EXPLOITATION OF ORES, ROCKS AND MINERALS IN ANCIENT EGYPT

ŤAŽBA RÚD, HORNÍN A MINERÁLOV V STAROVEKOM EGYPTE

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Abstract: Ancient Egyptian quarrying and mining sites represent some of the most threatened archaeological sites not only in Egypt but also worldwide. These ancient Egyptian quarries and mines were the main sources for the building stones that used to construct most temples, pyramids, and mastaba tombs and for metals and gemstones. The gemstones of ancient Egypt used for jewelery, amulets, seals, and other small decorative items. They also mined for metals, e.g. copper and gold.

Key words: Ancient Egypt, mine, quarry, rocks, ores, minerals

Abstrakt: V Egypte možno dosiaľ identifikovať početné lokality, na ktorých sa v staroveku získavali rôzne suroviny. Časť z týchto lokalít tvoria rudné bane (významná bola predovšetkým ťažba zlata), ďalšiu lomy stavebného materialu, ktorý sa využíval na stavbu chrámov, palácov či pyramid, ako aj náleziská dekoračných a drahých kameňov, ktoré sa používali na výrobu šperkov.

Kľúčové slová: staroveký Egypt, bane, lomy, horniny, rudy, minerály

1. Introduction

Imagine, the ancient Egypt without any quarry and mining operations, one can expect that there would be no pyramids, temples and even the incredible Tutankhamen treasures. During the pharaonic period (began around 3100 BC), quarrying and mining were obviously of intrinsic importance to the flower and stability of ancient Egypt's economy.

Egypt were located near the Nile River which cuts through various rock formations, furnishing the growing civilization with supplies of sandstone, granite, basalt, gypsum, and in particular, limestone. The ancient Egyptians quarried huge quantities of sandstone, limestone (near Memphis in the Muqattam hills), red and gray granite (near Aswan), alabaster (Tal El Amarna), diorite, marble, serpentine, imperial porphyry (Jabal Al Dokhan), basalt and dolomite. Limestone above all, were used in huge quantities. The Khufu pyramid (Fig. 1) alone contains about 2.3 million blocks of limestone and granite, weighing up to 15 tons each (Tompkins, 1971). Herodotus claimed that he was informed in that it took twenty years to build the pyramid and that levies numbering a hundred thousand men were employed for periods of three months to transport stone from the quarries (Tompkins, 1971). With an abundance of limestone, the ancient Egyptians were able to experiment with various construction techniques and are credited to be the first inventors of hydraulic cement. Radford (1910) mentioned that in some of the marvelous constructions which still endure as monuments of their engineering skill, the Egyptians used a porous lava possessing hydraulic properties and containing the basic element necessary to the making of cement.

Fig. 1 Granite and limestone boulders at the Giza pyramid

Fig. 2 Pottery making

Fig. 3House contraction

Fig. 4 Turin Mining papyrus

The early Egyptians were also the first to use mortar, initially produced from the mining of gypsum, for binding blocks together, which is considered as one of the earliest uses of manufactured cement (Snell and Snell, 2000). Over time, they improved the efficiency of their operations by using lime mortar, which is still used today in cement production.

The ancient Egyptians had an interest in various materials as far back as prehistoric times, where the world's oldest example of an underground mine is found in a site known as Nazlet Khater-4 (see below). They also exploited and mined various metals, minerals and precious and semi-precious stones, e.g. emeralds, malachite, turquoise, carnelian, amethyst, among others. Copper, gold, Galena (PbS), Rock salt (NaCl, halite), Natron (($Na_2CO_3 \cdot 10H_2O$, a kind of soda ash) and Alums [$AM(SO_4)_2 \cdot 12H_2O$, where A = K, NH_4, Na and M = Al, Cr] are also mined. Furthermore, Nile clay was used for pottery (Fig. 2) and bricks making (Fig. 3).

