Diffusion of ^{226}Radium through Opalinus clay: a combined diffusion and sorption study

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^{226}Ra is considered to be relevant not only as important contributor to naturally occurring radioactive materials (NORM) and the environmental hazards associated with NORM but also as a critical radionuclide that needs to be considered in safety cases for the deep geological disposal of spent nuclear fuel. Clays are known to have a significant retention potential for bivalent cations such as ^{226}Ra. However, the sorption and diffusion of ^{226}Ra in clay rocks is so far derived from known values of Ba and Sr.

Here, we report new experimental data to improve the quantitative understanding of the retention of ^{226}Ra in clay rocks relevant for nuclear waste management. Opalinus clay samples originating from the Mont Terri Underground Rock Laboratory (bore hole BMA-A1) and synthetic OPA pore water were used, both for diffusion and batch sorption experiments. The breakthrough of ^{226}Ra was monitored after 100 days (planar) and 120 days (radial), respectively, whereas the steady state occurs after about 400 days in both cases. First modelling results (PHREEQC and COMSOL) indicate that the retention within the consolidated OPA clay core samples is higher than predicted based on the batch sorption experiments which could be due to enhanced sorption at frayed clay edges and/or to solid-solution formation of ^{226}Ra with sulphates present in the OPA core samples.