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Petrophysical evaluation of Lower Bahariya Reservoir using integrated well-logs and core data analysis in Yasser field, North Western Desert, Egypt.

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ABSTRACT

The Northwestern Desert represents one of the most important oil and gas regions. Yasser oil field is a major producer in this region, with multiple reservoirs contributing significant production. This study aims to evaluate the reservoir characteristics of Lower Bahariya Memberusing logging data for four wells and core data for three wells. Core data analysis allows direct examination of reservoir parameters and collaboration with other tools as well-logging data analysis. In this work, core data analysis includes statistical analysis, construction of histograms and relationships for the porosity and permeability of the Lower Bahariya reservoir. The well-log analysis includes data gathering and formation evaluation tasks. Petrophysical data are illustrated in iso-parametric maps for total gross thickness (ft), net-pay thickness (ft), effective porosity (ϕ_e %), volume of shale (Vsh %), water saturation (Sw %), hydrocarbon saturation (Sh %), bulk-pore-volume (BPV) and oil-in-place indicator (OIPI). These maps indicate the lateral variation and the promising areas for new productive wells. The obtained high porosity and permeability values indicate that the Lower Bahariya Member is a good to very good reservoir. The average of porosity values (helium and fluid) in the three wells range from 16.75% to 22.63%. The porosity values give homogeneity whereas the permeability values were heterogeneous.The positive trends with strong correlation coefficients in the relation between porosity types (fluid and helium) and porosity - permeability indicate homogeneity of pore space types and high percentages of effective porosity. The distribution maps reflect that the north and northeastern parts are the most promising in the studied area due to increasing in net-pay thickness, effective porosity, bulk pore volume, and oil-in-place indicator. These parts are recommended for future exploration and drilling of new wells.

1. Introduction

The research area is situated in the northern region of the Western Desert. It lies in the southern part of Shushan Basin between latitudes 30° 37' 40'' and 30° 39' 0'' N and longitudes 26° 57' 20'' and 26° 59' 40'' E (Fig. 1).

The Northwestern Desert represents one of Egypt's most prolific and promising petroleum provinces. Its importance began in the period from 1970 to 1983, when petroleum companies discovered many oil and gas fields. The depositional environments, such as marine and fluvio-marine, and many structural controls, play an important role in oil accumulation and trapping. The hydrocarbon production of the Western Desert is concentrated in Cretaceous carbonate and clastic reservoirs. Both clastic and carbonate reservoirs have been deposited under relatively high energy conditions and associated with paleo-highs.

The majority of the oil production in the Western Desert originates from the northern basins, such as the Matruh and Shushan basins, from Jurassic-Cretaceous sands and deeper Jurassic pools (Metwalli, 2004).

Analysis of core data has a highly significant role in reservoir evaluation. It is used in exploratory wells to evaluate the porosity and permeability and estimate the production potentiality. It provides a direct calibration for other evaluation tools such as well logs. Well logs give the best tools for determining the accurate petrophysical parameters of a defined rock section and then clearly help us in finding, locating, evaluating, and outlining the hydrocarbon reservoirs.

The present work aims to evaluate the petrophysical characteristics of Lower Bahariya reservoir in the studied area. This study focuses on the evaluation of the reservoir properties through studying the petrophysical parameters (Permeability and Porosity), the reservoir characteristics (Goss thickness (ft), Net pay thickness (ft), effective porosity (ϕ_e %), volume of shale (V_{sh} %), water saturation (S_w %), hydrocarbon saturation (S_h %), bulk pore volume (BPV) and oil-in-place indicator (OIPI). The objectives of

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this work have been achieved by using the analysis of well logs data for wells (Yasser-2, Yasser-3, Yasser-5, and Yasser-13) and conventional core reports for wells (Yasser-2, Yasser-3 ad Yasser-5). The used data is licensed and approved by the EGPC.

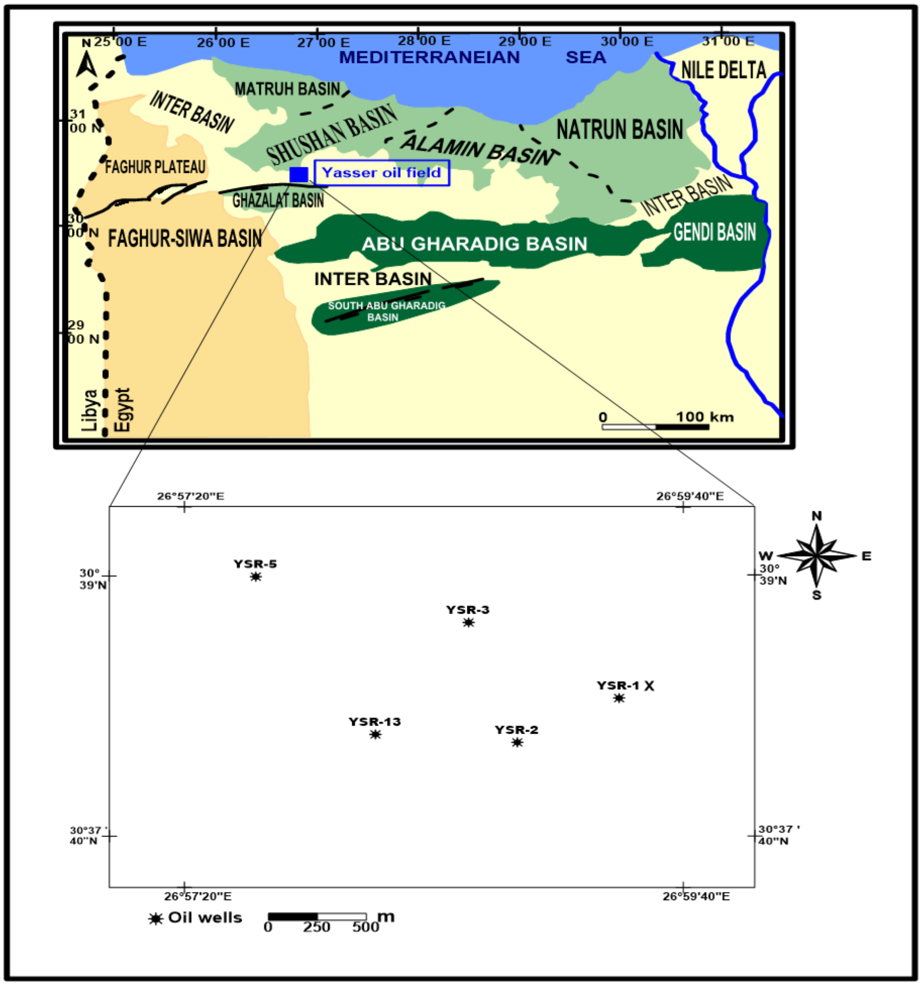


Fig. (1): Location map of study area showing the location of drilled wells in Yasser oil field, Northwestern Desert, Egypt.

2. Geologic settings

The northern part of the Western Desert comprises a number of basins along the margins of Mediterranean Sea (Fig. 1). The basins originated as a single rift during the Permo-Triassic and peaked in the Middle Jurassic. They formed during the Gondwana landmass rifting and Neotethys Ocean opening during the Early Mesozoic (Dolson et al. 2001; Garfunkel 2004; Guiraud et al. 2005; Bosworth and Tari 2020; Torfstein and Steinberg 2020).

