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MIXED-DIMENSIONAL HYDROMECHANICAL MODELLING OF AN IN SITU HYDROSHEARING EXPERIMENT

Ivar Stefansson[1], Haakon L. L. Ervik[2], Mohammadreza Jalali[3], Antonio P. Rinaldi[4], Thomas Driesner[5] and Inga Berre[6]

[1] University of Bergen, ivar.stefansson@uib.no
[2] Caltech, haakon@caltech.edu
[3] RWTH Aachen University, jalali@lih.rwth-aachen.de
[4] ETH Zürich, antoniopio.rinaldi@sed.ethz.ch
[5] ETH Zürich, thomas.driesner@erdw.ethz.ch
[6] University of Bergen, inga.berre@uib.no

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The applicability of laboratory experiments does not necessarily extend to the scale of geothermal reservoirs. The gap may be partly bridged by mesoscale in situ experiments such as those conducted at the Grimsel Test Site in Switzerland. We consider a hydraulic stimulation experiment [1] involving fracture permeability enhancement through shear deformation and non-linear elastic deformation and use it to validate our numerical model [2].
The mixed-dimensional discrete fracture-matrix model includes linear poroelasticity in the matrix. Fluid mass balance is imposed in the fractures, while fracture deformation is governed by contact mechanics relations. We apply a monolithic, fully coupled solution strategy using an algorithmic differentiation approach to the strong nonlinearities arising from the coupling between deformation and permeability of the fractures. The model is implemented in the open-source simulation toolbox PorePy [3].
Reasonable matches are obtained between simulated and experimental pressures, deformations and permeability enhancement. We exploit the tight monitoring of the dynamics during the experiment to investigate the interplay between and relative importance of the two fracture stimulation mechanisms included in the model.

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