

# The Tomb of Menna (TT 69) Conservation and Documentation Project

Assessment Season (april 10-15 2007)

Internal Report  
for  
The Color Analysis sub-project



raking light photograph of the offering table before Menna and Henuttawy  
(broad hall, far right wall, upper register)

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## 1. The project for the coloranalysis

The color analysis sub-project in The Tomb of Menna (IT 69) Conservation and Documentation Project aims to produce a full documentation of color uses in the whole painted decoration of the chapel of TI 69, in order to study the pictorial practices attested in the tomb, to determine the palettes and painting techniques of the artists who decorated this tomb and to track through material evidence these ancient artists and understand precisely how they painted the tomb.

Unfinished tombs and archaeological evidence regarding painting activities in Ancient Egypt have revealed that Ancient Egyptian painters worked pigment by pigment, preparing as much of one color as they needed for a single area to be decorated, before moving to another color. This process implies that the pigment recipe was homogeneous for a single working area and from a working area to another. It also allows one nowadays to track anonymous ancient artists who painted a tomb by systematically characterizing, on a physical and chemical level, the colors they used, and to distinguish each color palette employed in the monument. But, if such analysis could be performed on isolated fragments in Museum's laboratories, the study of complete monuments, on site, has always been limited by the necessity of taking samples from these works of art, a practice that is not conceivable on a completely extensive scale from a conservation point of view and, very understandably, not accepted by the Supreme Council of Antiquities.

In this context, the project aims to be innovative by proposing to integrate, for the first time, in a single global, systematic and totally non-destructive analysis all the available data that allow to understand the process of creating the paintings of an Ancient Egyptian tomb.

## 2. Activities performed during the assessment season

Dr Françoise Mathis and Dr Dimitri Laboury have evaluated on site the conditions to use in a systematic analysis the different techniques involved in the project in order to produce a complete documentation of color uses in the tomb, *ie*:

- High-resolution photographic survey (in this very purpose of pictorial practices analysis);

- Raking light photographic survey (to study the 3D aspects of the colors, its variable thickness, brushstrokes, losses and holes, layering, ... );

- UV light photographic survey (to determine any trace of varnish or organic elements in the paintings);

- colorimetric characterization by means of a UV / visible light spectrometer;

- XRF / XRD analysis of pigments;

- Raman spectrometric analysis of pigments;

The methodology of producing and integrating all the information needed to reach the goals of the project has also been established.

Paintings details that will help the development of the non-IR reflectography technique that is currently studied in the Optics Laboratories of the University of Liege were systematically documented.

D. Laboury has also made a preliminary visual survey of the different painting techniques and effects attested in the tomb.

### 3. Conclusions on the feasibility of the projected archaeometric operations and necessary means to reach the proposed goals

The conclusions of the assessment season for the color analysis sub-project are:

From a technical point of view, they should be no major problem of heat or dust to use the portable devices proposed in the project during November and December, if it is possible to close the present door of the tomb from time to time and to regularly use a vacuum cleaner (for example on every Saturday morning, at the beginning of every working week).

As stated from the beginning of the project, a generator will be necessary to supply electric power for all the devices used in the tomb.

(estimated electric power need:  $\pm 1500$  watts)

To work in the tomb, a minimum normal lighting system should be used (just to see the painting to analyze)

(such a lighting system will probably already be in position for the conservation process, the month before).

For the precise positioning of the probe of the analyzing devices, it is very strongly suggested - and almost necessary - to use a translation system developed by the European Center for Archaeometry at the University of Liege, Belgium, which will allow the device to be moved easily, precisely and quickly. This system will be freely loaned by the ECA, but it will need to be brought to Egypt with the other devices (see below: addendum).

It will be customized in University of Liege for its specific use in TT 69 before being sent to Egypt, but it is highly recommended that a specialist technician from the ECA could come to install the device for its first week of use within the tomb.

