Three Questions about Arizona's Mineral Resources

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Mineral resources have had, and continue to have, a significant impact on Arizona's economy. Minerals were exploited on a limited scale for three centuries before the Arizona Territory was established in 1863. Accelerated settlement of the Territory, due in large part to discovery and mining of metallic mineral resources, began after the Civil War. By the late 1870's and early 1880's, many mining communities had been established and were thriving. Reported production of metallic minerals from the late 1800's through 1981 is shown in Table 1.

Arizona was the Nation's leading nonfuel mineral producer until 1983. In 1987 Arizona ranked second in the Nation, with a total value of $1.76 billion in metallic and nonmetallic mineral production. The value of nonfuel mineral production from 1980 through 1987, inclusive, as reported in U.S. Bureau of Mines' Yearbooks and Mineral Industry Surveys, totalled nearly $14.5 billion. These estimated values are for the mineral commodities only and do not include wages paid to miners or processors; taxes paid to local, State, and Federal governments; or value of products manufactured from the mineral commodities.

The Arizona Geological Survey (AGS) is directed by statute to (1) inform the public about the geologic environment and the development and use of mineral resources in Arizona and (2) encourage the wise use of land and mineral resources in the State. This article addresses this mandate by answering three questions that are commonly asked and frequently misunderstood.

Where are Arizona's mineral resources?

Metallic mineral districts include mineral deposits that formed under a variety of conditions and at many different times. Districts were defined by Keith and others (1983) on the basis of types and amounts of metals produced and geologic origin (Figure 1). Mineralization occurred millions of years ago and, for almost all deposits, at considerable depths below the land surface. Today the mineral deposits are exposed at or near the surface because overlying rocks have been stripped away by erosion. Some mineral deposits have been completely removed. Others are hidden, perhaps only a few feet or tens of feet below the surface.

Table 1. Reported production of metallic minerals in Arizona from the late 1800's through 1981 (Keith and others, 1983).

Commodity	Production
Copper	66,619,200,000 lb
Gold	14,043,000 oz
Lead	1,387,561,000 lb
Manganese	413,000,000 lb
Molybdenum	489,000,000 lb
Silver	482,836,000 oz
Uranium	18,427,000 lb
Vanadium	45,261,000 lb
Zinc	2,264,300,000 lb

It is difficult to define precisely the boundaries of mineral districts because of inadequate subsurface information. As additional drilling is completed and other information becomes available, the boundaries will be adjusted accordingly.

Nonmetallic resources (clay, gypsum, limestone, salt, sand and gravel, zeolites, etc.), which are scattered throughout the State, are not shown in Figure 1. Neither are the energy resources such as coal, natural gas, and petroleum.

Have all of Arizona's mineral resources been discovered?

Emphatically, no! A great deal of potential still exists. Prospectors have walked virtually every square foot of Arizona. In so doing, they have found most of the obvious deposits, those exposed directly at the surface. Discovery of the subtle and hidden deposits has become progressively more difficult.

The opening of the Cyprus Copperstone gold mine in La Paz County in late 1987 is proof that all deposits have not been found. The Copperstone deposit was discovered by a prospector who noticed a few very small, isolated outcrops of mineralized rock and staked a claim. This mine will produce 50,000 to 60,000 troy ounces of gold per year during its projected life span of 5 to 6 years. In 1985 Arizona's gold production totalled 52,000 troy ounces. The new mine, therefore, will double Arizona's gold production.

Where will future mineral discoveries be made?

Some discoveries will be made within or adjacent to the mineral districts shown in Figure 1. Others will be made far from known mineral districts.

To make an accurate assessment of mineral-resource potential, one must define the geologic framework by doing field investigations, mapping rock formations, conducting laboratory analyses and geophysical or geochemical studies, and drilling to obtain more detailed information. Geologic mapping in Arizona, a major responsibility of the AGS, is incomplete. Large areas have not been mapped in detail (Figure 2), and others must be remapped or reinterpreted. Knowledge of rocks and minerals in the subsurface is practically nonexistent. New geologic concepts are constantly being developed to help explain the relationships between mineral deposits and the geologic framework. New geologic maps are being prepared to show detail that was previously unavailable. Because of new geologic mapping in portions of western Arizona, the geologic framework is much better known than it was 10 years ago. Mineralized areas along low-angle detachment faults that are favorable for exploration can now be identified. Extensive exploration, however, will be necessary to determine if economic mineral deposits are present.

New exploration, mining, and processing techniques are also being developed to find more effective or efficient ways to locate and produce the resources. Exploration is driven by economics. The prevailing price of the potential resource must be high enough so it can be extracted profitably. Land must also be available for exploration.

