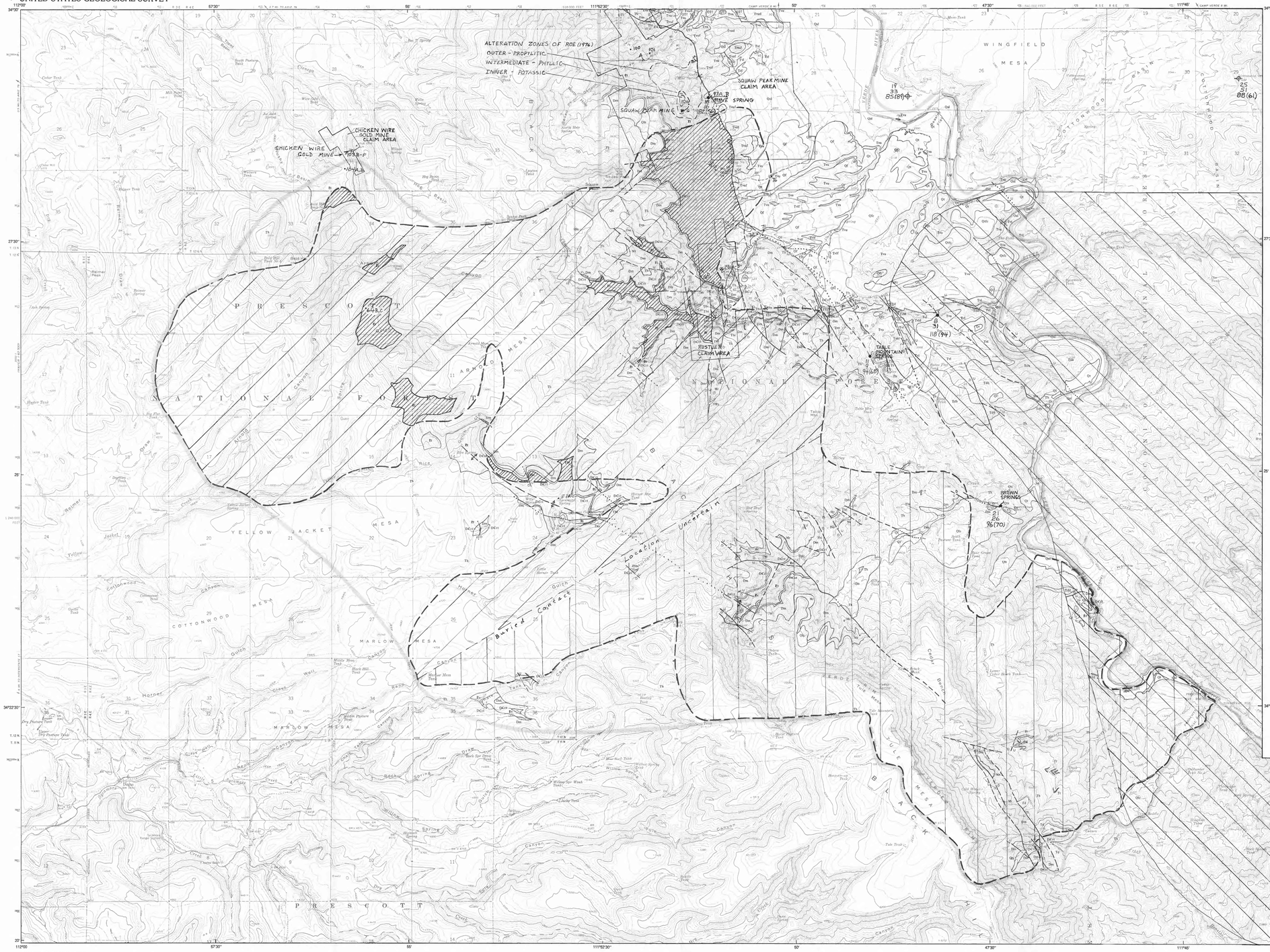


STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and 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 Arnold Mesa Roadless Area (U.S. Forest Service number 03092), Prescott and Tonto National Forests, Yavapai County, Ariz. Arnold Mesa Roadless Area 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

Proterozoic volcanic rocks of Gap Creek underlie the southern part of the Arnold Mesa Roadless Area. They strongly resemble the host rocks for the large massive sulfide deposits at Jerome, and so they may have the potential for the occurrence of similar ores of copper, silver, and gold. However, the units largely covered by younger rocks with an aggregate thickness of up to 2,500 ft. Despite this, the similarity between rock types in this area and at Jerome gives the area containing the volcanic rocks of Gap Creek a moderate potential for the occurrence of copper, silver, and gold resources in massive sulfide deposits.

