An Integrated Investigation of Inner-Shelf Strata on the Eel Margin: The Coarse-Grained Portion of a Transgressive Shelf Sequence (Shallow-Water Swath-Mapping Component)

Roger D. Flood
Marine Sciences Research Center
State University of New York
Stony Brook, NY 11794-5000
phone: (631) 632-6971 fax: (631) 632-8820 email: roger.flood@sunysb.edu
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LONG-TERM GOAL

The ultimate goal of this research is to understand the mechanisms by which continental-margin sediment is deposited, modified and preserved, so strata recorded over various time scales (events to millennia) can be interpreted better.

OBJECTIVES

High-resolution bathymetry and surficial acoustic backscatter data acquired from the Eel Shelf using the EM 1000 system show dramatic changes in backscatter along the margin, which cannot be related to topographic features. However, there is only limited information as to how those patterns change on the inner shelf. Backscatter anomalies may be related to surface sediment nature and relief (e.g., shell content, ripples, sand dollars), sedimentary structure (e.g., near-surface interbeds), or the presence of gas rising through sandy sediments -- resulting in low backscatter in regions of coarse sediment. However, the origin of the anomalies on the Eel Shelf is not well understood. The next step in a more detailed understanding of the seabed surface is to show clearly how detailed bathymetry and backscatter patterns (including angular variations in backscatter) are related to near-surface sediment structure as well as surficial sediment character. Our immediate objective is to collect and analyze multibeam bathymetry and backscatter data from the inner Eel Shelf using a dual-head EM 3000 multibeam echosounder.

APPROACH

The MSRC/SUNY EM 3000 multibeam system was used to map bathymetry and backscatter (at 300 kHz) in water depths from about 6 to 70 m, extending from the Eel River to the Mad River. Our EM 3000 (in a dual-head configuration, using a leased second head) was installed on the R/V Clifford A. Barnes (University of Washington) for the survey. The EM 3000D multibeam echosounder simultaneously collected depth and backscatter information in a swath that was typically 8 times the water depth. About 100 bottom grab samples were recovered from the survey area to help understand the relationship between backscatter and sediment properties.

WORK COMPLETED

Our multibeam survey was undertaken from August 2 to August 25 following diver installation of the multibeam transducers on the R/V Barnes. We had good weather, and were able to study a somewhat

larger area than expected. We worked out to over 60 m for almost all of the proposed area. We also worked as shallow as 5 m, and resolved a number of features near the beach that relate to sediment movement that extend from near the beach to 10s of meters deep. Data were processed during the cruise, resulting in a preliminary bathymetric and backscatter data set gridded at 5 m. We had hoped to use a bottom camera to characterize bottom morphology during the cruise, but the bottom camera (a new digital stereo photograph system) wasn't ready when we were at sea.

RESULTS

Our coverage shows the general form of the inner shelf as well as the presence of distinct features (Figures 1 and 2). The larger primary Eel River delta extends offshore from 25 m to over 60 m water depth; the bathymetric expression of this feature is much less shallower than 25 m suggesting that it may be a relict feature. A distinct bathymetric bulge about 4 km north of the Eel River mouth, at 15-30 m water depth, may be a separate nearshore depositional area. Offshore of this bulge, the shelf flattens suggesting an area of sediment accumulation on an otherwise gently sloping bottom. Other distinct bathymetric features observed in our survey include a broad but distinct channel trending towards the Mad River as well as anthropogenic features such as an outfall pipe and several dredge spoil deposits near the entrance to Humboldt Bay. There are large backscatter variations observed in our survey because sediments range in size from coarse sand and gravel to muds. In addition, bedforms, probably oscillatory ripples, with wavelengths of approximately 1m were observed in the sonar images, and may contribute to broad patterns in backscatter, particularly in the nearshore region. A directionality dependence of backscatter, which may be related to the presence of these bedforms, was also noted during our survey.

A multibeam survey conducted in 1995 in this region used a lower frequency system (the 100 kHz EM 1000) and extended from the slope to the mid-shelf. The outer limit of our survey overlaps the inner limit of the previous survey providing the opportunity to identify temporal variation on the mid-shelf. In some areas our backscatter data agree fairly well with the previous survey, but in other places there are significant differences. In particular, a zone of higher backscatter was noted trending NE-SW near the Mad River in the 1995 multibeam data. However, our data show that the sediments in this region (coincident with the broad channel described above) are characterized by lower backscatter than the surrounding sediments. This change in backscatter may be related to the relocation of the Mad River mouth which shifted 5 km southward in 1999 and which may now be delivering more sediment to this region.

