

TECHNICAL ANALYSIS REPORT

Conservation of the Northern Lobe of the Sanctuary. Study of the constitutive materials
and of the techniques employed for the realization of the different pictorial phases.

Laboratory tests carried out using non portable instruments.

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Conservation and Documentation of the Wall Paintings at the Red Monastery, Sohag

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Foreword

Investigation analyses have been carried out using non portable instrumentation on two samples collected in December 2004. In particular the samples have been analysed by infrared spectrophotometry (FT-IR: Infrared Spectrophotometer Fourier Transform) to study the binding mediums and the pigments of pictorial layers and of the fixative-protective agents.

The results of the analyses are set down in analytic sheets in which, for each sample, the necessary graphic documentation is reported.

In order to compare the results obtained by the analysis of the two samples, the same type of analysis has been carried out also on some of the samples collected during the first study campaign in November 2003. Of these samples, quite similar to the first two, only the spectrums are reported as the results of the analyses are exposed in the paragraph of the conclusive remarks.

Rome, 4th October 2005

Domenico Poggi

Materials and methods

All the samples, including some sub-millimetric scales of the analysed pictorial layers, have been accurately grounded with an agate mortar together with KBr

The material has been analysed in transmittance by DSR cell.

The interpretation of the FT-IR spectrum obtained by the analysis has been carried out by comparison with the laboratory data base and with the one reported by various scientific publications. In particular, assignment was made on the basis of the vibration frequencies, recorded under the same test conditions, of reference standards, either pure or mixed with specific matrixes (calcite, calcite and gypsum, etc.).

Sample n. 1



Sampling zone

High portion beneath the dome, from the “fresco” fragment representing a Saint.
Sample of millimetric dimensions comprehending rendering and pictorial film with yellow coloured external layer, collecting carried out by bistoury.



Stereomicroscope, reflected light, approx. 6.5 X enlargement

The two images represent respectively the superficial portion (on the left) and the internal one of the collected fragment. Along the border of the fragment it is possible to see the beige mortar (M), applied during the recent restoration.

In the image on the right is instead possible to observe some traces of a reddish pictorial layer (R) relative to the II pictorial phase, previous to the studied one pertaining to rendering and to the ochre yellow layer (Phase III).

In the following pages are exposed the results of the infrared spectrophotometric analysis (FT-IR).

Infrared spectrophotometric analysis (FT-IR)

Results

The study of the IR spectrum obtained by the analysis (see next page) has made it possible to define the sample as essentially composed by the following components (listed in order of relative abundance):

- jarosite and/or natro-jarosite;
- calcite (CaCO_3);
- calcium oxalate bihydrate (weddellite: $\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$);
- nitrates (NO_x);
- layered silicates (micas and/or clay minerals: calcium, sodium, potassium and other ions silicon aluminate hydrate);
- proteic substances referable to yolk;
- mineral silicates (i.e. quartz, feldspars).

