



Sculptures
Paintings
Wall Paints

Sampling Method



Smithsonian
Museum Conservation Institute

Introduction

The Smithsonian Center for Materials Research and Education (SCMRE) in Washington, D.C., under the project *Imaginería de Las Californias* has designed a simple sampling method for artwork and decorative painting surfaces. SCMRE wishes to provide this information to institutions and professionals that are conducting conservation and technical studies.

The *Imaginería de Las Californias* project focuses on, among other things, *imaginería* (painted wooden sculptures) from the Northern Spanish Frontier of New Spain, today the northern states of Mexico and the southwest United States. Because of the large number of samples needed, it was necessary to establish a process that permitted registration of sampling in a very clear and simple way.

Technical studies of the sculpture's source materials and production techniques, in combination with art historical research, are performed to learn more about the *imaginería* and their origin. Even so, to establish this origin, it is critical to corroborate the data collected directly from the sculpture with the historical documentation that can be obtained from the mission or temple where the sculptures currently are, as well as general historical investigation of the study area.

During a period of two years more than 1300 samples from 92 decorative sculptures, 10 moveable church artwork and 8 mission churches with mural painting were collected. The sample methods used by SCMRE are suitable for large numbers of samples taken and have been satisfactory to the demands of various specialists involved in the study and interpretation of the analyses.

SCMRE is one of the few laboratories in the world that has the technology to analyze and identify any kind of organic or inorganic component from artworks or artifacts to be studied. The technology used regularly are:



Figure 1.
SCMRE specialist examine samples on the optical microscope



Figure 2.
Optical Microscopy view of a wall paint cross section.

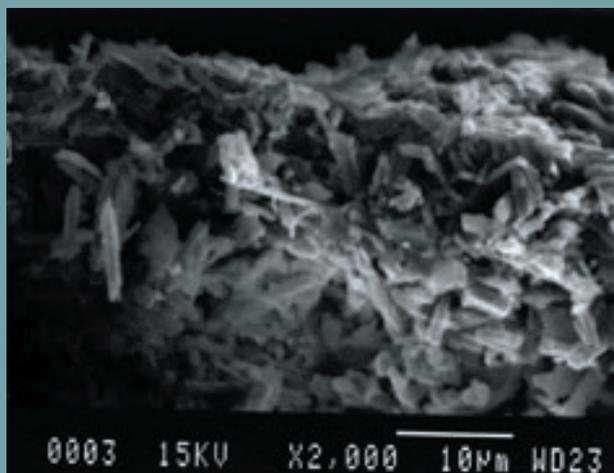


Figure 3.
Through SEM-EDS Image the internal structure of the material of study can be seen.



Figure 4.
The specialist is reading the negative obtained by X-ray diffraction.

Optical Microscopy

Provides unique information about the objects structure and state of preservation and its component materials not possible with high-tech instrumentation.

GC-MS • gas chromatography with mass spectrometry

Provides definitive analysis and identification of components in complex mixtures of organic materials, such as paint binders.

XRD • X-ray diffraction

Uses very small samples to identify crystalline materials. solids in which the molecules are arranged in a regular repetitive structure, such as minerals, corrosion products, or most traditional pigments • It is less useful for “amorphous” materials, in which the molecules are arranged more or less randomly, such as glass, rubber, and most plastics

SEM-EDS scanning electron microscopy with energy dispersive X-ray spectroscopy

Magnifies samples up to 100,000 times • through an attachment, analyzes the chemical elements of a sample • can help to identify pigments in cross-sections of paint layers • can map location of elements

FTIR • fourier transform infrared spectroscopy

Used to identify organic (and in some cases inorganic) materials. This technique measures the absorption of various infrared light wavelengths by the material of interest. These infrared absorption bands identify specific molecular components and structures.

Visual Study of the Artwork

Before taking a sample, it is important to conduct a visual examination and assess the condition of the artwork. The following sections present four steps that are essential for carrying out a high-quality visual study.

