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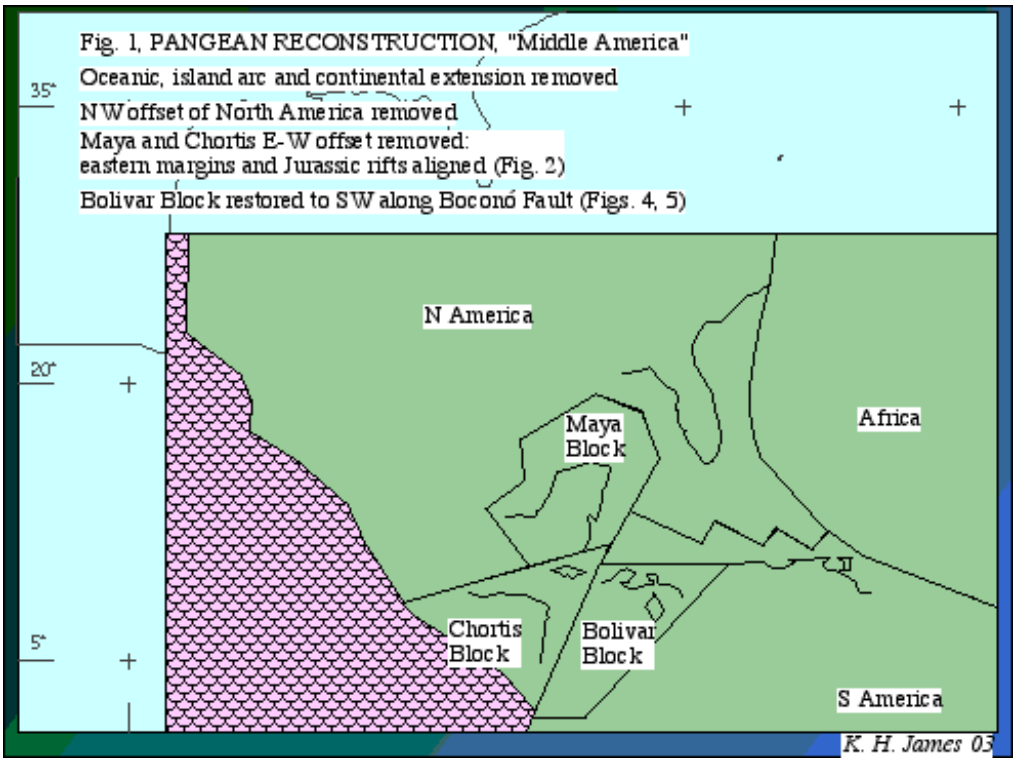
A Simple Synthesis of Caribbean Geology

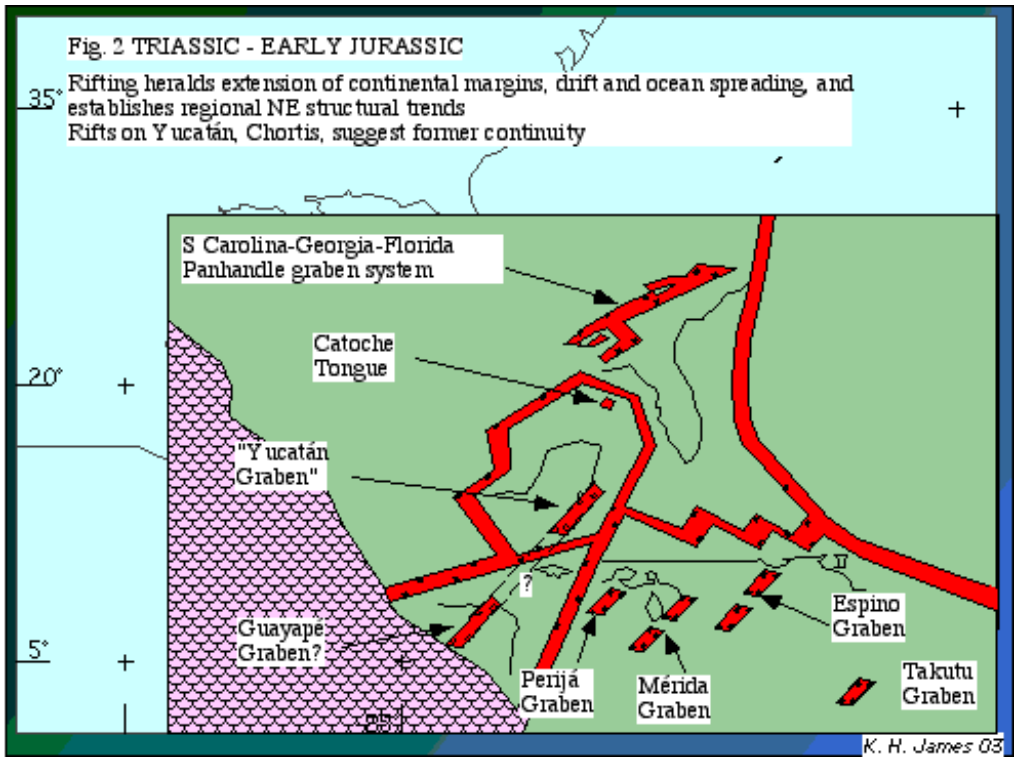
This model holds that the regional plate tectonic history of the area between continental North and South America is simply one of NW-SE extension and sinistral offset.

