Field Trip No. 7

The Eocene and Oligocene Paleo-Ecology and Paleo-Geography of Whale Valley and the Fayoum Basins: Implications for Hydrocarbon Exploration in the Nile Delta and Eco-Tourism in the Greater Fayoum Basin

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INTRODUCTION

The Greater Fayoum Basin (Figure 2) holds a rich heritage of paleontological, archeological and geological exposures. The Qasr El Sagha (Temple of the Crocodile), Wadi Ryan and Wadi Hitan (Whale Valley) sites are the primary points of interest in the trip.

The location, within a 1½ hour drive from Cairo’s 16 million inhabitants, makes this an area of high potential for eco-tourism and scientific discovery. However, the growing awareness of the scenic, recreational and scientific value, coupled with roads created by seismic and well drilling has now placed this fragile area in jeopardy of becoming damaged by uncontrolled visitation.

This field guide touches upon major facets of the area’s natural science with a focus on:

1) learnings for petroleum exploration in the offshore Nile Delta
2) the paleo-ecology of the Eocene and Oligocene vertebrate paleontological sites
3) human history
4) the potential for eco-tourism and need for strong conservation measures

Much of the area is currently under the protection of the Egyptian Environmental Affairs Agency (EEAA). This group, in conjunction with the Italian Government, has formed the Egyptian-Italian Environmental Program (EIEP) at the Wadi Rayan and Wadi Hitan sites. The EIEP is also aligned with the World Conservation Organization (IUCN).

The Fayoum Basin formed initially along the Tethyan margin in Jurassic time. Its current shape is from subsidence that terminated in late Eocene time. The basin is largely below sea level.

Natural breaks in the levee of the Nile River have caused repeated flooding of the basin. Ancient Lake Moeris was much more extensive than the current Lake Qarun. Egypt’s climate 8500-4000 years ago was significantly wetter, and this large natural lake with its abundant wildlife and surrounding fertile soils, attracted very early human occupation. The basin has seen continuous human habitation from Neolithic time to present.

In Pharonic times, Egyptians built an extensive network of canals, locks and irrigation systems designed to maintain the level of Lake Moeris. During Roman occupation, the level of the lake was dropped to make room for more irrigable land and the present Lake Qarun is only a fraction of its former size.
Figure 2. Regional landsat with location of the Fayoum Basin, regional sections and detailed cross-section (Gingerich, 1992) of the Whale Valley stop.
GEOLOGICAL SETTING AND PRIOR WORK

Egypt’s tectonic history can be summarized in 8 major events (Dolson et al., 2001).

1. Paleozoic craton
2. Jurassic-Early Cretaceous rifting
3. Cretaceous passive margin
4. Syrian Arc inversion (84 MA-50 MA) and foreland transgression
5. Oligo-Miocene Gulf of Suez rifting
6. Late Miocene Red Sea breakup
7. Messinian salinity crisis
8. Plio-Pleistocene delta progradation

Jurassic rifting and Syrian Arc inversion were the dominant tectonic events shaping the current geometry of the Fayoum Basin. The basin is in excess of 6000 meters deep and is flanked to the northwest by a prominent Syrian Arc inversion structure known as the Kattaniya Horst. The Bahariya oasis, formed on another large Syrian Arc structure, bounds the basin to the southwest.

German geologists in the 1880’s performed the earliest modern surveys of the Fayoum (Schweinfurth, 1886). More thorough treatments of the geology were those of (Andrews, 1901; Beadnell, 1901, 1905). Working on camel back and foot, the early maps of Beadnell actually contained navigation units in “camel hours” but were surprisingly accurate for their day.

In 1907, an important expedition was launched by the American Museum of Natural History under the leadership of Henry Osborne (see Table 1 for web-based information on this expedition). One of the lead geologists, Walter Granger, “cut his teeth” in the Fayoum Basin, excavating the rich vertebrate assemblages in the Oligocene Jebel Qatrani formation. Granger went on to discover the first dinosaur eggs in the world in the Gobi Desert in the 1920s.

Table 1. Web page hotlinks to geological information on the Fayoum Basin

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The most definitive work on the Eocene and the paleo-ecology of the Basilosaurus and Sirenia (sea cows or manatees) is that of Gingerich (1992).
Details of the Oligocene stratigraphy in the immediate field trip are covered by (Bowen and Vondra, 1974; Bown and Kraus, 1988; El-Araby and El-Barkooky, 2000). The vertebrate paleontology of the Fayoum is summarized by (Simons and Rasmussen, 1990). An excellent regional overview of the Cenozoic history of Egypt is covered by Said (1990).

**Basin outlines and regional geology**

Figure 3 illustrates the shape of Egypt’s basins. It is derived from data presented in part by (Loutit et al., 2001), and from new seismic data attained in 2000 in the Mediterranean Basin. A dominant trend of NE-SW oriented basins reflects the Tethyan Jurassic rift margin. This margin was re-activated and inverted during the Syrian Arc transpressional event (Kuss et al., 2000).

Along the Mediterranean coastline, a prominent NW-SE oriented ridge extending toward Libya marks the “hingeline”, an old fault whose age dates at least to the Jurassic, if not Precambrian. This trend intersects the old Tethyan margin due north of the Kattaniya horst in the vicinity of the “transfer zone” indicated on Figure 3.

This intersection marks the transfer of throw on the Tethyan margin fault systems to the NW-SE structural belt. It forms a classic transfer zone structural low and has been the point of sediment input into the Nile Delta since at least early Cretaceous time. More detailed discussion of evidence for this conclusion is presented later. As shown on Figure 3, we speculate from gravity and aeromagnetic (Loutit et al., 2001) that the oceanic to continental crust transition occurs approximately where shown by the white arrows.

The positions of these Tethyan margin basins and subsequent inversion and modification during the Syrian Arc event exerted a fundamental control on Eocene and Oligocene paleogeography.
Figure 3. 3D relief map of basins within the study area.

Nomenclature

Figure 4 presents a simplified stratigraphic column for the Eocene and Oligocene of northern Egypt. This compilation is calibrated to a world-wide chronostratigraphic chart (Hardenbol et al., 1998). Additional paleontological data constraining unconformities shown on this figure comes from Bown and Kraus (1988), Said (1990), Gingerich (1992) and from unpublished nannofossil data from wells.

The offshore Oligocene and Eocene nomenclature is poorly developed, due to a general lack of deep drilling. Data from seismic, however, suggests extensive sandstone development in the form of deep water channels and fan complexes occur in Upper Eocene through Oligocene strata offshore (Dolson et al., 2002). These facies will most likely have no correlative age equivalent onshore. They represent deposits shed basin-ward during regional sea level lowstands. Their time equivalent onshore intervals will be represented by unconformities.
Figure 4. Oligocene and Eocene Nomenclature.
Regional Setting, Eocene

Northern Egypt during the Eocene was characterized by low relief islands (brown hachure) and shallow water embayments (limestone symbols) connected northward to the Mediterraean. The drainage networks shown on the map below are postulated to have developed following exposure of the area during the Late Cretaceous. The drainage networks are derived from isopach data (not shown) from over 250 onshore wells (Figure 2). Isopach data from two major intervals were used to derive this map:

1) the top of Cretaceous unconformity to the top Eocene unconformity
2) top Oligocene unconformity to top Eocene unconformity.

The isopach patterns are similar for both intervals, indicating repetitive structural control from Cretaceous through late Oligocene time. Facies analysis and log correlations suggest isopach thins represent karsted paleohighs and isopach thicks poorly developed stream systems. Early Tertiary patterns appear weakly developed, but late Eocene or early Oligocene isopachs show strongly developed systems, some of which contain a high sand content. Similar conclusions were reached by (Said, 1990).

Why the difference? In late Cretaceous time, broad uplift as the Syrian Arc transpressional event occurred exposed low relief carbonate platforms and structures. Thick clastic reservoirs are uncommon in Egypt in Paleocene and Upper Cretaceous (Turonian thru Maastrichtian time). The environment during periods of exposure apparently consisted of low relief karsted hills. During transgressions, shallow water reefal deposits often built up over the underlying exposed structures, but very little clastic sediment occupying the intervening lows. The dominant facies during transgressions consist of carbonates, highly anoxic organic rich shales and marls and thin, discontinuous sandstones of the Abo Roash (Santonian), Khoman (Maastrichtian) and Paleocene Esna formations (Moussa and Matbouly, 1994 and Moussa and Matbouly, 1992).

By Upper Eocene and Early Oligocene time, however, broad regional uplift associated with the opening of the Gulf of Suez rift caused a general northward tilt of Egypt toward the Mediterranean Sea. As the Syrian Arc event reached its climax in Eocene time, structures with as much as 1700 meters of relief existed across northern Egypt. Highlands to the south were exposed to Lower Cretaceous and older levels and large volumes of clastics were once again available for translation of reservoir facies basinward. At Bahayira oasis, for example, Oligocene basalts lie directly upon Cenomanian Bahariya Formation non-marine fluvial channels and coals.

Oligocene isopach maps suggest that the ancestral Nile River drainage network lay west of its current position, as shown in Figure 5. The drainage appears to localize down the axis of the Abu Gharadig basin into the transfer zone discussed earlier at the junction of the oceanic to continental crust transition.
Figure 5. Late Eocene paleogeography with superimposed Late Eocene and Early Oligocene drainage networks formed during intermittent sea level lowstands.

The areas shown in Figure 5 as land have thin to no Eocene or Oligocene strata. These areas were either completely emergent or repeatedly transgressed and eroded. The ancestral Nile River was structurally controlled, lying between prominent paleohighs to the north along the Mediterranean Coast and the Kattaniya horst to the southeast. Evidence for these conclusions follows in the next section.
Evidence for regional uplift, erosion and basinward translation of reservoirs in Upper Eocene and Oligocene time

At least 4 major unconformities (Figure 4) are recognizable from seismic and well logs along the northern Egypt coastline. The subaerial nature of these surfaces is apparent from paleobathymetric data, seismic signature and descriptions of cuttings and lithologies in well bores. These surfaces are significant as they mark by-pass points for reservoir facies to enter the Mediterranean Sea and are probably correlative with some of the surfaces examined in outcrop strata at Qasr El Sagha (Day 2).

Eocene carbonates preserved along the northern coast of Egypt are commonly described as pelloidal, oolitic or as packstones interbedded with red and green shales or other light colored facies. All of these physical characteristics indicate shallow water facies and the presence of paleosols or supratidal deposits.

In other locations, the Eocene is totally absent and replaced by a thickened Oligocene section. This inverse relationship strongly suggests that the thickened Oligocene strata are within incised valley systems that have eroded out the Eocene strata.

Examples of well-log evidence of exposure and erosion of Eocene strata are common. For example, the Shaqiq-1 well (Figure 6) has Eocene oolitic limestones associated with green/red clays (paleosols?) and missing nannofossil zones suggesting numerous hiatuses. In contrast, the Marakia-1 well (Figure 7) has Oligocene clastics resting unconformably on Upper Cretaceous limestones. Within the “Dabaa” shale interval in the Marakia well, a number of missing nannofossils zones are also recorded, indicating unconformities within the shale that are not readily visible from log data alone.

The Shaqiq and Marakia wells are two of the northern-most penetrations of Oligocene strata along the Egyptian coastline (see wells 1 and 2 on Figure 8). The occurrence of many missing nannofossil zones in Oligocene and Eocene strata is typical of all wells examined along the northern coastline.
Figure 6. Shaqiq-1 well log showing typical paleontological and lithological evidence for exposure of Eocene strata. Note multiple nannofossil omissions at various levels indicating significant time breaks. See figures 5 and 8 for location of this well on regional section 1, well number 2.
Marakia-1 well

Figure 7. The Marakia-1 well. Note the complete absence of Eocene, Paleocene and parts of the Upper Cretaceous (nannofossil zone cc25), as well as the upper portion of the Oligocene (NP 23-25 zones). See figures 5 and 8 for location on regional section 1, well number 2.

The stratigraphic architecture that results from correlating these well logs regionally using available seismic and biostratigraphic tops is shown in Figure 8. The Fayoum and Whale Valley area contain Clastic reservoirs that we speculate are the preserved high stand systems tracts created during regional transgressions. Time equivalent reservoirs to the unconformities will lie in the offshore Mediterranean and remain future exploration targets.
A number of key features are apparent in Figure 8. These include:

1) Significant folding beneath the Oligocene, with prominent structural highs shown along the northern coast in wells 1-5
2) Preservation of a thick Eocene basin (Abu Gharadig) between wells 6 and 9
3) The inverted structure of the Kattaniya horst (wells 10-13)
4) The position of the Fayoum/Whale Valley basins between landmasses to the north (Kattaniya horst) and to the South (well 15)
5) A northward tilt of the Oligocene sections with only the thin non-marine to estuarine highstand facies preserved to the south at the Qasr El Sagha outcrops (near well 13)
6) Extensive erosion by early Miocene unconformities (24MA) and the Messinian surface (6.3 MA)
Figure 8. North-south section regional section 1 (not scaled) showing Oligocene and Upper Eocene stratigraphic relationships. See figures 3 and 5 for location.

