Geology in the British Museum: The monumental stones of the Eastern Desert

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2013

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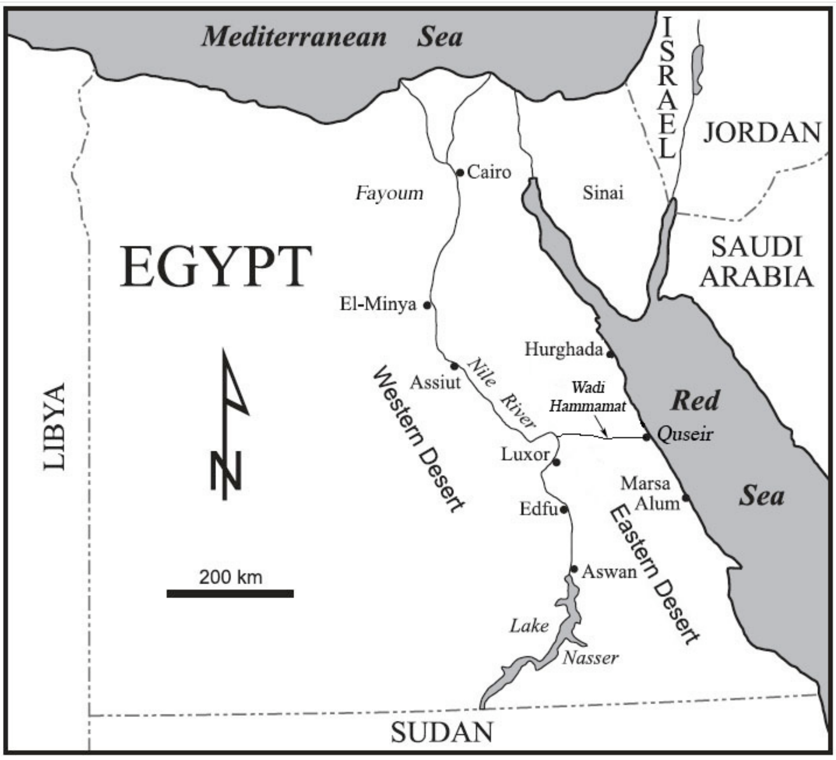
James & Davies (1994) provide an excellent guide to the chronology, iconography and art history of the Egyptian Sculptures located in the Southern and Northern Egyptian Sculpture Galleries in the British Museum which is well supplemented by Klemm & Klemm's (2008) study of the quarries of Egypt. This brief guide takes the opportunity to use these beautiful stones to discover (primarily) the basement geology of Egypt within the comfortable climate of the Museum and an opportunity to see at a macro-scale igneous and metamorphic textures on outcrop-scale blocks of stone.

This guide concentrates on the geology of the Eastern Desert Region of Egypt, a range of hills outcropping east of the Nile, between the river and the Red Sea. The majority of hardstones used in Ancient Egypt were derived from the Eastern Desert as were copper and gold, and thousands of quarries with the associated infrasctructure of quarrymen's camps, roads and ramps are dotted throughout the wadis[1] and neighbouring mountains. These geological resources were of huge importance to Ancient Egyptian society and culture. Decorative stones were seen as highly prestigious materials, they were hard won and their working required great skill and patience. The Egyptians of the 12th Century BC can be credited with producing the first geological map, now known as the Turin Papyrus[2]. This scroll was discovered in the early 1800s in a tomb near Luxor by the agents of the French Consul General in Egypt, Bernardino Drovetti, and now belongs to the Egyptian Museum in Turin, Italy. Harrell & Brown (1992) have shown that this map shows a portion of Wadi Hammamet with hills and wadis, and areas painted in black, green, pink and brown depicting different rock types, granites, sandstones and serpentinites. Principal quarries and gold-workings are also marked. Hieroglyphs label places and roads. This is an astonishing document at the fact that it exists at all is testament to the importance placed on stones in Ancient Egypt.

