[PS]Controls on the Miocene to Recent Infill of the Lower Guajira Basin of Northern Colombia*

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Abstract

Approximately one-quarter of Colombia's natural gas demand is supplied by lower Miocene reservoirs in three fields of the Lower Guajira Basin, a strike-slip-related, Miocene to Recent depocenter located in the northern part of the country. While most of the previous stratigraphic studies in the basin have focused in offshore areas, less stratigraphic studies have been performed in the onshore portion. In this study, we use a regional seismic and well database to build an updated Miocene to Recent sequence-stratigraphic framework of the onshore Lower Guajira Basin, to reconstruct the paleogeography and to link the sedimentation history to the tectonic events in surrounding provinces such as the Sierra Nevada de Santa Marta and the Perijá Ridge. Early Miocene sedimentation is characterized by a shallow-marine clastic and calcareous transgressive sequence that onlapped the crystalline basement and was deposited in a wide (~80 km) platform. The main control on sedimentation was the basement morphology, consisting of an E-W-trending depocenter dipping to the West. An important unconformity of middle Miocene age (~12 Ma), expressed in proximal areas as a notorious erosional surface, marks an increase in sedimentation and the onset of faster clinoform progradation to the West. Middle Miocene to Recent sequences accumulated in a moderately deep-water margin, with clinoforms ~ 1000 m high, rates of shelf-edge progradation ~11 km/My, and aggradation <270 m/My. These sequences filled the basin relatively rapidly, exhibiting a clear progradational architecture, morphologically smooth slopes, and thinning towards the Oca Fault, as an indication of the fault's activity. The middle Miocene unconformity that marks the increase in rates of shelf-edge sedimentation and progradation, would be related to reported Neogene exhumation pulses starting at ~ 16 Ma in the Sierra Nevada de Santa Marta and Perijá, and with the birth of the proto-Ranchería river. The middle Miocene to Recent infill of the Lower Guajira Basin was thus controlled by the pre-existing basement paleotopography, by exhumation pulses of Santa Marta and Perijá ridges, and by the dextral strike-slip activity of the Oca Fault. In this structural and stratigraphic context, the Miocene reservoirs associated to stratigraphic traps in the Guajira Basin still have an important potential to be explored.

Selected Reference

Villagómez, D., R. Spikings, A. Mora, G. Guzmán, G. Ojeda, E. Cortés, R. Van der Lelij, 2011, Vertical Tectonics at a Continental Crust-Oceanic Plateau Plate Boundary Zone: Fission Track Thermochronology of the Sierra Nevada de Santa Marta, Colombia: Tectonics, v. 30/4, 18 p. doi:10.1029/2010TC002835

CONTROLS ON THE MIOCENE TO RECENT INFILL OF THE LOWER GUAJIRA BASIN OF NORTHERN COLOMBIA

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1. INTRODUCTION

The study area is located in northern Colombia (Figure 1), in the Lower Guajira Basin.
Approximately one-quarter of Colombia's natural gas demand is supplied by lower Miocene reservoirs in three fields of the Lower Guajira basin, a strike-slip-related, Miocene to Recent depocenter located in the northern part of the country. While most of the previous stratigraphic studies in the basin have focused in offshore areas, less stratigraphic studies have been performed in the onshore portion. In this study, we use a regional seismic and well database to build an updated Miocene to Recent sequence-stratigraphic framework of the onshore Lower Guajira basin, to reconstruct the paleogeography and to link the sedimentation history to the tectonic events in surrounding provinces such as the Sierra Nevada de Santa Marta and the Perijá Ridge.

2. LOCATION AND TECTONIC SETTING

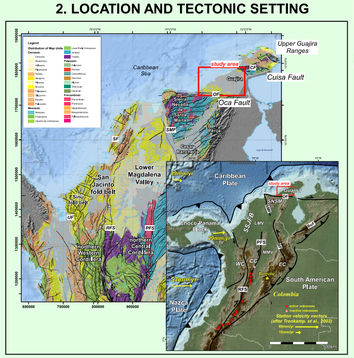

Figure 1. *Location and tectonic setting of the Lower Guajira Basin, showing the main structural and morphological features, such as Oca Fault, Cuisa Fault, Sierra Nevada de Santa Marta and Upper Guajira Ranges.*

3. DATABASE

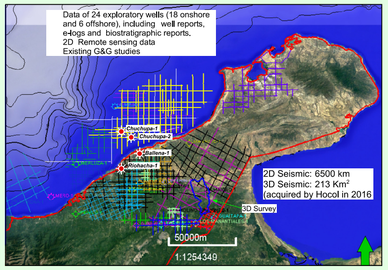

Figure 2. *Well and seismic database*

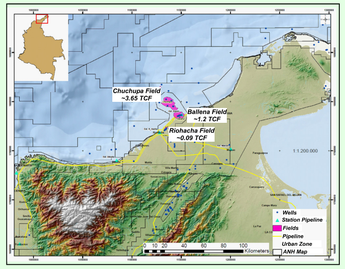

Figure 3. *Infrastructure and hydrocarbon occurrences (Chuchupa, Ballena and Riohacha fields)*

