SUMMERY AND CONCLUSIONS

October field is considered one of the largest oil fields in the Gulf of Suez. It lies between Latitudes 28° 46′ 40″ and 28° 57′ 10″ North and Longitudes 32° 57′ 33″ and 33° 10′ 00″ East. October field consists of a number of platforms; begins from platform " A " at the southeastern to platform " J " at the northwestern parts of the field. Platform " J " is considered one of the most important platforms for oil production from Asl Sand reservoir.

Aim of Study:

The aim of this study is to perform complete evaluation of Asl Sand reservoir (lower part of Asl Formation) in the area north of October field, the area bounded by coordinates 692.000 and 698.000 N and 803.000 and 808.000 E, through the study of the petrophysical characteristics of 12 wells (9 for complete analyses and 3 for correlation and matching) along with some geochemical and seismic characteristics.

Also, this study deals with evaluation of Asl Marl section (upper part of Asl Formation) and Hawara Formation which underlies Asl Formation as possible source rocks in order to detect their total organic carbon content (TOC) and check for the possible relationship between the implied hydrocarbons and the detected source materials if found.

Avaialble Data:

The different available Electric logs (Sonic, Density, Neutron, Gamma Ray, Resistivity logs, Caliper, Dipmeter log...etc) for the 12 studied wells were used. Moreover, the geochemical analyses of some of the drilled wells in October field area were also used besides some velocity records.

Methods of Study:

Different methods, either qualitative or quantitative, were used for detecting the different petrophysical parameters, which are necessary for performing complete evaluational analyses of the two studied formations. Many environmental corrections were made for the dataset before running the analytical evaluation system, like correction of temperature with depth, correction of Gamma Ray and Neutron logs for borehole variations, matrix correction and so on.

Total and effective porosities were determined using single porosity tools (Neutron, Density and Sonic logs) and the combinations of two of them besides Porter method. Volume of shale was determined using both single log indicators (Gamma Ray, Resistivity, Neutron logs) and double log indicators (Neutron-Density, Neutron-Sonic and Density-Sonic). Water and hydrocarbon saturations were calculated using different methods in case of clean and shaly formations. Source rock parameters and total organic carbon (TOC) were also calculated using both techniques of Schmoker and Passey.

Moreover, Gas saturation, pay cut-off parameters and the different lithological components constituting Asl and Hawara formations were also estimated.

In addition to the analytical quantitative methods, many qualitative relationships, histograms and crossplots of two and three-dimensional Z-axis were also constructed. Shale parameters were deduced using the M-frequency crossplots and the different histograms. Resistivity of water was determined in both clean and shaly formations using V_{sh} - $(R_w)app$ crossplot. Water saturation was determined using Pickett plot. Quick determination of the implied hydrocarbons was also made through the study of the $(R_w)app$, R_o-R_t and F-F_{deep} curve overlays. Gas saturation was tested using GR - (ϕ_N-ϕ_D) and fluid identification (FID) plots.

Porosities (total and effective) and shale volume were determined using the combined crossplots of Neutron-Sonic and Neutron-Density with Gamma Ray as Z-axis. Lithology identification was done using MN, AK and MID plots.

Petrophysical Evaluation:

A complete petrophysical evaluation system was applied upon the two studied formations. All the necessary petrophysical parameters which are of prime interest such as porosities (total and effective), volume of shale, fluid saturation (water and hydrocarbon), lithological components...etc, were deduced. Two different methods for representing and interpreting the data were used. The first is the vertical representation, in which the different deduced petrophysical parameters were represented as function with depth. This type of presentation is called the petrophysical data log (PDL) or the litho-saturation crossplot. The second is the lateral presentation in which a number of iso-parametric maps were constructed to clarify the aerial lateral distribution of certain characteristic phenomena.

For Asl Sand reservoir, which is our target in this study, its found that total porosity is high and ranges between 8% and 14% with increasing order to the northwest and southeast directions of the study area. Effective porosity also shows the same behaviour as it ranges between 8% and 14%. This is due to the clean petrophysical properties of the Asl Sand which attains very low shale content. Such low shale content is reflected in the pore space characteristics of this sand which are closely similar to each other, either total or effective. Effective porosity values increase to the northwest and southeast directions. The water saturation distribution map of Asl Sand reservoir reveals that there is decreasing order of water saturation towards the southern parts of the study area. While in the central and northern parts there is a remarkable increase. Water saturation ranges between 12% and 99%.

Thickness distribution map of Asl Sand section is also constructed. It shows that the thickness of Asl Sand section is not uniform in the study area as it exhibits irregular thickness distribution ranging in values between 58ft and 328ft. The sandstone distribution map of Asl Sand section was also constructed. Asl Sand zone consists mainly of thick sand body. This is indicated by the high recorded sand volume values in all studied wells. The sandstone distribution map of Asl

Sand zone shows remarkable decrease in value towards the northwest and southeast directions.

