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The Study of Lithology by Using the Cross-Section Profiles of The Logs of Shiranish and Mushorah Formations in Ain Zalah and Butmah Fields, Northwestern Iraq

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ABSTRACT

This study deals with the determination of lithology in the Shiranish and Mushorah Formations in wells (Az-24, Az-29, and But-15). The graphical representation of the neutron porosity log (NØ) and the bulk density (ρb), shows that the Shiranish (Late Campanian – Early Maastrichtian) and Mushorah (Early Campanian) Formations consist of limestone and dolomite, as well as shale. The proportion of dolomite and chert increases at the expense ofcalcite in the Mushorah Formation. Also, the graphical representation results of the M-N profile for each well indicate that the limestone of the Mushorah Formation were affected by the dolomitization with the development of secondary porosity. Moreover, the limestones were suffered silicification in the form of chert nodules. The MID profile, used in this study to determine the mineralogy gives better and more precise results than that of the M-N profile. The results showed that the dominant minerals are calcite in the Shiranish Formation while dolomite and quartz in the Mushorah Formation, regardless of the gas effects within the studied wells.

Keywords: Shiranish Formations, Mushorah Formation, Ain Zalah, Butmah, neutron porosity, bulk density.

دراسة الصخارية باستخدام المرتسمات المتقاطعة للمجسات تكويني شرانش ومشورة في حقلي عين زالة وبطمة / شمال غرب العراق

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الملخص

تتناول الدراسة الحالية تحديد صخارية تكويني شرانش ومشورة في الابار (Az-24 ,Az-29 ,But-15).
تبين من خلال استخدام التمثيل البياني لمرتسمي مسامية النيترون (NØ) والكثافة الكلية (ρ_b) أن صخور تكويني

شرانش ومشورة تتكون من صخور الحجر الجيري وصخور الدولومايت مع تواجد للسجيل بيد أن نسبة الدولومايت والجيرت تزداد على حساب الكالسايت في صخور تكوين المشورة. كذلك تدل النتائج المستقاة من اشكال التمثيل البياني للمرتسم M – N لكل بئر على ان صخور الحجر الجيري لتكوين المشورة قد تاثرت بعمليات الدلمتة ونشوء المسامية الثانوية فضلا عن تاثرها بعملية السلكتة المتمثلة بنشوء عقد الصوان. استخدمت مرتسمات MID في تحديد المعادن الرئيسية التي تشكل صخور كلا التكوينين، اذ اعطت هذه المرتسمات نتائج افضل واكثر دقة من مرتسمات M – N. تبين من خلال استخدام هذه المرتسمات (MID) ان المعادن السائدة لتكوين شرانش هي الكالسايت، بينما يكون الدولومايت والكوارتز من المعادن السائدة في تكوين المشورة بغض عن التأثيرات الغازية ضمن الآبار المدروسة.

الكلمات الدالة: تكوين شيرانش، تكوين مشورة، عين زالة، بطمة، مسامية النيترون، الكثافة الكلية.

INTRODUCTION

The use of Cross-Section profiles is one of the methods for deducing lithology, mineralogy and rock cement, based on well-logs readings, where several profiles are used to identify the lithology (Al-Berty, 1994; Bigelow, 2002 and Ellis and Singer, 2007). This is particularly important in the depths where there are no lithology samples from the core. Compensated Neutron Log (NØ) with Density Log (ρb), the density, neutron and sonic logs are affected by many variables such as lithology, clay content and the presence of gas.

These logs are commonly used interconnected instead of being used alone to identify the lithology (Al-Saadouni, 2001). Thus, in the present study we use well log cross-plots to MID and M-N, the main objective of this study is to analyze well logs data the density, neutron and sonic logs in order to delineate the lithology and mineralogy of the Shiranish and Mushorah formations using the clusters (OR combination) of log cross-plots.

Geological Setting and Stratigraphy

In this study, several well−logs are used from the North Oil Company for wells (But -15, Az-29, Az-24) in northwestern Iraq (moved to methodology).

The present study includes three subsurface sections distributed on the fields of Ain Zalah and Butmah (Figure 1, 2 and Table 1). These sections include But-15, Az-29, and Az-24. They are located within the foothill zone of the mountain range in the area of Chemchamal - Butmah subzone. This subzone is characterized by long, narrow, and asymmetric Anticline folds separated from each other by wide Syncline folds Buday and Jassim (1987).

Ain Zalah field is located 64 km northwest of Mosul city, which is an asymmetric double plunging Anticline fold extending east-west. Its length is about 19.3 km, and its largest width is 4.8 km (the final report of Ain Zalah well 29). The southern limp of the field is steeper than the northern limp except at the central part of its northern one. The western plunge is more inclined than the eastern one.

