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Reservoir Quality Variations within the Lower Cretaceous Minagish Formation: Insights From Undevelopped Areas, Onshore Kuwait

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ABSTRACT

The Minagish Formation forms one of the most prolific oil reservoirs in onshore Kuwait. This work focuses on understanding the variations of reservoir potential within the Middle and Upper Minagish Members, and assessing the extent of potential sweet spots in the unexplored south-western area of Kuwait. The Minagish sediments were deposited in an intertidal to proximal mid-ramp setting, with the development of oolitic shoal corridors and sand bars formed in a more landward position on the inner ramp. The hydrocarbon stain is present where carbonate sand bars/intertidal deposits sit below an exposure above which a distinct change in deposition to clay/organic matter-prone deposits (Upper Minagish) occurs. The well correlation shows a condensation of the sand bars/intertidal deposits in the south-western part of the area due to a progressive decrease in accommodation at the end of the regression. Several diagenetic phases have been identified within the Minagish. The main cementation phases include synsedimentary marine fibrous calcite, equant/blocky calcite potentially formed by meteoric fluids and burial saddle dolomite. An early dissolution phase is observed, creating secondary macropores. A late dissolution phase is also likely to occur due to corrosive burial fluids. Porosity and permeability are closely related to sedimentological variations: better reservoir potential is hosted within initially macroporous, coarse-grained peloidal and oolitic deposits (creating sweet spots), and lower reservoir quality is associated with micritic-rich facies. Subsequent diagenesis influences the pore system evolution: the early mechanical compaction reduces the primary interparticle macropore volume and pore-throat radii in the grainy textures. The development of fibrous calcite within these units is likely to limit the negative impact of compaction on the pore volume, while pore-filling calcite and dolomite phases partially to locally completely occlude the macropores. The early dissolution event results in the creation of secondary vuggy and mouldic macropores, while it possibly enhances the micrite-hosted microporosity. In the grainy textures, the effect of this dissolution phase is minor and may enhance the interparticle macropore volume. Since the sedimentary fabric plays a significant role on porosity and permeability, the sedimentary framework can be used as a direct platform for the reservoir architecture and prediction within the studied area.