Nature of Rifting, Salt Deposition and Seafloor Spreading in the Gulf of Mexico: Analysis of Regional Seismic Reflection and Refraction Data

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ABSTRACT

The collective, integrated ION seismic reflection and refraction database over the Gulf of Mexico (GoM) covers the entire basin and its margins. At the basement level, this unique dataset allows assessment and refinement of tectonic models for GoM evolution, and also of rift processes related to continental break up, mega-salt basin deposition, and initiation of seafloor spreading. Top of continental and oceanic basement, base of autochthonous salt, the “step up” at the oceanic transition, and the Moho are mappable in most areas, as are intra-crustal reflectors within the Yucatan Block that help to understand rift geometries and processes. Synrift sequences in the GoM basin are interbedded with volcanic flows of unknown age in two areas. Overlying the synrift section is a clastic sag section topped by the base salt unconformity, neither of which is affected by magmatism. The continent-ocean transitions are devoid of excess magmatism other than that belonging to typical oceanic crust. Although the synrift was locally “magmatic”, final continental break up was magma poor, probably a useful distinction for heat flow models and preservation of early source rocks. We mapped 103 crossings of the limit of ocean crust, allowing a refined Oxfordian reconstruction for Yucatan-North America. We can directly observe and define the trace of the Western GoM transform, also aiding kinematic restorations. From north to south along western Florida, the base salt / top rift unconformity becomes refaulted and replaced by a younger top rift unconformity (top Berriasian?), which we interpret as the record of southward propagating, near-pole rifting while spreading ensued farther west, during the rotation of Yucatan. Some interesting correlations concerning probable clastic sections may be made between northern Yucatan and the NE GoM margin, which we continue to pursue. Finally, we judge that nowhere was salt ever deposited directly on ocean crust, and neither is salt ever intruded by dikes. Salt deposition thus pre-dates break up along the rifted margins, yet the base salt unconformity usually merges quite smoothly with the top of the ocean crust. This lack of relief at the oceanic limit is counterintuitive, but it seems that outer marginal collapse (Pindell et al., 2014) remains a viable, if poorly understood, explanation. Continued mapping and analysis of the GoM basin with reflection data will continue to improve our understanding of the GoM’s petroleum systems.