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## Hydraulic fracturing for plaster under brittle-ductile transition condition

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Japan is one of the most volcanically active countries in the world and has rich geothermal resources. Geothermal power generation does not result in dis-charges of greenhouse gases, such as carbon dioxide, to the same extent as other energy generation methods that combust fossil fuels. This form of energy generation is also stable, not being dependent on weather or season. To promote geothermal research and development, Muraoka et al. proposed the Beyond-Brittle geothermal system [1]. This is designed to demonstrate the feasibility of a new type of power generation method, using an artificial brittle fracture reservoir system in high temperature ductile zones. To control fracture formation, various fracturing methods have been proposed. A hydraulic fracturing method is considered to be one of the reasonable method. In this study, we used a plaster as a simulated ductile rock it has greater ductility compared to the brittle rock under a moderate temperature, and conducted hydraulic fracturing experiments under brittle-ductile conditions.

Figure 1 shows the triaxial testing system used to examine the mechanical properties of the plaster under brittle-ductile conditions. Figure 2 shows the true-triaxial hydraulic fracturing testing system. The experimental system mainly consists of a true-triaxial compression machine, a supplying system of hydraulic fluid, and a measuring system. The plaster specimen was placed in the true-triaxial compression machine. Three compressive stresses were applied to the rock specimen using three hydraulic rams. The fracturing fluid was injected into the borehole within the specimen.

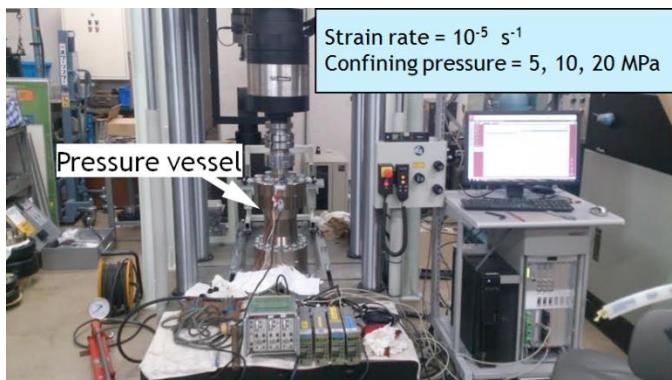


Figure 1: Triaxial testing system

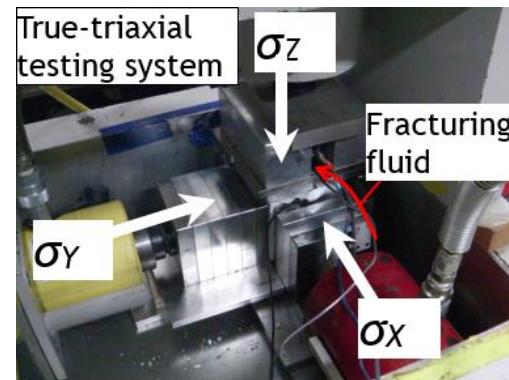


Figure 2: True-triaxial hydraulic fracturing testing system

As the results of the triaxial tests, the behaviours of elastic deformations of the plaster obtained for both ductile and brittle conditions were almost similar. On the other hand, the remarkable differences on the stress-strain behaviours after yielding points were observed between ductile and brittle conditions. The results of the hydraulic fracturing experiments showed that the fractures obtained for both brittle and ductile conditions were almost similar shapes. Accordingly, these results suggest that the hydraulic

fracturing were strongly affected by the mechanical properties of the elastic region even though the brittle-ductile conditions.

*References:*

- [1] Muraoka H. et al. (2013) Chigakuzasshi 122: 343-362
- [2] Brantut N et al. (2011) Journal of Geophysical Research: Solid Earth 116, B01404, DOI: 10.1029/2010JB007675

