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IDENTIFICATION OF HYDROCARBON POTENTIALITIES FROM WELL LOGGING DATA, AT PALMYRA ARIA, "SYRIA"

By

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Key Words: Hydrocarbon Potentialities, Well logging

ABSTRACT

Fourier analysis technique is applied on well logging data "natural gamma ray (GR), self potential (SP), interval transit time (DT), and resistivity (LLD)" in order to get the most probable locations of hydrocarbon traps. The data is obtained from four wells "Twenan-101, Hrit-1, Al Akram-1, and Al Hureia-1" located in the Northern part of Palmyra area, Syria.

The significant power spectrum of the different petrophysical parameters (when clustered and packed) are believed to be due to hydrocarbon contents. A satisfactory agreement between the results obtained and those obtained by actual field observations (by exploration companies in this particular study area) is found.

STUDY AREA

The area under investigation lies in the Northern part of the Palmyridian region. It is located approximately between the Latitudes 35°00'00" and 35°15'00" N, and the Longitudes 38°18'00" and 38°38'00" E, and covers an area of about 800 square kilometers (Fig. 1). The main features of the study area are low mountains, which consist of few ridges oriented sublatitudinally and North-Westerly with absolute elevation of about 800 to 1000 m, and the hilly

part of the study area is densely cut by valleys (Russian Technoexport Mission, 1966).

Subsurface stratigraphy:

Triassic, Jurassic and Cretaceous rock formations are penetrated in the study area. According to the data obtained from the Syrian Petroleum Company (S.P.C), (Swidan, 1993, and Naimeh et al. 1993) we can describe the subsurface rocks and the local formations as follows:

a- Cretaceous System; consists of two groups:

I- Upper Cretaceous group; which in turn consists of the following local formations:

i- Shiranish formation; which consists of interbeds of limestone and marlstone.

ii- Soukhne formation; which is divided into two secondary formations:
- Ark Marl formation which consists of limestone.

- Rmah Chert formation which consists of limestone and interbeds of chert.

iii- Judea formation; which consists of limestone.

iv- Hayan formation; which consists of dolomite and interbeds of anhydrite and limestone.

v- Lower Hayan formation; which consists of dolomite and thin streaks of anhydrite.

II- Lower Cretaceous group; which includes only one formation called Rutba formation. It consists of sandstone with dolomitic cement and thin interbeds of clay.

b- Jurassic system;

It includes only one formation called Quamchouka formation which consists of limestone and interbedded with dolomite layers.

c- Triassic system;

It consists mainly of three groups of formations:

I- Upper Triassic group; which in turn consists of five formations:

i- Serjelou formation; which is detrital rock consists of clay, sandstone and shale, and intercalations of dolomite, limestone shale, clay and anhydrite.

ii- Muss formation; which consists of dolomite.

iii- Adayah formation; which consists of interbeds of shale, dolomite and anhydrite.

iv- Butma formation; which consists of dolomite and successive beds of shale and limestone.

v- Kurachine Anhydrite formation; which includes successive beds of anhydrite, shale and salt rocks.

II- Middle Triassic group; which includes only one formation called Kurachine Dolomite formation. It consists of dolomite interbedded with limestone, shale and anhydrite.

III- Lower Triassic group; which includes only one formation called Amanous Shale formation.

Surface stratigraphy:

On the surface, Cretaceous, Paleogene, Neogene and Quaternary rocks are outcropping at different positions in the study area (Fig. 2). Only the upper Cretaceous rocks are exposed while the main rocks outcropping at the surface are; dolomite, fine grained limestone and dolomitic limestone with sandy limestone which are medium grained and hardly dolomitic. The rocks of

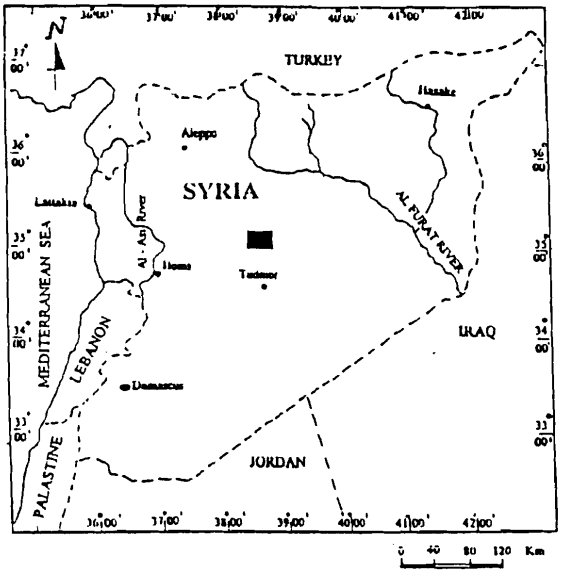


FIG.(1): LOCATION OF THE STUDY AREA.

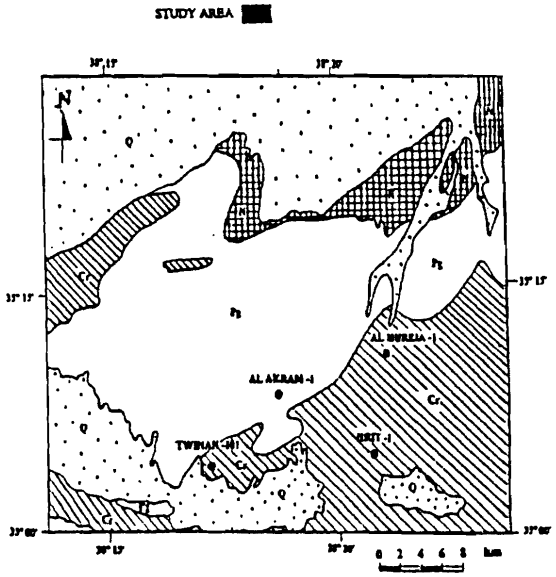


FIG.(2): SURFACE ROCKS DISTRIBUTION IN THE STUDY AREA.