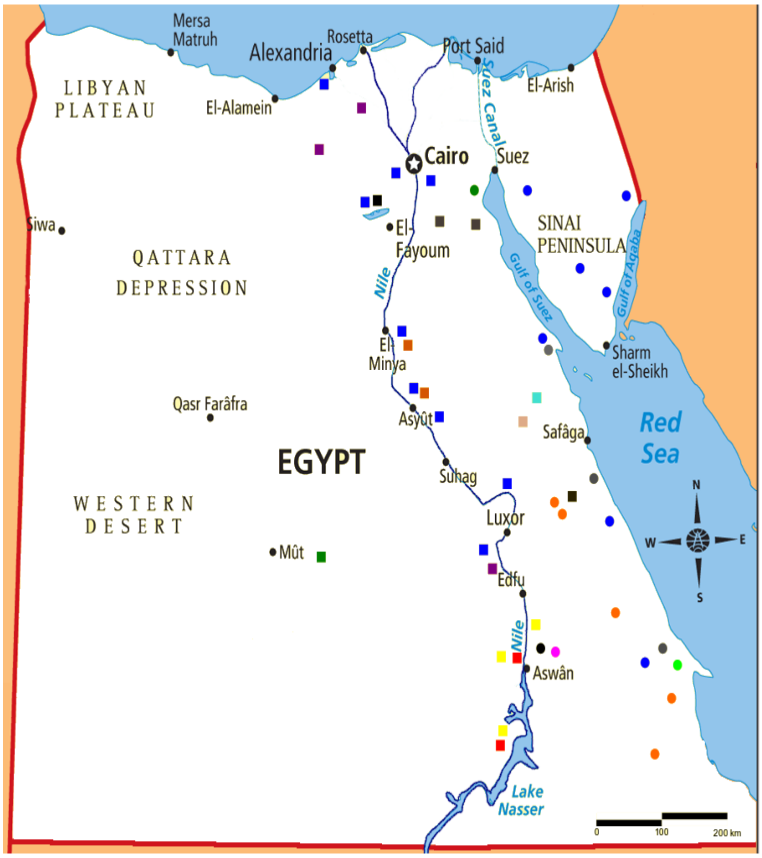

Fig. 5 Some important ancient Egyptian mines and quarries

2. Aswan grante quarries

Aswan granite quarries, which were first exploited at least as early as the beginning of pharaonic times, are still in use today. Aswan Granite was the third most important stone used in Egyptian civilization, after sandstone and limestone (Kelany et al., 2009). Its use for vases, obelisks (Fig. 6), statues, sarcophagi and buildings commenced from the early dynastic period (Aston et al. 2000). In terms of quantities, its largest use was during the Old Kingdom, particularly associated with the 4th dynasty pyramid complexes at Giza and again during the New Kingdom for obelisks and enormous statues (Röder, 1965).

It is estimated, based on surviving buildings and other monuments, that during the Old Kingdom about 50,000 m^3 of stone were removed from these quarries. The term Aswan granites (Fig. 7) constitute a range of granitoid rocks, ranging from granitic to tonalitic in composition (Klemm and Klemm, 1993, 2008). The most widely used type is the red or pink granite, which is essentially coarse grained to very coarse grained, but porphyritic and gneissic varieties are occasionally found (Kelany et al., 2009). The so-called ‘black granite’ is medium- to coarse grained, commonly porphyritic granodiorite to tonalite (Kelany et al., 2009). A third type is red to grey, fine-grained granite or the Younger granite (Klemm and Klemm, 2008). The Unfinished Obelisk (Fig. 8) and the colossal statue at Shallal are the most attractive sites in the granite quarries on the east bank of Aswan (Kelany et al. 2009). Many researchers have paid attention to these two sites, in particular Engelbach (1923, 1983) who was the first person to excavate the Unfinished Obelisk quarry. The Unfinished Obelisk (1168 ons) carved from the rock was not yet completely detached when it cracked. It dates to the 18th dynasty and measures nearly 42 m in length. It derives its name from the fact that is was abandoned, no doubt reluctantly, at an advanced stage in the process of extraction, due to faults in the stone.

Fig. 6 Granite obelisk, Egyptian museum, Cairo

During the pharaonic period, even the relatively soft limestone was difficult to cut with Old Kingdom copper saws and chisels. They were worked with hammer stones of dolerite from the dykes cutting the granite. Such pounding is considered to be the only technique involved until the stone block reached the rough shape of a statue or other object (Kelany et al. 2009). In the Unfinished Obelisk open-pit mine, channels were made directly into the granitic bedrock. The massive amounts of dolerite hammer stones found in the quarry lead Röder (1965) to the conclusion that the channeling was made by pounding only. Holes were cut into the rock, wooden wedges driven into the slots and moistened. The expanding wood cracked the rock. Doubt has been cast on wood being strong enough for the purpose, but no alternative theories for pharaonic stone extraction have been proposed. However, in recent excavations (Kelany, 2003) massive amounts of charcoal, ash and burned mud bricks were found, suggesting that heat must have been an important agent in one or more steps of the quarrying process (Kelany et al., 2009).

