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High Resolution Sequence Stratigraphy of a Shoreface and Estuarine Embayment Succession: A Devonian Gas Reservoir in the Ghawar Super Giant Field, Eastern Saudi Arabia

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The Devonian (Praghan to Frasnian) Jauf Formation in the Ghawar Super Giant Field and adjacent areas of eastern Saudi Arabia thickens from 650 feet in the west to 1100 ft thick in the east, and comprises a marginal to shallow marine siliciclastic succession. It consists of a lower 3rd order sequence (S1), here called the Lower Jauf, which is dominated by a sand-prone progradational *falling stage systems tract* (FSST), totally lacking an overlying coastal plain deposits. Whereas the upper 3rd order sequence (S2), named the Middle and Upper Jauf, is comprised of a mud-prone, estuarine *transgressive systems tract* (TST), forming the Jauf Embayment (Middle Jauf), and an overlying *highstand systems tract* (HST) composed of progradational shoreface and an overlying coastal plain deposits (Upper Jauf). A key aspect of the succession, and a critical point in making a predictive model for a wider area, is that the Jauf 3rd-order sequences can be subdivided into a series of building blocks of 4th order depositional sequences of transgressive-to-regressive character. The lower 3rd order sequence (S1) consists of 16 fourth order sequences, while the upper 3rd order sequence (S2) consists of 15 fourth order sequences. Three types of 4th order sequences with different systems tracts architecture are recognized. The **D3B biozone**, an extensive stratigraphic marker consisting mainly of dark colored shale, occurs at the top of the TST in 3rd order sequence S2 and marks its *maximum flooding surface* (MFS).

It is the detailed stacking patterns of these high-frequency sequences (4th order) and an understanding of their well-to-well architecture that will provide a powerful tool for the prediction of sand- and shale-dominated areas away from the data set. A notable feature of these 4th order sequences that can be seen in the sequence array is that the transgressive tract tends to thicken significantly landwards whereas the highstand tract thickens in the opposite direction, i.e. basinwards. This trend becomes an important tool in prediction into unknown areas.

The exploration implication of the model is that in both sequences S1 and S2 the 3rd order LST, not present in the study area, with its high reservoir quality potential may be present in the eastern areas, beyond the study region somewhere in the eastern Arabian Gulf or thrust in Iran.