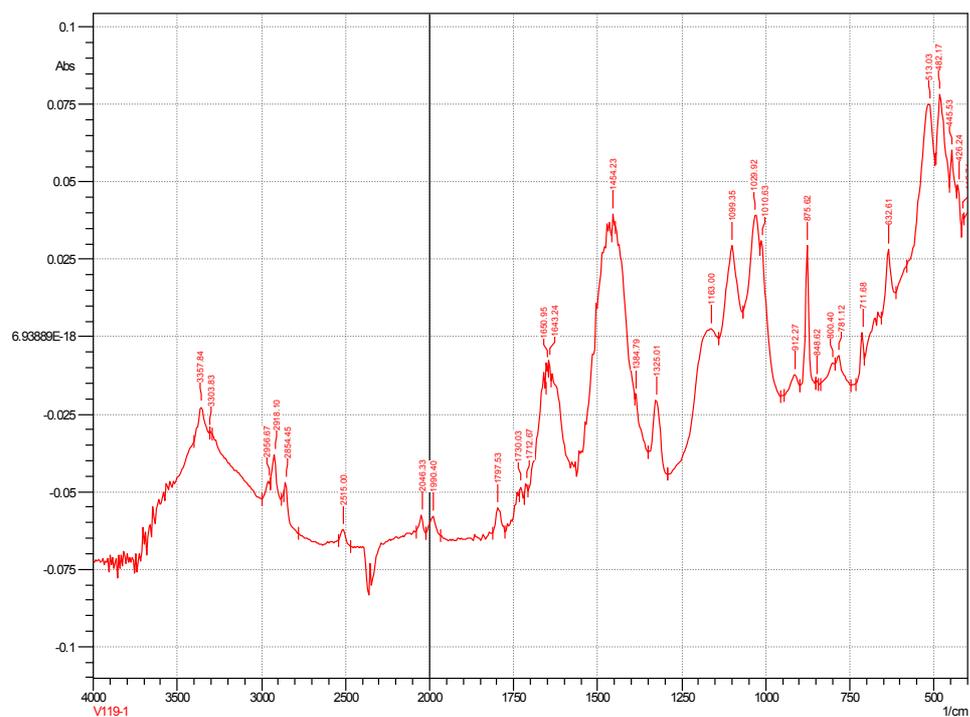
Remarks and interpretation of analytical results

Jarosite and/or natro-jarosite represent the yellow pigment used for the pictorial layer preparation. The layered silicates and the silicates are minerals associated with the “jarosite”, a natural substance obtained by the use of grounds relatively diffuse in Egypt. The calcite derives mainly from the white preparation layer, removed during the collecting together with the overlying yellow pictorial layer.

The yolk has been probably employed as binder of the pictorial layer.

The calcium oxalates are probably to be attributed to the mineralization of the pictorial layer binder.

The nitrates may derive from birds' faeces on the paintings.



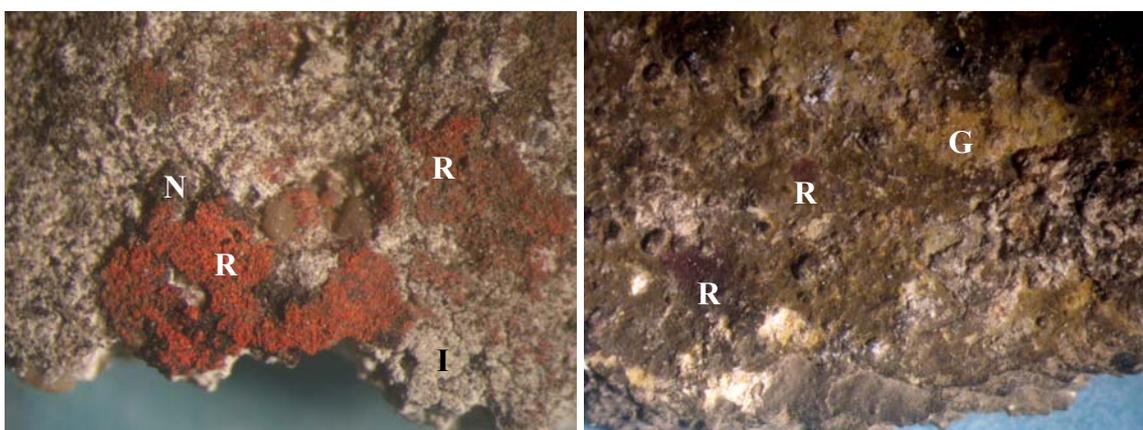
FT-IR spectrum

Sample n. 8



Sampling zone

East 'Dom', transept, II floor, second niche above the gazelle. Collecting carried out by bistoury. The sample consists of millimetric scales comprehending rendering and various overlapped pictorial layers.



Stereomicroscope, reflected light, respectively approx. 12 X and 7 X enlargement

The two images describe respectively a portion of the base of the collected fragment (on the left) and a part of its surface.

The image on the left shows small shreds of a red pictorial layer (R), at times surmounted by a blackish layer (N), which lie in contact with the rendering base (I).

