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RESERVOIR CHARACTERIZATION OF ABU ROASH C MEMBER, SOUTH WEST ABU SENNAN AREA, WESTERN DESERT, EGYPT

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توصيف خزان أبو رواش C جنوب غرب منطقة أبو سنان بالصحراء الغربية، مصر

الخلاصة: تقع منطقة أبو سنان فى شمال الصحراء الغربية لمصربين خطي عرض ٣٢' ٢٩° و٣٥' ٢٩° شمالاً وخطي طول ٣٠' ٢٨° و٣٥' ٢٨° شرقا ونهر النيلغرباً ومنخفض القطاره شمالا. تم حساب المعاملات البتروفيزيقية مثل محتوى الطفل والمسامية ودرجة التشبع بالماء. كما تم حساب السمك الصافي المنتج للهيدروكربونات لعضو ابو رواش **C** . كما تم عمل خرائط توضح توزيع كل معامل من هذه المعاملات فى المنطقه لعضو ابو رواش **C** وهذه الخرائط هي المساميه ومحتوى الطفل ودرجة التشبع بالماء وكذلك السمك الصافي المنتج للهيدروكربونات وتبين من عمل هذه الخرائط ان هذه المنطقة واعدة ويمكن حفر آبار تنموية إضافية واستكشافية ايضا

ABSTRACT: *The south west Abu Sennan concession is located on the south of Abu Gharadig basin, Western Desert, Egypt. The simple reason is that better reservoir characterization means higher success rates and fewer wells for reservoir exploitation. In this research work, seismic and well log data were integrated in characterizing the reservoirs on south west Abu Sennan field in Western Desert. The objective of this paper is to use the well log data to determine the reservoir characteristics, fluid contents, evaluation of the prospectivity and hydrocarbon potentialities of the south west Abu Sennan area and its importance in the development of this area. These petrophysical properties were mapped and helped in the delineation of sweet spots for the reservoir horizon, which in turn helped, along with other elements, in the promotion of the leads interpreted from the seismic data into prospects and they will represent potential reserve additions in the study area.*

INTRODUCTION

I. LOCATION: The study area of south west Abu Sennan field lies in the northern Western Desert of Egypt, between latitudes between latitudes 29°-32' and 29°-35' N, and longitudes 28°-30' and 28°-35' E. Fig. (1).

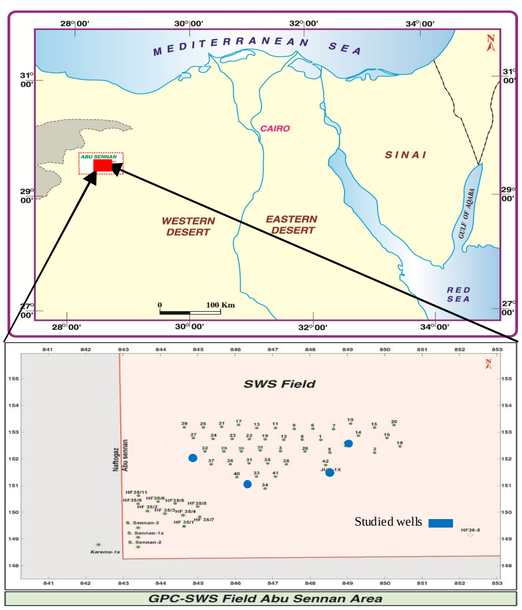

Figure (1): Location map of south west Abu Sennan area, Western Desert, Egypt

II. GEOLOGIC SETTING:

II. 1. Stratigraphy

This paper is concerned with the general geologic setting of the south west Abu Sennan area. Fig. (2)

Cambrian-Ordovician: section has an average thickness of 300m and is represented by the Gargaf Group, which consists mainly of sandstones intercalated with conglomerates. It was deposited under fluvial-continental or in a beach and tidal shoal environments (Schlumberger, 1984).

Devonian: section is represented by the Ghazalat Formation (Middle Devonian) and Blita Formation (Upper Devonian). The Carboniferous section is represented by the Rod El Hamal Formation. It has a thickness ranges from 600 to 700m represented by fine to coarse conglomeratic sandstone, siltstone, shale with limestone stringers. The Permian sediments are represented by the Eghi Formation, which consists of sandstone with shale (Hantar, 1990).