The Butmah field is located 41 km northwest of Mosul city to the southeast of the Ain Zalah field. It represents an anticline fold-structure that extends east west, forming an arc to the north of the region where it reaches the crest. This fold consists of two domes, namely, West and East Butmah, which is connected by a saddle structure.

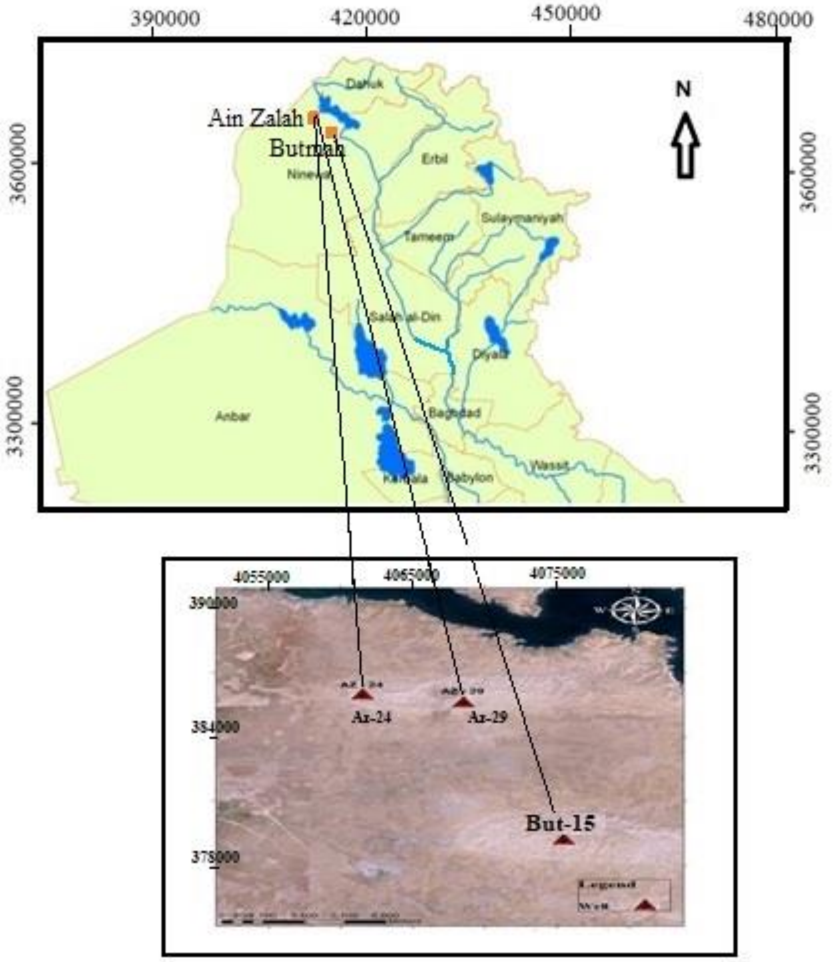

Figure 1: Location map of the study area

Table (1) the coordinates of the study wells with the limits of formation thickness

Shiranish Formation			(UTM)	well
Thickness of the composition	Lower Limit	Upper Limit		
619m	2223	1604	N:4068 905 E:282 523	Ain Zalah 24
708m	2225	1517	N:4067 743 E:286 130	Ain Zalah 29
577m	1743	1166	N:4057 017 E:290 279	Butmah 15

The Mushorah Formation in the type section of Mushorah well (1), which it consists of marly limestone and recrystallized alligostiganal limestone (Dunnington, 1953 in Bellen *et al.*, 1959). Not corrected (See first revision)

However, Hart (1959) notices that the formation in BH-13 differs from its equivalence in the Ain Zalah region due to the presence of chert lenses in the Kirkuk region. However, Hart (1962) sets new borders for the Mushorah Formation, and confirmed the Wajna Formation underneath it in many wells in the northwestern Iraq regions. Whereas, other authors (Ditmar *et al.*, 1971); Buday, 1980) were considered the Mushorah Formation facies at the upper part of the Kometan Formation and suggested the deposition during Turonian at the last stage of marine transgression.

The Shiranish Formation was described for the first time by Henson (1940) in Bellen *et al.,* (1959) from the high folded zone northern Iraq, at the type section near the village of Shiranish Islam near NE Zakho, where the formation attains a thickness of 227 m.

Abdel-Kireem (1983) studied the paleo-environment and the environmental conditions during sedimentation of the Shiranish Formation in the Late Cretaceous age. The formation is divided into two rock units, the lower unit consists of the marl, while the upper unit is composed of the marly shale, and the lower contact seam is graded sedimentary and paleontological ways with the Bakhme Formation, while the upper contact is unconformity with the Kolosh Formation Al-Atroshi (2007).

