

AGE030-03

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Contaminant transport in unsaturated fractured rock: Interacting imbibition, diffusion, and sorption processes

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In low-permeability unsaturated fractured rock, water flows predominantly through the interconnected fracture network, with some water imbibing into the neighboring matrix rock. Imbibition (driven by capillary pressure gradient) advectively transports contaminant from fracture into matrix. Diffusion (driven by concentration gradient) can diffusively transport contaminant into the matrix. Once in the matrix, sorbing contaminant can sorb onto matrix rock. All these interacting processes (imbibition, sorption, and diffusion) tend to retard breakthrough of a contaminant pulse released to the fracture network.

This presentation will discuss how these important processes and factors (water saturation, sample size, and pore connectivity) affect contaminant transport in unsaturated fractured rock. Innovative techniques [e.g., the unsaturated transport-sorption method, laser ablation coupled with inductively coupled plasma-mass spectrometry (LA-ICP-MS) for micro-scale solid sampling] have been developed to understand and quantify these interacting unsaturated transport processes.

Keywords: contaminant, unsaturated, rock, imbibition, diffusion, sorption