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Northern San Andreas Earthquake Recurrence: Rupture lengths, Correlations and Constrained OxCal Analysis of Event Ages

Details

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Abstract

We are using multiple proxies, including XRF analysis, to determine hemipelagic thickness between turbidite events recorded in cores along the offshore northern San Andreas margin. Inter-event times are calculated from these improved estimates of sediment thickness and regression-determined sedimentation rates, and used along with known stratigraphic information to constrain calibrated radiocarbon age ranges using Bayesian statistical methods within the program OxCal. OxCal can also be used to combine multiple ages for the same event. Multiple ages are given "credit" where age ranges overlap, resulting in reduced 1- or 2-sigma age ranges compared to averaging peak ages and propagating errors. These methods reduce calendar age variability of events along strike that are thought to correlate. We tested three methods of estimating calendar

ages, using the most recent events in a Noyo Canyon core. These methods are: 1. unconstrained radiocarbon age calibration, 2. age determination using known dates and inter-event time calculated from hemipelagic thickness and the regression-determined sedimentation rate, and 3. (preferred method) use OxCal's sequence option to calibrate and constrain radiocarbon ages given all available stratigraphic information, including date of collection, historical or geological datums, inter-event times and radiocarbon ages. The upper-most event was chosen for these tests because it is known to be the 1906 earthquake and the 20th century reservoir correction is well known in this area. The penultimate event was chosen because it has been dated at multiple land sites. 1906 event: Unconstrained calibration: calibration of the radiocarbon age of the 1906 event yields an age of ~1913, (1 σ : 1898-1940). Sedimentation time: subtracting the time represented by the hemipelagic thickness above the 1906 event from the date of collection (1999) yields an age of ~1904. OxCal sequence: constrained calibration yields an age of ~1902 (1 σ : 1880-1910). Penultimate event: Unconstrained calibration: calibration of this radiocarbon age yields an age of ~1753 (1 σ : 1660-1840). Sedimentation time: subtracting the time represented by the hemipelagic thickness below the 1906 event from 1906 yields an age of ~1756. OxCal sequence: constrained calibration yields an age of ~1700 (1 σ : 1650-1735), in good agreement with adjacent northern SAF paleoseismic sites on land: Fort Ross = 1710 (1610-1810), Vedanta = 1711 (1695-1720) (T. Niemi, K. Kelson, and T. Fumal pers. com. 2005). The close correspondence in time of our SAF penultimate event and the AD 1700 Cascadia event suggests the possibility that the Noyo Canyon site may have recorded the Cascadia event, ~ 130 km away, however we find that the penultimate event in Noyo Canyon is well correlated southward to at least Point Arena, too far to be related to the Cascadia event. We also continue to refine inter-site physical property correlation methods in parallel with radiocarbon ages. Depositional patterns within events, recorded as magnetic susceptibility, chemical, and density patterns, match at widely separated sites in surprising detail. Both individual event signatures, and the downcore stratigraphic patterns are both highly unique and strongly comparable from site.

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