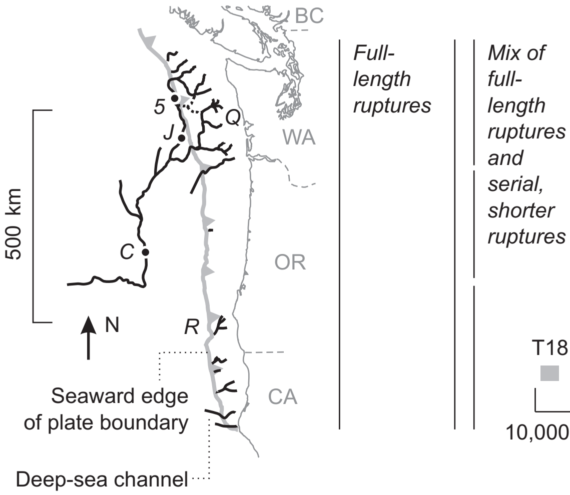
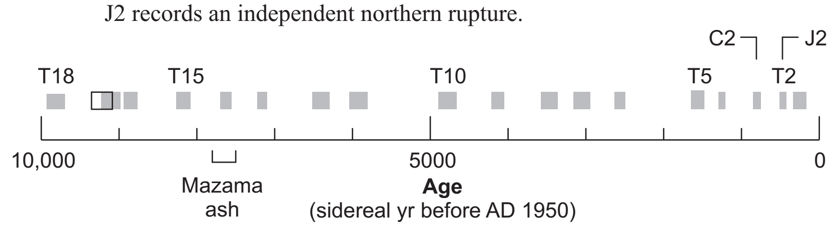
On recent use of deep-sea turbidites to define tsunami hazards at Cascadia [*p. 1 of 2*]

A Correlations built into turbidite names

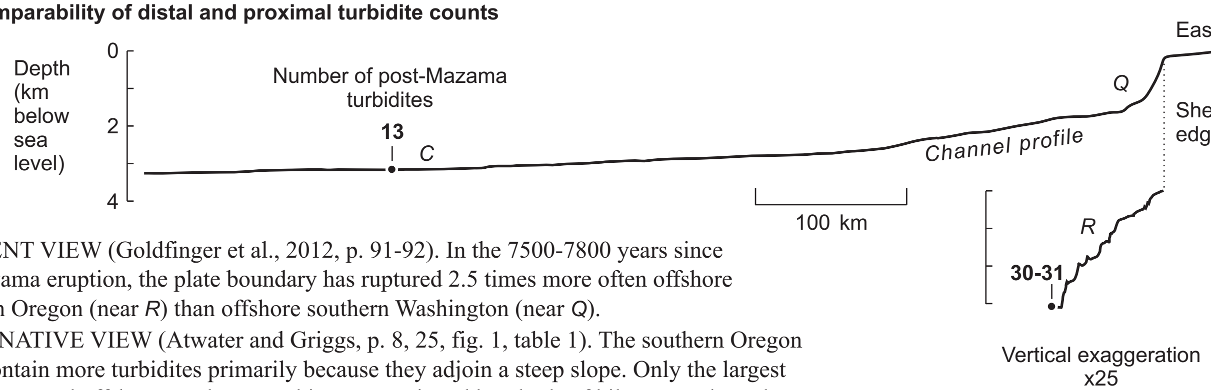


CURRENT VIEW (Goldfinger et al., 2012, p. 111, 124). Turbidites correlate exactly enough to warrant the same name (such as T2) along most or all the length of the subduction zone. The correlations demonstrate 19 full-length ruptures of Holocene age. The northern third broke at these times only.

ALTERNATIVE VIEW (Atwater and Griggs, 2012, p. 5-6, 21-25). Impartial description, as in Pouderoux et al. (2012), requires local turbidite names. The full length of the fault breaks not just in single ruptures but also in swift series of shorter ones. Turbidite C2 in Cascadia Channel is centuries older than turbidite J2 of Juan de Fuca Channel (though both have been called T2). J2 records an independent northern rupture.



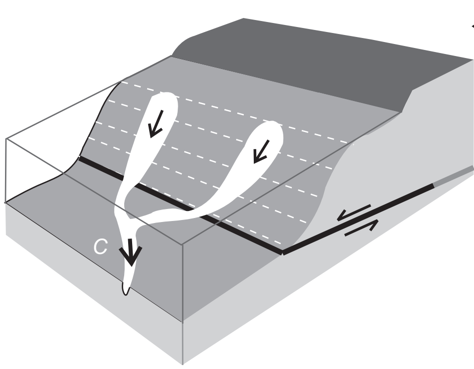
B Comparability of distal and proximal turbidite counts



CURRENT VIEW (Goldfinger et al., 2012, p. 91-92). In the 7500-7800 years since the Mazama eruption, the plate boundary has ruptured 2.5 times more often offshore southern Oregon (near *R*) than offshore southern Washington (near *Q*).

