
History of Tectonic Modeling and Implications for Depositional Architecture in the Gulf of Mexico: Where we should Go from Here

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ABSTRACT

Since Bullard's Atlantic reconstruction, pivotal plate kinematic, paleomagnetic, and crustal structural advances have allowed progressive refinement of tectonic evolutionary models for the Gulf of Mexico. A review of the history of tectonic advances shows how we have reached our current understanding of the Gulf's tectonic evolution. In the Jurassic and earliest Cretaceous, Yucatán moved independently between the separating North and South American continents. "Stage 1" involved Late Triassic–Middle Jurassic northwest-southeast crustal stretching astride Yucatán, followed by "Stage 2" Middle Jurassic–?earliest Cretaceous counter-clockwise rotation of Yucatán by ~40°. The North America/Yucatán rotation pole migrated from the eastern Gulf of Mexico to western Cuba, so Yucatán flowlines are imperfect small circles. Concerning the style of rifting, all parameters point to the high probability that North America was the proximal or footwall, and Yucatán the hanging wall, in an asymmetric, low-angle detachment model for Stage 1 rifting. In contrast to this fairly detailed model of tectonic history, high salt volume and mobility have hindered definition of the original depositional architecture to the extent that only very simple original architectures have generally been entertained. Thus a good understanding of the rift history is essential, so that we employ the correct subsidence models. If North America was the proximal side of the rift, its margin would undergo less post-rift thermal subsidence than would otherwise be predicted. This in turn infers a gentle ramped form for the top of syn-rift salt; since salt did not spill far across the Gulf of Mexico, some gentle gradient was maintained, and it did not behave as a perfect liquid. The ramp appears to have persisted into the Paleogene, probably with relatively minor but continuous deformation, when deep Wilcox sands exploited it to reach their depositional position far from the shelf. Future progress will issue from better definition of this ramp and its ongoing deformation, including paleo-depth estimates for offshore Bossier and "basinal" Cretaceous sections overlying salt. Data from Norton, Ewing, and Showboat suggest shallower environments than the traditional view had expected. Better definition of crust beneath salt (exhumed mantle?, subsalt igneous crust?) will refine the syn-rift model, and retrodiction of heatflow. Aeromagnetism will improve definition of North America/Yucatán drift, but only drilling in little-deformed section will allow confident dating (and source rock characterization) of deep Gulf of Mexico basal strata.

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