Simulation of the Transport Phenomena in the Horstberg Geothermal System

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Abstract

This study presents the simulation of transport phenomena in the Horstberg geothermal system in the North German Basin. The Horstberg geothermal system composed of a subsurface reservoir and a borehole. The borehole was completed in a multilayer sandstone reservoir and an induced hydraulic fracture was created by massive water injection. During reservoir life time, the warm water will be produced from the upper porous layer (Solling formation) and will be injected into the lower porous layer (Detfurth formation). The borehole is similar to a concentric pipe that allows injection through inner pipe (tubing) and production from outer pipe (annulus).
The subsurface structural model includes the major faults and induced hydraulic fracture that in turn provides the input geometry into COMSOL Multiphysics®. The Subsurface Flow and Heat Transfer Modules were employed in the subsurface model to couple the Darcy's Law and Solid Mechanics physics interfaces, as well as the Heat Transfer in Porous Media physics interface. The second model (borehole model) aims at a simulation of heat transfer and fluid flow in an approximately 4000 meter concentric pipe which acts similar to a counter-current heat exchanger.

The final goal of this simulation is to couple the subsurface and borehole models to model the performance of the reservoir at different wellbore conditions. The coupled simulator can be used in optimizing production, daily operation, designing well tests, etc.