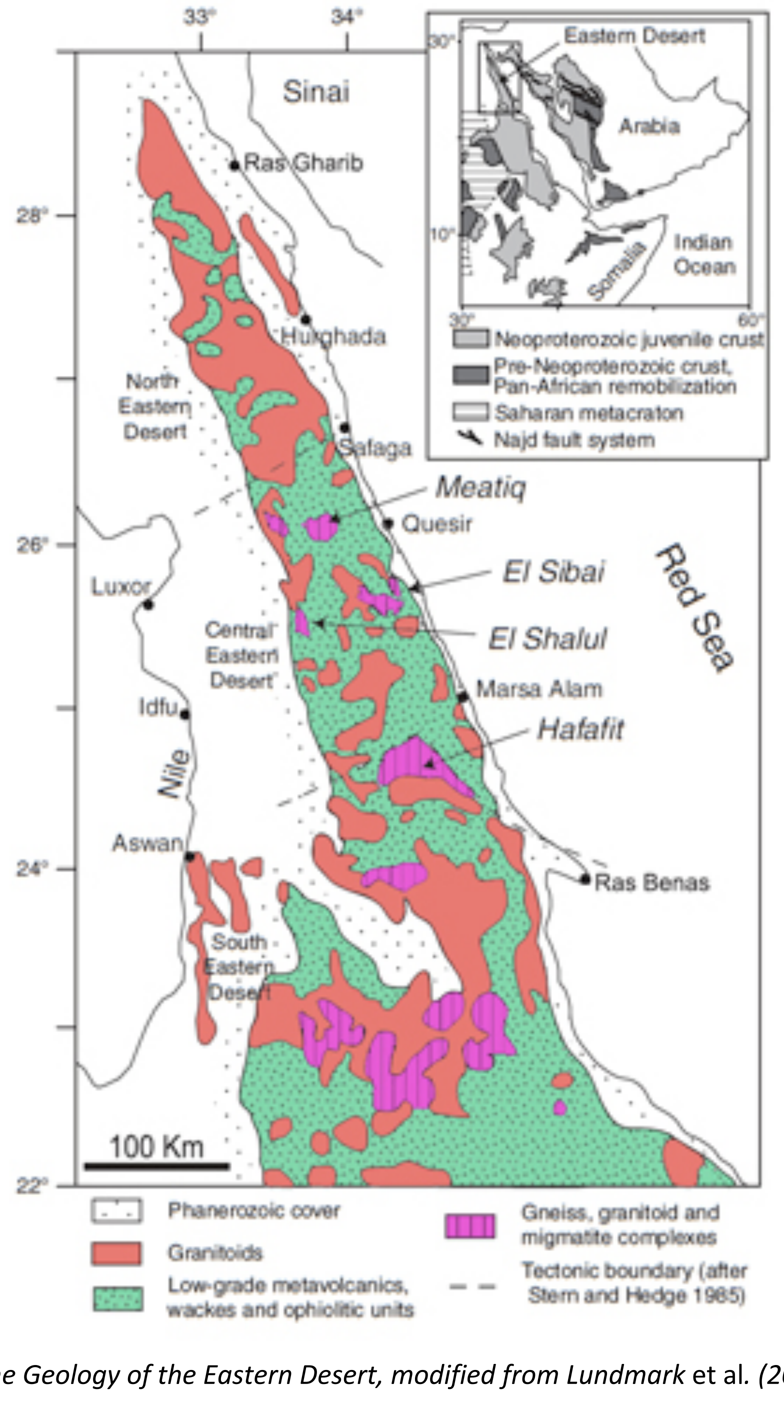


The Topography of Egypt (modified from Harrell, 2004).

[1] A wadi is dry river valley.
[2] Images of the Turin Papyrus can be seen here: http://en.wikipedia.org/wiki/Turin_Papyrus_Map

The Pan-African Basement of the Eastern Desert

The basement of the Eastern Desert, now exposed as the uplifted rift flank of the Red Sea, extends from the Red Sea coast around 200 km SE of Cairo, to the south of Aswan and beyond. The geology is the product of one of the collisional phases of the Pan-African Orogeny, a term coined to described the amalgamation of plates which have formed what would be the continent of Gondwana (of which modern Africa is a part) during the Proterozoic to early Palaeozoic, from c. 900 – 500 Ma (Azer & Stern, 2007). This represented a series of collisional events over this period which in African assembled the Kalahari, Congo, West African, Saharan and Arabian Cratons. The geology of the Eastern Desert is the consequence of the East African Orogen, caused in this region by the collision Arabian Nubian Shield with the Saharan Metacraton, which took place during the Neoproterozoic from c. 700 – 540 Ma, with at least six phases of magmatism and metamorphism over this time (Lundmark *et al*., 2011).



The Geology of the Eastern Desert, modified from Lundmark et al. *(2011)*

The rocks of the Eastern Desert belong to the Arabian Nubian Shield. They may be subdivided into three main rock types shown on the geological map above; relatively small amounts of gneissose basement, granites and other intrusive rocks and supracrustals, primarily greywackes and volcanics, the latter group at low metamorphic grade. They have been uplifted and exposed in the last 25 million years as the ocean basin of the Red Sea rifted and opened, and the rift flanks upwarped, once again exposing the Pan-African rocks in the Eastern Desert, Sinai and in Arabia.

Major quarries in the gneiss complexes are not recorded,

Basement Gneisses

There are surprisingly few outcrops of gneiss in the Eastern Desert basement, and none of them were intensively worked in Antiquity. The gneisses are not particularly old either, and represent Pan-African crusts, with ages not much older than 650 Ma. The gneisses are restricted to metamorphic domes, core complexes unroofed during late orogenic extension in the East African orogenic belt. In Egypt named from north to south, the Meatiq, El Sibai, El Shalul, Hafafit and Abu Swayel Metamorphic complexes (Fritz *et al*., 2002). They are composed of gneisses derived from both igneous (orthogneiss) and sedimentary (paragneiss) protoliths and are largely at amphibolite facies (Abd El-Naby & Frisch, 2006; Augland et al., 2012). Metagranitoids, amphibolites and schists dominate the lithologies.

Few gneisses from the core complexes appeared to be used in Egyptian or Roman monumental sculpture. There is apparently no evidence of systematic quarrying, small carvings may have been produced from fallen blocks.

Intrusive Igneous Rocks and Ophiolites

The igneous intrusive rocks of the Eastern Desert can be divided into two groups, the ‘older’ and ‘younger’ granitoids and a series of mafic-ultramafic complexes. The latter are either tectonically emplaced as ophiolites, largely serpentinised, and probably representing the earliest phase of island arc construction in the region, dated to c. 900-830 Ma. They are predominantly harzburgitic in composition and are believed to have formed in a fore-arc, suprasubduction environment (Azer & Stern, 2007). The few intrusive mafic-ultramafic complexes are primarily associated with NE-SW orientated shear zones. These intrusive mafic ultramafic complexes are elliptical plutons of gabbros, diorites and quartz- diorites (tonalites) and lenses of peridotites dated at 610-740 Ma (Helmy & Mogessie, 2001).

