Thermo-hydraulic modeling of a deep fault-related fracture system in the Upper Rhine Graben using MOOSE/TIGER

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ABSTRACT

The scope of the research project GeoFaces (BMWi: 0324025C) is the analysis of thermo-hydro-mechanic properties of possible geothermal reservoirs in the Upper Rhine Graben (URG) in SW-Germany / E-France. The aim is to quantify the amount of fluid circulation along or through joint faces (fractures and faults) under recent geological conditions.

Location and extension of geothermal reservoirs in the URG are well known through geophysical exploration (e.g. 3D seismic survey). A lack of understanding of the thermic, hydraulic, (geo-) mechanic, and chemical (THMC) processes in the reservoir and their mutual influence, might lead to problems concerning geothermal exploration and evaluation of the geothermal potential.

This presentation highlights the combination of different datasets to forecast the physical behavior of an Enhanced Geothermal Reservoir (EGS) in the URG. The former international geothermal research project in the URG, Soultz-sous-Forêts, targets a fault-related granitic reservoir with elevated temperatures at 5.000 m depth. During the long-term research activities, a large scientific and experimental database has been created, which offers the opportunity to characterize the geothermal reservoir in a detailed way.

These data, e.g. geophysical, hydraulic, temperature and seismic measurements, were evaluated and used as input parameters and for the definition of the boundary conditions in a FE-modeling of the geothermal reservoir at the Soultz site. Sausse et al. (2010) developed a 3D geological model of the fracture network at the location of Soultz-sous-Forêts. Held et al. (2014) extended this structural model to an input for a thermo-hydraulic evaluation of the long-term reservoir performance. The new simulation extends the model of Held et al. (2014) and uses hydraulic and thermal datasets to improve the understanding of the fracture network of the Enhanced Geothermal System. A tracer test, made in 2005 (Sanjuan et al., 2006), allows the evaluation of the interconnection of the different wells and the quantification of the flow field in the influenced fractures between the principle wells. We simulated a long-term production scenario with the MOOSE-based application TIGER. The application gives us the opportunity to quantify the geothermal potential by solving hydro, thermal and transport processes in a fully-coupled manner.

REFERENCES

Held, S., Genter, A., Kohl, T., Kölbel, T., Sausse, J. & Schönball, M., 2014. Economic evaluation of geothermal reservoir performance through modeling the complexity of the operating EGS in Soultz-sous-Forêts. Geothermics, 51: 270-280.

Sanjuan, B., Pinault, J.-L., Rose, P., Gérard, A., Brach, M., Braibant, G., Crouzet, C., Foucher, J.-C., Gautier, A., Touzelet, S., 2006. Tracer testing of the geothermal heat exchanger at Soultz-sous-Forêts (France) between 2000 and 2005. Geothermics 35, 622–653.

Sausse, J., Dezayes, C., Dorbath, L., Genter, A., Place, J., 2010. 3D fracture zone network at Soultz based on geological data, Imagelogs, microseismic events and VSP results. Comptes Rendus Geoscience 342, 531–545.