Al-Banna (2010) studied the Shiranish Formation in the Sinjar region, he stated that the formation was deposited in a deep marine environment, it consists of marl and marly limestone, he indicated that the formation is the core of the Sinjar fold and its thickness is (430m).

Bayrakdar (2011) emphasized the environment of Shiranish Formation is a deep marine basin environment using sedimentary and paleontological ways, microfacies and digenesis processes, this is because it is a deep basin environment in most parts of the studying area.

METHODOLOGY

In this study, several well logs from well But -15, Az-29, and Az-24 in northwestern Iraq (Fig. 1), obtained from “the North Oil Company”, and was analyzed using the (state the name of used software) software to generate log cross-plots that were interpreted. The well logs used for this analysis comprise Neutron Log (NØ), Density Log (ρb) and sonic logs. These logs are used interconnected to determine lithology and mineralogy. The neutron log for the porosity (NØ) is compared to the density log (ρb) on the proposed profile of the company (Schlumberger, 1984). The graphical representations of the figures (3, 4, 5, 6, 7 and 8) clarify the Shiranish and Mushorah Formations in the fields of Ain Zalah and Butmah in northwestern Iraq.

The Profile M- N Cross Plot**,** this profile is used to deduce mineralogy and lithology elicitation by mixing readings of density and sonic logs, with mixing the readings of the density and neutron logs, and then they are represented with a profile Schlumberger (1972). The logs are affected by the presence of gas, shale, and anomalous minerals (Saadouni, 2001). The values of MN, primarily projected in the profile, are based on porosity and provide information about lithology formation (Bigelow, 2002).

The M and Nare represented by the following equation:

$$M = \left(\frac{\Delta t_f - \Delta t_{\log}}{\rho_b - \rho} \right) \times 0.01 \qquad N = \left(\frac{\phi_{NF} - \phi_N}{\rho_b - \rho_f} \right)$$

MID Cross Plot throughout the MID profile, the lithology of cement can be diagnosed, based on three different logs (density, neutron and sonic logs). It is similar to the M-N profile, as it helps to diagnose the lithology and secondary porosity, and the values based on the log of Schlumberger (1978).

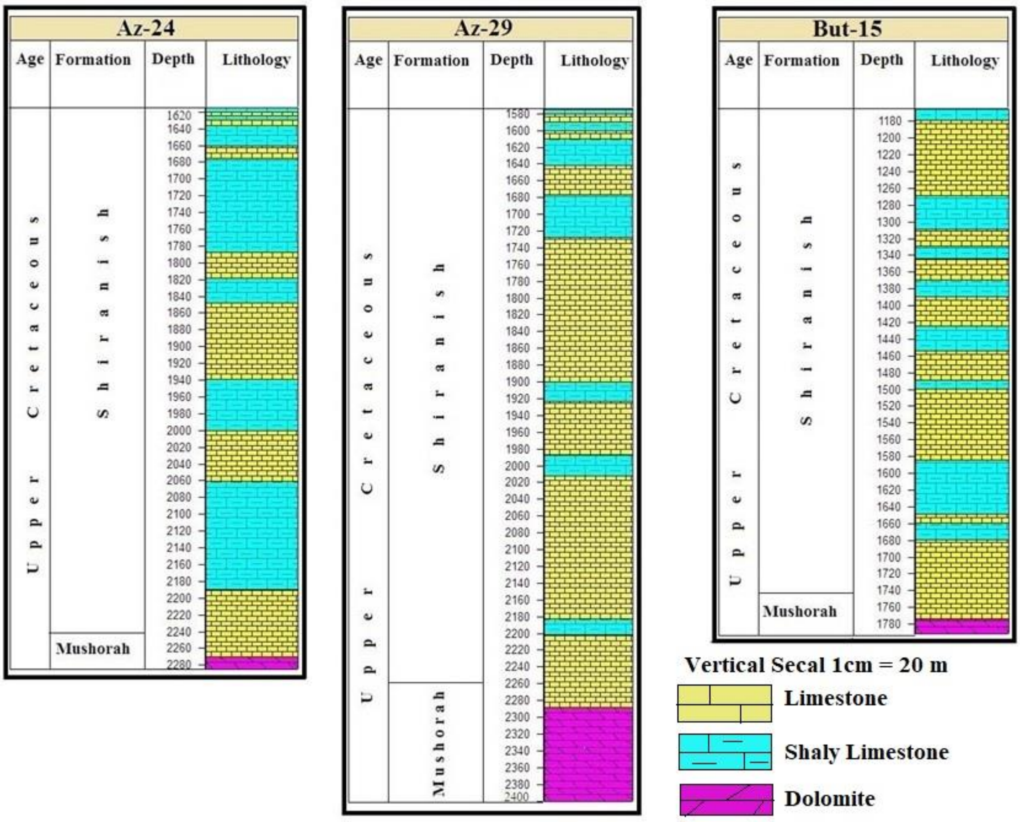

Figure 2: Lithology representation of the study wells.

