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Khasib and Tannuma oil sources, East Baghdad oil field, Iraq

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ABSTRACT

This work presents new insights of the generation, quality and migration pathways of the hydrocarbons in the East Baghdad Oil Field.

The Khasib and Tannuma formations in East Baghdad are considered as oil reservoirs according to their high porosity (15–23%) and permeability (20–45 mD) in carbonate rocks. The hydrocarbons are trapped by structural anticline closure trending NW-SE. Gas chromatography analysis on these oil reservoirshave shown biomarkers of abundant ranges of n-alkanes of less than C22 (C17–C21) with C19 and C18 peaks. This suggests mainly liquid oil constituents of paraffinic hydrocarbons from marine algal source of restricted palaeoenvironments in the reservoir. The low non aromatic C15 + peaks are indicative for slight degradation and water washing. Oil biomarkers of Pr./Ph. = 0.85, C31/C30 < 1.0, location in triangle of C27–C29 sterane, C28/C29 of 0.6 sterane, Oleanane of 0.01 and CPI = 1.0, indicate an anoxic marine environment with carbonate deposits of Upper Jurassic to Early Cretaceous age. Four Miospores, seven Dinoflagellates and one *Tasmanite* species confirm affinity to the upper most Jurassic to Lower Cretaceous Chia Gara and Ratawi Formations.The recorded palynomorphs from the Khasib and Tannuma Formations are of light brown color of TAI = 2.8–3.0 and comparable to the mature palynomorphs that belong to the Chia Gara and the Lower part of Ratawi Formations.

The Chia Gara Formation generated oil during Upper Cretaceous to Early Palaeogene and accumulated in structural traps of Cretaceous age, such as the Khasib and Tannuma reservoirs. The Chia Gara Formation generated and expelled high quantities of oil hydrocarbons according to their TOC wt% of 0.5–8.5 with S2 = 2.5–18.5 mg Hc/g Rock, high hydrogen index of the range 150–450 mg Hc/g Rock, good petroleum potential of 4.5–23.5 mg Hc/g Rock, mature (TAI = 2.8–3.0 and T_{max} = 428–443C), kerogen type II and palynofacies parameters of up to 100% AOM (Amorphous Organic Matters). This includes algae deposits in a dysoxic–anoxic to suboxic–anoxic environment.

Alternative plays are discussed according to the migration pathways.

1. Introduction

The East Baghdad Oil Field is within the Mesopotamian Fore deep Basin. The location, with special emphasis on Iraqi region, is shown in Fig. 1 and prepared by the U.S Geological Survey (Pollastro et al., 1999). The East Baghdad Oil Field is located northeastward to the Zagross Fold Belt and westward to the WidianBasin of the Interior Platform. Deposits of the TethysOcean, during the Jurassic and Cretaceous, are located southward in the Mesopotamian Fore deep Basin. The TethysOcean experienced mainly dysoxic-anoxic palaeoenvironments along the equator. This region experienced tectonic activities with regressive and transgressive cycles (Sharland et al., 2001) that permitted preservation of high organic matters, leading to the development of the biggest oil and gas reserves in the Arabian Region.

The generalized lithostratigraphic section consists of carbonates, shales and anhydrites, which are deposited in marine and subordinate lagoon environments of the southern TethysOcean. These deposits extend in geologic time through the Jurassic, Cretaceous and Palaeogene up to the Middle Miocene Lower (Fig. 2). They form gently folded strata in a graben-horst structural system of 100 km long, extending NW-SE of Baghdad (Al-Majid, 1992). The outcrops consist of Pliocene, Pleistocene and recent sediments, extending between well EB02 and well EB57 in northwestern Baghdad (Fig. 1b). The studied Khasib and Tannuma Formations are of grey fine-grained marly limestone (Bellen et al., 1959). The Khasib Formation changes upward to greenish grey shales and grey limestone, while the Tannuma Formation is of black shales with streaks of detrital limestone. The Khasib Formation and Tannuma Formation are of Lower and Upper Campanian age

