Rupture of the Northern San Andreas Fault and Possible Stress Linkages to Cascadia

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Abstract

We relate the late Holocene Northern San Andreas Fault (NSAF) Offshore/onshore paleoseismic history along the northern California continental margin to a similar dataset from the Cascadia margin. Evidence from stratigraphic correlation and merging of turbidity currents at channel confluences supports synchronous triggering of turbidity currents during the Holocene, when other sources such as storm river flows are less unlikely to reach the abyssal plain. In order to make comparisons between the temporal records from the NSAF and Cascadia, we refine correlations of southern Cascadia great earthquakes using 44 piston/trigger pairs, 7 box cores collected in 1999 and two Kasten cores from 2002, combined with the land paleoseismic record. Stratigraphic correlation is accomplished with P-wave velocity, gamma-ray density, RGB color reflectance, magnetic susceptibility, high-resolution imagery and AMS 14C ages. The late Holocene turbidite record off Cascadia and northern California passes several tests of synchronous triggering. Many turbidites can be correlated stratigraphically between channel sites supported by AMS 14C ages. Paleoseismic work at onshore sites along the Cascadia and NSAF systems shows good correspondence with the offshore record, further circumstantial evidence that the offshore record is primarily earthquake generated. During the last ~2800 years, 15 turbidites including the great 1906 earthquake establish an average repeat time of ~200 years, similar to the onshore value of ~210 years. The combined land and marine paleoseismic record from the southern Cascadia subduction zone, developed using similar methods includes a similar number of events in the past 3000 years. While the recurrence interval for full margin Cascadia events is ~530 years, the southern Cascadia margin has a repeat time of 260-290 years, similar to that of the NSAF. We observe that 11 of the previous 15 NSAF events were preceded by Cascadia events by ~0-80 years, averaging 47 years suggesting a temporal link (as compared to ~150 years if Cascadia follows the NSAF). We model the coseismic and cumulative postseismic deformation from great Cascadia megathrust events and compute related stress changes along the NSAF in order to test the possibility that Cascadia earthquakes triggered the penultimate, and perhaps other NSAF events. The Coulomb failure stress (CFS) resulting from the viscous deformation over ~ 60 years does not contribute significantly to the total CFS on the NSAF. However, the coseismic deformation increases CFS on the NSAF by a maximum of about 9 bars, in the section of the fault offshore of Point Delgada, most likely enough to trigger that fault to fail in north-to-south propagating ruptures. Triggering of Cascadia by the NSAF is also possible, though not favored by the paleoseismic data.

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