Base from U.S. Geological Survey
1:62,500: Woods Canyon, Young, 1961;
1:24,000: Buzzard Roost Mesa, Gisela, Sheep Basin Mountain, 1972; Diamond Butte, Diamond Point, McDonald Mountain, Payson North, Payson South, Promontory Butte, 1973

SCALE 1:48 000

CONTOUR INTERVAL 40 AND 80 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology from Conway (1976) and mapping by C. M. Conway, 1980-81

MINERAL RESOURCE POTENTIAL MAP OF THE HELLS GATE ROADLESS AREA, GILA COUNTY, ARIZONA

By

Clay M. Conway[1], Robert A. McColly[2], Sherman P. Marsh[1], Dolores M. Kulik[1], Ronny A. Martin[1], and James E. Kilburn[1]

1983

EXPLANATION

AREAS OF MINERAL RESOURCE POTENTIAL AND AREAS OF GEOCHEMICAL ANOMALY IN AND NEAR THE HELLS GATE ROADLESS AREA
[Subscript c - nonmagnetic panned concentrates from drainage sediments; subscript b - bulk drainage sediments (-80 mesh)]

Commodity	Area	Map Designation	Criteria
Tin (general)	Hells Gate Roadless Area and vicinity	none	Outcrops of alkali granite, granophyre, intrusive and extrusive rhyolite. These rocks are universally high in SiO_2, alkalis, and F, and low in CaO and MgO. Common high values of Sn_c, Be_c, La_c, Nb_c, and Y_c. Local high values of Ag_c, Ba_c, and W_c.
Sn: Low to moderate resource potential (The following groups of elements occur at sites within the area of low to moderate resource potential for tin; some groups are associated with higher than usual concentrations of tin-suite elements (Sn, Be, Nb, La, Y))	Northwestern parts of Hells Gate area	Sn_1	Underlain by granophyre and upper part of granite pluton; rocks commonly miarolitic and extensively oxidized; rocks locally contain tourmaline and are locally sericitized and rarely tourmalinized. Sn_c and Be_c values markedly higher than in Sn_2 (see fig. 2 in accompanying pamphlet). Common high values of La_c, Nb_c, Y_c, Pb_c, Sn_b, Cu_c, and Ba_c.
Sn, La, Nb, Y, Mo, Pb, Be: Geochemical anomaly	North of Gisela	1	Two adjacent drainage basins with high amounts of a large number of elements in both concentrates (Sn, Be, Nb, La, Y, Bi, Th, As, Mo, Ba) and bulk sediments (Fe, Mn, Ti, Pb, Mo, Th, La, Sn).
Ag, Cu, Ba: Low resource potential	East of Star Valley	2	Late Miocene fault; nearby barite vein. Large area of extensive oxidation and possible shearing in granite. High values of Ag_c, As_c, Sb_c, Cu_c, Pb_c, Zn_c, Ba_c, Nb_c, Ni_c, Co_c, La_c, and Bi_c.
Ag, Pb: Low resource potential	Mud Spring	3	Prospect pits in quartz veins in altered granite. Mineralized samples high in Ag, Pb, As, Sb, and Tx.
Ag, Au, Cu: Low resource potential	Bearhide Canyon	4	This upper-contact area of granite has local primary tourmaline, scarce sericitization, rare tourmalinization, and local pockets of pyrite. Prospect shafts and pits in quartz veins in granite; Au, Ag, and Cu mineralization. High values of Sn_c, Ba_c, Be_c, Y_c, W_c, B_c, K_c, Th_c, Pb_c, Pb_b, and Ag_b in one or both of two adjacent drainages.
Sn: Low resource potential (The following metals occur at sites within the area of low resource potential for tin and are associated with higher than usual levels of tin-suite elements (Sn, Be, Nb, La, Y))	Central and southeastern parts of the Hells Gate area	Sn_2	Underlain mostly by intrusive and extrusive alkali rhyolite. Sn_c and Be_c values markedly lower than in Sn_1 (see fig. 2 in accompanying pamphlet). La values higher than in Sn_1. Absence of La, Y, Nb, and Cu anomalies in bulk sediments. Absence of Co anomalies in concentrates. High values of Pb_c only in area 5.
Pb, Ag: Low resource potential	Apache Ridge and south across Tonto Creek	5	Small shaft or pit on Tonto Creek; type of mineralization not known. High values of Sn_c, Be_c, La_c, Y_c, Nb_c, Ag_c, Th_c, Pb_c, Ag_b, Zn_b, Mn_b, Ba_b, and Sr_b.
Barite: Low resource potential	East-west belts across the area approximately coincident with late Miocene faults	Ba	Barite veins near or on late Miocene faults; Gisela (Spook) mine and Barosite prospect. Late Miocene faults. High values of Ba (>1% in common) in concentrates. High values of V_c.
Cr, Bi, Co, V: Geochemical anomaly	Two adjacent drainages in Cherry Spring area	6	High values of Fe, Mn, Cr, Bi, Co, and V in both drainages. High values of Sn, Sb, and Bi in northern drainage. High values of Ag in southern drainage.
Cr, Bi, V: Low Geochemical anomaly	Two adjacent drainages in Spring Creek	7	High values of Fe, Mn, Cr, Bi, and V. High values of Cr_b, Co_c, Mg_c, and Ni_c.

