Nuclear Science and Security Consortium

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Monthly Webinar Series

Optimization and Application of a Sequential Extraction Procedure for Analysis of Multiple Actinide Elements

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View the live broadcast

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Abstract

A better understanding of radionuclide contaminant mobility in the environment can be achieved through investigation of the association of contaminants with specific soil host phases. Sequential extraction techniques, which employ the selective dissolution of soil phases with increasingly aggressive chemical treatment, are commonly used to investigate these associations. A sequential extraction procedure by Outola et al (2009) is used as the basis for this research. Five operationally defined soil fractions are leached during the procedure: exchangeable, carbonate, Fe/Mn oxides, organic, and residual. Analysis of resulting leachates containing multiple actinide elements requires sample separation and purification prior to alpha spectroscopy and can be very time consuming and labor intensive. An extraction chromatography based procedure by Maxwell et al (2006) is therefore investigated as an alternative separation method due to the quick and efficient separation of actinide elements that can be achieved. Plutonium, uranium, americium, and thorium samples are prepared for alpha spectroscopy using cerium fluoride microprecipitation. Stable elements are analyzed by ICP-MS/AES to assess leaching throughout the procedure and to model behavior of other potential contaminants including fission products and heavy metals. National Institute of Standards and Technology (NIST) standard reference materials of lake and ocean sediment are used to optimize the sequential extraction procedure. International Atomic Energy Agency (IAEA) certified reference materials moss soil and Fangataufa sediment are then leached in order to gain a better understanding of how the sequential extraction procedure may vary across a broad range of soil profiles. Application of microwave digestion and fusion methods to Fangataufa sediment tests the addition of a sixth fraction, complete dissolution. A better understanding of leaching behavior of actinides and stable elements across a broad range of soil profiles is obtained through this research. Information on bioavailability, mobility, origin and mode of occurrence can be furnished from this method, which is important for such applications as environmental remediation, fate and transport of radionuclide contaminants in the environment, and nuclear forensics. Results will be presented along with conclusions and suggestions for future work.

About Sherry Faye

Sherry holds an A.A. in humanities from Onondaga Community College, a B.S. in physics with a minor in forensic science from the State University of New York, College at Oswego, and an M.S. in health physics from the University of Nevada, Las Vegas. She is currently working on completing her Ph.D. in radiochemistry at the University of Nevada, Las Vegas. Her dissertation research experience involves investigation of a sequential extraction procedure for maximum dissolution of multiple actinide elements across a broad range of soil profiles. She is interested in continuing research in radiochemistry as it relates to nuclear security applications. Sherry has been a Nuclear Science and Security Consortium Fellow since 2011. She was awarded a Roy G. Post Scholarship in 2011 and a Global Nuclear Energy Partnership Fellowship in 2008-09.