No.603

Environmental Behavior of Plutonium: Challenges for clean-up and safe long-term storage

Humans have produced approximately 2,700 metric tons of Pu worldwide with ~1% (or 27,000 kg) that has been released into the environment where subsequently low-level transport in the surface and subsurface has occurred on the scale of kilometers. Because of its long half-life (^{239}Pu $t_{1/2}$ ~24,000 yrs) and high toxicity, Pu will persist in the environment for a long time and represents a significant environmental and public health risk. Understanding Pu behavior in the environment is critical for managing clean-up and planning for the safe, long-term isolation of nuclear waste from the biosphere. Although the lack of a robust model has hampered efforts to predict long-term enviromental behavior of Pu; advances in our understanding have recently resulted in an emerging conceptual model.

Understanding the interplay (the bio-geo-chemistry) between Pu and the repository environment is necessary to predict the conditions for which Pu will either migrate or remain immobile. A mechanistic understanding of the surface structure and reactivity of coupled Pu–mineral, Pu–organic ligand, and Pu–microbe, interfacial processes is needed to advance our understanding. To elucidate the mechanisms controlling Pu transport, we have investigated Pu sorption and desorption rates from mineral, organic and microbe surfaces over a range of concentrations found in the environment. Field and laboratory experiments show that the both inorganic and organic matter play an important role in stabilizing Pu in solution and on mineral surfaces. I will present an overview of our present understanding of the behaviour of Pu in an effort to develop a conceptual model of Pu subsurface behavior.

Annie Kersting is a environmental radiochemist whose current research focuses on understanding the biogeochemical processes that control actinide transport in the environment. In particular, she is interested in identifying the processes that control plutonium interactions on the molecular scale with inorganic, organic, microbial surfaces in the presence of water with the goal of reliably predicting and controlling the cycling and mobility of plutonium in the environment.

Dr Kersting is currently the director of University Relations and Science Education at LLNL. She oversees a broad range of educational science and technology programs and initiatives that advance the mission and vision of the Laboratory. She helps to build strategic partnerships

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