Journal of African Earth Sciences 125 (2017) 88–102

Contents lists available at ScienceDirect

Journal of African Earth Sciences

journal homepage: www.elsevier.com/locate/jafrearsci

New insights into the stratigraphic, paleogeographic and tectonic evolution and petroleum potential of Kerkennah Islands, Eastern Tunisia

Maroua Elfessi

Department of Geology, Faculty of Mathematics, Physics and Natural Sciences of Tunis, Campus University El-Manar, 2092 Tunis, Tunisia

ARTICLE INFO

Article history:
Received 11 January 2016
Received in revised form
7 October 2016
Accepted 28 October 2016
Available online 1 November 2016

Keywords:
Kerkennah Islands
Cercina and Chergui fields
Sirt basin
Western Mediterranean Sea
Pelagian troughs
Bou Dabbous
Reineche
Tilted block system
Pliocene unconformity

ABSTRACT

This work presents general insights into the stratigraphic and paleogeographic evolution as well as the structural architecture and the petroleum potential of Kerkennah Islands, located in the Eastern Tunisia Foreland, from Cenomanian to Pliocene times. Available data from twenty wells mostly drilled in Cercina and Chergui fields are used to establish three lithostratigraphic correlations as well as isopach and isobath maps in order to point out thickness and depth variations of different geological formations present within our study area; in addition to a synthetic log and isoporosity map of the main carbonate reservoir (the nummulites enriched Reineche Member). The integrated geological study reveals relatively condensed but generally continuous sedimentation and a rugged substrate with horsts, grabens and tilted blocks due to the initiation and the individualization of Kerkennah arch throughout the studied geological times. Furthermore, a relationship was highlighted between the evolution of our study zone and those of Sirt basin, Western Mediterranean Sea and Pelagian troughs; this relationship is due to the outstanding location of Kerkennah Islands. The main Bou Dabbous source rock is thicker and more mature within the central-east of the Gulf of Gabes indicating therefore the southeast charge of Reineche reservoir which shows NW-SE trending tilted block system surrounded by normal faults representing the hydrocarbon migration pathways. Besides, the thick Oligo-Miocene formations deposited during the collapse of the Pelagian block caused the maturation of the Ypresian source rock, while the Pliocene unconformity allowed basin inversion and hydrocarbon migration.

1. Introduction

Kerkennah Islands are situated in the offshore of Sfax, northwestern part of the Gulf of Gabes and at 25 Km from Sfax city. They are subdivided into two islands, Chergui and Gharbi and they occupy 160 km^2 within the south of the Pelagian Sea. Our study zone is also located west of the Sirt basin, south of the Pelagian block and the Sicily Channel rifting system and east of the Atlas belt. In 1991, British Gas discovered the productivity of the Middle Eocene Reineche reservoir which becomes the primary exploration target of all the next drilled wells in Cercina and Chergui fields located within our study area, therefore the aim of our work is to define the main petroleum system of Kerkennah Islands (Fig. 1a). However, if the neotectonic evolution of Kerkennah Islands is well developed by Burollet and Winnock (1979), Delteil (1982) and Oueslati (1995); the stratigraphic, paleogeographic and tectonic studies of Late Cretaceous, Paleogene and Neogene series remain poorly known. In the present work, seismic profiles and available data from twenty wells mostly drilled in Cercina oil field and Chergui gas field are used to establish lithostratigraphic correlations, isopach and isobath maps and a synthetic log in order to provide 'an image' of the subsurface of Kerkennah yielding the best understanding of its tectonic, paleogeographic and stratigraphic evolution.

2. Geological setting

2.1. Structural setting

Kerkennah Islands are considered as a paleohigh separating the Gulf of Hammamet, northern part of the Pelagian block, from the Gulf of Gabes towards the south. Today, these two gulfs show an active subsidence. The tectonic architecture of the study zone as

E-mail address: marwafessi@yahoo.fr.

http://dx.doi.org/10.1016/j.jafrearsci.2016.10.015
1464-343X/

well as the Pelagian Sea is in close relationship with the Tethyan ocean evolution and the African and Eurasian plates dynamic. The continuous opening of Tethyan Seaway and the breakup of the Pangaea (Ben Ferjani et al., 1990) have generated, during the Triassic period, an extensional tectonic regime as well as an important sedimentation within the Gulf of Gabes (Mejri et al., 2006). The Jurassic rifting has generated a N-S trending extensional regime (Bouaziz et al., 1994; Hlaiem et al., 1997). In fact, the Gulf of Gabes was characterized at this time by a low and continuous subsidence (Hlaiem et al., 1997) with development of E-W trending half-grabens (Guiraud and Maurin, 1991). The NW-SE trending compressional regime of Santonian times has generated, in the Gulf of Gabes, folds and flower structures (Boccaletti et al., 1989). The Campanian- Maastrichtian times are characterized by a NW-SE trending extensional regime. The Eocene times are characterized, in Tunisia, by the synchronism of compressional (reverse faults and NE-SW trending folds) and extensional deformations with reactivation of Mesozoic inherited faults (Touati, 1985; Brahim and Mercier, 2007; Taktak et al., 2010) delimiting NW-SE trending horsts and grabens (Chandoul et al., 1996). During Middle Eocene to Langhian times, salt remobilization (Touati, 1985) and positive flower structures were developed within the Gulf of Gabes (Mejri et al., 2006). During the Oligocene times, the opening of the Western Mediterranean Basins has generated a SW-NE and NW-SE trending extensional regime in the Eastern Tunisia (Dercourt et al., 1986). The Miocene compression, Alpine event, has generated, in the Gulf of Gabes, a W-E and NW-SE trending horsts, grabens, half-grabens (Bedir et al., 1992) and normal faults (Gharbi et al., 2014). During the atlassic phase, Serravallian to Tortonian times, the Eastern Tunisia was collapsed (Mejri et al., 2006); sedimentation and tectonic activity were important (Bishop, 1988; Ben Ferjani et al., 1990; Burollet, 1991) with reactivation of strike slip (Shahar, 1994; Guiraud and Bosworth, 1997; Bosworth et al., 1999) and major faults (Castany, 1951; Zargouni, 1985; Ben Ayed, 1986). During the Pleistocene times, Cercina town was submerged due to an active subsidence (Burollet et al., 1978). Finally, During Plio-Quaternary time, four structural directions were mobilized in Kerkennah Islands. Their kinematics correspond to an extensional regime interrupted by one compressive episode (Delteil, 1982). The four structural directions are:

