

**ASSESSMENT OF ARSENIC MOBILITY USING SEQUENTIAL EXTRACTION
AND MICROSCOPIC METHODS**

by

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(Hydrogeology)

Abstract

The mobility of arsenic is controlled by the mineral source of arsenic and a host of biogeochemical factors such as pH, oxidation-reduction reactions, precipitation-dissolution reactions, adsorption-desorption processes, and the activity of microorganisms. In this study, sequential extraction and microscopic methods were used to evaluate arsenic partitioning in different phases in sediments and host rock at the Brinton arsenic mine (BAM) site. Results demonstrate spatial variability of arsenic in sediments, although the partitioning of arsenic in different phases was similar in both mine tailing and stream channel sediments. The sequential extraction results demonstrate that between 60 and 80 % of the total arsenic in sediments is associated with iron oxides, and an additional phosphate extraction showed that the majority (80%) of arsenic associated with the oxides is adsorbed.

Imaging and analysis by scanning electron microscopy (SEM) and electron microprobe analysis (EMPA) show the presence of three arsenic bearing minerals, arsenopyrite, scorodite and arsenic-rich iron oxides, in both sediment and the host rock. In sediment, the minerals are present as individual grains, but in the host rock, they are present together, often with arsenopyrite at the core, surrounded by scorodite and/or elemental sulfur, which is rimmed by iron oxides. This spatial arrangement illustrates two weathering patterns of arsenopyrite, one that involves oxidation to form scorodite, which further dissolves to form arsenic-rich iron oxides; in this weathering series, sulfur presumably forms dissolved species which migrate away from the mineral. Another pattern, observed in several samples of host rock, involves formation of elemental sulfur in addition to scorodite and iron oxides.

Results of this study have implications for arsenic mobility at the Brinton site and other mine sites where arsenic minerals are present. Although arsenopyrite is the main ore mineral, the main reservoir of arsenic in sediments is iron oxides. However, in the end it is the biogeochemical mechanism that releases arsenic from the mineral that will control arsenic mobility. In the case of iron oxides, desorption or reductive dissolution will promote arsenic release, whereas oxidizing conditions are required for arsenopyrite to release arsenic.