The northern half of the roadless area is underlain by a Proterozoic tonalite pluton that is exposed in erosional windows in younger, overlying rocks. The tonalite is the host for a local porphyry copper deposit at Squaw Creek, gold-quartz veins at the Chicken Wire gold mine, and altered shear zones at the Rustler claims; all are outside of the roadless area. Evidence for similar deposits or for ore deposits of any type was not observed in exposures of the tonalite within the roadless area. The tonalite is, however, a known host for small ore deposits in the vicinity of the roadless area, and unexposed areas of the pluton may contain porphyry or vein deposits similar to those at nearby mining areas. The potential of the Squaw Peak mine for copper and molybdenum resources in a porphyry-type setting is very high.

Evidence gathered by Ross and Farrar (1980) suggests that a geothermal anomaly exists near the eastern margin of the roadless area. However, waters of suitable temperature for geothermal energy production have not been discovered. Therefore, the potential of the area for geothermal energy resources seems low.

INTRODUCTION

The Arnold Mesa Roadless Area comprises about 28,000 acres in and along the flanks of the Black Hills south of Camp Verde, in central Arizona. The total relief within the area is about 4,000 ft, and the area is deeply incised by the canyons of Gap and Chasm Creeks.

During 1980, the U.S. Geological Survey and the U.S. Bureau of Mines (USBM) conducted field investigations to evaluate the mineral resource potential of the Arnold Mesa Roadless Area. Field studies included geologic mapping (Wolfe, 1983a), aeromagnetic mapping (Davis and Wolfe, 1983), geochemical sampling (Wolfe, 1983b), and a survey of known mines and prospects (McColly and Korzeb, 1981).

The study area is within the transition zone between the Colorado Plateaus to the northeast and the Basin and Range province to the southwest. The zone is underlain by Precambrian rocks and gently dipping Paleozoic strata.

Proterozoic rocks in the northern part of the study area, in the vicinity of Squaw Peak Canyon, include foliated mafic and, locally, intermediate metavolcanic rocks of greenschist facies that are intruded by a Proterozoic pluton composed mainly of tonalite. In the southern part of the study area, Proterozoic rocks exposed along Gap Creek, in Chalk Creek Canyon, and locally along the Verde River are predominantly relatively unmetamorphosed dacite and rhyolite and subordinate mafic volcanic or volcaniclastic rocks. Gently dipping Paleozoic dolomite and limestone and subordinate sandstone and siltstone rest unconformably on the Proterozoic rocks. Basalts of the Hickey Formation of late Miocene age overlie the older rocks.

Northwest-trending linear basins and high-angle faults of Cenozoic age characterize the transition zone. The southernmost of the basins, the Verde basin, contains more than 3,100 ft of clastic deposits, and is exposed in the eastern part of the study area. The northwest-trending Verde fault bounds the basin on its southwest side.

GEOLOGY

The Proterozoic volcanic rocks of Gap Creek are lithologically similar to and probably correlative with rocks of the Ash Creek Group which host the large massive sulfide deposits at Jerome (Anderson and Creasey, 1958), about 30 mi to the northwest. Direct evidence of significant amounts of sulfides in the volcanic rocks of Gap Creek was not found during geologic mapping, although exposures of the rocks were limited. However, the volcanic units have intermediate to silicic compositions, and banded iron-formations are intercalated with the volcanic rocks; both lithologies are characteristic of other Proterozoic massive sulfide deposits in Arizona (Donnelly and Hahn, 1981). This suggests that the volcanic rocks of Gap Creek were deposited in an environment similar to that which also produced massive sulfide deposits in the region.