Seismic evidence for subaerial incision

Figures 9 through 13 show seismic evidence for erosion of Eocene strata along the northern Egypt coastline. The canyon incisions are significant, reaching up to 300 meters. The canyons themselves are most easily seen on figures 8 and 9, where they clearly cut through Upper Cretaceous strata. In some localities, these canyons reach as deep as the Bahariya deltas (uppermost UK sandstone shown on Figure 8).
East-west seismic section 2

Uninterpreted East-West Time Section Illustrating
Oligocene/Cretaceous Age Canyon Incisions

Figure 9. Uninterpreted east-west section. See Figure 5 for location.

Interpreted East-West Time Section Illustrating
Oligocene/Cretaceous Age Canyon Incisions

Figure 10. Interpretation of the east-west seismic line in figure 8. Oligocene canyon incisions are as deep as 350 meters.
NW-SE seismic section 1

Figure 11. NW-SE seismic section, uninterpreted. See Figure 5 for location.

Figure 12. Interpreted seismic from Figure 10.
Figure 13. Enlarged view of Eocene erosional remnants shown on Figure 12.

The NW-SE section shown in figures 11-13 clearly shows:

1) Significant expansion of Oligocene and Lower Miocene section northward beyond the Cretaceous shelf edge
2) Significant erosional relief at the top of the Cretaceous and Eocene levels
3) Erosional interfluves of remnant Eocene carbonates.

The rapid expansion of sediment thickness in the Mediterranean is due to accommodation space created by growth faulting along the Cretaceous shelf edge. The deep incisions along the coastline appear to be subaerial based on the evidence from cuttings and biostratigraphic data discussed earlier.

If these surfaces along the coast are subaerial, then hiatal surfaces exposed far to the south in the Fayoum area may have much more exploration as well as academic significance than previously recognized. The ancestral Nile Delta drainage basin, if positioned as shown on Figure 5, would have drained much of the southern Egyptian highlands northward into the transfer zone shown on Figure 2.
Geological evidence for western position on the Ancestral Nile Valley

Further geological evidence for the position of the ancestral Nile River drainage basin in this locality is shown by Figure 14.

Figure 14 illustrates a number of important features:

- The section preserved in the Oligocene to the south near the Qasr El Sagha field trip area (Khataba-1 well) is relatively thin and dominantly fluvial. The age of this fluvial facies in the Khataba-1 well is most probably early Oligocene. The overlying basalt flow is almost certainly part of the Widan El Faras basalt flows examined on this field trip. The Wadi El Faras basalts are no older than 32 MA, and may be as young as 23.5 MA.
• Rapid thickening of the Oligocene and Eocene strata occurs northward.

• An inverse relationship exists between Oligocene thicks and thins. This suggests progressive erosion of the Eocene carbonates. For example, the Damanhour South-1 well has the thickest Oligocene section preserved, but the Eocene section is gone. This well appears positioned near the axis of the ancestral Nile River, in a regional Oligocene isopach thick that extends southward as shown schematically on Figure 5.

• Numerous hiatal surfaces occur from Upper Cretaceous through Oligocene strata across the line of section. Three unconformities are highlighted (24MA, 32MA and 36MA). The ages are based on regional distributions of missing sections in a number of wells. They also correspond to regional sea-level drops documented by (Hardenbol et al., 1998). One of the largest (32MA) corresponds with the loss of the NP23 nannofossil zone in many coastal wells.

• Progressive erosion of Cretaceous strata also occurs as shown on the diagram by loss of the CC25 and older nannofossil zones.

• Paleobathymetric data illustrates a high degree of variability in the “Dabaa” shales that are often correlated lithostratigraphically as sheet deposits of the same age. The lower portion of the Damanhour-1 well, for instance, has outer neritic and deeper faunal assemblages, while the Tahrir-1 and other wells to the south contain littoral assemblages. Above the NP23 horizon in the Damanhour-1 well, the shales are littoral, indicating a strong basinward translation of facies consistent with a regional sea level lowering. This facies shift is almost certainly related to the 32 MA eustatic lowstand.

Sequence stratigraphic summary of Eocene and late Eocene stratal architecture

Based on the data shown earlier, a generalized schematic of the stratal architecture of the Upper Eocene and Oligocene is shown on the bottom portion of Figure 14.

Several key interpretations can be made:

• The outcrop exposures examined in both Whale Valley and the Fayoum consist of highstand systems tracts fluvial and estuarine strata. These highstand deposits preserve reservoir facies that will be similar to those transported offshore in the lowstand systems tract.

• Intervening hiatal breaks at these locations (discussed later) speculated to be minor, are probably much more regionally extensive than previously recognized by other workers.

• Reservoir facies detectable by seismic in the offshore Nile Delta will be correlative to unconformity surfaces onshore.

• The subaerial incisions shown will be updip of shallow marine deltaic lowstand wedges preserved offshore.

• The “Dabaa Shales” are highly diachronous and contain numerous unconformities and complex facies relationships that have previously been under-interpreted in many well log correlations.
Condensed sections associated with regional transgressions (MFS on figure 13) may contain significant source rocks.

**Oligocene Highstand Systems Tract—maximum transgression**

Figures 15 shows the southward limits of the Dabaa Shale (terminating at the “fluvial” facies belt). These marine shales are absent in the Qasr El Sagha field trip area, where Upper Eocene and Oligocene strata consist of fluvial, non-marine and estuarine facies.

Subsurface correlations and isopach data suggest a restored paleogeography at maximum transgression as shown below. This interpretation has much of the Dabaa Shale preserved as silled shallow marine shales in the Western Desert and deep marine facies offshore. A prominent exposed landmass remains along the Mediterranean coastline, and the fluvial and coastal facies have shifted to the southeast by over 80 km relative to the exposed canyons discussed earlier. This pattern is similar to that discussed by (Said, 1990).

![Figure 15. Oligocene highstand systems tract](image)

**Figure 15. Oligocene highstand systems tract.** Pink = land; orange = fluvial sandstones; yellow = delta front; dark grey = shallow marine silled basin shales (Dabaa); light grey = deep marine basin.
Exploration significance of the hiatal surfaces observed

In the offshore Nile Delta, no wells have penetrated deeper than the NP23 horizon. In the deep-water portion of the Nile Delta, no wells have penetrated beyond the NP24 horizon. Only a handful of wells have even penetrated the top of the Oligocene. Non-commercial hydrocarbon discoveries have been made in Oligocene strata at Tineh Field and in the Habbar-1ST wildcat wells (Dolson and Boucher, 2002; Dolson et al., 2002). Multiple, stacked deep water channel facies are evident from 3D seismic data to depths of up to 7 milliseconds (Dolson et al., 2002).

The largest unconformities documented from missing nannofossil horizons in wells occur at the 24 MA, 32MA and 36MA and older horizons. These surfaces should have shed large volumes of reservoir material northward into the deep water Mediterranean. The Qasr El Sagha Upper Eocene and Oligocene outcrop strata preserve excellent clean quartz arenites sandstones and conglomerates in fluvial and estuarine highstand strata. Subsurface penetrations offshore, though limited, show similar clean sands and quartz arenite lithologies with excellent porosities and permeabilities at depths of up to 4400 meters below mudline.
OUTCROP STRATIGRAPHY

The Eocene and Oligocene outcrops (black triangles on figures 2, 3, 5 and 15) are within the greater Fayoum Basin. These exposures consist largely of sandstones, shales and limestones deposited in a shallow water environment.

The high volume of Eocene clastics in the Fayoum Basin is markedly different from age equivalent strata to the north that consist dominantly of shallow marine carbonates. The larger percentage of clastics in the Fayoum probably reflects proximity to highlands to the south and emergent uplifts like the Kattaniya horst and other Syrian Arc structures flanking the Fayoum Basin.

Outcrop exposures visited on this trip

1) Day 1:
   a. The Middle Eocene Gehannam and Lower Qasr El Sagha Formations at Whale Valley
      i. shallow water lagoonal and shoreline facies capped by marine shales
      ii. extensive vertebrate graveyard of whales and sea cows
   b. Exposures of large scale basal thickening northward into the Fayoum Basin

2) Day 2:
   a. Temple Member of the Qasr El Sagha Formation
      i. coarsening upward parasequences of tidal flat and beach horizons interbedded with lagoonal and marine shales
   b. Giant foreset beds of a paleo-estuary in the Dir Abu Lifa member of the Qasr El Sagha Formation
   c. Oligocene Gebel Qatrani Formation
      i. non-marine paleosols
      ii. conglomeratic and fine-grained meander-belt sandstones
      iii. petrified forests
   d. Widan El Faras basalt flows

DAY 1: WADI HITAN FIELD AREA

Location and Access

The Wadi Hitan field site is now under the protection of the Egyptian-Italian Protectorate.

The entrance to the protected area can be difficult to find if one is not familiar with the roads around the Fayoum province. GPS points for the entrance are: N 29 deg 21.393 min, E 30 deg 27.215 sec.

Directions to the easiest route follow:

Take the main road to the Fayoum from Cairo. Turn right at a fork in the road at Lake Qarun by a large blue sign. Follow the tarmac road along the shoreline of Lake Qarun for 10-15 km. At the end of the lake when the tarmac road turns left, you will see signs for Wadi Rayan. Turn left (and note that a dirt track keeps going straight at this point—don’t take it). Continue until you see signs for Wadi Rayan that will bring you to the gate, where there will be a possible gate fee of 5 LE per person.
Figure 16. Map of the Wadi Ryan protected area (courtesy EIP). The whale fossil area shown is approximately 35 kilometers west of the entrance to the park.
Overview of Stratigraphy

The most recent detailed stratigraphic work is that of Gingerich (1992). Gingerich’s paper summarizes the history of stratigraphic work on the Eocene in Egypt, the vertebrate paleontology of the whales, and provides a regional framework summarized in part in this guidebook. To date, over 400 skeletons have been found, comprising multiple species as well as Sirenia (sea cows or manatees). The unusually high number of fossil whales and other vertebrates makes this area a truly unique “world heritage” site worthy of conservation and much further research. Table 2 provides the locations of all the Eocene sections used by Gingerich (1992).

Table 2. Latitude and Longitude of Eocene Outcrops used by Gingerich (1992) and in this study.

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<th>Outcrop Name</th>
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Sub-regional setting

Gingerich (1992) synthesized a regional transect from Whale Valley to the Qasr El Sagha area. The location of the cross-section and the regional interpretation concluded in this study of shoreline and basin positions is shown below.

Figure 17. Location of outcrop cross-sections. See Figure 18 for the regional outcrop correlation that ties Whale Valley to the Qasr El Sagha area. Locations of shorelines, basinal deposits (blue outline) are shown in italics. The “detailed section indicated above” is shown in Figure 19.

The Wadi Hitan fossil site is located on an Eocene paleo-shoreline (figures 17, 18 and 19). Excellent overviews of basin-scale geometry lying between the Whale Valley site and the Qasr El Sagha outcrops occur at Gebel Gehannam (“hill of the devil”—named for the blazing summer heat in that area).

Looking northward from Gebel Gehannam, it is easy to see the steady thickening of strata and the general decrease in sand content shown on Figure 18. Gebel Gehannam consists primarily of stacked shallow marine and shoreface systems. To the south and west, toward the Minqar Abayad outcrop (Figure 18), a prominent marine “black shale marker” bed is present. This shale pinches out and becomes progressively more carbonaceous to the southwest (see detailed section, Figure 19). To the northeast, it thickens and the probable equivalent at the “west end of Birket Qarun” measured section is a gray marine shale.
Figure 18. Semi-regional outcrop-based correlation of facies and environments, Whale Valley to Qasr El Sagha.

The basin shape is clear between the Gebel Gehannam and Garet Um Rigl measured sections, as indicated by the thickening of all strata toward Garet Um Rigl. Also clearly shown on the diagram is the large unconformity bounded estuarine sequence of the Dir Abu Lifa Member of the Qasr El Sagha Formation, discussed later.

The “black shale” marker bed is important, as it identifies the paleo-shorelines to both the southwest and northeast across the Fayoum Basin. This shale layer almost certainly contains a maximum flooding surface (MFS) separating a transgressive/regressive sequence at Wadi Hitan. The whales at the Wadi Hitan site are found in the Birket Qarun Formation. The “camp white layer” shown below the Birket Qarun Formation is a prominent mangrove root horizon that most likely represents a
sequence boundary. *Glossifungintes* borings are common and the surface itself has a sharp planar boundary.

Figure 19. Summary stratigraphy of the field stop. Modified from Gingerich (1992). See Figure 2 for the location of this section. The “mangrove root horizon” is part of the “camp white layer” shown on Figure 18.

The fossil area is located in a transgressive-regressive shoreline sequence summarized in more detail in Figure 19. The location of the cross-section is shown on figures 2 and 17.

A buried Syrian Arc landmass appears to exist south of the Wadi Hitan stop. Evidence for this landmass comes from gravity and magnetic data used to construct the basement topography map of Figure 3. Well log evidence for this landmass is also shown on Figure 8, well number 15. North of Qasr El Sagha, the Kattaniya Horst is the closest other large Syrian Arc landmass.

