Early Cenozoic Rift Inversion: Key to Understanding the Structural Framework and Petroleum Potential of the Nicaraguan Rise

Emmet, Peter A.[1]; Mann, Paul [2] (1) Brazos Valley GeoServices, Inc, Cypress, TX. (2) Jackson School of Geosciences, University of Texas at Austin, Austin, TX.

The Nicaraguan Rise is known as a Late Eocene to Recent carbonate province because vintage industry seismic and well data documenting its pre-carbonate history have remained largely unpublished. We have used 13 offshore wells, 2 wells in the coastal area of eastern Honduras, and 5000 line km of seismic data collected between 1970 and 1980 to reveal for the first time the importance of early Cenozoic rift inversion for the tectonic history and petroleum potential of the Nicaraguan Rise where numerous oil and gas shows have been reported since the 1970s but no production has resulted. Using these data we map numerous inverted normal faults striking roughly W-E. These normal faults bound non-marine rifts of Upper Paleocene-Lower Eocene age similar in fill but not orientation to the NW-striking Wagwater and Montpelier-Newmarket rifts of Jamaica. NNW-striking deep bathymetric channels that segment carbonate banks of the eastern Nicaraguan Rise may be late Neogene grabens or may simply reflect the distribution of the Paleogene uplifts upon which they aggraded. The newly-recognized inversion structures are characterized by steep fault dips and modest fault heaves, although some Paleogene growth faults have up to 1000 m of extensional throw. An angular unconformity separates a Middle Eocene onlap surface from older tilted strata and positive turtle stuctures related to inversion of wedge-shaped Paleogene rifts and fanning normal faults framing the turtle structures are common. The initial inversion event occurred in the Middle to Late Eocene but intermittent extension and compression have continued into the late Quaternary. Areas of maximum inversion provided a substrate for carbonate banks and are now areas of the thickest carbonate sections. Areas of “false basement” may document local rift-related volcanism as is well known from Jamaican rifts. Geochemical work shows that the highest quality source rock is confined to successor basins adjacent to the inverted Paleogene rifts. The Cretaceous is overmature in 6 of 10 well penetrations but may provide an additional HC source in some locations. Variations in inversion from area to area could mean that burial depths have varied greatly. Younger rifting of Miocene to Recent age is observed in the borderlands province adjacent to the Cayman Trough. One possibility is that the Paleogene rifts we observe are analogous to these younger rifts and accompanied the Eocene opening of the Cayman Trough.