

FORMATION EVALUATION OF RUDEIS FORMATION AT NORTH AMER OIL FIELD , GULF OF SUEZ, EGYPT

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ABSTRACT

The present work deals with the evaluation of Rudeis Formation encountered in eleven wells in North Amer area (FF/GG region) using well log analysis, such logging analysis have been carried out using developed computer program known as T log (Terrascience, 1988). The evaluated petrophysical parameters are used to study the lateral and vertical variation of petrophysical properties in Rudeis Formation. For this purpose, the isometric distribution maps of petrophysical parameters (shale content, effective porosity, water saturation and hydrocarbon saturation) and lithosaturaton crossplots in the study wells have been constructed.

INTRODUCTION

The study area is situated in the Gulf of Suez near the west coast, about 20 kms northwest of the offshore Amer Oil Field, it lies between Lats. $28^{\circ}42'$ and $28^{\circ}52'00''$ North, and Longs. $32^{\circ}52'00''$ and $32^{\circ}56'00'$ East (Fig. 1). The penetrated Miocene rocks in the study area from top to bottom are :

1- Zeit Formation 2-South Gharib Formation 3- Belayim Formation 4- Kareem Formation 5- Rudeis Formation and 6- Nukhul Formation.

Among them, more amphasis was made to Rudeis Formation

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which represent one of special important targets with respect to oil accumulation. Geologically, the Rudeis Formation is formed of sandstones intercalated with shales, limestones and occasional marls.

The Rudeis Formation was subjected to comprehensive well log analysis to perform quantitative estimation of oil potentialites encountered in eleven wells in the study area through a number of litho-saturation crossplots, distribution maps of petrophysical (shale content isoporsity, water saturation and hydrocarbon saturation maps).

1. Methodology of Well Logging Analysis.

Correction of resistivities (R_w) at the formation temperature was estimated using Schlumberger crossplots. The invaded zone correction was applied using LLD, LLS and R_{xo} logs following the procedure in the Schlumberger dual laterolog to calculate R_T . Environmental corrections were used to density neutron and gamma ray logs in order to determine the effective porosity (Schlumberger, 1972, 1974, 1979 & 1982). The water saturation (S_w) were determined using "Indonesia" equation (Schlumberger, 1972). The residual hydrocarbon saturation (S_{hr}) and movable hydrocarbon saturation (S_{hm}) were determined using the following equations :

$$S_h = I - S_w,$$

$$S_{hr} = I - S_{xo}, \quad \text{and}$$

$$S_{hm} = S_h - S_{hr} \quad \text{or} \quad S_{hm} = S_{ox} - S_w \quad (\text{Schumberger, 1974}).$$

After the calculation of V_{sh} , S_{xo} and S_w for the considered formation, the average value of each of these parameters and the net pay thickness in each well are calculation. The general flowchart

for such calculation is shown in figure 2. The software program used in the formation the evaluation process is known as T log (Terrasciences, 1988).

11. Reservoir Oil Potentialities.

The study of the oil potentialities of Rudeis Formation encountered in north Amer Field is achieved through the evaluation of their petrophysical parameters. This is illustrated through distribution maps of the petrophysical parameters together with litho-saturation crossplots. The vertical distribution of petrophysical parameters is presented through the litho- saturation crossplots which show the continuous logs and histograms reflecting variation in lithology and petrophysical parameters with depth.

II.1. Litho-Saturation Crossplots of Rudies Formation :

The study of litho-saturation crossplots for the selected wells (Fig. 3 a-b) show the following :

a. FF 83-3 Well is bottomed in the Rudeis Formation. Figure 3-a represents the litho-saturation cross-plot for the interval from depth 6944 to 7448 ft. The results are given by proposed computer techniques for lithology classification. The sandstone of Rudeis Formation in this well is about 128ft intercalated with shales ($V_{sh}=18\%$). The corrected effective porosity of this well is a considerable one for the overall section as 15%. Such porosity may store commercial quantities of hydrocarbons. Residual and movable hydrocarbon are considered in this well.

