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Cascadia Seismoturbidites: A Landlubber Critiqued

Details

Meeting	2013 Fall Meeting
Section	Seismology
Session	Understanding the Cascadia Subduction Zone: Contributions From the Cascadia Initiative and Multidisciplinary Studies III Posters
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Abstract

Atwater and Griggs (2012) and Atwater (2013) present several notional arguments against our recent interpretation of Cascadia turbidite paleoseismology. We disagree with the points made in this report, and suggest that they are contradicted or not supported by the stratigraphic, mineralogic and new bathymetric data (collected in the Cascadia Initiative), and in some cases, violate the physics of turbidity currents. First, the report suggests that a higher frequency of turbidites in southern Cascadia is attributable to sensitivity to steeper slopes rather that higher earthquake frequency, despite the evidence of higher frequency at onshore paleoseismic sites such as Bradley Lake. Turbidity current propagation and deposition are only partly related to initial slope, and are influenced by other factors, notably whether the flow is channelized or not. On the Washington margin, initial slopes in the canyon heads are similar to the southern Cascadia margin. The difference is that they are channelized thereafter, and flow great distances with little attenuation. The turbidite stratigraphy at the base of the steep section in Quinault Canyon in Washington is similar to that at the base of the slope, and similar to distal records on the abyssal plain > 300 km away, attesting to modest attenuation in this channelized system. There are several local turbidites with limited along-strike correlation, as noted by Adams (1990), which may or may not represent local northern segment earthquakes. Atwater suggests that the original “confluence test” of Adams (1990), reiterated by Goldfinger et al. (2012) fails because the source of both sides of the confluence is Willapa Canyon, or alternately that Quinault canyon had a pathway across the accretionary prism into Juan de Fuca Channel. In the former case, this pathway does not exist, and is blocked by a 250 m tall anticline. In the latter case, heavy mineral assemblages demonstrate that the JDF arm is fed by a northern source consistent with Vancouver Island/Nitinat fan, and inconsistent with a Columbia River source. Downstream in Cascadia Channel, heavy minerals indicate a mixed provenance. The Mazama ash is abundant along the length JDF channel, though patchy, not absent at the north end as stated by Atwater. Another alternate pathway through the prism is mostly likely related to the Missoula glacial outbursts, and has likely been dormant since that time as evidenced by overlapping Holocene levees of the modern channels. Atwater suggests that the turbidity currents flowed backward up JDF channel to fill that arm with Willapa derived turbidites. This is inconsistent with the heavy mineral data, and with momentum constraints . Willapa derived turbidity currents had essentially no barrier at the confluence that would redirect them through a ~ 130 degree turn uphill. Instead, the confluence is a smooth intersection at an acute angle, allowing smooth flow of Willapa sourced turbidity currents to the southwest. Some overbank of Willapa turbidity currents in the Pleistocene is indicated by a radial wave field to the west, consistent with momentum considerations, and inconsistent with sharp uphill turns. Radiocarbon age models will also be discussed. In summary, bathymetric, stratigraphic, heavy mineral, and ash data support the original megathrust rupture interpretation of Adams (1990), and evolved in Goldfinger et al. (2003, 2008, 2012).

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