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Paleogeographic Reconstruction of Northern Caribbean Region from Late Cretaceous to Recent

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SUMMARY

Using a regional data base of around 600 2D seismic lines, data from 166 wells and detailed field guides describing the geological history of Cuba, Hispaniola, Nicaraguan rise and continental highlands of Central America, task was to make the paleogeography of the Northern Caribbean. Paleogeographic reconstruction is for seven different time intervals, beginning with Late Cretaceous and running to the Recent. Moreover, these maps constructed and updated by PaleoGIS software. Previously Paleogeographic maps for seven different time intervals (late Cretaceous to recent) were prepared, describing tectonic controls on sedimentation, for the Northern and Eastern offshore South America.

Paleogeographic maps for Northern Caribbean region describes the effects of collision between Caribbean Plate in Northern and western part with Bahama platform and Chortis block respectively, including changes in positions of coastlines and inferred paths of major river systems draining from continental highlands of Cuba, Hispaniola, Jamaica and Central America to adjacent areas.

Paleogeographic maps are critical for petroleum exploration in Northern Caribbean region, in particular for the distribution of source rocks and high quality reservoir rocks.

Despite, the presence of oil and gas fields in Northern Caribbean region, several oil and gas shows reported from different exploratory wells drilled in Northern Caribbean Region.

Introduction

The Northern Caribbean region, defined in this work to be located in the western and northern parts of the Caribbean Sea, faces the continental margins of North and Central America and includes the Greater Antilles to the north and most of Central America (Figure 1). The region has evolved through a complex interaction between the Caribbean and the North and South American plates since Late Cretaceous. Main phases of tectonic evolution include: rifting and formation of the proto Caribbean seaway during the Jurassic; formation of the Caribbean plate in the Pacific as a large igneous province during the Late Cretaceous; oblique collision of the Great Arc of the Caribbean with the North American plate during Paleogene; and strike slip tectonics resulting in the development of the Cayman trough and major left-lateral strike slip faults during the Cenozoic allowing eastward escape of the Caribbean plate between the Americas. Most of these strike-slip faults are still active today (e.g. Enriquillo-Plantain fault system; Zimmermann and Leroy, 2013).

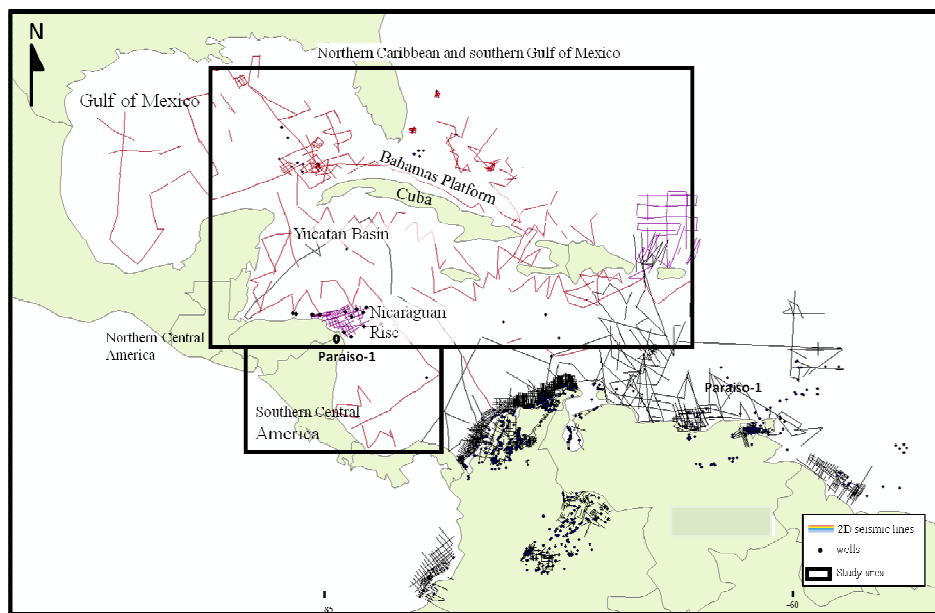


Figure 1 Location of the Northern Caribbean region and available data
Objectives.

The main objective of this study is to create paleogeographic maps of the central and northern Caribbean region, from Late Cretaceous to the recent in seven different time periods (80Ma, 60Ma, 52Ma, 44Ma, 30Ma, 14Ma, 5Ma) to understand how Caribbean tectonic evolution controls sedimentation and distribution of facies, source and reservoir rock distribution that will generate a framework for hydrocarbon exploration. This maps will be integrated with previous paleogeographic maps by Escalona and Mann (2011) done in the southern Caribbean region in order to build one of the most comprehensive compilations in the region.

Data and Methodology

The well database for this study comprises well reports for 166 wells, around 120,000 Km of conventional regional 2D seismic lines acquired during the 70's and 80's and some modern data acquired during the last decade (Figure 1).

