

Shu'aiba Formation Environments of Deposition: Southern Rub' Al-Khali, Saudi Arabia

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ABSTRACT

Environments of deposition (EODs) were interpreted for the lower-third (seismic thickness) of the Early Cretaceous, lower to middle, Shu'aiba Formation (including the Aptian-1, -2, and -3 parasequences) over more than one-million square kilometers. Additional EODs were interpreted for the upper two-thirds (including the Aptian-4, -5, and -6) over several thousand square kilometers. The EODs were interpreted on the basis of observations from 2D and 3D seismic and a priori knowledge of the depositional system. Significant new insights were gained by integrating new cross-sections based on wireline logs, cores, and biostratigraphic correlations. The lower-third is characterized by carbonate EODs that include lagoon, shoals, open marine platforms with isolated buildups, and deeper-marine intrashelf basins with sparse isolated buildups consistent with deposition along a low-angle ramp. It has consistent thickness over considerable areas with thinning observed in intrashelf basins. Deposition is consistent with aggradation, starting from antecedent topography and filling accommodation on paleo-highs and paleo-lows. For example, lagoons and shoals occupy paleo-highs; whereas, deeper-marine intrashelf basins occupy paleo-lows. In contrast, the upper two-thirds is characterized by progradational clinoforms, and varies considerably in thickness (i.e., deposited in some areas and not in others). Deposition is consistent with reciprocal sedimentation and filling accommodation in response to sea-level oscillations. Our EOD maps highlight areas with significant reservoir potential, allowing predrill reservoir quality predictions. Significantly, the basin margin is considerably more complicated than previously thought with potential for the Shu'aiba / Bab basin system to charge juxtaposed reservoirs. For example, in the lower-third, isolated buildups are underappreciated reservoirs expected to have moderate reservoir quality (RQ), (2) carbonate debris-flows and turbidites are unproven reservoirs expected to have fair-to-excellent RQ, and (3) reef mounds and patch reef complexes are unproven reservoirs expected to have moderate RQ. In the upper two-thirds, clinoforms on low-relief closures are proven reservoirs with potential for compartmentalization and stratigraphic closure. They are expected to have moderate-to-good RQ.