Analysis of the Petroleum System of Dima Oil Field by Using PetroMoD 1D

Haider A. F. Al-Tarim

Oil Exploration Company, Ministry of Oil, Baghdad, Iraq

Abstract

   The study of petroleum systems by using the PetroMoD 1D software is one of the most prominent ways to reduce risks in the exploration of oil and gas by ensuring the existence of hydrocarbons before drilling.

   The petroleum system model was designed for Dima-1 well by inserting several parameters into the software, which included the stratigraphic succession of the formations penetrating the well, the depths of the upper parts of these formations, and the thickness of each formation. In addition, other related parameters were investigated, such as lithology, geological age, periods of sedimentation, periods of erosion or non-deposition, nature of units (source or reservoir rocks), total organic carbon (TOC), hydrogen index (HI) ratio of source rock units, temperature of both surface and formations as they are available, and well-bottom temperature.

   Through analyzing the models by the evaluation of the source rock units, the petrophysical properties of reservoir rock units, and thermal gradation with the depth during the geological time, it became possible to clarify the elements and processes of the petroleum system of the field of Dima. It could be stated that Nahr Umr, Zubair, and Sulaiy formations represent the petroleum system elements of Dima-1 well.

Keywords: Petroleum System, PeroMod, Dima Oil Field

النظام البترولي لحقل ديما النفطي باستخدام برنامج البترومود احادي الاتجاه

حيدر احمد فالح

شركة الاستكشافات النفطية ، وزارة النفط، بغداد، العراق

الخلاصه

   تعد دراسة نظام البترول باستخدام البرنامج PetroMoD ، وهو واحد من أبرز الطرق للحد من مخاطر الحفر الاستكشافي في التنقيب عن النفط والغاز من خلال التأكد من وجود الهيدروكربونات قبل الحفر.

   تم بناء نموذج النظام البترولي في بئر ديمة-1 عن طريق إدخال البيانات التالية البرنامج ، بما في ذلك التتابع الطبقي للتكوينات المخترقة للبئر وأعماق الجزء العلوي من هذه التكوينات وسمك كل تكوين وصخارية كل تكوين والعصر الجيولوجي وفترات الترسيب وفترات التعرية أو عدم الترسيب وطبيعة الوحدات هل هي صخور مصدر أم مكمن وإجمالي الكربون العضوي (TOC) ونسبة مؤشر الهيدروجين (HI) لوحدات الصخور المصدرية ودرجة حرارة كل من السطح والتكوينات كما هي متوفرة ، وكذلك درجة حرارة البئر.

   من خلال نماذج الدراسة من تقييم الوحدات الصخرية المصدرية ودراسة الخواص البتروفيزيائية لوحدات الصخور في المكمن ودراسة التدرج الحراري مع العمق خلال الزمن الجيولوجي ، أصبح من الممكن توضيح

*Email: haiderafalih@gmail.com

عناصر وعمليات نظام البترول في حقل ديمة النفطي وبذلك يمكن القول أن تكوينات نهر عمر وزبير وسلي

تمثل عناصر نظام البترول في بئر ديمة –1.

Introduction

   One of the important concepts in the study of petroleum systems is the critical moment, which indicates time during which hydrocarbons generate and migrate within the traps formed in a pre-generation time. It occurs when the transformation ratio is 50 to 90%, which is known as the ratio of the conversion of organic matter in the source rocks to hydrocarbons by the effect of temperature changes with depth. This leads to the thermal maturity of organic matter, which is evidenced by the increased degree of reflectivity of a lot of data that can be obtained when building a model by using PetroMoD Software.

   The most productive interval in Iraq is the Cretaceous succession which contains about 80% of the country's oil reserves [1] The Lower Cretaceous succession rocks have about 30% of Iraq's hydrocarbon reservoirs, and it is recorded to contain hydrocarbons in many structures in the south and southeast of Iraq [2].

