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RESERVOIR CHARACTARIZATION OF THE JURASSIC LOWER SAFA MEMBER, AT QASR FIELD, NORTH WESTERN DESERT,EGYPT.

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ABSTRACT

Qasr Field is located in the northeastern part of Shushan basin. The study area is bounded by latitudes 30º 25' to 31º 40' N and longitudes 26º 30' to 26º 50' E.

Lower Safa Member of Khatatba Formation is a hydrocarbon producing unit, consists mainly of sandstone rock. The present work is devoted to study the subsurface setting and reservoir characteristics of the study area to evaluate the hydrocarbon potentiality of the Jurassic Age reservoir, mainly Lower Safa Member, based on interpretation of twenty 2D seismic lines to determine the subsurface structure of the study area and well log analysis of four wells to highlight on the subsurface formation evaluation in the study area. Using software programs, such as Petrel 2013software program (Shlumberger, 2013), and interactive Petrophysics version 3.5 (Shlumberger, 2009).

The Structural setting was studied through the constructing of structural cross sections, structural contour maps and structural modeling, which revealed that the area is affected by six normal faults trending ; NNE-SSW, NE-SW, and ENE-WSW. All inferred petrophysical parameters are represented vertically as litho-saturation cross plots and laterally as different iso-parametric maps such as effective porosity (Øeff), shale content (V_{cl}), net pay thickness, water saturation (S_w) and hydrocarbon saturation (S_{hr}) maps. These maps revealed that the promising hydrocarbon bearing zones are characterized by their low clay contents, moderate effective porosity, thick net-pay, low water saturation which in turn, high hydrocarbon saturation.

The net reservoir distribution map shows that the reservoir thickness of the Lower Safa Member, the main reservoir in the study area, ranges between 125 -390 ft. The effective porosity map shows that the reservoir porosity ranges between 11-13%, the shale content map shows that the shale content ranges between 3-10%, the water saturation map shows that the water saturation ranges between 10-18% and hydrocarbon saturation varies from 82- 90%.

Accordingly, two locations are proposed to be a prospect area, which are located on a three-way dip closure that looks very suitable place for production development.

***Keywords**: Reservoir Charactarization, Seismic, Petrophysics, Subsurface, Qasr, Lower Safa, and Jurassic.*

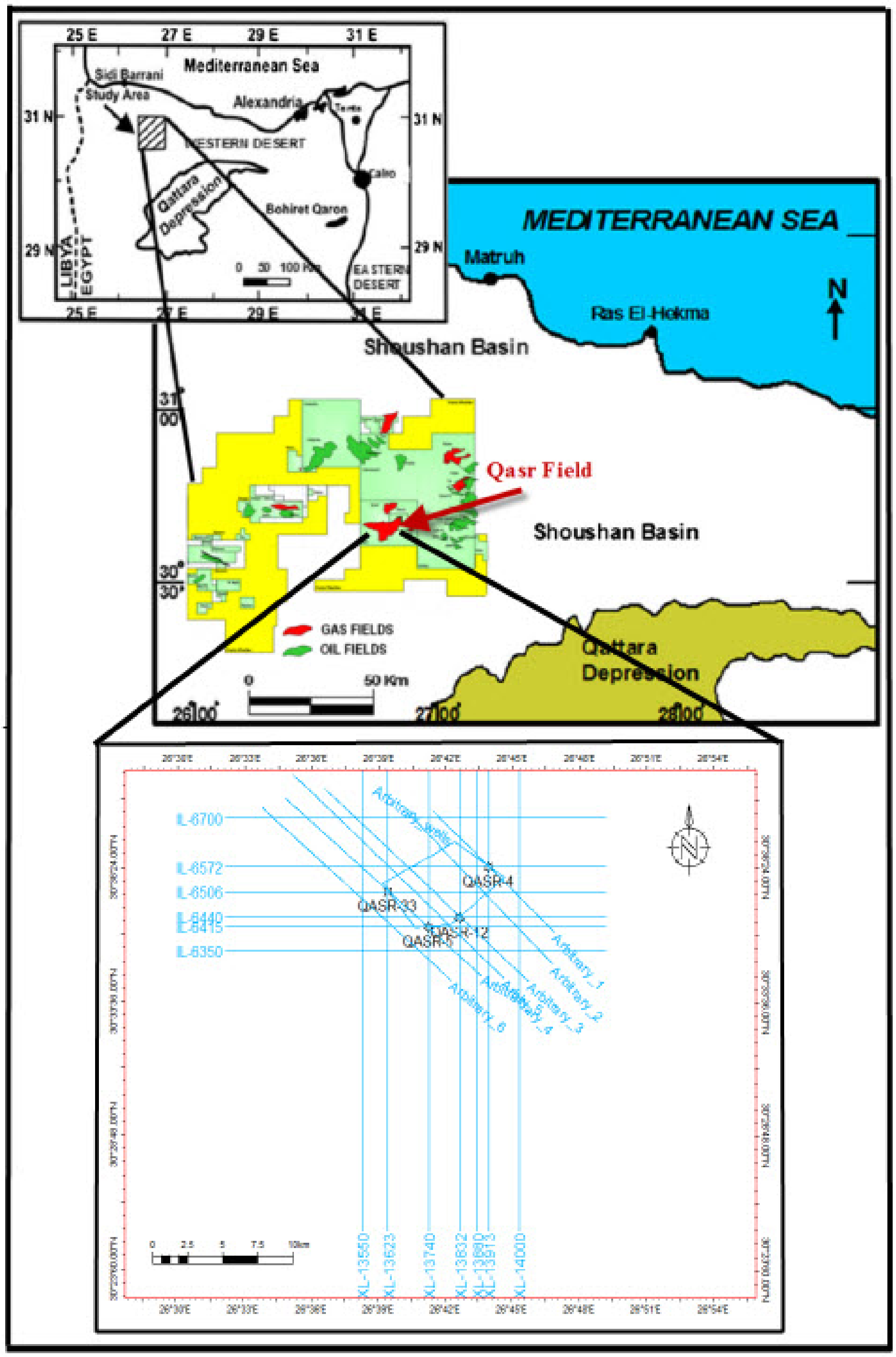
1-INTRODUCTION

The area under investigation is located in Qasr Field in the northeastern part of Shushan basin in the northern part of the Western Desert of Egypt, bounded by latitudes 30º 25' to 30º 50' N and longitudes 26º 30' to 26º 50' E **(Fig.1)**.

The Lower Safa Member consists of sandstone, siltstone with some shale streaks, indicating shallow marine facies, its sequence may reach a maximum thickness of over 900 feet in the northeastern part of Shushan basin **(Qasr Field)**.

Seismic interpretation is a process to transforming the physical responses displayed by the seismic lines into geologic information's of interest, such as the structure. Qasr field covered by twenty 2D seismic lines (**Fig.1).**

Different wireline logging suites (Gamma ray, Neutron, Density, Sonic, Resistivity, etc.), for four wells namely QASR-4, QASR-5, QASR-12 and QASR-33 are used in the analysis and performing the necessary calculations. The most important petrophysical parameters necessary for characterizing the potential reservoirs are deduced like effective porosity, shale volume, water saturation and hydrocarbon saturation.

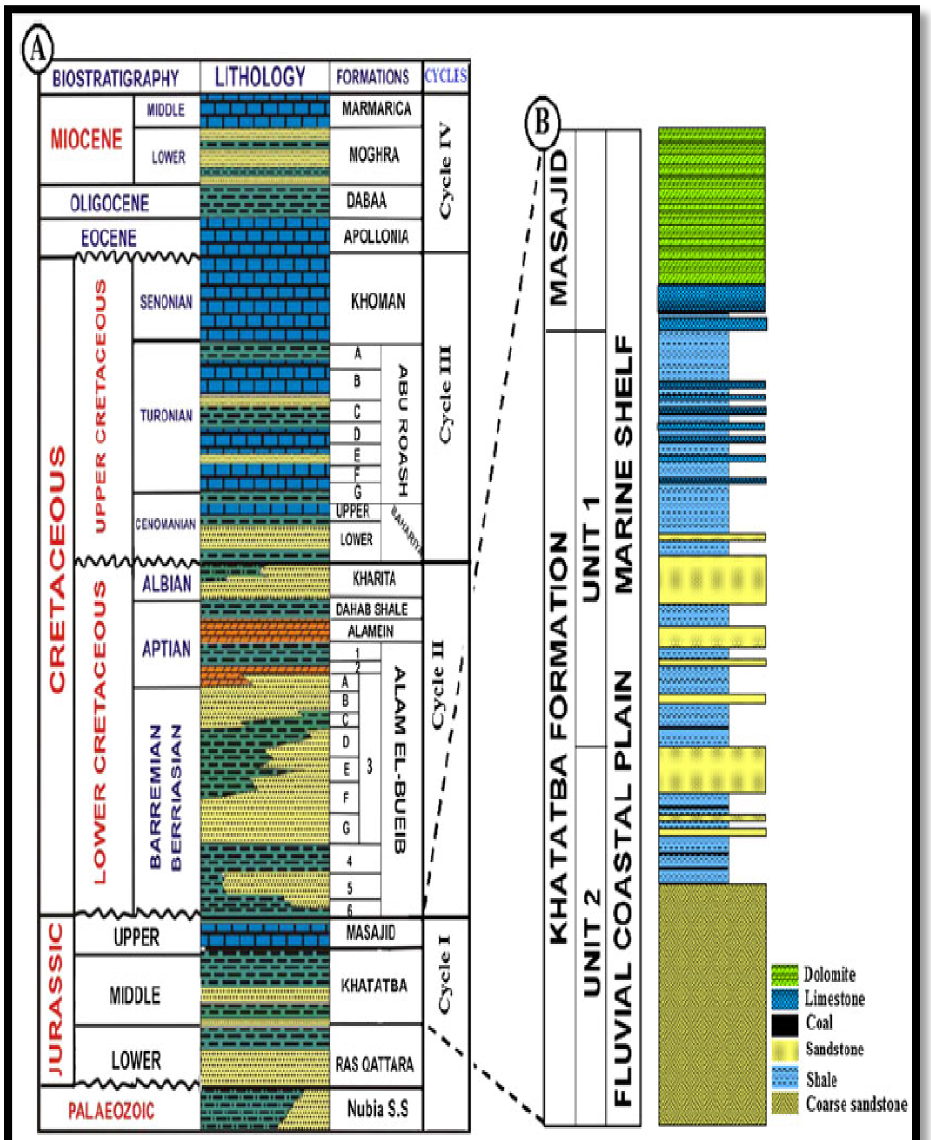


(Fig.1): Location map of the study area showing the available wells and seismic lines.

2-GEOLOGIC SETTING

2-1-Stratigraphic Setting

According to **Shalaby et al. (2014),** the stratigraphic column in the north Western Desert is including the most sedimentary succession from the Palaeozoic to Miocene.

