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PETROPHYSICAL LABORATORY INVESTIGATIONS OF ABU ROASH "C" MEMBER IN BED -15 FIELD, WESTERN DESERT, EGYPT

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الخلاصة: تتعامل هذه الدراسة مع تحليل العينات اللبية لعضو أبو رواش Roash "C" فى بئرين: BED 15-3 و BED 15-7 ، وتتناول الدراسة خواص هذا الخزان من ناحية: المسامية الفعالة وكثافة الحبيبات و تشبع الصخور بالهيدروكربونات والنفاذية، حيث تسمح المسامية الفعالة بنقل السوائل (زيت وغاز) فى كافة أنحاء فراغات المسام المرتبطة ببعضها.

فى بئر BED 15-3 وجد من التحليل الإحصائى لبيانات المسامية للعينات المختارة لخزان أبو رواش Roash "C"، أن قيم المسامية تتفاوت من ٢,١ % إلى ١٩,٨ % بقيمة متوسطة ١٨,١ %، من الناحية الأخرى تتفاوت مسامية نفس الخزان فى بئر BED 15-7 من ٢,٣ % إلى ٢٠,٥ %.

تتفاوت أيضاً قيمة النفاذية من ٠,٠٢ ملى دارسى و١٠٥٢ ملى دارسى فى بئر BED 15-3 بقيمة متوسطة ٥٥٠ ملى دارسى، بينما تتفاوت بين ٠,٠٣ ملى دارسى و٦٦٨ ملى دارسى للعينات المختارة فى بئر BED 15-7 (بقيمة متوسطة ٣٣٤ ملى دارسى).

تشير بيانات إشباع الصخر بالماء بأن فى بئر BED 15-3 يتفاوت القيمة من ١٦,١ % إلى ٩٦,٤ %

من الناحية الأخرى، يشير التحليل الإحصائى أن تشبع الصخر بالماء فى عضو أبو رواش Roash "C" فى بئر BED 15-7 تتفاوت قيمته من ٥,٤% و ٦١,٩%.

إن االمقارنه بين المسامية التى حصلنا عليها من كلا من تسجيلات الآبار وتحليل العينات اللبية الروتينية لعضو أبو رواش Roash "C" فى البئرين BED 15-7 وفى BED 15-3 تشير بأن العلاقة نسبية ومتوافقة تقريباً. أيضاً، وجد أن عضو أبو رواش Roash "C" فى الآبار المدروسة يمكن اعتباره عضواً متباين الخواص.

ABSTRACT: *This study deals with the core analysis data of the Abu Roash "C" Member in two wells : BED 15-3 and BED 15-7 wells. The studied parameters of the reservoir rock are the effective porosity, grain density, permeability and hydrocarbon saturation. The effective porosity allows the transportation of the fluid (oil and gas) throughout the interconnected pore spaces and the fluid permeability controls this process.*

In well BED 15-3, it was found that from the statistical analysis of porosity data for the selected samples of Abu Roash "C" Member shows that, the porosity values vary from 2.1 % to 19.8 % with an average value of 18.1%. On the other hand, the porosity of the same reservoir in well BED 15-7 ranges from 2.3 % to 20.5 %.

Also the permeability value varies from 0.02 md and 1052 md in well BED 15-3 well with an average value of 550 md, while it varies between 0.03 md and 668 md for the selected samples of BED 15-7 well with an average value was 334 md.

The water saturation data is between 16.1 % to 96.4 % in BED 15-3 well, and is between 5.4 % and 61.9% in BED 15-7 well.

The correlation between porosity obtained from the logging and routine core analyses versus depth for the Abu Roash "C" Member at BED 15-3 and at BED 15-7 wells indicates that the relationship is proportional andin good agreement. However, the Abu Roash "C" Member in the studied wells can be considered as a heterogeneous Member.

EXPERMENTAL PROCEDURE

A suite of 22 samples from the studied Abu Roash "C" Member at BED 15 Field were analyzed in Corelab at The Egyptian Petroleum Research Institute to study the petrophysical characterestics.

Porosity:

Porosity is defined as the ratio of the pore spaces to the total volume of the rock, it may be expressed in percentage and / or fraction. The term total porosity is used to describe the ratio of the total pore spaces to the total volume of the rock, where as the term effective porosity is used to describe the ratio of the interconnected pore spaces to the total volume of the rock.

The laboratory measurements of porosity (ϕ□%) were carried out on the rock samples. Each sample is well cleaned and dried. The dried and cleaned plugs were individually placed in the matrix cup of small volume porosimeter (model: Helium Porosimeter 3020-062 - Corelab) which is a type of gas expansion porosimeter that determines the volume by measuring the pressure change of helium in a calibrated volume. Helium at a known pressure from a reference cell of known volume was allowed to expand into the matrix cup with the plug inside, and then the new pressure was monitored . The grain volume of the plug was calculated based on the predictable of Boyle's law (Lerand, 1976; Loucks et al., 1977).

The grain volume of the plug was measured by the DEB-200 apparatus (Mercury displacement) based on Archimedes principle (Ragab et al., 1997) and then the porosity was calculated by the equation:

$(\phi) = (V_b - V_g) / V_b$

where : ϕ = porosity, in fraction.

V_b = bulk volume, in cc.

V_g = grain volume, in cc.

The measurements of rock samples from Abu Roash "C" Member for BED 15-3 and BED 15-7 wells are given in tables 1 and 2.

Grain Density:

The grain density (ρg) of the rock is defined as the mass of a unit volume of the solid phase of the rock. It is controlled by the specific weight of the minerals that form the rock. The grain density can be measured by several methods. In this study the grain density was measured by the following method. The grain density (ρ_g) was calculated by using the grain volume and the dry weight of each plug sample. The grain density was calculated by the equation:

$(\rho_g) = W / Vg$

where :

(ρ_g) = weight of the dry samples , in gm.

W (ρg) = grain density , in gm/cc.

Vg = the grain volume , in cc.

The grain density measurements of rock samples from Abu Roash "C" Member for BED 15-3 and BED 15-7 wells are given in tables 1 and 2.

Permeability:

The permeability of a porous medium to a certain fluid is the capability of that porous medium to transmit that fluid. The evaluation of the permeability is made according to Darcy's law. The permeability is controlled by many factors such as the rock porosity, the effective porosity, the shape and the geometery of the pore spaces, the shape and the geometery of the grain size and the effective post depositional processes. The permeability can be expressed by two units, the old one is the Darcy (D) where one Darcy is defined as the permeability that permits a fluid of one centipoise viscosity to flow at a rate of one cubic cm per second through a cross-sectional area of one cm^2 when the atmospheric pressure gradient is one atmosphere per cm. The permeability can also be expressed in milli Darcy (md) where one Darcy =1000 milli Darcy.

Gas permeability has been performed using the steady-state micropermeameter (model: 302138 micropermeameter Corelab), the dry clean core plug were individually placed in the Hassler holder of micropermeameter at a confining pressure of 400 psi.

Teflon mounted samples were placed in a hydrostatic core holder and confining stress of 400 psi was applied. For a set of differential pressures, the flow rate of dried air through the sample was monitored and used in conjunction with the measured plug length and diameter to calculate the steady-state gas permeability using the following equation:

$K \text{ (air)} = (2000 * Pa * Ma * Qa * L) I (p_1 - p_2)(p_1 + p_2) * A$

where:

K (air) = Permeability, in md.

Qa = Flow rate, in cc / sec at atmospheric pressure.

Ma = Viscosity of air, in cp.

L = Length of core plug, cm.

A = Cross sectional area of core plug, in cm.

p_1 = Upstream pressure, atmospheres.

p_2 = Outlet pressure, atmospheres.

Pa = Atmospheric pressure, atmospheres.

In this study both horizontal and vertical permeabilities were measured:

Horizontal Permeability:

Horizontal permeability is measured routinely on all sizes of cores. In full diameter analysis, two horizontal permeability values are reported. The highest permeability is labeled Kmax, the other, 90° from the direction of Kmax is labeled K90. Directional permeability can be measured with respect to north, east, south, west if the core has been oriented.

