The Guyana-Suriname Basin: An Evolving Exploration Opportunity

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The Guyana-Suriname Basin is a half graben Atlantic-margin basin on the northeast coast of South America (Figure 1). It was rated as the second most prospective unexplored basin in the world according to the USGS in its World Petroleum Assessment 2000. World class Canje source beds are in a mature position (Figure 2). The main reservoir targets are Upper Cretaceous and Lower Tertiary basin floor fans, shelf-margin deposits and turbidites directly overlying mature source. Recent seismic combined with 1970's well control provides an exploration framework. Depth mapping of deep closures have eliminated the distortion/ velocity pull-up by an overlying shelf margin carbonate bank of Tertiary age. Large closures have been mapped and are associated with significant shows from 1975 drilling.

Basin History

This basin evolved from a failed rift arm which extents on trend to the Takatu Basin to the east straddling the borders of Guyana and Brazil. It is bounded to the south by the Demerara Plateau high and to the north by the Pomeroon Arch. The basin architecture is described as a trap door structure plunging from the Pomeroon Arch and abutting against the Demerara Plateau. The basement is formed by the Atlantic Unconformity (Figure 3). The basement ranges from Precambrian to Jurassic in age.

The overlying basal sequence was deposited in a gradually deepening depositional environment formed by downwarping at the earliest stages of the South America Africa rifting as it progressed from south to north. Overlying the unconformity are: the continental Barremian Stabroek Formation, the Aptian Potoco Carbonate that gradually drowned and finally by the deposition of the Canje Formation which contains the regional deposited source beds.

A major unconformity ,(Berbice Unconformity), follows the Canje. The maximum incisement of this sequence boundary forms the Berbice Canyon that cuts over to 1000 m into the underlying sequence (Figure 4). To the south and north the unconformity grades into a disconformity as seen in the Arapaima 1 well to the north. A catastrophic change in sea level associated with a breach into an open oceanic environment from an epeiric sea as the Atlantic rift continued to expand from south to north is postulated.

The shelf margin begins to form at the time of the Berbice Unconformity as the drift stage of the Atlantic margin allows the formation of basement faulting and the basin to the east. This basin margin remains stable through to the mid-Miocene.

Overlying the Berbice Unconformity is the New Amsterdam Formation. On the shelf this formation is almost entirely sand as revealed in the Horseshoe #1 well drilled by CGX in 2000. Towards the shelf margin interbedded sand clays and modest carbonates are seen in the Arapaima 1 and other wells. Outboard of the shelf margin the Abary 1 penetrates the uppermost part of the New Amsterdam equivalent section that is dominated by clays (Figure 4). Seismic interpretation has identified basin floor fans in the basal New Amsterdam that is equivalent to the North Coroni sands in the North Coroni 1 well drilled offshore Suriname (approximately 100 km away).

Shelf margin deltas are postulated to exist between the basin floor fan and the upper sequence in the Abary well. The Berbice Canyon, North Coroni Fan, and Shelf Margin delta are focused by the pre-existing structural trough formed by the underlying failed rift arm and the associated trap door structure. Overlying the Cretaceous are a series of carbonate rich members of the Georgetown and Pomeroon formations. On the shelf the formations are dominated by sand with minor carbonates. The shelf margin is dominated by carbonates with interbedded sands. In the basin the section is dominated by clays and marls becoming more clay rich in the distal reaches. Several fan features have been identified and mapped as turbidites in the Lower Tertiary.

Beginning in the Mid–Miocene the deposition of the Corentyne Formation oversteps the shelf edge as the clastic-dominated surge form the Andean uplift is deposited and continues into the Recent.

Plays, Prospects and Ideas

The main play elements are present in the basin to allow for major hydrocarbon accumulations:

1) The presence of world class Canje source beds of Turonian age over 150 m thick that are equivalent to the main source beds of Venezuela, Trinidad, and Columbia (La Luna and Arapiama Hill), a regional anoxic event.

2) Recent depth reached to allow the Source Kitchen to reach maturity as demonstrated by the onshore oil fields of Suriname which have been typed to the Canje. Migration of over 150 km has occurred. Depth of burial exceeds 6.5 km.

3) Good lithologic seal has been identified in the Abary well supported by geo-pressure and temperature.

4) A huge basin floor fan complex with a massive canyon feeder system of Maastrictian age has been mapped with seismic and well evidence of excellent porosity preservation. An abundant sand source for reservoir is present on the shelf.

5) The use of existing seismic grid to identify large basement blocks and depth conversion to identify large closures of 10,000 and 30,000 ha in size with over 2000 meters of Cretaceous section that remains untested.

6) The Abary well drilled in 1975 which has abundant gas and oil shows and was abandoned on the flank one of the closures due mechanical problems near the top of the prospective targets. Closures of up to 400 meters have been mapped on the main reservoir targets using depth conversion.

7) Several postulated fan deposits of Lower Tertiary age have been mapped and show AVO response and apparent oil water contacts in at least one case.

