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

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

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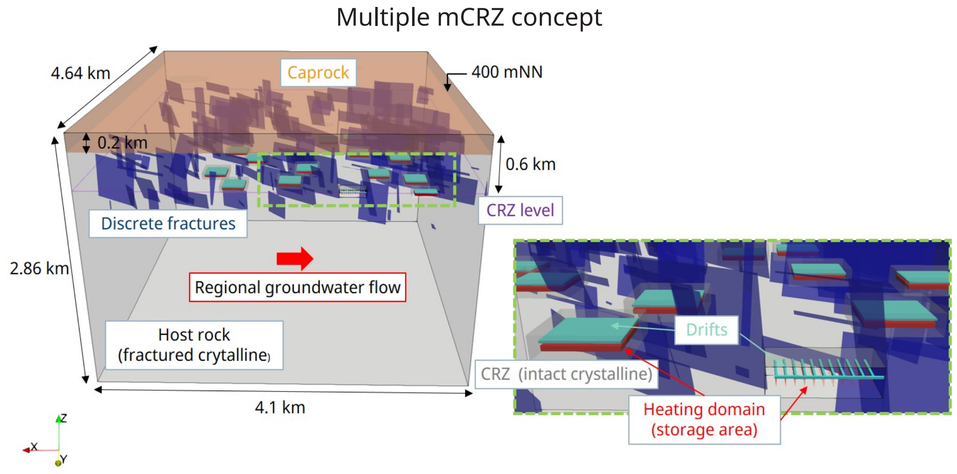
Motivation

In the CHRISTA [6] project, a numerical modeling concept for the assessment of barrier integrity of a generic nuclear waste repository in crystalline rock was developed. The concept is based on coupled thermo-hydro-mechanical (THM) simulations done with the open-source finite element software OpenGeoSys (OGS) [3] using the geological model described in [4] and the multiple containment providing rock zone (mCRZ) concept.

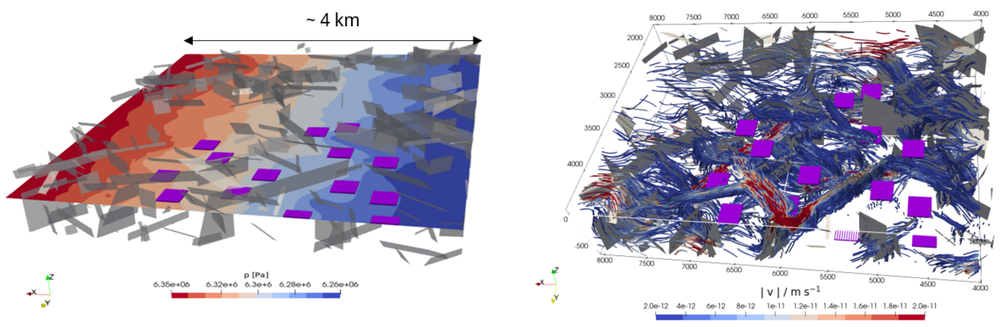
Multiple mCRZ concept



Integrity analysis

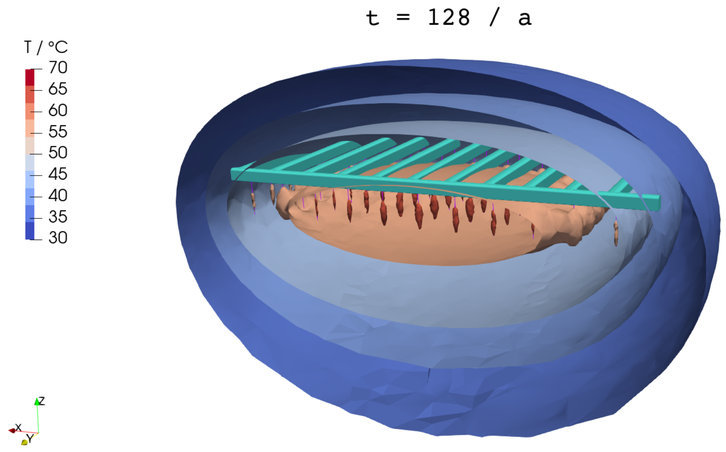
- Flow is strongly dominated by the fractures
- Ratio $\frac{V_{fracture}}{V_{matrix}} \approx$ 1e5

