Sequence Stratigraphy of Subsurface Late Jurassic Arab D Formation, Hawiyah and Harmaliyah fields, Saudi Arabia

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The Late Jurassic Arab D Formation and its overlying anhydrite in Hawiyah (Ghawar) and Harmaliyah (20 km east of Ghawar), Saudi Arabia, is an overall shallowing upward composite sequence with up to 8 higher frequency sequences. Both fields have very similar parasequences 3-5 m thick. Facies packages include, from deep to shallow: interbedded lime mudstone, skeletal pellet wackestone and intraclastic-oncolitic storm beds, in upward deepening cycles capped by hardgrounds; fine skeletal-pellet packstone forebank apron, extensive biostromal banks of domal and encrusting stromatoporoid floatstone (both muddy and grainy types) and the shallower water facies Cladocoropsis-peloid packstone/ grainstone/ floatstone; lagoonal facies are peloid packstone/grainstone, Thaumatoporella-Clypeina fine packstone/wackestone, followed by nearshore ooid/mollusk grainstone/packstone, peritidal microbial laminites, and sabkha nodular anhydrite.

From sequence to sequence, there is a progressive upward shallowing of facies with the lowest sequences dominated by deeper open marine facies and the upper sequences characterized by shallow water restricted facies, showing effects of increasing hypersalinity. Unequivocal subaerial exposure surfaces and tidal flat microbial laminites are only developed at the top, just beneath the evaporite. Lower in the Arab D, tidal flat facies may not have been deposited due to insufficicient shallowing, or perhaps any tidal flat facies were burrow homogenized, or eroded during trangressive ravinement. It is also possible that subaerial exposure at some of the sequence/parasequence boundaries was not manifested in obvious paleosols due to the arid climate.

The similarity of the Arab-D facies, parasequences, and sequence makeup between the two fields, as well as regional isopach maps (L.B. Smith, personal communication), suggest that they are part of one large platform that extended from the outcrop belt in the west, to the eastern shelf edge, rather than being initiated on syndepositional structural highs. West to E/NE progradation is suggested by isopachs and stromatoporoid and Cladocoropsi facies that thicken and become younger toward the east, and the more restricted ooid-peloidal grainstone facies and evaporites are thickest toward the west.