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The Tectonic History of the Gulf of Mexico

Seismic refraction and gravity data have been used to map three major, deep basement structures in the Gulf of Mexico. Two of these structures have dimensions that are consistent with chains of seamounts, or hotspot tracks, produced by mantle plumes. A Late Jurassic mantle plume may have generated these tracks on the North American plate and Yucatan block as the Gulf of Mexico opened. High-amplitude, distinctive gravity anomalies over these two structures provide the basis for a kinematic reconstruction that restores the western ends of the hotspot tracks with a 20 degree clockwise rotation of the Yucatan block. This rotation, which we estimate lasted 8 to 10 My, represents about one-half of the totals required to open the Gulf of Mexico basin. The third deep basement structure, which is located along the western boundary of the basin, is also associated with a high-amplitude, distinctive gravity anomaly. This anomaly is interpreted to be produced by a marginal ridge, which was created along the ocean-continent transform boundary as the basin opened.

The tectonic evolution of the Gulf began with extension of continental crust that lasted from about 160 Ma until 150 Ma and involved approximately 22 degrees counterclockwise rotation of Yucatan. Then, as seafloor spreading began, a mantle plume became active producing hotspot tracks on the North American Plate and Yucatan Block. This phase lasted until 140 Ma during which the Yucatan rotated another 20 degrees counterclockwise. Autochthonous salt appears to be confined to the continental flanks of the hotspot tracks indicating that salt was deposited during continental extension and not after ocean floor had begun to form. The eastern flank of the marginal ridge, and the northernmost, easternmost, and southernmost terminations of the hotspot tracks, are interpreted to coincide with the oceanic-continental crustal boundary in the basin.