

## USE OF IN-SITU SURFACE SPECTROSCOPIC AND MICROSCOPIC TECHNIQUES TO ASCERTAIN THE FATE AND MECHANISMS OF METAL CONTAMINANTS IN THE SUBSURFACE ENVIRONMENT

A. M. Scheidegger, K. G. Scheckel, D. G. Strawn, and D. L. Sparks

Department of Plant and Soil Sciences

University of Delaware, Newark, Delaware 19717-1303 USA

Definitively ascertaining the sorption mechanisms of metals on clay and metal oxide surfaces is important in understanding the fate of metals in contaminated soils and sediments. X-ray absorption fine structure (XAFS) spectroscopy and scanning force microscopy (SFM) are two in-situ techniques that were used to study metal reaction mechanisms at the mineral/water interface. These studies have shown that polynuclear surface complexes occur on an array of mineral surfaces that are common in the environment. The surface precipitates often form on rapid time scales, at metal surface loadings far below a theoretical monolayer coverage, and in a pH range well below that at which metal hydroxide precipitates would be expected to form according to the thermodynamic solubility product. XAFS studies indicate that the polynuclear complexes are mixed metal/Al hydroxide phases and form when a metal such as Ni(II), Co(II), Zn(II), or Mn(II) is introduced into an environment in which there is a source of hydrolyzed species of Al(III), Fe(III), and Cr(III). Scanning probe microscopy (SPM) studies show that the mixed metal/Al hydroxide phases extensively cover mineral surfaces and are much more resistant to dissolution than the pure divalent metal hydroxide compounds [1]. The formation of mixed-cation hydroxide compounds should be considered when conducting metal sorption experiments, modeling metal surface complexation, determining speciation, and assessing the risk of the migration of contaminants in polluted sites.

[1] Scheidegger, A. M., G. M. Lamble, and D. L. Sparks. 1997. Spectroscopic evidence for the formation of mixed-cation hydroxide phases upon metal sorption on clays and aluminum oxides. *J. Colloid Interf. Sci.* 186:118-128.