   This study aims to assess oil generation, migration, and accumulation in Dima oil field by constructing burial and thermal history diagrams to describe source rocks maturity and petroleum generation.

Location of the Studied Oil Field

   Dima oil field is located in Missan governorate, southeast of Iraq, to the south of Amara city with coordinates of E.712160 and N.3462010, as depicted in Figure-1. The area is covered by Quaternary sediments, which includes claystone and grey – light grey conglomerate [3].
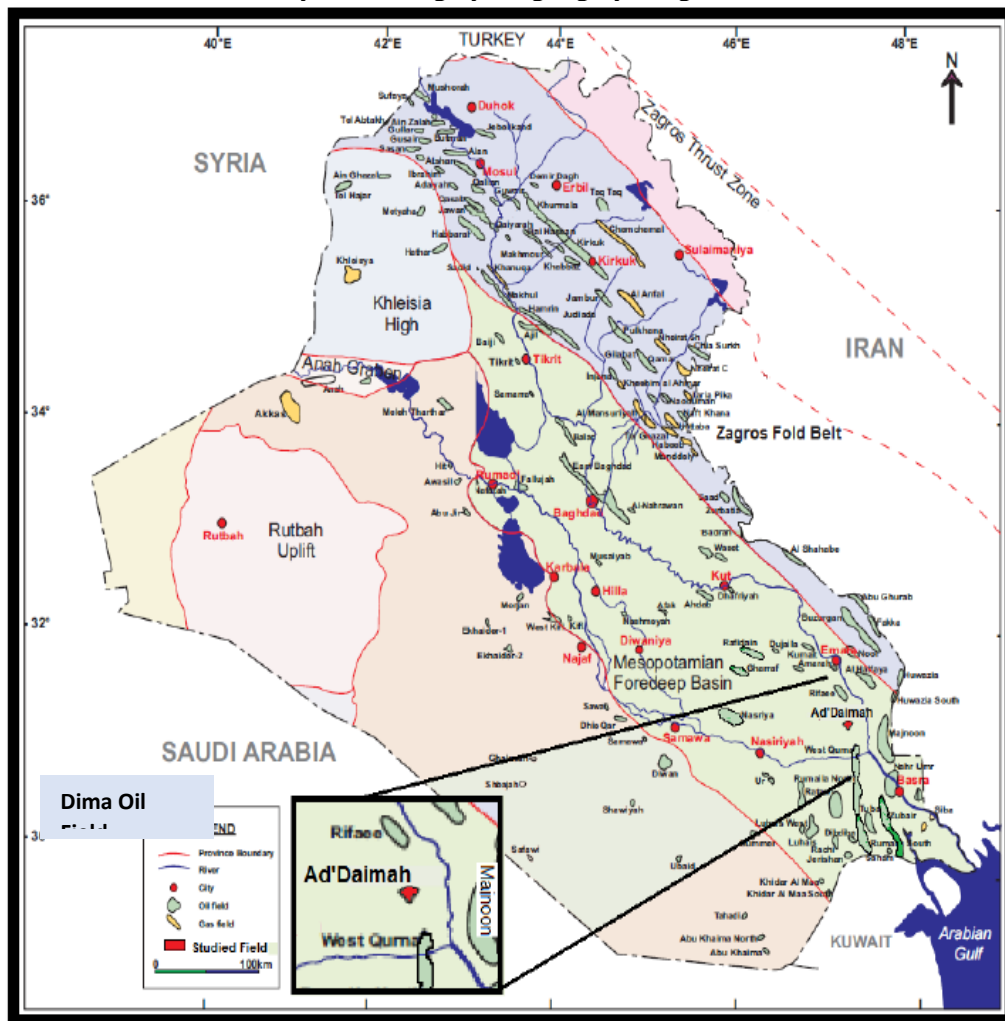

Figure 1-Location of the Studied Area [4].

