Depositional Processes at the Lower Wilcox Shelf–Slope Transition Zone

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Abstract

Recognition of bypass at the shelf margin is key to deep-water exploration. This study examines the shelf margin architecture of the Lower Wilcox Group in Texas by combining 3D seismic data with well log data. During the early Paleocene, an extensive (40 km wide), shallow shelf platform extended across South Central Texas making it difficult for the deltas to reach the shelf edge. The seaward pinchout of the Lower Wilcox sand-rich shorefaces is about 20 km updip from the shelf edge indicating that the sand remained on the inner and middle shelf and the shelf margin grew through mud accretion. High stand conditions of sea level favored the generation of hyperpycnal flows that incised into shelf deposits, and bypassed sand onto medial and distal slopes. In areas of shale withdrawal, extensional features such as growth faults produce long, linear to arcuate strike-elongated depocenters within the hanging-walls of faults and dictate sediment delivery pathway. Our work suggests that significant volumes of deepwater sands were deposited from sustained turbidity currents initiated by direct river effluents and accumulated on the slope. High density hyperpycnal flows created multiple sand-filled slope-channel complexes 10–20 m thick and 200 m to more than 1 km wide that served as conduits for bypass to the basin floor. Unconfined, low density hyperpycnal flows deposited lobes on the slope. Lobes spread 10–20 km laterally and 2–4 km downdip, with a maximum total sand thickness of 100 m; accumulative sand thickness can be as high as 500 m. A high net-to-gross ratio (0.5) suggests the sand-rich component of the flow was deposited on the slope, while finer grained sediment continued down the slope. The shelf-margin architecture exhibited by the Lower Wilcox sequence serves as an example of hyperpycnal flows being the primary initiator of turbidity currents for sand accumulation on the slope.