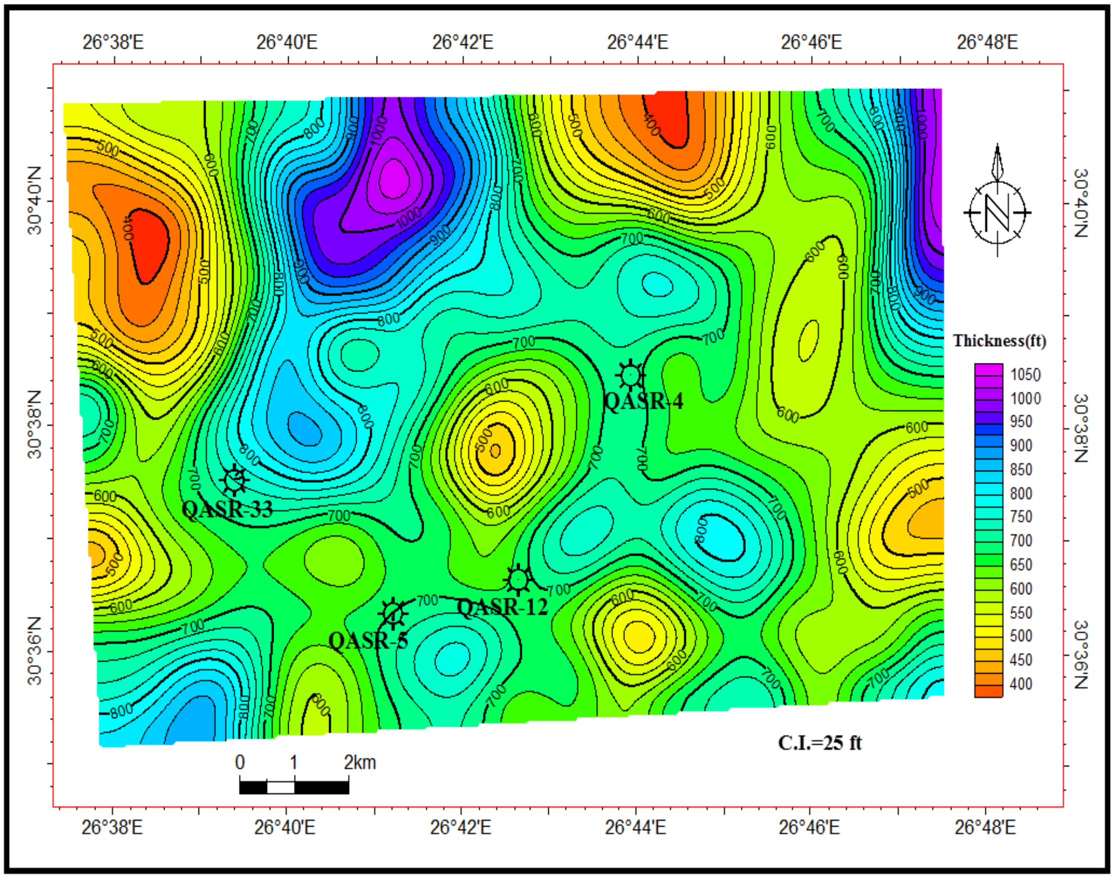


(Fig.2) Generalized stratigraphic column of the north Western Desert of Egypt. (Shalaby et al. 2014).

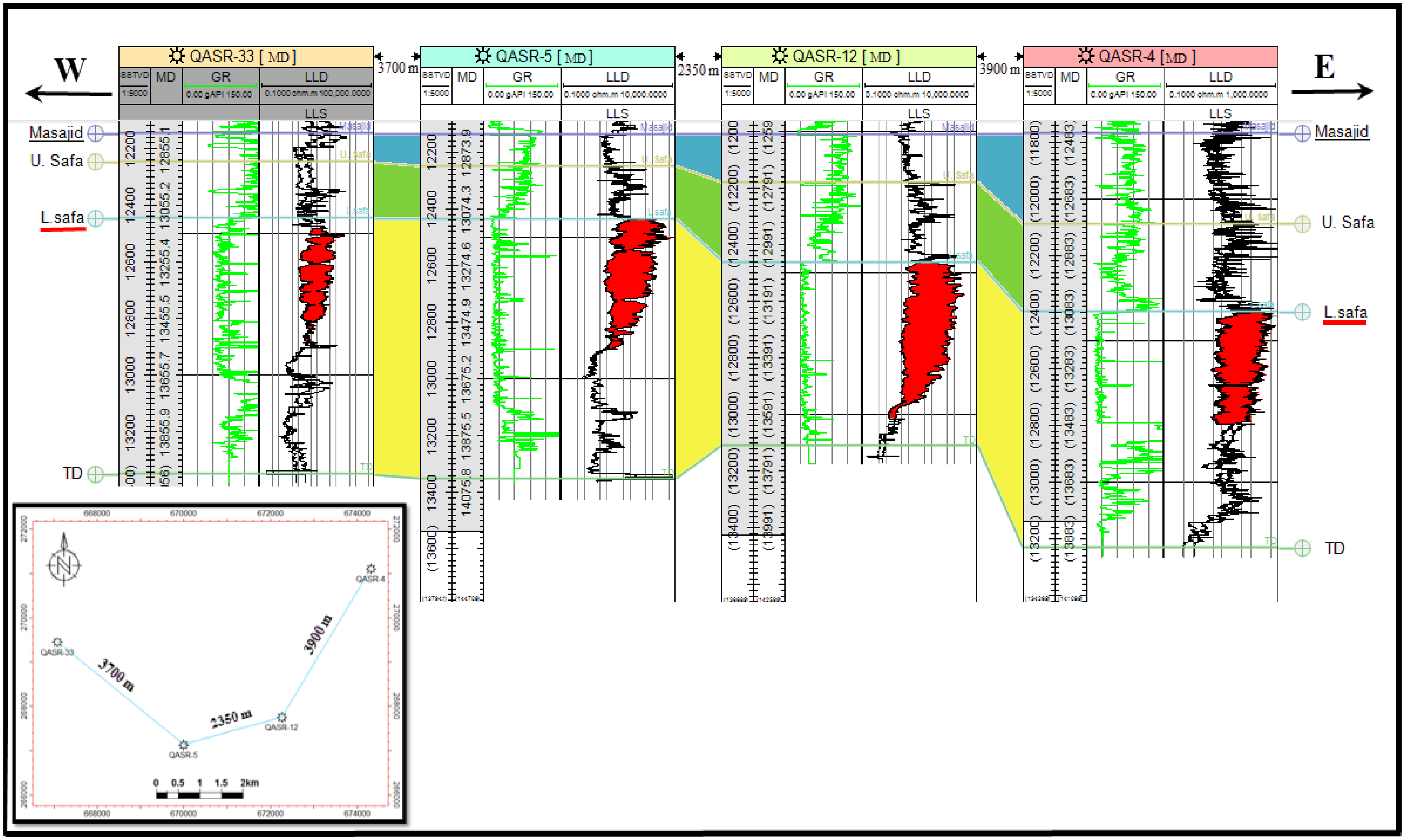
Safa Formation is divided informally into two Members, the Upper Safa Member varies from about 100 to 310 ft. thick and consists mostly from fine grained Sandstone, Silt, Shale and minor Limestone thin beds, and the Lower Safa Member (700-900 ft. thick) consists of sandstone, siltstone with some shale streaks. The Lower Safa member is the main productive horizon in the Qasr field.

In the study area the lower Safa is encountered in all drilled wells. Its thickness ranges between 900ft. in Qasr-5 to 700ft. in Qasr-12. The Lower Safa Member is composed of sandstone, siltstone with some shale streaks.

Isopach map **(Fig.3)**, constructed for the Lower Safa Member, and shows the variation in thickness that is ranges between (400 to 1050 ft.). In general, the basinal areas occur in the southeastern and north-northwestern parts recording its maximum thickness 1050 ft., however, the platform occurs in the northwestern part recording its minimum thickness 400ft. in the study area. **(Fig.4)**, the stratigraphic correlation hanged on top Masajid Formation, shows the Lower Safa Member of Khatatba Formation thickness distribution in the study area passed through the walls.



(Fig.3): Isopach Map of the Lower Safa Member of Khatatba Formation, Qasr Field.



(Fig. 4): Electric Logs correlation panel hanged on top Masajid Formation in the study area.

3-Structural Setting

The present analysis of the structural setting is based on interpretation of 2D seismic sections and well log data. In the present study the structural setting was studied vertically by interpreting the seismic sections and constructing structure modeling, and completed with constructing depth structure contour maps to illustrate the structural feature laterally on top lower Safa Member.

3-1.Interpretation of Seismic Sections

Seismic interpretation implies detection of the subsurface structure configuration. To understand the geology and subsurface structure of the area under investigation, it is important to throw light on the subsurface geological and structural setting through the interpretation of several seismic sections.

To delineate the subsurface structure of the study area, fourteen dip seismic sections are constructed and orientated towards N-S and NW-SE directions, and six strike seismic sections are constructed and orientated towards E-W direction. The location map of the available seismic lines is shown in **(Fig.1).**

The selected seismic sections reflect the subsurface structural features and reveal the following:

3.1.1 Interpreted Seismic Sections

The interpreted seismic section IL-6415 and IL-6440 are shown in **(Figs 5 to 6)** respectively. They are located in the north part of the study area. Seismic sections IL-6415 and IL-6440 are strike sections and taking the E-W trend. The interpretation of seismic section IL-6415 is done using the time-depth chart which is constructed using the checkshot data of Qasr-5 well. The interpretation of the rest of the seismic sections IL-6440 is done by tracing the continuity of the selected stratigraphic horizons at the intersection points with the interpreted seismic section IL-6415, so detection of the TWT of the selected stratigraphic horizons is easily done.

These sections pass through the selected studied rock units Khoman Formation, Abu Roash ”A” Member, U.Bahariya Member, Alam El Bueib-1 Member, Masajid Formation, Upper and Lower Safa Members of Khatatba Formation reflectors are picked at the proper time on these sections.

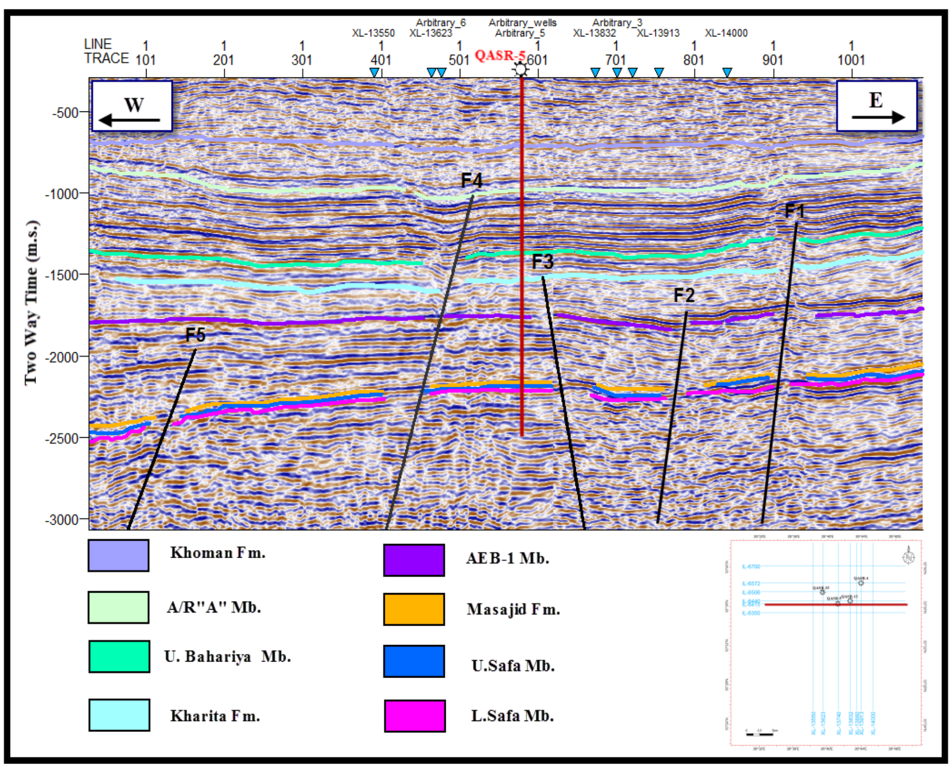
Seismic sections IL-6415 and IL-6440 show a set of normal faults (F1, F2, F3, F4 and F5). The F1, F2, F4 and F5 have the downthrown side towards the SW direction. F3 have the downthrown side towards the SE direction. This section shows a set of five normal faults (F1, F2, F3, F4, and

F5). F1 and F2 forming a step fault and F2 and F3 are forming a graben block, while F3 and F4 form a horst block, and F4 and F5 forming a step fault which affecting the stratigraphic units in the study area.

