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RESERVOIR CHARACTERIZATION OF MIOCENE "REEFAL LIMESTONE ", AL-HAMD-2 WELL IN AL-HAMD FIELD, GULF OF SUEZ, EGYPT

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توصيف خزان الميوسين " الحجر الجيرى المرجانى " فى بئر الحمد-٢ بحقل الحمد – خليج السويس – مصر

الخلاصة: يقع حقل الحمد للبترول فى الجانب الغربى من خليج السويس ويعتبر عضو حمام فرعون من عصر الميوسين الأوسط خزاناً بترولياً جيداً لهذه الدراسة وتهتم هذه الدراسة بتفسير المعطيات الجيولوجية لتقييم آفاق الإحتمالات الهيدركربونية لخزان الحجر الجيرى المرجانى لتكوين بلاعيم وعصر الميوسين السفلى فى البئر الحمد-٢ بحقل الحمد وقد قامت الشركة العامة بعمل الخرائط التركيبية للشكل التحتسطحى على أساس مضاهاة نتائج تسجيلات الآبار والتفسير السيزمى. وقد تضمنت هذه الدراسة تحديد عدد من الخصائص البتروفيزيائية لخزان الحجر الجيرى المرجانى لعصر الميويسن مثل المحتوى الطفلى للخزان والمسامية الفعالة ونسبة التشبع بالهيدروكربون بالإضافة الى معرفة السمك المغل للخزان، بناءً على نتائج هذه الدراسة فإننا نرى أن التقييم التحتسطحى ونتائج التقييم البتروفيزيائى يمكن أن يحدد القدرة الإنتاجية من الهيدروكربون لخزان الحجر الجيرى المرجانى بعصر الميوسين الاوسط وطبقات الميوسين السفلى لحقل الحمد بخليج السويس. وعلى ضوء ذلك فإننا نوصى بحفر المزيد من الأبار الإستكشافية والتقييمية ومن ثم التنموية للتعرف على إتجاهات إمتدادات هذا الخزان الجيرى فى مناطق أخرى لإضافة إحتياطيات بترولية جديدة بمنطقة خليج السويس.

ABSTRACT: *Al-Hamd Oil Field is located at the western side of the Gulf of Suez. The Middle Miocene Hammam Faraun Member of Belayim Formation and lower Miocene is considered to be a good reservoir in the study area.*

The present work mainly deals with the interpretation of geological data to evaluate the hydrocarbon potentials of the Miocene reefal limestone reservoir in Al-Hamd-2 well of Al-Hamd Oil Field.

Structural maps by GPC are constructed to study the subsurface configuration of the study area based on well-log correlations and seismic interpretation. Wire-line logs, from the drilled well in the study area are interpreted for petrophysical evaluation. Reservoir rock analysis includes the main reservoir parameters, namely the shale content (Vsh), effective porosity (Øe), water and hydrocarbon saturation (Shr &Sw), and net-pay thickness..

Using the integrated subsurface and petrophysical evaluation, the hydrocarbon potential of the Miocene reefal limestone in Al-Hamd Oil Field is determined.

INTRODUCTION

AL HAMD offshore field is located in the western side of the Gulf of Suez and belongs to the central province of the Gulf rift, and located in the Southern part of Amer offshore development lease, and to the east of Bakr field about 2Km from the western coast of Gulf of Suez (Fig. 1).

Structure setting:

The Structural model for Miocene sediments for Al –Hamd oil field was Constructed based on reviewing the geological data obtained from the drilled Al-Hamd Wells and the Seismic interpretation Khalil, B., and Meshrif, W. (1988) Winn Jr. et.al., (2001) .

The geological and geophysical data illustrate that the structure model of Al- Hamd Blocks is a part of the regional structural frame work of the Gulf of Suez, it is described as a tilted horst block & step blocks. Bounded by set of normal major faults trending to NW-SE. (Clysmic trend) and dissected by cross elements Milad, Ph. (1969), Moustafa, A.M. (1993) (Fig. 2).

Scope of study:

Detemined the petrophysical characterization of middle Miocene Reefal limestone in Al-Hamd field by using complete peterophysical evaluation for the reservoir and supported by conventional core photos which carried out by GPC and determind the depositional environement of the carbonate reefal limestone reservoirs by using the data intgration between the electrical logs and core photos.

METHODOLOGY

Log analysis of Miocene reefal Limestone reservoire performed by using Tech.Log softwear and conventional core photos which carried out by GPC proved the pesence of good quality reservoir which can follow up this reefal bulid up reservoirs in other areas Badawy, M. (1984). Already these techinques have been already invesitgated by GPC, and applied in oil industry. Carbonate reservoir appears as the different forms of log curve shapes. It was found that carbonate intervals are characteristically distinguishable by gamma ray and resestivity curves in which the carbonate interval is different (Fig. 3).

