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Stratigraphic and Structural Mapping of a Regional 2D Seismic Grid and Modeling of Petroleum Systems, Port Isabel Foldbelt, Northwestern Gulf of Mexico

Muhammad Nawaz Bugti[1] and Paul Mann[1]

[1]Department of Earth and Atmospheric Sciences, University of Houston, Science and Research Bldg., Rm. 312, Houston, Texas

ABSTRACT

Port Isabel Foldbelt in the offshore Texas sector of the northwestern Gulf of Mexico covers an area of 15,000 km2, yet has only yielded only one, uncommercial hydrocarbon discovery made in 1996. In order to understand this vast “hydrocarbon desert” in the northwestern Gulf of Mexico, we present new stratigraphic and structural observations based on mapping five, key seismic horizons using 25,000 linear km of depth-migrated 2D seismic data tied to eight wells. The five mapped surfaces include: (1) Middle Jurassic; (2) Upper Cretaceous; (3) Eocene; (4) Oligocene; and (5) Lower Miocene. These maps reveal both the updip extensional deformation of Miocene age along the Corsair fault trend of the Texas shelf with downdip detachments on the Middle Jurassic and Eocene horizons and coeval and downdip shortening related to the Port Isabel Foldbelt. Salt evacuation on the Middle Jurassic and Eocene horizons is most complete within the apex of the northwestern corner of the Gulf of Mexico shelf margins and can be explained by the process of radial gliding of the salt layer into the bisector area of the corner. The base of the slopes in the apex area are characterized by excess salt now remobilized into a 6000 km2 area of diapirism.

In order to better understand prospectivity in this complex area, 1D models were created for both existing and pseudo wells. 1D models were calibrated with previous studies in the area and various sensitivities were tested to quantify uncertainties. In the final stage, the model was enhanced to 3D. None of the previous, eight wells in the area are deep enough to penetrate potential source rocks. Using the new maps, two source rock intervals from the Upper Jurassic and Lower Cretaceous were modeling with a heat flow value of 60mW/m2. We also tested extreme values for sensitivities and included these objectives for the sensitivity analysis: (1) what are impacts of uncertainties in the input data on the model; (2) what could be the extreme scenarios and their probabilities; and (3) what are the relationships between the uncertainties and the final model? Our mapping and modeling results show that the both the Jurassic and Cretaceous sources are mature but are now isolated by multiple blocked pathways in both the Corsair normal fault trend and the downdip Port Isabel Foldbelt, these structural observations may prevent the charging of shallow reservoirs. We predict deeper and well-sealed accumulations may exist at depths of 7000 to 9000 m at Eocene level.

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