

High Resolution, Multidisciplinary Biostratigraphic and Petrographic Analysis of the Late Cretaceous to Early Tertiary Sediments and the Identification of Subtle Truncation Stratigraphic Traps in the Eastern Rub' al-Khali

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ABSTRACT

The lower Wasia Formation of the Rub' al-Khali Basin (RAK) consists of a mixed, layercake stratigraphic succession of sands, muds and carbonates, deposited during the middle to late Albian, during a period of relative structural stability and rising global sea levels. Compressional forces, associated with the emplacement of the Oman Ophiolites, during the Late Cretaceous, resulted in the formation of a series of NNE-SSW trending subparallel anticlines across the eastern RAK. A phase of strong uplift and erosion during the Danian resulted in the formation of the Base-Tertiary Unconformity (BTU), which cuts out the Aruma and the upper part of the Wasia Formation over the crest of the Zumul-Lekhwait High. This unconformity is overlain regionally by a 30 ft thick interval of late Paleocene to early Eocene aged terrigenous mudstone, tentatively correlated with the "Lina shale" or "Shammar Shale" (of Saudi Arabia and Oman), which provides a regional top seal and sets up the possibility for subtle truncation traps around the flanks of the High.

The base of the Wasia Formation consists of the "Nahr Umr Member," a 600 ft thick monotonous succession of early to middle Albian aged, silty terrigenous mudstones characterized by a highly restricted fauna of ostracods, small agglutinated foraminifera, gastropods, bivalves, and echinoids. These muddy facies were deposited within regionally extensive vegetated, tidal flats to shallow lagoon bay settings, located in front of the Khafji-Safaniya-Burgan delta systems. The mudstones are arranged into three to four subtle, coarsening upward log motifs. The lowest cycle is terminated by the post-Shu'aiba stringer, which was deposited by a low angle carbonate ramp formed in response to a brief marine transgression across the "Khafji delta front" during the "K100 mfs."

The "Nahr Umr Member" is overlain by three to four, thin, regionally correlatable, microporous carbonate stringers, informally referred to as the "Upper Safaniya Limestones." Around the Zumul High they consist of bioclastic packstone and wackestone, and represent deposition within middle to outer ramp settings. They are composed of orbitolinids (*Orbitolina sefina* and *Conicorbitolina cuvillieri* confirm a late Albian age), trocholinids, *Permocalculus* spp., echinoid debris, sponge spicules, agglutinating foraminifera, ostracods, *Roveacrinus* spp., *Lenticulina* spp., and rare coral fragments, surrounded by micritic rich micropeloidal matrix. Regionally, the limestones are arranged into an upward thickening succession, separated by intervals of yellow to green colored, illite-smectite rich silty claystones. This configuration is thought to record a series of increasingly pronounced marine transgressions across the Safaniya delta front.

The uppermost limestone is overlain by the "Safaniya Source Rock," a regionally correlative interval of finely laminated, organic-rich limestones, rich in planktonic foraminifera (including *hedbergellids*, *Heterohelix moremani* and the late Albian form *Favusella washitensis*),

calcspheres, Rotalipora, Macrolobigerinelloides, trochospiral ticinellids, Roveacrinus spp. and Bositra spp.. These condensed sediments were deposited within deep, anoxic to suboxic basinal settings, following the drowning of the carbonate ramp, during the “K110 maximum flooding surface” (Sharland et al. 2001). The “Safaniya Source Rock” is, in-turn, overlain by a series of shoaling upward muddy carbonate cycles, which eventually pass into the blocky, highstand platform carbonates of the late Albian aged Maaddud Member.