Dolomitization as Control on Reservoir Quality of the Marrat Formation, Qashaniyah Field, Kuwait

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Abstract

Objectives/Scope: In 2008, the Marrat Formation was discovered in north Kuwait, and is now considered one of the country's most important carbonate oil reservoirs. In 2021, Kuwait announced the discovery of the Marrat Formation within a new field, however, the controls of the reservoir quality of the Marrat Formation in Kuwait are poorly described in literature. Therefore, this study aims to shed light on the new discovery of the Marrat Formation within the Qashaniyah Field to understand its potential for further exploration and development. This study aims to investigate the controls of the reservoir quality of the Marrat Formation in the Qashaniyah Field through various sedimentological techniques.

Methods, Procedures, Process: Thin-section interpretation, X-ray diffraction data, log interpretation, detailed petrographical analysis, and cross plot of porosity and permeability were conducted on the samples from the Marrat Formation to investigate the controls of the reservoir quality.

Results, Observations, Conclusions: The results show that the porosity of the Marrat Formation is largely associated with dolomitization. Detailed petrographical analysis revealed the presence of replacive and pore-filling dolomite that occur either with or without bitumen. Saddle dolomite was recorded within a laminated interval of stromatolite. Saddle dolomite is a hydrothermal mineral that occurs in burial diagenesis at high temperatures. Saddle dolomite coexists with stromatolite, suggesting an interplay between shallow and deep diagenesis, in which the Marrat Formation's porosity was created. The cross plot of porosity and permeability indicates that the best reservoir within the Marrat Formation is associated with dolomite and stromatolitic bindstone. Digital rock analysis was conducted on a sample from each rock type, which indicates that stromatolite itself contains 85% of dolomite along with high porosity (up to ~12%). However, the permeability is very low (~0.5 mD) compared to pure dolomite sample (~10mD). Nevertheless, MICP analysis suggests that stromatolite can produce hydrocarbon efficiency from horizontal, connected pore space that were created from late dissolution. This study demonstrates the effect of dolomitization on reservoir quality within the Marrat Formation through various sedimentological techniques. The study provides a better understanding of the controls of the reservoir quality of the Marrat Formation, which can enhance hydrocarbon exploration and development in the Qashaniyah Field.
**Novel/Additive Information:** This study provides novel insights into the impact of burial diagenesis towards increases of reservoir quality in Marrat. Since the saddle dolomite is observed in coexistence with porous rocks, it indicates the control of burial diagenesis since saddle dolomite can only be a product of burial diagenesis from deep hydrothermal fluids. These findings are crucial for understanding the formation of reservoirs within the Marrat Formation, and can aid hydrocarbon exploration and development in the Qashaniyah Field.