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Physics of Earthquakes and Faults

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Detailed observations and theoretical results on brittle failure events in individual fault zones point to three general dynamic regimes [1]. The first is associated with broad range of heterogeneities, little dynamic weakening during failure, power law frequency-size statistics, and temporal clustering of events. The second is associated with relatively-uniform localized structures, significant dynamic weakening, and quasi-periodic occurrence of characteristic system-size events. For a range of conditions, the response can switch back and forth between the forgoing two types of behavior. These dynamic regimes, geometrical properties of slip, and observed moment rate shapes can be explained by a simple model having two tuning parameters: dynamic weakening and conservation of elastic stress transfer during failure events [2]. The model can also explain multiple aspects of deformation in volumetric regions, including stress-strain curves, acoustic emissions and related power spectra, with a continuous transition from brittle to plastic behavior, and statistics of failure events in granular media [3]. The results from the latter studies are in good agreement with experimental data [4] and simulations with other frameworks [5]. An extension of the model to include cohesion changes during failure and healing phases of deformation may account for transitions between solid and granular phases of materials [6].

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