Silurian: section is represented by the Acacus Formation and attains thickness ranging from 25 to 400m of white sandstone, Micaceous shale, siltstone and thin limestone Blita Formation-Upper Devonian (Hantar, 1990).

The Carboniferous section is represented by the Rod El Hamal Formation. It has a thickness ranges from 600 to 700m represented by fine to coarse conglomeratic sandstone, siltstone, shale with limestone stringers.

The Permian sediments are represented by the Eghi Formation, which consists of sandstone with shale (Schlumberger, 1984).

Bahrein Formation (Red beds): The formation is composed of red fine to coarse quartzose sandstones. It overlies Paleozoic units or Basement rocks and underlies unconformably the marine Khatatba Formation. It is belonging to Early Jurassic (Turonian) age (Hantar, 1990). Bahrein Formation in south west Abu Sennan area is not recorded in the studied wells because the undrilled section from Paleozoic to Wadi Natrun Formation.

Wadi Natrun Formation: The Wadi Natrun Formation in south west Abu Sennan area is composed of sand stone, shale and silt stone with limestone streaks (Fig. 5) the Wadi El Natrun Formation is of Lower Jurassic age (Hantar, 1990).

Khatatba Formation: The Khatatba Formation in south west Abu Sennan area is composed of sand stone, shale and silt stone with limestone streaks (Fig. 5) The Khatatba Formation is of Middle Jurassic Bathonian-Bajocian age (Said1, 1990 &Hantar, 1990).

Masajid Formation: the Masajid Formation in south west Abu Sennan area is composed of dolomitic limestone with shale streaks. The Masajid Formation is of Middle Jurassic age callovian (Norton, 1967).

Alamein Formation: In the study area, the Alamein Formation is consisting of dolomite with some shale interbeds, deposited in a shallow marine environment. It conformably overlies the shale and sandstone of the Alam El Bueib Formation (Issawi et al., 1999).

Dahab Formation: The Dahab Formation is of Aptian to Early Albian age the Dahab Formation is consisting of grey pyritic shale with siltstone, sandstone and limestone interbeds (Said, 1990 and Issawi et al., 1999).

Kharita Formation: Cretaceous (Barakat, 1982) The Kharita Formation consists of fine laminated sandstone, siltstone and shale intercalations of shallow marine environment and upper Kharita consists of sandstone, separated by shally and silt.

The Bahariya Formation; (Said, 1962, Norton 1967, Soliman & El Badry, 1980) The Bahariya Formation in south west Abu Sennan sandstone, shale and silt .the Bahariya sandstones are the main gas and /or condensates pay in the south west Abu Sennan area but higher than oil water contact.

Abu Roash Formation: (Aadland, Hassan, 1972, Gezeery and Oconner, 1975) in the study area the Abu Roash Formation is informally subdivided into several members which are termed alphabetically from (A to G). The members C, E and G are mainly fine clastics the members A, B, D and F are predominantly limestone with argilleous intercalation. Abu Roash Formation is of Turonian-Coniacian age and attains thickness up to 500 m in the south west Abu Sennan area and characterizes by a considerable percentage of the oil discovery reserves. It conformably overlies the Bahariya Formation and unconformably underlies the Khoman Formation.

Khoman Formation: is the Santonian to Mastrichtian age. Khoman Formation is composed of two intervals by (Aadland & Hassan, 1972)

1- Upper part consists of Cherty Limestone.

2- Lower part consists of Shale, silt and argillaceous limestone

The total thickness of Khoman Formation between 250-300m.

The Cenozoic rock units are divided from base to top, as follows:

Apollonia Formation: (EGPC, 1972) this Formation is mainly formed of limestone with shally and cherty interbeds near the top.

Dabaa Formation: (Norton, 1992) Dabaa Formation in the study area is composed of shales with some glauconitic, sandy limestone interbeds of shallow marine environment. It rests conformably on the Apollonia Formation and underlies the Moghra Formation. The Dabaa Formation in the study area is recorded in the all studied wells.

