Evidence for aseismic slip driven by pore fluid pressure following the 2016 Kaikōura Earthquake.

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Abstract

Pore fluid pressure plays a critical role in the failure of a rock mass. As a result of an increase in pore pressure, the effective normal stress is reduced leading to a drop in the shear resistance and fault stability. Here we document a short lived aseismic slip episode along ¸˜14 km-long unmapped fault following the 2016 Kaikōura earthquake which was likely triggered by a localized pore pressure increase within a shallow fluid trap. Using SAR data acquired by the European Space Agency's Sentinel-1 satellites, we form a post-seismic timeseries over the epicentral region of the Kaikōura mainshock. Immediately following the earthquake we observe ¸˜15 cm of uplift localized within a local sedimentary basin. The observed uplift rapidly dissipates with deformation becoming focused along a NE-SW trending discontinuity which cuts through the uplifted region. Due to its poor orientation with the coseismic rupture, slip along the fault should have been inhibited based on the estimated coseismic stress change. However, a reduction in the effective normal stress caused by the local pore pressure increase was sufficient to induce a short lived aseismic slip episode. The subsequent diffusion of pore pressure explains the observed decay in ground deformation and points towards a rapid relocking of the fault.

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