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UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
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PAMPHLET

MINERAL RESOURCE POTENTIAL OF THE GILA-SAN FRANCISCO WILDERNESS STUDY AREA, GRAHAM AND GREENLEE COUNTIES, ARIZONA

By

Donald H. Richter, Douglas P. Klein, and Viki A. Lawrence, U.S. Geological Survey
and
Michael E. Lane, U.S. Bureau of Mines

STUDIES RELATED TO WILDERNESS
Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, Oct. 21, 1976), requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas 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 Gila-San Francisco Wilderness Study Area, which includes the Gila Box (AZ-040-022/023/024A) and Turtle Mountain (AZ-040-022/023/024B) areas Graham and Greenlee Counties, Arizona.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The mineral resource potential of the Gila-San Francisco Wilderness Study Area (AZ-040-022/023/024) is low (fig. 2). Although favorable geologic environments for placer gold deposits and manganese vein deposits are present in the study area, the probability of discovering economically exploitable deposits of these metals is low, and not encouraging. Even more speculative is the study area's porphyry copper potential which is based solely on the possibility of favorable host terranes underlying the study area at depth. The study area does contain substantial deposits of pumice, but their economic significance is probably minor. A part of the study area has been previously designated a Known Geothermal Resource Area (KGRA).

INTRODUCTION

The Gila-San Francisco Wilderness Study Area includes about 46,200 acres (18,700 ha) at the northern end of the Peloncillo Mountains in Graham and Greenlee Counties in southeastern Arizona (fig. 1). Elevations in the study area range from a low of about 3,200 ft (975 m), where the Gila River emerges from a picturesque gorge and flows into the Safford basin, to a high of 7,004 ft (2,135 m) on top of Turtle Mountain, a broad, prominent topographic feature in the north part of the study area.

The northern Peloncillo Mountains occur in a transitional zone between the Colorado Plateau province to the north and the Basin and Range province to the south and west. The study area is underlain by middle Tertiary to Pleistocene (about 2-30 m.y. old) volcanic and volcaniclastic rocks that are locally mantled by Quaternary alluvium and colluvial deposits. Northwest-trending normal faults, related to Basin and Range extensional tectonism, bound both sides of the study area.

Mining activity in the study area has been limited to a few small and intermittently operated placer gold deposits along the Gila and San Francisco Rivers, and a small manganese vein deposit. No mining activity was observed during investigations in 1979 and 1980. A geothermal energy resource exists near Gillard Hot Springs along the Gila River in the eastern part of the study area.

GEOLOGY

The Gila-San Francisco Wilderness Study Area is underlain by more than 3,900 ft (1,200 m) of volcanic and volcaniclastic rocks ranging from Oligocene (about 30 m.y. old) to Pleistocene (about 2 m.y. old) in age (Richter and Lawrence, 1981). The apparently oldest rock unit is composed of a series of massive andesite flows and flow breccias that is exposed in the Gila River Canyon. A thin, discontinuous unit of rhyolitic air-fall tuffs and volcaniclastic rocks locally separates these older andesites from an overlying sequence of generally more mafic flows that constitute the bulk of the volcanic rocks in the study area. These flows and associated pyroclastics are chiefly olivine-bearing andesites and basaltic andesites that were erupted during a relatively long span of time, concurrent with silicic volcanic activity to the south and west of the study area. Thick, local accumulations of cinder, scoria, and short rootless flows are remnants of cones that mark some of the vent areas for the extensive andesite and basaltic andesite flows.

