Design of new high velocity frictional testing machine targeting on the shallow seismicity

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In general, a seismic slip velocity reaches to several m/s, and it dramatically increases a heating rate that also promotes chemical reactions within fault zones. Therefore, a slip behavior might be different from slow slip movement. To understand the dynamic slip behavior, high velocity frictional testing machine had been designed in the middle 90's. Now, five high velocity testing machine is working in the field of earth science in Japan. However, none of them can handle incohesive materials, such as clay rich fault gouge, and maintain and control the pore pressure under shallower and milled depth condition. Therefore, the tests were performed under dry condition and the effect of water on the friction had been neglected. However, to comprehend the fault slip behavior at shallow depth, frictional tests using incohesive fault rocks with full of water are necessary. Here, we introduce the new high velocity testing machine that copes with the above problem at Kochi Core Center/JAMSEC.

In our new machine, we can handle samples with the outer diameter of from 25 to 80 mm and maximum thickness of 40 mm. The capacities of axial load, torque, and motor are 100kN, 500Nm and 30kW, respectively, and we can produce 3 km depth condition assuming hydrostatic. We can easily get off the pressure vessel from the loading and rotation system, and we can select the size of pressure vessel for their purposes and sample volumes. When the largest vessels are used, 5 m/s of maximum velocity is achieved. We can monitor the changes of pore pressure and temperature during the slip tests. Furthermore, we can control the pore pressure, axial load, pore pressure and temperature independently. All parameters can be held at targeted values and be generated at constant incremental velocity. We can control the rotation more sensitively to program the complicated rotation history that slip velocity and acceleration change during the rotation. It enables us to produce the realistic slip that is similar to natural slip movement.

This machine is designed partly for the purpose of the research of NanTroSEIZE, and we are planning to use the core samples from the fault zones by IODP.