The Profile M- N Cross Plot**,** this profile is used to deduce mineralogy and lithology elicitation by mixing readings of density and sonic logs, with mixing the readings of the density and neutron logs, and then they are represented with a profile Schlumberger (1972). The logs are affected by the presence of gas, shale, and anomalous minerals (Saadouni, 2001). The values of MN, primarily projected in the profile, are based on porosity and provide information about lithology formation (Bigelow, 2002).

$$\Delta t_{maa} = \left(\frac{\Delta t_{\log} - \phi_a \Delta t_f}{1 - \phi_a} \right) \qquad \rho_{maa} = \left(\frac{\rho_b - \phi_a \rho_f}{1 - \phi_a} \right)$$

ρmaa = density of matrix (gm\ cm^3), ρb = Total density of the formation (gm\ cm^3, ρf = Fluid density gm\ cm^3), Δt maa = Wave separator during matrix, Ø = Porosity, Δt log = Wave separator during formation, Δt f = Wave separator during at fluid, ØN= porosity calculated from the Neutron log, N = saturation of carbonate rocks (ρmaa) and (Δtmaa) have been calculated based on the extracted values from the above logs.

RESULT AND DISCUSSION

The M-N profile requirements for each well of the current study are calculated and represented on the log of Schlumberger (1972) Figures (9, 10, 11, 12, 13 and 14). The lithology is made from limestone is affected by the dolomitization, and the presence of gas with the secondary porosity. Moreover, it remarks about the effect of silica in the form of chert nodules in the Mushorah Formation.

The MID profile is better and more precise than the M-N profile (Bigelow, 2002) because M values come from the sound log which the density log, and the N values come from the neutron and density log. As for the MID profile, the density and neutron logs give the first value, and the sonic logs and neutron log give the second value. By observing the profiles, the dominant minerals are calcite in the Shiranish Formation, dolomite and quartz in the Mushorah Formation, regardless of the gas effects within the studied wells see figures (15, 16, 17, 18, 19 and 20).

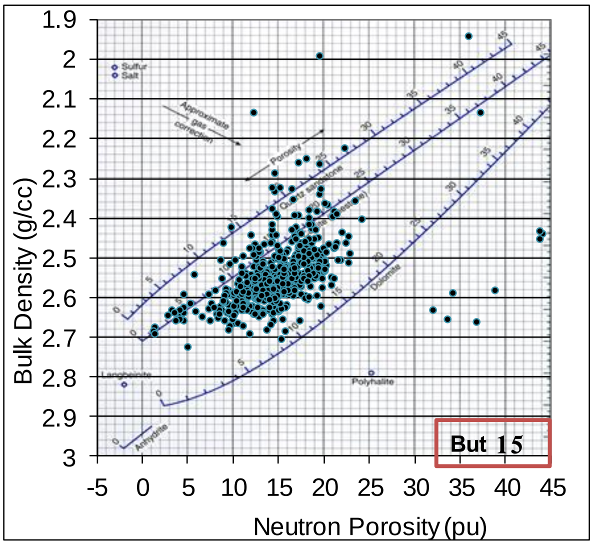

Figure 3: Lithology profile and Porosity form Neutron Density Log of Shiranish Formation

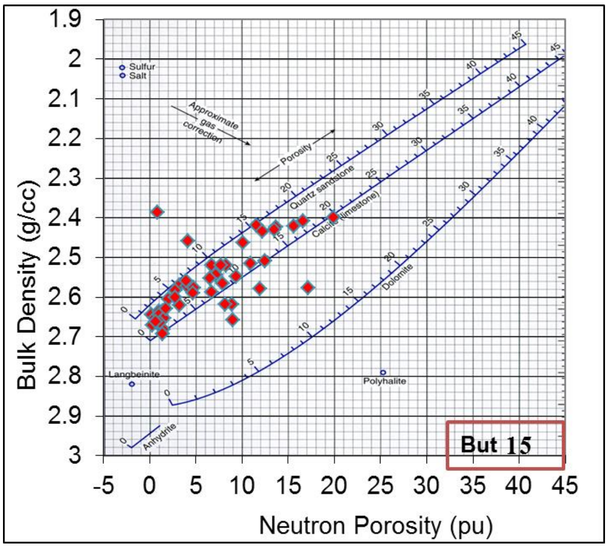

Figure 4: Lithology profile and Porosity form Neutron Density Log of Mushorah Formation.

