THE 4TH GEOLOGICAL CONFERENCE
OF
THE GEOLOGICAL SOCIETY OF TRINIDAD AND TOBAGO
June 17-22, 2007, Hilton Trinidad & Conference Center
Port-of-Spain, Trinidad and Tobago

"Caribbean Exploration – Planning for the Future"

ABSTRACT

STRUCTURAL AND DEPOSITIONAL MODEL FOR THIN, OUTER SHELF, PLIOCENE NCMA GAS RESERVOIRS, OFF THE NORTH COAST OF TRINIDAD, WEST INDIES

Laurent de Verteuil, BG Trinidad & Tobago Limited[1]

Marc Quesnel, BG Trinidad & Tobago Limited[1]

[1]BG House, 5 St. Clair Avenue, Port of Spain, Trinidad, West Indies

The North Coast Marine Area (NCMA), which contains the gas fields of Hibiscus, Chaconia, Poinsettia and Ixora, lie 50 km due north of Port of Spain, Trinidad, and 80 km due west of Crown Point, Tobago, on the northern continental shelf of South America. The fields produce biogenically sourced dry gas, which is transported via pipeline to Atlantic LNG in Point Fortin.

Structurally, the NCMA is within the Tobago Trough Basin, a back-arc wrench-affected basin on the southeastern margin of the Caribbean Plate, where it interacts with the South American Plate to the south and the Atlantic Plate to the east. Oblique strain tectonics in the NCMA area has created a northeast trending basement high (parallel to Tobago), known as the Patao-KK High, along which the NCMA and equivalent Patao, Dragon and Rio Caribe fields in Venezuela trend. The Tobago Trough basin is bounded to the south with Trinidad by the east-west oriented North Coast Fault Zone, a right lateral wrench system that also carries a down to the north normal slip component. The Tobago Trough has been in transtension and subsidence through the late Neogene, and a significant clastic continental shelf has prograded northward into the basin. This process continues to the present, with the modern day Caribbean Sea continental shelf edge laying some 30 km basinward (north) of the NCMA area.

The Pliocene clastic wedge is shale prone with lesser intervals of thin (40 – 150 ft), laterally extensive, very well sorted, clean sands, forming excellent reservoirs. Regional isochores and clinoform geometries from seismic, indicate that Pliocene sequences thicken and prograde to the NNW and strike ENE, parallel to the Patao-KK High. Seismic mapping indicates that these sands were deposited at the paleo-shelf edge on a 50-plus km wide shelf, with rapid shale-out that contributes to trap definition at the shelf-break rollover to the uppermost paleo-slope. Wholesale post-depositional tilting of the NCMA area down-to-the-

south, due to dip slip on the North Coast Fault System, hinges on the Patao-KK High and sets up the combination trapping structures.

The NCMA fields produce from the M6, M4 and M2 sands, of which the M2 is the thickest and youngest. Excellent quality seismic, with well logs, cores, biostratigraphy, pressure measurements and dynamic data have been integrated to develop a genetic stratigraphy and holistic depositional model for the producing Pliocene sequences. The NCMA M6 through M0 sequences are interpreted to be individual $4^{th}/5^{th}$ order lowstand sand deposits, superimposed on a higher order eustatic cycle that is falling from M6 to M2, with maximum lowstand occurring with M2 deposition, followed by 3^{rd} order transgression during the M1 and M0. Each sand/sequence shows the same overall genetic character, with between sequence differences being attributable to their relative position in the higher order sequence set (stacking pattern). The generalized NCMA Pliocene (Galloway) sequence consists of a basal maximum flooding mudstone that progrades upwards to a muddy offshore shelf transition zone environment. In logs and core this is sharply overlain by coarsening upwards clean sands of the main reservoir interval, representative of middle to upper shoreface environments. The emplacement of these sands is by forced regression onto a surface of marine erosion (RSME), during falling stage/lowstand in a eustatic cycle. At maximum lowstand a regional erosional unconformity is formed (Exxon sequence boundary), which may be coincident with the RSME. This is overlain and reworked by a fossiliferous, glauconitic/phosphatic, fining upwards, transgressive sand that passes upwards into the deeper water clays and mudstones of the sequence-capping maximum flood event.

In some of the sequences, this generalized model includes additional sand or shale filled channel-form elements of hundreds to thousands of metres in width, both below the RSME and in the top of the sand transgressive systems tract. These features have been identified in seismic attribute extractions and borehole logs, and have been cored in at least two wells. Sedimentary structures, bedforms, fossils and organic material from these cores indicate that these channel-form units were deposited from turbid density flows of interpreted quasi-steady-state hypopycnal origin. This interpretation has been incorporated into the genetic model and used predictively in field development and management, in relation to facies heterogeneity and aquifer behaviour.