In any case, the wooden support for the present protection glasses will have to be removed, in order to make the analysis of paintings.

If a preliminary colorimetric analysis can be done in advance (it will take 1 person for 1 week and should take place before or at the beginning of the conservation process), XRF / XRD analysis will need at least 4 weeks (and preferably 5 weeks), with 3 physicists.

(the colorimetric reading done before the conservation will help to produce an objective measurement of the results of the conservation work, since the colorimeter will be coupled to the XRF / XRD device for the XRF / XRD analysis)

If XRF / XRD analysis can be done in these conditions and with at least one week in advance of the Raman spectrometry, this last process will take 3 weeks to survey the whole paintings of TT 69's chapel.

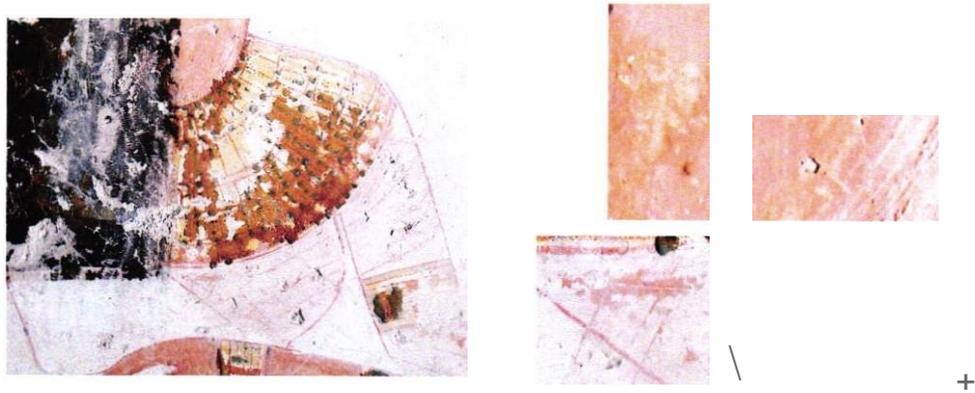
In these conditions, the goal of the archaeometric color analysis sub-project is to characterize on colorimetric, physical and chemical levels more or less 1000 target points in the painted decoration of the tomb of Menna. With such an amount of data, it will be possible to have a real statistical approach of the color uses in the tomb.

This invisible physical and chemical information will need to be integrated in a general systematic analysis of visible evidence regarding pictorial practices. It will be the task of D. Laboury and Kerstin Leterme (MA). Their study will be documented with high-resolution normal and raking light photographic survey.

The archaeometric non-destructive analysis of the pigments will give an accurate and precise characterization of the physical and chemical composition of the colors, but, in comparison to the sampling technique, the stratigraphy of the paintings will be missing. Nevertheless, preliminary researches made by D. Laboury during the assessment season have shown that it is possible to reconstruct and take into account this stratigraphical information regarding the paintings by systematically analyzing the holes and used zones of the painted surfaces. With this

information, it is possible to distinguish a color that has been produced by mixing two colors in the pigment pot from another one resulting from the superposition of two different layers.

- For example, in the following detail (from the representation of Henuttawy in the offering scene on the near right wall of the broad hall, next to the entrance into the tomb), the close-up analysis of the holes in the painting surface reveals that the hue of the skin was made by mixing a light pinky-orange ochre pigment with some argillaceous solution, whereas the transparency of the garment on the arm and the breast is produced by the superposition of a light pinky-orange ochre pigment (maybe the same) with a thin white wash of the white color used to render the opaque part of the robe.



- In many places in the tomb, the same detail was not colored with the same technique; for example, the pink hue of male shirts:



(Menna seated figure, broad hall, far right wall, lower register)

(son (?) offering bouquet to Menna and Henuttawy, broad hall, near right wall)

thin white wash  
on  
pink layer  
on  
white ground

(Menna seated figure, broad hall, near left wall, upper register)

So the proposed procedure will thus give the same precise information as the sampling technique, but without harming the paintings at all and for about 1000 target points in the painted decoration of the tomb of Menna.

