Using Palynology to Redefine Stratigraphic Units: A Case Study from the Caño Limon Fields and Adjacent Exploration Blocks, Northern Llanos Basin, Colombia

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Abstract

Palynomorphs, due to their relative resistance to degradation, have proved themselves to be a reliable tool for correlating chronostratigraphic units within the thick fluvio-marine clastic sequences of the Llanos basin, with an excellent general chronostratigraphic framework established in the past decade.

The Caño Limon oil fields produce from mixed fluvio-deltaic-marine reservoirs deposited in an eastward thinning foreland basin and ranging from Turonian to early Miocene in age. While the overall stratigraphic sequence is well established, it is challenging to reliably correlate second-order markers at the field and regional scale using the existing well logs and 3D seismic.

We present results from a multi-year (and still ongoing) palynological analysis project on wells from the Caño Limon fields and adjacent blocks. The work is integrated and involves analyses from cores, cuttings, electrical logs, image logs and seismic data. To date we have analyzed over 40 wells, principally from cuttings (from a total of more than 800 drilled wells).

The palynological results have significantly impacted our stratigraphic correlations at all scales. We will show examples of these improvements and changes.

At the field level, it has changed long-established correlations resulting in new workover opportunities. At a regional scale it has improved our understanding of reservoir and regional facies distributions. Alongside the seismic data it is being used to improve mapping of reservoir pinchouts and to predict expected reservoirs in exploration leads. It has improved our definition of the main stratigraphic hiatus in the area (Maastrichtian-Eocene). We also identified an additional hiatus, previously undocumented, within the Oligocene.

References

Cleveland, M.N. and Molina, J. 1990. Deltaic reservoir of the Caño Limón field, Colombia, South America. 12, p. 281 - 315.

Gabela, V. 1985. Campo Caño Limón, Llanos Orientales de Colombia. II Simposio Bolivariano, Bogotá, Colombia, Tomo I, p. 51 - 94.

Jaramillo, C., and Rueda, M. 2004. Impact of biostratigraphy on oil exploration. III Convención técnica de la Asociación Colombiana de Geólogos y Geofísicos del Petroleo (ACGGP), Bogotá, Colombia.

Jaramillo, C.A., Rueda, M., and Torres, V. 2011. A palynological zonation for the Cenozoic of the Llanos and Llanos Foothills of Colombia. Palynology, 35:1, p. 46 - 84.

Servicio Geológico Colombiano. Banco de Información Petrolera. Recovered from https://srvags.sgc.gov.co/JSViewer/GEOVISOR_BIP/

Zarate, G., Sanchez, J., Carrero, M., and Jimenez, L. 2006. Análisis de la capacidad sellante en fallas normales y su impacto en la disminución de riesgo en oportunidades exploratorias. Parte norte de los llanos-Colombia. IX Simposio Bolivariano, Cartagena, Colombia

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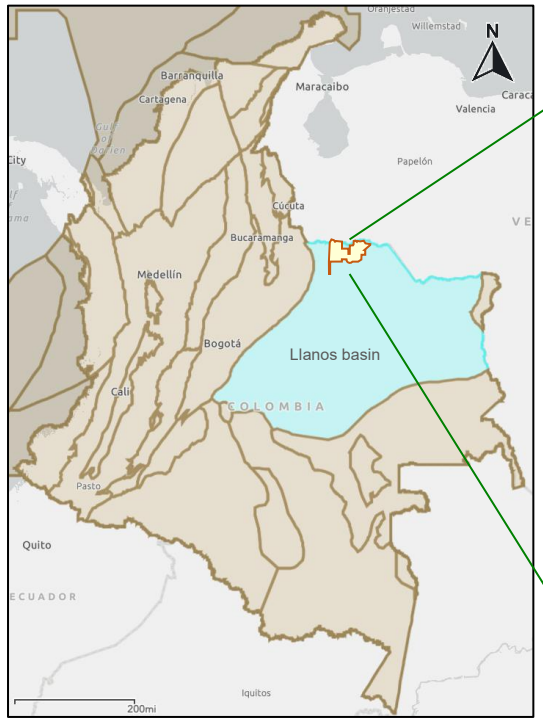
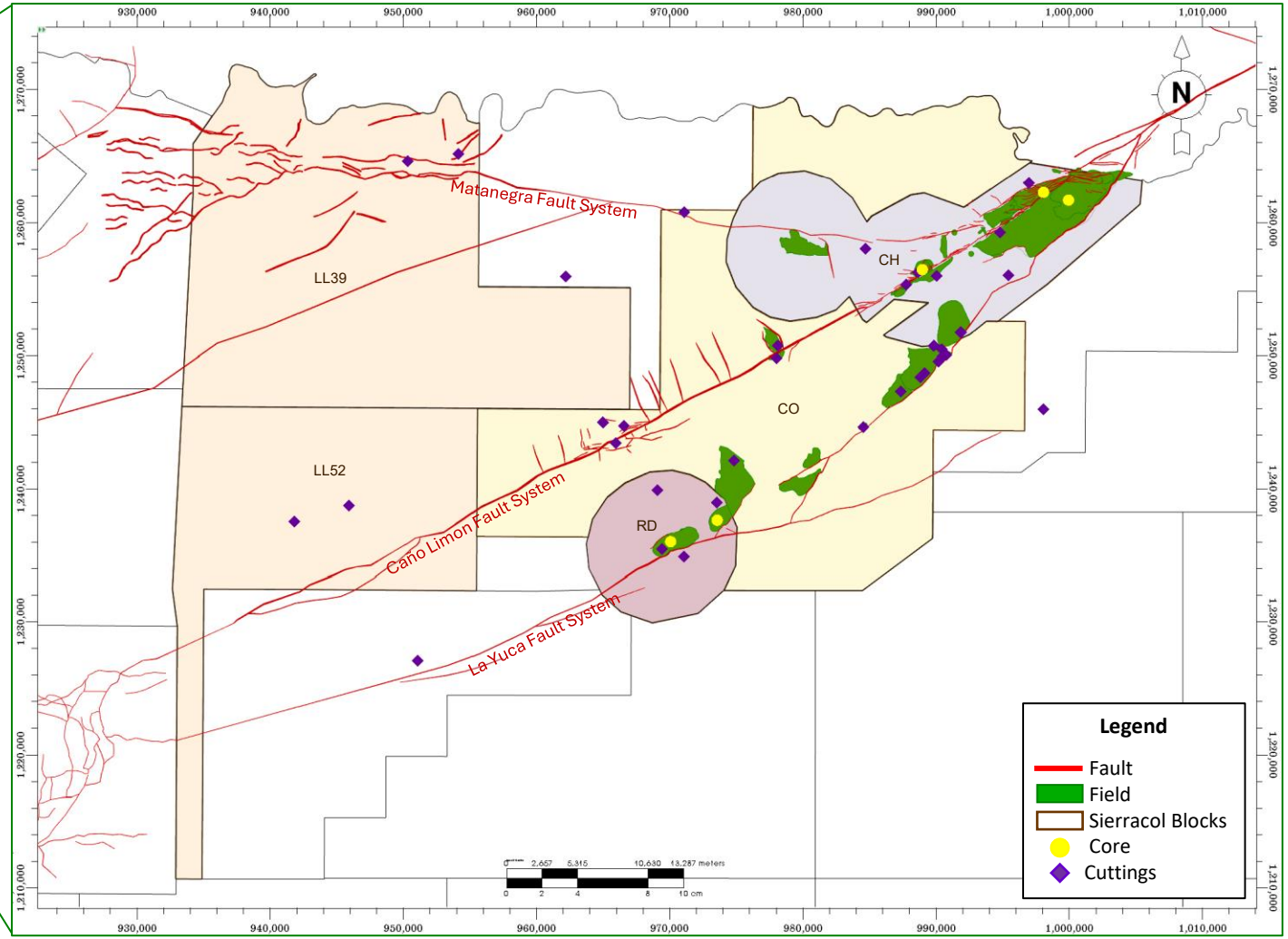
Sierracol Energy & Paleoflora Ltda

