Understanding the Evolution of the East African Extensional / Transform Margin in Tanzania and Kenya, Using Deep PSDM Seismic Images

Al Danforth [1], Steve Henry [2], Kelvin Komba [3], Peter Nuttall [4], and Sujata Venkatraman [4]
[1]Consulting Geologist, GX Technology, Houston, TX.
[2]Rift Institute for Teaching and Training, Los Cruces, NM.
[3]Tanzania Petroleum Development Corporation, Dar es Salaam, Tanzania, United Republic of.
[4]ION Geophysical-GX Technology, Houston, TX.

Regional deep imaging Pre-Stack Depth Migrated (PSDM) seismic data (ION/GXT SPAN™) from the east coast of Africa (Tanzania and Kenya) and from Madagascar have been interpreted to map the transition from Jurassic extensional rifting in Kenya to the Lower Cretaceous transform margin development in Tanzania. In this presentation, mapping of the continental-oceanic boundary (COB) in East Africa and Madagascar will be shown as well as conceptual paleo-geologic setting of the rift to early drift along the Tanzania and Kenya margins.

Mapping the COB, by consistently noting the seaward limit of the last blocks of continental crust, has resulted in geometries of the margins that have been used to reconstruct the relative fit of Madagascar with respect to East Africa. To avoid significant gaps between the plate margins, a large transform fault (~200 km) has been postulated in Madagascar. The northeastern two-thirds of Madagascar is interpreted to have started moving south in the Kimmeridgian, and with continuing extensional opening along the Somalia and Kenya margin the initial transform locked and a second more westerly transform developed during the Valanginian. The newly separated Madagascar / India plate then continued moving south, along the Davies Transform. India / Seychelles separated from Madagascar later, in the Santonian-Campanian, and rapidly moved to the north.

The interpreted geology during the transition from rift to drift is highly variable depending on which segment (extension or transform) is being observed. Volcanic activity is notable along the transforms which are observed to have generated volcanic transform ridges. The continental crust, however, remains thick (>25 km), and presumably, relatively cold even with the volcanism. In the extensional segments between the transforms, oceanic crust is generated in isolated “pull-a-part” basins, where sediments moved from the continental margins down these ramps and into the newly formed ocean basins in which source rocks could have developed.

Estimates of the ages of the first sediments deposited on oceanic crust are in general agreement with the published ages for the oceanic crust. Progressively younger drift sediments are observed on-lapping the newly formed ocean crust and fossil spreading ridge highs from the high areas in both East Africa and Madagascar. The position of the COB in this study is significantly different than any previously published.