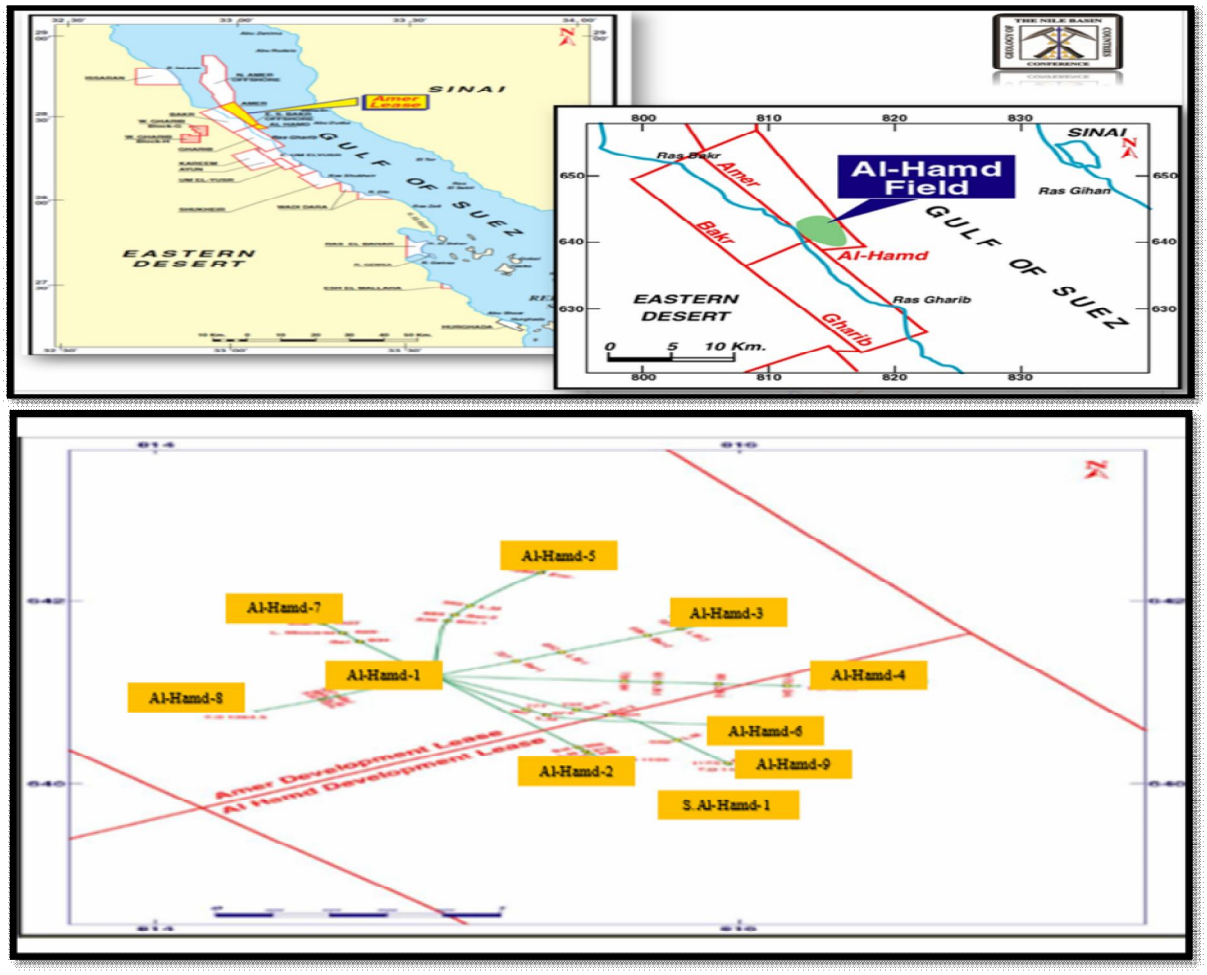


Fig. 1: Location map of study area and wells (GPC report, 2008).