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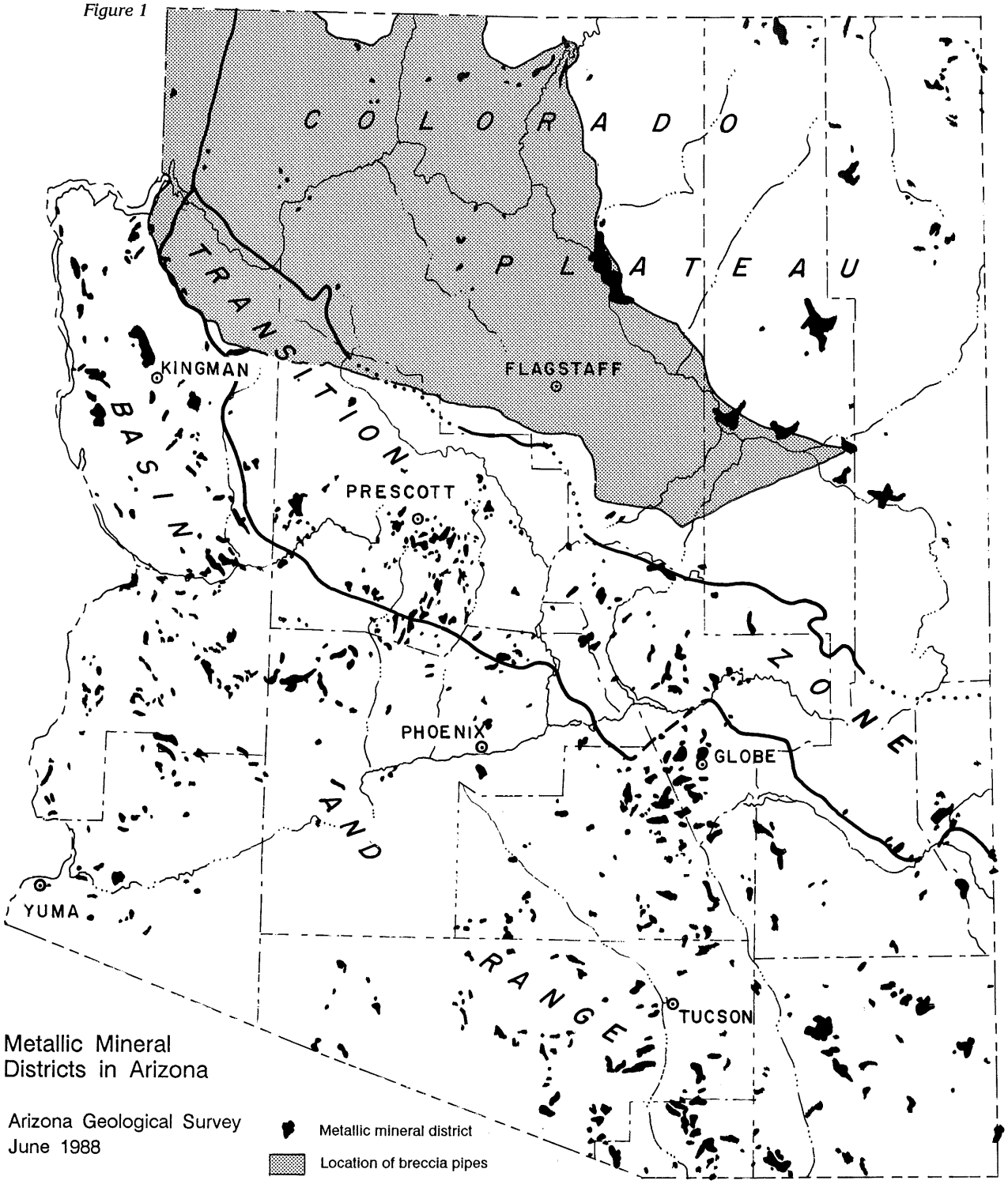
Figure 1



Metallic mineral occurrences in each district are of similar age and origin. Geologic controls of many individual mineral occurrences are poorly understood, however. District boundaries will, therefore, be modified as geologic knowledge increases. Districts shown on the map were defined by Keith and others (1983a). Their report, which includes a 1:1,000,000-scale color map and cumulative production for each district through 1981, may be purchased from the Arizona Geological Survey. A 1:500,000-scale black-and-white map is also available (Keith and others, 1983b). Nonmetallic resources (cinders, clay, gypsum, limestone, salt, sand and gravel, zeolites, etc.) are not shown on this map. Neither are the energy resources, such as coal, natural gas, and petroleum. Breccia-pipe deposits were described by Wenrich (1988). Although thousands of pipes are present within the lined map area, probably less than 8 percent were mineralized and less than 10 percent of the latter have economic value. Future metallic mineral deposits will be discovered both within and outside the districts shown on the map.