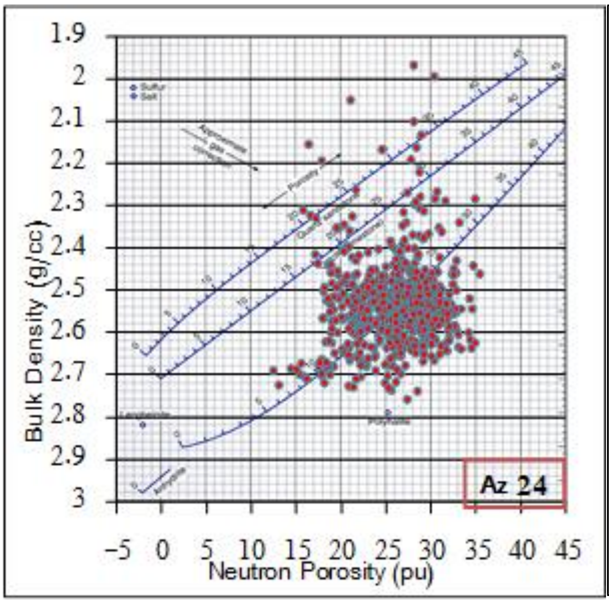

Figure 5: Lithology profile and Porosity form Neutron Density Log of Shiranish Formation.

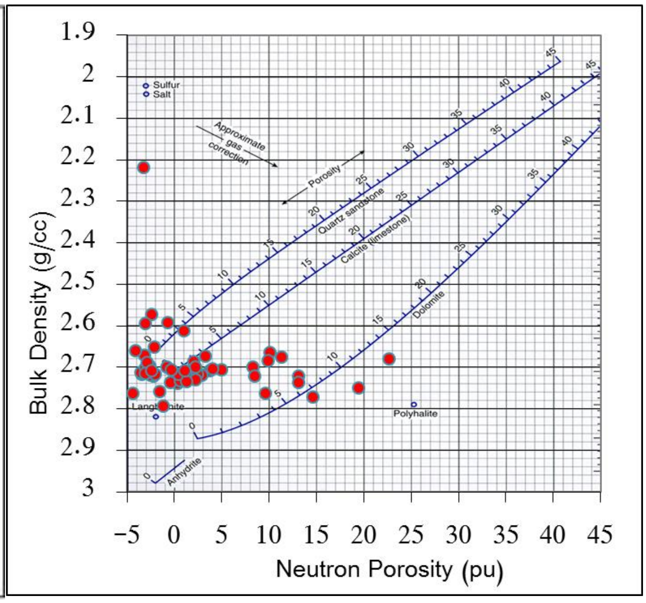

Figure 6: Lithology profile and Porosity form Neutron Density Log of Mushorah Formation.

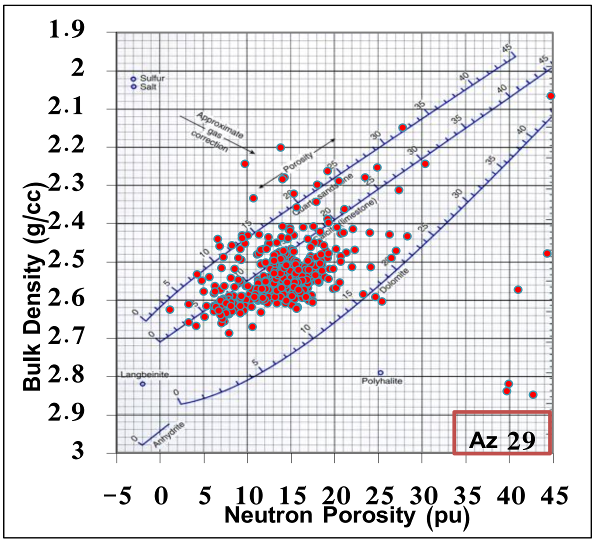

Figure 7: Lithology profile and Porosity form Neutron Density Log of Shiranish Formation.

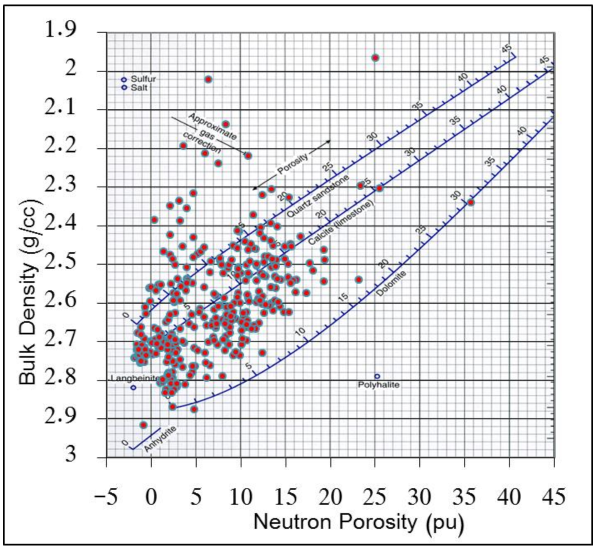

Figure 8: Lithology profile and Porosity form Neutron Density Log of Mushorah Formation.

