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Solute mass transfer from near field to far field in a HLWR experiment at real scale.

B. Buil, J. Peña, P. Gómez, A. Garralón, M.J. Turrero, L. Sánchez, and J.M. Durán
CIEMAT, Department Environment, Madrid, Spain (belen.buil@ciemat.es, +349134666542)

The FEBEX experiment located in Grimsel (Switzerland) is a 1:1 simulation of a high level waste disposal facility in crystalline rock according to the Spanish concept: two electrical heaters of dimension and weight equivalent to those of the real canisters were installed concentrically with the drift and simulated the thermal effect of the wastes and surrounded by a clay barrier constructed from highly-compacted bentonite blocks. This experiment started in 1996 and the external rim of bentonite is saturated with the granitic water. The difference between the chemical gradients generated by the bentonite porewater and the granitic water made possible the movement of solute into the geosphere. The experiment reproduces in the most realistic conditions, all the processes affecting the radionuclide migration in a HLWR.

Two boreholes parallel to the axis of the FEBEX drift were drilled in granite relatively close to the bentonite surface (20 and 60cm) in order to highlight the solute migration mechanisms in crystalline host rock, influenced by the presence of the bentonite buffer and by the geochemical gradients generated at the bentonite/granite interface.

After three years of periodic water sampling campaigns in those boreholes, the chemical composition of waters reveal that there is an appreciable increase of Na and Cl concentration in time in the waters sampled from the borehole located at 20cm from the bentonite surface. On the other hand, the Na/Cl ratio in waters is similar to the Na/Cl ratio in the bentonite porewater. For this reason Cl and Na are considered as the main natural tracers indicating the mass transfer process between the bentonite porewater and the granite.

A diffusion transport modelling (PHREEQC) was used to describe the mass transfer process. The results show that the Cl and Na concentration in the granitic waters is the result of a diffusive transport from the bentonite to the granite, with a calculated De$\approx$ 5,0E-11 m2/s.

These results could have some implications for the performance assessment due to the analogy between 36Cl (one of the dominant radionuclides in the average annual doses in the reference scenario) and the Cl ion. Safety case should take into account the transport of conservative solutes from the bentonite into the granite.