

Effective Geochemical Methods for Characterization of Two Major Source-Rocks in Kuwait through Samples Reduction by Selective Screening Technique

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ABSTRACT

The potential source-rocks Najmah and Makhul Formations in Kuwait, has both been subjected to thoroughly intensive studies by applying a range of geological and geochemical methods to determine their characteristics. As a cost-effective method, the screening analysis determines the hydrocarbon potential and treated as the earliest phase of the analytical processes. The next phase allows the elemental, molecular, and isotopic concentrations of several selected samples to be determined. Only a few of the selected samples from the representative region is further treated to high resolution geochemical analysis which consists of Quantitative Extended Diamondoid Analysis (QEDA) and Carbon Specific Isotopes Analysis (CSIA) for biomarker and diamondoid. The Najmah organic-rich interval provides the main contribution for Jurassic system in Kuwait, has TOC values range from 0.5 to 25 wt. %, characterized as type II and Type II-S organic matters, and matured source rock. The younger source rock Makhul has lower TOC values, less matured than Najmah and serves as the main active kitchen pot for the Kuwait Cretaceous System. A thick layer of anhydrite acts as natural sealing has split out of these two main source rocks. Najmah source is characterized by its low nickel content and varying vanadium concentration between 3 - 45 ppm. The vanadium concentrations increase progressively in the Makhul source. Both samples Makhul and Najmah has low Pristane/n-17 ratio with the range 0.07 – 0.33 (< 0.5) indicates deposited in marine environment. Makhul samples tend to have high phytanes/n-C18 ratio between 0.31 – 0.55, thus acknowledged as carbonates source rocks. Najmah has values of pristane/phytane ratios with the range 0.27 - 1.29 implies carbonate source rock deposited in marine environment. The isomerization ratios of 20S/ (20S+20R) of the Makhul extracts ranges from 0.46 - 0.56, suggests that all samples are thermally mature which indicates the samples has reached the oil window. Hence, the integrated result of steranes, monoaromatic steroid, and QEDA provides detailed interpretation for the organic facies. Based on QEDA concentrations, the organic-rich Najmah is divided into two organic facies in the northern zone and three in the western and southern zones. The western Makhul QEDA concentration is higher than the northern QEDA, dividing it into two organic facies. Incorporation of highly accurate methods that is cost-effective will reduce risks of petroleum exploration.