U.S. Geological Survey Fact Sheet

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Environmental Effects of Mineral Deposits and Mines in the Prescott National Forest, Arizona

Scientists from the U.S. Geological Survey (USGS), in cooperation with the U.S. Forest Service, are studying the environmental geochemistry of the Prescott National Forest and adjacent areas in Yavapai County, Arizona. This mountainous area in central Arizona (fig. 1), has been the domain of extensive mining and associated mineral processing mills and smelters since the 1860's. These activities have left numerous dumps and waste piles that are rich in base metals (copper, lead, zinc, and cadmium), and sulfide minerals that are unstable in the surficial environment. Waste from past mining, and potential hazards from future mining, pose risks for the forest, nearby areas of housing and ranching, and three of the major watersheds in the State.

Figure 1. Location of Prescott National Forest

The objectives of these studies are to characterize the geochemical hazards, identify sources of geochemical hazards, describe mechanisms of dispersion in air or water, and identify natural processes that may reduce the effects of the hazards.

Work in Progress

This study focuses on geochemical hazards associated with historic mines, mills, and smelters. Mine and processing sites in and adjacent to the forest that are possible sources of geochemical hazards were identified using reports in mineral-resource data bases of the USGS and U.S. Bureau of Mines as well as published literature. Although only a few records were found for mills and smelters, many additional processing sites were found during examination of mining districts. The locations of 10 smelters and 32 mills identified to date are shown in figure 2. Four types of geochemical samples were collected in 1994 to describe the mines, mills, and smelters: (1) water from mine portals, seeps, and streams; (2) alluvium from streams draining the mines, mills, or smelters; (3) mineralized rocks from mine dumps, mill tailings, and smelter slag dumps; and (4) soil samples at sites where airborne contamination from smelter smoke may have fallen (0.5 to 10 miles (1-16 km) from the smelter). The geochemical analyses focus on the amounts of base metals (copper, lead, zinc, cadmium) in the various samples, the pH of water, and the amount of sulfur available to potentially generate acid drainage.

USGS chemists have completed analyses of water samples for major and trace constituents. Preliminary interpretation of the results suggests moderate to very high concentrations of many potentially hazardous elements such as

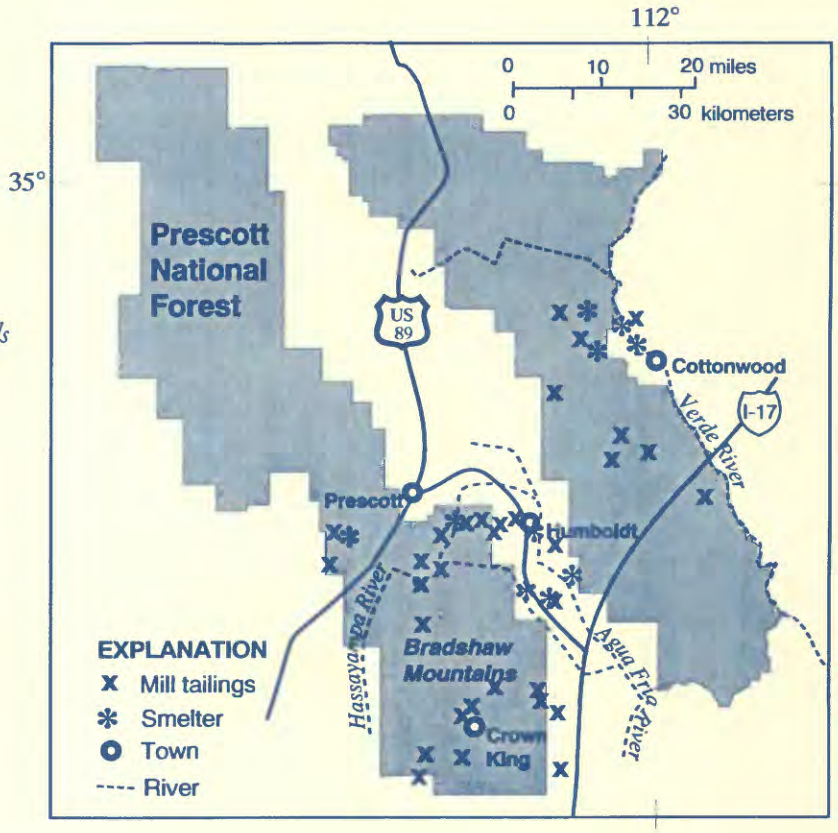

Figure 2. Location of mills and smelters in Prescott National Forest area.

zinc, cadmium, lead, copper, iron, arsenic, uranium, and molybdenum. Only a small number of waters are of concern for being highly acidic (pH less than 4), and those drainages have low flow volumes. Also, natural neutralization of the acid waters by limestone and caliche is indicated by geology and by downstream water compositions.

Chemical analyses of mill tailings and slag indicate high to extremely high concentrations of many base metals, including copper, lead, zinc, and cadmium. Analyses show that many tailing and dump samples have high sulfur content and could generate sulfuric acid upon oxidation.

Work Planned

This initial survey of the area is adequate to identify major problems and to characterize typical environmental situations in the forest. USGS scientists are publishing the geochemical data for use by the public. Maps will be prepared to show drainages that are at risk or are already contaminated.

Mill tailings have been found at nearly half of the larger mines. The fine grain size of the tailings, their mineral composition, and their susceptibility to erosion make these materials highly susceptible to dissolution in water. Smelter slag has been found at 10 smelter sites, and slag is present in alluvium along several streams and in fill along roads and railroads. Lab tests in progress will determine (1) how the tailings and slag decompose under aqueous, oxidizing conditions, and (2) the concentrations of metals taken into solution. For example, preliminary leaching tests using very weak sulfuric acid dissolved high concentrations of copper, lead, and zinc from tailings and slag.

Contamination from smoke emitted by 19th century smelters could be a problem for the Prescott Forest area, similar to the severe and widespread contamination found at several places in the U.S. and in Europe. ❑

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