A sequential extraction procedure for mining wastes: Partitioning of As

P. DRAHOTA*, Z. GRÖSSLOVÁ AND H. KINDLOVÁ

Institute of Geochemistry, Mineralogy, and Mineral Resources, Charles Univ., 128 43 Prague, Czech Rep.

A new sequential extraction scheme for As-rich mine waste materials has been developed and tested for arsenic partitioning in a range of both synthetic As-bearing minerals as well as natural mine waste materials. This sequential extraction procedure employs five extraction steps to quantify the following forms of arsenic: (1) water-soluble (H_2O extractable in the inert atmosphere), (2) specifically-sorbed (phosphate extractable), (3) amorphous and poorly-crystalline arsenates and oxides (oxalate extractable in the dark), (4) well-crystallized arsenates and oxides (hot oxalate extractable), and (5) sulfide- and arsenide-bound ($KClO_3$/HCl digestible). Given its intended use for mine waste materials (which frequently contain sulfides, arsenates, and oxides), a primary aim of this new sequential procedure was to differentiate arsenic bound to amorphous arsenates and oxides from arsenic bound to well-crystalline arsenates and oxides as well as arsenic contained by sulfides. The results demonstrated that dissolution of arsenopyrite was effectively isolated in the last extraction step, with dissolution of crystalline oxides and arsenates (i.e. goethite, jarosite, scorodite) occurring in the fourth extraction step, and the amorphous and poorly-crystalline phases (i.e. ferrihydrite, schwertmannite, amorphous ferric arsenate) in the third extraction step.

Following a systematic examination of these synthetic arsenic-bearing mineral phases, the sequential scheme was applied to twelve synthetic mineral mixtures and different natural mine waste materials. Partitioning data for amorphous arsenates/oxides, crystalline arsenates/oxides and sulfide-bearing arsenic showed good agreements with those calculated in the synthetic mineral mixtures, expected in different natural mine waste materials. The pooled amount of arsenic recovered from all fractions using the method developed was similar (91-112%, n=34) to the total arsenic extracted by acid digestion. This implies that the new sequential extraction scheme is suitable for the assessment of arsenic partitioning in mine waste materials.