Geophysical Research Abstracts
Vol. 15, EGU2013-3683-1, 2013
EGU General Assembly 2013

Single-well and inter-well dual-tracer tests for CCS pilot site characterization at Heletz (Israel): scope and limitations

Julia Ghergut (1), Jac Bensabat (2), Auli Niemi (3), Tobias Licha (1), Torsten Lange (1), Alexandru Tatomir (1), and Martin Sauter (1)

(1) University of Göttingen, Applied Geology Dept., Germany (iulia.ghergut@geo.uni-goettingen.de), (2) EWRE Ltd., Haifa, Israel, (3) University of Uppsala, Sweden

A semi-analytical approximation to tracer signals is proposed for evaluating the chances of unambiguous tracer test interpretation for the CCS pilot site at Heletz (www.co2mustang.eu/Heletz.aspx), given the multiple constraints imposed upon tracer test execution at any deep geological formation regarding maximum pressure buildup admissible, fluid turnover rates, injection-fluid availability and conditioning capabilities, fluid disposal capacity, maximum test duration, tracer quantities/species available, tracer metering costs, etc. At the Ketzin site in Germany (www.co2sink.org), such constraints acted prohibitively towards conducting any tracer tests prior to CO_2 injection (cf. EGU2009-11625, EGU2011-2823-1). In contrast, at the Heletz site within the MUSTANG project, a particular sequence of single-well (SW) and inter-well (IW) tracer tests to be conducted prior to CO_2 injection (Bensabat et al. 2011, Niemi et al. 2011) is being regarded as a critical, indispensable contribution towards the goal of georeservoir characterization.

An advantage of the proposed approach, expressing tracer signals U in terms of fluid volume recovery fraction f (rather than time), is its independence upon IW distance and upon fluid injection/production rates (which may be difficult to prescribe in advance). It roughly predicts conservative- and sorptive-tracer signals, fluid mixing and temperature evolution in SW and IW tests, for stratified georeservoirs whose high- and low-permeability layers have thicknesses of same magnitude order. Thus, besides the CCS context, it can be extended to a range of geothermal applications, including some aquifer-dominated systems in the Upper Rhine Rift Valley, S-German Malm/Molasse Basin, N-German Sedimentary Basin, but excluding fracture-dominated (petrothermal) systems.

IW tracer signals are sensitive to storage capacity (measured by transport-effective porosities n), but suffer from ambiguity between longitudinal heterogeneity (Peclet number Pe) and vertical heterogeneity (hydrostratigraphy Prf(z)), and from all-parameter ambiguity at early times ($f<0.3$); Pe–n ambiguity diminishes with increasing observation time. SW signals carry all-time Pe–n ambiguity. IW signal inversion can be freed from Pe–Prf ambiguity, exploiting SW signals' insensitivity to Prf. In both IW and SW, Pe–n ambiguity is resolvable by using sorptive tracers, and/or fluid temperature differences, alongside with conservative tracers.

While IW signals do respond to permeability contrasts, absolute values of individual-layer permeabilities cannot be determined from tracer tests; the latter remains a task for hydraulic tests. Layer-resolved permeability determination from tracer tests would solely be possible from IW tests with depth-resolved fluid sampling, which is rather difficult to ensure in practice. A kind of 'depth-targeted sampling', though, was attempted at the Ketzin site during the CO_2 injection and monitoring test (www.co2sink.org). At Heletz, depth-resolved fluid sampling is technically feasible (Bensabat 2011), though not primarily for the reason of enabling a tracer-based permeability measurement.

Acknowledgements: Heletz hydrostratigraphy scenarios were provided by the **MUSTANG** project (www.co2mustang.eu), funded by EU/FP7 (grant no.227286). Heat and tracer transport modeling for IW and SW in layered reservoirs was performed within the **gebo** project (www.gebo-nds.de), funded by the Lower-Saxonian government and Baker Hughes (Celle), Germany.