We have been investigating the recurrence pattern of Great Earthquakes along the Cascadia and Northern San Andreas margins using the record of abyssal plain turbidites. In Cascadia, we have previously suggested that virtually all turbidites record great earthquakes, based on identical numbers of events in widely separated cores, and relative dating techniques that demonstrate synchronicity of the triggering mechanism. The correlation used thus far has relied upon the presence of the Mazama ash in most cores. We have additionally tested this correlation with radiocarbon ages and physical properties of the core sediments. We find that a good stratigraphic correlation can be made between three key core sites at Juan de Fuca, Cascadia, and Rogue Channels and other supporting sites at Barclay, Astoria, Willapa, Channels, and Hydrate Ridge using Gamma density and high-resolution magnetic susceptibility records of these cores. This correlation is independent of other correlation methods including the Mazama ash datum, event number comparisons, the “confluence test” of synchronous triggering, and radiocarbon ages, but is consistent with them. Despite a systematic spatial and temporal variation in 14C reservoir ages, we find that regional correlations support correlation of 18 Holocene events extending along at least 700 km of the margin. Several other events are limited to the central Oregon margin, and are recorded at the Hydrate ridge site, and possibly at several land sites. That we are able to correlate physical property “wiggle” plots between turbidite channels that are not connected, implies that something of the earthquake shaking signal may be contained in these records.

With strengthened correlations, and improved estimates of the reservoir correction, we infer that the pattern of Cascadia Great Earthquakes appears to include clustering of events separated by long intervals of 700-1000 years. The clusters include 2-4 events. Over the last ~9000 years, the pattern appears to have repeated four times.

We also observe that event “size” as recorded by turbidite thickness, is in most cases a robust characteristic for the margin-wide correlated events. “Large” events include T8, T11, and T16, small events include T2, T5, T10, T12 and T17. The remaining events are “middle” sized. At first glance it would seem that turbidite thickness would be unlikely to record anything of the earthquake source, however the persistent size patterns we see in many channels suggest that there is probably a connection. At least one of the “small” events, T2, is not recorded at all sites, and has been eroded partially by T1 (AD 1700) at other sites. T2 was not recorded at most onshore paleoseismic sites.

We are similarly investigating the turbidite record on the abyssal plain adjacent to the Northern San Andreas Margin. Unlike Cascadia, no regional stratigraphic datum has yet been found in our cores, however correlation of individual turbidites both along individual channels and across non-connecting channels is robust, providing numerous stratigraphic ties between these systems. We are using Gamma density, p-wave velocity, high-resolution magnetics, x-ray, mineralogic, and color reflectance data to build a comprehensive regional correlation along the length of the northern San Andreas. As in Cascadia, correlation of events along the margin for large distances suggests an earthquake origin for these turbidites, since other potential triggering mechanisms (except perhaps very large storms) operate in only single channels. We also observe mixing of separate mineralogic provenances at confluences, below which we see either doublets, with no intervening time (hemipelagic sediment) between them, or bimodal coarse fractions in single turbidites, each density and magnetic peak representing a separate provenance. The mixing of flows from distinct provenances into single turbid flows below confluences also
demonstrates synchronous triggering of separate channel systems. Like Cascadia, we suggest that the information contained in these physical property wiggles may be the energy signature of the earthquake itself, in effect a paleoseismogram.

Thus far we are able to correlate 35 Holocene events between San Francisco and Cape Mendocino. Of these, 10 events can be correlated along the length of the study region, from the northern limit of the SAF to south of San Francisco. Twelve events correlate along a northern "segment" and nine events correlate along a southern "segment". We find no events that occur clearly in only one channel, and only four events that are found in two and three channels only. These events are in close proximity to the seismically active Mendocino Triple Junction, and probably are related to local earthquakes there. The "segment boundary" along the SAF, if such exists, appears to lie between Point Reyes and Point Arena.

Noyo channel/channel, the only offshore channel to actually intersect the submerged San Andreas, records the most robust and complete record. Noyo Canyon is located near the northern end of the SAF, near the Mendocino Triple Junction. It is 90 km distant from southern end of the Cascadia subduction zone, yet it appears to also contain Cascadia events, including the three youngest Cascadia earthquakes, and several others during the Holocene. The temporal pattern of the youngest SAF events (the best dated sequence thus far), suggest possible clustering of SAF events, with clusters terminating in a coincident Cascadia event, suggesting a possible stress linkage. Preliminary Coulomb stress models suggest the SAF events bring southern Cascadia closer to failure on the updip "locked" portion of the thrust.

**Figure 1.** A. Correlation diagram for Cascadia and Juan de Fuca Channels (see Fig. 1 for location). Two trigger-piston pairs at the same station are shown, light blue traces (left) are raw Gamma, dark blue (right) is high-resolution point magnetic susceptibility (inner trace) and Geotek loop mag (outer trace). Red correlation tie at T13 is the Mazama ash, also indicated by ash % values on vertical red ash content trace. Red traces shown next to 23PC are from 12PC, a core from the Juan de Fuca Channel, 375 km distant. Left trace is Gamma, right trace is Geotek loop magnetics. Correlation between separated sites is by $^{14}$C, and ash, but also uses "wiggle matches" with magnetic and density traces. Note strong similarities for most events. Strong ties include T11 and T16, a large doublet, and large triplet respectively in all cores. Other ties include T6 and T8, which have triple peaks at all sites, and T9 and T17 which are doublets at all sites. Visual correlation uses these patterns, spacing, size, and distinctive sequences, constrained by $^{14}$C and ash stratigraphy. AMS $^{14}$C ages are shown in red (JDF) and black (Cascadia). Grey ages are suspected of basal erosion. (intercept ages are shown for simplicity).