



Seismic structural analysis of the miocene section in Zaafarana offshore area, North Gulf of Suez, Egypt

A. S. A. Abu Atta^a, A. A. Hewaidy^b, T. H. Abdelhafeez^b and M. I. Hammam^c

^aGeophysics Department, Faculty of Science, Ain shams University, Cairo, Egypt; ^bGeology Department, Faculty of Science, Al Azhar University, Cairo, Egypt; ^cExploration Department, Gemsa Petroleum Company (Gempetco), Cairo, Egypt

ABSTRACT

Thirty 2D seismic lines interpreted, with help of velocity well, and time-depth trace conversion, to construct the depth structural maps of Zaafarana area. This is to characterise the different stratigraphic tops of the Zaafarana area. The 2D seismic lines in Zaafarana area investigated and reviewed to select the best quality set.

The depth contour maps and structure of three different reflectors Top Kareem, Top Rudeis and Top Nukhul formations in this area were constructed and detected.

These depth structural maps indicate that the Miocene Formations in the Zaafarana Field affected by elongated fault block dipping 5–15°, to the east-southeast. It lies downthrown and adjacent to a major down to basin, east-dipping and clismic fault system. At the level of the Miocene reservoir section, the structure is more indicative of a large, northwest trending and compactional anticline. It is a four-way dip closure to the south-north and probable fault closures, to northeast, northwest, and southwest side of the structure.

The central portion of the structure is relatively unfaulted based upon the current seismic interpretation, it is enhancing sweep efficiency within the reservoirs.

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1. Introduction

The Zaafarana area is about 103 km² in the offshore, northern province of Gulf of Suez Basin. It is located 90 km from Suez City, and about 45 km to the southeast of Ras Budran and October fields as shown in (Figure 1).

The field discovered in 1990 by British gas (BG) Egypt, with the drilling and testing oil zone of the Hb78-2 well, it is located 4 km off the mouth of the Wadi Araba on the west side of the north-central Gulf of Suez, reached a total depth of 8400 ft in Nubia clastics. A second well, Hb77-1 drilled about 1 km away from Hb78-2 well. Both wells tested oil from several Miocene reservoirs at combined rates of 8000 BOPD with oil gravity ranging from 15° to 25° API. The second appraisal well, Hb77-4, was drilled to evaluate the reserves on the northwestern portion of the Zaafarana area. HB- 77-2 well-tested separate structural elements in the vicinity of the Zaafarana area. These wildcat wells failed to find significant reserves.

In 1994, Zafco Oil Company started to drill and develop several wells thought the construction of a platform and the drilling deviated development A-2 well the well-confirmed good oil flow at Rudeis clastics, and reached a total depth of 7479 ft in Lower Rudeis clastics. The wells encountered oil shows at Rudeis and upper part of Kareem Formation and

producing oil from Rudeis Formations. This field is a byproduct of a complex positive structure which located in Gulf of Suez (Northern Province), which is distinguished by major unconformities between Miocene and pre-Miocene section with SW-dip style.

The big issue of this work is interpretation of the 2D seismic lines of Zaafarana area to define the structural configuration intervening and appraisal of the petroleum system of the Northern province of the Gulf of Suez.

The seismic interpretation achieved in parallel manner with the geological interpretation. The seismic, geo-seismic and geological maps were set up and interpreted. Using the vertical seismic profile (VSP) of a lot of available boreholes, geological well-data, the picked horizon and mapped seismic unit had been calibrated.

The scope of this manuscript represents a detailed idea of the structural situation in Zaafarana area. This goal achieved by integrating the available 2D seismic data & geological borehole data. This to clarify the area geological features and its structural framework.

2. Geological setting

The work is located within the main structural elements of the Gulf of Suez basin as shown in (Figure 2). The Gulf of Suez is a rift graben formed from tectonic movement's onset in the Olig-Miocene, which

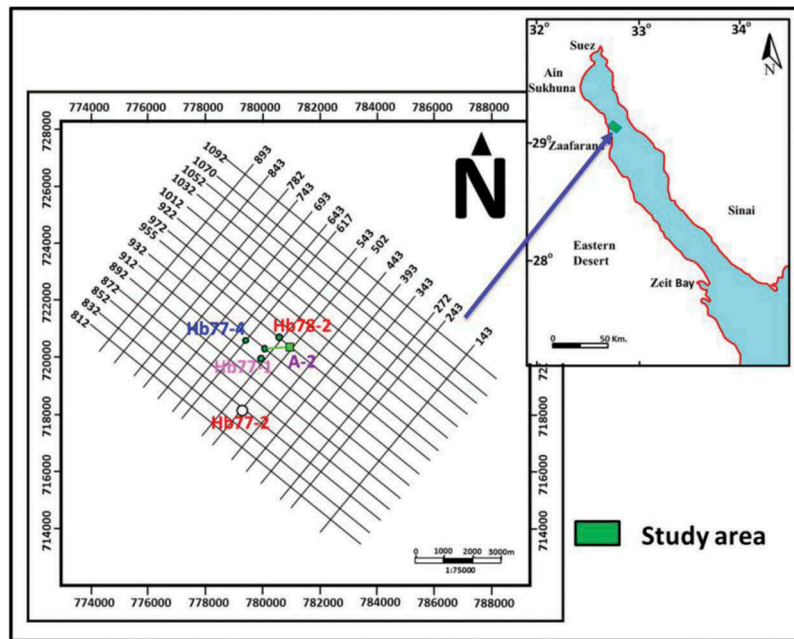


Figure 1. Location map of the study area, with available seismic lines and wells.

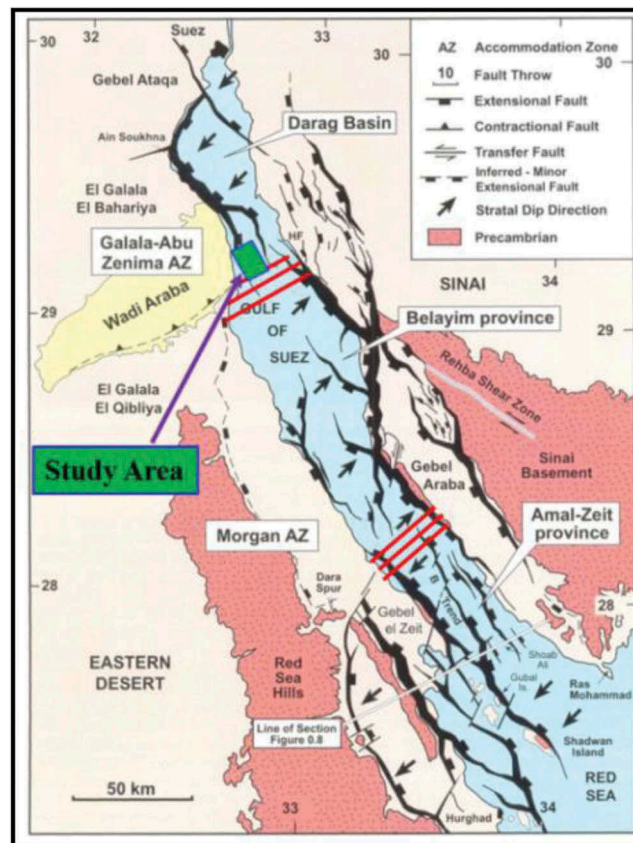


Figure 2. Tectonic map of the Gulf of Suez showing the three dip domains (Modified after McClay et al. 1998).

continued with intensity until Post-Miocene times the Gulf of Suez is divided into three uplifted belts separated by two structural lows. The highest and lows are of Gulf parallel trend and dissected by NE-SW Aqaba trending fault, Said (1990) (Figure 2).

