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ABSTRACT

REVISED PLATE-TECTONIC MODEL, CARIBBEAN-GULF OF MEXICO REGION

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The influential "Caribbean Oblique Collision Model" invokes Jurassic rifting of western Pangea, then Oxfordian-Campanian sea-floor spreading to form the Proto-Caribbean Ocean, flanked N and S by passive margins which collided obliquely (Campanian-Neogene) with the relatively E-migrating Caribbean Arc. Among other fundamental revisions to this model, a new ocean and a new arc are proposed here (Fig. 1).

"Jurassic" rifting in the south (Colombia, Venezuela, Trinidad) in fact lasted much longer, as Berriasian through Albian strata show syn-tectonic characteristics (laterally confined; evaporites; sand rich; isolated carbonate banks separated by deeper-water shales). Deposits of this "Carib Graben" include a largely dissolved, Berriasian-Valanginian "Carib Halite Formation" (crops out near Bogota).

The "delayed" Proto-Caribbean opening (Albian) means that inter-Americas divergence (Jurassic-Campanian, from Atlantic kinematics) until then must have been accommodated in a "Proto-Yucatan Ocean" (PYO), separating the Chortis-Greater Antilles

Terrane (CGA, at that time part of S America; Chortis includes Nicaragua Rise) from the S Yucatan-E Yucatan-Bahamas margin. Within CGA, Hispaniona and Puerto Rico lay south of Cuba (pre-Yucatan Basin; pre-Cayman Trough pullapart). In this reconstruction, there was no space for Gulf of Mexico spreading until Cretaceous time, contrary to popular opinion (Jurassic-Cretaceous). CGA detached from the Ecuador-Colombia-Venezuela-Trinidad margin in Albian time by Proto-Caribbean spreading. The terrane migrated northwest, subducting PYO at a CGA Arc (Albian-Campanian volcanism; Escambray Albian HP subduction metamorphism of Jurassic rift deposits and early PYO crust). Then, inter-Americas convergence from Campanian time led to northward diachronous Campanian-Paleogene collision of the Arc (trailed by Yucatan interarc basin and Cayman Ridge remnant arc) against Yucatan-Bahamas, thereby joining CGA to the N America Plate. Thus Cuba-Hispaniola-Puerto Rico were never part of the Caribbean Arc, which simply migrated past later (see below). The Proto-Yucatan Ocean precursor rift is the long-lost "Hispanic Corridor", fully marine by Early Jurassic time; marine deposits of this age are scarce along the paleosuture (N fringe of Chortis-Cuba) due to subduction and/or non-exposure.

A second, Inter-American Arc (IAA) bridged the N America (Mexico)-S America (Peru) gap from its Jurassic inception, separating the Pacific (Farallon Plate) from the PYO (shrinking), CGA Arc, and Proto-Caribbean (expanding). PYO consumption ended in Campanian time (start of CGA collision against Yucatan-Bahamas), thus the Proto-Caribbean filled the inter-Americas gap. The IAA then switched polarity, forming the Caribbean Arc, which thereafter migrated east by Proto-Caribbean subduction. The

reversal cannot have been Aptian (widely supposed), as this predates the Proto-Caribbean. Instead, reversal was Campanian, during a plate reorganization which also caused the onset of N and S America convergence, forcing Proto-Caribbean subduction at the Ecuador-Colombia-Venezuela-Trinidad margin, causing synchronous uplift of a cratonward-verging, outer-margin nappe, driving an inboard Proto-Caribbean Foreland Basin.

From Campanian until mid-Oligocene time (30 Ma), the Caribbean Arc migrated E relative to S America (ENE relative to N America), along a strike-slip plate boundary in the north (S flank of CGA). In the S, the Arc collided obliquely from Ecuador to "Guajira corner", obducting the Amaime forearc nappe, and driving a Caribbean Foreland Basin that diachronously supercedes the Proto-Caribbean Foreland Basin. Caribbean relative motion then changed to SE and ESE (30-1.5 Ma). In the N, the plate boundary jumped from the S to the N side of Chortis and, eastward, stepped-over to the N side of the Hispaniola-Puerto Rico block; the stepover allowed the Cayman Trough oceanic pullapart to form (Oligocene-Recent). In the S, the Arc ripped open the Falcon-Gulf of Venezuela "transform pullapart" (parallel to SE relative motion), then collided obliquely with the Caracas-Trinidad margin (ENE trend), obducting the Villa de Cura-Margarita-Tobago forearc nappe, again driving a Caribbean Foreland Basin that diachronously (Miocene-Quaternary) supercedes the Proto-Caribbean one.

Around 1.5 Ma, Caribbean motion relative to S America switched back to E (085; published GPS), due to the Panama Arc at the rear of the Plate suturing against Colombia. This causes transpression in the N (Hispaniola-Puerto Rico region; ENE relative motion).

In S America the plate boundary jumped to its present position along the Eastern Cordillera-Merida Andes bivergent oblique thrust system (accelerated Quaternary uplift), passing NE into the coastal San Sebastian-El Pilar Fault Zone, whose 080 trend causes highly oblique dextral transpression (Quaternary raised beaches), but this is widely masked by 11-0 Ma halite-dissolution basins like the Gulf of Paria (see accompanying abstract). The "Maracaibo Block" thus moves E as part of the Caribbean Plate, and has never "escaped" north.

Rapid passage of the Caribbean Arc from Guajira to Trinidad (30-0 Ma; cf. generally accepted 60-0 Ma) implies forearc tectonic erosion at the subduction zone, to maintain the Arc "neutral", or sometimes "extensional" (Grenada interarc basin?), but never "compressional" with Andean relief. Tectonic erosion also explains why rocks from the WEST side of the IAA (Villa de Cura, Margarita, Tobago arc rocks metamorphosed in IAA subduction zone; La Desirade Pacific-affinity Jurassic chert) came to lie at the EAST edge of the Caribbean Plate, requiring (1) growth of the initial Caribbean Arc well to the west of the IAA (lower-angle subduction, of young Proto-Caribbean), and (2) removal of the abandoned IAA by tectonic erosion.

Figure 1.

Plate reconstructions, Caribbean-Gulf of Mexico region, from Jurassic (top left) to Miocene time (bottom right). Relative positions of N and S America plates through time from figures

in Pindell & Kennan 2001 (see those figures for distribution of stretched and unstretched continental crust). Wavy pattern is oceanic crust. Open-headed arrows indicate motion direction (not velocity) of N America (NA) and Caribbean Plates relative to S America (SA). CH Chortis block, YU Yucatan block, C Cuba, H Hispaniola, PR Puerto Rico.