Land-Marine Paleoseismic Integration for the Northern Cascadia Margin, USA

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Abstract Text:

New and archive cores (N=70), bathymetric, backscatter and sub-bottom data from the Washington margin reveal patterns of Holocene sediment transport and deposition. Barkley, Nitinat, Juan de Fuca (JDF), Quillayute, Grays, Guide, and Willapa Canyons each have different post-glacial mechanisms of loading and dispersal of sediment via turbidity currents. In high-stand conditions, the northern canyons, Barkley, Nitinat, JDF, and Quillayute are mostly relict systems. The remaining canyons, Quinault, Grays, Guide, and Willapa, are recharged to varying degrees by northward transport of Columbia River derived sediment. All systems are nonetheless active conduits for turbidity currents during the Holocene. Sedimentologic and CT analyses, supported by radiocarbon ages, micropaleontology, and the Mazama Ash show that the Holocene sedimentary sequence consists of a series of sand to mud turbidites in the active portions of all systems, interbedded with hemipelagic sediment. The relict systems are finer grained, commonly not visually detected, with Holocene turbidite counts the same as recharged systems. Use of 1960's core sketches (Atwater) fails to capture the full record, as noted by Barnard (1973). Hydrodynamic models and heavy mineral distributions show that the northern canyon systems (Barkley, Nitinat, JDF, Quillayute) are independent of the southern systems, (Quinault, Guide, Grays, Willapa) during the Holocene. Best fitting flow inversions suggest turbidity currents range in height from 80-170 m, consistent with earlier work and backscatter observations. Mass balancing suggests sediment supplied to the slope canyons and abyssal channels is 4-6 times greater than supplied by recharge to the canyon heads by external sources, strongly indicating autogenic sourcing by earthquakes. Turbidite deposition off Washington is not very sensitive to either sediment supply or slope angle. Lithostratigraphic correlation and age models of Holocene turbidite sequences suggests deposition of ~ 20 Holocene turbidites in most parts of the Canyon systems, with little variation. The explanation most consistent with the data is triggering by a series of 18-20 Holocene earthquakes, in agreement temporal and lithostratigraphic linkages to new marine sites in Canada, as well and land paleoseismic data.

Table 1. Holocene and Post-Mazama turbidites, Washington Margin

Core	Location	CT observation Holocene beds	CT observation Post Mazama beds	Faunal H-P	Color Change	Radiocarbon	Lithostrat. + phys props.	Reported In Original Logs Holocene/Post MA	Reported by Atwater et al., 2014 Post Mazama	Original ref.
TT063-18PC	Mid JDF Canyon	>18[9]	11[1]	X	X	X	X	7/3	4	Barnard (1973)
TT063-20PC	Mid JDF Canyon/fold	19[2]	16[2]	X	X	original bulk	X	7/4	3	Barnard (1973)
NV982-14GC	Mid JDF Canyon	≥ 18[9]	na	NA	X	NA	X	NA	not used	This paper
TT039-06PC	Upper JDF Channel	23	16[7]	X	X	original bulk	X	3/2**	R likely >6	Carson (1971)
TT039-27PC	Upper JDF Channel	≥13[3]	≥11[7]	X	X	original bulk	X	7/6**	0?	Carson (1971)
M9907-05TC/PC	Upper JDF Channel	>19[11]	18[11]	X	X	X	X	8	3-6	Goldfinger et al., 2012
TT048-08PC	Mid JDF Channel	≥21[4,10]	16	X	X[1]	X+original bulk	X	15/14	≥6	W.D. Barnard (unpub)
TT048-09PC	Mid JDF Channel	≥21[4,10]	16	X	X[1]	X+original bulk	X	15/12**	≥6	W.D. Barnard (unpub)
M9907-012TC/PC	Mid JDF Channel	21	14	X	X	X	X	13	13-14	Goldfinger et al., 2012
TT029-28PC	Mid JDF Channel	≥17[9]	15	X	X	X	X	10/9	likely >6	W.D. Barnard (unpub)
TT063-17PC	Quillayute Basin	18	14	X	X	X+original bulk	X	7/5	5	W.D. Barnard (unpub)
TT053-14PC	Quillayute Basin	20	15	X	X	X+original bulk	X	10/8	8	W.D. Barnard (unpub)
TT053-18PC	Mid Quinault Canyon	19[9]	16	X	X	X+original bulk	X	15/14	14	W.D. Barnard (unpub)
NV951-09	Mid Quinault levee	>12[9]	>12[7]	NA	X[1]	NA	X	NA	not used	this paper
NV967-15	Mid Quinault levee	≥16[9]	na	NA	?	NA	X	NA	not used	this paper
NV951-06	Lower Quinault levee	>12[9]	>12[7]	NA	?	NA	X	NA	not used	this paper
TT-063-10PC	Lower Quinault levee	23	15	X	X	original bulk	X	16/9	not used	Carson (1971)
NV967-10	Mid Quillayute levee	>17	na	NA	X[1]	NA	X	NA	not used	this paper
TT053-22PC	Upper Willapa Channel	>15[9]	15[9]	X	X	original bulk	X	9/9	not used	Barnard (1973)
TT053-20PC	Astoria Canyon	14[13]	14[13]	X	X[1]	NA	X	11/11	not used	Barnard (1973)

[1]unusually late appearance of Mazama ash at T10 in this core

[2]based on high resolution magnetic susc. Other data pending

[3]weak bioturbated mud turbidites, core outside channel. Interp uncertain.

[4]Color change and HP boundary not reached. Color indicates all Holocene

[5]all Pleistocene

[6]Radiocarbon near HP boundary, approximate time line with very low precision

[7]based on log correlation to adjacent T14, ash data not available

[8]Color change and HP boundary not reached. Color indicates all Holocene

[9]count truncated by erosion

[10] Faunal HP boundary data not available

[11] upper 5? Beds amalgamated and bioturbated, interp uncertain. Minimum Holocene beds present = 17

[12] Color change and HP boundary not reached. Color indicates all Holocene

[13] Core bottoms in T11. Count includes T10b, T10f and T4a

Note: Table 1 has been revised to correspond to the version shown at the meeting, which is slightly different that that submitted originally to AGU.