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Numerical assessment of the barrier integrity for a generic nuclear waste repository in crystalline rock

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Abstract. Since a sufficiently large undisturbed rock zone to provide the essential safety function for containment of radioactive waste cannot be assumed in crystalline rock, a concept for disposal in multiple smaller unfractured rock volumes has been developed and investigated in the joint research project CHRISTA-II (Thiedau et al., 2021). This repository concept, which relies on the host rock as an essential barrier for the containment of the disposed radionuclides, thus requires the existence of sufficiently large unfractured areas.

Integrity evaluation of the geological barrier as part of the safety assessment comprises a safety-oriented assessment of mechanical, hydraulic, thermal and chemical processes occurring in the host rock as well as their couplings. Fractures and other types of discontinuities, which usually characterize crystalline rock, are expected to influence the hydraulic behavior of the system. Therefore, representing adequately the fracture network is necessary in order to capture its relevant properties, which will ultimately define the hydraulic boundary conditions surrounding the unfractured containment rock zones. Typically it is only possible to characterize fracture networks statistically, which requires a systematic investigation to quantify the influence of multiple realizations on a repository system. Moreover, the estimation of the potentially available undisturbed rock zone volume, making use of an ensemble of statically equivalent fracture networks, is relevant for the repository concept presented here. This contribution aims to further develop the methodology for integrity assessment presented in Thiedau et al. (2021) with a focus on the influence of the uncertain fracture distribution.

References

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