Geophysical Research Abstracts,
Vol. 11, EGU2009-12625, 2009
EGU General Assembly 2009

A new experimental approach for studying tracer diffusion through partially-saturated Callovo-Oxfordian argillite

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It is expected that unsaturated conditions could prevail for about a hundred thousand years in the very first meters of the argillaceous rocks hosting a high-level radioactive waste repository. Such phenomenon would originate at first from the gallery ventilation during the operational phase (for about the first hundred years) and then from hydrogen production linked to the canister corrosion. One key point that has to be estimated concerns the impact of such desaturation on the migration velocity of radionuclides through the clayey rock.

This paper presents an original approach allowing us to make tracers diffuse through partially-saturated Callovo-Oxfordian argillite samples (saturation degree ranging from 80% to 100%). The suctions are generated by the process of osmosis, whereby samples are separated from solutions highly-concentrated in polyethylene glycol (PEG) by semi-permeable membranes which are permeable to all but PEG.

First of all, we determined the PEG concentrations necessary to obtain the right suction values and in the meantime, the duration of the hydrous treatment before reaching the osmotic equilibrium in the rock samples. Finally, we compared results obtained from through-diffusion experiments carried out on rock samples displaying various saturation degrees (suction varying from 0 to 9 MPa).