Quaternary
Paleogen
Borehole
Neogene
Cretaceous

Paleogene make a uniform series of marl, clayey limestone and calcareous clay which in place grades into clay. The main Neogene rocks are quartz sandstone, clayey limestone and calcareous clay. The Quaternary deposits are of two genetic types; alluvium and proluvium.

MATERIAL AND METHODS

Fourier analysis is the decomposition of a signal into its harmonic constituents. It extracts the domination periodic components. Generally, a periodic function can be represented by a Fourier series as:

$$y_i = \sum_{n=1}^{x} \left(\alpha_n \cos \frac{2 n \pi x_i}{\lambda} + \beta_n \sin \frac{2 n \pi x_i}{\lambda} \right)$$

Where: y_i : is the amplitude at a point x_i
α, β : are coefficients
λ : is wavelength
n : is the harmonic number.

A plot of ordinate (the power $\sqrt{\alpha_n^2 + \beta_n^2}$) versus harmonic number (n) is known as the power spectrum of the function. The principal peaks in the power spectrum are perusable in repeated manner at regular intervals of depths, while the lower peaks are more or less of no significance.

Examining the power spectrum of data sequence may give us great informations about its nature and origin. Also, if the values beyond the end of the data sequence were calculated, the predicted values are found to be simply repeated (Davis, 1973).

Logging data taken from wells located in the Northern part of Palmyra area, Syria, and namely; Twenan-101 well (2500 m depth), Hrit-1 well (2813 m), Al Akram-1 well (2500 m) and Al Hureia-1 well (2500 m), are used in this study. This data was kindly provided by the Syrian Petroleum Company (S.P.C), where the logs were run by Schlumberger Company.

The natural gamma ray (GR), self potential (SP), interval transit time (DT), and resistivity (LLD) for each well are used in this study (Fig. 3-a,b,c,d).

By plotting each of GR-, SP-, ΔT-, and LLD- log series in periodogram forms, we can get the power spectrum, which represents the values that repeated

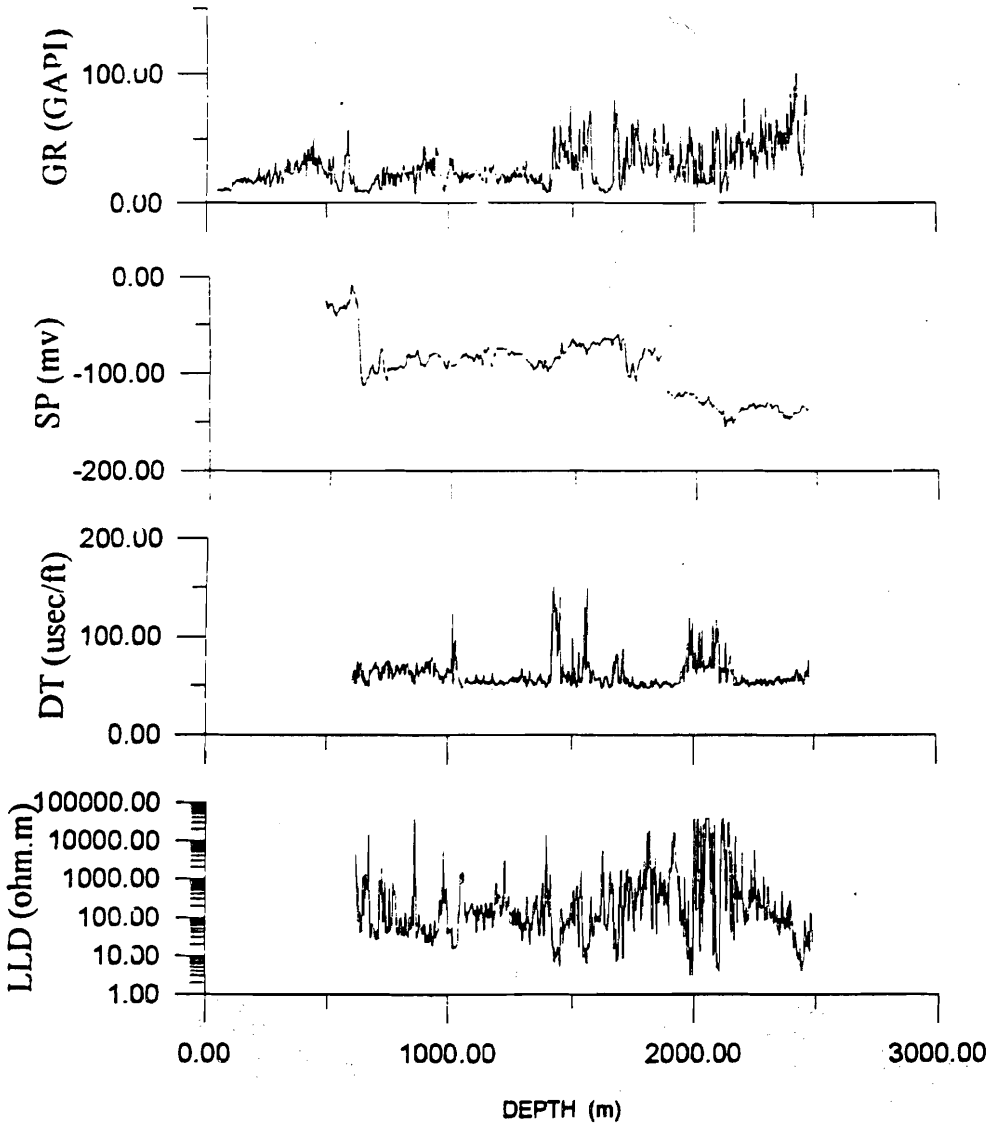


FIG.(3-a): DATA AVAILABLE "GR, SP, DT AND LLD" LOGS IN TWENAN-101 WELL, NORTH PALMYRA, SYRIA.

