Middle America - intracontinental extension, geology of the Caribbean

The Caribbean is seen either:

 to have formed in the Pacific as oceanic crust overlain by a mantle plume oceanic plateau (e.g., Pindell & Kennan, 2009; Escalona & Mann, 2011), or:

 to have formed in place by intracontinental extension (e.g. James, 2009, 2012, 2013).

This poster presents data supporting the latter model, wherein the Caribbean shares its origins with the Gulf of Mexico and the Yucatán Basin. Lying between the Gulf and northern South America, it could have significant hydrocarbon potential.

Regional data show that Middle American geology reflects intercontinental extension between the separating Americas. Its N60oW and N35oE tectonic fabric demonstrates internal integrity. The latter reflects reactivation of Palaeozoic (Appalachian) orogenesis. The former parallels major fractures of the western Central Atlantic and faults crossing North and South America and define faults along which Gulf of Mexico – Caribbean extension occurred. Crustal thicknesses and gravity data record thinning away from the cratons. Seismic data reveal Appalachian sub-salt orogenic fabric below the Gulf of Mexico. Architecture of salt-bearing rifts bounded by basement highs, outboard seaward-dipping wedges and thin crust repeats architectures of offshore eastern N America and the extended margins of the N and S Atlantic. The Caribbean interior shows the same architecture and tectonic fabric. This contrasts with the classic interpretation of internal Caribbean seismic data as a 20 km thick “oceanic plateau”, formed over a mantle plume in the Pacific, with forty kilometer-wide blocks of vertical dykes carrying seamounts and flanked by wedges of volcanic material. Upper Cretaceous basalts, Seismic Horizon B””, cover the Caribbean interior. Diapiric piercing and tilting/uplift of Horizon B” recalls the salt rafting of igneous layers in the Five Islands and Alderdice Bank areas of Louisiana. Horizon B” is not the final stage of thick, plateau extrusion, it is similar to flows above extended crust offshore Norway and NW UK. Change from smooth to rough character probably reflects change from subaerial to subaqueous environments. Ten km thick layers of continental velocities below Central America and the Lesser Antilles arc are consistent with the often-emphasized “continental-like” high silica chemistry of volcanic rocks. They are conventionally explained as new continental material formed in “subduction factories” by complex geochemical models involving ocean basalt and wedge rocks in multiple episodes of partial differentiation and mixing. Layers of continental velocity and inherited zircons reported from other arcs reveal ancient continental fragments dispersed by rifting and drifting. The layer below the Lesser Antilles extends as far as Barbados, where produced oil correlates chemically with Venezuela’s Maracaibo crude. Good seismic correlation at Eocene and Cretaceous levels between these areas. In the Caribbean inherited zircons reported from Cuba, Margarita, Granada and Carriacou are interpreted to indicate continental capture, subduction and resurrection from Colombia and Mexico or by subduction of craton-derived sediments. Eocene ash on Barbados records Lesser Antilles volcanism, but admixed zircons are suggested to have Saharan origins. These data should be considered in the light of the regional setting, the tectonic fabric of Middle America and data from other parts of the world. They indicate presence of original, ancient crustal foundations to the volcanic arcs. Internal integrity of Middle America spotlights exploration potential of the Yucatán and Caribbean basins, located between the prolific hydrocarbon provinces of the Gulf of Mexico and northern South America. They are as poorly known today as was the North Sea in 1965 and five times larger in area. Upper Cretaceous source rocks are known.

Drew, E., G. Christeson, H. van Avendonk, I. Norton, G. Karner, D. Johnson, E. Kneller and J. Sneddon, 2013, Seismic Refraction Profiles Indicate a History of Syn-Rift Volcanism and Seafloor-Spreading in the Northeastern Gulf of Mexico: AAPG Annual Convention and Exhibitiion, Pittsburgh, 1555049: **crystalline crust thins significantly across the continental shelf and Florida Escarpment from ~25 km to ~7 km in the deep-water eastern Gulf of Mexico**. **Multi-channel seismic reflection data coincident to GUMBO 3 displays seaward-dipping reflectors (SDRs) within this zone of crustal thinning**. **Additionally, localized areas of anomalously high seismic velocities (>7.5 km/s) are found beneath thick crystalline crust at the landward end of GUMBO 3.** These seismic velocities exceed those of continental lower crust in the eastern US. On the other hand, t**he seismic velocity structure is similar to that observed at volcanic rifted margins, where underplating and/or infiltration of asthenospheric melts have modified the lower crust**. We image **high crustal seismic velocities (6.0-7.5 km/s) and minor lateral velocity variations at the seaward ends of GUMBO 3 and GUMBO 4, along with 6-8 km crustal thicknesses; we interpret these regions as mafic ocean crust produced by normal seafloor-spreading**.