Cascadia Great Earthquake Recurrence: Correlation Evidence for Repeated Margin Wide Rupture

Details

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Authors	Goldfinger, C*, Oregon State University College of Oceanic and Atmospheric Sciences Active Tectonics, Ocean Admin Bldg 104, Corvallis, OR 97331 United States Nelson, C H, Inst Andaluz de Ciencias De La Tierra, CSIC/Univ De Granada Fac De Ciencias, Campus de Fuentenueva S/n 18002, Granada, S/n 18002 Spain Morey, A E, Oregon State University College of Oceanic and Atmospheric Sciences Active Tectonics, Ocean Admin Bldg 104, Corvallis, OR 97331 United States Johnson, J E, Oregon State University College of Oceanic and Atmospheric Sciences Active Tectonics, Ocean Admin Bldg 104, Corvallis, OR 97331 United States
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Abstract

We are now testing correlation between turbidite event records at widely separated sites in Cascadia with radiocarbon ages and physical properties of the core sediments. We focus here on physical property correlations between sites to test for connections between sites independent of radiocarbon ages. Gamma density, magnetic susceptibility, and P-wave velocity data were routinely collected for all cores at a 2 cm interval. We find that a good stratigraphic correlation can be made between Juan de Fuca Channel (JDF, a tributary of Cascadia Channel) and Cascadia Channel based on individual event signatures, and upon the sequence of unique signatures through the Holocene record of 18 events. 16 individual event density-magnetic signatures between JDF and Cascadia Channel have correlation coefficients of 0.6-0.9, with two scores (0.16 and 0.32) for events with similar, but out of phase characteristics. Non correlated events have lower coefficients in most cases. The event sequence includes a mix of many unique signatures and some events that are similar to others. The unique sequence of these signatures limits the possibility of miscorrelation because rarely do similar events occur adjacent in time. These correlations further support the temporal correlation to great earthquake records in Willapa Bay (this session), as well as extend the record to ~ 9800 years. We find that many events can be correlated in this way between JDF, Cascadia, Hydrate Ridge (central Oregon margin), and Rogue (southern Oregon margin) core sites. The signatures vary more between sites that are not directly connected, but many robust features are preserved, including in many cases, the relative volume of the turbidite, and the number of coarse pulses in the turbidite. These features allow direct correlation between sites independent of other methods. That we are able to correlate physical property "wiggle" plots along channel systems is intriguing, given the expected chaotic nature of deposition controlled by turbid flow. However, the inter-site correlations between turbidite channels that are not connected, implies that the deposition process is influenced by more than long distance transport of event characteristics. We suggest that such correlation implies that something of the earthquake shaking signal may be contained in these records. While not all sites can be correlated on the basis of physical properties, we find that key events in the event sequence have characteristics observable at most if not all sites. Events T6, T8, and T16 are large triplets at all sites, T4 and T9 are single events, T10, T12 are small events at all sites, and T11 is a massive doublet event at all sites. These observations strengthen the correlation, and thus the inference of earthquake origin for these events. The correlations further support the un-segmented nature of most Cascadia ruptures, since direct correlation effectively eliminates this option. Currently, not all events can be correlated margin wide, leaving open the possibility of several segmented ruptures. Strengthened correlations further support a repeating pattern of Great Earthquakes in Cascadia. The pattern appears to have repeated at least four times, with the most recent AD 1700 event being the third of three events following a long interval between events T4 and T5.

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