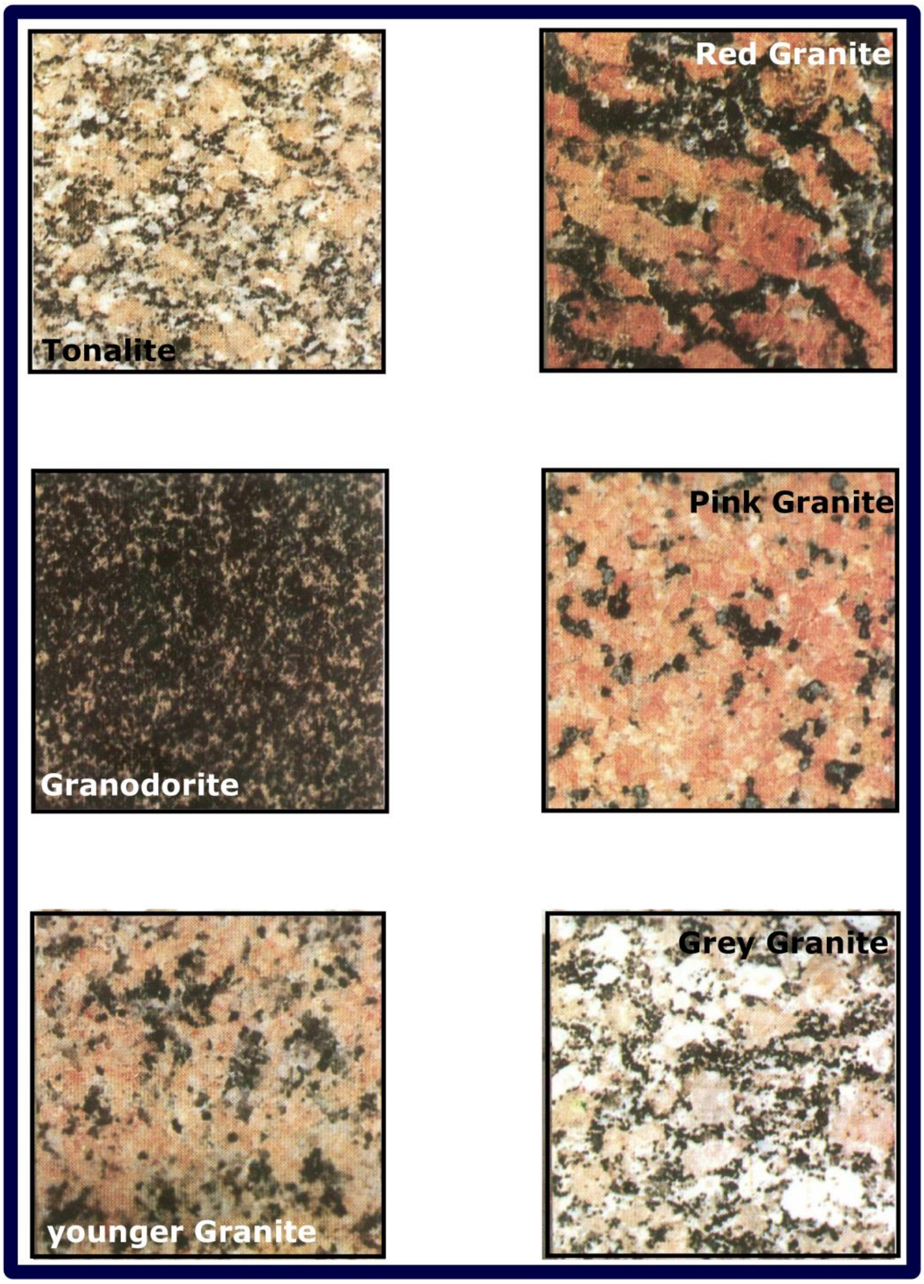

Fig. 7 Aswan granite

Transport of large objects from the granite quarries usually involved two steps: first, from the quarry pits out of the actual extraction area and second, from the quarry areas to the main branch of the Nile. Evidence from the excavations undertaken at the Unfinished Obelisk suggested that another large quarry operation was needed to remove remaining granite on the north side of the Unfinished Obelisk, before the actual piece could be moved (Kelany et al., 2009).

Fig. 8The Unfinished Obelisk

3. Nazlet Khater chert

Nazlet Khater (located on the western Nile bank between Asyut and Sohag) is a series of Middle and Upper Paleolithic archaeological sites, where most of the sites are associated with intermittent mining activities beginning 40,000 years ago. Nazlet Khater 4 can without doubt be considered as a chert mining site (Vermeersch, et al., 1984) (30,000-33,000 RCYBP, stands for Radio Carbon Years Before the Present) that was exploited by Upper Palaeolithic people for the raw material for the production of a blade stone tool industry. This age means that the Nazlet Khater 4 site is the most ancient Upper Palaeolithic sites of this region (Leplongeon and Pleurdeau, 2011). Three mining efforts were identified and associated with the Upper Paleolithic occupation: trenches, vertical shafts and subterranean galleries, which in fact foreshadow quarrying methods during the pharaonic period.