Study Area

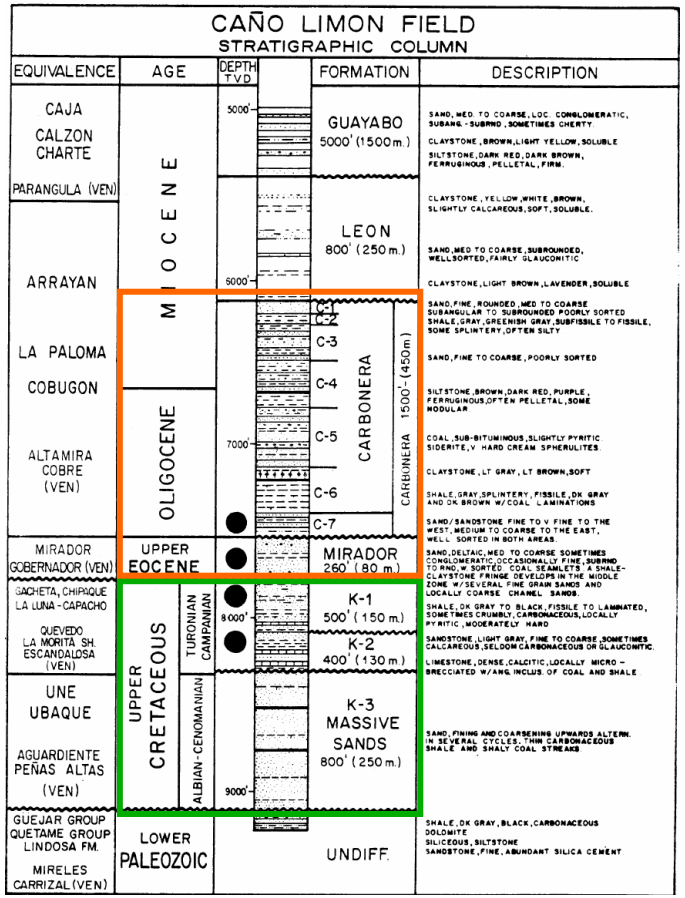




- Northern Llanos basin
- Multi-year palynological project
- Over 40 wells analyzed

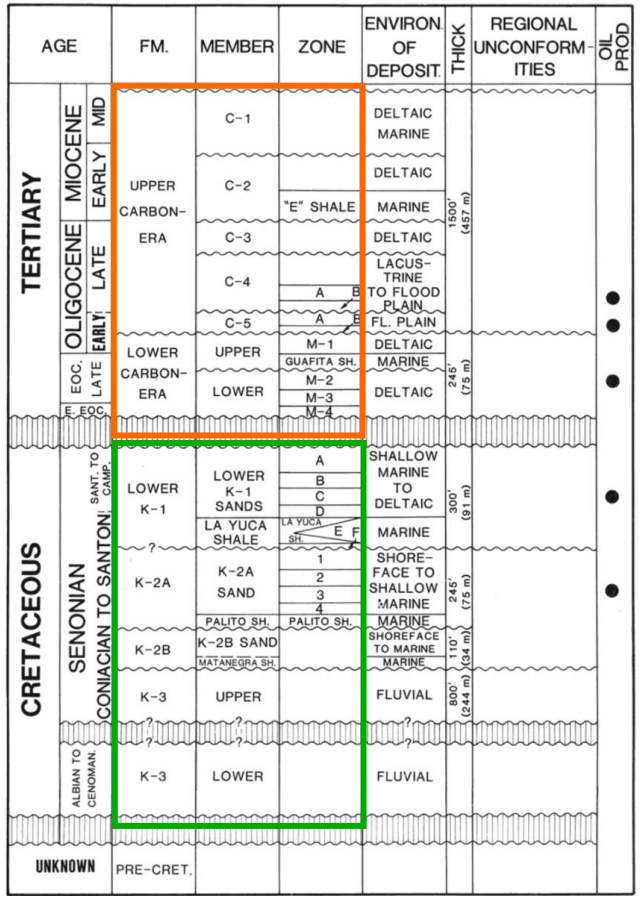
Evolution of Stratigraphic Definition

1985 OXY



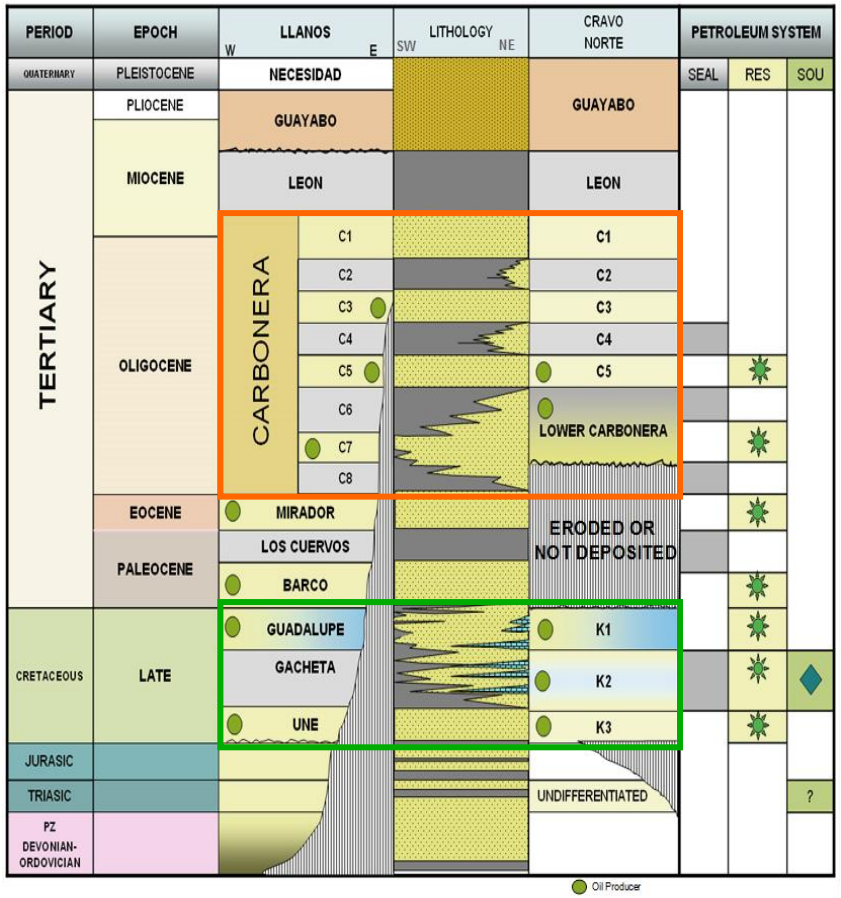
- Mirador Fm – Upper Eocene
- C7 to C1 – Oligocene/Miocene
- Une Fm (K3) – Albian/Cenomanian

1990 Cleveland & Molina



- Lower Carbonera Fm – Late Eocene
- C5 to C1 – Oligocene/Miocene
- K3 – Albian/Cenomanian/Coniacian

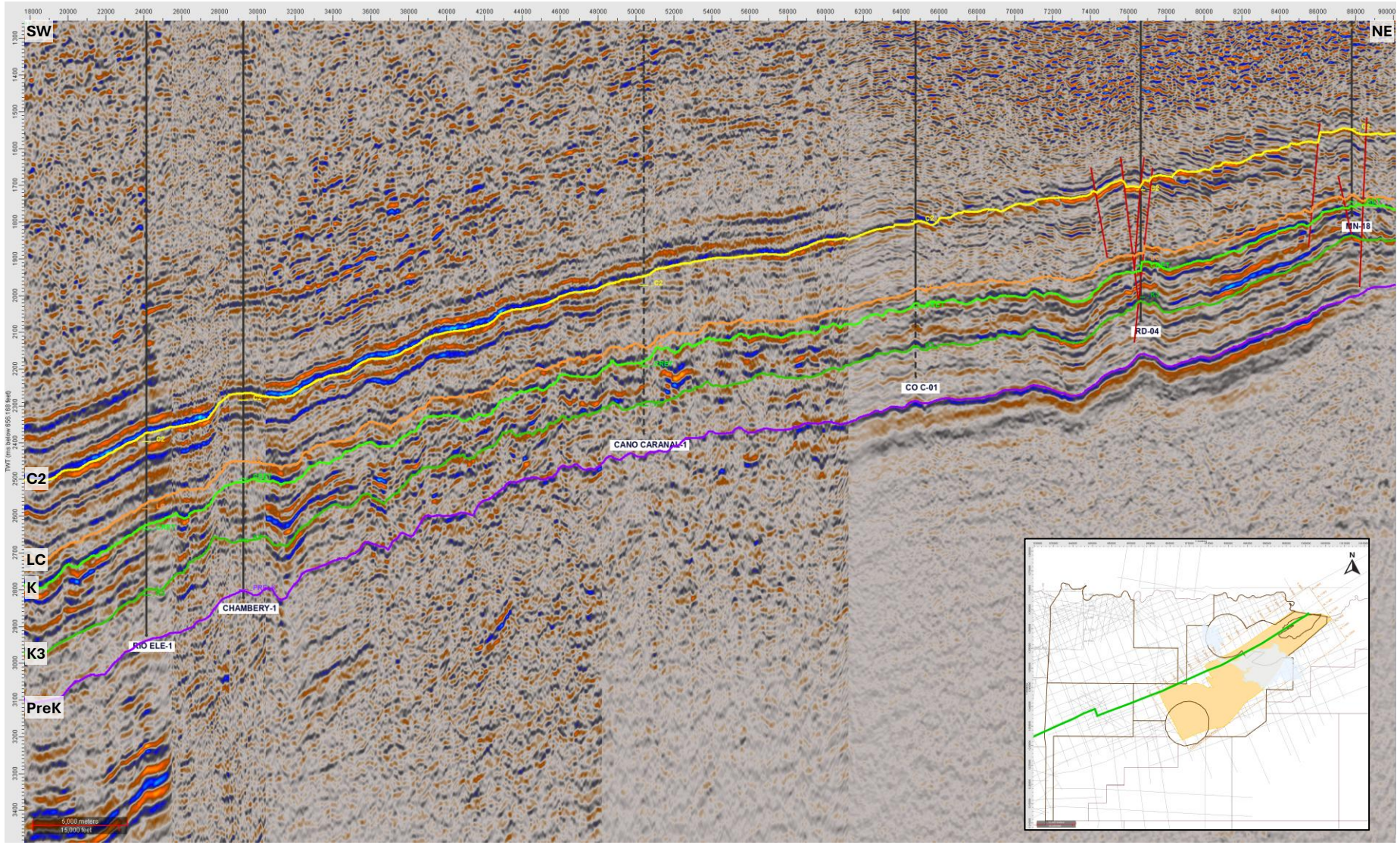
2006 OXY



- Lower Carbonera Fm – Oligocene
- C5 to C1 – Oligocene
- K3 – Une Fm from the Late Cretaceous