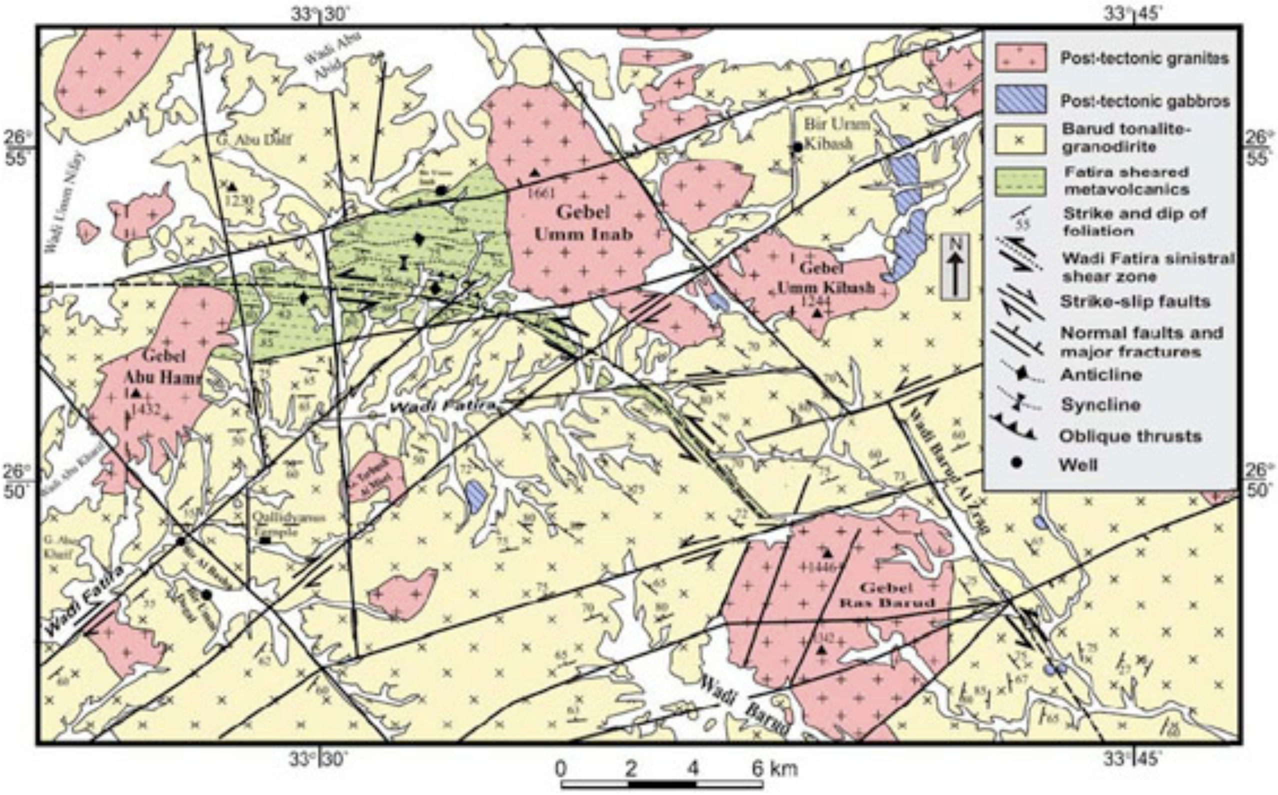
The Older Granitoids comprise tonalite-granodiorite suites with rare true granites. These are I-type, calc alkaline intrusions, associated with syntectonic island-arc formation in the Arabian Nubian Shield, forming between 665 and 614 Ma (see El-Mahallawi & Ahmed, 2012). The ‘Younger Granitoids’ are an abundant series of I-type to A-type, calc-alkaline affinity, late orogenic granitoids, ranging in composition from alkali granites (syenogranites) and quartz monzonites, intruded between 610-550 Ma (see Saleh, 2006).

These rocks were not widely worked for decorative and building stones. However, gabbroic and tonalitic rocks were worked in in the Central Eastern Desert at Wadi Balad, Wadi Semna and Wadi Maghrabiya, the latter producing the coarse-grained gabbro known in the Renaissance as *gabbro eufotid*e and *granito verde plasmato*. At Wadi Balad and Wadi Umm Wikala, a tributary of Wadi Semna, tonalitic intrusions were worked for stones known by the Romans as *Lapis Ophites* (‘snake-stone’; the texture was thought to resemble snakeskin) and an altered tonalite known *as Granito verde fiorito di bigio* (Klemm & Klemm, 2008; Harrell, 2010; Sidebotham *et al*., 2001).

At Mons Claudianus near Wadi Fatiri and in the Wadi Barud regions, a tectonised tonalite, the *Granito del foro* (granite of the forum) of the Romans was quarried.

At Wadi Umm Esh, a bright green, mottled serpentinite was worked which was known as *Lapis Batrachites* ('frog stone') to the Romans (Harrell, 2012).

The main source of granites to the ancient Egyptians and their successors was the Aswan Pluton (see below). However a pink-grey granite from the Eastern Desert Basement Complex was also worked from Wadi Sid during the Roman Period.



The geology of the Wadi Fatiri region, adapted from Abd El-Wahed & Abu Anbar (2009). This region is typical of the intrusive rocks of the Eastern Desert Basement Complex. The Roman Quarries at Mons Claudianus are in the south west corner of the map.

Supracrustal Rocks

The Dokhan Volcanics

The volcanic rocks of the Dokhan Volcanics are perhaps the most famous decorative stones ever used, however they were rarely used by the Ancient Egyptian and do not feature in the British Museum Egyptian sculpture Gallery. However such is there importance both as part of the geology of the Eastern Desert and their subsequent cultural significance, it would be churlish to ignore them here. The most famous variety of stone extracted from this unit was the Imperial Porphyry (left, used for the toga on a bust of the Emperor Caracalla in the Capitoline Museum, Rome) which was prized by the Romans. The word 'porphyry' is derived from the latin for 'purple' but it has become used in geological parlance to describe igneous rocks which have a bimodal grain-size distribution; a spotted texture with large crystals, phenocrysts, set in a fine-grained matrix. This rock texture is typical of lavas and other volcanic rocks.

There are numerous outcrops of the Dokhan Volcanics in the Eastern Desert Basement Complex and also in Sinai. In the Eastern Desert they are intercalated with the Hammamat Series (below). They are a series of lavas, ignimbrites and other pyroclastic rocks, ranging in composition from trachytes, through andesites and dacites (Abdel Wahed *et al*., 2012; Breitkreuz *et al*., 2010). All contain phenocrysts of white feldspar, the dacitic varieties also contain quartz phenocrysts. They were erupted from 630 - 592 Ma in between the emplacement of the Older and Younger Granitoids. The Imperial Porphyry are the youngest rocks in the sequence (Breitkreuz *et al*., 2010; Wilde & Youssef, 2000). Despite their age, they are largely non-metamorphosed. Not all of the Dokhan Volcanics are red-purple in colour, in fact the majority are dark grey or greenish and the Imperial Porphyry is gradational with these.