b. Figure 3-b represents the litho-saturation crossplots of

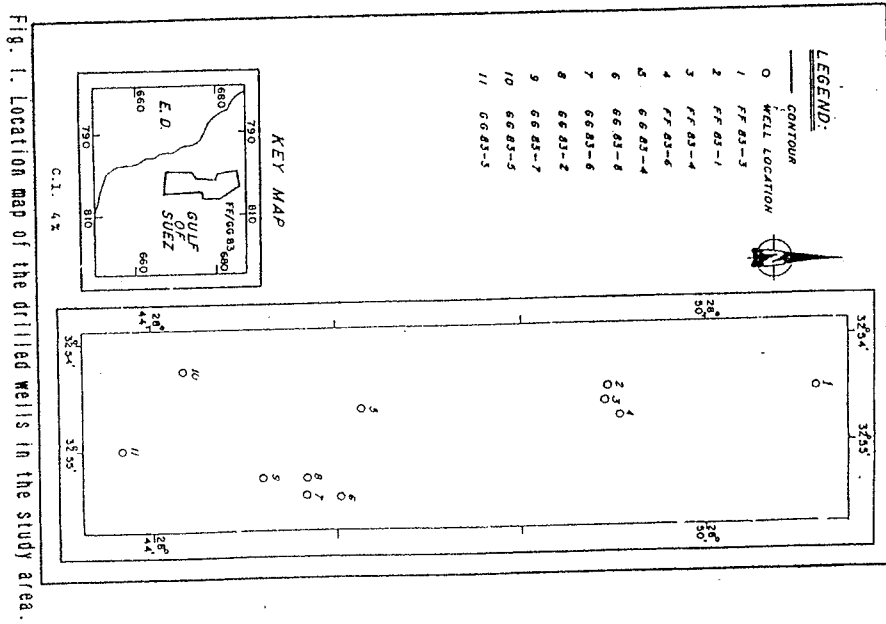


Fig. 1. Location map of the drilled wells in the study area.

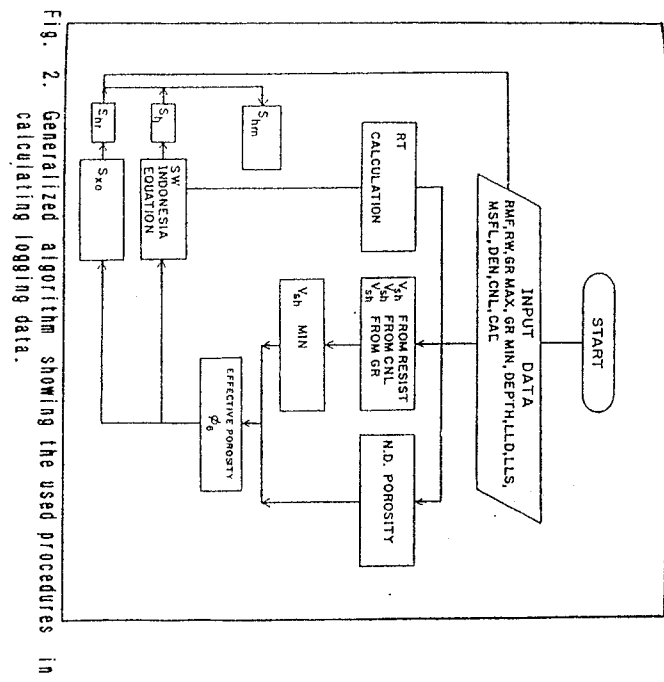


Fig. 2. Generalized algorithm showing the used procedures in calculating logging data.