An exploration 2D seismic survey consisting of 103 square-kilometres was shot in 1989, prior the

Zaafarana discovery as shown in (Figure 1). This survey provides an optimal data set for the structural elements of the Zaafarana area. Structurally, below the Pre-Miocene unconformity, the field consists of a half-graben fault block dipping 15–20°, to the east-southeast. It lies downthrown and adjacent to a major downward basin, east dipping, clysmic fault system.

At the level of the Miocene reservoir section, the structure is more indicative of a large, northwest trending, compactional anticline. It is a four-way dip closure at the north and south and probable fault closures to the northeast, northwest, and southwest sides of the structure as shown in (Figure 6–10). The central part of the structure is relatively unfaulted based upon the current seismic interpretation, thus enhancing sweep efficiency within the reservoirs.

The stratigraphic sequence in the Gulf of Suez includes three phases: pre-rift, syn-rift and post-rift stratigraphy, the article related to syn-rift phase as shown in (Figure 3). Rapid subsidence, accompanied by the deposition of both carbonates and clastics (Kareem unit) consist through the Serravalian (Tewfik and Deighton 1992). The predominantly marine Rudies and Kareem Formations together with the Nukhul Formation set up the Gharandal Group, which sometimes gives a name of “Globigerina Marls”. The main reservoir units are located in the Rudeis & Kareem Formations. The description of each reservoir unit is as follows:

2.1. Lower Rudeis unit

Lower Rudeis unit is composed mainly of sandstone sequences and dolomite deposited in a marginal marine alluvial braided plain. This unit has also been subjected to secondary dolomitisation.

2.2. Middle Rudeis unit

Middle Rudeis unit consists of sandstone and shale sequences with minor dolomite streaks varying in

thickness. This was deposited in a transgressive shelf type fan delta.

2.3. Upper Rudeis unit

Upper Rudeis unit is mainly composed of a massive sand body intercalated with thin streaks of dolomite and Shale. These sands deposited in a regressive alluvial-braided plain unit, which suffers from extensive secondary dolomitisation.

2.4. Kareem formation unit

Kareem unit is a predominantly a sandstone sediments in the Upper Kareem. Sediments which covered by the Belayim, South Gharib and Zeit Formations, which are made up of shales, with thick dolomite and anhydrite beds, which form the vertical seal. The base of the Belayim is marked by a significant heavy-dolomitised bed which forms a predominant seismic marker.

3. Database and methodology

The context of this work is shown in the Seismic lines location map as shown in (Figure 1). These data include:

a) Two-way travel times (TWT) of 2D seismic sections from gemsa Petroleum Company, which include a total of 30 individual 2D offshore seismic sections in two directions (In-line and X-line located in Zaafarana Concessions). The Seismic data cover about (103 km²) of the area which called Zaafarana oil field.

b) Logging data of five offshore wells, in which the available open E-logs

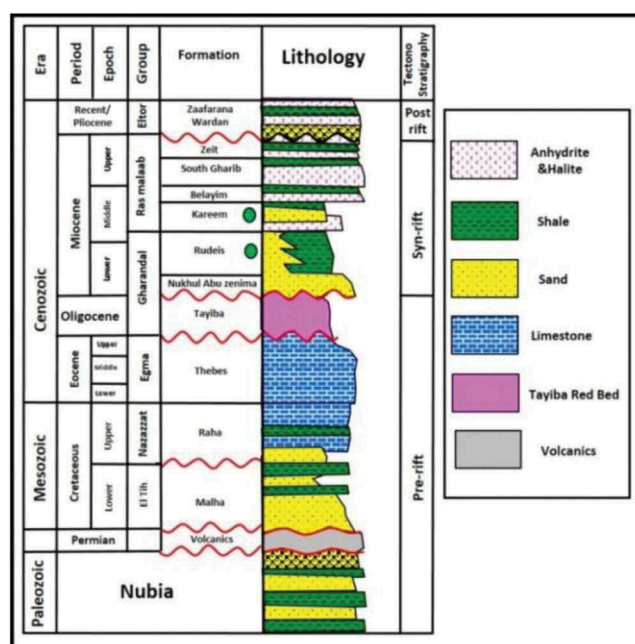


Figure 3. Simplified stratigraphic column, Zaafarana (BG, 1991).

c) One well velocity survey are vertical seismic profiling (VSP).

3.1. Techniques and methodology

The present work is based on the available 2D seismic data, well-logging data. All evaluations and interpretations have been established using Petrel Software 2015 geophysics.

The approach to the analysis of the data is divided roughly into the seismic interpretation for the interpreted faults and horizons. The usually employed methods to achieve this target are;

- (1) A careful study to the geology of the area, correlated with the control points or borehole data (geologic tie).
- (2) The use of the available borehole density & sonic logs are of great importance in order to make synthetic seismograms where the major reflectors are to be expected.
- (3) The reflectors picked and must be tied together with around the network of the seismic lines.
- (4) The fault and Horizon patterns have to be interpreted and marked on the seismic sections.
- (5) Time values and fault patterns have to be contoured giving rise to two-way time structural contour maps.
- (6) The use of average velocity will enable the convert of the travel time into depth and thickness values and this allows the preparation of thickness and depth maps.
- (7) Geo-seismic cross sections for productive wells, as well as geo-seismic structure contour maps, have been constructed.

4. Stratigraphic correlation chart

The aim of correlation chart is to follow the changes in lithologic characters vertically and laterally, or any break in the depositional continuity. It shows the equivalency of stratigraphic units and to exhibit the thickness variations.

The correlation chart (A-A') extends along the NE-SW direction, and passing through Hb77-2, Hb77-1, Hb77-4 and Hb78-2 wells (Figures 4 and 5). The chart shows three main units, they are Kareem, Upper Rudeis, Middle Rudeis, Lower Rudeis and Nukhul Formations as arranged from top to base, respectively. These units clarify that the Rudeis Formation represents more thickness and the Kareem/Nukhul Formations, are lesser thickness than the other units. All the tops of units are higher in Hb77-2 well (at the North-west direction) than the other wells. This means that the western area may be subjected to uplifting (Figures 4 and 5). They are differing in lithology from one unit to another. Kareem Formation consists mainly of sandstone, with intercalations of shale and dolomite, while, the Rudeis unit consists mainly of sandy dolomite, with strikes of shale units. Meanwhile, the Nukhul Formation consists mainly of sandstone towards the eastern direction.

The stratigraphical analysis of the study area has been made on steps as follows: stratigraphic successions penetrated by wells change their thicknesses significantly, because of the faulting and lateral variations in subsidence. Electrical log correlation among the penetrated wells, in the study area. The main reservoirs were discovered in the upper part of Kareem, Middle and upper parts of the Lower.

