

EA02

Tectonic History and Structural Evolution of the East Africa Margin

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Summary

Understanding petroleum systems within a complex region such as East Africa requires an approach that focuses on identifying controls on distribution of hydrocarbon systems, reservoir and seal, and trap history. We have defined several genetic tectono-stratigraphic domains across the East Africa offshore margin that share key hydrocarbon system characteristics whilst at the same time reflecting important spatial and temporal margin trends.

East Africa's margin history records rifting, continental break-up and long-lived structural reactivation and rejuvenation due to far-field tectonic stresses. Continental rifted margins in the north (Somalia to Northern Mozambique) are characterized by hyper-extension and/or mantle exhumation. In contrast, magma-rich margins developed in the south between Southern Mozambique and Zululand, were influenced by the long-lived Karoo hot spot track.

The varied tectonic history observed along the margin will be discussed utilizing a series of geo-seismic transects from northern South Africa to Somalia. These will illustrate the influence that genetic margin character has on the potential for source rock deposition, reservoir and seal development, trapping styles and hydrocarbon retention.

ABSTRACT

Understanding petroleum systems within a complex region such as East Africa requires an approach that focuses on identifying controls on distribution of hydrocarbon systems, reservoir and seal, and trap history. We have defined several genetic tectono-stratigraphic domains across the East Africa offshore margin that share key hydrocarbon system characteristics whilst at the same time reflecting important spatial and temporal margin trends.

East Africa's margin history records rifting, continental break-up and long-lived structural reactivation and rejuvenation due to far-field tectonic stresses. Early attempts at characterizing Gondwanan rifting focused over Proterozoic accretionary "grain" with rheologic weaknesses that would become important during later break-up. Jurassic to Early Cretaceous extensional and transform motion affected most margin segments. Continental rifted margins in the north (Somalia to Northern Mozambique) are characterized by hyper-extension and/or mantle exhumation. In contrast, magma-rich margins developed in the south between Southern Mozambique and Zululand, were influenced by the long-lived Karoo hot spot track. In these regions, seaward-dipping reflectors (SDRs) and over-thickened magmatic crust underpin the entire passive margin sedimentary prism (Figure 1). How this process linked with the magma-poor rifts trending north-south along the Somalia margin is uncertain, although events appear to be broadly contemporaneous. Early continental separation created a relatively restricted seaway, modified by the Davie Transform Zone, linking from Tethys into the nascent Weddell Sea (Figure 2). Following Early Aptian realignment of oceanic spreading centers, a long period of relatively passive sedimentation ensued. However, margin segments were modified with varying intensity and timing by far-field tectonic processes sweeping through Africa and from the evolving Indian Ocean margins. Extension related to the East African Rift System (EARS) has modified the northern part of the margin since Oligocene time, having particularly important implications for petroleum systems in the vicinity of the Rovuma delta.

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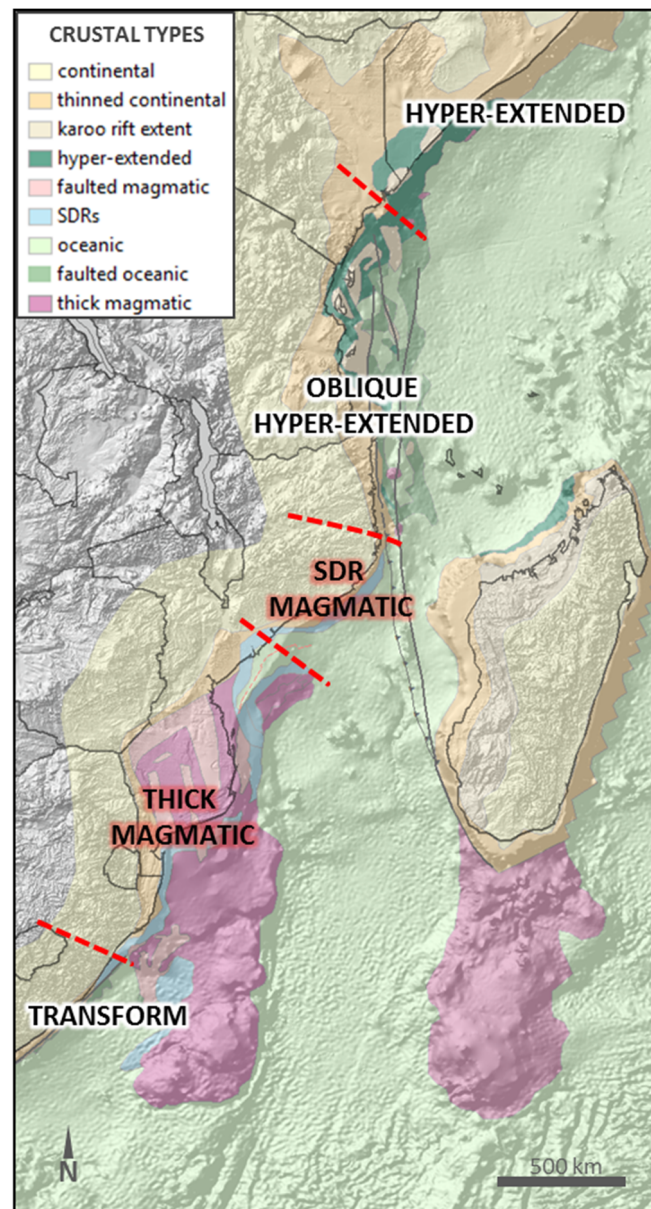


