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Three-dimensional numerical modelling of heat transfer through fractured geothermal reservoirs

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The necessity of an accurate estimation of heat potential in geothermal production zone due to existing fractured networks has been increased. In this research, we demonstrated a three-dimensional model including three parallel fracture plates through a geothermal well.

The goal is to couple the heat convection to structural anomalies to observe and predict heat production potentials and limitations within geothermal reservoirs. We modelled a three-dimensional cube in the meter, which Darcy porous media and fracture flow govern the fractured porous media. The numerical model has been built in COMSOL Multiphysics, applying heat transfer and Darcy flow modules, simultaneously.

To investigate the temperature anomalies, we extracted the temperature distribution through the fracture plates and the entire reservoir space. The simulation period is planned till reaching a steady state of thermal convection through the fracture plates. The convection term depends on hydraulic conductivity, the thickness and the orientations of the fractures.

The convection which is occurring in highly fractured reservoirs generates regions with high-temperature gradients. The hydraulic conductivity and porosity of the fracture planes directly affect the convection through the geothermal reservoir.

We specified various temperature differences between exterior boundaries of the fractures and the flow, due to the change of the reservoir temperature gradient. Applying different thermal boundaries allows us to investigate various heat convection scenarios through the geothermal reservoir.