Many researchers such as Norton (1967), El Gezeery et al. (1972), Rebortson (1982), El-Khadragy et al. (2010) and Shalaby et al. (2011) have studied the subsurface geology of the North-Western Desert. It has a thick stratigraphic column, extending from the Pre-Cambrian to the Holocene (Fig. 2).. The main four sedimentary cycles during the Carboniferous, Upper Jurassic, Middle and Late Cretaceous, and Pliocene are corresponded to the maximum southward transgressions (Said, 1990)

Ras Qattara Formation represents the earliest Jurassic sediments. Khatatba Formation formed during the Middle Jurassic rift-related subsidence. (Ayyad and Darwish 1996).

The Upper Cretaceous (Bahariya and Abu Roash Formations) are all part of the post-rift unit. Guiraud and Bosworth 1997; Bosworth et al. 2008 stated that the end of this transgressive sedimentation cycle detected at the Late Cretaceous a result of African and Eurasian plates convergence.

The lithology of the Lower Bahariya is sandstone (fine to medium-grained, glauconitic and cross-bedded), as well as heterolithic sand/clay lithofacies (Nemec, 1996). The depositional environment of the sand was continental to marginal marine. The individual sand bodies, which represent stacked channels, are separated by heterolithic sands and claystones deposited in a shallow marine tidal flat, and carbonaceous claystones deposited in lagoons or muddy tidal flats. It rests unconformably over the coarsegrained sands and sandstone of the Kharita Formation and conformably overlain by the Upper Bahariya Member.

Hydrocarbon production is mostly concentrated in the Aptian and Cenomanian-Turonian carbonate and clastic reservoirs. Large oil deposits were later discovered and investigated in the Lower Cretaceous rocks. Eocene carbonate has been claimed to have good oil and gas, possibility due to hydrocarbon migration (EGPC, 1992).

3. Materials and methods

Conventional core reports for three wells (Yasser-2, Yasser-3 and Yasser-5) are used for evaluation of Lower Bahariya Reservoir. Core analysis is interpreted by creating histograms, statistical analysis and relationships for porosity and permeability data.

According to (Levorsen, 1967), reservoir porosity is classified into five categories as Negligible (from 0 to 5%), Poor, (from 5 to 10%), Fair (from 10 to 15%), Good (from 15 to 20 %) and very good (from 20 to 25 %). Permeability is one of the most significant characteristics of hydrocarbon bearing reservoirs. It measures the flowing ability of a fluid with certain viscosity under pressure gradient **(**Lynch, 1962**)**. The reservoir rock quality can be graded based on its permeability (k) values as follows: Fair (from 1 to 10 md), Good (from10 to 100 md), Very good (from 100 to 1000 md) and Excellent (k >1000 md).

The available well log data in four representative wells (Yasser-2, Yasser-3, Yasser-5 and Yasser-13) are used in quality evaluation of Lower Bahariya reservoir. Well logs give the best tools to determine the accurate petrophysical parameters of a defined rock section and then clearly help us in finding, locating, evaluating and outlining the petrophysical parameters. The corrected well-logs data are used to calculate the reservoir parameters using the log analysis software package (Logwizard). The distribution maps (Iso-parametric contour maps) provide an explanation of the obtained reservoir parameters. The water saturation is calculated using dual water model and the net-pay thickness is calculated using the following cut-offs (10% porosity, 35% V_{sh} and 50% S_w). The bulk volume of pores is calculated using equation (1) whereas equation (2) used to calculate the oil-in-place indicator.

$$\mathbf{BPV = (PHIE * integrated\ net\ pay)} \ldots\ldots\ldots(1)$$

$$\mathbf{OIPI = integrated\ BPV * (1-S_w)} \ldots\ldots\ldots\ldots(2)$$

The estimated reservoir parameters include gross thickness (ft), net pay thickness (ft), effective porosity (ϕ_e %), volume of shale (Vsh %), water saturation (Sw %), hydrocarbon saturation (Sh %), bulk pore volume (BPV) and oil-in-place (OIPI).

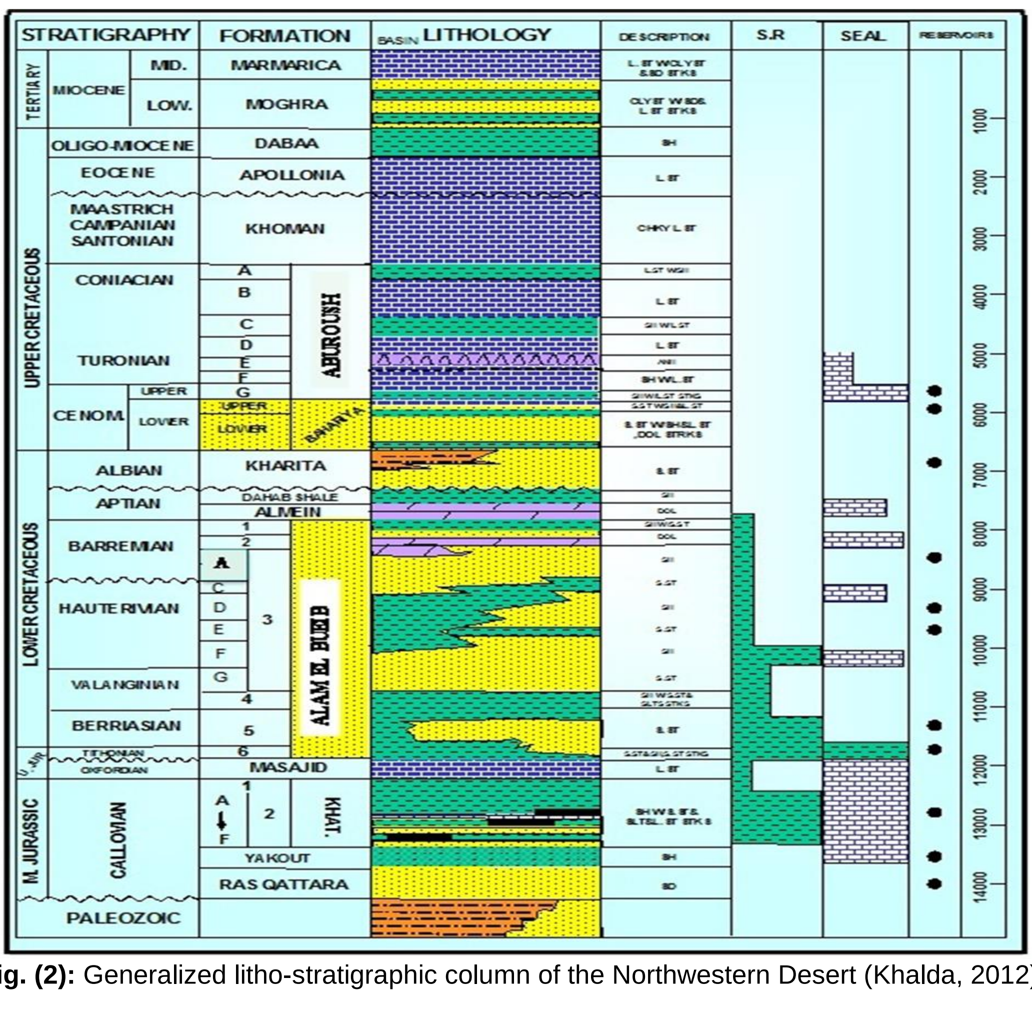


Fig. (2): Generalized litho-stratigraphic column of the Northwestern Desert (Khalda, 2012).

