Subsurface basement, structure, stratigraphy, and timing of regional tectonic events affecting the Guajira margin of northern Colombia

Eleine Vence[1] and Paul Mann[2]
http://dx.doi.org/10.1190/INT-2020-0016.1

Abstract

We have combined previous data from Mesozoic-Cenozoicoutcrops in the Guajira Peninsula of northern Colombia with regional gravity, bathymetric, and seismic interpretations to demonstrate the existence of a 280 km long western extension of the Great Arc of the Caribbean (GAC) along the continental margin of Colombia. Seismic data reveal an 80-100km wide domal-shapedbasement high that exhibits internal chaotic seismic facies. This elongate and domal-shapedstructure extends 1800km from the Aves Ridge in the Caribbean Sea to the study area in offshore Colombia. The western extension of the GAC in Colombia and western Venezuela is buried by 700-3000mof continental margin sedimentary rocks as a result of the GAC colliding earlier with the Colombian margin (Cretaceous-early Paleogene collision) than its subaerially exposed eastern extension along the Leeward Antilles ridge (late Paleogene-Neogene). Our compilation of geologic information from the entire GAC reveals that GAC magmatismoccurred from 128 to 74 Ma with magmatismages progressively younger toward the east. Six upper Eocene to recent marine seismic sequences overlying the domal basement high of the GAC have been mapped by our analysis of 2400 km of seismic lines and 12 well logs. Based on subsurface mapping correlated with well-log information and onland geology in the Guajira Peninsula, these six sequences record four major deformational events: (1) late Eocene rifting in an east-west direction produced half-grabensin the northern part of the area, (2) Oligocene transtension in the southern part of the area expressed by right-lateral Oligocene strike-slip faulting and extensional basin formation, (3) early-middle Miocene transtension, and (4) late Miocene-early Pliocene Andean uplift accompanied by rapid erosion and clastic infilling of offshore basins by the Magdalena delta and deep-seafan. The significance of this basin framework is discussed for known and inferred hydrocarbon systems.

