Holocene Turbidite Recurrence Frequency off Northern California: Insights for San Andreas Fault Paleoseismicity

Details

Meeting	2004 Fall Meeting
Section	Tectonophysics
Session	Marine and Coastal Paleoseismology I
Identifier	T12B-08
Authors	Nelson, C H*, University of Granada, Campus Fuentenueva s/n, Granada, GR 18002 Spain Goldfinger, C, Oregon State University, 104 Ocean Admin Bldg, Corvallis, OR 97331 United States Gutierrez Pastor, J, University of Granada, Campus Fuentenueva s/n, Granada, GR 18002 Spain Johnson, J E, Oregon State University, 104 Ocean Admin Bldg, Corvallis, OR 97331 United States Morey, A E, Oregon State University, 104 Ocean Admin Bldg, Corvallis, OR 97331 United States
Index Terms	Seismology [1734]

Abstract

Numerous turbidites along the northern California continental margin are influenced by the northern San Andreas Fault (SAF). The fault parallels the coast near San Francisco Bay and further north underlies the California margin. Multiple tributary slope canyons and proximal channels join downstream into large channels, and all systems are dominated by the deposition of turbidite silt and sand beds. Our research aims to: 1) test the hypothesis that synchronous turbidites along the margin result from turbidity currents triggered by great earthquakes on the SAF and 2) thus define a paleoseismic record. Most important, we want to outline the recurrence history of paleoseismic events. Several lines of evidence suggest that there is synchronous SAF triggering of turbidites. Channels below tributary confluences are characterized by many single-event turbidite beds with multiple coarse-grained sediment pulses that contain different mineralogy from tributary source canyons. The rate of turbidite bed deposition (number/m) above and below channel tributary confluences typically is the same and not additive in downstream channels. Geotek log signatures of turbidites from different channel systems correlate along the margin and our present limited number of 14C

ages suggest correlative events. The most complete and reliable turbidite record is found in Noyo Channel where the canyon head source of turbidites is directly underlain by the SAF. The five youngest turbidite 14C ages of Noyo show general agreement with the SAF paleoseismic record on land.This apparent correlation suggests that Noyo Channel may provide a much longer paleoseismic record for 24 events on the SAF during the past 6,000 yr. We utilize multiple cores with 24 correlative turbidite events from the channel to define event recurrence time between turbidites. We base this time on two independent methods: 1) hemipelagic sediment thickness (H) between two consecutive turbidites (i.e. H/sedimentation rate =recurrence time)(24 events), and 2) 14C ages (i.e. difference in ages between two consecutive turbidites= recurrence time)(8 events). The average recurrence time we find between events is 210 yr (H method) and 180 yr (14C age method). Both methods show a minimum recurrence time of 140 yr and a maximum time of 275 yr with 75 percent of the recurrence times between 150 to 225 years. With two major assumptions that 1) Noyo Channel turbidites represent great earthquakes on the SAF and 2) the Noyo recurrence pattern continues into the future, the Noyo recurrence data suggests that we are not yet in a window for another great earthquake on the northernmost SAF. This statement is based on present evidence indicating that in the Noyo Channel area: 1) an earthquake greater than 7.2 magnitude is necessary to trigger a turbidity current, 2) minimum recurrence times are140 yr, and 3) the great earthquake in 1906 triggered the youngest turbidite.

Cite as: Author(s) (2004), Title, *Eos Trans. AGU, 85*(47), Fall Meet. Suppl., Abstract T12B-08

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