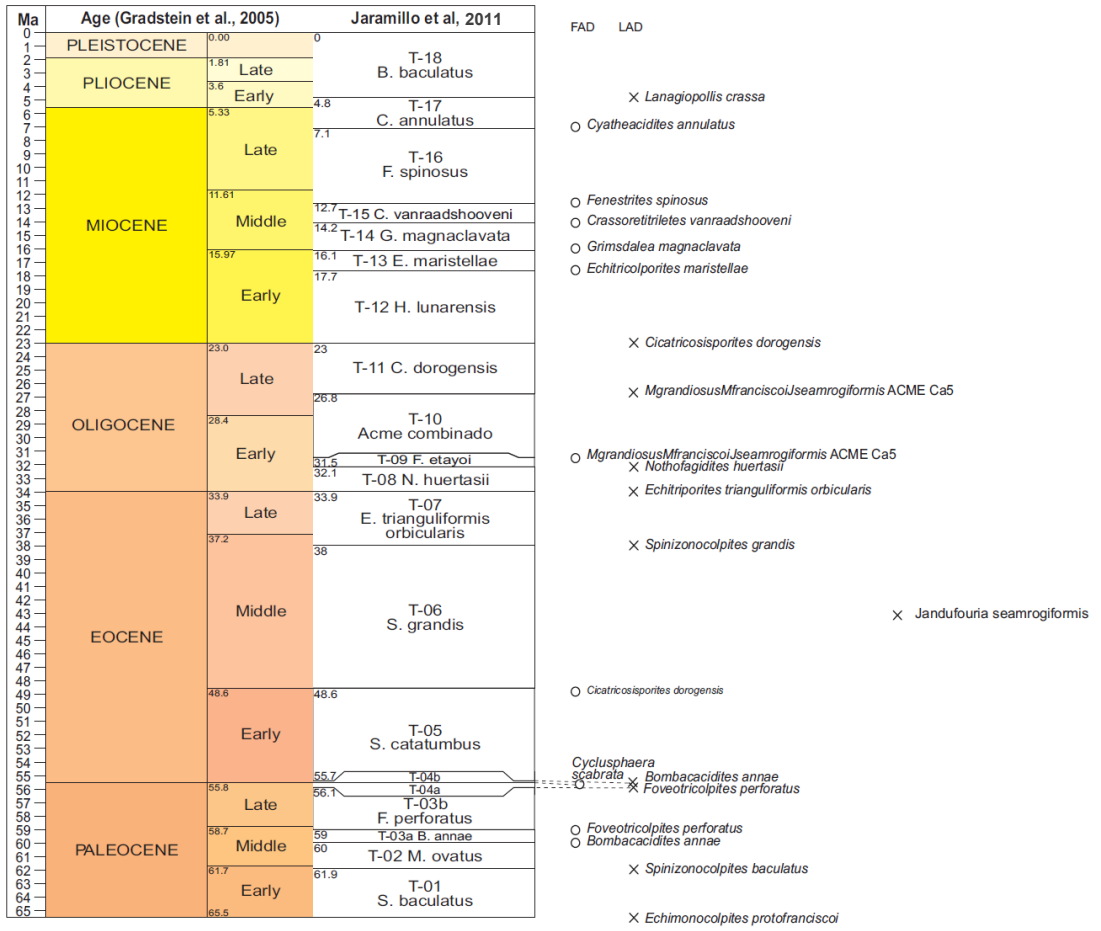
Regional Seismic Section

- Sediments thinning eastwards
- Main markers are well defined
- Second-order markers are challenging to interpret using seismic alone



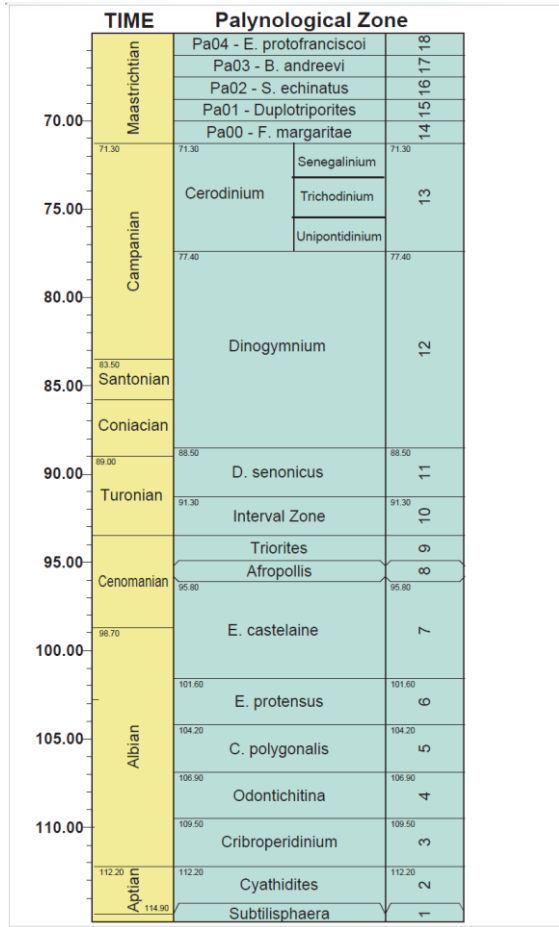
Palynological Zonation

Cenozoic zonation



Modified From Jaramillo et al, 2011

Cretaceous zonation



From Jaramillo & Rueda, 2004

This zonation proposed for Cenozoic and Cretaceous is currently applied to the Llanos basin

