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Stress Interaction Between the Cascadia Subduction Zone and the Northern San Andreas Fault

Details

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Session	Postseismic Deformation: Measurements, Mechanisms, and Consequences I Posters
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Abstract

We evaluate the stress changes along the Northern San Andreas Fault (NSAF) associated with coseismic and postseismic deformation from Cascadia megathrust earthquakes in order to test the possibility that Cascadia earthquakes have triggered subsequent NSAF earthquakes. As a test case, we modeled the coseismic deformation from the 1700 Cascadia earthquake, the deformation from deep afterslip and sixty years of viscoelastic deformation prior to the ~1760 penultimate NSAF earthquake. We model the elastic and viscoelastic deformation on a layered spherical geometry, assuming that the entire Cascadia megathrust experienced a uniform fourteen meters of slip (~Mw 9.1) and seven meters of deep afterslip. The coseismic deformation increases Coulomb failure stress (CFS) on the NSAF by a maximum of about nine bars, in the section of the fault near Point Delgada, which may be enough to trigger a north-to-south propagating rupture. Postseismic afterslip both increases and reduces CFS along the NSAF, but its negative peak reduces the extent of the largest positive coseismic CFS by half. The CFS resulting from the estimated sixty years of viscous deformation leading to the penultimate NSAF earthquake does not contribute significantly to the total CFS on the NSAF. We compare our uniform-slip full-margin earthquake model with coseismic and postseimic CFS changes resulting from a southern Cascadia earthquake, with a uniform eight meters of slip

(~Mw 8.6), and from a heterogeneous full-margin earthquake that includes less slip on the southern fault planes. Total CFS on the NSAF from both the southern Cascade earthquake and the heterogeneous full-margin earthquake peaks in the same northern location as from the homogenous full-margin model, however the CFS magnitudes are reduced by about a factor of two. Based on these results, it appears that the most likely nucleation point of a triggered NSAF event, from whichever of the three Cascadia source models, would be near Point Delgada. We also modeled CFS on the Cascadia receiver faults from a NSAF type earthquake using a distributed slip model for the 1906 earthquake. The maximum positive coseismic CFS on the Cascadia megathrust is about 20 bars at the southern tip of the margin, at depths between 12-16 km. This may be sufficient to trigger an earthquake on southern Cascadia or on the smaller upper plate thrust faults in the region, although the 1906 events failed to do so. The paleoseismic record however strongly favors the former case, with Cascadia events preceding the NSAF by ~50 years, whereas Cascadia earthquakes follow NSF events on average by 150 years.

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