Geophysical Research Abstracts
Vol. 13, EGU2011-4125, 2011
EGU General Assembly 2011

Fault lubrication during earthquakes

Giulio Di Toro (1,2), Raehee Han (3), Takehiro Hirose (4), Nicola De Paola (5), Stefan Nielsen (2), Kazuo Mizoguchi (6), Fabio Ferri (1), Massimo Cocco (2), and Toshihiko Shimamoto (7)

(1) University of Padova, Dipartimento di Geoscienze, Padova, Italy (giulio.ditoro@unipd.it, ++39 0498279107), (2) Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy, (3) Korea Institute of Geoscience and Mineral Resources, Daejeon, South Korea, (4) Kochi Institute for Core Sample Research, JAMSTEC, Kochi, Japan, (5) Department of Earth Sciences, University of Durham, Durham, United Kingdom, (6) Central Research Institute of Electric Power Industry, Chiba, Japan , (7) State Key Laboratory of Earthquake Dynamics, Institute of Geology, Beijing, China

The determination of rock friction at seismic slip rates (about 1 m/s), is of paramount importance in earthquake mechanics, as fault friction controls the stress drop, the mechanical work and the frictional heat generated during slip. Given the difficulty in determining friction through seismological methods, elucidating constraints arise from experimental studies. Here we review a large set of published and unpublished experiments (about 300) performed in rotary shear apparatus at slip rates of 0.1 – 2.6 m/s. The experiments indicate a significant decrease in friction (up to one order of magnitude), which we term fault lubrication, both for cohesive (silicate-, quartz- and carbonate-built) and non-cohesive (clay-rich, anyhdrite, gypsum and dolomite gouges) rocks typical of crustal seismogenic sources. The available mechanical work and the associated temperature rise in the slipping zone trigger a number of physico-chemical processes (gelification, decarbonation and dehydration reactions, melting, etc.) whose products are responsible for fault lubrication. The comparison between (1) experimental and natural fault products and (2) mechanical work measures resulting from these laboratory experiments and seismological estimates allows for the extrapolation of experimental data to conditions typical of earthquake nucleation depths (7-15 km). It appears that faults are lubricated during earthquakes, irrespective of the fault rock composition and of the specific weakening mechanism involved.