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Cascadia Segmentation and Long Term Temporal Rupture Pattern based on Paleoseismicity: some Global Implications *(Invited)*

Details

Meeting	2011 Fall Meeting
Section	Tectonophysics
Session	Source to Subduction: The Interplay of Sedimentation and Deformation at Subduction Zones I
Identifier	T44C-08
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Index Terms	Paleoseismology [7221] Seismicity and tectonics [7230] Subduction zones [7240]

Abstract

Onshore and offshore paleoseismic evidence from 41 Cascadia earthquakes strongly suggest that segmentation plays a significant role in Cascadia, and may have multiple sources. Offshore turbidite records show a remarkable correspondence along strike in 14C ages, physical property correlations, and even details such as mass per event and number of coarse fraction units per event. The joint correlation of these parameters allows approximate delineation of paleo-rupture extent, limited mostly by the spatial distribution of cores. The onshore-offshore space-time diagram reveals that recurrence intervals and segment length decreases southward along the margin. Southern segments may be controlled by obvious structural boundaries such as the Blanco Fracture zone, and two subducting pseudo faults. Along the northern margin, where segmentation is not apparent, basement structure is masked by thicker incoming sediment supply from two large fan systems, supporting a primary control by sediment thickness on the subducting plate. We suspect, supported by paleoseismic data, that northern Cascadia and northern Sumatra may be prone to large ruptures by similar mechanisms. One segment boundary in Cascadia appears not to be related to sediment supply, but may linked to a narrowing of the locked interface in map view. The Cascadia forearc is composed of an Eocene-Pliocene accretionary complex, outboard of which lies a Pleistocene-Holocene wedge of low taper, mixed vergence, and high pore fluid pressure. The young wedge is widest off Washington and northernmost Oregon, tapering both north and south. Mixed vergence, open folds, mud volcanoes and backstop parallel trends indicate poor coupling of the young wedge that is easily mapped from surface data. The long-term average downdip limit of significant coupling appears to be consistent with thermal, geodetic, and structural evidence of a transition from arc normal to arc parallel contraction. An average boundary consistent with these disparate data suggest significant heterogeneity in along-strike width and or magnitude of coupling. A seaward swing of the downdip locked zone, combined with a landward position of the updip limit may create a “pinchout” in central Oregon, where we observe a paleoseismic segment boundary. The 10ka paleoseismic record includes evidence of temporal variability as well. Temporal clustering, and the presence of several outsized events is apparent. When we compare the mass of correlated turbidite deposits along strike, we find a surprisingly strong correspondence between disparate sites, enough to conclude that earthquake magnitude and turbidite mass are crudely related for many Cascadia events. The two outsized events, dated at ~ 5960 and 8810 yrs. BP, consistently have two to five times the average turbidite mass for Holocene events at many sites, a relation not related to sediment supply. Plotting the long term energy balance based on mass per event reveals a robust pattern including long term increases and declines in stored “energy state” or “supercycles”. If Cascadia is representative of other plate boundary faults, this suggests that recurrence models may be neither time nor slip predictable and cannot be based on short instrumental records.

Cite as: Author(s) (2011), Title, Abstract T44C-08 presented at 2011 Fall Meeting, AGU, San Francisco, Calif., 5-9 Dec.