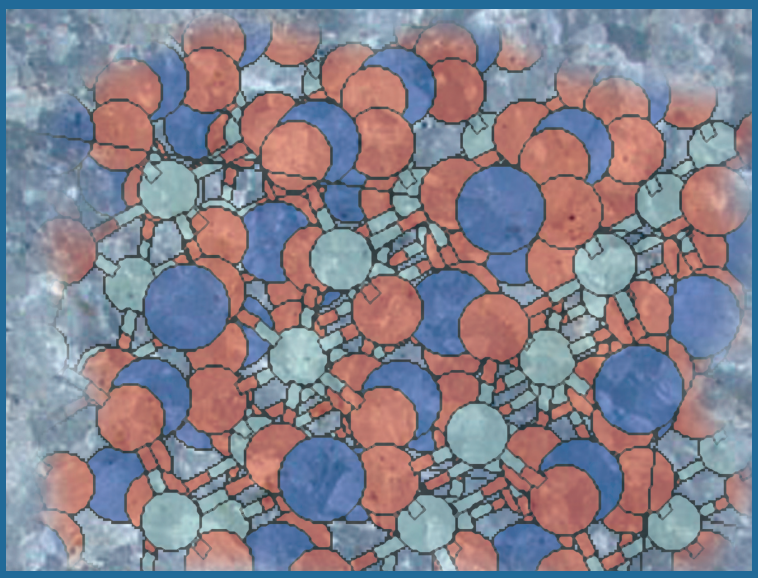
BCH Supplément 51

ASMOSIA VII

Actes du VII^e colloque international de l'ASMOSIA
Thasos 15-20 septembre 2003



Proceedings of the 7th International Conference of
Association for the Study of Marble and Other Stones in Antiquity
Thassos 15-20 september, 2003

Études réunies par Yannis MANIATIS

BULLETIN DE CORRESPONDANCE HELLÉNIQUE

ASMOSIA VII

ÉCOLE FRANÇAISE D'ATHÈNES

Directeur des publications : Dominique Mulliez
Adjointe aux publications : Catherine Aubert

Révision et mise au point des textes : Y. Maniatis

L'École française d'Athènes, qui a contribué à l'organisation de la rencontre ASMOSIA VII *à Thasos, avec le centre Dimokritos, la 18e éphorie des antiquités préhistoriques et classiques de Kavala et l'IGME, a pris en charge la totalité du coût de fabrication des actes dans sa collection, mais a autorisé à titre exceptionnel Yannis Maniatis à recourir aux normes éditoriales anglo-saxonnes.*

Pré-presse et photogravure : EFA Velissarios Anagnostopoulos, Thymeli s.n.c.
Coordination de la fabrication : EFA, Velissarios Anagnostopoulos
Impression, reliure : Break In s.a.
Conception graphique de la couverture : EFA, Velissarios Anagnostopoulos

Dépositaire : De Boccard Édition-Diffusion – 11, rue de Médicis, F – 75006 Paris, www.deboccard.com

ISBN 978-2-86958-207-1

BCH
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PRÉFACE

L'acronyme ASMOSIA désigne l'*Association pour l'étude du marbre et autres pierres dans l'Antiquité* (Association for the Study of Marble and Other Stones in Antiquity), fondée lors d'un atelier de recherche avancée de l'OTAN qui s'est tenu à l'hôtel Il Ciocco, à Lucca, en Italie, du 9 au 13 mai 1988. L'atelier était intitulé : *Le marbre en Grèce ancienne et à Rome : Géologie, carrières, commerce et artefacts*. Il fut suivi par une cinquantaine de participants qui représentaient de nombreuses professions : des physiciens, travaillant dans le domaine de l'archéométrie, des archéologues, des historiens de l'art et des conservateurs. Il fut organisé par Marc Waelkens et Norman Herz avec le but affiché d'encourager les projets associant scientifiques, historiens de l'art et autres pour une meilleure compréhension des questions relevant de l'usage de la pierre par les Anciens. À la suite de cet atelier, une série de rencontres fut programmée tous les deux ans et demi environ : la seconde rencontre eut lieu du 16 au 20 octobre 1990 à Louvain, en Belgique ; la troisième du 17 au 19 mai 1993 à Athènes, en Grèce ; la quatrième du 9 au 13 octobre 1995 à Bordeaux, en France ; la cinquième du 11 au 15 juin 1998 à Boston, aux États-Unis ; la sixième du 15 au 18 juin 2000 à Venise, en Italie ; la septième du 15 au 20 septembre 2003 à Liménas, sur l'île de Thasos, en Grèce. Cette série de colloques fait partie intégrante de l'association ASMOSIA : ils ont pour objectif de promouvoir la collaboration entre les sciences, l'archéologie et l'histoire de l'art pour une meilleure compréhension de l'exploitation, du transport, du traitement et de l'emploi de la pierre brute dans l'Antiquité.