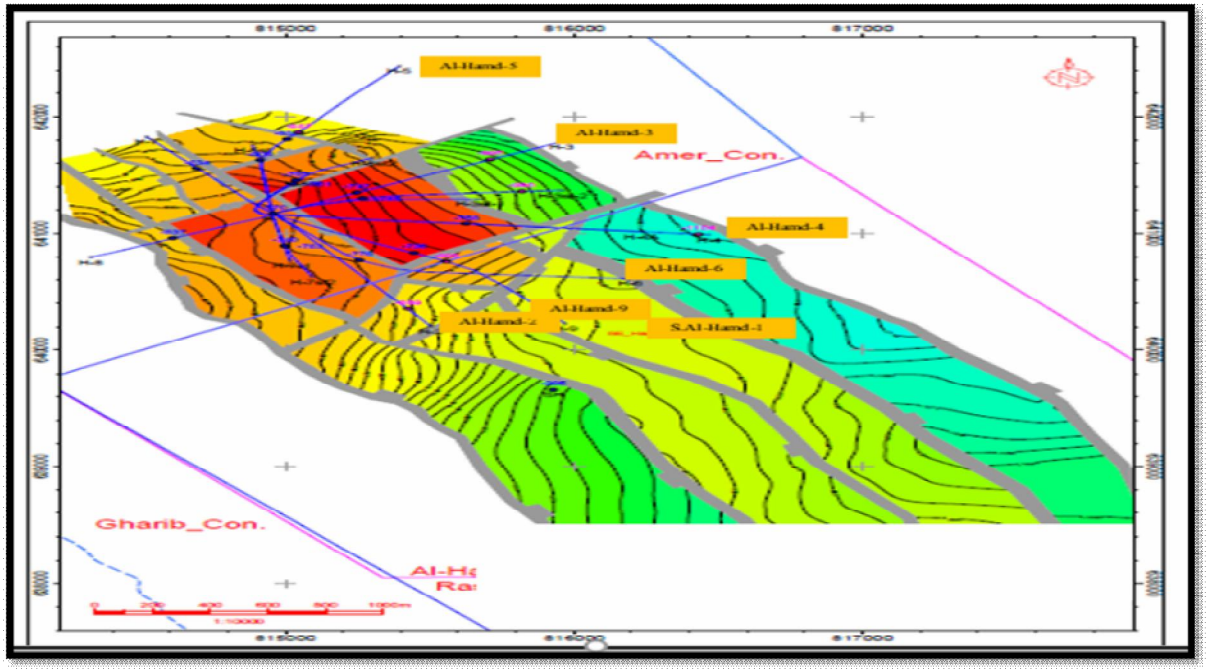


Fig. 2: Depth structure contour map on top Belayim Fm. (GPC report, 2008).

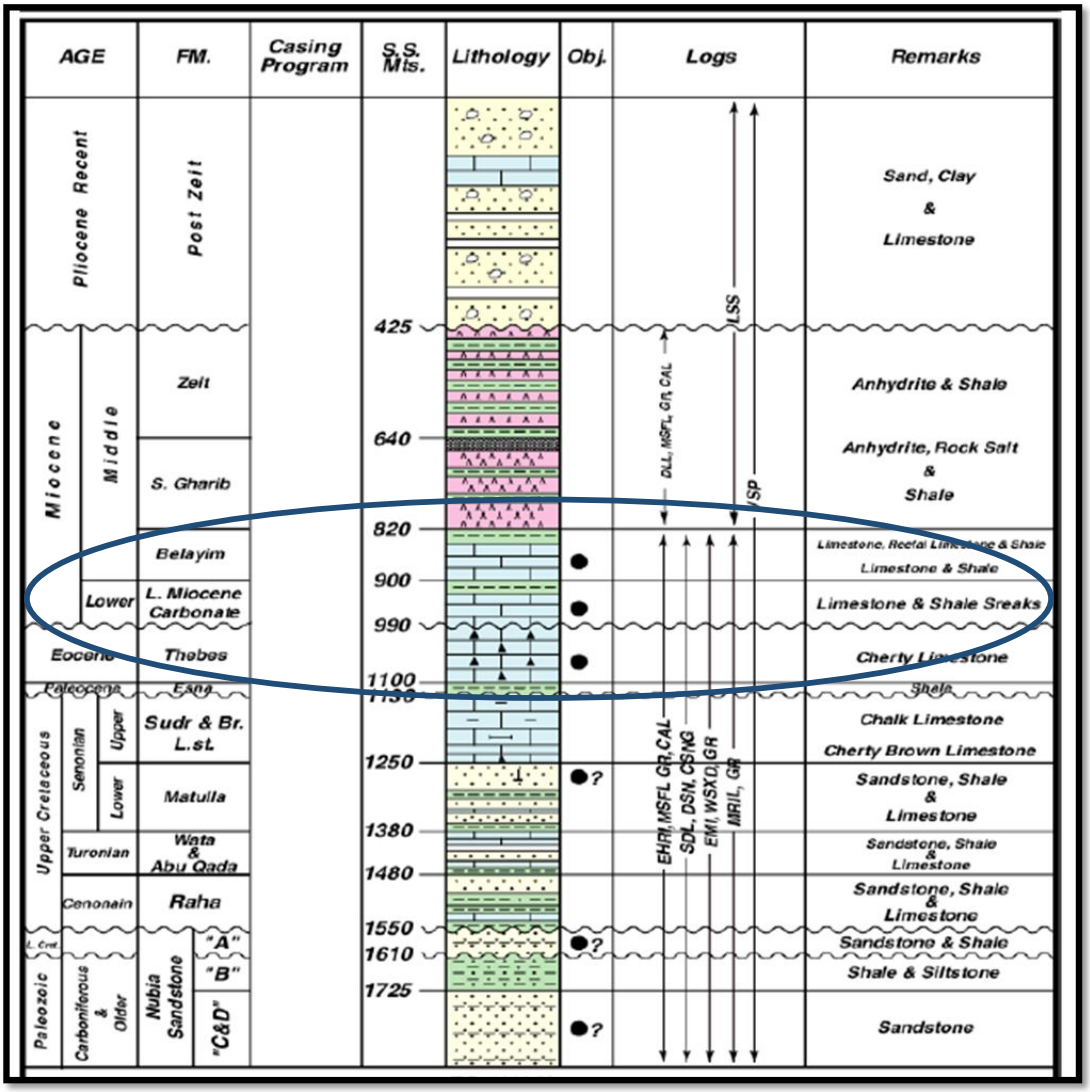


Fig. 3: Al-Hamd -2 strtigraphic succession and the circle on our reservoirs After (GPC report, 2008).