The image on the right describes a part of the fragment surface. The yellow pictorial layer (G) is interested by some small circular stains of a red layer (R: squirts from above or a wanted effect?). Upon these layers is a slim brown level representing residues of gum arabic ⁽¹⁾, laid for protective purpose, mixed with fine carbonic particulate (lamp-black) produced by the church lighting systems.

In the following pages are reported the results of the infrared spectrophotometric analysis (FT-IR) carried out on dust collected from the upper pictorial film (photo on the right).

¹ The positive result of the test for the identification of polysaccharides, carried out on dust collected from the surface of the sample, attested the presence of gum arabic.

Infrared spectrophotometric analysis (FT-IR)

Results

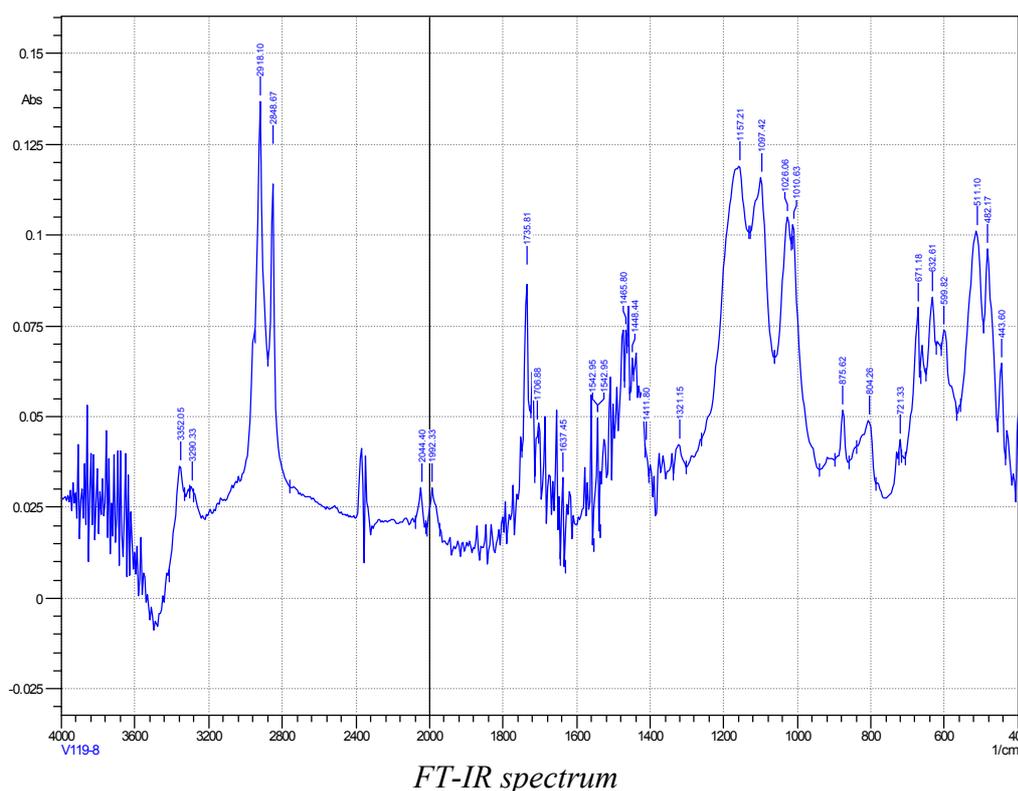
The study of the IR spectrum obtained by the analysis (see next page) has made it possible to define the sample as essentially composed by the following components (listed in order of relative abundance):

- beeswax;
- jarosite and/or natro-jarosite;
- calcite (CaCO_3);
- layered silicates (micas and/or clay minerals: calcium, sodium, potassium and other ions silicon aluminate hydrate);
- calcium oxalate bihydrate (weddellite: $\text{CaC}_2\text{CO}_4 \cdot 2\text{H}_2\text{O}$);

Remarks and interpretation of analytical results

This sample differs from the other essentially for the presence of beeswax. The microscopic inspection has in fact shown the presence, above the yellow pictorial layer, of some traces of a waxy layer which represent the residues of an encaustic layer, now almost completely eroded.

