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Influence of rock environment on radionuclide migration

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As the final barrier of the multi-barrier deep geological repository (DGR) for radioactive waste (RAW) the rock environment fulfils the primary safety function by limiting the transport of radionuclides to the biosphere via the low hydraulic conductivity of the rock mass compared to other rock massifs (1). Moreover, the various properties and characteristics of the rock environment comprise important considerations with respect to the DGR safety assessment.

Samples of the various types of igneous and metamorphic rocks present in the Bohemian Massif were collected as part of the Research Support for the Safety Assessment of the DGR project (SURAO). The study of the rock materials also included that of the fracture fillings, the characteristics of which supplemented the input data set for the future DGR safety assessment. All the rock samples were subjected to both mineralogical (X-ray analysis) and petrological characterisation (2).

Fracture fillings (e.g. clay minerals, biotite, Fe oxyhydroxides, calcite) generally evince higher specific surface areas and cation exchange capacities than do the rocks themselves, i.e. properties that are able to significantly influence the sorption of radionuclides

The sorption experiments performed with radionuclides revealed differing degrees of sorption on the rock and fracture filling samples (e.g. ^{134}Cs, ^{85}Sr, U, Se). The initial experiments on the fracture filling materials determined that their presence can to significantly enhance the capture of radionuclides (e.g. ^{134}Cs) during their migration towards the biosphere, and thus to enhance the safety function of the rock environment (2).

The diffusion characteristic values were determined experimentally using the through diffusion method (2). With respect to the diffusion characteristics (the effective diffusion coefficient D_e), although the samples were taken from different parts of the Czech Republic and from differing rock types, the effective diffusion coefficients were found to lie within a relatively narrow range: for ^{3}H (4–10) · 10^{-13} m^2 s^{-1}, for ^{36}Cl (1–10) · 10^{-13} m^2 s^{-1} and for ^{125}I (1–4) · 10^{-13} m^2 s^{-1}. Anionic exclusion was demonstrated for the metamorphic rock samples, which led to the determination of lower D_e values for ^{36}Cl and ^{125}I in comparison to ^{3}H (2)

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