βαρρ

Target Exploration

The 8th Middle East & North Africa Oil and Gas Conference

MENA 2010

20 & 21 September 2010, Imperial College, London

Post-MENA 2010 Fieldtrip No. 2

Red Sea Rift System:

Typical Reservoirs, Cap Rocks and Tectonics of African Rift Basins.

Sat. 25 to Mon. 27 September 2010

Fieldtrip Programme

This three days fieldtrip is a followup of MENA 2010 Oil and Gas Conference theme (Offshore MENA: The Last Frontiers) designed to illustrate typical exploration potential of one of several yet to be drilled structures in offshore MENA. The trip starts and ends point at the Lobby of "InterContinental, City Stars Hotel" (near Cairo International Airport) on the 25th September 2010, 6:30AM.

The prolific Mesozoic rifts basins of North Africa began with pre upper Cretaceous inversions, followed by late cretaceous rifting and in-filling. The Gulf of Suez rift dissects the upper Proterozoic to lower Paleozoic continental crust of the Arabo-Nubian Shield which forms the basement of much of northeast Africa and Arabia.

This field trip will examine Proterozoic to Recent rocks outcrops along the western margin of the Gulf of Suez. These provide examples of the pre- and syn-rift stratigraphy, various scales of fault block rotation, the significance of cross-faults and hard fault linkage, regional scale rift segmentation by accommodation zones, and the effects of rift shoulder uplift.

The Red Sea is one of the best present-day example of the birth of a new oceanic basin. Located at the northern end of the greater Red Sea basin, the Gulf of Suez was abandoned at an early stage of continental rifting when the plate boundary shifted to the Gulf of Aqaba.

Throughout this trip we will integrate examples of seismic and well data with our outcrop stops, and emphasize the significance to exploration plays and field development in rift settings.

This three days fieldtrip to fascinating outcrops, mountains, desert plains, beaches and fossilized and living reef communities. Our hotel/resort will be located on the beach and swimming can be enjoyed in the evenings after our return from the field.

Day One: Saturday, 25/9/2010

6:30 Hr.: Meet at Main Lobby InterContinental, City Stars Hotel, Cairo, Egypt.
7:00 Hr.: Bus departs to:

Stop 1: Eocene Rock Units

1. The first stop represents the Upper Plateau of Gebel Mokattam in the eastern Greater Cairo area. It is 160 m higher than the rest of Greater Cairo.
2. Gradual subsidence of the land took place during middle Eocene time and the deposition of the limestone and chalky limestone of that age occurred.
3. A gradual uplift seems to have taken place at the end of middle Eocene time.
4. The deposition of the upper Eocene followed with unconformities in places.
5. The upper Eocene sediments are of neritic to littoral origin. With the close of the Eocene period continental conditions prevailed over the district and the Eocene rocks were subjected to erosion.
6. The faults produced are of the high-angled normal type; and long many of the fissures produced by these faults. Smearing material climbed to the surface in the form of flows that are known in many parts of the district.
7. The rocks have a gentle NE regional dip of about 2-3 degrees. Local increase in dip is related to some monoclines which in addition to NW- and WNW-oriented normal faults, are the large geologic structures of the area.

Stop 2: Northern Galala

1. The northern Galala Fault separates the Galalas Province from the Cairo-Suez Province and is considered to be the westward extension of the Themed Fault in central Sinai.
2. The pre- Eocene rocks are affected by northeast to east-northeast-orientated folds and reverse faults, as well as east-west-orientated oblique-slip faults with dextral and normal components.
3. Some folds and reverse faults are interpreted to have been formed by northwest to north-northwest-orientated compression related to the Syrian Arc movement, whereas the others by the secondary northwest orientated shortening, which accompanied dextral strike-slip component along the planes of the east-west-orientated faults.
4. The NeoTethyan began to close due to convergence between the two plates, leading to the Syrian Arc deformation. This deformation mildly started in Late

Cenomanian and followed by a more intensive phase in Conacian-Santonian. It mildly continued in the Maastrichtian, Early Palseocene and Late Palaaocene/Early Eocene. The southward thinning of the pre-Eocene rocks controlled the intensity and style of deformation.

5. 6. The northern Galala Fault consists of several east-west-orientated listric normal faults that are linked by northwest-orientated synthetic transfer faults.
6. Jurassic-Cretaceous rocks in the downthrown block of this fault are folded by right-stepping *en echelon* of doubly-plunging folds orientated northeast to east-northeast.

