An Evaluation of Nickel Sorption Sites in Soil. R.D. Harter* and A.A. Mahd, Univ. of New Hampshire. Correlation studies on a large number of soil samples indicates that Ni sorption capacity is related to iron content, but differences in iron content cannot explain individual differences between soils. In an attempt to specifically identify the fraction responsible for Ni sorption, soils having Ni sorption capacities of from 0 to 63 μg g⁻¹ and from 3 to 57 gF g⁻³ were selected for detailed study. The six soils selected showed no correlation between Ni sorption and Fe content; while the soil having lowest Fe content also exhibited the lowest Ni sorption, two soils having 57 gF g⁻³ had the second lowest and the second highest Ni sorption capacities. Highest sorption capacity was observed in a soil containing 37 gF g⁻³, but another having similar iron content sorbed only 27 μgNi g⁻¹. Electron microprobe analysis indicated that, despite this discrepancy, sorbed Ni was associated with Fe. Subsequent x-ray evaluation has led us to propose goethite as the specific Fe fraction dominant in Ni sorption by soils. Differences in Ni sorption capacity between individual soils can be explained on the basis of soil goethite content.

R.D. Harter (603) 862-3944

Surface Reactions Involved in the DTPA Extraction of Soil Iron. R.C. HARTWIG* and R.H. LOEPPEERT, Texas A&M Univ. The diethylenetriaminepentaacetic acid (DTPA) extraction solution is routinely used as an index for plant availability of micronutrients such as Fe. The DTPA extraction mechanism may be considered as a two-step process: (1) the complexation of DTPA at the Fe-oxide surface resulting in the weakening of the structural Fe-O-Fe bonds, and (2) the subsequent release of Fe into solution. The amount of Fe extracted is dependent on oxide mineralogy, surface area, surface reactivity, and surface hydration. This study examined the effects that wetting, drying and heating of several different Fe oxides had on DTPA adsorption (step 1), DTPA desorption, and Fe extraction (step 2). Poor correlations between the quantity of adsorbed DTPA and Fe extraction rate among the oxides indicated that the DTPA extraction mechanism is dependent on oxide mineralogy and surface properties. Heat treatments increased Fe extractability from all oxides. The rewetting of heated-samples resulted in extractable Fe intermediate between untreated and heat-treated samples, suggesting the occurrence of permanent heat-induced surface defects.

R.C. Hartwig, (409) 845-3814

Sulfate-Organcic Acid Release in a Forested Ultisol. L. H*, A. EVANS Jr. and A.E. COX, Clemson University. A column study was conducted to examine the influence of low molecular weight diprotic organic acids on sulfate release from a forested Ultisol. Three organic acids were studied: Succinic, malonic, and oxalic each at a concentration of 3.5 x 10⁻³ mol L⁻¹. Analysis of the breakthrough curves for sequential leaching of the soil by these acids indicated the occurrence of two possible sulfate release mechanisms. Soil leaching with succinic acid indicated that ligand exchange mechanism may predominate, while leaching with malonic and oxalic acids indicated that a ligand exchange and Al hydroxide dissolution processes may be occurring simultaneously. Subsequent leaching of the soil with organic acids indicated that the stronger acids were able to displace weaker acids in the order oxalic > malonic > succinic.

Liming He, (803) 656-3532

Interpreting the Temporal Dynamics in the Soil Water Composition with the Bulk Soil Electrical Conductivity measured by TDR. T.J. HEIMOVAARA*, A. FOCKE, W. BOUTEN and J.M. VERSTRATEN, Univ. of Amsterdam. Interpreting the temporal dynamics of the soil water composition from total element analyses of soil water sampled once every two weeks is very difficult. In the time between two samples, concentrations in the soil solution may change because of the water content changes due to precipitation and transpiration. Positive site specific correlations between the measured electrical conductivity of the soil solution and the ion concentrations in the soil solution were found from linear regressions. An automatic Time-Domain Reflectometry system gives a continuous measurement series of the volumetric water content and bulk electrical conductivity of the soil. Calculation of the electrical conductance of the soil solution from the measured bulk soil electrical conductivity makes it possible to use TDR for a more reliable interpretation of the temporal dynamics of the chemical composition of the soil solution between sampling.

T.J. Heimoivaara, ++31 20-5257451

Comparison of Measured Free Ion Activities in Soil Solution to Those Predicted by GROCHEM PC. P.A. HELMKE* and A.K. SALAM, Univ. of Wisconsin-Madison. Concentrations of all dissolved elements in the solution phase of the soil-water system were determined by IC-DEP and the activities of the free hydrated cations Ca⁷⁺, Mg²⁺, Cd²⁺, Cu²⁺, and Zn²⁺ were determined by Donnan membrane equilibrium with graphite furnace atomic absorption spectrophotometry. The soils had various concentrations of trace elements and values of pH due to applications of sewage sludge and lime 14 yr ago. Solution samples were obtained from water saturation extracts. Concentrations of major elements and pH beyond those indigeneus to the samples were obtained by addition of their respective nitrate salts or acid and base during extraction. Activities of Cd²⁺, Cu²⁺, and Zn²⁺ were calculated with GROCHEM PC from the concentrations of total dissolved elements and pH. GROCHEM PC predicts copper ion activities as much as 30 times and cadmium as much as 20 times higher than those measured. The predicted and measured activities of zinc generally agree within a factor of two and are significantly correlated.

P.A. Helmke, (608) 263-4947

Kinetics of Chloride Removal from an Iron-Rich Industrial Condensate. G.J. HENDRICKS*, Y. SALINIGAR, and D.J. SPARKS, Univ. of Delaware. An industrial TiO₂ extraction process results in a filter-cake material (Fe) rich in Fe and containing substantial chlorides. The Fe was physicochemically characterized to determine the suitability for agricultural uses and to assess possible environmental risks. Removal of chlorides from the Fe was also investigated to determine if the rate of CI removal was governed by chemical kinetics or transport-controlled kinetics. Equilibrium batch studies showed that the amount of CI that could be adsorbed on the Fe was small, even though the point of zero charge (pzc) of the Fe was 8.3. A first-order model of CI concentration vs time suggested that CI removal from Fe cakes was a time-dependent process, while stirred-flow studies showed that CI leaching is a function only of the total volume that flows through the columns. These data indicate that results obtained from columns may lead to erroneous conclusions concerning time-dependent processes, since no uniform mixing occurs in the columns.

G.J. Hendricks, (302) 831-2532

Probing Soil Porosity with Nuclear Magnetic Resonance. Z. R. Hinedi*, T.H. Skaggs, Z. J. Kabala, R. W. K. Lee and A. C. Chang, Univ. of California, Riverside. Rate-limited sorption of organic pollutants is affected by the inter- and intraparticle porosity of the sorbent matrix. Probing the pore space under a water saturated regime provides a more realistic description of a soil/aquifer fabric than the porosity measurement (e.g. N₂ desorption) obtained under dry conditions. Nuclear magnetic resonance provided, through the measurement of the relaxation rate of the filler fluid (i.e., water), the true ratios of pore volume to surface area (i.e., hydraulic radii), in the heterogeneous sorbent matrices studied.

Z. R. Hinedi, (714) 787-5613