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Behavior of phyllosilicate minerals in friction-flow transitional regime

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Comparing with other silicate minerals, the phyllosilicates have several characteristic properties. The phyllosilicates show lower frictional strength than the strength of other silicates obeying Byerlee's law and behave like plastic flow even under lower temperature condition. These properties are caused by that the phyllosilicates have easy sliding cleavage at (001) plane. Thus, the shearing experiment using the phyllosilicates could simulate conveniently the rock properties at the brittle-plastic transitional regime. The velocity step test on chlorite gouge was employed to clarify what mechanism mainly controls the sliding deformation of the phyllosilicate mineral. We, using a biaxial testing machine, observed the transitional behavior of the chlorite gouge after the velocity was changed instantaneously at a constant normal stress (10 - 50 MPa) under room temperature condition. The sliding velocity range was widely covered from 0.0014 to 14 micrometer/sec.

The plastic flow mechanism lets the strength increase gradually to be the new steady state strength posterior to the instantaneous increase of the velocity. On the other hand, if the friction mechanism controls the gouge behavior, the strength change follows the Dieterich's frictional constitutive law, drawing the exponential decreasing of the strength posterior to the instantaneous increasing at the instantaneous increase of the velocity. On the chlorite gouge, changing the velocity from 1.4 to 0.14 micrometer/sec, we obtained the flow and friction mixed behavior. Lowering the velocity from 0.14 micrometer/sec to the lower, the transitional behavior of the flow was appeared. At higher velocity, on the other hand, the frictional behavior was appeared stronger. Therefore, this velocity, 0.14 micrometer/sec, could be the boundary velocity of brittle-ductile transition of the chlorite under the room temperature condition. We considered that these complicated behavior could be explained by a model: a series of the Dieterich's frictional constitutive law and the flow behavior of Maxwell-body. We will also try to analyze each parameter constituting the model using the iterated inversion technique. We, here, would like to present the unique properties of the chlorite and summarize the rheology of the phyllosilicate minerals.