

# **PS Tectono – Stratigraphic Events of the Northern Caribbean Offshore, Colombia\***

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## **Abstract**

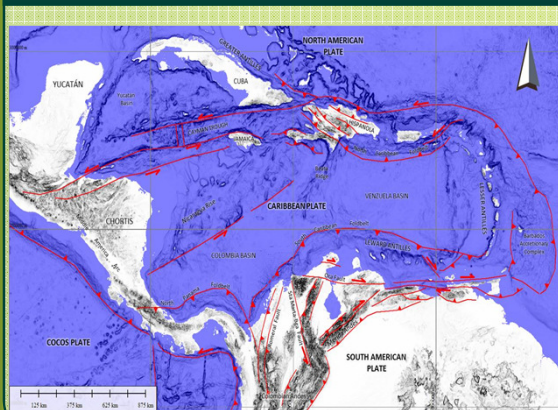
Colombian Caribbean offshore is located at the boundary between the Caribbean and South American plates, which have a relative movement towards the ESE and WNW, respectively, producing an oblique convergence of this margin and driving the major tectonostratigraphic features of the area. The occurrence of several tectonic events throughout geologic time, have generated different provinces and structural styles turning this area into a geologically complex region. These events also controlled both the distribution and type of plays and the timing of the petroleum systems in the basin; hence, their study is the key to understand the tectonic evolution of the Colombian Caribbean offshore, aiming to reduce the exploratory risk in this basin. Taking this into account, the goal of this work was to perform a tectono-stratigraphic analysis in the offshore Guajira using 2D and 3D seismic data, biostratigraphy, sedimentology and well logs. Six tectono-sequences from the Mesozoic to the Pliocene separated by five major unconformities were recognized. Some of these were previously documented by other authors (Guajira, Falcon and Maracaibo Basin), evidencing the regional tectonic control on depositional and structural trends of the interpreted sequences. These sequences reflect the next regional events: (1) Rift Jurassic - Early Cretaceous (opening of the proto-Caribbean); (2) Sedimentary deposition within a passive margin environment during the Late Cretaceous; (3) Interaction of Caribbean and South American plates in the Colombian Caribbean during the late Cretaceous - Paleocene with accretion of oceanic lands; (4) Late Eocene deformation event - early Oligocene (Guajiro Orogeny and Guarao); (5) Eustatic changes that generated a paraconformity of strata during the late Oligocene - early Miocene; and (6) deformation event during the late Miocene – Pliocene.

## ABSTRACT

The Colombian Caribbean offshore is located at the boundary between the Caribbean and South American plates, which have a relative movement towards the ESE and WNW, respectively, producing an oblique convergence of this margin and driving the major tectono-stratigraphic features of the area. The occurrence of several tectonic events throughout the geologic time, have generated different provinces and structural styles turning this area into a geologically complex region. These events also controlled both the distribution and type of plays, and the timing of the petroleum systems in the basin; hence their study is key to understand the tectonic evolution of the Colombian Caribbean offshore, aiming to reduce the exploratory risk in this basin. Taking this into account, the goal of this work was to perform a tectono-stratigraphic analysis in the offshore Guajira Basin using 2D and 3D seismic data, biostratigraphy, sedimentology and well logs.

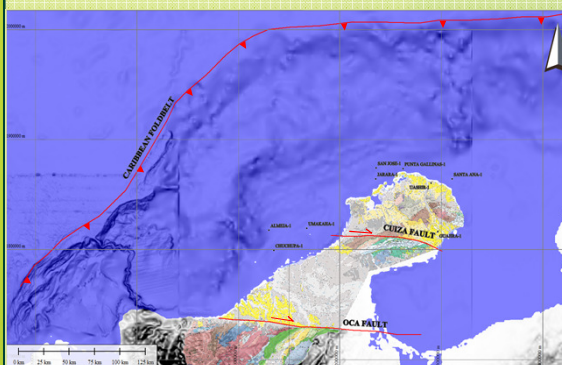
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## TECTONIC SETTING OF THE CARIBBEAN



