# SUMMARY AND CONCLUSIONS

The present work is concerned with the subsurface setting and the evaluation of the geochemical characteristics of the potential source rocks and the crude oils, which are produced from October area. Thirty seven (37) wells were penetrated in this area namely October A-1 to 9, October B-1,2 ,7 and 9, October C-1, 3, 4, 6, 7 and 8, October D-3, October F-1, October G-1, 4, 5, 6, 8 and 10 October J-1, 3, 4B, 5, 6, 7A and 9, GS 184-2, NO 159-4, and NO 183-1.

Gulf of Suez stratigraphy is split between Pre-rift ad Syn-Rift and break-up unconformity. Pre-rift stratigraphy is platform to passive margin, which has been inverted in two phases – the first distinctly at the Lower/Upper Senonian boundary, and the second during the Upper Senonian to Eocene, in a growth fold style. Syn-rift sedimentation begins with Oligocene red beds and volcanic, followed by series of clastic sequences in Nukhul to Belayim formation. Post Aqaba initiation, late syn-rift sedimentation shows a much more restricted basin with formation of salt and anhydrite in the S. Gharib & Zeit formations.

The geochemical characteristics of the source rocks were evaluated to identify;

1. The Organic richness
2. Types of Organic matter
3. depositional environment
4. Thermal maturation
5. and the maturation level of Cretaceous, Eocene-Paleocene, Early and Middle Miocene formations

This evaluation is based on the pyrolyses (TOC, S2, Tmax, HI, OI, PI) for “286” ditch samples representing the different rock units penetrated by eleven wells in the study area. Representative saturated hydrocarbon fractions from different rock units are also analyzed by gas chromatography and gas chromatography-mass spectrometry. The geochemical thermal burial history is also discussed to investigate the maturation level and time of hydrocarbon generation and expulsion.

The obtained data suggested the following:

- In Cretaceous source rock (Brown Limestone Formation) the organic richness is rated good to very good, except few samples which are ranged from poor to very good organic richness, with mixed kerogen type (I/II), the source is

mature and lies within the immature stage to oil generation stage. The organic matter is derived from algal bacterial marine carbonate source

- Eocene – Paleocene source rock (Thebes Formation) has organic richness varying from poor to very good. The genetic type of organic matter is mainly kerogen type (II/I) to produce mixed oil and gas. The Thebes formation was deposited from mixed organic source. The source rock is immature to oil generation stage and one sample in gas generation. The organic matter is derived from algal bacterial marine carbonate source
- Lower Miocene source rock (Lower Rudeis Formation) show fair to good organic richness, the genetic type of organic matter is mainly kerogen type (III) to produce oil and gas. The lower Rudeis source rock is immature to oil generation stage. The organic matter is derived from algal bacterial marine siliciclastic source with some terrestrial input.
- Middle Miocene source rock (Belayim Formation) show poor to good organic richness. The genetic type of organic matter is mainly kerogen type (II). Source rock of Belayim is predominantly oil-prone with some gas potential. The Belayim source rock is immature stage except four samples. The organic matter is derived from algal bacterial hyper saline marine carbonate source.

  Burial history modeling of the different hydrocarbon-bearing rock units in the studied area, gives clear information about the time-peaks of oil and/or gas generation and expulsion.
- The Cretaceous source rock (Brown Limestone Formation) started to generate hydrocarbon and the onset of generation is in Middle Miocene age (Kareem formation Time from 10 to 15 my).
- Thebes Formation has less mature than Brown Limestone and the onset of generation is in Middle and younger Miocene time (Belayim formation time from 7 to 12 my).
- Lower Rudeis Formation has low maturity than Brown Limestone and Thebes and the onset of generation is in Pliocene and Pleistocene to Middle and Late Miocene time (South Gharib formation time from 5 to 10 my)
- Belayim formation is immature source rock.

Forty representative oil samples have been collected from the producing horizons of “38” productive wells scattered within the study area; including the Nubia, Nukhul, Nezzazat and ASL reservoirs.

The oil samples were subjected to routine geochemical analysis as API gravity, sulfur content, crude oil composition and stable carbon isotope analyses for the saturated hydrocarbon fraction, gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) for saturated hydrocarbon fractions to evaluate the geochemical characteristics of the oil samples.

The results of these analyses revealed the following:

- The studied oil samples show an increase in API gravity and decrease in sulphur content with increasing depth which indicate increasing in maturity level
- The oil samples can be classified into two groups according to their maturity level and their physical properties. The first group contains Heavy to medium oils and less mature in NO 159-4, October J-7A, October J-5, October J-3, (Asl Reservoir), October J-9, October B-1, October B-2 , October B-9 and October C-8 (Nezzazat Reservoir) , October D-3, October F-1(Nukhul Reservoir) and October A-1, October A-2, October A-4, October A-6, October A-7, October A-8, October A-9,October B-7, October C-1, October C-3, October C-6, October C-7, October G-1, October G-10, October G-4, October G-5, October G-6, October G-8, October J-1, October J-4B and October J-6, October A-3 and October A-5 (Nubia Reservoir). The second group contain light mature crude oil in wells NO 183-1 and GS 184-2 (Asl reservoir), October A-1 (Nezzazat reservoir)
- The distribution of the saturate, aromatics and (NSO+ asphaltene) show that, the studied oil samples located within the normal oils class away from the mostly heavy degraded oils except one sample for Nukhul reservoir of October F-1 within the mostly heavy degraded oils
- Based on carbon isotope composition of the study oil samples there are a minor variation in its value that reflect genetic relationship between the oil samples.

- From the study of normal alkane distribution, isoprenoid (pristane and phytane), isoprenoids/n-alkanes (Pr/n-C17 and Ph/n-C18) carbon isotopes, triterpanes and sterane, biomarkers reflect that the studied crude oils originated from mixed organic source deposited under marine environment
- Geochemical correlation of some studied source rocks and oil samples recognized distinct physical and chemical similarities or differences summarized as follows:-
- From normal – alkanes distribution for the Brown Limestone extract GS 173-1 well, Thebes N. October 124-1 well and Lower Rudeis GS 138-1B well and the Nubia, Asl, Nezzazat and Nukhul reservoirs in October A-3, October J-5, October J-9 and October F-1, it appears that oil and extracts are genetically related as they are sources from mixed organic sources and deposited under transitional environments.
- The gas chromatography- mass spectrometry analysis for triterpanes (m/z 191) and steranes (m/z 217) of correlated samples reflects that there are a well correlation between the extract and oil samples.

Therefore, from the discussion of geochemical characteristics it can concluded that there are a well correlation between oil and extract samples of some potential source rocks and reservoirs in the October area, where they are similar in their origin and maturation. This indicates that the oil of the Nubia, ASL, Nezzazat and Nukhul reservoirs are related to different sources including the Brown Limestone, Thebes and Lower Rudeis extracts.