Vertical Permeability:

Measurements of permeability in the vertical orientation are made upon request. For plug-type analysis, samples must be drilled in a vertical direction. Therefore, the vertical sample can have different properties than the adjacent horizontal sample. Horizontal and vertical permeability can be measured on the full diameter sample.

The measured values of vertical and horizontal permeabilities of rock samples from Abu Roash "C" Member for BED 15-3 and BED 15-7 wells are shown in tables 1 and 2 .

Oil Saturation Determination:

Sidewall and plug-type core samples have oil content determined atmospheric distillation of the oil from the sample. The oil distilled from a sample is collected in a calibrated receiving tube where its volume is measured. Temperatures up to 1200°F (about 650°C) are used to distill the oil from the sample. This causes some choking and cracking of the oil and the loss of a small portion of the oil. An empirically derived correction is applied to the observed volume to compensate for the loss. The corrected volume of oil (Vo) is used to determine the core oil saturation. Calibration tests are made on each type of oil. Sand, water and known volumes of produced crude oil from a given field are all retorted.

The volume placed in is plotted against the volume out to make the necessary corrections.

Whole core samples have oil content determined by vacuum distillation.

This technique is used to remove oil from the sample without destroying the minerals of the sample. A maximum temperature of 450°F is used. The oil distilled from the sample is collected in a calibrated receiving tube which is immersed in a cold bath of alcohol and dry ice at about -75° F. This prevents the oil from being drawn into the vacuum system. As in the atmospheric distillation method, corrections must be applied to the measured volumes.

The corrected oil volume divided by the pore volume yields the oil saturation (So) of a sample in percent of pore space.

So = Vo/Vp

Water saturation Determination:

Sidewall and plug-type samples have their water content determined by atmospheric distillation concurrently with the oil content determination. The water is collected and its volume (V_w) determined in the same manner.

A distinction must be made between pore water and water of hydration or crystallization. A plot of the water recovered versus the elapsed time shows a plateau which indicates the removal of the pore water. Higher temperatures and time remove water of hydration and / or water of crystallization. Lithologies with minerals rich in bound water do not yield distinctive plateaus. The work of Hensel (1980) showed that 350°F is an optimum retort temperature to remove pore water. The sample temperature remains at 212° F until all pore water is removed. The retort temperature is then raised to 1200° F to remove oil.

Water of hydration from smectite clays can be removed at temperature as low as 212° F (100°C).

Whole cores have their water content estimated by vacuum distillation concurrently with the oil content determination. The technique is restricted to the analysis of minerals that do not decompose at the pressures and temperature used. No attempt is made to distinguish between pore water and water of hydration or crystallization. If sensitive minerals are present, this technique is not suitable.

The water volume divided by the pore volume yields the total core water saturation in percent of pore space (S_{tw})

$S_{tw} = V_w/V_p$

The measured values of both oil and water saturation for BED 15-7 well are shown in table 3.

Statistical Analysis:

The Porosity:

The statistical analysis of porosity data for the selected samples of Abu Roash ”C” Member at BED 15-3 well indicated that the porosity values vary from 2.1 % to 19.8 % with a mean value of 18.1 % . The variation of porosity data of all studied rocks is illustrated in the form of relative frequency distribution histograms (Figure 1).

On the other hand, the statistical analysis of the porosity of Abu Roash”C” Member at BED 15-7 ranges from 2.3 % to 20.5 %, with a mean porosity value of 16.1 %.

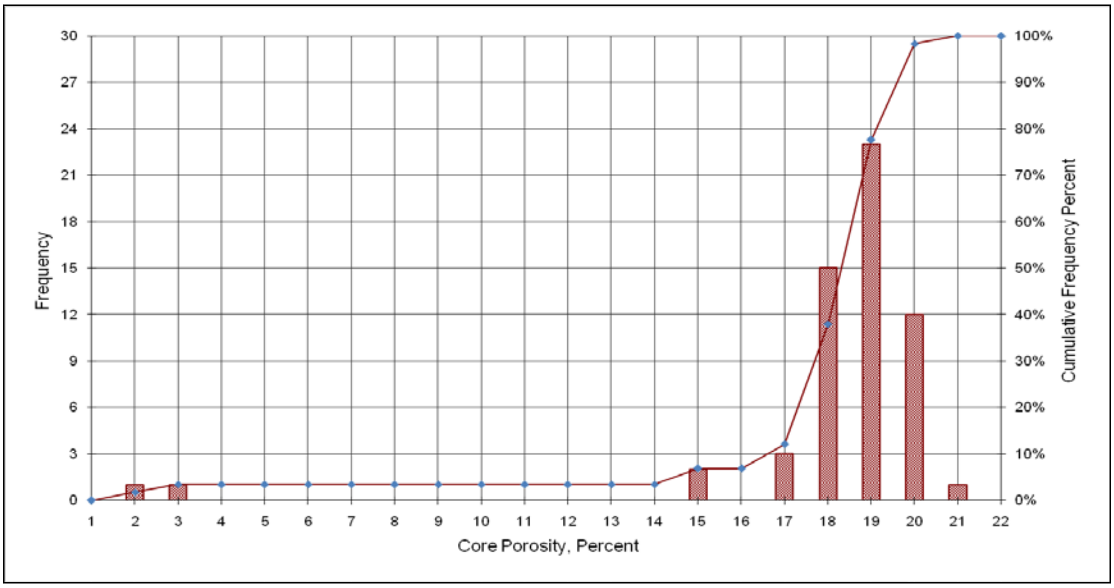

Figure (1): Core porosity frequency diagram for Abu Roash “C” Member in BED 15-3 well.

Table (1): The measured values of porosity, permeability and grain density of Abu Roash "C" Member samples in BED 15-3 well.

Sample number	**Depth (m)**	**Nitrogen permeability md**		**Helium porosity**	**Grain density gm/cm³**	**Lithological description and remarks**
Core no. 1		**Core intervals : 3120.00 - 3138.00m**				
1	3120.15	226	126	17.0	2.66	S.S
2	3120.30	328	84.7	18.9	2.65	AA
3	3120.60	637	395	19.4	2.65	AA
4	3120.90	515	350	19.0	2.65	AA
5	3121.15	621	213	18.7	2.65	AA
6	3121.36	531	382	17.4	2.65	AA
7	3121.54	675	221	18.6	2.66	AA
8	3121.82	511	339	17.9	2.67	AA
9	3122.08	661	510	18.6	2.66	AA
10	3122.28	348	289	18.0	2.66	AA
11	3122.66	666	447	17.8	2.64	AA
12	3123.02	601	217	18.3	2.66	AA
13	3123.25	872	192	19.0	2.65	AA
14	3123.50	791	619	18.8	2.65	AA
15	3123.70	925	183	20.2	2.65	AA
16	3123.95	380	338	19.2	2.66	AA
17	3124.20	468	192	18.7	2.66	AA
18	3124.46	297	183	18.0	2.74	S.S
19	3124.64	572	547	18.3	2.64	S.S
20	3125.06	534	NPP	16.9	2.65	AA
21	3125.20	485	410	17.8	2.65	AA
22	3125.45	643	74	18.9	2.65	S.S
23	3125.70	412	258	18.3	2.65	S.S
24	3125.95	504	438	18.0	2.66	AA
25	3126.20	753	640	18.8	2.66	S.S
26	3126.45	946	712	19.0	2.65	S.S
27	3126.70	367	238	17.3	2.66	AA
28	3126.95	138	48	16.9	2.86	S.S
29	3127.20	505	173	17.1	2.66	S.S
30	3127.45	0.06	0.03	1.7	2.68	S.S
31	3127.70	681	636	18.5	2.65	S.S
32	3127.95	669	143	18.6	2.65	S.S
33	3128.20	341	150	19.5	2.69	S.S
34	3128.57	866	619	19.5	2.64	S.S
35	3128.70	626	446	19.1	2.65	S.S
36	3128.95	411	187	17.3	2.65	S.S
37	3129.20	515	441	18.0	2.65	S.S
38	3129.45	597	564	19.2	2.65	AA
39	3129.70	565	508	17.9	2.65	AA
40	3129.98	440	390	17.9	2.65	AA
41	3130.20	398	297	17.1	2.63	AA
42	3130.45	344	205	17.8	2.66	AA
43	3130.70	416	334	18.1	2.66	AA
44	3130.95	592	158	19.8	2.65	AA
45	3131.20	498	663	19.5	2.66	AA
46	3131.45	459	428	18.3	2.65	AA
47	3131.70	215	212	17.1	2.65	AA
48	3131.95	339	183	18.1	2.67	S.S
49	3132.20	722	107	19.3	2.65	S.S
50	3132.45	559	223	19.0	2.65	S.S

Table (2): The measured values of porosity, permeability and grain density of Abu Roash "C" Member samples in BED 15-7 well.

