Estimates of Thermal Stress and Expelled Petroleum from Mesozoic-Cenozoic Potential Source Rocks, Southern Gulf of Mexico

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Abstract

The Campeche and Yucatan salt basins remain two of the least explored areas of the Gulf of Mexico Basin. This study uses a grid of 23,600 line-km prestack depth migrated (PSDM) 2D seismic reflection profiles, shipborne gravity data, and open-source geologic information to model the thermal stress of four potential source intervals (Oxfordian, Tithonian-centered, Cenomanian-Turonian, and lower Miocene). We performed map-based and 1D thermal modeling along two margin-perpendicular transects, each consisting of five pseudo wells tied to the regional grid of seismic reflection data. Our modeling considers thermal stress variations related to the depth of base lithosphere, crustal type and thickness, paleo-water depth, Jurassic salt thickness, and the transient heat flow effects of recent clastic sedimentation. We predict that deeply buried, salt-related minibasins along the outer marginal trough are mature for petroleum expulsion with deeply-buried Mesozoic source rocks within the oil window from late Paleogene to early Neogene time. The ‘lag time’ required for vertical oil migration explains why oil maturation occurred during the late Paleogene to early Neogene, but active oil seeps are observed today at the sea surface. We predict that oil is present in subsurface traps in the deepest part of the outer marginal trough, and we calculate that the Oxfordian source interval has expelled a cumulative 20 million barrels of oil equivalent (BOE)/km^2 and that the Tithonian-centered source interval has expelled 67 million BOE/km^2.