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Effects of anisotropic faults on fluid flow and temperature pattern

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In geothermal fields convection is significant and widespread mechanism affecting the subsurface temperature. Natural thermal convection in a geothermal area arises from unstable variation of fluid density due to uneven temperature distribution. Depending on the physical properties of the porous medium and the boundary conditions, convection cells are controlled by the critical Rayleigh Number, which is the value for an infinite flat-lying porous medium with fixed upper and lower boundary temperatures. As the Rayleigh Number increased, convective circulation pattern shifts progressively from stable state to unstable state with more complicated spatial and temporal behavior. Based on numerical simulation results, large-scale convection can occur on the size of basin thickness, and the presence of faults also modifies the thermal convective flow pattern by constraining the size and location of convective cells. Furthermore, faults can induce convection in neighboring units even the thermal condition is not favorable for the convective flow. The objective of the study is to investigate the changes in fluid-flow and temperature field with respect to the anisotropic faults in geothermal areas by numerical modeling. Temperature distribution and fluid flow vectors pattern can be modified by anisotropic structures of the faults where permeability is direction dependent. Permeability of faults and fractures are generally quite complex both in time and space and the small-scale variations in permeability within a fault can increase/decrease the bulk permeability by one order of magnitude. FLUENT computational fluid dynamics software is used to model the faults with varying permeability ratios. Several numerical simulations is presented to reveal the evolution of the anisotropic fault related changes in the fluid flow and temperature in geothermal fields.