Refined Reservoir Architecture of the Early Cretaceous Burgan and Wara Formations in the Greater Burgan Field, South Kuwait

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ABSTRACT

The Greater Burgan Field in South Kuwait is the world's largest siliciclastic reservoir with producing zones from a series of Cretaceous reservoirs including the Burgan and Wara Formations. Key to an optimised development of these important reservoirs is an improved geological understanding of their reservoir architecture and connectivity within a robust stratigraphic framework. This was derived from a multidisciplinary study of 123 cored wells, integrating core sedimentology, petrography, bio- and chemostratigraphy, well and image logs. The distinct stratigraphic changes in gross sand-mud ratio in the Burgan Formation are linked to four depositional models. Aggradationally stacked, low-sinuosity fluvial channel sandbodies dominated by steeply dipping, NE-E oriented, downstream migrating bars in the lower Burgan account for a relatively simple, sheet-like depositional architecture across the field with only limited divergence of sandbody orientations. A more distal, tidally-influenced channel system bound at the base by an erosional unconformity prevails in the middle Burgan, potentially showing a more complex internal architecture due to higher channel sinuosity. Cannel abandonment plugs, floodplain and rare marine mudrocks form laterally restricted baffles with limited application for further stratigraphic zonation. The transgression of a wave-influenced and possibly tidally-affected river delta on top of the compositionally mature lower and middle Burgan channel sands accounts for reduced reservoir volumes mainly hosted in isolated mouthbar and delta-front sandbodies. Tidally-influenced and locally heterolithic channel sandbodies form the main reservoir in the Wara Formation. These are confined to three, several tens of feet thick, dominantly SW/W to NE/E oriented incised valleys that cut into marine-dominated shoreline mudrocks and glauconitic sandstones in the lower Wara and brackish-dominated bay deposits in the upper Wara. The typical upward-fining/muddying, composite fill of the valleys control their permeability architecture. Intra-valley depositional heterogeneities, such as cm to dm-thick muddy laminae, beds and thicker mud plugs, account for smaller scale permeability variations possessing a risk for unswept reserves. Unravelling the sub-field scale depositional architecture of bay-type reservoir sandbodies outside the incised valleys in the upper Wara could be a critical aspect to enhance future field development.