La publication des actes a été bien accueillie à la fois par les historiens de l'art, les archéologues et la communauté scientifique, comme par les corps de conservateurs; elle a contribué à susciter une coopération interdisciplinaire sans cesse élargie. Dans la mesure où, avant la création de l'association, cette coopération était minimale, ce fut là, en fait, un progrès décisif. Pour la bonne organisation et la publication de ces rencontres, on a également eu la chance de bénéficier du soutien financier d'agences nationales et internationales, comme la fondation Samuel H. Kress Foundation, l'OTAN, etc.

Le nombre de membres de l'association a plus que quadruplé, passant de 50 en 1988 à environ 250 aujourd'hui, représentant 25 pays. En dehors des actes de colloques, ASMOSIA publie également à raison de deux fois par an l'*ASMOSIA Newsletter.*

À ce jour, ce domaine de la recherche a fait preuve d'importantes avancées dans la mesure où les sources matérielles dont on dispose pour l'usage du marbre et des autres pierres dans l'Antiquité ont été largement étudiées et où les matériaux eux-mêmes ont fait l'objet de caractérisations géologiques et physico-chimiques. Les bases de données avec leurs paramètres analytiques se sont développées et les

caractéristiques de différents types de pierres brutes se sont accumulées. Bien des problèmes archéologiques ou relevant de l'histoire de l'art trouvent désormais une meilleure réponse et une meilleure explication par le recours aux analyses scientifiques et aux bases de données, qu'il s'agisse de la provenance, de l'identification, de la diffusion, du traitement, des assemblages et de la préservation d'importants artefacts.

Le 7e colloque international de l'association ASMOSIA s'est tenu à Liménas, la ville principale et le port de l'île de Thasos, en Grèce. Il a été organisé par le laboratoire d'archéométrie-NCSR « Demokritos », l'École française d'Athènes, la 18e éphorie des antiquités préhistoriques et classiques, l'IGME (Institute of Geology and Mineral Exploration). Le comité d'organisation, composé de Y. Maniatis, K. Polikreti, Z. Bonias, S. Papadopoulos, T. Kozelj, M. Wurch-Kozelj et M. Varti-Mataranga, tient à adresser ses remerciements à la Municipalité de Thasos qui a mis à disposition la salle de conférences du « Kalogeriko » et a tout mis en œuvre pour faciliter le bon déroulement du colloque, le ministère grec de la culture et le ministère grec de l'Égée ainsi que l'Association des entreprises du marbre de Thrace et de Macédoine pour leur soutien financier.

Ce volume réunit les contributions présentées au 7e colloque international de l'association ASMOSIA. Les thèmes abordés dans ces communications sont à la pointe du domaine interdisciplinaire où se rejoignent les sciences, l'archéologie et l'histoire de l'art ; ils reflètent un large spectre de la recherche poursuivie sur les pierres grâce à la coopération des sciences et des humanités. En particulier, les thèmes abordés recouvrent presque tous les aspects qui concernent la pierre depuis la carrière jusqu'au produit décoré dans son état final, sans exclure les questions du vieillissement et de la restauration.

Tous les textes soumis pour publication dans ces actes ont fait l'objet d'une révision attentive par un ou plusieurs réviseurs, ce qui en garantit le haut niveau, le caractère innovant et la portée scientifique.

En la matière, nous exprimons nos sincères remerciements aux membres du comité exécutif de l'association ASMOSIA, N. Herz, L. Lazzarini, P. Storemyr, J.J. Herrmann Jr., Ph. Jockey, S. Kane, J. Harrell, ainsi qu'aux members du comité scientifique du colloque qui ont apporté leur concours à la difficile révision des textes présentés dans ce volume.

En outre, nous voulons remercier V. Zatta, secrétaire de l'Institute of Materials Science-NCSR « Demokritos » pour son aide dans le traitement des actes et les étudiants-chercheurs du laboratoire d'archéométrie-NCSR « Demokritos » D. Tambakopoulos et M. Maniati pour leur aide dans l'organisation et la relecture des épreuves.

Nous tenons aussi à exprimer notre plus profonde gratitude à l'École française d'Athènes et, en particulier, à son directeur, le professeur D. Mulliez : l'École française d'Athènes, en effet, a supporté la totalité du coût de fabrication et du travail de publication des actes dans le *Supplément* 51 du *Bulletin de Correspondance Hellénique*. Nos remerciements vont également à Sandrine Huber, ancienne adjointe aux publications de l'École française d'Athènes, et à Catherine Aubert, qui lui a succédé à ce poste, pour la part qu'elles ont prise dans l'élaboration de la publication.

Yannis Maniatis
Président de l'association ASMOSIA

PREFACE

ASMOSIA stands for the Association for the Study of Marble and Other Stones in Antiquity and was founded at a NATO sponsored Advanced Research Workshop held at Il Ciocco, Lucca, Italy, 9-13 May, 1988. The Workshop was entitled, "Marble in Ancient Greece and Rome: Geology, Quarries, Commerce, Artifacts" and was attended by fifty persons representing many varied professions: physical scientists working in Archaeometry, archaeologists, art historians, and conservators. It was organized by Marc Waelkens and Norman Herz with the avowed goal of encouraging collaborative projects among scientists, art historians and others in order to better understand the problems associated with ancient man's use of stone. Following that a series of meetings were held scheduled approximately every two and a half year: the second meeting was held October 16-20, 1990 in Leuven, Belgium; the third May 17-19, 1993, in Athens, Greece; the fourth October 9-13, 1995 in Bordeaux, France; the fifth June 11-15, 1998, in Boston, USA; the sixth June 15-18, 2000 in Venice, Italy; and the seventh in September 15-20, 2003 at Limenas on the Island of Thassos, Greece. These series of conferences form an integral part of the Association for the Study of Marble and Other Stones Used in Antiquity (ASMOSIA) and their aim is to promote the combined scientific, archaeological and art-historical research for a better understanding of the exploration, transportation, treatment and use of stone raw materials in Antiquity.