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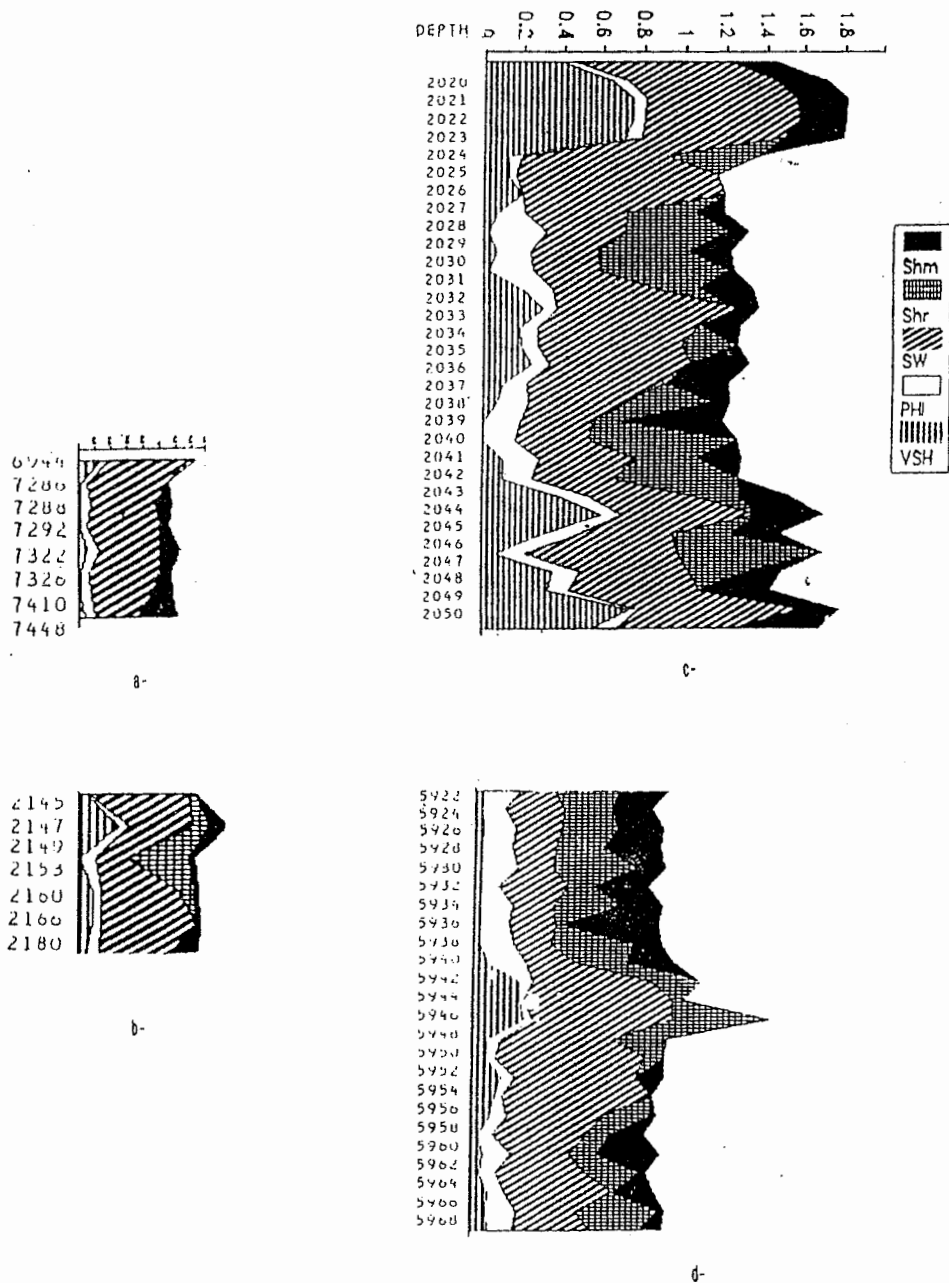


Fig. 3 . Litho-saturation cross-plot of a- FF83-3 b- FF83-4
c- GG83-7 d- GG83-2.

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Rudeis Formation in FF 83-4 Well. The interval of payzone thickness ranges from 2145 to 2180 ft. The shale content in sandstone of Rudeis Formation is 3%. The calculated effective porosity are found to be a good value (17%) which is considered as a level of commercial amounts of hydrocarbon. Residual and movable hydrocarbons are 26 % and 14 % respectively.

c. Well GG 83-7 shows that there is a remarkable oil saturation with missing gap at interval from depth 2024 ft to 2026 ft in the Rudeis (Fig. 3c). It is also obvious a remarkable porosity in the sandstone (10%) and a relative high movable, residual hydrocarbon and oil saturation. The shale content in the sandstone payzone of the Rudeis Formation in this well is relatively high (45%) which reflects higher argillaceous sandstone. It obvious from this study that the Rudeis Formation is consisted of two types of sandstones, these are nearly clean sandstone in GG83-2 and GG83-4 Wells (figs. 3-d & 3-b) and highly argillaceous sandstone in GG83-7 Well (Fig. 3-c). The sandstone of the other wells can be considered as a mixture of the above mentioned types of sandstones.

11.2. Petrophysical Iso-Parametric Maps.

The calculated values for petrophysical parameters (V_{sh} , ϕ_e , S_{hr} & S_{hm}) for Rudeis Formation in the study area are represented in shale content, iso-porosity, water saturation, and hydrocarbon distribution maps respectively.

a. Shale Content (V_{sh}) Map.

The shale content distribution map (Fig. 4) shows that the

shale content varies from 3% at well GG 83-4 to 45 % at GG 83-7 well. It shows an increase of shale content from western and northern part toward eastern area where GG 83-8, FF 83-6, and GG 83-7 Wells are located. It also shows that the Vsh values of Rudeis Formation in the FF83-2, GG83-4 and GG83-5 Wells are not exceeding 10 %.

b. Iso-Porosity (On) Map.

