Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS38-26 会場:303 時間:5 月 24 日 09:45-10:00

南海トラフ断層浅部物質の大変位条件下における摩擦の速度依存性
Friction velocity dependence of the shallow parts of faults within the Nankai Trough at a large displacement

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Frictional velocity dependence of clay-rich fault material collected from the Nankai Trough in IODP Exp.316 at the shallow portion of the megasplay system (C0004) and at the frontal thrust site (C0007) were examined in frictional experiments performed at a normal stress of 5 MPa under water-saturated conditions with >250 mm of displacement. Experimental results derived for slip velocities from 0.026 to 2.6 mm/s reveal that there exist both velocity-weakening and velocity-strengthening materials along the megasplay fault. In contrast, all of the tested fault material from the frontal thrust region shows only positive velocity dependence at the same experimental conditions. The frictional coefficient values for slow slip velocities (v = 0.26 mm/s) are relatively low (0.2 to 0.35) for velocity-strengthening samples compared to the values for velocity-weakening samples (0.38 to 0.49). Microstructural analyses reveal that velocity-strengthening samples generally show homogeneous deformation textures in which the entire gouge layer is deformed, whereas velocity-weakening materials show evidence of shear localization in which deformation is concentrated along narrow subsidiary shears.

Results of XRD analysis shows that each of the tested fault rock samples contains clays (smectite, chlorite, illite and kaokinite), quartz, plagioclase and calcite. Low values of friction recorded for the velocity strengthening samples may indicate a higher content of weak clays in the experimental fault layers [e.g., Summers and Byerlee, 1977; Morrow et al., 1992]. However, a semi-quantitative XRD analysis of the clay fraction performed both on the velocity-strengthening samples and the velocity-weakening samples reveals that clay composition are rather uniform and the variations are small among the all examined fault materials.

These results may imply that velocity dependence of friction along the shallow parts of the faults within the Nankai Trough is sensitive to the variation of the clay content of the fault zones. Alternatively, it could be suggested that another property of the fault material, such as the size distribution of the grains within the fault zone also plays an important role in controlling deformation processes of the faults, whereby the velocity dependence of friction could be affected.

キーワード: 南海トラフ, 断層, 摩擦, 前縁断層, 分岐断層
Keywords: Nankai Trough, fault, friction, frontal thrust, splay fault