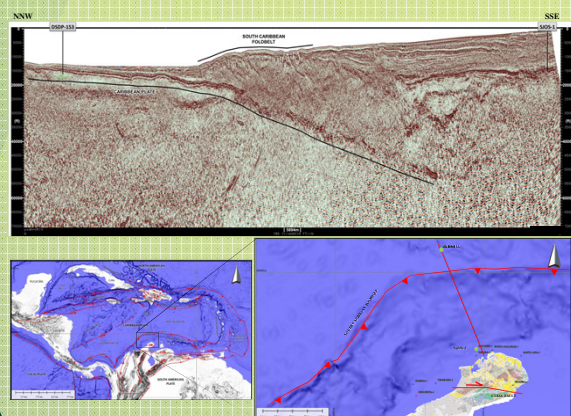
The Colombian Caribbean offshore is the current boundary between the South American and Caribbean plates. The most important geological features are: the Hess escarpment, the Beata Ridge, the Aves Ridge and the Caribbean Deformed Belt. The occurrence of several deformation events results in a geologically complex area, characterized by diverse structural styles such as thrust belts and rotated blocks controlled mainly by transpressive strike-slip movements related to the oblique plate convergence generated as the Caribbean Plate advances in an E-SE direction relative to the South American Plate.

## STUDY AREA



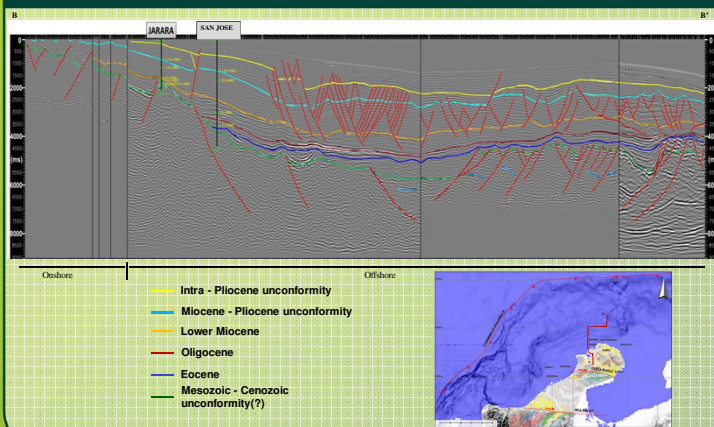
The Guajira Basin is located in the northern corner of Colombia covering an area of nearly 50,000 km<sup>2</sup> including both onshore and offshore areas. The basin is bounded to the north and northwest by the Caribbean Deformed Belt (CDSC), to the south by the Oca Fault and to the east by the Curacao, Bonaire, and Aruba basement highs. The Guajira Basin is traditionally divided into two basins: the Upper Guajira Basin to the north and the Guajira Basin to the south, separated by structural feature of the Cuiza Fault with an E-W trend.

## STRUCTURAL FEATURES



Seismic section depicting the main structural features that highlight three structural provinces: (1) the subduction zone of the Caribbean plate, (2) the Caribbean Deformed Belt, and (3) the Rancheria Basin, which is mainly filled by Tertiary sediments.

## ONSHORE – OFFSHORE REGIONAL SECTION





# TECTONO – STRATIGRAPHIC EVENTS OF THE NORTHERN CARIBBEAN, OFFSHORE COLOMBIA

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## GENERALIZED STRATIGRAPHIC COLUMN

PERIOD	EPOCH	SUBEPH	AGE	FORMATION	System elements
QUATERNARY					Soils
NEOGENE	Pliocene			Castilletes	
	Early				
	Late				
	Early				
PALEOGENE	Early			Jimol	
	Early			Uitpa	
	Early			Siamana	
	Early			Macarao	
CRETACEOUS	Early			Guadalupe	
	Early			La Luna	
	Early			Maraca	
	Early			Cogollo Inferior	
JURASSIC	Early			Chimera	
	Early			Caja	
	Early			Chetito	
	Early			Uitpa	
TRIASSIC	Early			Rancho Grande	
	Early			Basement	
	Early				
	Early				