Methodology

PetroMoD 1D software was used as an efficient tool for basin analysis and description of thermal histories, source rock maturity, and petroleum generation for Dima well-1 that was drilled in Dima structure. The requirements of the studied well were provided from well logs and final geological reports prepared by the Oil exploration Company (OEC).

Petroleum System of Dima Oil Field (Dima -1 well)

The petroleum system model of Dima-1 was developed by inserting the data of the well, including names, depths of the tops, and thickness values of the penetrating formations of the well. Also, the data included lithology, geological age, periods of sedimentation, and periods of erosion or non-deposition. In addition, information were collected that are related to the type of units (source, reservoir, cap), total organic carbon (TOC), hydrogen index (HI) ratio of source rock units, temperature of both surface and formations as they are available, and well-bottom temperature.

After inserting the above data, calibration, and using the necessary equations and calculations [5], a set of indicators was obtained from the study area. These indicators could explain the geochemical specifications of thermal maturity of the source rock units (figs. 2 and 3), degrees of reflectivity of the vitrinite (figs 4 and 5), and percentage of hydrocarbon generation indicated by the transform ratio (TR) (Figure-(x) 6). Through the interpretation of the above parameters, we could describe and evaluate the source rock units within the drilled well for Dima -1 well, as follows:

1- Nahr Umr Formation

The thermal gradient charts Figures-(2 and 3) showed that the temperature of Nahr Umr Formation was 25 ° C in the lower Cretaceous period and started to rise during the geological time [6]. The highest temperature was about 50 ° C during the recent period, which implies that the organic material in this formation did not enter the oil-generating window. This caused a degree of reflectivity of the vitrinite (Ro of about 0.40%), as shown in Figures-(4) and (5), which indicates the immaturity of the Kerogen and its inability to change to hydrocarbons through the TR (Fig.6). This refers to the absence of any potential transformation of the Kerogen to hydrocarbons, making the generating efficiency of this formation weak.

2 – Zubair Formation

The temperature of this formation was about 20 ° C in the Cretaceous period and started to rise over time until it reached 55-60 ^{0}C at the present time (Figs. 2 and 3), with reflectivity levels of (4) and (5). This indicates that the organic matter in the formation at the stage of diagenesis was not mature enough to enter the range of oil generation through the change of organic matter to hydrocarbons [7] (Figure-6). It could be noted that there is no conversion rate of the Kerogen, which makes the generation efficiency of the formation weak .

3 - Sulaiy Formation

Thermal gradient charts (Figures-(2 and 3) showed that the formation temperature is about 80 ° C and the degree of reflectivity of vitrinite (Ro) is higher than 0.6% (figs. 4 and 5), which indicates that the organic matter entered the beginning of the oil-generating window within the stage of catagenesis, as shown in Figure-6 . This is confirmed by the TR value of 40%. The generation efficiency of this formation is medium (Figure-6).

