Use Repeat Formation Tester for Determination of Some Reservoir Characteristics for Kareem Formation in Some Wells at Amal Field, Gulf of Suez Area, Egypt

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ABSTRACT

Repeat Formation Tester (RFT) data are used for interpreting some reservoir characteristics such as the nature of fluids and contacts between fluids for the Kareem Formation by using nine wells in the Amal Field in Gulf of Suez of Egypt. The Schlumberger RFT is an open hole wireline device showing a continuous recording of the pressure which leads to constructing the pressure gradient. These gradients give information about the fluid density and then the nature of fluids (gas, oil, and water). Also the depths of contacts between water and hydrocarbon products can be located by the abrupt change in the pressure gradients.

It was found that, the pressure profile clearly indicates two distinct areas. The first gradient represents the gas gradient with a density of 0.18 g/cc and the second is the oil gradient with density of 0.7g/cc. The gas oil contact at depth 6750 ft, while the other gradients represent the oil gradient with a density of 0.74 g/cc and the second is the water gradient with density of 1g/cc. The oil water contact is at depth 7500 ft.

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1. INTRODUCTION

Amal area is about 27 square kilometers in the offshore, southern part of the Gulf of Suez basin (Fig. 1). It is located some 55 kilometers from "Ras Gharib City" and about 15 kilometers south west from Morgan oil field. This study is applied on Kareem Formation for nine wells located in Amal Field in the Gulf of Suez of Egypt. These wells are Amal 8, 9, 10, 11, 12, 16, 17, 18 and 19 wells (Fig. 1).

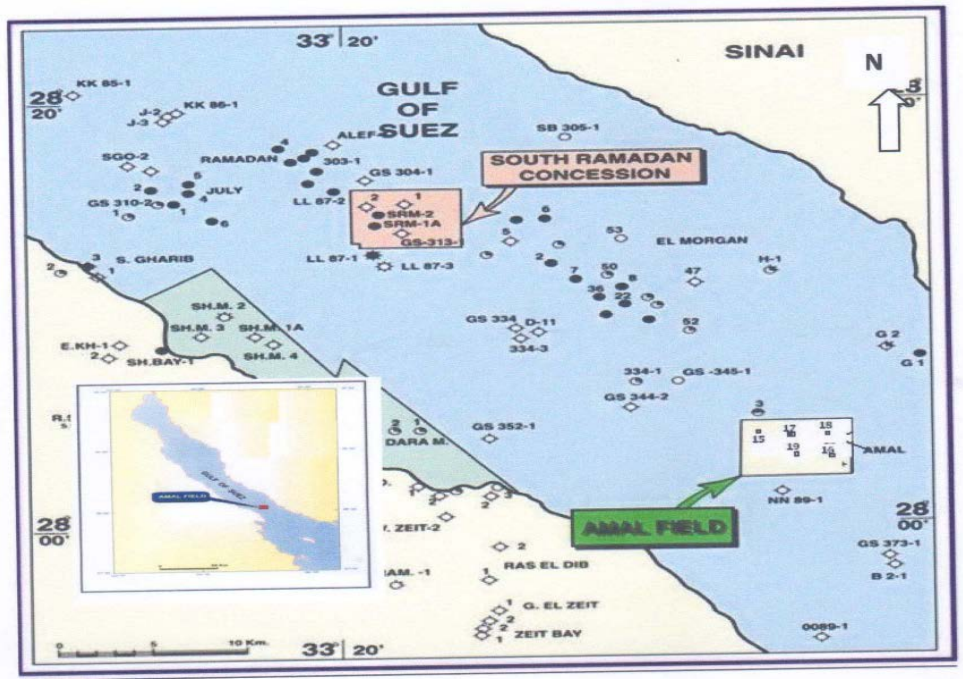

Fig. (1) Location map of the study area.