Moghra Formation: (Said, 1962)The Moghra Formation in the study area consists of light-colored sandstone, interbedded soft shales and deposited in shallow marine environment to lagoonal passing up into fluvial deposits. It rests conformably over the Dabaa. This formation was recorded in all wells with changeable thicknesses and almost the same lithology.

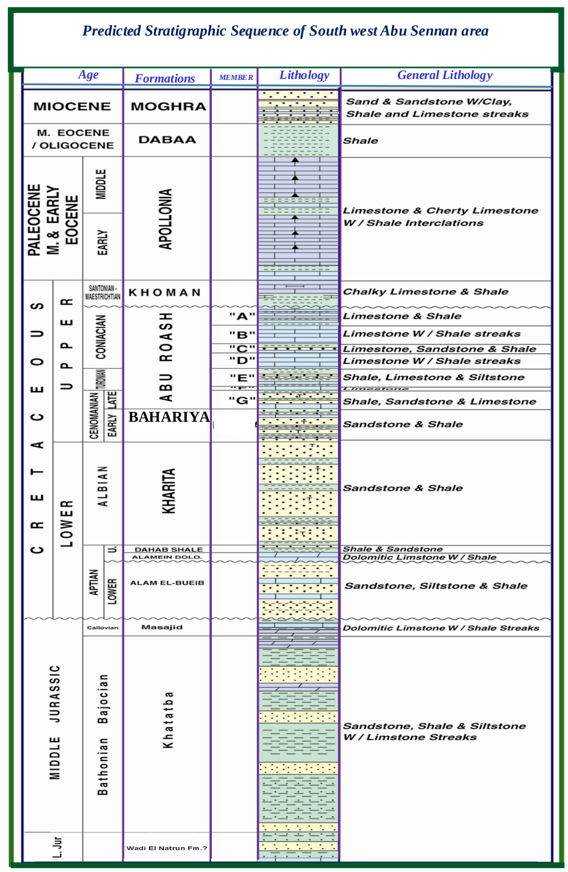

Figure (2): General stratigraphic succession of Abu South west Abu Sennan (SWS) area after (GPC, 2014).

III. PETROPHYSICAL RESERVOIR CHARACTERISTICS:

III. 1. Available Well Logs:

The available well-log data used in this work are in the form of Gamma-Ray, Porosity (Density and Neutron) and DLL (deep and shallow) Resistivity logs.

The cut offs used for the Abu Roash C of south west Abu Sennan area as follows: effective porosity 10%, volume of shale 40% and water saturation 60%. The (Techlog 2011.1) software mark of Schlumberger was used for petrophysical analysis.

III. 2: Petrophysical parameters of Abu Roash C Member:

III. 2.1: Gross sand of the Abu Roash C Member:

Fig. (3) Illustrates the distribution of the gross sand in the area where it is observed within the range of 0.1m – 2.1 m maximum value at sws-31 and decreases to the north eastern part of Field at SWS -10 well. The highest gross sand is distributed at the southeastern and central parts of the area and decreases to the northeastern and southwestern parts of the study area.

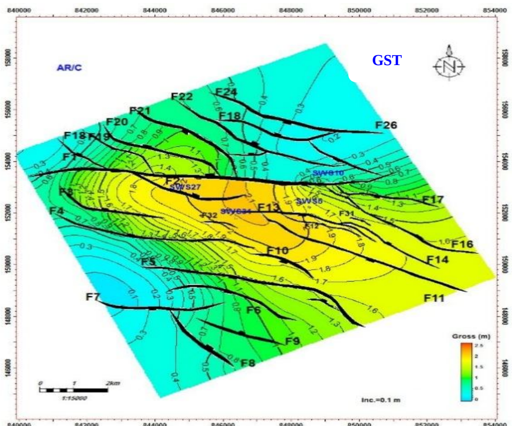

Figure (3): Gross sand Thickness (GST) map of the Abu Roash "C" Member.

