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Effect of oxidation state and ionic strength on sorption of actinides (Th, U, Np, Am) to geologic media

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The Waste Isolation Pilot Plant (WIPP) near Carlsbad, NM has been accepting transuranic (TRU) waste since 1999 and is the only operating nuclear waste repository in the US. The WIPP is located in a salt deposit approximately 650 m below the surface overlain by multiple layers of dolomite and other geologic material. Performance assessment (PA) modeling for a 10,000 year period is required to recertify the operating license with the US EPA every five years. Human intrusion caused by drilling operations is the main pathway of concern for environmental release of radioactive material. We are evaluating the degree of conservatism in the estimated sorption partition coefficients (K_ds) used in the PA model based on a complementary batch and column method (Dittrich and Reimus, 2016, 2015, 2014, 2013; Dittrich et al., 2015). The main focus of this work is to investigate the role of ionic strength, solution chemistry, and oxidation state (III-VI) in actinide sorption to dolomite rock. Based on redox conditions and solution chemistry expected at the WIPP, possible actinide species include Pu(III), Pu(IV), U(IV), U(VI), Np(IV), Np(V), Am(III), and Th(IV). We will present (1) a conceptual overview of K_d use in the PA model, (2) background and evolution of the K_d ranges used, and (3) results from batch and column experiments and model predictions for K_ds with WIPP geologic media. We will also briefly discuss the challenges of upscaling from lab experiments to field scale predictions, the presence of ligands (e.g., acetate, citrate, EDTA), the role of colloids and microbes, and the effect of engineered barrier materials (e.g., MgO) on sorption and transport conditions.

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