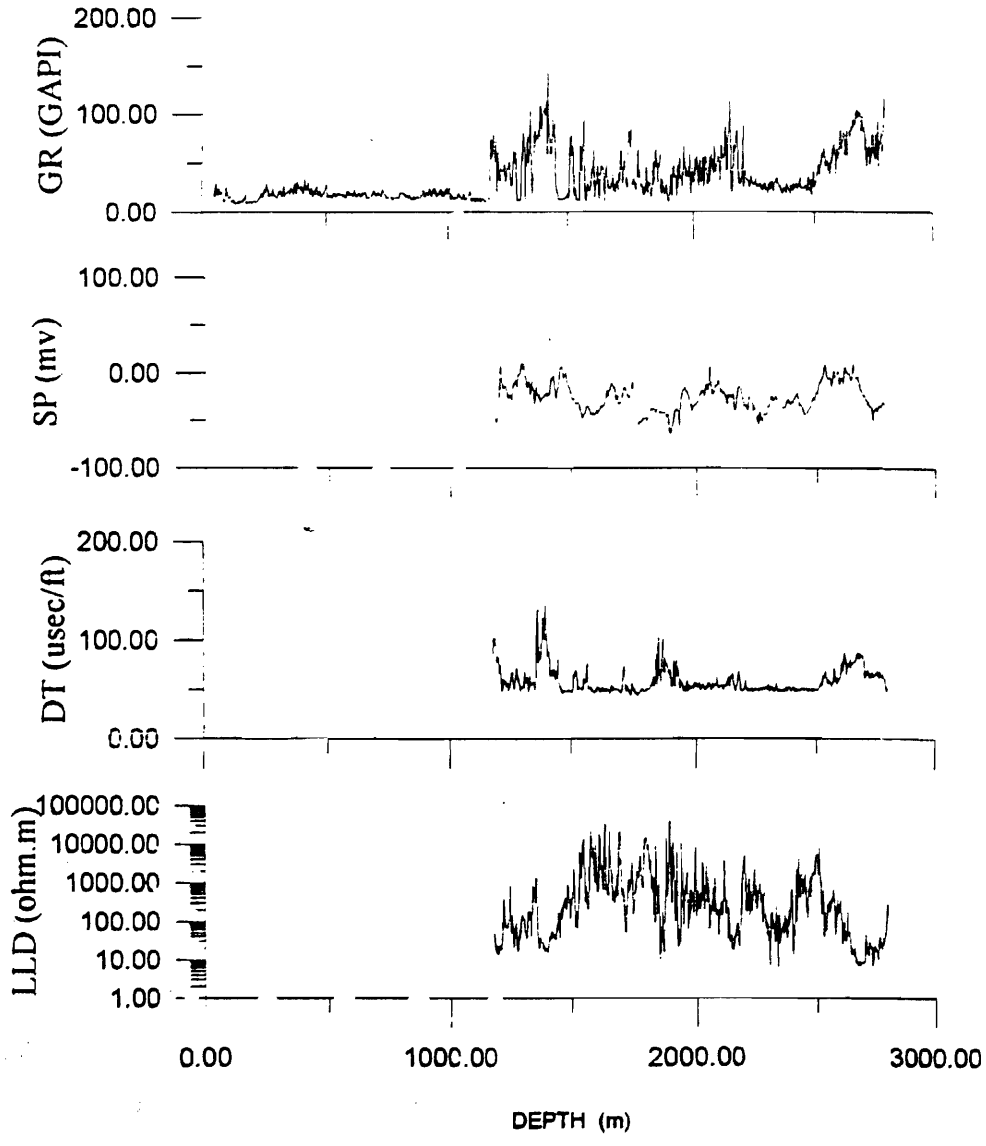


FIG.(3-b): DATA AVAILABLE "GR, SP, DT, AND LLD" LOGS IN HRIT-1 WELL, NORTH PALMYRA, SYRIA.

