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Frictional behavior of talc at seismic slip rates: preliminary results from high-velocity experiments.

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Talc is one of the few minerals not following the Byerlee law, its static friction velocity is 0.2-0.25. Talc has been identified in the San Andreas Fault, and is expected to occur within subduction zone. Talc can then affect their seismic behavior.
Yet, the details of its frictional properties are poorly known, especially at seismic velocities. Our study aims at understanding its behavior at these velocities.

The properties of the talc were studied during high-velocity rotary-shear experiments carried out at from 0.01 m/s to 1.31 m/s, at normal stresses of 0.6 to 1.4 MPa, using the frictional testing apparatus of the JAMSTEC. The experimental gouge is a pure natural talc schist powder (99.9% wt). The samples were test used in dry (i.e. at room moisture conditions) or wet conditions. During experiments, we were able to measure simulated fault thickness evolution, moisture release and to calculate friction coefficient.

Even though it is from the start a weak material, talc schist follows a slip weakening law, which appears to depend strongly on the saturation of the sample.
Dry samples sliding at speed of 1.31m/s an exponential decrease of friction coefficient from a peak value of 0.98-0.71 to a steady state value between 0.18 and 0.59. This weakening is strongly dependent on normal stress. Dry sample also experienced large gouge dilation.
Results from experiments on wet samples are different. The friction peak values of 0.52-0.36 drop to a steady state value between 0.1 and 0.18. Moreover the steady state friction seems to be independent on the applied normal stress. Finally, the wet samples do not experience dilation, but a large release of water steam.
This preliminary work suggests two different weakening processes for dry and wet conditions, respectively.

To understand the talc friction behavior, we performed studies on talc schist decomposition, in case flash heating would locally alter the talc structure. Differential thermal analysis (DTA) combined to thermogravimetric measurement (TG) of the initial talc schist powder determine the temperature of dehydration reactions occurring during our experiments, and the corresponding amount of released water: free water at ∼30-175 °C and at ∼475-600 °C, and structural water at ∼725-1075 °C. Associated with XRD analysis, the last temperature step shows thermal decomposition of talc to the products of enstatite + amorphous silica.
The onset of the latter reaction may explain the strengthening regimes that separate the two stages of weakening from a single run done on a decomposed talc schist powder (heated at 1000 °C).