

Learnings from Shallow Water and Deep Water Exploration, East Venezuelan Basin, Trinidad and Tobago

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Abstract

BHPB has been exploring in the East Venezuelan basin since 1988. During the last 27 years, BHPB has acquired eight 3-D seismic surveys, two of which were recently completed in deep water. In addition, BHPB has drilled 21 shallow-water exploration wells and has more than 40,000 line km of 2-D seismic data. As a result of this large database, BHPB has an integrated, regional interpretation across the entire region from eastern Venezuela through shallow- and deep-water Trinidad and Tobago to Barbados.

The learnings from the wells drilled in the shallow water have greatly enhanced our understanding of the deep water area of the basin. All 21 exploration wells are located in the south-central sheared area of the Barbados Accretionary Prism and most have intersected multiple low angle thrust sheets with significant displacement of Oligocene to Cretaceous aged sediments. These sheets are cut by numerous higher angle faults showing obvious transtensional/ transpressional geometries. Hydrocarbons were discovered in the Oligocene section of the Angostura field in Block 2c and, based on seismic observations and well data, Oligocene sediment deposition and deformation have been interpreted to be coeval and sequences are rarely isopachous.

Only 12 wells in water depths >500 m have been drilled, of which two penetrated deep water deposits no older than late Miocene (Catfish-1 and Sandy Lane-1). Existing seismic data is widely spaced and of poor to fair quality. Nevertheless, BHPB has identified large antiforms on the existing data and has constructed a geologic model that indicates that all of the elements are present for the discovery of giant hydrocarbon accumulations in the deep water.

BHPB currently operates nine blocks (14, 23(a), 23(b), 28, 29, 3, 5, 6 and 7) over two deep water plays in the Barbados Accretionary Prism. These plays are underpinned by a proven world-class Cretaceous source rock. They target deep water clastic reservoirs sourced from the Orinoco delta system to the south and west. Traps were formed by folding and thrusting in front of the Caribbean plate as it has travelled eastwards over the Atlantic plate during the last 90 million years, and each play has its own characteristic structural style. Here, as in the shallow water area to the southeast, compressional features with an overprint of extensional faulting are present, but shear deformation of thrust sheets appears to be minimal by comparison.

Due to the poor quality or sparseness of the existing 2-D data within and adjacent to BHPB's deep water blocks, high quality 3-D seismic was determined to be critical to the success of the exploration program. Between March 2014 and February 2015, BHPB and its JV partners acquired 21,216 sq. km of broadband 3-D seismic data with gravity and magnetics data in two surveys over the nine block area. The combination of these two surveys is the largest ever acquired by an IOC. Currently, the data are being processed and the first well is scheduled to spud in August 2016.