Frequency characteristics of acoustic emission in granite during triaxial compression tests

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Fluid flow-induced seismicity has been observed in various engineering fields such as geothermal system (e.g., Grigoli et al., 2018). Especially, in the Pohang enhanced geothermal systems project, the moment magnitude 5.4 earthquake was induced by fluid injection after the events in the entire period of stimulations (Kim et al., 2018). To understand the generation processes of induced earthquakes due to fluid injection, it is necessary to research the propagation process of pre-existing cracks in thermally damaged granites. The acoustic emission (AE) is defined as elastic waves released by rapid cracking, which is a useful tool for investigating rock fractures. The frequency of AE signals from fracturing contains information about internal structure of a rock. In this study, we measure acoustic emission (AE) and P-wave velocity during triaxial deformation of thermally cracked granite.

We conduct a triaxial compression test on granite at confining pressure of 22.5 MPa and strain rate of 10-5 1/s under dry condition using the loading system at GSJ/AIST (Lei et al., 2011). Cylindrical intermediate-grained Oshima granite and coarse-grained Inada granite (50 mm in diameter and 125 mm in length) which are thermally damaged at 550 ℃ are used as samples. We measure AEs with twenty-eight piezoelectric transducers (PZT) and strains with six strain gauges.

A preliminary result shows that a sample deforms elastically until at 384 MPa. After the peak stress of 438 MPa, post-yield behavior of the sample indicates brittle deformation with drastic stress drop. AE activity was initiated at around 80 % of the peak stress, and increased rapidly after reaching the peak stress. Initiation and growth of cracks inferred from AE events is consistent with the damaging process proposed by Lei (2006). Frequency analysis based on the fast Fourier transform shows that frequency of AE signals released during deformation are in the range of 100-300 kHz. Previous study reported that low-frequency events were dominant as rock approached failure under compression (Ohnaka and Mogi, 1982). However, no clear variation in frequency band was found from the results of this study. This is because AEs were not recorded in a range sufficient to understand the whole trend, and it is necessary to record AE signals from the initial stage of deformation, such as using transducers with different frequency band.

Keywords: acoustic emission, frequency, triaxial compression test