Thus, it could be stated that the origin of the petroleum in the reservoir formation of the Dima oil field (Saadi, Khasib, Mishrif, Nahr Umr, and Yamama) is not from the common source units (Sulaiy, Zubair, and Nahr Umr) [8], but could be from the Jurassic era represented by the Sargelu and Naoelikan, which are rich in organic content and have a very good generation efficiency.
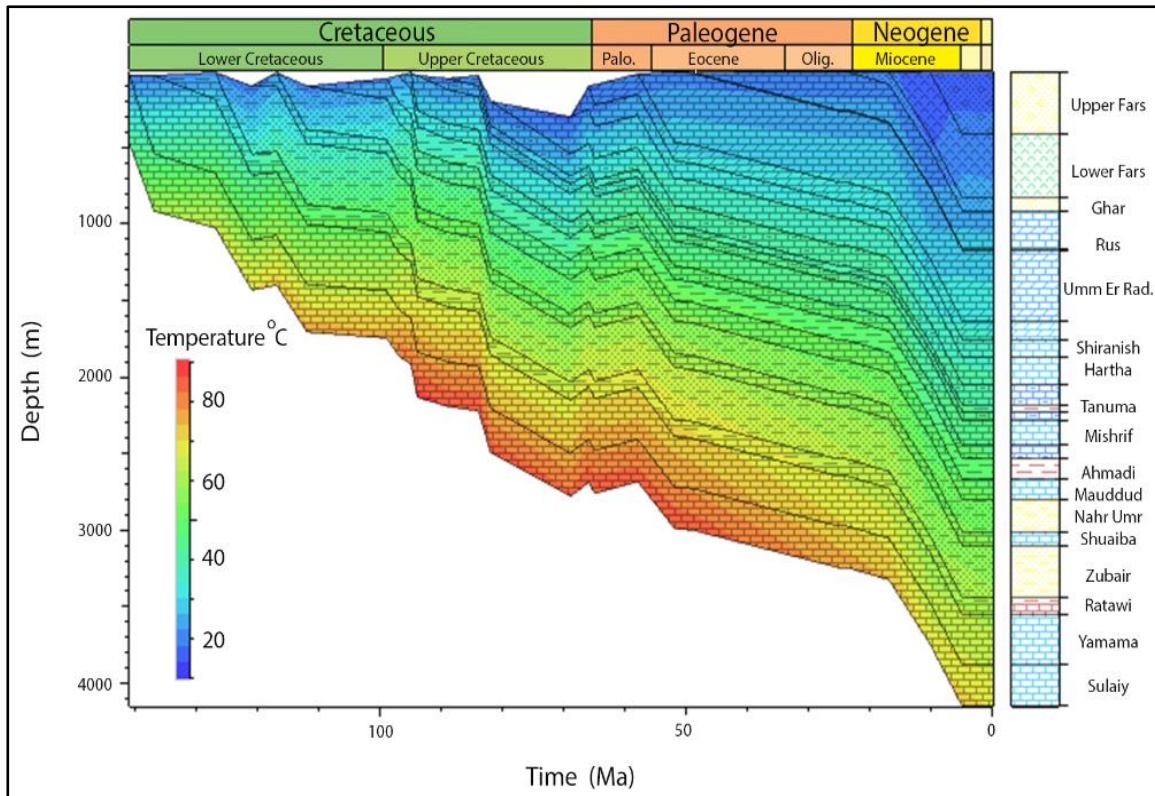
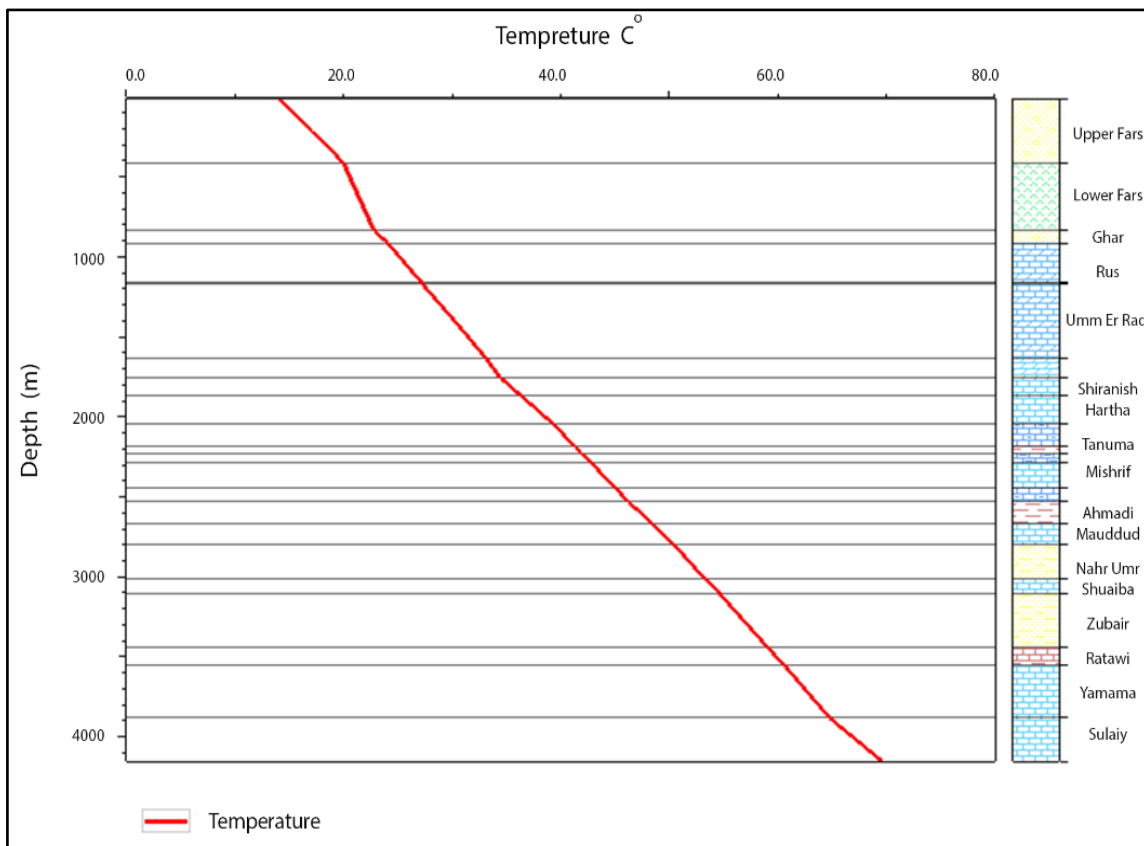**Figure 2**- The relationship of temperature with depth in
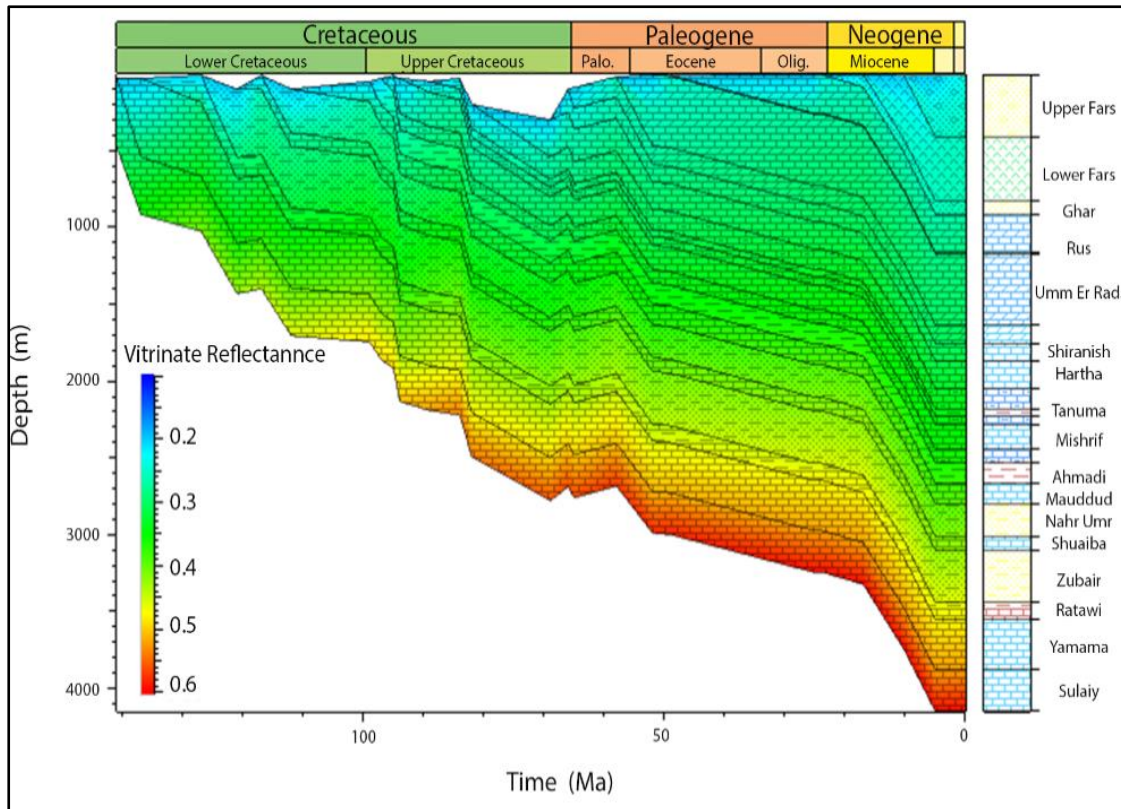

