Comparison of metal sorption in laboratory and field environments

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The challenge in applying the surface complexation concept in the natural environment is to simplify the model, such that predicted sorption is still calculated with mass laws that are coupled with aqueous speciation, while lumping parameters that are difficult to characterize in the environment in with other parameters. In order to be applied by solute transport modelers, the complexity of the surface complexation model (SCM) needs to be balanced with the goal of using the simplest model possible that is consistent with observed data. This can be achieved with the semi-empirical, site-binding generalized composite (GC) modeling approach. This approach is a compromise between the simple constant-K_d approach and more complex SCM that are difficult to apply. The GC modeling approach is preferable to empirical approaches because the important linkage between surface and aqueous species (and associated thermodynamic data) can be retained in geochemical or reactive transport models.

A study was conducted of uranium(VI) sorption on natural and U-contaminated sediments in the laboratory and in the field environment. The location of the study and the source of sediments was the uranium mill tailings site near Naturita, Colorado, USA, which has a well characterized uranium(VI) contaminant plume in a shallow alluvial aquifer. It was shown in laboratory batch and column experiments with uncontaminated Naturita sediments that the sorption and retardation of U(VI) transport by the Naturita sediments was strongly influenced by the dissolved bicarbonate concentration (alkalinity). An SCM was developed to describe U(VI) sorption measured in the laboratory on the uncontaminated sediments. For the range of chemical conditions observed in the Naturita aquifer, variable bicarbonate was more important than either variable pH or U(VI) concentration in influencing U(VI) mobility.

Methods were also investigated to measure U(VI) sorption on the sediments under field conditions. Such methods are needed for: 1) validation of SCM model parameters for transport simulations within performance assessment (PA) models, and 2) estimation of initial conditions for sorbed metals at contaminated sites for predictive transport simulations. It was shown that isotopic exchange and desorption extraction methods can be an important part of a field characterization and modeling program. SCM-predicted U(VI) sorption agreed to within a factor of 2 to 3 with estimates of U(VI) sorbed on contaminated sediments from the Naturita aquifer. Another approach used to validate the SCM was the determination of *in-situ* K_d values by suspending uncontaminated sediment in wells with U-contaminated groundwater for periods of time ranging from 3 to15 months. There was close agreement between the U(VI) sorbed on these sediments and that predicted with the SCM.

Strontium Isotopic Systematics of Meso proterozoic Lower Vindhyan Shales: Implication for Provenance

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The Mesoproterozoic Lower Vindhyan succession is well developed at western margin of north Indian shield. It contains thick succession of shales and sandstone with limestone at different stratigraphic levels. Strontium isotopic ratio of five shale units, namely Khardeola Shale, Palri Shale, Binota Shale, Bari Shale and Suket Shale occurring in chronological order, have been analyzed to understand the evolution of source rock during pre-depositional period. The strontium isotopic ratios have been utilized to investigate the provenance characteristics, weathering conditions, paleoclimate and possible tectonic setting of depositional basin. The high strontium isotopic $^{87}Sr/^{86}Sr$ ratios (2.388651) suggest that the source rocks were granitite and mafic enclaves of Banded Gneissic complex occurring west of Vindhyan basin of southwestern Rajasthan. The large variation in strontium isotopic ratio also suggests that the source area underwent severe weathering in warm and humid tropical climate that prevailed throughout the sedimentation of Lower Vindhyan succession.