The site known as Nazlet Khater-4 documents that chert was extracted not only by trenches and mining pits (with a maximum depth of 2 m.), but also by underground galleries covering an area of more than 25 km^2 (Vermeersch, et al., 1984). The ditches and galleries have been filled with either prehistoric dump or aeolian sand, whereas the vertical shafts have been filled at the base with prehistoric dump and on top with aeolian sands (Vermeersch, et al., 1984).

4. Gebel (Jabal) El-Silsila sandstone

Predynasties mining exploration was relatively very small in comparison with the massive royal expeditions that were sent out to the Sinai and to Nubia during the first two dynasties. One of the most notable stone quarries during the pharaonic period is Gebel (Jebel) el-Silsila (Fig. 9). It was the border of the Egyptian region and Nubia and in ancient times Egyptians believed that the Nile originated here. The ancient Egyptian name of the Gebel el- Silsila was

Kheny or Khenu, perhaps “Rowing-Place” (Thiem, 2000). The name is first attested as that of a funerary domain in the 5th dynasty (Jacquet-Gordon, 1962). Another designation, pa mu wab, “The Pure Water,” applies to the religious dimension of Gebel el- Silsila and was perhaps restricted to a small area at the southern extremity of the site (Kucharek, 2012). The modern Arabic name Gebel el-Silsila, “Mountain of the Chain,” is generally applied to the whole area (Klemm and Klemm, 1993). According to Weigall (1910), the word “Silsila” is said to be derived from “Khol-khol,”, which meaning barrier or frontier, transformed to Sil-sil or Silsili in Roman times.

Fig. 9Gebel el-Silsila

Gebel el-Silsila is located in Upper Egypt, about 40 km south of Edfu and 18 km north of Kom Ombo, on both banks of the Nile. Gebel el-Silsila sandstones - representing one group of the formerly so-called "Nubian Sandstone" (Fig. 10) that are stratigraphically attributed to the Quseir-Formation of the Lower Campanian / Upper Cretaceous (Said 1962). While the east bank today is mainly known for the huge quarries dating mostly to Ptolemaic and Roman times, there was also a Predynastic cemetery and a Ramesside temple, probably the only remnant of the settlement Khenu/Kheny (Kucharek, 2012). In the Middle Kingdom a fortress may have been located at Gebel el-Silsila, as implied by a partially destroyed toponym in a list of Nubian fortresses preserved in Papyrus Berlin 10495 (Gardiner, 1916). The sandstone rock quarries are located on both banks of the Nile River. The amount of sandstone quarried in Gebel el-Silsila during pharaonic times is estimated at eight million tons (Klemm and Klemm, 2001). Quarrying continued at least into the late twentieth century (Caminos, 1987; Klemm and Klemm, 1993).

Fig. 10 Nubian sandstone, near Aswan

Sandstones from the Gebel el-Silsila were used for the construction of most of the pharaonic monuments in Upper Egypt as well as in the course of past and current restoration works. The quarrying of sandstone set in, on a rather small scale, during the Middle Kingdom (Bloxam, 2010; Harrell, 2012; Klemm and Klemm, 1993). When, from the reign of Hatshepsut onwards, sandstone replaced limestone as the main building material for temples, quarrying began on a serious scale (Klemm and Klemm, 1993). The probable reason for the change of material was the exhaustion of the limestone quarries (Delvaux, 1998). Nearly all of the great temples (e.g. Karnak and Luxor as well as the Theban mortuary temples, Dendera, Esna, Edfu, Kom Ombo) were built with sandstone from Gebel el-Silsila with one notable exception being the Temple of Isis at Philae (Klemm and Klemm, 1993).

5. Tura (Torah) limestone

The Egyptian name for limestone was the fine white stone. Tura is located on the east bank of the Nile, about 23 km south of Cairo, on Maadi - Helwan road, which was associated throughout antiquity with the important limestone and calcite quarries. Geologically, the quarry deposit is mainly composed of thick bedded limestone belongs to Mokattam Formation (Middle Eocene) (Said, 1962). Processing of high-grade limestone began during the 3rd dynasty or earlier and still continues today and modern activity is responsible for the destruction of much of the evidence for the dynastic period. From early dynastic times onward, limestone was the construction material of choice for temples, pyramids (Fig. 11) and mastabas wherever limestone bedrock occurred. When there was no good source of local building stone, rock was usually brought from quarries upriver because it was easier to float a heavily loaded boat down the Nile than to sail it upriver against the current, even with a good northerly wind (Harrell, 2012). The autobiography of a 6th dynasty official called Weni, carved on one wall of his tomb at Abydos, describes the quarrying expeditions he organized for the king and mentions the royal gift of a fine limestone sarcophagus from the quarries at Tura (Lichtheim 1973).

