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Preface: La Guajira, Colombia: a new window into the Cenozoic neotropical biodiversity and the Great American Biotic Interchange

C. Jaramillo[1] · F. Moreno[1,2,3] · A. J. W. Hendy[4,5] · Marcelo R. Sánchez-Villagra[6] · Daniel Marty[7]

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Abstract Over the past four years, we have conducted extensive fieldwork in the Cocinetas Basin of La Guajira Peninsula, including geological mapping, stratigraphic descriptions, and exhaustive paleontological collection of plants, microfossils, and marine and terrestrial invertebrates and vertebrates. Moreno et al. (Swiss J Paleontol 134: 1–39, 2015) provide an overview of these efforts, including a revised Neogene stratigraphy for Cocinetas Basin and redefined (Jimol and Castilletes formations) and newly named (Ware Formation) lithostratigraphic units. Hendy et al. (Swiss J Paleontol 134, 2015) utilize the extensive invertebrate fossil record of the basin to develop paleoenvironmental interpretations and a chronostratigraphic framework buttressed by 87Sr/86Sr isotopic analyses and biostratigraphy. This geological exploration highlights the tremendously diverse and important fossil assemblages throughout the Jimol, Castilletes and Ware formations. These new fossil data will be of great value for future paleobiogeographic, paleogeographic, paleooceanographic and paleoenvironmental interpretations. Already, the faunal and floral fossil record of Cocinetas Basin indicates that once the humid ecosystem of the Neogene underwent drastic climatic changes over the last two million years.

Keywords La Guajira · Neogene · Neotropics · Paleontology · Great American Biotic Interchange (GABI)

The verdant tropical belt that enfolds the Earth through equatorial lands is by far the most biodiverse terrestrial region in the planet. Thousands of species of animals and plants constitute this absorbing and intriguing web of ecosystems. The clues to understand its evolutionary history and forecasting its biological response to the current anthropogenic global warming are enclosed in the geological and paleontological record. In the Americas, the history of that biome is particularly interesting, as during Late Cenozoic times the clash of two gigantic landmasses took place. North- and South America joined together by the uplift of the Panamanian Isthmus allowing one of the most important ecological events in the recent history of the earth, the Great American Biotic Interchange (GABI) (Wallace 1876; Webb 1976, 1991, 2006; Marshall et al. 1982; Stehli and Webb 1985; Woodburne 2010). The geological drivers and timing of this event are still the subject of contentious debate. Traditional thinking (e.g., Coates et al. 2004) suggests that the final uplift of the Isthmus, ~3.5 million years ago, determined the onset of GABI. However, recent geological studies suggest that the timing of the uplift of the land bridge connecting both continents is older, and, may not be coincident with the mammal biotic interchange [Jaramillo et al. 2013; Montes et al. 2012a, b; Sepulchre et al. 2014; Montes et al. (2015) (in press); Bacon et al. (2015) (in press)]. Therefore, re-assessment of several hypotheses about the timing and

✉ F. Moreno
federicomrn@gmail.com

1 Smithsonian Tropical Research Institute, Panama, Panama

2 Corporación Geológica ARES, Bogotá, Colombia

3 University of Rochester, Rochester, NY, USA

4 Natural History Museum of Los Angeles County, Los Angeles, CA, USA

5 Florida Museum of Natural History, Gainesville, FL, USA

6 Paleontological Institute and Museum, University of Zurich, Zurich, Switzerland

7 Section de Paléontologie, Hôtel des Halles, Office de la Culture, Porrentruy, Switzerland

trigger of the GABI becomes necessary. Further understanding of these issues may lie in the tropical Cenozoic sedimentary basins of the American continent.

Nevertheless, ancient diversity dynamics within the tropics are still poorly understood. This has resulted from both environmental and political factors. The tropical belt is distinguished for having extremely high weathering rates due to the dense vegetation and humidity conditions. Therefore, the outcrop area in this region is very low. In addition, there has been a lack of both geological and paleontological research, given the poor economical and political situations of the countries located on the tropical belt, considerably restricting field opportunities. Consequently, only five Neogene faunal assemblages have been studied in detail in the tropical Americas: the Early Miocene terrestrial deposits of the Panamanian isthmus

Fig. 1 Landscape and fossils from Cocinetas Basin, La Guajira Peninsula: **a** paleontologists returning from one day of fieldwork in Cocinetas Basin; **b** collecting fossil mollusks in the Castilletes Formation; **c**, **d** gavial rostrum and astrapothere inferior jaw from Castilletes Formation; **e** typical outcrop of the Neogene sequence in the Cocinetas Basin showing Macuira Range in the background. Photographs taken by Christian Ziegler

(Whitmore and Stewart 1965; MacFadden 2004, 2006, 2010; Rincon et al. 2012), the Middle Miocene deposits from La Venta in Colombia (Kay et al. 1997), the Late Miocene vertebrate deposits from Acre in Brazil (Cozzuol 2006), the Early to Late Miocene deposits in the Peruvian Amazon (Marivaux et al. 2012; Antoine et al. 2013; Tejada-Lara et al. 2014), and the Late Miocene and Pliocene deposits of the Urumaco sequence in northwestern Venezuela (Linares 2004; Quiroz and Jaramillo 2010; Sanchez-Villagra and Aguilera 2006; Sánchez-Villagra 2006; Sanchez-Villagra and Clack 2004).

Here in this volume, Hendy et al. (2015) and Moreno et al. (2015) report on a new fossiliferous sedimentary basin found in the region of La Guajira Peninsula (northern Colombia), the Cocinetas Basin. This region is subjected to an arid climate resulting in an almost complete exposure of the Neogene sequence of this astonishing sedimentary basin (Fig. 1a, d). Given the time span of the sedimentary deposits (Neogene), the proximity to the Panamanian Isthmus and its excellent preservation of fossils, La Guajira Peninsula offers tremendous paleontological potential to examine both the geological and biological dynamics related to GABI. Moreover, this exceptional fossil record will contribute to our understanding of how the neotropical rainforest has evolved to reach its present day extremely high biodiversity.

Over the past 4 years, we have conducted extensive fieldwork in the Cocinetas Basin of La Guajira Peninsula, including geological mapping, stratigraphic descriptions, and exhaustive paleontological collection of plants, microfossils, and marine and terrestrial invertebrates and vertebrates (Fig. 1b–d). Moreno et al. (2015) provides an overview of these efforts, including a revised Neogene stratigraphy for Cocinetas Basin and redefined (Jimol and Castilletes formations) and newly named (Ware Formation) lithostratigraphic units. Hendy et al. (2015) utilize the extensive invertebrate fossil record of the basin to develop paleoenvironmental interpretations and a chronostratigraphic framework buttressed by $^{87}Sr/^{86}Sr$ isotopic analyses and biostratigraphy. This geological exploration highlights the tremendously diverse and important fossil assemblages throughout the Jimol, Castilletes and Ware formations. These new fossil data will be of great value for future paleobiogeographic, paleogeographic, paleooceanographic and paleoenvironmental interpretations. Already, the faunal and floral fossil record of Cocinetas Basin indicates that once the humid ecosystem of the Neogene underwent drastic climatic changes over the last two million years.

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