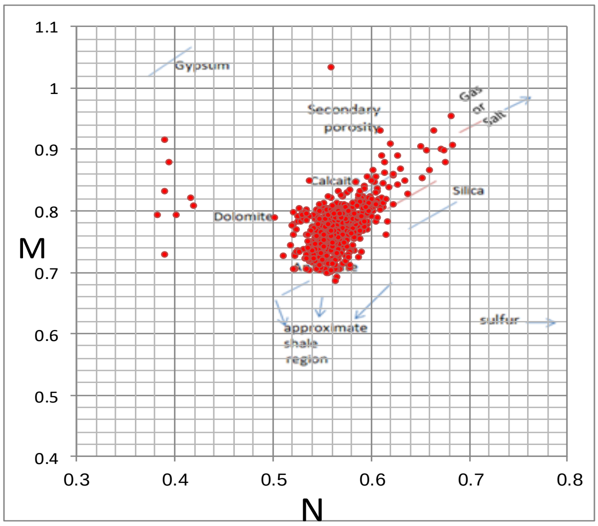

Figure 9: MN Profile of Shiranish Formation.

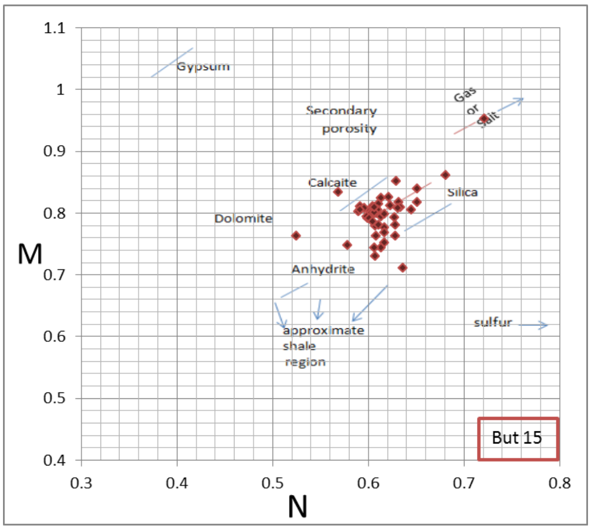

Figure 10: MN Profile of Mushorah Formation.

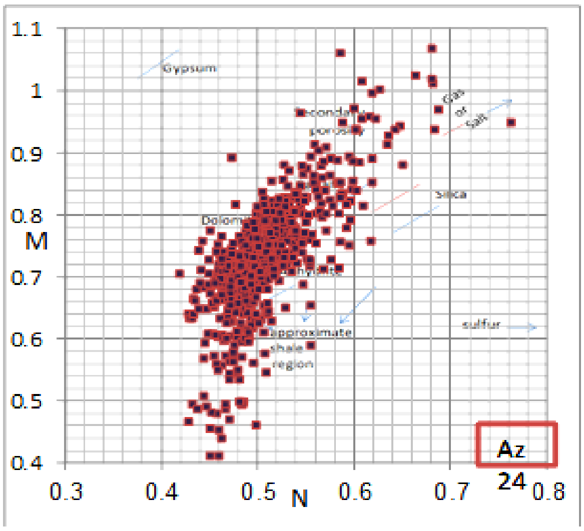

Figure 11: MN Profile of Shiranish Formation.

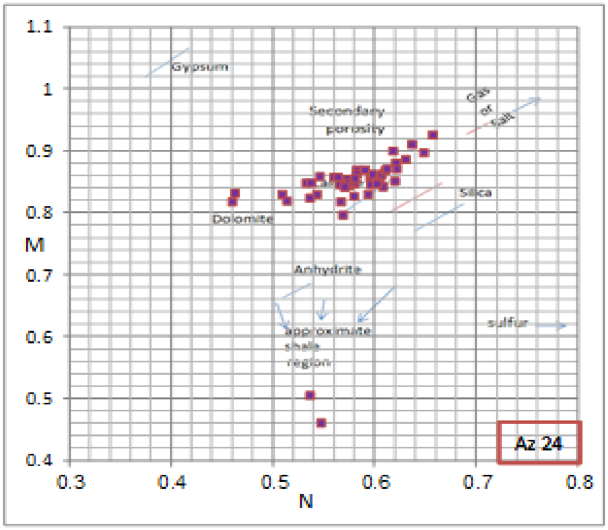

Figure 12: MN Profile of Mushorah Formation.

