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Sequence Stratigraphic Framework and Depositional Systems of the Arab-D Reservoir in Ghawar Field, Saudi Arabia

The Late Jurassic (Kimmeridgian) Arab-D member consists of complex facies associations and clinoform units deposited in the intrashelf Arabian basin and associated platform. A 300 km-wide ramp bordered the Arabian basin, which extended from the offshore Abu Safah and Berri fields southwestwardly into central Saudi Arabia. This basin encloses the largest field in the world, Ghawar, as well as other super-giant fields (Qatif, Abqaiq and Khurais), all of which produce oil primarily from the Arab-D member.

From bottom to top, the Arab-D member consists of numerous mud-, organic, and grain-dominated facies associations, which record an overall shallowing-upward history and a longterm base-level fall. Several high-frequency sequences, however, are recognized on the basis of facies stacking patterns and regional correlations. Lime mudstones, common in the lower Arab-D, represent a sub-wave base (<100 ft) outer-ramp setting. Overlying intraclastic and oncolitic rudstones represent storm-dominated channel-fill and algal-bank environments. Thick, amalgamated rudstones record base-level fall and storm-wave erosion of the firmground substrates. The upper Arab-D reservoir consists mainly of open marine organic buildup facies and grainstones. Coral-stromatoporoid facies accumulated as sheets and northward-thickening and backstepping low-relief mounds during a base-level rise that culminated with the bank margin centered in northern Ghawar and Abqaiq fields. Subsequent base-level fall led to the deposition of several basinward-(south) stepping, skeletal, peloidal, and ooid grainstone units with a shingled, or clinoform, geometry. The youngest clinoforms were followed by lowstand to overlapping transgressive anhydrite units that formed in a subaqueous to desiccated salina, which extended across the remnant Arabian basin.