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Evidence for Segmented Ruptures in Cascadia, an Analysis of Alternatives

Goldfinger, C.[1], Black, B.[1], Enkin, R.[2], Hamilton, T.[3], Hausmann, R.[1], Galer, S.[1], Romsos, C.[1]

[1]*Oregon State University, College of Earth, Ocean and Atmospheric Sciences, 104 Ocean Admin. Bldg., Corvallis, Oregon 97331, USA. gold@coas.oregonstate.edu, 1+ 541 737 9622*

[2]*Geological Survey of Canada, Pacific Geoscience Centre, 9860 West Saanich Road, POB 6000, Sidney, BC V8L 4B2, Canada, randy.enkin@canada.ca, 250-363-6431*

[3] *Camosun College, Department of Chemistry and Geoscience, Lansdowne Campus, 3100 Foul Bay Rd., Victoria, British Columbia, Canada, V8P 5J2 tark_hamilton@yahoo.com*

Evidence of segmented ruptures along the Cascadia margin comes in the form of correlated turbidites offshore, lacustrine turbidites, and coastal paleoseismic records. Alternatives to segmentation of earthquake frequency have been suggested based on slope stability, sediment supply, and variation in local ground motions. Steeper slopes in S. Cascadia have been suggested as a mechanism to increase turbidite frequency on the southern margin. However, upper canyon slopes are steeper in Washington canyons (15-24º), and cores at the base of the steep reaches contain the same lower frequency records found on low gradient reaches (.5-2º), even those with locally expanded sedimentary sections. Sediment supply could also pertain, given the high sediment load delivered by the Eel River in southern Cascadia. However, core records show that the well-documented high-frequency turbidite record from the Eel system is largely contained between the Mendocino Ridge and the Trinidad Canyon plunge pool and fan. This leaves the turbidite frequency largely unchanged between the Rogue and Trinidad systems, with a slight southward increase. Grain size and proxies show a southward coarsening source, but no evidence of systematic southward increase in bed thickness, with some beds actually thinning southward. Sediment supply and stronger shaking in S. Cascadia are thus not likely causes of higher event counts. Vancouver Island records also show no increase in event frequency despite the higher Q (low attenuation) setting similar to that of S. Cascadia. While remote turbidity triggering from distant events has been suggested in Cascadia, the close match with the onshore paleoseismic record over the last 3500 years precludes this mechanism. In addition, lacustrine paleoseismic records closely parallel the southward increase in event bed frequency found offshore, thus increasing event bed frequency remains best explained by southward increase in earthquake frequency in S. Cascadia.