



MEDISTONE

Preservation of ancient Mediterranean sites in terms of their ornamental and building stone

Newsletter n°4 May 2007

Editorial

Welcome to the fourth issue of MEDISTONE Newsletter. BRGM as co-ordinator of the MEDISTONE project, launches in the name of the consortium this fourth newsletter to inform about the aims and the work under progress of the project since January 2007.

MEDISTONE project (call FP6-2003-INCO-MPC-2 ; contract n°015245) proposes to contribute to the knowledge and the conservation of three of the most important archaeological sites in North Africa (Volubilis in Morocco, Djemila in Algeria, the Alexandria Lighthouse in Egypt) :

- identifying stones used and determining their origins in terms of geographic areas and, if possible, the former quarry sites
- establishing diagnosis of the state of conservation of the stones, and describing mechanisms of the deterioration to stone for semi-arid continental climate
- providing answers to the main problems regarding stone conservation / restoration that are liable to be met at the selected sites i.e. reassembling fractured and fissured stones.

This newsletter is part of MEDISTONE ongoing dissemination activities. All partners are acknowledged for their contributions.

David Dessandier, co-ordinator, BRGM

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Works under progress

PROGRESS MEETING N°1 VENICE (19-20 JANUARY 2007)



The first Progress Meeting of MEDISTONE took place in the University IUAV of Venice the 19 and 20 January 2007 with the kind organisation of Partner 4. It gathered the following persons:

- n°1 / BRGM : Fabian Delorme and David Dessandier
- n°2 / CPP-LRMH : Lise Cadot-Leroux, Mohamed Nasraoui and Jena-Didier Mertz
- n°3 / CICRP : Philippe Bromblet and Jean-Marc Vallet
- n°4 / IUAV : Fabrizio Antonelli, Stefano Cancilliere and Lorenzo Lazzarini (organisers)
- n°5 / LITHOS : Paolo Pagnin and Michele Rigoni
- n°6 / IGME : Myrsini Varti-Matarangas and Dyonisis Matarangas
- n°7 / PONS ASINI : Arnulf Daehne
- n°8 / MCA : Rachida ZADEM
- n°9 / UNIB : Messaoud Hamiane
- n°10 / No representative
- n°11 / MIUM : Said Kamel and Mohammed El Rhoddani (doctorate student)
- n°14 / CSA : Adel Akarish, Ashraf Nageh (doctorate student), Ahmed Shoeib

The detailed program and corresponding discussions are summarized as follows:

Day-1 / Morning :

→ The co-ordinator Dr Dessandier welcomes the participants and presents the main news related to the coordination of the project, in particular the contract amendment related to partner n°8 due to the reorganisation of Algerian Ministry of Culture.

→ Presentation of the results of WP1 concerning Volubilis (Morocco):
Geological data and ancient quarries (MIUM – S. Kamel and M. El Rhoddani) / Typology of the building stones (IGME – M. Varti-Matarangas) / Results on ornamental stones (LAMA – F. Antonelli)
Discussions:

First case of exported Portuguese marble (except Spain) / Question about evolution of the origin of the stones used with time / Find the origin of the local pinkish ornamental stone and the origin of the Greco Scritto marble / Necessity to harmonise the nomenclature of stones between the different partners

→ Presentation of the results of WP2 and WP3 concerning Volubilis (Morocco) :

WP2 : Systematic of degradation phenomena (PONS ASINI – A. Daehne) / First results on the origin of degradations (CICRP – J.M. Vallet) / WP3 : Preliminary results on fractured building limestones (LRMH – M. Nasraoui) / First trial tests on production of local grout (LITHOS – P. Pagnin)

Discussions:

Materials to make autochthon mortar have been found / Terminology for decay have been established / Dilatation not stabilized even after 72 h / Measurements of ultrasonic velocities to complete.