A border dispute resolution has suspended exploration in Guyana. A tribunal dispute resolution process under the UN Law of the Sea is due to issue a binding decision regarding the Maritime boundary between Guyana and Suriname early in the summer of 2007. Repsol and partners Occidental, Noble have committed to drilling in 2007 in the adjacent Block 30 in Suriname. Shallow water depths of less than 100 meters make jack-up drilling feasible with reasonable costs for deep water type targets.

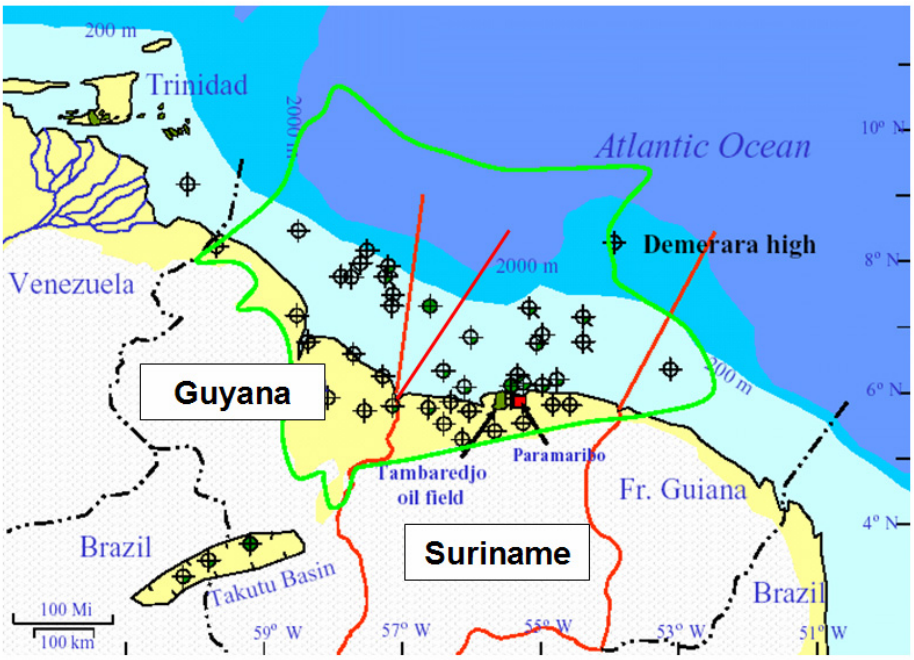