Bio zones in Northern Llanos

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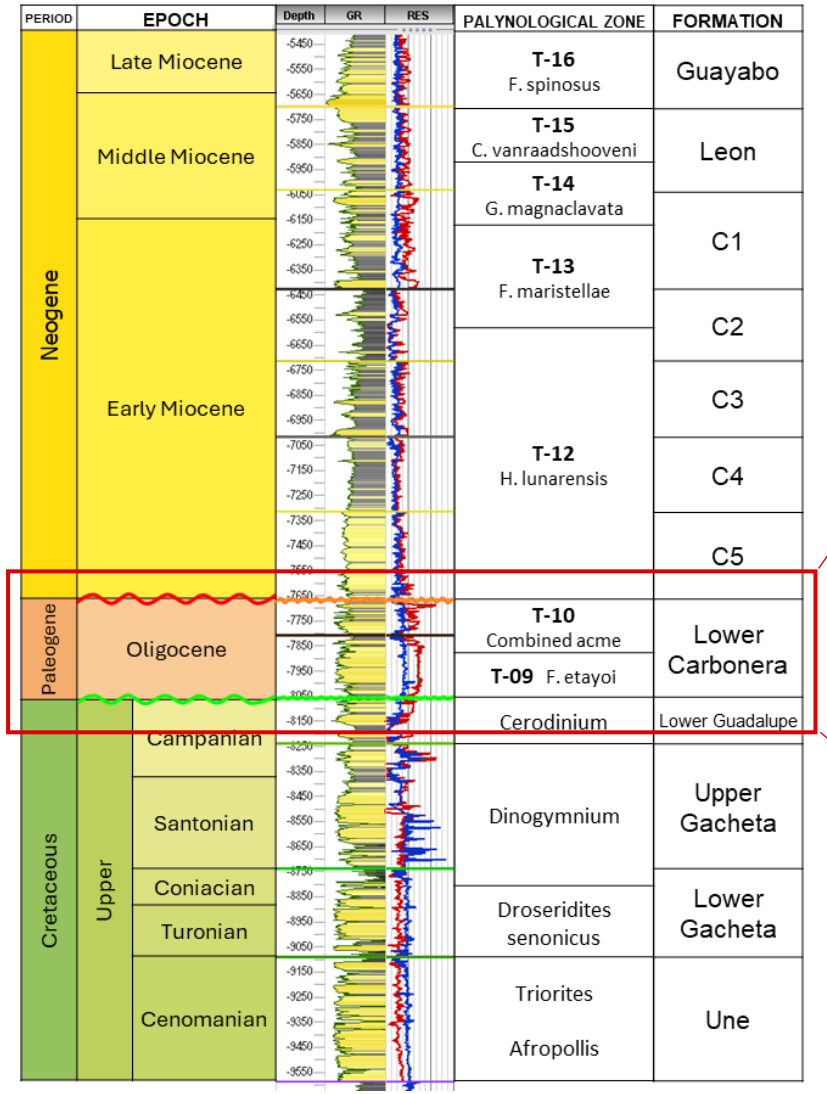
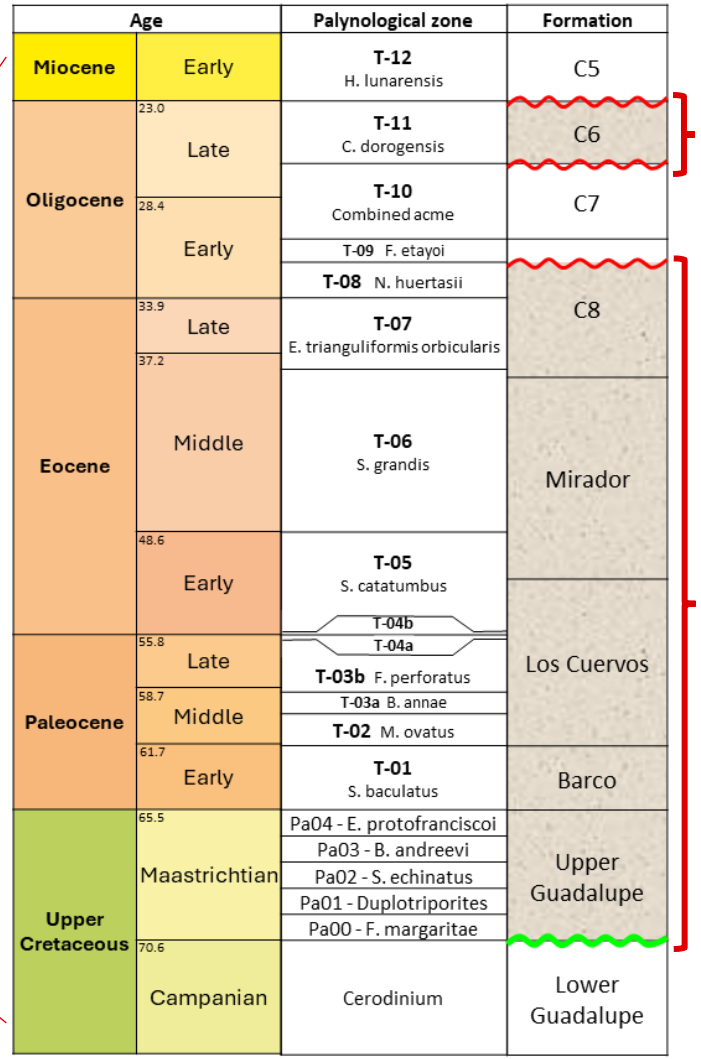
Type well



Missing zones in LLN



Additional hiatus identified in the late Oligocene ~ 3.8 ma

Main hiatus Maastrichtian to early Oligocene ~ 39.1 ma

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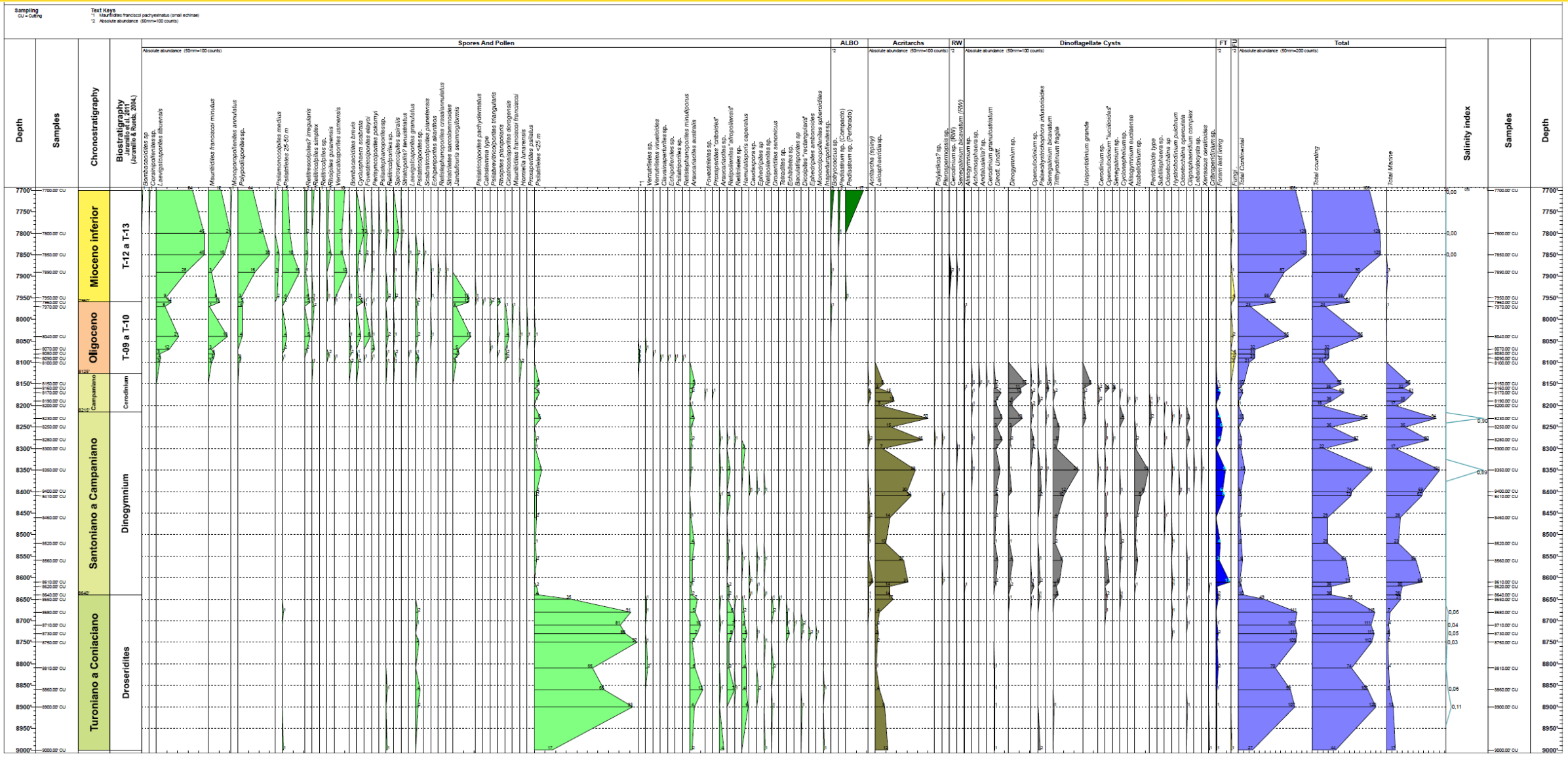
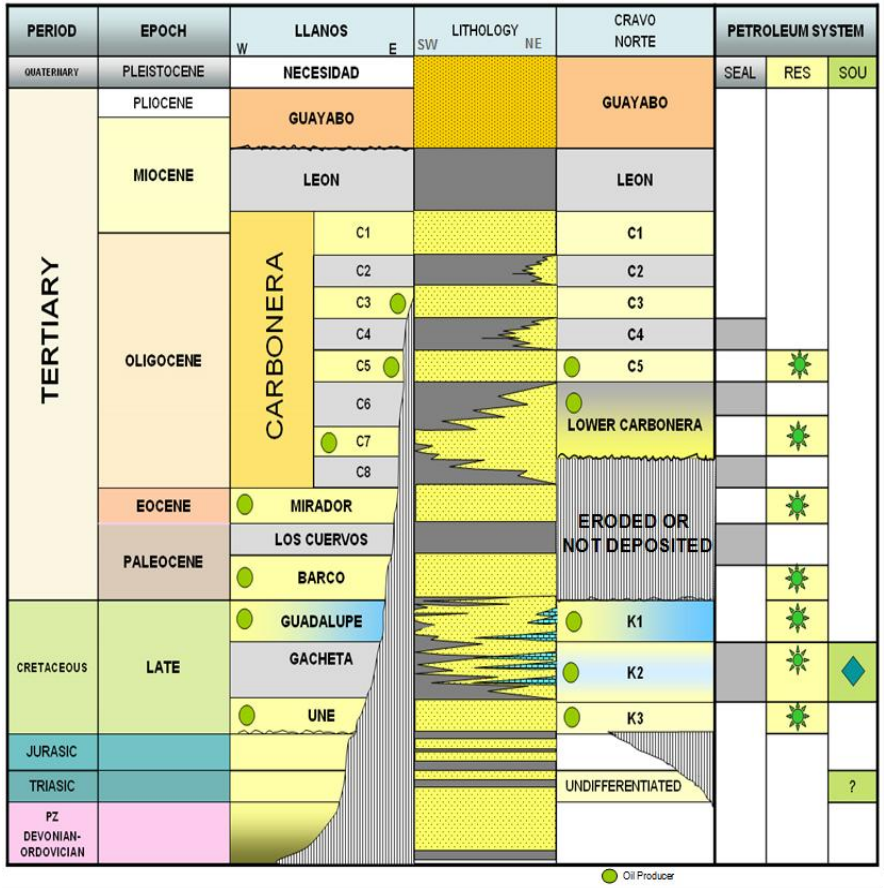
Palynological Distribution