Evidence for Pharaonic use of the Imperial Porphyry is scarce, but is seems that small, probably fallen, blocks were worked for vessels during the 1st & 2nd Dynasties (Harrell, 2003). Quarrying for stelae and statuary stone at Mons Porphyrites probably began during the Ptolemaic Period (3rd Century BC). The main period of production began under the reign of the Emperor Tiberius (1^{st} Century AD) and continued until the 5th Century AD (Klemm & Klemm, 2008).

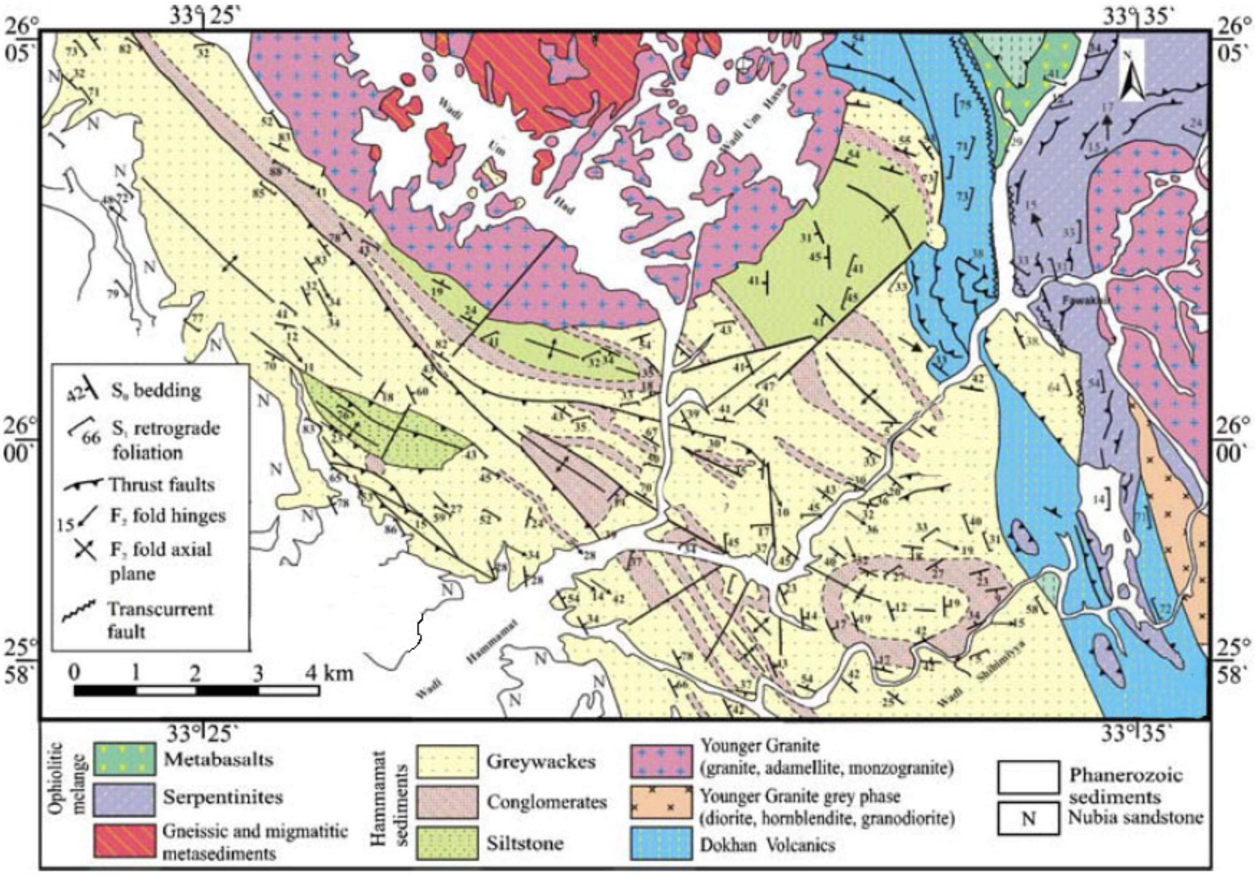
In London, Imperial Porphyry can be seen in Westminster Abbey in the Sanctuary Pavement and a particularly large slab of this stone faces the Tomb of Henry III. The Dokhan Volcanics are associated with a swarm of Porphyry Dykes which were utilised for stone vessels and a striking example of these with large(2-3 cm) white phenocrysts of plagioclase feldspar set in almost black, fine grained matrix can be seen in the Upper Egyptian Gallery in the British Museum.

The Hammamat Series

The Hammamat Series clastic sediments were deposited into a Pan-African Orogeny molasse basin, broadly co-eval with the eruption of the Dokhan Volcanics, deposited between 650-580 Ma. They are sediments typical of this orogenic setting, a series of siltstones, through sandstones (greywackes) to conglomerates. They were deformed deformed into folds and subject to low greenschist facies metamorphism. The main mineral present is quartz, but the stones have an overall greenish colour which is imparted by epidote, chlorite and sericite (Abd El-Wahed *et al*., 2010; Abd El-Rahmen *et al*., 2010). These stones were heavily worked by the Ancient Egyptians both from quarries and fallen blocks in Wadi Hammamat. Wadi Hammamat, ‘The Valley of the Baths’, is named because of the half-worked tubs, actually Roman Sarcophagi, abandoned there. It has always been a major route from the Nile Valley, just north of Luxor, to the Red Sea Coast at Quseir. Slatey rocks from the Hammamat Series were used for palettes, but two particularly prestigious stones were worked from the Hammamat Series. The most famous is the variety that the Ancient Egyptians called Bekhen Stone (Klemm & Klemm 2008; Harrell & Stormemyr, 2001) the quarry for which is clearly marked on the Turin Papyrus (Harrell & Brown, 1992). This is a hard, dense and extremely compact variety of metagreywacke. Superficially, this stone may be, and has been, mistaken for a basalt and was called *basalto verde antico* by the Renaissance Italian scalpellini. Also known as *basanites lidos* - a term for a touch stone for assessing the quality of precious metals. This is also the etymology of the basaltic rock variety basanite, but there are no basanites in Wadi Hammamat!

