Generation mechanism of slow stick slip verified from friction properties of mixed quartz/talc gouges

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In order to understand effects of phyllosilicate content on stick-slip behavior of fault zones, we conduct frictional sliding experiments on mixed quartz/talc gouges, using a direct shear apparatus. The experiments are carried out at room temperature, a normal stress of 10 MPa, and sliding velocities of 0.66–2.00 μm/s. Values of the steady-state friction coefficient and ($a-b$) for the quartz/talc gouges decrease with increasing talc content from 0.69 to 0.18 and from 0.0039 to −0.0032, respectively. For the gouges with talc contents of 0–8 wt.%, fast or slow stick slips occur. In slow stick-slip events, duration increases with increasing slip distance (up to 76.8 s), while stress drop decreases with increasing duration (down to 0.0046 MPa). The ratio $K = k/k_c$, where k is the elastic loading stiffness and k_c is the critical rheologic stiffness, slightly increases from 3.88 to 19.76 with increasing talc content. The range of K values (5.81–15.74) obtained for slow stick-slip events is above theoretically estimated K values of ~1 producing them.

Keywords: phyllosilicate, slow stick slip, rate- and state-dependent friction law, stiffness, friction sliding experiments, coefficient of friction

