[PS]How Palynology Contributes on Hydrocarbon Exploration: A Case Study from Colombia, South America*

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Abstract

Oil exploration in Colombia is now focused on transitional to shallow marine Cretaceous sequences from the Upper Magdalena Valley Basin (UMVB). Regionally, the complex architecture of these strata, usually due to structural and sedimentological constraints, hinders seismic modeling, and is the cause of the high exploratory risk in the basin. A type-example of such complexity is Guando field, where reservoir correlation has been a challenging task. In order to solve this problem, it is necessary to have a thorough characterization of the different rock units in the area for correlation purposes. Consequently, a detailed palynostratigraphic and palynofacial analysis has been conducted. In preliminary results, 28 core samples from the sequence traversed by the Guando 73 well (UMVB) have been analyzed. Four biozones were recognized and a late Campanian - Maastrichtian age was assigned to the studied interval, based on the palynological zonation for the basin. In addition, four palynofacies zones were identified revealing an overall shallowing trend (from base to top): Palynofacies D (dominated by amorphous organic matter and dinoflagellate cysts), Palynofacies C (dominated by fitoclasts and a mixture of continental and marine palynomorphs), Palynofacies B (dominated by amorphous organic matter, black debris and continental palynomorphs) and Palynofacies A (dominated by black debris). Interestingly, the zonal boundaries between both biozones and palynofacies zones do not overlap; generating a higher stratigraphic resolution than the traditionally palynological zonation utilized for the area, which is based merely on palynomorphs. The results of this study will constitute an additional correlation tool for Guando field as well as a useful paleoenvironmental and age-constraning proxy for the sequences within the basin.

References

Haq, B., J. Hardenbol, and P. Vail, 1987. Sea level changes: An integrated approach, Mesozoic and Cenozoic chronostratigraphy and eustatic cycles: Science, v. 235, p. 1156-1167.

Jaramillo, C.A. and M. Rueda, 2004, Impact of biostratigraphy on oil exploration: Memorias III Convencion Tecnica de la ACGGP.

Oboh-Ikuenobe, F.E., C.G. Obi, and C.A. Jaramillo, 2005, Lithofacies, palynofacies, and sequence stratigraphy of Palaeogene strata, in Southeastern Nigeria: Journal of African Earth Sciences, v. 41, p. 79–101.

Rovira, D., 2006, Arquitectura estratigráfica de la Formación Areniscas Superiores del Grupo Guadalupe en el Campo Guando – Valle Superior del Magdalena: Memorias IX simposio Bolivariano Exploración Petrolera en Cuencas Subandinas, 7 p.

HOW PALYNOLOGY CONTRIBUTES ON HYDROCARBON EXPLORATION: A CASE STUDY FROM COLOMBIA, SOUTH AMERICA

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Abstract

Oil exploration in Colombia is now focused on transitional to shallow marine Cretaceous sequences from the Upper Magdalena Valley Basin (UMVB), Colombia. Regionally, the complex architecture of these strata, usually due to structural and sedimentological constraints, hinders seismic modeling, and is the cause of the high exploratory risk in the basin. A type-example of such complexity is Guando field, where reservoirs correlation has been a challenging task. In order to solve this problem, it is necessary to have a thorough characterization of the different rock units in the area for correlation purposes. Consequently, a detailed palynostratigraphic and palynofacial analysis has been conducted. In preliminary results, 28 core samples from the sequence traversed by the Guando 73 well (UMVB) have been analyzed. Four biozones were recognized and a late Campanian - Maastrichtian age was assigned to the studied interval, based on the palynological zonation for the basin. In addition, four palynofacies zones were identified revealing an overall shallowing trend (from base to top): Palynofacies D (dominated by amorphous organic matter and dinoflagellate cysts), Palynofacies C (dominated by fitoclasts and a mixture of continental and marine palynomorphs), Palynofacies B (dominated by amorphous organic matter, black debris and continental palynomorphs) and Palynofacies A (dominated by black debris). Interestingly, the zonal boundaries between both biozones and palynofacial zones do not overlap: generating a higher stratigraphic resolution than the traditionally palynological zonation utilized for the area, which is based merely on palynomorphs. The results of this study will constitute an additional correlation tool for Guando field as well as a useful

Location

Well Guando 73 is located on the Norhteastern side of the Upper Magdalena Basin, sub-basin of Girardot.

