Egyptian Journal of Petroleum (2016) xxx, xxx–xxx

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Egyptian Journal of Petroleum

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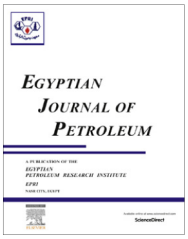

FULL LENGTH ARTICLE

Source rock evaluation for hydrocarbon generation in Halal oilfield, southern Gulf of Suez, Egypt

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Received 20 June 2015; revised 6 September 2015; accepted 10 September 2015

KEYWORDS

Kerogen;
Maturation;
Source potential;
Gulf of Suez;
Egypt

Abstract The aim of this paper is to define the source rock potential of hydrocarbon generation through the determination of: (1) the quantity of organic matter, (2) present day kerogen types, (3) thermal maturity and (4) source organic matter input and depositional conditions of the source rock from Kareem, Rudeis and Matulla Formations, and Nubia Sandstone in 2 wells namely GH 376-1 and GH 404-1 throughout pyrolysis, vitrinite reflectance measurements and gas chromatographic analyses. The results suggest that Kareem and Rudeis source rocks have poor to good generating potential to generate both gas and oil at optimum maturity, Matulla source has a very good while Nubia has poor generating potential to generate both oil and gas at optimum maturity. The organic matter of Kareem, Rudeis and Nubia source rocks was deposited in marine environment under reducing conditions, while Matulla Formation deposited in transition environments and tends to be of terrestrial rather than marine sources.

1. Introduction

The Gulf of Suez in Egypt has a north-northwest–south-south east orientation and lies at the junction of the African and Arabian plates where it separates the northeast African continent from the Sinai Peninsula. It has excellent hydrocarbon potential, with the prospective sedimentary basin area measuring approximately 19,000 km^2, and it is considered as the most prolific oil province rift basin in Africa and the Middle East. This basin contains more than 80 oil fields, with reserves ranging from 1350 bbl to less than 1 million bbl; in reservoirs of Precambrian to Quaternary age [1]. The southern Gulf of Suez (Fig. 1) in Egypt is located at the junction of the African and Arabian plates, and has excellent hydrocarbon potential.

The hydrocarbon potential of the southern Gulf of Suez is generally high because (1) rifting tended to produce both restricted and open marine settings favorable to source rock accumulation; (2) relatively high geothermal gradients helped convert organic matter in the source rocks to hydrocarbons; (3) subsequent rotational faulting and marginal uplifting produced clastic systems served by the mature shield terranes and formed shoal areas where porous reef buildups and dolomitized limestone potential reservoirs could develop; (4) rotational faulting of these units produced structural traps, which were sealed by onlapping basinal mud rocks or

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Peer review under responsibility of Egyptian Petroleum Research Institute.

http://dx.doi.org/10.1016/j.ejpe.2015.09.003

Please cite this article in press as: M.M. El Nady, N.S. Mohamed, Source rock evaluation for hydrocarbon generation in Halal oilfield, southern Gulf of Suez, Egypt, Egypt. J. Petrol. (2015), http://dx.doi.org/10.1016/j.ejpe.2015.09.003