Stop 3: Rift Transfer-Fault Sealing

1. During the Middle Palaeocene-Middle Eocene, an extensive transgression flooded broad areas of North Africa.
2. The Middle /Upper Paleocene marl and shale of the South Galala Formation unconformably overlies the Maastrichtian chalks in the southern Galala Plateau and in the Hg69-1 well area. They also overlie the Turonian marl and shale in the northern Galala Plateau and Gebel Ataqa.
3. Bandel and Kuss (1987) demonstrated that the deposition of the South Galala Formation in a southward ramp basin extended parallel to the shoreline of the Gulf of Suez between Gebel Ataqa in the north (tidal flat) and the southern Galala Plateau in the south (deeper shelf).

Stop 4: Southern Galala

1. The pre- Eocene rocks are affected by northeast to east-northeast-orientated folds and reverse faults, as well as east-west-orientated oblique-slip faults with dextral and normal components.
2. Some folds and reverse faults are interpreted to have been formed by northwest to north-northwest-orientated compression related to the Syrian Arc movement, whereas the others by the secondary northwest orientated shortening, which accompanied dextral strike-slip component along the planes of the east-west-orientated faults.
3. The Precambrian rocks are exposed in the area south of the southern Galala Plateau.

Stop 5: Wadi Araba

4. The tilted fault blocks and the wedge-shaped basins on the downthrown sides of the listric normal faults.
5. Different structural styles.
6. A thick carbonate-marl section of Cenomanian-Turonian age is overlain by an unconformity that extends throughout the area. This section is covered by Campanian-Maaszrichtian chalk in the southern Galala Plateau and the Hg69-1 well.

Stop 6: Sant Antoni

1- Paleozoic rock units are exposed in the core of the Wadi Araba Anticline and in the eastern scarp of northern Galala Plateau. These rock units are dominantly sandstone with subordinate carbonate intervals. The same facies was found overlying Precambrian rocks in the Hg69-1 well.

2- In most of the area, thick shale, sandstone and limestone represent the Jurassic rocks, whereas a thin Jurassic sandstone section is exposed in the northern Galala Plateau.
3- The Lower Cretaceous Malha Formatoin forms a major sandstone lens in the central part of the area. It has a maximum thickness of 850 m in the Abu Hammad-l well and decreases in thickness to 320 m northward at the Monaga-1 well and to 50 m southward at the northern Galala Plateau.

19:00 Hr. Bus arrives for dinner and sleep over at El-Gunah Resort.

<u>Day Two: Sunday, 26/9/2010</u>

6:30 Hr.: Meet at Main Lobby, El-Gunah Resort.

7:00 Hr.: Bus depart to :

Stop 7: Gebel Abu Shaar

1. Restricted record for the Esna Shale Formation (SEAL) at Gebel Gharamul-Abu Shaar El Bahari outcrops as in south of Gebel El Sufr El Dara, East Gharamul and east of Wadi Khorm El Ayun.

2. Generally, the Miocene rocks have demonstrative exposures at Gebel Gharamul, Gebel El Zeit, Gemsa, Abu Gerfan and Abu Shaar El Qebli, as well as some limited exposures at the footslope of the Red Sea hills that have a great significance on the tectonic constrains of the Esh El Malha basin. The exposed Miocene strata belong to Abu Gerfan, Gharamul, Gemsa and Abu Alaqa Formations.

3. The Dara Dorsal basement ridge is terminated to the east-northeast by the intersection of the Gulf-parallel fault. The latter is the only major NE-dipping Gulf-parallel fault and is termed West Abu Shaar El Bahari Fault. This fault lies at the nose of Dara Dorsal basement, juxtaposing against the syn-rift sediments (Gharamul Formation) of Gebel Abu Shaar El Bahari.

4. The absence of the clastics and reefal slumping features (as indicated in Abu Shaar El Qabli) indicate a period of passive activity along the Dara Dorsal bounding F7-fault. Later, a younger tectonic activity caused the growth rejuvenation of the hanging wall F7-folds with mild folding of the Gharamul Formation.

Stop 8: Wadi Beli

1. The Miocene rocks are widely distributed in the Gulf of Suez. This sequence has a special economic interest, since more than 60% of the oil and gas production of Egypt is confined to it.
2. Many authors studied and classified the Miocene rocks of the Gulf of Suez since their first description on the western coast of the Gulf of Suez by (Mitchell, 1887). The simple and common classification of the Stratigraphic Committee (1964) includes

two major Groups, namely Gharandal and Ras Maalab. The former includes Nukhul, Rudies and Kareem Formations whereas Belayim, South Gharib and Zeit Formations belong to the latter.

