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### 1. Introduction

Imperial Porphyry is a purple stone which is found in one location in Egypt. This stone was so highly valued during the imperial Roman and early Byzantine period (Vasiliev 1948:4) that they reserved it exclusively for imperial use (Klemm and Klemm, 2001:634-635).

Archaeologists are concerned with identifying when, where and by whom an object was made (Mantler and Schreiner, 2000:3). This is especially challenging for Imperial Porphyry because the demand for this prized commodity resulted in it being relocated or reused and it is difficult to trace its post-roman distribution (Lynn, 1984:19). Portable X-Ray Florescence (PXRF) spectrometry allows non-destructive and on-site testing. Archaeologists analysed Imperial Porphyry artefacts, primarily in museums, and natural rocks within Egyptian quarries using PXRF in an attempt to answer the question 'which locations did artefacts made from Imperial Porphyry originated from' (Potts and West, 2008:v).



Figure-1: Imperial Porphyry  
(New World Encyclopedia, 2007)

### 2. Imperial Porphyry

Porphyry is an igneous rock formed by columns of magma which, when cooling, embedded large-grained crystals of feldspar into the stone. It was formed in the upper-most layer of volcanic succession, i.e. highest topographic locations, within a layer of stone approximately 30 meters deep and 300 meters wide [see Figure 4.1]. Porphyry [Greek for purple (Potts and West, 2008:v)], is relatively common and is often associated with rich deposits of metals such as gold, copper and tungsten. It is found in a variety of colours but primarily black or green (Wilde and Youssef, 2000:404).

Gebel Dokhan in Egypt, and no where else in the world, has a rich deep purple-red variant known as Imperial Porphyry. Gebel Dokhan [Arabic for Smoking Mountain (Vasiliev, 1948:3)] is approximately 140 kilometers from the Nile in a remote and barren part of Egypt's eastern desert at 1600 meters above sea-level.

### 2.1 Mons Porphyrites

Rome knew the location as ὄρος πορφύριτες or Mons Porphyrites (Vasiliev, 1948:3). Caius Cominus Leugas (Jackson 2002:4-6) claimed to have found the location and he dedicated a stela during 18 AD to the god Pan-Min celebrating the find. A number of quarries were built as well as villages, a fortress, temples and wells - as well as a series of wells, cisterns and guard-stations along the route to Kainepolis [modern Qena] [see Figure 4.2]. Klemm and Klemm (2001:635) estimate that 10,000 tons of stone were excavated between the 1<sup>st</sup> and 5<sup>th</sup> centuries (Harrell, 2004:222-223):

Quarry	Type of Porphyry
Foot	Greenish-black
Bradford	Black
North-West	Imperial
Romulus or Rammius	
Lepsius	
Lycabettos	

### 2.2 Special qualities of Imperial Porphyry and its use in antiquity

Porphyry is exceptionally dense and can be polished to a highly reflective-finish and the embedded feldspar seems to 'sparkle'. Paul the Silentiary, a 6<sup>th</sup> century member of the Byzantine imperial household (Vasiliev, 1948:5), wrote that it was "powdered with bright stars".

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, 2001:635) 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, 2001:635) and baths (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, 2003:162). The most prized use was for sarcophagi; Vasiliev (1948:6,10) wrote that the first Byzantine emperors of the 4<sup>th</sup> and 5<sup>th</sup> centuries were interred in Imperial Porphyry sarcophagi (between Constantine the Great and Marcian except Valens who's body was not recovered after the battle of Adrianople).

Since the Middle-Ages Imperial Porphyry has been extensively reused, for example within Christian Basilicas (Lynn, 1984:19) and decorative items such as vases (Tomasso Brothers Fine Art, 2011). Post Roman quarrying has been restricted; an exception includes a sculpture by Stephen Cox (Henry Moore Institute, 2011).

### 2.3 Archaeology and Imperial Porphyry

The Tetrarchs [see Figure 5.3] are two separate statues, carved from large block(s) of Imperial Porphyry, which were designed to be displayed as a single piece. They are believed, but not with certainty, to represent Diocletian, Maximian, Constantius, and Galerius who ruled the Roman Empire jointly between 284 and 324 (Godfrey, 1998:83) and used statues to emphasise their group identity

(Rees, 1993:182). The statues were sacked from the Philadelphion in Constantinople in 1204 during the 4th Crusade, and are now in the southwest corner of St. Mark's Basilica in Venice.

Non-scientific analysis of The Tetrarchs, and other similar statues, has typically been restricted to dating the statues by comparing the faces and stylistic representation with Tetrarchic coinage (Rees, 1993:187-188). This is unreliable and it has not been possible to definitively identify who the statues represent or their date. If Archaeologists can identify which quarry the stone originated from it may be possible to use the established chronology of quarry working, provided by excavations, to date the stone's extraction to the Tetrarchic period.

