Colloid-Facilitated Plutonium Transport in Saturated Alluvium

ABDEL-FATTAH, A. I., Reimus P. W., Ware S. D., and Haga M. J.
Los Alamos National Laboratory, Mail Stop J514, Los Alamos, NM 87545

Abstract

Natural groundwater colloids have been recognized as possible agents for enhancing the subsurface transport of strongly-sorbing radionuclides. To evaluate this mechanism, packed-bed column experiments were conducted comparing the simultaneous transport of dissolved plutonium (Pu), Pu sorbed onto natural colloids, 190-nm and 500-nm diameter fluorescent CML microspheres, and tritiated water in saturated alluvium. Experiments were conducted in two columns having slightly different porosities at two flow rates, resulting in average linear velocities (v_z) of 0.6 to 3.65 cm/hr in one column and 0.57 to 2.85 cm/hr in the other. In all experiments, Pu associated with natural colloids transported through alluvium essentially *unretarded*, while dissolved Pu was entirely retained. These results were consistent with the strong sorption of Pu to alluvium and the negligible desorption from natural colloids, observed in separate batch experiments, over time scales exceeding those of the column experiments. Breakthroughs of natural colloids preceded tritiated water in all experiments, indicating a slightly smaller effective pore volume for the colloids. The enhancement of colloids' transport over tritiated water decreased with v_z, implying ~ 40% enhancement at v_z = 0. The 500-nm CML microspheres were significantly attenuated in the column experiments compared to the 190-nm microspheres, which exhibited slightly more attenuation than natural colloids.