III. 2.2: Abu Roash Net pay thickness distribution map:

Fig. (4) the net pay thickness is observed within the range of 0-2m which is restricted to the northwestern and central part of south west Abu Sennan field with the maximum value at sws-31 and decrease to the north eastern part of field at SWS -10 well. The Well SWS 27 is not found net pay thickness due to a fault in Abu Roash "C" Member. This distribution pattern indicates that the hydrocarbon potential of the Abu Roash "C" Member is promising in the central and southwestern part of the study area.

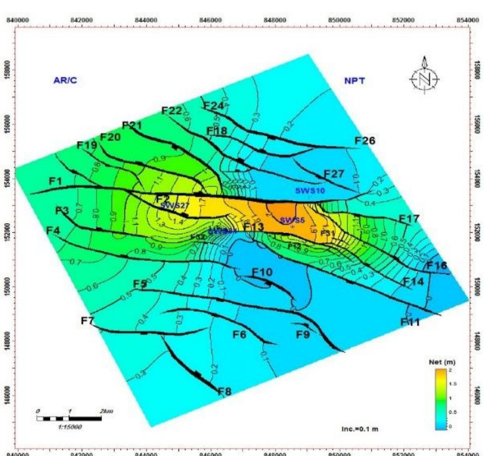

Figure (4): Net pay Reservoir (NPRT) Thickness Map of the Abu Roash "C" Member.

III.2.3: Shale content of the Abu Roash C Member:

Fig. (5) Illustrates the distribution of the shale content (Vsh) in the area, where it is observed

Within the range of 12-42%. The highest shale content distributed at the northern part of the area and decreases to the southern and central parts of the study area. The Well SWS 27 don't contain shale content due to fault in Abu Roash "C" Member.

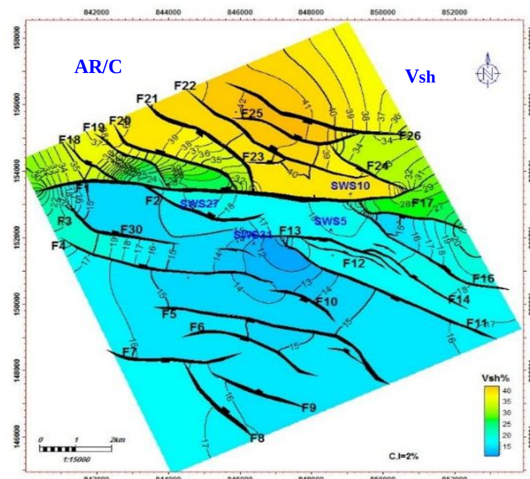

Figure (5): Shale Content (V_{sh}) Map of the Abu Roash "C" Member.

III. 2.4: Porosity of the Abu Roash C Member:

Fig. (6) Illustrates the distribution of the porosity in the study area. The frequent porosity occurrences are observed within the range of 10-32%. The highest porosity distribution is found at southern and central parts of the study area, whereas the lowest porosity distribution is found at the northern part of the study area.

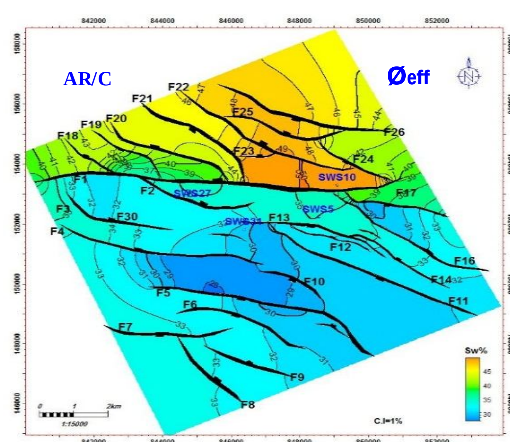

Figure (6): Effective Porosity Map of the Abu Roash "C" Member.

III. 2.5: Water saturation of the Abu Roash C Member:

Fig. (7) Illustrates the distribution of the water saturation (Sw) in Abu Roash "C" Member in the area, where it is observed within the range of 28-51%. The highest water saturation value 50% is recorded in SWS10 well in the northeastern part of the study area. Whereas the lowest saturation value 30% is recorded in SWS31 well in the central part of the south west Abu Sennan (SWS) field. The general trend of water saturation increases in the northern part direction and decreases toward the southern and central parts of the south west Abu Sennan (SWS) area.