The contact between the volcanic rocks of Gap Creek and the tonalite pluton is buried by younger rocks and was not seen. It must trend northeast or east from the vicinity of Marlow Mesa in the southwestern part of the roadless area. Regardless of the intrusive or fault origin of the contact, the zone may be the locus of fractures that could have provided pathways for mineralizing fluids. Although the cover of younger rocks is 1,000 ft or more over much of the contact zone, it is relatively thin, locally less than 100 ft, in the vicinity of Marlow Mesa.

The Proterozoic tonalite pluton underlies the Phanerozoic rocks in the northern half of the roadless area and is exposed in several large erosional windows in the overlying units. Sulfides or weathered products of sulfides were not seen in the tonalite. Quartz veins, fractures, and shear zones cut the pluton, and sericite, epidote, and chlorite alteration locally envelopes these veins and fractured zones. However, quartz veins and alteration zones do not extend into the Paleozoic rocks, nor are they known elsewhere in the Paleozoic or Cenozoic rocks. They may represent Precambrian fractures or shear zones that subsequently provided access for hydrothermal fluids.

The tonalite pluton is the host for copper and molybdenum sulfides and related alteration in the Squaw Peak mine area just north of the roadless area boundary. Roe (1976) concluded that the deposit was part of a porphyry copper-molybdenum system related to a quartz monzonite stock of Laramide age. Concentric alteration, trace-element, and ore-mineral patterns focus on what Roe (1976) mapped on the surface as a quartz monzonite porphyry. Wolfe (1983a) did not recognize such a pluton where Roe had mapped it and concluded that exposures in that area were of altered tonalite. However, examinations by Roe of more than 24,000 ft of drill core and drill cuttings revealed that a porphyritic pluton is present in the subsurface and that it dips southwest. Alteration zones grade outward from a central potassic core through successive haloes of phyllic and propylitic alteration; the areal extent of the latter zone is 2,400 ft wide and 4,600 ft long (Roe, 1976). The major mineralized zone contains 0.3 percent copper and more than 0.01 percent molybdenum, and it forms a north-trending zone, coincident with the potassic alteration, that is approximately 800 ft wide and 1,200 ft long on the surface. The mineralized zone is bowl-shaped, concave upward, and extends to a maximum depth of about 800 ft (Roe, 1976).

Additional mineralized areas containing copper, and some gold and silver, occur where quartz fills breccia zones in the tonalite at the Chicken Wire gold mine, just north of the far western part of the roadless area. Sulfides and secondary copper minerals (indicative of mineral deposits similar to those of the Chicken Wire gold mine or of the Squaw Peak mine) were not seen in tonalite in the roadless area even where quartz veins, fractures, or sheared zones with sericitization, epidotization, or chloritization were found.

The rocks that bury most of the Proterozoic rocks in the Black Hills within the study area are Paleozoic sedimentary rocks and Cenozoic volcanic rocks that have an aggregate thickness as much as 3,000 ft, but locally are as thick as 2,500 ft. Evidence for the occurrence of mineral deposits was not recognized in these rocks nor in the Verde Formation where it occurs east of the Verde fault within the roadless area (fig. 1).

GEOCHEMISTRY

A total of 128 samples, all but 27 of which were grab samples, was collected during the course of geologic mapping. The other 27 samples are of unconsolidated sediment, which were collected from drainages that contained Precambrian rocks, considered to be the major hosts for ore deposits. The minus 80-mesh fraction of the sediments was analyzed for 30 elements by semiquantitative spectrographic analysis and for uranium and thorium by neutron activation analysis. The results are given with the geochemical map (Wolfe, 1983b).

Local mineralized zones and attendant chemical anomalies in the tonalite are associated with quartz veins that cut the pluton and the metamorphic rocks of Squaw Peak Canyon. Some of the quartz veins, which are most abundant north of the roadless area, also contain chemical anomalies. Certain elements include manganese, silver, arsenic, boron, copper, molybdenum, lead, and zinc, but not all are concentrated in anomalous amounts in any single sample.

The greatest anomalies are outside of the roadless area in a mineralized quartz vein (sample 101) that cuts the metamorphic rocks of Squaw Peak Canyon near the intrusive contact with the tonalite and in brecciated and mineralized tonalite adjacent to a quartz vein at the Chicken Wire gold mine (samples 103A-F). Samples collected in this study showed lower levels of enrichment in the area of the Squaw Peak mine (samples 97A, 97B, 100), which is also outside of the roadless area. Roe (1976), in a survey of soil geochemistry in the vicinity of Squaw Peak mine, reported maximum concentrations of approximately 0.8 percent for copper, 140 ppm for molybdenum and 700 ppm for zinc.