4. Results and discussion

4.1 Core data analysis

4.1.1 Descriptive statistical analysis of porosity data

Table (1) represents the statistical analysis results for the two porosity types of Lower Bahariya Reservoir in wells Yasser-2 (163 sample), Yasser-3 (122 sample) and Yasser-5 (59 sample). The helium porosity values in the three wells range from 5.6 % in Yasser-2 to 33.5 % in Yasser-3 well with average values from 17.01 % in Yasser-2 to 20.47% in Yasser-3 well. On the other hand, the maximum fluid porosity value was 30.1% which recorded in Yasser-5 well and the minimum value was 2.3% and recorded in Yasser- 5 well. The average values range from 16.75% to 22.63% indicating a good to very good reservoir porosity. The standard deviation values for both fluid and helium porosity were between 5.23 and 5.83 indicating partially homogenous porosity.

Table (1): Descriptive statistical analysis for the porosity data of Lower Bahariya Reservoir in studied wells.

Well	Yasser-2		Yasser-3		Yasser-5	
Descriptive Statistics	Helium porosity (ϕ_h), %	Fluid porosity (ϕ_f), %	Helium porosity (ϕ_h), %	Fluid porosity (ϕ_f), %	Helium porosity (ϕh), %	Fluid porosity (ϕf), %
Mean	17.01	16.75	20.47	18.65	19.76	22.63
Standard Error	0.41	0.42	0.50	0.50	0.50	0.73
Median	16.90	16.20	20.85	19.45	21.00	24.40
Mode	22.80	16.40	23.80	17.00	21.00	26.00
Standard Deviation	5.23	5.38	5.51	5.51	3.83	5.63
Sample Variance	27.37	28.91	30.37	30.31	14.65	31.65
Kurtosis	-0.87	-0.74	-0.69	-0.49	-0.54	-0.26
Skewness	-0.08	0.39	-0.34	-0.50	-0.60	-0.93
Range	23.20	21.90	26.70	26.40	15.10	20.60
Minimum	5.60	7.40	6.80	2.30	10.80	9.50
Maximum	28.80	29.30	33.50	28.70	25.90	30.10
Sum	2772.10	2730.40	2497.90	2275.20	1165.60	1335.30
Count	163.00	163.00	122.00	122.00	59.00	59.00

4.1.2 Porosity histograms

The porosity histograms and cumulative frequency are represented in figures (3, 4 and 5). If the porosity cut off 15 % is applied to helium porosity, it will be noticed that about 59.51%, 79.51% and 81.36% of the studied samples from wells Yasser-2, Yasser-3 and Yasser-5 respectively have helium porosity values more than 15 %. About 56.44%, 72.13% and 83.05% of fluid porosity values exceeds 15 %. These high values of porosity types mention that Lower Bahariya Member is described as a good to very good reservoir porosity.

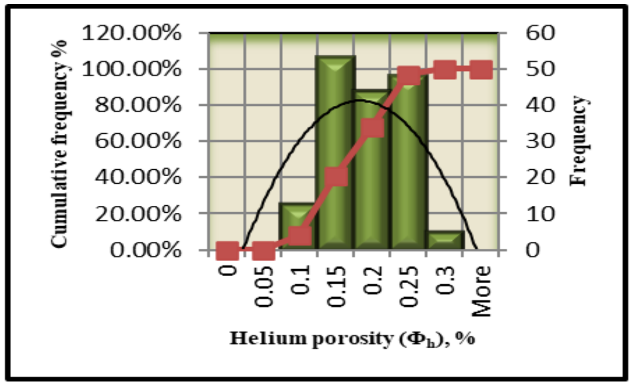
4.1.3 Descriptive statistical analysis of Permeability data:

Table (2) represents the descriptive statistical analysis of horizontal and vertical permeability data in the three studied wells. The maximum value of horizontal permeability (1399 md) was recorded in Yasser-5 well and the minimum value (0.04 md) was recorded in Yasser-3 well. The average of horizontal permeability values ranges from 76.93 to 248.78 md in the three wells indicating good to very good reservoir quality. The maximum and minimum vertical permeability values (1125 &0.01 md) are recorded in Yasser-3 well. The average of vertical permeability values ranges from 24.92 to 88.64 md indicating a good reservoir quality. It is observed that the horizontal permeability in the three wells gives values better than the vertical permeability ensuring high quality reservoir. The standard deviation values indicate that the permeability of Lower Bahariya Reservoir in Yasser field is heterogeneous.

4.1.4 Permeability histograms:

The histograms and frequencies of the horizontal and vertical permeability (Kh & Kv) for wells (Yasser-2, Yasser-3 and Yasser-5) are represented in figures (6, 7 and 8). The cutoff 10 md is applied to horizontal and vertical permeability in the three studied well to evaluate them. It is noticed that, 57.46%, 77.59% and 85.96% of the values in the three wells respectively give a good to very good horizontal permeability. About 31.51%, 35.59% and 52.54% of the vertical permeability values of the same thee wells indicate a good to very good permeability. It indicates that most of the samples of Lower Bahariya in the study area reflect a good to very good permeability and fit the requirement of good reservoir due to the determined permeability values. The high readings of standard deviation indicate heterogeneity in both horizontal and vertical permeability values.

Helium porosity (Φ_h), %	Frequency	Cumulative Frequency %
0	0	0.00%
0.05	0	0.00%
0.1	13	7.98%
0.15	53	40.49%
0.2	44	67.48%
0.25	48	96.93%
0.3	5	100.00%
More	0	100.00%



Fluid porosity (Φ_f), %	Frequency	Cumulative Frequency %
0	0	0.00%
0.05	0	0.00%
0.1	17	10.43%
0.15	54	43.56%
0.2	44	70.55%
0.25	32	90.18%
0.3	16	100.00%
More	0	100.00%

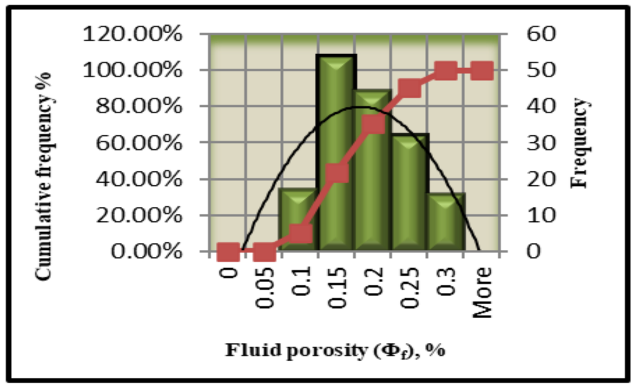
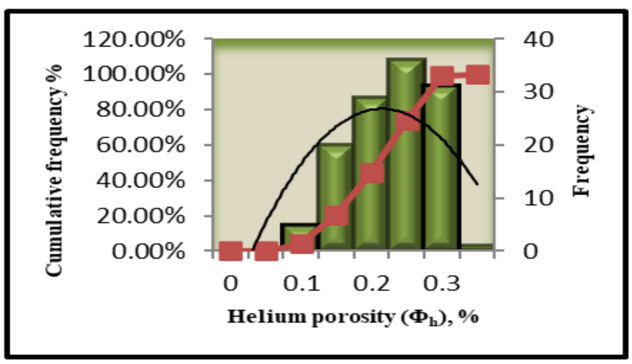


Fig. (3): Histograms and cumulative frequencies of helium and fluid porosities of Lower Bahariya Member in Yasser-2 well.