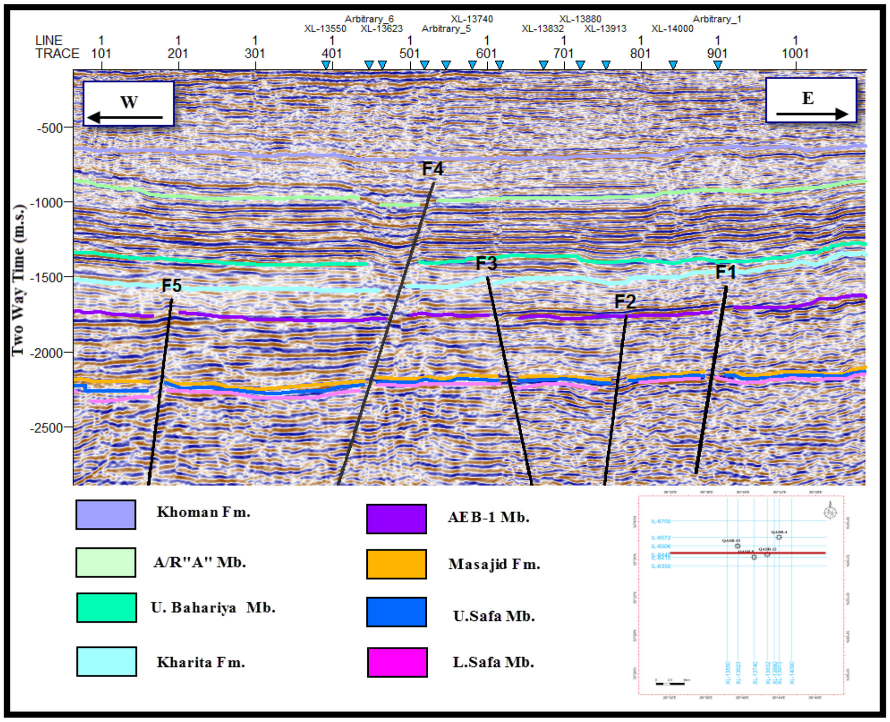
The interpreted seismic section XL-13740 is shown in **(Figs 8)**. It is located in east part of the study area. Seismic sectionXL-13740 is dip sections and taking the north-south trend. The interpretation of seismic section XL-13740 is done using the time-depth chart which is constructed using the checkshot data of Qasr-5 well.

This section pass through the selected studied rock units Khoman Formation, Abu Roash ”A” Member, U.Bahariya Member, Alam El Bueib-1 Member, Masajid Formation, Upper and Lower Safa Members of Khatatba Formation reflectors are picked at the proper time on these sections.

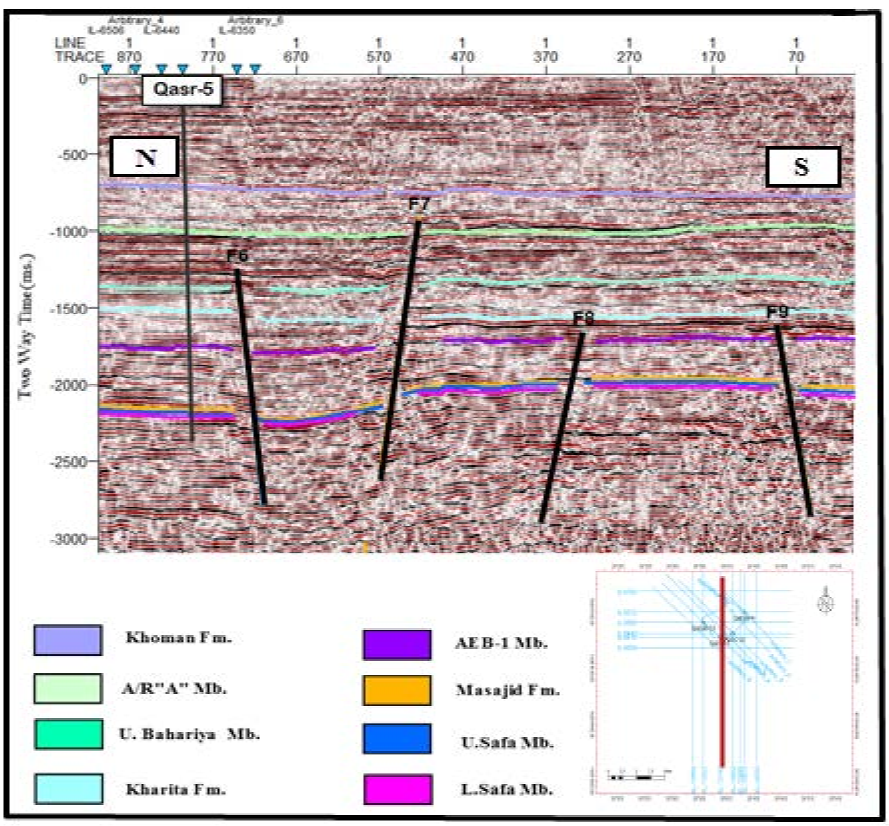
Seismic sections XL-13740 show a set of normal faults (F6, F7, F8, and F9). F6 and F9 have the downthrown side towards the SE direction. The F7 and F8 have the downthrown side towards the SW direction. F6 and F7 are forming a graben block, while F8 and F9 are forming a horst block which affecting the stratigraphic units in the study area.



(Fig. 5): Interpreted seismic section IL-6415.



(Fig.6): Interpreted seismic section IL-6440.



(Fig. 7): Interpreted seismic section XL-13740.

3.2-Structural Configuration

To illustrate the subsurface structural configuration of the study area, three depth structure contour maps are constructed with the aid of the interpreted seismic sections.

3.2.1 Structure Contour Maps

Once seismic sections are interpreted, the next step is to construct a time structure contour map for each of the selected stratigraphic horizons.

After interpreting the seismic lines, the two-way time (TWT) values for the stratigraphic horizon can be posted on the seismic lines' shot points on the base map. These values become ready to be contoured, after posting the faults' heave on the map and tying the faults together across the seismic lines, and then a time structure contour map is constructed.

The two-way time values of various horizons can be multiplied by the velocity values to get the depth values. These depth values can also be posted on the map and contoured, the same way as of making a time structure contour map, to get a depth structure contour map.

The dip, oblique, and strike seismic sections form a grid, as these lines cross each other at the intersection points, so the reflectors of the stratigraphic horizons can be followed from one line to another by correlating the seismic events and tying their times. In this study, the interpretation of seismic sections and making the depth structure contour maps are done using Petrel 2013 software program at (Schlumberger, 2013).

To illustrate the subsurface structural configuration of the study area, three depth structure contour maps are constructed on selected formations tops (Masajid Formation, Upper and Lower Safa Members of Khatatba Formation (reservoir rock in the study area).

3-2-1-1. Structure Contour Map on the top of Lower Safa Member of Khatatba Formation.

The structure contour map on the top of Lower Safa Member of Khatatba Formation are shown in **(Fig.9),** These maps show three prominent sets of normal faults can be aligned to:

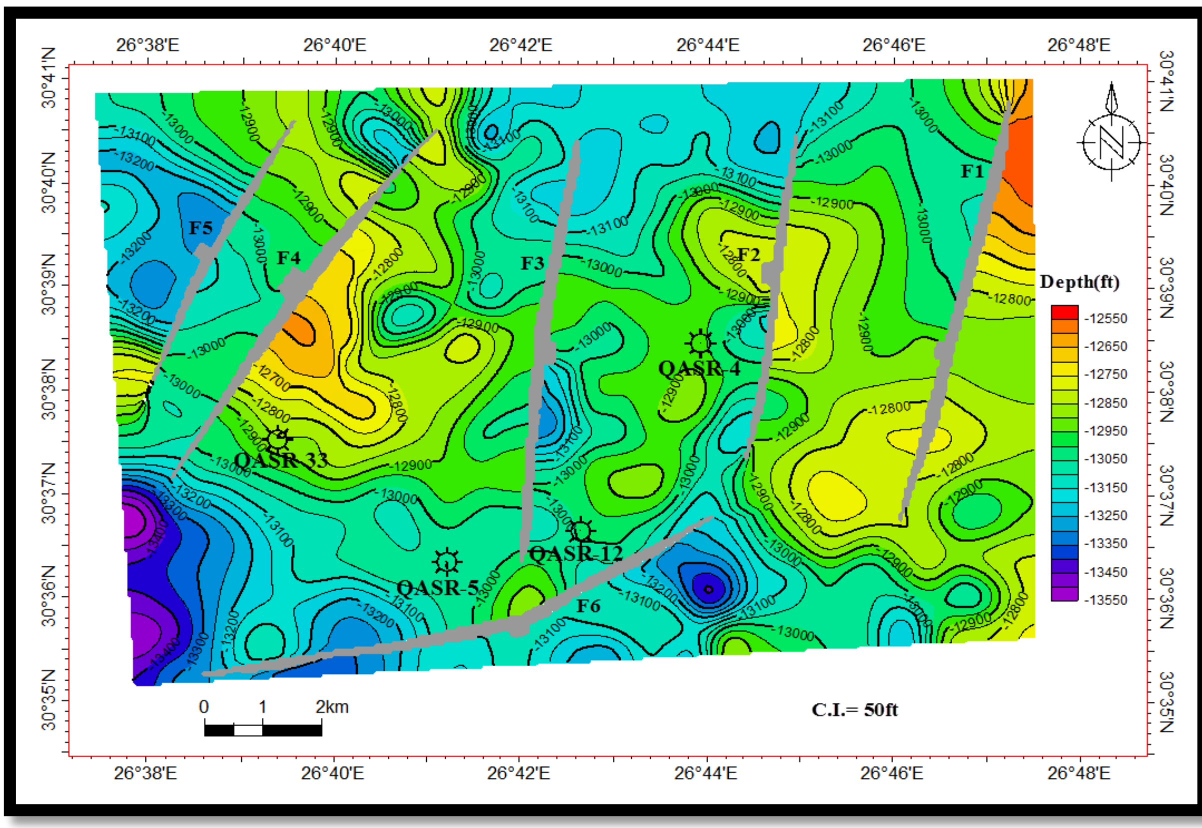
a) NNE-SSW direction : F1, F2 and F3

b) NE - SW; F4 and F5.

c) ENE-WSW; F6.

Such faults undertake defining a series of fault blocks with varying degrees of throw magnitudes. However, F1, F2, F4, and F5 tend to dip due northwest. F3 dip at the direction of north east, F6 dip at southeast.

Unless the faults had acted as conduits for the hydrocarbons to escape to the surface, the delineated blocks in the northern half of the map where the structural and dip closures interact: represent prospective areas for development and in turn proposed well locations.



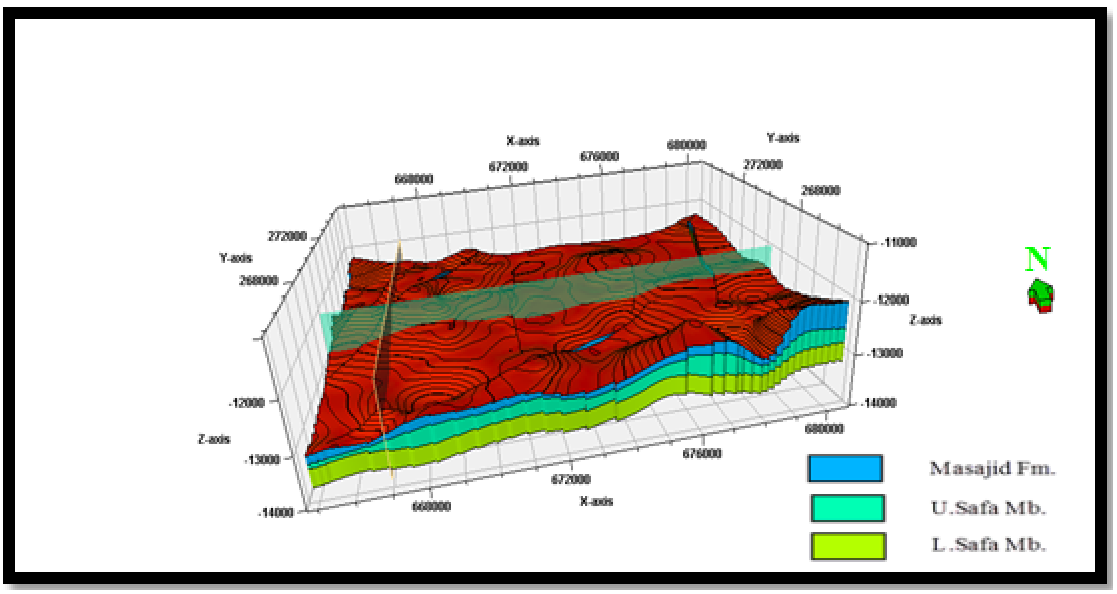
(Fig.8): Depth Structure contour map on top of Lower Safa Member of Khatatba Formation in the study area.

