Innovative Infield Exploration Ideas from a Field Development Exercise: The Case of Yusr Field, Eastern Desert, Egypt

Sharma Dronamraju[1]

[1]AKD Professional Solutions Inc

Abstract

The Gulf of Suez is a prolific petroleum province and has the most unique geological setting to study sedimentary responses to tectonics. The short source-to-sink distance (less than 30km) and active rifting provide a chance to study the rapid sedimentary response to rifting, accommodation space, and rate of sediment supply. For this reason, the Gulf of Suez has become a field-scale textbook for studying rift geometry and sedimentary response.

Recent work on the Yusr Field, Eastern Desert for an EOR project provided an opportunity to test new exploration ideas. The study is focused on Rudeis Fm. in the syn-rift section, and its hydrocarbon potential. Low- quality of 3D seismic and legacy lithostratigraphy ideas prevented subsurface clarity. This led to poor history match in production, poor injection response, and early water breakthrough in production and production simulations.

Late Cretaceous Limestone member (Brown Limestone) is considered to be the predominant source of hydrocarbons, with millions of barrels of oil recovered in classical fields such as Gemsa, Ramadan, and a few other well-known fields. Other factors include rapid burial of high-quality sands from arid provenance, formation of several horst-graben structures, sediment drapes due to differential subsidence, effective entrapment by shallower evaporite sequence, etc. Traditional production came from the pre-rift clastics and carbonate sequences, in well-defined faulted-block structures. However, much of the future exploration in the Gulf of Suez will depend on understanding the sedimentation trends in syn-rift and post-rift sag periods (Oligocene-Miocene), in extraordinarily complex fault systems in the regionally extensive Nukhul, Rudeis, and Kareem formations. These reservoirs are poorly imaged due to a thick overburden of evaporites, and the sparse well coverage adds to subsurface uncertainty.

In the current study, analogs from the East African Rift System interpreted in satellite imagery and intra-cratonic rifts of Eastern Brazil, supplemented by scaled physical models of experimental deformation contributed to a better understanding of the oblique extension and its sedimentary response. This exercise compensated for the poor quality of the 3D seismic image of the subsurface. Carefully extracted seismic attributes illuminated fault patterns that were previously unrecognized. Detailed high-resolution sequence stratigraphy, anchored in chronostratigraphy, using several dip and strike-trending well correlations enabled a clearer definition of prograding parasequences. This stratigraphic clarity is the basis of understanding fluid distribution in the field and re-allocation of the 20-year production data. The correlations demonstrated the dynamic nature of sedimentation. Structurally elevated transfer zones sourced and redistributed sands, which were trapped in

depocenters between the transfer zones, with several areas of up-dip stratigraphic terminations and lateral seals. New infill wells were planned in these locations for bypassed pay. Mature basins offer a wealth of data and potential infield and nearfield opportunities. While better imaged 3D seismic is imperative, a geologist must use every possible analog data and resource to understand the dynamic nature of syn-rift sediment distribution in a rift basin.