Stop 9: Wadi Kharaza

1. The crescentic exposure of Gebel Abu Gerfan is a result of intersection and hook-shape connection of the ENE- and WNW-trending pre-rifting faults. The structural low-stand of the area has not escaped from erosion where the Miocene sediments are found overlying the Nubia sandstone.

Stop10: Gebel Zeit

1. The Gebel El Zeit block consists of two distinct basement cored fault sub-blocks separated by a 4 km wide topographic saddle (Sarg El Zeit). They are named as North Zeit and South or Little Zeit. Both of them are bounded to the northeast by the major Rift Coastal Fault (RCF) trending N030oW parallel to the Gulf of Suez trend that causes up to 2 km offsetting of the basement.
2. The North Zeit consists of two prominent ridges separated by Wadi Kabrite. These ridges are a basement ridge on the northeast and a West Zeit (Cuesta) underlain by Pre-Miocene and Miocene successions on the southwest.
3. The smaller South Zeit block lies to the southeast of the North Zeit and offsets laterally across the NNE faults of the saddle. South Zeit is structurally much more complex than the North Zeit. It shows deeper erosion where the Miocene sediments directly overlay the basement.
4. The basement rocks of Gebel El Zeit represent a part of the northern segment of the Late Proterozoic shield of the Egyptian Eastern Desert. Most of the shield belongs to the orogenic belt of northeast Africa and the Arabian Peninsula.
5. The constructed geologic maps show the aerial distribution and the field relations between the different rock units. Detailed field studies and petrographic investigations revealed the existence of four phases of granitoids with different modal mineralogical composition as well as a group of stratified volcanics and their pyroclastics of Dokhan type. These rock units were intruded by Late Precambrian dikes of bimodal composition.

Stop 11: Gebel Zeit, Oil Seepage

1. This block presents excellent exposures to classify the Precambrian granitic rocks of the Arabo-Nubian Shield and a field analogue to study the fracture system in correlation with the subsurface basement reservoir. This also will provide clues concerning the bulk structure and the role of Precambrian-inherited structures on the development of the Red Sea rift.

- The ridge of Gebel El Zeit received

its name (meaning oily mountain) from the Roman name "Mons Petroleus", due to its famous oil seepage.

- The earliest explorations took place during the late 19th and early 20th centuries and were focused around the known oil seeps.
- Fifteen years later, in 1884, American, Russian and Rumanian rigs drilled wells with depths up to 235 m without success. The Egyptian Petroleum Company (registered in 1905), passed parts of its Gemsa lease to the Egyptian Oil Trust Limited, which then proceeded to drill in 1909. Actually, the Gemsa Field was put into commercial production in 1911 and contains proper oil production (32-41° API) originating from Miocene reefal carbonate reservoirs. Exploration activities at Gebel El Zeit were abandoned after four dry drills by Shell.
- The next stage of exploration by the Anglo-Egyptian Oilfields led to the discovery of the Hurghada Oil Field, (some 60 km south of the Gemsa field) that produced 22-23° API oil from Paleozoic and early Miocene sandstone reservoirs at depths between 550-700m.
- In 1916, the Eastern-Suez Group drilled into the structural highs of Jubal and Ranim Islands but all exploration activities ceased until 1919 because of the First World War. After then, many companies such as British Burmah Petroleum Company, QSP syndicate, the Suez Oil Company, Anglo-Persian, Egyptian Central Oilfields Limited, Eastern Petroleum and Finance Company, Affiliated Oilfields and Oilfields of Egypt Limited, started their exploration programs again.

Stop 12: Little Zeit

- The Gebel El Zeit block consists of two distinct basement cored fault sub-blocks separated by a 4 km wide topographic saddle (Sarg El Zeit). They are named as North Zeit and South or Little Zeit. Both of them are bounded to the northeast by the major Rift Coastal Fault (RCF) trending N030oW parallel to the Gulf of Suez trend that causes up to 2 km offsetting of the basement.
- The North Zeit consists of two prominent ridges separated by Wadi Kabrite. These ridges are a basement ridge on the northeast and a West Zeit (Cuesta) underlain by Pre-Miocene and Miocene successions on the southwest.
- The smaller South Zeit block lies to the southeast of the North Zeit and offsets laterally across the NNE faults of the saddle. South Zeit is structurally much more complex than the North Zeit.