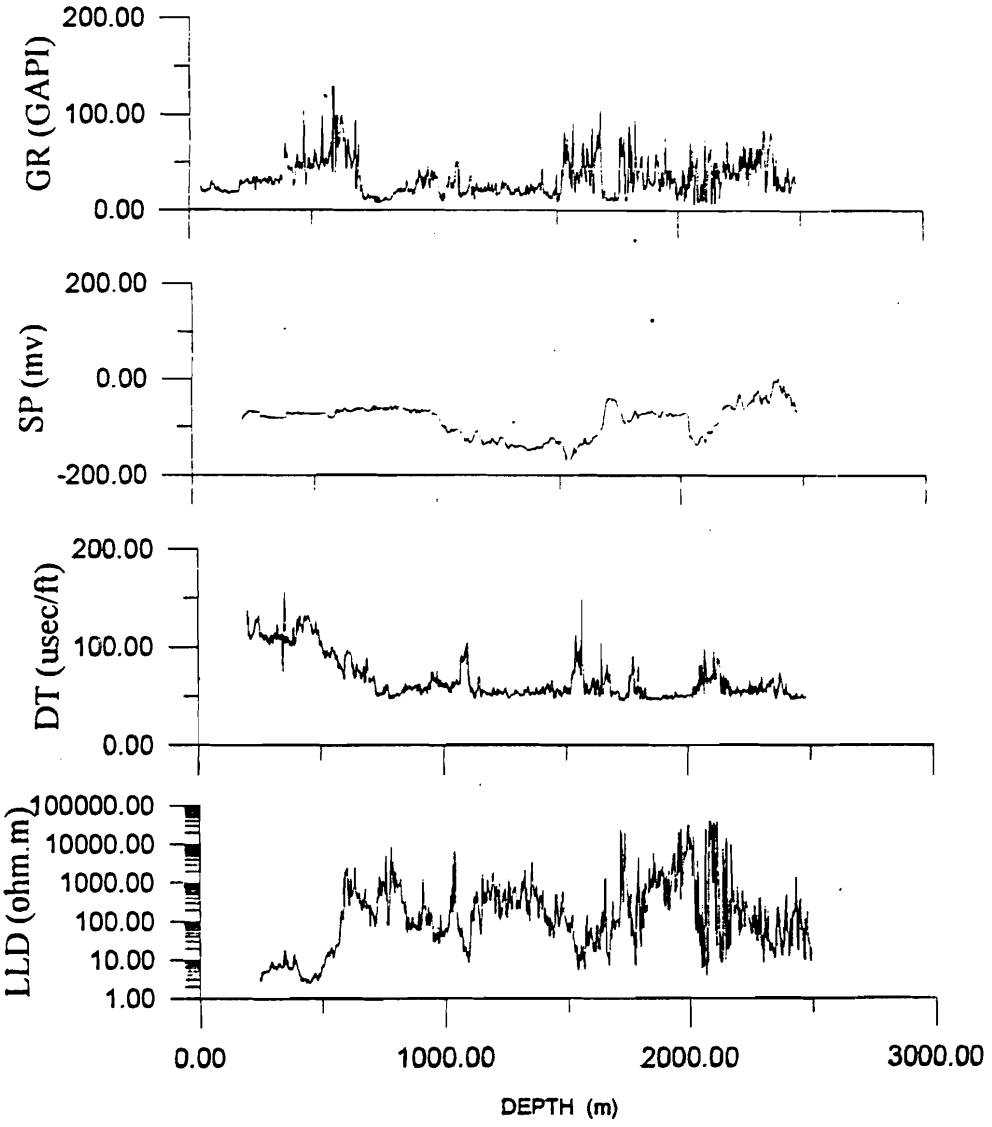


FIG.(3-c): DATA AVAILABLE "GR, SP, DT, AND LLD" LOGS IN AL AKRAM-1 WELL, NORTH PALMYRA, SYRIA.

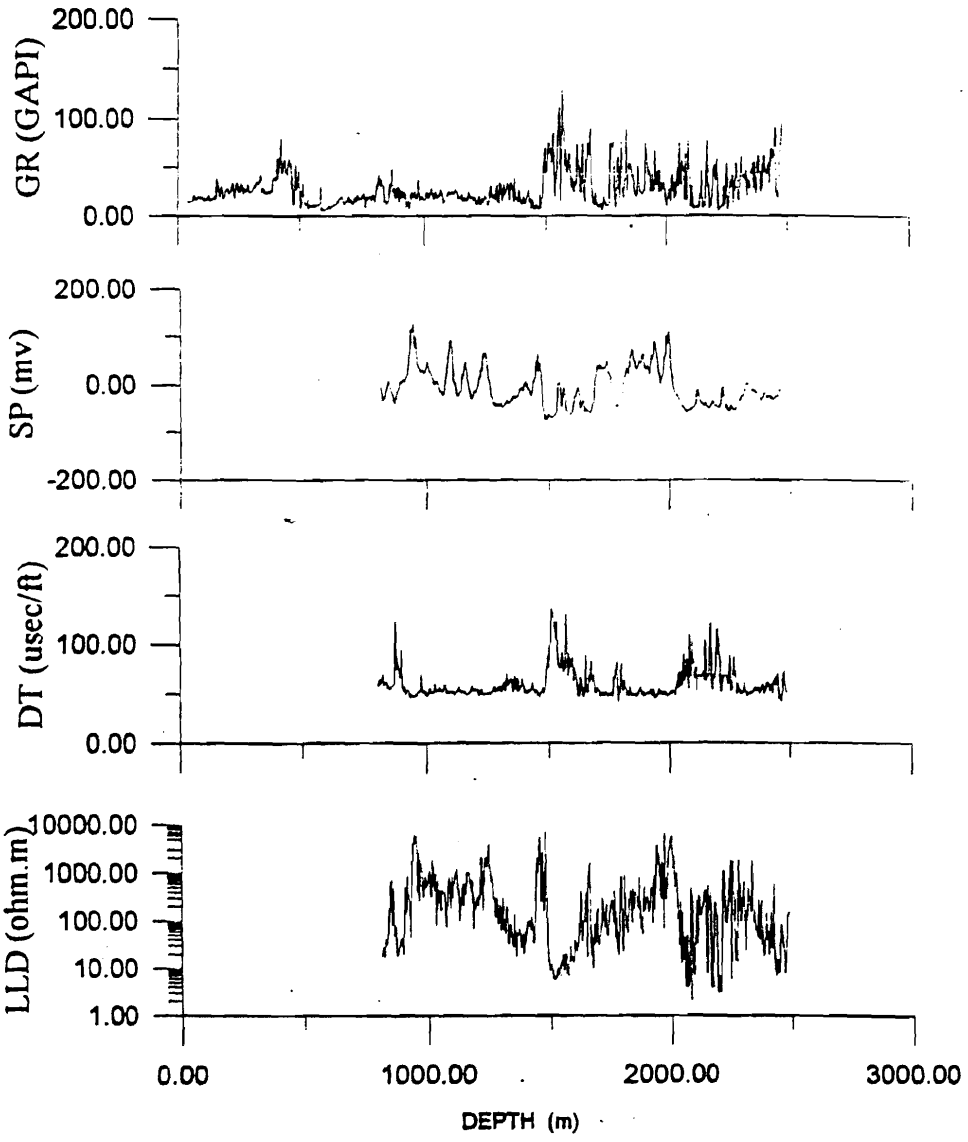


FIG.(3-d): DATA AVAILABLE "GR-,SP-,DT-, AND LLD-" LOGS IN AL HUREIA-1 WELL, NORTH PALMYRA, SYRIA.

along the depth extension of the wells (Figs. 4 to 7). Then by picking the corresponding real values of the log series, when represent the principal peak,by using Fourier analysis we could reach to a type of cross plots of the parameters, that are matched together versus depth (Figs. 8-a,b,c,d). These analysis had been carried out at the computer center of the Physics Department, Faculty of Science, by means of IBM PX2 computer, and using the software STATGRAF

RESULTS AND DISCUSSION

1- Inspection of Figure (8-a) shows that, more power spectrum values in Twenan-101 well are clustered in two zones. The first zone is relatively shallow at a depth of about 800 - 1100 m, and the other is deeper at a depth of about 1400 - 1900 m.

2- Inspection of Figure (8-b) shows that, same configuration was found in Hrit-1 well, where there are two clear zones, the first is at depth of about 1400 - 1650 m, and the other is at depth of about 2000 - 2600 m.

