International Conference On

Petroleum Engineering 2018

Dubai | UAE August 06-07, 2018

Evaluation of the Zaghouan region oil potential: Inferred thermal maturity through 1D modeling

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Key words

Zaghouan, Bahloul. M'Cherga, Bou Dabbous, Abiod, Aleg, biomarker, past3, oil potential, modeling 1D.

Abstract

This study focused on a geochemical characterization of the M'Cherga (Valanginian-Barremian), Bahloul (upper Cenomanian-Lower Turonian) and the Bou Dabbous (Ypresian) formations, outcropping in the Zaghouan area (northeast of Tunisia). The study used specific analyses based on Rock Eval pyrolysis and the GC-MS techniques. In addition, five oil indices collected from the Abiod, Aleg and Bou Dabbous formations, were also analyzed by Gas Chromatography coupled to Mass Spectrometry.

The oil seeps-source rock correlations (Past3) indicate that the oil seeps found in the Abiod and Aleg formations are generated by the Bahloul formation while the Bou Dabbous Formation oil seep was generated by the same rock.

The modeling by the GENEX software shows that the M'Cherga, Fahdene and Bou Dabbous source rocks at the P1 well, drilled not far from the study area, have all started to generate hydrocarbons since the Santonian, Campanian and Tortonian respectively. Nevertheless, only the M'Cherga Formation began to expel its hydrocarbons since the Pliocene

Introduction

In Tunisia, oil explorations have been mainly concentrated in the Pelagian Sea, Southern , Central and East of the country (ETAP, 2013). However, the occurrence of surface indices and oil seeps in northern Tunisia may indirectly indicate the existence of subjacent functional petroleum systems. Based on Belhaj Mohamed et al, 2015, the area of Zaghouan includes few oil seeps, which may indicate the occurrence of active petroleum systems below the surface (Fig.1).

