

Cascadia Great Earthquake Recurrence Based on the Holocene Turbidite Record, an Update

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Numerous Holocene turbidite events have been identified in piston cores taken from the major canyon-channel systems of the Cascadia margin from Vancouver Island to Cape Mendocino. The consistent pattern of events from these multiple canyon sources along 1100 km of the continental margin has several implications for the Cascadia Subduction Zone earthquake record. Correlation of the events is based on (1) the first occurrence of Mazama Ash in turbidites, (2) the approximate onset of Holocene sediment deposition, as determined by a dominance of radiolarian fauna in hemipelagic sediment, and (3) AMS radiocarbon ages from foraminifera in the hemipelagic sediment just below the base of each turbidite. The first post-Mazama turbidite event (MA) occurred about 7400 cal yr ago, or about 100 yr after the Mt. Mazama eruption forming Crater Lake, Oregon. The Holocene onset is estimated to be about 12,300 calendar yr BP (cal yr) near the base of the continental slope. Thirteen post-MA events are found in the Cascadia, Astoria and Rogue channel systems, which drain the northern 700 km of the Cascadia Subduction Zone margin. Assuming event 13 took place 7400 cal yr and event 1 took place 1700 AD (Satake et al., 1996), 12 turbidite events have occurred during 7200 years or on average every ~600 years. South of the Rogue Canyon, at the southern end of Cascadia Basin (Gorda Plate) and where Mazama Ash stratigraphy is absent, the number of Holocene turbidite events in channel systems where the Gorda plate is subducted. Based on AMS radiocarbon ages, the Holocene turbidite event recurrence interval for Trinidad Canyon is 492 years, for Eel Canyon is 246 years, and for Mendocino Channel is 40-65 years. The synchronicity of turbidite events in the northern two thirds of Cascadia Basin (1 per 600 yr) are best explained by seismic triggering. The longevity of the record, and the synchronicity over time, distance, and between tributary and main channels make alternative explanations untenable. Since 1986, earthquakes up to 7.2 magnitude have occurred in the Mendocino vicinity, however, because there is no surface sand in a 1999 box core taken at the 1986 Mendocino Channel site or other southern Cascadia channel locations, it appears that southern Cascadia Basin turbidite events represent greater than 7.2 magnitude earthquakes, though this is likely to be site-specific. This suggests that turbidite event stratigraphy is in effect a well-tuned filter that passes the record of Cascadia great earthquake recurrence and little else.