Bekhen stone was frequently used for smale-scale, but particularly finely carved, sculpture. The rock unit is well jointed and this limits the extraction of large blocks.

The second important stone from Wadi Hammamat is a polymict conglomerate, known by the Romans as *Lapis Hecatonlithos* (left), literally the ‘stone of a hundred stones’. It is a poorly sorted conglomerate composed of pebbles of vari-coloured, volcanics, microgranites, siltsones, greywacke, quartz, etc. supported in a green, epidote-chlorite-sercite matrix. This is the Um Had Member of the Hammamat Series described by Abd El-Rahmen et al. (2010). This stones was known as *Breccia Verde* or *Breccia Universale* by the Renaissance stoneworkers who scavenged it from Roman 'excavations' (Borghini, 2004).



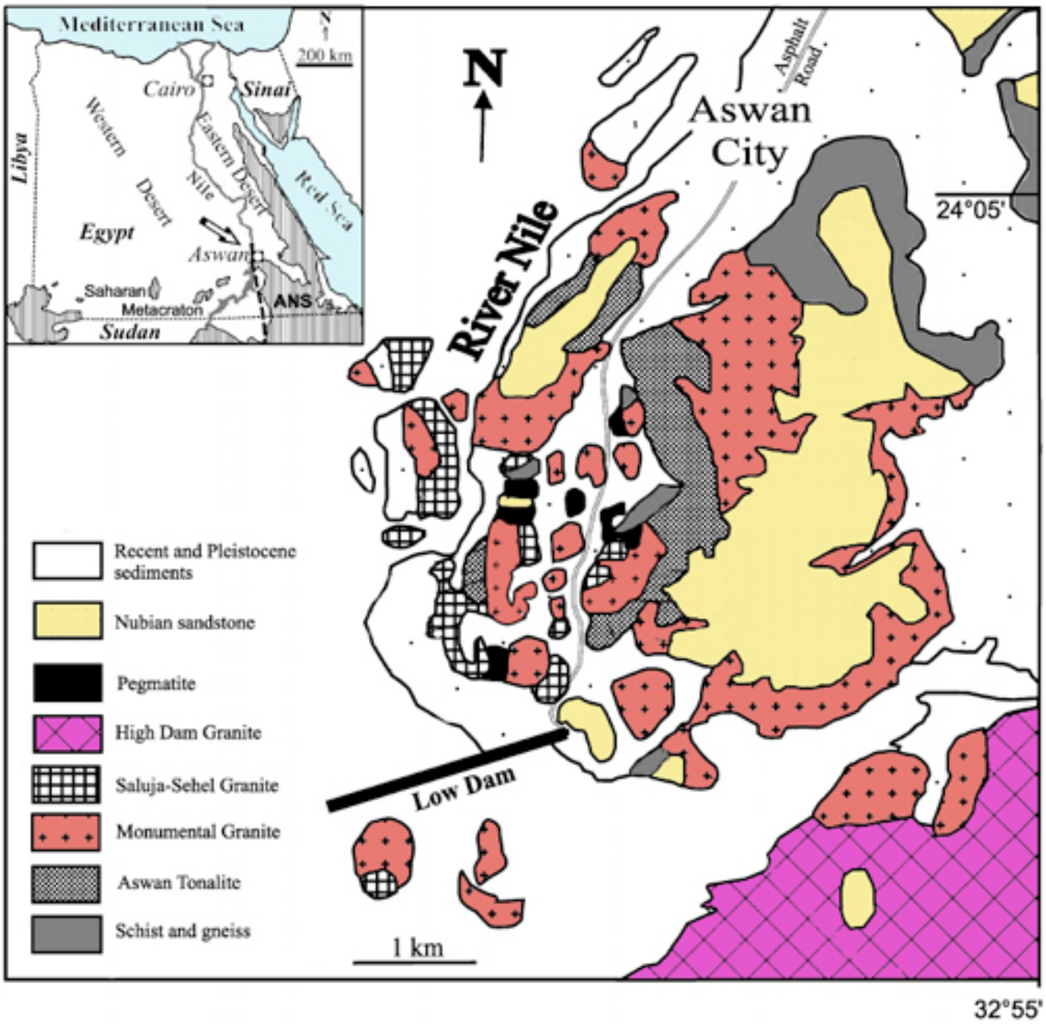
Geological Map of Wadi Hammamat, adapted from Abd El-Wahed (2010).

The Aswan Pluton

Situated in the South Eastern Desert, an inlier to the west of the main outcrops, the Aswan Pluton sits on the suture between the Arabian Nubian Shield to the east and the Saharan Metacraton to the west. As such it can be treated as separate from the rocks of the Eastern Desert proper. This plate collision occurred during the Neoproterozoic with the closure of the Mozambique Ocean. Finger *et al.* (2008) have studied the petrology and geochronology of the intrusions and dated them from c. 606 – 600 Ma (U-Pb, zircon), relating them to the late orogenic extensional phase of the collision. Geochemically they are shoshonitic A-type granites indicating a highly potassic, island arc melt affiliation. Their melts were probably generated in an enriched mantle wedge and were emplaced during slab detachment which occurred following continent-continent collision. The intrusions were emplaced into a gneissic basement which was comparatively young at the time, dated to around 620 Ma.

The intrusion is composite and consists of four main phases. The earliest phases of intrusion are the Monumental Granite (606 Ma) and the more or less coeval, Aswan Tonalite. The largest body of the intrusion is the High Dam Granite, outcropping to the south which is c. 600 Ma and there is an undated but younger phase of intrusion the Saluja Sehel Granite. The main quarries were in the Monumental Granite and Aswan Tonalite and various facies have been recognised and described in terms of their petrology and textures by Finger et al. (2008) and Klemm & Klemm (2001, 2008). All of these can be seen in monuments in the British Museum's Egyptian sculpture gallery; they are distinctive stones and easy to recognise. The ancient quarries lie to the south of the modern city of Aswan and are accessed from what is now the main road running through the region.