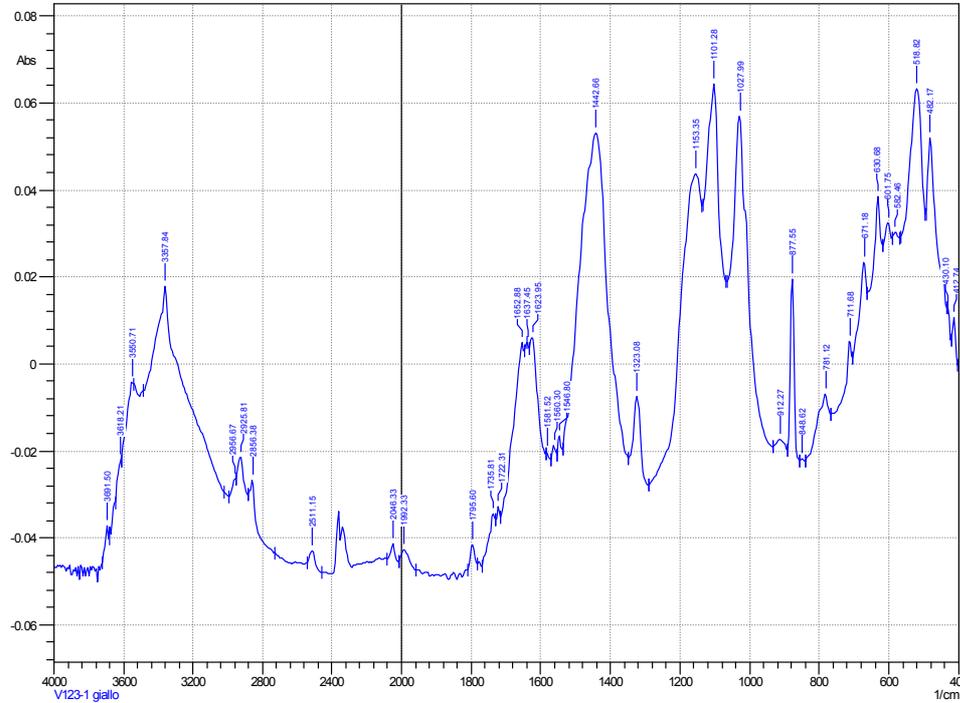
In this sample no effects referable to proteic substances have been noticed. Nevertheless it can't be asserted that these substances are absent. The strong interference of the beeswax absorption bands could in fact have totally covered the peaks of the proteic substances.



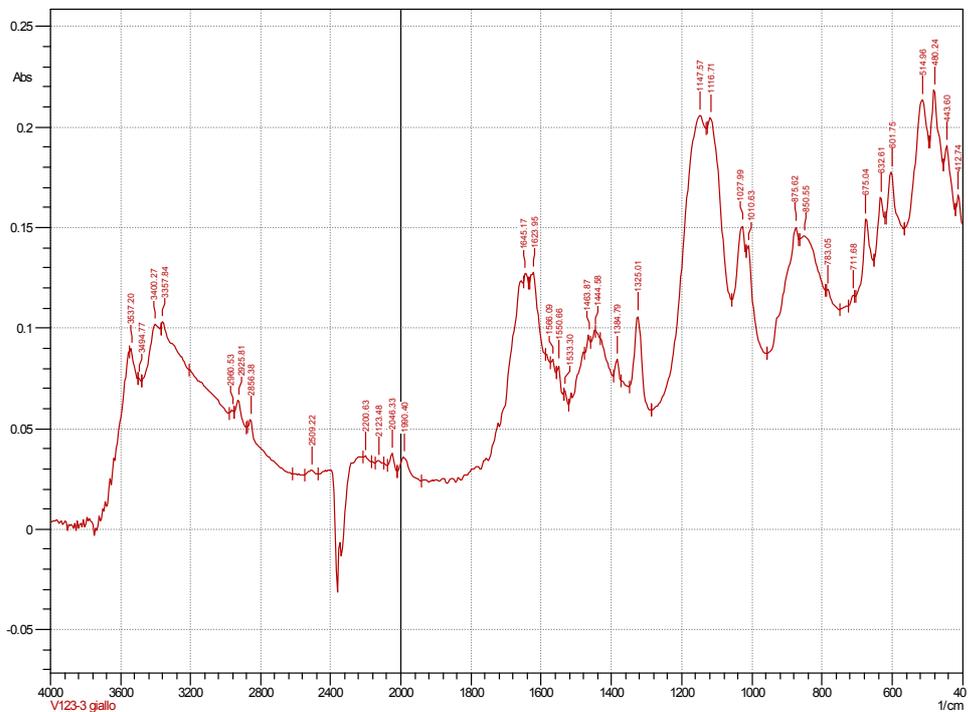
Nature of the yellow pigments present in pictorial layers of samples n. 1, 3 and 20 (report of February 2004)