Fig. (2) shows the generalized stratigraphic column of Amal area in the Gulf of Suez for which three deposition phases are generally assumed. That comprises the deposition of formations ranging in age from a postulated Devonian to Eocene. These formations which include the Nubia sands, are important as reservoir rocks, and to a lesser extent as source rocks. In turn, it is represented by the lower Miocene and is characterized by its overall excellent qualities as source, reservoir and seal rocks. Also, the Upper Middle Miocene to Upper Miocene and Pliocene age in essence, closes the depositional history of Suez graben area.

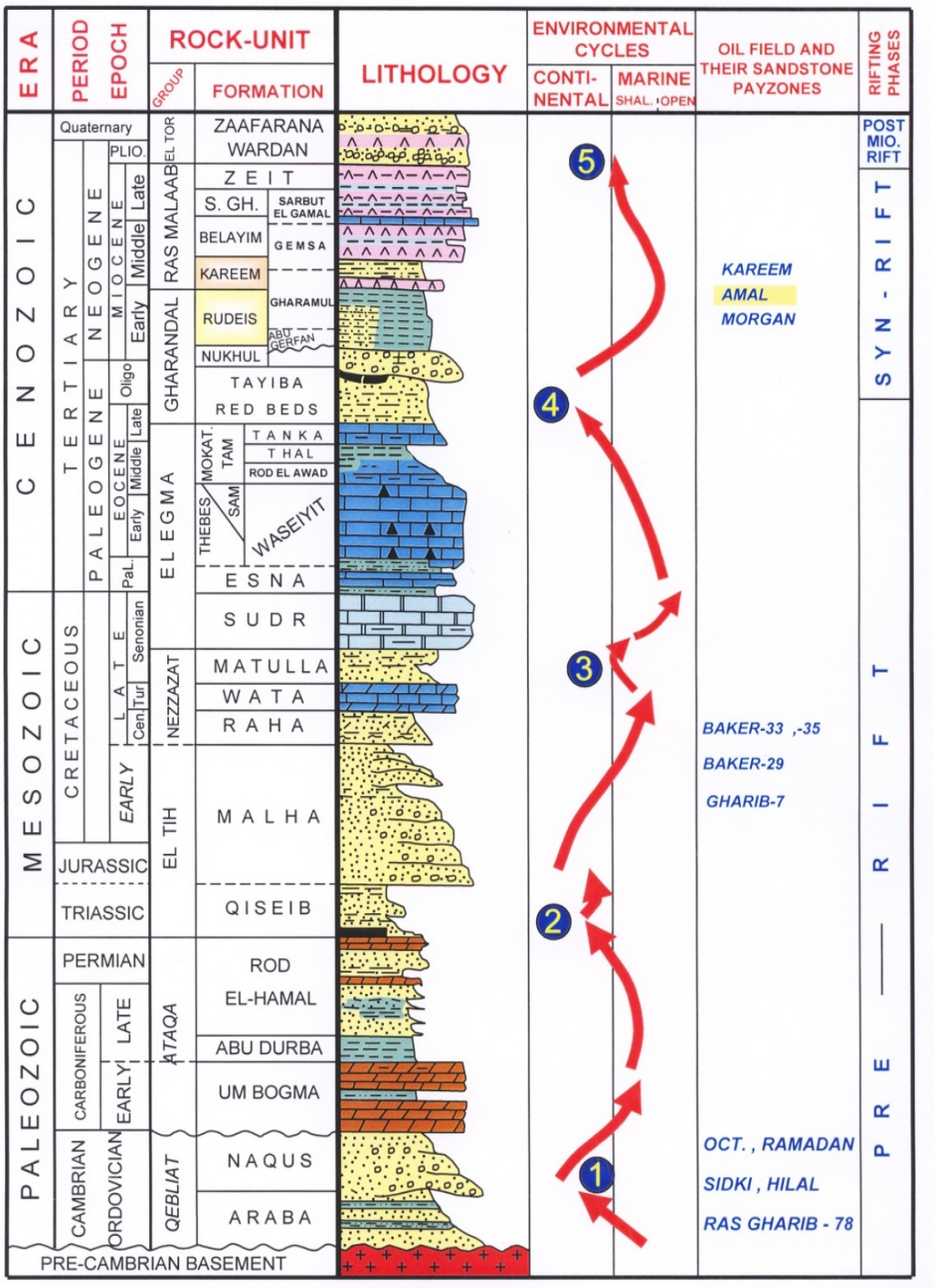

Fig. (2) A generalized litho- stratigraphic column of Amal Area, Gulf of Suez, Egypt (After Darwish& El-Araby, 1993 with modifications).

