The Caribbean – overlooked hydrocarbon potential on N America's doorstep

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Recent huge discoveries below salt in the Gulf of Mexico and Brazil show that much remains to be learned about deepwater areas. They also disprove the notion that the elephants have all been found. Another paradigm that needs to fall is the 40 year-old idea that the Caribbean Plate formed in the Pacific and migrated between the Americas. This understanding implies that the plate consists mostly of oceanic crust and volcanic arc rocks -- not many think about hunting for oil in deep water here. However, there is much evidence (continental rocks, continental gravity densities, seismic velocities and crustal thicknesses, abundant high silica rocks and regional tectonic fabric) that continental crust is abundant (Figs. 1, 2).

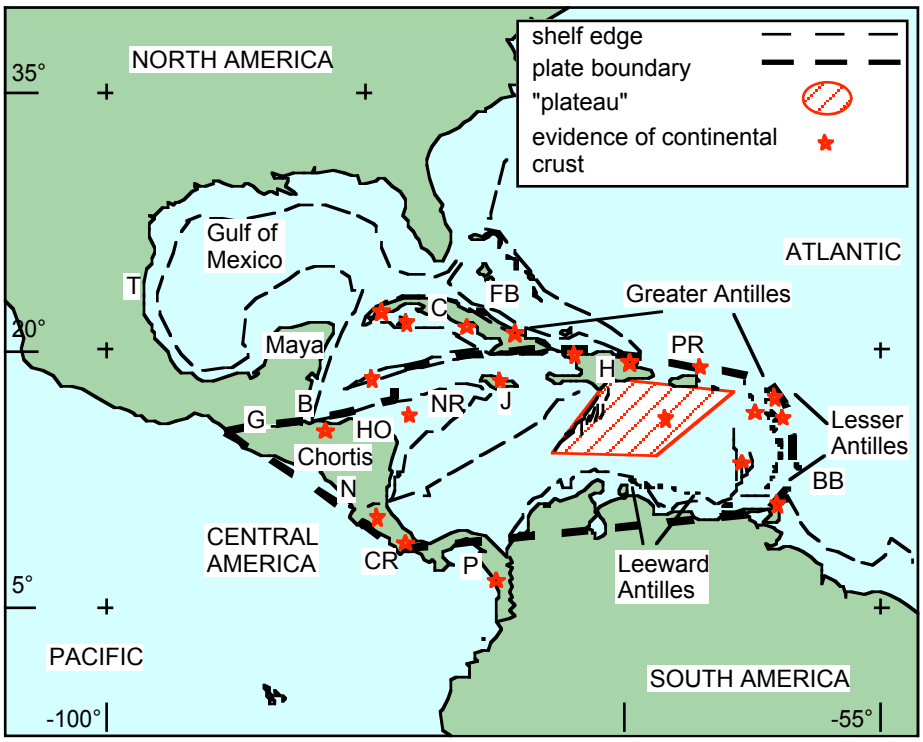

Figure 1. Middle America. On the Caribbean Plate (heavy dashed line) only Chortis is supposed to carry continental crust. Red asterisks locate indications of other continental fragments. B – Belize; BB – Barbados; C – Cuba; CR – Costa Rica; FB – Florida-Bahamas; G – Guatemala; H – Hispaniola; HO – Honduras; J – Jamaica; N – Nicaragua; NR – Nicaragua Rise; P – Panamá; PR – Puerto Rico; T - Tehuantepec.

Middle America, including the Caribbean Plate, exhibits a regional NE and NW structural pattern (Fig. 2). The former reflects Triassic-Jurassic rift/drift reactivation of Palaeozoic sutures and is well known in N and S America. The latter is the trend of ocean fractures and major intra-continental faults active during northwestward separation of N America from Gondwana. Major Jurassic faults crossing the Maya and Chortis blocks in the west (Fig.1) remain parallel to the regional NE trend (Fig. 2) and show that they have not rotated, as commonly

believed. Continental rocks are exposed on mainland Chortis but this block extends to Jamaica via the Nicaragua Rise and forms a large part of the western Caribbean. Its presence there precludes migration of a Pacific plate both geometrically and geologically.

