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Fault permeability and rupture in injection-induced earthquakes

Thursday, 3 June 2021 10:30 (15 minutes)

Injection-induced seismicity has arisen as a central concern in the development of subsurface energy technologies such as enhanced geothermal energy, unconventional hydrocarbon production, wastewater injection, geologic carbon sequestration, or underground gas storage. The effect of the hydraulic properties of faults on the rupture of injection-induced earthquakes is still poorly understood.
Here, we study the effect of the hydraulic properties of faults on the rupture of injection-induced earthquakes. The hydraulic properties can range from sealing to complete conductive, both in terms of flow along and across the fault. Our research question is how these properties may alter the onset of slip, the symmetry of the rupture process, or the magnitude of the earthquake in terms of the seismic moment.
We simulate earthquakes through sophisticated two-dimensional computational models where events are triggered by fluid injection. We describe the fault frictional contact with the Dieterich-Ruina rate-and-state law. Rock is simulated as a poroelastic solid and we couple fluid flow and rock mechanics.
Our approach lets us quantify the impact of longitudinal and transverse fault permeability on the mechanisms that control the evolution of fault strength and shear stress during the rupture. We find that fault permeability drives fault stress and strength states at the onset of the rupture, and these in turn control the magnitude of the subsequent earthquake. Therefore, fault permeability exerts a fundamental control on the magnitude of earthquakes.

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Time Block Preference

Time Block A (09:00-12:00 CET)

References

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