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

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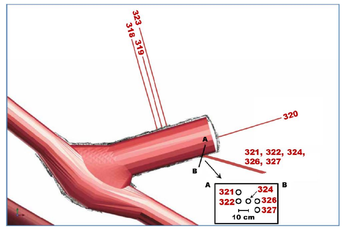
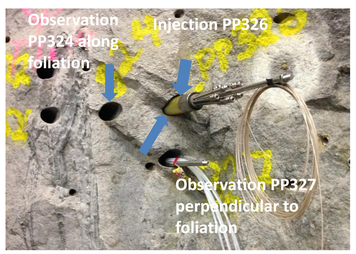
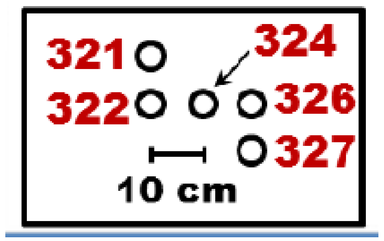
1. The experiment and task description





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, ^{22}Na, ^{36}Cl, ^{133}Ba, ^{134}Cs
Start: November 19th, 2015



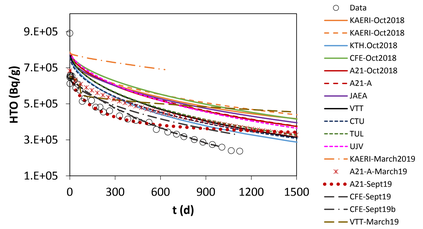
The experiment was initiated in November 2015 and is planned to end December 2019. It is carried out between three parallel drillholes arranged as a right-angled triangle. Drillhole ONK-PP326 is used as the injection hole and drillholes ONK-PP324 and ONK-PP327 as observation holes. This facilitates tracer 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

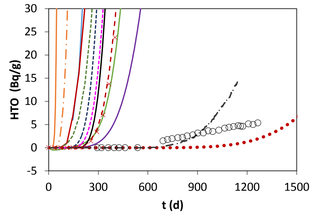
Teams (Predictive modeling)

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).

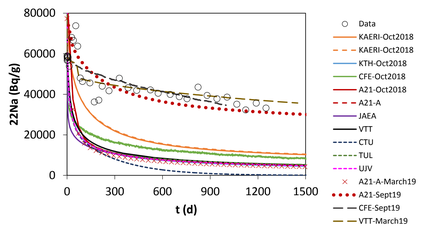
HTO, injection hole



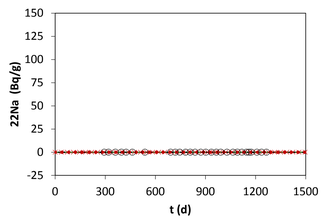
HTO, observation hole



^{22}Na, injection hole



^{22}Na, observation hole



3. Modeling

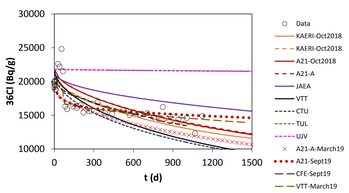
Teams (Back analysis, on-going)

VTT – Comsol, 3D.

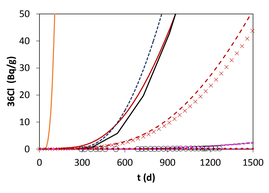
A21 - Pflotran, 2D + BDZ (Borehole Deformation Zone)

CFE – DarcyTools, 2D microDFN model, based on X-ray micro Computed Tomography data

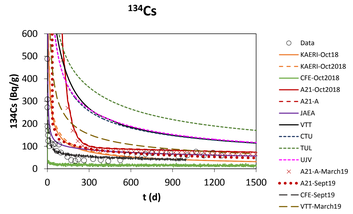
^{36}Cl, injection hole



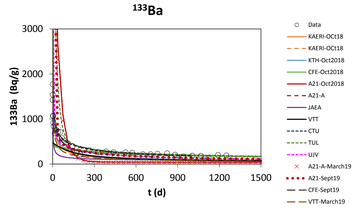
^{36}Cl, observation hole



^{134}Cs



^{133}Ba



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, ^{36}Cl, ^{22}Na). Advection pulses?

Injection borehole:

- HTO: calculated trends OK (effect of higher C_0 in the calculations).
- ^{36}Cl: Larger spread in the prediction results (probably due to larger spread in D_e values).
- ^{22}Na: Less sorption (or slower diffusion) than expected.
- Already observed in REPRO WPDE.
- ^{134}Cs, ^{133}Ba: 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 ^{22}Na (on rock matrix or BDZ) is consistent with observations.
- Strong sorption of ^{134}Cs (on rock matrix or BDZ) is consistent with observations.

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