

Research paper

Origin of crude oils from oilfields in the Zagros Fold Belt, southern Iraq: Relation to organic matter input and paleoenvironmental conditions



Mohammed Hail Hakimi ^{a,*}, Ahmed Askar Najaf ^b

^a Geology Department, Faculty of Applied Science, Taiz University, 6803 Taiz, Yemen

^b College of Geophysics and Remote Sensing, Al-Karkh University, Iraq

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ABSTRACT

Crude oil samples from Cretaceous and Tertiary reservoir sections in the Zagros Fold Belt oil fields, southern Iraq were investigated using non-biomarker and biomarker parameters. The results of this study have been used to assess source of organic matter, and the genetic link between oils and their potential source rocks in the basin. The oils are characterized by high sulphur and trace metal (Ni, V) contents and relatively low API gravity values (17.4–22.7° API). This indicates that these oils are heavy and generated from a marine source rock containing Type II-S kerogen. This is supported by their biomarker distributions of normal alkanes, regular isoprenoids, terpanes and steranes and the bulk carbon isotope compositions of their saturated and aromatic hydrocarbons. The oils are characterized by low Pr/Ph ratios (<1), high values of the C₃₅ homohopane index and C₃₁-22R/C₃₀ hopane ratios, relatively high C₂₇ sterane concentrations, and the predominance of C₂₉-norhopane. These biomarkers suggest that the oils were generated predominantly from a marine carbonate source rock, deposited under reducing conditions and containing plankton/algal and microorganisms source input. The presence of gammacerane also suggests water column stratification during source rock deposition.

The biomarker characteristics of the oils are consistent with those of the Middle Jurassic Sargelu carbonate as the effective source rock in the basin. Biomarker maturity data indicate that the oils were generated from early maturity source rocks.

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1. Introduction

The Zagros Fold Belt and Mesopotamian Basin are the main basins in Iraq, extending from northern to southern Iraq (Fig. 1). These two Iraqi basins have large oil and gas reserves contained in giant oilfields (Al-Sakini, 1992; Sadooni, 1993; Sadooni and Aqrabi, 2000) as defined by Bally and Snelson (1980).

The area of interest of this study lies in the southern part of the Zagros Fold Belt (Fig. 1). The Zagros Fold Belt is an important hydrocarbon province in Iraq and contains several, well known hydrocarbon fields (Fig. 1a). The Zagros Fold Belt has attracted the interest of numerous researchers and oil companies (e.g., Al-Ahmed, 2006; Al-Ameri and Zumberge, 2012; Mohialdeen et al., 2013; Al-Ameri et al., 2013; Sachsenhofer et al., 2015). All of these

prior publications have studied the northern part of the Zagros Fold Belt. These studies report the presence of possible source rocks occurring within the Jurassic to Cretaceous rock units. These potential source rocks are the Upper Jurassic-Lower Cretaceous Chia Gara, Upper Jurassic Naokelekan and Middle Jurassic Sargelu formations. The Jurassic-Lower Cretaceous source rocks of the northern part of Zagros Fold Belt are bituminous limestones and black shales, which have high total organic carbon (TOC) contents ranging from 2 to 20 wt%. These source rocks all contain high sulphur-rich (Mohialdeen et al., 2013; Sachsenhofer et al., 2015), and suggests the presence of Type II-S kerogen, which can be expected to generate early-mature sulphur-rich oils (Baskin and Peters, 1992). These source rocks were deposited in a carbonate-rich, anoxic environment with elevated salinity (Mohialdeen et al., 2013; Al-Ameri et al., 2014; Sachsenhofer et al., 2015). However, little is known about the quality and maturity of the potential source rocks or about the oil characteristic accumulated in the southern part of the Zagros. In this regard, eleven crude oil

* Corresponding author.

E-mail address: ibnalhakimi@yahoo.com (M.H. Hakimi).