Stop 13: Wadi Kabrite

1. Rocks of the Late Cretaceous Clastic Group were encountered in most of the drilled wells in the Gulf of Suez. They are well exposed at northern Gebel El Zeit and sporadically exposed along the Esh El Malaha range and Gebel Gharamul environ. The most complete section of this group was mapped in the northern Wadi Kabrite where it attains thickness of about180 m.
2. The trace of this RCF displays a remarkable zigzag geometry through linkage with an N70oW-trending fault segment. The northern segment of the fault is excellently exposed at the mouth of Wadi Kabrite. Subsurface observations show the absence of the pre-rift sediments in the down faulted block of the RCF where the drilled wells penetrated a Miocene sequence overlying the basement rocks.

Stop 14: Northern Escarpment of Zeit Block

1. Early rifting fault can be modified into scarp along the up-dip of the block with an original dip of 60 degrees that modified to 38 degrees along the fault scarp.
2. After deposition of the Late Miocene and the reactivation of the rifting faults, both of the original fault (60 degrees) and its scarp (38 degree) were also reactivated.
3. The correct mapping of the reactivated fault plain or fault scarp can provide up-dip potential to the trap size.

Stop 15: Gebel Abu Gerfan

1. Zigzag pattern of the main leading fault when reaching a sharp lateral angle. The fault bifurcates to produce a liver block.
2. The whole mountain is a sliver block, analog with Ras El Esh oil field of Marathon
3. Minor antithetic faults in Cretaceous section.
4. Economic applications in subsurface to predict slivers along main leading fault.

Stop 16: Wadi Abu Marwa

1. Leading fault of the Esh El Mellaha range
2. Onlap of the Late Miocene reefal limestone over eroded crest of the tilted basement
3. Zigzag pattern of the main leading fault of Esh El Mellaha range
4. Retreated fault scarp from top basement to top Eocene, analog with subsurface
5. Predicting geometry of the scoop fault at the fault scarp during late reactivation

Stop 17: Gebel Gharamoul and Sufr El Dara

1. Middle to Late Miocene gypsum (Ras Malaab Group)- Seal
2. The Charamoul-Sufr El Dara are represents the center of the accommodation zone between the southern part of the Gulf (SW dip) and the central part of the Gulf (NE dip)
3. Complex structures including minor folding thrust faulting and dipping in different directions characterize this zone. The Dara Dorsal is a given expression of this zone
4. It seems that deep-seated E-W faults predominated this area since the Pre-Cambrian time. Recognize the E-W faults controlling outcrops of the Pre-Cambrian metasediments. These faults acted as stress barriers during early rifting where the basement blocks at the two sides of this zone rotated in two opposite directions. This mechanism produced the accommodation zone.

Stop 18: Tarbul Basin

1. Structural features associated with accommodation zone between NE dip in the central Gulf of Suez and the SW dip in the southern Gulf of Suez (Gharamoul accommodation zone)
2. Termination of structural trend
3. Syncline of Gebel Tarboul
4. Extension of the drag syncline to the main rift bounding fault, western shoulder of the Suez rift.

Stop 19: Wadi Lagia

1. Analysis of the fractures orientation of the subsurface data of the basement reservoir at the Geisum oil field revealed three dominant sets, namely NW, ENE to

NE and NNE sets similar to those in the basement of the Gebel El Zeit block and Zeit Bay and Ashrafi Fields. However, the fracture attitude may differ due to the difference in the fault block orientation and the amount of block rotation. The northwest dominant set shows a large scatter in the dip magnitude to the S30^o-40^{o}W.
The distribution of fracture density in the subsurface varies according to its relation to faulting, dike and presence or absence of the pre-rift sequence.

Stop 20: Gebel Tarbul

1. Structural features associated with accommodation zone between NE dip in the central Gulf of Suez and the SW dip in the southern Gulf of Suez (Gharamoul accommodation zone)
2. Termination of structural trend
3. Syncline of Gebel Tarboul
4. Extension of the drag syncline to the main rift bounding fault, western shoulder of the Suez rift.