The Monumental Granite is coarse grained and porphyritic, with red-pink phenocrysts of K-feldspar perthite. These minerals dominate the texture and colour of the granites and are present in amounts up to (40%) It also contains significant amount of quartz (30%) with smaller amounts of plagioclase, biotite and hornblende.



Geological Map of the northern part of the Aswan Pluton (adapted from Finger et al., 2008).

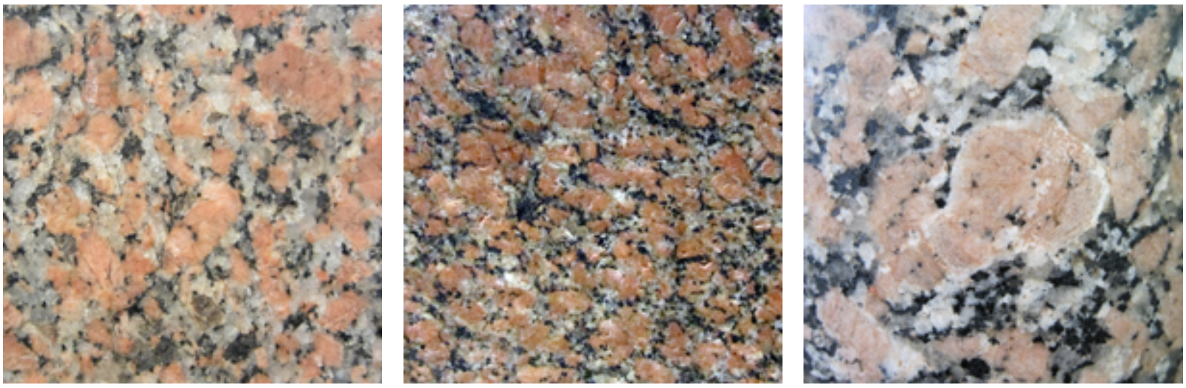
Although the Greek name for Aswan 'Syene' gave us the rock-name syenite, these rocks contain too much quartz to be true syenites by the modern classification. These rocks may be termed syenogranites. Archaeologically and architecturally these stones are known as the Granito Rosso Antico and were worked from numerous quarry sites in the hills south of Aswan. The three distinctive facies within this rock are defined here:

MG-I. Undeformed or weakly foliated porphyritic granite with red K-feldspar phenocrysts.

MG-II. Strongly foliated porphyritic granite with aligned red K-feldspar phenocrysts.

MG-III. Very coarse grained, pale-pink granite, sometimes with a rapakivi texture; porphyritic with feldspar phenocrysts often showing zonation with pale pink K-feldspar cores rimmed with white sodic feldspar.

The Monumental Granite is probably the most iconic building stone produced in ancient Egypt. Klemm & Klemm (2001) estimated that over one million tonnes of the granite was quarried. Most notably the relatively joint free rock produced the great obelisks, including Cleopatra's Needle on the Thames Embankment and many other examples of stonework which were recycled across Europe first by the Romans and then by the armies and explorers who visited Egypt in the nineteenth century.



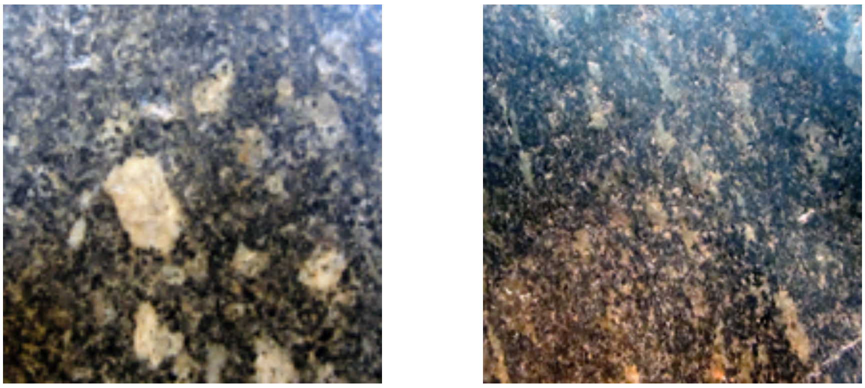
The three main varieties of the Monumental Granite; from left to right, MG-I, (Field of View 10 cm) MG-II (FOV 10 cm) and MG-III (FOV ~ 5 cm) which shows the rapakivi-textured granite.

The associated 'black granites', in fact tonalites, were quarried less and due to their closer joint spacing were used to produce smaller items such as sculpture and sarcophagi. The Aswan Tonalite is also often referred to as a granodiorite. However for the most part it contains up to 40% plagioclase feldspar, less than 20% quartz and less than 2% K-feldspar putting it clearly in the tonalite classification field. The rock is mafic with the colour imparted by biotite and hornblende which together make up ~ 40% of the rock. Nevertheless, porphyritic granodioritic components do occur (Serra et al., 2010) with microcline present. Three distinct varieties are defined here:

AT-I. Uniformly black tonalite, with individual grains (2-3 mm) visible to the naked eye. Non-porphyritic. Larger blocks may show veining with granitic material.

AT-II. Porphyritic tonalite-granodiorite with large (1-2 cm), aligned phenocrysts of white, sometimes slightly pinkish plagioclase feldspar in a medium grained dark grey matrix. Some blocks veined with pink granitic material.

AT-III. As AT-II above but very strongly foliated, all grains are aligned with an almost gneissose texture.



Porphyritic (AT-II, FOV ~ 8 cm) and strongly foliated (AT-III, FOV ~ 8 cm) Aswan Tonalite-Granodiorite.

These rocks are transitional with the Monumental Granite. The Saluja Sehel Granite (the 'grey granite' of Klemm & Klemm, 2008) is fine grained. It is mainly exposed in the eponymous islands in the Nile, in the western areas of the Aswan Pluton This phase post-dates the Aswan Tonalite and Monumental Granite.

The High Dam Granite (595 Ma; Finger *et al*., 2008) is coarse grained but equigranular without the distinctive phenocrysts of the Monumental Granite. It is also richer in plagioclase and does not contain hornblende. It is a biotite granite.

