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High velocity frictional properties of pure kaolinite and natural kaolinite-bearing fault gouges

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The present study focuses on the experimental measurement and theoretical understanding of the high-velocity frictional behaviour of the Median Tectonic Line Tsukide fault gouge and on its consequences on the large scale natural fault behaviour during co-seismic slip.

Several experiments were conducted on the MTL fault gouge using a rotary-shear apparatus at high velocities (up to 1.3 m.s^{-1}), low normal stresses (up to 1.4 MPa), for displacements up to 60 m. During these experiments, we observed systematically a slip-weakening behaviour, i.e. a dramatic decrease in the coefficient of friction, from a value of ~ 1.2 to a value of ~ 0.3. In addition, the slip-weakening distance D_C we calculated from these experiments decreases to several meters with increasing normal stress. XRD analysis also show that kaolinite content decreased after shearing. For comparison, additional experiments were conducted under similar conditions on pure kaolinite gouge samples. Monitoring humidity, we observed a release of water vapor during these experiments. XRD data indicated that kaolinite minerals were dramatically disorganized after high-velocity shearing, which may indicate thermal decomposition (in particular, dehydration).

Theoretically, at least three essential processes can take place during the high velocity shearing of a saturated clay fault gouge: frictional heating, thermal pressurization and mineral decomposition (dehydration). A short theoretical analysis of our experimental results shows that thermal pressurization was probably a negligible phenomenon during these experiments, due to the low normal stresses and very high hydraulic diffusivity along the fracture plane. However, our preliminary analysis shows that this might not be the case in-situ, where the mechanism of thermal pressurization (includ-

ing a production term due to mineralogical decomposition) may play a particularly important role during earthquake faulting of the MTL. Indeed, field observations on the MTL show that several gouge layers exist and that their mineral content may vary.