Pangean palaeogeography of North and South America (Fig. 1) is reconstructed by:
1 Removal of oceanic (Gulf of Mexico, Yucatan Basin, Cayman Trough and Caribbean) and island arc material (Greater, Lesser and Netherlands-Venezuelan Antilles.
2 Removal of continental/transitional crust extension (Gulf of Mexico and Venezuela margins, Florida-Bahamas platform, Nicaragua Rise).
3 Removal of sinistral offset between continental areas of North and South America and between the Maya and Chortis Blocks.
4 Restoration of northwestern South America (Bolivar Block) to the southwest

The area evolved from this Pangean configuration as follows:

?Triassic-Jurassic migration of North America to the west (ca. 1000 Km) and north (ca. 850 km), relative to Pangea, was accompanied by intracontinental rifting (Fig. 2), extension of marginal continental crust, sinistral offset of





remnant continental blocks (Maya and Chortis) and development of oceanic crust (Gulf of Mexico, the Yucatan Basin, the Cayman Trough and Caribbean).

In the Early Cretaceous parts of the Yucatan, Venezuelan and Colombian basins thickened into oceanic plateaus, probably because of decompression melting associated with extension over triple junctions (Fig. 3). Spreading between South America and Africa resulted in connection of the Central and South Atlantic by the beginning of the Albian. Convergence between Pacific and Atlantic spreading areas and the Caribbean resulted in a newly isolated plate, bounded by subduction island-arcs (Fig. 3).

Throughout the Cretaceous the Mid Atlantic Ridge lengthened, N-S, by some 650 Km and stepped westward in the latitudes of 7-15 degrees N. Associated NW-SE sinistral shear in the Caribbean to the west caused NE-SW oriented intraplate extension and plate thickening (further decompression melting) in the western Venezuelan Basin/Beata Ridge/Haitian Basin area. The Aves Ridge may have formed similarly at the same time.

By Middle Eocene time island arc activity ceased along the northern and southern Caribbean Plate boundaries. Increased clastic input reflected ocean-continent interaction, possibly triggered by the K/T impact. Violent Middle Eocene culmination of this episode, recorded by regional wildflysch deposits containing multi-kilometre olistoliths, may record a further impact (Fig. 4). Deposits included the Villa de Cura ophiolite of Venezuela and its original western extension, the Aruba-Blanquilla complex (Fig. 5). A regional Middle Eocene unconformity and regional, overlying, shallow marine, Middle Eocene carbonates record regional uplift to the photic zone, erosion and carbonate deposition.

Since the Oligocene, the Caribbean plate has moved eastward relative to South America. Northwestern South America (Bolivar Block, Fig. 2) moved northwards at the same time, driven by sea-floor spreading in the Pacific. Its northernmost part transgressed the Caribbean-South America dextral plate boundary, suffering major internal pull-apart strain (Fig. 6). Eastward migrating pull-apart basins, thrust fronts and molasse basins developed in a dextral regime along northern Venezuela/Trinidad and in a mirror-image, sinistral regime in the Greater Antilles. Extension