Quarrying of the Aswan Pluton probably began during the 3rd Dynasty (third millennium BC), for blocks to build the tomb chamber in the Pyramid of Djoser and for other Royal building projects (Klemm & Klemm, 2008). Earliest quarrying would have utilised weathered tors of granites, where the rock had split to form 'woolsack' blocks, of around a cubic metre in size. Large obelisks, such as Cleopatra's Needle (now on the Thames Embankment) and other large-scale monolithic sculpture would have required quarrying out of the bedrock, and this would have required removing loose blocks from the surface and then removing the weathered upper parts of the granite with dolerite hammers. The stone was worked with the same tools. It was not until the Ptolemaic and Roman Periods that iron tools were used and the plug and feather technique became the standard method for splitting blocks.

Guide to selected sculpture in the British Museum's Egyptian Galleries

The main Egyptian Sculpture Gallery is Gallery 4 on the Ground Floor of the British Museum, where this tour starts. Further information about the objects can be accessed via the British Museum's collections database (see Resources at the end of this guide). Please do not touch the objects on display.

1. Statue of Amenhotep III from his mortuary temple at Thebes: 18th Dynasty (c. 1350 BC)

This statue is one of the first encountered in the Egyptian sculpture gallery at the British Museum. Amenhotep III is depicted sitting upright with his hands on his knees. This is a very good example of the porphyritic Aswan Tonalite (AT-II). There is a greater than normal amount of felsic (pale-coloured) minerals in the groundmass, indicating that this particular blocks comes from the facies of the Aswan Tonalite that are transitional with the Monumental Granite. Large euhedral phenocrysts of plagioclase speckle the tonalite.

Left, the feet of Amenhotep III showing the speckled black and white Aswan Tonalite (1); right; one of Amenhotep's lions of dark rose Monumental Granite (2).

2. Lion of Amenhotep III from Soleb, Sudan: 18th Dynasty (c. 1370 BC)

Two lions of dark rose Monumental Granite sit on either side of the gallery. Both are carved from relatively unfoliated granite and their polished surfaces make textures and mineralogy easy to examine. In this coarse grained rock, the individual minerals are easily identified. Randomly orientated orange-pink potassic feldspars are prominent, up to 2 cm in length. These are phenocrysts in a groundmass composed of grey to pale yellow sodic plagioclase, grey, translucent quartz and black biotite and hornblende.

3. Three Statues of Sesostris III, Deir El-Bahri: 12th Dynasty (1878-1843 BC)

These three statues of the Pharoah Sesostris III are clearly good portraits and the Pharaoh's facial features are easily recognised in each of them. They are all carved from Aswan Tonalite and all show different textures of this stone. The statue on the left-hand side is made of porphyritic Aswan Tonalite with contrasting pale phenocrysts set in a dark, medium grained groundmass. The central statue is also porphyritic, but less obviously so, as the feldspar phenocrysts are dark grey. The statue of the right-hand side is a very good example of foliated Aswan Tonalite (AT-III), with elongated, aligned feldspar phenocrysts.

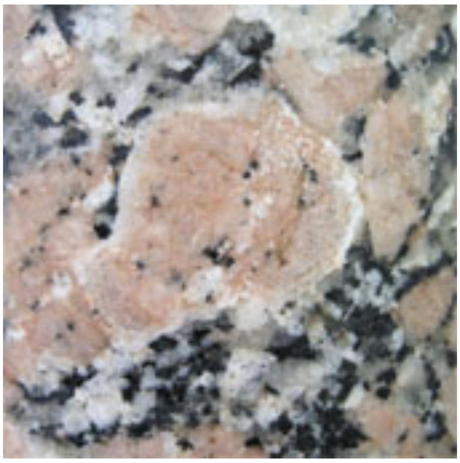
Three Statues of Sesostris III (3).

4. Sarcophagus, Giza: 5th Dynasty (2494-2395 BC)

This ancient sarcophagus with a lid of foliated, dark rose granite and a base of light rose granite is a good example for noting the differences in colour between two varieties of the Aswan Monumental Granite; the dark rose variety on the lid and the pale rose (MG-III) variety forms the coffin base. The two colours were presumably chosen with an intention. The lugs on the ends of the lids are there to sling ropes around to lower the lid onto the coffin. The decorations on the side of the sarcophagus are thought to resemble a palace frontage, a house for the dead. The sarcophagus is rough dressed and so textures are not very clear. However the lid is of a strongly foliated dark red granite with 'schlieren' (streaky segregations) of biotite and hornblende. The same mineralogy as in the Lions (3) can be observed in this artefact. The coffin base has an unfoliated texture, again with grey plagioclase, and black biotite and hornblende, but the potassic feldspars are a pale rose pink in colour.


Sarcophagus of the 5th Dynasty (4) with contrasting dark rose granite lid on a pale rose granite base.

5. Head and arm from a Colossal Statue of (?)Amenhotep III, Karnak: 18th Dynasty (c. 1370 BC)



The head on the plinth above is out of reach for close inspection of the mineralogy and textures of the granite. However, the arm at its side, with the clenched fist shows interesting textures. Once again this is the pale rose variety of the Monumental Granite, but in this polished example the textures are easier to see. This is a weakly foliated variety with pale pink phenocrysts of potassic feldspar, white plagioclase, grey quartz and black biotite and hornblende. Looking at the front of the clenched fist, a large and striking pink phenocryst has a rim of white plagioclase feldspar. This is a rare variety of the Monumental Granite which shows the so-called rapakivi texture. The 'true' rapakivi granites are known from the Scandinavian (Baltic) and North American Cratons and are a billion years older than these Neoproterozoic Egyptian granites. Nevertheless they were formed in a similar plate tectonic environment and the characteristic texture seen here is caused by a two pulses of magma creating the intrusion, the second one hotter than the first.