Sample number	Depth (m)	Nitrogen permeability md		Helium porosity %	Grain density gm/cm³	Lithological description and remarks
		Horizontal	Vertical			
Core no. 1		**Core intervals : 3226.80 - 3234.80 m**				
1	3227.10	0.83	0.5	9.4	2.68	**S.S**
2	3228.50	153	115	16.0	2.66	**S.S**
3	3228.60	152	138	15.7	2.66	**AA**
4	3228.85	193	121	16.6	2.69	**S.S**
5	3229.10	213	160	16.1	2.66	**S.S**
6	3229.37	301	134	17.8	2.67	**S.S**
7	3230.73	153	111	16.8	2.72	**S.S**
8	3230.98	412	360	19.4	2.67	**S.S**
9	3231.25	167	137	18.3	2.69	**S.S**
10	3231.50	300	250	20.5	2.71	**S.S**
11	3231.78	199	93	19.1	2.67	**S.S**
12	3232.05	0.03	0.02	2.3	2.69	**S.S**
13	3232.30	229	0.05	14.5	2.72	**AA**
14	3232.45	0.03	0.03	1.9	2.69	**AA**
15	3232.70	0.15	0.02	3.4	2.69	**AA**
16	3232.95	525	467	18.8	2.67	**S.S**
17	3233.20	668	Npp	20.0	2.67	**S.S**
18	3233.48	0.03	0.03	2.1	2.70	**S.S**
19	3233.73	0.06	0.03	1.8	2.70	**AA**

Table (3): The measured values of porosity, permeability, saturation and grain density of Abu Roash "C" Member samples in BED 15-7 well.

Sample no.	Depth M	Permeability		Porosity		Saturation (Pore volume)		Grain Density gm/cc
		(Horizontal) Kair md	(Vertical) Kair md	(Helium) %	Fluids) %	oil %	water %	
1	3226.8-3227.1	0.86	0.16	10.7				2.67
2	3227.1-3227.4	No plug						
3	3227.4-3227.7	No plug						
4	3227.7-3228.0	No plug						
5	3228.0-3228.3	No plug						
6	3228.3-3228.6	No plug						
7	3228.6-3228.9	181	124	15.6				2.66
8	3228.9-3229.2	274	158	15.8	15.0	7.7	17.9	2.66
9	3229.2-3229.5	No plug						
10	3229.5-3229.8	No plug						
11	3229.8-3230.1	No plug						
12	3230.1-3230.4	No plug						
13	3230.4-3230.7	295	165	17.6				2.65
14	3230.7-3231.0	207	149	16.5				2.66
15	3231.0-3231.3	257	90	17.1				2.65
16	3231.45-3231.42	242	145	18.9				2.65
17	3231.69-3231.62	179	320	18.2				2.66
18	3232.13-3232.16	0.02	0.01	1.6	5.6	0.0	7.9	2.69
19 A	3232.23-3232.22	0.01	0.01	1.8	2.01	0.9	12.0	2.69
19 B	3232.41-3232.43	0.02	0.01	1.5				2.68
20	3232.68-3232.71	0.04	0.01	2.7	4.0	0.0	54.4	2.68
21	3233.96-3233.90	369	559	17.7	20.7	0.9	54.9	2.65
22	3233.28-3233.24	359	268	13.3	19.6	1.0	61.9	2.65
23 A	3233.46-3233.50	0.04	0.02	5.4	2.0	0.0	5.4	2.67

The statistical analysis of the porosity data of the sandstone of Abu Roash ”C” Member in both BED 15-3 and BED 15-7 wells indicated that, Abu Roash “C” reservoir at BED 15-3 has different porosity ranges with also different relative frequencies (Figs. 2). This may suggest a more than one origin of the porosity (primary or secondary) in this rock.

Permeability

The statistical analysis of the permeability data for 11 selected samples of Abu Roash”C” Member in BED 15-3 well indicated that the permeability varies from 0.02 md and 1052 md, with a mean value of 513.12 md (Figs 3 and 4).

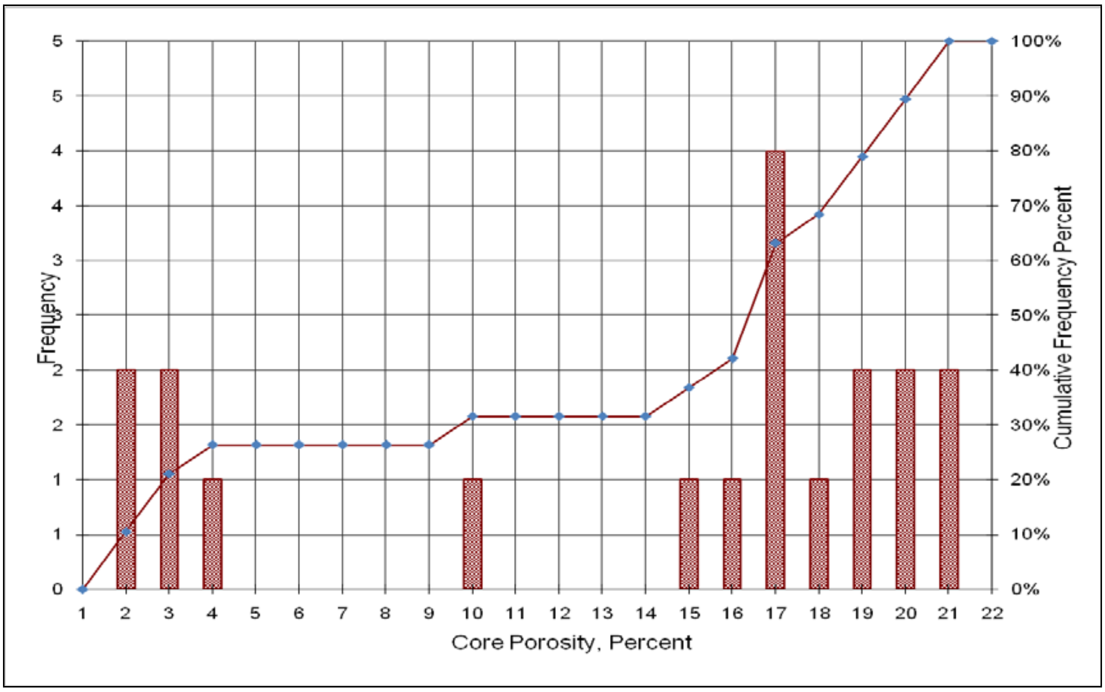

Figure (2): Core porosity frequency diagram for Abu Roash “C” Member in BED 15-7 well.

