# Dynamic water permeability change of simulated fault induced by moderate velocity friction

*Wataru Tanikawa[1]

1. Japan Agency for Marine-Earth Science and Technology, Kochi Instutute for Core Sample Research

Co-seismic events induce sudden changes in pore pressure, flow rate, and fluid chemistry at depth. These temporal transitions could be explained by water permeability changes of fault zones at depth during earthquakes, and change in permeability in fault zone also plays an important role in dynamic processes. Considerable change of permeability may occur during the transition from coseismic to post-seismic period, though the change is not well documented. Therefore, I designed the laboratory system to measure the change of water permeability during low to high velocity friction tests using simulated fault rocks. Similar permeability-friction tests were conducted in the past studies (Tanikawa et al., 2012, 2014). However, the previous tests were conducted by using nitrogen gas as pore fluid, and slip rate was not so high compared to dynamic fault motions.

In this study, Belfast dolerite and Aji granite were used as test specimens. For each experiment, two 20-mm-long hollow cylindrical specimens with 40 mm and 16.5 mm outer and inner diameters, respectively, were used. To measure the permeability, radial flow from the inner wall to the outer wall of the specimen was induced by applying a differential pre pressure between inner and outer walls. 0.1 to 0.8 MPa of constant pore pressure was applied from the inner wall, and water flowing out from the outer wall was released to the atmosphere. I applied constant normal stress of 2 MPa and constant rotation speed from 0.1 to 100 rpm (0.001 to 0.1 m/s) for a slip displacement of 1 to 10 m.

The result shows that permeability (flow rate) increased suddenly at the onset of sliding by a factor of more than two, and the rate of increase was nearly proportional to permeability before sliding. After sliding, permeability was decreased gradually with time, and had almost stabilized within few minutes. To compare the permeability before and after sliding, higher velocity friction (>0.03 m/s) results in the increase of permeability, and slower velocity friction induced the permeability reduction. This transition appears to be related to velocity dependent friction behavior, as velocity weakening was observed at above 0.03 m/s of slip velocity. Permeability reduction and velocity weakening behavior at slower velocity regime is probably explained by gouge compaction and gouge friction. On the other hand, high velocity friction will produce thermal pressurization, flash heating, and thermal cracking, therefore, the transition process of water permeability for high velocity friction would be more complicated than slow velocity friction.

Keywords: permeability, friction coefficient, fault

 