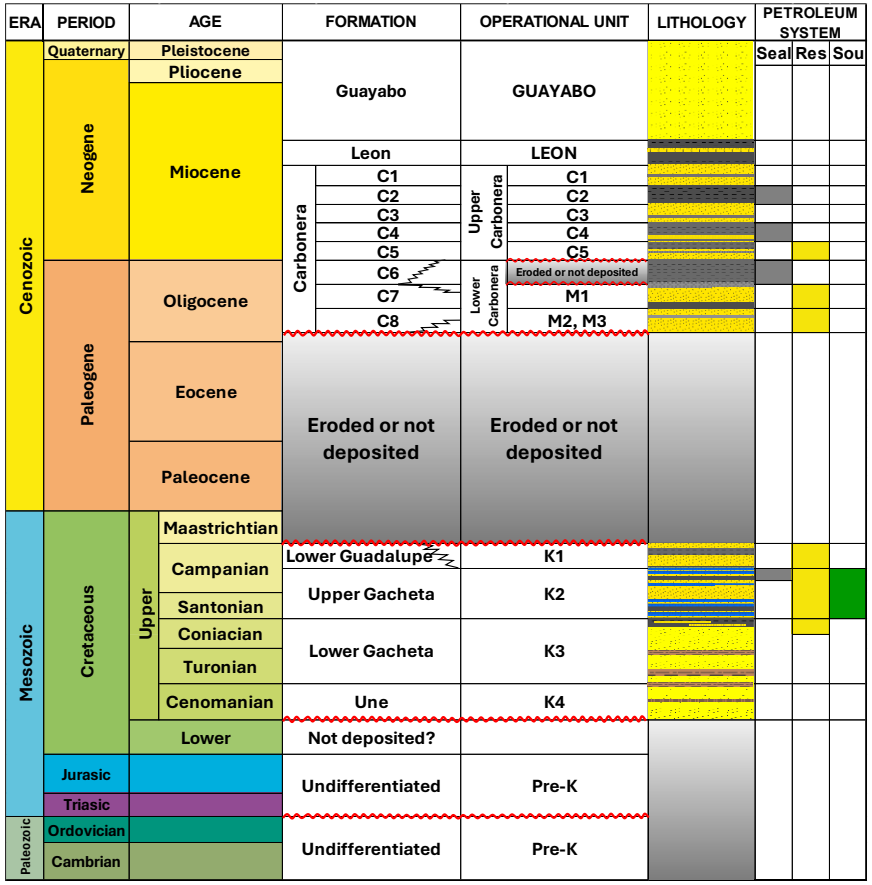
Stratigraphic Column

Previous Stratigraphic Column



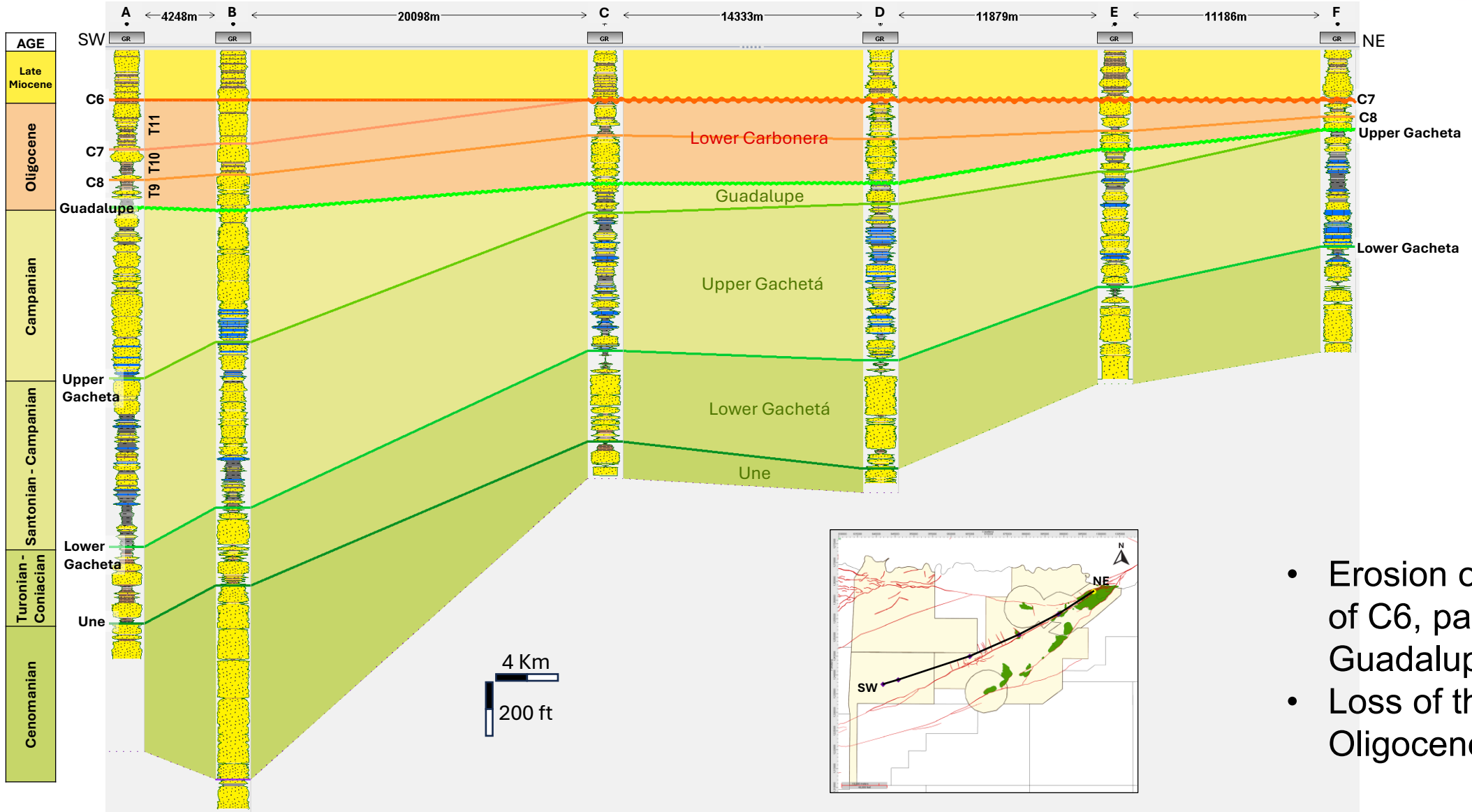
- Carbonera Fm – Oligocene
- K3 – Une Fm from the late Cretaceous
- Main hiatus – absence of Barco, Cuervos, Mirador and C8 units