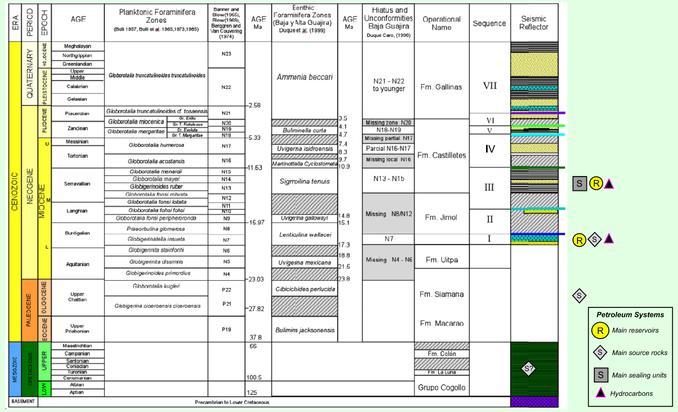

Figure 4. *Biostratigraphic chart showing the planktonic foraminifera biozones recognized regionally and the benthic foraminifera zones reported by Duque Caro (1998). This chart was used to correlate biostratigraphic data with seismic reflectors in order to identify the main sequences in the Lower Guajira Basin.*

4. REGIONAL FRAMEWORK

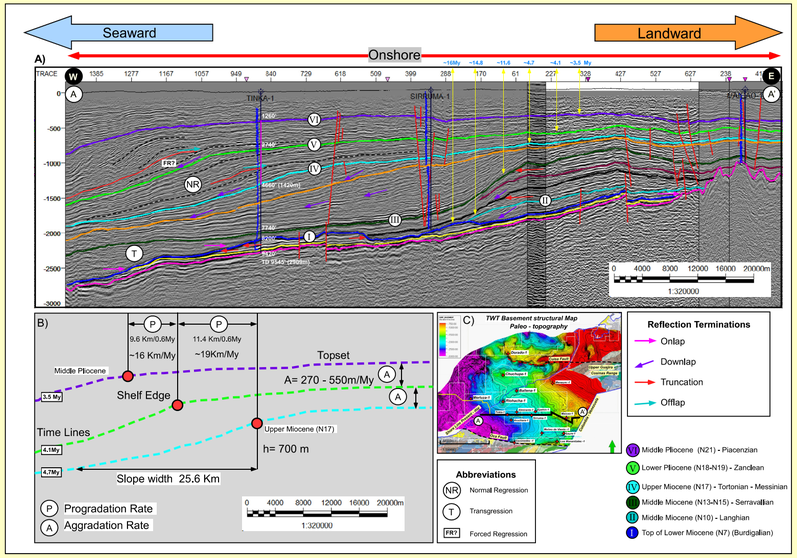

Figure 5. *A) East - West composite seismic line through the onshore Lower Guajira Basin, showing the interpreted stratigraphic sequences (I - VI). The reflection terminations and subaqueous clinoforms at the shelf edge are also depicted. B) Clinoform growth in moderately deep - water margins, architecture and dimensions (aggradation and progradation rates) are illustrated and C) Structural map of the top of the basement with the location of the transect .*

