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Long term diffusion experiment (LTD): Analyses of 3H, 22Na and 134Cs diffusion in crystalline rock under real deep geological repository conditions

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The term matrix diffusion usually considers the process by which species, being transported in distinct flow paths, penetrate the surrounding rock through connected system of pores or microfractures. The importance of matrix diffusion is that it provides a mechanism for potential specie retention within enlarged area of rock surface in bulk rock pore network. This is especially crucial when considering the calculated contribution to dose for potential escaping radionuclides from deep geological repository (DGR).

The Long Tern Diffusion Project (LTD) is an international project consisting of a series of experiments that aim was to obtain quantitative information on matrix diffusion under in situ conditions.
The 1st phase of the project included an in-situ diffusion experiment where radionuclides (3H, 22Na, 134Cs) were injected into the borehole in undisturbed rock matrix in Grimsel test site (Switzerland) for 800 days. Here the borehole was drilled up to 8 m into the granodiorite massive in the depth 400 m under surface. The experimental interval was left opened in the borehole packer system in order the injected radioactive cocktail got int the contact with undisturbed rock matrix.
The activity decrease was observed by regular sampling of the experimental solution in the system. The radionuclide tracer activity was measured by liquid scintilation spectrometry (LSC, 3H) and gamma spectrometry (22Na, 134Cs). After 24 month the system was closed and the borehole was overcored. The active rock, surrounding the experimental interval, was then sawed and the tracer profiles were measured in the rock samples in order to determine the diffussion extent. 3H content in pore water in each subsample was measure by LSC after pore water destillation and condensation. 22Na and 134Cs was measured by standard gamma spectroscopy.
Eventough it had been envisaged that 3H might be undetectable in the rock, the methodology used enabled to determine that the tracer, being concerned as conservative non sorbing one, migrated up to 17 cm into the rock matrix. 22Na as slightly sorbing tracer migrated up to 7 cm. Finally, sorbing 134Cs migrated surprisingly up to 1,5 cm, instead expected several mms. The analyses results were afterwards used as a base for post mortem modelling.

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