The interpretation shown on figures 17-19 shows a narrow mini-basin between the Wadi Hitan and Qasr El Sagha field trip stops. This narrow inlet, interpreted from the thickening of strata northeast of Wadi Hitan and then thinning by Qasr El Sagha, appears to broaden southeastward into the greater Fayoum Basin. The southern terminus of the “black shale marker” approximately shows the southwestern landward edge of the Fayoum Basin at this point in Eocene time. It is interesting to note that a similar embayment exists in the modern Lake Qarun, most likely caused by a deep structural graben still active today.
Paleo-shoreline at Wadi Hitan

Prominent mangrove root horizons (the Camp White layer of Gingerich, 1992) are present in the western portion of the field area. These same root zones are absent to the northeast, replaced by shallow marine and tidal flat sandstones. Two prominent sandstones overlie the rooted horizon at the fossil site. These beds consist of burrowed and horizontally laminated sandstones interpreted as beach deposits. They inter-finger with the “black shale” member and pinch out into marine shales northward.

At least 38 whale skeletons lie on or in close proximity to the strandline of the lower sandstone. In the greater Whale Valley area, numerous skeletons are found at many other locations vertically.

Figure 20 Map of 38 whale skeletons and location of heavily rooted mangrove shoreline within the partially developed protected area. Numbers for location are eastings and northings in meters.

The map above shows details of the location of the mangrove-rooted horizon. The 38 protected whale skeletons are shown with red dots. The stratigraphic section shown in Figure 19 runs roughly southwest to northeast across this area.
The paleogeography shown on Figure 5 suggests the Wadi Hitan may have been an ideal site for annual whale migration and birthing. To the north lay a narrow marine embayment terminating at the exposed landmass of the Kattaniya Horst. At Qasr El Sagha (day 2 stop) age equivalent strata to the Wadi Hitan section are not exposed. However, upper Eocene strata of the Temple Member of the Qasr El Sagha Formation at stop 2 consist of shallow marine and tidal flat facies. *Glossifungites* ichnofacies, ravinement surfaces and rooting at the top of parasequences are also common. These strata were most likely formed as shoreline and tidal flat facies rimming the exposed landmass of the Kattaniya Horst.

The narrow marine embayment between Day 1 and Day 2 stops would have provided a favorable site for whales to migrate annually for calving purposes. These sheltered bays may have provided a rich feeding ground, especially near river input points. Modern birthing areas such as the Baja California estuary provide analogues. The open ocean of the Mediterranean could be entered through numerous estuaries and inlets.

![Worm-bored petrified tree located along a paleoshoreline at Whale Valley](image1)

![Enlarged view of bored wood](image2)

Figure 21. Along the northeast edge of the mangrove horizon (Camp White Layer) is a heavily worm-bored fossil tree. The extensive worm borings would have occurred in shallow water within the Wadi Hitan estuary.

**Paleo-ecology, exploration history and vertebrate paleontology of Whale Valley**

Wadi Hitan (Whale Valley or Zeuglodon Valley) was first explored and mapped during the winter of 1902-1903 by geologists of the Egyptian Geological Survey as part of a long-term investigation of the potential of the western Fayoum for storage of Nile River flood water. The German explorer Schweinfurth had passed by the area in 1886 but turned eastward from Garet el-Gehannam to explore the Qasr el-Sagha escarpment north of Birket Qarun.
Surveys were carried out by University of Michigan Museum of Paleontology and Cairo Geological Museum field teams. Following its discovery, Wadi Hitan was virtually ignored for eighty years until 1983-1993 when a systematic survey of fossil vertebrates was carried out cooperatively by the University of Michigan Museum of Paleontology and the Cairo Geological Museum. More than 400 whales and other fossil vertebrates were mapped in an area of about 25 square kilometers (Figure 22).

Figure 22. Distribution of 406 identifiable whale and sea cow skeletons, partial skeletons, and groups of bones or isolated bones identified in 1983-1993 surveys of Wadi Hitan.

The first mention of whales in Wadi Hitan was by Andrews in 1904 and Beadnell in 1905. Beadnell proposed the name *Zeuglodon isis* for the lower jaw of a large adult whale found west of Birket-el-Qurun, and Andrews later named a second genus and species, *Prozeuglodon atrox*, based on the skull and jaw of a smaller juvenile whale. The name *Zeuglodon* is a junior synonym of *Basilosaurus*, and the name *Prozeuglodon* is a junior synonym of *Dorudon*, so the accepted names for these whales are now *Basilosaurus isis* and *Dorudon atrox*. Living whales are divided into Odontoceti (simple-toothed whales including dolphins and porpoises) and Mysticeti (baleen whales), but the whales of Wadi Hitan belong to a more primitive division of Cetacea called Archaeoceti (archaic whales retaining primitively complex teeth and functional hind limbs).

Of the 400+ skeletons, 205 were complete enough to identify with some certainty. Some of these are the large skeletons of *Basilosaurus* that are so conspicuous in Wadi Hitan today, while others are more cryptic skeletons of *Dorudon*, partial skeletons of smaller sea cows (mammals of the order Sirenia), and sometimes isolated groups of bones or single bones. All come from the upper part of the
Gehannam Formation of latest middle Eocene age (late Bartonian) or from the overlying Birket Qarun Sandstone of earliest late Eocene age (early Priabonian).

There are possibly as many as five species of archaeocete whales present in Wadi Hitan, but only two are well known. *Basilosaurus isis* is very large whale, with large complex teeth, a short neck, well developed five-fingered flippers on the forelimbs, and an unusually long serpentine body about 18 meters in length. One of the surprising discoveries in Wadi Hitan was the presence of hind legs, feet, and toes on *Basilosaurus* (Figure 23), which were not known previously in any archaeocete.

![Figure 23. Skeletal reconstruction of an 18 meter long *Basilosaurus isis* skeleton from Wadi Hitan (top) and a close-up of its 10-centimeter-long foot. This discovery provided the first evidence that archaeocetes retained feet and toes as vestiges of their land-mammal ancestry in archaeocete whales. The hind limbs of *Basilosaurus* are greatly reduced in size relative to the rest of the skeleton, but still have well-formed joints and robust processes for muscle attachment showing that they were functional in some sense. Hind limbs were possibly used as copulatory guides in basilosaurid archaeocetes.

The hind legs are reduced to internal vestiges in modern whales, and the presence of small but well-muscled hind limbs in *Basilosaurus* is undoubtedly a primitive retention from an earlier land-mammal ancestry. Such small limbs and feet could not have been useful for locomotion, but were possibly still important for copulation. We do not know if the hind limbs differed in male and female *Basilosaurus*, and at present assume that both sexes had similar hind limbs.

*Dorudon atrox* is a smaller whale with a skull, neck, and flippers like those of *Basilosaurus*, but with a more compact dolphin-like body that was about 5 meters long in life (Figure 24).
Figure 24. Full skeleton of a five meter long *Dorudon atrox* from Wadi Hitan on public display in the University of Michigan Exhibit Museum, Ann Arbor. Note the more normal dolphin-like body proportions of *Dorudon* as compared to *Basilosaurus*, and similar retention of reduced hind limbs and feet.

*Dorudon* retained hind limbs and feet, and these too, are reduced in size like those of *Basilosaurus*. The two or three additional whales known from Wadi Hitan are *Dorudon*-like, but differ in vertebral proportions or forelimb configuration.

Three species of early Sirenians are known from Wadi Hitan belonging to the genera *Eosiren*, *Eotheroides*, and *Protosiren*, respectively. These have skulls, teeth, and skeletons very much like those of living sea cows. One partial skeleton of the primitive proboscidean land mammal *Moeritherium* is also known from Wadi Hitan.

In addition to the mammals, lower vertebrate remains from Wadi Hitan include a very diverse shark fauna. Three different kinds of sawfish are known. Skulls and partial skeletons of bony fish are reasonably common. These are principally marine catfish, but billfish like the modern swordfish are also known. There are also several kinds of turtles, of which the one most commonly found is a sea turtle. Vertebrae of sea snakes are common. Finally, two kinds of crocodiles have been found, but their remains are fragmentary and relatively rare.

What do the vertebrate fossils found in Wadi Hitan tell us about the environment where they lived? First, both *Basilosaurus* and *Dorudon* are found in Eocene deposits of the Gulf and Atlantic coasts of North America, showing that they were widely distributed, fully marine, and probably highly mobile. Their teeth are sharp, indicating that they were predators. The larger *Basilosaurus* is represented by about 97 partial skeletons in Wadi Hitan, of which only one is a juvenile (1%). *Dorudon atrox* is represented by about 82 partial skeletons, of which 63 have been classified as adult or juvenile. Twenty-six of these (41%) are juvenile. Thus *Basilosaurus* and *Dorudon* are present in approximately equal numbers in Wadi Hitan, but they have very different population structures. The presence of a high proportion of juveniles in *Dorudon* suggests Wadi Hitan was probably a favored calving ground. Whales today seek warm, sheltered embayments and lagoons to give birth. Several juvenile specimens of *Dorudon* have bite marks across their skulls indicating that they died when bitten by a predator. The predator could have been a large shark, but these are relatively rare. It seems more likely that *Basilosaurus* was the predator preying on young *Dorudon*. The fact that so many juvenile *Dorudon* are found in Wadi Hitan reinforces the idea that it represents a protected embayment or inland sea rather than open ocean.

Sirenians or sea cows living today inhabit sheltered estuaries and feed on seagrass meadows growing in shallow coastal waters (maximum 30 m water depth). Fossil sea cows known from Wadi Hitan are so similar to modern Sirenians in skeletal form, with tusked skulls, compact bodies, forelimb flippers, dense expanded ribs neutralizing their buoyancy, reduced hind limbs, and fluked tails, that we can safely infer that they lived like their modern relatives do. This is further evidence that Wadi Hitan
was part of a shallow protected embayment. The only land mammal found in Wadi Hitan is one partial skeleton of the amphibious early proboscidean *Moeritherium*. This may indicate that the shoreline was nearby, but the *Moeritherium* may also have been caught and transported some distance from shore by *Basilosaurus* or another predator.

Abundant mangrove and several crystal logs of beached shipworm-bored wood reinforce evidence from vertebrates that the fossils in Wadi Hitan accumulated during a time of relatively low sea stand in a shallow embayment or inland sea.

Wadi Hitan is unusual in having such a large concentration of fossil whales in a relatively small area. There are several possible explanations for this. First, the area was sheltered and seemingly favorable for *Dorudon* calving. This would encourage these whales to return generation after generation. The presence of calving *Dorudon* females might have attracted larger predators like *Basilosaurus*, further increasing the diversity of whales. Second, if the proto-Nile or other large river system debouched into the embayment, this may have provided nutrients supporting a large biomass including fish, which would have attracted whales. The presence of sea cows might have attracted whale predators (though the whales greatly outnumbered such potential prey). Finally, the rich concentration of fossils may be due to excellent exposure of fossil-bearing strata, and it is possible that other areas like Wadi Hitan may be found as more of the Western Desert is explored with the same intensity.

How did the Wadi Hitan whales die? The presence of a large number of whales dying in the same area is reminiscent of the beachings or strandings of whole groups or pods of extant whale species on modern beaches. There is no question that multiple skeletons are found on single bedding planes, and multiple skeletons are found on steep vertical escarpments. However, the skeletons are almost always found separated from each other spatially and stratigraphically, and, with one or two possible exceptions, whales are not found in the close single-species associations expected of strandings.

One final observation in Wadi Hitan is interesting. Adult skeletons of *Dorudon atrox* are fossilized in circles, as if they were attempting to stretch backwards and bite their tails. This is undoubtedly due to desiccation of the powerful back and tail muscles in salt water, which caused the skeleton to curl backwards into a circle before it was buried and fossilized. However, when an adult *Basilosaurus isis* skeleton is found it is always straighter and never curled back in the same way. This indicates that the two were differently muscled, which is not surprising given their greatly differing body lengths and vertebral proportions.

Of interest here, the orientation of *Basilosaurus* skeletons has the potential to tell us something about the environment of accumulation. In the course of studying *Basilosaurus*, the bearing of the head relative to the rest of the body was recorded for 14 individuals scattered across the whole of Wadi Hitan. These bearings are plotted as a rose diagram in Fig. 25.
Figure 25 Rose diagram showing orientations of 14 *Basilosaurus isis* skeletons in Wadi Hitan. Tails are at the origin, and heads point away from the origin. Bearing of head relative to the trailing skeleton was recorded in the field, to the nearest five degrees, using a brunton compass. Eight of the 14 specimens are oriented pointing north (N) or south (S), which is unlikely to happen by chance alone, and those pointing north and south occur with equal frequency.

