

Stratigraphy and Depositional Environments of the Late Jurassic Hanifa Formation along the Tuwaiq Escarpment, Saudi Arabia

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ABSTRACT

A sequence stratigraphic framework of the Late Jurassic (Oxfordian) Hanifa Formation at its exposure in Central Arabia is presented for the first time. This study offers the first high-resolution stratigraphic framework of the Hanifa along the Tuwaiq Escarpment by measuring 15 sections (~770 m total thickness) over an oblique-to-dip distance of 260 km and collecting 295 samples for petrographic analysis. On the basis of these data, the Hanifa Formation can be subdivided into eight facies; 1) tabular cross-bedded quartz-peloidal-skeletal grainstone, 2) cross-bedded skeletal-peloidal grainstone, 3) bioturbated foraminiferal wackestone/mud-dominated packstone, 4) oncolitic rudstone, 5) stromatoporoid-coral biostrome/bioherm, 6) peloidal/composite-grain grain-dominated packstone/grainstone, 7) bioturbated spiculitic wackestone/mud-dominated packstone, and 8) thinly-bedded argillaceous mudstone/wackestone. The vertical and lateral distributions of these facies along the exposure define their sequence setting using the principals of sequence stratigraphy. By recognizing erosional surfaces, facies offset, and changes in facies proportions, five composite sequences, with an average duration of 1.1 my, are interpreted for the Hanifa Formation. The correlation of the sequences across the study area shows that only four sequences are preserved in the north where shallow-water deposits are well-developed. Facies trends within these sequences are further illustrated in a depositional model, which depicts the presence of an offshore structurally controlled skeletal-peloidal shoal body described here for the first time at the Hanifa exposure in the Hozwa area. A ramp depositional model is proposed having normal open-marine conditions and characterized by a high-energy inner-ramp shoreline, which is documented herein for the first time. This work provides a predictive framework and outcrop analog for applications in hydrocarbon exploration and development. Furthermore, a basinal setting predicted to the south of the study area is a potential site for unconventional plays.