TECTONIC CONTROL ON DEPOSITION OF MIOCENE INCISED VALLEYS IN NORTHERN BRAZIL.

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Estuaries are important components of drowned valley systems. Studies focusing on incised valley deposits have increased greatly in the past decade, with a large volume of work contributing for identifying facies and stratigraphic expressions of these highly variable and architecturally complex depositional systems. Many previous studies have tended to consider sea-level changes as the primary mechanism responsible for the origin and filling of most of the valley systems (e.g., Zaitlin and Shultz 1984, 1990; several papers in Dalrymple et al. 1994; Blum and Törnqvist 2000), but this might be due to the fact that other factors, such as tectonics, climate and sediment supply, were overlooked in the past by the lack of distinguishing criteria. Differentiating among these causes in the sedimentary record is indeed difficult. However, there has been an increased documentation of climate- and tectonic-influenced valley systems (e.g., Schumm et al. 1987; Lukie et al. 2002; Carr et al. 2003), revealing that these processes might be responsible for many valley fills in the sedimentary record. Despite these works, a larger number of documented examples is needed in order to gain a better understanding of the causes of valley formation and the mechanisms that control and/or affect valley filling in the various geological settings. In particular, incised-valley systems in areas characterized by low accommodation rates have been discussed only in a few studies (e.g., Zaitlin et al. 2002, Ardies et al., 2002, Lukie et al 2002).

The present work aims to synthesize the depositional history of incised-valley estuaries recorded by the Miocene Pirabas/Barreiras formations in northern Brazil. The main goal is to contrast their facies characteristics and stratigraphic architectures in different geologic settling (i.e., São Luís Basin, Cametá Sub-basin of the Marajó Graben System, and Bragantina Platform) in the attempt to develop solid criteria for demonstrating that tectonics influenced base-level variation and contributed to valley establishment and subsequent infill. A comparison of the sedimentological and tectono-stratigraphic characteristics of these estuarine successions might help in the establishment of sequence models in areas with low accommodation rates.

The results show the importance of tectonics in valley establishment and infill in such areas with low accommodation rates. Valleys formed in such geological settings are shallow, with tectonics probably playing the main role on the preservation of typically thin, but internally complex fills formed mostly during the transgressive and highstand stages of relative sea level fluctuations.

The studied deposits were formed in a variety of depositional environments attributed mostly to wave-dominated estuaries formed within incised-valley systems. Instead of filling the valleys continuously, deposition took place during the transgressive to highstand stages of several relative sea level cycles, producing compound fills (Rossetti 2001, 2004). Although other causes (e.g., eustasy) can not be completely ruled out, tectonic influence on valley evolution is suggested by: 1. vertical superposition of chronologically distinct incised valley successions; 2. time gap of several million years before valley formation, which indicates that sediment preservation took place solely when accommodation space was created by increased subsidence; 3. overall orientation of estuarine channels parallel to the main structural features of the basins; 4. faults that disrupt basal unconformities; and 5. stratigraphic horizons with a variety of seismogenic soft-sediment deformation structures including both ductile and brittle deformation. The following characteristics are common to the deformed horizons: occurrence within entirely undeformed deposits; great lateral continuity for several hundreds of meters or even kilometers; recurrence through time; lack of facies control; and presence in sediments not susceptible to gravitational instabilities or sediment overloading. These characteristics, and the highly complex nature of the deformed horizons revealed by the intimate coexistence of different styles of deformation, imply an origin related to syn-sedimentary seismic activity, supporting the contention that the northern Brazilian marginal basins were tectonically unstable during deposition.

Excluding a eustatic cause for the origin and evolution of the paleovalleys described herein is probably not possible, as the studied succession formed during a time of significant worldwide

transgression. However, the above-mentioned characteristics lead to propose a tectonic model for valley development, which involves channel capture in fault-produced depressions. Increased accommodation space favors thicker estuarine deposition in downdropped areas as transgression takes place, which have greater preservation potential. A subsequent phase of tectonic stability promotes aggradation and even progradation. Eventually, this process culminates with periods of subaerial exposure and soil development, resulting high frequency unconformities. Subsequent episodes of tectonic reactivation lead to renewed subsidence, which starts the process over again, resulting in compound valley fills.

In summary, it can be suggested that post rift areas with low accommodation seems to favor the development of shallow incised valleys that are not filled continuously, resulting in thin, but internally complex successions formed mostly during the transgressive and highstand stages of relative sea level.

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