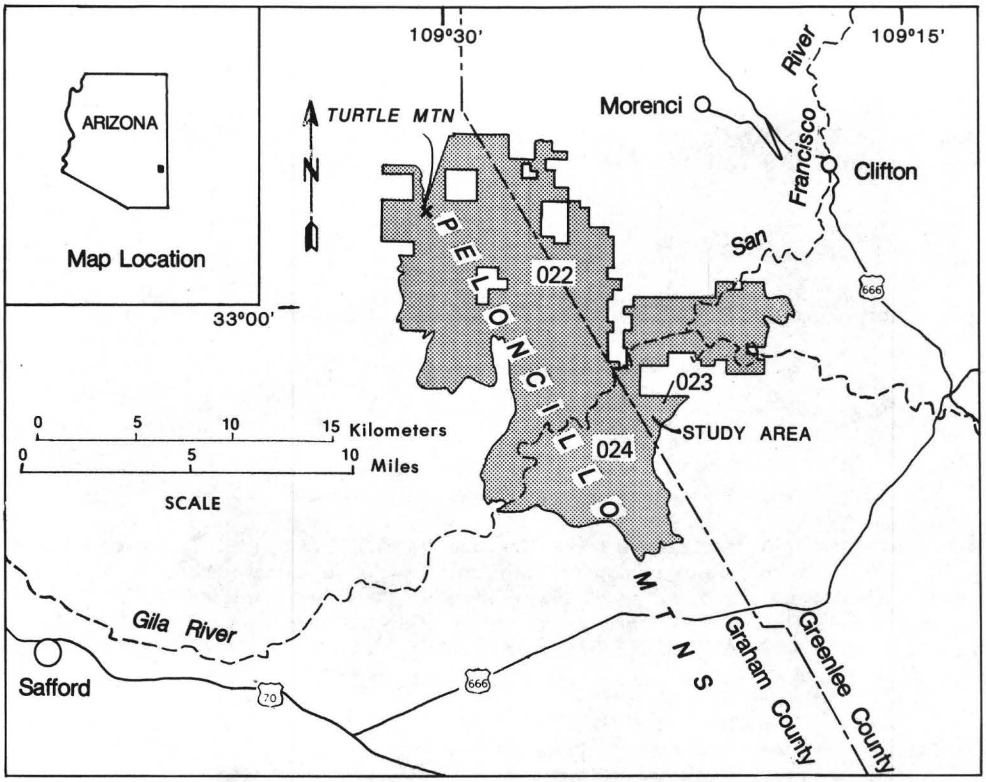


Figure 1.--Index map showing location of Gila-San Francisco Wilderness Study Area (AZ-040-022/023/024), Graham and Greenlee Counties, Arizona.

A variety of silicic volcanic rocks are intercalated with the andesite and basaltic andesite flows. Southeast of the Gila River a rhyolite ash-flow and air-fall unit occurs in the upper part of the andesite and basaltic andesite sequence. These deposits and a few rhyolite dikes and extrusive bodies, which cut and overlie andesite, are apparently related to a major 20-m.y.-old eruptive center 4 mi (6.5 km) south of the study area. In the northwest corner of the study area, a complex eruptive center is overlain by younger flows of andesite and basaltic andesite, but may also be the source for some of the older flows of the sequence. Two, thick, hornblende-bearing dacite flows and a series of air-fall deposits, exposed south of Turtle Mountain, are from a large stratovolcano, about 25 m.y. old, centered about 6 mi (10 km) west of the study area.

The final eruptive event in the study area was the development of a small andesitic cinder cone in the Gila River valley. The cone is built on a very irregular erosion surface cut by the Gila River on older andesites.

Prior to the end of volcanism, thick deposits of volcaniclastic sedimentary rocks began to accumulate in basins flanking the volcanic highlands. Basal parts of the volcaniclastic sequence contain a number of intercalated andesite and basaltic andesite flows and silicic ash-flow and air-fall deposits. Development of the basins was initiated by Basin and Range faulting, probably between 20 and 25 m.y. ago, when volcanic activity began to wane. Faulting continued concomitantly with deposition of the volcaniclastic rocks, probably until the end of the Tertiary.

GEOCHEMISTRY

The geochemical investigation of the Gila-San Francisco Wilderness Study is based on the analyses of 38 stream sediment samples collected from major drainages. The minus 80-mesh fractions of the samples were analyzed semi-quantitatively for 31 elements by M. S. Erickson (U.S. Geological Survey) using emission spectroscopy techniques. Thirty six of the samples generally contained less than two times the average concentration of these elements in basaltic and andesitic rocks.

