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Diffusion and sorption of radionuclides in veined gneiss from Olkiluoto, Finland

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A project "rock matrix REtention PROperties"(REPRO) at ONKALO, the underground rock characterization facility in Olkiluoto, Finland, consists of extensive series of in situ sorption and diffusion experiments that are supplemented by laboratory work [1]. A supporting laboratory Through Diffusion Experiment (TDElab) described here aims to study transport of 3H, 36Cl, 133Ba and 134Cs in Olkiluoto veined gneiss with strong foliation. The non-sorbing elements 3H and 36Cl provide data on diffusion coefficient of the rock while the sorbing nuclides, 133Ba and 134Cs, provide also data on distribution coefficient. Solution with known activities of 3H, 36Cl, 133Ba and 134Cs was injected into injection hole in the rock sample (length 29 cm; diameter 29 cm) and their diffusion to four observation holes were monitored weekly by collecting water samples from the observation and injection holes. The water samples were analyzed using beta and gamma measurements. The observation holes located 1 cm and 4 cm away from the injection hole so that main transport directions were perpendicular and parallel to foliation.

After 39 weeks, 46 % of initial 3H and 27 % of initial 36Cl were intruded into the rock while the intrusion of initial 133Ba and 134Cs were 82 % and 95 %, respectively. Diffusion of all radionuclides was fast along foliation that indicates plausible fractures along the foliation. A breakthrough of all four radionuclides was observed at the distance of 1 cm from the injection hole, along the foliation. No diffusion of sorbing radionuclides was observed at a distance of 4 cm in observation hole perpendicular to foliation. Diffusion of non-sorbing 3H and 36Cl was clearly slower perpendicular to foliation. The results of TDElab will be interpreted by modelling with Time Domain Random Walk (TDRW) method [2]. The effects arising from diffusion, sorption, structural and mineralogical heterogeneity and foliation can be taken into account with the TDRW method.

References

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