The result is clearly bimodal, with four of the 14 skeletons oriented with their heads in the North octant and four oriented with their heads in the South octant. The remaining six skeletons fall in four of the remaining octants, and two octants are empty. The probability of eight of 14 skeletons being oriented in opposing octants is only about .04 (here N-S, shaded in the figure), and this is thus not likely to have happened by chance alone. Orientation could reflect alignment with prevailing sea floor currents, but then we would not expect equal numbers of heads in the opposing octants. Alternatively, orientation might reflect alignment with the ancient shoreline determined by the ebb and flow of tidal currents.
A typical whale skeleton is shown below. These skeletons have been partially reconstructed, but many vertebrae and other bones have been stolen over the years, leaving only partial skeletons at each site.

Figure 26. Typical Basilosaurus skeleton reconstructed on the lower sandstone layer shown in Figure 17.

Many complete skeletons remain to be excavated, preserved and reconstructed.

Figure 27. Prozeuglodon skull (now called a Dorudon) at the Egyptian museum. Note large teeth of an efficient predator.
Figure 28. A complete whale skeleton in the vicinity of the field trip stop (courtesy of Ahmed El Barkooky). The reconstructed whale diagram is somewhat inaccurate, as the Basilosaurus whales were much more serpentine in shape. Note the curved spine typical of most skeletons. This is caused by muscle contraction after death that distorts the spine (see text for discussion).
DAY 2: FAYOUM BASIN

The Upper Eocene and Oligocene strata at Qasr El Sagha in the Fayoum Basin are the sites of some of Egypt’s oldest and most important geological expeditions. This area contains one of the most complete records of late Eocene through early Oligocene vertebrate evolution in Africa. It is especially noted for its early primates, such as *Aegyptopithecus*, one of the oldest primate fossils discovered to date.

As mentioned earlier, expeditions by H. J. J. Beadnell, Henry Osborn, Walter Granger and other early researchers established the framework for understanding the geology of this area. These early expeditions focused on the rich vertebrate finds of the area. The Granger expedition used a unique method of locating large vertebrates. Using binoculars, they would scan the horizon looking for the large coprolite fossils of extinct *Arsinoitherium* species lying at the top of prominent red paleosols.

Figure 29. Typical Oligocene fauna recovered from the Jebel El Qatrani Formation, Fayoum Basin. The Beadnell expeditions of 1901-1904 produced some of Egypt’s oldest and most important museum specimens
Once these surfaces were located, they would comb the area for vertebrate fossils preserved along the tops of the paleosols.

Research continues annually under joint projects between the Egyptian Geological and Mining Authority (EGSMA) and Duke University, under the leadership of Elwyn Simons. Methods of fossil extraction remain the same as those pioneered by Granger and others nearly a century ago. Once a promising site is found, the surface hardpan is raked away by laborers and then revisited about six months later after the Khamsin winds have excavated another foot or so during the sandstorms common from March through May. The more resistant vertebrate fossils remain exposed and area easily collected.

More recent work, and the most comprehensive treatment of detailed depositional environments and measured sections is that of Bown and Kraus (1988) and El-Araby and El-Barkooky (2000).

The following section provides a summary of much of this work and an analysis of the regional context of some of the unconformities noted by these workers.
The section at Qasr El Sagha temple (Figure 30) consists of three major depositional sequences. The first is the shallow marine facies of the Temple Member of the Qasr El Sagha Formation. This interval is capped unconformably by a significant sequence boundary overlain by large scale cross-beds interpreted as an estuarine valley fill of the Dir Abu Lifa Member. This sequence is in turn
overlain by an unconformity surface covered by stacked fluvial and paleosol horizons with multiple erosional surfaces noted vertically. The overlying dominantly non-marine section is called the Jebel El Qatrani Formation. It is in turn overlain unconformably by multiple basalt flows of the Widan El Faras basalt. The flows are variously dated or reported by Bown et al (1988) as 1) 31 +-1.0MA 2) 27 +- 3.0 MA 3) 24.7 +-0.4 MA. These ages have been thrown in doubt by Kappelman et al. (1992), who report the lowest flow radiometric age as 23.5-23.7 MA. They consider the 30-31 MA age reported initially (Fleagle et al., 1985) as unreliable, possibly due to post-depositional chemical alteration of the basalt.

These ages confirm that the underlying non-marine facies is as old as 31 or 32 MA and possibly as young as 23.5 MY. It is possible, based on the regional reconstructions shown, that the 32 MA and 24 MA unconformities are merged under the lowest basalt flow and that there is a significant time break below the basalts. Alternatively, the “24MA” surface cited from subsurface nanofossil stratigraphy along the coastline may be above the basalts at a large and well-defined erosional surface described below the Kashab Formation. If so, then the “24MA” surface previously discussed might actually be slightly younger than 23.5 or 23.7 MA. Numerous hiatuses between individual flows are also noted based on scorched and weathered zones internal to the basalt complex, suggesting repeated exposure events.

In any case, the surface below the basal basalt is most certainly a significant unconformity. Vertebrate zonation in time within the underlying strata is of insufficient resolution to definitely rule out that some of the Oligocene section exposed not late Oligocene. Stratigraphic reconstructions previously shown, however, make an Early Oligocene age most likely, with a significant time break below the lowest basalt.

We speculate that the 36 MA surface discussed earlier is equivalent to one of the two lower surfaces shown in Figure 30. The Dir Abu Lifa Member of the Qasr El Sagha Formation has been dated as late Eocene and, in fact, the lower part of the Jebel El Qatrani Formation may also be late Eocene in age.
Temple Member Parasequences--Tectonically induced unconformity surface

Figure 31. Thining upward parasequences of the Temple Member, Qasr El Sagha Formation. Arrows indicate thickness of various parasequences.

The Temple Member at Qasr El Sagha (figures 31 and 32) consists of coarsening and thinning upward parasequences. Typically, they consist of lignitic, highly carbonaceous shales overlain gradationally by horizontally laminated or bi-directional cross-bedded sandstone containing numerous marine trace fossils. *Arenicolites* and *Thallassonoides* burrows are ubiquitous. Parasequence sets are generally capped by root horizons, *Gossifungites* ichofacies and/or layers of oyster shell hash.

The individual parasequences become rapidly thinner vertically and are capped by a prominent erosional surface overlain by the Dir Abu Lifa member “green and gold muddy sandstone” or the “giant cross-bedded sandstone” of Bown and Kraus (1988).

The thinning upward of each parasequence, plus a general increase in the amount of lignitic and carbonaceous material, indicates a rapid basin shallowing and loss of accommodation space. This in turn suggests that the overlying erosional surface is a major tectonically induced sequence boundary. The presence of the Kattaniya horst directly northwest provides an excellent structural feature to cause such a rapid shallowing. The overlying erosional contact is well documented by Bown and Kraus (1988).

*Temple Member depositional environment*

The Temple member parasequences have been interpreted by Bown and Kraus (1988) and Vondra, (1974) as beach and lagoonal deposits. The presence of bi-directional cross-bedding and ichnofacies such as *Arenicolites* support this interpretation but add a tidal flat and tidal channel origin to many of these exposures (Figure 32). There is abundant evidence of repeated exposure of many of the parasequences (Figure 33).
Figure 32. Typical facies and surfaces of the Temple Member below Qasr El Sagha temple.
Figure 33. *Glossifungites* zone and shell hash developed at a parasequence boundary, Temple Member. The network of *Thallasinoides* burrows below the flooding surface (Th) is filled with shelly material from above.

**Dir Abu Lifa Member giant cross-bedded sandstone**

Bown and Kraus (1988) subdivided the Qasr El Sagha Formation into the Temple and Dir Abu Lifa members based on recognition of the capping unconformity (Figure 30). Prior work by Vondra (1974) suggested the contact was conformable and represented a transition from shallow marine to deltaic sedimentation.

However, Bown and Kraus’s detailed work on the Dir Abu Lifa Member clearly shows that the “giant cross-bedded sandstone” thought by Vondra to have formed as deltaic foresets are actually large scale accretionary bedforms. Bown and Kraus interpreted these bedforms as fluvial, based on internal geometries and the recognition of scroll bar tops visible at some locations near the top. Lateral accretion (as opposed to delta-front progradation) is also supported by the overall fining-upward of many of the channel fills.

Figure 18 shows that the giant cross-bedded sandstones are not present southward at the Garet El Esh exposure, where thick marine limestones are present. The most likely explanation is that the limestones are eroded out by an incised valley that the Dir Abu Lifa Member infills at this location with estuarine and shallow marine strata.

Spectacular exposures of these large channel-fills are shown in figures 34 and 35. Individual channel-fill deposits are marked by fine-grained drapes, probably representing temporary channel abandonment. The top of the channel system is truncated by a marine transgressive surface marked by a fine-grained calcareous unit (“Bare Limestone”) and a well-developed *Glossifungites* trace-fossil assemblage.
More recent reconnaissance work within the Dir Abu Lifa Member indicates significant marine influence and a more complex stratigraphic story. Marine trace-fossils are present within many of the channel-fills, bedforms on the inclined surfaces are not consistent with a fluvial origin, and beautifully developed tidal features are abundant (Figure 36). In one area, the top of the channel-fill consists of a succession of thin, rippled-bedded sandstone and mudstone with abundant *Arenicolites* traces, possibly representing late-stage fill of mixed tidal-flat deposits. A distinctive facies of thin hummocky-bedded sandstone and mudstone locally occurs below the laterally accreting channel-fill (Figure 37), possibly representing a marine shoreface or wave-influenced delta-front that has been mostly cannibalized by the overlying channels.

The giant cross-bedded sandstone is capped with a planar bed of oyster shell (‘bare limestone’ of figures 30 and 34) interpreted as overlying a marine ravinement surface. *Glossifungites* traces are ubiquitous below and above this limestone bed. It completely bevels the upper units and is laterally extensive.

The Oligocene Jebel Qatrani Formation unconformably overlies this easily recognizable limestone layer.

![Giant cross-bedded sandstone of the Dir Abu Lifa Member](image)

Figure 34. Giant cross-bedded sandstone of the Dir Abu Lifa Member. Note the inclined stratification and prominent lateral accretion surfaces (red arrows). BL= bare limestone of Figure 30. Vertical exaggeration of 2X. The cross-bedded facies here is over 25 meters thick.
Figure 35. Giant cross-bedded estuarine point bar deposits, Dir Abu Lifa Member above Qasr El Sagha.

Figure 36. Well developed tidal bundels above a reactivation surface in the giant cross-bedded sandstone, Dir Abu Lifa Member. Changes in thickness of individual sandy foresets in this facies is interpreted as a response to neap-spring tidal cycles.
Figure 37. Thin hummocky beds near the base of the Dir Abu Lifa Member. These are flat-lying beds below the channel-fill facies and may represent a marine platform incised by the estuarine channels.

**Jebel Qatrani Formation**

The Jebel Qatrani Formation is 397 meters thick and consists of interbedded fine to conglomeratic sandstone, red shales and rare thin limestone beds. Two major benches of petrified forests are preserved, with logs in excess of 30 meters long. Fossil rhizoliths are common and are among some of the best preserved anywhere in the world. Fossil termite nests, fruit, crocodile and turtle fossils are also common.

The formation is fully continental with the exception of some thin marginal marine intervals near the top, where mangrove roots and large burrows are preserved near the base of the overlying Widan El Faras basalts. The high net-gross ratio of sand to shale shown in Figure 30 indicates an abundant sand supply during deposition.

The authors speculate that these exposures, and those of the underlying Dir Abu Lifa Member, represent fluvial and estuarine facies associated with the ancestral Nile River drainage basin, which lay largely to the west as discussed earlier. The west-southwest paleo current directions suggest these streams were moving around the flank of the Kattaniya Horst, which formed a barrier to the northwest. Along the crest of the Kattaniya Horst, the Oligocene thins to less than 100 meters (see Khataba-1 well on Figure 14).

Bown and Kraus (1988) interpreted the paleoclimate as one of a tropical rain forest. Based on observations that the fossil forests are confined only to localized point bars, and that thick paleosols in laterally equivalent strata are barren of big trees, we believe a fossil savannah with a monsoonal climate is more likely interpretation.
Figure 38. Typical petrified forests and laterally associated paleosols of the Jebel Qatrani Formation.

The thick paleosols (Figure 38) observed are consistent with those formed in alternating wet/dry climates (Retallack, 1988).

Widan El Faras Basalts and upper portions of the Jebel El Qatrani Formation

The upper portion of the Jebel El Qatrani Formation is the only part of the formation that shows any significant marine influences. El-Araby and Barkooky (2000) interpret parts of this section as estuarine near the contact with the Wadin El Faras basalts. The fact that the interpreted estuarine channels are surrounded by paleosols would suggest a very proximal position near fluvial input points and/or a significant hiatus in the section.

The upper contact of this interval with the overlying Widan El Faras basalts is strongly erosional and the basalt flows thicken into lows. The age of this surface, as discussed, is in doubt, as old as 32 or as young as 23.5 MA. The world-wide 32 MA eustatic event is well documented by Hardenbol et al. (1998) and corresponds, as discussed earlier, with the common absence of the NP23 nannofossil zone in wells along the northern coast of Egypt. It is possible that this surface lies beneath the basalt flow and that a significant unconformity occurs at this contact.
Figure 39. Widan El Faras basalt and features near the contact with the underlying erosional surface. In 2) the termite nests for abundant circular casts.