The publications of the proceedings have been well received by both the art historical, archaeological, and scientific, as well as museum communities and have helped to inspire an ever increasing interdisciplinary cooperation. Since previous to ASMOSIA, such cooperation was minimal, this has indeed been a great accomplishment. We have also been fortunate in receiving financial support for our meetings and publications from national and international agencies, such as the Samuel H. Kress Foundation, NATO etc.

Membership in ASMOSIA has grown over four-fold, from under 50 in 1988 to about 250 now and representing 25 countries. Publications apart from the conference proceedings include the currently twice-yearly *ASMOSIA Newsletter*.

Today, the field has witnessed important advances as the raw material sources for marble and other stones used in Antiquity have been studied to a great extend and the materials have been characterised geologically and physicochemically. The databases with analytical parameters have been expanding and experience with the characteristics of different types of raw stone materials has been accumulating. Many archaeological and art-historical problems can now be better resolved and explained using the advanced scientific methods and databases. Such problems may be related to provenance, identification, movement, treatment, assemblages and preservation of important artifacts.

The 7th International ASMOSIA Conference was held at Limenas, the main town and harbour of the island of Thassos, Greece. It was organized by the Laboratory of Archaeometry-NCSR "Demokritos", the French School at Athens, the 18th Ephoreia of Prehistoric and Classical Antiquities and the Institute of Geology and Mineral Exploration. The Organizing Committee, Y. Maniatis, K. Polikreti, Z. Bonias, S. Papadopoulos, T. Kozelj, M. Wurch-Kozelj and M. Varti-Mataranga would like to thank and acknowledge the Municipal Authorities of Thassos for providing the Conference building "Kalogeriko" and all the necessary facilities in order to make this Conference possible, the financial support of the Greek Ministry of Culture, the financial support of the Greek Ministry of the Aegean and the financial support of the Association of Marble Enterprises of Macedonia and Thrace.

This book contains the papers submitted to the 7th International ASMOSIA Conference. The subjects of the papers represent the state-of-the art in the field and reflect a very broad range of research and applications carried out in cooperation between the sciences and the humanities. In particular, the subjects cover almost everything on stone from the quarry to the final decorated object, including even aspects of weathering and restoration.

All the papers submitted for publication in these proceedings went under a peer reviewing process by one or more reviewers. This guarantees that the papers published in this volume are of high standards, innovative and scientifically sound.

For this, we expresses his sincere thanks to the Executive Committee of ASMOSIA, N. Herz, L. Lazzarini, P. Storemyr, J.J. Herrmann Jr., Ph. Jockey, S. Kane, J. Harrell, and the Scientific Committee of the Conference and also to other professional colleagues who helped with the difficult task of reviewing the papers presented in this volume.

In addition, we want to thank Mrs V. Zatta, the Secretary of the Institute of Materials Science of NCSR "Demokritos" for her help in processing the proceedings and the research students of the Laboratory of Archaeometry-NCSR "Demokritos" Mr. D. Tambakopoulos and Mrs. M. Maniati for their help in organising and proof readings of the papers.

We also expresses his deepest gratitude to the French School at Athens and particularly to its Director prof. D. Mulliez for undertaking the full cost and effort of publication of the proceedings as *Supplement* 51 of the *Bulletin de Correspondance Hellénique*. Thanks are also due to Mrs. S. Huber, former publication officer of the French School, and Mrs. C. Aubert, present publication officer, for organizing the publication.

Yannis Maniatis

Current President of ASMOSIA

NEW EVIDENCE OF SMALL-SCALE ROMAN BASALT QUARRYING IN EGYPT: WIDAN EL-FARAS IN THE NORTHERN FAIYUM DESERT AND TILAL SAWDA BY EL-MINYA

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ABSTRACT

Two small, previously unknown Roman basalt quarries in Egypt are described and discussed. One is located within the known Widan el-Faras Old Kingdom basalt quarry in the northern Faiyum desert, showing that the Romans reopened a part of this quarry for a short campaign. The other is situated at Tilal Sawda near El-Bahnasa, formerly the site of the Graeco-Roman city of Oxyrhynchus in Middle Egypt. Here, the Romans undertook very modest quarrying and also seem to have carried out systematic prospecting for basalt, but with negative results. Since Roman statuary in Egypt may also have been worked from re-used Old Kingdom blocks remaining at the pyramid fields, it is not yet known whether the two quarries actually produced finished basalt objects.

