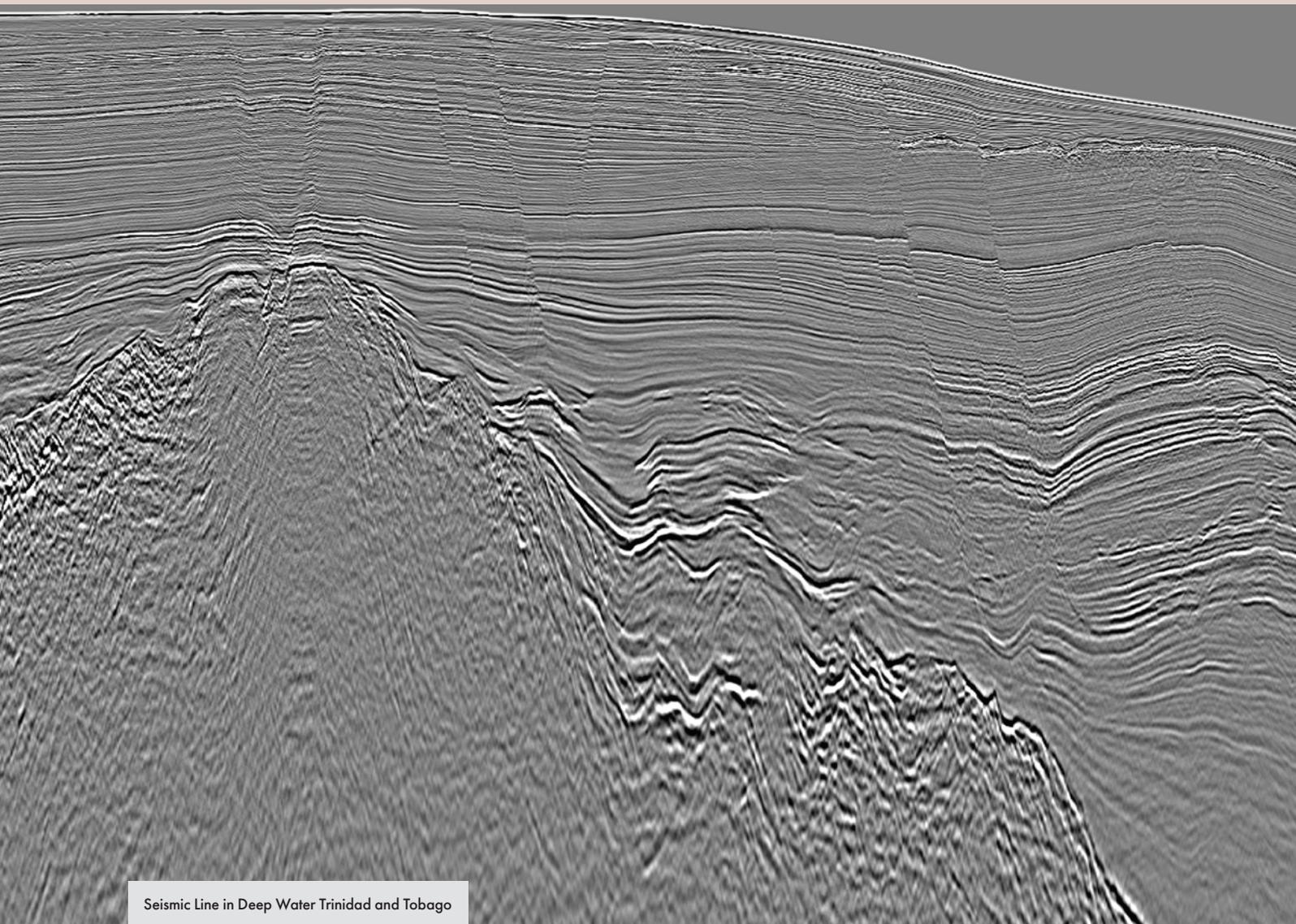


Trinidad and Tobago's advantage: Underexplored frontier amongst discoveries

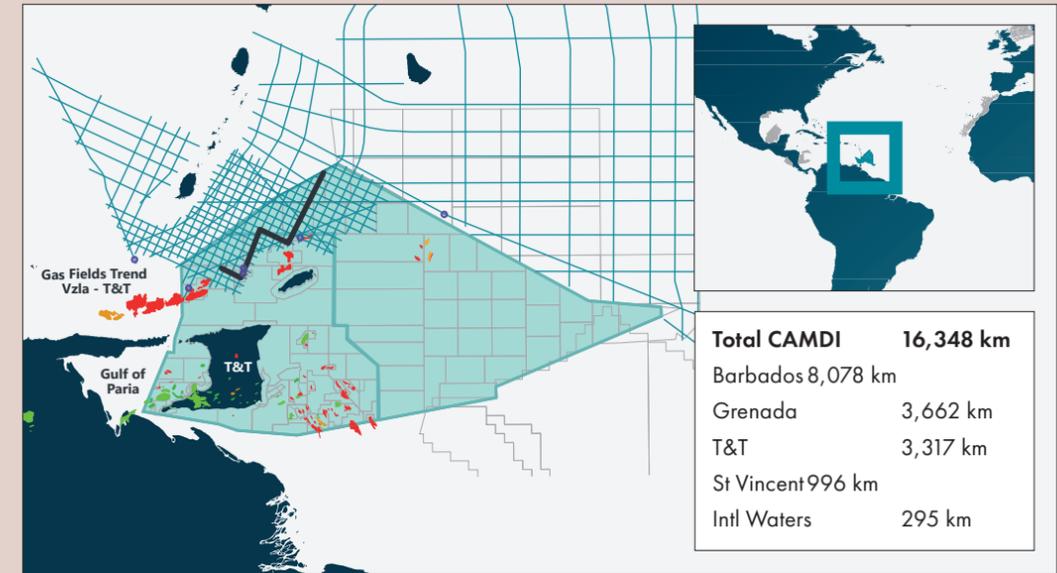


Seismic Line in Deep Water Trinidad and Tobago

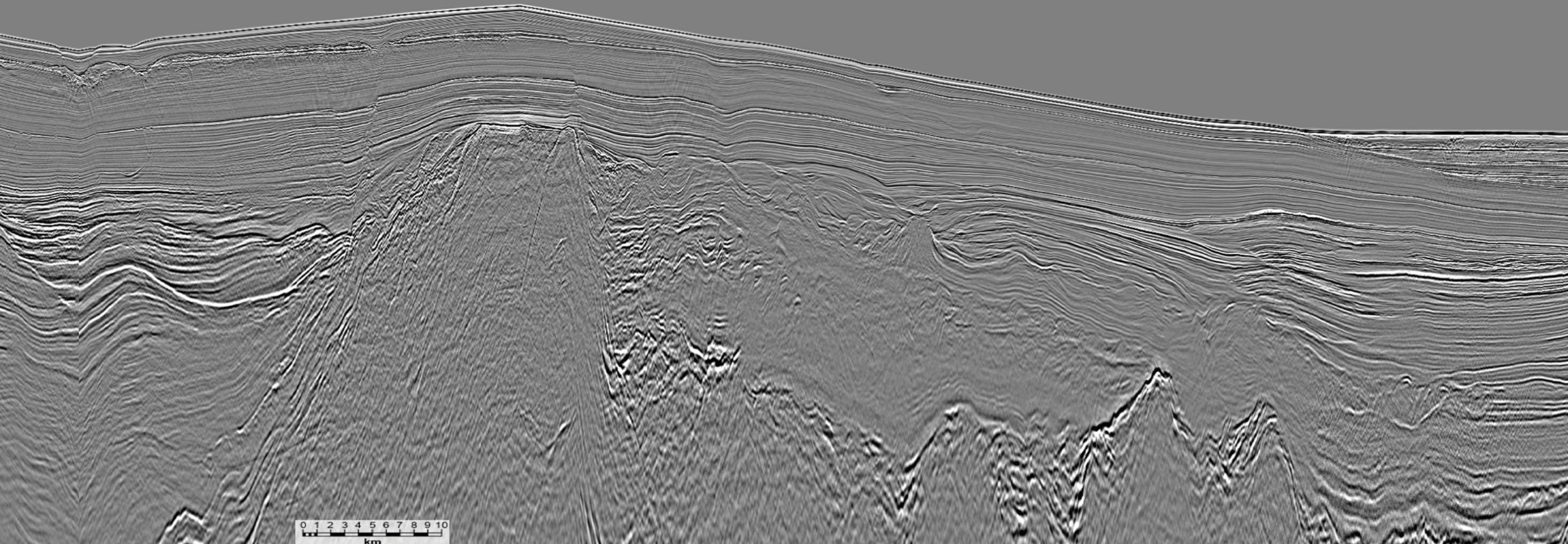
The Tobago Trough is an underexplored area that has excellent exploration potential, evidenced by surrounding discoveries. However, only a few exploration wells have been drilled in this vast frontier area. To unlock this potential, Geox MCG acquired 16,348 km of long-offset high resolution 2D seismic data in the region.