Figure 3- The temperature curve with depth in Dima-1

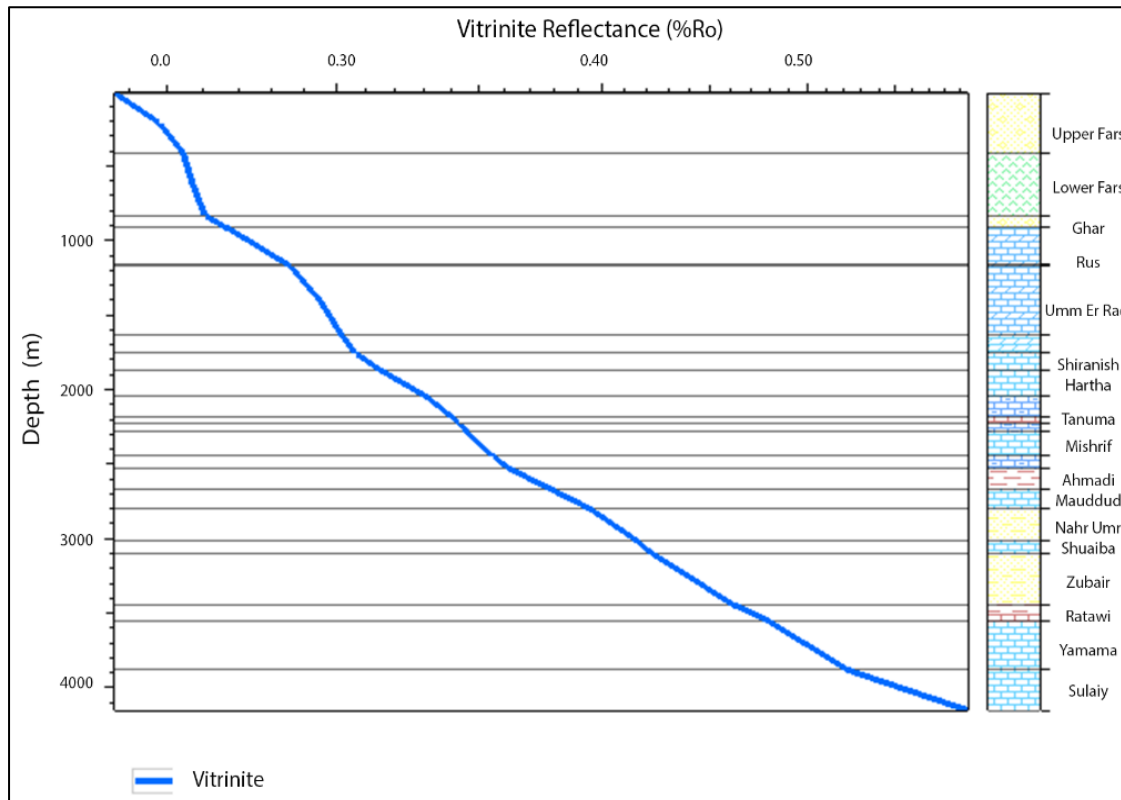**Figure 4-**Vitrinite reflectance with depth in Dima-1

