

New Exploration Frontiers in North Africa: An Architectural Evaluation of Potential Paleozoic Resource Plays

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ABSTRACT

The proven Paleozoic petroleum systems of North Africa are considered mature for exploration and need new exploration concepts to significantly expand their proven portfolios of reserves. A recent evaluation of the Paleozoic hydrocarbons in the Illizi Basin identified it as one of the World's 25 super basins- that is, a basin with at least 5 BBOE of reserves and at least 5 BBOE of undiscovered reserves. This supports the notion that significant exploration potential can occur across the region because of the pan-regional nature of productive successions. The most likely location of unproven reserves will occur within unconventional plays, either as shale plays or within tight reservoirs. A high-resolution sequence stratigraphic interpretation of the Paleozoic facilitates a comparison of these sediments that allows for a better definition of unconventional exploration potential. It is well-established that the main source rocks in the Paleozoic are Early Silurian and Late Devonian in age. These are prolific and have charged multiple stacked reservoir targets in structural or stratigraphic traps through long-distance lateral migration. A significant stratigraphic "migration corridor" occurs between the source kitchen and reservoirs such that hydrocarbons are potentially stranded in tight formations. This is especially the case for Silurian-derived hydrocarbons. Applying a sequence stratigraphic model, it can be demonstrated that Silurian and Devonian successions were deposited by several third-order cycles of sea-level change with organic matter preservation being dominant around some maximum flooding surfaces where paleogeographic conditions facilitated restriction and/or oceanic effects limited oxygenation in the water column. During times of lower sea-level, the influx of coarser grained sediments into these shales has the potential to impart a more brittle fabric on the rock and enhance its potential as a shale play. In addition, the inundation or development of subtle paleogeographic highs during these sea-level changes assists the development of tight plays. These are identified as perched (or isolated) lowstand shorefaces, shorefaces located around onlapped paleohighs or truncation sandstones associated with subtle unconformities. The challenge for the explorationist is the visualization and exploitation of such technically challenging hydrocarbon resources.