Geochemical Evaluation:

In this respect the upper part of Asl Formation (Asl Marl) and the underlying Hawara Formation were studied as possible source rocks. Total organic carbon was determined using two different methods. The first method is of ***Schmoker*** and ***Hester (1983)***, in which the total organic carbon content (TOC %) is related to the density log only. The constants of this method (A and B) were re-calculated and calibrated with the available geochemical analyses. While the second method (Δ log R Technique) of ***Passey et al. (1990)*** depends mainly on the combination of resistivity with porosity logs and allows organic richness to be accurately assessed in a wide variety of lithologies and maturities using common well logs.

It is found that the calculated total organic carbon (TOC %) of Hawara Formation is less than 1% in all studied wells using both techniques indicating the non-source rock characteristics of this formation. Within the poor source rock limits, the TOC % content tends to increase to the north and south borders of the study area, while it decreases in the central parts. NO 159-1 well exhibits the maximum recorded value (0.65%) of total organic carbon, while the minimum value is recorded in J4ST2 well (0.37%).

On the other hand, good variable TOC content values were recorded for Asl Marl section in the majority of the studied wells. Meanwhile, faire content was found in three wells. The higher TOC% content is represented in wells J3A, J4ST2 and J6A. The recorded TOC% values of Asl Marl section are found to be 1.85, 1.36 and 1.79 for these three wells, respectively. Relatively good, not so high, total organic content was recorded in J2ST1, J5 and NO 159-1. TOC% values of 1.10, 1.16 and 1.11 are given for these wells, respectively. Fair TOC% values were found in GS 172-2, J7A and NO 159-2 wells. The implied organic matter deflections

(Δ log R) are very small in these wells. Fair values of 0.99, 0.98 and 0.87 are given for the total organic carbon in these wells. The values of TOC % tend to decrease to the north and south margins of the study area, while a well observed increase in values is recorded in the central parts and tends to extend eastward.

Seismic Evaluation:

This evaluation deals with the different petrophysical and structural characteristics of the two studied formations, which can be concluded from integrating seismic and logging data. Many two and three dimensional crossplots were made. Different time (one way and two way) and velocity (average and interval) analyses were enhanced. Time-depth and velocity curves as correlated with the synthetic seismic trace for a number of selected wells (GS 172-2, NO 159-1, GS 173-2 and NO 183-1) were also made.

Good regular time and average velocity curves were observed. The response of interval velocity curve is very good in all studied wells as it fluctuates effectively in front of the different formations reflecting their lithological compositions in terms of velocity variations. Moreover, good matching is observed between interval velocity curve and the synthetic seismic trace.

A number of synthetic seismograms have been also constructed for some of the studied wells whose sonic and density records are complete and in good status. Zero phase Ricker wavelet of 30 Hz frequency was used. In the majority of the studied wells, good differentiation between the four members of Belayim Formation is well observed. Baba and Feiran evaporites are characterized by their high velocity, high acoustic impedance and good positive reflection coefficient value at the top of each of them. This is reflected in the normal polarity synthetic seismic trace, which exhibits good high amplitude peak.

Asl Marl section is characterized by its moderate velocity, moderate acoustic impedance, small positive reflection coefficient and week amplitude synthetic seismic peak. Meanwhile, Asl Sand section has higher velocity and impedance than the underlaying Hawara shale. The contact between the higher velocity sand and the lower velocity shales of Hawara Formation is marked by intermediate synthetic seismic trough.

Porosity was estimated using seismic records and compared with that computed using normal logging analyses. Forward linear relationship was observed between both of them in front of Asl Sand section, Hawara shale Formation and only in front of some few levels of Asl Marl section.

Velocity is used as a key parameter for differentiating from one hand, between the shales of Hawara Formation and the Marl section of Asl Formation, which have nearly the same density range, and between both of them and the interesting Asl Sand section, on the other hand. Many velocity-related crossplots were also used and interpreted. Velocity (Vp) - Gamma Ray and Velocity (Vp) - Density crossplots with water saturation (S_w) as a third Z-parameter were also constructed to illustrate the relationship between velocity, lithology and water saturation. Good differentiation between the different studied sections of sand, marl and shale is observed which exhibit three different trends.

Hydrocarbon Potentialities:

The hydrocarbon potentialities of the study area were studied as an integration of the different deduced petrophysical parameters, which are gathered from the different evaluational systems. Its found that Asl Sand section is very good oil-bearing reservoir. The hydrocarbon distribution map confirms this result as a remarkable increase in the hydrocarbon saturation towards the southern parts of the study area is well noticed. The hydrocarbon saturation in this area is very high as it reaches value of 88%.

From the study of the petrophysical characteristics of Asl Sand reservoir, we can suggest the southern portion of the study area to be the best area for further drilling. This area is occupied by wells GS 172-2, J5 and J7A and exhibits good porosity, low shale volume, low water and high hydrocarbon saturations.