086. MONITORING THE KINETICS OF METAL SURFACE PRECIPITATE FORMATION USING X-RAY ABSORPTION FINE STRUCTURE (XAFS) SPECTROSCOPY. Andre M. Scheidegger, Donald L. Sparks, Department of Plant and Soil Sciences, University of Delaware, Newark, Delaware 19717-1303, and Geraldine M. Lemble, Building 510E, NSLS, Brookhaven National Laboratory, Upton, New York 11973.

Metal sorption on clay and oxide minerals is typically fast initially, then the rates gradually diminish. In the literature the decline in reaction rate has been attributed to metal sorption onto sites of lower reactivity, diffusion of the adsorbate into the adsorbent or by a precipitation reaction. Unfortunately, the above hypotheses were normally based solely on macroscopic studies. We investigated the effect of reaction time on the surface coordination environment of Ni sorbed onto pyrophyllite using X-ray absorption fine structure (XAFS) spectroscopy. The kinetics was studied over a long reaction period (months to months) and changes in the XAFS spectra were monitored. As reaction time progresses, surface precipitates increasing in size were depicted. This finding implies that slow nucleation processes cause the slow sorption kinetics. This study also emphasizes the importance of coupling kinetic studies with in-situ spectroscopic investigation in elucidating sorption mechanisms of metal ions onto mineral surfaces.

087. IMMOBILIZATION OF LEAD BY APATITE. Valérie Laperche, Pranitha Gaddam and Samuel J. Traina, School of Natural Resources, Ohio State University, Columbus, Ohio, 43210

Previous studies have shown that lead interactions with hydroxylapatite induced hydroxyoxypomorphite precipitation and thus can reduce Pb solubility. In the present study we investigated the solid-phase speciation of lead, immobilized by synthetic hydroxylapatite and natural fluoro- and chlorapatites. In order to understand the mechanisms of lead immobilization (precipitation of pyromorphite, etc.), we studied the phosphates formed after reaction of aqueous lead with apatites or after co-precipitation of (Pb, Ca)-phosphates. These phosphates were analysed by different spectroscopic methods (XRD, IR, EXAFS and SEM) to determine the structure of the precipitated Pb-phosphates, and the mechanisms of formation of pyromorphite (OH, F and Cl) as a function of pH, solid/solution ratio, and the reacting mineral and solution chemistry. The preliminary results showed that pure pyromorphite and not (Pb, Ca)-apatite was formed when we let aqueous lead react with apatite. (Pb, Ca)-apatite can be formed only by co-precipitation.

088. IMMOBILIZATION OF METALS USING APATITE MINERALS: PRECIPITATION OR SORPTION? Judith Wright, NESTT; James Conca, Washington State University; Tim Moody, Bechtel Hanford, Xiaobing Chen, Pacific Northwest Laboratory; all at Richland, WA 99352

Metals can be immobilized into stable phosphate phases (apatite minerals) in contaminated soils, sediments and groundwater. Most affected by this treatment are Pb, Zn, Cr, Cu, Cd, Ni, U, Ba, Cs, St, Pu, and all other lanthanides and actinides. The reaction can be nearly irreversible under subsurface conditions. Mine tailing soils from the Bunker Hill Mining District containing 0.4 wt% Pb, Zn and Cd, were treated using various apatites, and modelled using MINTEQA2. Under subsurface conditions, the metal-apatite phases were predicted to be the most stable for Pb, and only moderately stable for Zn and Cd. In column experiments on untreated and apatite-treated soils using vadose zone water, leachates from untreated Bunker Hill soils contained hundreds to thousands of mgkg⁻¹ (ppm) Pb, Zn and Cd, but leachates from apatite-treated Bunker Hill soils showed concentrations below the ICP/MS detection limits of 1 µg kg⁻¹. SEM and XRD indicated precipitation of Pb-hydroxyapatite that accounted for most of the Pb removal, but no Cd or Zn phosphate minerals appeared. A minor amount of otavite was precipitated, but most of the Cd and Zn were removed in such a way as to produce no XRD patterns. Either sorption dominated Cd and Zn removal or X-ray amorphous materials precipitated. pH had no effect on Pb removal, but significantly affected Cd and Zn.

089. SORPTION AND PCOPRECIPITATION OF CrO₄²⁻ IN ETRRINGITE (Ca₆Al₄(SO₄)₆(OH)₁₆·26H₂O). S. Myeni¹, S.J. Traina², and G. Waychunas³.
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Ettringite is a Ca-Al-hydroxysulfate mineral which forms in alkaline fly ashes, cements and alkaline waste materials. It has recently been studied as a solid for encapsulation and immobilization of arsenate at pH values in excess of 10. In the present