Day-1 / Afternoon :

→ Presentation of the results of WP1, WP2 and WP3 concerning Alexandria Lighthouse (Egypt) :
WP1 : Results on QaitBay Limestones and corresponding quarries (IGME – M. Varti-Matarangas +CSA – Adel Akarish) / Macroscopic investigations on worked stones (BRGM – D. Dessandier + CSA) / Deterioration and treatment of different granitoïds (LAMA – L. Lazzarini) / WP2 : Proposed methodology of study of sub-marine deterioration (CICRP – Ph/ Bromblet) / WP3 : Presentation of selected items and proposed test procedure (LRMH – M. Nasraoui + LITHOS).

Discussions:

Origin of limestones : Al Max and Abu Sir quarries / Test zones selected : Red Sphinx and Dark Sphinx stored at Kom El Dikka / Mission to Assouan for granites quarries survey in March.

→ Presentation of the results of WP1, WP2 and WP3 concerning Djemila (Algeria) :

WP1: Macroscopic investigations on building stones (IGME+BRGM+LRMH – L. Cadot-Leroux) / First results on marbles and coloured ornamental stones (LAMA – F. Antonelli) / WP2: First observations on stones degradations (CICRP+PONS – J-M. Vallet) / WP3 : Presentation of selected areas and proposed test procedure (LRMH+LITHOS – M. Nasraoui).

Discussions:

Visual typology of the stones have been performed / Mostly greek decorative stones but also Turkish, and local stones such as Greco Scritto, Alabastra Pecorella, or Numidic Marble / Locally available materials for restorers / perspective of the organisation of a “Chantier-Ecole” for the restoration of the arch of Bath. Mrs Zadem representing the Algerian Ministry of Culture does agree. The organisation details will have to be discussed.

Day-1 / Conclusions :

→ Correct advancement of the project.

→ Small meetings within WP and between some WP are encouraged by the Co-ordinator Dr. Dessandier to further enhance synergies.

Day-2 / Morning :

D. Dessandier reminds the partners of the deadlines for the reports to produce (Periodic Activity Report, Periodic Management Report, form C and 3 Reporting Questionnaires).

The organisation of the 2 workshops is discussed. The first one “Identification and origin determination of stones” is planned in Meknès in March 2008, and the second one “Diagnosis and conservation techniques of stones” planned in Alexandria in March 2009. For the 2 workshops the partners have decided to open the audience to a list of people involved in cultural heritage from the African countries and to students. The lists will be established by cultural authorities of each African partner. The presentation will be exclusively reserved to project partners. For each workshop an on-site session will be organised.

Thus, the valorisation of the data by the participation to workshops has been discussed. D. Dessandier has proposed to coordinate the different participations to maximise the dissemination of results. It has been decided to participate at least to the following workshops :

→ Orléans (France) - June 6-9 2007 - 7th International Symposium on the conservation of Monuments in the Mediterranean Basin : Presentation of the results of WP1 concerning Volubilis for building stones

→ Marrakech (Morocco) - October 24-26 2007 - 2^{nde} Rencontre Internationale sur le Patrimoine Architectural Méditerranéen / 4 foreseen presentations : final results of WP1 concerning Volubilis, final results of WP1 concerning Alexandria Lighthouse, intermediate results of WP2 concerning Volubilis and intermediate results of WP3 concerning Volubilis

Day-2 / Afternoon :

Practical case study : presentation of the decorative stones of the Basilica San Marco and presentation of restoration/conservation works of the facades by L. Lazzarini.

WP1 - IDENTIFICATION OF STONES AND DETERMINATION OF THEIR PROVENANCE :



Photos 1-2 :Aïn Schkor quarries



Photos 3-4 : Bou-Acila and Tiskram marble quarries



Photo 5 : Gebel Ibrahim Pacha granodiorite quarries

During the first trimester 2007, several on-site and in-laboratory works were undertaken.

→ 7-10 January 2007 : continuation of the research of ancient quarries of ornamental and building stones of Volubilis (Morocco) :

A team composed of Dr David Dessandier (partner n°1 / BRGM), Prof. Said Kamel (partner n°11 / University of Meknès) and Mr. Mohammed El Rhoddani (doctorate student / University of Meknès) visited different potential areas of provenance of stones used for the construction and the decoration of Volubilis.

