

The Formation, Alteration and Preservation of Flood Deposits on the Pacific Northwest Continental Margin

Robert A. Wheatcroft
College of Oceanic & Atmospheric Sciences
Oregon State University
Corvallis, OR 97331
phone: (541) 737-3891 fax: (541) 737-2064 e-mail: raw@oce.orst.edu
Grant Number: N00014-99-1-0006

LONG-TERM GOALS

The ultimate objective of this research program is to obtain a predictive understanding of the physical and biological processes responsible for the formation, alteration and preservation of marine sedimentary deposits. While present focus is on the biological alteration of sedimentary event layers, the physical processes leading to the deposition and erosion of marine sediment remains an area of interest. The general approach of this research program is the development and testing of theory mainly through field observations and measurements.

OBJECTIVES

This is a proposal, within the STRATAFORM Shelf Program, to study the formation, post-depositional alteration and preservation of flood deposits on the Pacific Northwest continental margin, with an emphasis on the Eel River shelf. Five related activities are being pursued: (1) continuation of time series measurements of the areal distribution and small-scale properties of the 1995 and 1997 flood deposits, (2) statistical analysis of the small-scale spatial variability of flood bed thickness and geometry at stations K60 and S60, (3) x-radiographic examination of piston cores for past flood deposits, (4) testing of simple conceptual ideas of event layer alteration and preservation using the above data sets, and (5) examination of patterns of sediment accumulation and event layer preservation offshore of other Pacific Northwest river systems (e.g., Russian, Klamath, Rogue).

APPROACH

Box cores are the primary sampling device used in this research. Cores are taken in two different modes: (1) replicate time-series sampling of four stations along the 70-m isobath, and (2) broad, large-scale coverage of the Eel and other river system margins. Subsequent sources of data include transmission x-radiographs, microresistivity profiles, profiles of the naturally occurring radionuclides, Pb-210 and Th-234, and macrofaunal community composition, abundance and biomass.

WORK COMPLETED

During FY 99, I was chief scientist on Leg 3 of STRATAFORM cruise TN9908. During this week-long cruise, box cores were collected on the shelf and upper slope to document the state of the Eel margin shallow stratigraphy and piston cores were collected in stratigraphically-critical regions identified by seismic profiles. In addition, I participated in a piston core analysis effort in Seattle

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE 30 SEP 1999		2. REPORT TYPE		3. DATES COVERED 00-00-1999 to 00-00-1999	
4. TITLE AND SUBTITLE The Formation, Alteration and Preservation of Flood Deposits on the Pacific Northwest Continental Margin				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Oregon State University, College of Oceanic and Atmospheric Sciences, 104 Oceanography Admin Bldg, Corvallis, OR, 97331				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

during February. Laboratory analyses primarily focused on Pb-210 geochronology of cores from other Pacific Northwest rivers.

RESULTS

The primary results obtained during FY 99 involve the preservation of flood deposits on the Eel and other Pacific Northwest river margins. Time-series measurements of macrofaunal abundance and species composition, as well as Th-234 derived mixing rates indicate that the Eel River flood deposits have little impact on the shelf fauna and bioturbation intensity. As a consequence, flood layers are rapidly destroyed. Layers < 5 cm thick are destroyed in a year, whereas layers < 10 cm thick have residence times of only 2-3 years (Wheatcroft and Wiberg, 1999). These findings suggest that sediment accumulation rate and event layer thickness will control the preservation of event beds.

Core x-radiographs clearly illustrate previous event layers at a wide variety of depths below the sediment water interface. Using Pb-210 derived sedimentation rates (Sommerfield and Nittrouer, 1999) and January 1995 flood deposit thickness data (Wheatcroft et al., 1997) it is possible to estimate the age of these event beds. Surprisingly, the most widely preserved layer of the past 50 years was produced in 1974 (Fig. 1), even though that year's flood was far smaller than other recent events. This result suggests that sediment accumulation rate immediately following an event, not event magnitude, is the key to preservation.