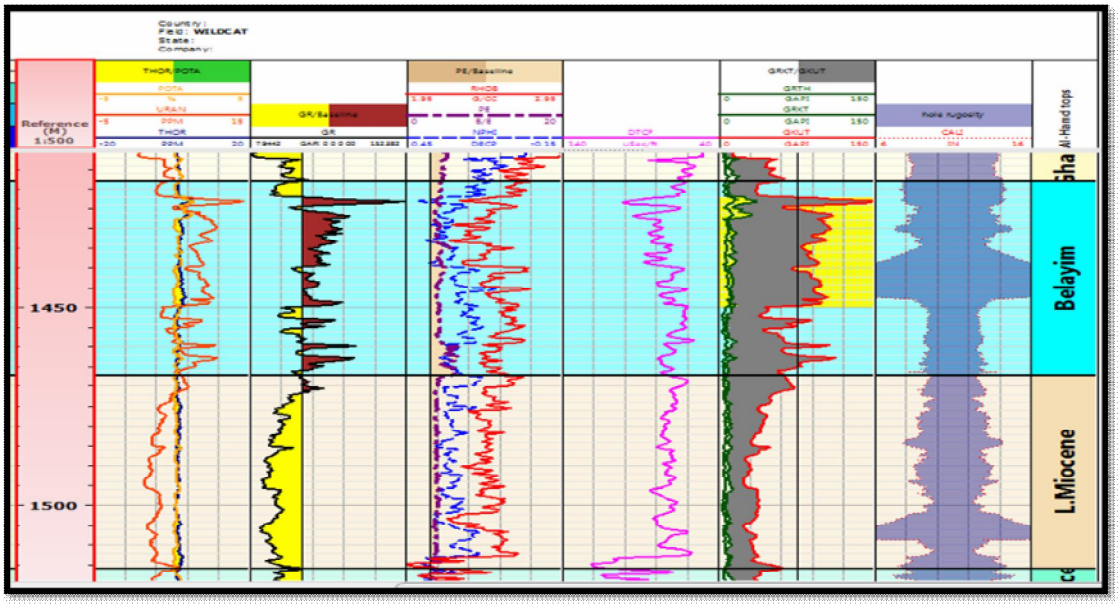


Fig. 4: The layout of the target formations Belayim and L. Miocene.

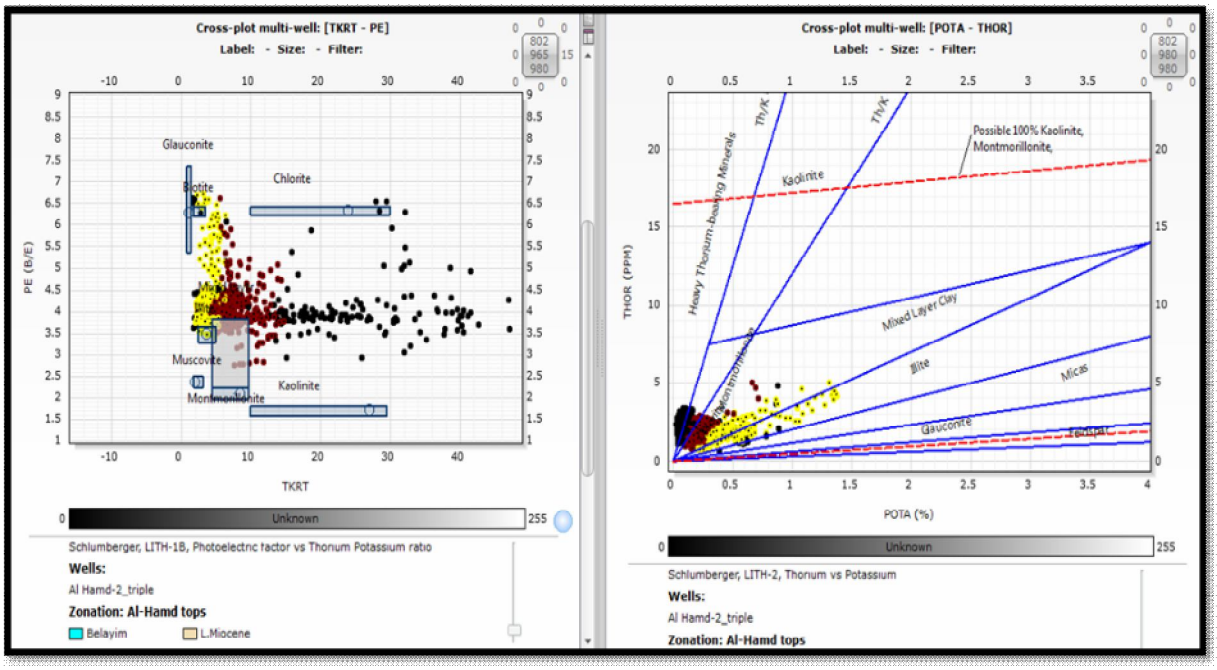


Fig. 5: The clay identification crossplots of the target formations Belayim and Lower Miocene.