5. Well velocity survey and seismic-well tie

The accuracy of seismic data Acquisition, processing and interpretation depend mainly on the velocity

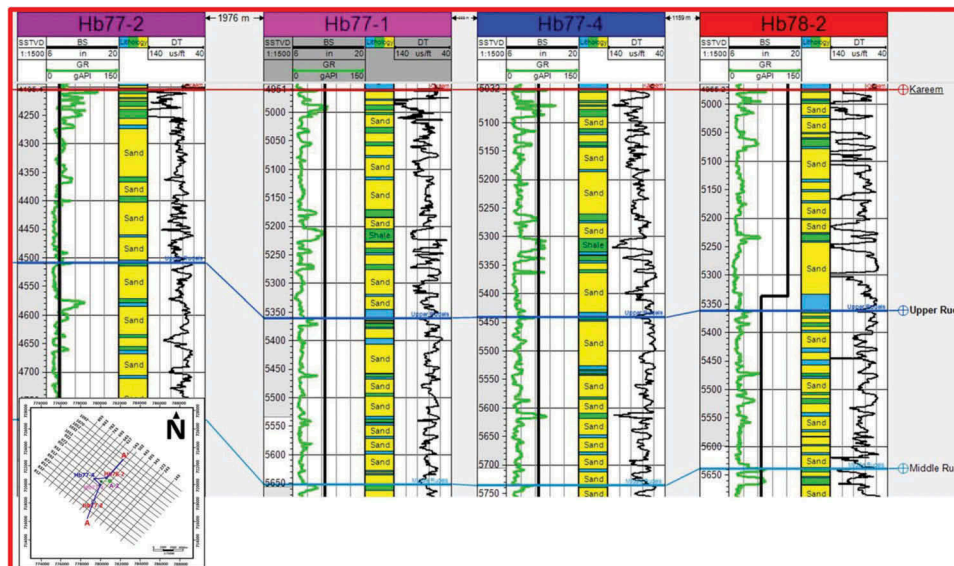


Figure 4. Stratigraphic correlation chart of the Kareem and Upper Rudeis Formations in the study area.

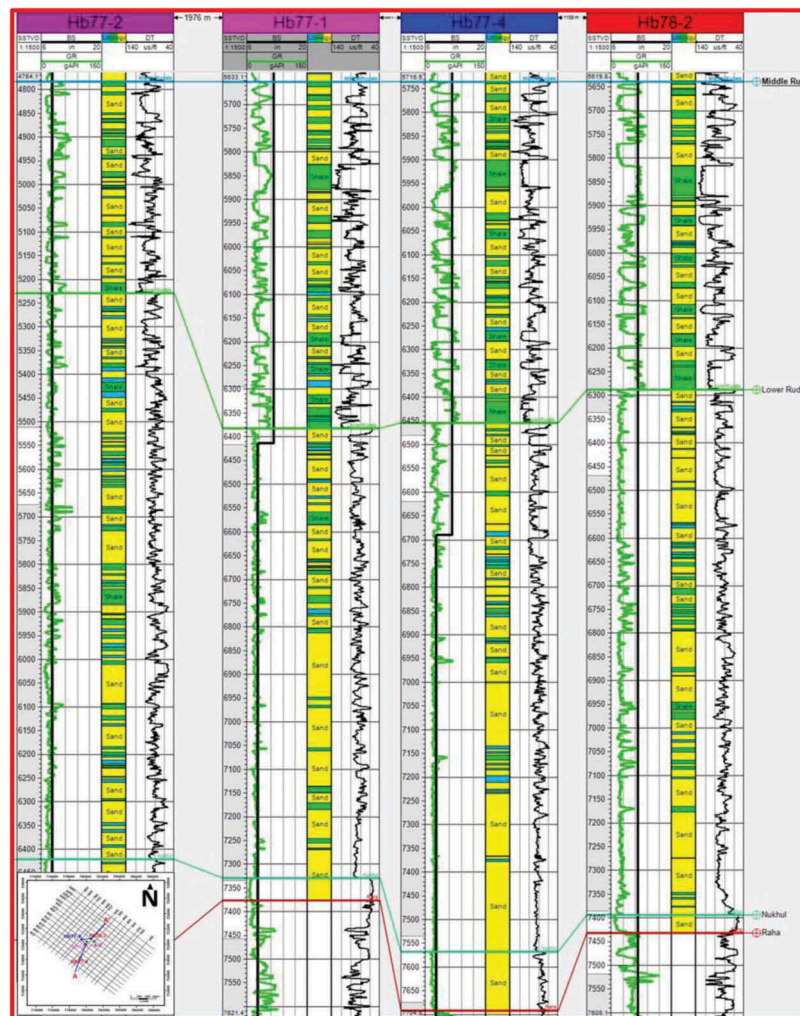


Figure 5. Stratigraphic correlation chart of middle, lower Rudeis and Nukhul Formations in the study area.

measurement. Erroneous velocity estimations can lead to drastically distorted geological pictures. For this reason, the question of velocity accuracy always demands serious attention. The relationship between depth and velocity can be determined below this approach:

5.1. Synthetic seismogram

In order to tie-in the well results, it is customary to compile the so-called, synthetic seismogram or trace. The input data is consists of: * Sonic log. *Density log. *VSP. *Seismic wavelet

The reflectivity pike trace is subsequently convolved with a seismic wavelet and a synthetic trace is created. This trace is compared with the seismic reflectors on the seismic sections, through the tied well. For this aim, the same synthetic seismogram trace is usually repeated four or five times in the display. It is then overlaid or split-in with the seismic data at the well location (Veeken 2007). In this study, the seismic-to-well tie was conducted on the one well, Hb778-2 as seen in (Figure 6).

6. Fault structural pattern

Zaafarana area is characterised by a complex pattern of faulting dominantly in the direction of the Gulf of Suez, trending in SE-NW direction (major and minor faults). This direction is intersected by other relatively NE-SW direction, called as X-faults. Most of the major and minor faults penetrated all the Miocene section while the rest can be traced only on Top Nukhul formation. The magnitude of major fault (F3) is relatively large and varied widely all over the area with amount of thrown reach to 200 ft, this fault is considered the greatest one in the area. Cross faults (F1, F9 and F10) are running from NE to SW directions and having a moderate magnitude ranged from 50 ft to 100 ft. Generally, the fault pattern of the study area is NW – SE trend as illustrated in (Figure 7), which is considered the strongest event with relative frequent degrees from 75° to 85° through the total-interpreted fault. This summarised demonstrates an enormous harmony with the interpreted potential field data which show that trend can be considered the basic tectonic trend affecting the area (Amer 1985).