First, according to two bibliographic references (1. R. ETIENNE, « Les carrières de calcaire dans la région de Volubilis » in B.C.T.H., 1950 (séance du 16 janvier), pp. 23-32 – 2. G. FERAY et R. PASKOFF, « Recherches sur les carrières romaines des environs de Volubilis » in B.A.M., tome VI ; 1966 pp 279-300), the supposed ancient quarries of « Aïn Schkor » area were located, described and sampled for inlaboratory analysis.

It is an extensive area of very numerous small to medium size quarries, located on a hill (cf. photos 1-2), and hard to find because of the vegetation. The most important quarries are located on the upper part of the hill. Many traces of ancient exploitation are visible

Secondly, three marble quarries located in Central Morocco (near Khénifra City - about 120 km in the south of Volubilis) that have potentially supplied decorative material for Volubilis were visited, described and sampled :

- Hreni-Ifrou quarries, supplying a whitish marble striped with greyish, micro-fractured
- Bou-Acila quarries, supplying a whitish marble striped with maroon (cf. photo 3), exploited at the present time for decorative stone (as wall and floor covering).
- Tiskram quarries (cf. photo 4), supplying a whitish marble striped with greyish, exploited at present as gravel.

Several samples were collected to be submitted to a complete in-laboratory characterisation with the objective to be compared to the Volubilis samples collected previously. At the present time, the analyses (chemical, mineralogical, petrographic and physical) are in progress mainly in the BRGM Labs.

→ 22-31 January 2007 : Practical works session of identification of ancient marbles (s.l.) in the “Laboratorio di Analisi dei Materiale Antichi” (LAMA – University IUAV of Venice) for Mr. Mohammed El Rhoddani (doctorate student / University of Meknès) supervised by Dr F. Antonelli and L. Lazzarini (University IUAV of Venice)

→ 26-29 march 2007 : Geological survey of the Aswan quarries of granite and granodiorite (Egyt) :

Most of the stones from the Alexandria Lighthouse corresponds to coarse pink granite and dark granodiorite. According to bibliographic study, these stones are supposed to come from quarries located in Aswan area. They belong to Late Precambrian age.



Photos 6-7 : Gebel Masala pink granite quarries

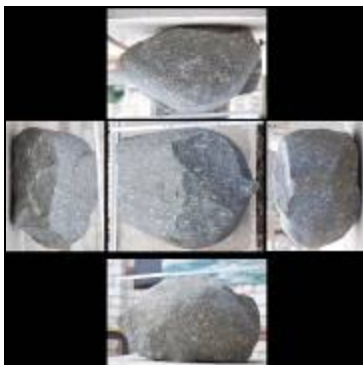
The quarries of the coarse pink granite are mainly located at the eastern bank of the Nile Valley, in an area between Aswan City and El Shellal district to the south (cf. photos 6-7).

The most famous localities are at the vicinity of unfinished Obelisk and near El Shellal railway station. Additional quarrying occurring in Sehel, Saluga and Elphantine islands in the Nile. These quarries were active from the Early dynastic to the Greco-Roman periods. On the other hand, the granodiorite quarries are mainly located in the south of Aswan city, around Gebel Ibrahim Pasha (cf. photo 5) and Gebel Togok. These quarries were worked from the Early dynastic to Roman periods.

A WP1, WP2, WP3 partners common mission in Aswan area was undertaken at the end of March 2007 to visit, study and sample these previous quarries areas. Concerning WP1, the team was composed of Dr David Dessandier (partner n°1 / BRGM), Dr Lise Cadot-Leroux (partner n°2 / CPP-LRMH), Dr Ahmed Shoeib, Dr A. Akarish and Ashraf Nageh (doctorate student - partner n°14 – Suprem Coucil of antiquities).

The main objective was to collect representative samples of the different kind of granite and granodiorite. Those samples will be submitted to a complete in-laboratory characterisation with the objective to be compared to the Alexandria Lighthouse samples collected previously. The analyses are currently in progress mainly in the BRGM labs (for chemical and physical analyses) and in the IUAV University lab (for mineralogical and petrographic optical characterisation).

