

Bridging the Gap between Conventional and Unconventional Reservoirs: A Regional Sequence Stratigraphic Correlation of the Middle and Upper Jurassic Carbonates in Saudi Arabia

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ABSTRACT

The carbonate succession deposited during the Middle to Late Jurassic of Saudi Arabia is a crucial element in the petroleum system of the Kingdom, as it contains excellent source, reservoir and seal intervals. Within that succession, this study focuses on three formations: Tuwaiq Mountain (Callovian), Hanifa (Oxfordian) and Jubaila (Lower Kimmeridgian). Despite the long-established and generally accepted stratigraphy of said formations in the conventional realm, the relatively recent push toward unconventional exploration in the Jafurah Basin area highlighted the need to identify the sequence stratigraphic signature of the organic-rich Jurassic succession, tying it with its conventional counterpart at the regional scale. An extensive, core-based analysis was carried out on tens of measured sections and wells across central and eastern Saudi Arabia, from the outcrop belt (Riyadh area), to the eastern offshore area. The c.500 km long W-E transect discussed in this study was chosen as an optimal representation of the regional stratigraphic trends, and is based on integrated sedimentological, biostratigraphical and chemostratigraphical data. Wireline log responses and core data from offset wells were used to interpret any uncored intervals. In line with the established sequence stratigraphic framework of the Arabian Plate, four separate 3rd order sequences were identified between the base of the Tuwaiq Mountain and the lower Jubaila formations. Several 4th and, in some cases, 5th order sequences were also identified and correlated across the transect with variable degrees of accuracy, as the stratigraphical constraints become less reliable and eventually disappear in the deeper water, organic-rich succession of the intrashelf basin. The studied succession shows an overall c.70% thickness reduction (c.1300 ft to <400 ft) from the outcrop belt to the Jafurah Basin. The greatest thickness reduction seems to affect the upper part of the Tuwaiq Mountain and the whole Hanifa formations, where the highest organic matter contents are recorded. The regional correlation work is undergoing continuous improvement, and further sedimentological, biostratigraphical and chemostratigraphical analyses are being carried out on newly acquired cores. Moving on from a purely core-based approach, the next step in firming up the sequence stratigraphic correlation of the Middle to Upper Jurassic succession in Saudi Arabia is to integrate core-based analyses with seismic interpretation.