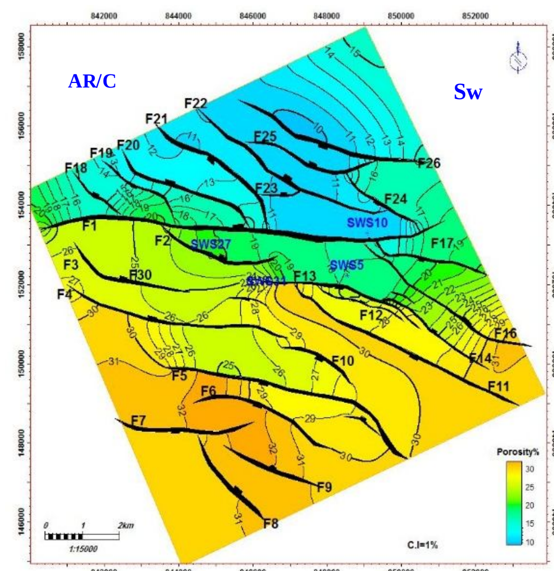

Figure (7): Water saturation map of the Abu Roash "C" Member.

Results of CPI evaluation of the Abu Roash "C" Member:

Fig. (8) The studied interval of SWS-31well. Extends between 1650m and 1698m and constitutes the Abu Roash C Member the fluids used in this model were water and oil. The Gamma ray curve show a thick clean sand section penetrated in the well. The low Gamma ray reading indicates the presence of shale streaks or the highly argillaceous sandstone interval. The resistivity curve indicates the presence of hydrocarbon between LLD curve and MSFL curve. It also indicates that the section have a good Permeability.

Reservoir	Net (m)	Øeff (%)	Vsh (%)	Sw %
AR/C Mb.	0-2	10-32	12-42	28-51

Petrophysical analysis for Abu Roash "C" Member in the SWS -5 well:

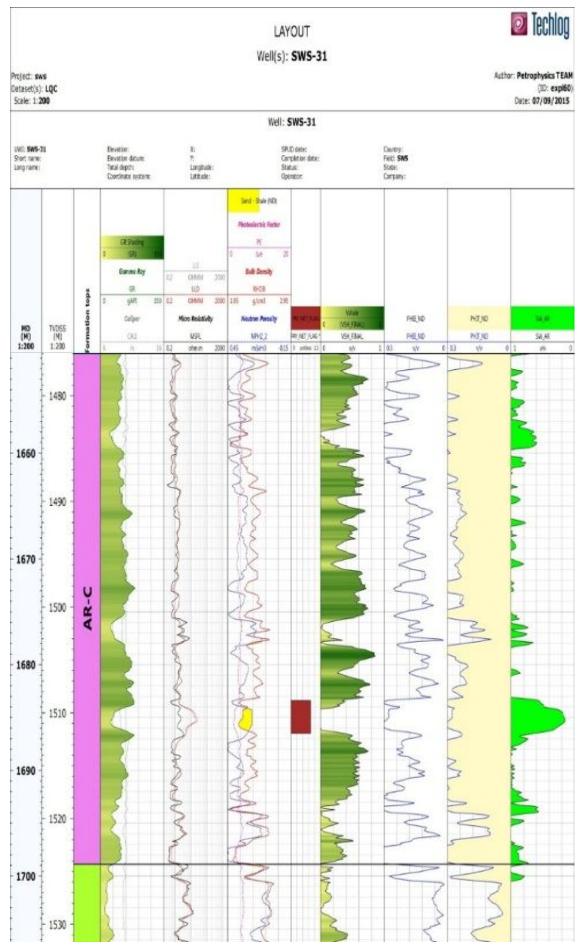

Figure (8): CPI evaluation of the Abu Roash C Member.

The Neutron Porosity -Bulk Density Cross plot: From Neutron Porosity-Bulk Density Cross plot can be detected in AR/C formation lithology in 4 Wells; the SWS5, SWS10, SWS27 and SWS31. The main samples is Shale with Limestone and some sandstone. (Figure.9, 10, 11). SWS 10 well is faulted in AR/C Member. The SWS31well is very good facies in this area more than any other well in the 4 wells (Fig.14).