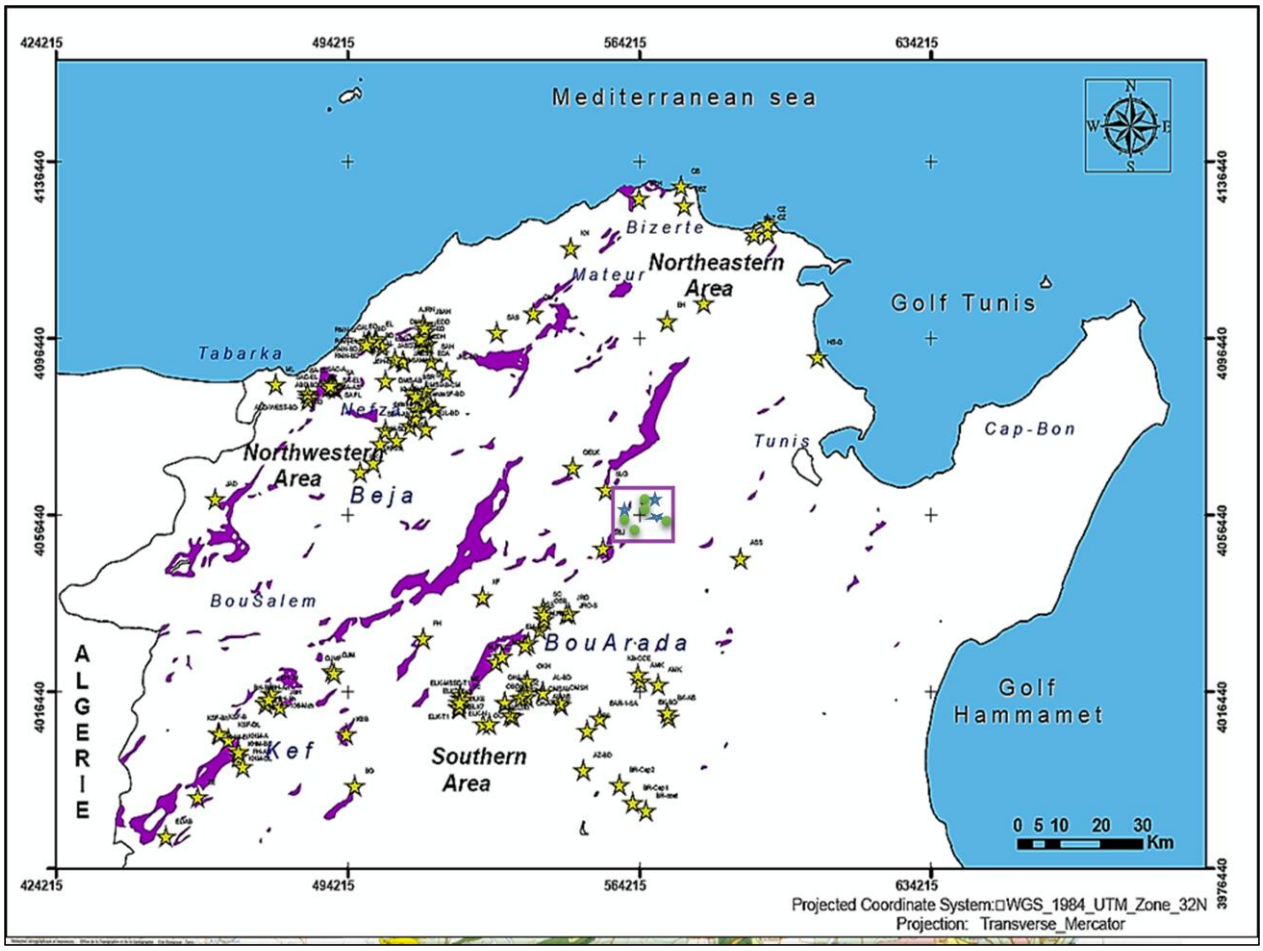


Fig. 1: Map showing the position of the main identified oil seeps (until 2015) in the northern part of Tunisia (Belhaj Mohamed et al., 2015)

For this, this study were proposed aiming to geochemically evaluate the Zaghouan region.

Three potential source rocks were targted which are the M'Cherga, the Bahloul and the Boudabous Formations.

In addition, five oil indices were collected in the region in order to establish their relation to occuring source rocks.

Analytical Methods

Laboratory analysis were carried out using two methods (1) Rock Eval pyrolysis techniques to evaluate the organic richness and maturity. (2) Gas chromatography coupled to mass spectrometry (GC/MS) enabling the

study of biomarkers and allowing oil-oil and oil-source rock correlation. 1D modeling of source rocks maturity was evaluated through the Genex software.

Results and comments

The M'Cherga Formation is rich in marine-dominated organic matter; it has reached the oil-window stage (mature), and can therefore constitute an average-to-good-quality source rock. The Bahloul Formation is rich in organic matter with a marine origin (type II), immature to marginally mature. The Bou Dabbous Formation, outcropping at Jebel el Guebli is characterized by a moderate richness of organic matter of type II / III but it is mature with Tmax values averaging 449°C (Fig. 2)

