Cascadia Great Earthquake Recurrence: Rupture lengths, Correlations and Constrained OxCal Analysis of Event Ages

Details

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Authors	Goldfinger, C*, Oregon State University, College of Oceanic and Atmospheric Sciences, Ocean Admin Bldg 104, Corvallis, OR 97321 United States Morey, A E, Oregon State University, College of Oceanic and Atmospheric Sciences, Ocean Admin Bldg 104, Corvallis, OR 97321 United States Erhardt, M, Oregon State University, College of Oceanic and Atmospheric Sciences, Ocean Admin Bldg 104, Corvallis, OR 97321 United States Nelson, C H, C.S.I.C.- Universidad de Granada. Instituto Andaluz de Ciencias de la Tierra., Campus de Fuentenueva, Granada, 18002 Spain Johnson, J E, Monterey Bay Aquarium Research Institute, 7700 Sandholdt Rd., Moss Landing, CA 95039-9644 United States Gutierrez-Pastor, J, C.S.I.C.- Universidad de Granada. Instituto Andaluz de Ciencias de la Tierra., Campus de Fuentenueva, Granada, 18002 Spain
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Abstract

We are continuing to test correlation methods for a series of offshore cores along the Cascadia subduction margin. We are applying multiple proxies, including XRF analysis, to the determination of hemipelagic thickness between turbidite events. With improved sedimentation rates, and time intervals represented by inter-event sedimentation, we use Bayesian statistical methods to combine and constrain radiocarbon ages. Using OxCal we incorporate limiting ages with known criteria including ash ages, hemipelagic sedimentation rates, and historical data to refine the error ranges for a given event. Multiple ages for the same event are also given `credit' for this, and rather than averaging, iterative Bayesian models are used to reduce the error range for events that are known to correlate, and or have independent constraints. This method significantly reduces

14C variability between along strike events that are thought to correlate. We also continue to refine inter-site physical property correlation methods in parallel with 14C ages. Depositional patterns within events, recorded as magnetic susceptibility, chemical, and density patterns, match at widely separated sites in surprising detail. 16 individual event density-magnetic signatures between JDF and Cascadia Channel have correlate with coefficients of 0.6-0.9, with two scores (0.16 and 0.32) for events with similar, but out of phase characteristics. The character of each event is clearly evident in the cores. For example, T5 is a small doublet at all sites; T6 is a triplet at most sites, T8 is a large triplet at most sites, T17 is a couplet at all sites, T11 is a large flat topped peak at all sites. In some cases, correlation of events hundreds of km apart is almost as robust as the correlation between piston and trigger core pairs only one meter apart. Numerical tests of the correlation patterns strongly support this conclusion. Values for other measures include: the number of sandy pulses per event down core(r=0.84-0.92), relative thickness pattern downcore (r=0.70-0.89), and whether these values could have come from a random sample of a normal distribution (rejected with 99% confidence). Thus, both individual event signatures, and the downcore stratigraphy are both highly unique and strongly comparable from site. Strengthened correlations, refined 14C ages, and closer correlation with land events support long rupture lengths for at least 16 great earthquakes in the Holocene, extending at least from 42N to 48N. Several partial ruptures are evident, four limited to southern Oregon, one from central Oregon Northward, and one from central Oregon southward. The penultimate event at ~ 1500 AD, is recorded at all offshore sites as a thin turbidite, and only recorded at a few land sites, suggesting a small event.

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