



## Source rock evaluation and petroleum generation of the Lower Cretaceous Yamama Formation: Its ability to contribute to generating and expelling petroleum to cretaceous reservoirs of the Mesopotamian Basin, Iraq

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### ABSTRACT

The Yamama Formation is an important reservoir as well as a good source rocks in many of the oilfields of the southern Mesopotamian Basin, Iraq. The formation represents a regressive cycle deposited in a shallow carbonate ramp that was under clastic influence from the nearby land. This setting is a determining factor in the organic matter content. Geochemical pyrolysis, palynofacies, biomarkers, and carbon isotope analyses were conducted on 152 samples from 27 oil wells. The formation represents a regressive cycle deposited in a shallow carbonate ramp that was under clastic influence from the nearby land. Based on pyrolysis analyses, the source rocks have poor to excellent hydrocarbon potential. The kerogen types of the Yamama source are varied, including II, II/III, III, and I. This is due to the varied depositional environments and related organic matter sources (continental to marine).

The studied samples also showed a variety in distribution between oil-prone kerogen type II, distal sub-oxic–anoxic and the dysoxic–anoxic marine carbonate environments of (IX) and (VIII) zones of Tyson Ternary, which reflect the wide variations in the sediment depositional paleo-environments. The difference in the variations of normal alkanes of light alkanes in the range of n-C13 to n-C19 of the gas chromatography analyses, as well as the verities of the biomarker ratio of the tricyclic terpanes, hopane, and homohopane, indicate differences in the depositional setting. Similarly, the carbon stable isotope compositions of <sup>13</sup>C (‰) saturated and <sup>13</sup>C (‰) aromatic hydrocarbons, as well as the canonical variable value for Yamama source rock extracts, correspond to a variety of organic matter sources, ranging from open marine to terrestrial with plants.

The Tmax values for most Yamama source samples range from 430 °C to 451 °C, the C<sub>27</sub> Ts/Tm, C<sub>29</sub> sterane 20S/(20 S + 20 R) and ββ/(ββ+αα) stereoisomer, and triaromatic steroids 3 [TAS3] ratios, indicating that the studied samples are in the range “immature to oil window”, and that Tmax of 430–450 °C corresponds to an early to peak oil window stage. The Yamama source intervals entered the early oil window in the Late Cretaceous ranging from 80 to 62 Ma and completed oil generation in the early Eocene to Late Miocene approximately 80 to 62 Ma, according to 1D-Burial, thermal history modeling, and the timing of oil generation of selected wells covering the studied area (58–7 Ma). This confirms that these source intervals have completed petroleum generation and have contributed significantly to the supplies of crude oil and gas to surrounding reservoirs.

### 1. Introduction

The Yamama Formation of Valanginian age was introduced to the Arabian stratigraphy by (Steinke and Bramkamp, 1952) in Saudi Arabia

to be distinguished from the Ratawi Formation. By extension, the formation name has been applied to the upper part of a more or less continuous pelley limestone sequence which underlies the shaly Ratawi Formation in the Ratawi well of southern Iraq, and also Burgan 113 in

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