[JJ] Evening Poster | S (Solid Earth Sciences) | S-CG Complex & General

[S-CG64]Brittle-Ductile Transition and Supercritical Geofluids for Crustal Energy in Island Arc

convener:Noriyoshi Tsuchiya(Graduate School of Environmental Studies, Tohoku University), Hiroshi Asanuma(AIST), Yasuo Ogawa(東京工業大学理学院火山流体研究センター)
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Nature of rock mass below the brittle-ductile transition (BDT) is of great scientific interest to understand various phenomenon in the Earth's crust. We will review and discuss current understanding of characteristics the rock mass below the BDT, including composites, stress, failure mechanism induced by liquid injection and associates earthquake generation mechanism, and water rock interaction, considering engineered geothermal development in the BDT. Discussions on the possible phenomena in the geothermal development in the BDT will be followed in this session.
New drilling technology is key of issues. This session will cover advanced drilling technology under high temperature conditions for energy extraction.

[SCG64-P01]Mechanical and hydrological properties of fractured granite under supercritical conditions

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To extract geothermal energy effectively and safely from magma and/or adjacent hot rock, we need to tackle many issues which require new technology development. One of them we are targeting on is to develop a technology to mitigate induced-earthquakes. It is required to understand roles of factors on occurrences of the induced-earthquake (e.g., strength, crack density, and fluid-rock reaction) and their intercorrelations (e.g., Asanuma et al., 2012).

Our purpose of this series of experiments is to clarify a relationship between the rock strength and the fracture density under hydrothermally supercritical conditions. We conducted triaxial deformation test on intact granite rock strength under high-temperature (250 – 750°C), high-pressure (104 MPa) condition at a constant load velocity (0.1 μm/sec) using a gas-rig at GSJ, AIST. We used Oshima granite, which has initially <0.2 % of the porosity, 4.26±0.42 km/s in V_p at dry condition (dry). All experimental products showed brittle feature having several oblique fracture surfaces, but both value of peak stress and amount of stress drop became smaller at higher temperature. Additionally, Young’s modulus decreases with increasing the temperature from 57.4 GPa at 250°C to 32.3 GPa at 750°C . At 400 °C, the stress drop accelerated the deformation with ~98 times faster velocity than that at load-point. In contrast, at 650 °C and 750 °C, the velocity during stress drop kept the same order of the load-point velocity. Therefore, the deformation feature may start to be of ductile when the temperature exceeds 650 °C.
Highly dense cracked granite specimens were formed by a rapid decompression test (RDT) using an autoclave settled at Tohoku University (Takagi et al., 2017GRC Trans.). We reduced fluid pressure within 2 seconds from vapor/supercritical state (10 – 48 MPa, 550 °C) to ambient pressure. X-ray CT scanning on the specimens after RDT showed that numerous microcracks were generated in them. The RDT imposed the porosity increasing towards 3.75 % and V_p decreasing towards 1.46±0.22 km/s (dry). We conducted the permeability measurement on fractured granite after RDT with the porosity of 1.06% under a combined condition of 400 °C in temperature and 104 MPa in the confining pressure.

Permeability measured by pore pressure oscillation method decreases from 4.3×10^{-18} m^2 at pore fluid pressure (P_p) of 70 MPa to 9.0×10^{-19} m^2 at P_p of 38 MPa. In the meeting, we will present results of triaxial deformation test on such cracked granites and show the relationship between strength and crack density under supercritical conditions.