
The Structural and Sedimentological Controls on the Reoccupation of Quaternary Incised Valleys, Belize Southern Lagoon¹

Dominic Esker, Gregor P. Eberli, and Donald F. McNeill²

ABSTRACT

A grid of high-resolution single-channel seismic data from the Belize southern lagoon has documented the development of several generations of stacked late Pleistocene (400 ka-Holocene) incised-valley fills. A feedback mechanism between tectonics, reefal buildups, and incised-valley location is apparent in the data.

Incised valleys are recognized as medium- to high-amplitude reflections that truncate reflections produced by older strata on the seismic data. The Holocene valley fills in the Belize southern lagoon contain three seismic facies units (from bottom to top): (1) a basal unit characterized by moderately high-amplitude, chaotic reflections, or progradational patterns, that downlap onto the valley floor; (2) a middle unit characterized by continuous, horizontal, near-transparent reflections that drape the basal unit and onlap the valley walls; and (3) an upper unit that consists predominantly of transparent to low-amplitude, low-angle downlapping reflections. The middle and upper units are separated by an erosional surface. Based on core evidence and seismic facies analysis, the basal, middle, and upper seismic and sedimentary facies units are interpreted as fluvial and carbonate sands,

estuarine muds, and marine sands and muds, respectively. The erosional surface separating the upper and middle units is interpreted to be a ravinement surface that marks the transition from brackish estuarine conditions to open-marine conditions.

Faulting decreases and reefal buildups increase upsection. The oldest valleys mimic structural trends and flow through areas currently occupied by extensive carbonate reefs. Rapid, high-amplitude late Pleistocene sea level rises may have led to widespread reef development, creating a template that subsequent incisions (reoccupation valleys) followed, regardless of structural trends. The intimate relationship among tectonics, sea level change, carbonate reef buildups, and incised-valley reoccupation serves as a model for understanding ancient, tropical mixed-carbonate-siliciclastic systems.

Accelerator mass spectrometer ¹⁴C dates of sediment core samples (marine gastropods, marine mollusks, barnacles, worm tubes, peat, and oysters) indicate all the sediment cored (1-4 m) in this study is Holocene in age (between 4740 ±60 and 11,230 ±90 ¹⁴C age). This radiocarbon dating consistently links the erosional surface between the upper and middle units with the intersection of the regional sea level curve (nonmarine/marine boundary).