



The Role of Humic Acid in Cobalt Sorption to Soil Minerals

Gemma Woodward (1), Caroline Peacock (1), Olivia Thompson (2), Gareth Law (3), Alba Otero Fariña (4), and Ian Burke (1)

(1) School of Earth and Environment, University of Leeds, Leeds, United Kingdom, (2) National Nuclear Laboratory, Warrington, United Kingdom, (3) School of Chemistry, University of Manchester, Manchester, United Kingdom, (4) Department of Physical Chemistry, University of Santiago de Compostela, Santiago de Compostela, Spain

Batch sorption experiments have been carried out to investigate cobalt sorption to ferrihydrite, kaolinite, and humic acid (HA) as a function of pH; and to ferrihydrite-HA and kaolinite-HA composites at three different total carbon contents. Sorption to the composites was enhanced at low pH values (<7) compared to the pure ferrihydrite and kaolinite systems. For the ferrihydrite-HA composites, there was no significant difference in the amount that sorption was enhanced by for the different composites. However, sorption was dependent on the C content of the kaolinite-HA composites, with more Co sorbed to the composites at higher C concentrations.

Changes in Co speciation in the kaolinite and kaolinite-HA composite system was investigated using XAS analysis. EXAFS spectra collected from kaolinite samples at pH 5-6 show a single shell of 6 O backscatters; indicative of Co present in an outer-sphere sorption complex. At pH 7-8, Co-Al(Si) and Co-Co backscatters were also resolved indicating Co present in inner-sphere complexes or as Co(OH)₂ surface precipitates. At pH 5-6, EXAFS spectra for Co sorption to pure HA and the kaolinite-HA composite are similar, with Co-carboxyl bonding evident, suggesting that Co is predominantly associated with the HA phase of the composite at low pH.

Co sorption to natural humic acid was also studied as a function of pH, and determined in samples after filtration at both 0.22 μ m and 10kDa. Data from the samples filtered at 10kDa (<~2nm) represent the best estimate of true sorption behaviour. Co sorption increased with increasing pH, reaching ~90% at pH 7. The 0.22 μ m filtered samples showed incomplete sorption above pH 5, indicating that increased solvation of HA at high pH values results in a 1.5-220nm Co-HA phase that is potentially mobile at pH values where high Co sorption would be expected.