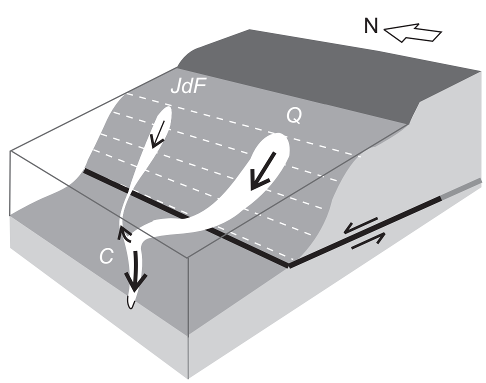
ALTERNATIVE VIEW (Atwater and Griggs, p. 8, 25, fig. 1, table 1). The southern Oregon cores contain more turbidites primarily because they adjoin a steep slope. Only the largest flows generated offshore southern Washington continued hundreds of kilometers down lower Cascadia Channel (*C*). Two Juan de Fuca cores contain 13-14 post-Mazama turbidites (at site *J* in *A*) but these may represent overbank flows of chiefly Quinault origin. A more proximal Juan de Fuca core (at site *5*) shows as many as 20 turbidites of post-Mazama age.

C Extent of merger of tributary flows



← CURRENT VIEW (Adams, 1990). Cascadia Channel (*C*) monitors fault rupture beneath both its main tributaries by transmitting, for hundreds of kilometers, their merged turbidity currents.

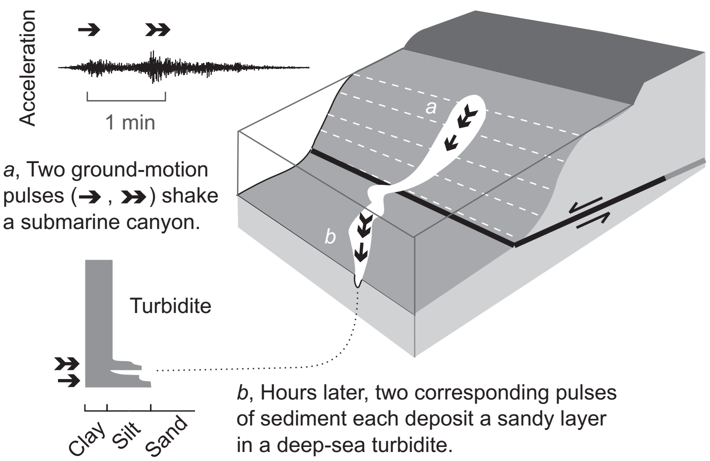
ALTERNATIVE VIEW → (Atwater and Griggs, 2012, figs. 3, 4). The southern tributary (*Q*) dominates. The resulting distal turbidites are indifferent to fault rupture that extends beneath the northern tributary (*JdF*).



D Turbidites as seismograms

CURRENT VIEW (Goldfinger et al., 2012, p. 135). Each broad pulse in ground motion produces a sediment pulse in a turbidity current. The sediment pulse yields a sandy layer low in a turbidite. The sandy layer, like the ground-motion maximum it represents, correlates along hundreds of kilometers of fault rupture (rupture lengths in *A*).

ALTERNATIVE VIEW (Atwater et al., 2012, p. 13-16, fig. 5). Shaking varies along and across strike. Initial mass movements respond to cumulative shaking and are prone to delay. Flows are transformed by changes in slope (hydraulic jumps), erosion of bed (ignition), division at bends (flow splitting), sequential merger, and eventual self-organization. Geophysical logs of the sandy layers are too simple and variable for these signal shredders to be discounted.

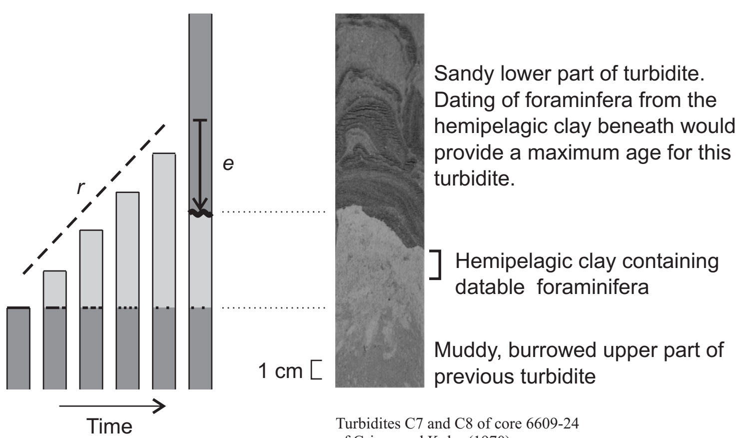


a, Two ground-motion pulses (➔ , ➔➔) shake a submarine canyon.

b, Hours later, two corresponding pulses of sediment each deposit a sandy layer in a deep-sea turbidite.

Accelerogram: Furumura et al. (2011)

E Erosion of hemipelagic deposits



Turbidites C7 and C8 of core 6609-24 of Griggs and Kulm (1970)

r Hemipelagic deposition rate (commonly 1-2 cm/century)

e Thickness of hemipelagic deposits eroded by turbidity current (commonly difficult to estimate)

CURRENT VIEW (Goldfinger et al., 2012, appendix 1). Correction for erosion *e* helps reduce the difference between the age of foraminifera dated and the time of deposition of the overlying turbidite. Uncertainty in *e* is ±0.5 cm, or about ±25 to ±50 yr of hemipelagic deposition. This and other adjustments add more than a decade to the total uncertainty in dating a turbidite.

ALTERNATIVE VIEW (Atwater et al., 2012, p. 17-19, figs. 6-8). Estimates of *e* for a correlated hemipelagic unit differ by several centimeters among nearby cores, and the radiocarbon sample commonly spans at least half the unit's thickness. The resulting erosion corrections doubtfully shift a series of turbidite ages by about 500 years—an entire average recurrence interval. With a smaller correction, the nominal T2 turbidite in Cascadia Channel dates from T3 time (*A*)—an alternative that improves agreement between offshore and onshore estimates of earthquake ages.

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