3-3. Structural Modeling

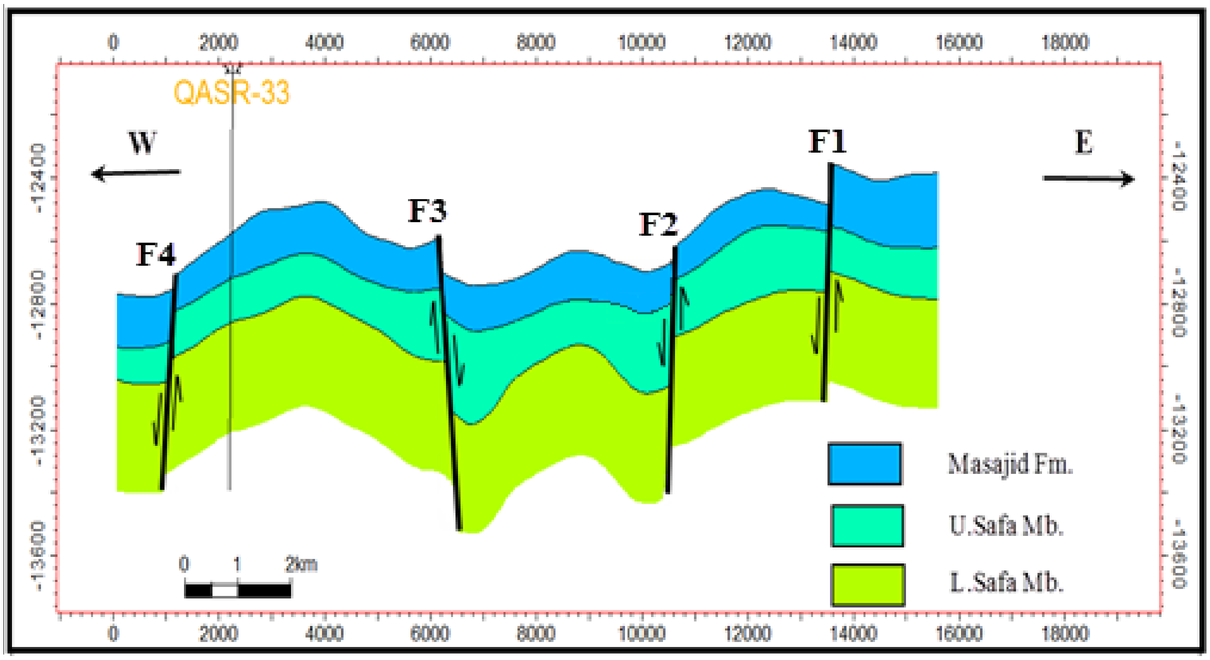
The structural model shows the surface distribution over all the study area **(Fig.9).** A Structural model from Masajid Formation down to the lower Safa Member and constructed cross sections are shown in**(Figs 10and 11).**

The cross sections-1 **(Fig.10)** is an E-W cross section illustrating the structural setting of the central part of the study area. As is shown in this cross section the study area is affected by a set of normal faults (F1, F2, F3 and F4). The F1, F2 and F4 have the downthrown side towards the SW direction. F3 have the downthrown side towards the SE direction. F1 and F2 forming a step fault, F2 and F3 are forming a graben block, while F3 and F4 forming a horst block which would be an excellent place for oil and gas accumulations in the study area.

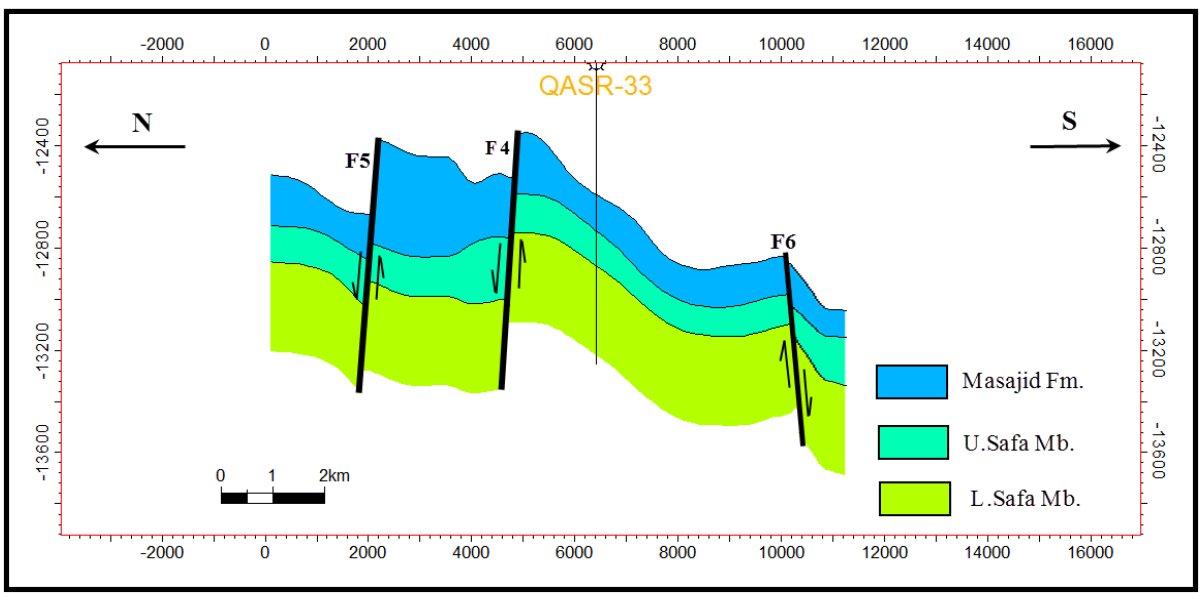
The cross section-2 **(Fig.11)** is an N-S cross section illustrates the structural setting of the western part of the study area. As is shown in this cross section the study area is affected by a set of normal faults (F4, F5 and F6). The F4 and F5 have the downthrown side towards the SW direction. F6 have the downthrown side towards the SE direction. F4 and F5 forming a step fault, while F4 and F6 form a horst block which affecting the stratigraphic units in the study area.



(Fig. 9): Structure modeling of the study area.



(Fig.10): E-W structural cross section in the central part of the study area.



(Fig.11): N-S structural cross section in the western part of the study area.

4-Petrophysical Evaluation

4-1 Well-Log Analysis:

Well log analysis represents the most important stage in the evaluation of Petrophysical characteristics (effective porosity, Shale content, water saturation, and hydrocarbon saturation).

The evaluation consists of level by level calculation of Formation true resistivity (R_t), Formation water resistivity (Rw), Shale volume (V_{sh}), total porosity (Φt), effective porosity (Φ_{eff}), water saturation (Sw) and hydrocarbon saturation (S_h).

A set of well logs has been run in the selected 4 wells. These wells named (QASR-4, QASR-5, QASR-12, and QASR-33). The available open-hole well logging tools that are used in the present study are (GR, ROHB, NPHI, LLS, LLD) required for petrophysical analysis. In this investigation, Interactive Petrophysics version 3.5 software program at (Schlumberger, 2009) is used, with a processing steps, to evaluate the petrophysical characteristics of the studied formations in the form of litho-saturation cross-plots.

Formation Water Resistivity is an important parameter for the fluid saturation determination. The value of formation water resistivity (R_w) for Lower Safa members of Khatatba Formation is obtained from the composite-log data at S_w equals 100%, by using the Archie's water saturation equation **(Schlumberger, 1987)**:

$$S_w^n = \frac{FR_w}{R_t}$$

Where; R_w: is the formation water resistivity, R_T: is the formation resistivity, F: is the formation resistivity factor. Archie’s experiments revealed that the formation resistivity factor could be related to porosity by the following formula:

$$F = \frac{1.0}{\phi^m}$$

Where; m is a cementation exponent.

Another method for determining R_W is the using of "Pickett plot", which is developed by plotting porosity values with deep resistivity values on two-by-three cycle log-log paper **(Asquith and Gibson, 1982)**. The value of formation water resistivity (R_W) for Lower Safa Member of Khatatba Formation ranges from 0.095 (Ohm.m.) in Qasr-33 to 0.041 (Ohm.m.) in Qasr-12.

The calculated net pay, Effective porosity, water saturation and hydrocarbon saturation are tabulated and mapped for Khatatba Formation. The cutoffs used for the Khatatba Formation are as follows: effective porosity 10%, volume of shale 35%, water saturation 65%. **(Table 1)** shows the petrophysical parameter of Lower Safa members of Khatatba Formation, which is the main reservoir of Qasr field.

(Table 1) The Petrophysical parameters of Lower Safa Member of Khatatba Formation in Qasr field.

Well No.	Net Pay (ft.)	Effective Porosity (Φ_{eef} %)	Water Saturation (Sw %)	Shale Content (V_{cl} %)	Hydrocarbon Saturation (S_h%)
QASR-4	125	11	10	4	90
QASR -12	385	12	10	10	90
QASR -5	390	12	11	3	89
QASR -33	135	13	18	7	82

4.2 Illustration of Results

In this investigation, the hydrocarbon potentialities for the Khatatba Formation of Jurassic age have been evaluated by studying the petrophysical characteristics of this formation. The study of hydrocarbon potentialities is very important to understand the hydrocarbon situation in the area under investigation. Petrophysical characteristics that are deduced from the process of well-log analysis are generally varied vertically and laterally.

The vertical distribution of the petrophysical characteristics has been performed through the Litho-saturation cross-plots by the software program technique. Litho-saturation cross-plots are considered as an important vertical representation for petrophysical characteristics, because they are used for more accurate evaluation in the individual wells and in comparison between the different wells. The litho-saturation cross-plots are presented to give complete vision about the lithological analysis (shale volume and matrix), effective porosity and the internal resolution of the available water and hydrocarbon saturations.

The lateral variation of petrophysical characteristics in the area under investigation could be studied through a number of gradient and saturation maps (iso-parametric maps); that include, net pay (ft), shale content (V_{sh} %), effective porosity ($Ø_{eff}$ %), water saturation (Sw %), and hydrocarbon saturation (Shr %) to complete the vision of hydrocarbon potentialities in the study area.

4.2.1 Vertical Variation of Petrophysical Characteristics

The vertical distribution of hydrocarbon occurrences can be explained and presented through the construction of the Litho-saturation cross-plots. Litho-saturation cross-plot is a representation, zone-wise, for the content of fluids and rocks with depth through the studied well. The contents of rocks include shale and matrix, while the contents of fluids include water and hydrocarbon saturation. The Litho-saturation cross-plots of Lower Safa members of Khatatba Formation show the predominance of sandstone. Also, show that Lower Safa Members of Khatatba Formation reveal hydrocarbon saturation reaches up to 90%. This is obtained from Interactive Petrophysics version 3.5 software program at (Schlumberger, 2009).

