Structure, Stratigraphy, and Recent Hydrocarbon Indicators in the Grenada and Tobago Basins, Southeastern Caribbean Sea

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Abstract

The Grenada and Tobago basins flank the western and eastern margins of the active, Lesser Antilles island arc in the southeastern Caribbean and contain 11-14 km of Cenozoic, marine clastic sedimentary rocks, respectively. We use a grid of 16,563 km 2D, pre-stack, time-migrated seismic reflection data tied to a well to understand the stratigraphic and structural relationships of the two, parallel basins to each other and to theintervening and active Lesser Antilles volcanic arc. Using the seismic grid tied the well located 82 km east of our study area, we identify three tectonosequences with distinctive seismic facies that can be recognized in both basins and indicate thecommon depositional setting of both basins prior to the intrusion of the Lesser Antilles arc ridge during the Oligocene to Early Miocene: 1) Paleogene tectonosequence with half-grabens extending late Cretaceous island arc crust; rifts are formed along listric locally inverted normal faults; rift stratigraphy shows discontinuous, non-parallel reflectors; gas chimneys extend vertically ~7 km to form large pockmarks produced by gas blowouts at the seafloor; and BSRs overlie the area of Paleogene half-grabens; 2) a narrow zone of oceanic crust is adjacent to the rifted zone in the Grenada basin but is not apparent in the Tobago basin; 3) Paleogene to Middle Miocene tectonosequenceis characterized by parallel and continuous reflectors inferred to represent distal, deepwater submarine fan deposits derived from large river systems in northern SA; 4) Middle Miocene to Recent tectonosequence coarsens upwards from the Middle Miocene and reflects divergent depositional systems in both basins caused by the intervening ridge of the Lesser Antilles arc. As both basins exhibit

identical seismic facies of similar thickness for the Paleogene and Early Miocene interval, we propose that the Lesser Antilles arc intruded into the oceanic centerline of a pre-Middle Miocene forearc basin during the Oligocene to Early Miocene. We have structurally restored the normal faults in the southern GBAB section and TFAB section and derived the same amount of extension (~33km) for both basins now separated by the Lesser Antilles arc. The presence of hydrocarbon indicators emanating from the Paleogene rifted section buried to a depth of 11-14 km indicates an active, gas-prone petroleum system with traps that includes large anticlines formed over inverted, Paleogene half-graben structures.