1. Palynomorphs.

A total of 872 palynomorphs were counted: identifying 79 species of pollen and spores and 22 species of dinoflagellate cysts. Following the palynological zonation proposed by Jaramillo & Rueda (2004), four biozones were identified *(Cerodinium, Buttinia andreevi and Proteacidites dehaani/Echimonocolpites protofranciscoi)* and a late Campanian - Maastrichtian age was assigned.
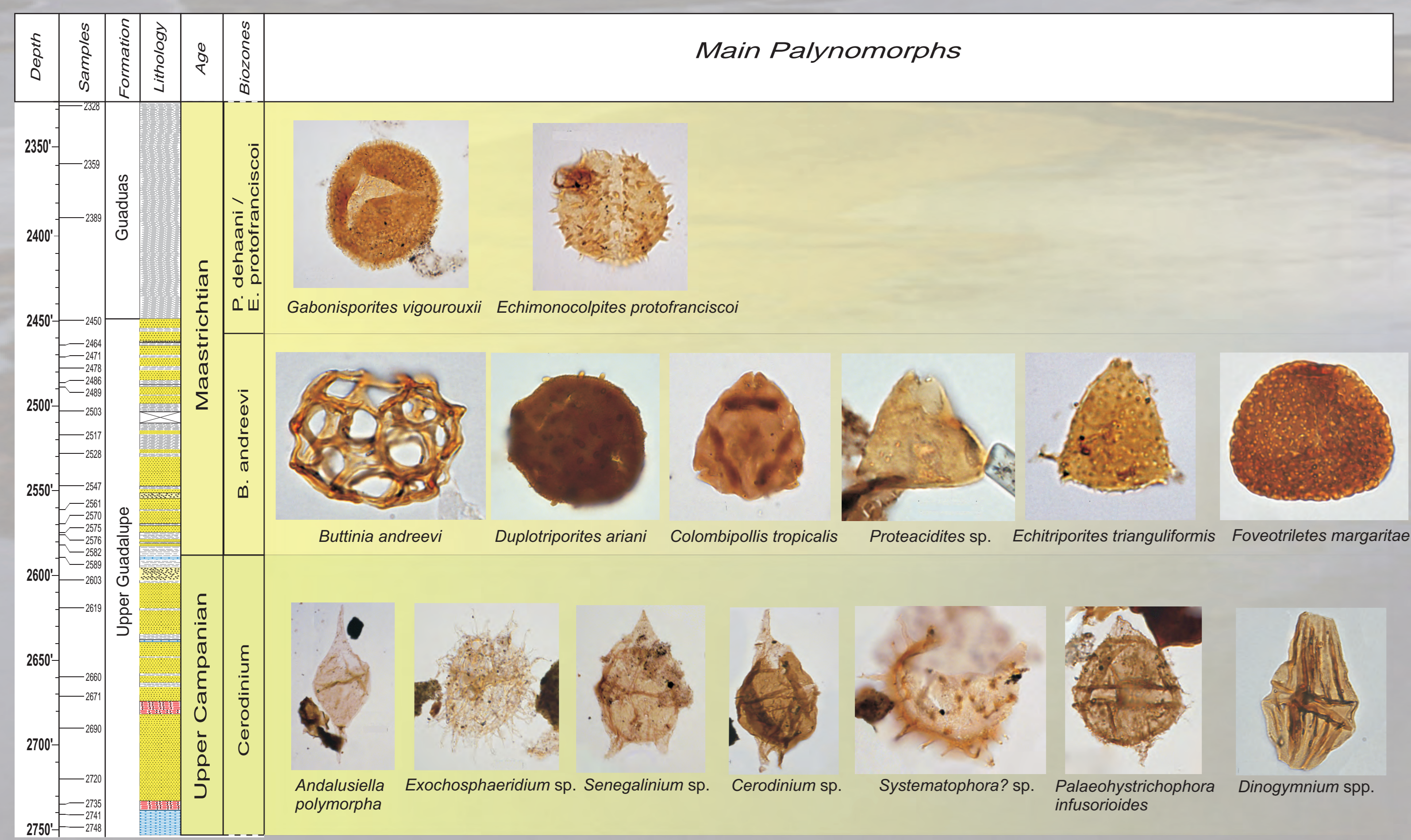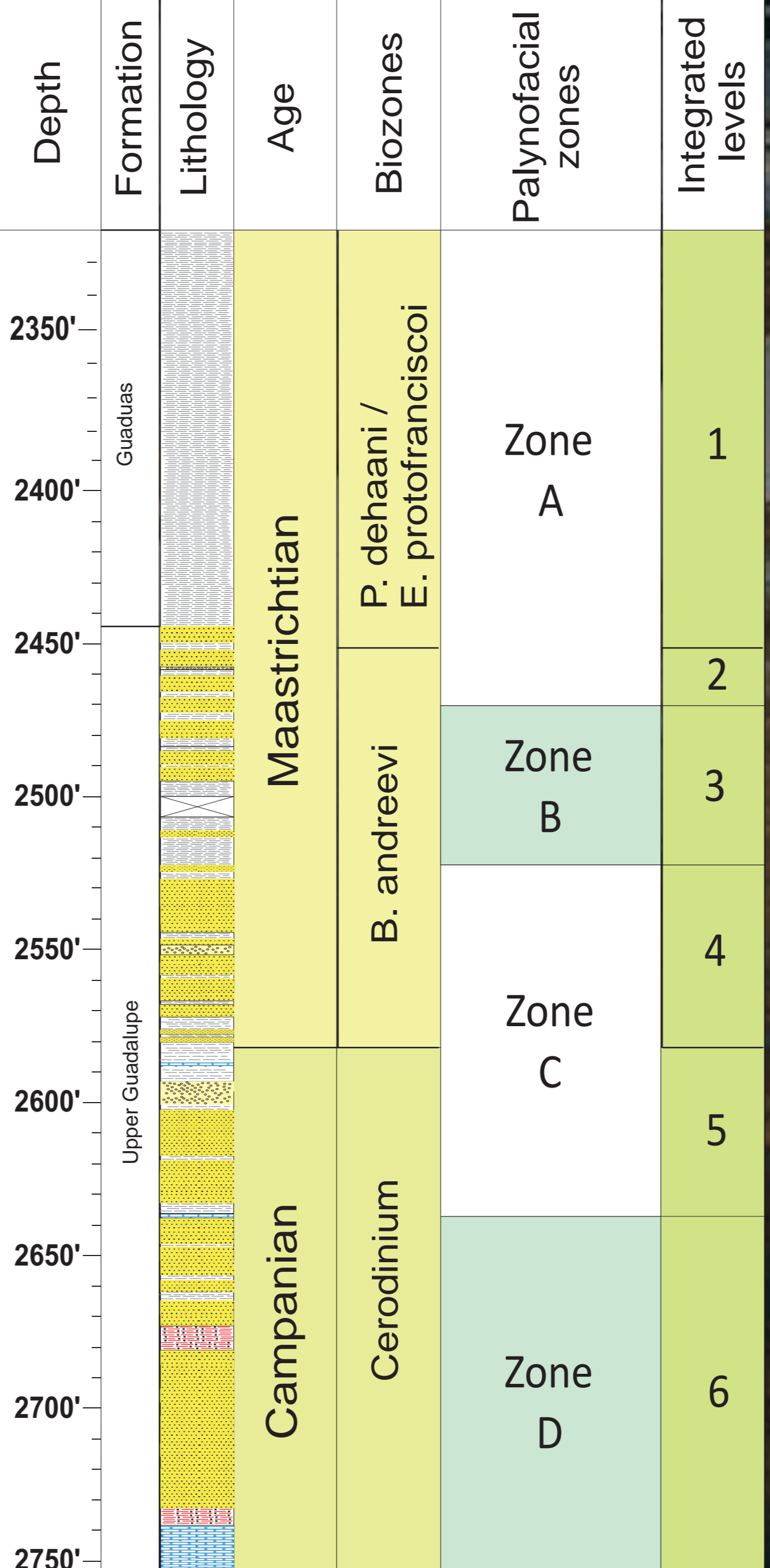