KEYWORDS: EGYPT, OLD KINGDOM, ROMAN PERIOD, STONE, QUARRYING, BASALT

INTRODUCTION

During a survey of Egyptian basalt outcrops in June 2002 a small quarry was discovered in the El-Minya basalt flow at Tilal Sawda near El-Bahnasa, formerly the site of the Graeco-Roman city of Oxyrhynchus in Middle Egypt. As evidenced by pottery scatters, the quarry appears to have been opened in the Roman period and its small size suggests that only a very short ex-

traction campaign was carried out at the site. However, modern quarrying may have destroyed similar, nearby quarry sites and thus the discovered quarry may have belonged to a larger group of quarries at Tilal Sawda.

The discovery of the Tilal Sawda quarry is important insofar as it supplements the picture of Roman basalt quarrying in Egypt. Until recently the only known basalt quarry in the country was the Widan el-Faras quarry in the northern Faiyum desert. This quarry provided stone for mainly Old Kingdom (26th to 22nd centuries BC) mortuary temples (HARRELL and BOWN 1995; MALLORY-GREENOUGH *et al.* 1999; BLOXAM and STOREMYR 2002). Surveys carried out in 2001 and 2002 show that the Romans reopened a part of this quarry, as evidenced by pottery scatters and other features (BLOXAM and STOREMYR 2002).

Together, these discoveries suggest that Roman basalt sculpture found during excavations may also have been worked from "fresh" basalt and not only from re-use of Old Kingdom blocks, of which there were many suitable at the pyramid fields in Giza, Sakkara and Abu Sir, as well as in the vicinity of the Widan el-Faras quarry.

This paper first gives a brief overview of the sources and petrography of basalt in Egypt and the use of basalt from the Predynastic (4th millennium BC) to the Roman period. Subsequently, a description and discussion of the Widan el-Faras and Tilal Sawda quarries are given. The description of the former is included here since the earlier brief portrayal (*ibid.*) is inadequate.

BASALT SOURCES, MINERALOGY AND TEXTURE

Most of the basalt flows relevant as possible sources of artefacts and building stone in ancient Egypt are of Tertiary (Cenozoic) age (MENEISY 1990) and occur as shown on the map in **Figure 1**. The Oligocene (c. 25 m.y.) Haddadin flow, with the Widan el-Faras quarry, in northern Egypt is until now the only one that has been positively identified as a source for Predynastic/Early Dynastic vessels and Old Kingdom building stone (MALLORY-GREENOUGH *et al.* 1999; GREENOUGH *et al.* 2001). The el-Minya basalt flow is of similar age, but as shown below, of a different textural nature than the Haddadin flow.

Although no other quarries have been found in the Haddadin flow, it is likely that outcrops by especially Abu Roash would have provided some stone, at least for vessels. Possible ancient quarries by Abu Roash will probably have been destroyed by the heavy modern exploitation to be observed here. Abu Zabal to the northeast of Cairo is another possible source, but here it seems that the upper layer is too weathered to be used for building stone and statuary. Modern exploitation here takes place in a deep pit.

As shown by thin-section petrography, the Tilal Sawda and Widan el-Faras basalts are mineralogically and geochemically quite similar; both are olivine basalts, containing plagioclase, clinopyroxene (augite), ortho-pyroxene and Fe-Ti oxides as their primary minerals. Texturally, however, they differ significantly (see also KLEMM and KLEMM 1993). The Widan

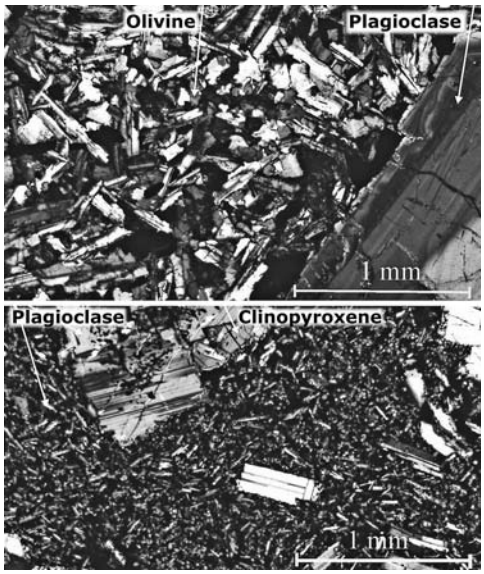

Fig. 1. — Landsat satellite image of Middle and Lower Egypt. Important basalt flows and basalt quarries are marked (dark gray).
Fig. 2. — Widan el-Faras (top) and Tilal Sawda (bottom) basalt. Note that the groundmass of the latter is very fine-grained. Thin-section micrograph, X-nicols.

el-Faras basalt (**fig. 2**) displays a porphyritic texture with interstitial groundmass. The very characteristic plagioclase phenocrysts measure up to 10 mm, whereas the plagioclase in the groundmass rarely exceed 0,5 mm. Patches of glass and alteration products from olivine and glass are common.

The Tilal Sawda basalt (**fig. 2**) displays a porphyritic to glomeroporphyritic texture, and the grain size is much smaller than the Widan el-Faras (less than 2 mm for phenocrysts/glomerocrysts, matrix grain size less than 0,2 mm). In addition, the investigated part of the Tilal Sawda basalt has vesicular cavities filled with zeolites. Small patches of altered glass are also common in the groundmass.

