

Modelling trace-metal sorption to bacteriogenic iron oxides: Cu(II) and bacteriogenic ferrihydrite

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Bacteriogenic iron oxides (BIOS) are composite materials comprised of poorly ordered Fe (hydr)oxides intermixed with intact and fragmented bacterial cells. They are abundant in both surface and ground water systems, and in analogy with their abiotic counterparts, are powerful sorbents of dissolved metal cations. In order to accurately predict fate and mobility of trace-metals in natural freshwaters, thermodynamic surface complexation models must be correct for both actual surface species and reactive phases present. Here we have synthesised 2-line ferrihydrite in the presence of the common soil bacterium *Bacillus subtilis* to produce bacteriogenic ferrihydrite. We have characterised the macroscopic sorption of Cu (II) to *B. subtilis*, ferrihydrite and our bacteriogenic ferrihydrite, and determined the microscopic Cu (II) sorption mechanisms using EXAFS spectroscopy. We are able to fit our EXAFS of Cu-sorbed bacteriogenic ferrihydrite to a linear combination of the Cu-sorbed composite end-member phases, namely Cu-sorbed *B. subtilis* and Cu-sorbed ferrihydrite. We have subsequently used our microscopic results to develop and constrain surface complexation models for Cu (II) sorption to *B. subtilis* and ferrihydrite, and then combined these end-member models to fit Cu (II) sorption to our bacteriogenic composite. Using a basic Stern formalism for the electric double layer at the bacteriogenic mineral-water interface, we find the predicted distribution with pH of sorbed Cu (II) among bacterial biomass and mineral fraction to be in excellent agreement with our microscopic linear combination results.

Here we will present our macroscopic pH adsorption edge data, our microscopic EXAFS results and fits, and our newly developed surface complexation models for Cu (II) sorption to *B. subtilis*, ferrihydrite and bacteriogenic ferrihydrite, and discuss the possibility that trace-metal sorption to BIOS might be successfully modelled as a combination of sorption to the bacteriogenic composite end-member phases.

Impacts of atmospheric deposition on iron distributions and biogeochemistry in the North Atlantic

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An ocean biogeochemical model is used to examine the influence of atmospheric deposition on iron distributions and marine ecosystem dynamics in the North Atlantic basin. The Biogeochemical Elemental Cycling (BEC) model includes multiple potentially limiting nutrients and phytoplankton functional groups, and explicit iron cycling, with atmospheric and sedimentary Fe sources to the oceans (Moore *et al.* 2004). In this work, the extensive field observations of dissolved iron distributions and atmospheric deposition from the CLIVAR-CO2 Repeat Hydrography A16N transect (Measures *et al.* 2008; Buck *et al.* 2008) are used to derive input fields and evaluate iron distributions in the simulations. The spatially and temporally coherent nature of these field measurements provides much stronger constraints on the biogeochemical model simulations than the previously available, sparsely distributed observations. This model-data synthesis will examine aerosol iron solubility, particle scavenging removal, biological uptake and export, and ocean advection in the context of the observed iron distributions and biogeochemical cycling in the North Atlantic.