Molybdenum was detected in two samples, from streams draining an area underlain by extensive andesite and basaltic andesite flows, with an intercalated rhyolite ash-flow tuff unit, and some small, intrusive and extrusive rhyolite bodies. Spectrographic re-analyses of the two samples confirmed the anomalous molybdenum, but in lesser amounts. Examination of rock samples from the drainage areas on an activation analyzer (Cd^{109} source) revealed that the ash-flow tuff contains minor amounts of molybdenum and hence is the likely source of the weak anomalies. The ash-flow tuff is from a rhyolite eruptive complex centered about 4 mi (6.5 km) south of the study area.

GEOPHYSICS

The northwest-trending Basin and Range faults that bound the Gila-San Francisco Wilderness Study Area, and are mapped on the surface at numerous exposures, are fairly well marked by anomaly lineations and truncations in both gravity and magnetic data (Hay and others, 1981; U.S. Geological Survey, 1981). These data allow extrapolation between and beyond exposures, but do not suggest any unusual changes of trend.

A geophysical feature of potentially economic interest is a northeast-trending gravity high (about 10 mgals) just northwest of the Gila River. Its southeast boundary is a series of distinct northeast magnetic linears and magnetic anomaly truncations that suggest a structural break correlating with the Gila River. The northwest boundary of the gravity high is marked by a northeast-trending gravity gradient and some less distinct magnetic anomaly truncations. The overall level of the residual magnetic field associated with the gravity anomaly is about 400 gammas lower than that to the southeast of the Gila River linear.

This feature may be an expression of a crustal weakness that has controlled the intrusion of Tertiary and possibly older igneous bodies. Buried ore deposits should be considered possible within this trend because it lies on line with the Safford and Morenci districts where northeast structures have apparently had an influence on the emplacement of Laramide plutons that host important porphyry copper deposits. If mineralization were present, however, it would probably be beneath about 0.6 mi (1 km) of Tertiary volcanic cover.

MINING DISTRICTS AND MINERALIZATION

The Gila-San Francisco Wilderness Study Area contains no organized mining districts, and courthouse records revealed only a small number of claims, most of which could not be located. Mining activity has been limited to small, intermittent, gold placer operations along the Gila and San Francisco Rivers, small prospect pits, and the development of a small manganese deposit.

The presence of placer gold in the older alluvial terraces of the Gila and San Francisco Rivers has been known since before 1900 (Wilson, 1961). The deposits have been occasionally worked but total production has been low, with most values from deposits outside the study area (fig. 2, localities 1 and 3). No placer deposits were being worked in the study area in 1979 or 1980, nor were there evidence of any recent activity. In 1980, Universal Mining Company completed construction of a million-dollar mining and milling facility at the Dorothy B placer deposit (fig. 2, locality 1).

The Gila Hot Springs manganese deposit (Hult Pyrolusite property) is composed of four unpatented claims just within the study area boundary north of the Gila River (fig. 2, locality 4). According to Farnham and others (1961), the claims were first located in 1938, were relocated in 1954, and in 1955 produced a few tons of hand-sorted ore that contained about 40 percent manganese. The workings were inactive in 1979. The deposit, of shallow epithermal origin, consists of wad, pyrolusite, and calcite in short lenses and irregular pods, as much as 3 ft (1 m) wide, along fractures in well-indurated, older Gila Conglomerate.

Other than the Gila Hot Springs manganese deposit, there are no known metallic mineral deposits in the middle Tertiary volcanic and volcaniclastic rocks in the study area, nor was there any evidence of mineralization observed. A number of shallow pits have been dug into unaltered volcanic flows (fig. 2,

