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Title: Long Term Risk from Actinides in the Environment: Modes of Mobility

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Los Alamos
NATIONAL LABORATORY

Technology Development Report

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Long-term risk from actinides in the environment: modes of mobility

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Number of graduate students actively involved in the project: 2

Research Objective:

The overall goal of the study is to quantify the mobility of soil actinides from all three modes of mobility: wind erosion, water erosion, and vertical migration. We are conducting a set of studies at DOE facilities where actinide kinetics are of concern, particularly Rocky Flats, Hanford, and WIPP. Wind erosion is being quantified using spatially-distributed aerosol measurements, including finely time-resolved measurements, and will be correlated with meteorological and ground cover conditions. Water erosion is being quantified using rainfall simulator experiments in the field to measure vertical and horizontal changes in the tracer distribution. Vertical migration is being studied using tracers in soil columns to quantify the effects of various biological and weathering processes. The results are being integrated using a modeling approach, building on existing code and modifying the predictions based on experimental results.

Research Progress and Implications:
This report summarizes work after 2 and 1/2 years of a 3 year project. The mobility of actinides in surface soils is the major driver of risks to human health and the environment for DOE facilities in arid/semiarid environments. Understanding this mobility is an EMSP priority in the category of Health/Ecology/Risk for addressing numerous and extensively contaminated DOE sites. Uncertainty in actinide mobility is the fundamental driver for remediation decisions, litigation issues, and long-term stewardship strategies. Indeed, actinide mobility is already a high-visibility issue at Rocky Flats and Hanford, upon which current litigation and clean-up decisions are pending, and public groups are increasingly concerned about changes resulting from environmental disturbances such as fire that increase mobility. Similar issues exist at other DOE facilities in arid/semiarid environments (i.e., Nevada, Idaho, Los Alamos, Pantex, and WIPP). Uncertainty in actinide mobility hinges on the relative roles among three modes of transport: (1) wind erosion, (2) water erosion, and (3) vertical migration, each of which depends on several interrelated environmental factors. The objective of our study to date has been to quantify the mobility of soil actinides from all three modes using a combination of field studies, laboratory studies, and modeling for several sites. We have developed a data set that quantifies actinide mobility by the three processes and have integrated our results by developing initial assessment tools that will provide the basis for incorporating a strong technical information into the cleanup decision-making process. Our goal is to provide DOE with data and tools that improve risk assessments, cut cleanup costs, and facilitate technology transfer. Our accomplishments to date include development of advanced measurement techniques for assessing the three pathways; new data on each pathway based on site-specific field and laboratory measurements at three major DOE facilities; and multi-pathway, multi-site assessments of mobility based on existing long-term transport models. Our measurement and assessment results point the way to future payoffs for DOE. First, estimates from equilibrium-type models indicate that the relative importance of actinide transport by wind erosion, water erosion, and vertical migration differ among and between sites, that these differences can be more than an order of magnitude within a site, and more than an order of magnitude across sites. These results can be used to prioritize efforts to improve risk assessments and remediation and are some of the first multi-pathway, multi-site estimates for DOE facilities. Second, field studies demonstrate that disturbances that reduce ground cover, such as fire or heavy grazing, can increase wind and water erosion by more than two orders of magnitude. These results demonstrate the need to factor in disturbance events and recovery rates into

long-term assessment of actinide mobility. Third, all three pathways are driven by low frequency, extreme climatic and disturbance events that greatly increase transport rates compared to long term averages. These results highlight the need to account for extremes in climate and disturbance that occur on a finer time-scale but may contribute most to long-term risks. Improved risk assessment for addressing remediation, litigation, and long-term stewardship will require a more mechanistic understanding and predictive capability for these low frequency, high impact events.

Planned Activities:
In the next 6 months, we will collect data from Hanford, complete data and modeling analyses, and report on results of field and lab measurements and model assessments. In addition, we will present a talk and a poster at the EMSP meeting in April and a symposium at the Health Physics Society in June in Denver. We will submit an EMSP renewal proposal to extend this work to account for low frequency, high impact events that drive contaminant transport.

Information Access:
Many of the results will be presented at a Symposium at Health Physics this summer, with abstracts to be published in a supplement to Health Physics. Several manuscripts are in progress