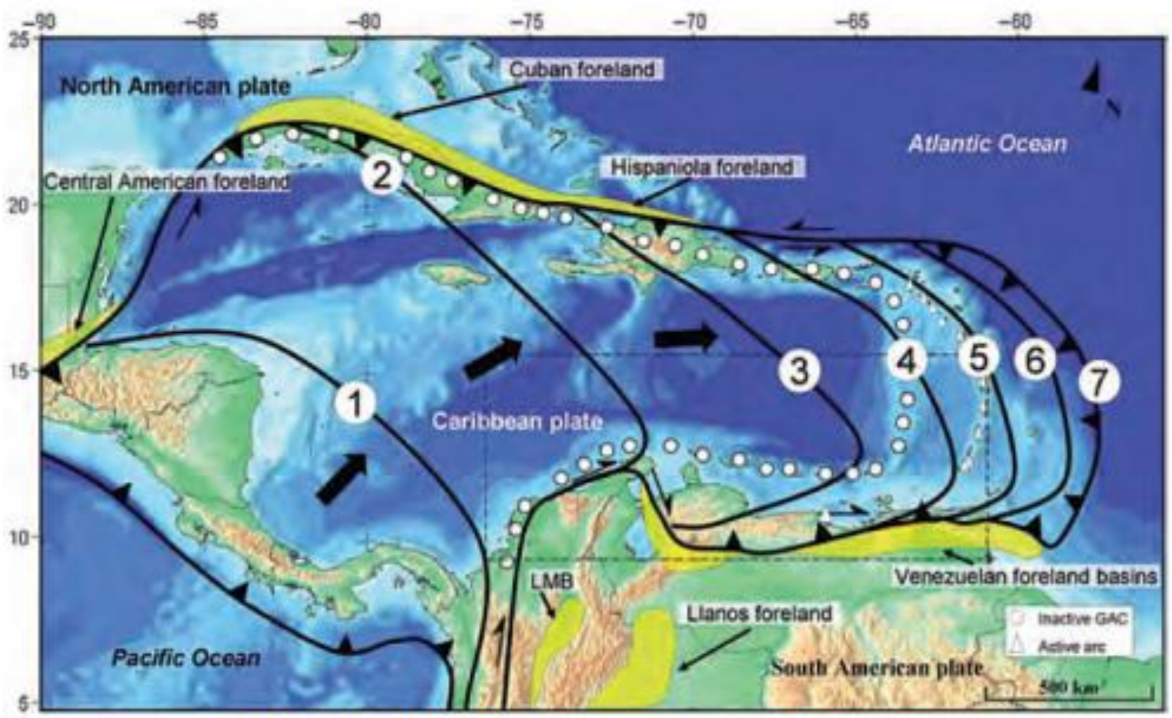

Figure 1. Inferred position of the leading edge of the GAC from the Late Cretaceous (1), to Paleocene (2), to Eocene (3), to Oligocene (4), to Miocene (5), to Pliocene (6), and to recent (7). The map is modified from Lugo and Mann (1995). The yellow-shaded areas are foreland basins formed during the collision of the Great Arc with continental areas of North and South America.

[1]ConocoPhillips, 925 North Eldridge Parkway, Houston, Texas 77079,USA. E-mail: Eleine.M.Vence@conocophillips.com.

[2]University of Houston, Department of Earth and Atmospheric Sciences, Houston, Texas 77204,USA. E-mail: pmann@uh.edu.

