

4.3 CHARACTERIZATION OF AN UNCONVENTIONAL ORGANIC-RICH CARBONATE MUDSTONE, LATE JURASSIC OF SAUDI ARABIA

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ABSTRACT

Five cores from a late Jurassic (Kimmeridgian) carbonate mudstone succession from Saudi Arabia were evaluated for sedimentologic, stratigraphic, organic geochemical, and geomechanical properties. A broad range of data allowed a comprehensive characterization of this potential source-rock interval that was deposited in a basinal setting during Kimmeridgian time in the Jafurah basin of eastern KSA.

Twelve lithofacies were identified through centimeter-scale core descriptions, standard petrography, and XRD and XRF characterization. Lithofacies are grouped into two distinct facies associations based on similarities in sedimentological and geochemical properties. Organic-rich facies of calcareous and mixed-calcareous mudstones with low bioturbation indices, high-redox sensitive elements, medium to high paleo-productivity indices, and good to excellent TOCs, corresponded to anoxic to dysoxic oxygen levels. In contrast, calcareous- and silica-rich mudstones with high bioturbation indices, light coloration, poor TOC values, and low redox-sensitive elements were deposited in more oxygenated water in a more proximal setting. Based on multiple data sets, a high-resolution sequence stratigraphic interpretation will be discussed.

The twelve lithofacies have also been characterized by their organic richness and hydrocarbon potential. Organic richness and hydrocarbon generation potential are good to excellent in the more anoxic facies association. Thermal maturity estimates from pyrolysis T_{max} and maturity related biomarker ratios suggest a medium- to high-maturity source rock, analogous to the mature oil and wet-gas windows.

KEYWORDS: Carbonate mudstone, unconventional petroleum system, sedimentology, stratigraphy, geochemistry