Likewise, another documented erosional surface beneath the uppermost basalt is dated between 23.5 MA and 27 MA. An approximately age equivalent erosional surface recognizable on seismic and logs of approximately this age is present in many wells to the north. This surface may be correlable with the 24MA event discussed earlier.

Summary

The fluvial and estuarine strata preserved at Qasr el Sagha represent only a fraction of the sedimentary section preserved in the offshore Nile Delta. These highstand deposits contain reservoir lithologies analogous to those that have, and will be, drilled offshore at some time in the future.

The sections are significant from both an academic and hydrocarbon exploration standpoint. Additional investigation as to the magnitude and ages of the unconformities documented, plus recognition of additional surfaces that may lie completely within the non-marine Jebel Qatrani Formation will have economic implications in the future.
SECTION 3. ECO-TOURISM POTENTIAL IN THE GREATER FAYOUM BASIN

Protected Areas in Egypt

Egypt's natural heritage is rich with a wide diversity of ecosystems, rendering it unique worldwide. The government of Egypt, through the Ministry of State for Environmental Affairs, accords a particular importance to maintaining this heritage for future generations. Primary references dealing with the topics discussed in this section are Euroconsult and Darwish Co. (2000), NorthSouth Consultants Exchange (NSCE (2000), Fakry (1973a, 1973b) and Healy (1994).

Currently, there are 21 protected areas (PA) in Egypt, covering about 8% of the total national surface, with plans to have this extended further to 17% by 2017. Two new protected areas, Siwa and the White Desert, were declared in 2002. Not all declared PAs are actively managed, and not all areas are open to tourists and visitors.

Table 3. Existing Protected Areas in Egypt

<table>
<thead>
<tr>
<th>Name of the Area</th>
<th>Governorate</th>
<th>Size (km²)</th>
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<tbody>
<tr>
<td>Ras Mohamed National Park</td>
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<td>Port Said</td>
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<td>Marsa Matrouh</td>
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<tr>
<td>Siwa Protected Area</td>
<td>Marsa Matrouh</td>
<td>?</td>
</tr>
<tr>
<td>White Desert Protected Area</td>
<td>New Valley</td>
<td>2 300</td>
</tr>
</tbody>
</table>
Protected Areas of the Western Desert

The Western Desert of Egypt covers about 600,000 km². It stretches from the Nile River to the Libyan border and from the Mediterranean coast to the Sudanese border. An excellent summary of its geology and human history is covered by (Vivian, 2000).

There are seven important depressions within this area and with the exception of the largest depression (Qatarra), all of these are considered oases (Siwa, El Faïyum, Bahariya, Farafra, Dakhla, Kharga). There are also two large agricultural developments in the south, Sharq Oweinat near the Sudanese border and Tushka near Lake Nasser. The Western Desert is one of the driest areas of the African Sahara with almost no rainfall. As of this writing, five areas in the Western Desert have been declared protected due to their importance and unique biodiversity.

El Omayed

El Omayed PA, located in the eastern province of the North Coast, 80 km west of Alexandria was the first PA created in Egypt. It was established in 1983 and in 1986 UNESCO added it to its list of biosphere reserves. The area of the PA totals 700 km².

Omayed lies within the desert and semi-desert region and is bounded in the north by the Mediterranean Sea. The area possesses an impressive array of flora, up to 130 perennials and over 75 annuals, which are important to the traditional way of life of the area’s inhabitants. Five thousand Bedouins from the Auwlad Ali tribe call Omayed home, herding sheep and goats and cultivating fig and olive trees, wheat and corn.

Lake Qarun Protected Area and Wadi Rayan Protected Area (FIELD TRIP AREA)

Qarun PA and Wadi Rayan PA are both located within the Fayoum Governorate. The most important biological and natural features are two fresh-water lakes. Large numbers of migratory birds visit the lakes. The area also contains some of the most unique collections of fossil fauna and flora, as discussed in detail earlier.

Qarun PA covers over 230 km². Lake Qarun is the remainder of the ancient freshwater Lake Moeris, which once covered a substantial portion of the Fayoum depression. Today, the shallow lake is a wetland of international importance. It has been listed by Bird Life International as an important bird area.

The inhabitants of the PA are mostly farmers who work the land with ancient methods and grow a variety of crops such as oranges, lemons, apricots, dates and olives. Fishing is also a major industry, capitalizing on the lake and numerous irrigation canals as well as small artificial fish farms. On the north shore of the lake, quarries and mining provide additional jobs.

Wadi Rayan was once a barren, uninhabited depression that served only as a transit route for caravans leaving the Fayoum to the Western Desert. When agricultural drainage into Lake Qarun increased in the 1960s, the lake overflow threatened the adjacent farmland. The Wadi Rayan depression was found suitable to divert par of the Fayoum drainage water. Canals and tunnels were built to transfer water...
from the Fayoum to Wadi Rayan. This drainage water eventually created two lakes, which today provide a wetland habitat for a variety of resident and transient wildlife.

The creation of the lakes also allowed various new land uses and brought inhabitants to the area. An abandoned monastery was renovated and reoccupied. Two agricultural land development schemes for landless farmers were planned and developed. Landless farmers from the south were relocated to the area where they cultivate fruits, vegetables, and olives under harsh conditions. Fisherman come from the Fayoum to the Wadi Rayan lakes to fish. They do not live permanently in the area.

Demand for both areas as a recreational destination by locals is high. Cairo is located less than 100 km away. Recreational use is undoubtedly on the rise given the over crowded and polluted conditions prevailing in and around Cairo. The recreational possibilities and challenges to management of the number of visitors pose both an opportunity and a real problem.

More general information on the Fayoum is available in Hewison (1984).

Siwa

Siwa Oasis, located 300 km south of Marsa Matruh and 70 km east of the Lybian border, is the most distinctive oasis of the Egyptian Western desert. In the summer of 2002, it was declared a protected area. It occupies a space of 1125 km² and stretches 75 km east to west and 15 km north to south. The oasis enjoys a unique environment combining cultivated areas, natural vegetation and stark desert landscapes. Large numbers of fresh water artesian springs nourish a lush habitat.

Its inhabitants are mostly Berbers, a people who once roamed the North African coast from Tunisia to Morocco. The oasis was inhabited as early as 10,000 B.C. and was a frequent headquarters for Alexander the Great, who is thought to be buried in the oasis. When Arab invaders arrived in the seventh century, the sedentary Berbers became nomadic Bedouins. As a result, the Siwan language, traditions, rites, dress, decorations, and tools are mostly alien to the other oases in the Western Desert. The Siwan natives remain more closely aligned with the people of the Maghreb and the northern coast of Africa in Libya.

Siwans have lived in extreme isolation from the outside world over long periods in history. Access to Siwa was restricted and no travelers were permitted to the oasis until 1980, when restrictions were lifted. Within a few years, the oasis was open to tourism with restaurants, craft shops and desert tours. The Egyptian government, in an effort to more closely align Siwans with Egyptian traditions, has instituted many new programs in Siwa. Governors, teachers, and other officials have been imported from the Nile Valley. Farmers and other laborers have been encouraged to settle in the area. Industrial investments have been encouraged and several factories have emerged.

Agriculture, however, is still the major industry in Siwa. The most important crops are dates and olives. Olives have been important to the Siwan economy since antiquity. Recently, dates surpassed olives as the most important crop in Siwa. Today, the oasis is inhabited by approximately 16,000 people. Seven thousand tourists visit Siwa annually. Large numbers of Italians and Germans, whose parents and grandparents experienced the beauty of the area under General Rommel’s occupation in North Africa in the Second World War, continue to flock to this beautiful and tranquil oasis.
The White Desert

The Farafra depression spans 90 kilometers east-west and 200 km north-south. It is the second largest depression in the Western Desert. The depression floor comprises a mixture of Cretaceous age white chalk and limestone. As a result, the sand grains are a bright white color, giving the area the name White Desert. One of the more unusual aspects of the White Desert are occurrences of exhumed Cretaceous and early Tertiary caves. The cave floor fills and large stalagmites now stand fully exposed with no roof, with modern sand dunes drifting into the unusual rock outcroppings. These sites are part of the tours offered in Field Trip 8 (Bahariya Oasis) at this convention.

The White Desert is part of the New Valley Governorate. Ambitious development plans will change forever the serene atmosphere of the Western Desert at large and of Farafra Oasis in particular. Over 60,000 acres of land are being prepared for development in a new agricultural scheme that has brought immigrants into the area. Qasr Farafra was once the only village in Farafra. Now, a dozen new communities, mostly consisting of Egyptians from the Nile Valley, have emerged on the southwestern plain.

The White Desert was declared protected in 2002, due to its unique and fragile environment. The area is a must-see for every desert lover and has become one of Egypt’s prime desert tourism areas. Many new hotels have been erected during the last several years. In 1980, about fifty tourists a year visited the oasis. That number has now grown to more then 2,500.

Institutional Background of Protected Areas

The Egyptian Environmental Affairs Agency (EEAA), through its Nature Conservation Sector (NCS), is the main administrative body responsible for the enforcement of environmental protection. Established under decree No. 631/1982 within the Prime Minister’s Office, the EEAA acts as the umbrella body to co-ordinate all government activities pertaining to the environment and conservation. In 1983, a presidential directive established EEA offices within each of the Governorates of Egypt. Through the provisions of Law 102/1983, the Ministry of Justice has issued decree No. 1611/1989 granting police power to the manager of the EEAA governorate branch protected areas. Another of the EEAA’s chief mandates is to monitor environmental issues and the activities of various other ministries. Under decree No. 360/1982 the Governorate EEAA offices can require the public or private sector to carry out environmental impact assessments for proposed large-scale physical development schemes.

Under ministerial decree N.30/1991, and subsequent Decrees N. 264/1994, the EEAA was restructured. A department dealing specifically with protected areas was created. As of 1991, the policy of the EEAA towards protected areas is as follows:

"to construct an efficient network of natural parks, protected areas and managed areas by developing the recently declared sites and selecting new locations; integration of protectorates program with the social and economic development, to attain sustainable development, conservation of biological resources, its monitoring, surveying, survival and development; to maintain sound management and administration of protected areas projects and enforcing Law No. 102/1993” (EEAA, 1991)."
Funding for administration and management of Egyptian natural protectorates is channeled through the EEAA from various sources. After the restructuring and the inclusion of EEAA within the Ministry of State for Environmental Affairs, discussions were underway to restructure the Nature Conservation Section (NCS) as a semi-autonomous unit of the EEAA.

**Inventory of major antiquity sites in Fayoum**

The following maps and figures provide a framework for the important geological, cultural and archeological sites in the Fayoum Basin. Field trip areas are shown in black rectangles. Table 3 summarizes details of the most important sites. A continuous record of 45 million years of geology through modern human history awaits protection, interpretation and development.

![Figure 40. Current eco-tourism initiatives and major geological, cultural and archeological sites.](image)

**Eco-tourism in the Fayoum**

The Fayoum depression has played an integral part in every culture that has swept through Egypt from the pharaohs to the Greeks and Romans to the Byzantine and Coptic Christians and finally Muslim Arabs.

Beyond its human history, the Fayoum has long been distinguished by its natural beauty. This beauty is rare to the settled lands of the Nile Valley and Delta. With its lakes, palm trees, pristine deserts, fossil remains, bird sanctuaries, and rural quietude, the area has much to offer visitors.
Economically, the Fayoum has throughout the last century remained largely on the periphery of the social and economic developments. Despite its proximity to Cairo, Egypt’s economic heart, and its physical link to the Nile irrigation network, the Fayoum remains poor. It has the fourth-lowest per capita income of the governorates in Egypt. Literacy and school enrollment rates are the lowest in the country. Additionally, the residents of the Fayoum suffer from a lack of awareness of environmental and cultural assets, over-exploitation of limited natural resources, and low participation of the local population in tourist development.

While the Fayoum currently suffers from deprivation, under-education and deteriorating economic and environmental conditions, its resources can, if appropriately used, become a major economic asset. These resources include the oasis itself, lake Qarun, the Wadi el-Rayen natural protectorate, the Wadi Hitan fossil site and the numerous historical monuments.

A number of social and economic development projects have been undertaken in the Fayoum, some of which aim to preserve the cultural and environmental stability of the area. However, much more remains to be done to arrest the economic deterioration and the environmental degradation that threatens to destroy the natural and historical beauty that will draw tourists.

The climate of the region is amenable to tourism, especially in the winter and spring. It is an extremely arid region, receiving only a little winter rainfall. It has bright sunshine throughout the year, very high summer temperatures, and moderately low winter temperatures.

Traditional mass tourism is not the answer for the Fayoum. Instead, the development of tourism should concentrate on making full use of sustainable potential. Ecotourism provides a rapidly developing form of tourism that fits what the Fayoum has to offer.

