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.

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)

UVI – 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 (macrostructural 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

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, ⁷¹Na). Advection pulses?

Injection borehole:

• HTO: calculated trends OK (effect of higher C in the calculations).
• ³⁶Cl: Larger spread in the prediction results (probably due to larger spread in D values).
• ⁷¹Na: Less sorption (or slower diffusion) than expected.
• Already observed in REPRO WPDE.
• ¹³³Cs, ¹³⁷Ba: Discretization effects?

4. Conclusions

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.

The authors gratefully acknowledge the support from SKB, Posiva and the other organizations (BMWi, DOE, JAEA, KAERI, and SURAO) within the SKB Task Force on modelling Groundwater Flow and Transport of Solute.