Fig. 11 Small limestone "pyramidion" at Giza

Fig. 12 Fossiliferous limestone at Giza plateau

Fig. 13 Fossiliferous and white limestone at Giza pyramid

Fig. 14 Limestone used in Azhar Majed, Cairo

Most of the stone (fossiliferous limestone, Figs. 12, 13) in the Giza pyramids was quarried on the Giza plateau itself. The white, fine-grained limestone casing was brought across the Nile from Tura (Tura Limestone, Fig. 13). However, the quarries certainly serviced the pyramid building activities of the Egyptian kings from the 4th dynasty, where nearly all of the casing on these pyramids as been removed in later times and used in other structures, including some relatively recent buildings in Cairo (Fig. 14).

The ancient quarries themselves extend for some 2.5 km along the eastern cliffs above Tura and consisted of galleried mines in the rock face (similar in technique to most rock-cut tombs), which contrast with the open-pit method of quarrying used nowadays. The administration of the industry was probably based at Saqqara or Memphis, since a group of papyri mentioning the pyramids of Kings Merenre and Pepi II, including a letter from the commander of workmen to the vizier, was found within the Zoser pyramid enclosure.

6. Gebel al-Dokhan imperial porphyry

Ghobrial and Lotfi (1967) mentioned that the imperial porphyry (a distinctive purple- colored andesite) was favored as a building stone by a number of Roman emperors (Fig. 15). The imperial porphyry belongs to the Dokhan volcanics (Fig. 16), where thier type locality is around Gebel Dokhan (approximately 140 km from the Nile and 1600 m above sea-level) in the Eastern Desert, though their supposed equivalents are reported at several other localities in the Eastern Desert (e.g. Basta, 1997). There are also possible extensions reported in Sinai (Blasy et al., 2001; Basta, 1997).

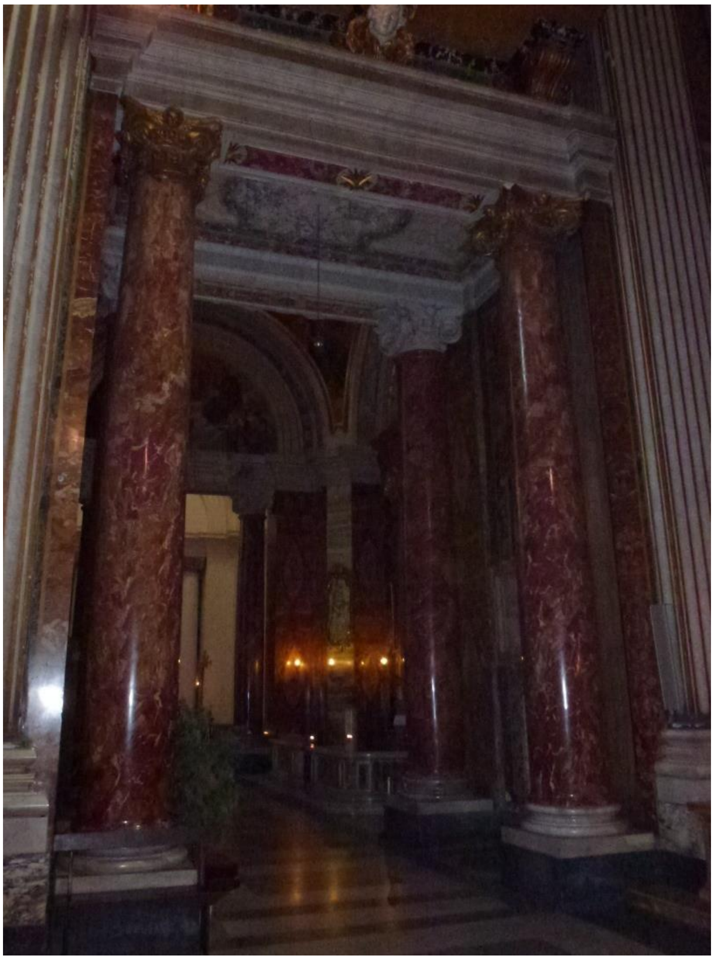

Fig. 15 Imperial porphyry columns at St. Ignazio cathedral, Rome, Italy

The Dokhan Volcanics are mainly dark gray to greenish in color; the exception being the distinctive deep purple-red shade of the imperial porphyry (Wilde and Youssef, 2000). Imperial porphyry is a quartz andesite containing phenocrysts of feldspar (oligoclase) and hornblende, in a cryptocrystalline groundmass. Porphyry is exceptionally dense and can be polished to a highly reflective-finish and the embedded feldspar seems to 'sparkle'. Paul the Silentiary, a 6th century member of the Byzantine imperial household (Vasiliev, 1948), wrote that it was "powdered with bright stars".

