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# The role of slow slip in triggering dynamic frictional ruptures

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## Abstract

An earthquake occurs when a seismic fault suddenly slips, releasing stresses that have accumulated during tectonic movement. These stresses can also be released by slow slip events, which can be detected by monitoring crustal deformation. The role of slow slip events is critical because they influence the occurrence of earthquakes along a fault. However, the mechanisms by which slow slip affects earthquake initiation remain poorly understood. A seismic event consists of the propagation of an interfacial rupture along a seismic fault, which can be described as a frictional interface. These ruptures, which break the microcontacts that form the interface and resist shear, have been shown to be pure shear (mode II) cracks (1). The question of how slow slip affects earthquake triggering is then related to the question of mode II crack initiation along a weak plane.

In a recent experimental study, we studied the case of laboratory fault, along which slow slip was induced by the presence of a heterogeneity in the composition of the interface, a granular inclusion. By measuring the response of the fault to shear and performing interfacial slip measurements and high-frequency strain measurements, we show that the slow-slip region acts as a nucleation center for seismic rupture, thereby increasing the frequency of earthquakes. The destabilization of the slow-slip region follows the same trends as a crack initiation criterion: the longer the slow slip patch, the earlier the destabilization into dynamic rupture and the more frequent the triggering of earthquake-like ruptures. Our work suggests that a fracture mechanics-based description may be used to predict the destabilization of a slowly slipping patch into a dynamic rupture. This provides further insight into how to account for fault complexity in models and improve understanding of the diversity of seismic fault behavior.

## References

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