

Insights of phosphate binding on schwertmannite

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Schwertmannite is a poorly crystalline iron oxyhydroxide sulfate mineral ubiquitously present in acid mine drainage (AMD) and acid sulfate soils. This mineral plays a major role in acid sulfate-rich environments since is a naturally occurring attenuator for ionic pollutants, such as arsenate or chromate. Many authors have devoted their research to assess the binding mechanism involved, pointing out to ligand exchange and anion exchange reactions with the iron hydroxyl groups and sulfate groups, respectively, as the major mechanisms.

Even though phosphate adsorption to schwertmannite has been also studied, microscopic information about the mechanisms or the surface complexes occurring is still limited. The present study provides new and robust adsorption data for the phosphate binding on schwertmannite. Adsorption envelopes were obtained under oxic conditions at different initial P/Fe molar ratios (from 0.007 to 0.7) and pH values (from 3 to 9). Anion exchange reactions between sulfate, present in the schwertmannite structure, and phosphate ions, was identified in the batch experiments and later confirmed by ATR-FTIR measurements. At acidic pH values and low phosphate loading (P/Fe < 0.07) two sulfate surface complexes were detected. Increasing concentration of phosphate produce a gradual decrease on the contribution of one the sulfate complexes, while the contribution of the second complex remains fairly constant. At high phosphate concentration and relatively high pH the presence of both surface complexes is negligible. XAS spectra at the P k-edge were conducted with schwertmannite, and other iron oxide analogues, to evaluate the nature of the surface complexes present, allowing to constraint the phosphate binding environment at the mineral surface for surface complexation modelling calculations.