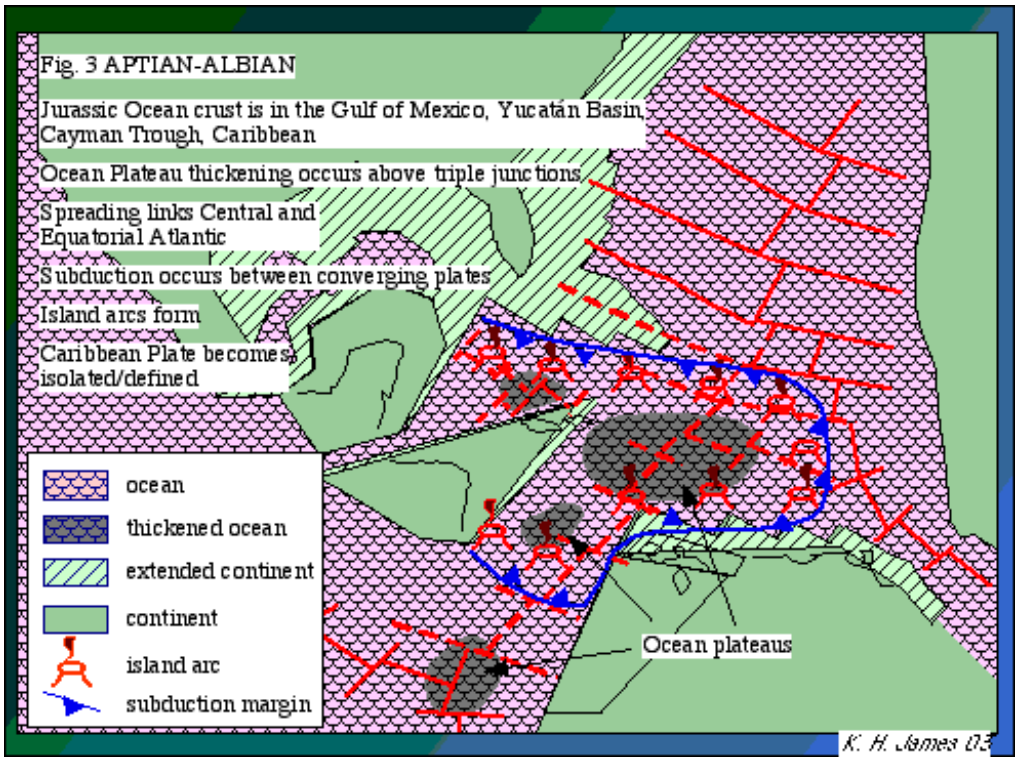


Fig. 3 APTIAN-ALBIAN
Jurassic Ocean crust is in the Gulf of Mexico, Yucatán Basin, Cayman Trough, Caribbean
Ocean Plateau thickening occurs above triple junctions
Spreading links Central and Equatorial Atlantic
Subduction occurs between converging plates
Island arcs form
Caribbean Plate becomes isolated/defined
ocean
thickened ocean
extended continent
continent
island arc
subduction margin
Ocean plateaus
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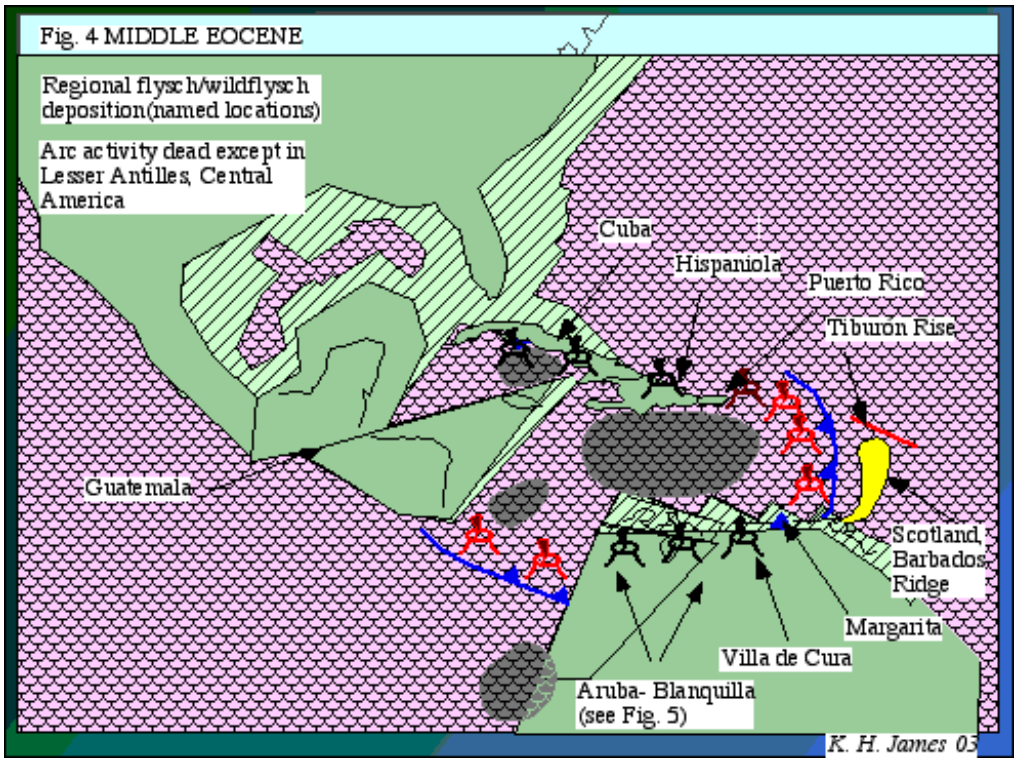
Fig. 4 MIDDLE EOCENE
Regional flysch/wildflysch deposition(named locations)
Arc activity dead except in Lesser Antilles, Central America
Cuba
Hispaniola
Puerto Rico
Tiburón Rise
Guatemala
Scotland, Barbados Ridge
Margarita
Villa de Cura
Aruba- Blanquilla (see Fig. 5)
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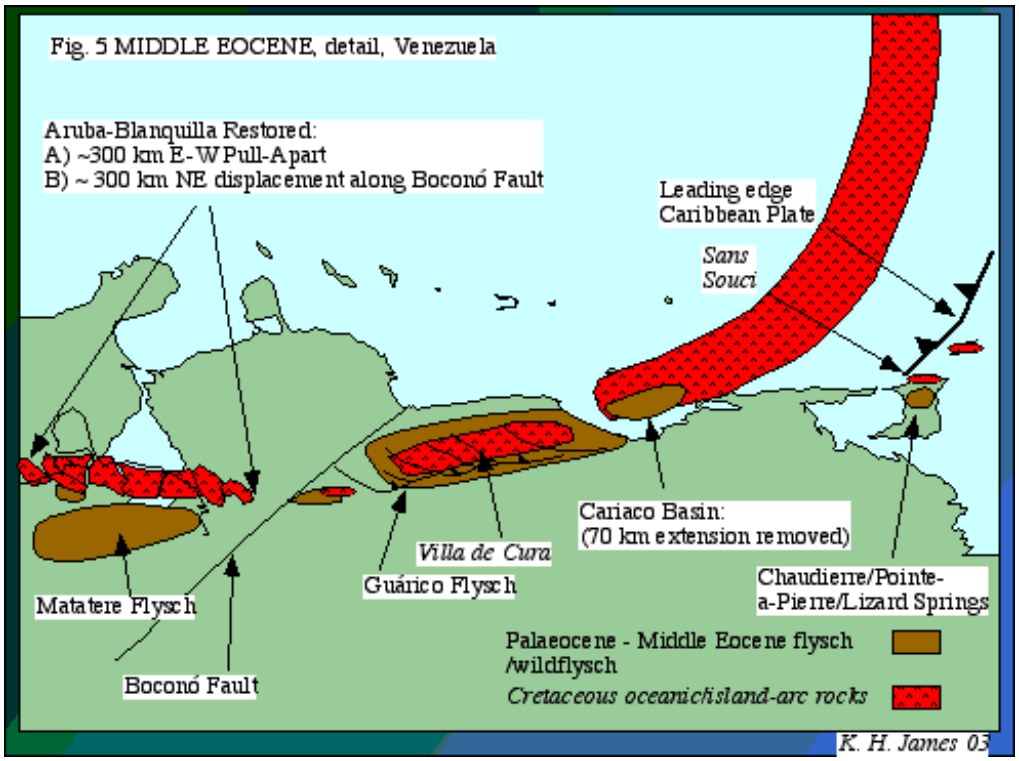
Fig. 5 MIDDLE EOCENE, detail, Venezuela
Aruba-Blanquilla Restored:
A) ~300 km E-W Pull-Apart