Helium porosity (Φ_h), %	Frequency	Cumulative Frequency %
0	0	0.00%
0.05	0	0.00%
0.1	5	4.10%
0.15	20	20.49%
0.2	29	44.26%
0.25	36	73.77%
0.3	31	99.18%
More	1	100.00%



Fluid porosity (Φ_f), %	Frequency	Cumulative Frequency %
0	0	0.00%
0.05	2	1.64%
0.1	5	5.74%
0.15	27	27.87%
0.2	29	51.64%
0.25	48	90.98%
0.3	11	100.00%
More	0	100.00%

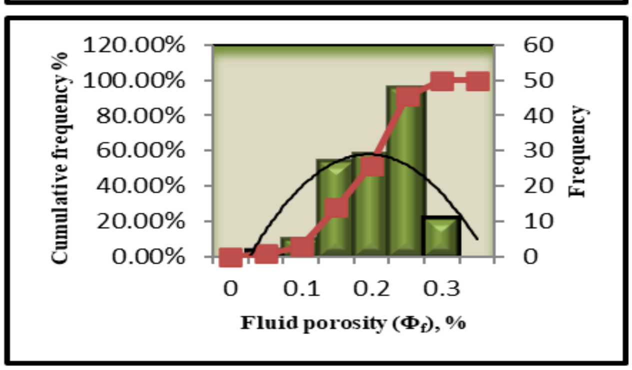
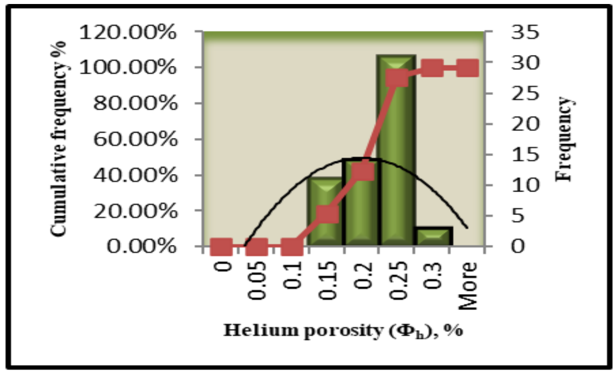


Fig. (4): Histograms and cumulative frequencies of helium and fluid porosities of Lower Bahariya Member in Yasser-3 well.

Helium porosity (Φ_h), %	Frequency	Cumulative Frequency %
0	0	0.00%
0.05	0	0.00%
0.1	0	0.00%
0.15	11	18.64%
0.2	14	42.37%
0.25	31	94.92%
0.3	3	100.00%
More	0	100.00%



Fluid porosity (Φ_f), %	Frequency	Cumulative Frequency %
0	0	0.00%
0.05	0	0.00%
0.1	1	1.69%
0.15	9	16.95%
0.2	4	23.73%
0.25	19	55.93%
0.3	25	98.31%
More	1	100.00%

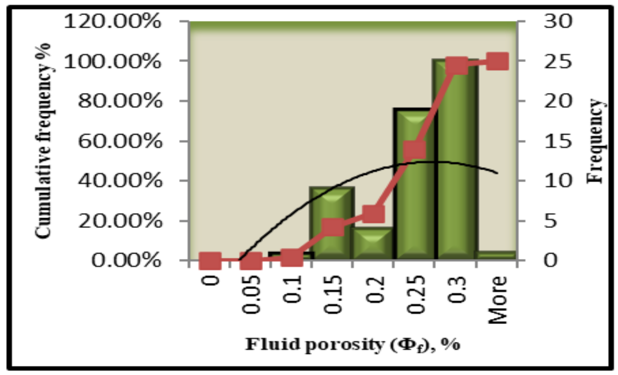


Fig. (5): Histograms and cumulative frequencies of helium and fluid porosities of Lower Bahariya Reservoir in Yasser-5 well.

Table (2): Descriptive statistical analysis for permeability data of Lower Bahariya Reservoir in studied wells.

Descriptive Statistics	Yasser-2 well		Yasser-3 well		Yasser-5 well	
	Horizontal permeability (Kh), md	Vertical permeability (Kv), md	Horizontal permeability (Kh), md	Vertical permeability (Kv), md	Horizontal permeability (Kh), md	Vertical permeability (Kv), md
Mean	76.93	24.92	248.78	75.73	204.8	88.64
Median	17.95	2.08	120.00	3.02	142.0	16.00
Standard Deviation	115.06	64.45	284.97	201.25	254.1	210.5
Minimum	0.08	0.07	0.04	0.01	0.6	0.2
Maximum	520.00	435.00	1215.00	1125.00	1399.0	1050.0
Count	134.00	146.00	116.00	118.00	57.0	59.0

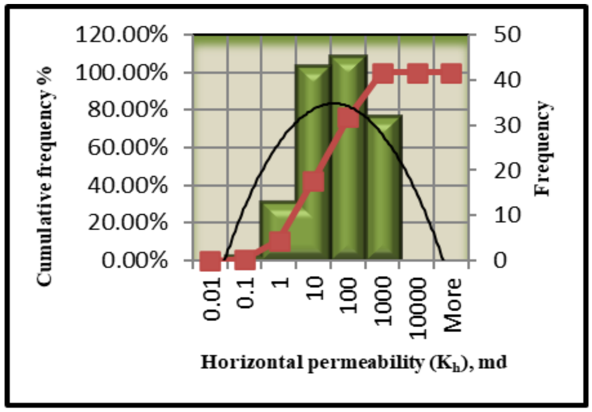
4.1.5 Relationships between porosity types

The relationships between porosity types of Lower Bahariya Member in Yasser-2, Yasser-3 and Yasser-5 wells were strong. It indicates homogeneous pore diameter in the reservoir. These relationships are represented in Figure (9). The equations controlling these relationships and correlation coefficient values are illustrated in Table (3).

4.1.6 Porosity-permeability relationships

The relation between helium porosity and horizontal permeability of Lower Bahariya Member is shown in Figure (10). Table (4) represents the equations and correlation coefficients. Relationships with high correlation coefficient values (0.85, 0.87 and 0.8) are noticed. These values indicate the homogeneity of pore space types and the high percentages of effective porosity.

K_h (md)	Frequency	Cumulative Frequency %
0.01	0	0.00%
0.1	1	0.75%
1	13	10.45%
10	43	42.54%
100	45	76.12%
1000	32	100.00%
10000	0	100.00%
More	0	100.00%



K_v (md)	Frequency	Cumulative Frequency %
0.01	0	0.00%
0.1	8	5.48%
1	51	40.41%
10	41	68.49%
100	36	93.15%
1000	10	100.00%
10000	0	100.00%
More	0	100.00%

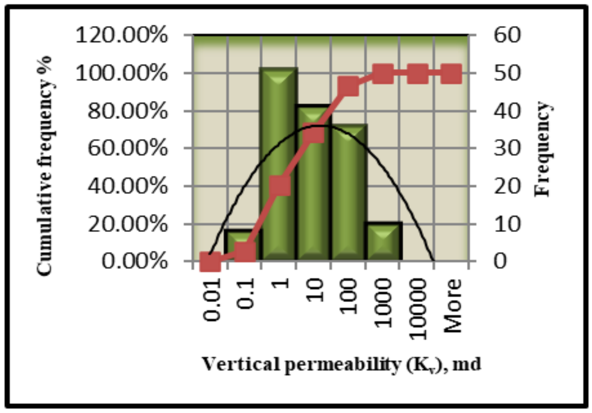
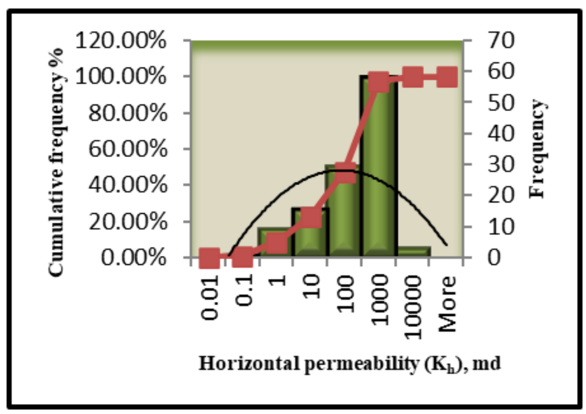


Fig. (6): Histograms and cumulative frequencies of horizontal and vertical permeabilities of Lower Bahariya reservoir in Yasser-2 well.