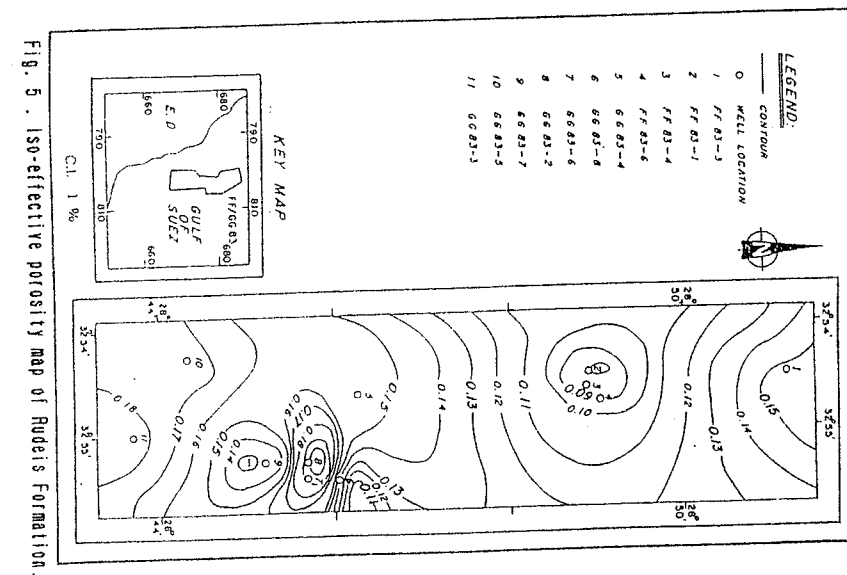
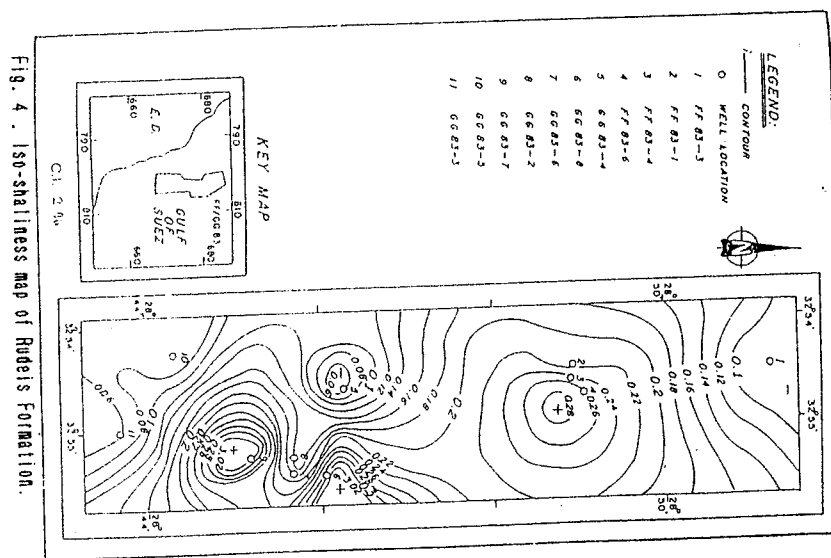
This map shows the corrected and average porosity changes in the Rudeis Formation (Fig. 5). It exhibits considerable high values occupying the area around Wells GG 83-6 and GG 83-2 and low values existing near Wells GG 83-7 in the south and FF 83-1 in the northern part of the area. These variations in porosity can be returned to sedimentary processes and structural factors.

c. Water Saturation (Sw).

The Rudeis Formation in the well encountered in the study area have water saturation (Sw) ranging from 17 % in GG83-2 Well to 92% in FF 83-1 (Fig. 6). Also this map reveals an increase in water saturation from eastern and southern parts of the area towards the west (FF 83-3 Well). The higher closures in porosity around GG 83-6 and GG 83-2 Wells are replaced by the water saturation minima reflecting the migration of oil up to these closures of high structure.

d. Hydrocarbon Saturation.