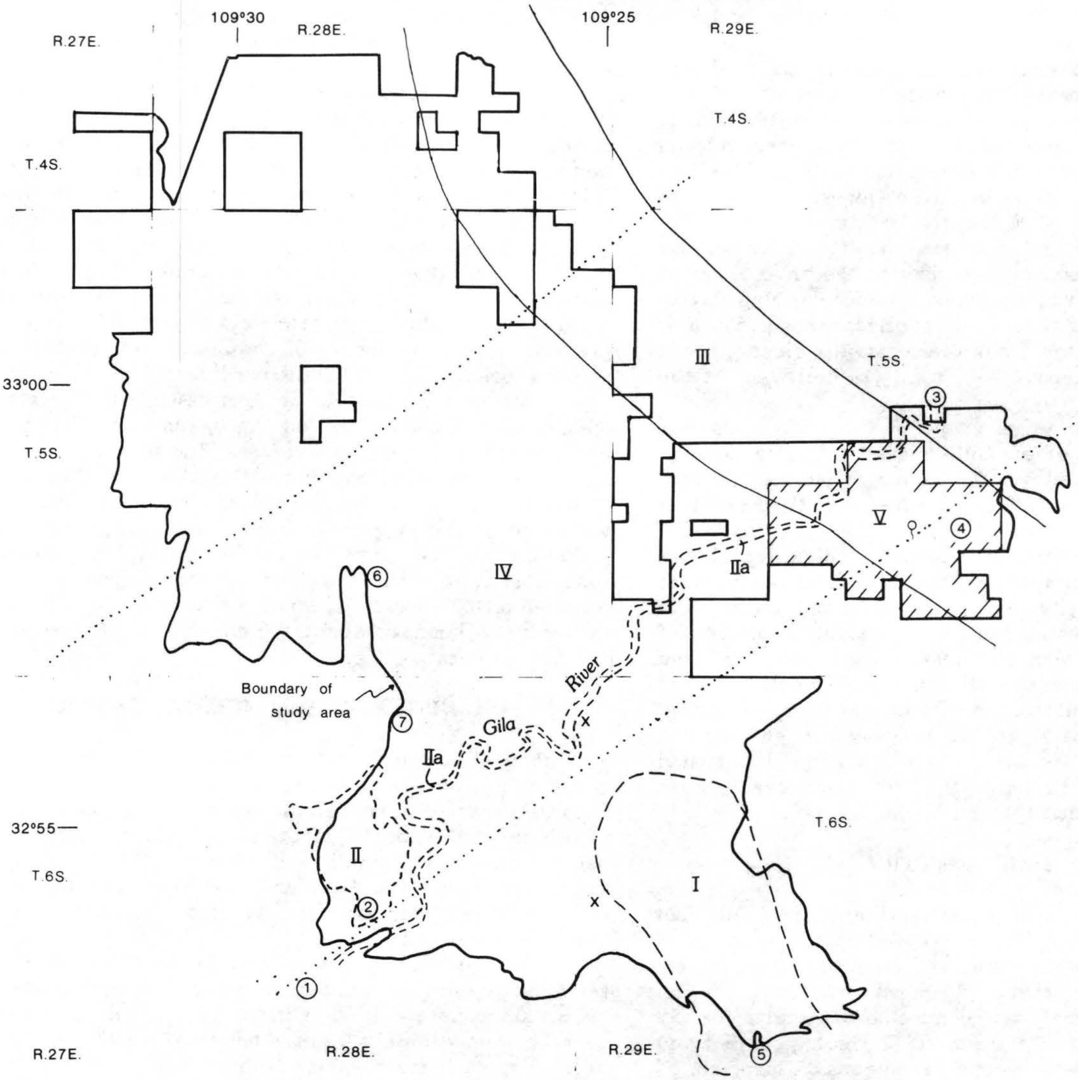
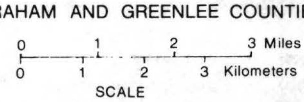


Figure 2- MINERAL–RESOURCE POTENTIAL MAP OF THE GILA — SAN FRANCISCO WILDERNESS STUDY AREA, GRAHAM AND GREENLEE COUNTIES, ARIZONA



AREAS OF MINERAL-RESOURCE POTENTIAL

--- I --- Area I PUMICE--Identified resource with low potential

--- II --- Area II PLACER GOLD--Hypothetical resource with low potential

--- IIa --- Area IIa. PLACER GOLD--Hypothetical resource with very low potential

—— III —— Area III. MANGANESE--Hypothetical resource with low potential

···· IV ···· Area IV. COPPER--Speculative resource

V Area V. GEOTHERMAL ENERGY--Gillard Hot Springs Known Geothermal Resource Area (KGRA)

EXPLANATION

x Stream sediment sample anomalous in molybdenum

(5) Locality mentioned in Summary Report

♀ Gillard Hot Springs

localities 6 and 7), but six samples collected from these pits did not reveal any anomalous concentrations of metals.