During 1996 the Universities of Southampton and Exeter used non-destructive PXRF testing to characterize the [1] Mons Porphyrites quarries and [2] thirty artifacts carved from Imperial Porphyry. Their objective was to identify which quarry supplied the stone for a given artifact (Harrell, 2008:223). Potts and West (2008:193-194) explain that the Imperial quarries had similar and/or overlapping chemical properties but the Black/Green quarries were marginally more distinguishable and their results were limited to provenancing most of the artefacts to the Lycabettos quarry and a vase, in the Ashmolean Museum, to the Rammius quarry.

PXRF analysis was not able to definitively associate the majority of artefacts to a quarry; we could dismiss this technique as unsuccessful because it was not unambiguously useful in addressing the archaeological question. However, as Potts and West (2008:202) stress, "the contribution of PXRF is still in its infancy" and we should be optimistic that this, and other related techniques using chemical analysis, will make useful contributions to non-destructive sampling and the association of artefacts and their origins.

### **3. Conclusion**

Artefacts carved from Imperial Porphyry were in demand from the early 1<sup>st</sup> century AD. The reuse and relocation of this prized stone makes it difficult to firmly provenance most artefacts. A scientific technique, Portable X-Ray Florescence (PXRF), was used in an attempt to 'marry' artefacts to Egyptian quarries at Mons Porphyrites and to remove some of the unknowns that Non-scientific analysis cannot. The initial efforts were partially successful and future developments may offer more definitive techniques for chemically analysing stone.

#### 4. Figures

Figure-4.1: Topographic location of Gebel Dokhan  
(after Wilde and Youssef 2000:405 and The British Museum 1999)

