Geophysical Research Abstracts
Vol. 21, EGU2019-18611, 2019
EGU General Assembly 2019

Anatomy of dynamic slip in laboratory earthquakes at crustal condition

Stefan Nielsen (1), Chris Harbord (1), Nicola De paola (1), Daniel Faulkner (2), and Francois Passelegue (3)
(1) Department of Earth Sciences | Durham University, (2) Liverpool University, (3) École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

The dynamic evolution of fault strength during earthquakes cannot be fully determined from seismological data. Hence high velocity friction laws currently used in earthquake simulations are inferred from theoretical models and experiments, where thermally-activated processes triggered by frictional heating are invoked to explain pronounced co-seismic weakening. However, the full validation of theoretical constitutive laws requires the direct observation of both slip and friction during spontaneous propagation of rupture. Here we report the coseismic slip function and frictional evolution measured directly on a simulated fault surface, during spontaneous dynamic rupture propagation in a rock at conditions representative of nanoearthquakes at hypocentral depths. We show that slip can accelerate up to $\sim$0.6 m/s within tens of microseconds, concomitant with large dynamic stress drops due to the dramatic weakening of the sliding interface. Velocity dependence of friction is compatible with a flash heating model during the weakening, however the recovery phase is slower than expected from a thermally-activated process. Small and large slip pulses are similar upon normalization, but larger events show more effective weakening. Results provide an important validation of flash heating for use in rupture models and offer clues into the scaling of crustal earthquakes.