Fig. 16 Dokhan volcanics, Eastern Desert, Egypt

Fig. 17 Porphyry basin, The Metropolitan Museum of Art collection

This stone was so highly valued during the imperial Roman and early Byzantine period (Vasiliev 1948) that they reserved it exclusively for imperial use (Klemm and Klemm, 2001). Rome knew the location as Mons Porphyrites (Vasiliev, 1948). Klemm and Klemm (2001) estimate that 10,000 tons of stone were excavated between the 1st and 5th centuries. Very little Imperial Porphyry was used during pharaonic Egyptian period, such as small bowls and animal-figures that originated from wadi boulders rather than quarrying (Klemm and Klemm, 2001) and there is evidence that the quarrying happened during the Ptolemaic period. Purple porphyry was reserved exclusively for imperial Roman/Byzantine use and, probably because of its scarcity, was restricted to uses such as columns, statues (Klemm and Klemm, 2001) and baths (Fig. 17) (Metropolitan Museum of Art, 2011). It was used to panel the chamber where Byzantine royalty were born - which explains the phrase “born to the purple" (Sampsell, 2003).

7. Bir Umm Fawakhir gold mining

One of the most prominent and charming characteristics of ancient Egyptian culture is the extensive amounts of gold used by ancient Egyptians. Gold jewelry from 2500 BC was found buried in the tomb of the king Djer from the 1st Egyptian dynasty (National Mining Association, 2006). Within one thousand years, gold had become the life-blood of Egyptian civilization. By 1200 BC, the Egyptians had mastered the art of beating gold into leaf, which extends its use, as well as alloying it with other metals for hardness and color variation. They also started casting gold using techniques which are still at the heart of jewelry making today (National Mining Association, 2006).

Fig. 18Ancient Egyptian hieroglyphic writing at Wadi Hammamt, Central eastern Desert, Egypt

The Egyptians obtained gold from the Eastern Desert from an early period and from Nubia in the Middle Kingdom. Gold was valued by Egyptian pharaohs and was called *nub* in ancient Egypt and may be the source of the name Nubia (Meyer, 1992).

Bir Umm Fawakhir lies in the rugged Precambrian mountains of the central Eastern Desert and is almost exactly halfway between the Nile and the Red Sea. It is approximately 65 km from Quft (ancient Coptos). This route, which is the shortest from the Nile to the Red Sea, has been in use for at least 5,000 years and follows a series of wadis cutting through the mountains (Meyer, 1997). The most famous ancient site enroute is the Wadi Hammamat (Fig. 18), which was the source of a fine-grained dark graywacke that was highly prized in pharaonic times for statues, sarcophagi, and the like.

Bir Umm Fawakhir lies in a different geological zone. The Fawakhir granite is a stock intruded into the older Precambrian rocks. Most importantly, however, the quartz veins injected into the granite are auriferous, particularly towards the edge of the stock (Meyer, 1997). Many other minerals occur, including pyrite, chalcopyrite, and hematite, which stains the quartz. The granite was quarried to no great extent in the Roman period, but it also acts as an aquifer, carrying water in tiny cracks until it is stopped by the dense ultramafic rocks to the west. Wells have always been dug there.

The main settlement at Bir Umm Fawakhir lie in a long, narrow wadi, where the steep sides of which enclose the town like a wall, while the sandy bottom serves as the main street (Meyer, 1997). The basic pattern is a two- or three-room house, but several houses are often joined into larger agglomerated units. Scattered around the houses are a number of one-room outbuildings, which cannot be determined whether the they were used for kitchens, workshops, animals, storage, latrines, or something else (Meyer, 1995). Several cemetery areas have also been identified on the ridges around the town.

Fig. 19 Crushing stone

The ancient miners used two techniques: open-cast trenches following the quartz veins from the surface and shafts sunk horizontally or diagonally into the mountains (Meyer, 1995, 1997). A number of the shafts had stone walls reinforcing the entrances or platforms at the edge, presumably to aid in raising and lowering men, baskets, tools, and ore. The largest mine at Bir Umm Fawakhir runs about 100 m horizontally into the mountain and is roughly two meters high. It has two short side galleries, an air shaft, and oblong holes pounded in the rock at the working faces (Meyer, 1997). The accounts of 19th century travelers do mention gold-washing tables at Bir Umm Fawakhir, but they have probably been destroyed by modern mining activity. It is unlikely that final refining was carried out on site. It seems more reasonable that the washed gold dust was then transported to the valley, where fuel was more abundant. Iron tools, or metal of any sort, have not yet been found at Bir Umm Fawakhir. However, metal and wood are so precious in the desert that they would have been the first things removed. Mortars, in the sense of deep basins for pounding, are also not common at Bir Umm Fawakhir. Those that have been recovered are limestone, which is unsuitable for crushing quartz. On the other hand, hundreds of crushing stones have been found on the site. They are made of rough blocks of basalt, granite, or porphyritic granite with smooth upper surfaces that measure about 20 cm x 20 cm square, with a depression pecked in the middle (Fig. 19).

