Neogene Biome reconstruction from Northern Venezuela

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Introduction

We present preliminary results from a high-resolution palynological reconstruction from an entire Neogene sequence of sediments retrieved in Northern Venezuela (Fig. 1). In a paleoenvionmental context, the Negeone is a period of special relevance because it includes the configuration of major mountain chains and the origin of modern ocean currents with and the subsequent establishment of current climate regimes (Zachos et al 2001, Potter and Szatmari 2009, Pound et al 2011). In the Neotropics, the uplift and closure of Central America Seaway (CAS) during the Neogene played an essential role in the Great American Biotic Interchange (Webb 2006). The uplifting of CAS has also implications on the transition towards current salinity concentrations in the Caribbean, which along with climatic gradients, leaded into the strengthening of the Atlantic Meridional Overturning Circulation and modern climate regimes (Molnar 2008; Sepulcre 2010, 2014). This period is highly significant in the history of South American biodiversity and climatology. However, paleoenvironmental reconstructions for the entire time-sequence for the Neogene (i.e. the last 23 Ma years) are difficult to retrieve due to unconformities present in most of the stratigraphic sequences, and to the thinness of the Miocene deposits.

The importance of the nine kilometers of sequence sediments from the Urumaco trough in Northern Venezuela resides on its time continuity. Isolated from the central region of Venezuela by the Merida Andes since the Eocene (Escalona and Mann 2006), the Urumaco region has undergone fluctuations from deltaic - marine environments to a fluvial – continental dominated system (Smith et al 2010, Quiroz and Jaramillo 2010).

The complexity of the tectonism in the Caribbean basin, intermittent marine transgressions, and the arid climatic conditions, have shaped the environmental conditions for the deposition of sediments in the Falcón basin (Fig. 2) (Kellogg 1984, Audemard 2002, Smith et al 2010, Quiroz and Jaramillo 2010). The characteristic aridity of the region is due to the influence of the Caribbean low level jet with minimal seasonal variations associated with the Intertropical Convergence Zone (ITCZ) (Peterson et al 2002).

Research Questions

- Does our palynological record reflect the same paleoenviromental conditions as inferred by Quiroz and Jaramillo (2010) in their facies analysis?
- Is the environmental change linked to climatic events during the Neoegene (i.e. permanent warm phase of ENSO and the migration of the ITCZ)?
- Was it an abrupt or a transitional change towards the xeric environment that dominates at present time?
- What was the dynamic of sea level rise in this Neogene record? Do sea level rising events lag the marine incursions recorded in other records from South America? Did they constrain the abundance of plant species?

Study Site

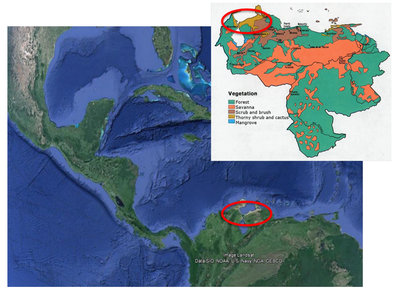

Figure 1. Location of the area of study. Current vegetation is restricted to thorny shrubs and Cactus. Image taken from Google Earth and Venezuela vegetation map 1972 of Public Domain.

The composite stratigraphic sequence was retrieved from the Falcón region in Northern Venezuela (Quiroz and Jaramillo 2010) (Figs 2 and 3). The Falcón basin started to form during the late Eocene as a result of the interaction between the South America, Nazca, and Caribbean plates (Audemard 2001).

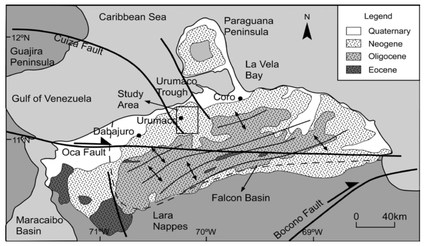

Figure 2. Geological context of the Falcón *basin and the Urumaco trough* (after Quiroz and Jaramillo 2010)

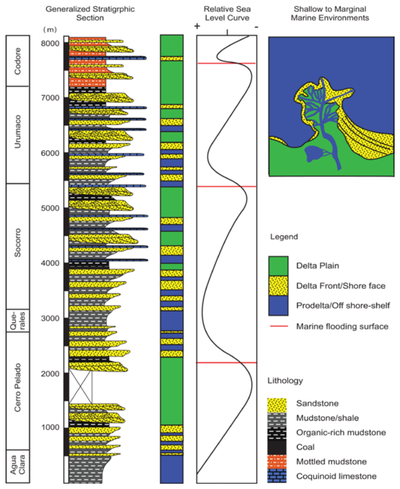

Figure 3. Stratigraphy of Urumaco Trough including marine transgression events (Quiroz and Jaramillo 2010)

Methods

Palynological analysis of the entire composite section has been carried to complete a total of 357 samples. Marine and non-marine morphs have been with emphasis on pollen and spores. First Appearance Datum and Last Appearance Datum will be used to establish the chronosequence of the deposits (after Jaramillo et al. 2009).