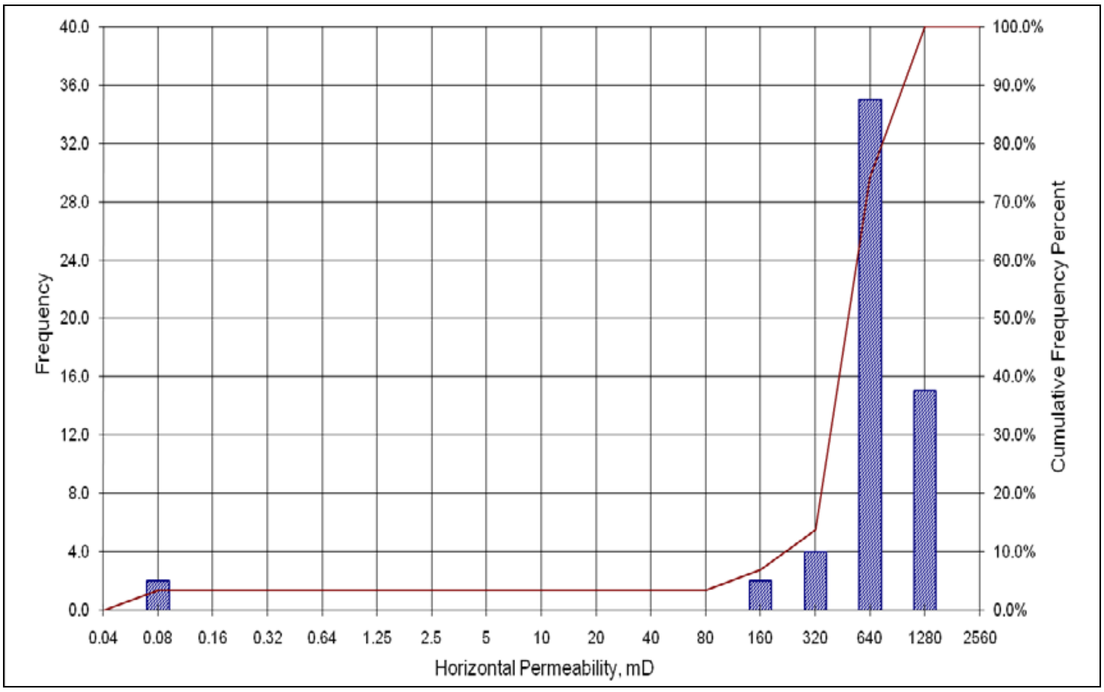

Figure (3): Horizontal permeability frequency diagram for Abu Roash “C” Member in BED 15-3 well.

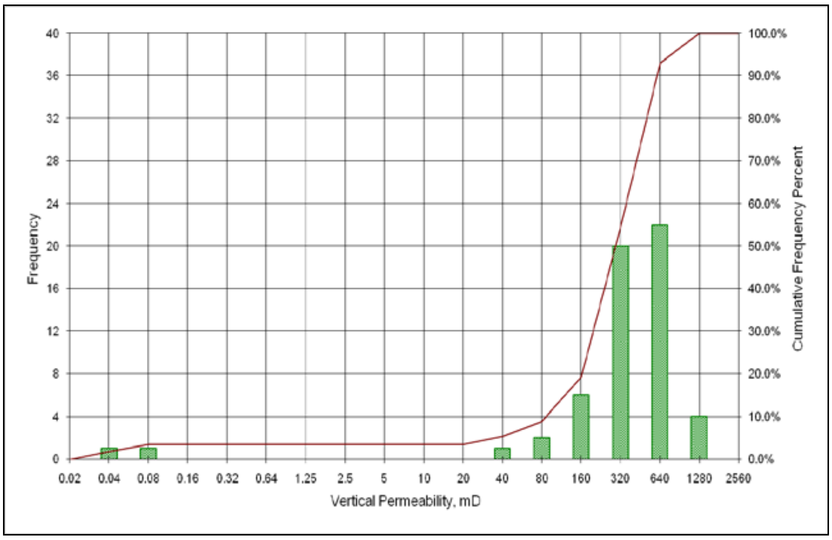

Figure (4): Vertical permeability frequency diagram for Abu Roash "C" Member in BED 15-3 well.

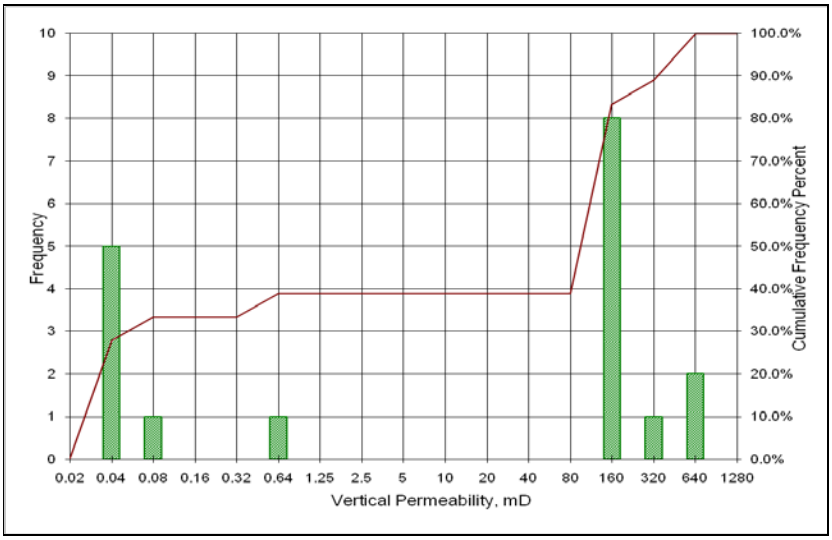

Figure (5): Vertical permeability frequency diagram for for Abu Roash "C" Member in BED 15-7 well.

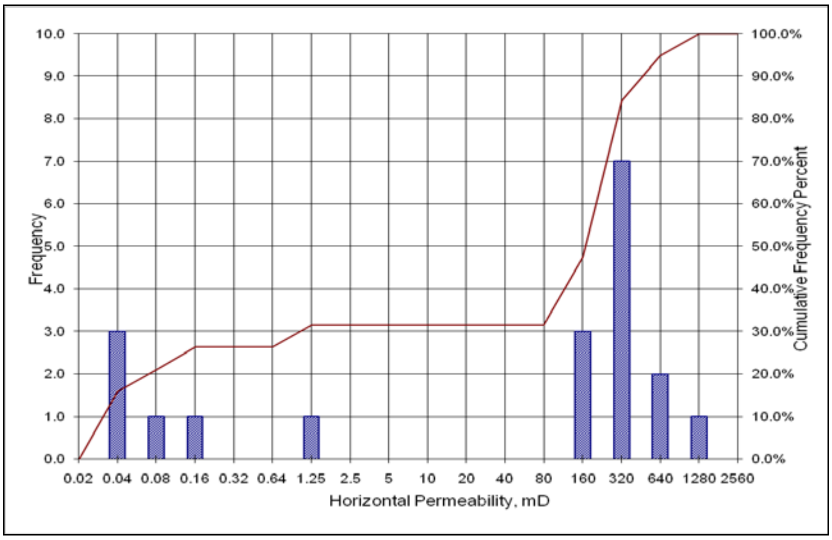

Figure (6): Horizontal permeability frequency diagram for Abu Roash "C" Member inBED 15-7 well.

The statistical analysis of the Permeability for the selected samples of Abu Roash"C" Member in BED 15-7 well reveals that the permeability ranges between 0.03 and 668 md with a mean permeability value of 166.2 md (Figs 5 and 6).

Water saturation:

The staistical analysis of water saturation data for 11 selected samples of Abu Roash"C" Member in well BED 15-3 indicated that the water saturation varies from 16.1 % to 96.4 % with a mean value of 63.10 % and standard deviation of 12.9 %.

On the other hand, the statistical analysis of water saturation of Abu Roash "C" Member in BED 15-7 well ranges from 5.4 % and 61.9%, with a mean saturation value of 30.20 % .

Integrating Well logging Analysis and Laboratory Measurements:

The correlation between porosity obtained from the log and routine core analyses versus depth for The Abu Roash "C" Member in BED 15-3 and in BED 15-7 wells indicates good relatioship between the data obtained from the core analysis and those obtained from log analyses (Figure 7). This infers that the core samples were good representative for the member, also the accuracy of the data obtained from logs with their corrections, and finally the process by which the data was processed.