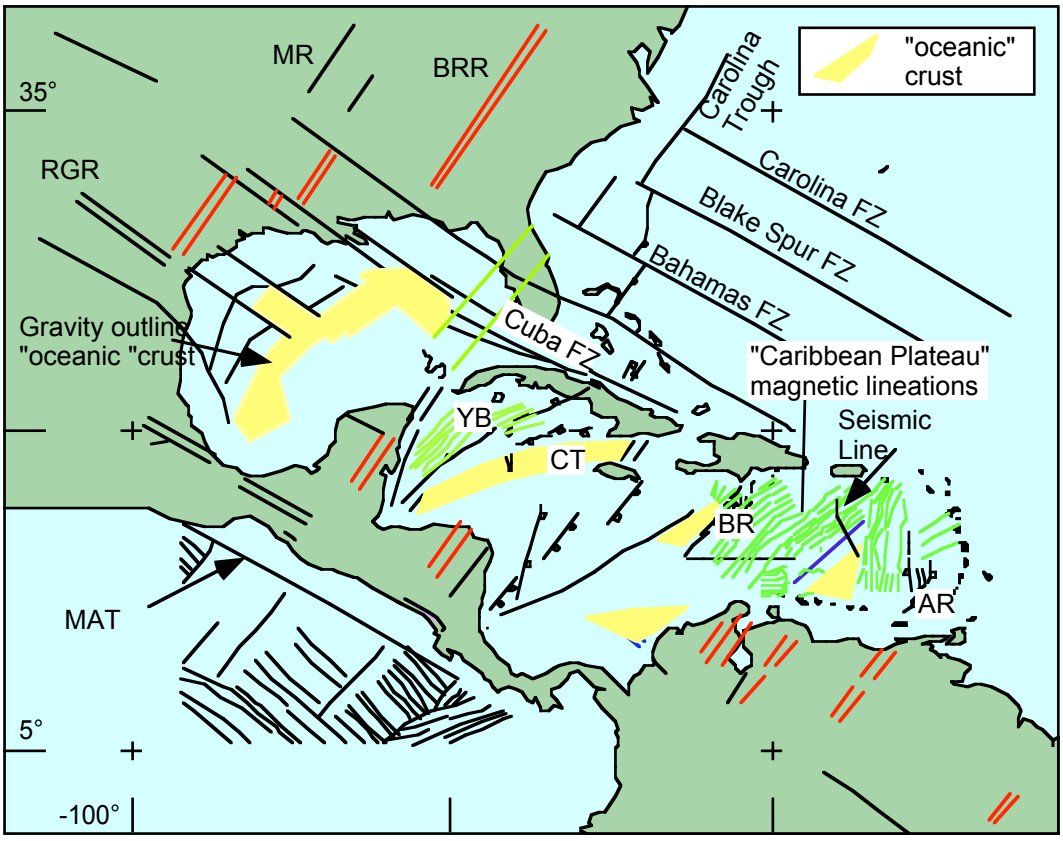

Figure 2 Middle America NE and NW structural fabric. Red lines highlight known Triassic-Jurassic rifts. Green lines indicate mapped structural trends indicated by magnetic anomalies. The blue line marks the SE limit of the Caribbean "Plateau" – the Central Venezuela FZ (Fig. 3). The NE trend over the "plateau" area (Fig. 1) reflects basement structures and shows that it shared regional geological history. AR – Aves Ridge; BR - Beata Ridge, BRR – Blue Ridge Rift; CT – Cayman Trough; FZ – fracture zone; MAT – Middle America Trench; MR - Mississippi Rift, OR – Ouachita Rift, RGR - Río Grande Rift, YB - Yucatán Basin.

Part of the Caribbean Plate is up to 20 km thick. DSDP drilling encountered Turonian basalts at the top of this Caribbean "oceanic plateau" (Fig. 1), which is generally seen to be the result of Cretaceous oceanic plate thickening over a hot spot or mantle plume in the Pacific. If this were true, the plateau would exhibit a radial structural pattern. Instead, it shares the regional NE trend of Middle America – an unlikely coincidence if it had formed in the Pacific

Seismic data over the plateau (Fig. 3) reveal a deep architecture that repeats the form of distal basins along the eastern seaboard of N America from Baltimore Canyon to the Blake Plateau. These asymmetric basins contain wedges of Triassic red beds and Jurassic – Cretaceous sediments, source rocks and salt. They share the Gulf of Mexico history of Mesozoic extension. The Caribbean "plateau" is probably their southern continuation. Instead of blocks of vertical igneous dykes flanked by

wedges of volcanic flows and volcaniclastic sediments, with seamounts locally at the seafloor (current understanding) it probably consists of 40 km wide continental blocks flanked by 100 km wide wedges of Triassic- Jurassic clastic sediments, including source rocks and salt, overlain by Jurassic - Cretaceous carbonates. Smoothness and great lateral extent of seismic Horizon B" (Fig. 3) and vesicularity of cored Turonian basalts suggest they were shallow/sub-aerial, perhaps causing restriction that produced prolific source rocks known along northern S America. Supposed seamounts push up through overlying upper Cretaceous – Recent sediments are very similar in appearance to Sigsbee salt knolls of the Gulf of Mexico. At least some are salt diapers, with indications of adjacent rim synclines,

