Tectonic Habitat of Hydrocarbons in the Deep- and Ultra-deepwater Frontier Areas of Trinidad and Tobago

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The Trinidad deepwater and ultra-deepwater provinces together form a structurally complex, frontier basin adjacent to the prolific and well studied Columbus Basin shelf province that has produced over 3 billion barrels of oil and 22 trillion feet of gas. The Trinidad deep and ultra-deepwater area includes the southern termination of the Barbados accretionary prism (BAP). The only commercial hydrocarbon discovery to date in the BAP is located in southern Barbados where 9 million barrels of oil have been produced from the Woodbourne field. The deepwater area remains largely underexplored with only eight dry exploration wells and the ultra-deepwater area remains undrilled to date.

We use a grid of 2D seismic lines and wells to construct regional transects traversing the Columbus Basin shelf, slope, deepwater and utra-deepwater basins. Transects restore deformation related to three tectonic belts that converge in the deepwater and ultra-deepwater area of Trinidad: 1) Northeast-striking and strongly curving folds, thrusts and deformed shale diapirs of the BAP, 2) East-northeast-striking folds, thrusts and strike-slip faults including imbricated thrust sheets of the Central Range-Darien Ridge uplift and Southern Basin provinces, 3) Northwest-southeast-striking regional and counter-regional listric faults which sole out along the top of the Cretaceous carbonate unit.

Seismic interpretation of the seafloor and shallow horizons illustrate a 50-km-wide, northeast-trending transition zone between normal faults of late Neogene age in the west and thrusts and normal faults of late Neogene age in the east. The transition from extension to compression coincides with an increase in the eastward dip of the undulating top Cretaceous surface at depths of 12.5 to 18.8 km from 5° to 23°. This change in top Cretaceous dip also aligns with a 40-80 km wide, northwest-trending, lineated gravity low that parallels other fracture zones in the down-going oceanic crust of the Atlantic Ocean. We show how the configurations of the down-going Atlantic plate affect the three tectonic provinces that merge in the deep and ultra-deepwater area and explain how these structures are affecting the habitat of deepwater hydrocarbons.