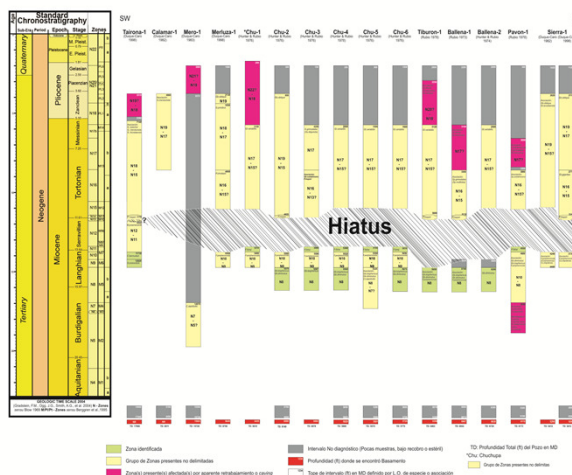
The Guajira Peninsula is characterized by a series of massive and isolated highlands with low elevations identified as the Cocinas, Macuira, and Jarara Mountain Ranges that are surrounded by Cenozoic sedimentary basins. The lithologic record in the Guajira Basin ranges in age from Paleozoic to Pleistocene, with the sedimentary sequences starting in the Triassic. These rocks have been identified both outcrop and subsurface. From the point of view of the petroleum system there are source rocks in the Cretaceous, Eocene and Oligocene, and reservoir facies in the Eocene, Oligocene, and Early to Middle Miocene.

