Geochemical behaviour of amorphous iron oxides occurring in copper mining environments

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Acid mine drainage (AMD) constitutes a serious environmental problem in mining areas due to acidification and to the release of toxic metals to soils and aquatic systems. Many of the pollutants that occur in AMD display a high affinity for the amorphous iron oxides that are typically present in the environmental settings affected by AMD. This binding affinity reduces the mobility of trace metals and metalloids, such as copper and arsenic, thus helping to mitigate contamination of aquatic systems.

Weathering of the iron sulphide minerals present in mining areas produces large amounts of secondary iron precipitates. The nature and composition of the secondary iron precipitates occurring in AMD systems is mainly determined by the concentration of sulphate ions and the pH of the aqueous phase. Acidic pH values, together with the presence of high amounts of sulphate, will favour the formation of schwertmannite which is a metastable iron oxide that will be transformed within weeks or months to goethite under oxic conditions.

In the present study, water samples and iron-rich bed sediments were collected in areas affected by copper mining activities. The iron precipitates collected at the sites affected by AMD occurred as mixtures of varying proportions of schwertmannite-, goethite-, and ferrihydrite-like particles. The dominant mineralogy of the precipitates changed through the sampling sites due to the differences in the water chemistry and the overall AMD affection. The stability and reactivity of the iron precipitates was established in the presence of arsenate and copper to determine their ability to reduce the concentration of these ions in solution and how these properties affect the cycling of trace elements.