2. Palynofacies

A systematic counting of the organic particles was carried out in order to determine compositional variations of the organic particles in the studied interval. The classification was made after Oboh-Ikuenobe et al. (2005). Four palynofacial zones were identified (from base to top): Palynofacies D, dominated by amorphous organic matter and dinoflagellate cysts; Palynofacies C, dominated by phytoclasts and a mixture of continental and marine palynomorphs; Palynofacies B, dominated by amorphous organic matter, black debris, continental palynomorphs and presence of *Pediastrum* sp. and Palynofacies A, dominated by black debris.
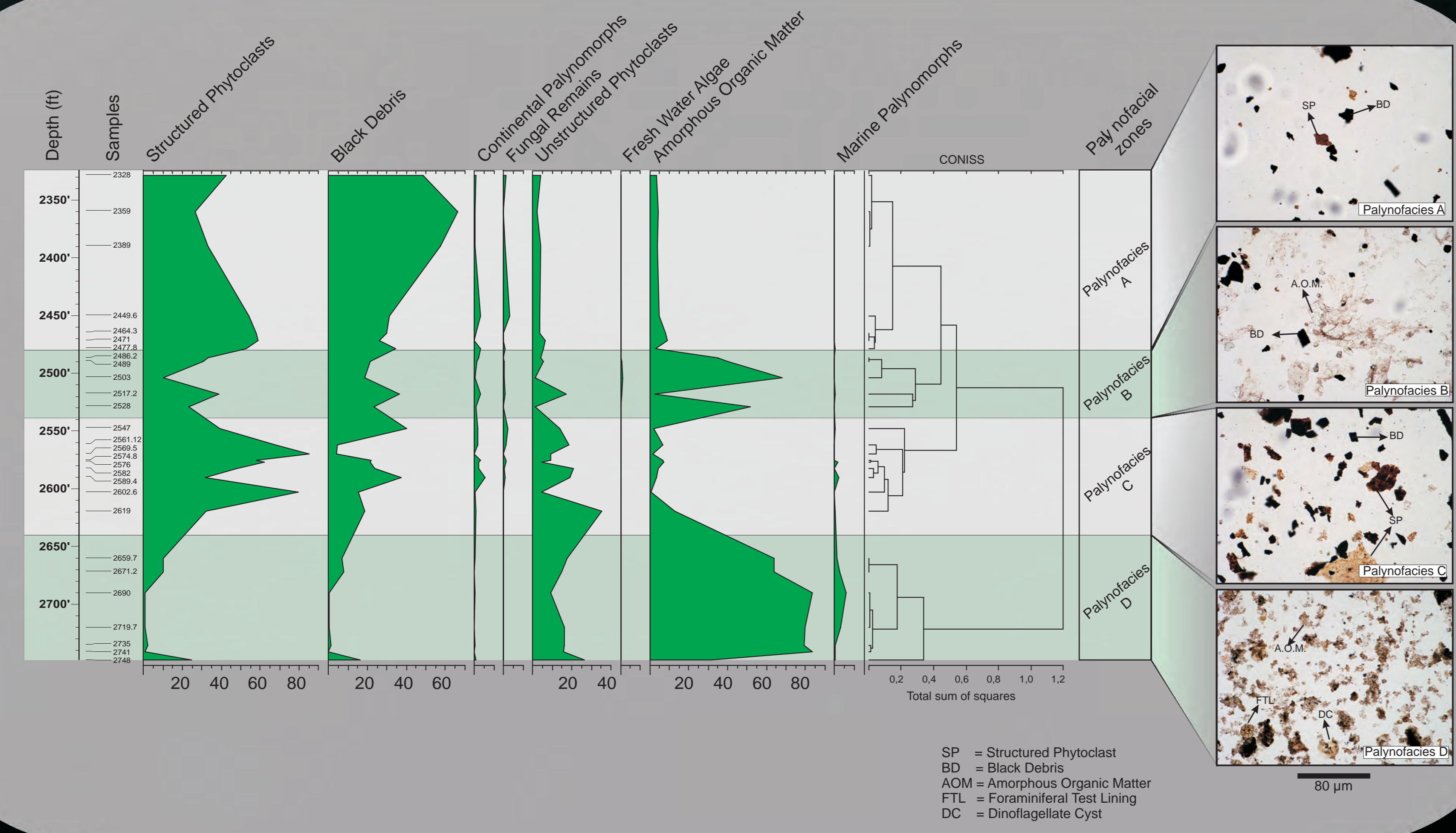
3. Integrating Palynomorphs and Palynofacies

