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Dissolution and Mineral Transformation of Jarosite coprecipitated with Toxic Oxyanions and Related Mobility of Those Ions

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Jarosite coprecipitation with toxic oxyanions can attenuate the concentrations of these ions in acid mine drainage. However, jarosite can be easily transformed to goethite with changes in geochemical conditions. Therefore, the released oxyanions can greatly affect environments. The changes in the mineralogy and mobility of five oxyanions, namely AsO_4, SeO_3, SeO_4, MoO_4, and CrO_4, which were coprecipitated with jarosite, were investigated at pH 4 and 8 by adding 0.1 g of samples in 100 mL deionized water for 5 h and 1, 3, 15, 45, 90, and 180 days at 25°C. X-ray diffraction (XRD) was used to identify and characterize the jarosite and the other mineral phases after the reaction. Inductively coupled plasma atomic emission spectroscopy was also performed to analyze the S, As, Se, Cr, and Mo concentrations in the solution. Our results show that the oxyanion species and the pH values greatly affect the mineral transformation and dissolution rates of jarosite-containing oxyanions. The transformation and dissolution rates of the jarosite samples at pH 8 are noticeably higher than those at pH 4. The XRD results show that the CrO_4 and SeO_4 jarosites are as effectively transformed to goethite as the jarosite without oxyanions, while the SeO_3 and AsO_4 jarosites are least transformed, resulting in different sulfate and oxyanion concentrations in the solution. The oxyanions in jarosite are the main controlling factor in the mineral transformation and dissolution rates. In acid mine drainage, although CrO_4 is easily attenuated by the jarosite precipitation, it has the highest mobility during the transformation to goethite. On the contrary, AsO_4 shows the opposite case.