8. Serabil el-Khadim Turquoise and copper mining

Fig. 20 Copper staining, Eastern Desert, Egypt

Copper extraction is in all probability the first metal to be mined in ancient Egypt during the Neolithic Period (6000-2900 BC, also called New Stone Age). Ancient Egyptian copper mines contain those at Wadi El-Maghara, Wadi Samra and Serabit el-Khadim in Sinai (Fig. 20), and at Wadi Araba, Wadi Sitra, Hamash, Wadi Dara and Buhen in the Eastern Desert. The amount of copper the Egyptians produced annually was about four tons during the

Bronze Age. This quantity is quite small compared to the 17 tons extracted yearly in the eastern Alps during the same period. Therefore, considerable quantities of copper had to be imported from Syria, Cyprus and other countries of the region. The most direct evidence for copper trade in ancient Egypt comes from Tel el Amarna or Akhenaton, the capital city of the pharaoh Akhenaton (Amenophis IV), who ruled in Egypt during the late 14^{th} century BC (Moran, 1992). Egyptians discovered its mineral wealth very early on, perhaps at the beginning of the dynastic period. Archaeologists have found that the very earliest known settlers in the Sinai, about 8,000 years ago, were miners.

The ancient mining complex of Serabit el-Khadim lies on a small plateau north of Al-Tor city.

To mine the turquoise and copper, the Egyptians would hollow out large galleries in the mountains, carving at the entrance to each a representation of the reigning pharaoh who was the symbol of the authority of the Egyptian state over the mines. A huge quantity of turquoise over that period was mined, carried down the Wadi Matalla to a garrisoned port located at el-Markha (south of Abu Zenima), and loaded aboard ships bound for Egypt. The turquoise was then used both for jewelry and to make color pigments for painting. Stone tool assemblages made up of flint scrapers, hand axes, and pounders comprise the largest corpus of mining tools found at the Serabit el-Khadim turquoise and copper mines (Elizabeth, 2010).

9. Zabargad island peridot

Peridot is one of the oldest known gemstones, with ancient written records documenting the mining of peridot as early as 1500 B.C. It is a gem especially connected with ancient Egypt, and some historians believe that the famous emeralds of Cleopatra were actually peridots. In natural terms, peridot's history is different from that of almost all other gems. Most gems are formed in the earth's crust. The two exceptions are peridot and diamond, which are formed much deeper in the earth, in the earth's mantle. Peridot forms in magma in the upper mantle, it is brought to the surface by tectonic or volcanic activity (Keller, 1990).

The main source of peridot in the ancient world was St. John's Island (also known as Zabargad, Zebirget, Topazios, Fig. 21), in the Egyptian Red Sea. It covers an area of 4.50 km^2. The island was discussed in the natural history of Plinius the Elder (23-79 A.D.) as having been explored in the fourth century B.C. Peridot was probably known originally as topaz; only much later did the name come to be applied to the gemstone we know today as topaz. Peridot has been mined on Zabargad almost continuously for over 3,500 years. But it is an interesting fact that the exact location of the island was lost for several centuries and was only rediscovered in 1905. The tiny island, often shrouded in fog, is located about 50 km off the Egyptian costal port of Berenica.

St. John's Island is is believed to be an upthrusted part of upper mantle material. The island is considered geologically unique as it is uplifted mantle, a fragment of the sub-Red Sea lithosphere. Rocks on the island are mainly lower crustal metamorphic rocks. The island comprises three massives of peridotite, which are rich in the gemstone peridote (the gem variety of forsterite olivine) (Keller, 1990).

Recently, Harrell (2011) discover an old peridote mine on the island’s southeast shore and consists of roughly 150 surface pits, which individually are up to 20 m across with adjacent spoil piles as high as 5 m. Associated with the mine are the ruins of stone dwellings and a well. Pottery fragments, which are especially common around the well, date mainly from the 3rd to 1st centuries BC of the Hellenistic period with the rest extending into the Roman period. The miners and their supplies would have come from the Graeco-Roman port city of Berenike, on the Egyptian mainland 80 km northwest of Zabargad Island. Mining activity on Zabargad probably closely mirrored the rise and fall of Berenike’s fortunes, which peaked in the 1st century AD, and when this city was abandoned by the mid-6^{th} century AD, so also was the peridot mine on Zabargad Island.

