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Thermal Fracturing of Volcanic Rocks for Geothermal Field Applications

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Thermal fracturing is considered to be a potential mechanism to create additional fractures in geothermal fields. The injected cold water into the hot host rock suddenly cools down the host rock, causing a considerable shrinkage of the material and thus potentially increased local stresses that may potentially lead to the formation of cooling related fractures. This is likely to happen in the near wellbore environment or along existing faults or fractures, ie. areas where the hot rocks juxtaposed to cold fluids. In this research, we experiment with thermal fracturing by exposing heated granitic and basaltic samples with cold water to see the extend of the thermal microfracturing inside the samples at different temperatures. Before and after the heat treatment, the micro CT-scanner is used to get high-resolution 3D images of fracture planes and fracture network connectivity. Moreover, the porosity is measured before and after treatment by using the pycnometer to see the effect of the different temperatures. In addition, the changes in geomechanical behaviour are tested by using an unconfined compressive strength (UCS) apparatus on heat treated and non-heat treated samples. We compare the changes in Young Modulus, Poisson's Ratio and ultimate strength of the various samples and record the influence of the thermal fractures on the stress-driven fracturing behaviour in the UCS test.