Tectonic Setting, Structure, and Hydrocarbon Potential of Pre-Salt, Mesozoic Rift Basins in the Northeastern Gulf of Mexico

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Abstract

Previous workers have interpreted pre-salt, basinward dipping reflectors in the northeastern Gulf of Mexico (GOM) as either clastic fill that is tilted within Mesozoic half-grabens - or, alternatively, as layered, igneous units erupted during the GOM rift phase ("seaward-dipping reflectors"). We use a 35,000 km grid of 2D, depth-migrated, ~40-km-deep-penetrating, industry seismic reflection data, tied to 5 wells in the basin to map these features in three dimensions to distinguish these two previous interpretations. We focus our study on the 140-km-long, northeast-trending Apalachicola rift basin that contains 8-10 km of undrilled clastic deposits inferred to be of late Triassic-early Jurassic age. The 140-km-long half-graben contains basinward dipping reflectors controlled by a low-angle normal fault (LANF) with a dip angle ranging between 14° to 21° which is consistent with previous work on rift-related LANFs in the northeastern GOM and along the east coast of North America. The NE-trending Apalachicola half-graben terminates in a T-shape on an orthogonal, NW-trending half-graben whose normal fault dips 21° to the northeast. Given the variety of orientations of normal faults and the 240-km distance from this area to oceanic crust beneath the deep GOM, we propose that the previously proposed, origin of these features as igneous, seaward-dipping, reflectors is unlikely. We integrate these mapping results from a five-layer, 3D gravity inversion model to determine the crustal thickness of the GOM and the southern continental of North America. From this regional crustal thickness map, we can trace the northwest-trending Florida lineament for over 740-km along a 35-km-wide, corridor of thinned, continental crust ranging in thickness from 23-

to 26-km that abruptly truncates northeast trends of the Appalachian foldbelt, the Paleozoic Suwannee Basin and Suwanee Suture Zone, the Mesozoic South Georgia rift system, and the Apalachicola rift described here. The Florida lineament aligns precisely with the 450-km-long Pickens-Gilbertown-Pollard fault zone that truncates the southeastern edge of the Appalachian orogenic belt in the Mississippi Valley. This extensive Florida-to-Arkansas northwest strike-slip zone likely formed as a right-lateral indenter fault along the eastern edge of the Yucatan block during late Paleozoic collision and was reactivated as a left-lateral transfer fault during Late Triassic-early Jurassic continental rifting.

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