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Mesozoic Break-up of the Trinidad-Suriname and Bahamas Conjugate Margins, and the Cenozoic Caribbean Tectonic Imprint on the Trinidadian Portion of the Guiana Margin

James Pindell[1]

[1]Tectonic Analysis

ABSTRACT

Bathymetric, seismic, and potential surface data show that the Trinidad-Suriname (Guyana) segment of the northeastern South American continental margin is underlain by a linear and abrupt NW-SE trending transition from thick continental to "oceanic" basements. At the SE end of this segment, the Demerara Rise forms a submarine projection in the margin that until recently was presumed to be underlain by thinned continental crust beneath carbonate bank strata. The geographic re-entrant formed by the Guyana margin and the Demerara Rise formed the southern end of the Jurassic-Early Cretaceous Central Atlantic Ocean when it was narrow and restricted in terms of circulation due to the proximity of the conjugate Bahamas Platform margin. Hence, Jurassic or Early Cretaceous source rocks are possibly present along the margin, but better known is that the margin formed the eastern part of the Upper Cretaceous La Luna-Querecual-Gautier/Naparima Hill-Canje drowned passive margin platform, with excellent source rocks. In addition, the margin has received mature continental quartzose clastics from the Guyana Shield/Roraima Sandstone, especially during eustatic lowstands, wet climatic periods, times of epeirogenic uplift, and episodic Andean orogenesis for at least 150 Ma. In the Neocomian to Aptian, a westward-flowing river may be hypothesized along the line of nascent Equatorial Atlantic rifting, perhaps reaching the basin at the reconstructed juncture between Demerara Rise and Guinea Plateau.

1970's vintage plate tectonic reconstructions of Atlantic opening employed the classic but loose Bullard (1965) Equatorial Atlantic fit, and allowed for a wide range of options for the Guyana segment of the developing margins. However, the tightening of models of the Equatorial fit since the 1980's, and further revision of Central Atlantic opening kinematics, have provided a fairly precise kinematic framework for Jurassic breakup models. Interpretation of deep seismic data corroborates the kinematic prediction that the Guyana margin is primarily a transform margin, with possible transtensional steps, while the Demerara Rise is underpinned by very thick sequences of westward-facing magmatic seaward-dipping reflectors and only minor continental crust. It is also clear that the Great Bank of the Bahamas, now partly overthrust by the allochthonous Cuban arc, is the conjugate to the Guyana/Demerara Rise margin. A big question in the break up story concerns the nature of the basement beneath the Great Bank, and what the nature of that basement implies for the South American margin. Is it entirely thick magmatic crust associated with Atlantic opening? Or, is it thinned continental crust, with or without significant syn-rift magmatism, that was positioned there by sinistral transcurrent faulting across Florida (Trans-Florida Fault Zone) during the syn-rift stage of break up in the Gulf of Mexico? Presently, we can only be certain that the depositional setting of the Great Bank in the Late Jurassic was very shallow marine, such that reef-rimmed carbonate platforms were able to form, which have persisted to this day. However, our attempts to resolve this question lead us to favour a largely continental foundation beneath the Bahamian Great Bank, with associated implications for the Guyana margin.

No matter what the nature of the crust is beneath the Great Bank, the final plate tectonic event along the Guyana margin was the northwestward migration of a NE-SW trending seafloor spreading ridge (southern end of the Central Atlantic system) away from the Demerara Plateau and toward Trinidad. Thus, the margin was a sinistral transform margin until the passage of the ridge at any point, behind which the margin

progressively became a dead continent-ocean fracture zone, with little faulting into the overlying sedimentary section. However, the significance of the nature of the Great Bank's basement is this: if it is entirely magmatic, then the AGE of the crust along the Guyana segment can date back to 200 Ma, whereas if the crust is continental, then the age of the crust along the Guyana segment is likely entirely Late Jurassic. Current seismic reflection data show only a thin Jurassic section over the oceanic crust, possibly favouring the Late Jurassic option, with less predictable continental clastic run off due to relatively higher sea level. This interpretation constrains deep source and reservoir rocks to the Late Jurassic and younger, and also suggests that Late Jurassic-Cretaceous heat flow should have been higher than if the basement is Early to Middle Jurassic in age.

In the Cenozoic, Caribbean tectonic events modified the Trinidadian portion of the margin greatly. In the Paleocene, N-S compression between the Americas began, with most of the effects recognised thusfar affecting the northern South American margin. For example, seismic tomography shows that the original Mesozoic oceanic crust of the Proto-Caribbean Seaway has been detached from the continental margin. A key question is whether this was driven progressively as the Caribbean Plate advanced along the margin from the west, or whether it pertains strictly to intraplate shortening prior to the arrival of the Caribbean. Preliminary evidence points to the latter, with Trinidad's Northern Range beginning to form in the Paleogene, and possibly controlling Eocene (Pointe-a-Pierre) and Oligocene (Plaisance-Angostura) clastic fairway position. The encroachment of the Caribbean from the Oligocene, then, might be viewed as a superposition of transpressional tectonic settings upon the earlier developments. Of greatest importance to Trinidad's Columbus Basin is the arrival of the migrating Caribbean foredeep, caused by loading of the Caribbean's crust and accretionary prism on the South American continental crust. Since the Middle Miocene, the Orinoco River has transported enormous volumes of clastic detritus onto and across the Columbus portion of the margin. This great overburden has, in turn, driven enormous counter-regional and regional extensional fault systems above the autochthonous Cretaceous section, which trap sediments and collectively increase the total sediment isopach. Thus, there is far greater Cenozoic structural complexity in the Columbus Basin than farther SE in Guyana and Suriname, along with higher thermal maturity at the Cretaceous over a large region. However, the western flank of the Demerara Rise in Suriname underwent one of the largest submarine slides of strata, probably in the Albian, that I have ever seen.