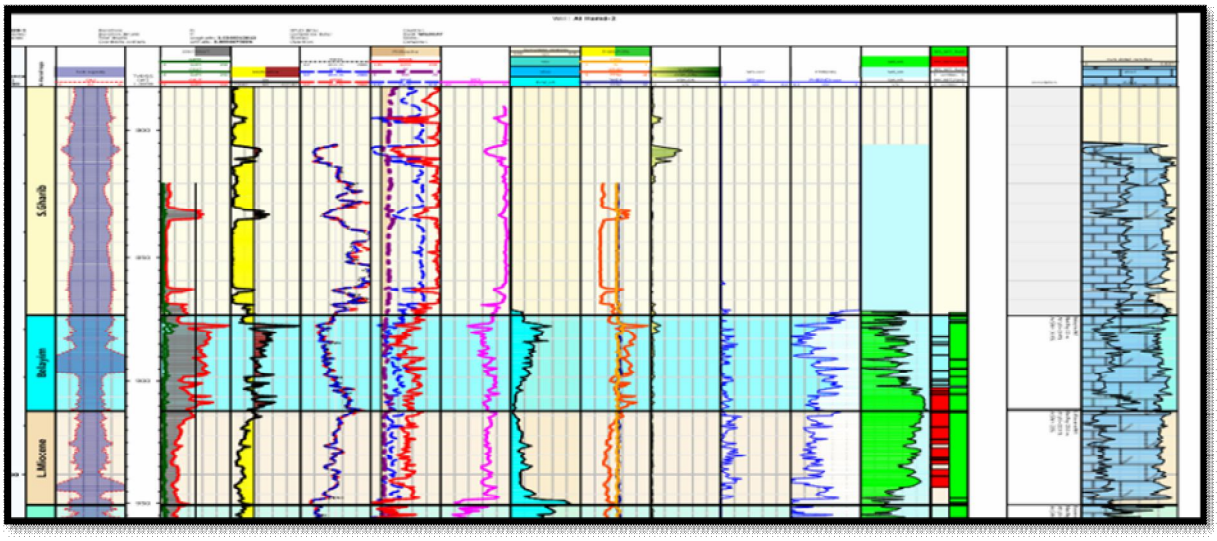


Fig. 6 : The results of petrophysical evaluation of Belayim Formation and Lower Miocene carbonates EL Kadi et.al. (2009).

In Table 1 are given the results of the petrophysical evaluation in well Al-Hamd-2.

Zone	Flag Name	Net Pay m	Av. Shale Volume	Av. Porosity	Av. water Saturation
Belayim Nullipore	Pay	10	0.021	0.194	0.14
L.Miocene	Pay	26	0.019	0.21	0.20

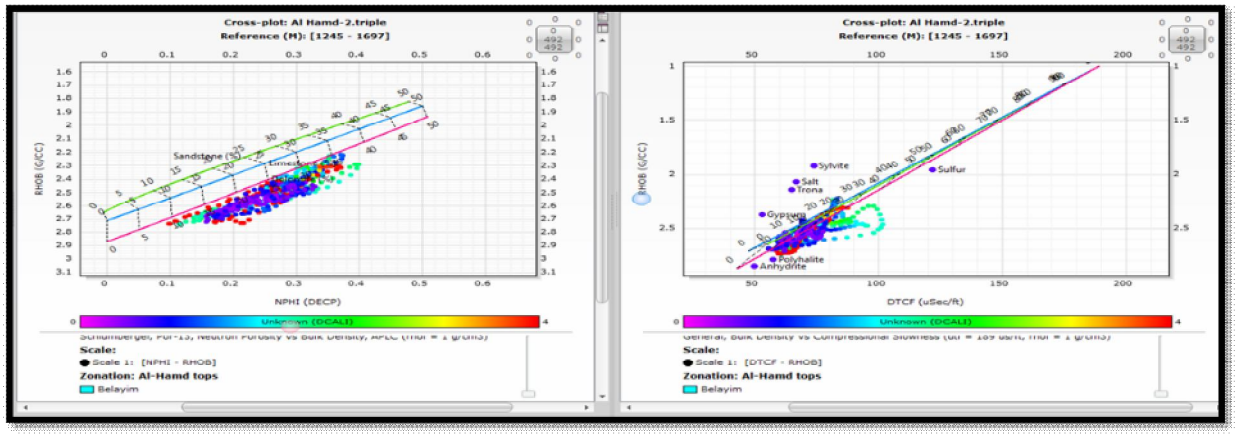


Fig. 7: The RhoB-NPHI and RHOB vs DT crossplot "with DCALI on the third axis" of Belayim Fm"Nullipore reservoir".