NOTE OF EXPLANATION: Drainage-sediment geochemical data constitute the only criteria for definition of areas 1, 6, and 7. The boundaries of these areas are actual drainage-basin boundaries and boundary gaps are at the drainage outlets where samples were taken. Areas 2, 3, 4, and 5 are defined by multiple criteria and their boundaries cross drainage basins.

LIST OF MINES AND PROSPECTS IN THE VICINITY OF THE HELLS GATE ROADLESS AREA

[Information from references cited and from field investigations and analyses made during this study; n.a. - no analyses]

Name	Location	Commodities	Abundant trace elements	Type of mineralization and host rock	Development and production	References
Green Valley (Payson) mining district						
Gisela (Spook) mine	Sec. 7, T. 9 N., R. 11 E.	barite	n.a.	Two- to four-foot-wide vein in diorite (Ld) near Willow Spring fault.	Open-cut mining in 1970's. Filled and reclaimed in early 1981. No production records.	Stewart and Pfister (1960, p. 15-16)
Royal Flush (Bishops Knoll) mine	Sec. 36, T. 10 N., R. 10 E and Sec. 31, T. 10 N., R. 11 E.	Cu	n.a.	Pyrite and chalcopyrite disseminated and along fractures in diorite (Xd) and small pendants.	Several adits and a shaft. No record of production.	Lausen and Wilson (1925, p. 41)
Agate Mountain prospect	Sec. 20, T. 10 N., R. 11 E.	agate, amethyst	none	Thick, brittle, thrust fault zone in which voids were filled mostly with silica and hematite.	Collecting locality for local rock hounds. No commercial exploitation.	Phillips (1973, p. 1)
Barosite prospect	Sec. 15, T. 10 N., R. 11 E.	barite	n.a.	Barite veins in granite (Kg) along the Star Valley fault.	No prospect workings. No production.	Stewart and Pfister (1960, p. 18-19)
Mud Spring (Hidden Valley) prospect	Sec. 36, T. 11 N., R. 11 E.	Ag, Pb	As, Sb, Te, Bi, Zn	Quartz veins in a small altered area (gresen?) in granite (Kg). Abundant secondary green lead-arsenic mineral.	Open cut with flooded pit or small shaft; prospect pits. No production.	None
Bearhide Canyon prospect	Sec. 24, T. 10-1/2 N., R. 12 E.	Ag, Au, Cu(?)	n.a.	Quartz veins and masses in granite (Kg).	Two shallow shafts and a few pits. No production.	None
Promontory Butte prospect	Sec. 24, T. 11 N., R. 12 E.	U	n.a.	Thin carbonaceous (fossil plant) beds in shale and sandstone of the Paleozoic Supai Formation. Beds contain coal, pyrite, and secondary uranium minerals.	Extensive open-cut exploration and diamond drilling. Less than 500 tons of ore produced.	Scarborough (1981, p. 184)
Christopher Mountain homatite occurrence	Sec. 36, T. 11 N., R. 12 E.	Fe	n.a.	Proterozoic lateritic concentration in the Mescal Limestone of the Apache Group.	No known prospects or productions.	Harrer (1964); Shride (1967, p. 38-39)
Spring Creek (Young) mining district						
Diamond Butte xenotime occurrence	Sec. 3, T. 9 N., R. 12 E.	Y	n.a.	Xenotime occurs in ironstone concretions from middle member of the Dripping Spring Quartzite of the Apache Group.	No known prospects or productions.	Gastil (1954, p. 280)
Board Cabin Draw-Gold Gulch prospects	Secs. 1, 2, 11, and 12, T. 9 N., R. 12 E.	Au	n.a.	Quartz veins and associated placer deposits.	A few shafts, adits, and prospect pits. Small production likely, none recorded.	None
Ellison mine (in Gold Gulch)	Sec. 12, T. 9 N., R. 12 E.	Au	Ag, B, Te, Cu	Quartz veins with minor sulfides in Proterozoic quartzite (Xq) and mafic volcanic rocks (Xsv).	Mine (adit) reopened recently and active in 1981. No production records.	None
Breadpan Canyon prospect	Sec. 23, T. 9 N., R. 12 E.	Be	B, As	Zone in Proterozoic shale (Xsv) near a major Proterozoic fault (Breadpan fault) with intense foliation and local parallel quartz veins. Sparse beryl in mine is mostly with quartz.	Few trenches and one large fenced pit. No recorded productions.	Smith (1962, p. 1)
Soldier Camp and Gun Creek prospects	Secs. 25 and 36, T. 9 N. R. 11 E.	Ag, Au, Cu	As, B, Sb, Bi, Te, Hg	Zone in Proterozoic shale (Xsv) of intense foliation and probable distributed shear with abundant small quartz veins. Primary metallic-gray sulfides and abundant secondary copper minerals.	Shallow shafts and prospect pits. No production.	None
Fred Prenty mine	Sec. 4, R. 12 E., T. 8 N.	Cu	n.a.	Small massive sulfide lenses in Proterozoic shale and graywacke (Xsv). Possibly volcanogenic.	Several adits and shafts. Recent mapping and drilling by private exploration. No recorded production.	Donnelly, M. K. (oral comm., 1981)
Mine near Ernie Tank	Sec. 11, R. 11 E., T. 8 N.	Cu, Ag, As	Pb, Zn, Cd, As, Sb, Hg	Veins of metallic gray sulfide-bearing quartz probably related to nearby east-west fault.	Several adits. No recorded production.	None