3- Figure (8-c,d) show that, there are no clear zones shown in the plots of both Al Akram-1 and Al Hureia-1 wells.

In fact, when the different parameters were plotted on the same cross plot diagram, that could be configured in the same pattern of zonation, although these parameters belong to different petrophysical characteristics, but in such case they are consistent in zonation form at different depths. This is probably due to the inclusion of an extra common medium tying up all of these parameters, and making such type of zonation, i.e. such inclusion which is most probably hydrocarbon material, or rich in organic matter, could be considered as common medium.

This picture exists only in both of Twenan-101 and Hrit-1 wells (Figs. 8-a, b). While in both Al Akram-1 and Al Hureia-1 wells (Figs. 8-c,d), there is no such inclusion in their formations, and in turn there are no fluid contents present. This may lead to the conclusion that these two wells are approximately dry.

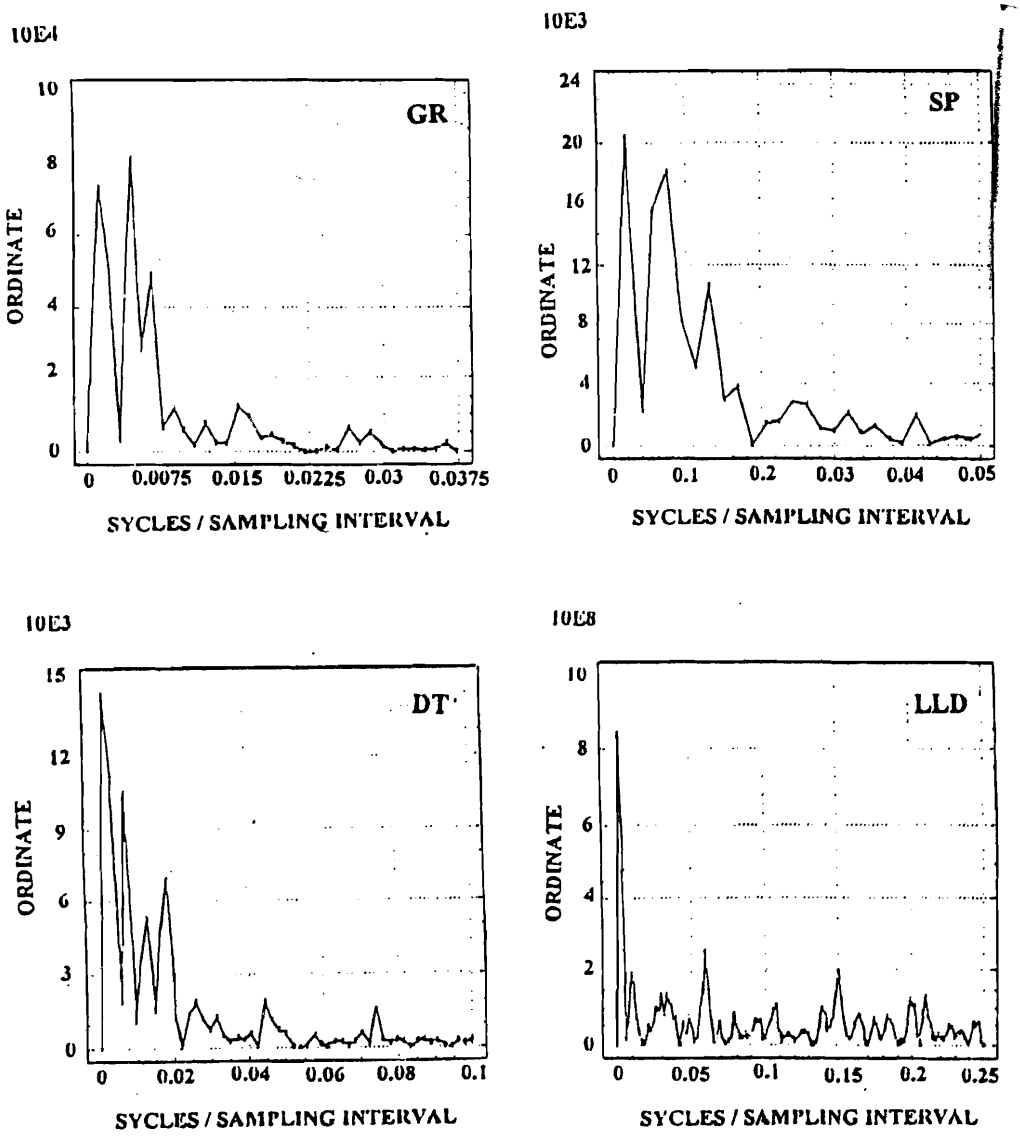


FIG. (4): POWER SPECTRUM OF GR-, SP-, DT-, AND LLD- LOG IN HRIT-1 WELL, NORTH PALMYRA, SYRIA.

