

A Holistic Reappraisal of the Geological Evolution of the Tertiary East African Rift System, Kenya; Understanding the Controls on Basin Evolution and Petroleum Play Development

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ABSTRACT

The Kenyan East African Rift System (EARS) is a series of highly complex, spatially diachronous continental extensional rift basins that were formed between the Eocene and present day. Early exploration of these basins in Kenya revealed that effective petroleum systems existed in these continental systems where lacustrine shale source rocks charge fluvial and turbidite sands with oil. Exploration in the region has increased notably in the past decade with variable success rates in different basins. The results of exploration drilling have highlighted significant variability in both basin evolution and fill. The main challenge for explorers, in this complex region, is being able to predict which of the numerous unexplored basins will be potentially prospective. As with other petroleum provinces, the key to understanding play development is first to understand the Mega-regional geological controls and subsequently zoom into understanding the individual basins within this context. Based on voluminous academic research and proprietary geophysical (seismic and gravity), well, remote sensing, geochronology and outcrop data; we have conducted a full reappraisal of the evolution of the EARS in Kenya and the geological controls on play development. The holistic analysis has highlighted that the critical controls on basin and play development in the EARS of Kenya are:- Tectonic evolution: timing of basin initiation and rift maxima, influence of far-field stresses and mantle plume activity, crustal thickness, heat flow (influences source maturity). Basin geometry: influence of pre-rift basement architecture, basin accommodation, source rock deposition and overburden thickness (controls on source maturity). Paleogeography / Gross depositional environment: sediment provenance, sediment maturity and facies, regional and local scale uplift, Paleotopography and drainage pattern evolution, source rock distribution. Volcanics: reservoir quality / sediment provenance, volcanic doming and influence on drainage, heat flow, and basin fill. Paleo-climate: sediment flux, source rock deposition. The outcomes of this study have resulted in the development of a regional chronostratigraphic and tectonic framework which has helped in understanding the relationships between basins and controls on play development.