I. Photographic Documentation

Photographic documentation of the artwork consists of making a specific series of general photographs and detailed photographs that can distinguish visually between one artistic work and another. It is recommended to use a fabric of neutral color such as gray for a background. This establishes homogeneity with all the objects that comprise of the study and to catch the original colors correctly. For each photograph taken, a color chart and the title and catalogue number of the artifact should be placed next to the object. (see figure 5)



Figure 5. Example of the photographic documentation of a sculpture. Photographs were taken utilizing a gray fabric as background, in order to maintain consistent background and to avoid elements that can disrupt the silhouette. A color scale is placed near the sculpture, along with the title of the sculpture or object and the catalogue number.

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San Jerónimo de Huejotitán, Chihuahua, México



An object is considered fully documented when all sides, different angles and significant details are photographed. Significant details might help to establish a relation between studied works. Examples of these details are eyes, ears, hair, design used to decorate the clothing, or any distinguishing element that can help to establish similarities found between the sculptures and base. These elements can also relate to the results of the chemical and technical analyses of the materials. These potential chemical and structural relationships can identify the possible place or workshop of origin. (see figure 6)

The photographic record presented on the forms helps to maintain a control of each one of the photographs and creates a photographic system in all studied works. (see formats 1 and 2).

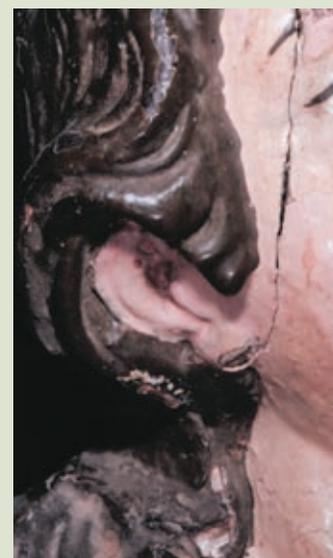


Figure 6.

These pictures are details of the sculpture in figure 5. From left to right, one can distinguish: the face of the Virgin, the face of the central angel, and the right ear of the virgin. Pictures of these details allows establishment of parameters to compare studied works.

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2. Condition Assessment Report



Figure 7.

These pictures are details of the Inmaculada Concepción (Immaculate Conception) sculpture. The separation of the wood sections (separate components of the original,) can be seen, these have separated because of temperature and humidity changes over the years. The photo on right shows the original design in gold leaf under the blue overpaint.

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SCMRE designed a condition assessment report in a simple format in order to obtain the major information from the sculptures. (See format 1)

In the report, deterioration causes are registered and the materials are initially observed. This information orients the specialist when processing the samples for different technical studies. This section also includes a complete description of the work and basic iconographic study. The accomplishment of the description and the iconographic analysis allows establishment of differences and similarities between two sculptures or paintings that share the same subject. The iconography study helps identify special characteristics in the objects compared to traditional representation of the subject. Some of these representations change by region or by time period.

3. Treatment Proposal

Formulating a treatment proposal is not required for a sampling process. Nevertheless, establishing one can help to prioritize the actions necessary for the object's conservation. In addition, the results obtained by chemical and technical analyses of the materials will be those that determine an accurate process of conservation. Unfortunately, these studies are expensive so the conservator rarely requests analysis before they undertake a treatment to an artwork.

The format designed by SCMRE lists treatments that can be used in the conservation of a painting or sculpture depending on its state of preservation (See format 3)



Figure 8. View of the wall paint located at the upper frieze of the Santa María de Cuevas Mission nave. The water leaking of from the roof has caused the loss of large sections of adobe and decorative surface. Fortunately, recent water-proofing treatment has been done on the roof, and there is no more leaking. However the section of this frieze is about to collapse.

M-CH 022-014.PNC Santa María de Cuevas,
Dr. Belisario Domínguez, Chihuahua, México

