

Evaluation of the organic matter and arsenic effect on the Fe(II)-catalyzed transformation of schwertmannite to iron oxyhydroxide minerals

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Acid mine drainage (AMD) occurs as a consequence of the weathering and oxidation of iron sulphide minerals. Subsequently, the formation of secondary iron oxides takes place. However, these secondary iron oxides can undergo important transformations upon changes in the pH or redox conditions that will affect the mobility of associated toxic species. Environmental risks associated with the transformation of iron oxides include acidification of soils and waters, mobilisation of trace metals and metalloids, soil infertility, or release of sulfur gases, etc.

Among these oxides, schwertmannite is commonly found in AMD, and can act as scavenger of bioessential elements, as phosphate, and contaminants, as arsenate. In the present study we evaluated the effect that the incorporation of arsenic or natural organic matter has on the reactivity and stability of natural and synthetic schwertmannite under variable pH values and redox conditions. The transformation products obtained at different time periods were evaluated in terms of crystallinity, reactivity and mineral dissolution with small organic acids, e.g. oxalic and ascorbic acid. The presence of increasing concentrations of Fe(II) ions enhances the reductive dissolution rate of schwertmannite at slightly acidic to neutral pH values, leading to the formation of more crystalline phases such as goethite. This process decreases the attenuation capacity of the system to immobilize contaminants such as arsenate, chromate or copper. However, the presence of increasing concentration of natural organic matter or arsenate ions on the mineral surface decreases the transformation rate of this process. The changes in mineral structure, as well as the oxyanion speciation upon transformation, were followed by XRD, EXAFS and ATR-FTIR measurements.