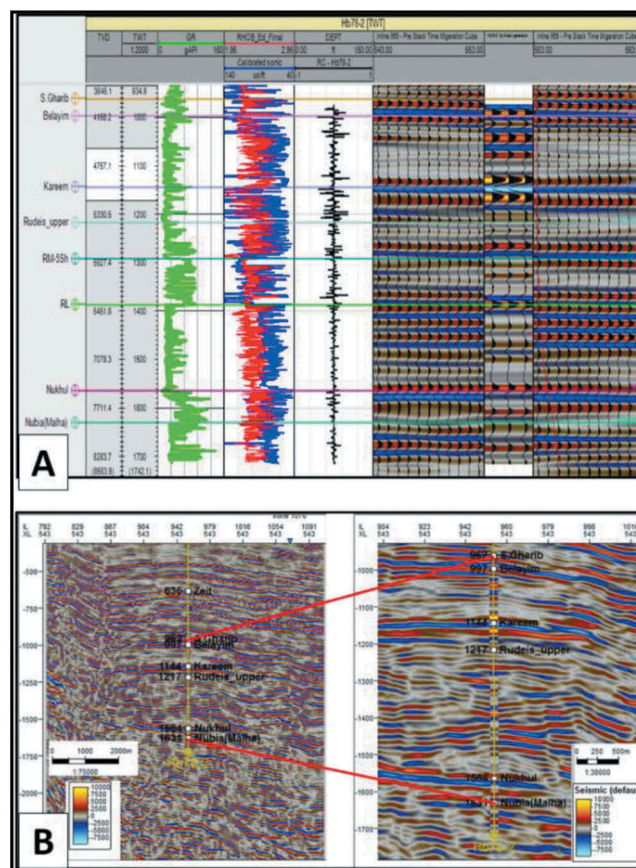


Figure 6. Synthetic trace construction methods for Hb78-2 well.

- (A) Acoustic impedance is calculated by multiplying the values of density and sonic logs, reflection coefficients are computed and convolved with a seismic wavelet to obtain the synthetic trace.
 (B) Part of the seismic line with a synthetic seismogram.

7. Seismic lines interpretation

Two samples of the seismic lines named IL 543 and XL-955 were interpreted with the structural elements

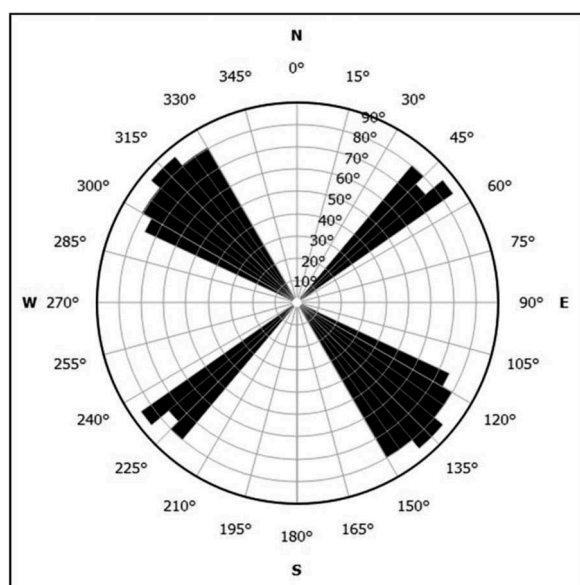


Figure 7. Rose diagram showing structural trends systems analyzed and plotted.

expected and by migration of the interpreted time intervals to depths through the well-known velocities across the various rock units. The locations of these two lines are reflected in the shot-points location map (Figures 8–9).

The first seismic section IL 543 (Figure 8) was acquired in the dip direction (NE-SW), that parallel to the cross-gulf elements and passing through Hb77-1 and Hb78-2 wells. It highlights many of the longitudinal faults and the widths of the tilted fault blocks. The structure along this trend was distinguished by a general dipping of the sedimentary strata towards the SW-NE, with thickening of the sedimentary section as a whole. The structural elements exhibit the presence of three normal faults with downthrown sides mostly northeast-southwestward. They show that some of the faults were activated from the Pre-Miocene surface, extending upwardly into the overlying sedimentary sequences, including the Miocene rock units. The structures indicate that the deduced faults not influenced in the Quaternary and younger rocks. This suggested that the basin almost tectonically ceased since the post-Miocene time, with minor faulting accompanied with the recent tectonics.

The second seismic section XL 955 (Figure 9) is trending in the NW-SE (strike) direction that may

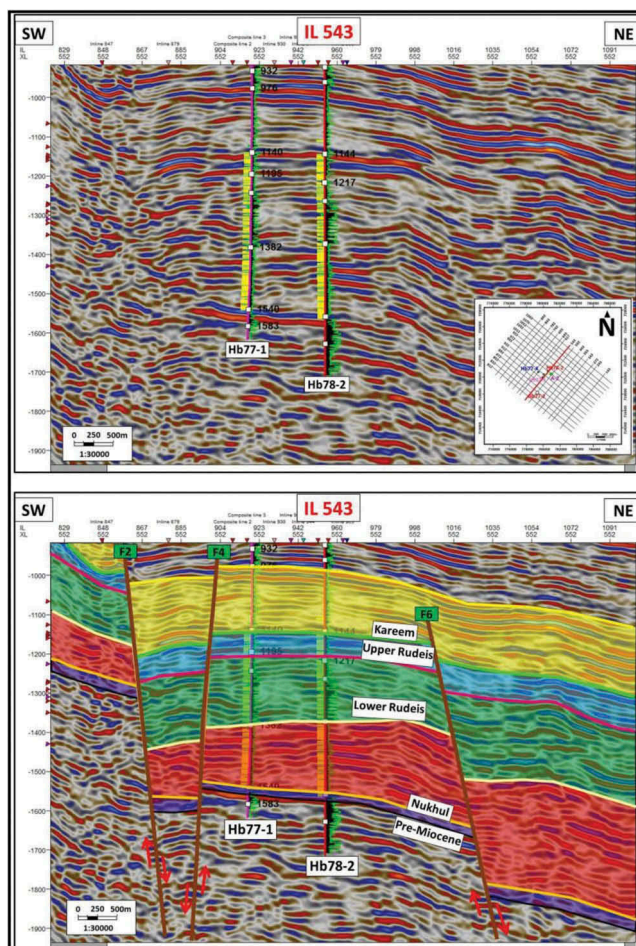


Figure 8. Uninterpreted and interpreted seismic section IL543, with NE-SW (dip) direction.

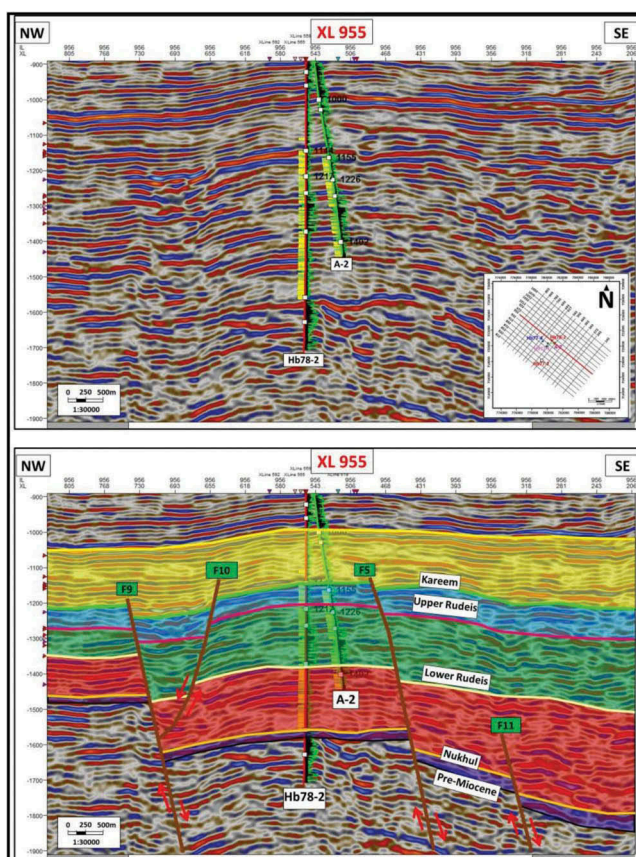


Figure 9. Uninterpreted and interpreted seismic section XL955, with NW-SE (strike) direction.

