

Regional Extent and Tectonic Origin of the Mesozoic Marginal Rift System of the Deep-Water Gulf of Mexico Basin

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Abstract

The marginal rift system (MRS) is a continuous, commonly salt-filled, full-graben that bounds the edge of late Jurassic, oceanic crust of the deep, central Gulf of Mexico (GOM). We use regional gravity and magnetic datasets integrated with ~90,000-km of 2D industrial seismic grids to map the complete extent of the MRS on both GOM conjugate margins in the US and Mexico. We integrate potential fields and seismic reflection data to map the MRS over a distance of 378-km - as it progressively widens from 25-km along the eastern GOM to 50-km at its westernmost point in the north-central GOM where the MRS is buried beneath the Louann salt canopy. This east-to-west widening trend of the MRS is accompanied by its full-graben deepening from an average of 1-km of pre-salt clastic and evaporite fill along the west Florida margin to an average of 4-km of fill in the north-central GOM. On the southern (Mexican) conjugate margin, we use the same methods to trace the MRS for a distance of 678-km from the eastern Yucatan margin to its westernmost point where it disappears beneath the Campeche salt province. Along this margin, the MRS progressively widens from east to west from an average width of 25-km along the Yucatan margin to a width of 55-km to its westernmost point. The observed pre-salt fill of the MRS varies from 1-km along the Yucatan margin to 7-km at its western point. We reconstruct the location of the MRS conjugates at 160 Ma within an error of 20 km by closing the post-160 Ma oceanic crust in the deep-central GOM along the direction of its oceanic fracture zones and restoring the northern and southern branches of the MRS. Analysis of seismic, gravity, and magnetic data shows that the crust underlying the

MRS is thinned continental crust. The age of the formation of the MRS must precede the formation of oceanic crust at 152 Ma (Tithonian) as proposed by previous workers. The tectonic origin of the MRS is likely the result of extension and necking of the continental crust immediately prior to the formation of oceanic crust in the Tithonian. Westward widening and deepening of the MRS reflects greater extension and necking of the crust further from the GOM pole of the opening located in western Cuba. Most hydrocarbon seeps and discoveries are found landward of the MRS indicating that source rocks present on the thinned, continental crust are a critical component for active petroleum systems.