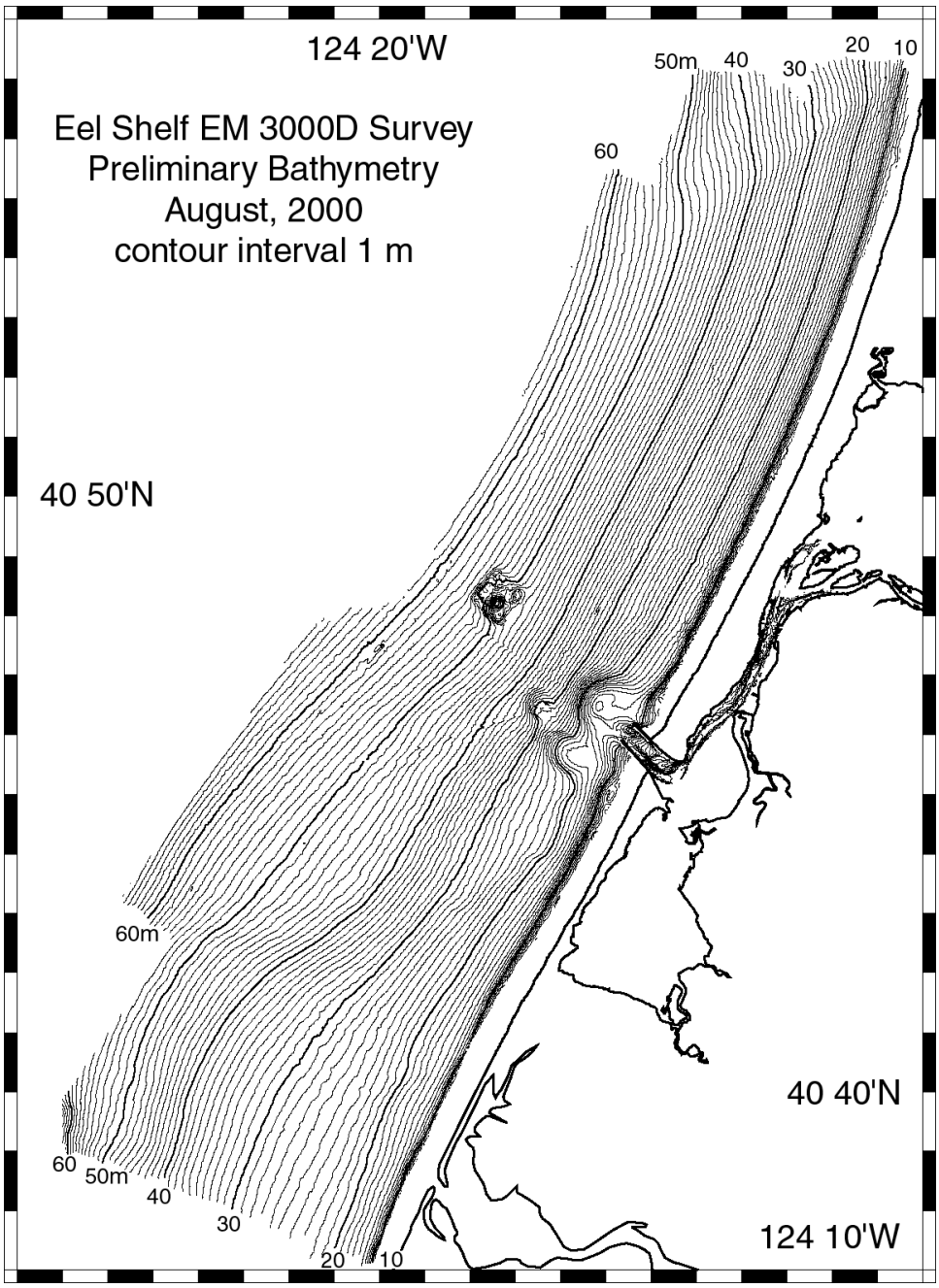

Figure 1. Preliminary contour map of the inner Eel Shelf and a portion of Humboldt Bay (contour interval 1 m) determined by the EM 3000D multibeam survey.

