

Influence of As(V) on precipitation and transformation of schwertmannite in acid mine drainage-impacted waters

Cruz-Hernández, Pablo

Carrero, Sergio

Pérez-López, Rafael

Fernandez-Martinez, Alejandro

Lindsay, Matthew B.J.

Dejoie, Catherine

Nieto, José M.

Iron-rich sediments commonly cover riverbeds affected by acid mine drainage (AMD). Initial precipitates are often dominated by schwertmannite, which has an exceptionally high capacity to sequester As and other toxic elements. This poorly crystalline Fe oxyhydroxysulfate rapidly recrystallizes to goethite; however, the influence of trace elements on ageing rates and products is poorly understood. This study examined the influence of As(V) concentrations on the kinetics of schwertmannite precipitation and transformation. Schwertmannite was synthesized in the presence of various initial dissolved As concentrations (i.e., 0–2 mM) and subsequently aged at 40, 60 or 85 °C for 1 h to 300 d. The initial As concentration had a profound impact on schwertmannite precipitation and transformation. Schwertmannite precipitation was inhibited at higher initial As concentrations in favor of pseudo-amorphous Fe-hydroxyarsenate formation. Schwertmannite transformation to goethite was accompanied by sulfate release and, over longer time, As release. Pair distribution function (PDF) analysis of high-energy X-ray diffraction (HEXD) patterns revealed that increasing initial As concentration produced structural defects in associated precipitates. Schwertmannite precipitation exerts an important control on As mobility in AMD-impacted waters; however, this study has demonstrated that the long-term stability of schwertmannite and associated precipitates should be considered when designing AMD remediation strategies and AMD treatment systems.