

Base from U.S. Geological Survey 1:62,500, Big Lue Mountains, 1962; York Valley, 1959; Steeple Rock, 1959; 1:24,000, Mule Creek, 1965

Geology by J. C. Ratté (assisted by T. M. Grotbo) and D. C. Hedlund, 1979. Compiled by J. C. Ratté.

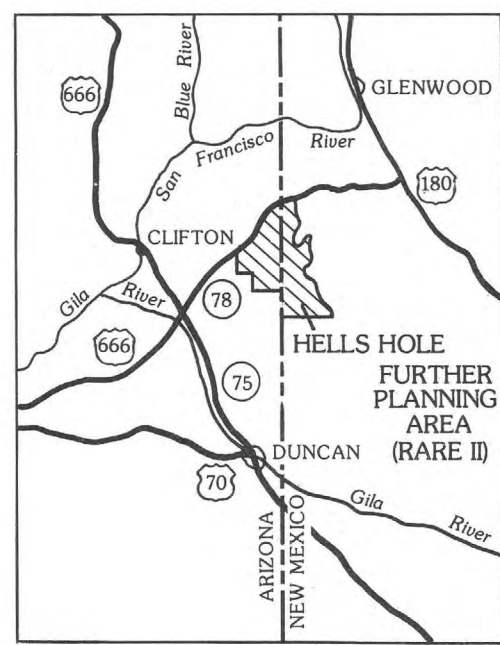
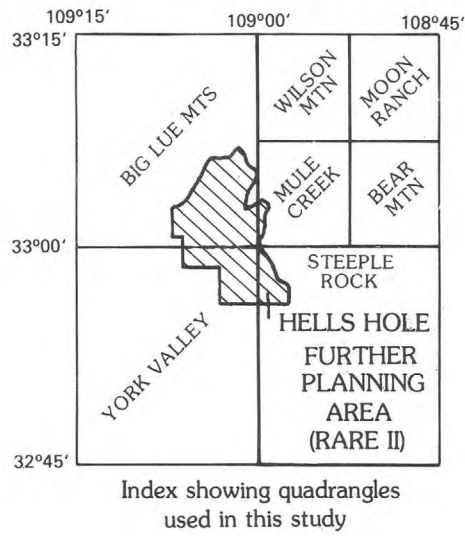
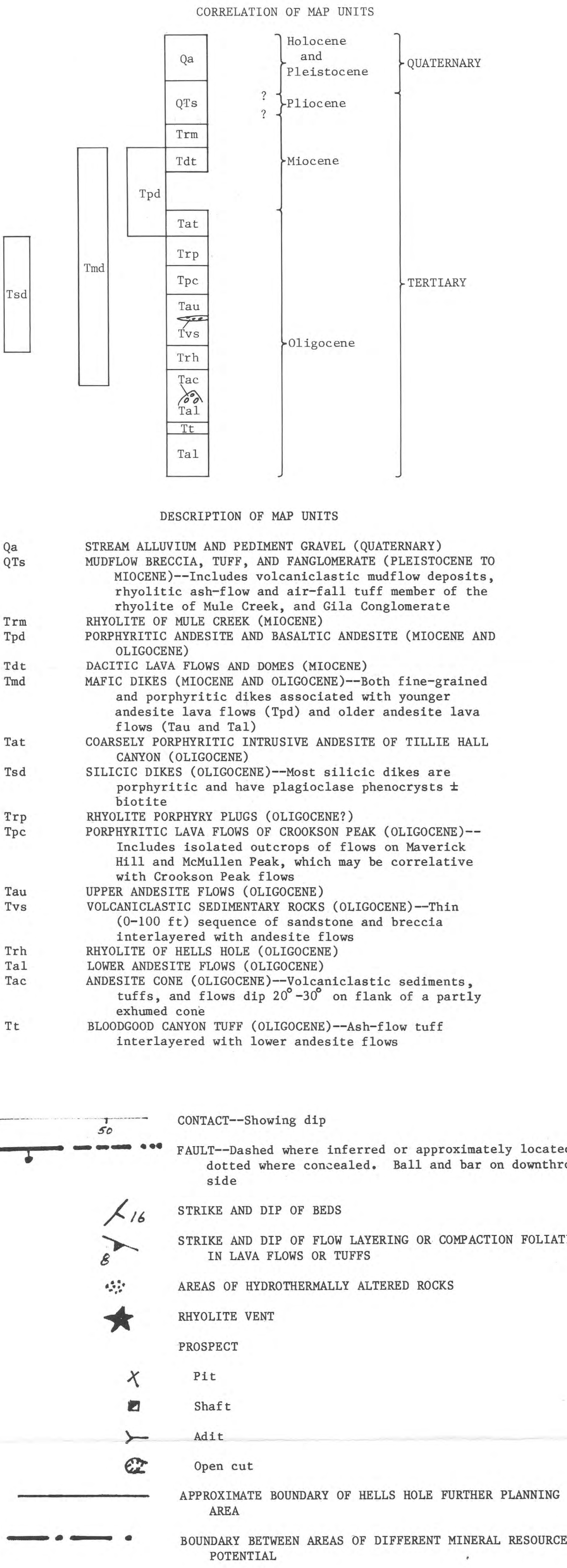
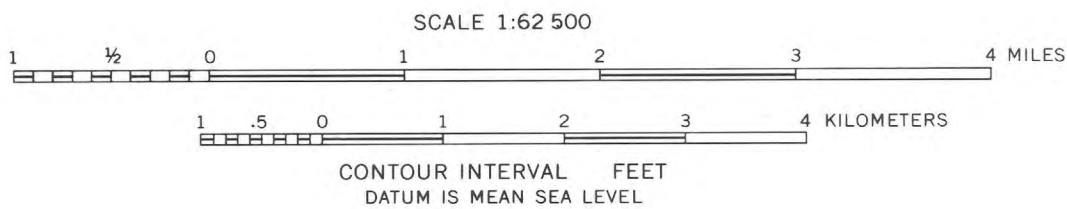