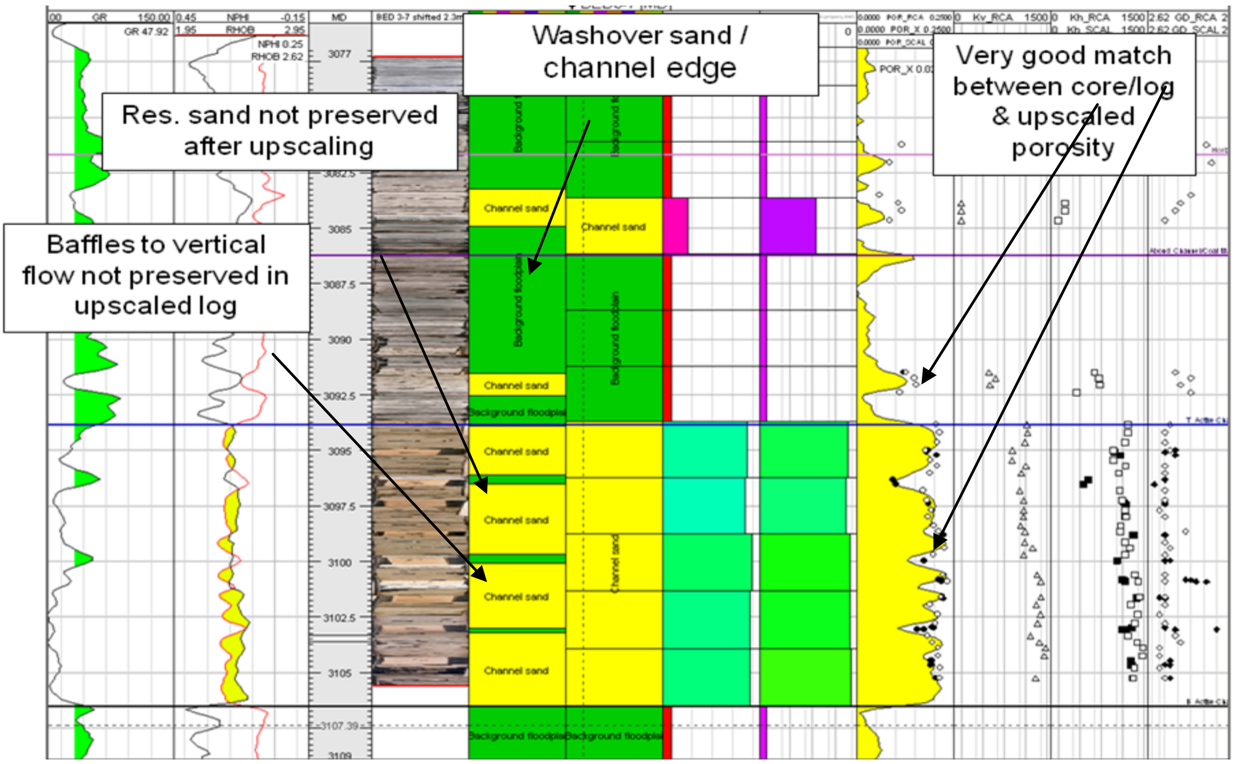

Figure (7): The relation between the porosity from log and core analysis versus depth of Abu Roash "C" Member at BED 15-7 well.

Factors affecting porosity and permeability:

Cement and shale form significant barrier to flow (permeability) and this could be the reason for the scatter distribution of porosity and permeability as shown in Figures : 2 to 6.

This can be recognized from the core samples (Figures 8 and 9).

Also, this scattering in porosity and permeability values may refer to the facies association (active facies channel / flood tidal delta (Figure 10) can be locally heterogeneous (organic rich shale drapes) to act as baffles to vertical and lateral flow perpendicular to the main direction (Figure 11).

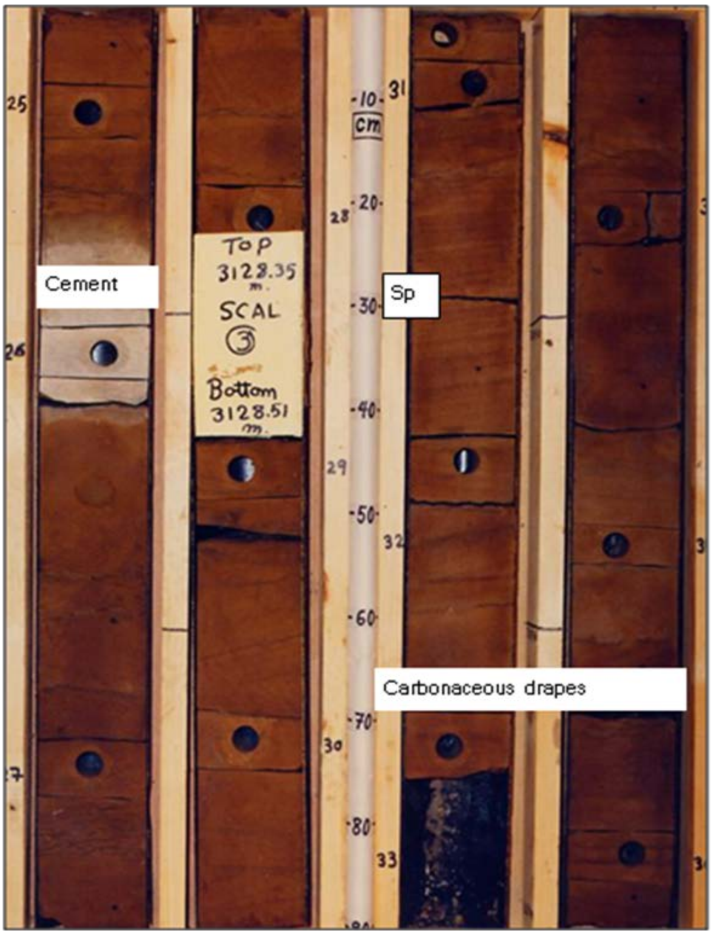

Figure (8): Cement barrier at BED 15-3 (Abu Roash C).

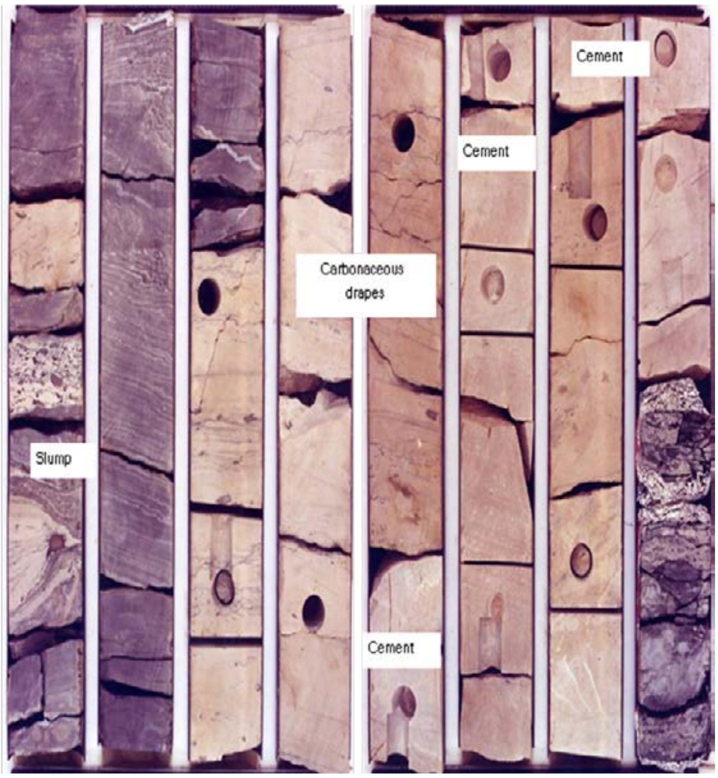

Figure (9): Cement barrier and carbonaceous draps at BED 15-7 (Abu Roash C).