Ecotourism would make excellent use of the Fayoum’s most important asset: authentic natural and cultural resources. Ecotourism is sustainable. Investments will have revenues for a long period, if the most important assets of the Fayoum are preserved. Ecotourism activities in the Fayoum include such things as desert safaris, boat trips, bicycling and walking through the countryside, horse and donkey rides, guided tours to the famous fossil areas and antiquities, camping in the desert and working with local craftsmen.

The Fayoum has a unique combination of several important assets:

- World class fossil areas of Wadi Hitan and Jebel El Qatrani
- Rural environment with authentic living crafts
- Spectacular desert landscapes, natural areas north, east and west of Lake Qarun and in the Wadi el-Rayen area supporting a unique bird population and other rare fauna such as fennek and dorcas gazelles
- Well preserved monuments from the different periods of Egypt’s history, including Palaeolithic, Neolithic, Pharaonic, Graeco-Roman, Coptic and Islamic
- Migratory birds on the mud flats of Lake Qarun and in Wadi el-Rayen

The most popular sites are the recreational sites of Lake Rayan and El Seileineen Springs. They have visitors in excess of 175,000 per year, the majority being local tourists. The next most popular sites are educational; the Fayoum Zoo and the Museum. About 10,000 tourists a year, mostly foreigners, arrive to look at the antiquities of the Fayoum and, increasingly, its rich geological heritage.

Ecotourism is concerned with the preservation of nature and culture with the involvement of the local population. The hotel space is currently underused and the potential for further growth is clear.
None of the sites visited currently has more than minimal protection from theft, vandalism or simple wear and tear on these ancient ruins. Plans are underway, however, to provide more interpretive and protective oversight.

Environmental areas in the Fayoum

![Figure 41. Proposed environmental zonation of the Fayoum Basin.](image)

The area in and around the Fayoum Basin offers a plethora of animals, plants, varied landscapes, historical artifacts, and culture.

The Fayoum can roughly be divided into three different environments (Figure 41):

1) interior of the oasis
2) lake and shore
3) desert areas outside the oasis

Lake Qarun and the Wadi Rayan region are legally protected environmental safe zones where development is supposed to be severely restricted.
Birds

The Fayoum is already a popular site for Egyptian, expatriate, and foreign birdwatchers. It is included as a destination on most bird tours to Egypt. There are three main habitats for birds in the area: wetlands, inhabited farmlands, villages and towns, and desert areas.

Winter, spring, and autumn are particularly plentiful seasons for seeing the highest number and diversity of birds. Birds from Europe and Africa pass through the Fayoum on their annual migratory journeys during these periods. Some of the rarer species for which Fayoum is known include the Painted Snip, the Senegal Coucal, the Senegal Thick-knee, the Little Green-bee-eater, the Great Black-headed Gull, the Slender-billed Gull, and the Egyptian Nightjar.

Despite having been designated as core zones of the bird sanctuary, the eastern and western tips of the Lake Qarun tourism facilities have seen extensive development. Buildings have been constructed immediately at the shoreline of the lake within the declared buffer zone. These buildings have caused substantial damage to the bird habitats from processes of construction, site works or clearing, waste water and solid waste, noise and obstruction of the view to the lake. They have also substantially contributed to polluting the fragile shallow water ecosystem.

In 1998 Lake Qarun witnessed a plague of gull deaths that claimed the lives of at least 3000 slender-billed gulls at the height of their breeding season. The reason for the deaths, which claimed mostly young birds, ranged from toxins and increased salinity in the lake waters to deliberate poisoning by area fishermen who compete with the gulls for their catches.

In the past, Lake Qarun was considered one of the most prime areas for duck hunting in Egypt. This hunting was among the dominant attractions of this region. However, due to excessive uncontrolled hunting and the environmental degradation of the lake, its duck population has declined drastically. Consequently, the Fayoum governor issued a decree banning bird hunting. Hunting has stopped, at least in the southern and more populated areas around Lake Qarun. However, ducks and other birds are still illegally hunted in the eastern, western and northern parts of the lake and throughout Wadi El Rayan.

The development of birding tourism in the Fayoum is hampered by a number of factors. The major problem is the ongoing habitat destruction through the expansion of hotels and vacation homes along the shoreline that is destroying the bird’s natural habitat. Unregulated hunting is another problem. There is also little information about birding and basic infrastructure for birders is lacking. Very few local tour companies cater to this specialized market. Lastly, the tight security restrictions that require foreigners to be accompanied by military convoys further reduce the number of visitors to the area.

Other animals and environmental threats

A large land reclamation project has been undertaken which encompasses 1500 feddans in the area adjacent to Oyun El-Rayyan west and north west of the lower lake. This is a clear threat to the environment. It includes the building of a number of settlements and a paved road to serve this cultivated area. Without proper integration into the protectorate regulations, this reclamation could result in the total destruction of the reserve and adversely affect the wildlife habitats throughout the southern parts of the lower lake of Wadi El-Rayyan and Oyun El-Rayyan area.

As a result of the introduction of the agricultural population and the excesses of some of the many tourists who are visiting the natural habitats of Oyun El-Rayyan, signs of deterioration are evident everywhere. A number of animal species have already been introduced by humans and are having
detrimental effects on local species. Among these are rodents such the house mouse *Mus musculus* and the Nile rat *Arvicanthus niloticus*, both considered pest species, and red fox *Vulpes vulpes* which may out-compete, or even prey on the much smaller local foxes, the sand fox *Vulpes rueppelli* and the Fennec *Vulpes zerda*. The Egyptian Jackal *Canis aureus* is another carnivore capable of killing gazelles and smaller native carnivores.

Slender-horned and Dorcas gazelle have in the past frequently been illegally hunted in Oyun El Rayan. Other mammals and reptiles are intensively collected in Wadi El Rayan by professional hunters and sold to private collectors and zoos. Trapping of wild falcons (Peregrine, Saker and Lanner) is widespread in both the Qarun and El Rayan areas. They are sold illegally to wealthy foreign falconers.

These uncontrolled activities are, fortunately, increasingly being controlled by the Wadi Ryan and Qarun Protected Areas.

**Cultural Heritage of the Fayoum**

![Image of Important Craft Centers in the Fayoum](image_url)

**Figure 42. Important craft centers in the Fayoum.**
Apart from the green rural landscape in which traditional agricultural methods are still used, the Fayoum has several craft centers that are authentic. The most important of these are shown in Figure 42.

**El-Nazlaa**

In the eastern part of Fayoum, a branch of the Bahr el-Youssef runs through a deep clay bed. The river clay is used for a local handmade pottery produced with the ‘paddle and anvil’ technique. This is an age-old method of producing pottery. Only the rims of the large round pots are made on the throwing wheel. The pots are used to carry and store water and milk. The potters’ village at el-Nazlaa is built itself completely out of pots. The clay-covered potters are friendly and ready to spend time showing the tricks of the trade. They do expect a little financial token of appreciation.

**Medinet el-Fayoum**

The potters of Medinet el-Fayoum specialize in extremely large wheel thrown pots. These pots are for sale in Cairo but not produced there. The pots are built in a number of stages and left to dry and harden in between. The potters of the Fayoum are proud of their work and prepared to explain what they are doing.

**Tunis**

In the village of Tunis, near the south shore of Lake Qarun towards the western tip of the lake, a French potter took up residence in the early 1960's. He uses a variety of different clay types and glazes. This pottery centre also has a school for local children who make beautiful designs, primarily of animals in warm earth tone glazes.

**El-Alaam**

El-Alaam village, 7 km north of Medinet Fayoum, is a center of the famous Fayoum basket making tradition. Made of rice straw and date palm leaves, the coiled baskets of the Fayoum come in a large variety of shapes varying from large laundry baskets to dainty ones for little trinkets. This basketry technique has been found in Fayoum since the Neolithic period, long before the pharaohs came into power. The baskets are made by women working at home.

At present, the pots from El-Nazlaa and Medinet al-Fayoum are sold in Cairo at the pottery centers like that of Fustat. The Tunis pottery is more “upmarket” and “arty”. It is sold in galleries or craft shops in neighborhoods of Cairo where there is a high concentration of well-to-do Egyptian and foreign residents.

**Antiquities**

Antiquities in the Fayoum have long been overshadowed by the more well known and spectacular ruins of sites like the Pyramids of Giza, Saqarra and the temples and burial sites in Upper Egypt at Luxor, Aswan and Abu Simbel. However, as the following figures show, the Fayoum has seen human habitation since Neolithic times, and a large number of significant antiquities exist in this important protected area.

The most comprehensive and earliest archeological investigation of the Fayoum Basin was that of (Caton-Thomson and Gardner, 1934). This ground-breaking summary of the Neolithic and Pharonic...
ruins of the Fayoum (see Table 4 for ages) remains an important source of documentation of human habitation. Interestingly, the Neolithic site of Kom W in the Fayoum yielded large numbers of flint sickle blades attached to wooden shafts with combinations of twine and tar. The nearest tar and oil seeps are at the Gebel El Zeit outcrop over 200 km to the southeast along the shores of the Red Sea near Hurghada. This clearly indicates a flourishing trade route was established here over 8500 years ago.

The Fayoum has an extremely interesting history linked with its function as a “miniature Nile Valley”, a garden in Egypt with an important agricultural function. The development of the Fayoum is closely connected to that of the earliest stages of what now is Lake Qarun. In the Pleistocene the lake was much larger than at present (Figure 43). In the Neolithic period, the borders of the lake had retreated and were densely inhabited by a population that clearly lived a sedentary, agricultural life. Large basketry grain silos have been found to the north of Lake Qarun, dating to a period in which the pharaohs did not even exist.

There have been large fluctuations in lake shorelines. Caton-Thomson noted two basic groups of Neolithic people who she termed the “A” and “B” people. The arrowheads of the “A” type are quite sophisticated while the “B” points are poorly constructed. Caton-Thomson erroneously assumed that the lake level had lowered in one continuous drop. Many “B” blades are located near the present shorelines while many “A” blades are found higher up the ancient Lake Moeris highstands. She assumed that the “B” people populated the area after the more advanced “A” people had mysteriously disappeared. Most workers today note that the blades are actually mixed and that multiple highstands occurred in the past. The “A” points were almost certainly made by more advanced civilizations that replaced the older “B” population with time.

The first real pyramid of Egypt was built at the border of Fayoum in Meidum and several Middle Kingdom kings built their pyramids in the shadow of this great example. The Middle Kingdom saw an enormous bloom of life in the Fayoum. Efforts to control the swampy area resulted in some magnificent buildings and statuary. Today there are only traces of the pedestals of two giant statues that once stood in Biahmu. Envisioning the Fayoum as a swamp with sandy patches also explains why there were so many different crocodile gods worshiped in the oasis. The place must have been crawling with them.

Table 4. Major periods in human antiquity in the Fayoum. Modified from (Vivian, 2000). Bold script indicates stops visited on this trip.

<table>
<thead>
<tr>
<th>Human period</th>
<th>Years ago</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Acheulean</td>
<td>900000</td>
</tr>
<tr>
<td>Acheulean</td>
<td>50000</td>
</tr>
<tr>
<td>Pleistocene</td>
<td>10000</td>
</tr>
<tr>
<td>Holocene</td>
<td></td>
</tr>
<tr>
<td>Terminal Paleolithic</td>
<td>9000</td>
</tr>
<tr>
<td>Neolithic—Kom W in Fayoum</td>
<td>6000</td>
</tr>
<tr>
<td>Bronze</td>
<td>2000</td>
</tr>
<tr>
<td>Pharonic</td>
<td>3100-332 B.C.</td>
</tr>
<tr>
<td>Old Kingdom</td>
<td>3100-2125 BC</td>
</tr>
<tr>
<td>Middle Kingdom (Qasr El Sagha; Oldest Paved Road; Basalt Quarries)</td>
<td>2125-1570 BC</td>
</tr>
<tr>
<td>New Kingdom</td>
<td>1570-1070 B.C.</td>
</tr>
<tr>
<td>Late Period</td>
<td>525-332 B.C.</td>
</tr>
<tr>
<td>Greek period (Dimai ruins)</td>
<td>332-30 B.C.</td>
</tr>
</tbody>
</table>
Day 2 of the field trip traverses the Qasr El Sagha area, commencing with the ruins of Dimai.

Figure 43. Major Pharonic sites in the Fayoum.
Qasr El Sagha is one of the few ruins located on the north side of ancient Lake Moeris (see ancient shorelines are indicated in Figure 43). It may have been an important burial site, as discussed later.
Figure 44. Major Greco-Roman ruins in the Fayoum.

The port city of Dimai (Figure 44) flourished until approximately 336 A.D. It currently stands 65 meters above the Lake Qarun water level and 2.5 km from the shoreline. It was built on the shore of Lake Moeris and was once a peninsula and, at times, may even have been on an island. It was built by early Greeks, possibly by Ptolemy II, on the site of a pre-existing Neolithic tell. At its peak occupation, there were 114 Greek villages in the Fayoum with only sixty in existence by 1809 (Vivian, 2000). During this time, the Fayoum had running water from canals manned by workers using Archimedean screws worked 24 hours daily. The infrastructure of the Fayoum slowly degraded under Greek rule until these canals were clogged by the time the Romans conquered the area in 30 B.C.

