EGU21-8561
https://doi.org/10.5194/egusphere-egu21-8561
EGU General Assembly 2021

Flow-induced microfracturing of granite in superhot geothermal environments

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Superhot geothermal environments with temperatures of approximately 400-500°C at depth of approximately 2-4 km are expected as a new geothermal energy frontier. In order to efficiently exploit the superhot geothermal resources, fracture systems are necessary as flow path of working fluid. Hydraulic fracturing is a promising technique because it is able to create a new fracture system or enhance the permeability of preexisting fracture system. Laboratory-scale hydraulic fracturing experiments of granite have demonstrated the formation of densely distributed network of permeable fractures throughout the entire rock body at or near the supercritical temperature for water. Though the process has been presumed to involve continuous infiltration of low-viscosity water into preexisting microfractures followed by creation and merger of the subsequent fractures, plausible criterion for the fracturing is yet to be clarified. The possibility that the Griffith failure criterion is available to predict the occurrence of fracturing was shown by hydraulic fracturing experiments with acoustic emission measurements of granite at 400°C under true triaxial stress. The present study provides a theoretical basis required to establish the procedure for hydraulic fracturing in superhot geothermal environment.