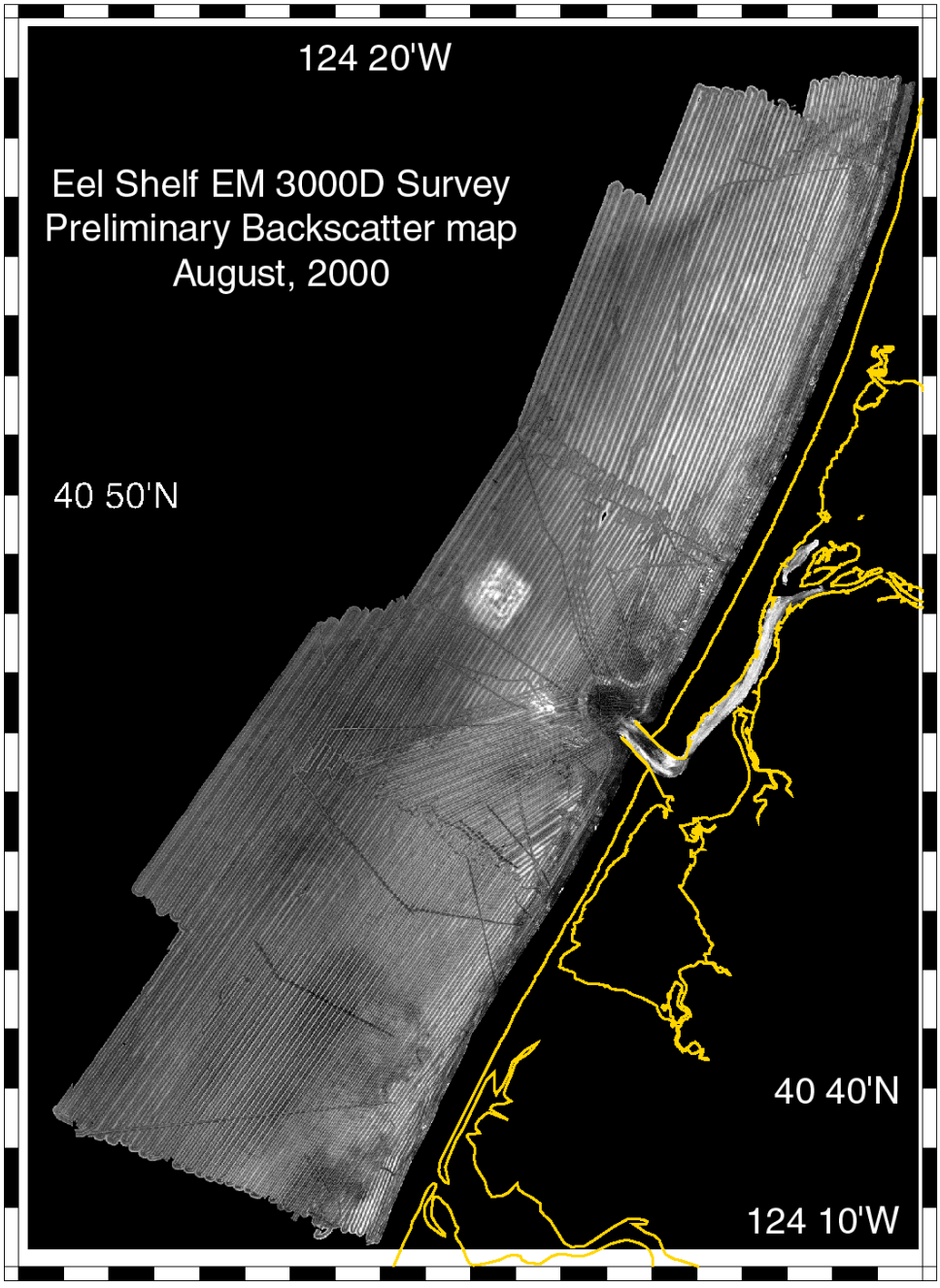

Figure 2. Preliminary backscatter map of the inner Eel Shelf and a portion of Humboldt Bay determined by the EM 3000D multibeam survey.

IMPACT/APPLICATIONS

Our study suggests that high-resolution multibeam surveys (bathymetric and backscatter) on the inner-shelf provide some of the information needed to link the processes and patterns of the outer-shelf, a primary focus of the STRATAFORM project, with the inner shelf and near-shore regions.

TRANSITIONS

These data will be available to other STRATAFORM workers to provide a context for understanding sedimentation on the Eel Shelf. The US Army Corps of Engineers is planning a modeling study of Humboldt Bay and they will also be able to use our multibeam data in support of that effort.

RELATED PROJECTS

Our project is closely related to studies of sediment nature and structure being undertaken by Chuck Nittrouer (sediment cores) and by Neal Driscoll (seismic profiles) in the same area, and we will work with those investigators to understand depositional history and patterns in the area. We are also analyzing EM 3000 data from several different areas, including as part of the High Frequency Acoustics Experiment DRI (SAX 99). Advances in data analysis will benefit all mapping studies.