CORRELATION OF MAP UNITS

QTg	QUATERNARY AND TERTIARY	CENOZOIC
Unconformity		
Pzs		PALEOZOIC
Unconformity		
Ya		MIDDLE PROTEROZOIC
Unconformity		
Xgp, Xq, Xir, Xer, Xsv, Xd, Xg		EARLY PROTEROZOIC

DESCRIPTION OF MAP UNITS

QTg — GRAVEL AND SAND (QUATERNARY AND TERTIARY)--Unconsolidated and unsorted to moderately well-bedded and well-sorted gravel and sand

Pzs — SEDIMENTARY ROCKS (PALEOZOIC)--Sandstone, limestone, dolomite, and shale of the Cambrian Tapeats Sandstone, Devonian Martin Formation, Mississippian Redwall Limestone, and Pennsylvanian Naco Formation

Ya — APACHE GROUP (MIDDLE PROTEROZOIC)--Conglomerate, sandstone, and siltstone of the Pioneer Formation and Dripping Spring Quartzite

Xgp — GRANOPHYRE (EARLY PROTEROZOIC)--Intrusive, micrographic, commonly miarolitic porphyry similar to intrusive rhyolite except for groundmass texture. Occurs as stills between granite and overlying units

Xq — QUARTZITE (EARLY PROTEROZOIC)--Medium- to coarse-grained, thin- to thick-bedded, cross-stratified quartz arenite and minor basal siltstone and shale

Xir — INTRUSIVE RHYOLITE (EARLY PROTEROZOIC)--Intrusive porphyritic alkali rhyolite. Occurs mostly as concordant sheets between the granophyre and overlying extrusive rhyolite

Xer — EXTRUSIVE RHYOLITE (EARLY PROTEROZOIC)--Extrusive porphyritic alkali rhyolite and minor interbedded conglomerate, shale, graywacke, and mafic volcanic rocks. Rhyolite is largely ash-flow tuff

