PAUL SCHERRER INSTITUT

Memorandum

Datum: 8. Mai 2015
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Einladung zu einem ausserordentlichen LES Palaver

Ich lade Sie herzlich ein.

Referent: Dr. Jeffrey G. Catalano
Washington University, St. Louis
Department of Earth and Planetary Sciences

Thema: Molecular Interactions of Uranium and Phosphate in Subsurface Sediments

Zeit: Dienstag, 26. Mai 2015, 10:00 Uhr

Ort: Sitzungszimmer OHSA/E13

Abstract

Past activities associated with nuclear energy and weapons development has resulted in widespread contamination of shallow groundwater systems with uranium. Many such systems are naturally oxic, posing difficulties for remediation via uranium bioreduction because of the potential for reoxidation. Phosphate addition is under consideration in the United States as a non-reductive approach to remediate uranium in groundwater. However, the geochemical factors that determine the dominant immobilization mechanisms upon phosphate addition are insufficiently understood to design efficient remediation strategies or accurately predict uranium transport. We have investigated the molecular interaction of uranium and phosphate in subsurface sediments and the resulting impact on uranium immobilization. Laboratory analogue studies have identified a series or cooperative and competitive effects in systems containing iron oxide and clay mineral adsorbents. In these systems, a nuclear barrier exists that limits the precipitation of uranium phosphate solids. Phosphate addition may also form calcium phosphate minerals; these solids take up uranium, but the mechanism varies with formation condition. Batch and column studies show that phosphate addition to sediments from two uranium-contaminated field sites from the western United States enhances uranium retention, primarily through enhanced sorption to sediment minerals and neoformed calcium phosphates. Uranium phosphate minerals form under limited conditions but rapidly dissolve following termination of phosphate addition. Under no circumstances did phosphate addition lower aqueous uranium concentrations below water quality standards. Solution complexation, nucleation barriers, competitive adsorption, and limited uptake of uranium by calcium phosphates all inhibit the effectiveness of phosphate addition as a remediation method under field-relevant conditions.

Freundliche Grüsse

R. Dähn