
Selenite adsorption and sequential desorption was studied in ten California soils using a batch method with saturated gypsum solution as the background electrolyte to simulate the soil solution in the sampling area. The adsorption isotherms, which ranged from 20 to 120 ppb Se in the initial solution, were linear for all soils studied. The desorption isotherms showed distinctive, adsorption-history-dependent hysteresis. The results of two supplementary experiments indicated that the hysteresis was not an artifact of the batch method. A mathematical model developed to describe the adsorption isotherm does not include an analytical solution of two discrete parameter functions: a linear function of surface occupation and a power function of solution concentration. The linear function of surface occupation indicates that selenite desorption is proportional to the surface retention but is independent of adsorption/desorption history and of solution concentration.

R.G. Burau, (916) 752-0194

Surface Precipitation of Hydroxylable Metal Ions on Oxide Surfaces. S.E. FENDORD* and D.L. SPARKS, Univ. of Delaware.

Heavy metal retention on solid surfaces is a primary determinant in affecting the environmental hazard of these elements. Thermodynamic models are necessary to accurately assess the potential binding of metals, and thus their potential mobility. Numerous thermodynamic models have been proposed to explain the metal sorption process. However, these models have been based on macroscopic data and do not give direct evidence for the sorption mechanisms. Increasingly, surface spectroscopic and microscopic techniques have been used to ascertain the binding structure of sorbed ions. In this research, we have used high-resolution transmission electron microscopy (HRTEM) coupled with suitable studies to discern the mechanism of Al(III) and La(III) sorption on MnO2 and TiO2 near and beyond monolayer coverage. Surface precipitation of Al(III) and La(III) was observed on MnO2, but was not apparent on TiO2 in bulk solution. Al(III) formed a surface precipitate at lower concentrations and pH values than La(III). We conclude that surface precipitation can occur prior to bulk solution and is dependent on the type of solid and metal ion. Mechanisms are needed to incorporate such processes since the formation of a surface precipitate encapsulates the oxide and the resulting conglomerated colloid exhibits the properties of the metal hydroxide.

S.E. Fendorf, (302) 451-1595

Distribution of Se and As in Ground Water, Tulare Basin, California. R. FUJI* and A.T. DICKSON, USGS, Sacramento, CA.

Large parts of the Tulare basin are adversely affected by saline shallow ground water with high concentrations of Se and As. Sediment porewater and water samples from two sites were analyzed to evaluate distributions of salinity, Se, and As to depths of 33 m below land surface. Site 1 is in the southern Tulare Lake bed area, which is dominated by a marshland depositional environment; site 2 is near Wheeler Ridge in the Coast Ranges alluvium. Salinity, as measured by specific conductance, ranged from 2,000 to 60,000 μS/cm at site 1 and from 1,000 to 38,000 μS/cm at site 2. Concentrations of Se in porewater, mostly present as Se(VI), ranged from 1 to 265 μg/L at site 1 and from <0.5 to 775 μg/L at site 2 and were correlated with salinity at both sites (r²=0.89). These data and oxygen-18 and deuterium isotope ratios indicate that evaporation was an important process that contributed to the high concentrations of salinity and Se in shallow ground water at both sites. In contrast, as concentrations ranged from 12 to 170 μg/L at site 1 and from 2 to 22 μg/L at site 2 and were not related to salinity or evaporative concentration of shallow ground water. The differences in distribution of As at each site probably are related to differences in depositional environments and redox conditions.

R. Fuji, (916) 978-4648


Our objectives were to determine the influence of pore water velocity on the adsorption and transport of picloram and evaluate the use of dimensionless Damkohler numbers for identifying experimental conditions conducive to nonequilibrium transport. Three sets of transport experiments were performed by displacing a 100 mL Br-Clabeled picloram pulse through disturbed soil columns (5 cm dim; 30 cm length) at pore water velocities of 4.07, 40.82, and 200.07 cm d⁻¹. Results indicated that Br breakthrough curves (BTC’s) were symmetrical with no observable difference among pore water velocities. In contrast, picloram BTC’s shifted to the left on a pore volume basis and demonstrated increased tailing with increasing pore water velocities. The use of a batch Kᵣ in the corresponding dispersion equation adequately described picloram BTC’s at the 4.07 cm d⁻¹ pore water velocity, but overestimated the elution time at faster pore water velocities. The observed BTC’s were consistent with conclusions derived from criteria used to assess LEA applicability.

H. M. Gaber, (408) 994-5077

Factors Affecting Arsenic and Alkalinearsine Evolution From Arsenicals Added to Soil. S. GAO* and R.G. BURAU, Univ. of Calif., Davis.

The effect of soil moisture, temperature, arsenic source, arsenical concentration and energy source on the evolution of total arsines from As-treated soil were investigated. The maximum evolution of total arsines from soil treated with 100 mg K₂As as Na cacodylate (CA) occurred at 350 g Kg⁻¹ moisture content between 0 to 50 days and at 250 g Kg⁻¹ moisture after 50 days. Production of total arsines at 25°C was about 3 times that at 5°C. The temperature coefficient e for the first 10 day incubation was 1.95. Total arsines evolved from different arsenicals were in the order: Na cacodylate (CA) > methane arsonic acid (HMA) > Na arsenite (AsO₃⁻) > Na arsenite (AsO₃²⁻). The amount of evolved arsines increased linearly with As in the range 10 to 100 mg K₂As (R²=0.999). The production also increased linearly with cellulosic additions to soil treated with 10 mg K₂As as CA. It is concluded that different soil conditions greatly affect the evolution of arsines.

S. Gao, (316) 752-1491


The adsorption of equimolar cobalt and EDTA by γ-Al₂O₃ was examined over ranges of pH (5 to 9.5), adsorbent concentration (0.2 to 10 μM), adsorbent concentration (0.1 to 10 g/L), and ionic strength (0.1 to 0.001 M NaClO₄ in the presence of dissolved Al (0.2 to 10 μM) in equilibrium with γ-Al₂O₃. The anionic Co(II)/EDTA and Co(III)/EDTA chelates exhibit ligand-like adsorption behavior as a function of pH; however, under identical conditions, Co(III)/EDTA adsorption was much less than that of Co(II)/EDTA. A comparison was made between adsorption of EDTA for both Co(II)/EDTA and Co(III)/EDTA-only experiments. Al₂O₃ appears to adsorb, although the affinity of surface hydroxyls (OH⁻) is greater for Co(II)/EDTA than for Al-EDTA. Significant variation in Co(II)/EDTA and Al-EDTA adsorption with ionic strength suggests that there is a major electrostatic contribution to adsorption and supports the hypothesis that these chelates form outer-sphere complexes (on-pairs) with OH⁻. Adsorption reactions are proposed and discussed in terms of "bound" and "free" chelate carboxylic groups of the metal-EDTA chelate. This research was supported by the U.S. Department of Energy.


Boron adsorption on the iron oxide, goethite, the aluminum oxide, gibbsite, the clay minerals, kaolinite and montmorillonite, and two arid zone soils was investigated as a function of solution pH (3-11) and ionic strength of the background electrolyte (0.001-1.0 M NaCl). Boron adsorption on the oxides and kaolinite increased from pH 3 to 7, exhibited a peak at pH 7.5 to 8.5, and decreased from pH 8.5 to 11. For boron adsorption on montmorillonite and the soils, the adsorption maximum was located near pH 9. Ionic strength dependence of the adsorption maximum increased in the order: goethite<kaolinite<gibbsite<kaolinite soil<montmorillonite<montmorillonite soil. Boron adsorption decreased with increasing ionic strength below the zero point of charge (ZPC) and...