Oral | Symbol S (Solid Earth Sciences) | S-SS Seismology

[S-SS32_1AM1]Fault Rheology and Earthquake Dynamics

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Interdisciplinary discussions on the rheology of seismogenic faults and earthquake generation processes among the following specialists; (1) fault rocks and fault zones, (2) theoretical and numerical studies on earthquake dynamics, and (3) seismology and geodesy. Presentations on fault-zone drilling projects are also welcome.

10:30 AM - 10:45 AM

[SSS32-P08_PG]The experimental study about frictional instability of fault gouges in terms of Rowe's energy ratio

3-min talk in an oral session

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Keywords:frictional instability, simulated fault gouge, Rowe's minimum constant energy ratio, friction experiments

1. Introduction The stress-dilatancy relationship for granular materials in a dense packing state was introduced by Rowe (1962). He used the energy ratio (K), which was the ratio of rate of energy dissipation in the direction of minimum principal stress to energy supply in that of maximum principal stress. According to the concept, K shall be a minimum and constant value (Rowe, 1962). However, there are many questions about the physical meaning of K. Therefore, the Rowe's low has not been applied much for fault mechanics until now. Nevertheless the stress-dilatancy relation is related to the onset of frictional instability, it has not been clear yet. So, we conducted friction experiments using simulated fault gouges in order to confirm whether Rowe's law can be applied to fault situation or not.**2. Methods** The friction experiments using simulated fault gouges were conducted in a gas-medium apparatus. The confining pressure was ranging from 140 to 180 MPa. We used a cylindrical gabbroic forcing blocks (20 mm in a diameter, 40 mm in a length, and cut by a 50 degree from their cylindrical axis) and quartz gouges were sandwiched by them. The sample sustained loading initially and holding at several values of axial stresses at 190, 450, 640 and 800 MPa. The strain rate was 10^{-3} /s. In order to measure strain, three strain gauges were glued onto a gouge layer through the Teflon jacket. Another one was placed to a forcing block in a vertical direction and far from a gouge layer. Data were recorded at 2 MHz. **3. Results and Discussion** From our friction experiments, we obtained K of gouges at different confining pressures. K is given by the ratio of rate of energy dissipation in σ_3 direction to energy supply in σ_1 direction, so it can be represented by the ratio of output energy to input one. We obtained strain of σ_3 direction from three strain gauges glued onto a gouge layer. Similarly, σ_1 and strain of σ_1 direction were obtained from another gauge. σ_3 was the confining pressure. Our results showed that the output energy was the linear function of input one. K increased with confining pressure and showed a certain constant value at each loading and holding stage. Moreover, the change in K was remarkable at the final loading stage. In other words, the output energy increased suddenly because gouge particles began to slip. So,

the change in K is large under high stress, including just before unstable slip. It matched shear localization (e.g. Logan et al., 1992; Marone, 1998). Because K is represented by a function of internal friction angle, we suggest that the change reflects the process of microstructural development. It implied that the statistical particle arrangements of gouges changed at each stress level. After gouges become a closest packing state at the peak stress, the grain size reduction (GSR) of gouges occurs leading to the development of shear structure. Under GSR occurrence, K became a new state. From previous study, it is known that the microstructural development has a close relation with frictional instability (e.g. Logan et al., 1992; Marone, 1998; Onuma et al., 2011). During progressive shear, the angle of R1-shear developed in gouges decreases with cumulative slip (Gu and Wong, 1994). Hence, the change in K, that is to say the change in internal friction angle must be connected with not only microstructural development but also frictional instability. **4. Summary** From our experiments using simulated fault gouges, we obtained relationships among microstructural development, frictional instability and energy ratio of it. We confirmed that the Rowe's law could be applied to simulated fault gouges. Therefore, we can assess frictional instability in terms of the energy ratio based on Rowe's law. Systematic laboratory observation provides better understanding on energetical or microstructural consideration on the sh