Stop 21: Gebel Gharamoul

1- Active extensional basins are important because their sedimentary fills and bounding tectonic structures provide: Sinks with high preservation potential for sedimentary and fossil records of past changes in climate, sea/lake level and sediment/water supply Information on the growth, activity, decay and death of normal faults

2- Basin analysis evaluation of the Gulf of Suez rift basin and its reservoir quality, source rock distribution, maturation history and hydrocarbon potential are attempted. The investigation was attempted in order to show the reservoir lithology, distribution, quality; source rock distribution, organic richness, type and maturity, burial/maturation history models; sealing rock; timing of hydrocarbon generation, migration pathways and entrapment style.

18:00 Hr. Dinner and sleep over at El Gunah Resort

<u>Day Three: Monday, 27/9/2010</u>
6:30 Hr.: Meet at Lobby of.
7:00 Hr.: Bus depart to

Stop 22a: Abu El Darag
1. Rocks belonging to the Permo-Triassic form a distinct unit which is termed by Qiseib Formation. The Jurassic rocks recorded in different areas .These areas are Abu Darag , Wadi Qiseib, Ras El-Abd, Ain Sukhna.
2. The Qiseib Formation made up of alternating vari-coloured sandstone & mudstone which recognized by its reddish colour so it is commonly known as “red beds”. This character is an evidence of early oxidation of the Siderite cement.
Different fault styles and system, characteristic for the rift basin.

Stop 22b: Abu El Darag

1- Malha Formation made up of sandstone with subordinate sandy siltstone and claystone interbeds. The mudstone layers are usually kaolinitic & it is a potential source of white glass sand
2- In Abu Darag area there is 5 spotty occurrences of Jurassic sediment discovered .They are alternating between limestone& marl, they cut by E-W dykes, sills &plugs, so they are the limestone are thermally metamorphosed.

Leave to Cairo
190:00 Hr. Bus arrives to InterContinental, City Stars Hotel, Cairo.

Fieldtrip Leader: Dr. Abdulwahab Noufal, Ph.D.

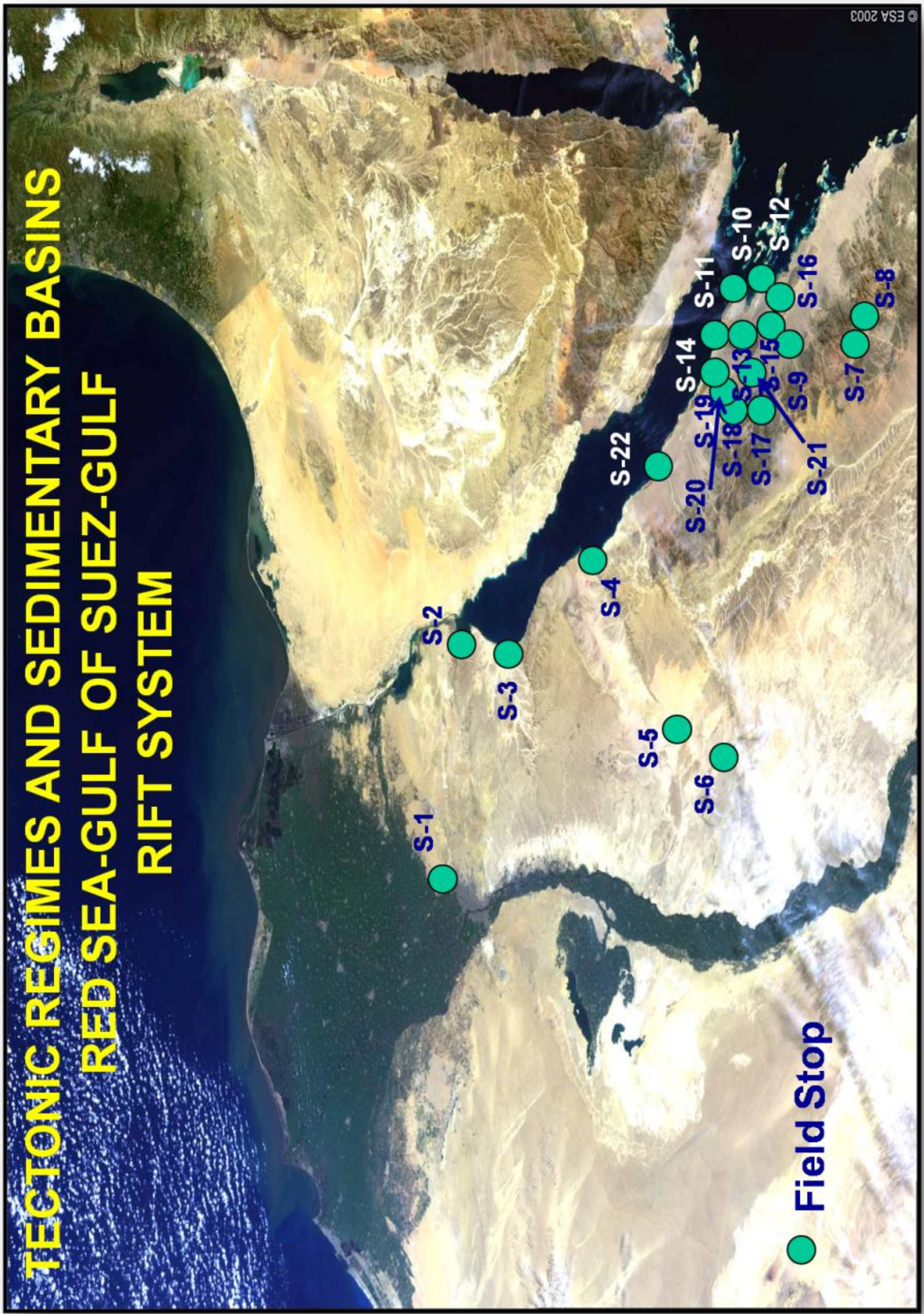
Dr. Abdelwahab Noufal joined PETRONAS Carigali, in June 2009 and is now a Staff-Specialist of Structural Geology. He holds a Ph.D. in 'Tectonics and structure analysis of rift basins from Tuebingen University, Germany. He is an ex Schlumberger Geoscientist, and has 21 years experience, including 10 as a lecturer at Cairo University, Egypt. He has worked in the exploration and development for oil and gas, primarily in Middle East, North and West Africa, Malaysia, Vietnam, Uzbakistan and E Europe. Innovative integration and clear, practical recommendations typically result in improved reservoir models and increased reserves at low cost. He has continually evolved and chaired this field trip and other courses, publicly and in-house, for eighteen years through NEXT, OGS, GEOPEX and independently.

