プレート境界断層の摩擦速度依存性への影響因子：コスタリカ沈み込み帯の例

Factors affecting frictional velocity dependence of a plate-boundary fault: The Costa Rica subduction zone.

*堤 昭人[1]、並木 由香[1]、比嘉 咲希[1]
*Akito Tsutsumi[1], Yuka Namiki[1], Saki Higa[1]

1. 京都大学大学院理学研究科
1. Graduate School of Science, Kyoto University

It has become increasingly clear that slow earthquakes occur on a plate interface in the vicinity of high pore-fluid pressure. This likely reflects the importance of pore-fluid introduction for the underlying mechanism of slow earthquakes. Application of rate- and state-dependent friction laws can also simulate the occurrence of slow earthquakes without fluids, yet there have been few relevant experimental studies. In order to understand possible factors that affect frictional velocity dependence of plate interface materials, we have conducted friction experiments on the input biogenic sediments to the Costa Rica subduction zone.
Frictional experiments were conducted on the following materials: silty clay, calcareous to silicic ooze, basalt, and amorphous silica extracted from the ooze. In the experiments, velocity dependence was examined at a water-saturated condition for loading velocities of 0.0028–2.8 mm/s. The ooze sample was tested also at elevated pore-fluid pressures within a range of effective normal stresses from 1 to 5 MPa. Frictional velocity dependence changes as a function of pore pressure. Frictional velocity dependence of the ooze sample is slightly negative at a range of relatively higher effective normal stresses (>2.5 MPa). When the level of pore fluid pressures is increased, frictional velocity dependence changes into velocity strengthening behavior. Microstructural analyses reveal that the velocity-strengthening sample shows homogeneous deformation textures, while the velocity-weakening sample shows evidence of shear localization. Experimental results show that content of amorphous silica may be one of the important factors affecting the velocity dependence of faults in oozes. Velocity dependence of the amprphous silica gouge is negative at all the tested velocities at the water-saturated test condition.
Occurrence of SSEs has been described as conditionally stable sliding of faults. Pore pressure increase will make weakly velocity-weakening fault conditionally stable. Our experimental results show that velocity-weakening behavior changes into velocity-strengthening behavior at high fluid pressures. This may provide an alternative interpretation for the role of pore-fluid pressure to stabilize intrinsically unstable faults.

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