Colloid and Colloid-Facilitated Contaminant Transport Experiments and Models to Support Assessments of Radionuclide Migration at Yucca Mountain and the Nevada Test Site

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In recent years, numerous laboratory and field experiments have been conducted to assess and parameterize colloid and colloid-facilitated radionuclide transport for the Yucca Mountain Project and the Nevada Test Site (NTS) Environmental Restoration Project. Radionuclide contamination of ground water currently exists within or near underground nuclear test cavities at the NTS, and the proposed Yucca Mountain high-level nuclear waste repository represents a potential future source of radionuclide contamination of ground water at the NTS. Furthermore, recent field observations have indicated that small amounts of Plutonium, which normally adsorbs very strongly to mineral surfaces in aquifers, can transport quite rapidly and over significant distances in ground water when associated with inorganic colloids (Kersting et al., 1999).

Groundwater samples from all over the Nevada Test Site have been analyzed for colloid concentrations and size distributions, and it is clear that there are significant mass loadings of colloids in the ground water at some locations. These colloids represent mobile surface area for potentially transporting strongly-adsorbed radionuclides. Field transport experiments have involved the use of fluorescent-dyed carboxylate-modified latex (CML) microspheres in the 250- to 650-nm diameter size range as surrogates for natural colloids in forced-gradient tracer tests. These experiments have indicated that effective colloid filtration coefficients appear to decrease as time and length scales increase. They suggest that a small fraction of colloids may be able to transport significant distances in groundwater systems. Laboratory experiments have been conducted to determine radionuclide sorption and desorption parameters onto inorganic colloids present in the groundwater systems and also to determine transport parameters for inorganic colloids in both fractured and porous media present at the Nevada Test Site. More recent laboratory experiments have involved injecting inorganic colloids with radionuclides adsorbed onto them into fractured or porous media to determine the ability of the colloids to facilitate the transport of the radionuclides through the media. Recent experiments have also involved comparing the transport behavior of CML microspheres and inorganic colloids so that more defensible inferences about inorganic colloid transport can be made from CML microsphere transport observations in field tracer tests.

All of this experimental information has been collectively used to develop a modeling framework for evaluating sensitivities of predicted colloid-facilitated radionuclide transport to various colloid-transport and radionuclide-colloid-interaction parameters. This modeling framework is helping to focus future experimental efforts on processes and parameters that have the greatest potential impact on colloid-facilitated radionuclide transport at the Nevada Test Site.

Reference:

Kersting, A.B., D.W. Erfund, D.L. Finnegan, D.J. Rokop, D.K. Smith, and J.L. Thompson, Migration of plutonium in groundwater at the Nevada Test Site. *Nature* 397:56 (1999).