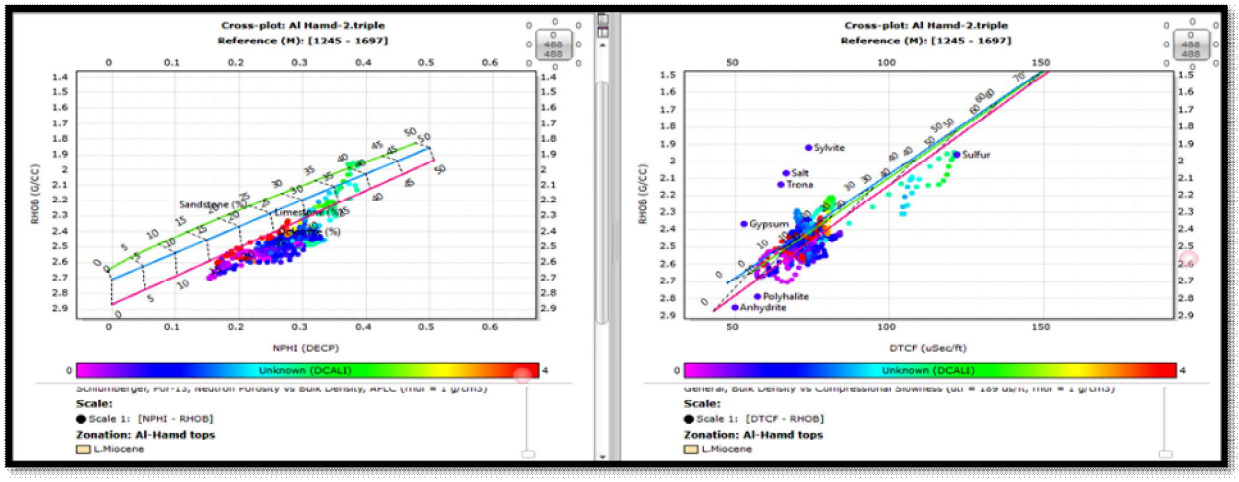


Fig. 8: The RhoB-NPHI and RHOB vs DT crossplot "with DCALI on the third axis" of Lower Micene Reservoir.

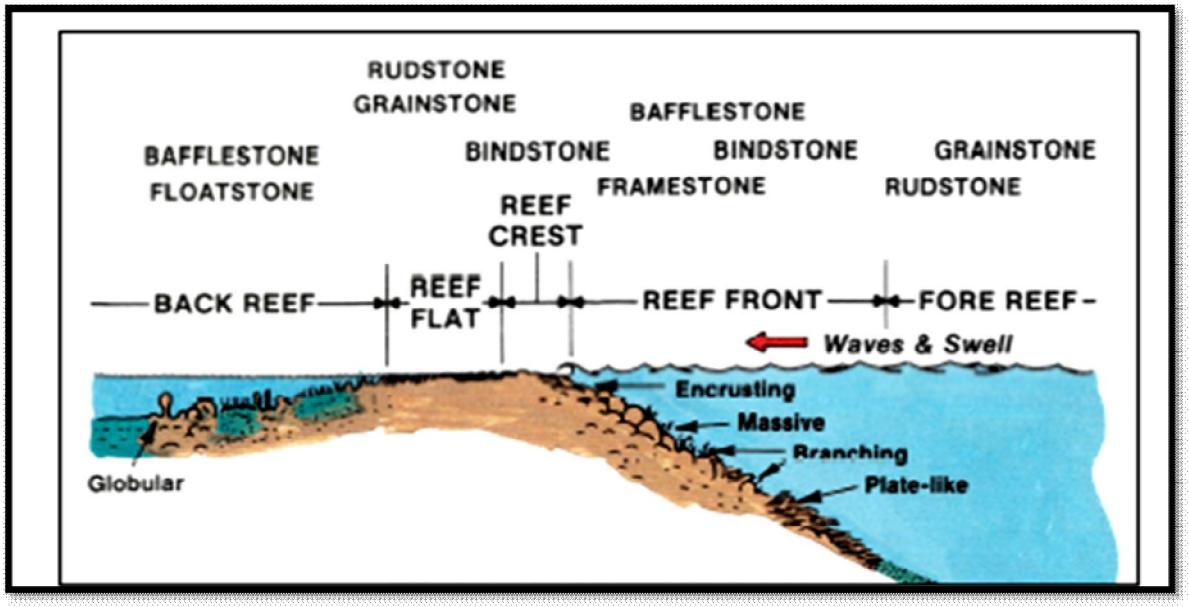


Fig. 9: The reefal limestone depositional environment.