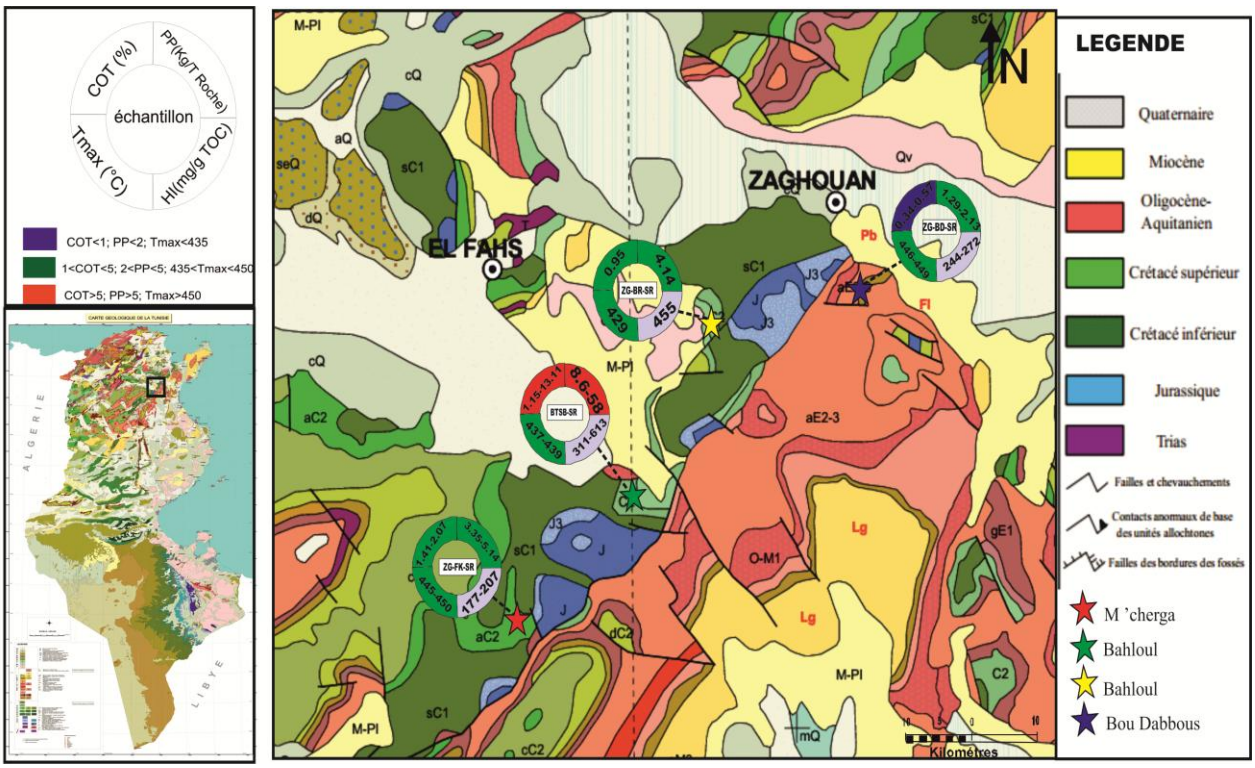


Fig. 2: Location and geochemical characterization of source rocks in the study area (Extracted from the geological map of Tunisia 1 / 500,000)

The oil seeps-oil seeps correlation allowed the identification of two large families using the Past3 software. The first family consists of samples of oil seeps associated with the Abiod and Aleg formations. The second family includes the oil seep associated with the Bou Dabbous Formation.

The oil seeps-source rock correlations indicate that the oil seeps found in the Abiod and Aleg formations are generated by the Bahloul formation while the Bou Dabbous Formation oil seep was generated by the same rock.

The modeling by the GENEX software shows that the M'Cherga, Fahdene and Bou Dabbous source rocks at the P1 well, drilled not far from the study area, have all started to generate hydrocarbons since the Santonian, Campanian and Tortonian respectively. Nevertheless, only the M'Cherga Formation began to expel its hydrocarbons since the Pliocene (Fig. 3.)

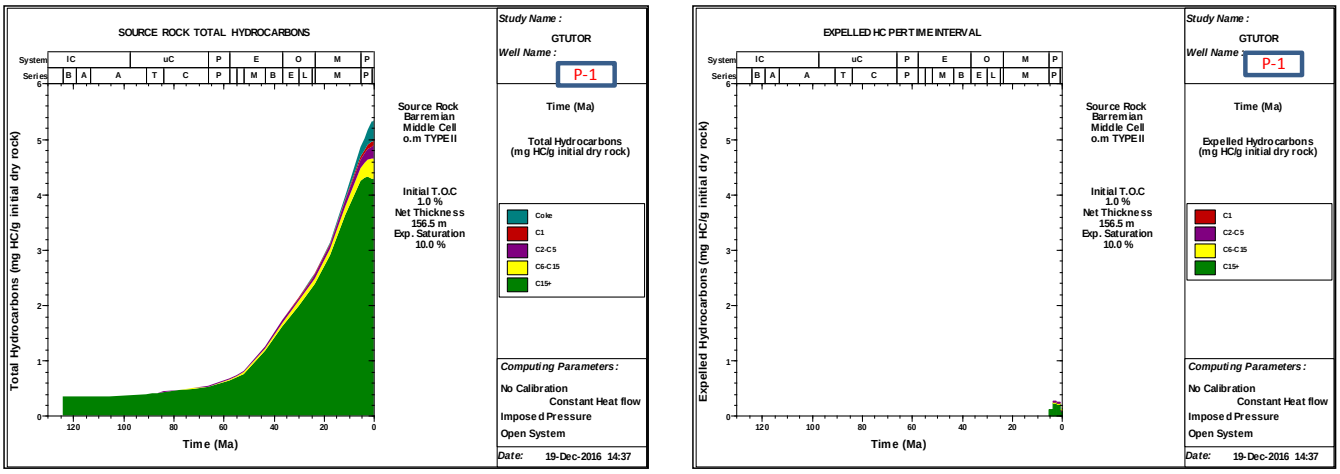


Figure 3: History of Generation and Expulsion of P-1 Oil and Gas Wells for M'Cherga source rock.

CONCLUSION

It can be concluded that there are probably two main systems in the region.

A Cretaceous oil system formed by the chalky fractured carbonates of the Abiod formation, sealed by the clays of the El Haria formation, and were probably charged during the Pliocene by the Albian-Cenomanian (Fahdene Formation) and / or Valanginian –Aptien (M'Cherga Formation) source rocks.

A Eocene oil system composed by the Bou Dabbous fractured carbonates playing as a source/reservoir rock and sealed by the Souar Formation on the top.

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