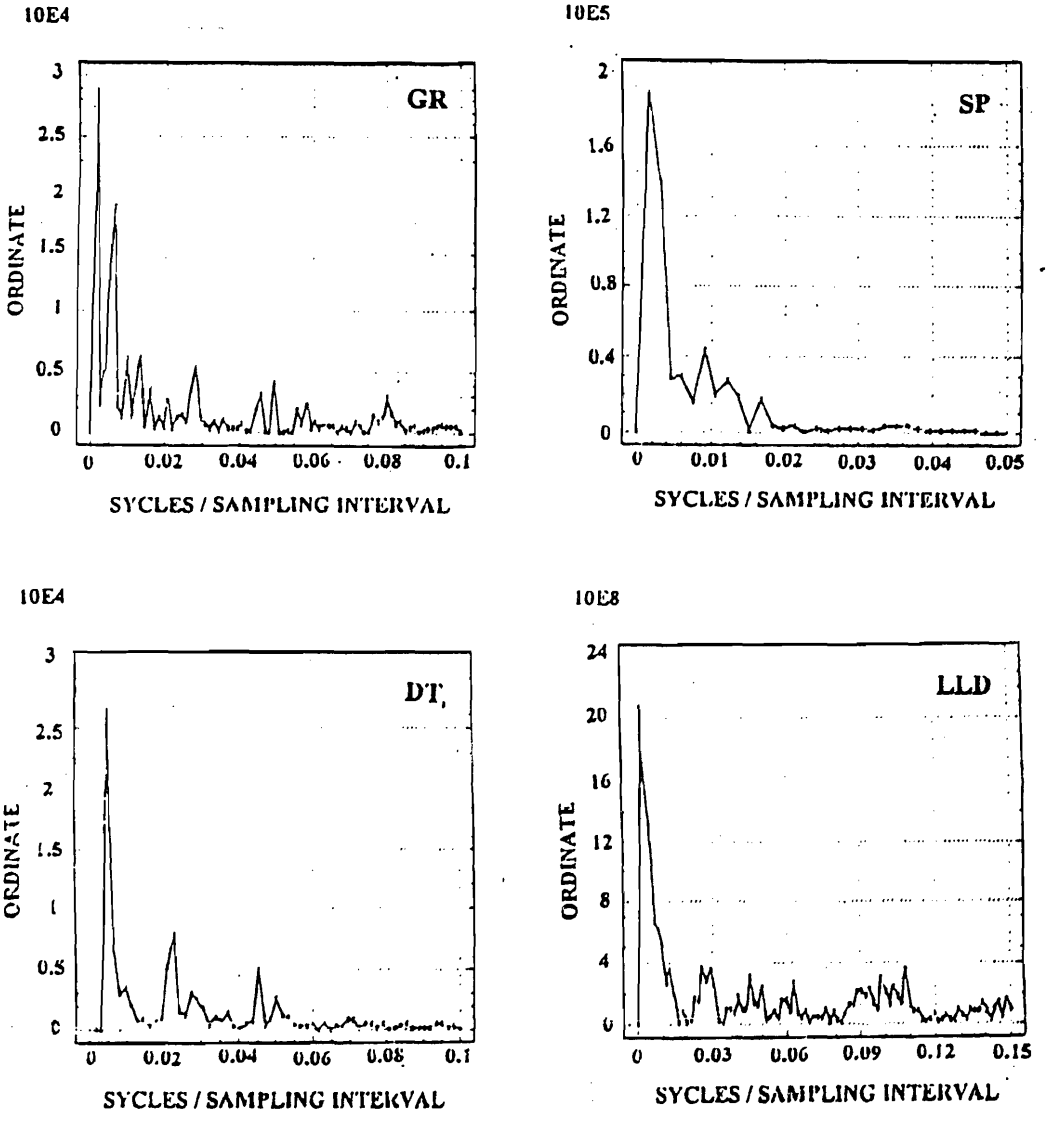


FIG. (5): POWER SPECTRUM OF GR-, SP-, DT-, AND LLD- LOG IN TWENAN-101 WELL, NORTH PALMYRA, SYRIA.

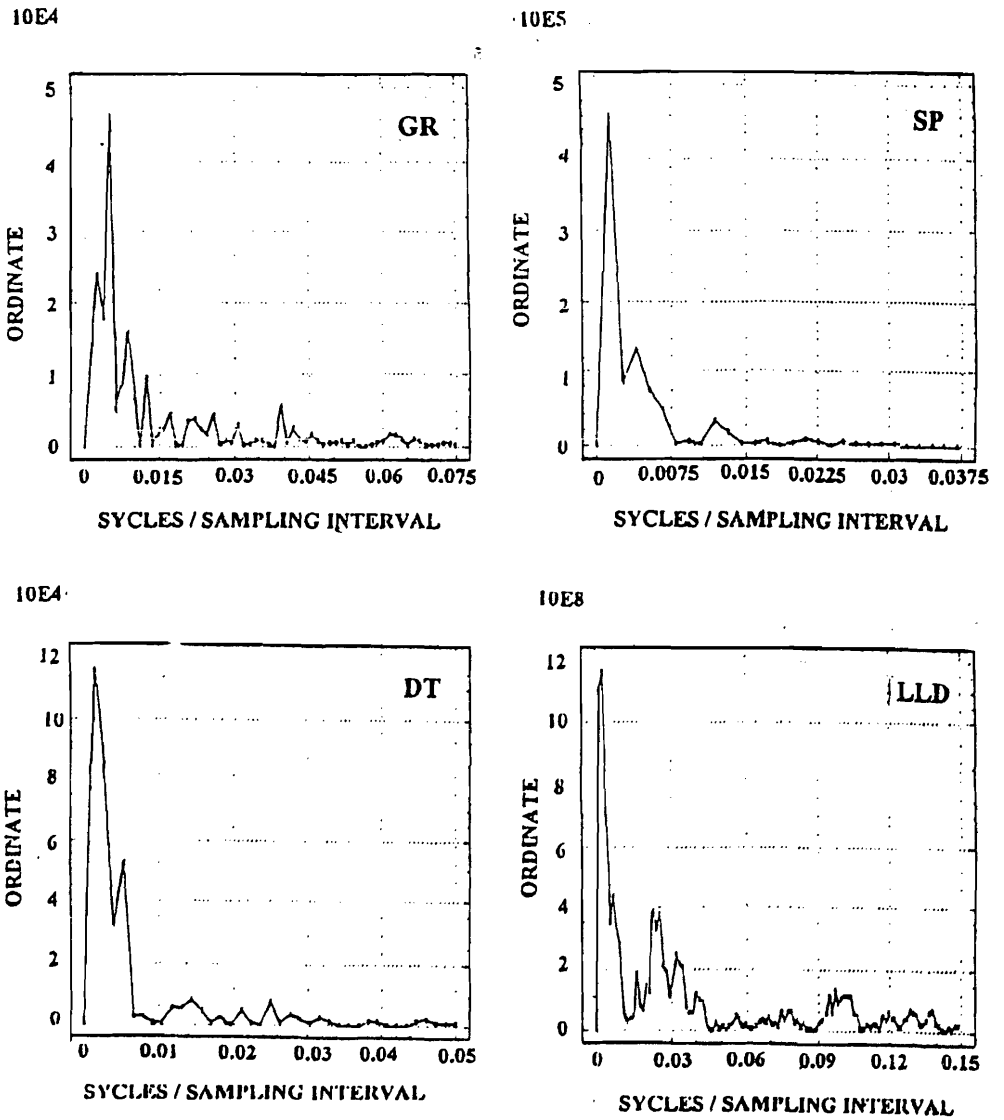


FIG. (6): POWER SPECTRUM OF GR-, SP-, DT-, AND LLD- LOG IN AL AKRAM-1 WELL, NORTH PALMYRA, SYRIA.

