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Evolution of hydro-mechanical properties during shearing in an EGS reservoir using a DFN model

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In geothermal systems such as Soultz-sous-Forets, the hydraulic stimulation will ensure the efficient hydraulic exchange between injection and production wells by improving hydraulic conductivity of the fracture network through shear of pre-existing fractures. Shear motion creates permanent changes in hydraulic conductivity because of dilation angle of asperities existed on both sides of fracture planes which in most cases do not match each other after stimulation and create a conduit of open space between. This operation is normally accompanied with microseismicity and is monitored by deploying surface and down-hole seismic receivers.
4-D P-wave tomography derived from seismic monitoring during hydraulic stimulation of well GPK2 of Soultz-sous-Forets, an unexpected occurrence in the P-wave velocity variation. In two steps of stimulation, when the injection flow rate was increased, the P-wave velocity in the stimulated area increased as well (Calo et al., 2011). This is vice versa with what experienced in the laboratory by lockner et al., (1974) and Rummel (1991), which may be caused by non-linear evolution of hydro-mechanical coupling of discontinuities as explained by Bandis et al, (1983).
Hence, the aim of current project is to numerically model the non linearity for the elastic response of fractures and to investigate the role of dilatancy associated with shear motions along fractures once they reach instability. 3DEC numerical modeling tools developed by Itasca Consulting Group is used to fulfill the aim of project, considering that dilatancy in 3DEC develops only if shear slip occurs. So far, to pace on abovementioned track, first a numerical model of stochastic discrete fracture network (DFN) on the basis of wellbore scale fracture network description (Massart et al., 2010) is created and after that its effects on mechanical behavior of a 100x100x100 m3 block is investigated.

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