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Geothermal reservoir characterization through active thermal testing

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Development and deployment of Enhanced Geothermal Systems (EGS) as renewable energy resources are part of the Swiss Energy Strategy 2050. To pioneer further EGS projects in Switzerland, a decameter-scale in-situ hydraulic stimulation and circulation (ISC) experiment has been launched at the Grimsel Test Site (GTS). The experiments are hosted in a low fracture density volume of the Grimsel granodiorite, similar to those expected at the potential enhanced geothermal system sites in the deep basement rocks of Northern Switzerland. One of the key goals of this multi-disciplinary experiment is to provide a pre- and post-stimulation characterization of the hydraulic and thermal properties of the stimulated fracture network with high resolution and to determine natural structures controlling the fluid flow and heat transport.

Active thermal tests including thermal dilution tests and heat tracer tests allow for investigation of groundwater fluid flow and heat transport. Moreover, the spatial and temporal integrity of distributed temperature sensing (DTS) monitoring upgrades the potential and applicability of thermal tests in boreholes (e.g. Read et al., 2013). Here, we present active thermal test results and discuss the advantages and limitations of this method compared to classical approaches (hydraulic packer tests, solute tracer tests, flowing fluid electrical conductivity logging). The experimental tests were conducted in two boreholes intersected by a few low to moderately transmissive fault zones (fracture transmissivity of about 1E-9 m2/s - 1E-7 m2/s). Our preliminary results show that even in low-permeable environments active thermal testing may provide valuable insights into groundwater and heat transport pathways.

Read T., O. Bour, V. Bense, T. Le Borgne, P. Goderniaux, M.V. Klepikova, R. Hochreutener, N. Lavenant, and V. Boschero (2013), Characterizing groundwater flow and heat transport in fractured rock using Fiber-Optic Distributed Temperature Sensing, Geophys. Res. Lett., 40, 2055–2059, doi:10.1002/grl.5039