Stratigraphic Column of this work



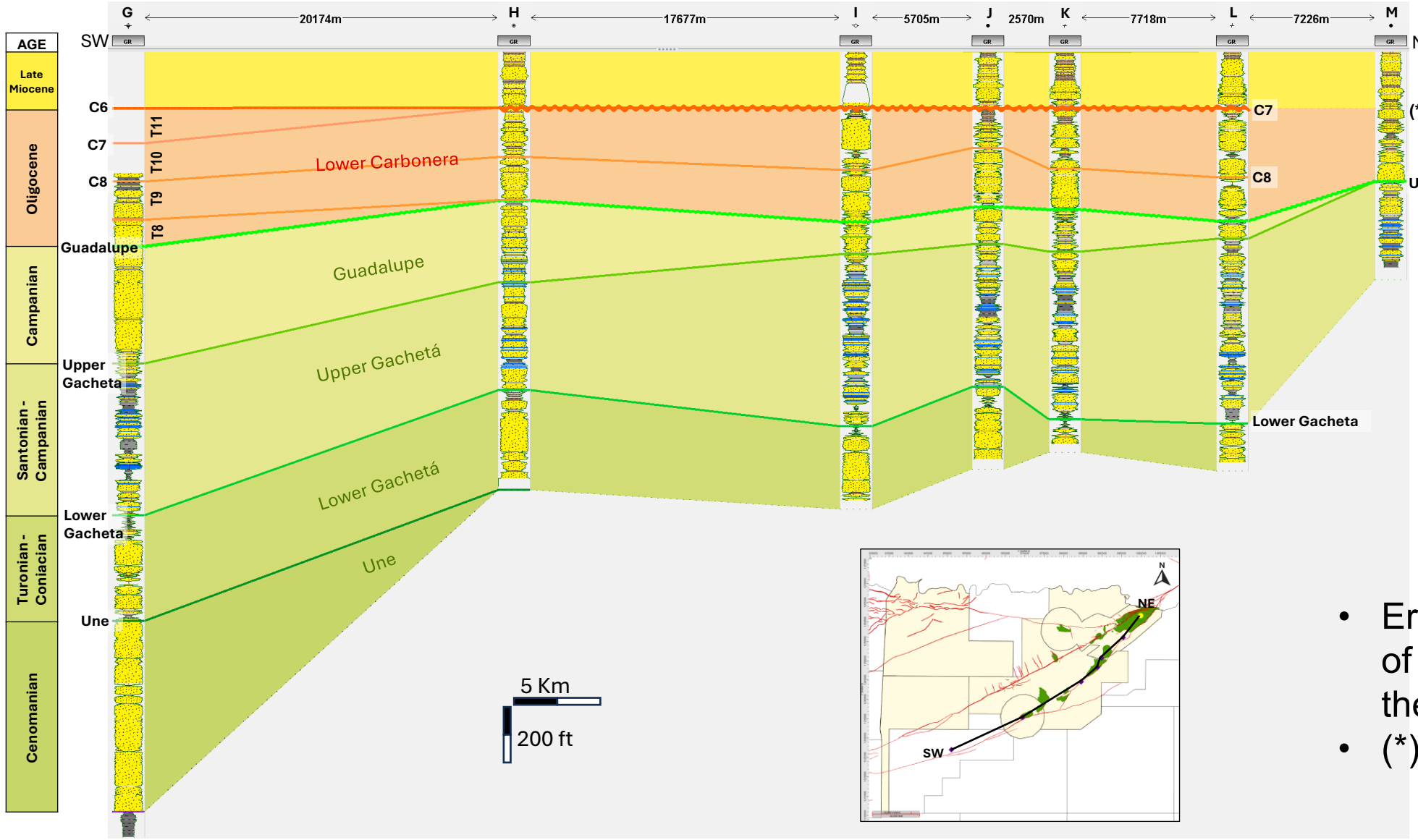
- Lower Carbonera – Oligocene & C5 to C1 – Miocene
- K3 – Gacheta Fm of the Turonian-Coniacian
- Main hiatus – absence of U. Guadalupe, Barco, Cuervos & Mirador
- Additional hiatus – absence of C6

Correlation 1



- Erosion or non-deposition of C6, part of C7 and Guadalupe to the East
- Loss of the late Oligocene towards the E

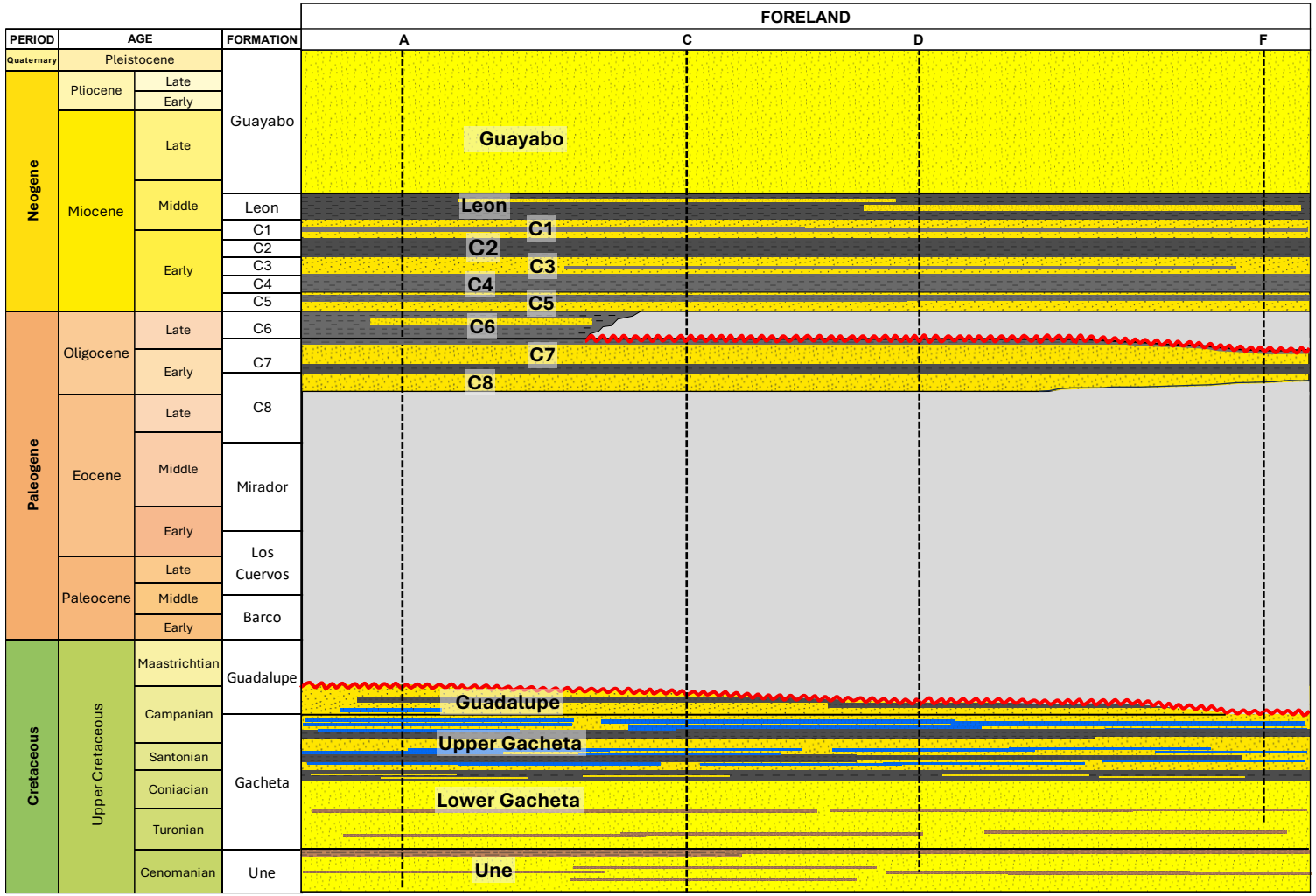
Correlation 2



- Erosion or non-deposition of C6 and Guadalupe to the East
- (*) ongoing palynology

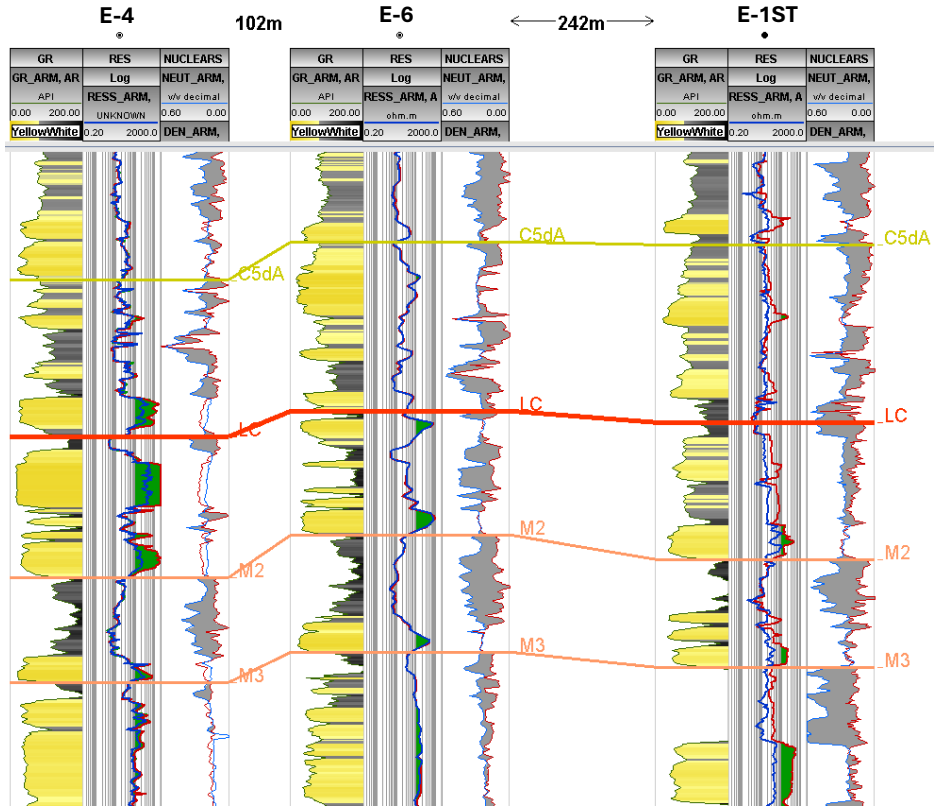
Chronostratigraphic Chart

- The facies distribution in Northern Llanos is slightly different from the foothills
- C8: Fluvial-deltaic
- Gacheta has two members:
  - Lower: fluvial-transitional
  - Upper: shallow marine