Figure 1. Index map showing location of Hells Hole Further Planning Area (RARE II), Arizona and New Mexico

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 Hole Further Planning Area in the Apache National Forest, Greenlee County, Arizona, and the Gila National Forest, Grant County, New Mexico. The Hells Hole Roadless Area was classified as proposed wilderness and further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

AREAS OF MINERAL RESOURCE POTENTIAL

The Hells Hole Further Planning Area (RARE II) is appraised as having a moderately high potential for the discovery of base- or precious-metal deposits related to igneous intrusions of middle to late Tertiary age, and a lower potential for discovery of a copper porphyry deposit of Laramide age beneath the younger Tertiary volcanic rocks that cover the area. There is little or no potential for the discovery of oil or gas, or geothermal energy resources, or other mineral resources of economic value within the area. Although a uranium occurrence has been prospected in the northern part of the study area, there is little potential for the discovery of economic uranium deposits there.

For the purpose of mineral resource assessment, the mapped area is divided into three parts, two largely within the Hells Hole Further Planning Area, but the third outside the boundary, as shown on the accompanying mineral-potential map. The mineral resource potential of the three areas differs mainly in degree, particularly for areas I and II, where the potential is believed to be related directly to a volcanic and intrusive igneous center that underlies most of the study area. The potential in area III probably also is related to this center or to subsurface extensions or apophyses of the silicic stock or batholith that is interpreted to underlie the intrusive and volcanic center.

Detailed geologic (Ratté and Hedlund, 1981), geophysical (Martin, 1981), and geochemical studies (Hassemer and others, 1981b), and past and present mining activity (Briggs, 1981) on which this appraisal is based are available.

AREA I

Area I is considered to have the greatest mineral resource potential because:

1. It encloses that portion of the intrusive and volcanic center that was repeatedly active over a period of about 10 m.y. during the formation of subvolcanic intrusions, dikes, domes, and explosive vents, involving rocks that range in composition from andesite to high-silica rhyolite.
2. It includes the center of the broad magnetic low that is interpreted as outlining a silicic to intermediate composition stock or batholith; other geophysical anomalies also relate to the igneous center and indicate its probable composite nature.
3. It includes the areas of most intense hydrothermal alteration, which comprise small areas of brightly colored sulfatatic alteration locally within the rhyolites, and greenish-gray propylitic alteration throughout the porphyritic andesite intrusion, but particularly along its contacts, where it intruded the rhyolite of Hells Hole.
4. A vent for the most highly differentiated eruptives from the volcanic center is within this area.
5. Metal values for silver, copper, beryllium, and niobium from altered rocks and small quartz veins are the highest of any part of the study area; anomalous metals in the stream-sediment concentrates are also widespread, though the center of distribution of anomalous metals in the concentrates is chiefly within area II.

AREA II

The mineral resource potential of area II is appraised to be similar to that of area I because it shares the same general geologic setting, but it offers somewhat less specific ore-deposit targets. The following factors help to define the ore-deposit potential:

1. Geology and geophysics show that area II overlies much of the border zone of the silicic pluton that is expressed at the surface by the rhyolite of Hells Hole.
2. The range of Rb/Sr and Zr/Nb ratios and other trace element indicators (Ratté and Hedlund, 1981, table 2) shows that the rhyolite of Hells Hole, even in surface exposures, probably is a composite body, and differentiation of magma into fractions of different composition could have resulted in concentrations of ore minerals.
3. Concentration patterns for several anomalous metals from stream-sediment concentrates are centered over the rhyolite of Hells Hole in area II, including barium, beryllium, niobium, tin, copper, molybdenum, and boron.

