Constraints on the Mesozoic Evolution of the Gulf of Mexico from Seismic Interpretation of Basement, the Pre-Salt Section, and Autochthonous Salt

James Pindell[1], Andrew Hartwig[2], Ed Haire[2], Brian Horn[2]
[1]Tectonic Analysis Ltd; [2]ION E&P Advisors

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Abstract

Examination of 2D and 3D seismic data integrated with onshore syn-rift chronological constraints test key aspects of traditional models for the syn-salt and pre-salt (Early and Middle Jurassic) tectonic evolution of the Gulf of Mexico (GOM). We focus on crustal thicknesses and thinning zones, the position of SDR sets and basement structures such as the oceanic step-up and outer marginal troughs, the existence and style of fault zones, and the architectures of the syn-rift, sag and autochthonous salt depositional sections. We deduce objective interpretations for these aspects from the examination of the seismic data to test various tectonic models. We also review new regional tectonic and chronological aspects pertaining to GOM evolution that appear to require revision of traditional Jurassic models, including Sr isotope dating of the Louann/Campeche salt deposits as Bajocian rather than Callovian, and a looser Equatorial Atlantic closure reconstruction that gives 200 km more space between the Americas during GOM opening. The additional space circumvents the need to employ the Mojave-Sonora Megashear to move continental portions of Mexico into the “Colombian overlap position”, allowing consideration of other models. Our favoured alternative is a Basin and Range style of sinistral en-echelon crustal transtension from northern Mexico to Chiapas Massif, which is supported by anatectic granites forming much of the basement and implying tectonic unroofing during rifting, accompanied by an independent sinistral transcurrence of the Oaxaca Block in the south. By integrating seismic interpretations with the

new regional constraints, a revised model of Triassic-Jurassic GOM evolution provides a more accurate framework for future exploration and analysis. The model embraces ongoing debates over models of salt accommodation/deposition; the potential for local areas of deep-water salt deposition; and identification of areas most likely to possess pre-salt lacustrine successions. Implications are substantial: 1) Bathonian onset of seafloor spreading and deep-water marine deposition, 2) an 8 m.y. expansion of the “Norphlet depositional window”, 3) a protracted period (Bathonian-Oxfordian) of post-salt marine transgression, and 4) 8 m.y. of additional time for rift- and seafloor spreading- related heat to dissipate prior to Oxfordian-Tithonian source rock deposition.