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A new stratigraphic model for the deposition of the Dammam Formation

Stephen Lokier, Flavia Fiorini, and Jina Min
The Petroleum Institute, Petroleum Geosciences, Abu Dhabi, United Arab Emirates (slokier@pi.ac.ae)

In recent years, mixed siliciclastic-carbonate successions have increasingly become targets for hydrocarbon exploration and production activities. Despite the abundance of these successions throughout the Middle East, there have been very few attempts to employ quantitative techniques to interpret their depositional settings and to develop constrained sequence stratigraphic models for their deposition.

This study focuses on the Eocene age Dammam Formation that crops out on the flanks of the Jebel Hafeet anticline south of Al Ain in the United Arab Emirates. The Dammam Formation comprises units alternating between poorly-lithified, easily-weathered, siliciclastic and marly horizons and well-lithified limestones. These units were deposited in a foreland basin that formed in association with the Late Cretaceous obduction of the Semail Ophiolite onto the northeastern margin of the Arabian Plate. The Paleogene infilling of this basin is recorded in the shallowing-upward sedimentary sequence of the lithologies of the Pabdeh Group. This succession records the transition from marine carbonate sedimentation, through increasingly evaporitic-dominated units during the late Eocene to early Miocene to a fluvial-alluvial system by mid to late Miocene times.

The Dammam Formation was deposited in an open shallow-marine setting strongly influenced by the influx of siliciclastic material sourced from the close-by uplifted massif of the obducted ophiolite. The skeletal assemblage of the Dammam Formation is dominated by Nummulites and Assilina larger benthic foraminifera along with subordinate smaller foraminifera, echinoids, bivalves, corals, bryozoan, gastropods, echinoids and calcareous algae. Previous studies of the Dammam Formation have employed the biotic component in the reconstruction of water depth. However, these studies neglected to consider that turbidity, associated with the abundant siliciclastic component, resulted in a reduction in the depth of the euphotic zone and a consequent response of the benthic biota.

We employ a range of quantitative analytical techniques in order to constrain the influence of the siliciclastic component on the lithofacies of the Dammam Formation and present a new sequence stratigraphic model for the deposition of the formation.