WP2 – DIAGNOSIS OF THE CONSERVATION STATE OF THE STONES :



Digital rebuilding of a block of granodiorite



In progress mapping on a statue

The first four months in 2007 were devoted to:

- prepare and participate to the first year meeting in Venice
- end the first in field campaign
- prepare samples coming from Alexandria and Djemila

Samples preparation

First observations have been done on samples coming from both Alexandria and Djemila sites. 10 cross sections had been made on Djemila samples and 6 thin sections had been made on Alexandria samples.

End of the first in field campaign

Cicrp and Pons Asini Alexandria ended their first in field campaign in Egypt.

In January, Pons Asini made the mapping and the database of deterioration patterns on the stones which had been first selected last September. Within the MEDISTONE project the restorers of Pons Asini are concerned with the preliminary survey of the stone decay phenomena.

They had to make mappings of the degradation stones patterns. This documentation gave rise to of a systematic catalogue of stone decay patterns and their mapping, based on the forthcoming ICOMOS-ISCS illustrated glossary on stone deterioration patterns.

Thus the restorers of Pons Asini completed the catalogue examining granite sculptures coming from the lighthouse with their typical damages at the sites of Alexandria. Measuring pictures in order to do mapping on objects were produced.



Weak deferrification of ferro-magnesian minerals of the granite, from the surface to the depth (South Mahmodia quarry)

This work concerned the pieces of a colossus at the marine-museum, three sphinxes at the theatre-museum and two architectural fragments at the mole near the Citadel of Alexandria. The mappings were done as hand-drawings. Later the drawings were digitized (CAD).

Cicrp participated also to the mission in Aswan. One of the difficulties to provide a diagnosis on the causes of deterioration of the masterworks stones is to separate the intrinsic degradation factors acquired before their creation from those due to the external environment. Therefore an examination of some different former quarries had been done. The in granite statues are more deteriorated on Alexandria sites than granodiorite ones. So the in field work and the sampling had been then focused more on granite quarries than on granodiorite quarries. We focussed our observations on the research of the successive first steps of alteration. Different deterioration features of these oriented granites were observed as:

- contour scaling on cutting faces, degradation of plagioclases and deferriferous biotites in the granitic site from the unfinished obelisk
- intra and inter granular fracturing of granitic blocks and gradient of deferrification ferro-magnesian minerals from the surface to the depth (first centimetres) in the South Mahmodia area quarry

These observations would have to be confirmed by laboratory analysis on samples and also compared to results coming from the laboratory analysis of Alexandria's samples until the end of MEDISTONE program.

WP3 - DEVELOPMENT OF APPROPRIATE CONSERVATION / RESTORATION TECHNIQUES :

The last work in Alexandria (Egypt) has confirmed the importance of the fractures as among the main decays occurring in the sculptures. Indeed the 36 pieces (sphinxes, obelisks, papyriform columns and fragments of colossal statuary) lifted (by CEAlex team) from the waters in 1995 on the submerged ancient site of Qaitbay Fort show serious fractures or broken/missing parts. Since 2005, These pieces are exhibited in open-air museum in the Roman Theatre area.

It is clear that no large samples could be taken from such pieces of high importance, even if the ongoing work on compatibility of reassembling products require pluricentimetric specimens.

Based on our first on-site investigation, we have distinguish two main degradation types:

- desquamation up to a decimetric scale, active from 1 to 5 mm depth on the epidermis of rose granite with phenocrystals of K-feldspar. The red sphinx (1617 open museum-code) is a representative example of such surface stripping inducing losses of material and illegibility of hieroglyphic inscriptions. Such degradation requires the set-up of an appropriate consolidation technique probably combined with injections to give back some hardness to the powdering surfaces.

- Fractured and broken pieces: most of pieces are broken in different pieces (as an obelisk dedicated to Seti I). A representative example is a granodiorite sphinx with 3 fractured parts lifted from water: 2 exhibited in the open air museum (plastron, main body), while the head is laying in the store of Shallalat garden and a fourth last part that should be still underwater. Such broken sculptures require the set-up of reassembling techniques, combined if necessary (for large/heavy pieces) to pinning.