K_h (md)	Frequency	Cumulative Frequency %
0.01	0	0.00%
0.1	1	0.86%
1	9	8.62%
10	16	22.41%
100	29	47.41%
1000	58	97.41%
10000	3	100.00%
More	0	100.00%



K_v (md)	Frequency	Cumulative Frequency %
0.01	1	0.85%
0.1	7	6.78%
1	24	27.12%
10	44	64.41%
100	24	84.75%
1000	16	98.31%
10000	2	100.00%
More	0	100.00%

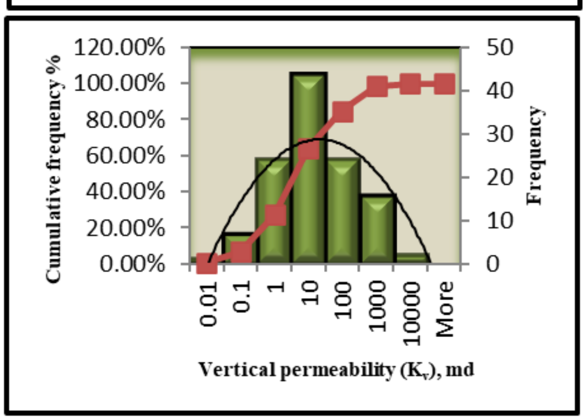
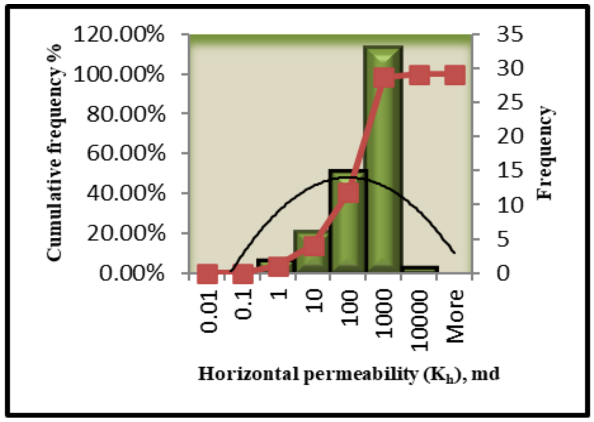


Fig. (7): Histograms and cumulative frequencies of horizontal and vertical permeabilities of Lower Bahariya reservoir in Yasser-3 well.

K_h (md)	Frequency	Cumulative Frequency %
0.01	0	0.00%
0.1	0	0.00%
1	2	3.51%
10	6	14.04%
100	15	40.35%
1000	33	98.25%
10000	1	100.00%
More	0	100.00%



K_v (md)	Frequency	Cumulative Frequency %
0.01	0	0.00%
0.1	0	0.00%
1	10	16.95%
10	18	47.46%
100	23	86.44%
1000	7	98.31%
10000	1	100.00%
More	0	100.00%

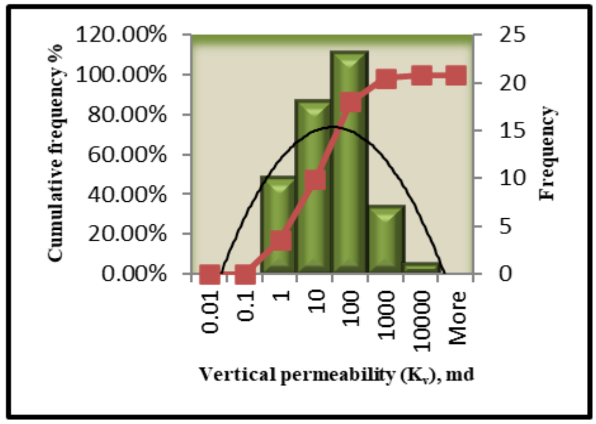


Fig. (8): Histograms and cumulative frequencies of horizontal and vertical permeabilities of Lower Bahariya Member in Yasser-5 well.

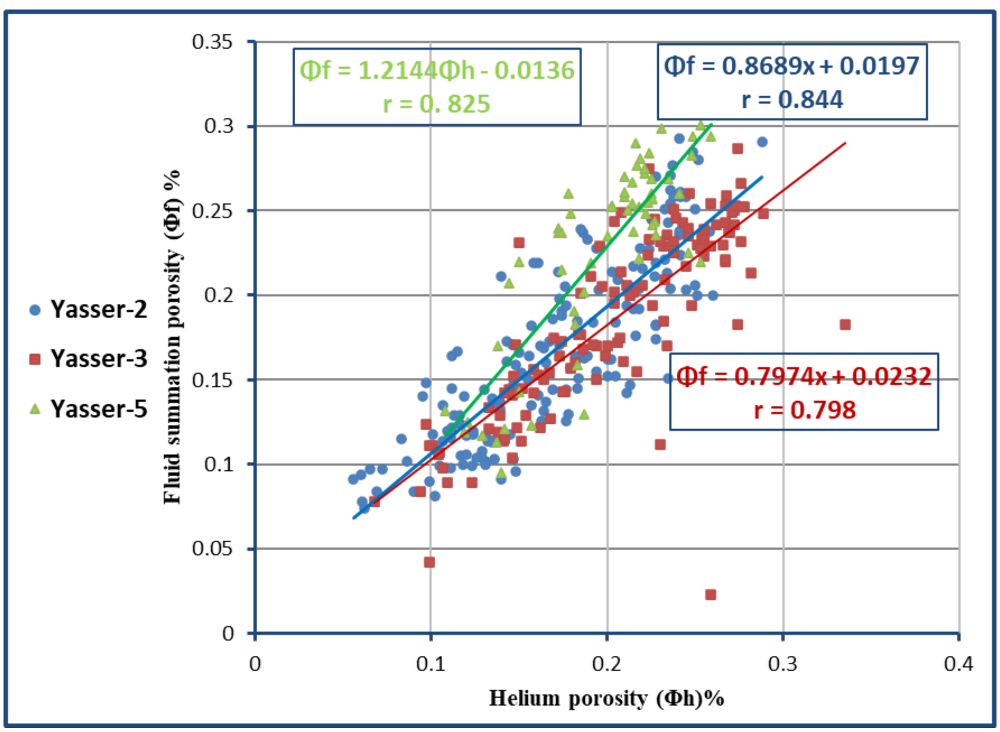


Fig. (9): Relationships between helium porosity and fluid summation porosity of Lower Bahariya Reservoir in wells (Yasser-2, Yasser-3 and Yasser-5).