B) ~ 300 km NE displacement along Boconó Fault
Leading edge
Caribbean Plate
Sans
Souci
Cariaco Basin:
(70 km extension removed)
Villa de Cura
Guárico Flysch
Matatere Flysch
Boconó Fault
Chaudiere/Pointe-
a-Pierre/Lizard Springs
Palaeocene - Middle Eocene flysch
/wildflysch
Cretaceous oceanic/island-arc rocks
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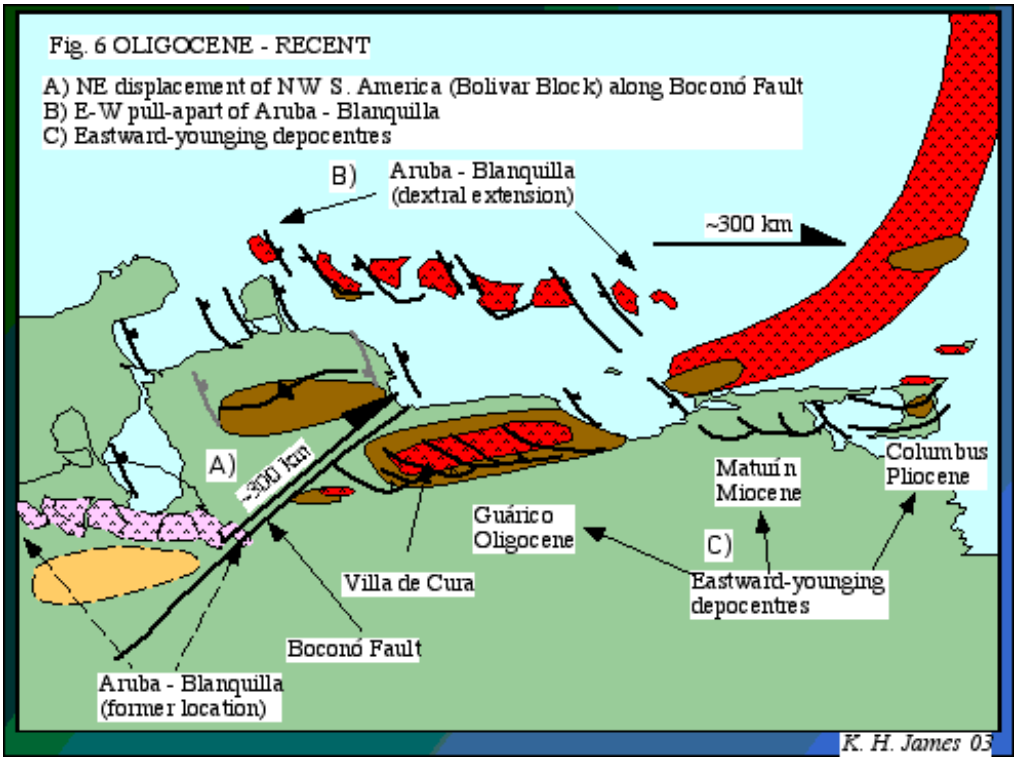
Fig. 6 OLIGOCENE - RECENT
A) NE displacement of NW S. America (Bolivar Block) along Boconó Fault
B) E-W pull-apart of Aruba - Blanquilla
C) Eastward-younging depocentres
B)
Aruba - Blanquilla
(dextral extension)
~300 km
A)
~300 km
Columbus
Pliocene
Maturín
Miocene
Guárico
Oligocene
C)
Villa de Cura
Eastward-younging
depocentres
Boconó Fault
Aruba - Blanquilla
(former location)
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of the Aruba-Blanquilla island chain (Fig. 6, formerly obducted island-arc, Fig. 5) indicates up to 300 Km of eastward movement of the Caribbean relative to South and North America.

Important features of this model are:

-It's simplicity contrasts sharply with the unlikely complexity and geometric improbability of models that derive the Caribbean Plate from a Pacific location.
-No major block rotations were involved.
-No major plate migration occurred.
-Oceanic crust in the Gulf of Mexico, Yucatan Basin, much of the Cayman Trough and the Caribbean, including the Grenada Basin) formed in the Jurassic. Only the central Cayman Trough, Miocene-Recent, is young oceanic crust.
-Cretaceous, Caribbean ocean plateau thickening resulted from decompression melting. No mantle plume/hotspot was involved.
-Sinistral (Cayman) offset between North America and the Caribbean Plate occurred along the northern boundary of the Caribbean Plate and offset the continental fragments of Maya and Chortis; it did not relate to the southern Caribbean boundary.
-Eastward relative strike-slip between the Caribbean and North and South America amounts to no more than 300 Km and occurred in the Oligocene-Recent.