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Barrier-island aggradation via inlet migration: Mustang Island, Texas

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Abstract

After establishing its present location around 9.5 ka, Mustang Island aggraded, stacking over 20 m of barrier-island sand in the same location. Throughout Mustang Island's history, tidal inlets shifted within nearly the same location from 7.5 ka to the present, leaving 10–15 m thick deposits of clean, well-sorted, quartz sand deposited within only a few centuries. These deposits lack some of the sedimentary features normally associated with tidal inlets, such as tidal couplets and shell hash. The lack of such features is attributed to the uniform nature of the deposits cut by the inlets during the island's relatively long period of aggradation. Mustang Island was able to maintain an aggradation character throughout most of the Holocene due to the sediment eroded from three sources: Pleistocene headlands, the transgressive Colorado River delta of Texas, and the OIS 3 shoreline of the central-Texas shelf. Each of these sources was exposed to waves and accompanying longshore drift during the island's early history when sea level rose quickly, but was flooded or capped by transgressive muds by the time sea-level rise slowed during the middle Holocene.
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Keywords: Mustang Island; Barrier island; Aggradation; Tidal inlet; Aransas Pass; Texas coast; Grain size; Environmental interpretation

1. Introduction

Dickinson et al. (1972) suggested the presence of three types of barriers: 1) prograding 2) stationary, and 3) landward migrating. Following a similar scheme, Galloway and Hobday (1983) also suggested three types of barrier islands: regressive, aggradational, and transgressive (Fig. 1). Aggradational barriers are the least documented type of barrier islands. Consequently, they are seldom used as models in subsurface and outcrop studies. The purpose of this paper is to describe the history of Mustang Island — a Holocene aggradational barrier island located on the central-Texas coast.

Most of the Texas barrier islands have been studied in great detail (LeBlanc and Bernard, 1954; Fisk, 1959; Shepard, 1960; Bernard et al., 1970; Wilkinson, 1975; Wilkinson and Basse, 1978; Morton and McGowen, 1980; Morton, 1994; Rodriguez et al., 2004) and are often used as analogues to interpret the rock record (Dickinson et al., 1972). One of the more notable barrier sub-environments documented in these studies is a tidal inlet within a microtidal setting. From other studies we learn that tidal-inlet deposits are characterized by shell hash, tidal couplets, and herring-bone cross stratification (Moslow and Tye, 1985; Israel et al., 1987). Within cores, only the first two of these sedimentary features are

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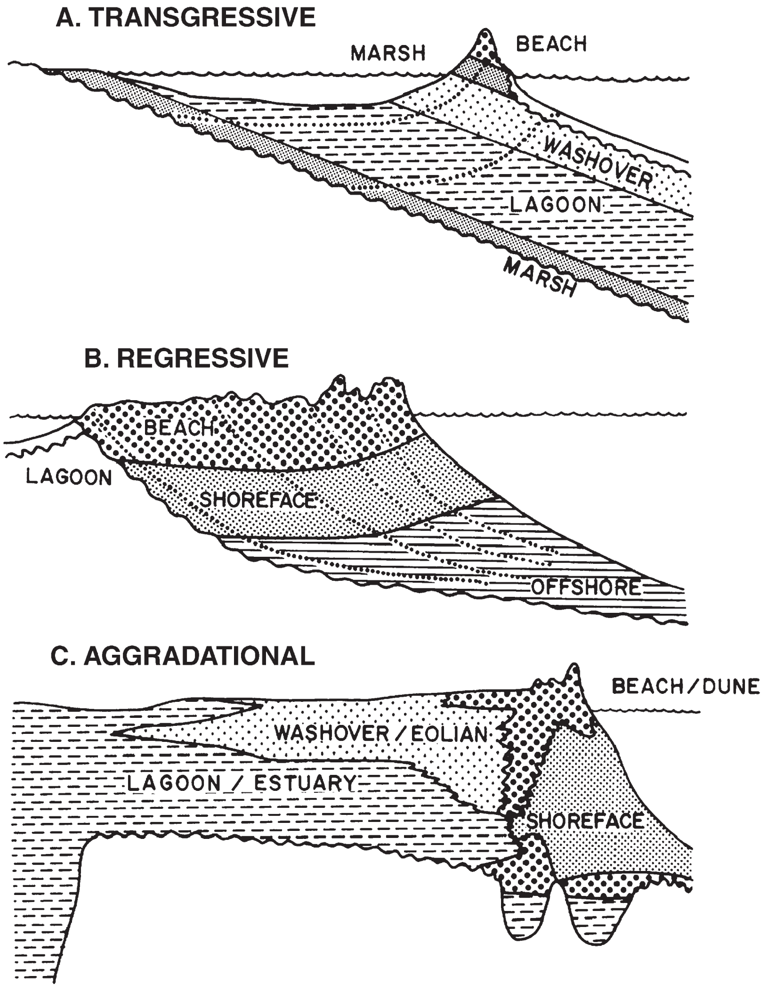

Fig. 1. Three models of barrier-island evolution (after Galloway and Hobday, 1983). A) After Kraft and John (1979), B) after Bernard et al. (1970) and C) after Fisk (1959) and Morton and McGowen (1980).

commonly preserved or identifiable. Another purpose of this paper is to document how reliance on these features alone to identify tidal inlets can lead to a gross underestimation of the amount of tidal-inlet deposits. In addition, a large amount of work conducted on the Texas coast documents the evolution of most of the Texas barrier islands. Mustang Island is a notable exception; in this paper we document the history of Mustang Island.

During this investigation we attempted to distinguish barrier environments with a paucity of sedimentary structures, fossils, and relatively uniform grain size using detailed grain-size analysis as an indicator of depositional environment. It is ironic that some of the first studies using grain size as an indicator of depositional environment were conducted on Mustang Island (Mason and Folk, 1958; Moiola and Spencer, 1973). Since these studies were conducted, newer technology, including laser diffractometry, has lead to techniques with better precision in determining grain size (Sperazza et al., 2004) and some authors have suggested once again that grain size might be a viable method in determining depositional environment. We tested classic methods of distinguishing environments, such as plotting grain size versus skewness and discriminant analysis (Friedman, 1961; Moiola and Weiser, 1969; Greenwood, 1969; Moiola and Spencer, 1973; Taira and Scholle, 1979; Toscano, 1986), with newer grain-size analysis technology. At first glance, the results appear favorable. However, placing the interpreted environments into context with sea-level data from around the region casts doubt on the effectiveness of grain size as a reliable indicator of depositional environment.

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