Stationary flow at CRZ plane



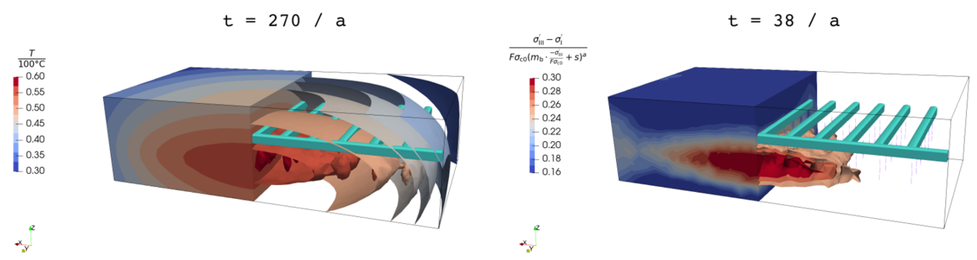
- Decay heat from radioactive waste
- Imposed heat source at heating domain (storage area)

Temperature at detailed CRZ



- Temperature criteria with T_{limit} = 100 ° C (left)
- Dilatancy criteria according to Hoek-Brown (right)

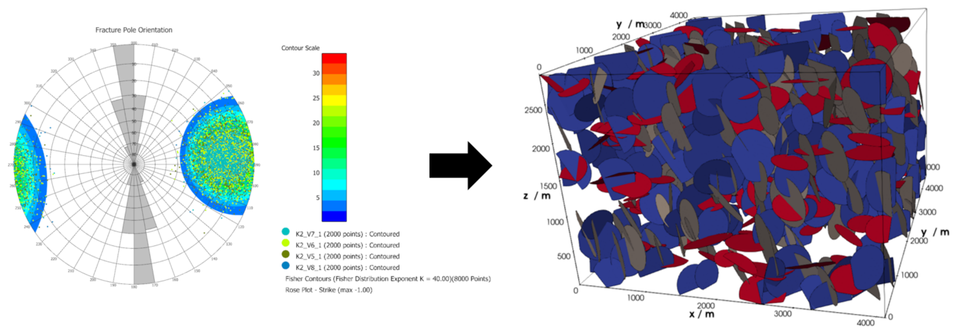
Evaluation of the integrity criteria at detailed CRZ



What can a characterization of the jointed rock mass tell us about the feasibility of the mCRZ concept?

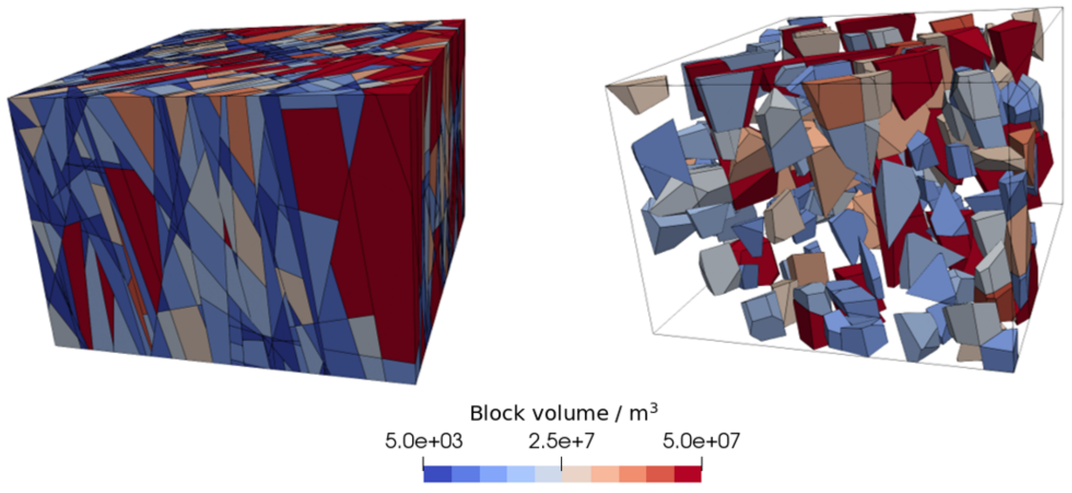
- Jointed rock mass properties (e.g. fracture orientation, length, density, etc.) are assumed to be known
- Rock properties used for the creation of a DFN

Statistical characterization of jointed rock mass for DFN creation



- Intersection of discontinuities creates blocks of intact rock masses with variable 3D geometry [2]
- Using one realization of a DFN, based on the model from [4], intact rock blocks were created using the rock slicing method [1, 5]

Workflow: from jointed rock characterization to blocks for CRZ emplacement



The proposed concept can help among others with the following aspects:

- Geometrical block filtering
- Quantification of the amount of blocks for the mCRZ emplacement

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Project partners

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