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Discrete fracture network modelling of Groß Schönebeck stimulation treatment

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Microseismic events associated to geothermal reservoir are recorded before, during and after the establishment of an Enhanced Geothermal System (EGS). Differentiating recorded seismicity between natural and induced can be ambiguous, but reservoir response to stimulations treatment can be modelled and give useful insights in designing treatment.
Our model reproduces the stimulation treatment done at Groß Schönebeck reservoir.
The stimulation target was the volcanic layer of the Rotliegend formation at 4km depth. The treatment increased by a factor 22 the productivity index (volume of fluid produced per unit of time per drawdown) of the reservoir, while recorded seismicity was lower than expected (<100 events recorded, max magnitude mL=-1). The microevents signal properties are compatible with shearing events and their locations along a plane give us little information on the processes occurring during the water injection. Bottom hole injection pressure was over the minimum stress, therefore we expect fracture opening due to both tensile and shearing opening. The interaction between a primary fracture initiating from the wellbore due to the injection and the secondary discrete fracture network (DFN) has been modelled with a hydraulic fracturing simulator. The DFN has been populated on the basis of available borehole data and lithological properties determined from rock sample analysis.
Heat transfer has been computed since the temperature difference between injected fluid and reservoir rocks is over 100°C, inducing thermoelastic stresses around the the fractures.
The model shows the importance of the natural fracture network, perturbing the reservoir state at distance in direction parallel to the minimum stress. Results are compared with commercial tensile and shear fracture models, which are compatible in term of predicting increased productivity of the well.
We justify the absence of larger magnitude events after shut-in with the low natural seismicity and the high overpressure required to bring critically stressed faults to failure. We will calculate seismic rate, on a probabilistic approach basis, due to varying pore pressure and thermal stresses.