Complexity Science Seminar

Monday, October 29 2018, 2:00 PM
Earth Sciences 136

Complexity of spatiotemporal microfracturing processes and stress field evolution before and after fault slip: Laboratory perspective

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We investigate details of spatial and temporal evolution of the stress field and damage at a pre-existing fault surface during laboratory stick-slip friction experiments performed on Westerly Granite samples. Specimens were deformed at constant strain rate of 3×10-6 s-1 and confining pressures of 150 MPa. Here we analyze a series of 6 macroscopic slip events, each associated with intense microseismic activity. The Acoustic Emission (AE) events were recorded using a 16-channel transient recording system. Monitoring and mapping AE properties allowed recovering spatiotemporal damage and stress evolution. We investigated source characteristics (magnitude, seismic moment tensors and focal mechanisms) as well as the statistical properties (b-, c-, d- value) of microseismicity to unravel the micromechanical processes governing nucleation and propagation of slip events. In addition, the calculated AE focal mechanisms were used to derive time-dependent local stress orientations, stress shape ratio, and additional parameters such as scaled shear traction, quantifying proximity to failure of individual fault patches. The calculated characteristics are used to evidence the clear complexity of the preparatory and post-slip damage and stress evolution framing the macroscopic slip in the microscale. The observed fault processes and characteristics are discussed in the context of global strain and stress changes, fault surface maturation (roughness), and earthquake stress drop.

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Everyone is welcome!

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