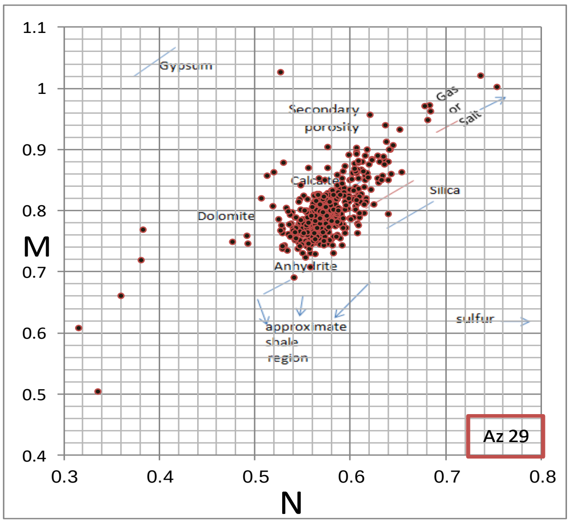

Figure 13: MN Profile of Shiranish Formation.

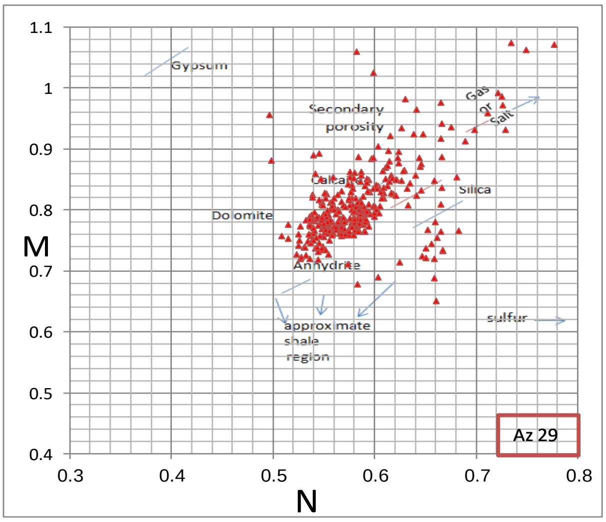

Figure 14: MN Profile of Mushorah Formation.

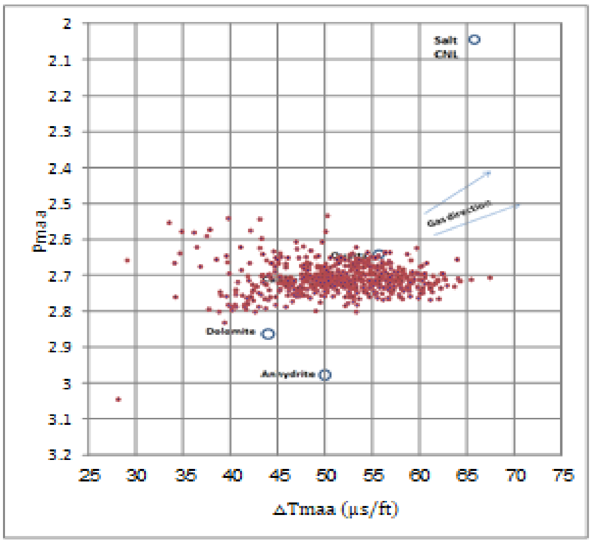

Figure 15: MI Profile of Shiranish Formation.

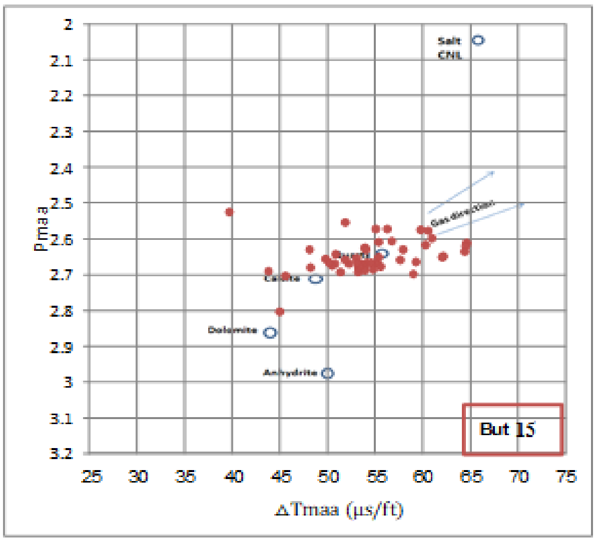

Figure 16: MID Profile of Mushorah Formation.