The survey is designed to improve understanding of the regional tectonic framework of the various basins along the Southeastern Caribbean. Additional seismic was acquired in a detailed grid, spanning T&T and Grenada, which ties producing areas to the deeper part of the Tobago Trough, and covers parts of T&T's shallow and deep-water blocks. This seismic remains an indispensable dataset, supporting upcoming licensing rounds with high quality PSTM, PSDM, gravity and magnetic data.

The Ministry of Energy and Energy Industries (MEEI) of Trinidad and Tobago has published the expected blocks on offer for Competitive Bidding in late 2023.



Map: CAMDI Seismic Lines over T&T Bid Round Blocks



T&T: A closer look at oil and gas exploration prospects

The Caribbean Atlantic Margin Deep Imaging seismic survey (CAMDI) spans 16,348 km, with long offsets (12 km) and a deep record length (18 seconds). This transnational survey covers acreage across the maritime borders of Barbados, Trinidad & Tobago (T&T), Grenada, and St. Vincent

JENIFFER MASI AND MIKE POWNEY, GEOEX MCG

THE SURVEY WAS ORIGINALLY DESIGNED in two grids. The regional grid provides a better understanding of the tectonic framework of the different basins along the Southeastern Caribbean and Western Atlantic Margin of Northeast South America. The detailed grid, offshore Trinidad & Tobago, and Grenada is designed to provide more localized detail, and to outline potential prospects. Seismic within the detailed grid ties the producing areas of T&T to the underexplored deeper part of the Tobago Trough. Approximately 3315 km of the CAMDI survey are located offshore Trinidad & Tobago, covering shallow and deep-water blocks.

GEOLOGICAL PROXIMITY TO PRODUCING FIELDS

The CAMDI MC2D survey is situated in close proximity to the producing areas of the Orinoco Delta and Northern T&T. The tectonic history of the region has afforded a preferential setting for hydrocarbon accumulations.

Tectonics offshore T&T were significantly influenced by the North/South American tectonic plates and their interaction with the Caribbean plate. During the Late Jurassic to Early Cretaceous, significant rifting occurred between North and South America. Following this rifting, the Caribbean

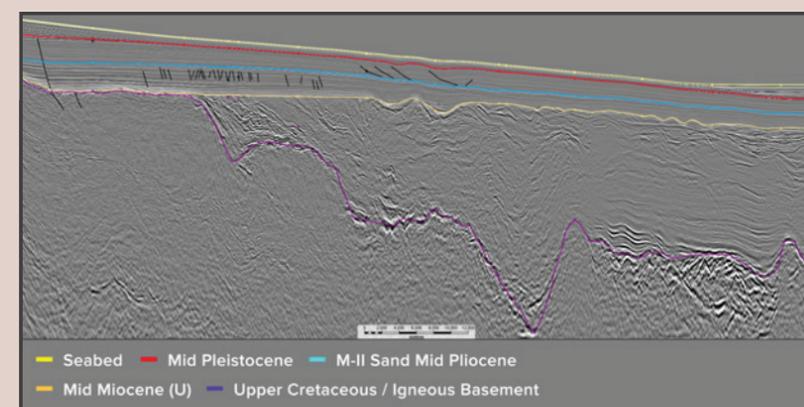


Figure 1: Seismic Section SSW-NNE across T&T showing the interpreted horizons.

