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The Organic-Rich Limestones of Najmah Formation in Kuwait – An Unconventional Play

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ABSTRACT

The Najmah Formation (Callovian – Kimmeridgian) in Kuwait is represented by highly variable lithologies, deposited in a shallow ramp to basin environment. The base of the formation is assigned above a major hardground surface (sequence boundary). A disconformity marks the boundary between the Najmah and the overlying Gotnia Salt. The sediments comprise mainly of organic-rich limestones deposited in an anoxic outer ramp to basin environment. A wide range of clean limestones forms several cleaning-upward cycles. The Gotnia Basin formed during one of the later extensional phases associated with the formation of Tethys.

Based on distinct predominant lithologies, in the South (400 ft) the formation is divisible into five units, whereas in the North (150 ft.) the formation has four units. Two of these units represent clean, carbonate-platform type limestones. They are good reservoir. Porosity is present mostly as fractures. Three other units are organic-rich limestone, which are the object of this study. They can act as both source rock and reservoir locally (hot spots). The other play parameters place them in the category of tight, unconventional plays (see below), and objective is to present the nature and properties of these units.

Integrated sedimentology, XRD, SEM and geochemical studies, contribute to the recognition of the true geological nature of the formation. The petrographic analysis reveal detrital and authigenic mineralogy, the texture, and the controls on reservoir quality. Matrix is compacted faecal pellets. Detrital clay is present as illite and kaolinite. Calcite is present at all forms of cements. Dolomite and pyrite are present in small amounts. SEM studies show the presence of nano-porosity lower than 6% and negligible permeability. The Rock-Eval Pyrolysis studies show values of kerogen of 10-15 %, and TOC of 2-25%. The geochemical studies show vitrinite reflectance values of 0.7-1.2, suggesting the oil to light oil/condensate window. The hydrogen index (HI) values are higher than 250 mg/g, characterized as type-II kerogen. It is an excellent source rock. Conducting geochemical tests and mapping the thermal maturity of the formation is one of the key elements of success. The maturity seems to relate directly to the gas to oil ratio, one of the key factors controlling gas flow rates. The above studied properties increased the chances of locating hotspots in the area under investigation.