

Complexation and precipitation reactions in the ternary P(V)/As(V)-Fe(III)-NOM (natural organic matter) systems

PER PERSSON¹ ANNELI SUNDMAN²
TORBJÖRN KARLSSON² AND STAFFAN SJÖBERG²

¹Centre for Environmental and Climate Research &
Department of Biology, Lund University, SE-223 62 Lund,
Sweden. per.persson@biol.lu.se

²Department of Chemistry, Umeå University, SE-901 87
Umeå, Sweden. anneli.sundman@chem.umu.se,
torbjorn.karlsson@chem.umu.se,
staffan.sjoberg@chem.umu.se

NOM (natural organic matter) has a strong influence on Fe speciation, and this will in turn affect the interactions between Fe and nutrients and contaminants such as phosphate and arsenate. Previous studies have shown that Fe speciation in the presence of NOM varies as a function of pH and Fe concentration [1-3]. At low Fe concentrations and low pH mononuclear Fe(III)-NOM complexes predominate whereas at high Fe concentrations and high pH Fe(III) is hydrolyzed and precipitated as Fe(III) (hydr)oxides. It is likely that these changes in Fe(III) speciation will also be reflected in the P(V) and As(V) speciation. Hence, a central question is how environmental conditions affect the P(V)/As(V)-Fe(III)-NOM interactions. To answer this question, herein we have probed conditions that cover a large variation in Fe(III) concentrations, Fe(III):P(V)/As(V) ratios, and pH, and the studies included two different NOMs. The local structures of the ternary P(V)/As(V)-Fe(III)-NOM systems have been probed by X-ray absorption and infrared spectroscopy. We have also used chemical equilibrium modeling to corroborate the trends in the spectroscopic data. The collective results showed that the ternary P(V)/As(V)-Fe(III)-NOM systems could be explained by the presence mononuclear Fe(III)-NOM complexes, Fe(III) (hydr)oxides and precipitated P(V)/As(V) either as FePO₄(s)/FeAsO₄(s) or coprecipitated with ferrihydrite. The relative distribution among these species varied with the experimental conditions. The precipitated P(V)/As(V) was favored at high total concentrations and high Fe:P/As ratios. However, at low Fe:NOM ratios the mononuclear Fe(III)-NOM complexes were sufficiently stable to be unreactive towards the phosphate and arsenate oxoanions.

[1] Bauer and Blodau (2009), *Sci. Total Environ.* [2] Karlsson and Persson (2010), *GCA*. [3] Karlsson and Persson (2012), *Chem Geol*.