Mudstones Sealing Capacity of the Cenozoic Formations of the Red Sea Basin

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Abstract

Jabal Kibrit, Burgan, and Al Wajh formations are syn-rift deposits, associated with opening of the Red Sea, during the Oligocene to middle Miocene. Each of the formations host mudstone intervals which their sealing capacity is evaluated individually and locally.

Three wells located in the central and northern Red Sea were examined to inspect the mudstone units within the three formations. Samples from the cored intervals revealed different types of mudstone differentiated based on clay content and sorting. The analysis of the three formations, which differ in age but represent similar depositional environments, allows the assessment of the influence of depositional processes and diagenesis on the sealing capacity of mudstones.

In this study, Petrographical and petrophysical analyses were carried out on the mudstones in question to assess their sealing capacity through understanding the influence of pore network, brittleness, clays presence and the impact of later diagenesis. The analyses include Optical microscopy, Scanning Electron Microscopy (SEM) and X- ray Diffraction (XRD), Quantitative Evaluation of Minerals (QEMScan) analyses integrated with gamma ray, density, porosity and sonic velocity petrophysical logs analyses.

The results show low sealing capacity of the mudstones examined within all of the formations. This is caused by increased total porosity which positively correlates to their heterogeneity and brittleness. The high grain content contributes to brittleness and the abundancy of framboidal pyrites and illite stacks contributes to the increase of macro-porosity and permeability.

The integration of petrographical and petrophysical analyses is essential as variations at a finer scale can be easily ‘missed’ when utilizing petrophysical logs in isolation. The study recommends Mercury Injection Capillary Pressure (MICP) tests for further characterization of mechanical properties, in order to gain a better understanding of the implications of pore networks and mudstone sealing capacity.