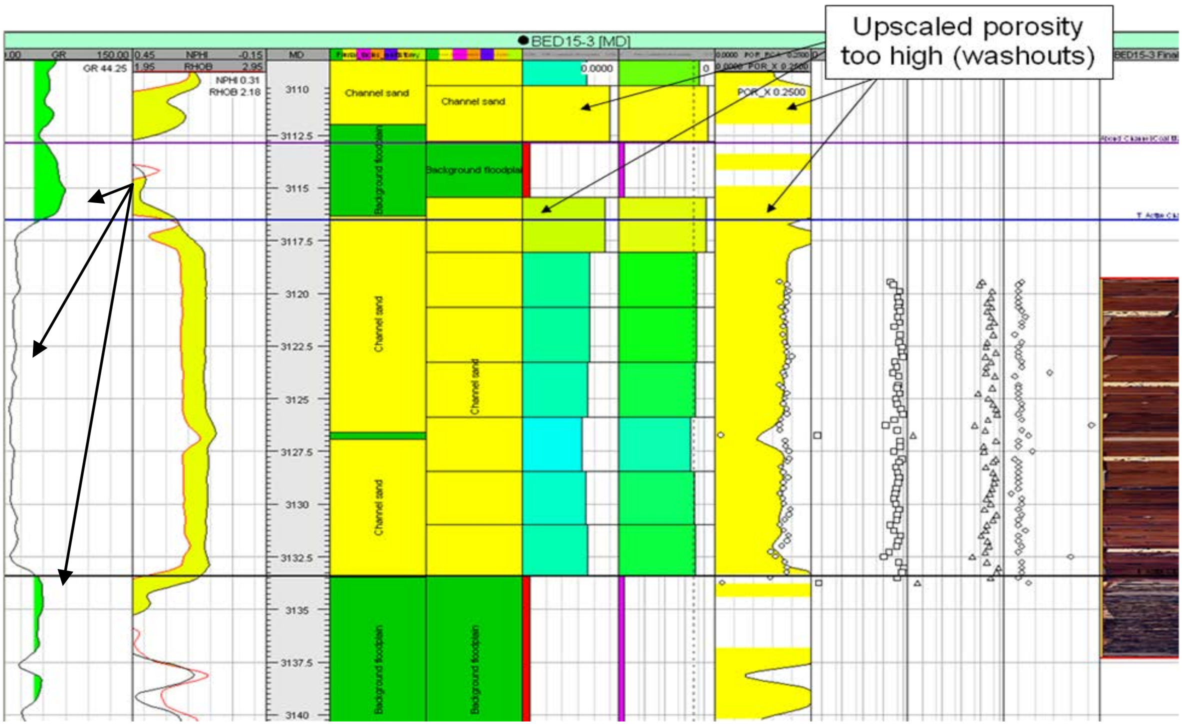

Figure (10): Log response showing a tidal channel at BED 15-3 well.

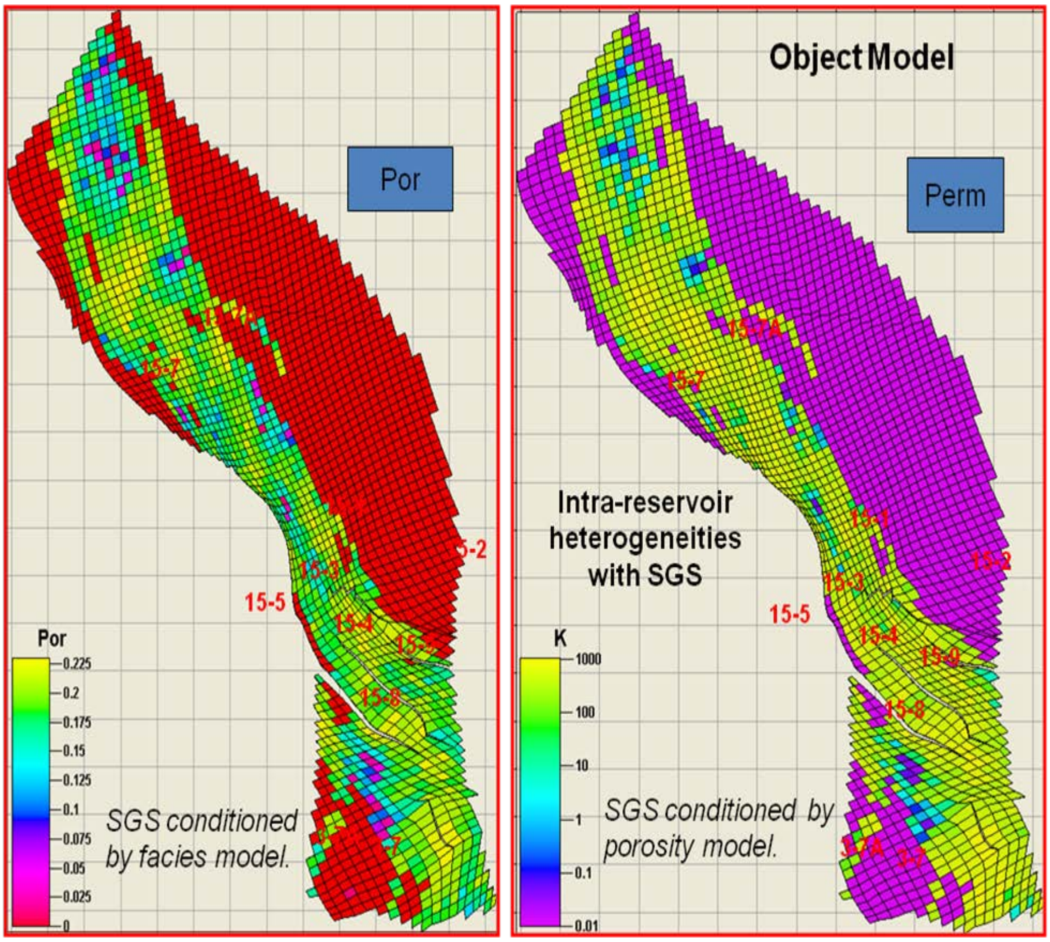

Figure (11): Porosity and permeability model showing the heterogeneity within Abu Roash"C" Member

Capillary Pressure:

Capillary pressure measurements are available for the well BED 15-3. Some 8 plugs were available having these measurements. The data were filtered and corrected to reservoir condition. The detailed process to derive a capillary function from the measurements. The final match between measured and fitted capillary curves is shown in Figure 12.

Relationship between Porosity and Permeability:

The relationship between porosity and permeability for the selected samples of Abu Roash"C" Member in both BED 15-3 and BED 15-7 wells show a positive relation, with a correlation coefficient r = 0.64 and r = 0.77 (Figures 13 and 14) respectively.

Also, from this relation we can distinguish between two main channels: a clean active tidal channel and intra-channel reservoir baffles (cemented) (Figure 15).

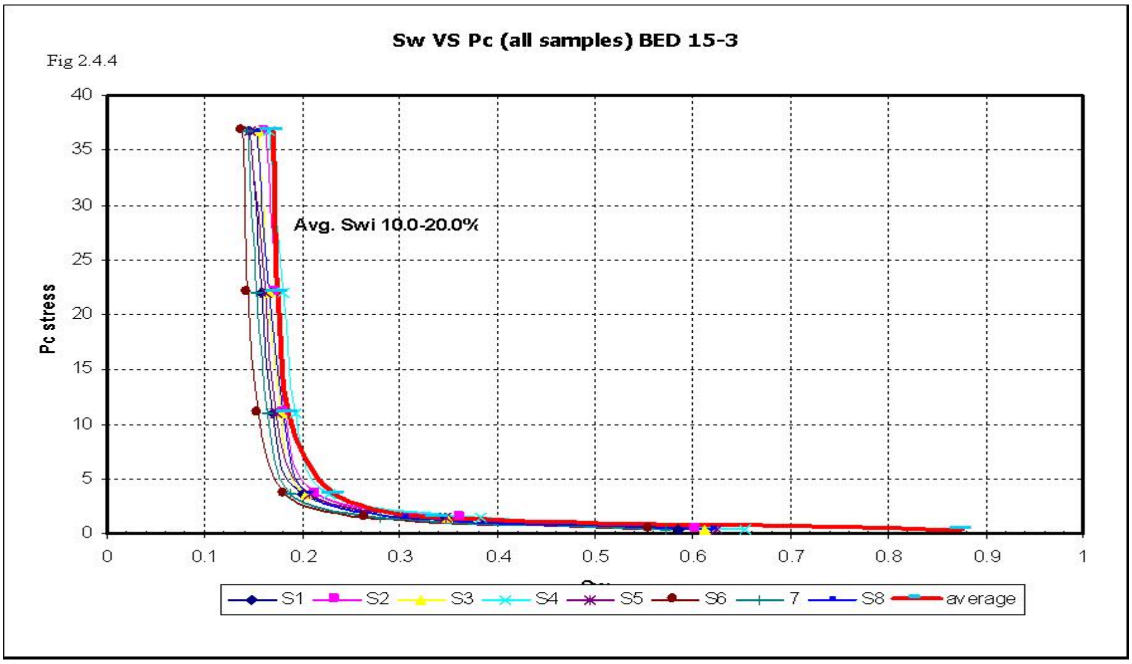

Figure (12): Capilary pressure curves For BED 15-3 well.

