Geophysical Research Abstracts
Vol. 21, EGU2019-13806, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

A New State-of-the-art Apparatus to Study Earthquake Nucleation and Propagation: HighSTEPS

Marie Violay (1), Carolina Giorgetti (1), Chiara Cornelio (1), Giuseppe Di Stefano (2), Stefan Weimer (3), and Jean-Pierre Burg (3)

(1) EPFL, IIC, LEMR, Lausanne, Switzerland (marie.violay@epfl.ch), (2) INGV National Institute of Geophysics and Volcanology, Rome, Italy, (3) ETH Zurich, Zurich, Switzerland

The mechanics of rupture nucleation and propagation have long been investigated with seismological observations on active faults, geological observations on exhumed faults and rock deformation experiments on laboratory faults. However, the integration of these multidisciplinary observations collected at different scales is still challenging. Particularly, friction experiments are often limited in boundary conditions. We present a state-of-the-art biaxial apparatus able to study both rupture nucleation and propagation at boundary conditions typical of seismogenic faults. The HighSTEPS, High Strain Temperature Pressure Speed, apparatus simulates fault deformation in a wide range of velocities, i.e. from 10 μm/s to 0.2 m/s. Within this velocity range, it is possible to study both the rate-and-state friction and the dynamic weakening, under unique boundary conditions, i.e. normal stress up to 100 MPa, confining pressure up to 100 MPa, pore fluid pressure up to 100 MPa and temperature up to 100 °C. The apparatus consists of a hydraulic system integrated with four linear motors. The normal stress is applied by a horizontal piston. The confining pressure is applied through an oil-confining medium by an intensifier connected to a vessel implemented within the biaxial frame. The pore fluid pressure is applied by two pore fluid intensifiers connected to the sample, which also allow for permeability measurements. In addition, the vessel is implemented with two heating plates and feedthroughs for acoustic sensors and strain gauges. The main peculiarity of this apparatus is the system of four linear motors mounted in series in order to apply shearing velocities up to 0.2 m/s, accelerations up to 10 m/s^2 and shear stresses up to 100 MPa. Moreover, both experiments in sliding velocity control or shear stress control on the experimental faults are possible. Preliminary experiments are consistent with the previous literature on the topic. The investigation of fault friction under a wide range of velocities, normal stresses, confining pressures and pore fluid pressures will provide insights into the mechanics of earthquakes and reduce the gap between natural and laboratory observations.