Low levels of enrichment in silver, lead, boron, and zinc were found in a quarry in the Rustler mine area (samples 26A-D). Fractures, faults, or shears apparently provided conduits for fluids that produced minor alteration and mineralization of the tonalite. Low levels of enrichment in silver, lead, and zinc also occur in the tonalite in samples 71, 72, and 76 from gulies that drain the tonalite where it is within the roadless area between the Squaw Peak and Squaw Peak mine. This suggests that low-level mineralized deposits are present locally in the tonalite within the roadless area.

Additional sample values from the U.S. Bureau of Mines study of the Chicken Wire gold, Squaw Peak, and Rustler mines are included in the section of this report entitled "Mining districts and mineralized areas."

GEOTHERMAL ENERGY

Silica geothermometry of spring waters shows a zone immediately east of the Arnold Mesa Roadless Area and partly overlapping its southeast corner in which reservoir temperatures slightly above 100°C are indicated (Ross and Farrar, 1980). Slightly lower silica geotemperatures (82°C-96°C) were determined for springs distributed near the northeast boundary of the roadless area. Water temperature of Verde Hot Springs, located along the Verde River approximately 2.5 mi southeast of the southeast corner of the roadless area, is 39°C. Elsewhere in and near the study area spring and well temperatures measured by Ross and Farrar are from 8°C to 25°C. The sampled springs and wells all lie within and east of the Verde fault zone and its projection to the southeast. Their modestly elevated geochemical reservoir temperatures may be a manifestation of deep circulation in the Verde fault zone or along related faults.

MINING DISTRICTS AND MINERALIZED AREAS

Although most of the Arnold Mesa Roadless Area falls within the Squaw Peak mining district, the known mineral occurrences of the district lie outside of the roadless area boundary. Three mineralized areas, at the Squaw Peak, Rustler, and Chicken Wire gold mines, account for most of the local mining activity and for nearly all of the 98 claims identified from Yavapai County records. On the basis of descriptions, the remaining claims are randomly distributed inside the area, but vagueness and the general lack of development work or adequate monumentation prevented their identification on the ground.

Two adits in the Rustler claim area were the only prospects found inside the roadless area. No mineral production is known from either site. Some mineral production is known from the Squaw Peak and Chicken Wire gold mines, which are outside but near the roadless area boundary. Fringe claims from these properties extend into the roadless area, but mineral deposits have not been discovered or developed within them.

Squaw Peak mine

Roughly one-fourth of the Squaw Peak claims, centered in secs. 29 and 30, T. 13 N., R. 5 E., extend into the roadless area, but none of the mine workings or known mineral deposits do (Roe, 1976).

By 1916, the property was active, though no production was recorded until 1944-46. In 1946, there were more than 4,000 ft of underground workings, and the total production from treating 1,000 tons of ore was 6.40 dry tons of 98.8-percent molybdenite (MoS_2) and 36.034 tons of copper concentrate averaging 22.85-percent copper, 1.20 oz of silver per ton and 0.016 oz of gold per ton (Hill, 1949).

Exploration work conducted by Phillips Petroleum Co. and Essex International, Inc., during the early 1970's resulted in estimated reserves at Squaw Peak of 20 million tons averaging 0.36-percent copper with substantial molybdenum (Roe, 1976). Roe (1976) does not give an average grade for molybdenum, but on the basis of the reported production (Hill, 1949), it must have been 0.5 to 0.6 percent MoS_2 in the ore zone.

During the USBM study, 13 samples were taken from dumps, mineralized outcrops, and underground workings on the Squaw Peak claims. Five samples from the accessible parts of two adits, and eight samples from numerous cuts and pits were taken, approximately 300 ft of mine workings were mapped. Copper values ranging from 0.16 to 1.19 percent and molybdenite values ranging from 0.01 to 1.47 percent confirmed the presence of significant copper and molybdenum (sites A, B, C, G).