Xg — GRANITE (EARLY PROTEROZOIC)--Fine- to coarse-grained leucocratic alkali-biotite granite

Xsv — SEDIMENTARY AND VOLCANIC ROCKS (EARLY PROTEROZOIC)--Lithic arenite, graywacke, quartz arenite, conglomerate, shale, and mafic and felsic volcanic rocks

Xd — DIORITE AND GABBRO (EARLY PROTEROZOIC)--Fine- to coarse-grained diorite and gabbro with minor granodiorite and quartz monzonite. Includes pendants composed of mafic and felsic volcanic and volcaniclastic rocks

CONTACT--Arrow shows direction and amount of dip

FAULT--Dashed where approximately located, dotted where concealed. Arrows show direction of offset, bar and ball on downthrown side

THRUST FAULT--Sawteeth on upper plate

STRIKE AND DIP OF BEDDING
- Inclined
- Overturned

STRIKE AND DIP OF FLOW FOLIATION IN VOLCANIC ROCKS
- Inclined
- Vertical

STRIKE AND DIP OF TECTONIC FOLIATION

BEARING AND PLUNGE OF COLUMNAR JOINTS

ANTICLINE--Dotted where concealed

SYNCLINE
- Normal--Dotted where concealed
- Overturned--Dotted where concealed

APPROXIMATE BOUNDARY OF 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 Hells Gate Roadless Area in the Tonto National Forest, Gila County, Arizona. Hells Gate Roadless Area (3-021) 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 Hells Gate Roadless Area comprises 31,200 acres along the rugged Tonto Creek drainage south of the Mogollon Rim between Payson and Young, Gila County, Ariz. There is no history of mining and little evidence of prospecting in the Hells Gate Roadless Area. Several small mines and prospects (gold, copper, beryllium, barite, uranium, yttrium, iron) occur within 5 mi of the roadless area.

Tin-bearing alkali granite, granophyre, and rhyolite of Early Proterozoic age underlie most of the Hells Gate Roadless Area. On the basis of geologic and geochemical evidence, a low to moderate resource potential exists for tin along the north and west margins of the area in the upper part of a granite body and in structurally overlying granophyre. A low resource potential for tin exists in central to southern parts of the area in intrusive and extrusive rhyolite. The resource potential for barite in veins along Tertiary faults is low. Except for geochemical data there is no evidence of resource potential for gold, silver, copper, and lead in the area.

GEOLOGY, GEOCHEMISTRY, AND GEOPHYSICS

From 1980 through 1982 the U.S. Geological Survey and the U.S. Bureau of Mines conducted geologic mapping, geochemical analyses of stream sediments and mineralized and unmineralized rocks, gravity and aeromagnetic surveys, and investigations of mines, prospects, and mineralized areas. Map designations and criteria for potential resource areas are given in the explanation on this map and are discussed in the accompanying pamphlet.

Middle Proterozoic (Apache Group) and Paleozoic sedimentary strata once covered the Hells Gate Roadless Area. After late Miocene structural disruption in central Arizona, these strata were entirely stripped by erosion, exposing folded and metamorphosed Early Proterozoic plutonic, volcanic, and sedimentary rocks. These are the only rocks exposed in the roadless area except for a local thin cover of unconsolidated Tertiary and Quaternary gravel and sand.

Granite, granophyre, intrusive rhyolite, and extrusive rhyolite, all of essentially the same alkalic composition, constitute about ninety percent of the exposed Early Proterozoic rocks in the roadless area. They formed as subaerial and hypabyssal parts of a great volcanic complex. This complex is overlain by quartzite which constitutes most of the remaining rocks exposed in the area. The felsic volcanic complex stratigraphically overlies a thick section of variable sedimentary and volcanic rocks immediately southeast of the roadless area.

Petrographic and geologic studies (Conway, 1976) of the felsic volcanic complex have shown that the magmas were highly evolved (high in SiO_2, K_2O, and volatiles), that upper parts of the granite are particularly differentiated, and that extensive hydrothermal activity widely affected the hypabyssal rocks of the complex. Fluorite is a widespread accessory mineral throughout the complex. Tourmaline is locally present in upper parts of the granite; tourmalinized and sericitized rocks are present, but uncommon. In vuggy upper granite and granophyre, widespread hydrothermal oxidation has resulted in destruction of primary mafic minerals and in the formation of disseminated hematite.