2. REPEAT FORMATION TESTER (RFT)

RFT is a tool which is lowered by wireline means; it is designed mainly to measure formation pressure, and also to obtain fluid samples for further testing on it. This tool has a flexibility action which that it can be re-set any number of times; which enables us to record a series of pressure data. Also it permits the logging engineer to test the formation for permeable formations before attempting to produce from it.

This RFT tool records three different types of pressure readings:

1. The hydrostatic pressure of the fluids in the well, it produces two readings.
2. The pore pressure of the formation.
3. The pressure transient induced by the withdrawal of 2 small samples. The tool has two pre-test chambers of 10cc volume which can be used to sample the formation at two differing rates.

The advantage for this tool to produce two readings for the well fluids hydrostatic pressure, is that these readings can be used for quality control for the data. These data can be compared with each other to ensure that the tool is working efficiently, the difference between the two readings must be in the range of few (psi).

While drilling there are estimates made to construct a reservoir pressure profile, RFT data are used to verify these estimates. These data will allow me to know the pressure gradient and the nature of fluids in the reservoir.

The pre-test sample data which are pressure, flow rate and time can be used to calculate reservoir characteristics, such as permeability.

A typical recording of a pressure profile is shown in Fig. (3). The analog pressure recording provides an excellent means of evaluating the integrity and general character of the pretest and the producibility of the formation. The pressure is initially at hydrostatic (mud) condition. When the piston stops, the pressure build up due to continued comparison of the packer, but suddenly drops again at the beginning of the pretest. At time t1, the piston in chamber No. 1 is fully withdrawn and the first pretest is completed. It is immediately followed by the higher flow rate and hence larger pressure drop of the second pretest. At time t2, the piston in the second chamber is fully withdrawn and the pressure builds up to the formation pressure (Desbrandes, 1985). Beside the valuable information which can be gained, RFT also save rig time (Serra, 1986).

In the present study the Repeat Formation Tester (RFT) data is used for interpreting some reservoir characteristics such as the nature of fluids and permeability for Kareem Formation by using nine wells in Amal Field in Gulf of Suez of Egypt.

In the present study, the permeabilities of Kareem Formation were evaluated qualitatively by the direct interpretation of the pressure curve recorded at each test and quantitatively by the analysis of drawdown pressure data.

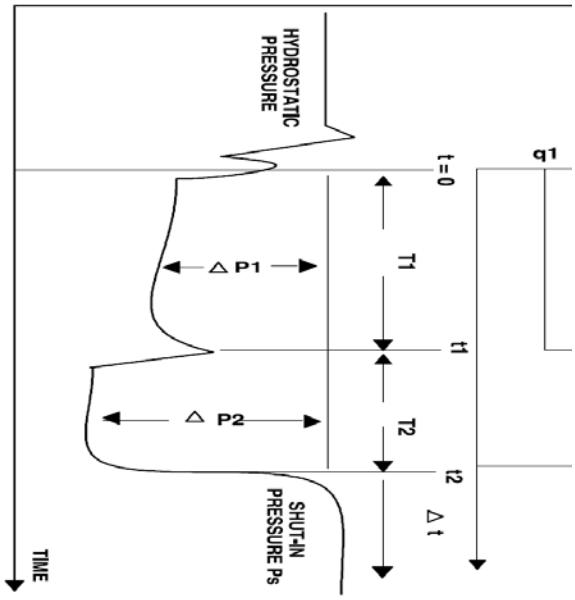

Fig. (3) Repeat Formation Tester analog pressure recording.