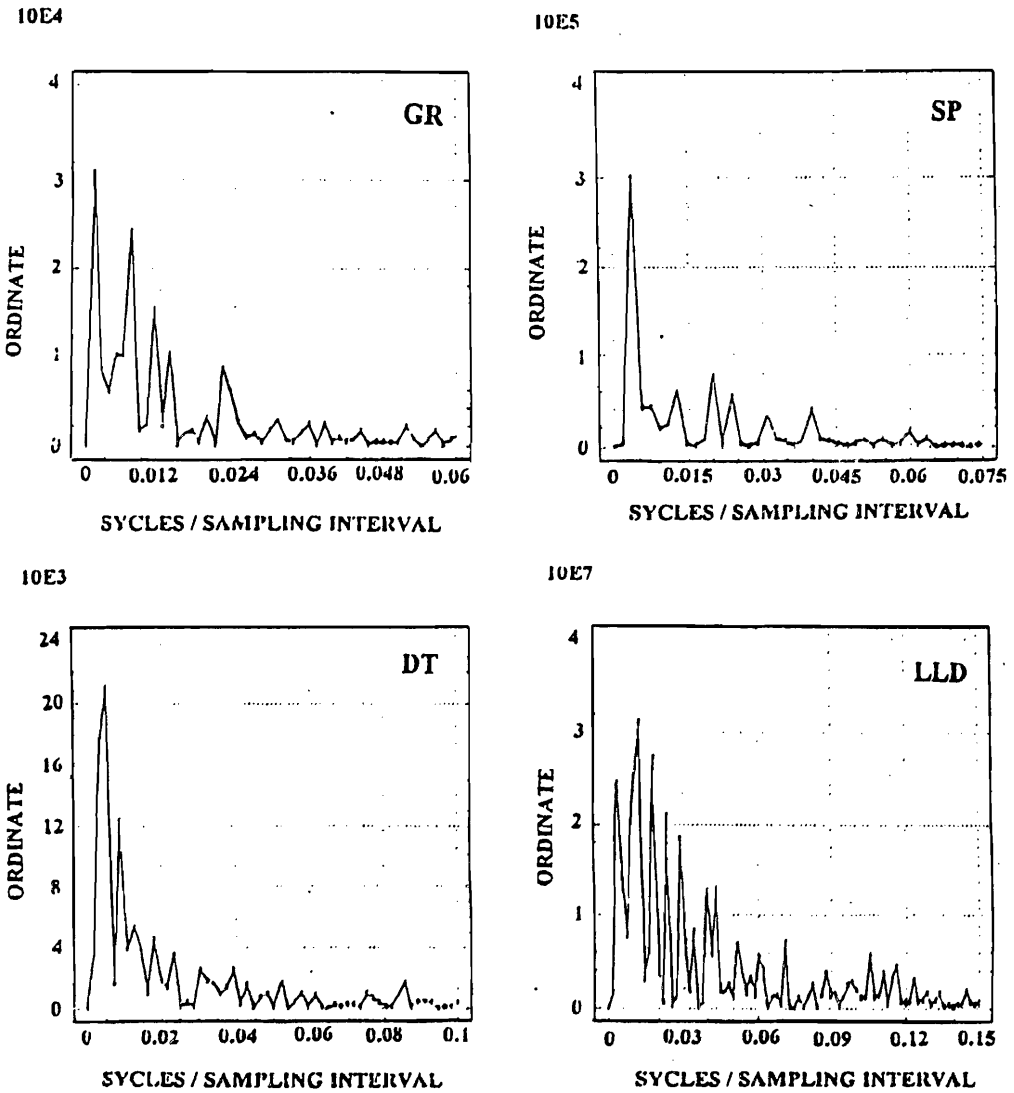


FIG. (7): POWER SPECTRUM OF GR-, SP-, DT-, AND LLD- LOG IN AL HUREIA-1 WELL, NORTH PALMYRA, SYRIA.