Aswan rock quarries

A second field work in Egypt was necessary in order to have samples large enough for the laboratory reassembling experiments. This mission was carried out (26-29 March 2007) in Aswan area known as the privileged source of plutonic rocks (granite and granodiorite) used for sculptures. The lab tests will be made on the specimens coming from the quarry and identified (WP1 & WP2) as similar to the exhibited sphinx in the open-air museum on Alexandria.

The region around the town of Aswan is a prominent ancient quarry landscapes. Its covers an area of some 150 square kilometres on both banks of the Nile from the Old Aswan Dam in the south to Wadi Kubhaniya in the north including the region of the famous Aswan granite quarries (8 km x 2 km).

After the building of the Aswan High Dam in 1960, the ancient outstanding quarry landscape has been increasingly utilised for dwellings and industrial activities. As consequences, modern quarrying and small-scale, but extensive artisan quarrying are taking place with the risk to change deeply or even destroy the ancient quarry landscape associated to the archaeology.

Within the Precambrian, metamorphic igneous rocks ring (in the North, the South and the East) occur a "window" outcrop of 'Aswan' granite. The granite subjected to quarrying (monumental granite) is often pinkish to occasionally reddish, very coarse to mainly coarse-grained and porphyritic (phenocrysts up to 4 cm), and mainly located in the centre of the zone limited in the West by Saluja and Sehel Islands and the old dam. This granite is associated occasionally to a medium to mainly fine-grained pink granite.

Coarse black granodiorite also occur : dark grey to nearly black, coarse- to mainly medium-grained, commonly porphyritic (phenocrysts up to 3 cm). The phenocrysts vary from white to pink in colour and may be largely or entirely absent in some specimens.

The granite is under variable alteration-state from fresh to under arenisation. A frequent alteration gives a rounded aspect to the granite cores, associated to pluricentimetric peeling moulding the morphology of the granite 'balls'. This peeling process seems to be close to the one occurring on the sphinxes 'pink'granite-made exhibited in Alexandria open-air museum. This alteration is clearly more intense in the quarry, especially in the rocks more exposed to the wind.

Quarry sampling

As indicated above, granodiorite close to one used for some sphinx exhibited in Alexandria has been observed (cf geologic map of Gindy, 1956).

The outcrop of granodiorite is mainly located within a narrow N-S strip along 2.5 Km in the centre part of the granitic body. These rocks are fresh contrasting with the altered granitic rocks, and they can contain some andesite or granite veins. These hard rocks are locally covered by the so called Nubian Sandstone strata extending toward the east part of the basin.

The field investigations have driven the sampling according to the goal of the WP3. 3 blocks of coarse-grained granite were collected: one fresh granite from a quarry North of Aswan, 2 samples slightly altered from an other quarry along NE-SW fault.

2 Samples of granodiorite were also collected from Ibrahim Bacha quarry: one phenocrysts-rich and the other phenocrysts-poor. Granodiorite samples are extremely dense and don't show any alteration sign.

Perspectives

The collected samples have been cut in the lab in order to obtain iso-dimensional specimens (core: 2 cm Ø and 6 cm height) adapted to the physical tests of dilation behaviour. These characterisations will be focused first on the rocks (granite and granodiorite) and to the composite specimens

(reassembling/product/rock/reassembling product). For the broken granodiorite pieces, the products used will belong to the highly adhesive products: epoxy-resin types. In close coordination with other WP3 partners, several products will be tested including Arg-Pox, an available product in Egypt and 2 other resins compatible with local temperature and mechanical properties of the tested rocks. The lab facilities, allowing the detection of small dilation variations under controlled hygric and thermal conditions, are under completion.

The fieldwork in Aswan finish the sampling missions on sites under study within the project: Volubilis in Morocco, Djamel in Algeria and Light house of Alexandria. The lab research, a necessary step towards the validation of the reassembling protocol before In-situ application, can start using the available samples.

