What is the Limiting Factor for Hydrocarbon Prospects of the Port Isabel Passive Margin Foldbelt, Northwestern Gulf of Mexico?

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ABSTRACT

The 40-km-wide Port Isabel Foldbelt (PIFB) is located in northwestern corner of U.S. Gulf of Mexico in a region where structural trends change abruptly from east-northeast to southward into Mexico. The northern PIFB is ~70 km wide to the north in the U.S. Gulf of Mexico and narrows to the south where its less than 10 km wide at the U.S.-Mexico maritime boundary. The northern limit of the PIFB is abruptly defined by the southeastward seaward projection of the San Marcos Arch of onshore Texas and the Texas shelf. The PIFB separates the deepwater Perdido Foldbelt (PFB) to the east from the Corsair normal fault trend on the Gulf of Mexico shelf and slope to the west. Previous work has determined that the PIFB formed in Oligocene to recent time as a passive margin foldbelt driving by gravitational forces that produced upslope extension along the Corsair normal fault trend and downslope convergence in the more basinward and deeper-water areas of the Port Isabel and Perdido foldbelts. Successive, dry wells in the PIFB during the late 1990s discouraged further drilling to the point that today the PIFB forms a conspicuous belt of non-production in the northwestern Gulf of Mexico that separates two highly productive zones: the Corsair normal fault trend on the Texas shelf and slope and the deepwater Perdido fold belt. We interpreted 3000 linear km of 2D seismic data in the PIF, including ultradeep seismic lines and integrated these results with less-penetrating, seismic lines published by previous workers to improve structural and timing relationships between these three structural domains. Controlling structures at depth beneath the PIFB include a northwestward-dipping, major salt weld and/thrust detachment at a depth of ~10 km and a shallower northwestward-dipping detachment with inferred shale lithologies of the Oligocene Anahuac Shale at a depth of 9 km. Ramps in both structures localize zones of intensive, imbricate thrust faulting and associated folding. We propose that the main driver of deformation is shortening at depth across these two surfaces with salt and that shale diapirism is a secondary effect of this shortening. Sub-circular shale and salt diapirs at the Oligocene and Miocene levels are a conspicuous characteristic of the PIFB. To the south, this diapir belt narrows and merges with the Mexican diapir belts of the Burgos Basin and Mexican Ridges. We propose that these inclined thrust surfaces may act as barriers that inhibit vertical migration of oil and gas into higher levels of the PIFB.

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