3. DETERMINATION OF DENSITY AND NATURE OF FLUIDS

The Repeat Formation tester which can make any number of accurate tests in one run in open hole has application in the determination of reservoir pressure, fluid density and fluid contact. Many pressure reading within a single reservoir can be taken.

The different measured formation pressure opposite the reservoir is plotted against the depth, and from this plot the nature of the flowing fluids (oil, gas or water) can be identified from their gradients. If this analyzed gradient give the value of density of water then, the continuous phase is water, while if the measured densities are that of oil or gas, the continuous phase will be oil or gas, (Serra 1986).

Also, the depth of free water level can be estimated by studying the abrupt change in pressure on the pressure gradient.

The pressure readings when plotted versus depth will normally produce gradients with pressures increasing with depth in which the slope of a particular gradient (extrapolated line) is related to fluid density within the reservoir (Basal, 1996). The relationship between fluid density and the pressure gradient can be expressed as follow:

fluid density (g/cm3) = 2.31 ∗ pressure gradient (1)

in which :

pressure gradient = 1 / m = pressure in Psi / depth in ft (2)

where: m is the slope of the extrapolated line.

Also, the intersection of the water gradient with the oil or gas gradient represents the free water level, as shown in the following figures.

Figures (4-8) represent the formation pressure against the depth, for Kareem Formation in Amal 8, 9, 10, 11, 12, 16, 17, 18 and 19 wells. The pressure profile clearly indicates two distinct trends. The pressure profile clearly indicates two distinct trends. The first gradient represents the oil gradient with a density of 0.74 g/cc and the second is the water gradient with density of 1g/cc. the oil water contact at depth 7500 ft (Fig. 4).

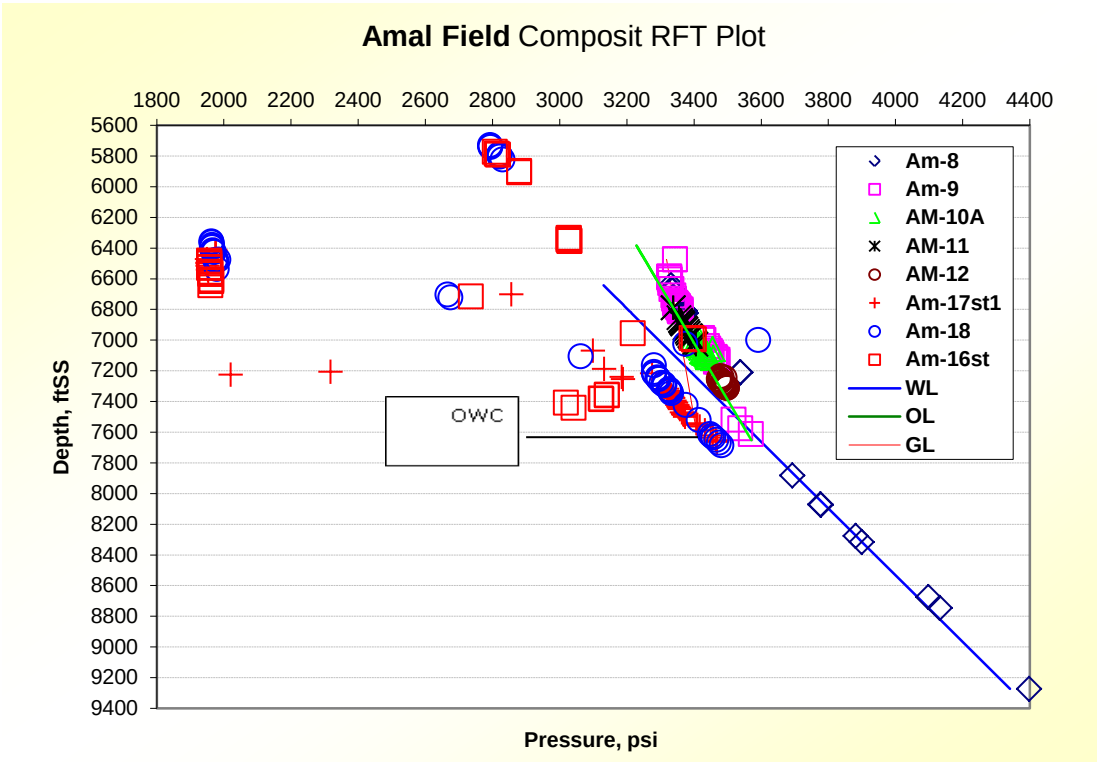

Fig. (4) Pressure profile of Kareem Formation in Amal (8-17) wells.

