DIFFUSION AND RETENTION EXPERIMENT AT THE MONT TERRI UNDERGROUND ROCK LABORATORY IN ST. URSANNE

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Because of their favourable hydraulic and retention properties that limit the migration of radionuclides, indurated clays are being considered as potential host rocks for radioactive waste disposal. Migration of radionuclides by diffusion and retention is thereby one of the main concerns for safety assessment and therefore carefully investigated at different scales. The transfer from dispersed sorption batch and diffusion data from lab experiments to field scale is however not always straightforward. Thus, combined sorption and diffusion experiments at both lab and field scale are instrumental for a critical verification of the applicability of such sorption and diffusion data.

The present migration field experiment "DR" (Diffusion and Retention experiment) at the Mont Terri Rock Laboratory (Switzerland) is the continuation of a series of successful diffusion experiments [1-4]. The design is based on these previous diffusion experiments [2, 3] and has been extended to two diffusion chambers in a single borehole drilled perpendicular to the bedding plane. The radionuclides were injected as a pulse in both upper and lower loops where artificial porewater is circulating. The injected tracers were tritium, iodide, bromide, sodium-22, strontium-85, caesium (stable) for the lower diffusion chamber and deuterium caesium-137, barium-133, cobalt-60, europium-152, selenium (stable) and selenium-75 for the lower diffusion chamber. Their decrease in the circulation fluid – as they diffuse into the clay – is continuously monitored by online γ-detection and regular sampling. The goals are fourfold (i) obtain diffusion and retention data for moderately to strongly sorbing tracers and to verify the corresponding data obtained on small-scale lab samples, (ii) improve diffusion data for the rock anisotropy, (iii) quantify effects of the borehole-disturbed zone for non-reactive tracers and (iv) improve data for long term diffusion. The overcoring of the two test intervals after a period of 3.5 years will reveal interesting insights into the 3D distribution of the radionuclides throughout the rock profile and rock heterogeneities using state-of-the-art spectroscopic and "conventional" techniques.

An extensive modelling exercise has accompanied the DR experiment in which four distinct reactive transport models are applied to model tracer evolution. Parts of this modelling exercise are presented in an accompanying paper by Gimmi *et al*. Preliminary results can be summarized as:

- The evolution of the tracer data from sampling and on-line measurements agrees fairly well with modelling predictions.
- Uncertainties are large for anion data because of their very slow decrease, large analytical uncertainty and perhaps also poor initial mixing.
- The teflon filter between the injection loop and the rock strongly influences the behaviour of strongly sorbing tracers. In order to obtain reliable sorption data for these tracers, highly resolved data from the rock profiles are required.

- The water chemistry in the upper loop has been significantly affected by microbially-mediated sulphate reduction. This is explained by leaching of glycerol which is a component of the pH electrode used. The lower loop, where no such component exists, does not show any signs of sulphate reduction.
- Modelling partly suggest the possible existence of a disturbed zone around the borehole.

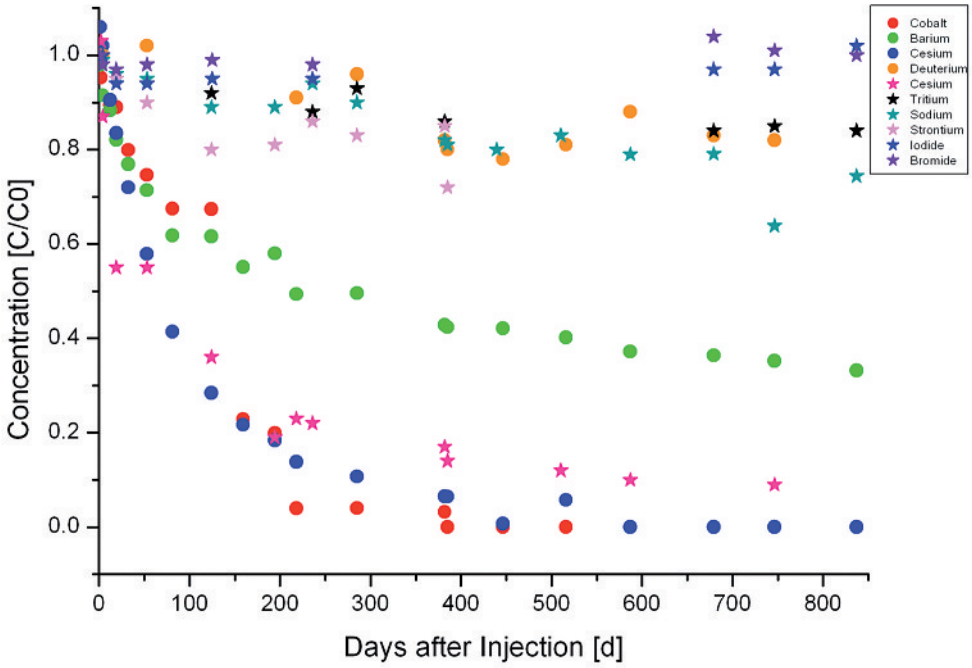

Figure 1: Evolution of the concentration of the tracers from the circulating solution by diffusion and sorption processes. Stars symbolize tracers in the lower interval and dots tracers in the upper interval respectively. Clearly, anions are decreasing at a lower rate than water and cations tracers.

References:

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