The integration of the results obtained after palynological and palynofacial analyses shows that the zonal boundaries between both zones, biozones and palynofacial zones do not overlap, giving in this way a higher stratigraphic resolution. After combining data, six "integrated levels" are proposed.

"Integrate levels" (From base to top):

• **Level 6:** Constituted by dinoflagellate cysts that characterize the *Cerodinium* biozone (Jaramillo & Rueda, 2004), associated with amorphous organic matter (AOM)

• **Level 5:** Dominated by the association of the *Cerodinium* biozone (Jaramillo & Rueda, 2004) along with palynofacies dominated by structured and unstructured phytoclasts and black debris.

• **Level 4:** Constituted by the palynomorphs assemblage that characterizes the *Buttinia andreevii* biozone (Jaramillo & Rueda, 2004) along with palynofacies dominated by structured and unstructured phytoclasts and black debris.

• **Level 3:** Constituted by the palynomorphs that characterize the *Buttinia andreevii* biozone (Jaramillo & Rueda, 2004) and accompanied with AOM, black debris and fresh water algae (*Pediastrum* sp.)

• **Level 2:** Presence of palynomorphs that constitute the *Buttinia andreevii* biozone (Jaramillo & Rueda, 2004) associated with black debris.

• **Level 1:** Constituted by the palynomorphs that characterize the biozones *Proteacidites dehaani* and *Echimonocolpites protofranciscoi* (Jaramillo & Rueda, 2004) associated with palynofacies dominated by black debris.

4. Depositional Conditions.

According to the chronological frame and the palynofacies data, marine conditions prevailed during the Campanian, followed by a regression evidenced by the increment of continental organic matter and the decline of marine material.

Part of the *Buttinia andreevi* biozone (Maastrichtian) was influenced by lacustrine environments, evidenced by the presence of *Pediastrum* sp. (zone B). In addition, specimens of *Azolla* sp. were recovered in some samples of the palynofacial zones B and A, indicating influence of fresh water.

This information supports the stratigraphical model proposed by Rovira (2006) for the field after electric logs, and also reflects the global regression for the late Campanian - Maastrichtian proposed by Haq et al. (1987).

Conclusions.

A detailed palynological and palynofacial characterization was developed for the analysed interval and a late Campanian - Maastrichtian age was assigned.

After integrating palynological and palynofacies data, six "integrated zones" were proposed. These zones provide a higher resolution and constitute additional criteria that could be implemented as a correlation parameter for the field.