Fig. 21 Zabargad island, Egypt

10. Other mines and quarries

Other mining operations included, alum from the Dakhla and Kharga Oasis in the Western desert, while galena from Gebel el-Zeit and Geble Rasas. Salts such as Natron were obviously mined from a deposit 20 m below sea level in the Wadi al-Natrun (Fig. 22). The ancient Egyptians also mined different gemstones, such as amethyst at Wadi el-Hudi and Gebel el-Asr.

Fig. 22Natron, Western Desert, Egypt

Emerald, a green transparent variety of beryl, was one of the most highly prized gemstones in antiquity. Egypt was the only known source of emerald and other green beryls for Europe and the Mediterranean region. Wadi Sikait’s place in the history of emerald mining is particularly noteworthy.

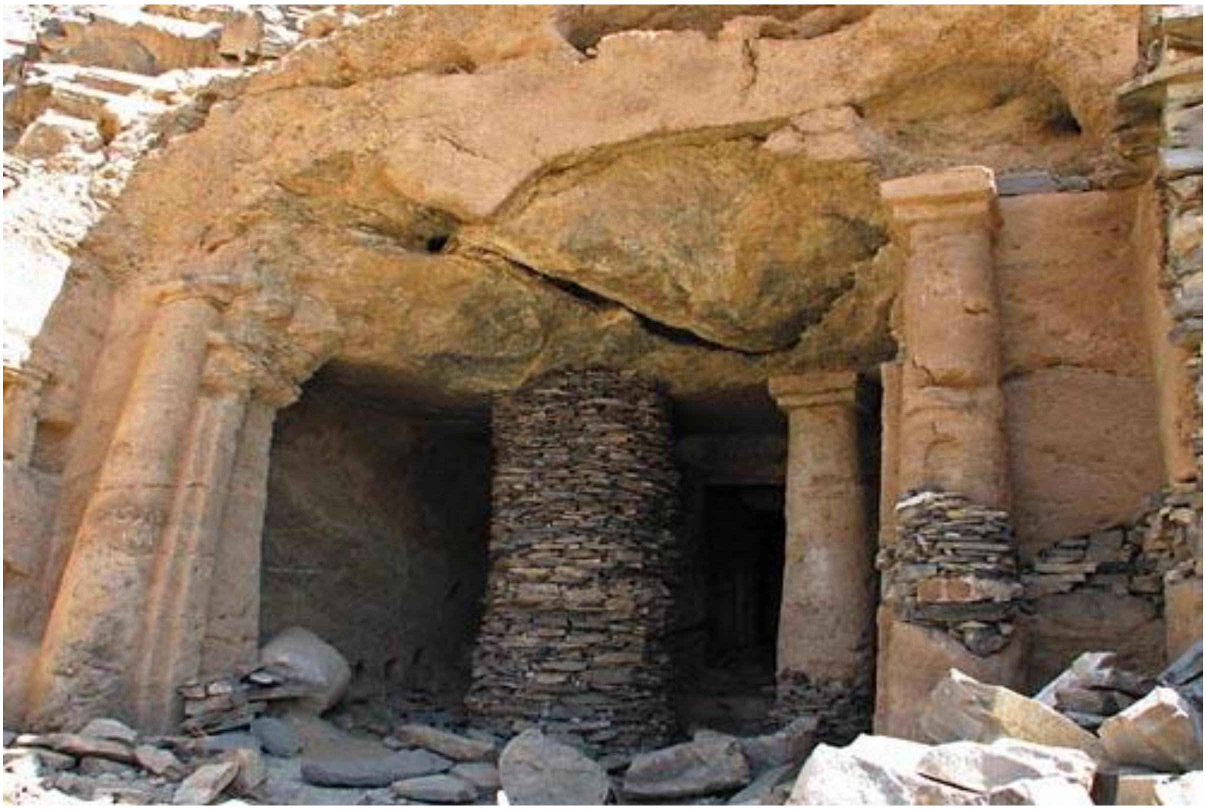

Fig. 23 Cleopatra's emerald Mine, Eastern desert, Egypt

There was ancient beryl mining not only in Wadi Sikait but also at several other sites within 15 km of this valley, including Gebel Zabara to the northwest, Wadis Nugrus and Abu Rushaid to the west, Wadi Gemal, to the southwest near Marsa Alam, which latter earned the name Cleopatra's Emerald Mine (Fig. 23) and Wadis Umm Kabu and Deba'a to the southeast. The earliest known emerald mine is located in the valley of Wadi Sikait in Egypt's southern Eastern Desert, where mining probably began toward the end of the Ptolemaic period in the 1st century BC. Most of the mining activity, however, dates to the early and late Roman periods (1st to 2nd centuries and 4th to 6th centuries AD, respectively) with much reduced activity during the middle Roman period (2nd to 3rd centuries AD). The Romans referred to emerald as smaragdus and named the Sikait region Mons Smaragdus or Emerald Mountain.

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