Table 1. Dip data of the wells drilled in Zaafarana field.

Formation	Hb77-2			Hb77-4		
	Dip	Azimuth	Depth ft. (MD)	Dip	Azimuth	Depth ft. (MD)
Kareem	9-10	NE	4320	8-10	NW	5150
Upper Rudeis	10	NE	4650	10	NW	5550
Middle Rudeis	8-12	NE-SE	5050	8-10	NW	6400
Lower Rudeis	8-10	NE-Se	5550	10	NW	6650
Nukhul	10-12	NE	6550	10-15	NW	7650

help in mapping the cross-gulf elements. The reflector picked in this line shows a gentle southeastern dip regime. Occasionally, it is difficult to recognise the faulting, folding and uplifting as those defined in the dip lines.

The structure is evidenced by a few faults that almost originated in the pre-Miocene surface and terminated through the Lower-middle Miocene and Ceased within lower Rudeis Formation before reaching the surface. This may explain the fact that the study area is recently stable like those adjacent areas in Northern Egypt. The northwest portion exhibits a substantial thinning of the sedimentary section, the result of the local folding and uplifting in the central part of the study area.

Commonly, these two examples reflect the effect of pre-Miocene structures on the Miocene clastics. They indicate that, the cross fault elements, either the SW or NE were originated in the pre-rift series.

8. Structural configurations

The interpretation of seismic reflections is the process of transforming the physical responses displayed by the seismic lines into geological information of interest, concerning either the structural style or the stratigraphic regime. Seismic reflection analysis has many applications in the interpretation of the subsurface geology. Stratigraphic and facies analysis assists in the delineation of the Paleoenvironment of deposition of the different rock units. Therefore, the principal aim of seismic interpretation is to identify the important reflectors and present them as isopach and depth maps (Badely 1985). Fitch and Miller (1988) thus expressed the fact that tectonics and sedimentation are closely linked so that both subjects must be considered together.

Three horizons were picked, both on the pre-stack volume within the time interval of 810 ms and 1860 ms. Top Kareem Formation picked time about 810 ms: 1150 ms, while the top Rudeis was picked at about 950 ms: 1200 ms; meanwhile, top Nukhul was picked at about 1220 ms: 1860 ms. In the following, the seismic boundaries are described. In this study, three chrono-stratigraphic boundaries

have been identified through (Figures 7–8), they from the youngest to the oldest, belonging to lower and Mid-Miocene Series.

8.1. Structural dip analysis

Structural dip is defined from the bedding facies (lithotypes) that are assumed to have been deposited with horizontal or near horizontal attitude. Analysis of the available dipmeter data for the drilled wells in Zaafarana field by the present author was carried out by using dipmeter data log, the dip values over the Held were analysed and tabulated in Table 1. The dipmeter data in Zaafarana field showed that the Miocene Formations all over the field showed variable dip directions.

The acquired dip data in Hb77-2 well have high quality which contains uniform NE-SE dip trend (Figure 10). Hb77-2 well-penetrated Kareem Formation at depth 4281 ft, dipmeter reading shows 9–10° dip magnitude with NE dip direction in this formation. The dip magnitude decreased down-ward and scattered at base of Kareem

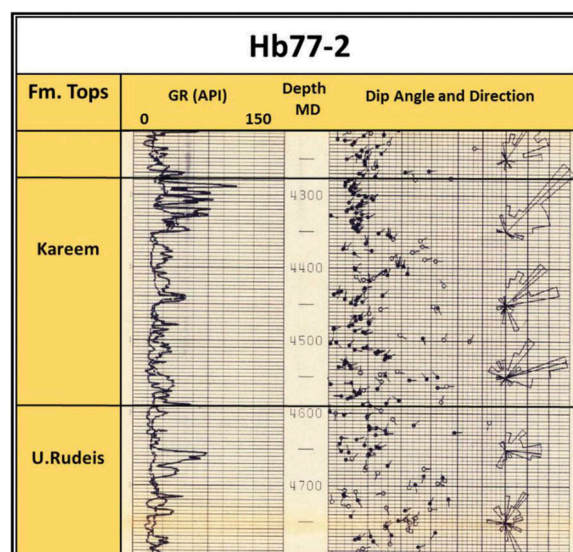


Figure 10. Dipmeter log shows NE dip direction in Kareem and upper Rudeis formations in Hb77-2 well.

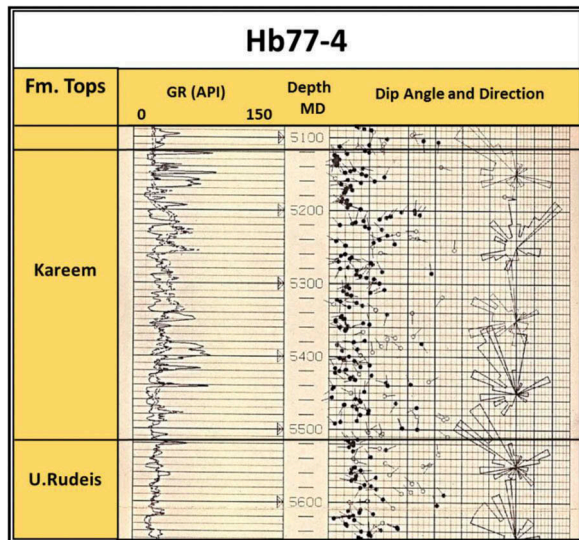


Figure 11. Dipmeter log shows NW dip direction in Kareem and upper Rudeis formations in Hb77-4 well.

Formation. The Rudeis Formation in this well shows dip angle ranges from 8° to 12° with NE and SE dip direction. The recorded dip magnitude in Hb77-2 well from depth 4600 to depth 6500 ft Measure Depth (MD) is 8–12° with SE dip direction. The well penetrated the fault (F2) from well log correlation at depth 5000 ft. The well-penetrated Nukhul Formation at depth 6500 ft, the dip reading in Nukhul Formation for the interval from depth 6500 ft to depth 6650 ft showed 10–12° dip magnitude and NE dip azimuth while the lower part of Nukhul Formation showed N dip direction.

And Hb77-4 well has dipmeter reading recorded on the composite log from/oil Formation to Nubia Formation. The dip magnitude in Kareem, Rudeis and Nukhul Formations through the interval from depth 5118 ft MD to 7780 ft MD ranges from 8° to 15° with NW dip direction (Figure 11).

8.2. Subsurface mapping

The interpretation has been traced three reflectors on the tops of Nukhul, Rudeis and Kareem Formations. The structure contour maps were constructed through converting the reflection times (TWT) into depth by using the average velocity.

