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Holocene turbidite history in the Cascadia Subduction Zone shows the potential to develop paleoseismicic methods for the Sumatra and other subduction zones.

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Marine and onshore paleoseismic records are being studied along the Cascadia subduction margin. Submarine channels have recorded a Holocene history of turbidites mainly triggered by great earthquakes. Cascadia subducion margin is an ideal place to develop a turbidite paleoseismologic method because: (A) a single subduction zone fault underlies the margin, (B) multiple tributary canyons and a variety of turbidite systems and sedimentary sources exist to examine for synchronous turbidite events, and (C) excellent turbidite marker beds with Mazama ash (MA) (7627 $\pm$ 150 cal yr BP)(Zdanowicz et al., 1999) are present for correlation of events in turbidite systems within the northern two thirds of the basin. We have found 13 post-Mazama ash turbidites along the whole margin and 18 Holocene events. Synchroneity of Holocene the turbidite event record for $\sim$ 600 km along the northern two thirds of the Cascadia Subduction Zone is best explained by paleoseismic triggering of great earthquakes (of $\sim$ M 9).

We have two methods of looking at the turbidite event record: 1) ^{14}C ages to estimate recurrence times between paleoseismic events and, 2) analysis of

hemipelagic sediment thickness (H) between turbidites because hemipelagic thickness (H)/sedimentation rate = recurrence time between events. Using the first method, samples are taken in hemipelagic sediment below each turbidite event and planktonic forams are dated to obtain AMS ^{14}C ages. The ^{14}C recurrence times are calculated by the substracting between one event and a subsequent event. The H method can be used to independently evaluate the ^{14}C ages because of the following reasons: the deep sea provides an independent time yardstick derived from a constant rate of hemipelagic sediment deposited between turbidites, the hemipelagic thickness/sedimentation rate = yrs which provides a set of turbidite recurrence times and ages to compare with similar ^{14}C data sets , H data from multiples cores can be used to correct ^{14}C ages obtained from eroded hemipelagic sediment and the hemipelaic data is available for every T event from multiple cores at each key channel site compared to a single incomplete set of radiocarbon ages at each key site. Most important, the H method defines accurate minimum recurrence times for great earthquakes in the Cascadia Subduction Zone, because H erosion corrections for some ^{14}C ages increase minimum recurrence times by several hundred years when they previously appeared to be as low as $\sim$ 100 yrs (Nelson et al., 2003). This correction method is crucial because the coastal paleoseismic stratigraphic record has no independent H method to assess reliability of minimum recurrence times based only on ^{14}C ages.

From both ^{14}C and H data, we find a repeating pattern of recurrence times in the Holocene paleoseismic history of the Cascadia Subduction Zone. The recurrence pattern consists of a long time interval followed by one to three short intervals. The pattern is shown by both ^{14}C and H recurrence times between turbidites. Utilizing the most reliable ^{14}C and H data sets from turbidites for the past $\sim$ 5000 yr, minimum recurrence times are $\sim$ 300 yr and maximum are $\sim$ 1300 yr (Nelson et al., 2003 and Gutierrez-Pastor et al., 2004).

Our paleoseismic methods developed in the Cascadia Subducion Zone could be applied to the Sumatra Subduction Zone because of the similar geological setting and history of megathrust earthaquakes, like the 1700 AD Cascadia or 2004 AD Sumatra event. In Sumatra, an estimated 1200 km of faultline slipped about 15 m on the interface of the subducted India and the overriding Burma plates (http://earthquake.usgs.gov/), comparable to the rupture length shown by the Cascadia turbidite record. In Cascadia like Sumatra, tsunamis extend over an ocean wide area. For example Satake et al, 1996 have shown that an 1700 AD earthquake from the Cascadia Subduction Zone generated a tsunami of 3 meters height along the Japanese Coast. The evidence from the most recent tsunamis generated by great earthquakes in the Sumatra and Cascadia Zones suggest that obtaining a turbidite paleoseismic record could be help define periodicity of great earthquakes in the Sumatra and other

subduction zones.

Atwater BF, Hemphill-Haley E. 1997. Recurrence intervals for great earthquakes of the past 3500 years at northeastern Willapa Bay, Washington: *U.S. Geological Survey Professional Paper* 1576, 108

Atwater, B F, Nelson H, Goldfinger C.2004. Onshore-offshore correlation of geologic evidence for great cascadia earthquakes–permissive agreement etween Washington estuaries and Cascadia Deep-Sea Channel: Eos Trans. AGU, 85(47), Fall Meet .Suppl., Abstract T12B-01.

Gutiérrez-Pastor J, Nelson CH, Goldfinger C, Johnson JE**.** 2004. Turbidite Stratigraphy on active tectonic margins and implications for Holocene paleoseismicity of the Cascadia Subduction Zone and northern San Andreas Fault: 32 ndInt. Geol. Congr. Abs. V., pt. 2, Abs. 265-5, p.1193.

Kelsey HM, Witter RC, Hemphill-Haley E. 2002.Plate-boundary earthquakes and tsunamis of the past 5500 yr, Sixes River estuary, southern Oregon. Geol. Soc. Am. Bull. V 114 p 298—314

Nelson, AR, Atwater, BF, Brobowski, PT, Bradley, LA, Clague, JJ, Carver, GA, Darienzo, ME, Grant, WC, Krueger, HW, Sparks, R, Stafford, TW, and Stuiver, M. 1995a. Radiocarbon evidence for extensive plate-boundary rupture about 300 years ago at the Cascadia subduction zone. Nature, V 378, p 371-374.

Nelson CH, Goldfinger C, Johnson JE**,** Gutierrez-Pastor J. 2003. Holocene history of great earthquakes in the Cascadia Subduction Zone based on the turbidite event stratigraphy: EOS Trans. AGU, 84(46), *Fall Meet. Suppl*., Abstract, S42I-05

Nelson CH, Goldfinger C**,** Gutiérrez-Pastor J, Johnson J E. 2004. Holocene turbidite recurrence frequency off northern California: insights for San Andreas fault paleoseismicity: Eos Trans. AGU, 85(47), Fall Meet .Suppl., Abstract T12B-08.

Satake K, Shimazaki K, Tsuji Y, Ueda K. 1996. Time and size of a giant earthquake in Cascadia inferred from Japanese tsunami records of January, 1700. Nature V 379, p 246-249.

Witter RC, Kelsey HM, Hemphill-Haley E.2003.Great Cascadia earthquakes and tsunamis of the past 6700 years, Coquille River estuary, southern coastal Oregon. Geological Society of America Bulletin, V 115(10), p 1289-1306.

Zdanowicz CM, Zielinski GA, Germani MS. 1999. Mount Mazama eruption: calendrical age verified and atmospheric impact assessed. Geology, V 27, p 621-624.