Number of Participants:

Minimum: 15
Maximum: 25

For Further Information:

Contact Muhammad Ibrahim at:
m.ibrahim@targetexploration.com
Telephone: (+44) 207 371 2240
Fax: (+44) 207 371 4120
Mobile: (+965) 976 350 26



TECTONIC REGIMES AND SEDIMENTARY BASINS
RED SEA-GULF OF SUEZ-GULF
RIFT SYSTEM
S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8
S-9
S-10
S-11
S-12
S-13
S-14
S-15
S-16
S-17
S-18
S-19
S-20
S-21
S-22
Field Stop
© ESA 2003

βapp

The 8th Middle East & North Africa Oil and Gas Conference

MENA 2010

20 & 21 September 2010, Imperial College, London

Target Exploration

Post- MENA10 Fieldtrip 2 Registration Form

Red Sea Rift System

Fieldtrip Starts on 25/9/2010 and Ends on 27/9/2010 at the InterContinental, City Stars Hotel, Cairo, Egypt.

Print and Fax or E mail this Registration Form to:
M. Ibrahim, Target Exploration, 65 Kenton Court, London W14 8NW, UK.
Tel: +44 (207) 371 2240 Fax: +44 (207) 371 4120, Mob. (+965) 976 350 26.
E mail: M.ibrahim@TARGETEXPLORATION.COM

Registration

NAME:____

POSITION:______________________________________

ORGANISATION:___________________________________

ADDRESS:______________________________________

____

TEL.:____________________FAX:____________________

E.MAIL:_______________________________________

Payment (Includes: Fieldtrip Guidebook, transport from and to the Hilton Dubai Hotel, two nights 5 stars hotel accommodation, 3 breakfasts, 3 lunches and 2 dinners).

Registration Fee: £1,550 or £1,750 after 1 July 2010

CHEQUE ENCLOSED:___________________________________

BANK TRANSFER: e mail details to _________________________

Credit Card Payment

CHARGE MY: VISA ________ AMEX ________ MASTERCARD ________

CARD NO.:_______________________________________

EXPIRY DATE:_____________ CARD VERIFICATION CODE ____________

CARD HOLDER:_____________________________________

CARDHOLDER SIGNATURE:____________________ DATE:________

No refund for registration fees after 1st of August 2010