A Long-term Diffusion Project at the Grimsel Test Site, Switzerland - Status and Outlook

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Matrix diffusion in rock formations is the process by which solutes in groundwater penetrate into the adjacent rock mass and are transported through an interconnected micro-porous network of micro fractures, grain boundary pores, intragranular and intergranular pores in the rock matrix. Rock matrix diffusion is particularly important when determining dose and risk calculations for weakly- and non-sorbing radionuclides such as I-129 and C-14 and therefore feed directly into the PA models of planned deep geological repositories.

The Long-Term Diffusion (LTD) project at the Grimsel Test Site (GTS), an underground rock laboratory located in the crystalline rocks of the Aare Massif of the Swiss Alps, is an international cooperative project∗and consists of a series of experiments which aim to obtain quantitative information on matrix diffusion under in situ conditions. Numerous in situ experiments with inactive tracers and radionuclides were successfully carried out over the past few years at the GTS. The LTD project is one of a series of recently initiated projects to study this long-term behaviour in a simulated repository near-field and the surrounding host rock. Phase I (2005 to 2008) of the LTD project is organised into four major work-packages including in-situ fied experiments, laboratory studies and hydraulic/process modelling:

(1) An in situ monopole diffusion experiment where radionuclide tracers are circulating and diffuse into undisturbed rock matrix;

(2) Characterisation of pore space geometry (including determination of in situ porosity for comparison with laboratory-derived data) using C-14 doped PMMA resin injection and NHC-9 chemical porosimetry techniques;

(3) A study of natural tracers in the rock matrix to elucidate evidence for long-term diffusion processes; and

(4) Investigation of the in situ matrix diffusion paths in core material from earlier GTS experiments.

Circulation of a cocktail of sorbing, weakly sorbing and non-sorbing radionuclides (3H, 22Na, 131I, 134Cs) in the monopole of work-package 1 was started in June, 2007 and will continue for at least two years with water samples being analysed to monitor the amount of sorption and diffusion. This laboratory and field work is combined with predictive and post mortem modelling exercises to increase confidence in the modelling of long-term and large-scale diffusion processes. Laboratory analyses of C-14 and NHC-9 resin impregnated overcores and other rock samples are being carried out in order to improve knowledge of matrix porosity and to refine predictive diffusion models carried out before the start of each in situ experiment. In order to examine the effect of flow wetted surfaces on the extent of diffusion, in-situ experiments are planned for Phase II (from 2009) where sorbing and safety relevant radionuclides will be circulated in a fracture to provide the opportunity to study the diffusion processes starting from a water conducting feature under realistic boundary conditions.

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