Depositional Architecture of the Gotnia Basin during Oxfordian in Southern Part of Kuwait

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Abstract

The Oxfordian, represented by the Najmah Formation, having a thickness close to 300 to 400 feet in the Southern part of Kuwait is tight, fractured, carbonate reservoirs which are often vertically and laterally heterogeneous due to depositional variability and diagenetic alteration through space and time. The Formation is subdivided into Lower, Middle, and Upper. The Lower unit is represented by dominantly wackestone and minor mudstone with few thin intervals of bituminous mudstone. The Middle unit is dominantly bituminous mudstone with several grain flow units sourced from the south, causing significant thickness variations within unit. The Upper unit is dominantly oncoidal bioclastic packstone with a thin mudstone unit at the top. The depositional architecture of the basin is suggestive of deposition of these grain-flows within intra-shelf basin from shallow shelf area of the basin, which are sourced from the south and might have been triggered by some tectonic activity. The Upper Najmah was deposited on a gentle ramp representing deposition in inner ramp setting with frequent exposure surfaces marked by leaching and dissolution. The topmost Najmah is represented by bituminous mudstone, representing their deposition within a restricted shelf. The sequence stratigraphic analysis based on detailed core descriptions of the Najmah Formation helped defining a high-resolution stratigraphic framework. The vertical successions of the interpreted depositional environments within the Najmah Formation represent deepening and shallowing events. Sediments have seen the diagenetic events from syndepositional to post depositional stages with fracturing as one of the major diagenetic event. The effect of diagenetic events on altering porosities is not very evident except fractures that have modified the porosity to some extent and permeability to a larger extent leading to a good productivity in spite of poor matrix porosities. Petrographic features of fractures, vertical paragenetic relations of the fracture system, and widespread sediment-hosted mineralization of the Najmah Formation and partially to completely mineralized cracks are suggestive of early cohesive sediment ruptures rather than lithified rock fracturing in the Najmah. Understanding the role of diagenetic events in deciphering the history of fracturing and relative timing of multiple fractures set and fracture cementation events and its relation to hydrocarbon migration can play a key role in future exploration and developments of these reservoirs.