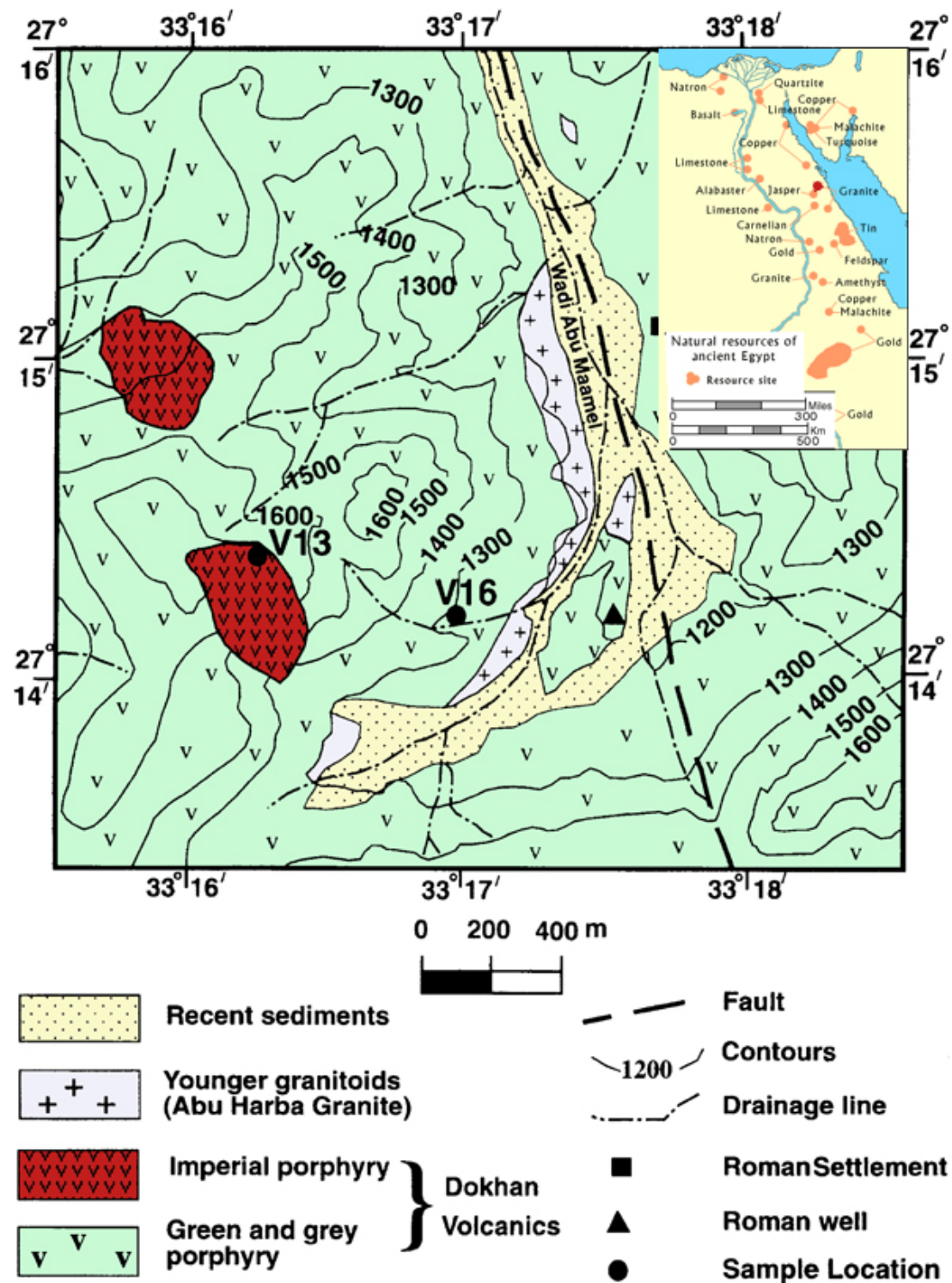


Figure-4.2: Eastern Desert of Egypt: Network of Roads and Guard-Station  
(after Meredith 1953:96)

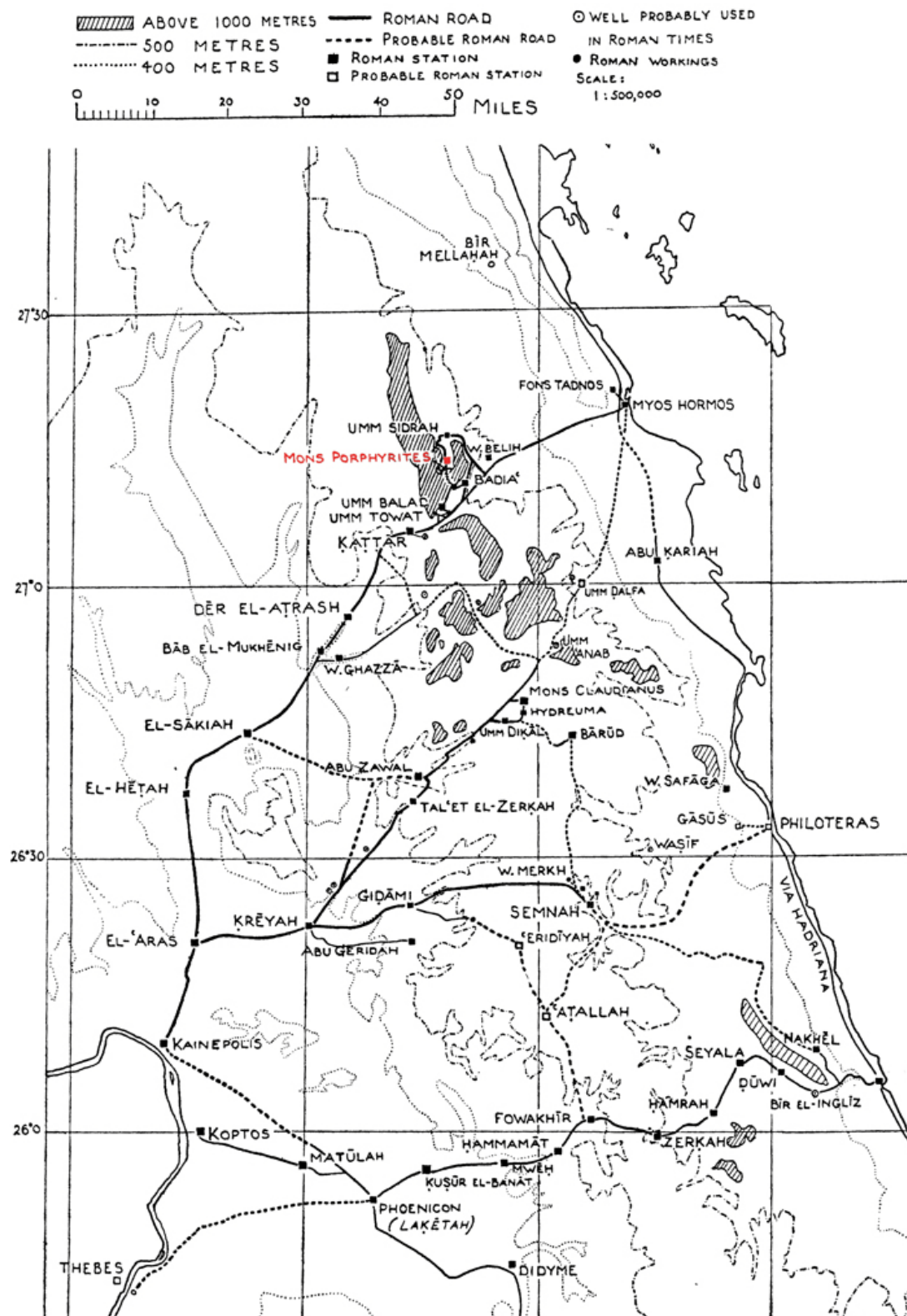




Figure-4.3: The Four Tetrarchs carved from Imperial Porphyry  
(The Great Mirror 2011)



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