

Structural Styles in the East Rub' Al Khali Basin, Saudi Arabia: Implications for the Paleozoic Petroleum System

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ABSTRACT

The East Rub' Al-Khali basin of Saudi Arabia can be differentiated into two main structural trends, one north – south striking, related to the continent configuration during the Neoproterozoic associated with the Amar collision (Al Hussaini, 2000), and a second with a northeast – southwest orientation related to the Najd Fault System in the Early Cambrian. The north – south structural trend is characterized by Neoproterozoic basement blocks with associated sediment-draped anticlines, which likely influence the deposition of the Paleozoic sedimentary sequences. This basement control affects the Lower Paleozoic deposition, but is also thought to influence the sedimentation patterns of the Carboniferous and Permian sections. The northeast – southwest structural trend is characterized by compressional folds over rotated blocks. These blocks show strike-slip components at their onset, and the main growth is thought to be associated with the tectonic uplift related to the Base Tertiary compressional event. The Paleozoic petroleum system is referred to in Cantrell et al., (2012) and comprises the Early Silurian Base Qusaiba Hot Shale source rock, and the Carboniferous – Permian reservoirs of the Unayzah Formation along with the Ordovician reservoirs of the Sarah Formation. The Unayzah Group is made up of the Late Carboniferous to earliest Permian Juwayl Formation at the base and the early Permian Nuayyim Formation at the top. The Juwayl Member consists of the glacio-fluvial Ghazal and glacio-lacustrine Jawb Members. The deposition of the Juwayl formation is strongly influenced by the antecedent topography whereby the sediments were preferentially deposited in the paleo-lows - compared with the thinner and sometimes absent sections observed on the paleo-highs. The Silurian Qusaiba Hot-Shale is characterized as a marine clastic source rock with Type II kerogen (Organo facies B of Pepper and Corvi, 1995). Preservation is variable leading to mixed oil and gas proneness. Paleo-highs, (N-S Structural trends) in the Silurian are thought to contribute to poor deposition and preservation of organic matter – reducing the effectiveness of the Qusaiba Hot Shale. A more subtle effect of the paleo-highs on source rock quality is demonstrated by historic and recent penetrations, where shallow water conditions and increased oxidation are thought to have decreased organic matter preservation.