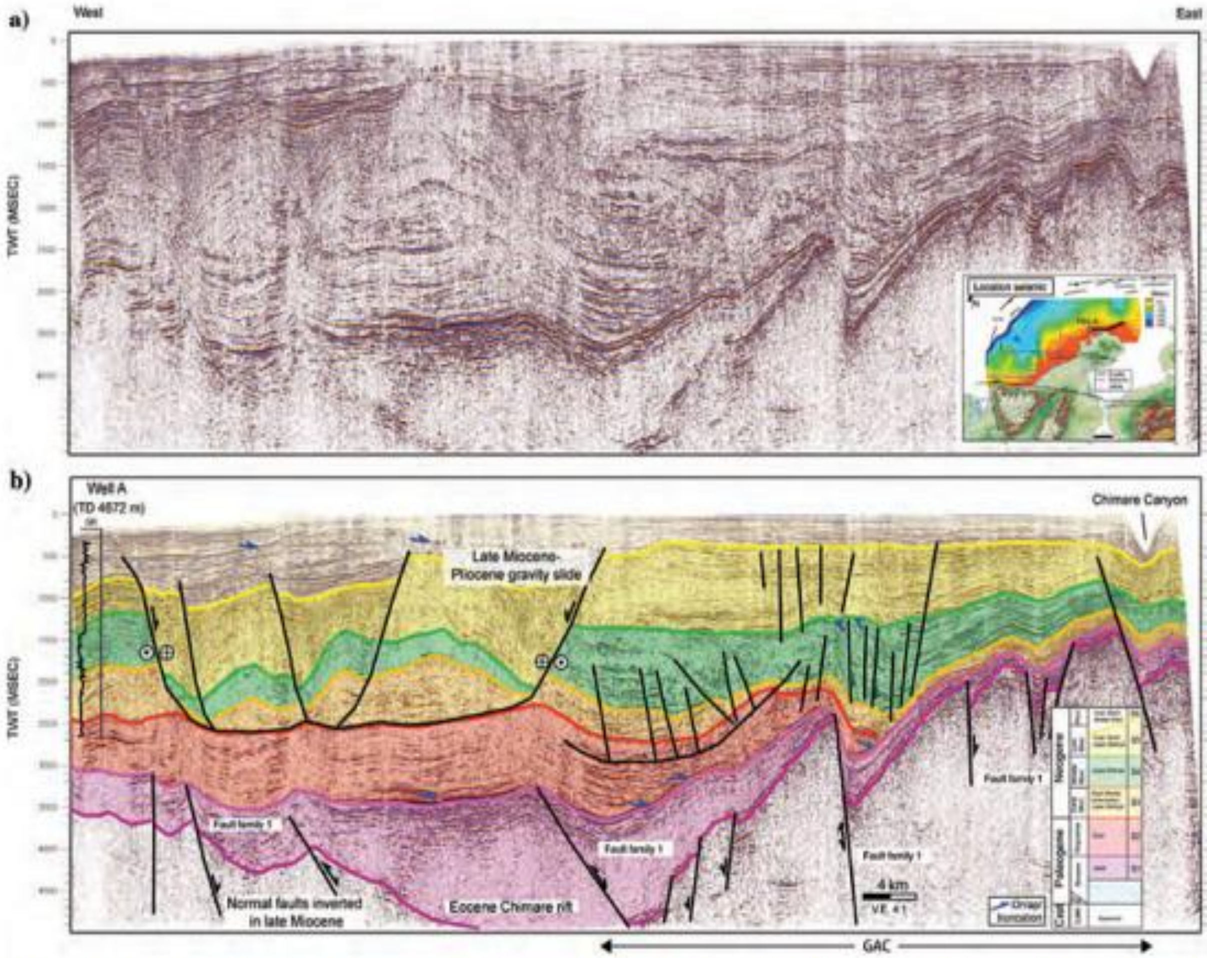

Figure 8. (a) Uninterpreted, east-west-strikingseismic section across the southern part of the Eocene Rancheria rift basin and the overlying continental margin sedimentary section (the line location is shown by the heavy line in the inset map). (b) Interpreted seismic section with the inset stratigraphic column showing a color-coded key that identifies the mapped seismic sequences and their ages. Well A is shown with its GR log.

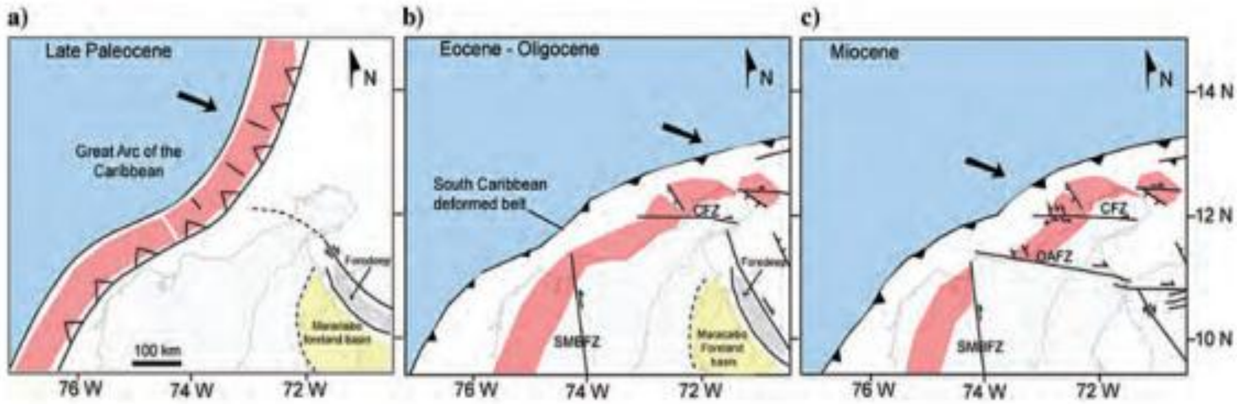

Figure 21. Schematic tectonic reconstructions of the offshore Colombian segmentwith three main tectonic phases affecting the GAC in offshore Colombia: (a) Late Paleocene collision and foreland basin formation (in yellow) between the GAC and the continental margin of South America, (b) Late Eocene-Oligocene rifting and extension and large-scale clockwise rotation of the GAC against the continental margin of South America and back thrusting along the SCDB, and (c) Miocene right-lateral strike-slipoffsets of the GAC by the Cuisa (CFZ), Oca-Ancon(OAFZ), and Santa Marta-Bucaramanga(SMBFZ). The Maracaibo foreland position in panels (a) and (b) is from Contreras et al. (2008).