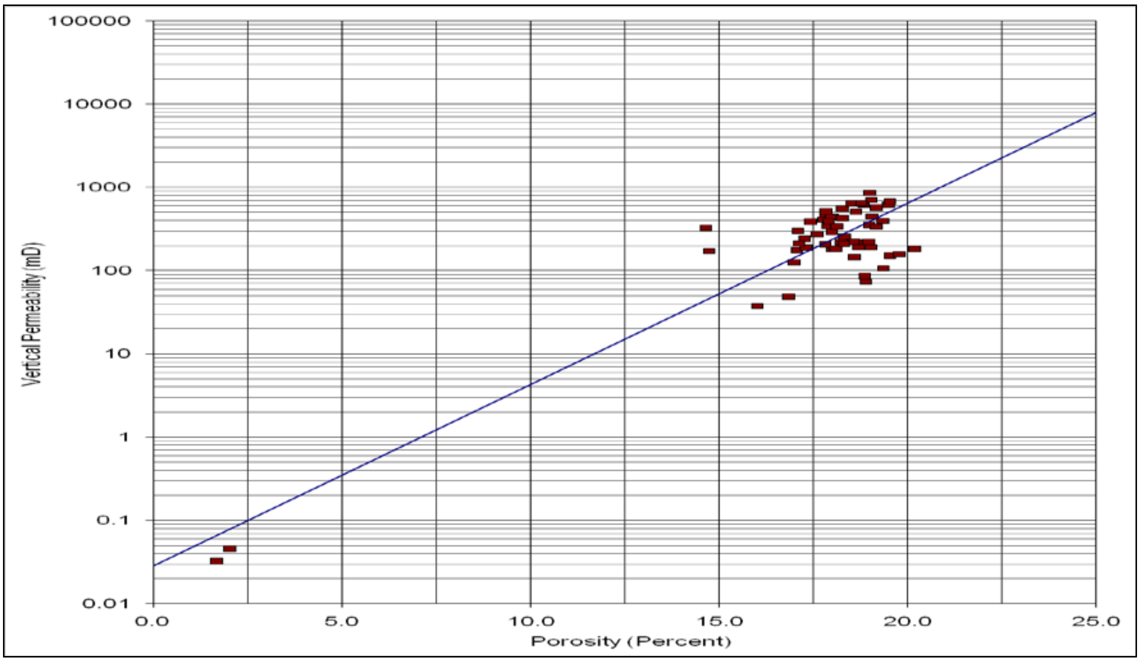

Figure (13): The relation between vertical permeability and porosity for samples of Abu Roash "C' Member in BED 15-3 well.

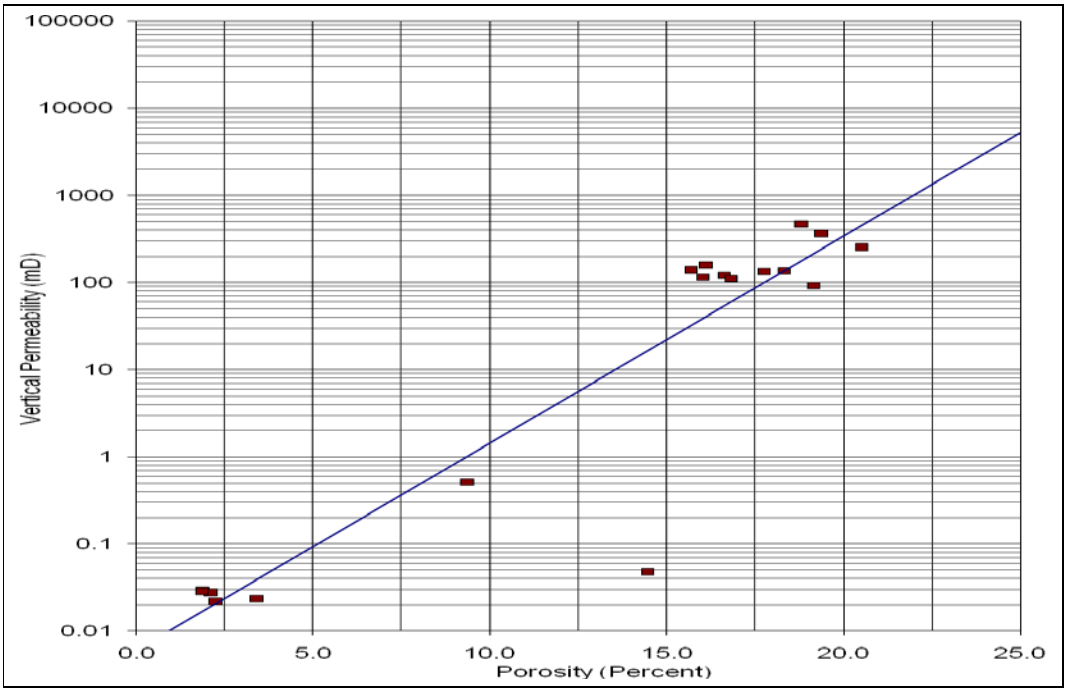

Figure (14): The relation between vertical permeability and porosity for samples of Abu Roash "c" Member in BED 15-7 well.

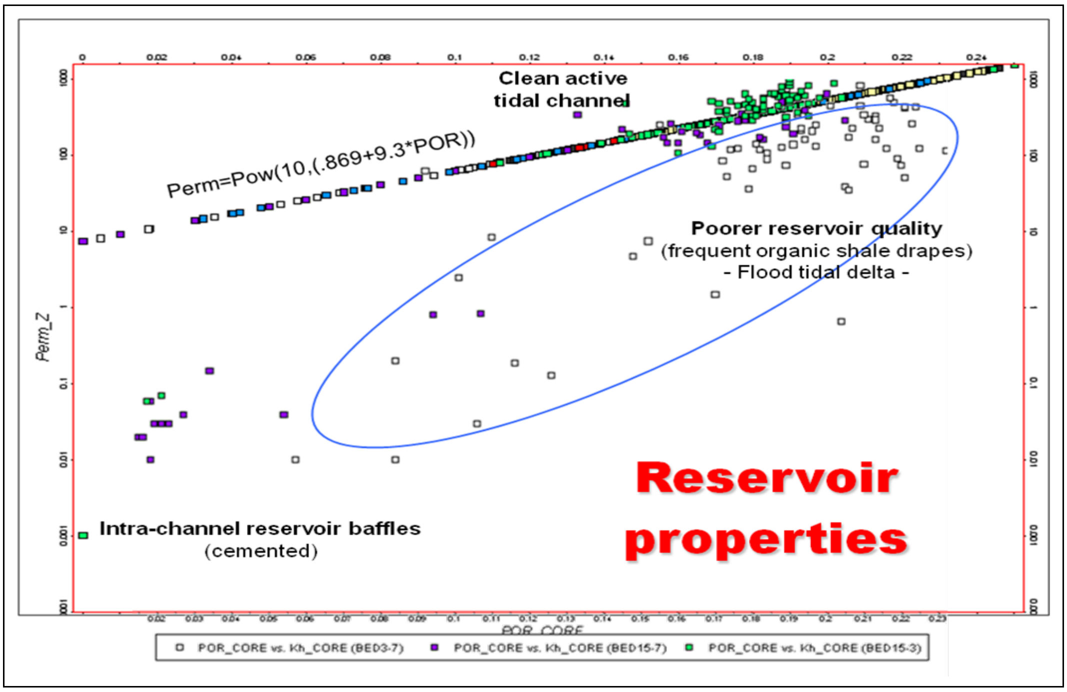

Figure (15): The relation between Porosity and Permeability from cores of Abu Roash "C" Member in BED 15-3 and BED 15-7 wells.

