ABSTRACT: The Mobile River incised-valley system located in the northern Gulf of Mexico occupies an area from southern Alabama through Mobile Bay to the outer Mississippi-Alabama continental shelf. During the Wisconsinan regression, this incised-valley system was fluvially eroded and extended across the exposed shelf to a shelf-margin delta complex. The last postglacial transgression drowned the entrenched alluvial valleys and reworked the alluvial fill and estuarine deposits to form shoals on the middle shelf. As the postglacial transgression slowed, Mobile Bay was formed. Mobile Bay is a large estuarine system protected by barrier islands. This paper documents the late Quaternary history of the Mobile River incised valley and fill.

Mobile Bay is a large (>1000 km²) microtidal estuary in southern Alabama that receives drainage through the Mobile River system. The Mobile River catchment is the fourth largest in the United States and terminates at the bayhead delta of Mobile Bay. The bay is a classic example of a wave-dominated, drowned, fluvial incised valley. During the middle-late Wisconsinan, glacial maximum, relative sea level was approximately 120 m lower than present. The Mobile River incised valley was a conduit for drainage from the catchment to the shelf margin. The sediment carried by the fluvial system during this lowstand passed through the Mobile River incised valley, across the exposed shelf and was deposited on the shelf margin as deltaic lobes.

Rapid sea-level rise forced coastal-plain shorelines seaward across the present mid-continent shelf. Transgression of the estuary mouth left a series of estuary-mouth-bar deposits that were reworked and overlie alluvial fill. These sand-rich deposits were submerged by the continuing transgression and reworked to form shoals. As the Holocene sea-level rise slowed, the Mobile River incised valley became an estuarine depocenter. In the present alluvial valley, lowstand deposits are over lain by estuarine sediments deposited during the initial flooding of the valley and subsequent formation of Mobile Bay.

During the present highstand, longshore sediment transport formed a spit across much of the bay mouth, creating a restricted estuary into which a bayhead delta has prograded. Late Holocene deposits in Mobile Bay consists predominantly of lagoonal sediments with bayhead-delta deposits encroaching into the northern end of the bay. The Holocene incised-valley fill (estuarine facies) underlying Mobile Bay fit well into the conceptual facies model of a microtidal wave-dominated estuary. The model does not fit as well, however, with the rapidly transgressed shelf portion of the incised valley. The down dip section does not contain a clearly identifiable (from seismic profiles) estuarine facies; the valley fill is primarily fluvial and is overlain by marine shoals. In the Mobile River incised valley, the distal portion of the valley was rapidly drowned, allowing the thin estuarine facies to be reworked. The proximal portion was drowned more slowly, leaving the estuarine facies intact. Thus, the single incised valley contains two very different types of fill.

INTRODUCTION

Recent industrial and academic concerns have ignited interest in the evolution and history of incised valleys. Incised valleys commonly result from fluvial down cutting in response to sea-level fall. Sediments that fill incised valleys form regionally elongated belts of channelized sandstones and are potential reservoirs for hydrocarbons (Weimer, 1984; Krystinik and Blakeney-DeJarnett, 1990; Blakeney-DeJarnett and Krystinik, 1992) and hard mineral resources (McBride and others, 1991). The geologic imprint of fluvial incisions across the modern continental shelf provides evidence of sea-level change and records the pathways for sediment transport from the river catchment to the shelf break. This sedimentary pathway can serve as an analog to ancient incised valleys that represent conduits for shelfward transport.

There have been many examples of Pleistocene incised fluvial valleys documented from around the world, including the Gulf of Mexico (e.g., Bouma and others, 1982; Suter and Berryhill, 1985; Berryhill, 1986; Suter and others, 1987; Thomas and Anderson, 1989, 1991; Anderson and others, 1990, 1991, 1993; Bartek and others, 1990, 1991; Nichol and others, 1993), the Atlantic shelf of the United States (e.g., Uchupi, 1970; Harris, 1983; Matteucci, 1984; Knebel and Circé, 1988), the southwestern French coast (e.g., Allen and Posamentier, 1993), and the French Mediterranean coast (e.g., Allen and Posamentier, 1993). Ancient examples include those from the Upper Carboniferous section in Namurian Clare basin, Ireland (Elliott and Pulham, 1991), the Viking Formation in Alberta, Canada (Allen and Posamentier, 1991; Boreen and Walker, 1991), and the Pennsylvanian and Cretaceous of the United States (Baum and Vail, 1988; Weimer and Sonnenberg, 1989; Krystinik and Blakeney-DeJarnett, 1990; Van Wagoner and others, 1990; Dolson and others, 1991; Jennette and others, 1991).

The deposits which fill incised fluvial valleys range from non-marine through estuarine to open marine (Allen and Posamentier, 1991; Boyd and Honig, 1992; Dailymple and others, 1992; Allen and Posamentier, 1993). Elliott and Pulham (1991) give an example of incised valleys completely filled with fluvial sediments. An example of highly complex mixed fills of fluvial, estuarine, and/or marine sands that onlap and fill incised valleys of the J Sandstone (Horsetooth Member) in the Denver Basin has been described by Baum and Vail (1988).

Mobile Bay and estuaries along the Gulf of Mexico margin typically originated as incised fluvial valleys that formed during the most recent eustatic sea-level fall and were drowned by the ensuing postglacial sea-level rise. Most of