#### 4. Suggested schedule for the color analysis sub-project during the Fall season

Two separated operations will be needed to achieve in the best conditions the projected goals:

- a) at the end of the photographic recording and before the conservation process:
- beginning of the systematic analysis of visible evidence regarding pictorial practices during the UV and raking light photographic survey
  - first colorimetric recording, before the conservation intervention

Suggested tentative dates	Name	Function	Duration of the work on site
10/ 12 - 10/ 19	D. Laboury	Supervision of UV / raking light photo survey and systematic visual analysis of pictorial practices	1 week
10/ 12 - 10/ 19	K. Leterme	<i>Idem</i>	1 week
10/16 - 10/23	R. Garcia-Moreno	Colorimetric recording	1 week

- b) after the conservation operations:
- the archaeometric analysis of colors

Suggested tentative dates	Name	Function	Duration of the work on site
11/15 - 12/20	D. Laboury	Supervision of archaeometric operations and systematic visual analysis of pictorial practices	4 weeks (back to Belgium 1 week in the middle)
11 / 15 - 12 / 20	Fr. Mathis	Archaeometric operations (more specifically XRF/ XRD - colorimetric recording)	5 weeks
11/ 15 - 12/ 20	R. Garcia-Moreno	Archaeometric operations (more specifically XRF/ XRD - colorimetric recording)	5 weeks
11/ 15 - 12/ 20	E. Laval (or another scientist of the C2RMF or ECA)	Archaeometric operations (more specifically XRF / XRD - colorimetric recording)	5 weeks
11/15 - 12/13	K. Leterme	Archaeometric operations and systematic visual analysis of pictorial practices	4 weeks
11 / 15 - 12 / 20	Specialist technician of the ECA (still to be chosen)	Installation and <i>in situ</i> adaptation of the translation system for XRF/ XRD - colorimetric devices	1 week
11/29 - 12/20	P. Vandabeele	Raman spectrometry <sup>1</sup>	3 weeks

<sup>1</sup> P. Vandabeele will probably bring with him a PhD student to help him on the Raman analysis but, if he can come, this assistant will be supported by Belgian funding.

**Addendum:****Wishes / needs list and extra information:**

- As stated by many of the Assessment Season members, one or two electric power stabilizers will certainly be necessary for the use of computers .  
For the archaeometric equipment, nonetheless, such a device might not be so unaffordable if the generator can produce stabilized electric power.
- The transportation of the archaeometric equipment must be included in the budget according to the following specificities:

Devices	Cases	Volume per case	Weight
XRF	1	1,25 × 0,45 × 0,60 m	50 kg
Translation system (XRF)	1	1,25 × 0,45 × 0,60 m	50 kg
Raman	1	1 × 0,50 × 0,50 m	50 kg
Translation system (Raman)	1	1 × 0,50 × 0,40 m	30 kg
Small equipment & materials	1 suitcase	1 × 0,50 × 0,40 m	50 kg
Total			230 kg

Transports needed: cargo flight Paris - Cairo - Paris  
+ transfer Cairo - Luxor - Cairo (by car ?)

- It would be very wise to take into account a budget for unpredictable rather low cost expenses (ex. \Wooden floor, plastic cover of the floor [in case of the destruction of the present concrete floor], unforeseeable expenses for entering the equipment in Egypt [?], ...)

- For the security list:

there is a possibility that Eric Laval will have to be replaced by a physicist of the ECA; if such is the case, the latter will be: François-Philippe HOCQUET (specialist of XRF technology)

the specialist technician of ECA will be: Said RAKKAA

it is possible that the C2RM will send us a physicist for complementary colorimetric analysis (with specific portable device), on a Belgian - French funding (so out of the budget); if this happens, this physicist will be: Elsa VAN ELSLANDE