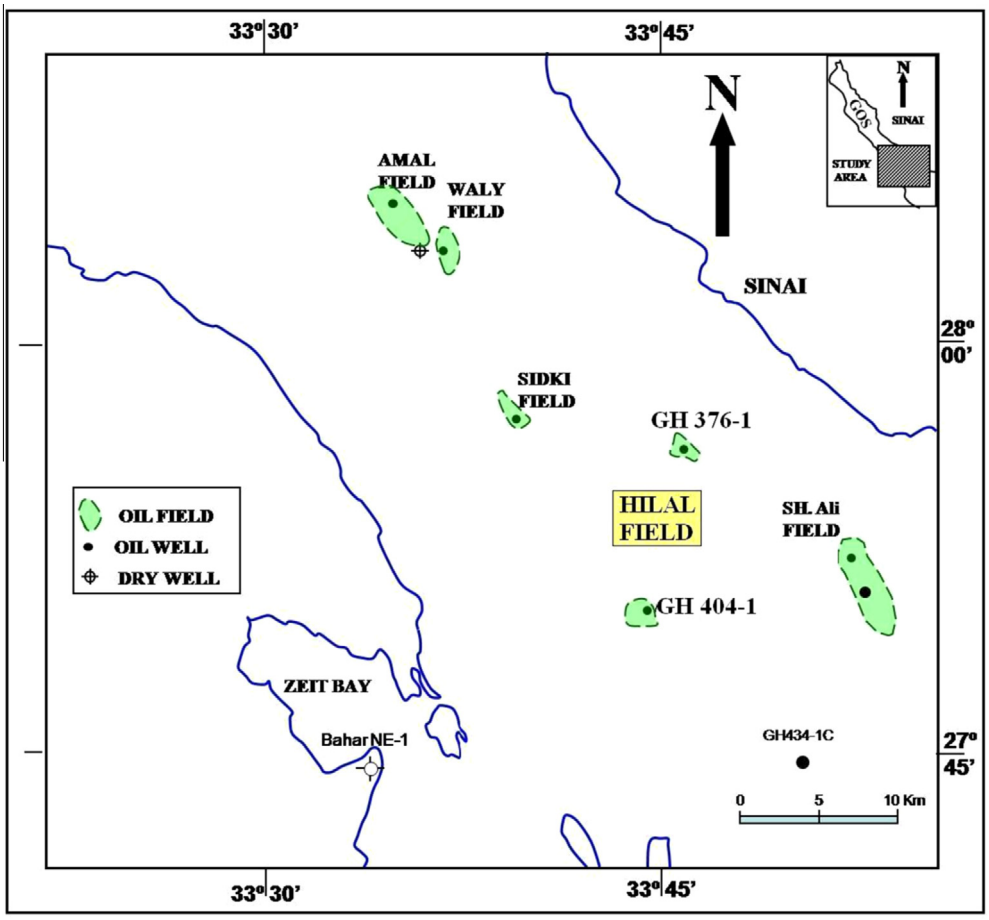

Figure 1 Location map of the studied wells, southern Gulf of Suez, Egypt.

evaporites during later thermal activities of the rift; (5) all faults in the Gulf of Suez are normal faults. The trapping structures of the numerous oil fields are horsts or tilted fault blocks. The intervening grabens contain thick accumulations of basinal shales and marls, producing favorable conditions for rich source rocks [2].

The principal aim of this paper is to define the source rock potential for hydrocarbon generation through the determination of the quantity of organic matter available for the formation of hydrocarbon, indicative of the present day kerogen type (oil or gas prone), and indication of thermal maturity. In addition, source organic matter input and depositional conditions of the source rock have been investigated for four formations namely Kareem, Rudeis, Matulla, and Nubia from well GH 376-1 and GH 404-1 within the southern Gulf of Suez (Fig. 1).

The stratigraphic sequence in the Gulf of Suez including the studied field in the southern part ranges from Precambrian to Recent (Fig. 2) and can be classified into three megasequences: a pre-rift succession (pre-Miocene or Paleozoic-Eocene), a syn-rift succession (Oligocene-Miocene), and a post-rift succession (Pliocene-Holocene). According to EGPC [3] the following studied formations are arranged from top to bottom:

Kareem Formation consists mainly of interbedded sandstone shale and carbonates with thin streaks of anhydrite in the lower part of the section. The depositional setting of the Kareem Formation was shallow, partly open marine.

Rudeis Formation consists mainly of shale and limestone interbedded with sandstone. The depositional setting of the Rudeis Formation is considered shallow to deep marine.

Matulla Formation consists mainly of sandstone, shale and carbonate interbeds deposited in a marine, sub-littoral to littoral setting.

Nubia Sandstone is applied for the Paleozoic-Early Mesozoic clastic section are predominantly sandstone with thin interbeds of shale.

The source rock potential of the Gulf of Suez has been studied by many authors, such as [4–13] Most of them reported that the Gulf of Suez has good source rocks for hydrocarbon generation. Source rocks and sandy reservoirs, which are abundant in both the pre-and post-rifts of sedimentary rocks, play an important role in petroleum exploration in the Southern Gulf of Suez [13]. Salah [14] reported that the Nubia Sandstone and basement rocks on both sides of the Gulf of Suez are the main sources for the Miocene sands in the central and southern part of the Gulf. El Nady et al. [15] recognized that the crude oils belong to marine oil and are characterized by a high level of maturation and sourced mainly from organic matters of marine origin with few terrestrial inputs. El Nady et al. [16] recognized that oils in the Ras Gharib oilfield are belonging to normal oil classes with no heavy biodegradation

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