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# Stick–slip dynamics of flow-induced seismicity on rate and state faults

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## ABSTRACT

Changes in pore pressure due to the injection or extraction of fluids from underground formations may induce potentially damaging earthquakes and/or increase the sensitivity of injection sites to remote triggering. The basic mechanism behind injection-induced seismicity is a change in effective stress that weakens a preexisting fault. The seismic potential of a given fault is controlled by the partitioning between seismic and aseismic slip, which emerges as a manifestation of stick--slip instabilities. Through fully coupled hydromechanical simulations, with fault frictional contact described by the Dieterich-Ruina rate- and state-dependent constitutive law, we investigate the evolution of slip due to pore pressure increase in an underground injection model. For the same flow conditions and rock mechanical properties, different constitutive parameters lead to a variety of stick-slip patterns, ranging from stable sliding or a sequence of many small slip events, to a single, larger slip event after significant aseismic slip has occurred. Our results suggest that good characterization of fault frictional properties and coupled geomechanical simulations are essential to assess the seismic hazard associated with underground flow processes.