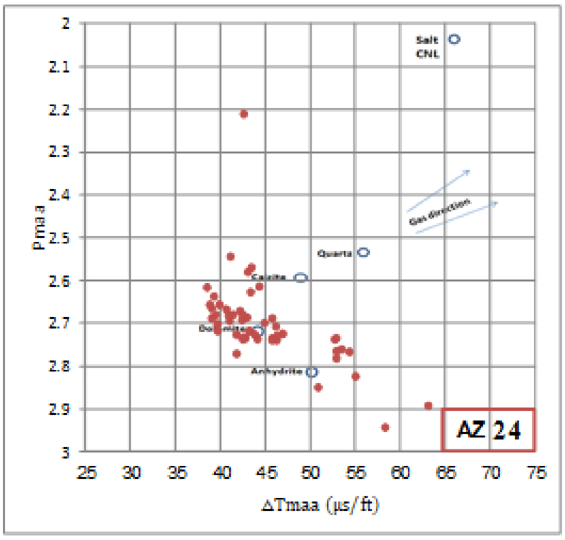

Figure 17: MID Profile of Mahsorah Formation.

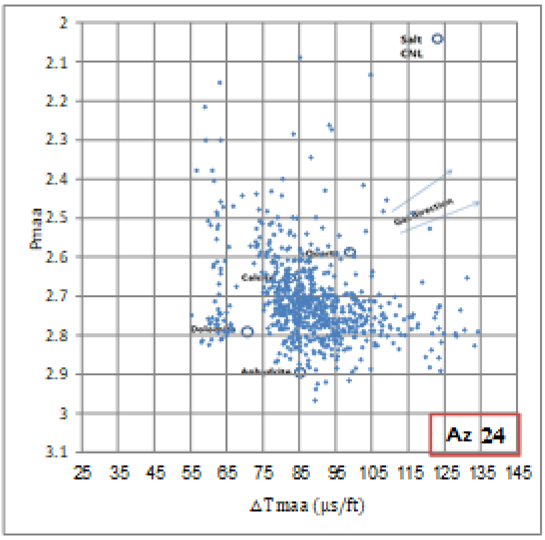

Figure 18: MID Profile of Shiranish Formation.

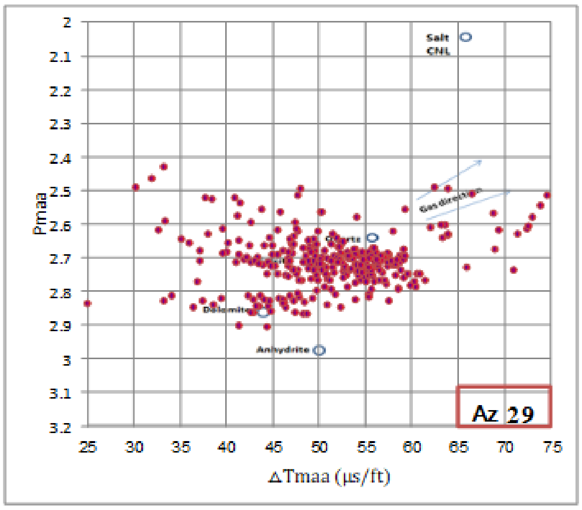

Figure 19: MID Profile of Mushorah Formation.

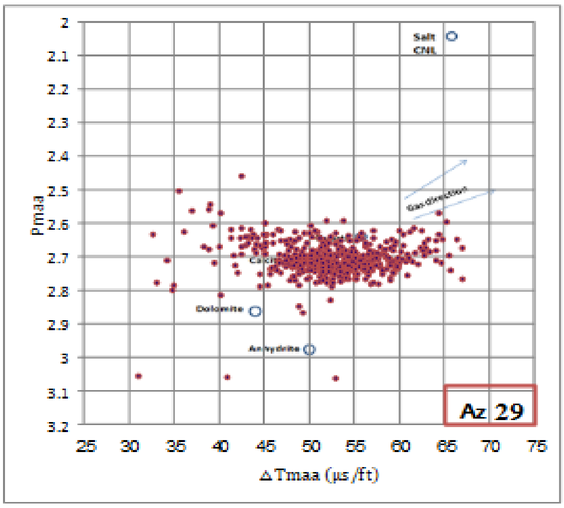

Figure 20: MID Profile of Shiranish Formation.

CONCLUSIONS

The result of Compensated Neutron Log (NØ) with Density Log (ρb) shows that the studied rocks consist of limestone and dolomite rocks with the presence of the shale, but the proportion of dolomite and chert increases at the expense of calcite in the rocks the Mushorah Formation.

The M- N Cross Plot profile shows that the lithology was affected by the dolomitization, the presence of gas and secondary porosity. Moreover, it demonstrates the effect of silicification in the form of chert nodules in the Mushorah Formation.

MID cross plot reveals that the calcite is dominant minerals in the Shiranish Formation, while dolomite and quartz in the Mushorah Formation, regardless of the gas effects of the study wells.

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