Table (3): Equations and correlations coefficients for the relationships between measured porosities in the three studied wells. ϕ_f :Fluid summation porosity and ϕ_h :Helium porosity

Well name	Linear regression equation	Correlation coefficient (r)
Yasser-2	$\phi_f = 0.868\phi_h + 0.019$	r = 0.844
Yasser-3	$\phi_f = 0.797\phi_h + 0.023$	r = 0.798
Yasser-5	$\phi_f = 1.214\phi_h - 0.013$	r = 0.825

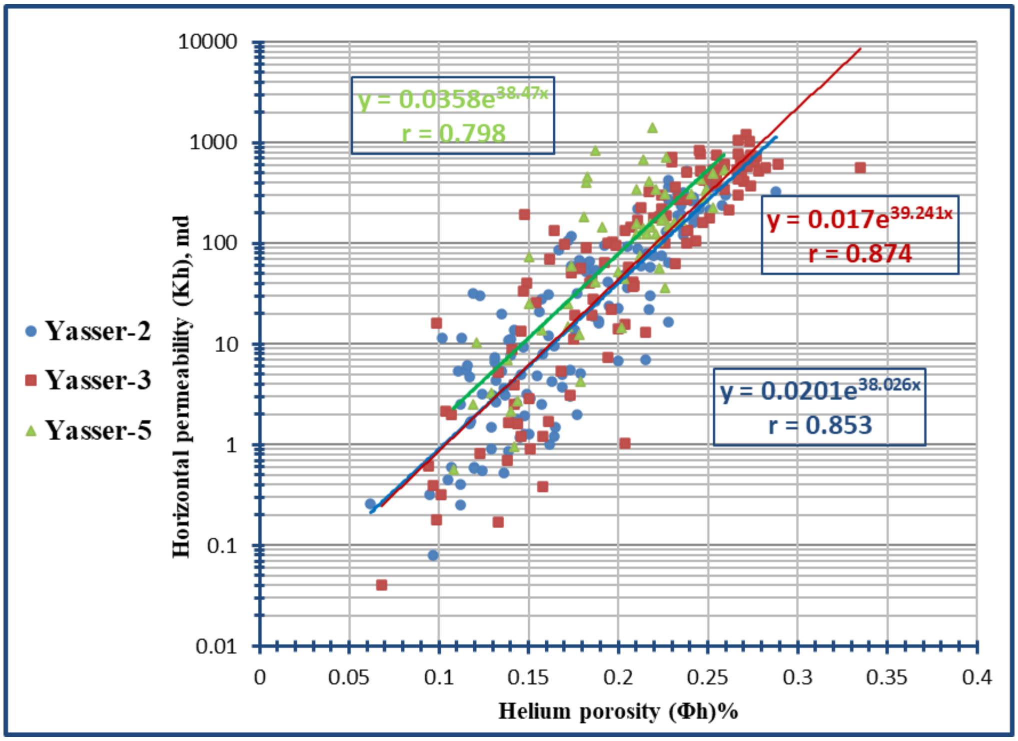


Fig. (10): Relationships between helium porosity and horizontal permeability of Lower Bahariya Reservoir in wells (Yasser-2, Yasser-3 and Yasser-5).

Table (4): Equations and correlations coefficients for the relationships between helium porosity and horizontal permeability in the three studied wells. K_h :Horizontal permeability and ϕ_h :Helium porosity.

Wells	Linear regression equation	Correlation coefficient(r)
Yasser-2	$K_h = 0.020e^{38.02\phi h}$	r = 0.853
Yasser-3	$K_h = 0.017e^{39.24\phi h}$	r = 0.874
Yasser-5	$K_h = 0.035e^{38.47\phi h}$	r = 0.798

4.1.7 Permeability-permeability relationships

The relations between vertical and horizontal permeability (K_v & K_h) in the three wells are shown in Figure (11). The equations are shown in Table (5). The strong correlation coefficients (about 0.76) in the three wells reflect a homogenous distribution of vertical and horizontal permeability which gives also an indication of good reservoir quality.

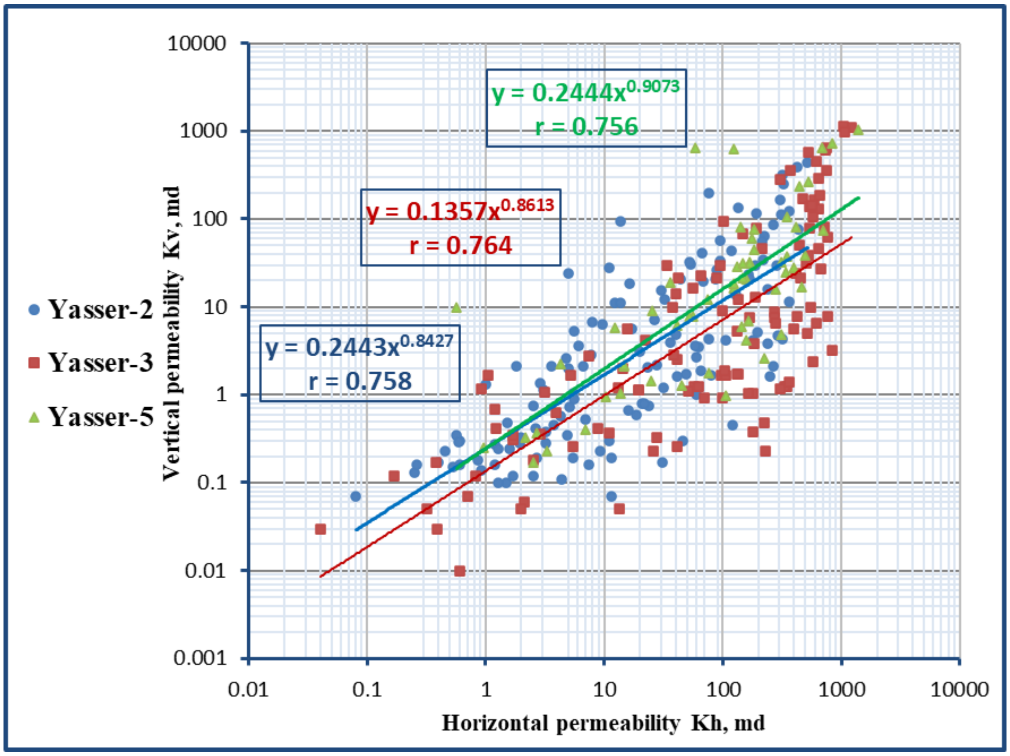


Fig. (11): Relationships between vertical and horizontal permeability of Lower Bahariya Reservoir in wells (Yasser-2, Yasser-3 and Yasser-5).

Table (5): Relationships between vertical and horizontal permeability of Lower Bahariya Reservoir in in the three studied wells. K_h :horizontal permeability and K_v :vertical permeability.

Well	Linear regression equation	Correlation coefficient(r)
Yasser-2	$K_v = 0.254K_h^{0.818}$	r = 0.758
Yasser-3	$K_v = 0.135K_h^{0.861}$	r = 0.764
Yasser-5	$K_v = 0.244K_h^{0.907}$	r = 0.756

4.2 Well log data analysis

4.2.1 Iso-Parametric maps of Lower Bahariya Reservoir

The results of well-log data analysis are listed in Table (6).These petrophysical parameters are contoured and shown in eight iso-parametric maps to illustrate the lateral variation of these parameters in studied area.