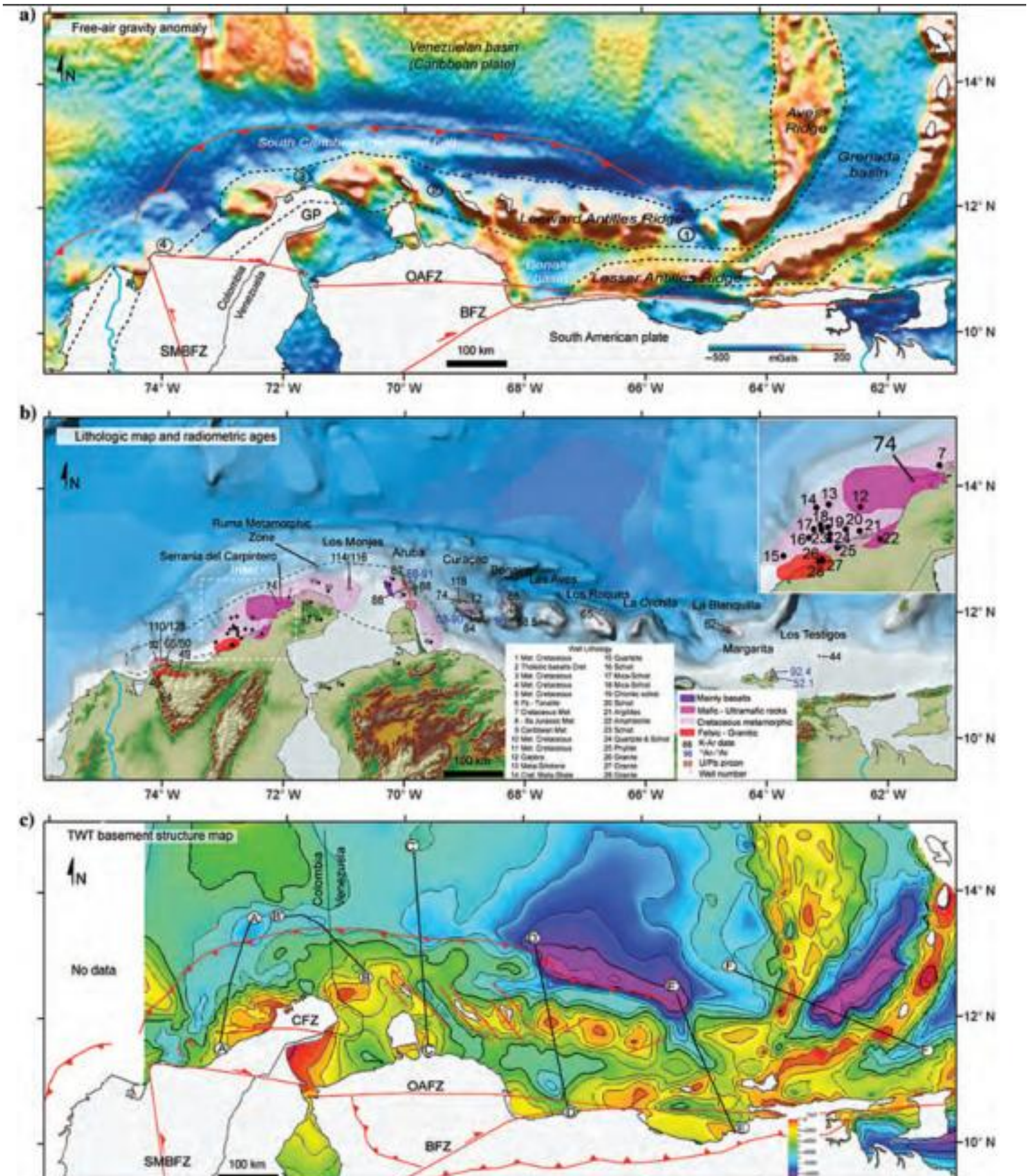

Figure 4. (a) Satellite free-airgravity map from Sandwell and Smith (1997) showing the inferred extent of the GAC composed of the AR and Leeward Antilles ridge. SMBFZ, Santa Marta-Bucaramangafault zone; GP, Guajira Peninsula; OAFZ, Oca-Anconfault zone; and BFZ, Boconó fault zone. (b) Compilation of basementrock types and radiometric ages (Table 1) for the Leeward Antilles ridge and Colombian offshore area displayed on bathymetry from Sandwell and Smith (1997). The underlined ages are from plutonic rocks. The inset map is magnified of offshore Colombia with basement rock types compiled from outcrop studies and industry well logs used in this study; the numbers correspond to the rock types shown in Table 1. (c) Two-way-timestructural map at the top of the acoustic basement of the GAC and associated areas from Escalona and Mann (2011). The red lines represent major faults; the black lines indicate the location of regional seismic reflection profiles shown in Figure 5.