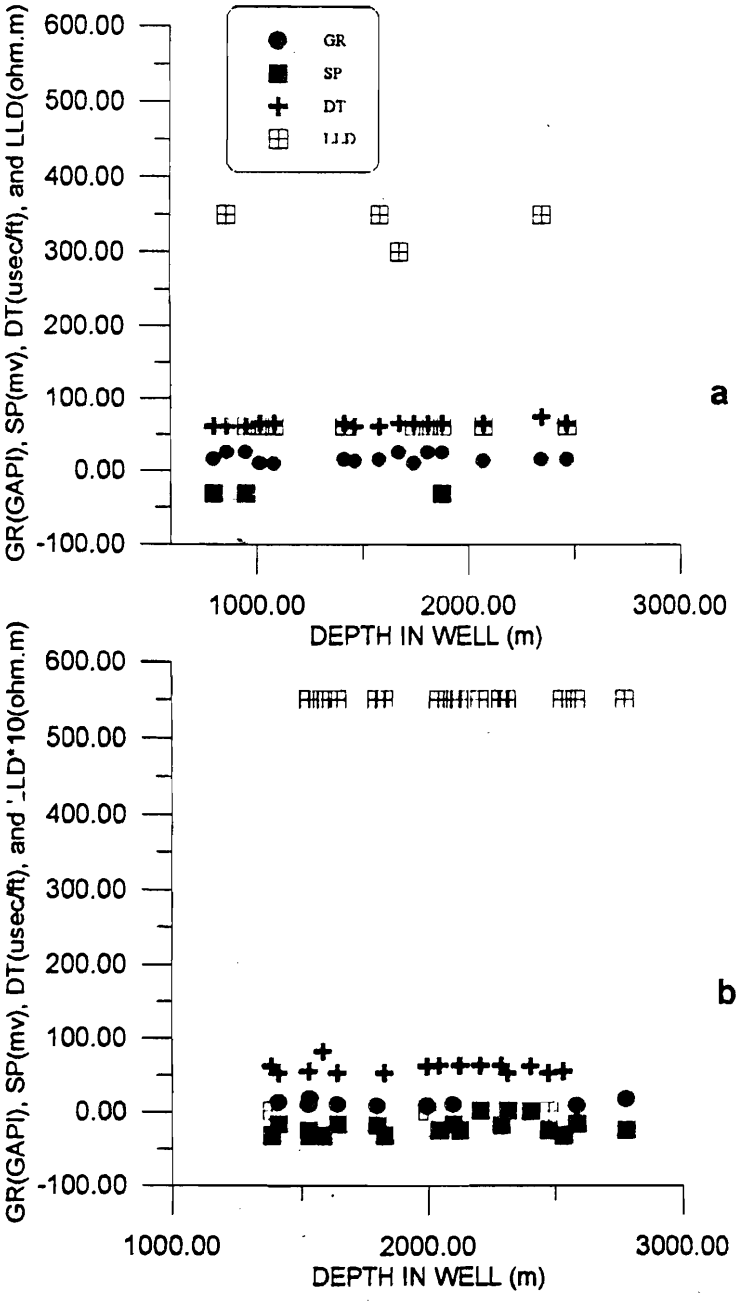
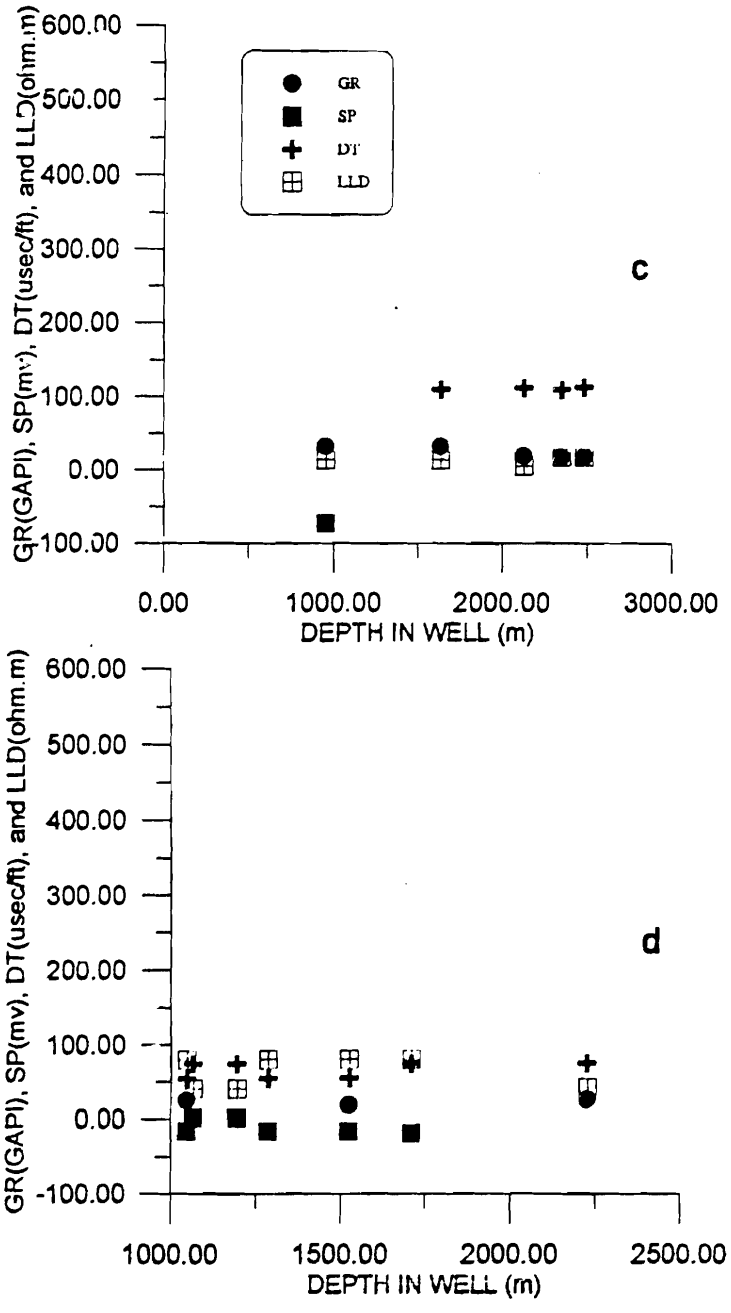


FIG.(8): CROSS PLOT DIAGRAM OF GR-, SP-, DT-, AND LLD- PARAMETERS a: IN TWENAN-101 WELL, b: IN HRIT-1 WELL, NORTH PALMYRA, SYRIA.



CONT. FIG.(8): CROSS PLOT DIAGRAM OF GR-, SP-, DT-, AND LLD- PARAMETERS
c: IN AL AKRAM-1 WELL. d: IN AL HUREIA-1 WELL, NORTH PALMYRA, SYRIA.

By comparing these results with the actual field observation, taken out from the final reports (Swidan, 1993, and Naimeh et al. 1993), it is found that there is a conformable agreement between these results. Twenan-101 well is producing oil at different depths (1000, 1022, 1429, 1522, 1578, 1715 and 1737 m) and Hrit-1 well is producing gas at different depths (1588, 1600, 1634, 1653, and 2010 m). Al Akram-1 and Al Hureia-1 wells do not include hydrocarbon material. This lead to the conclusion that the Southern part of the study area is more favorable for hydrocarbon potentialities.

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