The total gross thickness and net-pay thickness distribution maps (Figs. 12 a&b) represent an increase toward the northeast and north directions. The maximum gross thickness (560 ft) and the maximum net-pay thickness (160.5 ft) are recorded in in Yasser-3 well. They decrease gradually toward the southwest direction where the minimum values recorded in Yasser-13 well

The effective porosity increases toward the northeast direction and record minimum value (17.7%) in Yasser-5 well towards the northwest and west directions (Fig. 12 c).

The volume of shale and water saturation distribution maps (Fig. 12 d and 13 a) show an increase toward south and southeast direction and observed decrease to the northwest direction.

The hydrocarbon saturation contour map (Fig. 13 b) illustrates decreasing toward the east and southeast of the study area with minimum value (39%) recorded at Yasser-2 well. Whereas, the increase was observed to the west and northwest directions with maximum value was (49.5 %) at Yasser-5 well.

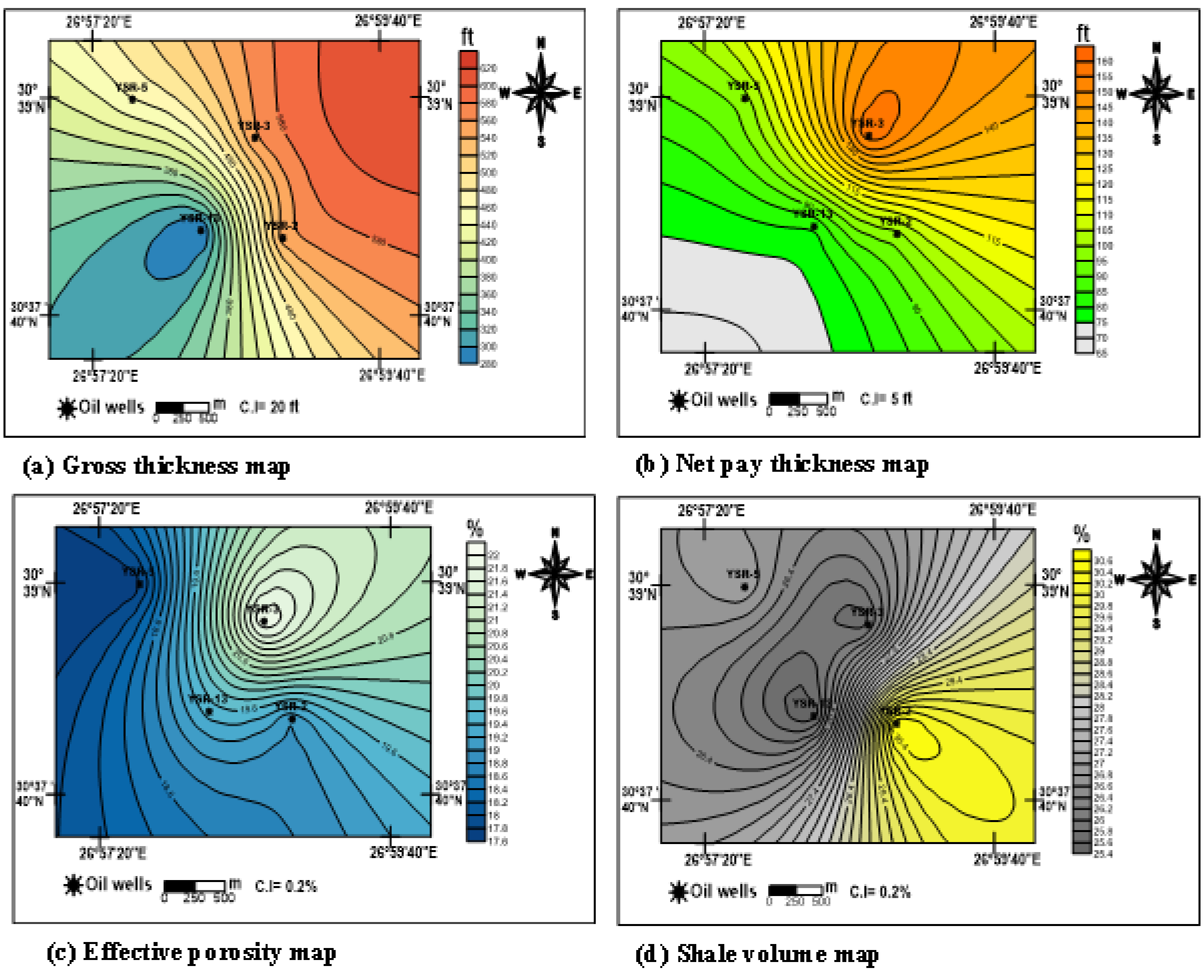
The values of bulk-pore-volume and oil-in-place (Fig. 13 c) increase to the north and northeast directions and decrease toward the southwest direction.

The oil-in-place map (Fig. 13 d) possesses an increase toward the directions of north and the northeast and a decrease toward south and southwest directions. The highest value (15.22) is recorded in Yasser-3 well and the minimum value of 7.13 is represented in Yasser-13 well.

Shale volume and water saturation maps show the same variation directions, while net-pay thickness, effective porosity, bulk-pore-volume, and oil-in-place indicator show nearly the opposite directions. This may reflect the effect of these parameters on the reservoir quality. Therefore, the north and northeastern directions are considered as the best promising areas of Lower Bahariya reservoir in the studied area.

Table (6): Well log parameters of Lower Bahariya Reservoir.

Well Name	Gross Thick, (ft)	Net pay, (ft)	ϕ_e, (%)	V_{Sh}, (%)	S_w, (%)	BPV	OIPI	S_h,%
Yasser-2	550	98	19	30.7	61	18.6	7.26	39
Yasser-3	560	160.5	22.1	25.7	57.1	35.5	15.22	42.9
Yasser-5	461	97.5	17.7	27	50.5	17.3	8.54	49.5
Yasser-13	272.5	80	19.5	25.4	54.3	15.6	7.13	45.7