Keith, S.B., Gest, D.E., DeWitt, Ed, Woode Toll, Netta, and Everson, B.A., 1983a, Metallic mineral districts and production in Arizona: Arizona Bureau of Geology and Mineral Technology Bulletin 194, 58 p., scale 1:1,000,000.

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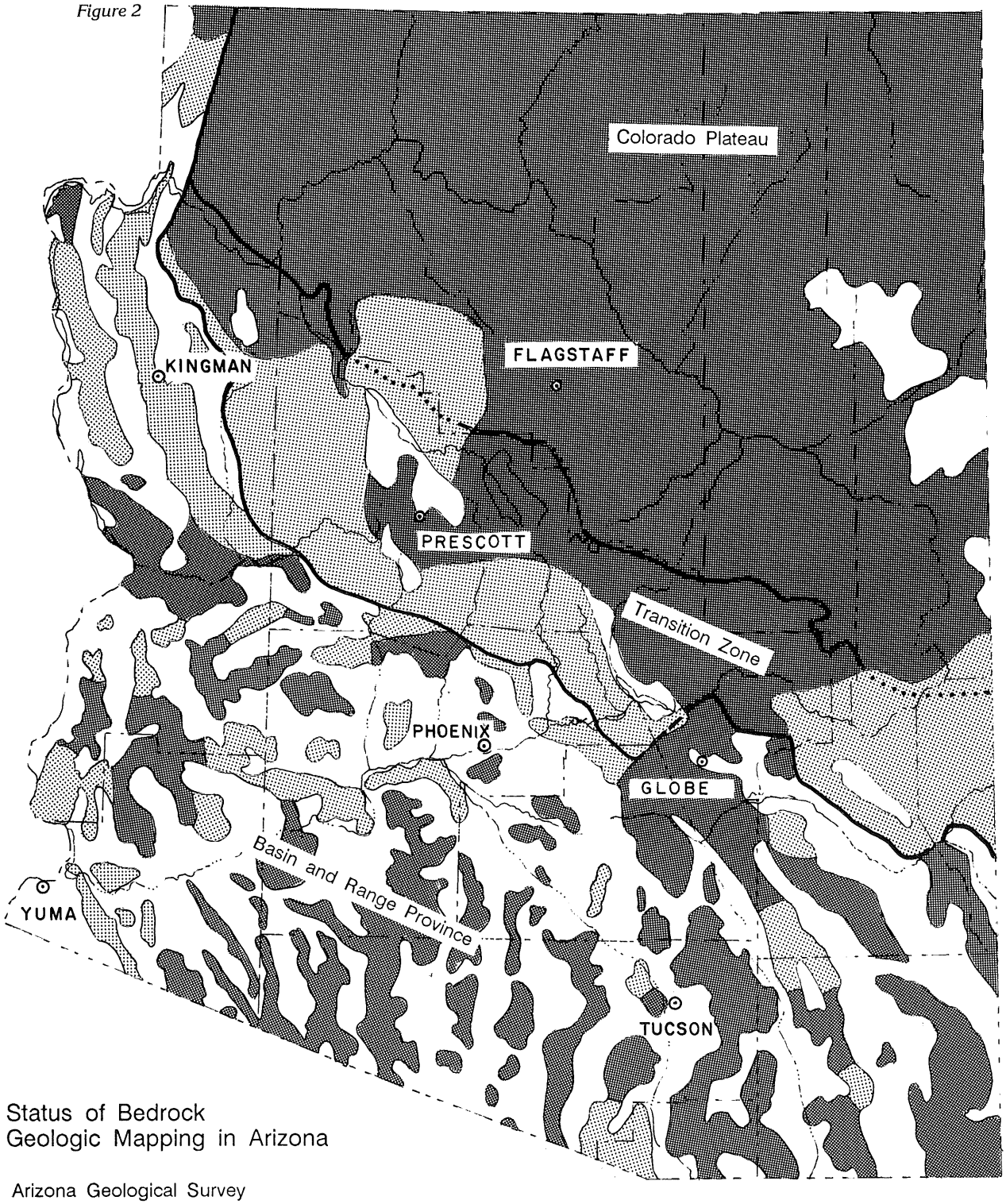
Figure 2



Status of Bedrock
Geologic Mapping in Arizona

Arizona Geological Survey
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Mapped at 1:100,000-scale or larger

Mapping in progress or mapped at scales smaller than 1:100,000

Bedrock covered by sedimentary deposits of late Cenozoic age

Geologic province boundary