A deposit of pumice is being quarried by the Gila Valley Block Company just outside the south boundary of the study area (fig. 2, locality 5) for use as lightweight aggregate. The pumice occurs as blocks in a nonwelded ash-flow tuff that is exposed throughout much of the study area southeast of the Gila River.

The Gillard Hot Springs (fig. 2) and surrounding 3,200 acres (1,295 ha) in the extreme eastern part of the study area have been designated a Known Geothermal Resource Area (KGRA) (Burkhardt and others, 1980). The springs, which apparently issue from faults covered by Gila River alluvium, discharge waters with an average temperature of 82°C. Estimated reservoir temperatures are as high as 139°C (Brook and others, 1979).

ASSESSMENT OF MINERAL-RESOURCE POTENTIAL

Geologic environments favorable for the occurrence of placer gold, manganese, pumice, and geothermal energy are present within the Gila-San Francisco Wilderness Study Area, but the resource potential of these commodities is low to very low. In addition, geological and geophysical inference suggests that porphyry copper deposits may possibly be present in terranes underlying the middle-Tertiary volcanic pile in the study area.

Placer gold, probably derived from mineralized rocks in the Clifton-Morenci area, is known to occur in old alluvial gravels deposited by the Gila and San Francisco Rivers, and to a lesser degree in the modern gravels of these rivers. Although past production from within the study area has been negligible, placers outside the study area probably yielded as much as \$30,000 between 1901 and 1949 (Wilson, 1961), and present mining operations downstream from the study area anticipate significant gold recovery. At the inactive Smuggler Mine (fig. 2, locality 3) preliminary investigations by private industry (P. M Hopkins, oral commun., 1980) indicate the presence of about 800,000 yds^3 of old river gravels containing 0.02-0.002 oz gold/yd^3. Lithologically similar, old gravels are present in the study area, but no reliable data concerning gold content are available. Although fire-assay analyses of three representative gravel samples collected in the study area (fig. 2, localities 2 and 3) indicated less than 0.01 oz gold/ton, values comparable to that at the Smuggler Mine could still be present. In addition, Hopkins states that the modern gravels of the San Francisco and Gila Rivers may contain as much as 0.001 oz gold/yd^3.

A few tons of hand-sorted manganese ore have been produced from a small epithermal vein-type deposit in the study area. The manganese (wad and pyrolusite) is associated with calcite and occurs in small irregular lenses along a fault cutting well-indurated Gila Conglomerate of Tertiary and Quaternary age. The presence of similar structures in the Gila Conglomerate together with known, active hot springs along the northeast side of the study area suggests that other deposits of similar size and grade may be present.

The identified pumice resource in the study area is substantial, but like many construction-oriented commodities its exploitation depends largely on proximity to urban centers and the fluctuating demands of local industry. Present pumice production from the operating quarry just outside the study area will probably be sufficient to supply the needs of the Safford area for many years, hence the economic significance of the pumice-bearing deposits within the study area is probably minor.

The Gillard Hot Springs KGRA, in the eastern part of the study area has been identified as a medium temperature (90°-150°C), hot-water, hydrothermal convection system. It has a mean reservoir thermal energy (resource) of about 1.1×10^{18}J (Brook and others, 1979), which could be utilized as a beneficial heat source (space heating), but is probably not adequate for electrical generation.

Speculative geological and geophysical data suggest that porphyry copper deposits may underlie parts of the Gila-San Francisco Wilderness Study Area at depth. In the Gila Mountains, about 5 mi (8 km) to the southwest, Cretaceous volcanic rocks intruded by Laramide (52-60 m.y.) granitic plutons underlie middle Tertiary volcanic rocks, and in the Clifton-Morenci area, 3 mi (5 km) to the northeast, a Precambrian to Mesozoic terrane also intruded by Laramide plutons is exposed. In both areas the Laramide plutons are associated with large porphyry copper deposits. Similar pre-middle Tertiary rocks could underlie the study area; however, based on the regional northeast dip for the Cretaceous-middle Tertiary contact in the Gila Mountains, these economically potential rocks may be as much as 2,300-6,300 ft (700-1,900 m) below the surface in the study area.

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☆ U.S. GOVERNMENT PRINTING OFFICE: 1982— 361-614/127