6. Colossal Bust of Ramesses II, 'The Younger Memnon': 19th Dynasty (1250 BC)

Moving into the second half of Gallery 4, another colossal torso and head towers above the gallery. This time it is Ramesses II, this sculpture is known as 'The Younger Memnon'. It shows a very careful selection of stone for this sculpture. This sculpture is a good example to see the intrusive relationships of the Aswan Pluton. Although carved from one block the torso is of porphyritic Aswan Tonalite and the head of the younger, fine grained, grey-pink, Saluja Sehel Granite, with a knife-sharp contact between the two intrusive rocks just under the chin, so that the Pharaoh's beard and the lappets of his headdress are in the tonalite. A thin dyke of the fine grained pink granite runs down his proper-right shoulder.

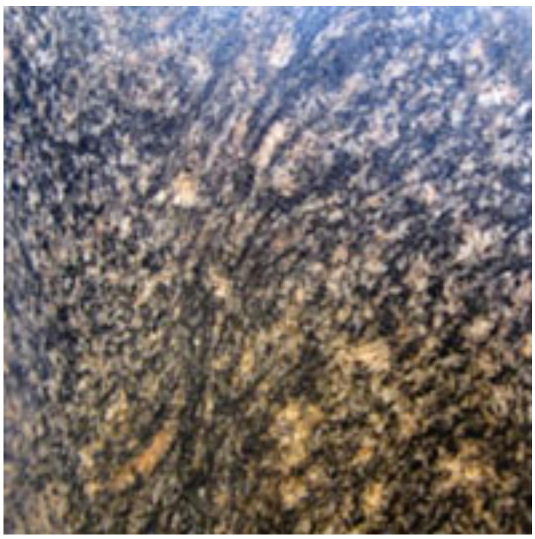
7. Sarcophagus of Nectanebo II, Alexandria: 30th Dynasty (c.343 BC)

A group of large sarcophagi dominate the display in the middle of the north part of Gallery 4. On the left stands the sarcophagus of Nectanebo II. This is made of the sediments of the Wadi Hammamat Series, in this case the Lapis Hecatonlithos, known geologically as the Um Had Conglomerate Member (Abd El-Rahmen *et al*., 2010). The surface of the sarcophagus is covered with tiny, beautifully carved hieroglyphics, but look closely and the reason the Romans named this the stone of a hundred stones becomes clear. Pebbles of sedimentary rocks of various colours are present along with clasts of volcanic and granitic rocks. On this large sarcophagus, the bedding can be clearly seen with beds of conglomerate alternating with sandstones apparent.

Sarcophagus of Nectanebo II of Hammamat Series conglomerates (7). On the front surface of the sarcophagus, bedding is dipping at around 70° towards the left of the photograph.

8. Torso of Nectanebo I: 30th Dynasty (380-362 BC)

Behind the Sarcophagus of Nectanebo II is a small torso of his predecessor, Nectanebo I. This is finely carved in a polished metamorphic rock at amphibolite facies.



Left, torso of Nectanebo I (8), and a close up of the small ductile shear zone running vertically down his chest (right). The torso's proper-left has moved up, relative to his proper-right.

The origin of the this stone is unknown, but it may be derived from one of the metamorphic core complexes of the Eastern Desert Basement Complex. It is composed of well and finely foliated orthogneiss (i.e. a gneiss derived from an igneous protolith) composed of hornblende and feldspar; an overall granodioritic composition. Evidence of tectonism is apparent in a miniature ductile shear zone running down the middle of Nectanebo's chest. The banding in the gneiss has been offset along the shear. The stone for this sculpture may not have been quarried, it may have been made from a fallen block collected from a wadi.

9. Kneeling statue of Mentuemhat holding a stela: 26th Dynasty.

The front cover of this guide shows this kneeling statue of Mentuemhat, holding a stela. It is a very good example of the porhyritic Aswan Tonalite, with well developed euhedral crystals of plagioclase in a hornblende and plagioclase-rich groundmass.

10. Head of a King: 26th-30th Dynasty (600-340 BC)

A particularly finely carved head of a king who may either be Amasis or Nectanebo I (left). This is carved from fine grained, greenish siltstone from the Hammamat Series, a stone very similar to the prized Bekhen Stone of the Ancient Egyptians, often mistaken for a basalt. This is a very dense, grey-green metagreywacke from the Hammamat Series with a grain size of ~0.2 mm. Microscopically, these rocks contain grains of quartz plus feldspar, opaques and epidote, chlorite and sericite. The epidote and chlorite impart the green colouration.

11. Granite Temple Columns

At the northern end of Gallery 4, stand two monolithic granite columns. They are good examples of coarse grained, foliated dark rose Monumental Granite, and once again the minerals present are clear to the naked eye; orange-pink potassic feldspar, grey plagioclase, quartz, biotite and hornblende. Of particular interest, on the left hand column (from Bubastis, 1250 BC), at about eye-level is a rounded xenolith of dark-coloured porphyritic Aswan Tonalite (left), with phenocysts in a dark hornblende-rich matrix. These field relations show that the Aswan Tonalite must pre-date the emplacement of the Monumental Granite.

12. Colossal Scarab: ?Ptolemaic Period

This colossal scarab was found in Constantinople; it's date is not well-attested but it may be from the Ptolemaic Period, or earlier. It was donated to the BM by Lord Elgin. The stone used here was known in the Renaissance as Granito verde fiorito di bigio (Borghini, 2004). It was derived from quarries near Gebel Dokhan in Wadi Umm Balad. Harrell (2012) ascribes a tentative Roman Period date for operation of these quarries. If it is from Wadi Umm Balad, this suggests that the quarries there were working in the Ptolemaic Period (or the Scarab is Roman ...).

This stone is an altered diorite. It is a grey-green plagioclase - hornblende rock. Close inspection reveals clusters of green, radiating, acicular amphiboles and yellow-grey plagioclase feldspar, and very minor grey quartz. The crystals are randomly orientated and therefore for the rock does not show a foliation. Whether it is the true Granito verde fiorito bigio or derived from a similar outcrop, it is certainly derived from one of the Older Granites intrusive suite of the Eastern Desert Basement Complex.

Colossal Scarab (12).

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How to cite this document: Siddall, R., 2013, Geology in the British Museum: The Monumental Stones of the Eastern Desert., Museum Geology 1., 16 pp., http://ruthsiddall.co.uk/Walks/Egypt-BM.pdf