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The LLNL BioGeoChemistry of Actinides SFA

Mavrik Zavarin[1*], Annie B. Kersting[1], Brian Powell[2], Yongqin Jiao[1], Enrica Balboni[1], Stefan Hellebrandt[1], Chao Pan[1], Nancy Merino[1], Gauthier Deblonde[1], Corwin Booth[3], Kurt Smith[3], William Casey[4], Gareth Law[5], Horst Geckeis[6], Francesca Quinto[6], Daniel Kaplan[7], Pihong Zhao[1], Ruth Kips[1], Harris Mason[1], Robert Maxwell[1], Keith Morrison[1], Tashi Parsons-Davis[1], Scott Tumey[1], Zurong Dai[1], Carolyn Pearce[8], and Vicky Freedman[8]

[1] Lawrence Livermore National Laboratory, Livermore, CA
[2] Clemson University, Clemson, SC
[3] Lawrence Berkeley National Laboratory, Berkeley, CA
[4] University of California, Davis, CA
[5] University of Manchester, UK
[6] Karlsruhe Institute of Technology, Germany
[7] Savannah River National Laboratory, Aiken, SC
[8] Pacific Northwest National Laboratory, Hanford, WA

Contact: zavarin1@llnl.gov

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The focus of the BioGeoChemistry of Actinides SFA is to identify and quantify the biogeochemical processes and the underlying mechanisms that control actinide mobility in an effort to reliably predict and control the cycling and migration of actinides in the environment. The research approach includes (1) Field Studies that capture actinide behavior on the timescale of decades and (2) Fundamental Laboratory Studies that isolate specific biogeochemical processes observed in the field. Located at Lawrence Livermore National Laboratory, this SFA harnesses the capabilities and staff expertise unique to this national laboratory to advance our understanding of actinide behavior in the environment and serve as an international resource for environmental radiochemistry research. In this SFA, we have selected five field research sites. Four sites were selected because they represent a diverse range of hydrologic and biogeochemical conditions (Ravenglass Estuary, UK; Pond B, Savannah River Site; Z-9 trench, Hanford reservation; E-tunnel ponds, Nevada National Security Site). The sites range from oxic to anoxic, vadose zone to saturated zone, pH 5 to 8, low to extremely high organic matter, low to high actinide concentrations, low to high ionic strength, and all have a well documented long- term contamination history (~60 years). The fifth site (the Radflex facility) is a unique simulated contamination site that is formulated to test the evolution of specific actinide source material over an extended timeframe. We are focusing on three broad categories of actinide stabilization which include co-precipitation of Pu in common minerals, the role of redox cycling on actinide stabilization on mineral surfaces, and the role of microorganisms and their exudates in actinide mobilization and immobilization. The combination of field and laboratory experiments are exploring actinide migration behavior at environmentally relevant timescales (years to decades), identifying the specific processes controlling the long-term behavior of actinides, and establishing conceptual models of actinide evolution under hydrologically diverse conditions.