Geophysical Research Abstracts
Vol. 21, EGU2019-15795, 2019
EGU General Assembly 2019

THM modeling of hydrothermal circulation at Soultz-sous-Forêts and Rittershoffen geothermal sites (France)

Bérénice Vallier (1), Vincent Magnenet (2), Jean Schmittbuhl (1), and Christophe Fond (2)

(1) University of Strasbourg, Institut de Physique du Globe de Strasbourg, Labex, Strasbourg, France (vallier@unistra.fr), (2) University of Strasbourg, ICUBE, Illkirch, France (vmagnenet@unistra.fr)

Numerical models of the deep geothermal reservoirs in the Upper Rhine Graben (URG) have been developed over the past decades. However, there is still a need of models able to integrate most of the thermal, mechanical and geophysical large-scale data. We develop a two-dimensional model based on a finite element approach. It includes thermo-hydro-mechanical (THM) coupling and temperature, fluid pressure dependent brine properties. A representative elementary volume of 100 m is assumed to homogenize the fault network complexity at small scales. A back analysis is performed to obtain large-scale rock properties using temperature logs and regional stress-depth profiles. This modeling approach is applied on the cases of the reference Soultz-sous-Forêts geothermal site and the close by industrial Rittershoffen project (France). At Soultz, our study provides new insights on the extension of the hydro-thermal convection cells through depth, on the interpretation of the linear temperature gradient at shallow depth. It supports a weak influence of the lithological transition between the sediments and the granitic basement on the hydro-thermal circulation contrary to previous studies. We also show the significant effect of the brine viscosity on the hydro-thermal circulation. Lateral variability of temperature profiles with depth in the URG is shown to be consistent with the predictions of this simple model. At Rittershoffen, the bottom of the hydraulic cap rock is shallower than the discontinuity of the thermal gradient like in the Soultz case. The comparison between both geothermal models highlights many similarities in terms of rock properties, decoupling of hydraulic and thermal cap rocks and temperature spatial variability. In both cases, the inverted large-scale rock properties are consistent with the measurements at the laboratory scale. Predictions of the relationship between reservoir temperature and surface thermal gradients are proposed for future explorations.