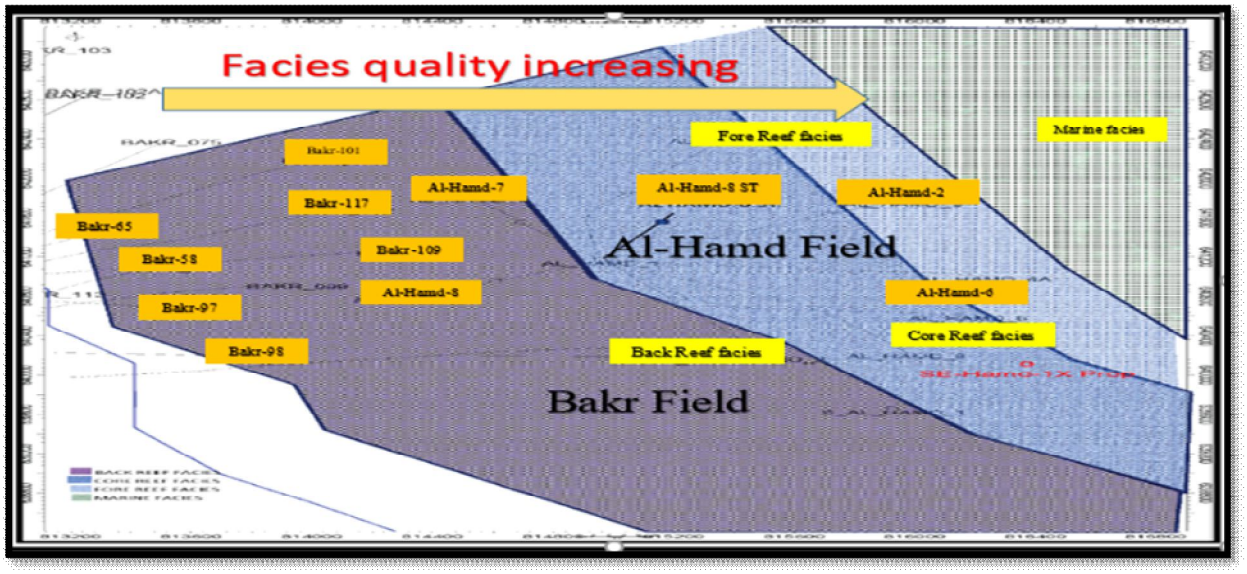
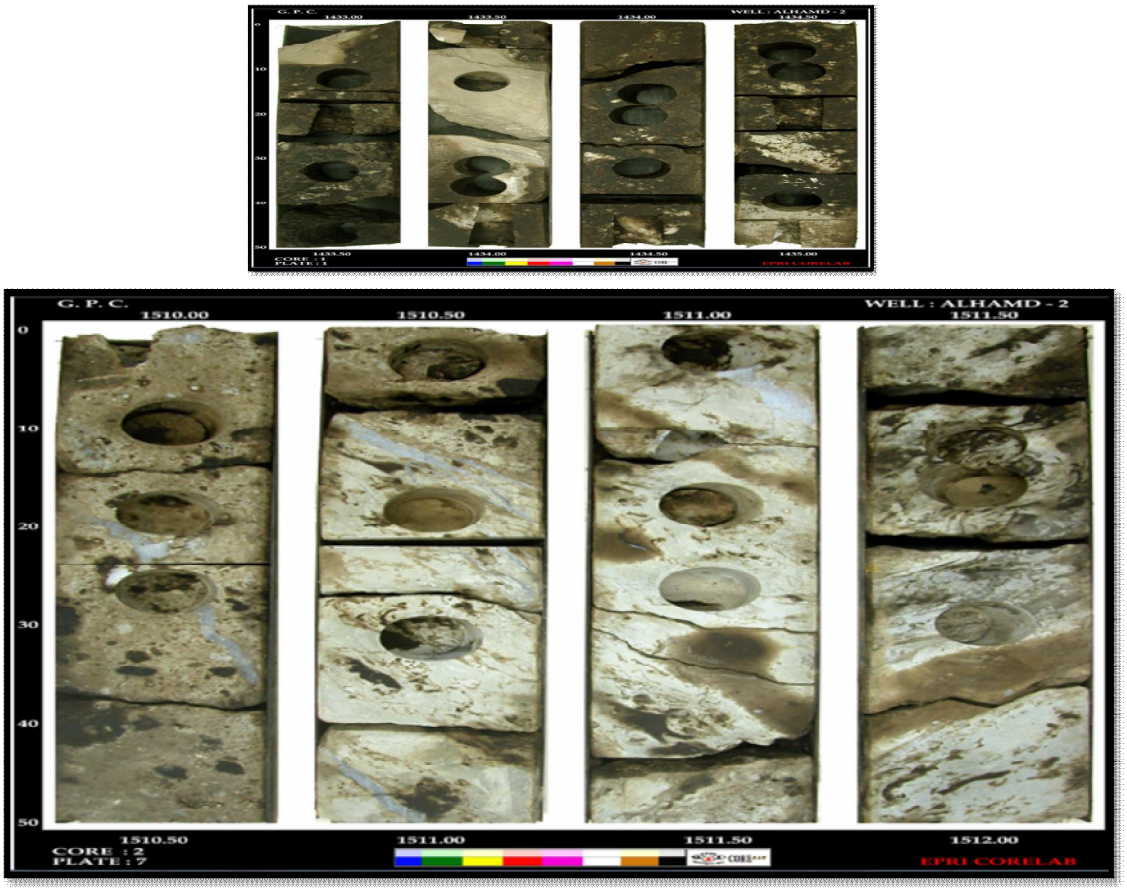


