DOE Environmental Management International Projects Highlights

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RESEARCH OBJECTIVES

Berkeley Lab provides technical assistance to the U.S. Department of Energy (DOE) Environmental Management (EM) Office in conducting projects with Russia, Ukraine, and Argentina. The overall objective of these EM international projects is to use foreign sites as analogs for DOE contaminated sites, to:

- Improve the capability of DOE's conceptual and numerical models for predicting radionuclide transport through unsaturated and saturated subsurface media.
- Predict the future environmental and human impact of radioactive contaminant releases.
- Assist DOE sites in designing effective remediation technologies and long-term stewardship programs.

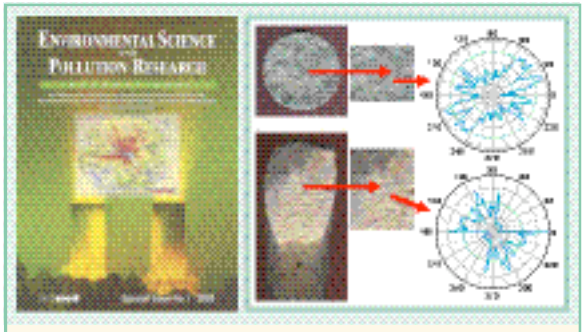

Figure 1. *Environmental Science and Pollution Research Journal* cover page (left), and photographs of basalt core and RIMAPS results (right)

APPROACH AND ACCOMPLISHMENTS

In 2004–2005, Berkeley Lab assisted DOE-EM in designing site characterization, radionuclide transport modeling, and selecting soil and groundwater remediation technologies at the Russian Research Center "Kurchatov Institute" (RRC KI). Information about the radionuclides leaking from individual waste disposal facilities, and the field observations of radionuclide distribution in groundwater at the RRC KI site, can be used to validate the source-term assessment approaches being used at nuclear waste disposal sites in the U.S.

The results from investigations conducted within the Chernobyl Exclusion Zone, established after the Chernobyl Nuclear Power Plant Accident of 1986, suggest several important potential areas of collaboration between DOE and the International Radioecology Laboratory (Slavutych, Ukraine). These collaborative possibilities include the development and testing of models for radionuclide migration through the chain of "fallout-soils-plants-animals-humans"; radionuclide transport in soils and groundwater; bioremediation, natural attenuation, and deactivation of radioactive contaminants; colloidal transport; nondestructive determination of Pu, Am, and Sr in hot particles, water, and soil samples (using alpha-, beta-, and gamma spectrometers as well as a fluid scintillation spectrometer); and resuspension of radionuclides as a result of wind and soil erosion.

The projects with Argentina consisted of two components: (1) numerical modeling and characterization of groundwater flow and contaminant transport at the Ezeiza Atomic Center, and recommendations for source containment and groundwater remediation; and (2) investigations of the physics of liquid flow and transport through partially saturated fractures. Within the scope of the second task, Argentine scientists developed a new technique, rotated imaging with a maximum average power spectrum (RIMAPS). This technique is used for the digital characterization of a fracture-surface topography, which is then applied to assess the main flow paths along the fracture surface. The RIMAPS technique was tested at Comisíon Nacional de Energía Atómica using (a) digital images of the fracture pattern and flow paths from fracture model flow experiments conducted at Berkeley Lab and (b) a fractured basalt core collected at the Box Canyon site in Idaho (Figure 1). The application of this technique will allow researchers to predict the water flow parameters from the analysis of fracture surfaces.

SIGNIFICANCE OF FINDINGS

It was determined that the international sites chosen could be used as analogs for some DOE contaminated sites. DOE would likely benefit from access to long-term and detailed monitoring of contaminant transport in the variety of contaminant, climatic, and geological settings provided by these analogous sites. These projects will allow DOE researchers, engineers, and managers to use international scientific resources to test and build confidence in DOE's fate and contaminant transport models and remediation technologies, which will allow DOE to reduce costs, improve remedy and mitigation reliability, and increase the effectiveness of remediation technologies during long-term stewardship of DOE sites.

RELEVANT PUBLICATION

Fuentes, N.O., and B.A. Faybishenko, RIMAPS and variogram characterization of water flow paths on a fractured surface. In: Proceedings of the Second International Symposium on Dynamics of Fluids in Fractured Rock, pp. 120–123, Berkeley, CA, 2004.

ACKNOWLEDGMENTS

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