From left to right, we find the following tracks: The first track is the GR log (API) track. The second track is the Depth (m) track. The third track is the Resistivity logs (Ohm. m) track. The fourth track is the porosity logs (Density, Neutron, and Sonic) track. The fifth track is the "reservoir flag", and the "pay flag" track. The sixth track is the water saturation (Dec) track. The seventh track is the effective and total porosity (Dec) track. The eighth track is the shale volume (Dec) track. The ninth track is the formation analysis (effective porosity, silt volume, clay volume, and matrix volume).

4.2.1.1 Lithosaturation cross plot of lower Safa Member of Khatatba Formation in Qasr-4

Figure 12, shows the computer processed interpretation (C.P.I) plot of Lower Safa Member of Khatatba Formation in Qasr-4 well. It is penetrated at depth ranges from 13080ft. to 13900ft. The gross interval of Lower Safa Member of Khatatba Formation is 820 ft. In this formation, The Shale content varies from 3% to 70% and increase downwards. The Effective porosity varies from 3% to 13% and decrease downwards. The Hydrocarbon saturation ranges between 70% to 90%, it generally decreases downwards.

4.2.1.2 Lithosaturation cross plot of lower Safa Member of Khatatba Formation in Qasr-12

Figure 13, shows the computer processed interpretation (C.P.I) plot of Lower Safa Member of Khatatba Formation in Qasr-12 well. It is penetrated at depth ranges from 13050ft. to 13750ft. The gross interval of Lower Safa Member of Khatatba Formation is 700ft. In this formation, The Shale content varies from 5% to 60% and increase downwards. The Effective porosity varies from 7% to 13% and decrease downwards. The Hydrocarbon saturation ranges between 10% to 90%, and decreases downwards.

4.2.1.3 Lithosaturation cross plot of lower Safa Member of Khatatba Formation in Qasr-5

Figure 14, shows the computer processed interpretation (C.P.I) plot of Lower Safa Member of Khatatba Formation in Qasr-5 well. It is penetrated at depth ranges from 13100ft. to 14000ft. The gross interval of Lower Safa Member of Khatatba Formation is 900ft. In this formation The Shale content varies from 2% to 40% and increase downwards. The Effective porosity varies from 5% to 12% and decrease downwards. The Hydrocarbon saturation ranges between 30% to 95%, it generally decreases downwards.

4.2.1.4 Lithosaturation cross plot of lower Safa Member of Khatatba Formation in Qasr-33

Figure 15, shows the computer processed interpretation (C.P.I) plot of Lower Safa Member of Khatatba Formation in Qasr-33 well. It is penetrated at depth ranges from 13100ft. to 13950ft. The gross interval of Lower Safa Member of Khatatba Formation is 850ft In this formation, The

Shale content varies from 3% to 50% and increase downwards. The Effective porosity varies from 2% to 13% and decrease downwards. The Hydrocarbon saturation ranges between 40% to 90%, and decreases downwards.

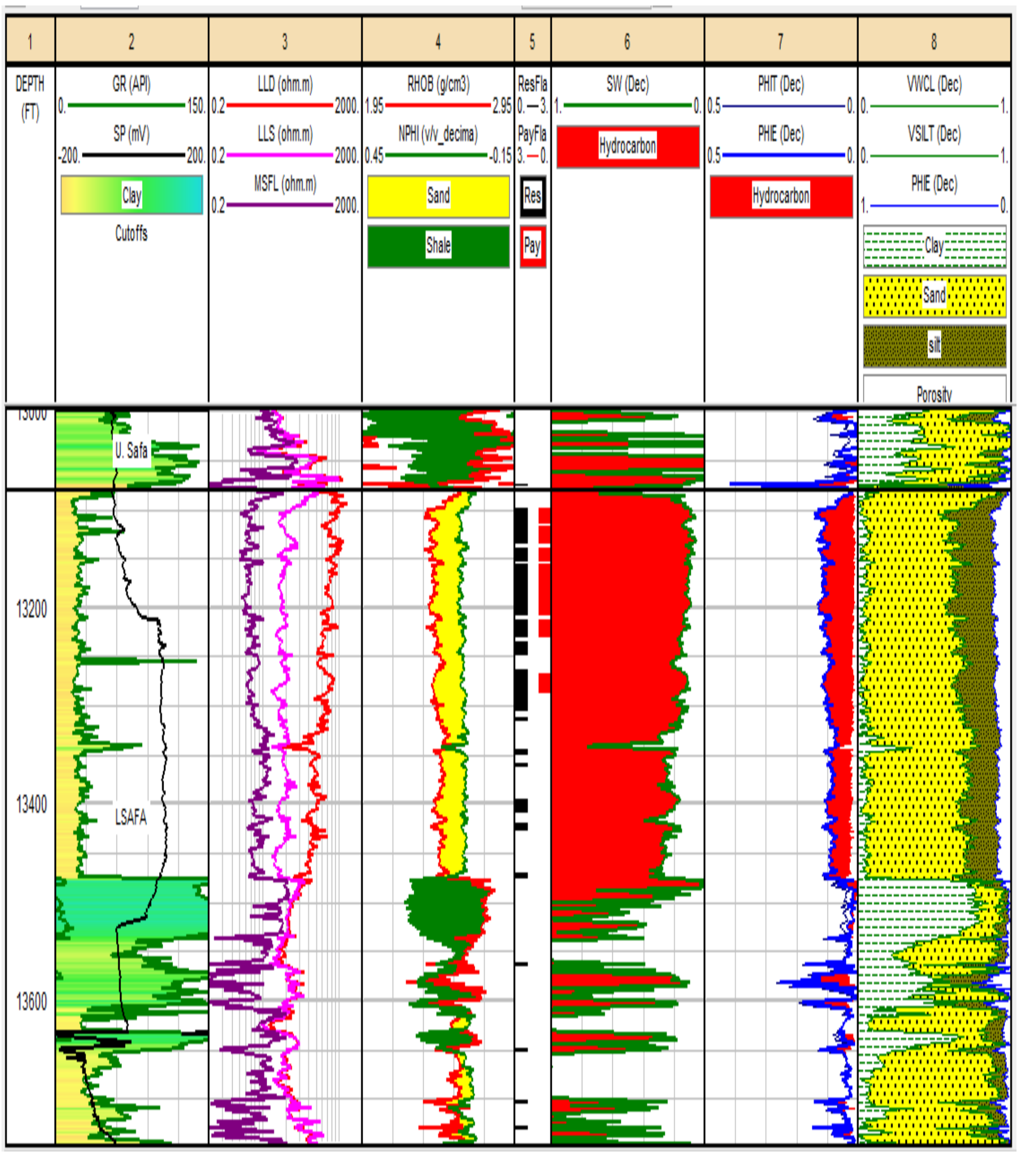


Fig. (12): Litho-saturation cross-plot of Lower Safa Member of Khatatba Formation Qasr-4 well.

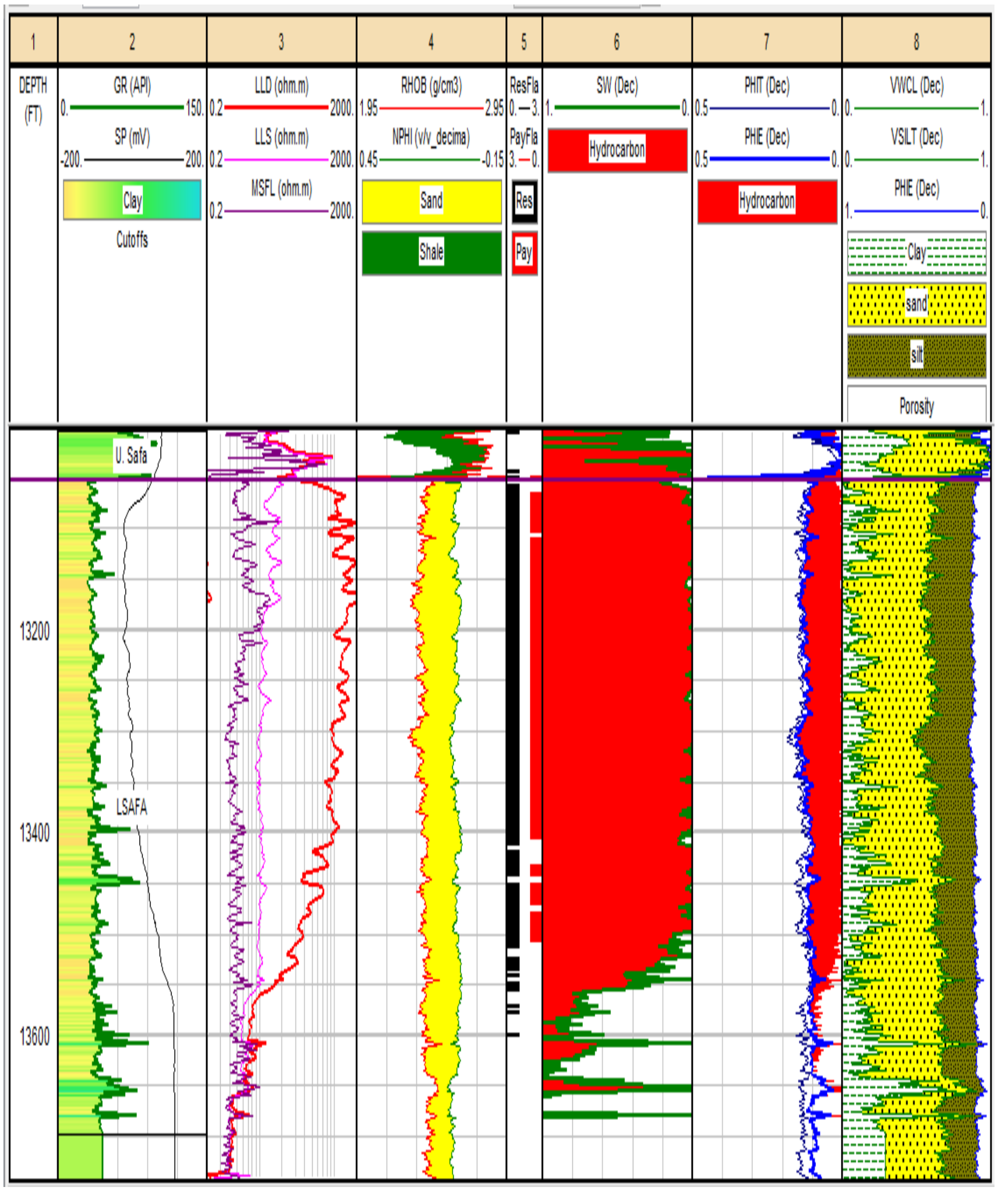


Fig. (13): Litho-saturation cross-plot of Lower Safa Member of Khatatba Formation Qasr-12 well.

