TECTONICS, SEISMIC AND SEQUENCE STRATIGRAPHY OF MELUT RIFT BASIN, SUDAN

Ahmed El-Tayeb ¹ & Othman Ali Mahmud ²

¹ Exploration Department
Petrodar Operating Co, Khartoum, Sudan

² XTG, PCSB
16th Floor Menara 2, Petronas Twin Towers
KLCC, 50778 Kuala Lumpur

Recently, the fundamental principles of seismic and sequence stratigraphy have been applied to the analysis of rift basin fills formed in tectonically active settings. The spatial distribution and temporal evolution of depositional systems in such settings are considered to be significantly influenced by tectonics. Tectonism may be the major factor controlling stratigraphic and facies patterns by increase or decreases of accommodation space, alters depositional base level and thus, control the distribution of source areas. Fault movement and stage of basin development control the potential for erosion and the rate of sediment flux. It was the aim of this study to reveal a sequence stratigraphic framework of the Melut rift basin to obtain better understanding of the petroleum system origination and to substantiate plays delineation in different areas of the basin.

The Melut basin exhibits typical rift extensional tectonic feature with strike-slip effects. Major fault trends throughout the basin are NW-SE to NNW-SSE, oblique to the main basin axis. The penetrated sedimentary infill of the basin is dominated by fluvial and lacustrine sandstone and mudstone of Upper Jurassic to Quaternary age. Distribution of the facies is likely to have been controlled by pulses of fault-controlled subsidence followed by more prolonged episode of thermal subsidence. Identification of depositional environments and outlining the Low Stand, High Stand and Transgressive depositional systems tracts within an evolving rift basin implies that shale source rocks, sand reservoir rocks and shale sealing rocks distribution and their quality can be estimated in addition to defining sediments transportation pathways.

Sequence stratigraphic understanding of the basin leads to depositional model construction; moreover, current techniques of basin analysis are initially associated with the tools of seismic and sequence stratigraphy. Reliability and predictive power of the depositional model is based on the body of knowledge already obtained from the modern and ancient rift basin analogous to Melut. Therefore, a scientific synthesis of analogous rift basins is considered as an important stage in developing the depositional model. The model should be able to enhance an ability to predict location, thickness and properties of the source rocks, sealing shales and the quality and maturity of reservoir sands.

Melut rift basin depositional model, together with the analysis of the petroleum system elements, could be used for the construction of the geological model and the prediction of hydrocarbon occurrences in the basin, and thus, opened an opportunity to delineate the fairways of the sediment transportation into the local depocentres, and locating stratigraphic traps.

This work concluded that development of the sequence systems tracts of Melut rift basin was dictated by the extensional tectonic events taken place from the late Jurassic to early Tertiary. Main source rock of Al Renk, Galhak formation were developed during early rift to rift climax stages in localized Major Fault Bounded basins, and deposited in deep-lacustrine settings. The main reservoir sands of Yabus and Samaa formation were developed during the second rift phase, partly in the progradational High Stand Systems Tracts and the lower part of the subsequent Transgressive Systems Tracts. Adar formation, as the regional top seal, represents the upper part of the Transgressive systems tracts, and was developed in late rifting time.