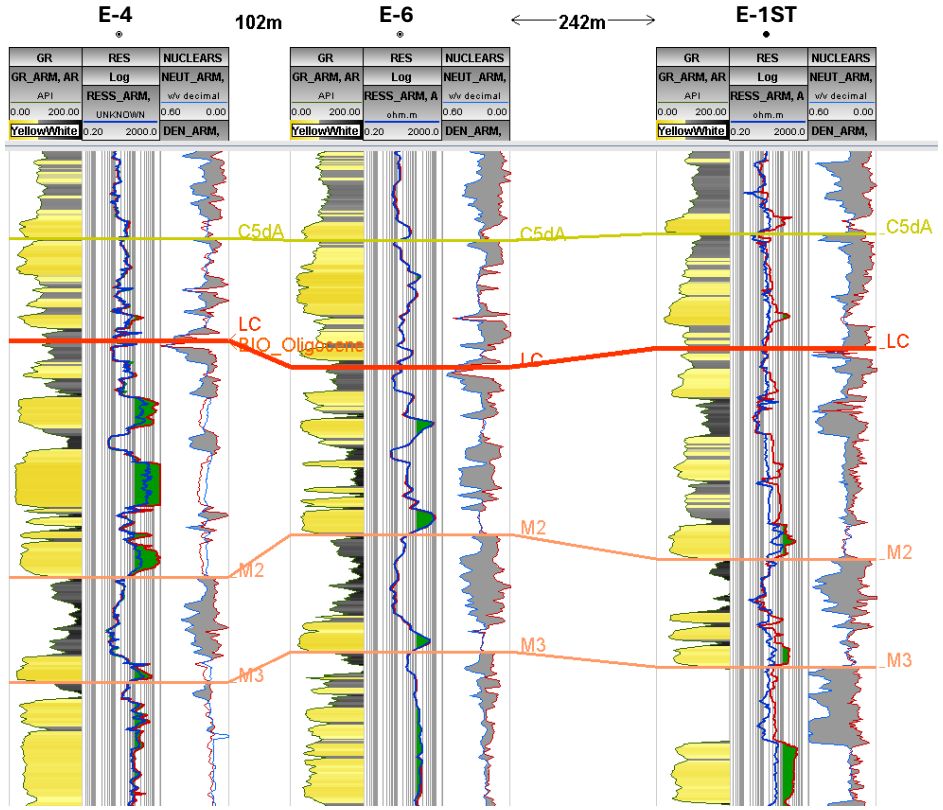


Applications of Palynology: Redefine Stratigraphic Boundaries

Before palynology



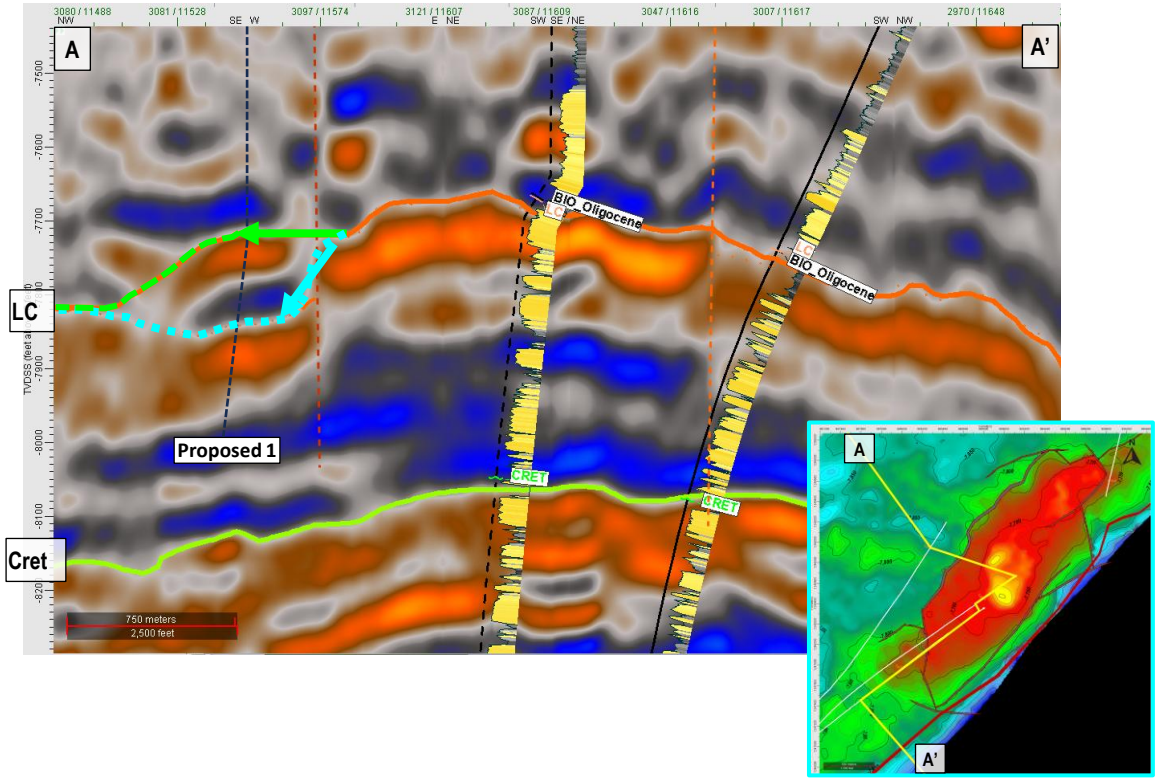
After palynology



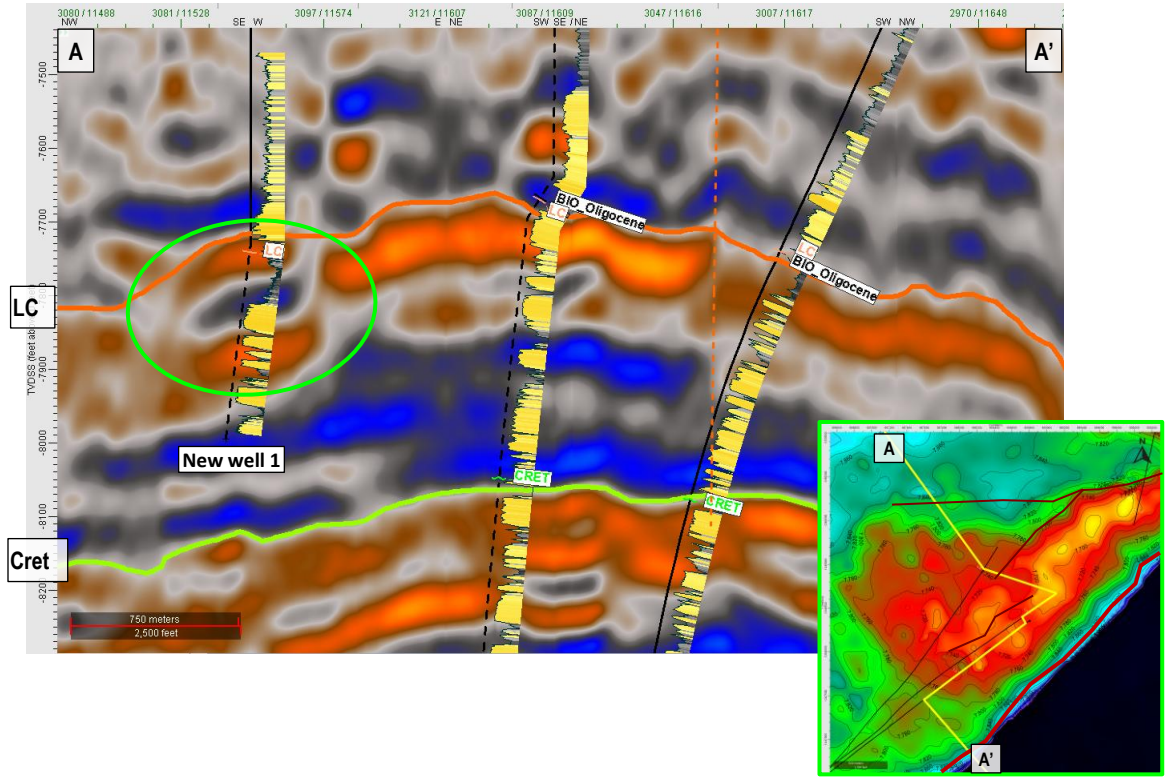
- The LC top is redefined according to the palynology results of E-4
- Understanding the production behavior of some reservoirs
- Production must be re-allocated

