EGU2020-21395
https://doi.org/10.5194/egusphere-egu2020-21395
EGU General Assembly 2020


# Inverse model of single-fracture hydraulic and tracer experiments including a laser scanning data correction

**Milan Hokr**[1], Aleš Balvín[1], Jakub Jankovec[2], Marie Grecká[3], and Filip Jankovský[3]
[1]Technical University of Liberec, Liberec, Czechia (milan.hokr@tul.cz)
[2]PROGEO Ltd., Roztoky, Czechia (progeo@1progeo.cz)
[3]ÚJV Řež, a.s., Husinec-Řež, Czechia (filip.jankovsky@ujv.cz)

We present inverse modelling results of a laboratory hydraulic and tracer experiment in a single fracture in a granite block. The full set of experiments, artificial and natural fracture examples, and various tracers used, are described in details in the separate conference contribution by Jankovsky et al. Here we focus on two blocks 80 x 50 x 40 cm, split by an artificial fracture and conservative tracers. Several test realisations include a choice of different in/out holes and a use of the in-plane sensor grid (boreholes) either for pressure sensors or for tracer (conductivity) sensors. The measurement is consistent across the tests, although there are some anomalies.

The model of artificial fracture is based on fracture geometry obtained by laser scanning, providing (x,y,z) point cloud in 0.1 mm resolution. The two surfaces are scanned separately and then the coordinate systems connected from the scan of the completed block. The aperture is determined with uncertainty in the mutual movement of the surfaces, so various parameterization of its correction is included as part of the inverse modelling.

The solved problem is 2D with spatially variable parameters (element-wise). The Darcy flow is calculated with the transmissivity obtained by the cubic law. The transport model is a standard case of advection and hydrodynamic dispersion. The dispersivity parameters are meant as representing the dispersion in a smaller scale then the aperture field variations captured by the laser scanning data. This is also subject of the inverse modelling (optimization).

The flow and transport simulations within the inverse modelling are made by Flow123d, the in-house open-source code of the Technical University of Liberec. The inverse solver UCODE (freeware of the US Geological Survey) uses a gradient based method with parameter perturbation sensitivity evaluation. Other simulations are made with MODFLOW/MT3D and FEFLOW. Some of the differences are analysed and explained as numerical effects depending on discretisation.

Hydraulic and transport aperture could be independently determined either from the flow rate and pressure data or from the tracer breakthrough. Each block had different correction of the relative position of the surfaces and different hydraulic resistance. This can be caused by small surface irregularities or loose grains, not captured by the laser scan, hindering the perfect contact of the surfaces.

The activities were funded by Czech Technological Agency under Project No. TH02030543