The depth structure contour map of the top Nukhul Formation based on 2D seismic data in the Zaafarana area (Figure 12) shows the most complicated Extensional structurally high. The contours are dipping steeply down toward the NE, where the maximum depth exceeds –8500 m, while the minimum depth reaches –6000 m at the northwest and southwest portion and moderately depth in the central portion of the study area. The structure shows the dominance of the NW-SE fault system, particularly along the coastlines of the gulf. The boundary faults extend over long distances and seem to have larger throws than the entire ones. Basinward, the longitudinal faults were traversed by smaller faults of NE to SW orientations. These faults represent the initiation of the seismic in the study area. Nukhul Formation is not pay in the study area.

The depth structure contour map of the top Rudeis Formation is based on 2D seismic data (Figure 13) shows

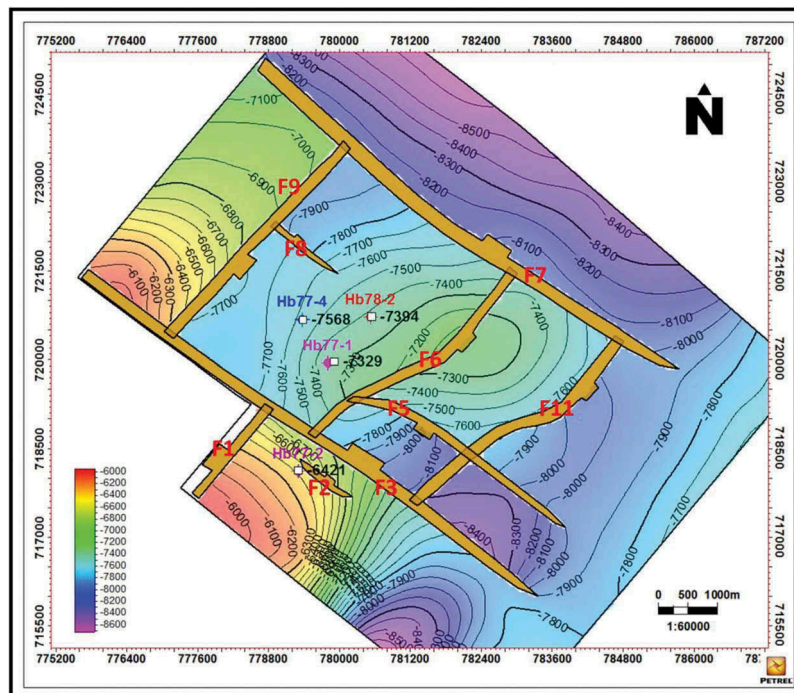


Figure 12. Depth structure contour map on the top Nukhul formation in study area.

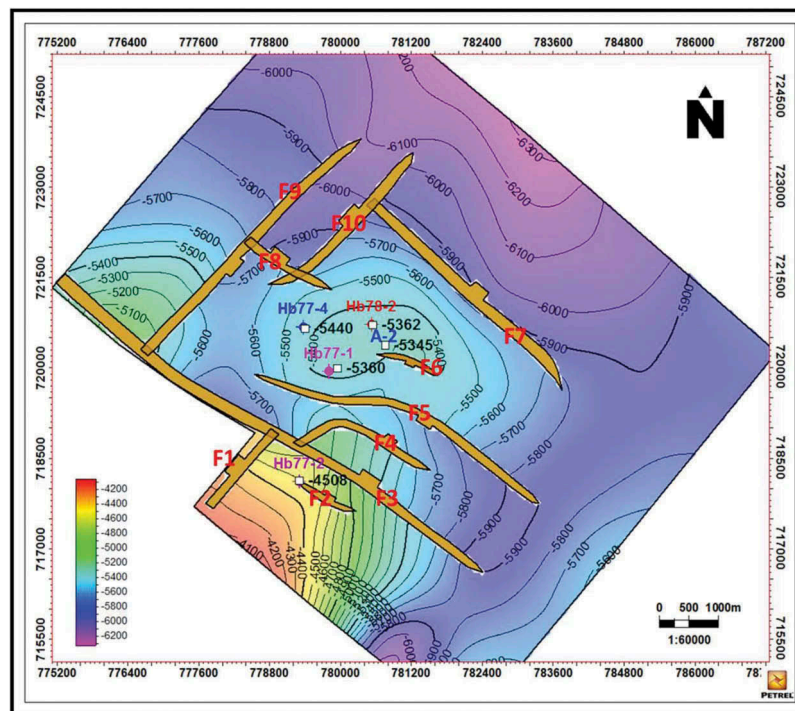


Figure 13. Depth structure contour map on the top Rudeis formation in study area.

two main faults trend the NW-SE and NE-SW while the NW-SE trend is the dominant one with compaction four-way dip closure distributed in the centre of Zaafarana field which records the highest depth values from -4100 ft in SW ward to -5700 ft in the central part directions. Where the structurally low present in the eastward direction and recorded maximum value -6400 ft. in the deepest location. The faults are normal and trending in an NW-SE direction and throwing toward the east forming half-graben structure and step faults, as well as the

closures, were observed on the top of Rudeis. Folding, generally, has played a minor role in the determination of the structural settings of Gulf of Suez; this may be due to the Syrian Arc tectonics (Moustafa 1976), it is believed that many structures as anticlines are probably the results of dropping of the Miocene sediments over Pre-Miocene tilted fault blocks.

The structure map on the top of Kareem Fm. (Figure 14) still reveals the distributions of most deformation systems that were active during the

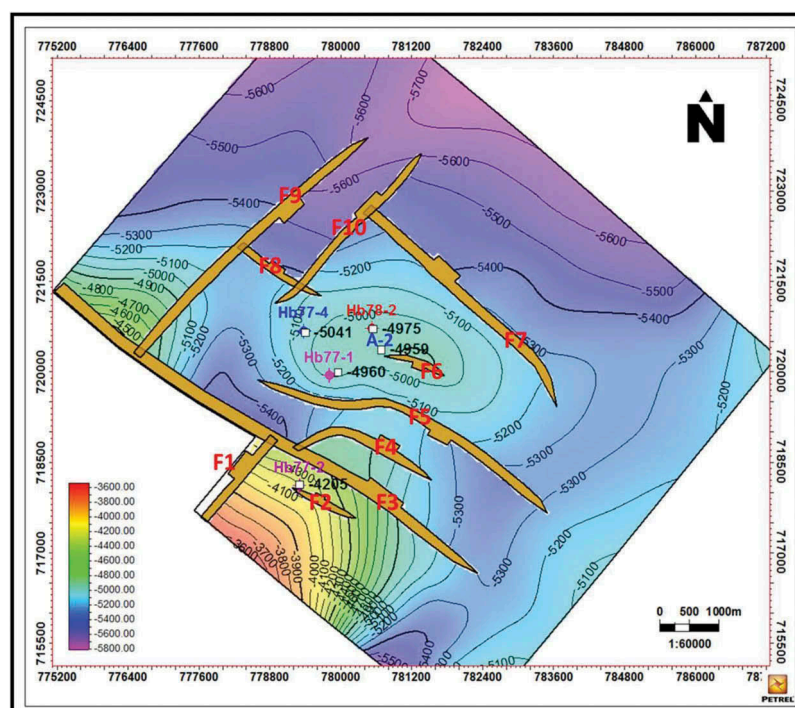


Figure 14. Depth structure contour map on the top Kareem formation in study area.