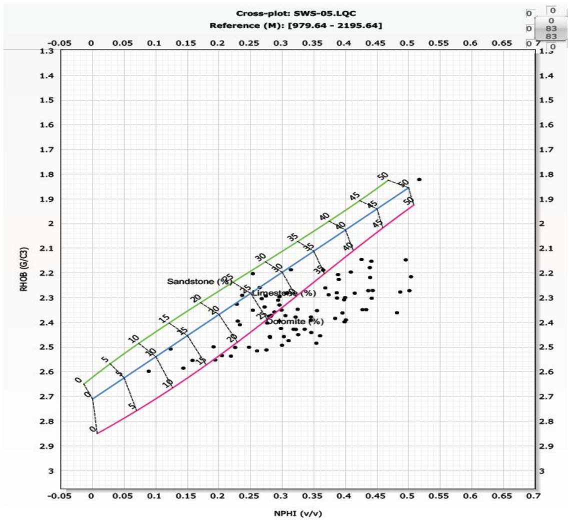

Figure (9): Neutron Porosity vs. Bulk Density Cross plot through (SWS5) well in Top AR/C.

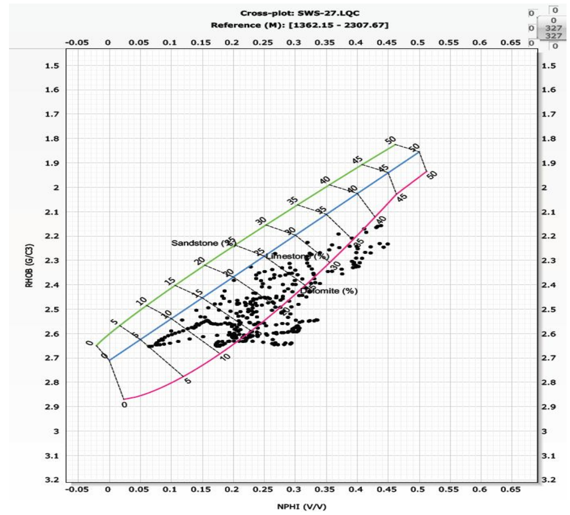

Figure (11): Neutron Porosity vs. Bulk Density Cross plot through (SWS27) well in Top AR/C.

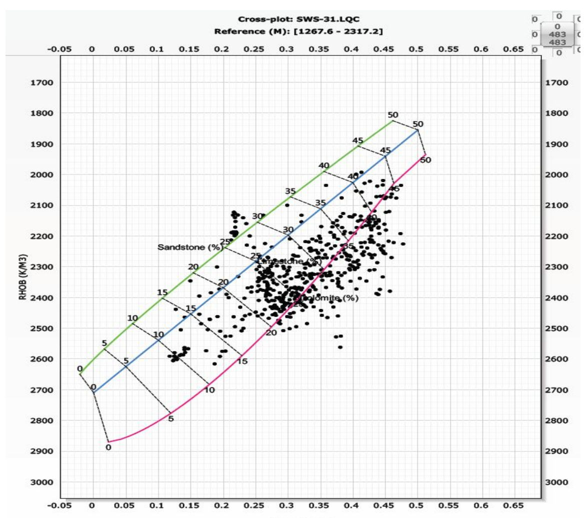

Figure (10): Neutron Porosity vs. Bulk Density Cross plot through (SWS10) well in Top AR/C

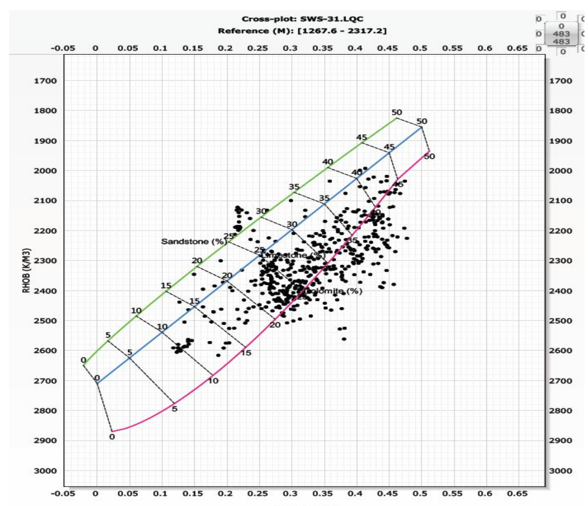

Figure (12): Neutron Porosity vs. Bulk Density Cross plot through (SWS31) well in Top AR/C.

