

Biological Alteration of Sedimentary Event-Layers on the Eel River Shelf: Phase 2

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LONG-TERM GOAL

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

The focus of this project, which is a component of the STRATAFORM program, is the documentation of the post-depositional biological alteration of sedimentary event layers (i.e., beds derived from wind-driven storms and river floods) on the Eel River shelf off northern California. Specifically, the spatial (along and across-isobath) and temporal variation of the small-scale geometry of event-bed contacts is quantified using digital x-radiography. Variations in geometry will be explicitly related to spatial and temporal patterns of independently measured forcings, such as bioturbation intensity, macrofaunal community structure, sediment accumulation rate and event bed thickness

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 margin. 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. X-radiographs are digitized on a flatbed scanner and analyzed using a variety of image processing techniques (e.g., enhancement, segmentation).

WORK COMPLETED

During FY 98, I was chief scientist on three STRATAFORM cruises (WR9710, PS9803 and leg 1 of W9807). During the first two cruises, replicate time-series samples were collected at four stations along the 70-m isobath representing areas severely to moderately impacted by the January 1995 and January 1997 flood deposits. The third cruise primarily focused on collecting (during transit) box and piston cores off other major river systems (e.g., Rogue, Klamath) in the Pacific Northwest.

Report Documentation Page

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RESULTS

Analyses during FY 98 focused on the time-series data collected over the past three years. A key finding is that despite greater than 15 cm of sediment accumulation over a 3 year period at some locations, the shelf macrofauna display remarkable resiliency. That is, it is difficult to recognize a flood-effect following the 1995 and 1997 events, except for a short-term decline in the abundance of small, tube-dwelling polychaetes (e.g., spionids). Within-sediment depth distribution is similarly unaffected by the flood deposits (i.e., animals do not appear to avoid the deposits). Lastly, sediment mixing intensity is relatively high ($\sim 50 \text{ cm}^2/\text{yr}$) and insensitive to the flood events. All of these data indicate that biological reworking on the mid-shelf is relatively constant in time.

A note-worthy feature of the Eel River shelf fauna, compared to that found on other West Coast shelves, is the dominance of polychaete worms and near complete absence of echinoderms (e.g., heart urchins and brittle stars) (Table 1). Presently, the explanation for this pattern is unknown; however, it may be a result of a local extirpation due to the 1964 flood (a 400-year return period event). That is, due to their extremely slow growth rates coupled with frequent floods over the past 35 years, the echinoderms have never recovered. Regardless of the cause, the absence of heart urchins has important ramifications for the preservation of event beds.

Table 1. Percent fraction of major phyla (1-mm sieve fraction)

Phylum	Site				
	WA	OR	Eel	Russian	LA
Annelida (worms)	48.2	55.1	86.1	61.8	65.6
Mollusca (clams, snails)	27.0	38.0	7.8	17.4	< 1
Arthropoda (crustaceans)	18.1	3.2	5.7	2.2	13.0
Echinodermata	6.6	3.6	< 1	18.5	21.6

Sources: WA (Lie and Kisker, 1970), OR (Richardson et al., 1977); Russian (C.A. Butman, WHOI, unpublished data); LA (Wheatcroft and Martin, 1996)

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 have 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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