Rudeis Formation. The faults are normal and trending in an NW-SE direction and throwing toward the east forming half-graben structure and step faults, as well as the closures, were observed on the top of Kareem. The site of the basin during the deposition of this sequence mainly in the southeastern part of the study area. Kareem Formation represents the reservoir in some well in Zaafarana area.

9. Isopach maps

Depending on the composite logs of the drilled wells in the area under investigation and the interpreted seismic sections, three isopach maps were constructed for Nukhul and Rudeis (reservoirs), as well as Kareem (reservoir) Fms. An isopach map is used to show thickness trends from the contour measurements. An isopach map can be interpreted as a paleo-topographic map if the upper surface of the unit was close to horizontal at the end of deposition (Groshong 2006).

The Isopach map constructed for the interval from top of the Nukhul Formation to top of the pre-miocene Formation (Figure 15) reveals that variations in thickness that ranges from 140 to 400 ft. The minimum thickness encountered in the central part and the maximum thickness encountered in the southeast and northwest of the study work. Nukhul Fm. was deposited unconformably over the Pre-Miocene sediments. This suggests a Late Cretaceous to Eocene/Oligocene erosion, followed by the deposition of Nukhul deposits (mainly Sandstone). During the Early Miocene rift phase, the Northern Galala and Wadi Araba were uplifted, actively eroded and established a site for sand supply, particularly at their scarps facing the gulf.

The isopach map of the Lower Miocene Rudeis Fm. (Figure 16) is evidenced by a major sediment accumulation (>1800ft.) It suggests a wide spreading

marine transgression over Zaafarana area. Southeastern thickening of Rudeis Fm. may reflect a great tectonic subsidence at the end of Nukhul Fm. Time associated with uplifting of the northern part. Commonly, the deepening of the rift is significantly recorded by the Lower Miocene Rudeis Fm, since it considered the most important and prospective syn-rift reservoir in the northern gulf. This map shows that the basinal areas during the deposition of the early Miocene exist to south part of the present study. The Rudeis sediments are reduced in thickness at the extreme west and northwest portion. The presence of North and south galala uplifts to the North & south of the study area is believed to be the main supply of these clastics.

The Isopach map from top Kareem to top Rudeis Formation (Figure 17) shows variable thickness of that interval where it ranges from 250 to 550 ft. The maximum thickness of the Kareem sequence is encountered in the southeast part of the study area, whereas it exhibits minimum thickness in the west part of the study area in Kareem Formation.

10. Geological cross-sections

Two geologic X-sections were constructed using the available wells data, to confirm and throw more light on the regional structures of the study area. These cross sections were created by using the fault framework from the seismic interpretation along with the structure contour maps. The Formation tops and dipmeter data with the fault cuts from E-Log correlation were used to construct the un-interpreted Formations between wells. Two X-sections were created to reveal the structure configuration within the Zaafarana field.

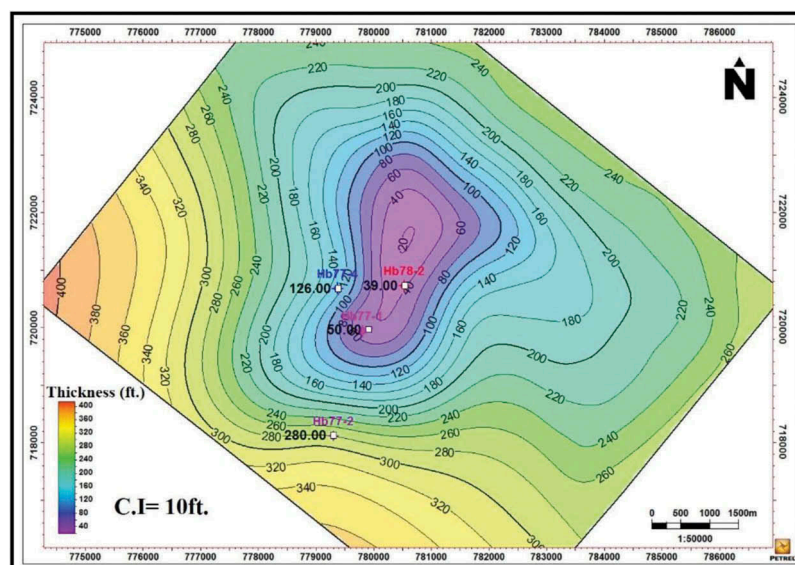


Figure 15. Isopach map of Nukhul formation in the study area. Contour Interval C.I = 20 ft.

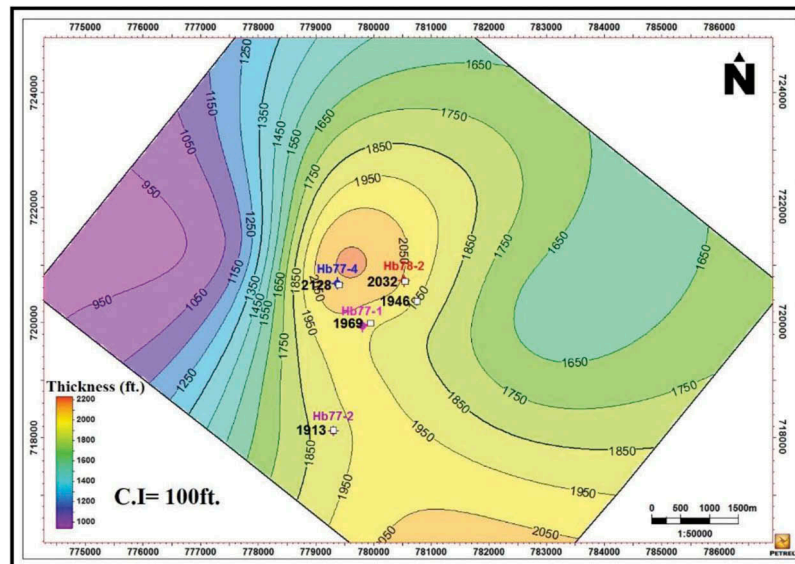


Figure 16. Isopach map of Rudeis formation in the study area. C.I = 25 ft.

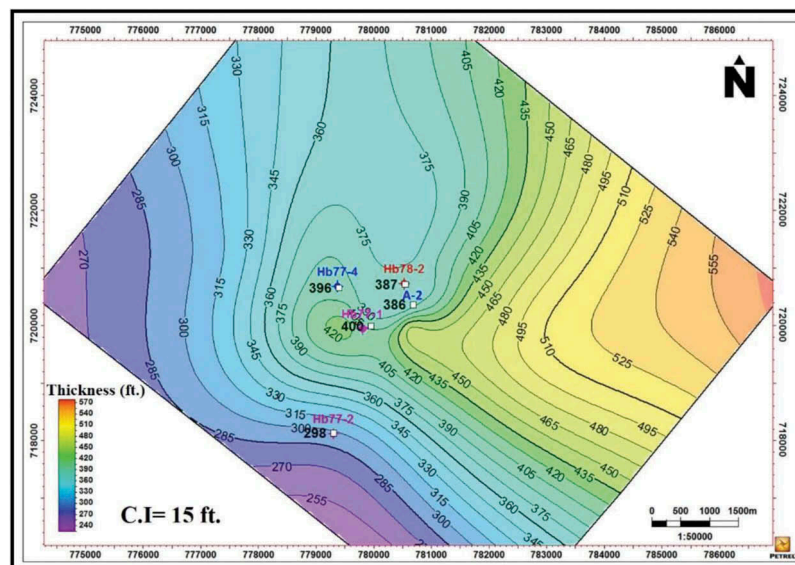


Figure 17. Isopach map of Kareem formation in the study area. C.I = 15 ft.

