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Impact of single faults on the fluid flow and heat transport: Results from 3D finite element simulations

Yvonne Cherubini (1,2), Mauro Cacace (1,2), Magdalena Scheck-Wenderoth (2), Mando Guido Blöcher (2,3), and Björn Lewerenz (2)

(1) University of Potsdam, Potsdam, Germany (yvonne.cherubini@gfz-potsdam.de), (2) Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences, Basin Analysis, Potsdam, Germany , (3) Brandenburg University of Technology, Cottbus, Germany

Fractures and faults are likely to have a significant impact on the solute, fluid and heat transport in the subsurface. Depending on their hydraulic properties, faults can act either as preferential pathways or as barriers to fluid flow. To investigate the influence of faults on the hydrogeothermal field, 3D simulations of the coupled fluid and heat transport are carried out. Such models allow to quantify the effects of different fault geometries and physical rock properties on the temperature distribution.

In general, it is a challenging task to investigate processes occurring in geological faulted systems due to their complex geometry with variable dipping and intersecting fractures. Furthermore, the huge number of faults encountered in many geological settings inhibits an exactly understanding of the respective role played by each individual fault. Therefore, it is crucial first to understand the impact of single faults on the fluid and heat transport before modelling more complex structural settings. These numerical models with simple fault geometries involve variations in fracture size, orientation, aperture and variable physical rock properties.

The faults are represented as 2D planar discrete structures embedded in an outer boundary tetrahedral volume. Results from modelling of simple fault systems show that faults have a significant impact on the fluid and heat flow by locally influencing the hydrostatic pressure, velocity and temperature field.