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New Seismic + Old Concepts – Derisking Exploration and Appraisal in a Mature hydrocarbon basin. Case Study from the Columbus Basin, offshore Trinidad

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In the offshore Columbus Basin, map-based attribute analysis and amplitude extractions have been historically used as a key tool to define the extent and character of paralic reservoirs. However, this approach is not without challenges, given the presence of significant shallow gas, fault-induced seismic attenuation, non-unique inputs for seismic attribute response and the inherent decay of seismic signal with depth.

In 2013 BP acquired more than 1000km² of high density, large offset and full azimuthal OBC data. Coupled with advanced processing workflows, the seismic image has been significantly upgraded to the historical towed-streamer datasets. For the first time, subtle seismic offlap breaks and clinoform geometries can be imaged in the deep subsurface of the Columbus Basin, previously documented only to the south in the relatively undeformed Plataforma Deltana region.

These Columbus Basin clinoforms are hundreds of feet in relief and exhibit consistent downdip seismic downlap onto underlying reflections. The seismic offlap break, which marks the top of the clinoform, consistently occurs in a predictable association with seismic attribute dimming. Additionally, wells drilled on either side of the offlap break and along the clinoform profile document a consistent progression of reservoir facies, consistent with classic outcrop models of shelf-margin depositional systems. As such these observed seismic features are interpreted as representing the reservoir shelf edge.

A second benefit of the improved seismic resolution is the ability to map intra-reservoir mudstones of typical Columbus Basin gross reservoir intervals, interpreted to represent the boundary between the subaqueous and subaerial clinoforms. This is a step change from the previous approaches of mapping just the top (and sometimes bases when possible) of gross reservoir packages. Attribute analysis on these constituent intra-reservoir packages exhibit spatial stacking patterns consistent with 1D vertical well-log stacking profiles, providing another possible tool for field-scale reservoir prediction and characterization.

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The Cenozoic dextral-oblique collision of the Caribbean and South American tectonic plates has progressively deformed, exhumed, and eroded the northern South American margin from Venezuela to Trinidad. Although sediment shed off the South American continent into the foredeep and accretionary prism ahead of the eastward-advancing Caribbean Plate provides a record of the timing and magnitude of collision, subsequent deformation and erosion limits preservation and the early history of the collision remains uncertain.