## TERTIARY SEQUENCES ONSHORE GUAJIRA

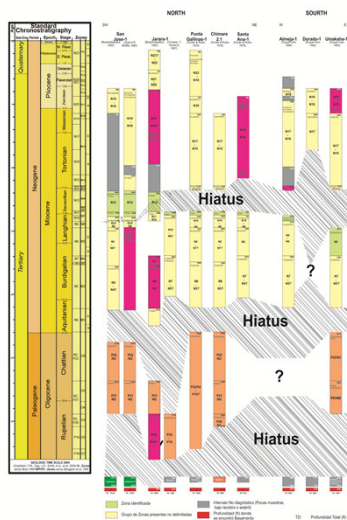


## CHRONOSTRATIGRAPHIC FRAMEWORK FOR GUAJIRA BASIN

### LOWER GUAJIRA

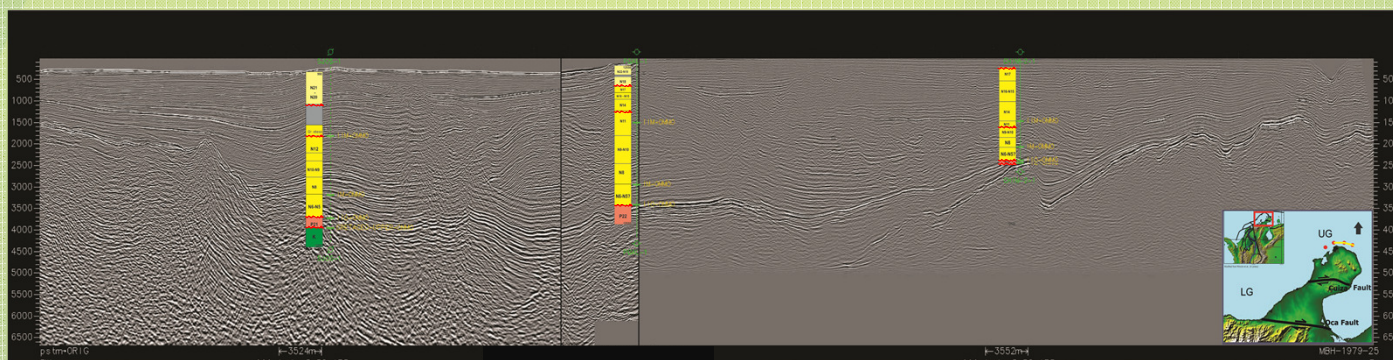


### UPPER GUAJIRA



This chronostratigraphic scheme allowed the identification of four diachronic hiatuses in the Upper Guajira Basin. In the sense of the sequences from oldest to youngest, the first gap identified is related to the Late Cretaceous – Paleogene time interval, which is well recognized in San Jose 1 well. The second gap is encompasses the Late Eocene – Oligocene time interval and was recognized in the Chimera 2-1 well, with missing time span of approximately 2.2 Ma. The third hiatus interrupts sequences deposited in the Late Oligocene - Early Miocene, representing a time interval of approximately 1.2 Ma. This unconformity was observed in the majority of the wells tested. The fourth identified gap was found between the Middle Miocene - Late Miocene time representing a missing time span of about 2 Ma. The last gap occurred in the Late Miocene - Early Pliocene sequences. This hiatus is not clear in the biostratigraphic record as the previous ones because the paleo-environmental analysis indicates shallow marine to transitional environments where foraminifera recovery is not robust enough.

## CHRONOSTRATIGRAPHIC FRAMEWORK INTO UPPER GUAJIRA BASIN REGIONAL SEISMIC DATA



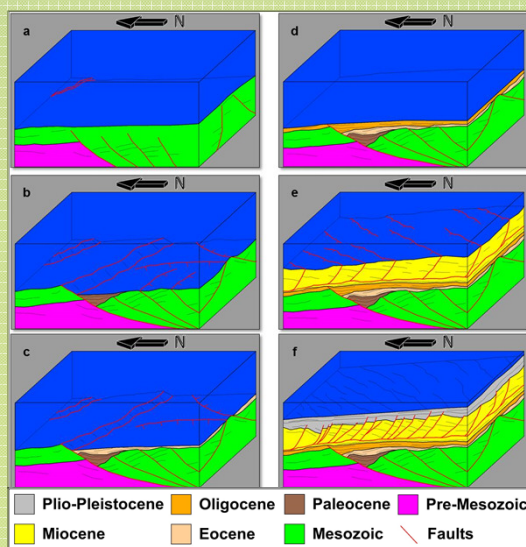
With the chronostratigraphic framework already defined, we integrated the seismic data to know the chronology of seismic sequences and their structural styles in order to predict prospective offshore areas.



# TECTONO – STRATIGRAPHIC EVENTS OF THE NORTHERN CARIBBEAN, OFFSHORE COLOMBIA

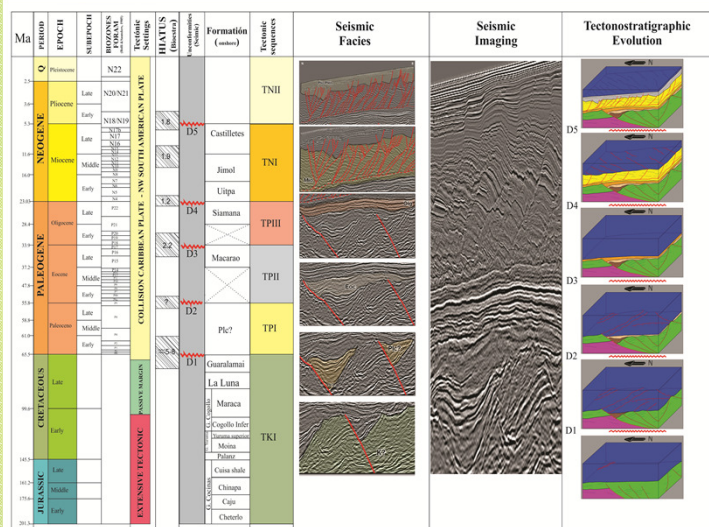
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## EVOLUTIONARY SCHEME PROPOSED



Extension Early Cretaceous and passive margin during the Late Cretaceous. b. Interaction of the Caribbean and South American plates from Late Cretaceous - Paleocene in the Colombian Caribbean c. Late Eocene - Early Oligocene Unconformity d. Eustatic change that generates a paraconformity between Late Oligocene - Early Miocene strata e. Late Miocene - Pliocene Unconformity f. Current Configuration.

## TECTONO-STRATIGRAPHIC SYNTHESIS



## ACKNOWLEDGMENTS

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