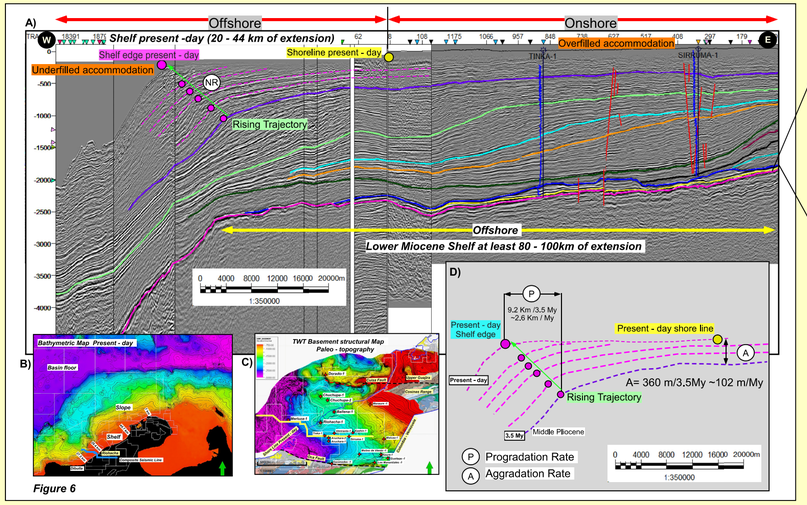

Figure 6

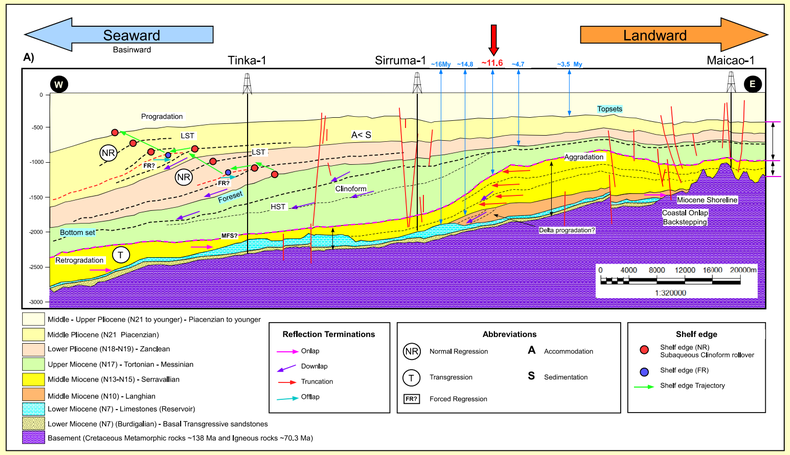

Figure 7. *Drawing with the sequences stratigraphic interpretation on the composite section in the Figure 5, showing the architecture of the sedimentary record, shelf edge subaqueous clinoforms, shelf edge trajectory, ~age of each sequence and the regional configuration of the Lower Guajira Basin.*

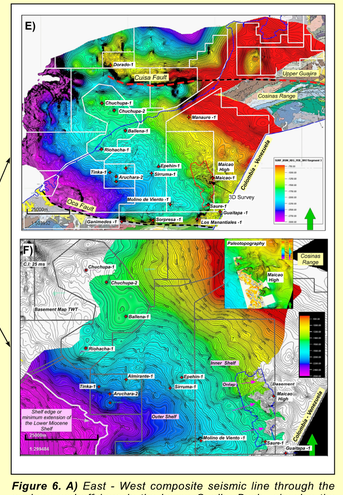

Figure 6. A) *East - West composite seismic line through the onshore and offshore in the Lower Guajira Basin, showing the minimum extension of the shelf in the Lower Miocene, at least 80-100 km* ***B)*** *Present - day bathymetric map showing the width of the current shelf for comparison with the Lower Miocene shelf, both carbonate shelfs.* ***C)*** *Structural map of the top of the basement with the location of the transect .* ***D)*** *Clinoform architecture and dimensions* ***E)*** *and* ***F)*** *TWT Regional structural Map of the Top of the Basement, and of the Top of the Lower Miocene (Seq I), respectively.*

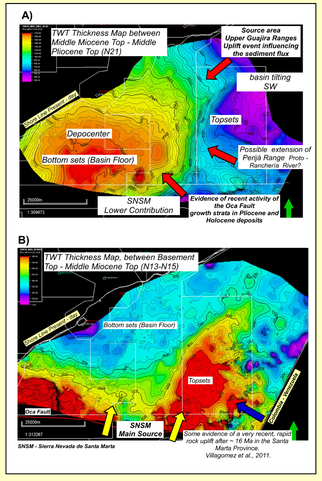

Figure 8. A) and B) *TWT Thickness Map between basement top and Middle Miocene top (Seq III) and TWT Thickness Map between Middle Miocene Top (Seq III) - Middle Pliocene Top (Seq VI) respectively, showing the main sediment source areas and proposed exhumation ages.*

5. CONCLUSIONS

The main control on sedimentation was the basement morphology, consisting of an E-W-trending depocenter dipping to the W. An important unconformity of middle Miocene age (~12 Ma), expressed in proximal areas as a notorious erosional surface, marks an increase in sedimentation and the onset of faster clinoform progradation to the W. Middle Miocene to Recent sequences accumulated in a moderately deep-water margin, with clinoforms ~ 1000 m high, rates of shelf-edge progradation ~11 km/My and aggradation <270 m/My. These sequences filled the basin relatively rapidly, exhibiting a clear progradational architecture, morphologically smooth slopes and thinning towards the Oca fault, as an indication of the fault's activity. The middle Miocene unconformity that marks the increase in rates of shelf-edge sedimentation and progradation, would be related to reported Neogene exhumation pulses starting at ~ 16 Ma in the Sierra Nevada de Santa Marta and Perijá, and with the birth of the proto-Rancheria river. The middle Miocene to Recent infill of the Lower Guajira basin was thus controlled by the pre-existing basement paleotopography, by exhumation pulses of Santa Marta and Perijá ridges and by the dextral strike-slip activity of the Oca Fault. In this structural and stratigraphic context, the Miocene reservoirs associated to stratigraphic traps in the Guajira basin still have an important potential to be explored.

ACKNOWLEDGEMENTS

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