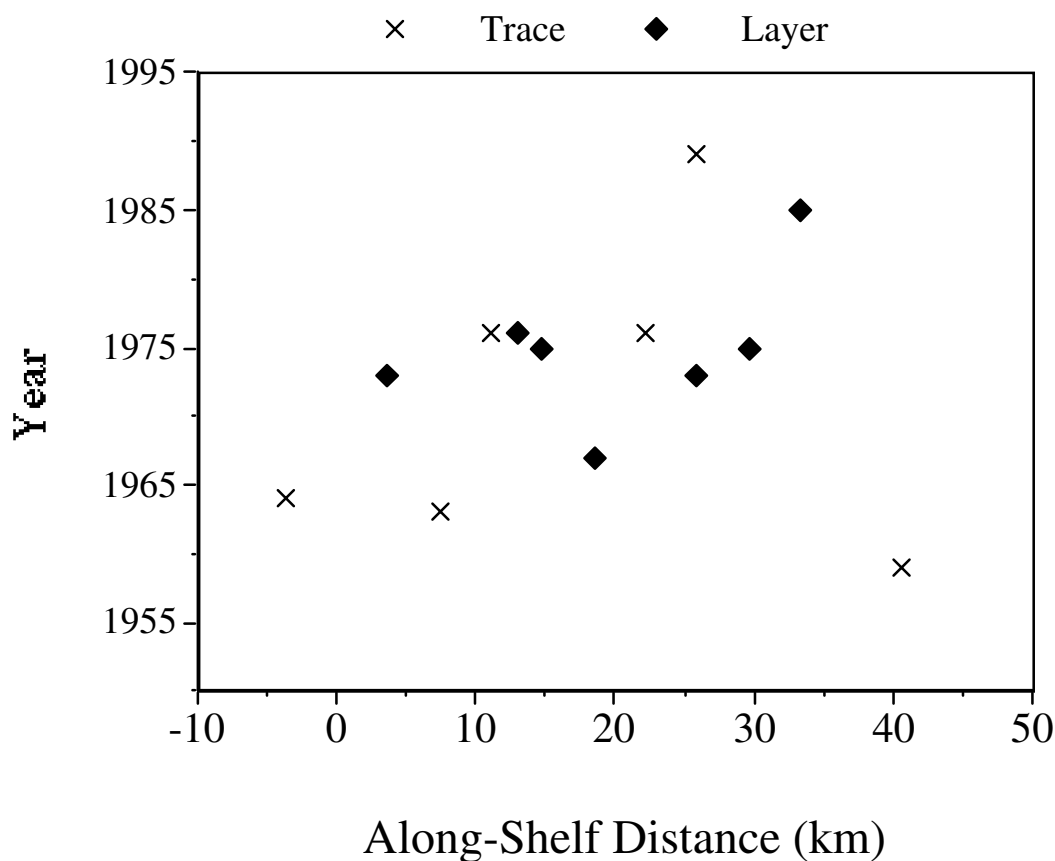


Fig. 1. Preserved flood deposits as a function of along-shelf distance and year. Major floods on the Eel River occurred in 1955, 1964, 1974 and 1986.

Preliminary analyses of x-radiographs collected adjacent to several other rivers in the Pacific Northwest (e.g., Umpqua, Rogue, Klamath and Russian) indicate few, if any, intact flood deposits (Wheatcroft and Borgeld, 2000). Whether or not flood deposits are ever produced by these rivers or simply not preserved due to lower regional sediment accumulation rates is unclear at the present time.

IMPACT/APPLICATIONS

Documenting the initial distribution and subsequent modification of sedimentary event beds will provide key insight for modelers of strata development on continental margins.

TRANSITIONS

Sedimentary strata have important and diverse acoustical implications. In a preliminary exploration of those implications, a selection of digitized x-radiographs has been subject to a statistical analysis in both the spatial and wave number domains by Dr. Dajun Tang (APL-University of Washington).

RELATED PROJECTS

Field sampling has been a joint effort with Drs. J. Borgeld (HSU), D. Drake (USGS), C. Nittrouer (UW) and C. Sommerfield (WHOI). In addition, collaborations have been initiated with Dr. P. Wiberg (UVA) to examine the formation and preservation of the flood deposits.

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PUBLICATIONS

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