Rustler claim area

The Rustler claim area contains three patented lode-mining claims and many adjoining unpatented claims, extending end-to-end along the roadless area boundary in an unsurveyed area north of Chasm Creek. Approximately 20 of these claims lie within the roadless area. Mine workings consist of a pit, an quarry, on the patented Rustler claim, and two adits about 600 ft apart, which lie 1,000 ft southwest of the patented claims. No evidence of mineralization was observed in the sheared tonalite exposed in the pit, but traces of boron, lead, and zinc were found.

Material from the pit was used for flood-control construction on the Verde River.

One adit is caved about 10 ft from the portal, and the other extends about 80 ft into the hillside. Two samples were taken at each site. The highest values found were 0.08 percent copper, 0.3 percent lead, 0.008 percent molybdenite, 0.003 percent silver, and 0.6 percent zinc (sites D and E). No gold was found in the four samples.

Chicken Wire gold mine

Two lode mining claims, one patented and one unpatented, constitute the property of the Chicken Wire gold mine in sec. 33, T. 13 N., R. 4 E., located a half mile north of the roadless area. Two other unpatented lode claims have been identified adjacent to the patented claim, but these are inactive.

Narrow, generally flat-lying quartz veins and stringers in Precambrian tonalite have been exposed and mined by means of several small, underground workings. Approximately 500 ft of workings were accessible at the time of the USBM evaluation; additional workings were either caved or back-filled.

Gold and silver values in three samples taken from the most prominent quartz vein ranged from 0.06 to 1.31 oz of gold per ton and 0.2 to 1.4 oz of silver per ton. Antimony, arsenic, bismuth, lead, and zinc were detected in the samples but were only slightly anomalous. Copper-oxide minerals were visible in portions of the workings, but were considered too scarce to justify sampling.

Production from the property is not recorded, but was probably small. The current owners stated that high-grade native gold worth a few hundred to a few thousand dollars was produced from pockets in the mine (A. F. Colored, oral commun. 1980). The current, part-time mining at the property is essentially exploration work.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The Proterozoic volcanic rocks of Gap Creek, which are exposed only locally within the roadless area, are inferred to underlie all of the southern part of the area. The limited exposures of the rock units reveal dominantly porphyritic dacite and rhyolite with minor amounts of tuff, welded tuff, basaltic or andesitic volcanic or metavolcanic rocks, and a small amount of banded jasperoid rock (iron-formation). These lithologies are strikingly similar to those that host large massive sulfide deposits at Jerome (Anderson and Creasey, 1958) and suggest a similar environment of deposition. Although evidence of a significant occurrence of metals in the volcanic rocks was not found, the similarity between the rocks in the roadless area and those at Jerome suggests that massive sulfide deposits containing copper, silver, and gold could occur within the roadless area. Jerome-type massive sulfide deposits do not have extensive surface expressions of ore or alteration (Anderson and Creasey, 1958), so the absence of sulfides or alteration in the limited exposures certainly does not preclude the presence of mineralized areas beneath the cover of younger rocks. The thick and nearly continuous cover of younger rocks is a severe impediment for exploration and mine development in the underlying rocks. Despite that problem, the potential of the area for resources of copper, silver, and gold in massive sulfide deposits in the volcanic rocks of Gap Creek is considered to be moderate; the economics or feasibility of exploration does not mitigate that potential.

The Proterozoic tonalite pluton underlies the northern half of the roadless area, although it is largely obscured by younger rocks. The pluton is the host for a local porphyry copper deposit at the Squaw Peak mine, gold-quartz veins at the Chicken Wire gold mine, and altered shear zones at the Rustler claim area. All three areas are outside the limits of the roadless area; the latter two are of very limited extent, and Roe's (1976) detailed maps and cross sections show that the Squaw Peak deposit is also of local extent and does not extend into the roadless area. Neither mineralized zones nor ore deposits were observed during geologic mapping in the exposed areas. Indeed, quartz veins, which are characteristic of the nearby deposits, are scarce in the exposed tonalite in the roadless area, although such veins can be of very local extent and therefore easily overlooked. Evaluation of the covered portions of the pluton is difficult. Laramide porphyry copper deposits similar to that at the Squaw Peak mine may be concealed by the cover of younger rocks; using the latter deposit as a guide, the horizontal extent of such a deposit would be less than 1 mi^2. Therefore, the potential of exposed areas of the tonalite is low for porphyry copper resources; that for the unexposed areas may be low to moderate because the pluton is a known host for small ore deposits. The identified resources at the Squaw Peak mine, which is just outside of the roadless area, indicate a high potential of the Squaw Peak mine for copper and molybdenum resources in a Laramide porphyry-type deposit.