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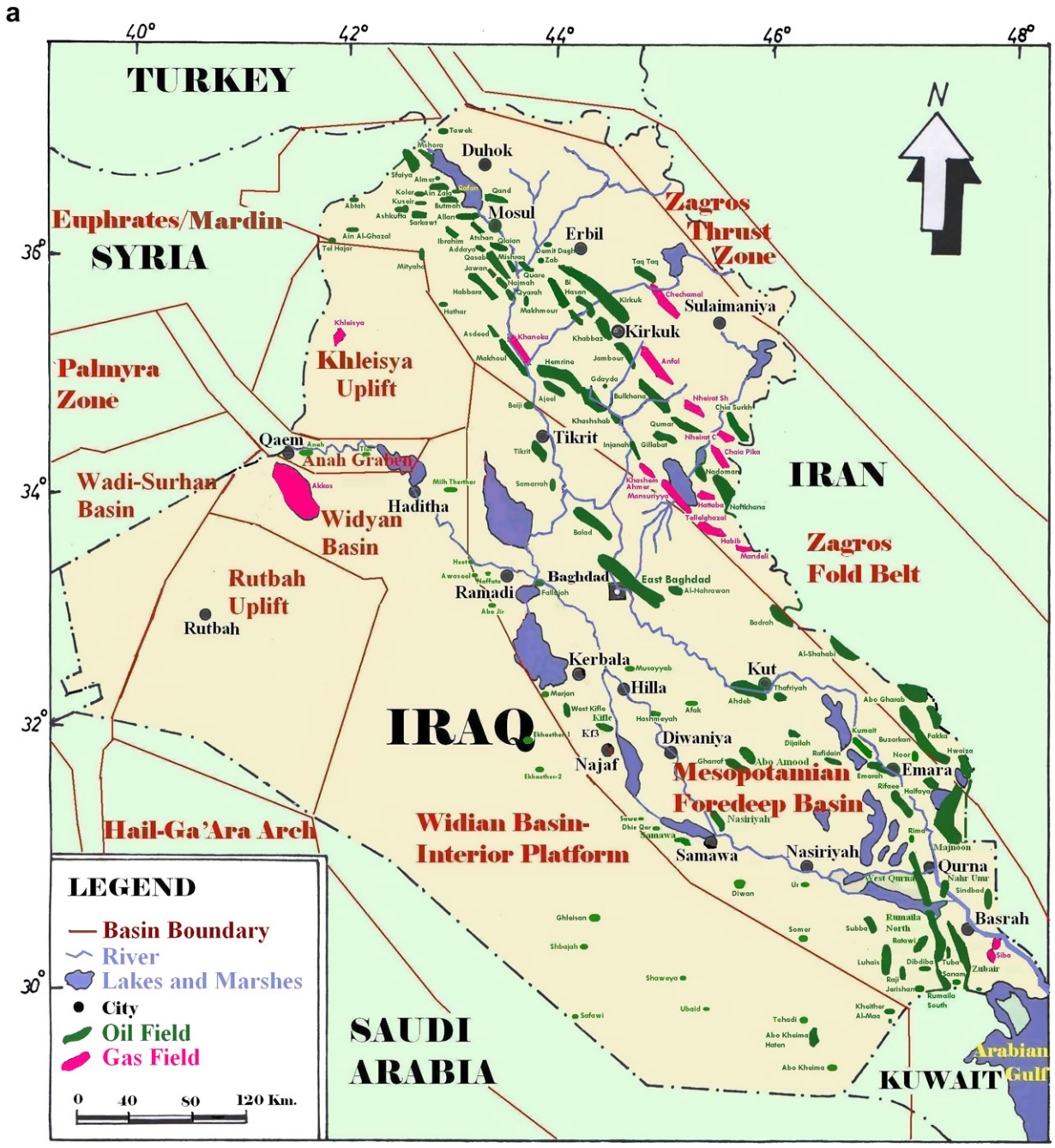

Fig. 1. Location map of Iraq showing; a- basins and oil fields with East Baghdad oil field in the middle, b- central Iraq and neighbor Iran with locations of East Baghdad oil wells on which this study is based.

respectively (Bellen et al., 1959). Their porosities are of 15 and 23 % and average permeabilities are 45 and 20 mD respectively (Al-Sharhan and Nairn, 1997).

In this study we analyze oil samples and source rocks to unravel the source for the oil accumulated in the Khasib and Tannuma reservoirs, including their pathways. The studied section encompass the Upper Jurassic Gotnia Anhydrite Formation to the Middle Miocene Lower Fars Anhydrite Formation (Fig. 2). These formations define the lower and upper seal of the total petroleum system, extending regionally and restricting the vertical migration of the hydrocarbons. The graben-horst structural system is the preventive factor of possible lateral dynamicity of the generated hydrocarbons.

2. Material and methods

The rock samples (Fig. 3) studied here, consist of: 86 samples from well East Baghdad −1 (EB1) at depths 3315–4842 m, 13 samples from well EB2 at depths 3342–3925 m, 16 samples from borehole EB3 at depths 3143–3635.5 m, 10 samples from well EB57 at depths 2274–3253 m, 6 samples from well EB11 at depths 2935–2943 m, and 18 samples from well EB80 at depths 2632–2790 m. Crude oil samples are collected from the oil reservoir in the Campanian Khasib Formation from well EB-31 (and EB-62) at depth of 7689 feet and in the oil reservoir in the Tannuma Formation from well EB-51 (and EB-11) at depth of 7903 feet.