Tawil Formation, Eastern Saudi Arabia: Sequence Stratigraphic Analysis and Implications for Better Understanding of Reservoir Heterogeneities

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ABSTRACT

The late Silurian-Early Devonian Tawil Formation is a proven hydrocarbon reservoir. In order to predict sandstone reservoir architectures, a sequence stratigraphic analysis has been applied using multiple disciplines such as sedimentology, biostratigraphy and chemostratigraphy. Biostratigraphy results for this unit is good in the north of Ghawar and the offshore area where various palynozones and regional events are identified. However, in some fields, palynological analysis proved barren of the sand-prone nature of the Tawil Formation. The samples were either barren or yielded sparse long-ranging spore species. Although no age can be assigned to this interval based on palynology in these fields, anywhere else Early Devonian (Lochkovian-Pragian) spore assemblages characterize the upper part of the Tawil Formation. Its lower limit is indicated by an unconformity and the upper limit with the Jauf Formation is probably disconformable. The chemostratigraphy indicate a close match between the recognized chemozones and lithostratigraphic schemes. Eleven lithofacies, grouped into two facies associations were identified in cores of the Tawil Formation. Integration of biostratigraphic, chemostratigraphy and sedimentological data indicate that the Tawil Formation contains more siliciclastics mostly fluvial sandstones, in southwest and western area, while the more distal facies is located in the north and northeastern Arabian Gulf region. The depositional environment is mostly fluvial distributary channels tidally influenced within an overall deltaic setting. Petrographic data indicate the main controls of reservoir properties that lithofacies of Tawil Formation are composed of well sorted, fine- to medium-grained, quartz arenites dominated by monocrystalline quartz grains and a few mica flakes. Pervasive quartz cementation have reduced the intergranular porosity, Pore-filling illite also occludes the intergranular porosity with local kaolinite and chlorite.