The first cross-section was constructed between Hb78-2, hb77-1 and Hb77-2 wells (Figure 18). The section has an SW-NE direction which mainly in the main dip direction of the area. All wells penetrated the Miocene Formations. This Formation constructs the four-way closure on the top of Kareem and Rudeis reservoirs. The well-penetrated Nubia Formation after Nukhul Formation. This missed section most commonly due to the unconformity surface that was happened on the horst block between the fault F1-F6 and the fault F1-F11, Hb77-2 well penetrated the thin section in the upthrown side at the southwest direction. The fault has NE dip direction and formed step structure with the fault F1 to the East. The fault-4 to fault-6 formed the four-way closure on top Kareem and Rudeis and formed three-way closure on top Nukhul Formation, also dipping to NE direction.

The second cross section was constructed between Hb77-4 and A-2 wells (Figure 19) Hb77-4 is vertical wells, meanwhile A-2 well is a devoted well, the section was constructed perpendicular on the well path of A-2 well, the section shows the faults, that affected on the both of pre-Miocene and Miocene sections. All wells in the study area do not reach basement, the depocentres lay either on the down-thrown side of the NW-SE Clysmic faults or on the down-dip flank of the blocked structures.

11. Hydrocarbon implications

Three major productive reservoir units are found in Zaafarana field: the Kareem (K), Rudeis Middle (RM) and Rudeis Lower (RL) (Figures 18–19). Most of the

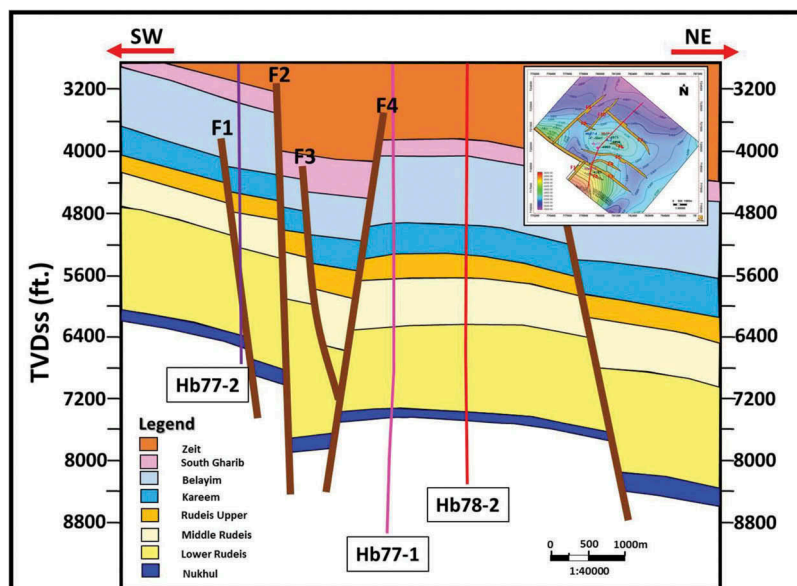


Figure 18. Geoseismic cross section along the NE-SW trend.

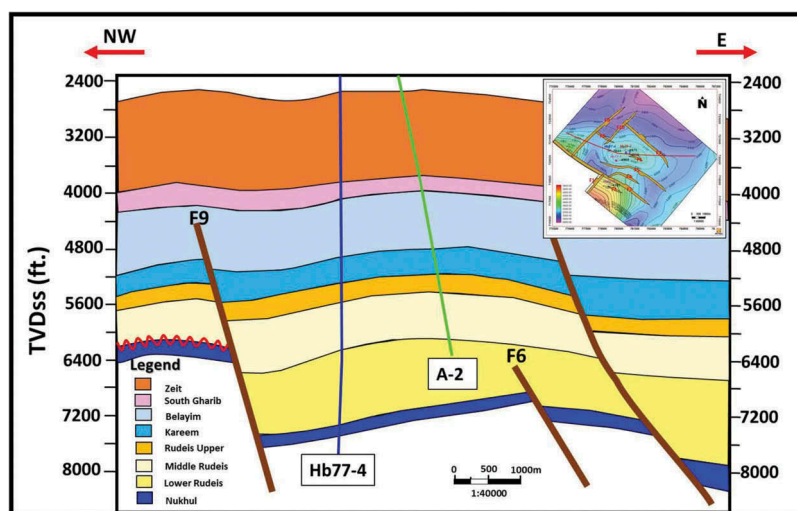


Figure 19. Geoseismic cross section along the NW-SE trend.

zones in these reservoirs are extremely porous and have excellent permeability. Porosity ranges from 23% to 30% and permeability about 4000 MD. The field already produced by the end of 1994, three boreholes are do not production yet, because the wells not tie by platform, except A-2 well-current production and Hb77-2 is dry well, while the production facilities were constructed offshore at Zaafarana offshore area. According to the knowledge, there are three types of hydrocarbon traps are formed in the Gulf of Suez. They are structural, stratigraphic and combined traps. About two of the oil discovery are from the structural traps and one from the others, the Miocene sediments were affected and controlled by fault block, block rotation and syn-sedimentary growth faults. The lithology were deposited on irregular Pre-Miocene relief, this results in rapid sedimentary thickness and facies changes.

12. Summary and conclusions

Zaafarana offshore area subjected to a comprehensive geophysical analysis in order to clarify and identify the subsurface geological settings. This was done through the interpretation of seismic data with the geophysical and geological information from the drilled wells. Geological data are performed over five wells which they Hb77-1, Hb77-2, Hb77-4, Hb78-2, and A-2 scattered across the study area. All Formations in the present study have been penetrated by all wells.

This study is focusing on a seismic investigation on Kareem, Rudeis and Nukhul sand hydrocarbon reservoirs, the structural configuration influenced and controlled by block faulting and syn-sedimentary fault movements (growth faults) and defined to be faulted four-way dip closure on top Kareem and Rudeis Formations, which faulted by the Pre-miocene, to late

Miocene (Tortonian) intervals, faults that varied from the NW-SE (F2, F3, F4, F5, F6 and F7) and the NE-SW Fault 1 to Fault 10 (F1 to F10) directions.

The seismic two-way time and the average velocity are analyzed and interpreted, in addition, the seismic impedance and the reflection coefficient are estimated and interpreted in tied with the constructed synthetic seismographs for one well in the study area, which show middle to high amplitudes and differentiating them from the overlying and underlying sediments. The synthetic seismic reflectors reflect intermediate seismic amplitude at the top of this sand, while the low-amplitude trough is defining the beginning of the underlying slower shale of the Rudeis Formation.

The conversion study to the time-depth was achieved on two seismic sections, to understand approximately their actual subsurface geological conditions. The geo-seismic sections matched with the structural prospects which has been proposed from the interpretation of seismic data as a good prospect.

The hydrocarbon potentially distributed through upper part of Kareem, middle Rudeis and upper part of lower Rudeis.

Disclosure statement

No potential conflict of interest was reported by the authors.

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