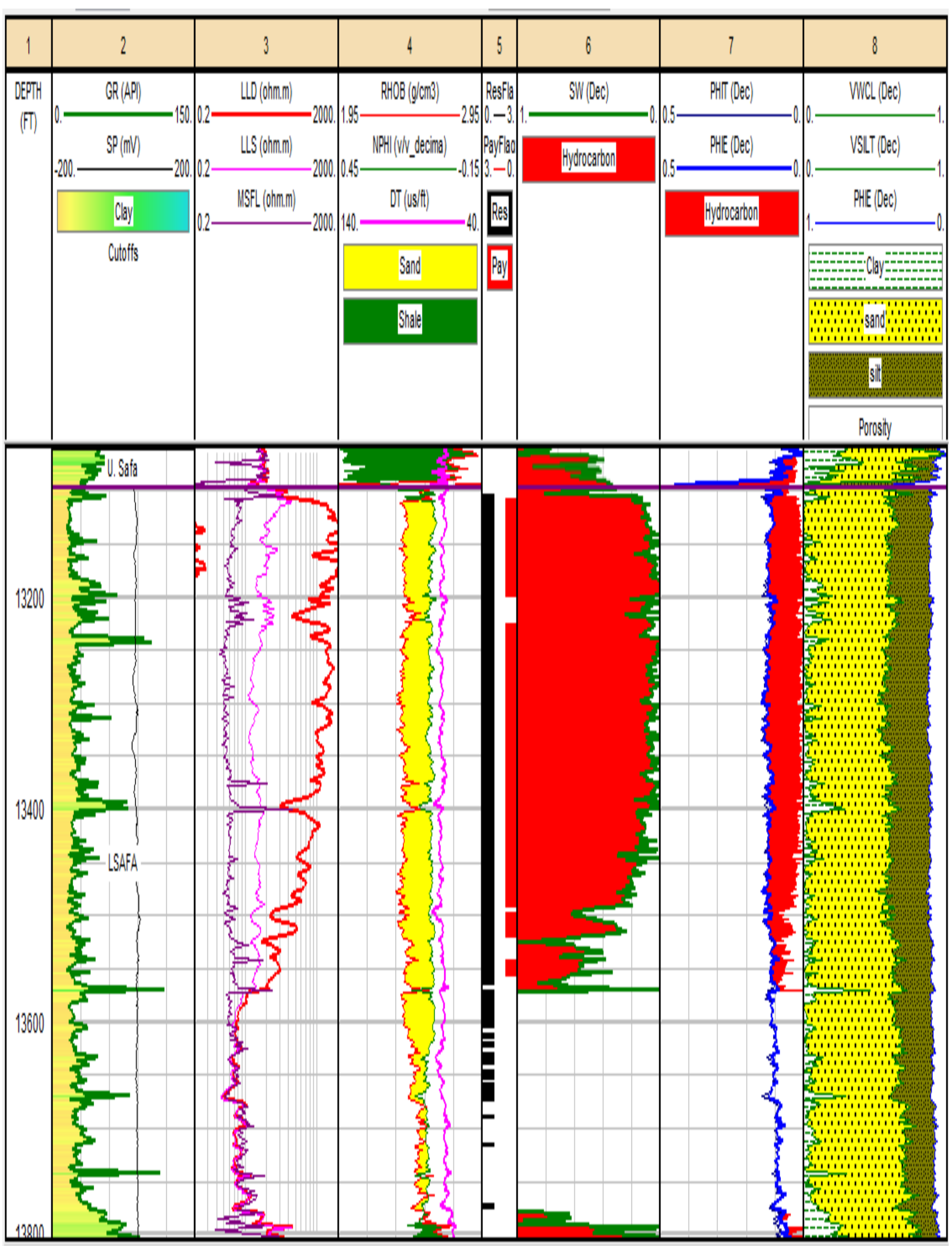

1
2
3
4
5
6
7
8
DEPTH
(FT)
GR (API)
0.
150.
SP (mV)
-200.
200.
Clay
Cutoffs
LLD (ohm.m)
0.2
2000.
LLS (ohm.m)
0.2
2000.
MSFL (ohm.m)
0.2
2000.
RHOB (g/cm3)
1.95
2.95
NPHI (v/v_decima)
0.45
-0.15
DT (us/ft)
140.
40.
Sand
Shale
ResFla
0.
3.
PayFlag
3.
0.
Res
Pay
SW (Dec)
1.
0.
Hydrocarbon
PHIT (Dec)
0.5
0.
PHE (Dec)
0.5
0.
Hydrocarbon
VWCL (Dec)
0.
1.
VSILT (Dec)
0.
1.
PHE (Dec)
1.
0.
Clay
sand
silt
Porosity
U. Safa
LSAFA
13200
13400
13600
13800

Figure (14): Litho-saturation cross-plot of Lower Safa Member of Khatatba Formation Qasr-5 well.

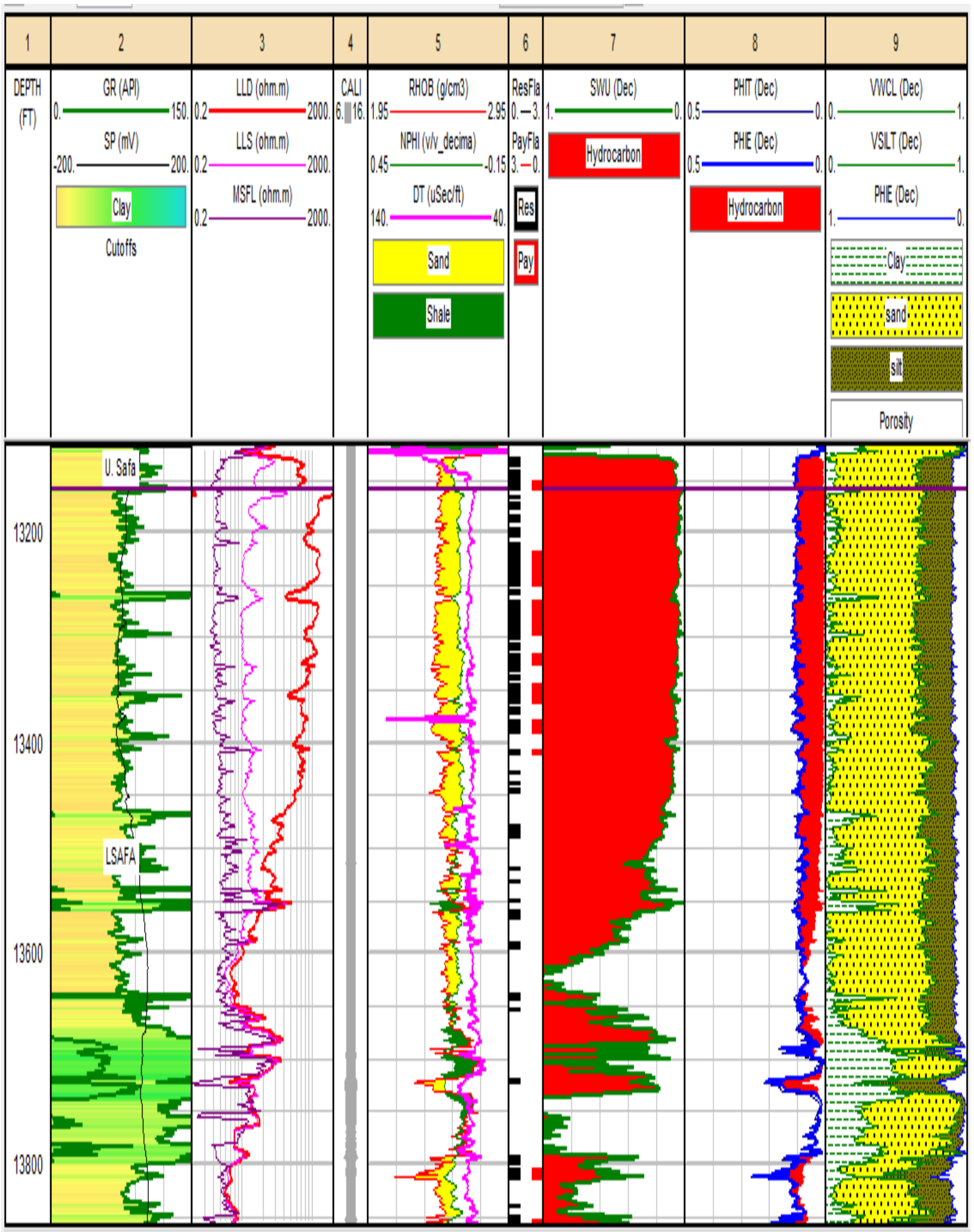


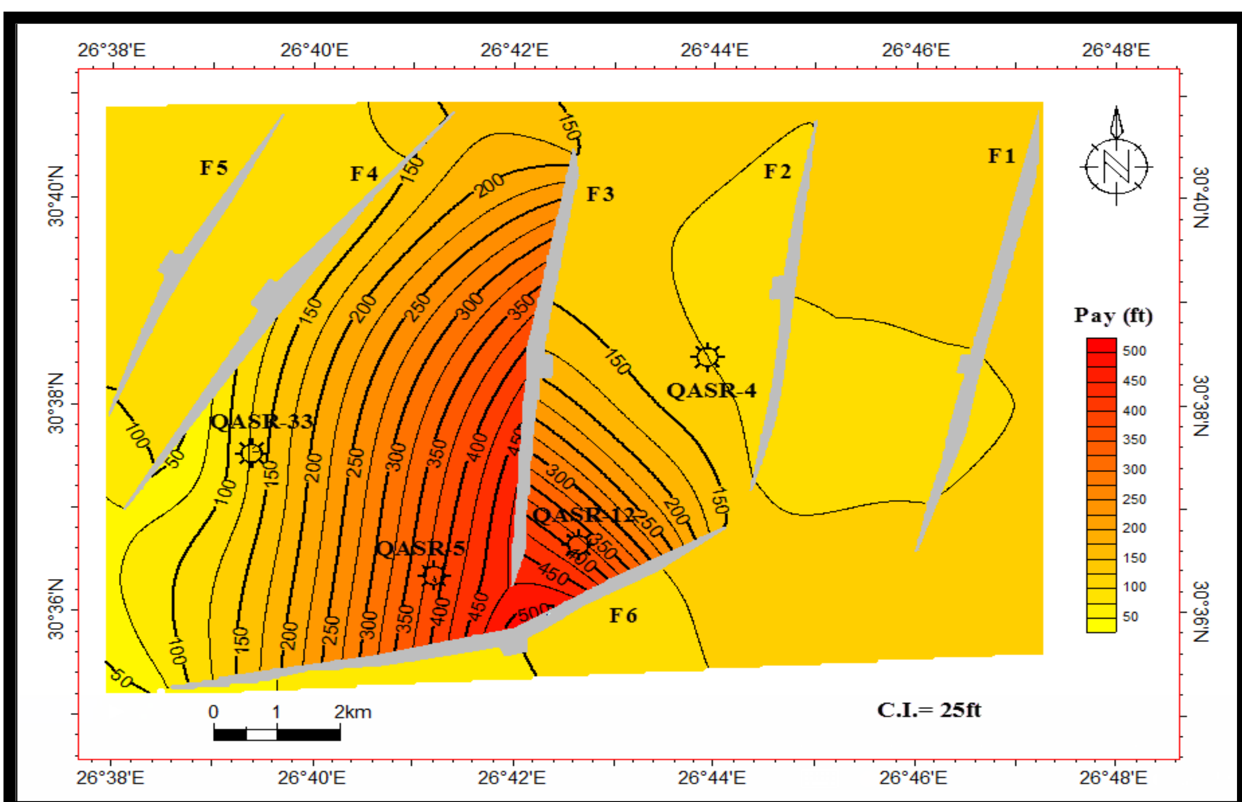
Fig.(15): Litho-saturation cross-plot of Lower Safa Member of Khatatba Formation Qasr-33 well.

4.2.2 Lateral Variation of Petrophysical Characteristics

A number of iso-parametric maps, which are the net pay, shale content, effective porosity, water saturation, and hydrocarbon saturation maps, represent the lateral variation of petrophysical characteristics.

4.2.2.1 Lower Safa Member net pay thickness distribution map:

This map shows the net pay thickness distribution, the thickness ranges between 125ft in Qasr-4 to 390ft in Qasr-5. **Fig.16 ,** shows that the highest thickness of the pay zone concentrated in the central and southern parts of the study area and decreased in the southwestern and northeastern parts of the study area. This map indicates that the central and northeastern parts of the study area are the most promising parts for hydrocarbon accumulations.



(Fig.16): Net pay thickness map of Lower Safa Member of Khatatba Formation in Qasr field.

4.2.2.2 Lower Safa Member Effective Porosity (Øeff %) Map:

This map illustrates the porosity distribution. The calculated effective porosity ranges from11% in Qasr-4 to 13% in Qasr-33. **Fig. 17** shows that the highest porosity distribution is found at the southwestern parts of the study area, where the lowest porosity distribution is found at the eastern part of Qasr field.