Other parts of the Caribbean Plate, west and southeast of the plateau, resemble oceanic crust (Fig. 3, Rough Horizon B"). However, they are abnormally thin (3- 4 km) and do not manifest spreading magnetic anomalies. They are likely to be areas of extremely attenuated continental crust or serpentinized upper mantle (serpentinite is remarkably abundant around the plate margins). The only spreading anomalies (Miocene – Recent) in the whole of Middle America occur in the central 300 km of the Cayman Trough.

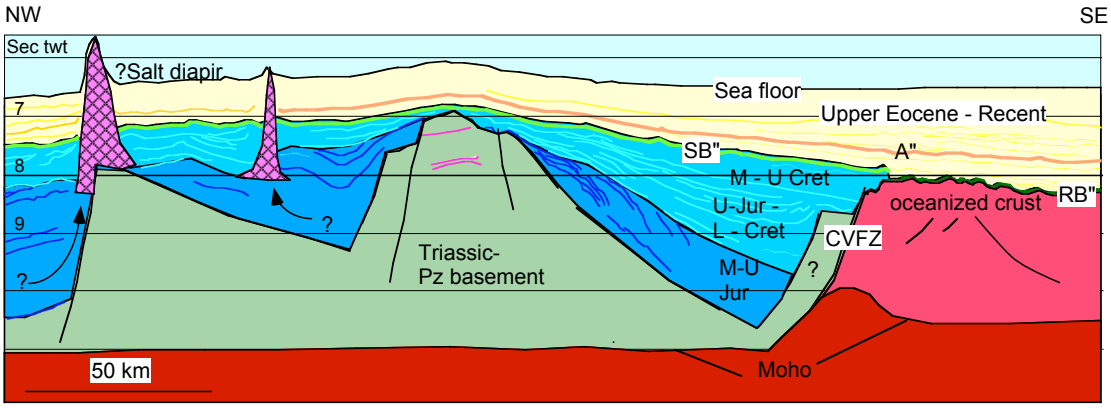

Figure 3. Interpretation of seismic line over the Caribbean Plateau (located on Fig. 2). The interpretation suggests that Caribbean, Gulf of Mexico and eastern N America basin histories were similar. Triassic-Jurassic rifting accommodated continental – shallow marine sediments and salt. Drifting introduced open marine Jurassic – Cretaceous sediments. Late Cretaceous extension resulted in shallow marine - subaerial flows over the Caribbean plateau, forming smooth Horizon B" (SB") and serpentinization of adjacent mantle, forming rough Horizon B" (RB"). Horizon A" is the Middle Eocene contact between chert and unconsolidated sediments. CVFZ – Central Venezuelan Fault Zone (Fig. 2).

Instead of bearing a "foreign" Caribbean Plate, Middle America shows an internal geological integrity that reflects ancient basement structures extended by drift of North America away from and South America. Proximal margins subsided gradually, accommodating carbonate platforms many kilometres thick (Florida-Bahamas, Tehuantepec, Campeche-Maya). More distal areas foundered below the deeper Gulf of Mexico and the Caribbean. Areas of greatest extension suffered "oceanization".

Caribbean geology is related to that of the Gulf of Mexico and marginal basins along the eastern flanks of the Americas. The area lies between the giant oil

provinces of the Gulf of Mexico and northern S America. It probably carries a wide variety of hydrocarbon plays involving Jurassic and Cretaceous source rocks. The risk is that igneous activity over-matured these in some areas. However, live oil stain occurs in fractured rocks on Puerto Rico, oil is present on Hispaniola, Jamaica, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panamá and Barbados. Some is thought to come from Tertiary sources, but oils of Guatemala, Belize, Jamaica, Costa Rica and Barbados have Jurassic or Cretaceous chemical signatures. This 2.5 million square kilometre, virtually unexplored area lies close to N America and is governed by friendly nations.