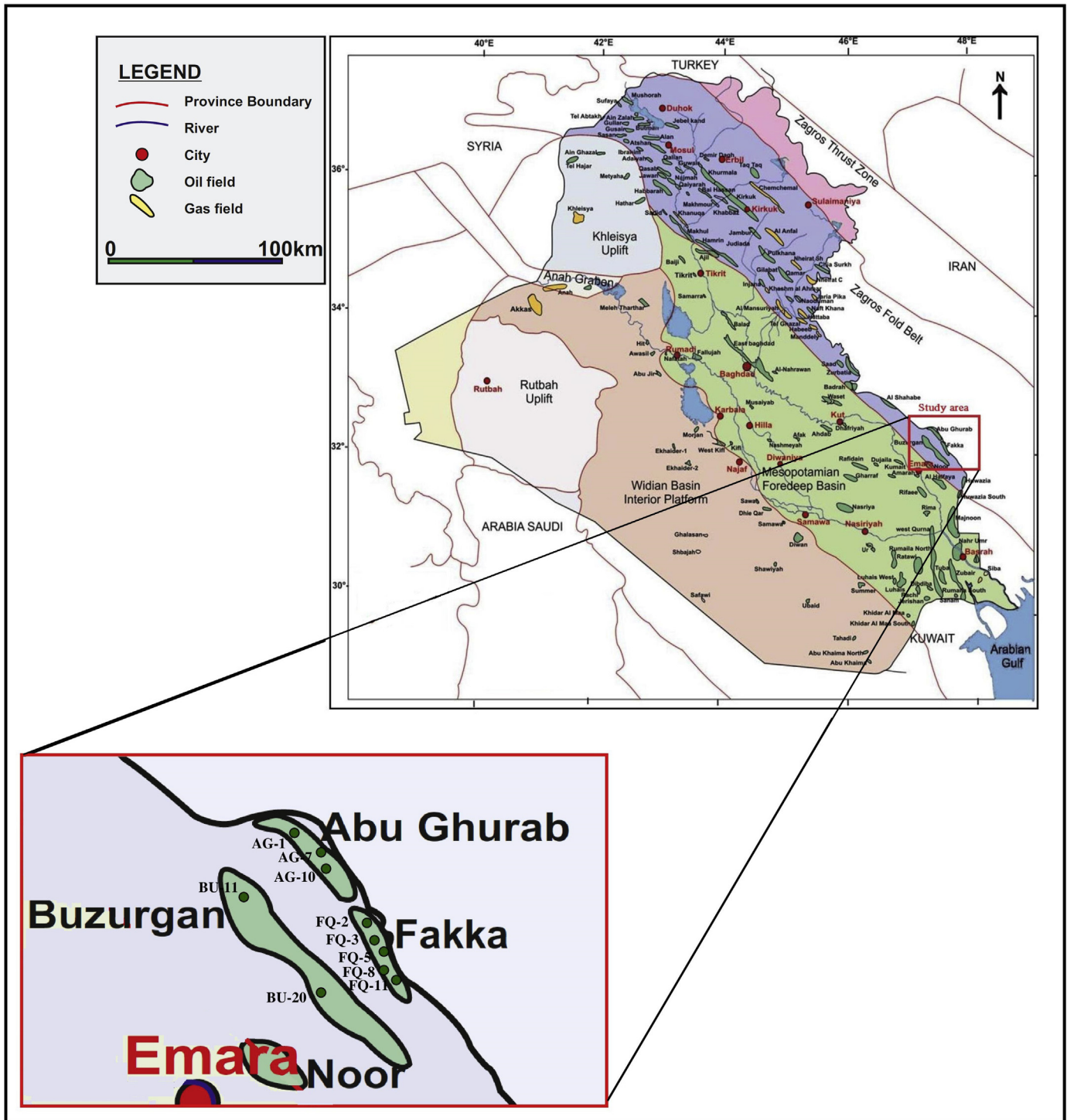


Fig. 1. Location map for the northeast Arabian Peninsula in Iraq, which shows Zagros Fold Belt with oil and gas field locations, including study oilfield locations (modified after Al-Ameri and Zumberge, 2012).

samples from different Cretaceous and Tertiary petroleum reservoirs in the Fakka, Buzurgan and Abu Ghurab oilfields from the southern Zagros region (Table 1) were characterized by a variety of biomarker and non-biomarker data. The main objectives of the current study were to: (1) characterize the oil types and compositions; (2) characterize the source organic matter input, depositional conditions, and thermal maturity, and (3) establish tentative correlation between source rock and oil. This study also aims to

provide further insight into the basin's source rock potential for future petroleum exploration.

2. Geological setting

Zagros Fold Belt extends throughout the elongated folded zone area between the thrust zone in the triple junction boundary with Iran and Turkey (Fig. 1a). The Zagros Fold Belt is located in the

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