- The North-South direction is manifested by normal faults affecting the Eutyrrhenian deposits in Ras Amer within Chergui Island and indicating an extensional dynamic (Delteil, 1982).
- The N 40 direction, the atlassic direction is manifested by normal faults structuring the southeastern part of Kerkennah Islands and indicating an extensional phase (Burollet et al., 1978).
- The East-West direction is represented by east-west folding, in Ras Amer within Chergui Island, affecting Neotyrrhenian and *Würmian* deposits and indicating a compressional phase (Delteil, 1982).
- The N 130 direction is manifested by normal faults causing an active subsidence and the collapse of the Roman town of Cercina

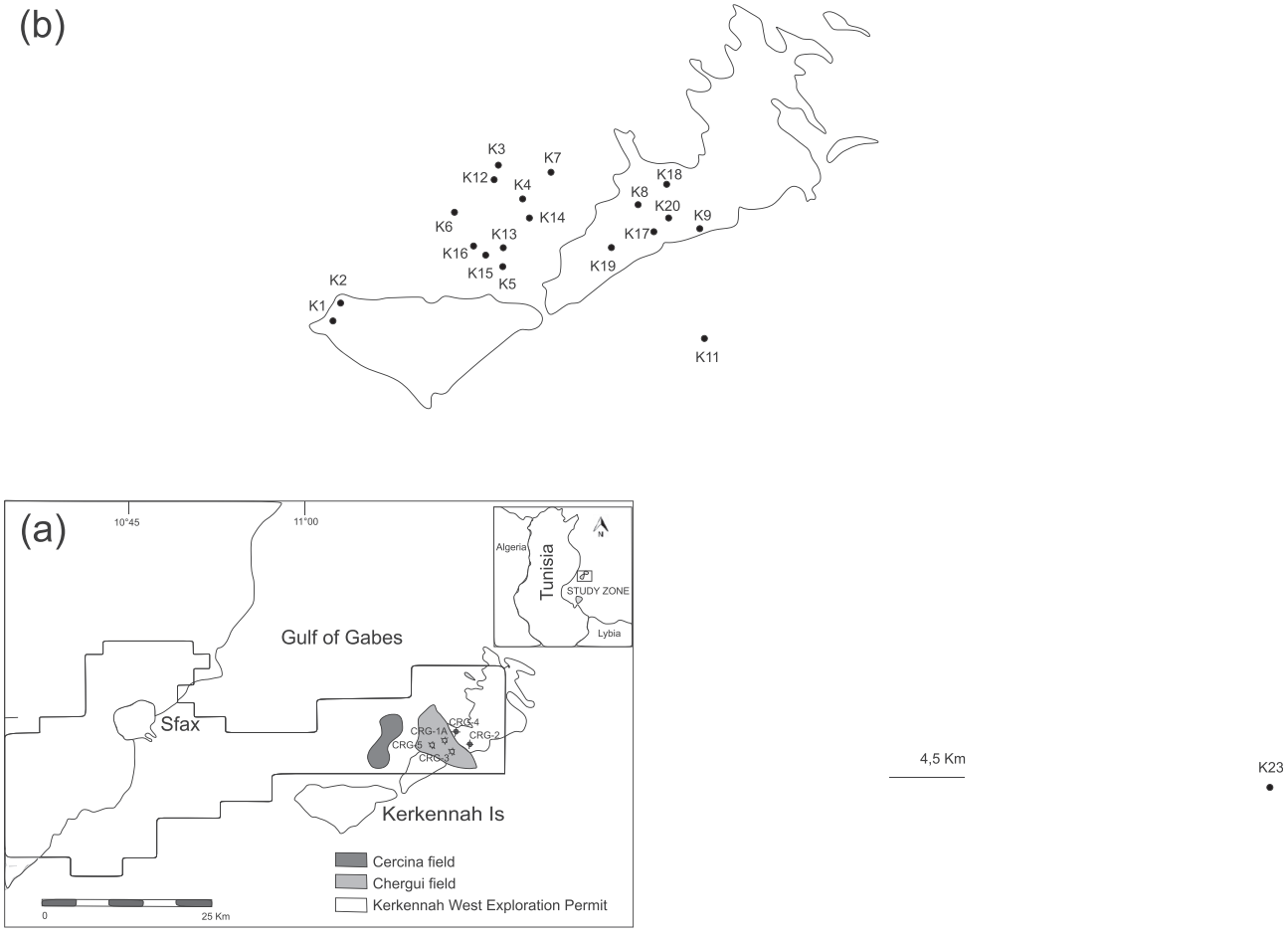

Fig. 1. (a) Location map of Chergui and Cercina fields within the Kerkennah West Permit, Sfax offshore (after Hauptmann et al., 2000). (b) Location map of the studied wells.