CBH-BCH, Belgian National IAH Chapter Study Day on Geothermy, Mons, June 5, 2015

Use and utility of combined solute and heat tracer tests for characterizing hydrogeothermal properties of an alluvial aquifer

M.V. Klepikova[1,2], S. Wildemeersch[1,3], P. Jamin[1], Ph. Orban[1], T. Hermans[4], F. Nguyen[4], S. Brouyère[1] and A. Dassargues[1]

[1] *Hydrogeology & Environmental Geology, Geo[3], ArGEnCo, University of Liège*
[2] *now at Geological Institute, ETH Zurich*
[3] *now at SPAQuE, Liège*
[4] *Applied Geophysics, Geo[3], ArGEnCo, University of Liège*

Abstract

Using heat as a tracer together with a solute tracer is interesting for characterizing hydrogeothermal properties of the underground. These properties are particularly needed to dimension any low temperature geothermal project using an open doublet system (pumping-reinjection) in a shallow aquifer. The tracing experiment, conducted in the alluvial aquifer of the River Meuse (Hermalle near Liège), consisted in injecting simultaneously heated water at 40°C and a dye tracer in a piezometer and monitoring the evolution of temperature and tracer concentration in the recovery well and in nine monitoring piezometers located in three transects with regards to the main groundwater flow direction. The breakthrough curves measured in the recovery well showed that heat transfer in the alluvial aquifer is slower. All measured results show also that the heat diffusivity is larger than the solute dispersion. These contrasted behaviours are stressed in the lower permeability zones of the aquifer. Inverse modelling is applied for calibrating the numerical simulation of the groundwater flow, heat and solute transport. First results are presented showing that the density effect must be taken into account and that, as expected, the most important parameter to be calibrated accurately is the hydraulic conductivity.

References

- Brouyère S. & Dassargues A., 2002, Reliability of transport models calibrated on field tracer experiments: breakthrough curve sensitivity to tracer injection conditions, in *Calibration and Reliability in Groundwater Modelling: A Few Steps Closer to Reality* (Proc. of ModelCARE'2002), IAHS Publ. n°277, pp. 339-346.
- Brouyère, S., Carabin, G. and Dassargues, A., 2005, Influence of injection conditions on field tracer experiments, *Ground Water*, 43(3), pp.389-400.
- Derouane J. & Dassargues, A., 1998, Delineation of groundwater protection zones based on tracer tests and transport modelling in alluvial sediments, *Environmental Geology*, 36 (1-2), pp. 27-36.
- Fossoul, F., Orban, P. & Dassargues, A., 2011, Numerical simulation of heat transfer associated with low enthalpy geothermal pumping in an alluvial aquifer, *Geologica Belgica*, 14(1-2), pp. 45-54.
- Hermans T., Wildemeersch S., Jamin P., Orban P., Brouyère S., Dassargues A. and Nguyen F., 2015, Quantitative temperature monitoring of a heat tracing experiment using cross-borehole ERT, *Geothermics*, 53, pp. 14-26
- Rentier C., Brouyère S. and Dassargues A., 2002, Integrating geophysical and tracer test data for accurate solute transport modelling in heterogeneous porous media, *Groundwater Quality: Natural and Enhanced Restoration of Groundwater Pollution* (Proc. Of GQ'2001, Sheffield, IAHS Publ. n° 275, pp. 3-10.
- Wildemeersch S., Jamin P., Orban Ph., Hermans T., Nguyen F., Brouyère S. & Dassargues A., 2014, Coupling heat and chemical tracer experiments for estimating heat transfer parameters in shallow alluvial aquifers, *Journal of Contaminant Hydrology*, 169, pp.90-99.