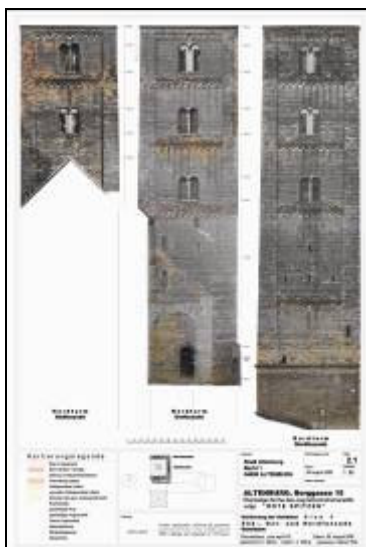
Focus on partners

IGME (Greece)

IGME – Institute of Geology and Mineral Exploration (Greece) is by legislation the State's technical adviser in geoscientific matters. Its fundamental aim is the geological study of the country and the exploration-evaluation of the mineral raw materials and ground water resources. Emphasis is also given to projects related to the protection of the environment and strong participation is demonstrated in competitive projects within the European Union Programmes.

I.G.M.E. is organised into six divisions, which are further subdivided into several Departments and Sections. Since 1976 six Regional Branches have been established. I.G.M.E. disposes appropriate laboratories and mechanical equipment, which meets the requirements of advanced laboratory needs and exploratory work demands.

PONS ASINI (Germany)



PONS ASINI is a consolidated company of freelancer. It was founded 2001 as an association of freelance professionals in the field of preservation and conservation, who mainly collaborated even several years before. PONS ASINI contains graduate conservators, architects and engineers, working as an interdisciplinary team. That makes enable to realise complex and extensive preservation projects from one source, in a symbiosis of planning and realisation. Because of that the scientific work as well as the planning gets a very close reference to the practice.

PONS ASINI operates mainly for the planning and investigations for preserving and restorations.

Subjects of the planning and investigation are buildings, sculptures, mural painting and mobiles articles of virtue.

Further PONS ASINI concerns itself with educational and scientific projects in cooperation with universities, State Offices and scientific institutions.

Since several years PONS ASINI acts in the course of a campaign of the German governmental society Gesellschaft für Technische Zusammenarbeit (GTZ) as trainer for Egyptian conservators and as consultants for preservation projects in Egypt. Currently PONS ASINI proceeds to intensify the educational activities in Egypt by an Egyptian-German joint venture conservators company, the ARab GERman union for conservation (ARGE).

Various Informations

Next planned meetings

- WP1 : Technical synthesis works about Volubilis site during May 2007 in Meknès, Morocco / Second field mission in Djemila, Algeria planned in November 2007 / Technical synthesis works about Alexandria Lighthouse during November 2007 in Venice, Italy.
- WP2 : Next field mission in Volubilis planned in October 2007 / Next field mission in Alexandria planned in December 2007.
- WP3 : Next field mission in Djemila planned in December 2007.

Next training for the doctorate students

- Training of the Moroccan doctorate student Mohammed El Rhoddani (partner n°11 / University of Meknès) on in-laboratory stone analyses (April-May 2007 – Place : BRGM Orléans, France)
- Training of the Egyptian and Algerian doctorate students Ashraf Nageh (partner n°14 / Suprem Council of Antiquities) Naïma Rebahi (partner n°9 / University of Boumerdès) on diagnosis of the stone conservation state and on the stone conservation techniques (June-July 2007 – Place : CICRP Marseille and LRMH Paris, France)

Next issue of Newsletter

N°5 (September 2007).

Dissemination of results

Presentations of POSTER or COMMUNICATION planned at the :

- 7th International Symposium on the Conservation of Monuments in the Mediterranean Basin – Orléans, France – June 6-9, 2007.
- 2^{ème} Rencontre Internationale sur le Patrimoine Architectural Méditerranéen – RIPAM2 – Marrakech, Morocco – October 24-26 , 2007.
- First MEDISTONE Workshop on the theme "Preservation of ancient Mediterranean sites in terms of their ornamental and building stone: 1. Identification and origin determination of stones" planned in March 2008 in Meknès / Morocco



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