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Faults & Earthquakes as Granular Phenomena: Controls on Stick-Slip Dynamics

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Granular and continuous materials fail in fundamentally different ways, yet inherently discontinuous natural fault materials have often been modeled as continuum processes. Within a sheared or compressed granular material, the internal stresses take the form of a network of force chains. This network of strong connections among the particles is observed to be highly heterogeneous, and the magnitude of the stress varies widely over short distances. I will present the results of laboratory experiments which highlight the granular conrols on earthquake fault behavior. We perform experiments in a quasi-two-dimensional shear zone containing several thousand 5 mm circular and elliptical photoelastic plastic disks, allowing us to monitor the spatiotemporal evolution of both internal stress and strain. While the time, length, and strength scales are vastly different from the natural case, the frictional behavior is found to be in agreement. Therefore, the experiments allow us to isolate the effects of granular interactions and choice of boundary conditions on the fault behavior, through the observation of large populations of stick-slip and creep events.