Flash Fracturing of Rock at Supercritical and Subcritical Conditions

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Artificial cracks creation in rocks can be applied to deep geothermal drilling. Thermal stress derived from rapid decompression is considered to be effective for crack creation of rocks (Tsuchiya et al., 2012). In this study, granite samples were heated to 500, 550 and 600 ˚C with water at up to 50 MPa confining pressure, then rapid decompression was carried out to investigate the effectiveness of flash fracturing. Temperature drop after decompression (defined as ΔT) is increased as pressure before decompression increases due to large amount of water in high pressure conditions causing large latent heat of evaporation.
Porosity of specimens after experiments is significantly depending on pre-heated temperature and ΔT. Especially porosity is largely increased between 550 ˚C and 600 ˚C. As naturally cooled samples have similar porosity change between 550 ˚C and 600 ˚C, this significant increase is mainly caused by α-β transition of quartz, dominant mineral of granite, which occurs at 573 ˚C (Ohno, 1995). However, porosity of rapidly cooled (decompressed) samples is greater than that of naturally cooled samples at each pre-heated temperature. This difference of porosity increment, in other words crack creation, by cooling treatment is affected by cooling rate of rock sample. Moreover, specimens decompressed at vapor phase (from 4 MPa to atmospheric pressure) have more fractures than naturally cooled ones. This result implies that even if decompression from pressure condition in geothermal reservoir to atmosphere is not realized, decompression for several megapascals can generate fractures in rocks.

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