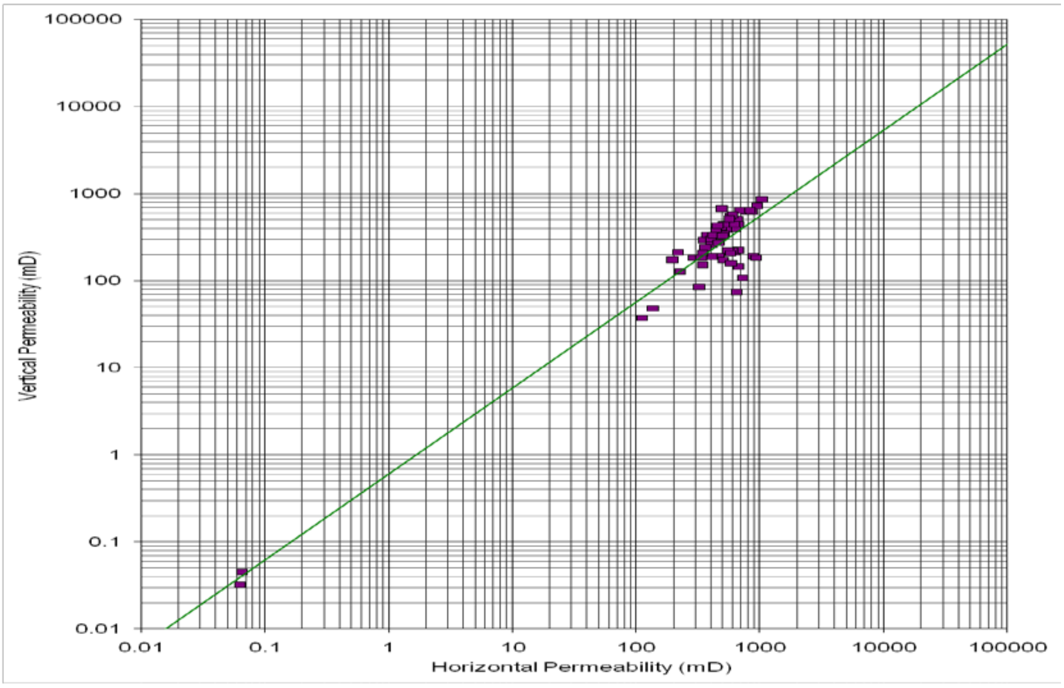

Figure (16): The relation between vertical and horizontal permeability for Abu Roash "C" Member samples in BED 15-3 well.

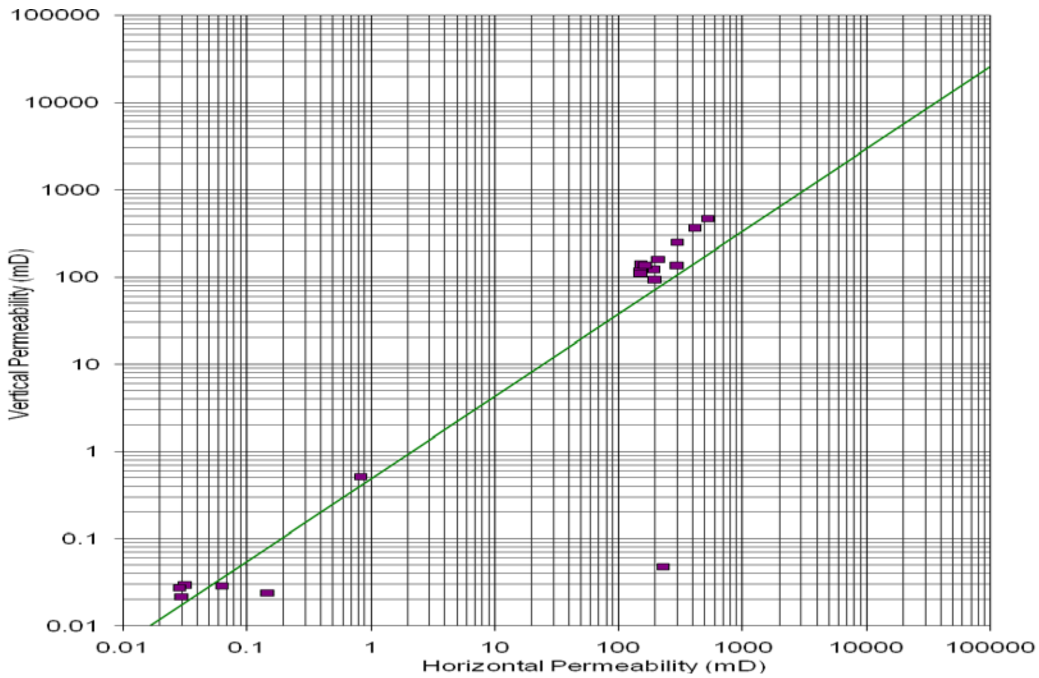

Figure (17): The relation between vertical and horizontal permeability for Abu Roash "C" Member samples in BED 15-7 well.

Relationship between vertical and horizontal permeability:

There is no much variation between the values of horizontal and vertical permeability especially for the selected samples of Abu Roash "C" Member in BED 15-3 and BED 15-7 wells (Figures 16 and 17).

SUMMARY AND CONCLUSION

Measurments of porosity of Abu Roash "C" Member in the studied wells suggested a more than one origin of the porosity in these rocks (primary and secondary). The statistical analysis of porosity data for the selected samples of Abu Roash "C" Member in BED 15-3 well indicated that the porosity values vary from 2.1 % to 19.8 % with a mean value of 18.1 %, while, the statistical analysis of the porosity of Abu Roash "C" Member at BED 15-7 well ranges from 2.3 % to 20.5 %, with a mean porosity value of 16.1 % . Cementation process could not reduce the intergranulr volume of the rocks but it fills the intergranular pore spaces, and this also reduces the volume of the effective porosity.

The statistical analysis of the permeability data for 11 selected samples of Abu Roash "C" Member in BED 15-3 well indicated that the permeability varies from 0.02md and 1052md with an average value of 550md. The statistical analysis of the permeability for the selected samples of Abu Roash "C" Member in BED 15-7 well reveals that the permeability ranges between 0.03md and 668md, with a mean value of 334md. In additions, the relationship between porosity and permeability shows a good positive relation in the studied wells. The cementation process increases the total microporosity of the whole rock but it did not increase either the effective porosity or the permeability. Also the precipitation of shale which was noticed between the grains affect on the distribution of permeability in BED 15-3 and BED 15-7 wells.

The relationship between porosity obtained from log and routine core analyses versus depth for The Abu Roash "C" Member in BED 15-3 and in BED 15-7 wells is a positive close correlation.

The net results of the study rock properties indicates that Abu Roash "C" Member has a good reservoir quality where the porosity reaches to 20.5 % and permeability is more than 1052 md. The water saturation is between 16.1% to 96.4% in BED 15-3 well and is between 5.4% and 61.9% in BED 15-7 well.

This is considered as a good reservoir quality, waiting for the hydrocarbon saturation.

Abu Roash "C" Member at the BED 15 conceptual model shows that the facies association (active facies channel / flood tidal delta) can be locally heterogeneous.

REFERENCES

Hensel, W. M., Jr. (1980) : "Core Analysis for Optimum Reservoir Exploration ". Paper SPE 4928 presented at Rocky Mountain meeting of SýPE, Billings, PP. 15 - 16.

Kessler, II, L.G. (1978) : " Diagenetic Sequence in Ancient Sandstones Deposited under Desert Climatic Conditions ". J. Geol. Soc. London, V. 135, PP. 41- 49.

Lerand, M. M., Nelson, H. R. and Shmidt , V.(1976) : " Reduction of Porosity in Reservoir Sandstone by Authigenic Minerals ", (Abs.). Geol. Assoc. Canada and Min. Canda Ann. Meet. Abs., 1, PP. 44-49.

Ragab, M. A. (1997) : " Diagenetic Effect on Petrophysical Nature of Cenomeanian and Albian Rocks, Mersa Matruh well – 1, North Western Desert, Egypt ". Sedimentology of Egypt, V. 5, PP. 55 - 76.