



Research paper

Organic geochemical evaluation of hydrocarbons in Lower Cretaceous Middle Minagish reservoir, Kuwait

F.H. Abdullah ^{a,*}, T. El Gezeery ^b^a Earth and Environmental Sciences Dept., P.O. Box 5969, Safat, 13060, Kuwait University, Kuwait^b Kuwait Oil Company, Field Development, West Kuwait, Minagish Team, Industrial Area, P.O. Box 9758, Ahmadi, 61008, Kuwait

ARTICLE INFO

Article history:

Received 10 March 2015

Received in revised form

5 December 2015

Accepted 11 December 2015

Available online 21 December 2015

Keywords:

Oolitic reservoir

Carbonate

Kuwait Cretaceous oil

Tarmat

Minagish Field

Minagish reservoir

Heavy oil

ABSTRACT

Organic petrography and geochemical analyses of 72 core samples from the Minagish Formation revealed vertical variations in oil composition between four wells from the Burgan, Maqwa, Minagish and Umm-Gudair fields. The Burgan Field has a homogeneous oil column while variations in oil column were recognized between fields. The thickest heavy oil column, 46 m, was identified in Minagish Field. GC and GC-MS of the light and intermediate parts of the oil indicates a similar oil type, with a common oil pool in all of the oil fields. Thus, the variation in the nature and distribution of the heavy fractions of the oil in the Minagish reservoir is not be related to the source rock, expulsion and/or oil migration, but related to changes that occurred after or during oil accumulation in the reservoir.

The methods and the results of this study are useful for planning drilling specially in reservoirs with heavy oil intervals such as the Minagish reservoir.

© 2015 Published by Elsevier Ltd.

1. Introduction

The Minagish Formation of Early Cretaceous age is one of the major oil reservoirs in south Kuwait (Fig. 1). It is divided into Upper, Middle and Lower members (Fig. 2). The Middle Oolitic Member is the main reservoir interval and is capped with an Upper Carbonate Mudstone Member. The sediments at the base of Middle Member together with the Lower Member are composed of fine-grained, bioturbated, peloidal lime packstones. Recently, unconventional hydrocarbon accumulations have been found in the Lower Member in the Minagish Field (El Gezeery et al., 2007). The thickness of the formation ranges from 160 m (528 ft) in the south to about 360 m (1188 ft) in the north of Kuwait, where the oolitic part of the formation changes into micritic limestone.

The formation is a reservoir in Burgan, Minagish and Umm Gudair, in Kuwait and in the Partitioned Neutral Zone in Wafra, South Fawaris, Khafji, Hout and Dorra oil Fields (Fig. 1). Oil in this reservoir ranges from 28° to 33.4° API with average sulfur concentration of 2.6%. The reservoir in the Minagish Field contains

15–30 m (50–100 ft) thick of tarmat, very high density oil, at the base of the oil column which has blocked the pores and has its impact in decreasing the reservoir pressure.

Understanding the quality of the hydrocarbon type in any reservoir interval is important to evaluate in-place oil and reproducibility. Oil density and viscosity affect production; heavy, viscous oils are much more difficult to produce than light oil. Production becomes even more difficult if the reservoir contains solid bitumen, which blocks the pores and reduces permeability to almost zero. Many studies have been carried out to investigate the heterogeneity of petroleum in reservoirs. For example, Zittel et al. (2006) used nuclear magnetic resonance (NMR) to calculate an oil viscosity profile. Thomas (2007) studied the effect of reservoir temperature on oil heterogeneity in the reservoir using a numerical method Wang and Buckley (2001) and Zuo et al. (2010, 2012) used mathematical models to calculate asphaltene concentration gradients and predict phase instability in oil reservoirs. Yen model which was initiated in 1967 is modified by Mullins (2010). The model was first initiated to model asphaltenes that is based on its characteristics and later modified to be used in reservoir characterization, as well as, refining.

Tar presence is identified in many of the Arabian Gulf countries. Carpentier et al. (1998, 2007) used pyrolysis with electrical logs to

* Corresponding author.

E-mail addresses: fozabd2008@gmail.com (F.H. Abdullah), tgezeeri@kockw.com (T. El Gezeery).



Fig. 1. Oil Fields in Kuwait (study wells in Minagish Oil Field: MN-A, MN-B, Umm Gudair Oil Field: UG-E-A, UG-E-B, UG-W-A, UG-W-B & Greater Burgan Oil Field: BG-A).

model the asphaltene in S. Field in Abu Dhabi (U.A.E.). Jones et al. (2004) used a pyrolytic technique to use it at Qatif Field in Saudi Arabia to assist geostearing horizontal water injection. Recently, Almansour (2014) investigated methods to produce tar mat and enhance recovery. He based his study using chemical techniques on tar mats from five core samples collected from Kuwaiti carbonate reservoir. The result of his study showed that the tar composition is not similar in the five samples and this information has to be conducted with porosity, permeability and viscosity to apply the oil recovery method.

Tarmat identification in Minagish reservoir in Kuwait is a challenge in the oil production (Fig. 3). Many studies were carried out on the tarmat in the Minagish reservoir in the Minagish Field (Osman, 1985; Al-Murairi et al., 2001; Al-Ajmi et al., 2001). Al-Ajmi et al. (2001) identified zones of tarmat in wells penetrated the formation in the Minagish Field using oil extracts from core samples, and then followed by the organic geochemical techniques on the extracted oil using thin layer chromatography. Using magnetic resonance imaging along with laser-induced breakdown spectroscopy El Gezeery et al. (2007, 2008) characterized the fluids in real time to discriminate bypassed zones of light oil from tarmat.

The objective of this study is to evaluate the nature of the hydrocarbons within the reservoir interval in the Middle Minagish Formation in Kuwait using Rock Eval pyrolysis. This technique is a simple and inexpensive way to identify zones of light, medium and heavy oil, nonproductive zones, and source-rock intervals, so that petroleum engineers and geologists may use the proper oil production techniques. This screening technique can minimize the

number of samples that require further organic geochemical analyses, such as gas chromatography (GC), gas chromatography-mass spectrometry (GC-MS), or even stable isotope studies, thus decreasing the overall cost of the evaluation.

2. General geology

The Minagish Formation is a major Lower Cretaceous reservoir, contains oil that was first discovered in the Minagish Field in 1958. In this field, the Middle Minagish Oolite accounts for more than 80% of the oil production. The Middle Minagish Member produces oil from fields in southern Kuwait and the Neutral Zone, including the Greater Burgan, Umm Gudair, Minagish, Wafra, Fawaris, Al-Hout and Dorra oil fields (Fig. 1).

The Middle Minagish reservoir is well developed in these fields, where its porosity varies from 20% to 28% (Rahaman et al., 2012). Oil gravity ranges between 20° to 33.4° API with sulfur concentration between 2.2 and 4.0% (Alsharhan and Nairn, 1997). The oil characteristics from this formation for the different fields are shown in Table 1. The Middle Member is an oolitic limestone consisting of peloidal, bioclastic oolitic grainstones deposited in a shallow marine environment (Fig. 2). It is bounded above and below by a hard, dense, bioclastic micritic limestone. The formation is fossiliferous, containing benthonic foraminifera, miliolids, ostracods, echinoderms and skeletal fragments. It was deposited in a shallow-water carbonate shelf environment, where ooid shoals were locally developed (Qabazard, 2000). The thickness of the formation varies between 160 m and 360 m (528 and 1118 ft)

Download English Version:

<https://daneshyari.com/en/article/4695416>

Download Persian Version:

<https://daneshyari.com/article/4695416>

[Daneshyari.com](https://daneshyari.com)