Fig. 10: The facies distribution reefal limestone from west to east direction.



Figs. 11: The core photos of core sample from A-Hamd-2 well (GPC, 2006).

FORMATION EVALUATION OF MIOCENE CARBONATE

Clay type identification:

The primary Mud log description provides info about presence of Limestone with no shale beds.

The washout and hole rugosity most probably have another reason for it except the shale effect, and the probability of presence of a certain type of clay mineral that causes washout "e.g. Smectite" is less likely Abd El Khalik, M.M. et.al. (1999) (Fig. 4).

The track 5 shows the reason of high GR is the presence of Uranium and not because of K and Thorium "red curve is the SGR and green curves are GR count for Th and K.

The points is located mainly in K vs Th towards the origin which indicates the low concentration generally of clay minerals in the main lithology "i.e. Lst" of the two formations.

The clay contents, with their very low concentration, is mainly towards Illite area "yellow points".The brown points represents some mixed clay illite-montmorillonite clay.

The black points show some heavy minerals (Fig. 5).

Which show high percentage of porosity value and low water saturation values with very low shale content the well results give positive reflect that there are two oil bearing reservoirs from top to bottom:

1- Belayim Fm. "Nullipore reservoir":

It is represented by Nullipore rock (reefal, vuggy limestone) with good porosity and low water saturation.

2- Lower Miocene reservoir:

It is composed of limestone vuggy and reefal in part, with good thickness and porosity (Fig. 6) (table 1).

Belayim Formation "Nullipore reservoir":

The points are concentrated in a trend close to the dolomite line showing possibility of some heavy minerals e.g anhydrite.

The right handed plot shows the same view of concentration of the points in dolomite zone towards the matrix point (Fig. 7).

Lower Miocene Reservoir:

The points are concentrated in a trend close to the dolomite line and showing extending the points toward the limestone area (Fig. 8).

Depositinal Environment:

Depositional environment of the studied reservoirs of the Miocene reefal limestone is marginal reefal environment (Back-Reef) deposited on submerged paleohights parallel to shore-Line and the seawater salinity characterized as brackish to rarely hypersaline and the type of paleo-climate appears as semi-arid with short-lived arid intervals through the shore line changes according to the tidal zone of the Gulf of Suez, Mekkey, M.A. (2007) (Fig. 9).

According to sedimentlogical and litho-facies analysis we found that, the western part of Al-Hamd oil field is dominated by bad facies and its quality (Sabkha to Back-reef), However when going farther to the east the carbonate build-up quality increases as shown in reefal facies distribution El Kadi, H. et al. (2008) (Fig. 10).

Core Photos:

indicating a lot of fracturing and vuggs in the limestone reservoir and oil impregnated also presence of anhydrite nodules in the photo which indicating to back reef to sabkha paleo setting and also presence of dolomite or dolostone due to dolomitization Walli, M. M., (1984**)**: representing back reef to reef falt and fore reef paleo setting as reef build up (GPC report, 2005) (Fig. 11).

CONCLUSION AND RECOMMENDATIONS

The present study reveal that the reefal limestone reservoir in Al-Hamd field is very promising reservoir because its petrophysical characters indicating high porosity and permeability and high hydrocarbon saturation due to fracturing and the presence of vuggs in the lithology of the reservoir in addition the presence of dolomite indicates a secondary porosity in the reservoir rock which increases the total porosity. the depositional environment determined that the reefal build up is marginal reefal environment (Back-Reef) deposited on the submerged paleo heights parallel to the shore-Line,this reefal limestone is a highly productive reservoir as supported by core photos performed by GPC.

The following recommendations can be given as well:

1- Evaluate and test the extension of the reefal limestone of the Belayim Fm."Nullipore" and Lower Miocene reservoirs towards the south and the north directions of Al-Hamd field.

2- Drill more wells to prove the extension of these carbonate reservoirs "reefal limestone" over the area as well as their petrophysical characteristics of this reservoirs to add more hydrocarbon reserves and increases the petroleum productivity.

3- Due to the lack of enough data the above characteristics of the reefal limestone reservoirs could be considered as tentative data.

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