Supplement of

Performance assessment of a generic repository in salt host rock based on Task F of DECOVALEX-2023 – BASE’s lessons learnt and future work

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Performance assessment of a generic repository in salt host rock based on Task F of DECOVALEX-2023

BASE’s lessons learnt and future work

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INTRODUCTION

DECOVALEX (DEvelopment of COupled models and their VALidation against EXperiments) is an international cooperative project, initiated in 1992, that aims to help better represent coupled THCM processes in PA of disposal systems for HLW (www.decovalex.org).

BASE co-funds and participates actively in Task F of DECOVALEX-2023 with the aim to exchange state-of-the-art modelling approaches and methodologies, develop further competence in process modelling, and assist in development of in-house PA tools.

This poster discusses selected aspects of BASE’s contribution to Task F2 (disposal in saltrock) of DECOVALEX-2023.

APPROACH and IMPLEMENTATION

Overall approach:
- The problem was pre-defined by a detailed Task Specification document (publishing pending).
- Modelling was carried out by (largely) independent teams (no comparison shown here).
- Individual processes were tested and implemented in a step-wise manner.

Main features of the model include:
- Implementation in the PFLOTRAN code.
- Fully unstructured finite volume grids.
- Evolution modelled over 100,000 years.
- Canister failure and radionuclide release at 500 years.
- Shaft failure and surface water ingress at 1,000 years.
- Simplified salt convergence (porosity reduction) based on external model calculations.
- Variably-liquid saturated, isothermal conditions.
- Radioactive decay and decay-chains.
- Elemental solubility limits.
- Transport by diffusion and advection in liquid phase.

CONTRIBUTION and EXAMPLE RESULTS

- Model results require extensive post-processing and analysis.
- BASE provided 21 pre-defined quantities of interest for inter-model comparison (Final Task Report).
- Many auxiliary quantities were additionally presented and used for system behaviour understanding.

LESSENTIAL AND EXAMPLE RESULTS

- A preliminary workflow allowing large-scale PA simulations (including pre- and post-processing) has been developed.
- Valuable hands-on experience has been gained by comparing approaches and discussing problems with other teams.
- Due to its coupled and non-linear nature, the model’s behaviour is complex and highly sensitive to certain parameter values.
- There are specific advantages and disadvantages to developing “fully integrated” and “nested” models.
- Costs of model elaboration increase rapidly and need to be balanced vis-à-vis benefits.
- Development of complex models requires maintaining and developing necessary competence and resources.
- Synergies with existing in-house projects should be explored further and taken advantage of.

OUTLOOK

- The computational workflow will continue to be elaborated (e.g. biosphere/dose model, probabilistic sampling, integration via scripting).
- Additional process (e.g. 2-phase flow, non-isothermal conditions) will be included.
- Systematic sensitivity and uncertainty assessment will be carried out.
- Comparison with simplified models will help evaluate the role of individual processes and their model representation.
- High Performance Computing will be employed for more efficient numerical solution (e.g. probabilistic uncertainty analysis).