The hydrocarbon saturation map (Fig. 7) exhibits the effects of structural and effective porosity of the formation on the distribution of fluids. It also shows high oil saturation areas in the southwest direction around GG83-2 Well which have a low shale content and



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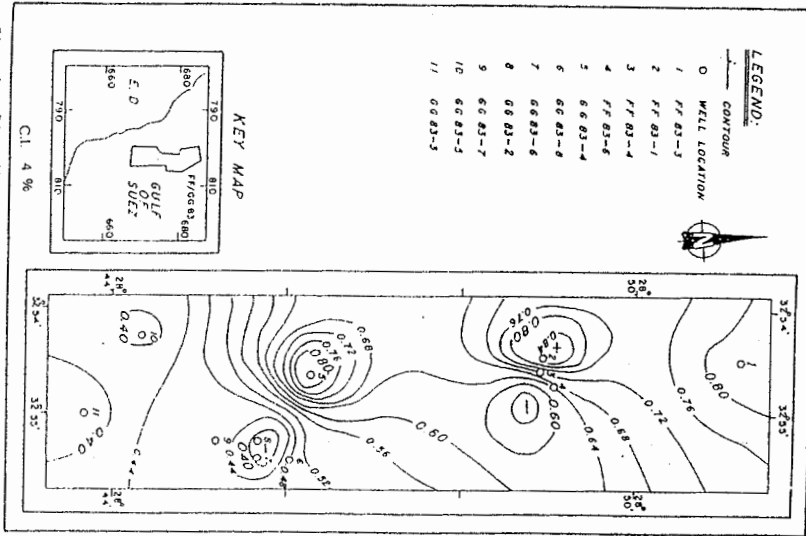


Fig. 6 . Distribution map of water saturation of Rudeis Formation.

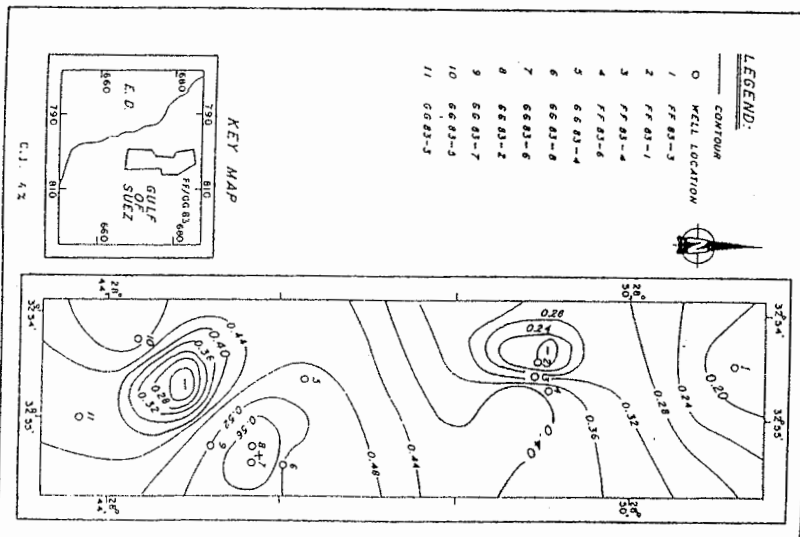


Fig. . Distribution map of hydrocarbon saturation of Rudeis Formation.

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remarkable porosity. Another two low hydrocarbon saturation anomalies are located in the central part around Well FF83-3 and in the south western part around well GG83-4.

CONCLUSIONS

Comprehensive well logging analysis have been performed for considered Rudeis Formation in eleven wells in the study area. The results obtained from litho-saturation crossplots and iso-parametric distribution maps (shale content, iso-porosity, water saturation, and hydrocarbon saturation maps) can be concluded as follows :

1. Frequent distribution of shale content from western and northern parts towards eastern area where GG 83-8, FF 83-6 and GG 83-7 Wells are located. While the considerable amounts of sandstone are found mostly in the wells GG 83-2 and GG 83-4.

2. The structural and effective porosity of the Rudeis Formation play an important role in the distribution of fluids in the study area.

3. The liquid hydrocarbon saturation shows a increase from eastern and southern part in the area towards FF 83-1, FF 83-3 and GG 83-4 Wells. The higher cisoures in porosity are replaced by the water saturation minima reflecting migration of oil up to these locations.

4. The absence of oil shows within the other parts of the area are due to lack of hydrocarbin migration or due to leakage . through the bounded faults.

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تقييم تكوينى لتكوين روريس بحقول شمال عامر خليج السويس - مصر

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تهتم هذه الدراسة بتقييم تكوين روريس فى احدى عشر بئرا فى منطقة حقول شمال عامر (منطقة FF / GG) باستخدام تحليل تسجيلات الابار . وقد استخدم لذلك برنامج معرف (Terascience log-T log) ولدراسة التغيرات الجانبية والراسية للخواص البتروفيزيقية لتكوين روريس استخدمت المعاملات البتروفيزيقية فى تصميم خرائط توزيع للطفلة والمسامية وتشبعات الماء والهيدروكربونات وكذلك صممت قطاعات بيانية للتشبع الصخرى .