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Imaging Radionuclide Transport in Porous Media

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This project is a part of Department of Energy, Experimental Program to Stimulate Competitive Research (EPSCoR) Implementation Grant “*Radionuclide Waste Disposal: Development of Multi-scale Experimental and Modeling Capabilities*”. It includes a combination of lab and field experiments over scales ranging from micrometers to decimeters. A variety of imaging modalities are utilized to image flow and transport processes through pore, column, and lysimeter scales.

1D scans of gamma-ray emitting contaminants have been conducted on lysimeters from the RadFLEX facility at the Savannah River Nationals Laboratory (SRNL). Following weathering of radionuclide contained within a cementitious wastefrom or incorporated into soil for three to four years, the spatial distribution of the radionuclide was quantified with 2.5 mm resolution. These scans showed downward mobility of cobalt-60 and barium-133 when the radionuclides were incorporated directly into the SRNL soil. When radionuclides were incorporated into the cementitious wastefrom positioned in the SRNL soil, cesium-137 exhibited both upward and downward dispersion while the other radionuclides showed no movement. Europium-152 was the only radionuclide of those studied that showed no movement from the original placement within the lysimeter.

Preclinical x-ray computed tomography (CT) technique was used to image macropores and preferential flow paths in the lab columns. Single photon emission computed tomography (SPECT) method, in combination with CT, allowed us to map 3D in-situ contaminant concentration distribution and relate anomalies in transport with the structural features in the porous media. These both methods were used to image the movement, absorption and retention of radionuclides in artificial (such as silica gel, glass beads, filter papers) and natural (SRS soil) materials.