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Frictional properties of simulated faults containing amorphous silica/calcite mixtures

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Various seismic behaviors such as large earthquakes, episodic slow slip events, or silent earthquakes are observed in subduction zones. Knowledge of the frictional properties of input material to subduction zones would help to understand the complicated seismic behaviors. On the Cocos plate, which subducts beneath the Caribbean Plate at Middle America Trench offshore Costa Rica, input sediments containing clay, silty clay sediments and silicic to calcareous ooze were collected during the IODP expedition 334. We have been studying the frictional properties of the collected input material to the Costa Rica subduction zone. In order to better understand frictional processes of a fault in silicic to calcareous ooze, we have performed a series of friction experiments on a simulated fault gouge containing mixtures of amorphous silica and calcite.

Frictional experiments were performed at a constant slip velocity of v = 0.28 mm/s, and also under a velocity-stepping condition. The silicic to calcareous ooze sample showed the following characteristic behavior. The friction coefficients at 0.28 mm/s showed initial peaks at 0.4?0.6 and subsequent little decrease, followed by a gradual increase to attain a constant friction value at 0.6?0.8. The analogue gouge containing 40?80 wt% of calcite reproduced such frictional behavior well. The experimental samples of the input ooze material required only about 40 mm of displacement to attain constant steady-state friction level. However, the calcite/amorphous silica mixtures needed larger displacement to attain steady-state friction. Furthermore, the calcite/amorphous silica mixtures could not reproduce friction velocity dependence observed for the collected ooze samples. The result suggests the importance of studying effects of grain size distribution and the grain morphologies on the frictional properties of the silicic to calcareous ooze material.

Keywords: subduction zone, frictional experiment, CRISP