Figure 1: Outline of Guyana-Suriname Basin and petroleum occurrences

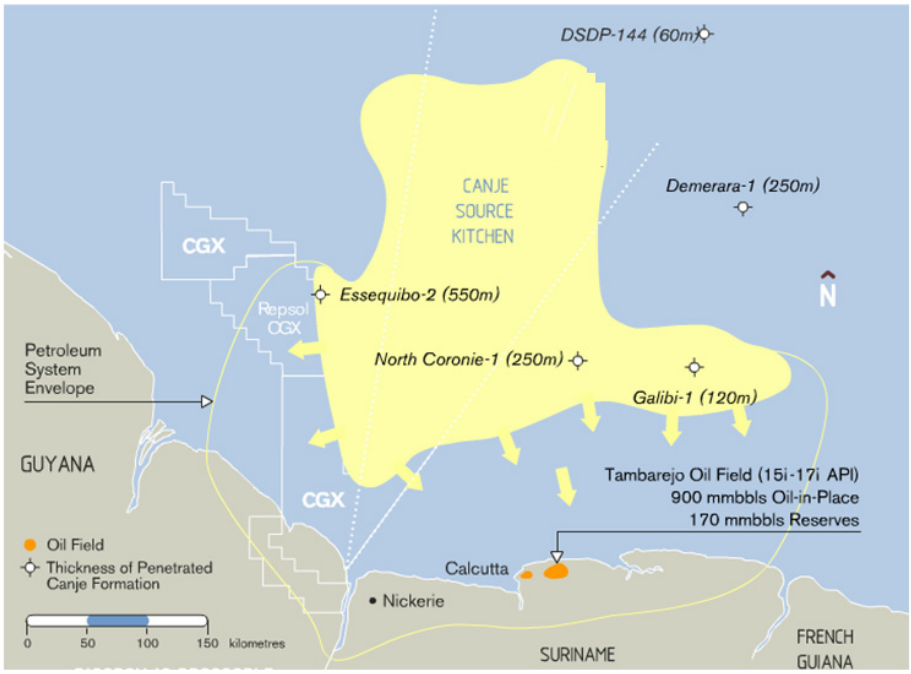

Figure 2: Schematic outline of Canje source rock area, mature below ~4000-4500 m

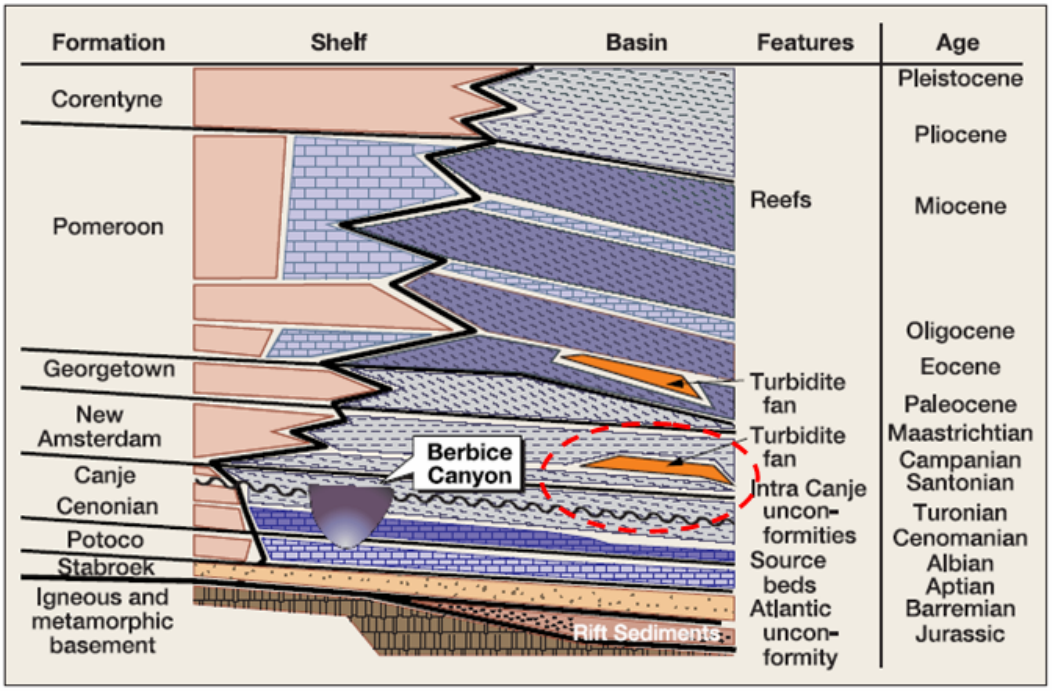

Figure 3: Guyana-Suriname Basin stratigraphic chart.
This paper discusses basin Cretaceous turbidite targets.

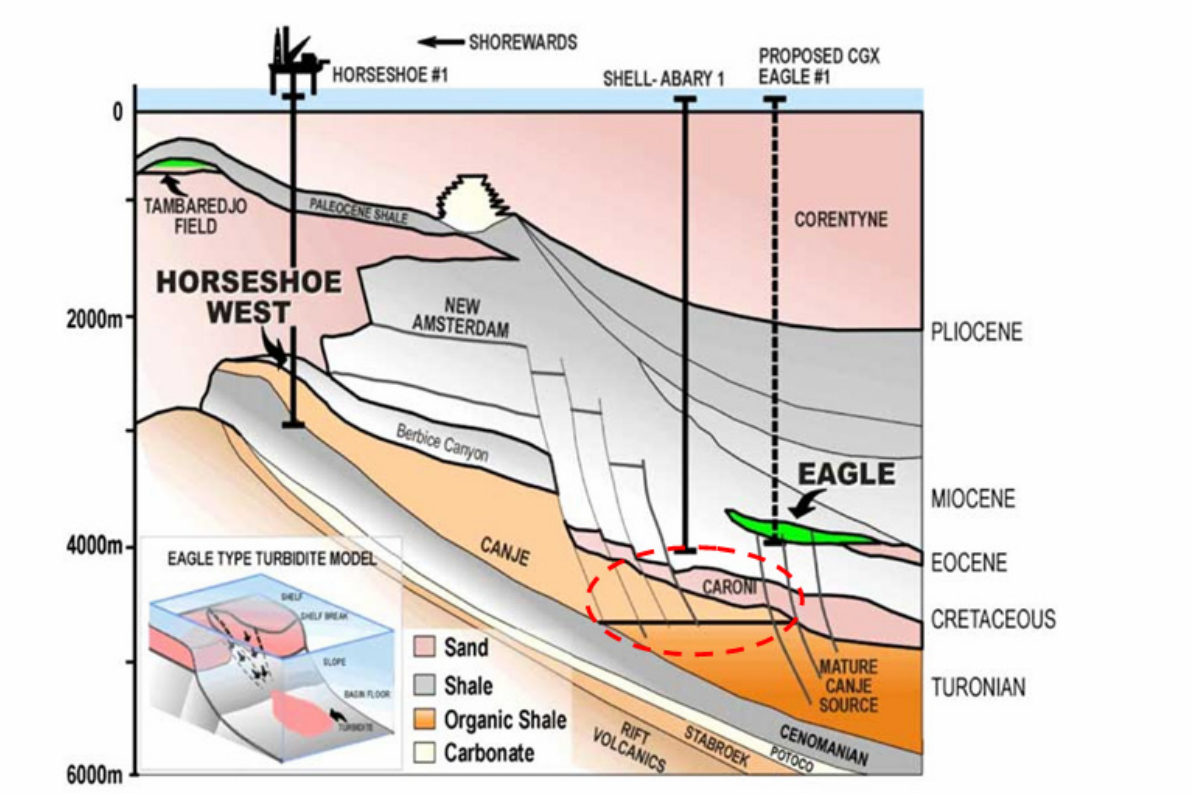

Figure 4: Schematic shelf to basin geologic cross-section.
This paper discusses basin Cretaceous turbidite targets.