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# The Petroleum System of the South Lokichar Basin, Kenya (EARS)

Kuper, G.V.[1] and Haberer, R.M.[1]

[1]Tullow Oil plc., London, United Kingdom, gion.kuper@tullowoil.com

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Following a series of hydrocarbon discoveries in the young Albertine Rift in Uganda, Tullow Oil shifted the focus of its exploration campaign in the East African Rift System (EARS) to the eastern branch, acquiring a strong acreage position with partners Africa Oil Corp. in Kenya and Ethiopia. Whereas the western branch of the EARS consists of a young continental rift, the eastern branch represents a failed, mature rift system [1].

The new exploration campaign initially targeted the South Lokichar Basin, where a single well drilled in 1992 proved the existence of a working petroleum system, but suggested issues with trapping and charge mobility. The first new well in the basin, Ngamia-1, was a significant discovery, opening a major new play along the western bounding fault. Further discoveries followed in quick succession revealing a highly prospective basin with high overall charge volumes.

The South Lokichar Basin has been identified as the oldest rift basin in a string of EARS basins in the Lake Turkana area [2]. Both the occurrence of source rock and its thermal evolution are strongly influenced by the structural development of the basin. The extent and rate of crustal thinning over time determine the heat flow history, with sedimentation and erosion rates having important transient influence. The rate of basin opening also affects the potential for the development of rift lakes and the deposition of lacustrine source rocks. Three source rock horizons have been identified. The most prolific source rock is the organic rich and highly oil-prone Miocene Lokone Shale [3]. Understanding source facies variations, identifying access to charge and determining reservoir conditions, oil quality and charge preservation are shown to be essential aspects of recognising and drilling the most prospective accumulations. Unlocking the basin requires a detailed understanding of the geochemistry of the source rock and its thermal evolution.

The thermal history of the basin was reconstructed in a comprehensive petroleum systems model, incorporating the well data from the extensive drilling campaign and the results of a comprehensive analytical programme, including an apatite fission track analysis study performed at Trinity College Dublin [4]. Based on advanced geochemical biomarker and stable carbon isotope analyses of source rock samples and oils, we are able to differentiate between three lacustrine source rock sub-facies within the Lokone Shale, varying in the relative amount of input from green algae, cyanobacteria and terrestrial plants into the organic matter. These inputs in the model allow a more accurate prediction of hydrocarbon potential and character.

The modelling results reveal source rock maturation and hydrocarbon generation upon burial under elevated rifting heat flow, influenced by rift flank uplift in a complex interaction of factors influencing the thermal history. The basin model provides valuable insights in the variation of prospectivity across the basin, reducing risk and uncertainty related to charge quality and producibility.

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