AREA III

Area III is distinct from areas I and II because it has an apparently different geologic setting and more obvious indications of mineral resource potential. The rocks are chiefly andesitic lava flows and an interlayered rhyolitic ash-flow tuff, all cut by locally mineralized northward-trending faults that are an extension of mineralized structures in the Steeple Rock mining district a few miles to the southeast. Production of metals from this northern part of the Steeple Rock district, which includes mine workings and prospects of the Commerce-Mayflower group, the Fraser-Martin mines, the Copper Basin mine area, and the Twin Peaks Mine (Briggs, 1981) has been:

Silver - 3,640 oz (113.2 kg)
Gold - 1,115 oz (34.7 kg)
Copper - 1,965 lbs (891.0 kg)

Some fluorite also has been mined from the Mohawk mine along Bitter Creek just southeast of the mapped area (Gillerman, 1964, p. 194).

A large rhyolite dike near the Twin Peaks Mine and other satellite bodies of rhyolite beyond the main exposures of rhyolite of Hells Hole are a sign that the geologic setting in area III may not be so different than in areas I and II. The Twin Peaks Mine, furthermore, is on the east flank of a geophysical anomaly about 2 mi (3 km) in diameter that is both a magnetic low and a gravity low. These anomalies may be the expression of a small rhyolite intrusion that never reached the surface. Thus, there may well be a relationship between the distribution of rhyolite in the subsurface and mineralization in area III; if so, the chief difference between area III and areas I and II may have been the more extensive fracture permeability available for migration of mineralizing solutions in area III.

Models of ore-deposit types indicate that the deposits most likely to occur in the geologic environment present in the Hells Hole Further Planning Area are:

1. Molybdenum-copper porphyry system.
2. Epithermal silver-gold-copper veins similar to those present in the adjacent Steeple Rock district.
3. Copper porphyry system.
4. Replacement base-metal deposits in hidden Paleozoic or Mesozoic sedimentary rocks in the contact zone of the silicic pluton.
5. Tin porphyry system.
6. Uranium deposits in volcanoclastic sedimentary rocks.

Any of the above deposit types could occur within depths accessible to mining within the study area. However, geological factors emphasize that the rocks exposed here are within the upper parts of the igneous system that underlies the area, and thus stockwork molybdenum and epithermal precious metal veins are the deposit types most likely to be present within about 3,000 ft (1 km) of the present surface. The presence of cassiterite-bearing rhyolite and anomalous boron (which could be present as tourmaline, though not identified as such) is compatible in this geologic setting with the occurrence of a tin porphyry (Sillitoe and others, 1975), but it would be a unique occurrence in this region, and thus is not likely. Because of the strategic importance of tin and the lack of significant domestic deposits, even the possibility of a tin porphyry system is noteworthy.

Anomalous radioactivity at the Pajaro Azul (Bluebird) prospect in the northern part of the study area attests to the uranium source-rock possibilities of the rhyolites. Such uranium could be removed by ground-water solutions and represented in suitable sedimentary rocks. The volcanoclastic sedimentary rocks in the northeastern part of the study area have been checked in reconnaissance for anomalous radioactivity and none has been found (C. S. Bromfield and C. T. Pierson, oral commun., 1980).

If an economic mineral deposit were found in the study area, there should be no unusual problems of access.

REFERENCES CITED

- Briggs, J. P., 1981, Mines and prospects map of the Hells Hole Further Planning Area (RARE II), Greenlee County, Arizona, and Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1344-C.
- Gillerman, E., 1964, Mineral deposits of western Grant County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 83, 213 p.
- Hassemer, J. R., Watts, K. C., Forn, C. L., and Mosier, E. L., 1981a, Methodology, statistical analysis, and listing of the spectrographic analyses of geochemical samples of the Hells Hole Further Planning Area (RARE II), Greenlee County, Arizona, and Grant County, New Mexico: U.S. Geological Survey Open-File Report 81-661.
- 1981b, Maps showing the distribution and relationships of selected metals in heavy-mineral concentrates of the Hells Hole Further Planning Area (RARE II), Greenlee County, Arizona, and Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1344-D.
- Martin, R. A., 1981, Geophysical surveys of the Hells Hole Further Planning Area (RARE II), Greenlee County, Arizona, and Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1344-B.
- Ratté, J. C., and Hedlund, D. C., 1981, Geologic map of the Hells Hole Further Planning Area (RARE II), Greenlee County, Arizona, and Grant County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1344-A.
- Sillitoe, R. H., Halls, C., and Grant, J. N., 1975, Porphyry tin deposits in Bolivia: Economic Geology, v. 70, no. 5, p. 813-827.



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MINERAL RESOURCE POTENTIAL MAP OF THE HELLS HOLE FURTHER PLANNING AREA
(RARE II), GREENLEE COUNTY, ARIZONA, AND GRANT COUNTY, NEW MEXICO

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