In Amal (8-12) wells the pressure profile clearly indicates two distinct where the first gradient represents the gas gradient with a density of 0.18 g/cc and the second is the oil gradient with density of 0.7g/cc. The gas/oil contact is at depth 6750 ft as shown in (Fig. 5).

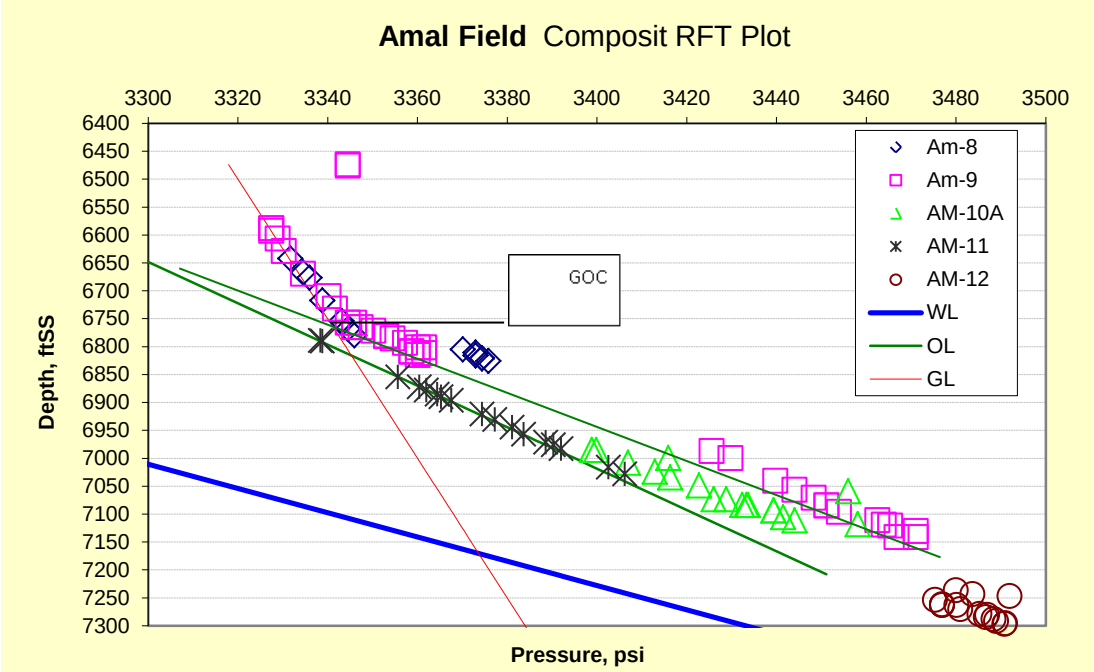

Fig. (5) Pressure profile of Kareem Formation in Amal (8-12) wells.

Fig. (6) shows, the pressure profile of Amal (8-16) wells which indicates two distinct gradients. The first gradient represents the oil gradient with a density of 0.6 g/cc and the second is the water gradient with density of 1.05g/cc. The oil/water contact lies at depth 7625 ft.