In addition to textural differences, MALLORY-GREENOUGH *et al.* (1999) have shown that the composition of augite can be useful for differentiating between the two basalt sources.

Fig. 3. — One example of a New Kingdom basalt relief can be found in front of the Egyptian Museum in Cairo. This relief probably originates from the Ptah temple at Memphis (reign of Amenhotep III), and may have been carved from a re-used basalt block found at Abu Sir (Stephen Quirke pers. comm. 2003).

THE USE OF BASALT IN ANCIENT EGYPT

Basalt was an important material for the ancient Egyptians. It was initially used for a great number of vessels in the Predynastic and Early Dynastic periods (ASTON 1994). The boom in basalt consumption occurred during a 150-170 year period between the 4th and 5th dynasties. In this period basalt was applied for floors, retaining walls and other architectural elements in four pyramid complexes: Khufu at Giza, Userkaf at Sakkara, and Sahura and Nyuserra at Abu Sir (MALLORY-GREENOUGH *et al.* 1999; BLOXAM and STOREMYR 2002). Basalt use in this period was usually restricted to the mortuary temples and may have had aesthetic and symbolic reasons; the black colour perhaps symbolising the earth, identified with the god Geb or Aker (HOFFMEIER 1993).

According to recent assessments, it seems clear that the bulk of the Old Kingdom basalt originated from the quarries at Widan el-Faras (BLOXAM and STOREMYR 2002). Although only representing a total quantity of perhaps less than 4.000 m^3, the Old Kingdom use of basalt was never equalled (*ibid.*). Some statuettes and reliefs are known from the Middle Kingdom, New Kingdom (**fig. 3**) and the Late Period (ASTON *et al.* 2000), but it is likely that most of these were carved from re-used Old Kingdom temple blocks or leftover blocks by the main basalt quarry at Widan el-Faras.

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Fig. 4. — Greek basalt statue in the Egyptian Museum, Cairo: The priest Horsahor, c. 40 BC, found at Alexandria (JE38310).
Fig. 5. — The basalt floor of Nyuserras mortuary temple, Abu Sir. Larger basalt blocks from retaining walls can be seen in the background.

There are quite a few basalt blocks remaining at these sites, especially at Abu Sir (**fig. 5**). Here, the remaining upright basalt retaining wall blocks (Nyuserra temple) are more visible than blocks used in floors and thus they were possibly quite suitable for later exploitation, given that floors might have been covered by sand after abandonment of the temples. In the vicinity of the Widan el-Faras quarry there are, moreover, hundreds of abandoned blocks (now heavily weathered), most probably from the Old Kingdom, in a kind of a storage area by the quarries, as well as on the quay by ancient Lake Moeris, where the 12 km long paved road from the quarries terminates. On the quay there are clear evidence of reworking of blocks, but it has not yet been possible to determine the age of this activity (BLOXAM and STOREMYR 2002).

In the Graeco-Roman period basalt was used again, but also then on a small scale. In this period is was used predominantly for statuary, of which there are some fine examples in the Graeco-Roman Museum in Alexandria (cf. EMPEREUR 2000, p. 11, fig. 13) and in the Egyptian Museum in Cairo. Famous pieces include the portraits of officials and priests found during excavations at Dimai (ancient Soknopaiou Nesos), close to Qasr el-Sagha in the Fayium (c.f. BOAK, 1935). As an example of a Late Ptolemaic sculpture, one could mention the statue of the priest Horsahor (**fig. 4**), found during excavations at Kon el-Damas, Alexandria and now in the Egyptian Museum (JE38310). It is dated to the reign of Cleopatra VII (c. 40 BC) (TIRADRITTI 1999, p. 389).

It seems that no basalt statuary has been found during excavations at Oxyrhynchus, which is first of all famous for Greek papyri. Given the fact that it was a place of sophistication and wealth in the Roman Period, and boasted a gymnasium, public baths, a theatre and 20 temples (PEACOCK 2000, p. 423), one can, however, assume a great use of stone, some of which might have been basalt.

The use of basalt in ancient Egypt has regularly been overestimated. The chief reason is the difficulty of distinguishing between basalt, dark grey to black granodiorite from Aswan and dark greyish-green greywacke from Wadi Hammamat (HARRELL and BOWN 1995). Our visual observations at several sites and in museums indicate, for instance, that all sarcophagi and pyramidions, often believed to have been made from basalt, were rather produced from greywacke or granodiorite. Recently, it was also found that the famous Rosetta Stone is not carved from basalt, but from granodiorite (ASTON *et al.* 2000). When aiming at an overview of basalt consumption in ancient Egypt, this shows that one cannot use literature describing objects as carved from basalt. All such information must be double-checked – and even then it will be, due to the patina on museum pieces, difficult to precisely determine stone type without petrographic investigations. However, with a magnet it might be possible to distinguish between granodiorite and basalt due to the presence of magnetite in the latter. Also, on "clean" objects, the greenish tint of greywacke is usually distinctive.