4.2.2.3 Lower Safa Member Shale content (V.cl %) map:

Shale content is an important quantitative function of log analysis. It is considered as an important indicator of reservoir quality, in which the less value of shale content usually reveals a better reservoir. **Fig.18** shows the distribution of shale content in the study area. This map illustrates that the shale content ranges from 3% in Qasr-5 to 10% in Qasr-12 and decreases at the northeastern part, where it increases in the southwestern and southeastern parts of the study area.

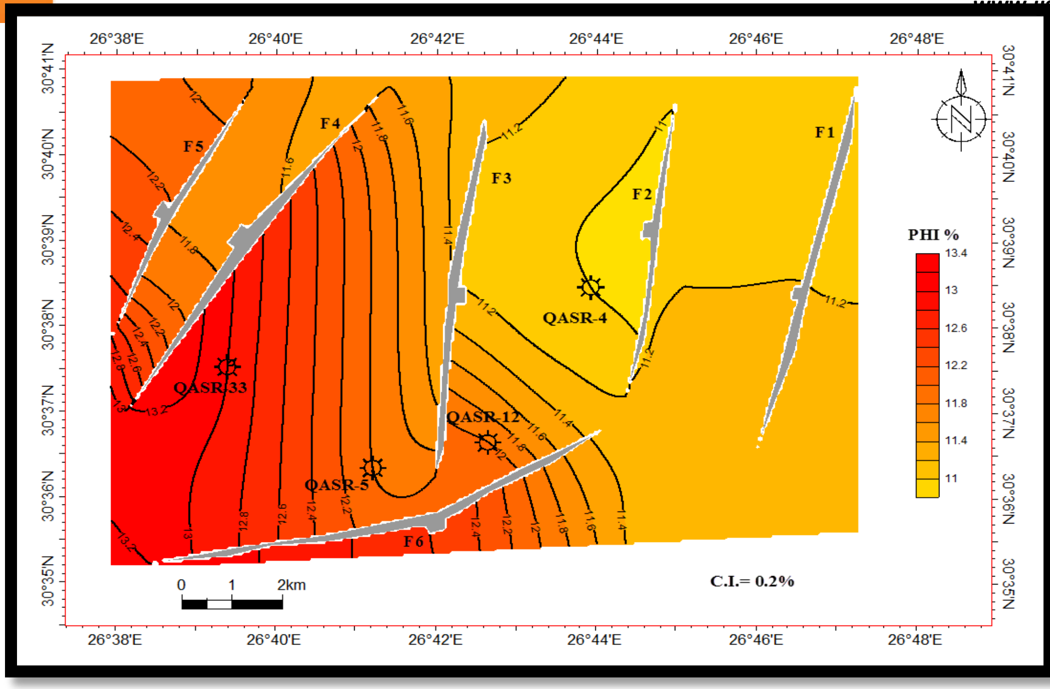
4.2.2.4 Lower Safa Member water saturation (SW %) map:

This map shows the distribution of water saturation in the study area. The most water saturation occurrence is observed within the range of 10% in Qasr-12 and Qasr-4 to 18% in Qasr-33. **Fig.19** shows that the highest water saturation is found at the southwestern part in the study area where the lowest water saturation is found at the eastern and in the study area.

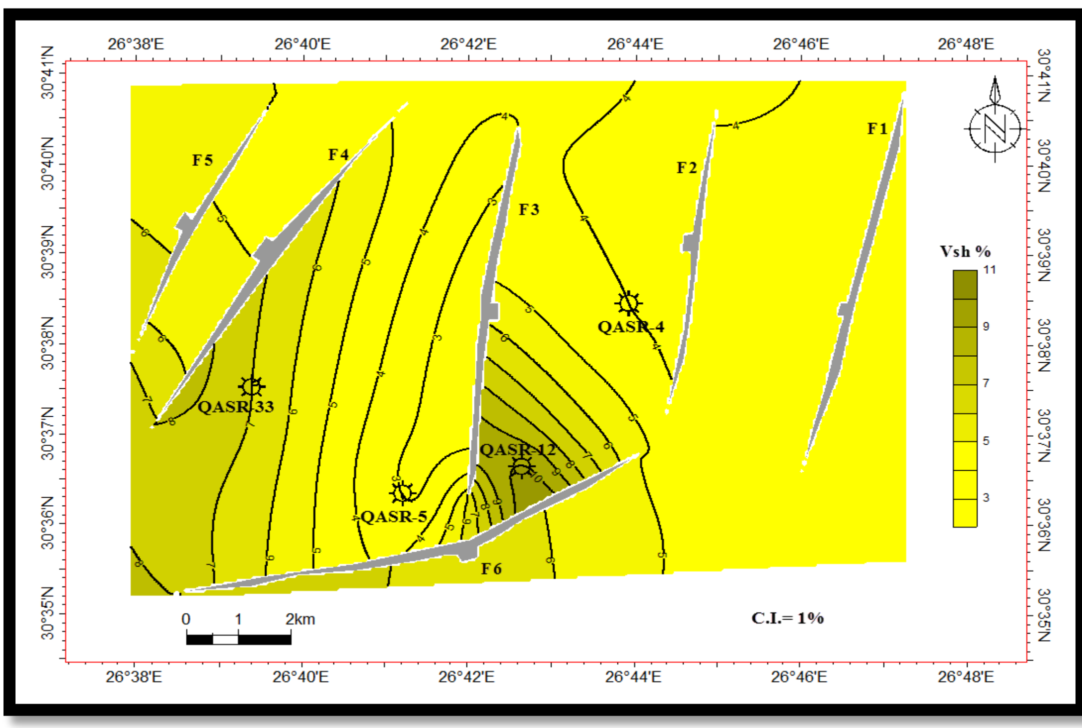
4.2.2.5 Lower Safa Member Hydrocarbon saturation map:

Determination of hydrocarbon saturation (S_{hr} %) is the main target of the current study. All maps show accurate matching between hydrocarbon saturation and water saturation. **Fig.20** shows the hydrocarbon saturation map of Lower Safa Member of Khatatba Formation. This map illustrates that the hydrocarbon saturation ranges from 82% in Qasr-33 to 90% in Qasr-12 and

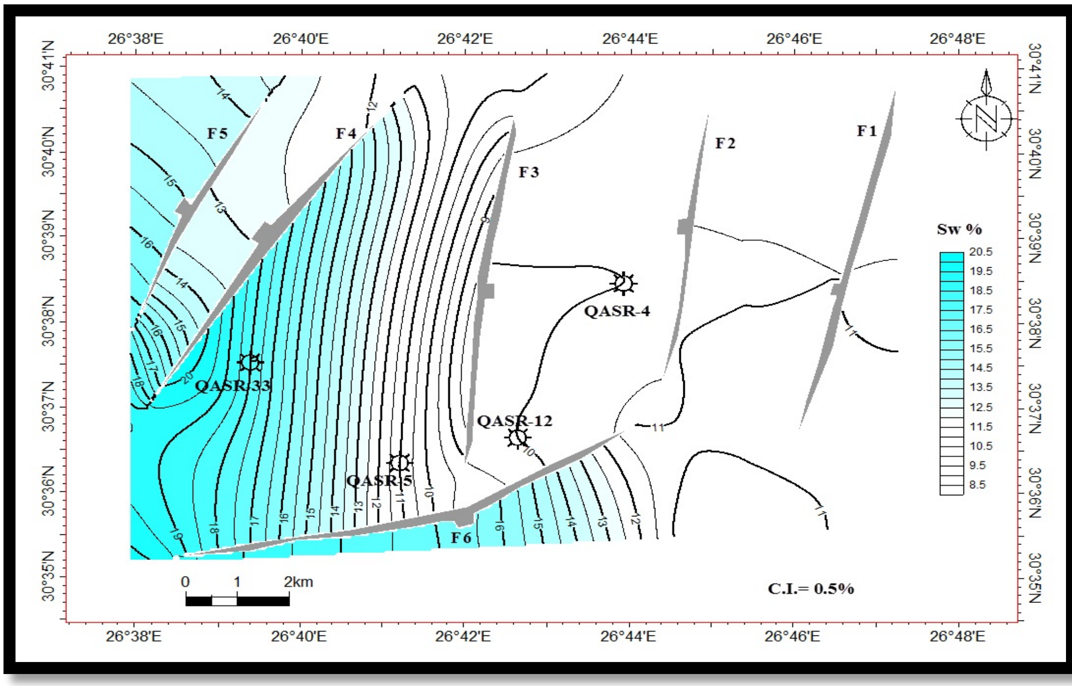
Qasr-4. This map illustrates that the hydrocarbon saturation in the study area increases in the eastern part and decreases in the southwestern part of the area.



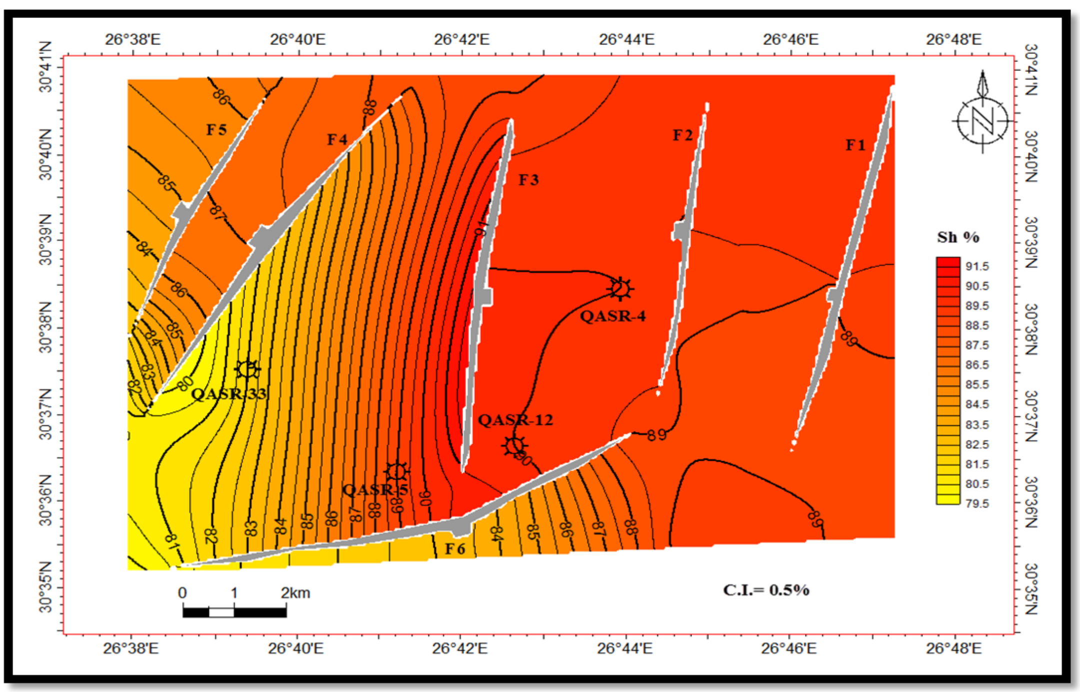
(Fig.17): The Effective porosity map of Lower Safa Member of Khatatba Formation.



(Fig.18): Shale content distribution map of Lower Safa Member of Khatatba Formation in the study area.



(Fig. 19): Water saturation map of Lower Safa Member of Khatatba Formation in the study area.