Chemical analysis of panned-concentrate and minus-80-mesh bulk-sediment samples from drainages in the area indicates that the felsic igneous rocks have high contents of tin, beryllium, niobium, lanthanum, yttrium, and, to a lesser extent, uranium. These elements are presumably enriched and concentrated in the evolved fluid-rich felsic magmas. Cassiterite has been identified in panned-concentrate samples but no source of the cassiterite or minerals hosting the anomalous metals has been found. The metals may be disseminated in the igneous rocks at levels too low to constitute a resource. Locally high concentrations of tin and related elements, along with anomalous amounts of silver, copper, lead, and arsenic, are present in drainage samples within the upper part of the granite and granophyre. The areas most favorable for tin enrichment in the form of greisen-style mineralization are largely outside the roadless area.

Barite veins occur in or near Miocene faults west of the roadless area. High barium values were obtained from panned concentrates from drainages crossed by the Miocene faults within the roadless area. High amounts of tungsten are present in these drainages also. Barium and tungsten may be concentrated along these faults.

Gravity and aeromagnetic data reflect the northeasterly Proterozoic structural grain in the roadless area, and detailed aeromagnetic anomalies correspond to the distribution of known rock types and structures. The tin-bearing felsic rocks have relatively uniform low-gravity and low-aeromagnetic signatures. The geophysical surveys provide no information directly applicable to mineral resource assessment.

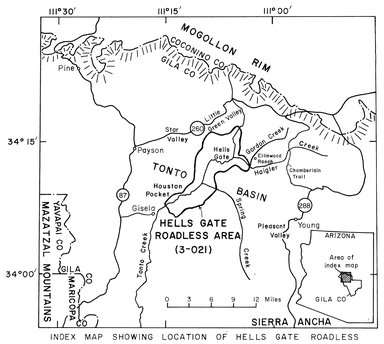
ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The absence of mining, a history of low-level prospecting and claim filing, and the absence of favorable geologic, geochemical, or geophysical evidence for specific sites of mineralization, indicate that the Hells Gate area has a low mineral resource potential.

There is a low to moderate potential for tin, and a low potential for barite. Sediment geochemistry indicates that local areas of low resource potential for gold, silver, copper, and lead are largely outside of the roadless area.

REFERENCES CITED

Conway, C. M., 1976, Petrology, structure, and evolution of a Precambrian volcanic and plutonic complex, Tonto Basin, Gila County, Arizona: California Institute of Technology, Pasadena, Ph. D. Dissertation, 460 p.
Gastil, R. G., 1954, An occurrence of authigenic xenotime: Journal of Sedimentary Petrology, v. 24, no. 4, p. 280-81.
Harrer, C. M., 1964, Reconnaissance of iron resource in Arizona: U.S. Bureau of Mines Information Circular IC 8236, 204 p.
Lausen, Carl, and Wilson, E. D., 1925, Gold and copper deposits near Payson, Arizona: University of Arizona, Arizona Bureau of Mines Bulletin 120, 44 p.
Phillips, K. A., 1973, Mine report - Beauty 1-7 claims group: Unpublished open-file report, Tucson, Arizona Department of Mineral Resources, 1 p.
Scarborough, R. B., 1981, Radioactive occurrences and uranium production in Arizona: University of Arizona, Arizona Bureau of Geology and Mineral Technology, 297 p.
Shride, A. F., 1967, Younger Precambrian geology in southern Arizona: U.S. Geological Survey Professional Paper 566, 89 p.
Smith, L. A., 1962, Mine report-Scorpion beryllium mine: Unpublished open-file report, Tucson, Arizona Department of Mineral Resources, 2 p.
Stewart, L. A., and Pfister, A. J., 1960, Barite deposits of Arizona: U.S. Bureau of Mines Report of Investigations RI 5631, 89 p.



INDEX MAP SHOWING LOCATION OF HELLS GATE ROADLESS AREA, NORTHERN GILA COUNTY, ARIZONA

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

Explanatory pamphlet accompanies map

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