Probing of high temperature geothermal reservoirs from electrical methods : HiTI EC project and the IDDP

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The general objective of the HiTI EC project is to provide geophysical and geochemical sensors and methods to evaluate deep geothermal reservoirs up to supercritical conditions (T>380°C). Supercritical geothermal wells are still non-conventional but may provide a very efficient way to produce electricity from a clean, renewable source. A deep geothermal well will be drilled in 2008 for this purpose into the NE Icelandic Krafla volcanic zone, as part of the IDDP (“Iceland Deep Drilling Project”).

Aimed to explore supercritical reservoirs, HITI is to develop, build and test in the field new laboratory or downhole tools and methods for deep high-temperature boreholes and a highly corrosive environment. The new set of tools and methods has been chosen to describe, in particular, the supercritical reservoir structure and dynamics. Slickline tools up to 450°C and wireline tools up to 300°C will be developed due to the present limitation in wireline cables (320°C). The more extreme, supercritical conditions will be explored taking advantage of cooling during the drilling phase.

For reservoir characterisation, the measured quantities are temperature and pressure (for in situ fluid, thermodynamic modelling of the reservoir and thermo-mechanical modelling of borehole integrity), natural gamma radiation and electrical resistivity (for basement porosity and alteration), acoustic signal (with borehole wall images for reservoir fracturing and in-situ crustal stresses) and reservoir storativity and equilibrium (from geothermometers and organic tracers). The presentation will focus here on the solving of the electrical problem as part of HiTI and as a means to describe reservoir structure and dynamics. This will include both laboratory and downhole measurements, aiming at describing the different components of the electrical signal, from alteration to porosity (matrix and fractures), and with the objective to identify in situ pore fluids in terms of salinity. This method will be developed first in a high temperature (200°C – 300°C) hole from the Krafla region, then appiled to the IDDP hole. The presentation will be illustrated with IODP core and downhole data from the oceanic crust.