Geophysical Research Abstracts
Vol. 20, EGU2018-7624, 2018
EGU General Assembly 2018

Thermo-hydro-mechanical modeling of hydro-thermal convection at Rittershoffen geothermal reservoir (France).

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The ECOGI deep geothermal project is located in Rittershoffen, six kilometers east from Soultz-sous-Forêts, where is operated the well-known European EGS pilot plant (France, Alsace). The project is based on a geothermal doublet GRT-1 and GRT-2 delivering a heat power of 24 Mwth. The doublet exploits the geothermal resource at the sediments-granite transition, where higher temperatures than at Soultz-sous-Forêts have been measured (around 170°C versus 150°C at 2.0 km in depth). Detailed stratigraphic and fracture data, temperature logs, tracer surveys have been collected in recent studies. However, no reservoir model, integrating large-scale geophysical measurements, exists for the Rittershoffen site. To address this issue, a model is developed in two dimensions (10 km in horizontal and 5 km in depth) based on a finite element method and involving thermo-hydro-mechanical (THM) coupling. The brine properties are taken dependent on the fluid pressure and the temperature. A representative elementary volume of 100 meters is used to neglect the fluid flow along the major faults such as the Rittershoffen fault in the crystalline basement. From large-scale temperature logs, effective thermal conductivity and permeability are inverted. Here, we obtain a large-scale convective solution in accordance with the linear geothermal gradient in the sediments. The upscaled rock properties for the Rittershoffen site are in the same range of values than the ones of Soultz-sous-Forêts. Moreover, contrary to recent interpretations, we show that the transition between the Keuper and Muschelkalk formations has a weak influence on the hydro-thermal circulation.