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Controls on Distal-to-Proximal Facies Variability Within a Eustatically Driven, High Resolution Sequence Stratigraphic Khuff C Carbonate Succession, Southern Ghawar, Saudi Arabia

The up to 500-meter Permo-Triassic Khuff Formation overlies Permo-Carboniferous siliciclastics, is overlain by Triassic fine-siliciclastics, and is made up of five informal subsurface members (in stratigraphic order): Khuff D, Khuff C, Khuff B/C, Khuff B, and Khuff A. In Ghawar Field, the Khuff C, B and A members are major reservoirs of non-associated gas, currently under development.

The up to 90 meters thick, Khuff C carbonates, are made up of two high-frequency sequences bounded by sharp, regionally mappable boundaries with varying degrees of exposure features and regionally mappable flood-backs. These sequences and component cycle-set boundaries are marked by regionally mappable gamma ray signatures, facilitating their mapping in non-cored wells. The TST of each sequence is made up of back-stepping cycle-sets (3 to 10 meters each), that are made up of peritidal, lagoonal, back-barrier, shoal, fore-shoal, and storm influenced facies. High-energy, fore-shoal/deep marine bryozoan mud, mark the maximum flooding (MF). The HST (during forced regression) of each sequence is made up of one cycle set, a few meters thick, with back barrier and shallow sub-tidal facies.

The Ghawar structure, active during Khuff deposition, partitioned facies from proximal on the crest to distal on the flanks. Crestal variability formed proximal facies over subtle highs to distal facies over subtle saddles. The structural differentiation along the crest, possibly, accentuated tidal influence to further facies differentiation. High-frequency (3rd/4th order) eustacy (low-to-moderate amplitude) during a transitional time from the Permo-Carboniferous glaciation into Permo-Triassic green house, gave rise to the regionally mappable high-frequency sequences, their TST, HST, and component cycle-sets.