Stonghold stock which intrudes the Abrigo and Martin Formations of the Paleozoic sequence. Skarn-type mineralized rocks enriched in base metals, silver, and tungsten, are present in scattered prospects near the contact. The linear magnetic anomaly of area 4 extends across the eastern part of area 5, too.

The area has moderate potential for other areas of lead and silver enrichment, particularly east of the ranch where the favored host rocks are expected to lie at moderate depth. The deposits may be small, but the area is accessible and would thus be easier to explore than most parts of the other areas.

Area 6 is almost entirely south of the study area, lying along a zone of northwest-trending faults mostly in Paleozoic and Mesozoic rocks. The Black Diamond mine, south of Middle Pass, is in this belt near the point at which the present study ends. The north end of this area is close to a gently south-dipping part of the Stronghold stock. With the exception of this northern end and some slices of limestone along fault zones, the rocks are unaltered. Part of the area coincides with a magnetic anomaly and geochemical anomalies, particularly of silver and tungsten.

These data indicate possible small deposits of base metals, silver, and perhaps tungsten in replacement bodies in fault slices of limestone or along heavily fractured ground near the larger faults. Where limestone replacement is found, it is also likely that the Glance Conglomerate, a basal conglomerate to the Mesozoic sequence, which locally is many tens of feet thick, could be mineralized, but in other circumstances this rock is generally barren.

Industrial minerals and rocks

Several industrial rock products have a low to moderate potential in the roadless area. Marble for use as crushed rock or as flux may be obtained in several zones in the southern end of the range; the most promising marble is in the Escabrosa and Horquilla Limestones of the Paleozoic sequence. The Horquilla Limestone may also be suitable for use in cement production, as it is near Tucson. A quartzitic variety of Pinal Schist near the mouth of Fourr Canyon may prove suitable for flux in copper smelters. In each of these instances, the proximity of the potentially useful material to a railroad enhances its possible value.

Petroleum and natural gas

Conditions for the accumulation of petroleum and natural gas are believed to be low. The roadless area does lie in the proposed southern extension of the overthrust belt in which exploration for possible deep targets has been in progress for a few years. The local accumulation through thrust faulting of a thick pile of sedimentary rocks notwithstanding, the entrapment conditions near so many young (mid-Tertiary) stocks, plugs, and dikes are probably poor.

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MISCELLANEOUS FIELD STUDIES
MAP MF-1521-B
PAMPHLET ACCOMPANIES MAP

MINERAL RESOURCE POTENTIAL MAP OF THE DRAGOON MOUNTAINS ROADLESS AREA, COCHISE COUNTY, ARIZONA

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