The 2D seismic data was uploaded and interpreted in Landmark's Decision Space to classify the seismic facies that represent the interpretation for building up the depositional history of the area. Time and depth structural and thickness maps were prepared. After detailed analysis and location of the data (e.g., well and seismic facies) at present day location, the data was reconstructed using Paleogis software using the plate tectonic model 'Plates_Carib_Aug2013' by A. Escalona and I. Norton that is part of the Caribbean Basins, Tectonics and Hydrocarbons consortium. Once the data was reconstructed to the seven time periods desired, the paleogeography was built.

Preliminary Results

The Paleogeographic maps of the northern Caribbean region show the spatial distribution of sedimentary facies in response to the extensive tectonics in the area. Main observations include:

Late Cretaceous: During this stage, North and South America had been rifted apart with formation of the proto Caribbean seaway in between them. The Great arc of the Caribbean was tectonically active due to subduction of the proto Caribbean seaway beneath the Caribbean Plate (Figure 2). To the north-west thick carbonates are deposited on the Yucatan Platform. To the south-east of the Gulf of Mexico, pelagic sedimentation was dominant.

Paleogene: The Yucatan platform area was under the influence of marine transgression from Late Paleogene to Quaternary where thick carbonates deposited. In the northern Corozal basin in northern Belize, prograding reefs developed at the shelf edge. To the north, a sediment starved Yucatan basin developed as a back arc basin of the Great Arc of the Caribbean during convergence with North America, in the Cuba region, where a foreland basin developed. Fine grained sedimentation is sourced from adjacent continental highlands of the Yucatan peninsula and Cuba (Fig. 3).

Neogene: In the Yucatan, Bahamas and the Nicaraguan rise platform areas, thick carbonates and evaporites were deposited on basement highs during the Cenozoic due to marine transgression. These highs were formed as transtensional tectonics affecting the Nicaraguan Rise during eastward escape of the Caribbean plate (Figure 3). In the Honduras offshore area, shelfal sedimentation occurred with clastic influence from developing paleodrainages in the highlands of Central America.

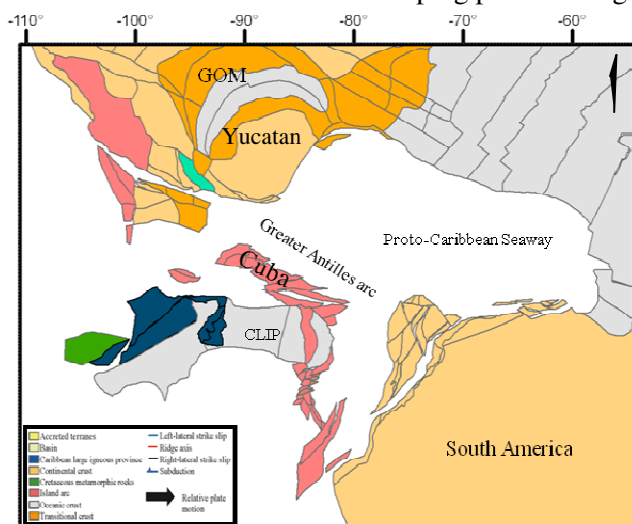


Figure 2 Plate tectonic reconstruction for Late Cretaceous (Escalona and Norton, 2011).

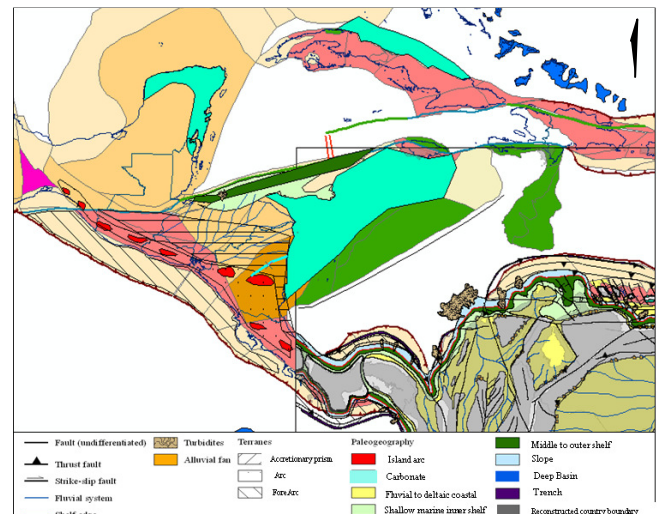


Figure 3 Simplified Paleogeographic reconstruction of the Caribbean region (modified from Escalona and Mann, 2011).

Conclusions

Integration of interpretations from a mega-regional seismic data set, well data, outcrop and previous work in reconstructed paleogeographic maps since Late Cretaceous to present of the northern Caribbean reveals the main basin types, source and reservoir rock distribution, relative motion and position of plates that accompanied oblique collision between the Caribbean plate, Central America and southern North America. Facies maps prepared for different time intervals reveal complex lateral changes in the distribution of source and reservoir rock that are intimately related to the petroleum system of the area and are useful for hydrocarbon exploration in this frontier region

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References

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