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The Stratigraphic Trapping Potential of the Paleozoic Unayzah in Eastern Saudi Arabia

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ABSTRACT

The upper part of the Permo-Carboniferous ‘Unayzah Group constitutes one of the main Paleozoic reservoirs that has been the target of hydrocarbon exploration in the eastern and central part of Saudi Arabia for the last three decades. Recently, and based on integration of various datasets, disciplines and technologies, we have identified a major east-west trending Aeolian facies of the ‘Unayzah A reservoir over 300 kilometers long, just south of the super-giant Ghawar field.

The ‘Unayzah A reservoir, is among the most prolific gas reservoirs in eastern Saudi Arabia. It is made up of sand flat facies and Aeolian sand dunes interbedded with fluvial and playa lake deposits. ‘Unayzah A can be predicted using well logs and seismic character. Seismically, it shows as bright seismic amplitude event representing porous Aeolian sand dunes facies. It has been encountered in wells drilled in the area south and downdip from super giant Ghawar field. A few kilometers updip to the north, along this major east-west Aeolian fairway, drilled wells targeting ‘Unayzah A reservoirs penetrated silty playa deposits rather than reservoir-quality sands. These silty playa deposits represent effective lateral seals as confirmed by core and log data.

Recent integration of well and seismic data clearly defined multiple stratigraphic trap configurations at the ‘Unayzah A level. Using wells penetrating good reservoir and tight facies, we were able to demonstrate that well logs and 3D seismic data can be used to predict the fairway of the well-developed ‘Unayzah A Aeolian reservoir. Aeolian facies (good reservoir) are characterized by low gamma-ray, high porosity and positive seismic amplitude while playa and interdune (nonreservoir) are characterized by high gamma-ray, low porosity and negative seismic amplitude. This work led to construction of more detailed Gross Depositional Environment (GDE) map that provided framework for further exploring the ‘Unayzah A. The current geometric configuration of the basin, facies distribution and migration pathways provide ideal setup for additional potential for stratigraphically trapped hydrocarbons at the north of Aeolian boundary where the facies change from Aeolian dune to playa facies in ‘Unayzah A in this region.