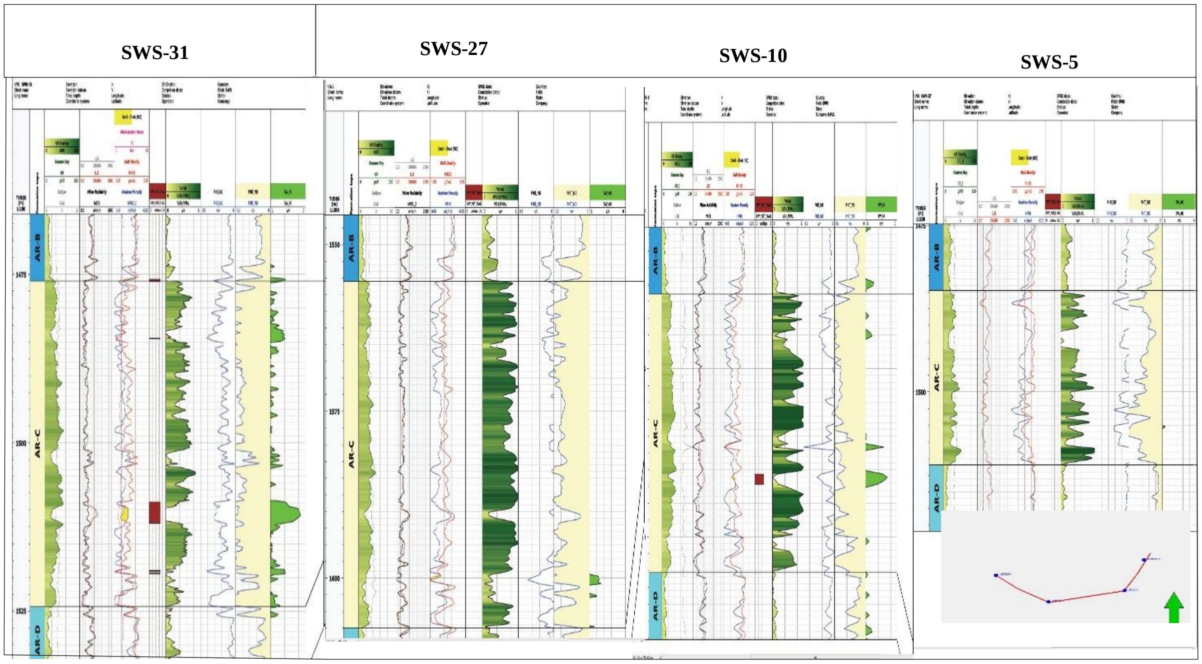

Figure (13): Correlation between SWS-5, SWS-10, SWS-27and SWS-31 on top AR/C Member.

From correlation between 4 wells (SWS 31, SWS27, SWS10, SWS5) (Figure .13) the sand facies in Abu Roash C Member increases in the SWS31 direction (Western and North Western in the study area) and decreases in the SWS 5 (Eastern part in the study area).

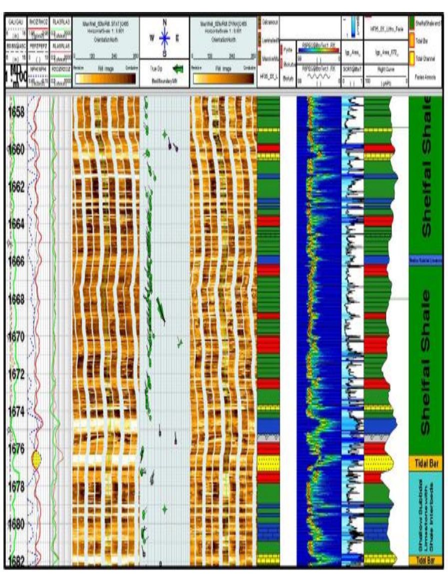

Figure (14): Abu Roash C member (HF35/4) is described as a single unit (after Schlumberger study, 2014).

