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# From Core to Hydrocarbon: Reservoir Sedimentology, Facies Analysis and Depositional Model of Early Oligocene Mahuva Formation in Tapti Daman Block, Western Offshore Basin, India

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**Abstract :** The Oligocene succession of the Tapti- Daman area is one of the established petroleum plays in Tapti-Daman block of the Mumbai Offshore Basin. Despite good control and production history, the sand geometry and continuity of reservoir character of these sediments are less understood as most reservoirs are thin and fall below seismic resolution. The present work focuses on a detailed analysis of the Early Oligocene Mahuva Formation at the reservoir scale through laboratory studies (sedimentology and biostratigraphy) of core and sidewall cores in integration with electro logs for firming up facies' distribution, micro-depositional environment and sequence stratigraphy, diagenesis and reservoir characterization from seventeen wells from North Tapti-C-37 area in Tapti Daman Block, WOB. The thick shale/claystone with thin interbeds of sandstone and siltstones of deeper marine in the lower part of Mahuva Fm represents deposition in a transgressive regime. The overlying interbedded sandstone, glauconitic-siltstone/fine-grained sandstone, and thin beds of packstone/grainstone within highly fissile shale were deposited in a prograding tide-dominated delta during late-rise normal regression. Nine litho facies (F1-F9) representing deposition in various microenvironments of the tide-dominated delta are identified based on their characteristic sediment texture, structure and microfacies. Massive, gritty sandstone (F1) with poorly sorted sands lithic fragments with calcareous and Fe-rich matrix represents channel fill sediments. High-angle cross-stratified sandstone (F2) deposited in rapidly shifting/migrating bars under strong tidal currents. F3 records the laterally accreted tidal-channel point bars. F3 (low-angle cross-stratified to parallel bedded sandstone) and F4 (Clean sandstone) are often associated with F2 in a tidal bar complex. F5 (interbedded thin sand and mud) and F6 (bioturbated sandstone) represent tidal flat deposits. High energy open marine carbonate shoals (F8) and fossiliferous sandstone in offshore bars (F7) represent deepening up facies. Shallow marine standstill conditions facilitated the deposition of thick shale (F9) beds. The reservoir facies (F1-F6) are commonly poorly to moderately sorted; bimodal, immature sandstone represented by quartz-wacke. The framework grains are sub-angular to sub-rounded, medium to coarse-grained (occasionally gritty) embedded within argillaceous (kaolinite/chlorite/chamosite) to highly Fe-rich matrix (sideritic). The facies F7 and F8, representing the sandy packstone and grainstone facies, respectively, exhibit poor reservoir characteristics due to sanitization, diagenetic compaction and matrix-filled intergranular spaces. The various diagenetic features such as the presence of authigenic clays (kaolinite/dickite/smectite); ferruginous minerals like siderite, pyrite, hematite and other iron oxides; bioturbations; glauconite; calcite and quartz cementation, precipitation of gypsum, pressure solution and other compaction effects are identified. These diagenetic features, wherever present, have reduced porosity and permeability thereby adversely affecting reservoir quality. Tidal bar sandstones possess good reservoir characteristics such as moderate to good sorting, fair to good porosity and geometry that facilitates efficient lateral extension and vertical thickness of reservoir. The sand bodies of F2, F3 and F4 facies of Well L, M and Q deposited in a tidal bar complex exhibit good reservoir quality represented by relatively cleaner, poorly burrowed, loose, friable sandstone with good porosity. Sandstone facies around these wells could prove a potential hydrocarbon reservoir and could be considered for further exploration.

**Keywords :** reservoir sedimentology, facies analysis, HST, tide dominated delta, tidal bars
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