The carrying out of transmitted light optical mineralogical analyses and of spectrophotometric analyses (FT-IR) has made it possible to establish that for the realization of the yellow colours minerals of the Alunite family were employed, in particular Jarosite [$\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$], Natro-jarosite [$\text{NaFe}_3(\text{SO}_4)_2(\text{OH})_6$], and mixtures of them. These are calcium sulphates of natural origin, quite common in Egypt and for this reason employed as pigments since the pharaonic ages (see the bibliography section). Following are the FT-IR spectrums of the samples.

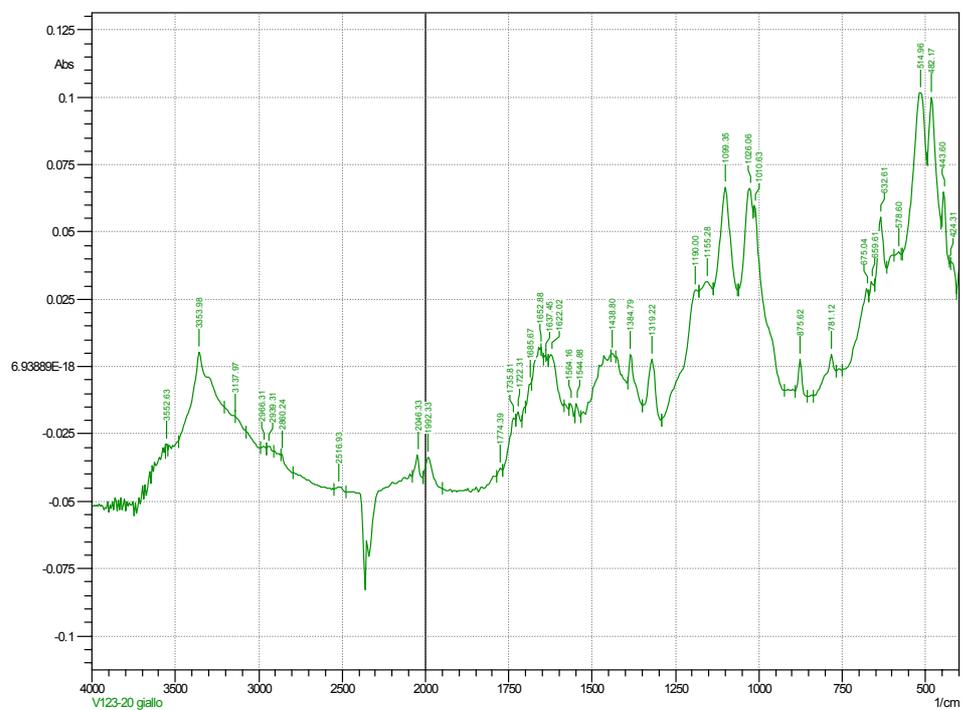
FT-IR spectra of samples collected in November 2003



Sample n. 1, yellow coloured pictorial layer relative to the III pictorial phase.



Sample n. 3, yellow coloured pictorial layer relative to the III pictorial phase.



Sample n. 20, yellow coloured pictorial layer relative to the III pictorial phase.