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Damage Evolution and Fault reactivation during Stimulation of a Geothermal Reservoir

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In many geothermal projects the generation of additional fluid pathways, for example by injecting fluid into the geothermal well under high pressure, is necessary to achieve the required rate of fluid flow. Because in a number of geological setting pre-existing faults are the prefered target structures for geothermal wells, the interaction between the faults and fluid pressures generated during the stimulation needs to be considered as well as the influence of the faults of fluid flow. Therefore a good understanding of the interaction and feedback between permeability, porous flow and damage evolution is needed.
In this study we are using numerical simulations of the coupled hydro-mechanical processes to investigate the relation between fluid injection, damage evolution and possible fault reactivation in a simplified model of a geothermal reservoir. The simulations are based on a Finite Element model including the damage evolution procedure developed by Karrech et al. 2014 [1].
The geometry, material properties and stress conditions used in the models are based on the available data from the geothermal site in Soultz-sous-Forets (France). The dominant geometrical structure in the model is a steeply dipping fault zone. Otherwise the rock is considered homogeneous. The geometry of the fault zone and its location relative to the well is simplified from Evans et al. 2005 [2]. The stress boundary conditions are taken from Cornet et al. 2007 [3].
Initial results show that the evolution of the damage, and therefore the permeability, in the model is strongly dependent on the material parameters, in particular the amount of pre-existing damage in fault zone. Under the injection pressures considered in this study a reactivation of the fault appears to be feasible only if the fault is already very weak prior to the stimulation.

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