The southern boundary of the tonalite is not exposed, but it must be within a zone that extends northeast or east through the roadless area from the vicinity of Marlow Mesa. If the contact zone is one along which the tonalite has been significantly sheared or fractured, it may represent a particularly favorable setting for hydrothermal deposits.

Rock suitable for crushing into aggregate occurs throughout the roadless area. However, deposits outside the area are more accessible and closer to markets. No other significant potential is known for the Paleozoic and Cenozoic rocks that cover most of the roadless area.

Ross and Farrar (1980) evaluated geochemical evidence that ground water near the eastern boundary of the roadless area had been in contact with reservoir rocks of elevated temperature. Their results suggest that a geothermal anomaly exists near the eastern margin of the roadless area. However, waters of temperature suitable for geothermal energy production have not been discovered, and the potential of the area for geothermal energy resources seems low. No potential is known within the area for other sources of energy.

REFERENCES

Anderson, C. A., and Creasey, S. C., 1958, Geology and ore deposits of the Jerome area, Yavapai County, Arizona: U. S. Geological Survey Professional Paper 308, 185 p.
Davis, W. E., and Wolfe, E. W., 1983, Aeromagnetic map of the Arnold Mesa Roadless Area, Yavapai County, Arizona: U.S. Geological Survey Miscellaneous Field Studies Map MF-1577-D, scale 1:24,000.
Donnelly, M. C., and Hahn, G. A., 1981, A review of the Precambrian volcanogenic massive sulfide deposits in central Arizona and the relationship to their depositional environment, in Dickinson, W. R., and Payne, W. D., eds., Relations of tectonics to ore deposits in the southern Cordillera: Arizona Geological Society Digest, v. 14, p. 79-94.
Hill, J. M., 1949, Report on the Squaw Peak copper mine, Yavapai County, Arizona, in Squaw Peak Mine: Arizona Department of Mineral Resources Open-file Report, 10 p.
McColly, R. A., and Korzeb, S. L., 1981, Mines and prospects map of the Arnold Mesa RARE II Further Planning Area, Yavapai County, Arizona: U. S. Bureau of Mines Open-file Report MLA 31-81, scale 1:24,000.
Roe, R. A., 1976, Geology of the Squaw Peak porphyry copper-molybdenum deposit, Yavapai County, Arizona: Tucson, University of Arizona M.S. thesis, 102 p.
Ross, F. P., and Farrar, C. D., 1980, Map showing potential geothermal-resource areas, as indicated by the chemical character of ground water in Verde Valley, Yavapai County, Arizona: U.S. Geological Survey Miscellaneous Field Studies Map MF-1577-B, scale 1:125,000.
Wolfe, E. W., 1983a, Geologic map of the Arnold Mesa Roadless Area, Yavapai County, Arizona: U.S. Geological Survey Miscellaneous Field Studies Map MF-1577-A, scale 1:24,000.
Wolfe, E. W., 1983b, Geochemical map of the Arnold Mesa Roadless Area, Yavapai County, Arizona: U.S. Geological Survey Miscellaneous Field Studies Map MF-1577-C, scale 1:24,000.

Table 1.--Anomalous geochemical values (ppm) in the Arnold Mesa area
[Leaders (---) indicate concentrations below anomalous values; from Wolfe (1983)]

