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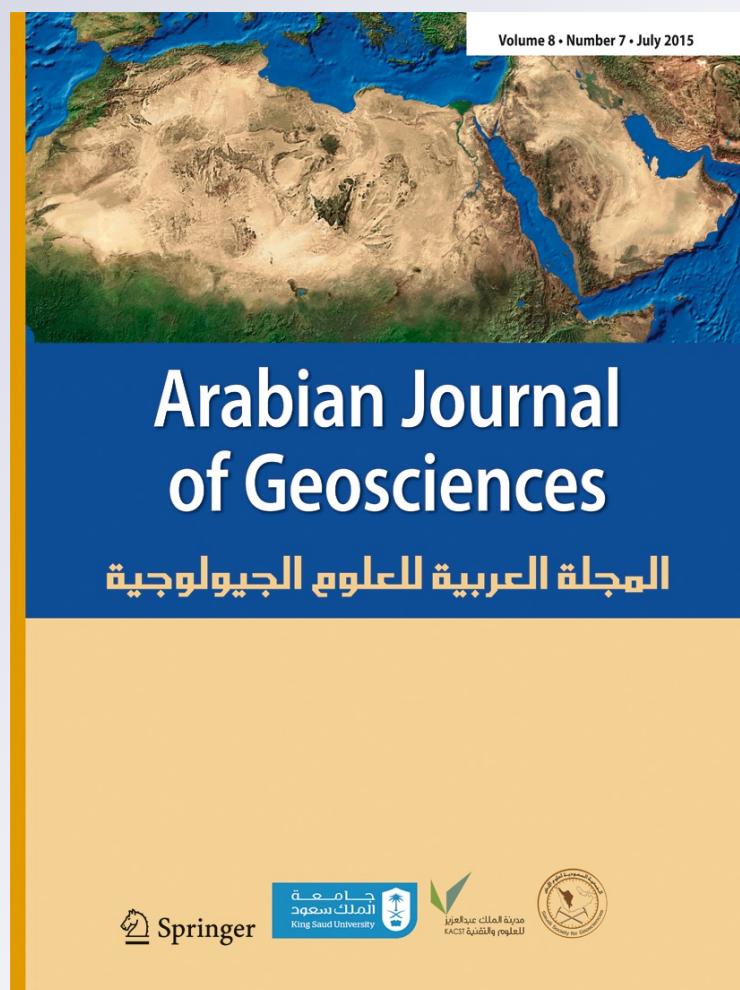
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Abstract The main parameters of the possible source rock within Zubair Formation are satisfying, in terms of quantity, quality, and thermal maturity. Thirty-eight samples (15 cores 23 cuttings) are analyzed to determine the pyrolysis parameters as well as nine rock samples (6 core and 3 cuttings) are introduced to gas chromatography/mass spectrometry (GC/MS) analysis. On the other hand, six oil samples were analyzed to determine the carbon isotopes, biomarkers, composition, and correlation. Quantitative analysis is done with GC/MS. In addition, 14 rock samples were subjected to infrared analysis. All these data are mainly obtained from Nassiriah, Gharraf, and Rafidain oil fields in Euphrates Subzone as well as from Rumaila North, Rumaila South, Zubair, and West Qurna oil fields in Zubair Subzone. Early-peak oil generation has been indicated from the Vitrinite reflectance (R_o) to the chosen samples in the Zubair Subzone (R_o maximum 0.81 %), while in the Euphrates Subzone, the maturity is indicated as immature-early oil generation (R_o maximum 0.69 %) due to shallow depths of Zubair Formation as well

as the terrestrial supply of organic matters. On the other hand, the optical investigation revealed that the formation is within the mature zone dependent of color index. From the total organic carbon (TOC) values' point of view, shale intervals within Zubair Formation are generally good to excellent as source rocks, except in the lower parts, namely, the Lower Shale Member in the Zubair Subzone, which has fair amounts of the total carbon content. While the kerogen types are mainly type III gas prone, but type II/III oil-gas prone, and type II oil prone are available, which the later concentrated in the upper and lower sandstone members. The dominant type of organic matters was the amorphous organic material (AOM), which is principally related to oil prone source rock. On the other hand, the IR analysis also indicates the oil prone type II and type I kerogens in dependence on the A and C factors. The Rock-Eval pyrolysis shows that the organic geochemical properties presented an effective and/or potential source rock depending on the values of S1, S2, and S3 and their derivatives. This source rock has started the oil expulsion, where the S1/TOC values were mainly more than 0.2 mgHC/g TOC. The source-related biomarkers suggested that the reservoir oils of Zubair Formation and the source rock-extracted oils indicate the same origin, depositional environment, sulfur content, and maturity level. The depositional environment of the source rock is indicated as the anoxic, shallow marine offshore facies of the prodelta shale intervals, which is located within the multi-story sand bodies.

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Introduction

Lower Cretaceous deposits are of great importance especially in southern Iraq because they contain a great hydrocarbon accumulations and reserves (Al-Obaidi 2009). Zubair