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Evolution of Lower Wilcox deltas in response to shelf margin collapse, Lavaca County, Texas

Introduction

Recent discoveries in the Perdido Fold Belt of the northwestern Gulf of Mexico have targeted previously unrecognized lower Tertiary turbidite sands (Zarra, et al, 2003). These Wilcox equivalent sands are located at least 250 miles downdip of equivalent Wilcox fluvial and deltaic depositional systems, suggesting long-distance sediment bypass must have occurred to supply the basinal deposits. Submarine canyons, formed by mass-wasting processes at the shelf-margin, are likely candidates to serve as funnels for sediment bypass into the basin. Several submarine canyon complexes exist in the subsurface below Lavaca County, Texas. The Middle Wilcox Yoakum Canyon lies just east of Yoakum, Texas, and has approximately 3000 feet of relief (Hoyt, 1959). The Lavaca and Hallettsville Canyon Complexes stretch from Hallettsville east to the Colorado County line and have lower relief erosional surfaces than the Yoakum Canyon. These complexes, of Lower Wilcox/Midway age, are actually thought to consist of four separate and overprinted canyon complexes (Galloway, et al, 1991). The Lavaca Canyon Complex is the youngest of the canyon-forming events and will be the focus of this study.

Fisher and McGowen (1967) characterized the depositional environments of the entire Lower Wilcox throughout Texas. Their interpretation shows Lavaca County to be at the edge of an interdeltaic sub embayment within the Rockdale Delta System. The Rockdale Delta System was a large clastic wedge that prograded over the underlying and partially time-equivalent Midway shale, serving as the main Lower Wilcox marine sediment source. The Rockdale system spanned the Houston Embayment from the San Marcos Arch to the Texas/Louisiana border and was composed of at least five separate deltas associated with long-lived modern rivers. Lower Wilcox sands in Lavaca County were sourced from the Guadalupe delta, an arcuate delta that was the

easternmost of the Rockdale system. The initial Lower Wilcox shelf-margin was controlled by the trend of the late Cretaceous Edwards shelf-margin located beneath N. Word and Hallettsville fields but was later modified by the canyon complexes introduced above.

Production associated with the canyon complexes occurs from sands truncated by shaley canyon fill, as well as from discontinuous sand bodies within the canyon fill. Valentine and Menking fields produce from Lower Wilcox sands that are stratigraphically trapped by a high-relief erosional surface that has been correlated with the Lavaca Canyon Complex downdip (Chuber, 1979). Regional and local wireline log correlation (Chuber, 1979) yielded sand isolith maps interpreted to show shoreline (barrier bar with tidal channel) and distributary channel environments for the productive sands. Chuber and Howell (1986) attribute Lower Wilcox production in Hallettsville, Kinkler, and N. Word fields to distributary channel sands. Alternatively, Berg (1979) interpreted core from the productive sands of Valentine field as being of outer-shelf to slope turbidite origin. The Lower Wilcox study of Fisher and McGowen (1967) also support the shallow marine interpretation of Chuber (1979). A deltaic/shallow marine environment for fields landward of the Edwards shelf margin will be used as the working assumption for this study. The discontinuous sands within the canyon complex are productive in South Hallettsville field. Berg (1979) interpreted these sands as slump blocks of previously deposited turbidites based on core. The slump block origin for these sands is likely and is supported by other authors (Galloway, 1991); however, the source of the slump blocks is probably shelf-margin deltas of the Rockdale system. This conclusion is partially based on a study of clay mineralogy beneath and within the sands indicative of a deltaic environment (Freed, 1980).

The goal of the study will be to characterize shelf and shelf-margin deltas in northeastern Lavaca County. Deltas within and away from the canyon complex will be studied and compared. Changes in process regime as the deltas prograde to the shelf edge will also be evaluated to determine if the deltas evolve in different manners in response to diverse shelf-margin types.

Methods

The main dataset for this project will be wireline logs from several fields around the Hallettsville area, including N. Word, Hallettsville, Sweet Home, Valentine, and Kinkler fields. A number of logs have already been obtained for this work. Additional logs will be copied from the Geophysical Log Facility at the Bureau of Economic Geology. A high-resolution sequence stratigraphic framework will be created as the basis for later work. Previous workers have correlated the Lower and Middle Wilcox section using genetic stratigraphic techniques (Xue and Galloway, 1993; Xue and Galloway, 1995). These authors divided the Middle Wilcox into two genetic third-order sequences and the Lower Wilcox into four genetic third-order sequences across the entire Texas Coastal Plain. We

propose to use depositional sequence stratigraphic techniques rather than genetic stratigraphy to subdivide the Lower Wilcox into higher order sequences and to delineate systems tracts within the sequences over a relatively small area.

From the high-resolution sequence stratigraphic framework, individual fourth-order clinoforms will be chosen for further study. Deltaic complexes that initially develop on the shelf and subsequently prograde into the submarine canyon complex at the shelf margin (canyon-influenced shelf-margin deltas) will form one clinoform group for study. Deltaic complexes prograding to an undisturbed shelf margin (normal shelf-margin deltas) will also be studied for comparison. Changes along the depositional profile of individual clinoforms will be characterized (i.e., how do shelf deltas change when they encounter a submarine canyon). In addition, sand isolith maps will be constructed to help determine the dominant process regime (fluvial, wave or tidal) of individual deltas. An attempt to acquire relevant cored intervals will also be made to facilitate the interpretation of process regime. Recent work by Steel, et al (in progress) hints that process regime of deltas evolves to dominantly fluvial at shelf margins and that wave processes become relatively insignificant. This study will help test this hypothesis in an area of high sediment supply/subsidence with a collapsed shelf margin.

A further possibility of this study will be to obtain seismic data from industry sources. This data would aid in the delineation of the canyon complex as well as in the interwell correlation of sands. However, the pursuit of this study is not contingent upon the availability of seismic data.

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