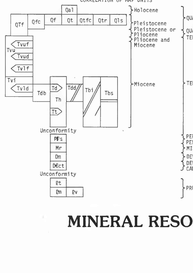
Element	Mn	Ag	As	B	Cu	Mo	Pb	Sb	Zn	
Limit of detection	10	0.5	200	10	5	5	10	100	200	
Threshold of anomalous values	2,000	1	200	100	200	100	200	100	200	
Sample No.	Mn	Ag	As	B	Cu	Mo	Pb	Sb	Zn	Notes
Quarry approximately 0.7 mi (1.1 km) north of Chasm Creek near east boundary of roadless area										
26A	---	2	---	---	---	---	---	---	---	Oxidized tonalite.
26B	---	3	---	---	---	---	---	---	---	Sheared tonalite.
26C	---	2	---	100	---	---	300	---	200	Do.
26D	---	1	---	100	---	---	---	---	300	Do.
Prospect in NE1/4SW1/4 sec. 3, T. 12 N., R. 4 E.										
64B	---	---	---	200	---	---	---	---	---	Altered tonalite adjacent to quartz vein.
64C	---	---	---	---	300	---	---	---	---	One fn.-wide epidote-quartz vein.
Dump at Mine Spring (Squaw Peak mine)										
97A	---	3	---	---	3,000	100	---	---	---	Altered, mineralized tonalite.
97B	---	5	---	---	5,000	150	---	---	---	Mineralized tonalite.
Granitic dike intruding metamorphic rocks of Squaw Peak Canyon										
100	---	5	---	---	---	---	---	---	---	
Prospect: mineralized quartz vein intrusing metamorphic rocks of Squaw Peak Canyon										
101	---	10	---	---	>20,000	>2,000	1,000	---	500	
Chicken Wire gold mine, NW1/4SE1/4 sec. 33, T. 13 N., R. 4 E.										
103B	>5,000	7	---	200	20,000	---	---	100	700	Altered, mineralized tonalite.
103C	---	7	300	100	7,000	---	1,500	---	1,000	Brecciated and mineralized tonalite.
103D	---	1	---	---	1,000	---	---	---	---	Quartz vein.
103E	5,000	3	200	200	1,000	---	300	---	1,000	Altered tonalite.
103F	---	1.5	300	300	1,000	---	---	---	---	Altered mineralized tonalite.
Dump at abandoned shaft, NW1/4SE1/4 sec. 33, T. 13 N., R. 4 E.										
104A	---	2	---	---	---	---	---	---	---	Quartz vein fragment.
104B	---	2	200	100	200	---	---	---	---	Altered tonalite fragment.
Dump at Squaw Peak mine										
106	---	5	---	---	500	---	---	---	---	Altered mineralized tonalite.
Sediment samples from washes draining tonalite										
57A	---	---	---	---	---	---	---	---	200	Panned in field.
71	---	3	---	---	---	---	200	---	500	
72	---	1.5	---	---	---	---	---	---	---	
76	---	---	---	---	---	---	---	---	200	

EXPLANATION OF MINERAL RESOURCE POTENTIAL

- VOLCANIC ROCKS OF GAP CREEK--Largely buried by younger rocks; moderate potential for resources of massive sulfide deposits containing possible copper, silver, and gold
- EXPOSED TONALITE--Low potential for resources of vein- and fracture-related gold and silver
- TONALITE BURIED BY YOUNGER ROCKS--Low potential for resources of porphyry copper deposits containing possible copper, molybdenum, gold, silver, lead, and zinc, or of quartz vein deposits with possible gold
- APPROXIMATE AREA OF HIGH-SILICA GEOTEMPERATURES (after Ross and Farrar, 1980). Quartz-silica geotemperatures >100°C and chalcedony-silica geotemperatures >70°C
- SAMPLE LOCALITY WITH ANOMALOUS GEOCHEMICAL VALUES From USGS geochemical survey (Wolfe, 1983b)
- ADIT OR SHAFT SAMPLED AND ANALYZED BY USBM
  - A--Adit
  - G--Shaft
- SPRING WATER ANALYZED BY ROSS AND FARRAR (1980)
  - First entry (8) is measured water temperature (°C)
  - Second entry (31) is calculated Na-K-Ca geotemperature, last water-rock equilibration (°C)
  - Third entry (118) is calculated quartz-silica geotemperature and, in parentheses (94), chalcedony-silica geotemperature (°C)
- WELL WATER ANALYZED BY ROSS AND FARRAR (1980). Notation as above

EXPLANATION OF GEOLOGIC BASE MAP
(Shown in gray on map)