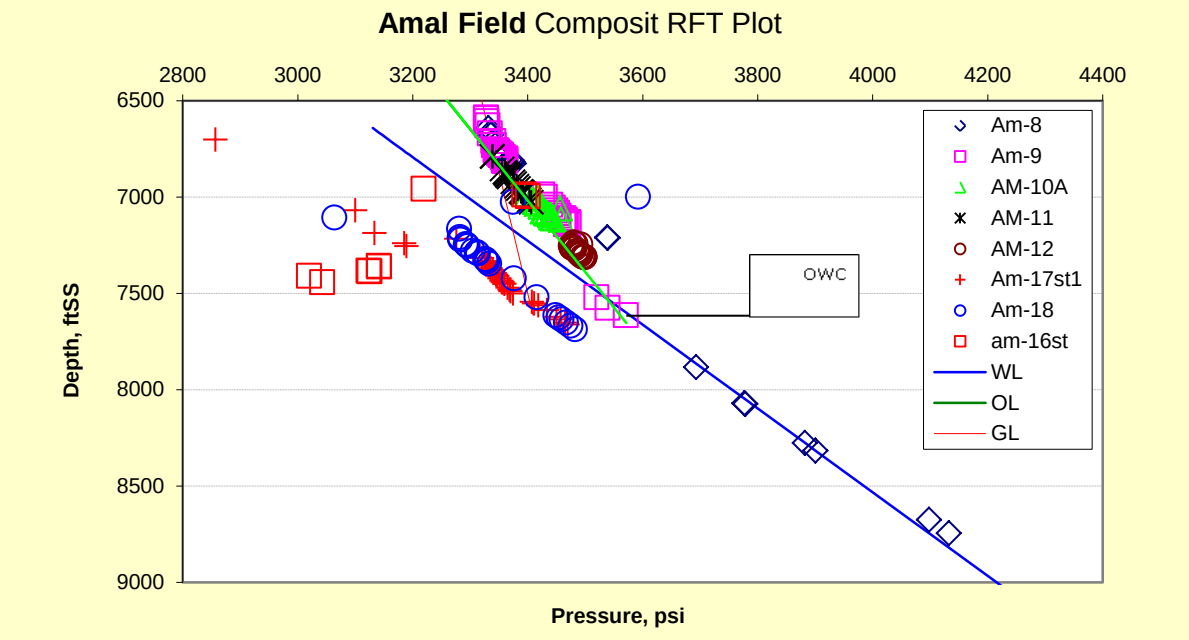

Fig. (6) Pressure profile of Kareem Formation in Amal (8-16) wells.

Fig. (7) exhibits that there are two distinct trends, the first gradient represents the oil gradient with a density of 0.62 g/cc and the second is the water gradient with density of 1.02g/cc. The oil water contact is at depth 7500 ft.

