Saf. Nucl. Waste Disposal, 2, 147–147, 2023
https://doi.org/10.5194/sand-2-147-2023

SaND
Safety of Nuclear
Waste Disposal
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Hydrogeochemical impact of Opalinus Clay system shown in migration lengths of uranium

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Received: 22 March 2023 – Revised: 17 May 2023 – Accepted: 22 May 2023 – Published: 6 September 2023

Abstract. Models and simulations allow a prognosis of how processes in the geosphere might occur in the future by considering physical and chemical processes. They are the only way to test future scenarios and hypotheses and to evaluate how a repository site will develop over a period of a million years, e.g. by quantifying potential radionuclide migration in the hydrogeological system of the containment providing rock unit.

An example is used to demonstrate the extent to which simulated migration lengths can vary for a million years, depending on the model concept and on the underlying data and parameters. In the case of uranium in the potential host rock Opalinus Clay (Switzerland), the range extends from 5 m, by applying experimentally determined transport parameters, over 50 m, using process-based approaches and taking hydrogeology into account, and up to 80 m, depending on the thermodynamic data set used.

The degree of reliability of the models is derived from comparison with laboratory tests, data from boreholes and underground laboratories or natural analogues. This is the only way to assess the simulation results. In addition, indications can be provided regarding where new data need to be collected. So our task is to find an answer to the following question: how accurate do the models for the repository site search have to be in order to produce resilient and robust forecasts? To reduce the uncertainty related to the migration length of uranium in the Opalinus Clay, the calcite carbonate ion and the hydrogeological system at a potential disposal site need to be known, whereas the quantity of clay minerals plays a subordinate role, as long as it is enough, which is the case in argillaceous formations.

Published by Copernicus Publications on behalf of the Federal Office for the Safety of Nuclear Waste Management (BASE).