grated exponential equation by band spacing and was used to compare different soil sampling schemes. A systematic sampling procedure consisting of collecting 10 continuous soil cores, 15-20 cm deep, perpendicular to the band application, was superior to a random sampling technique for determining available P.

D. H. Sander (402) 472-1501

Div. S-9 — Soil Mineralogy

Oxidative Weathering of Triocahedral Micas by H₂O₃

Solutions: K-depleted and Deuterated Samples. J. E. AMONETTE* and A. D. Scott*, Pacific Northwest Laboratory and Idaho State University.

Three triocahedral micas, a phlogopite, a biotite, and a siderophyllite, were K-depleted and Na-exchanged, and their structural OH groups were deuterated. Half of the specimens were resaturated with K. The Na- and K-exchanged specimens were then treated at 80°C with acetate solutions (pH 4.7) that were 0.1 M in EDTA, 1 M in either Na or KCl, and that did or did not contain 30% HOCl. Changes in structural Fe(II), K, Na, Rb, and OD contents, in solution concentrations of Al, Mg, and Fe, and in layer charge and OD-spacing were monitored. Results showed that part of the excess charge created by oxidation was balanced by octahedral cation ejection. A loss or exchange of OD during the oxidation process was also observed. However, little oxidation occurred without an expansion of the mica layers.

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J. E. Amonette, (509) 376-8415

An EXAFS study of metal ion complexation by EDTA and humic acid. Y.-Y. CHIEN* and W. F. BLEAM, University of Wisconsin-Madison.

Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy directly measures the coordination number and bond lengths of metal-ion complexes. This EXAFS study examines the number of nearest-neighbor carbon atoms surrounding Cu(II) and Pb(II) bound to EDTA and humic acid. We evaluate whether EXAFS can reveal the nature of metal-ion complexes with humic acid and whether it is possible to estimate the average number of humic-acid functional groups coordinating these metals. EXAFS measurements permit a more accurate assessment of the lability and bio-availability of metals bound to humic substances.

Y.-Y. Chien (608) 262-3956


Remediation of uranium-contaminated soils without seriously damaging the soils' physicochemical characteristics is the primary goal of the environmental restoration work being conducted at the Department of Energy's Fennland Environmental Management facility near Cincinnati, Ohio. Leaching studies were conducted by attrition scrubbing the soil in the presence of both acid and carbonate lixiviants. ICP analyses of the extracts demonstrated that large quantities of Al, Ca, Fe, Mg, P, and Si were removed along with the uranium by the acid lixiviants, suggesting chemical attack and weathering of the soil minerals. Therefore, a mineralogical investigation, using both X-ray diffraction and electron microscopy, was performed to document the degree of artificial mineral weathering caused by the uranium extraction techniques. X-ray and microscopic analyses substantiated the weathering of chlorite and carbonate minerals by the acid lixiviants. Therefore, a carbonate-based extraction strategy is recommended for the selective extraction of uranium from the Fennland soils.

M.P. Elless (615) 576-8192

Birnessite-Induced Removal of Aqueous Aluminum from Acidic Suspensions. S.E. FENDOR*, and M. FENDOR†. Univ. of Idaho, and †Univ. of California, Berkeley.

Aluminum is ubiquitous in soils, being a component of many prevalent soil minerals. The low solubility of various Al solid phases, e.g., gibbsite, results in low aqueous concentrations except under acidic conditions (pH < 5). Unfortunately, although most natural soil pH values limit aqueous Al levels, anthropogenic effects such as acid rain or mine tailings run-offs have resulted in highly acidic conditions (pH < 4). This, in turn, has led to dramatically elevated Al concentrations in solution. Here, we provide evidence for a reaction limiting aqueous Al even in under very acidic conditions: the formation of an Al-Mn-oxide at the birnessite/solution interface. High-resolution transmission electron micrographs revealed that their were two solid phases produced from reactions of aqueous Al with birnessite at pH 3, one amorphous and the other crystalline. X-ray absorption fine structure spectroscopy, electron diffraction, and X-ray diffraction were used to characterize these solid phases. The derived structural parameters were consistent with an Al-derivative of lithiophorite. This reaction has important environmental consequences since it limits soluble Al under acidic conditions.

S.E. Fendor, (208) 885-6767

Oxyanion Surface Structures on Goethite. S.E. FENDOR*, Univ. of Idaho, P.R. GROSSL, D.L. SPARKS, Univ. of Delaware, and G.M. LAMBLE, Brookhaven National Laboratory.

Many heavy metals have a dramatic influence on agricultural productivity and environmental quality. Their retention on soil constituents has important consequences on their mobility, bioavailability, and hence their risk. The sorption mechanism, however, determines the strength of retention and thus the potential for release of the metal into the aqueous environment. In this study, x-ray absorption fine structure (XAFS) spectroscopy was employed to discern the local structure of the oxyanions Cr(VI) and As(V) sorbed on goethite. Both oxyanions formed inner-sphere complexes. The interatomic distances determined with XAFS indicated that the dominant As(V) species on goethite was a bidentate binuclear surface complex. Chromium to Fe distances resulting from Cr(VI) sorption also indicate a bidentate surface complex. The results of this structural investigation indicate that both As(V) and Cr(VI) form inner-sphere bidentate complexes on goethite. Therefore, both of these oxyanions form stable surface bound states.

S.E. Fendor, (208) 885-6767

Two-dimensional X-ray Patterns of Spin-dried Smectite, A. FITCH and J. DU, Loyola Univ. of Chicago, M. CAPEL, National Synchrotron Light Source, and J.W. STUCKI*, Univ. of Illinois.

The performance of a clay-modified electrode depends on the conductivity of ions through the clay film when submerged in electrolyte solution, which in turn depends on the interlayer spacing, porosity, parallel orientation, and electrostatic properties of the clay. The purpose of this study was to determine the interlayer spacings and parallel orientation of clay films prepared by a spin-drying technique. A synchrotron X-ray source with a two-dimensional, position-sensitive detector was used. Angle calibrations were obtained from mica and cholesterol myristate. The smectite film contained a distribution of interlayer spacings and superimposed layers were reasonably well oriented compared to air- or oven-dried samples. Exposure of the clay film to electrolyte solutions of varying concentration had little effect on the orientation, but, as expected, inversely altered the interlayer spacings.

J.W. Stucki, (217) 333-9636

Characterization of Synthetic Apatites used in Zeponics Plant Growth Experiments. C. GALINDO*, D.W. MILLS, D.C. GOLDEN*, Lockheed and NASA Johnson Space Center, Houston, TX.

Zeponics is the cultivation of plants in a zeolite mineral substrate that contains essential plant growth nutrients. The Zeponics plant growth system developed at NASA Johnson Space Center has been designed to supply all the essential plant growth elements for several growing seasons with only the addition of water. Both Na⁺ and K⁺ are supplied by exchange reactions on a natural clinoptilolite (zeolite). A micronutrient-substituted hydrousapaticite was synthesized using a batch precipitation process. The synthetic apatite supplied Ca, Mg, Sr, and the micronutrients (i.e., Fe, Cu, Zn, Mn, Mo, and Cl) into "soil" solution by dissolution reactions. Characterization of synthetic apatites was performed using various