Brief visual investigations in the Egyptian Museum (Cairo) and the Graeco-Roman Museum (Alexandria) show that definitive basalt objects (e.g. those mentioned above) usually have been carved from Haddadin basalt, as evidenced by their relatively coarse-grained texture and large plagioclase phenocrysts. The likely sources are thus the newly discovered Roman quarry at Widan el-Faras or reused Old Kingdom blocks. No statuary clearly looking like basalt from the newly discovered quarry at Tilal Sawda has yet been located.

THE WIDAN EL-FARAS BASALT QUARRY

Widan el-Faras is located by Gebel Qatrani in the northern Faiyum desert (**figs 6, 7**), some 12 km north of the temple of Qasr el-Sagha and the previously mentioned quay by ancient Lake Moeris. Compared to the total extent of the Old Kingdom quarrying areas, described in detail in HARRELL and BOWN (1995) and BLOXAM and STOREMYR (2002), the Roman extraction area is limited. It can be found in the easternmost of the string of quarries along the basalt escarpment at Gebel Qatrani and has been given the number "1" in BLOXAM and STOREMYR (2002). As evidenced by pottery scatters and the presence of stone tools, this extraction area was clearly first opened in the Old Kingdom. At that time the normal way of quarrying the very fractured basalt included simple levering out of suitable blocks, leaving characteristic depressions and benches, as well as screes of waste along the escarpment.

The Roman extraction area appears to be superimposed on the Old Kingdom quarry "1"

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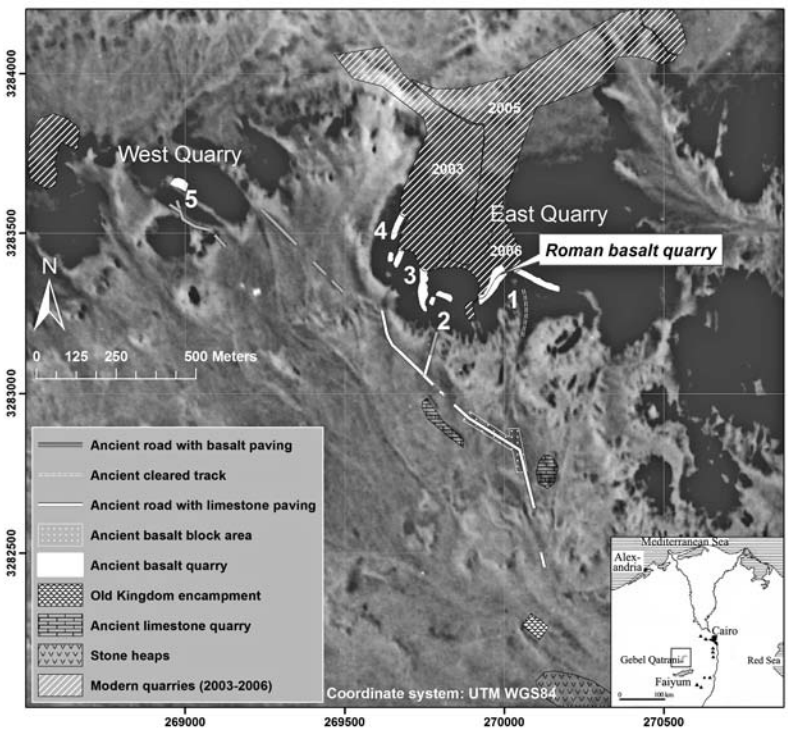

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Fig. 6. — Widan el-Faras, Northern Faiyum Desert: The picture shows the mainly Old Kingdom East Quarry site along the edge of the basalt escarpment. Roman quarry area marked with arrow.
Fig. 7. — Map of the mainly Old Kingdom Widan el-Faras quarry landscape. The Roman presence in the area is attested at quarry 1. Note the modern quarrying activities that are currently destroying the ancient quarries. Base image: Corona satellite image (1960s).

Fig. 8. — View of the Roman quarry area at Widan el-Faras in 2002 and after destruction in 2006.

(**fig. 8**). It is some 100 m long and differs from the other "pure" Old Kingdom extraction areas in having been cut farther into the escarpment, thus leaving less weathered basalt open for extraction. Moreover, waste from the quarrying operation was not only disposed of down the escarpment, but also left in ordered heaps in front of the extraction area. The basalt in these heaps is much less weathered than in the other "pure" Old Kingdom quarries, evidently because it has been exposed to the elements for a shorter period of time.

Fig. 9. — Roman wedge hole in the basalt quarry at Widan el-Faras..

Although the general Roman extraction method seem not to differ much from the Old Kingdom one, other indications of Roman extraction can be found in form of now rather weathered wedge holes. Three possible wedge holes have been found, of which one is shown in **Figure 9**. This hole is some 10 cm long, 2-3 cm deep and must have been used for splitting a block in order to get access to another, later removed, block in front of the split one.

These technical features are not proof enough of Roman quarrying in the area. However, in sharp contrast to the "pure" Old Kingdom quarries, in extraction area "1", many Early Imperial Roman (1st to 2nd centuries AD) pottery shards, mainly from amphoras, can be found (EL-SENUSSI 2001). Thus, there can be no doubt of Roman activity in this quarry.