CORRELATION OF MAP UNITS

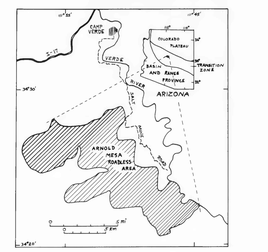


DESCRIPTION OF MAP UNITS

- Qal ALLUVIUM (HOLOCENE)--Silt, sand, and gravel
- Qls LANDSLIDE DEPOSITS (PLEISTOCENE)
- Qtr TRAVERTINE (PLEISTOCENE)
- Qtfc MIXED TERRACE AND ALLUVIAL-FAN DEPOSITS (PLEISTOCENE)
- Qt TERRACE DEPOSITS OF THE VERDE VALLEY (PLEISTOCENE)--Flat-surfaced deposits of well-rounded, well-sorted, resistant pebbles and cobbles
- Qf ALLUVIAL-FAN DEPOSITS OF THE MOUNTAIN FRONT (PLEISTOCENE)--Poorly sorted gravel
- Qfc ALLUVIAL-FAN DEPOSITS OF CHASM CREEK (PLEISTOCENE)--Poorly sorted gravel
- QTf ALLUVIAL-FAN DEPOSITS OF SQUAW PEAK CANYON (PLEISTOCENE OR PLIOCENE)--Dissected gravel deposits
- VERDE FORMATION
  - Tvs Upper member (Pliocene? and Miocene)--Conglomerate and sandstone
  - Tvsf Upper fanglomerate tongue (Miocene)--Poorly sorted, weakly indurated conglomerate composed of clasts of basalt and Paleozoic formations
  - Tvsd Upper dacite (Miocene)--Small volcanic dome and related flows of fine-grained, light-gray dacite
  - Tvlf Lower fanglomerate tongue (Miocene)--Breccia to conglomerate composed of basaltic detritus
  - Tvl Lower member (Miocene)--Conglomerate and sandstone with interbedded olivine basalt flows
  - Tvld Lower dacite (Miocene)--Tongue of dacite-porphyry breccia
- Tdb INTERBEDDED DACITIC PORPHYRY AND BASALT (MIOCENE)--Dacite breccia and tuff with interbedded olivine basalt flows
- Td DACITE PORPHYRY (MIOCENE)--Coarse dacite porphyry
- Tt TUFF OF TABLE MOUNTAIN (MIOCENE)--Rhyolitic ash-flow tuff
- Th HICKEY FORMATION (MIOCENE)--Basaltic lava flows and related pyroclastic deposits; minor andesite
- Tdd DACITE DIKES (MIOCENE)
- Tbd BASALT DIKES (MIOCENE)
- Tbs BASALT SILL (MIOCENE)
- PPs SUPAI GROUP (PERMIAN OR PENNSYLVANIAN)--Red siltstone
- Mr REDWALL LIMESTONE (MISSISSIPPIAN)
- Dm MARTIN FORMATION (DEVONIAN)--Dolomite, some limestone
- DEct CHINO VALLEY FORMATION AND TAPEATS SANDSTONE, UNDIFFERENTIATED (DEVONIAN AND CAMBRIAN)--Siltstone (Chino Valley Formation) and sandstone (Tapeats Sandstone)
- Pt TONALITE (PROTEROZOIC)
- Pm METAMORPHIC ROCKS OF SQUAW PEAK CANYON (PROTEROZOIC)--Greenschist
- Pv VOLCANIC ROCKS OF GAP CREEK (PROTEROZOIC)--Dacite, rhyolite, minor basalt and greenschist

- CONTACT--Dotted where concealed
- CONTACT--Separating adjacent compositionally or morphologically distinct gravel deposits within units Qf and Qt
- FAULT--Dashed where approximately located or inferred, dotted where concealed. U, upthrown side; D, downthrown side
- ANTICLINE--Dashed where approximately located, dotted where concealed

- STRIKE AND DIP OF BEDS
  - Inclined
  - Horizontal
- STRIKE AND DIP OF FOLIATION
- APPROXIMATE BOUNDARY OF ROADLESS AREA
- LIMIT OF GEOLOGIC MAPPING
- SHAFT
- TUNNEL
- PROSPECT
- QUARRY



INDEX MAP SHOWING LOCATION OF ARNOLD MESA ROADLESS AREA, ARIZ.

MINERAL RESOURCE POTENTIAL MAP OF THE ARNOLD MESA ROADLESS AREA, YAVAPAI COUNTY, ARIZONA

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