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The Diffusion of Selenium through Granite

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Spent nuclear fuel from Finnish power plants will be disposed of deep in the crystalline bedrock in western Finland. Estimating migration of radionuclides (RN) in groundwater is important in assessing the risk at the waste disposal site. If released into the bedrock, RN will be transported by advection along water conducting fractures (WCF). Retardation of mobile fission and activation products may occur by molecular diffusion from the WCFs into the stagnant pore water and by immobilisation on mineral surfaces in the rock matrix.

The Long Term Diffusion (LTD) experiment at the Grimsel Test Site (GTS) in Switzerland has been running for four years and is scheduled to continue until 2012/13. This international experiment has been initiated as part of the GTS Phase VI program to simulate the long-term behavior of contamination plumes in the surrounding host rock of the repository. A series of in situ and laboratory experiments have been executed to verify the well-established theoretical basis for matrix diffusion. In addition a complete and integrated approach to study matrix pore heterogeneity was performed to evaluate the matrix diffusion based on the pore structure of the matrix. According to recent studies, matrix pore space is highly heterogeneous and small scale lab experiments may not give a true reflection of rock retardation properties.

Kuru Grey granite from Central Finland was selected as a reference rock type for studies of porosity and pore structure by mercury porosimetry and electron microscopy together with water gravimetric analysis and the PMMA method for elucidating the diffusion behavior of RDs in the rock. In this work experiments to examine the diffusion of Selenium were executed on the decimetre scale using a granite block. The effective diffusion coefficients for tritiated water and chloride were determined in the similar block earlier. The water used in the experiment was simulated ground water which has typical composition to the Finnish ground waters. The experiments were carried out in oxygenated conditions and diffusion of the Selenium was followed over a period of one year. Selenium behavior in the Kure Grey granite rock block was evaluated by simple model calculations and the effective diffusion coefficient for Selenium was determined. The present De for selenium and previously obtained Des for HTO and chloride (Jokelainen et al 2 008) are compared.

L Jokelainen, J Ikonen, D Read, K-H Hellmuth and M Siitari-Kauppi, The Diffusion of Tritiated Water, Chloride and Uranium through Granite In: (eds.), Mater. Res. Soc. Symp. Proc. XXXII Vol. Materials Research Society Symposium Proceedings (2008), Volume Date 2009, 1124(Scientific Basis for Nuclear Waste Management XXXII)

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