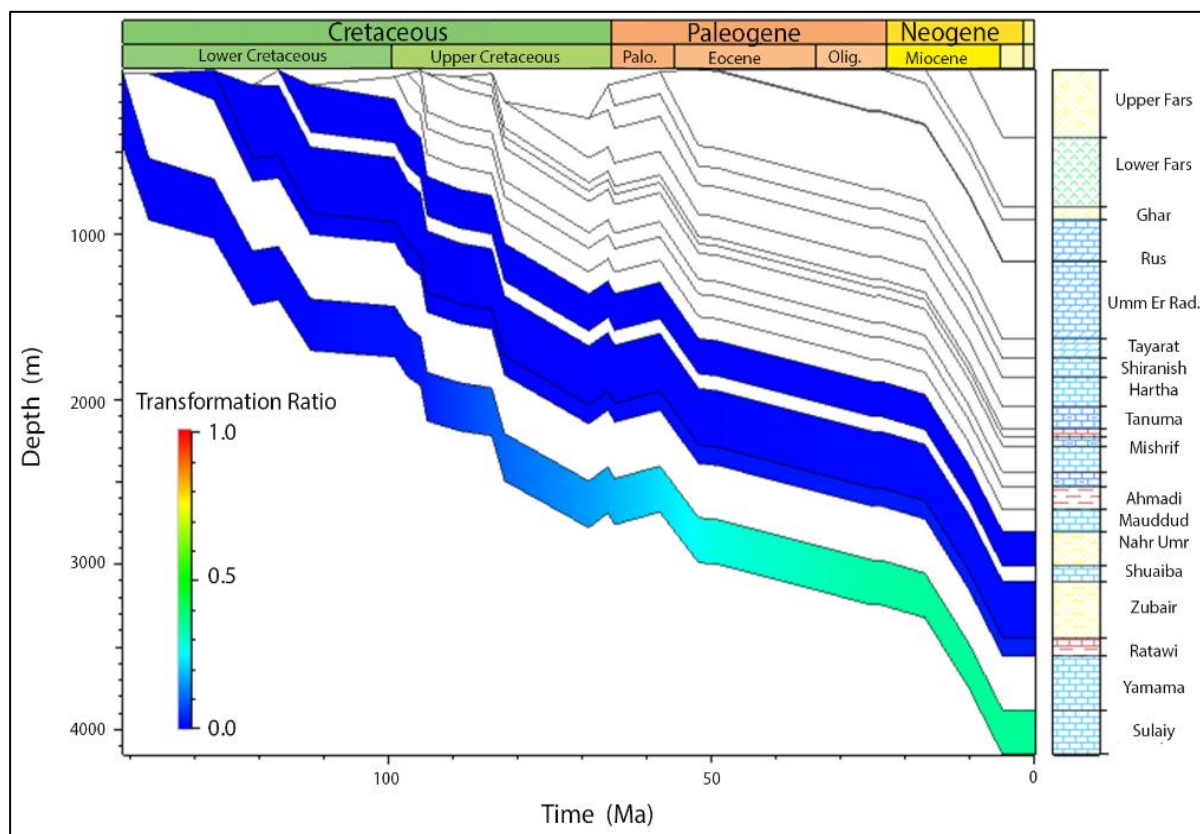**Figure 5**-Vitrinite reflectance curve with depth in

Figure 6-Transformation Ratio (TR) in Dima-1

Conclusions

The petroleum system model was suggested for Dima-1 well by utilizing several input data

Through the study of models of evaluation of the source rock units, the petrophysical properties of reservoir rock units, and thermal gradation with the depth during the geological time, it became possible to clarify the elements and processes of the petroleum system of the field of Dima. It could be stated that Nahr Umr, Zubair, and Sulaiy formations represent the petroleum system elements of Dima-1 well.

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