The most famous legacy of Greek occupation are the extraordinarily beautiful “Portraits of the Fayoum”, faces painted on coffins and mummies during this time period. This artwork is exquisitely documented by Doxiadi (1995).

Roman occupation was important to the welfare of Italy as Egypt as a whole produced up to 30% of the grain consumed in Italy. The Fayoum itself produced 10% of that volume, earning the nickname “bread basket of the Roman Empire” (Vivian, 2000).

Dimai Greco-Roman ruins

The ruins at Dimai cover six centuries of habitation by both Greek and Roman people. This large complex is constructed on an older Neolithic site and contains an incalculable number of pottery shards built up over this long time period. The original name given by the Greeks was Soknopaiou Nesos, inherited from the Egyptian name Sobek-en-Pai (Caton-Thomson and Gardner, 1934). The Greek translation of “Island of the crocodile-god” implies the city was on an island at one time. For
centuries, this area was the site of worship of the crocodile-god. Topographic studies conducted by Caton-Thomson, however, suggest it was more likely a peninsula and never was an island.

The main walls (Figure 45) surround two inner temples, with houses and businesses located outside the walls. A prominent hill to the southwest (cemetery hill) holds the remains of a number of mummies and catacombs.

![Greco-Roman ruins at Demai](Image)

Figure 45. Some of the ruins at Dimai.

A prominent road terminates at one end at the entrance to the temples and at the other at a dock located on the paleo-shoreline of Lake Moeris. The ruins contain two temples, houses, underground chambers, streets and 10-meter high walls. The city itself spreads from a great distance though the desert, and the mud brick walls that are still standing contain only the temple area.

The town stood on the fringe of the desert away from the cultivated lands on the south side of the lake. It was like frontier. Goods from the Fayoum were transported across the lake by boat and unloaded at the locks of Dimai and either stored or reloaded on animals for desert caravans. These caravans moved north over Gebel Qatrani, and probably via Wadi Natrun, to the Mediterranean Sea and on to Rome. Dimai was inhabited for six centuries and finally abandoned by the middle of the third century.

### Qasr El Sagha

Caton-Thomson (1934) dates the ruins at Qasr El Sagha as Middle Kingdom, but possibly originating in late Old Kingdom, an idea upheld by most workers since that time. The name refers to the “crocodile temple”. According to legend, wild dogs chased a young pharaoh to the lake edge, where he was fortunate enough to find a friendly crocodile. The crocodile allowed him to ride on its back to an island in the lake, where he stayed until the dogs had left. As the story goes, he built the temple in honor of the crocodile.

The building is unusual, made of sandy limestone with unique mortaring and jointing. Inside the temple are a number of rooms that held statues to various Egyptian gods. One room is completely enclosed with no entrance. The flat outer area appears to be a courtyard containing unfinished
columns and/or the remains of a much bigger temple complex that was subsequently looted. Behind the temple is a natural pyramid.

Caton-Thomson speculates that this temple was a significant funeral site, analogous to many of the larger temples like Karnak in Luxor. With the natural pyramid to the west, and at least one small Pharonic burial site located about 700 yards southwest, she speculates that significant burial chambers remain to be discovered in this area. South of the temple are man-made caves of fishing villages located along the maximum extent of the Lake Moeris shoreline.

Figure 46. Qasr El Sagha Temple. Note the natural pyramid in the background on the photo to the right.

### Oldest Paved Road

Day 2 of the field trip ends with a trip west from the Qasr El Sagha temple to the ancient basalt quarries of Widan El Faras (discussed earlier). The route passes by an ancient road (Figure 47) that is reputedly the oldest paved road in the world. Caton-Thompson and Gardner (1934) date the road and quarry activity as Old Kingdom, with a possibility of a Neolithic age. Doleritic basalt stone implements were are part of the “A” people’s Neolithic workings and it is clear that the Widan El Faras quarries were worked in Neolithic time. During the 4th and 5th dynasties (Early Kingdom), basalt was commonly used for construction, especially on the floors of mortuary temples in front of pyramids. During later periods it was used primarily for decorative items only. At Widan El Faras, there are a total of 8 quarries connected by this 11 km long road to docks and piers along the shoreline of Lake Moeris.

The road terminates at the shores of Lake Moeris at a long narrow ridge capped by jumbled blocks of basalt about 800 meters south-southwest of Qasr El Sagha. Caton-Thompson has definitively shown this to be a man-made pier and terminal dumping ground for the quarried basalt. Blocks of basalt here are untrimmed and cap a limestone ridge.

The ancient road stands elevated partially above the desert due to relative wind erosion estimated at 3 cm a century. Near the basalt quarry the road branches into a number of segments leading to the 8
individual workings. Although there is a drop in elevation from the quarry sites to the ancient lake shore, much of the route from the quarries actually went uphill due to the dip of the underlying beds. As such, a road facilitated transport of the basalt blocks over the uphill stretches.

Near the road as it tops out onto the lower portion of the Oligocene on a prominent scarp (approximately from the position in the photo in Figure 44) are parallel rows of five shallow rock-cut pits. Caton-Thompson speculated they may have been graves, water tanks or trial stone quarries.

Figure 47. The oldest paved road leading from the Qasr El Sagha area to the Widan El Faras basalt quarries. View to the east from the Oligocene strata above Qasr El Sagha temple. The Dir Abu Lifa Member giant cross-bedded sandstone forms the butte in the distance.
Dir Abu Lifa Monastery

Although not visited on this trip, about 2 km northeast of the Qasr El Sagha temple are the remains of Coptic Christian monasteries built about 686 A.D. Vivian (2000) indicates that the Dir Abu Lifa, Monastery of Father Lifa, was probably founded by St. Panoukhius and was in use from the 7th through the 9th centuries. It served as a haven for Christians seeking persecution. Immediately behind the Qasr El Sagha temple, and visible on the cliff face of the upper portions of the Dir Abu Lifa member giant cross-bedded sandstone, are a similar series of small man-made caves probably used for meditation.

The typical monastery is primitive, consisting of small caves carved into cliff sides that can be difficult to reach.

Figure 48. Typical early Christian monastery in the Fayoum area. Photo courtesy of Ahmed El-Barkooky.
Ancient Basalt Quarries

The eight ancient basalt quarries at Widan El Faras remain another unprotected historical landmark in Egypt. They are currently threatened by renewed quarrying of the basalt for modern road material. The basalt flow weathers naturally in loose blocks that were easy to quarry and remove. Large man-made caves are present at the quarries, suggesting homes for workers.

Figure 49. 1) Overview of the Widan El Faras basalt quarry area. Dark rock capping the ridge is the Widan El Faras basalt. 2) Basalt workings strewn about the desert floor near the base of the quarries.

Some of the most current research on the geo-archeology of the area is being done at the University of Toledo in Toledo, Ohio, USA by Dr. James Harrell. An excerpt from one of his upcoming publications is included below (courtesy of J. A. Harrell).


Widan el-Faras

From the Third through Sixth Dynasties, basalt was used for interior pavements, and occasionally for walls and causeways, in the pyramid temples of kings Zoser, Userkaf and Pepi I at Saqqara, Sahure and Niuserre at Abusir, and Khufu at Giza. The black, fine-grained basalt symbolized the dark, fertile Nile alluvium (Hoffmeier 1993) on which Egyptian civilization depended for its existence. It was from this alluvium, deposited by the annual Nile floods, that ancient Egypt took it name of kmt or kemet, "the black land". Basalt has also been reported used for some Old Kingdom sarcophagi and pyramidia but most, if not all of these, are carved from two other dark stones, granodiorite from Aswan and graywacke from Wadi Hammamat. Basalt was used, however, for vessels from the Late Predynastic period through the Fourth Dynasty and rarely thereafter until the end of the Old Kingdom (Aston 1994, 18-21). The stone for the vessels could have come from any of numerous basalt outcrops in the desert just outside the Nile Valley in the Giza-Saqqara region, with Abu Rawash being the closest source. No ancient quarries have been found among these outcrops, but a large basalt quarry does exist further west at the northern edge of the Fayyum Depression on Gebel el-Qatrani, near the two prominent buttes of Widan el-Faras. This site is just 26 km southwest of Umm el-Sawan, and it is
now known to be the source of basalt used for the Old Kingdom pyramid temples (Harrell and Bown 1995).

The presence of a quarry near Widan el-Faras had long been suspected because of the existence of an ancient road leading to it from the south with pieces of discarded basalt strewn along its length (Beadnell 1905, pl. 18; Caton-Thompson 1927, 338-339; Caton-Thompson and Gardner 1934 v. 1,136-138; Klemm and Klemm 1993, 414-416). The actual quarry was discovered only recently, the western part in 1987 and the eastern part in 1993, by T. M. Bown, S. E. and G. A. Correro, and the present author. The quarry, road and other associated features have been described by Harrell and Bown (1995).

The western and eastern parts of the quarry are separated by 0.5 km and both contain an excavated bench on top and along the edge of the Gebel el-Qatrani escarpment. These benches have a combined length along the escarpment of about 900 m, and are typically 3-5 m deep (below the original surface) by 5-10 m wide. Numerous dolerite mauls were found, but none made from anorthosite or gabbro gneiss. The quarry is large and so mauls of the latter rock types could easily have been overlooked if present. All the mauls seen were one-handed tools, both the helved (notched) and unhelved forms, but larger ones may yet be found. The two-handed mauls used to dislodge blocks at Gebel Manzal el-Seyl and Umm el-Sawan cannot be used for this purpose at Widan el-Faras because of the great size of the basalt blocks extracted. Based on the dimensions of pieces of basalt used in the pyramid temples, these blocks must have been commonly on the order of 0.5-1 m thick by 1-2 m across. The only way to remove blocks of this size is to excavate around their edges.

The trenches and other distinctive markings made by stone mauls in the Aswan granite-granodiorite quarry (Clarke and Engelbach 1930, 26-30; Arnold 1991, 36-40) are not seen at Widan el-Faras, but perhaps none should be expected. The basalt is naturally broken up by cross-cutting fractures with spacings comparable to the sizes of the basalt blocks in pyramid temples. Quarrying may, thus, have involved using mauls to break up the basalt along the fractures and copper gads (like the one found in the Gebel el-Asr quarry; see below) hammered into the fractures to further split the stone. Once a block was isolated, wooden levers and ropes were probably used to move it. The extracted blocks would have received some shaping and trimming with stone mauls but must have been taken from the quarry in fairly rough form. The final shaping was certainly done at the temple work sites where pavements and walls of close-fitting blocks were constructed, often by sawing (Moores 1991).

What was originally thought to be the quarrymen's camp (Harrell and Bown 1995: 77-78) lies at the foot of the escarpment below the quarry. It consists of a few dozen ovoid to circular, dry-laid stone rings that are made from pieces of basalt and range from 2 to 7 m across. Superficially they resemble the shelters found at the Umm el-Sawan quarrymen's camp, but recent work by Elizabeth Bloxam and Per Storemyr suggests that the Widan el-Faras 'camp' is more likely a workshop where the blocks of basalt were dressed. They found a smaller, less well-preserved site 400 m to the south and now believe that this is where the quarrymen made their camp. Here are the outlines of several rectangular stone huts.

Unlike Umm el-Sawan, no extensive archaeological excavations have been conducted at Widan el-Faras and so there is much more yet to be discovered about the quarry and its operations. Fully visible on the surface, however, is the site's most significant feature: a sophisticated network of paved roads (Harrell and Bown 1995: 78-83). From both pottery found on-site and known uses of basalt in pyramid temples, it is clear that the quarry was in operation from the Third through Sixth Dynasties. This makes the quarry road the oldest known paved road in the world. The next oldest was built by the Minoans on the Island of Crete and dates, at the earliest, to the Egyptian Eleventh Dynasty (Forbes 1934, 51-54; Lay 1992, 43-45). The road's main trunk runs along the foot of the Gebel el-Qatrani escarpment, below the quarry, and is joined in several places by short branches coming from different parts of the quarry. The pavement has a uniform width of 2.0-2.1 m or about 4 ancient Egyptian cubits.
(1 royal cubit = 52.4 cm). It is made from a single course of dry-laid, unshaped pieces of whatever stone was close at hand: basalt and sandstone near the quarry, and sandstone, limestone and silicified wood elsewhere. The road passes down the middle of the quarrymen's camp and then turns south toward the center of the Fayoum Depression. The total length of the road, including all its branches and several short sections now removed by erosion, is nearly 12 km, the last ten of which follow a nearly straight and mostly downward course from Widan el-Faras to its final destination on the shore of an ancient and now vanished lake.

The paved road was clearly built to facilitate the removal of large blocks of basalt from the quarry. These would have been placed on wooden sledges pulled by teams of men. The two largest dressed blocks known to the author are a paving slab in the Khufu pyramid temple measuring 2.10 by 1.85 by 0.80 m and weighing about 9000 kg (assuming an average density of 2.9 gm/cc for basalt), and a wall slab in the Niuserre pyramid temple measuring 2.60 by 1.05 by 0.95 m and weighing about 7500 kg. The original pieces from which these blocks were cut would have been larger. Most blocks were much smaller but still would have weighed on the order of a few thousand kilograms. Sledges carrying such heavy loads cannot be pulled across a soft, sandy surface like that over which the road passes.