Modern sediments were retrieved from a one of the tributaries of Mamón creek. We expect to have a representative modern analog of pollen and spores deposition. Resampling of the San Gregorio formation was carried out during the same field trip season to verify the preliminary results described below.

Preliminary Results

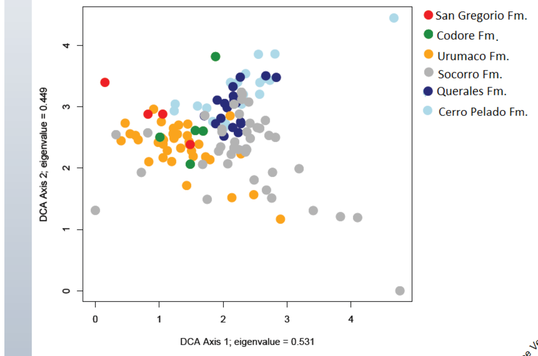

Figure 4. DCA including all the samples with a pollen sum over 20 grains. Spores and marine elements were excluded from this analysis.
Analysis done by Derek Haselhorst (Program in Ecology, Evolution, and Conservation Biology UIUC)

San Gregorio Fm. Pic Aleja Restrepo Nov. 2013

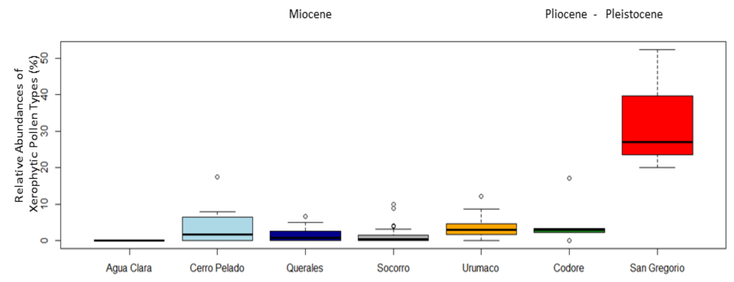

Figure 5. Relative abundances of Xerophytic pollen types. Relative abundances increase in samples from San Gregorio Fm.

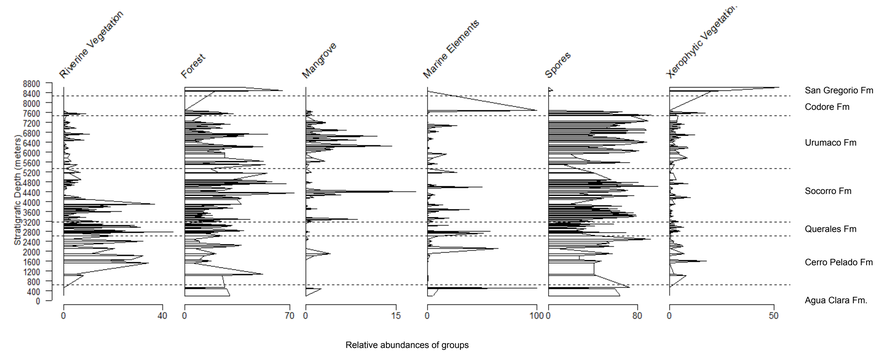

Figure 6. Relative abundances of the gropus of palynomorphos in samples whit 20 palynomorphs of recovery.

- 621 pollen and spores morphotypes have been identified and described.
- Palynological analysis of the early Miocene formations, Pedregoso and Agua Clara is completed along with the one for Cerro Pelado formation (Fig 6).
- Pollen composition in San Gregorio formation differs in the amount of palynomorphs preserved and in the relative abundance of taxa. Xeric elements dominate the abundances (Fig 4 and 5)

Preliminary Discussion

- The abundance of Acritarchs and Dynocysts over pollen grains, more of 50%, in samples from Pedregoso and Agua Clara formations (Early Miocene after Lorente 1986) (Fig 6.), represents the front deltaic environment of deposition described by Quiroz and Jaramillo (2010).
- One of the most striking shifts in palynological composition of the Urumaco Trough is the one observed at the contact between Codore and San Gregorio Formations (Fig 6). Smith et al. (2010) regarded this portion of the sequence as deposition of siliciclastic-carbonated sediments occurring during the Pliocene. The scarce pollen deposition and the taxonomic change might represent i) a change in biome towards the Xeric ecosystem that dominates currently, or ii) a shift in the coastline.
- The causes of the onset of arid climatic conditions might be related to be reflecting a southern migration of the ITCZ during the Pliocene-Miocene boundary (after Hovan 1995, Billups et al. 1999) or a permanent warm phase of el Niño Southern Oscillation during the Pliocene (Heydt et al 2011).
- Shifts of the ITCZ coupled to enhanced easterly trade winds might have also played a role in the origin of dry conditions that leaded towards the formation of a xeric environment in this region (Haug et al. 2001, 2004).

Acknowledgments

We highly appreciate the contribution of the Venezuelan geologist and paleontologist Rodolfo Sánchez. We also thank Marcelo Sánchez from University of Zurich and Austin Hendy from University of Florida. We thank all the comments from the members of Dr. Punyasena's lab and Alex Byrk (Geology Department) at UIUC.

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