The data obtained in this study contributes to the better understanding of the paleoenvironmental conditions that prevailed during the deposition of the rocks and also provides information that help the enhancement of the stratigraphic model proposed for the field.
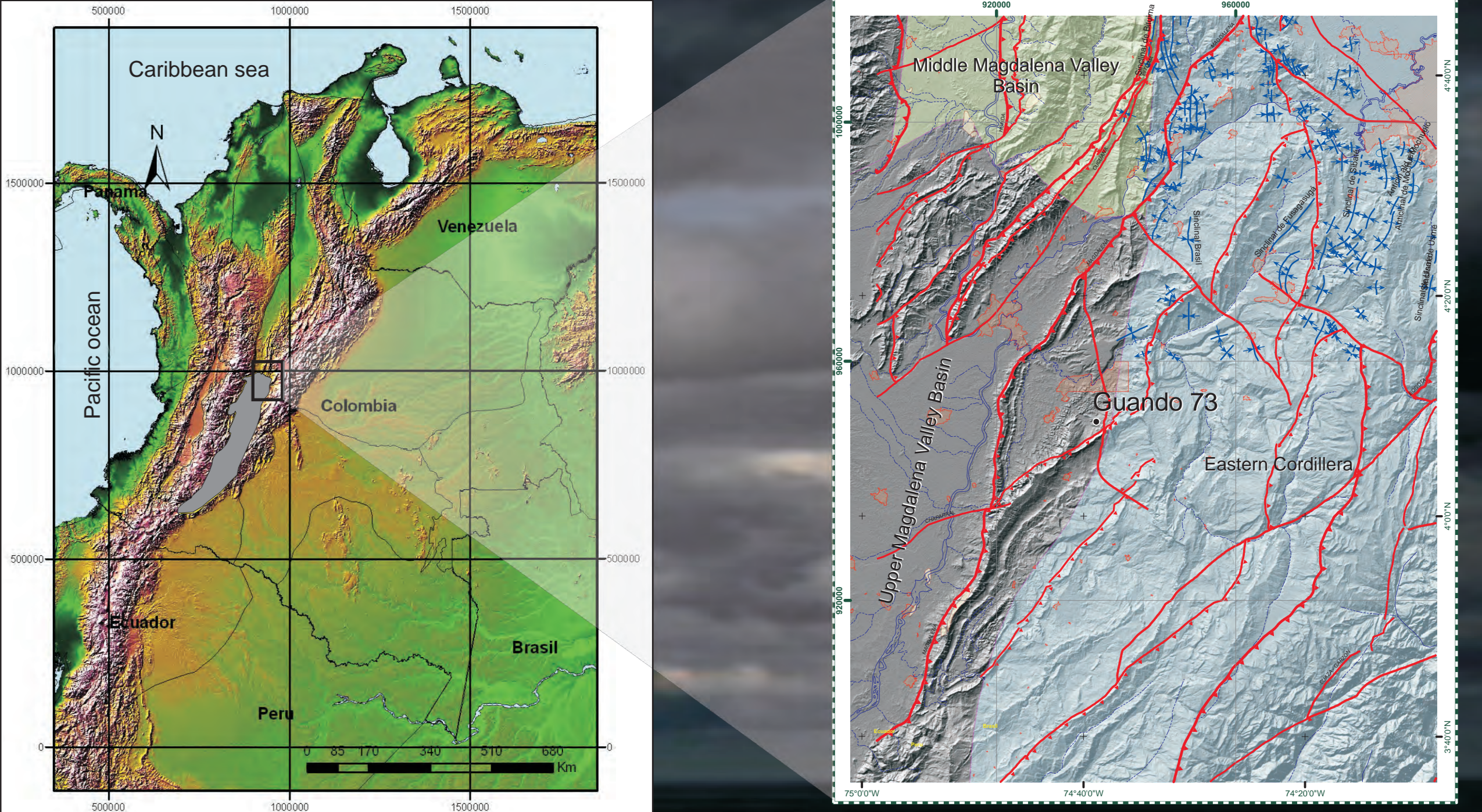
References:

Haq B., Hardenbol, J. & Vail, P., 1987. Sea level Changes: An Integrated Approach Mesozoic and Cenozoic Chronostratigraphy and Eustatic Cycles. Science, Vol.235, pp. 1156 – 1167.

Jaramillo, C. A. & Rueda, M., 2004. Impact of Biostratigraphy on Oil Exploration. Memorias III Convencion Tecnica de la ACGGP.

Oboh-Ikuenobe, F.E., Obi, C.G. & Jaramillo, C.A., 2005. Lithofacies, Palynofacies, and Sequence Stratigraphy of Palaeogene Strata in Southeastern Nigeria. Journal of African Earth Sciences, Vol. 41, pp. 79–101.

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