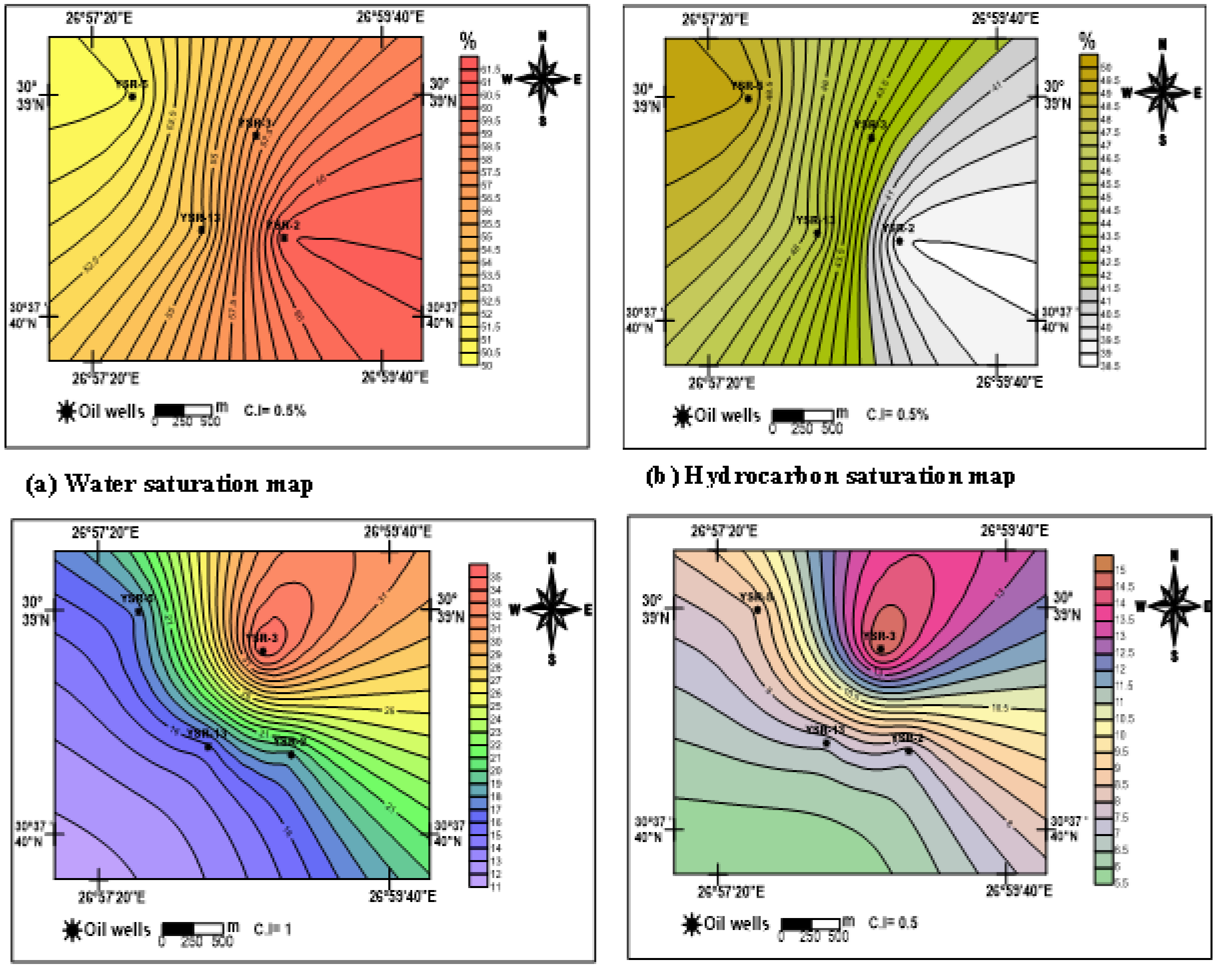
(a) Gross thickness map

(b) Net pay thickness map

(c) Effective porosity map

(d) Shale volume map

Fig. (12): Isoparametric maps of petrophysical parameters for Lower Bahariya Reservoir.



(a) Water saturation map

(b) Hydrocarbon saturation map

(c) Bulk pore volume map

(d) Oil in place indicator map

Fig. (13): Isoparametric maps of petrophysical parameters for Lower Bahariya Reservoir.

Conclusions

The present work has been carried out to evaluate Lower Bahariya Reservoir in Yasser oil field which located in Northwestern Desert, Egypt. The core data are analyzed utilizing several statistical methods and coordinated with the different log parameters to determine the different reservoir parameters. The interpretation of core data analysis including the porosity and permeability histograms, relations and statistical analysis indicate that Lower Bahariya Member can be described as a good to very good reservoir. The obtained high correlation coefficients values for porosity and permeability relationships indicate that the obtained equations could be helpful in evaluation of this reservoir in nearby areas.

The maps of petrophysical parameters reveal that the northern parts of Yasser field is the most favorable for accumulation and production, due to increasing in net-pay thickness, effective porosity, bulk-pore volume, and oil-in-place indicator. Therefore, we recommend directing the future exploration, prospection and development processes toward the north direction of this field.

References

Ayyad MA, Darwish M (1996). Syrian arc structures: a unifying model of inverted basins and hydrocarbon concurrencies in North Egypt. In: EGPC 13th exploration and production conference, 1, PP 40–59.

Bosworth W and Tari G (2020). Hydrocarbon accumulation in basins with multiple phases of extension and inversion: examples from the Western Desert (Egypt) and the western Black Sea. Solid Earth, vol 12(1), pp 59–77.

Bosworth W, El-Hawat AS, Helgeson DE and Burke K (2008). Cyrenaican "shock absorber" and associated inversion strain shadow in the collision zone of northeast Africa. Geology 36(9), PP 695–698

Dolson C, Shaan V, Matbouly S, Harwood C, Rashed R and Hammouda H (2001). The petroleum potential of Egypt. In: Downey W, Threet C, Morgan A (eds) Petroleum provinces of the twenty-first century. AAPG Memoir, 74, PP 453–482.

EGPC (Egyptian General Petroleum Corporation) (1992). Western Desert, oil and Gas fields, a comprehensive overview. EGPC, 11th Petrol. Expl. and Prod. Conf., Cairo, 431 P.

El-Gezeery NH, Mohsen SM, and Farid, MI (1972). Sedimentary Basins of Egypt & their Petroleum prospects. 8th Arab Petrol. Conf., Algiers, Paper, 83 (B-3), 13 P.

El-Khadragy AA, Saad M H and Azab A (2010). Crustal modeling of south Sitra area, north Western Desert, Egypt, using Bouguer gravity data. Journal of Applied Sci. Research, 61 (1), PP 22-27.

Garfunkel Z (2004). Origin of the Eastern Mediterranean Basin: a reevaluation Tectonophysics, 391, PP 11–34.

Guiraud R and Bosworth W (1997). Senonian basin inversion and rejuvenation of rifting in Africa and Arabia: synthesis and implications to plate-scale tectonics. Tectonophysics 282, PP 39–82.

Guiraud R, Bosworth W, Thierry J and Delplanque A (2005). Phanerozoic geological evolution of Northern and Central Africa: an overview. J Earth Sci, 43, pp 83–143.

Khalda Petroleum Company, 2012: Stratigraphy of North Western Desert, Int. report, 15 P.

Levorsen, AI (1967). Geology of petroleum. W.H. Freeman and San Francisco, 350 P.

Lynch EJ (1962): Formation Evaluation. Harper and Row Publishers, New York, Evanston and London, 422 P.

Metwalli FI (2004). Assessment of hydrocarbon potentialities in Matruh-Shushan-Basins, Western Desert, Egypt: New constraints from tectonic subsidence analysis and seismic stratigraphy. Geol. Surv., Egypt,27, PP 497-522.

Nemec MC (1996). Qarun oil field, Western Desert, Egypt. EGPC 14^{th} Petrol. Conf., Cairo, 1, PP 140-164.

Norton P (1967). Rock-stratigraphic nomenclature of the Western Desert, Egypt. Inter. Report of GPC, Cairo, Egypt, 557 P.

Rebortson Research International Limited (RRI) (1982). Petroleum potential evaluation of the Western Desert, Egypt. Unpublished report prepared for EGPC, Vol. 1, 306 P.

Said R (1990). Cretaceous paleogeographic maps. In Said, R. (ed.). The Geology of Egypt. Balkema-Rotterdam-Brook field, PP 439-449.

Shalaby MR, Hakimi MH and Abdullah WH (2011). Geochemical characteristics and hydrocarbon generation modeling of the Jurassic source rocks in the Shushan Basin, north Western Desert, Egypt. Mar Pet Geol, 28, PP 1611–1624.

Torfstein A and Steinberg J (2020). The Oligo-Miocene closure of the Tethys Ocean and evolution of the proto-Mediterranean Sea. Sci Rep, 10 (1), 13817.