



Model-based performance assessment of repository-induced effects: contribution to the site-selection process in Switzerland

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Abstract. The procedure for selecting repository sites in Switzerland is specified in the Sectoral Plan for a deep geological repository (DGR), which consists of three stages. In the last Stage 3, three candidate siting regions, Jura Ost, Nördlich Lägern and Zürich Nordost in northern Switzerland, were examined in detail. For each site, the performance of the geological barrier was evaluated based on the characteristics at the time of repository closure considering a certain degree of uncertainty associated with the exploration and characterization of the geology as well as the long-term evolution of the site. Furthermore, performance assessment includes an evaluation of the safety-relevant repository-induced effects on the disposal system, such as thermal, gas, chemical and mechanical (THMC) effects introduced by the interaction of the waste with the near field. A criterion-based indicator approach was adopted to ensure a traceable implementation of the site-selection process.

The complexity of the involved THMC processes calls for model-supported workflows to reach a quantitative assessment of the barrier performance and an adequate evaluation of the associated conceptual and parametric uncertainties. The first task of the workflow was dedicated to the elaboration of preliminary site-descriptive models for the proposed repository configurations at the candidate sites. Three-dimensional and two-dimensional representations of entire repositories and individual repository components were established and incorporated into the site-descriptive models to provide preliminary site-specific assessment models for the evaluation of coupled THMC effects. The models accounted for the entire life cycle of the repositories from construction to the post-closure phase. Safety-relevant indicators were developed to quantify the performance of different repository configurations and to establish potential discriminators for the site selection. The workflow integrated deterministic and probabilistic assessments on the repository and component scales. As a final step, the data acquired with the latest site investigations (i.e., new data from seismic and deep borehole campaigns) were integrated into the existing models for the elaboration of the site-specific analyses. The indicators were evaluated by integrating a wide range of information, including regional stress conditions, tectonic structures, stratigraphy, lithology, mineralogy, and the impact from effects induced by the repository for the entire spectrum of repository configurations. The spatial maps of indicators depicting the impact from repository-induced effects were synthesized in the site-selection process as aggregated georeferenced performance measures to evaluate the performance at each site with regards to the regulatory criteria.