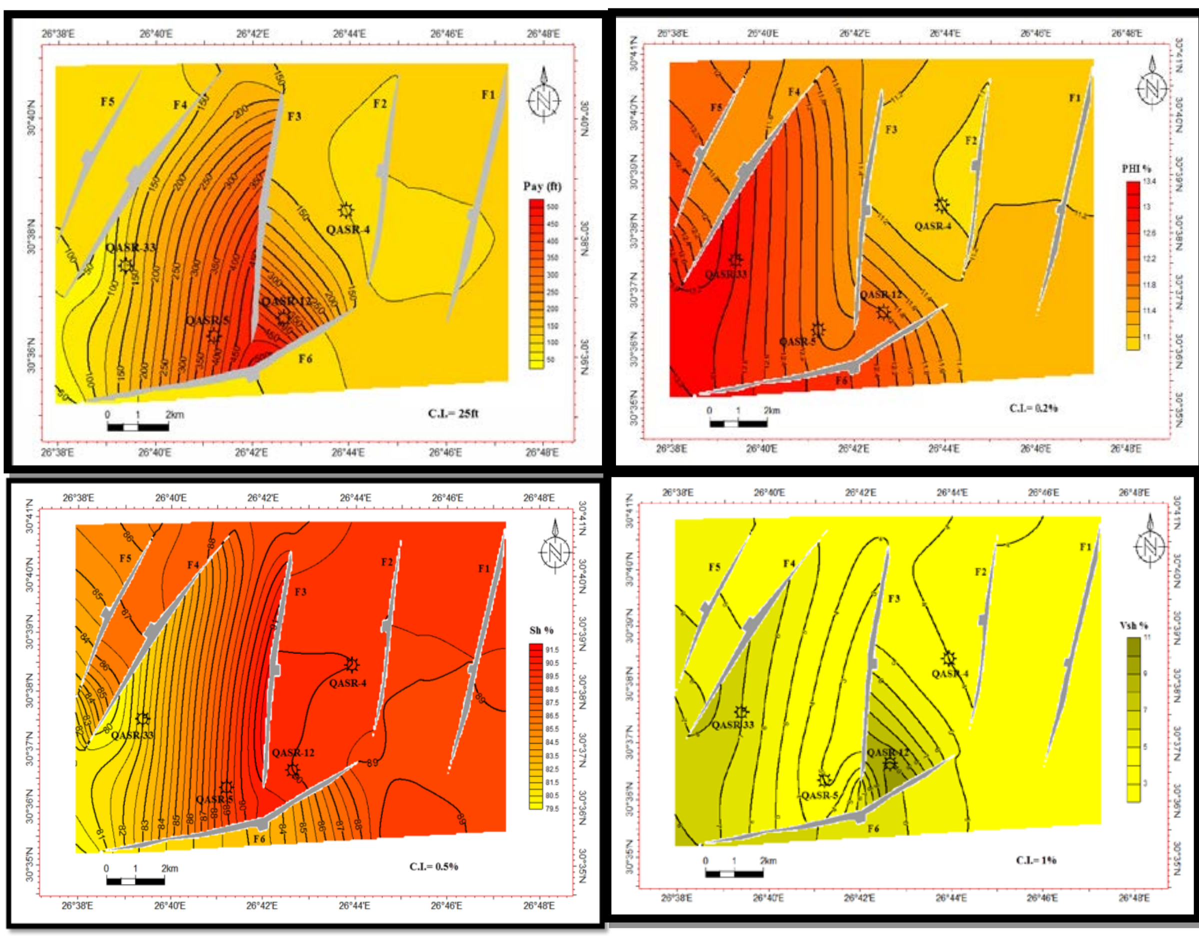


(Fig. 20): Hydrocarbon saturation map of Lower Safa Member of Khatatba Formation in the study area.

4.2.2.6 Integrated Petrophysical Parameters

Fig. 21 illustrates the combined petrophysical characteristics of Lower Safa Member of Khatatba Formation. This figure shows that the net pay thickness of Lower Safa Member of Khatatba Formation increases towards the central part of the study area, while the effective porosity increases towards and southwestern parts of the study area. The water saturation decreases towards the central and northeastern parts of the study area, where the shale content decreases towards the central and northeastern directions in the study area.

All resulted petrophysical parameters are represented vertically in litho-saturation cross-plots and laterally in different types of iso-parametric maps (iso-effective porosity, shale content, water saturation, and net-pay thickness variations) which Increases or decreases due to structure control.



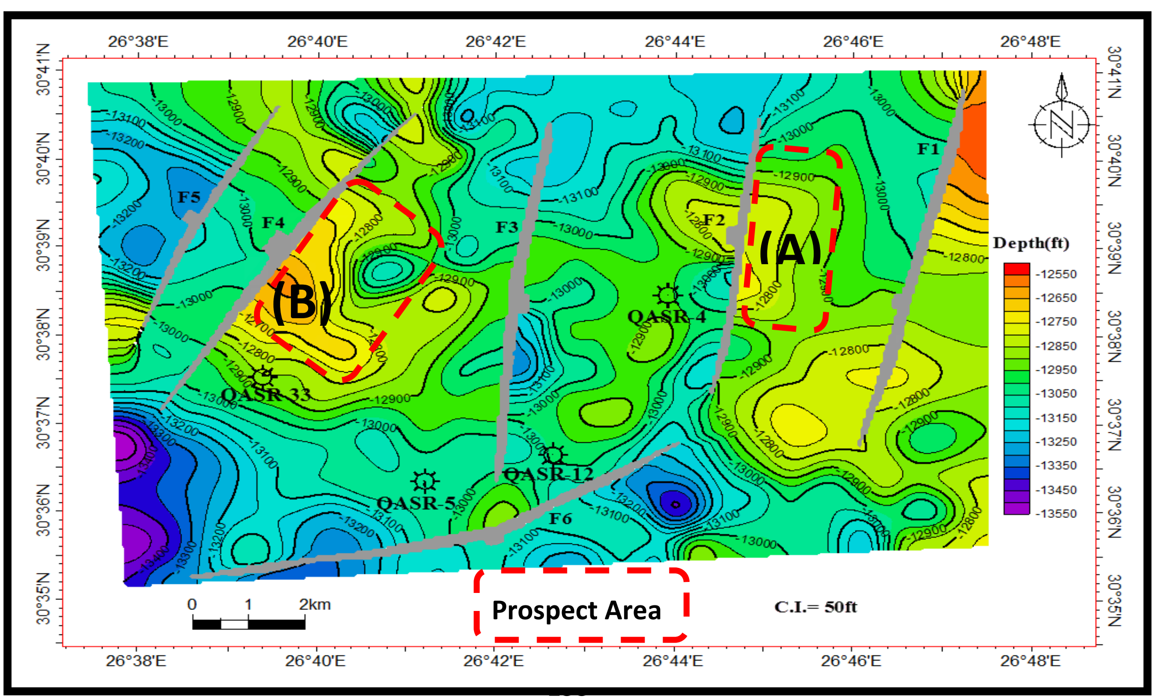
(Fig.21): Combined Petrophysical Parameters of Lower Safa Member of Khatatba Formation in the study area.

5-2 Prospect Evaluation

According to **Magoon et al. (1994),** prospects were first used by exploration geologists to describe present day structural or stratigraphic features that could be mapped and drilled. A series of related prospects called Play. Based on the previous studies on the Western Desert and Qasr field the source rock in the study area is considered to be the Khatatba Formation, the reservoir rock is the Lower Safa Member of Khatatba Formation based on the subsurface and petrophysical studies, the type of trap is supposed to be a structural trap and the seal rock is considered to be Khatatba Formation.

As a result of the subsurface study and the integration with the petrophysical results two locations are supposed to be a prospect which characterized by three way dip closure which would be an excellent place for oil and gas accumulations, also they give a good petrophysical results. The first prospect (A) is located in the northeastern part of the study area on the upthrown side of F2 in three way dip closure which forming a suitable place for oil and gas accumulations.

The second prospect (B) is located in the northwestern part of the study area on the up thrown side of the horst block between F3 and F4 and it’s also located in three way dip closure which forming a suitable place for oil and gas accumulations.



(Fig.22) Depth structure contour map on top of Lower Safa showing the locations of the prospects in the study area.

SUMMARY AND CONCLUSION

Qasr Field is located in the northeastern part of the Shoushan Basin in the Western Desert, Egypt. The study area is bounded by latitudes 30º 25' to 30º 50' N and longitudes 26º 30' to 26º 50' E. The present work dealt mainly with the interpretation of both geological and geophysical data to evaluate the hydrocarbon potentials of clastic reservoirs in Qasr field, Western Desert, Egypt.

Qasr gas field exhibits a good clastic reservoir. The integration of twenty seismic lines and available well-log data (electric, radioactivity and sonic logs) of four available wells; namely: (Qasr-4, Qasr-5, Qasr-12 and Qasr-33) which distributed in the study area assessed to make a clear vision of the subsurface geology and petroleum potentials in the study area and revealed an optimistic in the field development plan.

The subsurface evaluation in the study area was achieved by wireline well-log evaluation and seismic data analysis to determine both stratigraphic and structural features as related to the subsurface setting of the Western Desert province.

To delineate the subsurface structure of the study area, fourteen dip seismic sections are constructed and oriented towards N-S trend and NW-SE trend; six strike seismic sections are constructed and oriented towards the E-W trend. The available checkshot data for Qas-5 well are used to tie well data to seismic.

These sections show a set of six normal faults (F1 to F6). All penetrated rock units are cut by these faults. F1 and F2 forming step fault, while F3 and F4 forming a horst block, F2 and F3 forming a graben block. F4 and F5 forming a step fault. F4 and F6 forming a horst block. F1, F2 and F3 are taking the NNE-SSW trend with down-thrown side directed towards the southwest direction, while F4 and F5 are taking the NE-SW trend with down-thrown side directed towards the southwest direction. F6 is taking the ENE-WSW trend with down-thrown side directed towards the southeast direction. All the studied wells are located within the three-way dip closure that is very suitable place for oil and gas accumulations. The structural setting is delineated by the seismic interpretation. The structural model was constructed to study the structural setting of the study area.

To illustrate the subsurface structure of the study area, one depth structure contour map is constructed on the top of the Lower Safa Members of Khatatba Formation .

The structure contour map on the top of Lower Safa Member of Khatatba show three prominent sets of normal faults can be determined aligned to: NNE-SSW direction : F1, F2 and F3, NE - SW; F4 and F5, and ENE-WSW; F6.

Such faults undertake defining a series of fault blocks with varying degrees of throw magnitude. However, F1, F2, F4, and F5 tend to dip due northwest. F3 dip at the direction of north east, F6 dip at southeast.

Unless the faults had acted as conduits for the hydrocarbons to escape to the surface, the delineated blocks in the northern half of the map where the structural and dip closures interact: represent prospective areas for development and in turn proposed well locations.

Formation evaluation in the area under investigation aimed to evaluate the hydrocarbon potentialities in the clastic lithology (sandstone) that is encountered in the Middle Jurassic (Lower Safa Member of Khatatba Formation).

All resulted petrophysical parameters are represented vertically in litho-saturation cross-plots and laterally in different types of iso-parametric maps (iso-effective porosity, shale content, water saturation, and net-pay thickness variations) which Increases or decreases due to structure control.

The shale content shows that the amount of clay volume decreases gradually to the northeastern part and increases in southwestern and southeastern parts of the study area. It equals 3% in Qasr-5 well to 10% in Qasr-12 well.

The effective porosity increases towards the southwestern trend and decreases towards the eastern trend of the study area. It equals 11% in Qasr-4 well to 13% in Qasr-33 well.

The net-pay thickness distribution map for Lower Safa Member of Khatatba Formation reservoir revealed that the net pay increases towards the central part of the study area and decreases towards the southwestern and northeastern parts. It is 125ft. in Qasr-4 well to 390ft. in Qasr-5 well. The fluid content in the form of hydrocarbon saturation increases towards the northeastern and eastern parts and decreases in the northwestern part of the area. It attains 82% for Qasr-33 well to 90% in Qasr-12 and Qasr-5 wells.

As a result of the present study, using the subsurface and petrophysical evaluation, two locations are proposed to be a prospect area, which is located on such a three-way dip closure that is very suitable place for hydrocarbon accumulations.

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