plate migrated eastward from the Late Cretaceous onwards, relative to the North and South American plates to its present-day position.

During this migration and throughout the Cenozoic, the Caribbean plate converged obliquely with the North and South American plates in a diachronous manner. The points of collision shifted from westernmost Colombia during the Santonian era to western and central Venezuela in the Paleogene & eastern Venezuela in the Neogene. Present day convergence is believed to be between the Paria Peninsula of Venezuela and the Northern Trinidad Range. The Atlantic lithosphere has been subducting beneath the Lesser Antilles throughout these epochs and into the present day. The collision between these plate boundaries created a range of geodynamic processes including subduction, transpression and transtension, creating a large accretionary ridge which contributes to the regional geology.

The Tobago Trough is a curved-shaped forearc basin with a sedimentary fill of approximately 11-14 km of Oligo-Miocene to Pleistocene sediment. It is bounded by the Lesser Antilles arc to the west, the Barbados accretionary prism to the east, and the St Lucia Ridge to the north. To the east the Tobago Trough transitions to the Carupano basin offshore eastern Venezuela. The origin and age of the Tobago Trough basement is unknown. However, radiometric and paleontological ages from outcrops found in Tobago seem to indicate a Late Cretaceous forearc origin. This is supported by basement ages from Oil & Gas exploration wells in the Carupano basin.

The complex structural setting, geometries and subsidence mechanisms of the basins located in this area are controlled by several fault systems, that were the result of major tectonic events in the southeastern Caribbean.

DIRECT CONNECTION TO WORLD CLASS SOURCE ROCK (EQUIVALENT TO LA LUNA)

Distal DSDP and ODP wells offshore Venezuela and Barbados have shown evidence of a regional Upper Cretaceous source rock equivalent to the La Luna Formation of Venezuela. Maturation is predicted to have started during the Miocene in the Eastern Venezuelan Basin and during the late Miocene-Recent offshore Trinidad. Onshore Barbados, the Woodbourne oilfield produces oil and gas from the Eocene Scotland Group, sourced from a La Luna age equivalent source rock. This oil play remains unproven as there are no well penetrations in the Tobago trough. However, the CAMDI MC2D survey reveals a distinctive regional high amplitude horizon that could represent the Top Cretaceous Mejillones Complex (Figure 1).

STRUCTURAL TRAPPING PLAYS A MAJOR ROLE

The area covered by the CAMDI survey is significantly underexplored. However, several biogenic gas fields (Hibiscus, Sancoche, Orchid, etc.) have been discovered in close proximity. The producing intervals are Miocene and Pliocene aged turbiditic and deltaic sands, which were deposited during the progressive easterly progradation of the Orinoco Delta.

Structural trapping plays a major role within the study area as reservoirs are often trapped against faulted structures and turbidites. While most target intervals and discoveries are situated in Pliocene intervals, Mid Miocene and Eocene sands are also possible reservoirs. Sands in the basin are predominantly turbiditic and channelized features. Above these sands, there is a highly contrasting interval representing a good seal for the system. Example leads include (Figures 2 and 3):