The quarrying campaign must have been fairly short-lived. A rough estimate shows that a maximum of perhaps 100 m^3 of stone may have been extracted, mostly in the form of small-scale blocks rarely reaching the size of 0,5-1,0 m^3. This would, on the other hand, have been more than enough for probably all known statues and smaller Roman objects in Egypt.

It is not known which group of Romans undertook the quarrying, neither how, nor to where the basalt was transported. The most obvious guess would be transportation to Dimai, which is only a few km away from Qasr el-Sagha, but according to our knowledge no stone workshop has been found here. In this connection it should be underlined that we do not know whether freshly quarried blocks were ever used for statuary (see discussion in previous chapter). Without textual evidence it is virtually impossible to verify this.

During a field visit in February 2006 it was observed that most of the Roman quarry had been destroyed by modern quarrying activities, which started in 2002 in the area.

Fig. 10. — The Tilal Sawda basalt landscape by Bahnasa. Modern quarrying area in the front, the Roman quarry site in the distant background..

THE TILAL-SAWDA BASALT QUARRY

Tilal Sawda is located near Bahnasa, about 1 km to the west of the desert highway between Beni Suef and El-Minya on the west bank of the Nile. The basalt here consists of at least two distinct layers, and although it is difficult observe details because of sand dunes in this undulating terrain, it appears that the upper one is the most homogeneous and, hence, most suitable for stone extraction.

The upper basalt layer is thickest close to the highway, where modern quarrying operations are currently taking place (**fig. 10**), and thins out towards the northwest and the Roman quarry site. Here the thickness is only a few metres. The surviving quarry workings are very modest. A main extraction site measuring some 5×10 m is located in the top flow of the basalt, on the top of a small hill (**fig. 11**). There are no traces of quarry marks, thus extraction was obviously undertaken by simple means, using wedges and levers to split open existing, well developed columnar joints (**fig. 12**). In total, some 10-20 m^3 of usable basalt might have been extracted from this quarry, and most blocks would have been of a very modest size, measuring at maximum not more than 0,2-0,3 m^3. This would, however, be enough for many kinds of statuary.

Scatters of Late Roman to Early Islamic pottery can be found in the quarry area at large, but in the actual quarry site there are shards of probably one large Roman amphora only.

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Fig. 11. — The small Roman quarry site at Tilal Sawda is located on the top of the small hill. Note the few larger basalt blocks below the quarry.
Fig. 12. — The face of the Tilal Sawda quarry, showing well developed columnar jointing of the basalt.

Fig. 13. — Test quarrying (arrows) has taken place at several basalt hills by the Tilal Sawda Roman quarry.

Other quarries have not been found in the vicinity, but the top flow of basalt has been quite systematically tested in antiquity, as evidenced by tiny, weathered, and thus probably ancient, extraction sites on the nearby hills (**fig. 13**). There are some 10 such test-quarrying sites.

Whether the large modern extraction site close to the Beni Suef – El-Minya highway was also exploited in the Pharaonic and Graeco-Roman periods is now impossible to verify. However, given that the basalt flow apparently is at its thickest here and that the site is closer to the Nile and ancient Oxyrhynchus, it would have been strange if it was left untouched, also as seen on the background that the whole area appears to have been systematically tested for exploitable basalt outcrops.

As with the Widan el-Faras quarry, it is not known where the basalt from Tilal Sawda ended up and whether it was actually used for statuary or other objects. The best guess would be that it was possibly transported to Oxyrhynchus for further working.

CONCLUSIONS

In another paper in this volume (STOREMYR and HELDAL 2009) the destruction of the Widan el-Faras quarry by modern exploitation is more thoroughly described than above. The modern quarrying at Tilal Sawda has the same objective as at Widan el-Faras: the need for construction

materials, especially for road building and coastal erosion protection. Completing this picture, the many basalt outcrops between Widan el-Faras and Giza, at Abu Roash and probably also between Cairo and Suez are currently exploited on a large scale (cf. STOREMYR *et al.* 2003).

The current exploitation and destruction implies that we will never understand the true extent of Pharaonic and Graeco-Roman basalt prospecting and quarrying in Egypt. However, as the observations in the Tilal Sawda quarry area indicate, it seems that the Romans surveyed the area very systematically, not finding the basalt they would have liked, probably because of the highly fractured nature of the rock.

ACKNOWLEDGEMENTS

We would like to express our gratitude to the Supreme Council of Antiquities (SCA) and the Egyptian Geological Survey and Mining Authorities (EGSMA) for permission to work at the Tilal Sawda and Widan el-Faras sites. Special thanks are also due to Mohamed Madbouly and Ahmed Bedawy, both of EGSMA, for their assistance in the field.

BIBLIOGRAPHY

ASTON, B.G., 1994, *Ancient Egyptian Stone Vessels: Materials and Forms*, Heidelberger Orientverlag, Heidelberg.

ASTON, B. G., HARRELL, J., and SHAW, I.M.E., 2000, "Stone", in P.T. NICHOLSON, and I.M.E. SHAW (eds), *Ancient Egyptian Materials and Technology*, Cambridge University Press, Cambridge, pp. 5-77.

