Sediment and Contaminant Transport along the Southern California Bight

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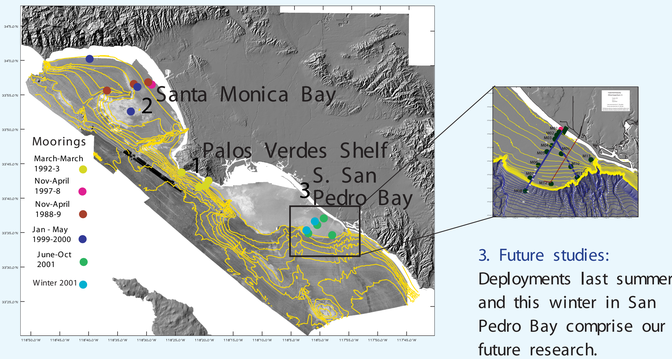
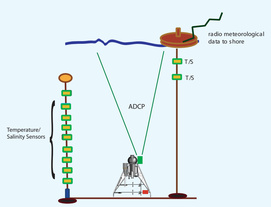
Introduction

Since 1992, we have undertaken a series of programs to determine the processes that transport sediment and contaminants in the highly urbanized, central part of the Southern California Bight. Because of the significant changes in bathymetry in the region, processes that move sediment and contaminants vary greatly across the shelf. Two large embayments, Santa Monica and San Pedro bays, are connected by the short, very narrow shelf of the Palos Verdes peninsula. Ocean sewage outfalls are located in the middle of Santa Monica Bay, on the Palos Verdes shelf and at the southeastern edge of San Pedro Bay. As a major part of these programs, arrays of instrumented moorings that collect oceanographic and sedimentary data were deployed on the shelf near each of the outfall pipes. Our data suggests that different mechanisms will continue to exhume and transport contaminated sediments along the shelf for a long period of time.

Three Deployment Regions



Data Collection

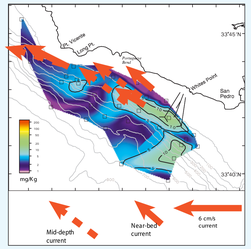


Moorings consisted of a combination of an instrumented benthic tripod and adjacent temperature and salinity sensors. ADCPs measured currents over the water column. Additional sensors measured temperature, salinity, pressure, and water clarity. Sediment traps collected resuspended materials.

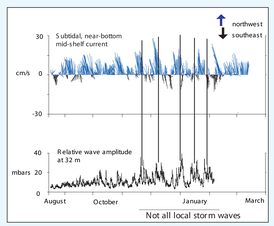
1. The Palos Verdes Shelf: Northwestward transport from the DDT source

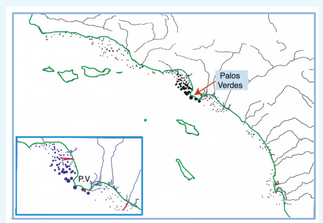
DDT is transported northwestward from a large deposit of contaminated sediment on the Palos Verdes shelf into Santa Monica Bay

The buried DDT that is sorbed onto marine sediments is brought to the surface by bioturbation and is transported by currents.



Sediments are then resuspended by storm waves are carried to the northwest by subtidal currents.





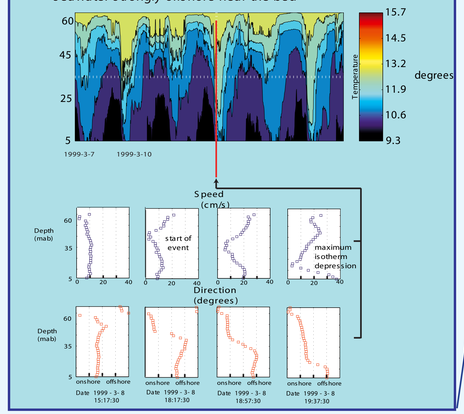
The DDT is spread along the entire Southern California Bight.

2. Santa Monica Bay

Internal bores are the dominant transport mechanism at the outer shelf while alongshore subtidal currents determine transport over the midshelf

ADCP view of thermoclinal depression events at the outer shelf

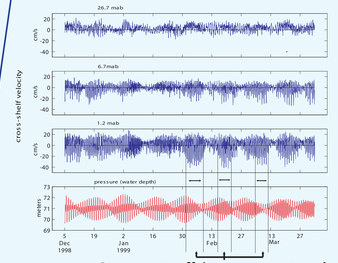
The figures reveal that warm surface water was brought downward without mixing during a daily event that forced seawater strongly offshore near the bed



During falling spring tides internal bores force seawater (and sediment) stongly offshore near the bed and less strongly onshore in mid to upper waters

Current velocities and sea level

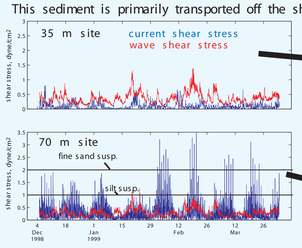
Top threee graphs show cross-shelf current velocities at various depths at the outer shelf mooring. Lower graph shows tidal flux for the corresponding times.



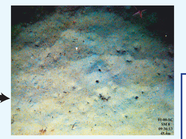
Strongest offshore current pulses occurred during falling spring tides

Shear stress of currents and waves at the mid and outer shelf

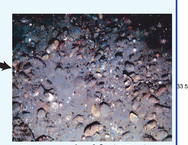
Strong internal bores move 2-8 times more sediment than waves at the outer shelf (70 m) and sweep the region clean of fine sand and mud. This sediment is primarily transported off the shelf.



Sea Bottom Photos



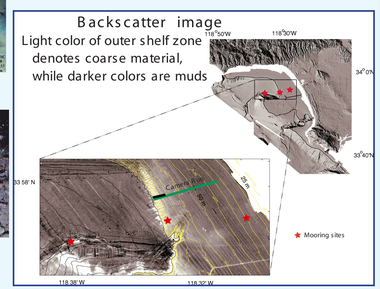
Midshelf (45m)



Outer shelf (88m)

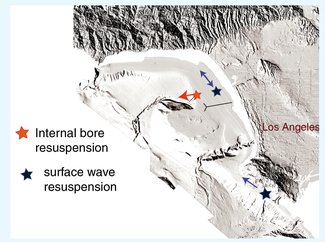
Backscatter image

Light color of outer shelf zone denotes coarse material, while darker colors are muds



Summary

Distinct sediment transport processes occur at the mid and outer shelf of the Bay and on the Palos Verdes shelf



*Transport in the Bay is both to the NW and SE (and offshore at the outer shelf)

*Transport past the peninsula is to the NW

Conclusions

A diverse measurement system is needed to model contaminated sediment transport. We need to understand the geology, phyiscal oceanography, chemistry and biology before numerical models are developed.

Contaminated sediment will continue to be exhumed and transported along the shelf by bioturbation, currents and waves.

Acknowledgements

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