Where the road pavement is well preserved one does not see any abrasions or other wear left by the passage of the sledges, and this suggests that they were pulled over closely spaced, stationary wooden beams (not rollers, which do not work well on an uneven surface) that were laid crosswise on the road. The beams behind would be picked up and set down ahead of the advancing sledge. Similar systems are well known from many ancient and modern examples. For instance, at the Twelfth Dynasty pyramids of Senwisret I at el-Lisht and Senwisret II at el-Lahun there are ancient construction ramps with embedded wooden crossbeams over which sledges were pulled (Arnold 1991, 86-90), and in this century, in Italy's Carrara marble quarry, sledges were lowered down slopes over wooden crossbeams that were advanced with the sledge (Pieri 1964, 154). It is obviously much easier to pull a sledge over smooth wooden beams than over a rough stone pavement, and this fact would not have escaped the ancient quarrymen. But why have a paved road at all, and why not simply place the beams directly on the sandy desert surface? While this might work for the sledges, the men doing the pulling could not obtain the necessary traction in the loose sand. The road may, thus, have been built more for the men pulling the sledges than for the sledges themselves.

Widan el-Faras is 66 km from the Nile Valley by the shortest overland route. Supplies and quarrymen may well have moved along the Dahshur Road, but the basalt blocks would not have been taken along this track when there was water transport just 10 km from the quarry. The quarry road ends at an artificial, rectangular structure that is 311 m long by 19 m wide, and is nearly covered with pieces of basalt. It slopes from +21-22 m (above mean sea level) at its north end to +18 m at its south end where it reaches its greatest height of 3 m above the more steeply inclined desert surface. Birket Qarun, a salt lake occupying the lowest part of the Faïyum Depression and now 8 km south of this structure, has a surface elevation of -45 m (below mean sea level). During the Old Kingdom it was a much larger and higher body of water (ancient Lake Moeris) with an elevation of +19-21 m (Harrell and Bown 1995, 83-87). The structure at the end of the quarry road is, thus, a quay that jutted out into the waters of Lake Moeris. This lake was at the same level as and in free communication with the Nile River during its annual summer flood. The connection between the two bodies of water was then, as now, through the gap in the hills between Hawara and el-Lahun. Barges came to the quay to pick up loads of basalt, and then sailed across the lake, through the Hawara/el-Lahun gap, and down the Nile River to the necropoli where the stone was used.
Other Fayoum Sites

The table below lists other important locations in the Fayoum Basin of antiquities and points of interest needing protection and restoration.

Table 4. Other points of interest in the Fayoum

<table>
<thead>
<tr>
<th>Modern name</th>
<th>Ancient name</th>
<th>Period</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Aarab</td>
<td>Unknown</td>
<td>Late Period</td>
<td>Late period cemetery</td>
</tr>
<tr>
<td>Abgig, Begig</td>
<td>Unknown</td>
<td>MK</td>
<td>Obelisk of Sesostris I, now in Medinet Fayoum</td>
</tr>
<tr>
<td>Batn Ihrit</td>
<td>Theadelphia</td>
<td>Graeco-Roman</td>
<td>3rd c. BC - 4th c AD. Poor state, Temple of Pnepheros</td>
</tr>
<tr>
<td>Biahmu</td>
<td>Unknown</td>
<td>MK</td>
<td>Stone pedestals of two statues of Amenemhat III</td>
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<tr>
<td>Damashqin</td>
<td>Unknown</td>
<td>Pharaonic?</td>
<td></td>
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<tr>
<td>Dimai</td>
<td>Soknopaiou</td>
<td>Graeco-Roman</td>
<td>(Island of the crocodile god). Ptolemaic 3rd c. BC to 3rd c AD. City walls,</td>
</tr>
<tr>
<td></td>
<td>Nesos</td>
<td></td>
<td>two temples, settlement, streets, Temple of Soknopaios</td>
</tr>
<tr>
<td>El-Hamoul</td>
<td>Unknown</td>
<td>Ptolemaic</td>
<td>Cemetery</td>
</tr>
<tr>
<td>Hawara</td>
<td>Unknown</td>
<td>MK</td>
<td>Pyramid (mud brick), labyrinth, tomb of princess Nefrotaph, cemetery,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ptolemaic Roman</td>
<td>Amenemhat III, Late Period, Ptolemaic and Roman cemeteries</td>
</tr>
<tr>
<td>Homeen</td>
<td>Unknown</td>
<td>Graeco-Roman</td>
<td>Probably Roman cemetery</td>
</tr>
<tr>
<td>Location</td>
<td>Name</td>
<td>Culture</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>---------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Kanais</td>
<td>Unknown</td>
<td>Graeco Roman</td>
<td>Settlement, unexcavated</td>
</tr>
<tr>
<td>Kom Aushim</td>
<td>Karanis</td>
<td>Graeco-Roman</td>
<td>3rd c BC to 5th c AD. Settlement, temple of Petesuchos-Pnepheros</td>
</tr>
<tr>
<td>Kom el-Atl</td>
<td>Bacchias</td>
<td>Graeco-Roman</td>
<td>Greek city 34d c BC to 4th c AD not excavated. Temple of Sokanobkoneus</td>
</tr>
<tr>
<td>Kom el-Hamam</td>
<td>Unknown</td>
<td>Graeco-Roman</td>
<td>Hill of archaeological remains from Roman era, not excavated</td>
</tr>
<tr>
<td>Kom el-Kharaba</td>
<td>Philadelphia Bubastos</td>
<td>Graeco-Roman</td>
<td>Town founded by Ptolemy II. Large centre in Roman period. Bisected by the Nile valley road.</td>
</tr>
<tr>
<td>Kom Ruqqaia</td>
<td>Unknown</td>
<td>MK Roman</td>
<td>Large shard-covered mount, very ruined. not excavated: rock tombs, fort, quarry and temple site. Roman cemetery to the north.</td>
</tr>
<tr>
<td>Kom Talit</td>
<td>Talei, Taleithis</td>
<td>Graeco Roman</td>
<td>3rd c BC to 8th c AD</td>
</tr>
<tr>
<td>Lahun</td>
<td>Unknown</td>
<td>Neolithic MK</td>
<td>Pyramid (mud brick), mastabas for princesses (Sit-Hath-Init), Queen’s pyramids and cemetery, all 12th dyn. Sesostris II Roman graves, prehistoric flint sites.</td>
</tr>
<tr>
<td>‘Kahun’</td>
<td>Hetep Senouseret</td>
<td>MK Roman</td>
<td></td>
</tr>
<tr>
<td>Lisht</td>
<td>Itj-Towy</td>
<td>MK</td>
<td>North and South Pyramid complex</td>
</tr>
<tr>
<td>Medinet Fayoum (Kiman Faris) (Mit Faris)</td>
<td>Shedet Crocodilopolis-Arsinoe</td>
<td>Old Kingdom to Graeco-Roman</td>
<td>Catial city in OK Crocodilopolis-Arsinoe (Ptolemaic) Kiman Faris: central area of ruins; temple of Sobek MK, Ramesside Late period cemetery, Roman temple and fortress</td>
</tr>
<tr>
<td>Medinet Maadi</td>
<td>Narmouthis, Ibion</td>
<td>MK to Graeco Roman</td>
<td>Probably most important site in the</td>
</tr>
<tr>
<td>Location</td>
<td>Name</td>
<td>Period</td>
<td>Notes</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Medinet Watfa</td>
<td>Philoteris</td>
<td>Graeco Roman</td>
<td>Settlement and cemetery</td>
</tr>
<tr>
<td>Medinet Quta</td>
<td>Unknown</td>
<td>Graeco Roman</td>
<td>Last Roman outpost before the desert. Settlement.</td>
</tr>
<tr>
<td>Meidum</td>
<td>Meret</td>
<td>OK</td>
<td>Pyramid of Huni / Seneferu and mastaba field (4th dyn). Meidum Geese painting in mastaba tomb of Nefermaat and his wife Atet.</td>
</tr>
<tr>
<td>Qasr el-Banat</td>
<td>Euhemeria</td>
<td>Graeco Roman</td>
<td>Settlement and temples, now surrounded by cultivation</td>
</tr>
<tr>
<td>Qasr el-Sagha</td>
<td>Unknown</td>
<td>Neolithic MK</td>
<td>Settlement (stone implements) 12th dynast temple and cemetery</td>
</tr>
<tr>
<td>Qasr Qarun</td>
<td>Dionysius</td>
<td>Graeco Roman</td>
<td>Settlement 3rd c BC, fortified by Romans. Temple.</td>
</tr>
<tr>
<td>Seila / Silah (Gebel el-Rus)</td>
<td>Unknown</td>
<td>OK Roman</td>
<td>Step pyramid of Seila (King Huny, 3rd dynasty, limestone. Site includes also a Roman cemetery.</td>
</tr>
<tr>
<td>Tell el-Rusas</td>
<td>Unknown</td>
<td>Roman</td>
<td>Hill of archaeological remains from Roman era, not excavated</td>
</tr>
<tr>
<td>Umm el-Brigat</td>
<td>Tebtunis</td>
<td>Late period Graeco-Roman</td>
<td>Founded in 22nd dyn, until 4th c AD. temple complex, settlement, mud brick architecture</td>
</tr>
</tbody>
</table>

**SUMMARY AND FUTURE**

The greater Fayoum Basin and Whale Valley area is a rich recreational, archeological and geological site. The spectacular geology, vertebrate paleontology and human history qualify it as a World Heritage Site. Without adequate protection, this special hidden treasure of Egypt runs the risk of being seriously degraded. Its proximity to Cairo and growing popularity are both an opportunity and a threat.

The authors urge people reading this guidebook to contact the Egyptian Environmental Affairs Agency (http://www.eeaa.gov.eg/) the Department of Antiquities or other groups working to interpret and protect the Fayoum. Offer your support for the ongoing conservation efforts.
REFERENCES


North South Consultants Exchange (NSCE), 2000. Ecotourism for Sustainable Development in Fayoum, Egypt, unpublished document prepared on behalf of the Egyptian Tourism Authority and Fayoum Governorate, pp. 88


Schweinfurth, G., 1886, Reise in das depressions Gebiet in Umkreise des Fajum im Januar 1886.: Z. Ges. Erdk., v. 21, p. 96-149.


A tranquil world, just one hour from chaotic Cairo

From the Fayoum there are links to the Wadi Rayan Protectorate, where eco-tourism is being coordinated by Italian cooperation and the Egyptian Environmental Affairs Agency. There is also access to the desert scenery of Whale Valley and the western shores of the lake. The treasures of Fayoum will only become apparent to visitors as the area develops and is protected.

Very few people know that there are whales in the desert.

The whale valley (Wadi El Hitan) and Jebel El Qatrane vertebrate fossil sites are among the most important fossil areas in the world. Visitors have already done considerable damage by disturbing or even taking fossilized bones. With better protection and interpretation, the sites can be preserved for future generations to enjoy.

Very few people know that ancient Fayoum is still visible today.

The temples and ruins of Karanis, Dimai and Medinet Maadi give a glimpse of the life and times when the Fayoum was the granary of the Roman Empire. The canals and ancient Qaar El Sagar temple shed light on the ancient pharos of Egypt.

Very few people realize the importance of the shores and islands of Lake Qarun.

The world bird population depends on the very few areas where migrating birds can find a place to forage. Lake Qarun is one of those areas and a unique and varied bird population exists. Thousands of visitors are expected to come to watch and study the birds.

Very few people know where to find the famous Fayoumi basket makers.

The Fayoum has many basket makers and the producers of palm rib furniture. Some of the basket making techniques are the same as used in the Neolithic period, 8500 years ago. The south coast of Lake Qarun is an obvious place to spend the night, with abundant hotel space with a panoramic view of the lake and desert cliffs.

One day, after eco-tourism is well established...

A small group of visitors meet early in the morning at the Kom Aushim eco-activities center. They are offered a local breakfast at one of the hamlets near by. They drive into the desert with a local guide for a brief visit to the Roman town of Dimai. Transferring to the North shore Jetty, they enjoy offshore bird watching around the Golden Heron (Qarn) Island. Lunch is served on the island. From there the boat continues to Shakashouk, Qaria Tamania or back to the north shore jetty.

One day...

In the desert beyond Qaar El Sagha, eco-tourists will enjoy a night camping in the desert. After a barbecue, the guests will sit around the campfire telling stories, making music or just gazing at the stars. The next morning camels will be waiting for a trip along the north shore of the lake to the eco-activities center at Qaria Tamania. From there they will be taken by boat or car to Shakashouk.

One day...

The solitude, beauty, ancient history, rich culture and spectacular geology will be open to thousands of visitors. Protected, interpreted and preserved for many generations. This will happen, with your help and your commitment.