STUDY OF THE UP-SCALING EFFECT BY MEANS OF THE RADIAL DIFFUSION METHOD APPLIED TO OPALINUS CLAY SAMPLES

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Consolidated argillaceous rocks have received increasing interest as potential host rocks for high level radioactive waste in virtue of their very low permeability and high retention capacity for radionuclides. Previous studies of the Opalinus Clay Mesozoic formation carried out in the Underground Research Laboratory of Mont Terri, in Switzerland, indicate that diffusion is the main transport process in such rocks. Diffusion parameters were obtained from either lab through-diffusion experiments with small sample (thickness ~1cm) or *in situ* diffusion experiments, carried out in a packed-off interval from which tracers can migrate through up to 10 cm of rocks.

This paper presents an improved radial diffusion experiment [1] that mimics the principle of *in situ* experiments on a core sample with a size intermediate between those used in through- and *in situ*-diffusion experiments. The objectives are (i) to estimate the up-scaling effect and (ii) *in fine* to develop a device with an implement easier than that of the *in situ* experiment and also allowing the experimental parameters to be better controlled.

In this test, deuterium- and oxygen-18-depleted water, bromide, sulphate and caesium were injected as pulses in a central reservoir drilled in a core sample from Mont Terri. The evolution of these tracers was monitored by means of samplers included into a circulation circuit for a period of 200 days. Subsequently, the core sample was dismantled and analysed for tracer profiles. A hydraulic test (pulse-test type) was also performed.

The obtained diffusion data for all tracers are consistent with those obtained from through-diffusion experiments [2]. The diffusivity and diffusion porosity of Br^- and SO_4^{2-} were found to be lower than those of deuterium and oxygen-18, showing the anion exclusion effects. Cs^+ data led to compute an effective diffusion coefficient higher than those computed from water isotope data, as already shown both at lab and in the field. Finally, hydraulic test led to an estimate of hydraulic conductivity in good agreement with that obtained *in situ*.

[1] Savoye et al., a) J. Contam. Hydrol, 86, 87-104, 2006 b) Radiochim. Acta, 94, 699-704 (2006).
[2] Van Loon et al., a) Env. Sci. Tech., 38, 5721-5728 (2004), b) Radiochim. Acta, 92, 757-764 (2004).