Diagenetic Controls on Reservoir Quality: Insight into the Late Ordovician Sarah Tight Sand, Rub' Al-Khali Basin, Saudi Arabia

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ABSTRACT

This study aims to understand the diagenetic processes involved in enhancing or reducing the reservoir quality of the Late Ordovician Sarah tight sand Formation in the Subsurface of Rub' Al-Khali Basin. Core samples retrieved from six wells that penetrated the Late Ordovician Sarah Formation in the basin were described to identify the lithofacies and determine their depositional environments. Thin sections, XRF, XRD and SEM studies were conducted to characterize the impact of diagenesis on reservoir quality. Based on the identified lithofacies associations from the six investigated cores, this study reveals four depositional environments including a nearshore lake, glaciolacustrine delta, subglacial tillites and glaciofluvial outwash environments. The petrographic analysis shows that compaction and feldspar dissolution are mostly common in subarkose nearshore and sublitharenite glaciofluvial sandstones. Besides, silica cement and a trace amount of mixed layer illite-smectite clay occurred in several intervals of these lithofacies with porosity values ranging from 3% to 13% and permeability values ranging from 0.1 to 1 millidarcy (mD). Anhydrite, barite, sericite and illite clay mineral cement occurred in sublitharenite to quartzarenite sandstones of the glaciolacustrine delta lithofacies which are characterized by porosity values ranging from 0.1 to 11% and permeability values which are mainly less than 0.1 mD. The observed porosity and permeability values for the subglacial lithofacies are less than 4% and less than 0.1 mD, respectively. Overall, this study reveals that diagenetic processes such as compaction and cementation are responsible for the low reservoir quality of the Sarah tight sand while feldspar dissolution and natural fractures likely enhanced the reservoir quality in some lithofacies. Understanding the diagenesis of the Sarah tight sand will help to predict reservoir quality and contribute significantly to the evaluation and stimulation activities of the reservoir in the Rub' Al-Khali Basin.