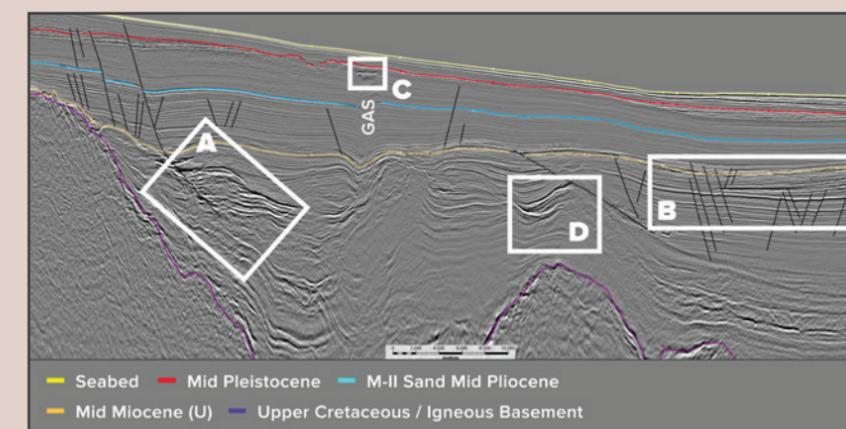


Figure 2: Lead Example. A. Turbidite Deposit. B. Mid Miocene Channels Exhibiting DHIs. C. Traditional Pliocene Play. D. Three Way Closure Against Fault with DHI's.

- Mid Miocene and older Turbidite Deposits
- Mid Miocene Channels exhibiting DHI's (Amplitude anomalies)
- Four-way closures exhibiting DHI's
- Three-way closures against a fault exhibiting DHI's
- Truncational play against the Ridge

All the necessary hydrocarbon elements for a working petroleum system are present in the region. Gas production from nearby fields offshore T&T, along with the onshore Barbados Woodbourne oil field production provide evidence for commercial hydrocarbon potential in the region.

The CAMDI MC2D survey shows a regional distribution of multiple, structural traps and potentially high-quality sheet turbidite reservoirs. Overlying hemipelagic marine clays would form the sealing facies with migration into the reservoirs (Miocene – Eocene) occurring along a combination of thrust and transtension strike slip faults associated with the deformation front. The presence of a La Luna age equivalent source rock suggests a potential oil play within the Tobago Trough, with further reservoir-seal pairs provided by the Plio–Pleistocene deep marine pelagic sediments.

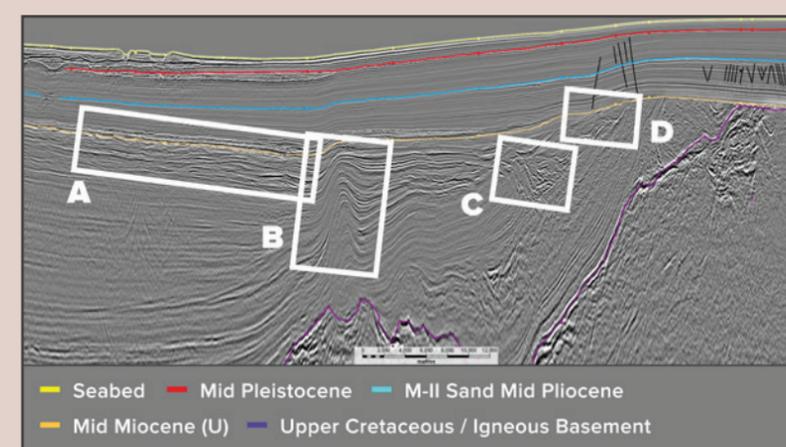


Figure 3: Lead Example. A. Mid Miocene Channels with DHI's. B. Four Way Closure with DHI's. C. Turbidite Deposit. D. Truncational Play Against Ridge.

A UNIQUE FRONTIER OPPORTUNITY

The Tobago Trough is an underexplored area flanked by oil and gas production in Barbados, T&T and a new gas discovery offshore Grenada. Seismic interpretation shows a thick sedimentary succession with high hydrocarbon potential. A Cretaceous, La Luna age equivalent, oil prone source rock is believed to have been identified, charging prospects in the area. The CAMDI survey offers the most modern PSTM, PSDM, gravity and magnetic data in the region, ideally positioned to support the upcoming license bid rounds in Trinidad & Tobago.

References provided online