SKB Task Force GWFTS: Increasing the realism of solute transport modelling in fractured media – Task 9C

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1. The experiment and task description

Task 9C concerns the combined predictive (earlier stage) and inverse (later stage) modelling of tracer breakthrough curves of the Through Diffusion Experiment (TDE). This in-situ tracer test has been carried out within the REPRO programme at about 400 m depth at the ONKALO underground rock characterisation facility in Olkiluoto, Finland, by Posiva.

HTO, ²²Na, ³⁶Cl, ¹³³Ba, ¹³⁴Cs
Start: November 19th, 2015

The experiment was initiated in November 2015 and is planned to end December 2019. It is carried out between three parallel drillholes arranged as a right-angled triangle. Drillhole ONK-PP326 is used as the injection hole and drillholes ONK-PP324 and ONK-PP327 as observation holes. This facilitates tracer migration along, and across, the rock foliation. The experiment is carried out in 1 m long packed-off intervals, at about 12 m from the tunnel wall.

2. Modeling

Teams (Predictive modeling)

UJV – GoldSim, 2D
TUL – Flow123D, 2D
CTU – GoldSim, 2D (non-sorbing), 1D-radial (sorbing)
KTH – Comsol, 3D (only non-sorbing) and 2D
KAERI – Comsol, 2D-linear (microstructural model)
A21 – Pflotran, 2D (Effect of foliation)
VTT – Comsol, 3D
JAEA – GoldSim, 2D (Effect of lab to in situ, foliation, BDZ, anion exclusion/cation excess.)
CFE – 2D ADE model, 2D microstructural model. (Anisotropy, foliation).

3. Modeling

Teams (Back analysis, on-going)

VTT – Comsol, 3D.
A21 – Pflotran, 2D + BDZ (Borehole Deformation Zone)
CFE – DarcyTools, 2D microDFN model, based on X-ray micro Computed Tomography data

4. Conclusions

From predictions:

- Presence of BDZ at observation boreholes?
 - Overestimation of calculated activities in the observation boreholes for non-sorbing tracers.
 - Pressure anomaly signals visible in the measurements (HTO, ³⁶Cl, ²²Na). Advection pulses?
- Injection borehole:
- HTO: calculated trends OK (effect of higher C₀ in the calculations).
 - ³⁶Cl: Larger spread in the prediction results (probably due to larger spread in D_e values).
 - ²²Na: Less sorption (or slower diffusion) than expected.
 - Already observed in REPRO WPDE.
 - ¹³⁴Cs, ¹³³Ba: Discretization effects?

From back-analysis:

- The presence of BDZs is possibly influencing the results (e.g. modeling results by A21). Could we observe BDZ by over-coring?
- Weak sorption of ²²Na (on rock matrix or BDZ) is consistent with observations.
- Strong sorption of ¹³⁴Cs (on rock matrix or BDZ) is consistent with observations.