



EXPERIMENTAL AND MODELING STUDIES OF COPRECIPITATION AS AN ATTENUATION MECHANISM FOR RADIONUCLIDES, METALS, AND METALLOID MOBILITY

C. Zhu (1), S. Martin (2), R. Ford (3), N. Nuhfer(4)

(1) University of Pittsburgh (czhu@pitt.edu), (2) Old Dominion University, (3) U.S. Environmental Protection Agency (ford.robert@epa.gov), (4) Carnegie Mellon University (tn06@andrew.cmu.edu)

Coprecipitation (CPT) is typically defined as the simultaneous removal of both the tracer and carrier constituents from an aqueous solution without regard to the specific mechanisms involved. CPT is potentially important to many environmental issues closely related to water resources, including acid mine drainage, radionuclide migration in fouled waste repositories, metal contaminant transport at industrial and defense sites, metal concentrations in aquatic systems, and wastewater treatment technology. The coprecipitation process may vary in each case and solid phase partitioning may be driven by surface adsorption, ion-exchange, surface precipitation, occlusion, and solid solution formation. Solid solution formation is a result of structural incorporation of the tracer into carrier structural sites resulting in a minor constituent in solid solution with the host phase possessing a solubility greatly reduced from that of its pure solid. Coprecipitation of Pb, Zn, Al, and As with ferric iron oxides has been or is being conducted in the laboratory. The coprecipitates have been examined by High Resolution Analytical Transmission Electron Microscopy, while the bulk solution results are modeled as surface complexation, bulk precipitation, or amorphous solid solutions. Coprecipitation with iron oxides may be relevant to a fouled repository where steel containers corrode and transform into iron oxides. Additionally, the coprecipitation of radium with barite, which has relevance to both naturally occurring radioactive materials (NORM) associated with oil and gas production and nuclear waste repositories, is assessed and modeled. A general correlation is found among excess thermodynamic

properties of binary solutions in the barite isostructural family, the volume mismatch between the two end-members, and the differences in the non-solvation contribution to the Gibbs free energy of formation of the substituting aqueous metal ions.