Figure 1 East African crustal types and tectonic domains. Topography data provided courtesy of Getech.

Callovian (165 Ma.)

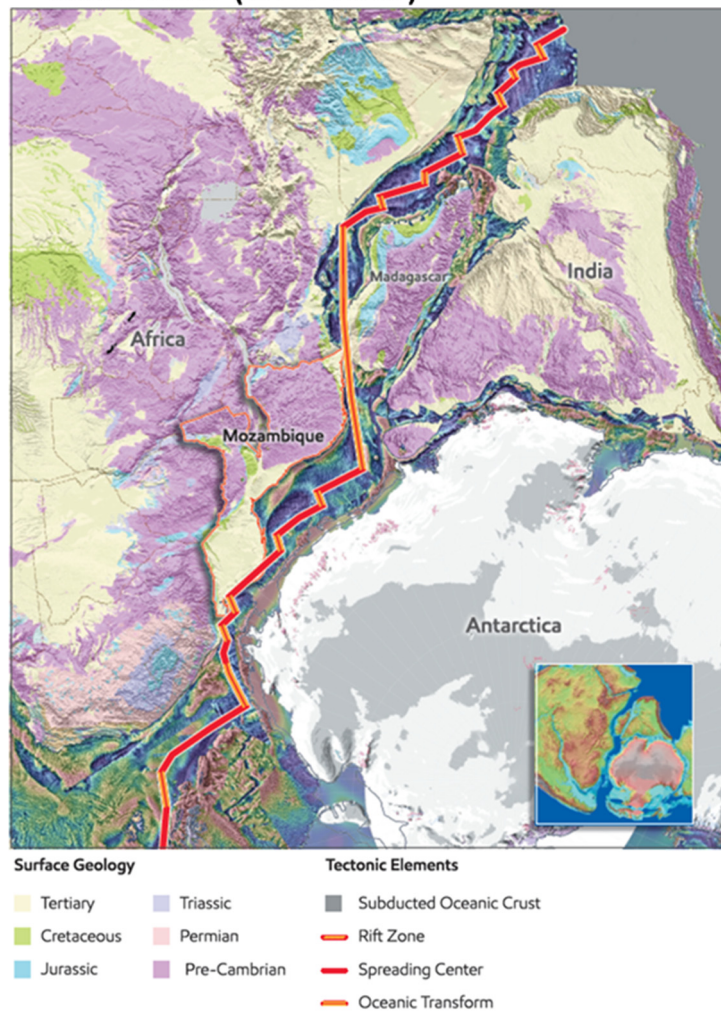


Plate Reconstruction Model from ExxonMobil URC/Global Tectonics.
 Gravity Data from Sandwell et al. Towards 1mGal Global Marine Gravity from Cryosat-2, Envisat & Jason-1, The Leading Edge 2013.
 Digital Surface Geology from Geologic Data Systems, 2003-2005; Digital Representation of the Geologic Map of Africa.
 Inset Map: Topography / bathymetry taken from Getech's global Digital Elevation Model.

Figure 2 Callovian plate tectonic reconstruction of East Gondwana. Surface geology data licensed by Geologic Data Systems.