Applications of Palynology: Improve Mapping

Without using palynology



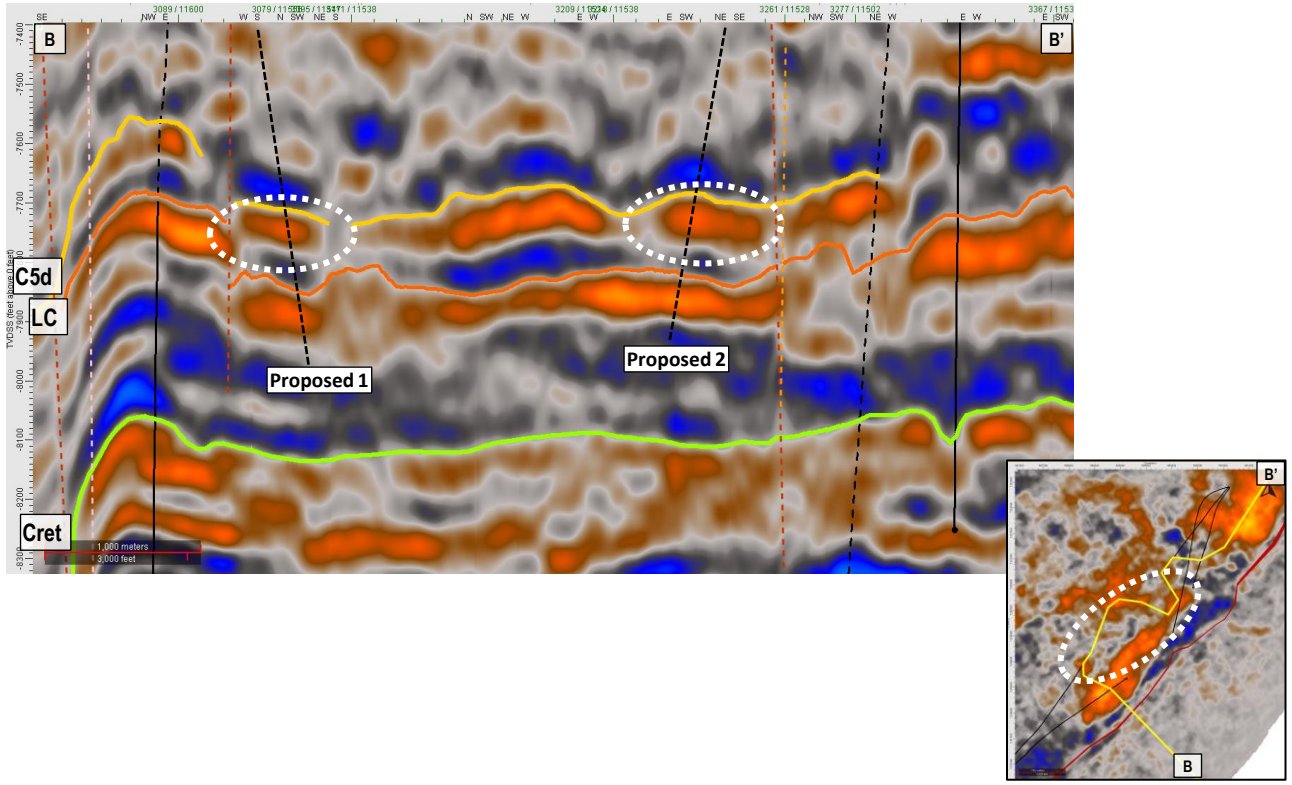
Using palynology



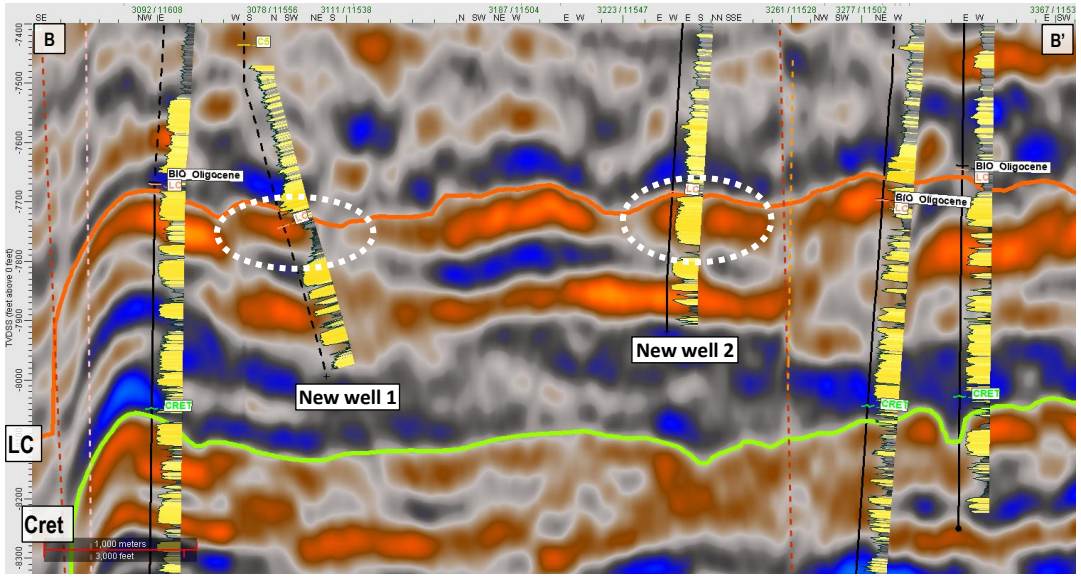
- Without using palynology, the interpretation could be either upwards or downwards
- Downwards, the map is the one on the left, but upwards, the map is the one on the right
- Using palynology, the interpretation is upwards, as corroborated by the new well

Applications of Palynology: Identify the Target

Without palynology

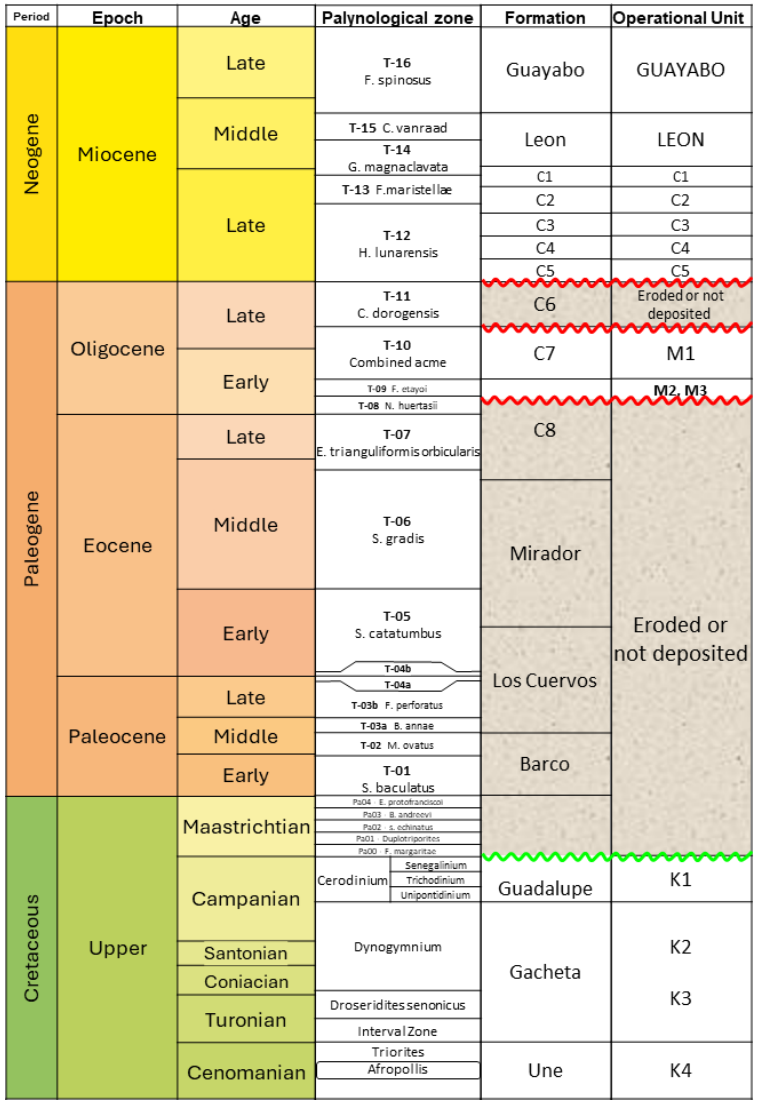


Using palynology



- The LC top could be interpreted following the most continuous reflector
- Using all palynology data, the LC top corresponds to the upper reflector
- The new wells, like the previous ones, confirm that the LC top is up

Conclusions



- Besides the main hiatus (Maastrichtian to early Oligocene); an additional hiatus was identified in the late Oligocene due to the absence of C6 (T11 biozone)
- On the easternmost side of Northern Llanos, the late Oligocene may have been completely lost by erosion or non-deposition
- Paleo-topography affected the deposition of Guadalupe Fm and/or this Unit was eroded on the easternmost side of the basin
- Gacheta Fm is thicker than the initial definition with two members; Lower Gacheta (Continental) and Upper Gacheta (shallow marine)
- Palynology is a powerful tool that allow us, among other things, to redefine the main geological units, understand the regional facies distribution, improve mapping, identify and/or predict reservoirs and indirectly estimate production

References

Cleveland, M.N. and Molina, J. 1990. Deltaic reservoir of the Caño Limón field, Colombia, South America. 12, p. 281 - 315.

Gabela, V. 1985. Campo Caño Limón, Llanos Orientales de Colombia. II Simposio Bolivariano, Bogotá, Colombia, Tomo I, p. 51 - 94.

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Servicio Geológico Colombiano. Banco de Información Petrolera. Recovered from https://srvags.sgc.gov.co/JSViewer/GEOVISOR_BIP/

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