Study of Deep-Sea Furrows: Physical Characteristics, Mechanisms of Formation And Associated Environmental Processes

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LONG-TERM GOALS

A field of sedimentary furrows was discovered on the abyssal plain at the base of the Sigsbee Escarpment during a 1999 deep-tow survey of the continental slope in the Bryant Canyon area of the northwestern Gulf of Mexico. The furrows are long, relatively narrow depressions in the seafloor that are generally oriented parallel to the escarpment. Furrows associated with deep-water currents have been found along the Blake Bahama Outer Ridge (Hollister et al., 1974; Lonsdale and Spiess, 1977; Tucholke, 1979; Flood and Hollister, 1980; Flood, 1983), the Bermuda Rise (Embley et al., 1980), and several other localities (see review by Flood, 1983). Though such observations exist, they have by necessity been limited to relatively small areas and only few individual furrows have been studied in detail. The massive areal extent of Sigsbee Escarpment furrow field (~10,000 km^2) and the detail with which the field has been imaged are unprecedented. Their character indicates the occurrence of previously unrecognized strong bottom water flow in the gulf and it highlights the important influence flow has on slope and rise sedimentary processes. Many questions about the nature of the furrows and their relationships to currents and other environmental processes exit. For example: What are the dimensions and morphologic features of the furrows? What is their mechanism of formation? What is their significance for the lower slope/rise sedimentary processes? What is the nature and cause of associated water flow? As a first step toward answering such questions, we have begun examining existing 3-D seismic data and deep-tow data.

OBJECTIVES

Our main objective is to use seismic data collected with the Texas A&M deep-tow system and 3-D seismic data made available to us from industrial sources to make initial characterizations of the spatial extent of the furrow field, the distribution of furrows within it, and variations of the morphologies of individual furrows. Our second objective is to identify and determine the extent of buried, relic furrows. Comparison of the orientation and morphology of relic and modern furrows will provide insight into both the spatial and temporal evolution of these features and the processes that form them.

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14. ABSTRACT
A field of sedimentary furrows was discovered on the abyssal plain at the base of the Sigsbee Escarpment during a 1999 deep-tow survey of the continental slope in the Bryant Canyon area of the northwestern Gulf of Mexico. The furrows are long, relatively narrow depressions in the seafloor that are generally oriented parallel to the escarpment. Furrows associated with deep-water currents have been found along the Blake Bahama Outer Ridge (Hollister et al., 1974; Lonsdale and Spiess, 1977; Tucholke, 1979; Flood and Hollister, 1980; Flood, 1983), the Bermuda Rise (Embley et al., 1980), and several other localities (see review by Flood, 1983).

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APPROACH

We have begun studying the seismic data collected with the Texas A&M deep-tow system and 3-D seismic data made available to us from WesternGeco and other industrial sources. As it becomes available, this data is being installed and analyzed on our seismic data interpreting workstations using state-of-the-art commercially available software. Graduate student D. Bean is carrying out data processing and interpretation; this work forms the basis of his Ph.D. dissertation research. N. Slowey and W. Bryant are overseeing the efforts of D. Bean and also participating in data processing and interpretation.

WORK COMPLETED

Currently we have processed all existing data collectected with the Texas A&M deep-tow system and we have received data from WesternGeco from 4 surveys in the Green Knoll area. The data has been loaded and the seafloor in all surveys has been picked. The next step will include creating time slice volumes and picking of specific horizons associated with paleo-furrows. Surveys from the Alaminos Canyon area are being processed by WesternGeco and additional surveys near the Mississippi Canyon will follow.

RESULTS

To the extent that existing data allows, we have delineated the extent of the furrow field and made an initial description of the furrow morphologies. The morphologies of the furrows are consistent with the largest furrows reported by previous studies. The presence of the furrows and available current meter measurements indicated the presence of previously unrecognized events of strong bottom water flow.

IMPACT/APPLICATIONS

The processes that form furrows are actively eroding sediment at the base of the Sigsbee Escarpment and play an important role in the development of the lower slope and rise. The results of this study reinforce the general notion that bottom water flow is The deepwater flow that produces the furrows needs to be characterized and the processes that produce it need to be understood. We anticipate that when similarly high quality seismic data becomes available from other areas of the world's oceans, similar scale furrow fields will be recognized.

TRANSITIONS

The results of this study contribute to our basic understanding of the processes that form and maintain the lower continental slope and rise, and contribute the industry's ability to safely and effectively produce oil and gas in deepwater.

RELATED PROJECTS

None.

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PUBLICATIONS

W. Bryant, N. Slowey, D. Bean, E. Scott, and T. Dellapenna, Mega-Furrows and Bottom Water Flow along the Sigsbee Escarpment, *Science,* submitted.

PATENTS

None.