FMI:

This member commences with a unit of inter-bedded shale and limestone of equal thicknesses. They are topped by thin calcareous sand. Interpreted as a tidal bar (lower) due to its coarsening up GR log motif. The inter-bedded shale and limestone reconvene atop the tidal sand bar up to another tidal bar (upper) consisting of a calcareous sand and massive limestone (Fig .14)

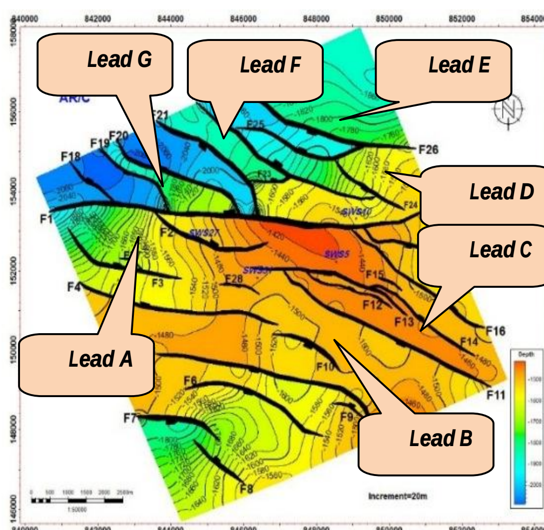

Figure (15): Depth structural contour map on the top AR/C of South west Abu Sennan area, Western Desert, Egypt Show leads.

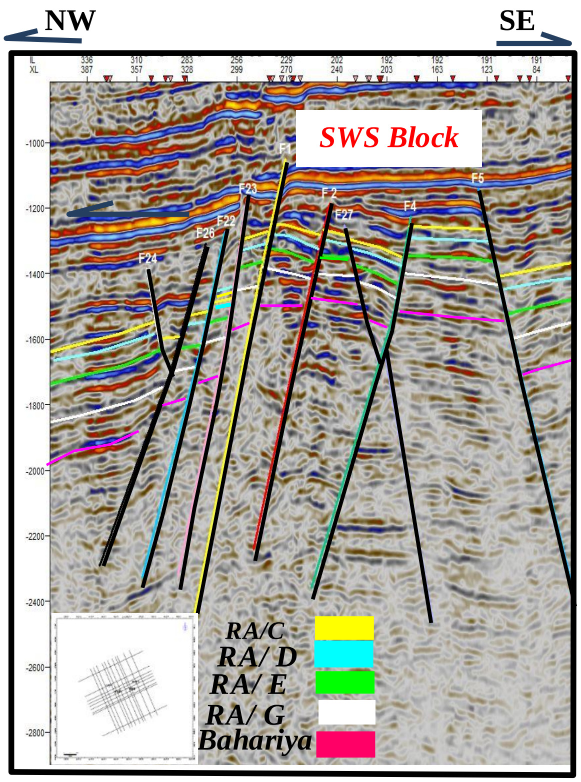

Figure (16): Seismic section shows the basin and the highest area of the South west Abu Sennan area.

SUMMARY AND CONCLUSION

The last and most important element in the hydrocarbon trap is the reservoir rock. Evaluation of the reservoir rock parameters was only possible through using well log data sets available to this study. Properties for the reservoir encountered by the wells drilled in the study area were obtained from detailed petrophysical analyses. Petrophysical analyses conducted for four wells drilled in the study area resulted in understanding of the reservoir rock parameters for reservoir of interest. These petrophysical properties were mapped and helped in the delineation of sweet spots for the reservoir horizon, which in turn helped, along with other elements, in the promotion of the leads interpreted from the seismic data into prospects. The results of the petrophysical analysis indicated the presence of oil-bearing sandstone reservoirs. Drilling more wells in these areas could result in adding more reserves in south west Abu Sennan area.

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