BLOXAM, E., and STOREMYR, P., 2002, "Old Kingdom Basalt Quarrying Activities at Widan el-Faras, Northern Faiyum Desert", *Journal of Egyptian Archaeology*, 88, pp. 23-36.

BOAK, A. E. R. (ed.), 1935, *1888-1962: Soknopaiou Nesos: the University of Michigan excavations at Dimê in 1931-32 I*, University of Michigan Press, Ann Arbor, Michigan.

EL-SENUSSI, A., 2001, *Pottery of the Widan el-Faras survey 2001*, unpublished report.

EMPEREUR, J-Y., 2000, *A Short Guide to The Graeco-Roman Museum Alexandria,* Harpocrates Publishing, Alexandria.

GREENOUGH, J.D., GORTON, M.P., and MALLORY-GREENOUGH, L.M., 2001, "The Major- and Trace-element Whole-Rock Fingerprints of Egyptian Basalts and the Provenance of Egyptian Artefacts", *Geoarchaeology*, 16(7), pp. 763-784.

HARRELL, J., and BOWN, T., 1995, "An Old Kingdom Basalt Quarry at Widan el-Faras and the Quarry Road to Lake Moeris", *JARCE*, 32, pp. 71-91.

HOFFMEIER, J.K., 1993, "The Use of Basalt in Floors of Old Kingdom Pyramid Temples", *JARCE*, 30, pp. 117-123.

KLEMM, R., and KLEMM, D.D., 1993, *Steine und Steinbrüche im Alten Ägypten*, Springer-Verlag, Berlin.

MALLORY-GREENOUGH, L.M, GREENOUGH, J.D., and OWEN, J.V., 1999, "The Stone Source of Predynastic Basalt Vessels: Mineralogical Evidence for Quarries in Northern Egypt", *Journal of Archaeological Science*, 26, pp. 1261-1272.

MENEISY, M.Y., 1990, "Volcanicity", in R. SAID (ed.), *The geology of Egypt*, A.A. Balkema, Rotterdam, pp. 157-172.

PEACOCK, D., 2000, "The Roman Period", in I. SHAW (ed.), *The Oxford History of Ancient Egypt,* Oxford University Press, Oxford, pp. 422-445.

STOREMYR, P., HELDAL, T., 2009, "Ancient Stone Quarries: Vulnerable Archaeological Sites Threatened by Modern Development", in Y. MANIATIS (ed.), *ASMOSIA VII, The Study of Marble and Other Stones in Antiquity – Proceedings of the 7th International Conference of the Association for the Study of Marble and Other Stones in Antiquity, BCH Suppl.*, 51, pp. 257-271.

STOREMYR, P., HELDAL, T., BLOXAM, E., HARRELL, J.A., 2003, *Widan el-Faras Ancient Quarry Landscape, Northern Faiyum Desert, Egypt: Site Description, Historical Significance and Current Destruction*, Report, no. 2002.062, Expert-Centre for Conservation of Monuments and Sites, Zurich (unpublished).

TIRADRITTI, F., 1999, *The Cairo Museum: Masterpieces of Egyptian Art,* Thames and Hudson, London.

Ce volume comprend les textes des communications d'ASMOSIA VII, 7e conférence internationale de *l'Association pour l'étude du marbre et des autres pierres dans l'Antiquité* (Association for the Study of Marble and Other Stones in Antiquity), qui s'est tenue dans l'île de Thasos, en Grèce. Les thèmes abordés dans ces communications sont à la pointe du domaine interdisciplinaire où se rejoignent la science, l'archéologie et l'histoire de l'art ; ils reflètent un large spectre de la recherche sur les pierres, depuis la carrière jusqu'au produit décoré dans son état final. Les sujets plus particulièrement abordés sont les suivants : (1) *Considérations archéologiques et emploi du marbre* ; (2) *Carrières, techniques d'extraction, géologie et propriétés de la pierre* ; (3) *Identification de provenance et caractérisation : le marbre* ; (4) *Identification de provenance et caractérisation : autres pierres* ; (5) *Techniques et développements* ; (6) *Bases de données* ; (7) *Propriétés de la pierre – Vieillissement –Restauration* et (8) *Pigments et peintures sur marbre.*

This book contains the papers submitted to ASMOSIA VII, which is the 7th International Conference of the *Association for the Study of Marble and Other Stones in Antiquity*. The conference was held in the island of Thassos, Greece. The subjects of the papers represent the state-of-the-art in the interdisciplinary field of Science and Archaeology and Art-History and reflect a very broad range of research and applications on stone, from the quarry to the final decorated object. In particular, the subjects cover: (1) *Archaeological considerations and use of marble*, (2) *Quarries, Quarrying Techniques, Geology and Stone properties*, (3) *Provenance Identification and Characterisation: Marble*, (4) *Provenance Identification and Characterisation: Other stones*, (5) *Techniques and Developments*, (6) *Databases*, (7) *Stone Properties – Weathering – Restoration* and (8) *Pigments and paintings on marble*.

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