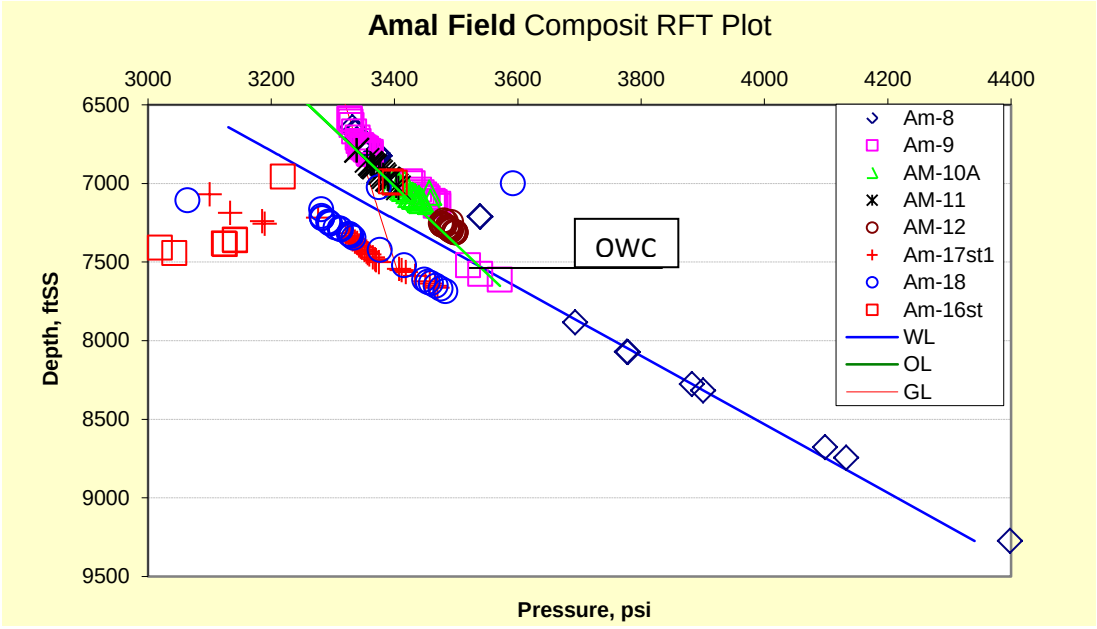

Fig. (7) Pressure profile of Kareem Formation in Amal (8-12) wells.

Also, two gradients can be shown in Fig. (8), where the first gradient represents the oil gradient with a density of 0.69 g/cc and the second is the water gradient with density of 1.07g/cc. and the oil water contact located at depth 2226 m. as shown in Fig. (8).

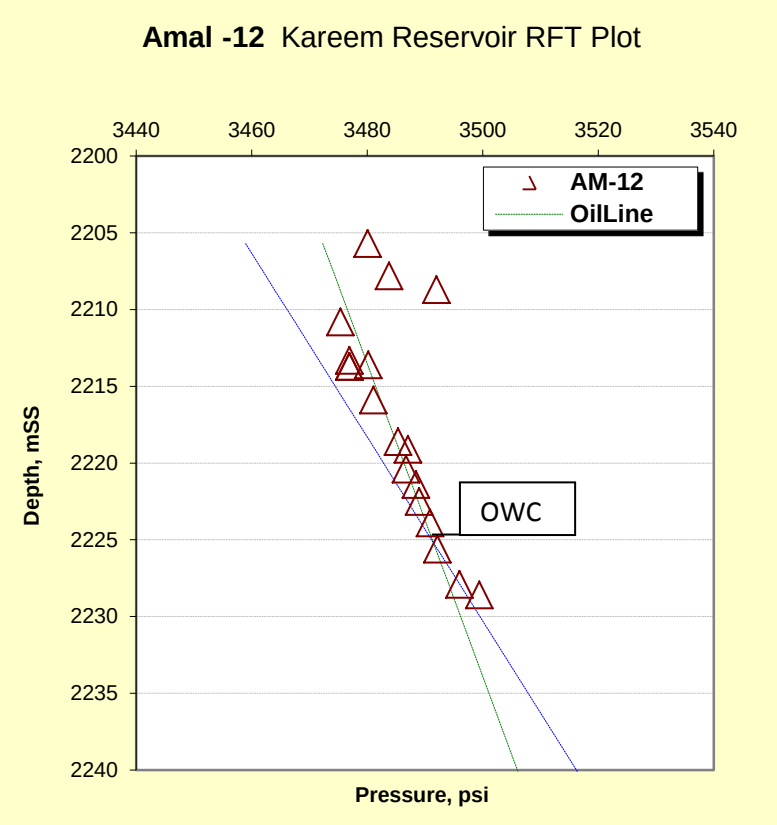

Fig. (8) Pressure profile of Kareem Formation in Amal-12 well.

SUMMARY AND CONCLUSIONS

The Repeat Formation Tester is an important tool for production and reservoir engineering. RFT pressure data can be interpreted to obtain formation permeability and actual formation pressure that can be applied for a better understanding of petroleum reservoirs.

The application is applied on Kareem Formation in nine wells distributed in Amal Field in Gulf of Suez area of Egypt.

The application discussed is based on the analysis of RFT pressure profiles. Plotting formation pressures versus true vertical depth produces a pressure profile. Evaluating the gradient of this profile provide information about the type of fluids and the contact between them by monitoring the abrupt changes in the pressure gradients. The pressure profiles of Kareem Formations in Amal 8, 9, 10, 11, 12, 16, 17, 18 and 19 were constructed. Through the pressure profile, most of the dominated fluids are the oil contacted with water which indicated that the oil can be extracted from the studied formation.

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