Geophysical Research Abstracts
Vol. 19, EGU2017-7282, 2017
EGU General Assembly 2017

The microphysics of phyllosilicate friction

Sabine A.M. den Hartog (1), Daniel R. Faulkner (2), and Christopher J. Spiers (3)

(1) Rock Deformation Laboratory, School of Environmental Sciences, University of Liverpool, Liverpool, United Kingdom (shartog@liverpool.ac.uk), (2) Rock Deformation Laboratory, School of Environmental Sciences, University of Liverpool, Liverpool, United Kingdom (faulkner@liverpool.ac.uk), (3) HPT Laboratory, Department of Earth Sciences, Faculty of Geosciences, Utrecht University, Utrecht, The Netherlands (C.J.Spiers@uu.nl)

Phyllosilicate-rich foliations in fault rocks are often thought to reduce overall fault strength and promote fault stability when forming an interconnected network. Indeed, laboratory measurements have shown that the average friction coefficient of dry phyllosilicates of ∼0.5 is reduced to ∼0.3 when wet or even 0.1 for smectite. A widely accepted interpretation of these observations is that the strength of phyllosilicates is controlled by breaking of interlayer bonds to form new cleavage surfaces when dry and by the low strength of surface-bound water films when wet. However, the correlation between phyllosilicate shear strength and interlayer bond strength, which formed the basis for this interpretation, was not reproduced in recent experiments (Behnsen and Faulkner, 2012) and is not supported by the latest calculations of the interlayer bond energies (Sakuma and Suehara, 2015). The accepted explanation for phyllosilicate friction also fails to account for the velocity dependence or (a-b) values, which decrease with temperature, reaching a minimum at intermediate temperatures, before increasing again at higher temperatures (Den Hartog et al., 2013, 2014). In this study, we developed a microphysical model for phyllosilicate friction, involving frictional sliding along atomically flat phyllosilicate grain interfaces, with overlapping grain edges forming barriers to sliding. Assuming that the amount of overlap is controlled by crystal plastic bending of grains into pores, together with rate-dependent edge-site cleavage, our model predicts most of the experimentally observed trends in frictional behaviour and provides a basis for extrapolation of laboratory friction data on phyllosilicates to natural conditions.