Stability and dissolution of schwertmannite-organic matter composites under oxic and anoxic conditions

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Colloidal particles, such as iron oxides and natural organic matter, control the mobility and bioavailability of trace elements in aquatic systems, soils, and mine impacted systems. Among these colloids, schwertmannite is commonly found in acid mine drainage (AMD) or acid sulfate soil, and can act as natural scavenger of bioessential elements, as phosphate, and contaminants, as arsenate or chromate. On the other hand, humic substances and bacteria are ubiquitous in surface waters and can form stable associations with iron oxides. The reactivity and stability of this organo-mineral associations can significantly differ from the pure components, which may be specially relevant in the case of schwertmannite.

In the present study we assess the surface properties, reactivity and stability of organo-mineral associations constituted by schwertmannite and fulvic acid. Following the formation of schwertmannite-fulvic acid associations with variable carbon content ranging from 3 to 12 %, the reactivity against common AMD oxyanions was studied under variable experimental conditions, i.e. oxyanion loading, pH, or ionic strength. The presence of fulvic acid produces an increase on the concentration of arsenic in the aqueous solution, but on the other hand it barely affects to the mobility of copper ions. Moreover, the stability of the organo-mineral associations was evaluated in the presence of small organic acids, e.g. oxalic and ascorbic acid, which may promote the reductive dissolution of schwertmannite under variable pH and Eh conditions. The presence of increasing concentration of carbon in the schwertmannite-fulvic acid associations decreases the dissolution of Fe(II) in the aqueous solution. Finally, the thermodynamic stability of this association and transformation to goethite, was also evaluated in the presence of Fe(II) ions under neutral-acid and oxic-anoxic conditions. The transformation products obtained at different time periods were evaluated in terms of cristallinity, reactivity and mineral dissolution.