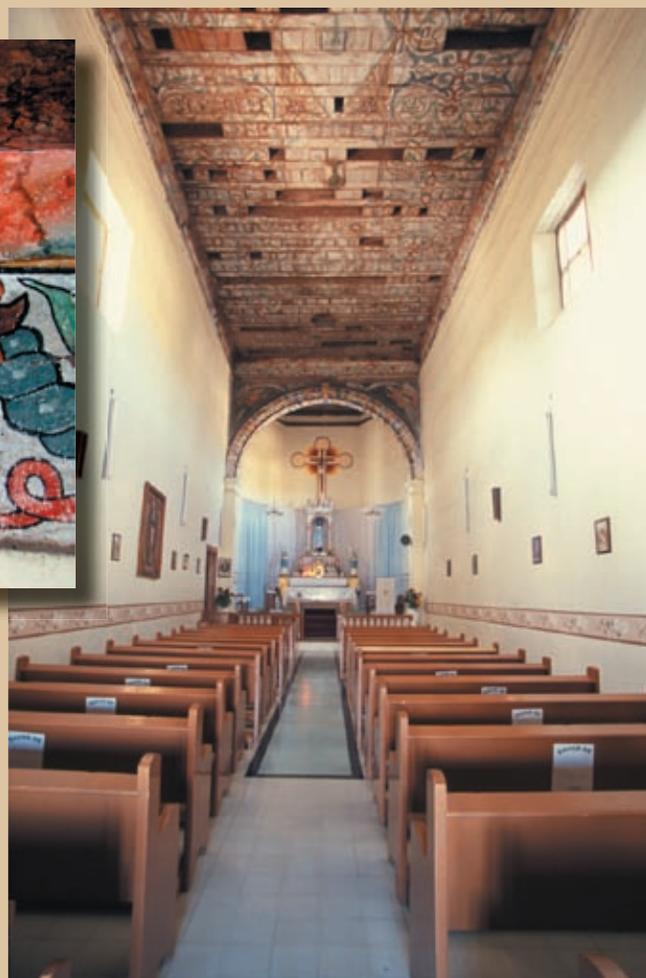


Figure 9. Santa María de Cuevas mission nave. Studies of the wall paint on this church have determined that there is original wall paint under several layers applied over the centuries. This is a unique ceiling because of its construction system and paint technique.

Santa María de Cuevas, Dr. Belisario Domínguez
Chihuahua, México

4. Identification of Sampling Areas

According to the questions the researcher is asking or what the primary target of the research projects, it is best to first identify the areas that are representative of the artwork. Significant elements or characteristics of the artwork need to be recognized as well. The composition of the artwork and the iconography are key elements that can identify these significant elements.

For example, two sculptures with the subject of San José (Saint Joseph) would be studied. It is recommended to remove samples from the mantle and the tunic, green and ochre are the traditional colors of San José's vestments. If both have the same colors, the similarities and differences of technique can be determined through cross sections analyzed with Electron Microscopy. This will also be true if the two representations of San José do not have the same mantel color.

The relationships with other visual characteristics can help obtain valuable information. Perhaps the sculpture was overpainted at some point in time, or is from other region or period of time. An example of a changes will be the color that San Antonio of Padua (Saint Anthony of Padua) is represented. Over the centuries In Europe San Antonio's Franciscan vestment was light brown, such as San Francisco of Asis (Saint Francis of Asis) vestment was. In America at the end of the 18th century, San Antonio was represented with a light blue Franciscan vestment.

The number of samples can be varied; it will depend on the complexity and dimension of the object or decorative wall painting area. It is also possible to find different techniques or materials in diverse areas of an object or in a wall painting decoration. In the case of decorative wall painting in a church, the technique used on the narthex might not be the same used on the sacristy, even if they visually follow the same characteristics. Is also possible to find varous techniques from one foot to another at the skirt section of a church nave. How can one tiny sample can provide the whole story of the decoration of a church? The reading for the building decoration could fail if the spot chosen it is not representative of the whole decoration of the church. For these reasons, it is important to understand the object and the wall paintings before sampling.

Depending on the type of technical analysis that will be used to identify organic compositions or inorganic elements, samples can be chosen for the purpose of these techniques. For example, it is only necessarily extract ground and paint layers to identify the binder used. In order to obtain accurate information of these techniques it is recommended to process between five to eight samples including each color present on the object or decorative surface.



Figure 10.
Detail of Inmaculada (Immaculate) sculpture tunic, showing the original paint and gold leaf design beneath the overpaint. Since the purpose of the Imaginería de las Californias project is to define the origin of this sculpture, samples were taking only from areas where original paint was found. It is not important for the project to obtain samples of the overpaint layers to complete the "history" of the sculpture.

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México



Figure 11.
Test "window" made at the upper level of the nave of Santa Maria de Cuevas Mission. The study was made to determine the presence of original wall paint under more than seven layers of lime wash and vinyl paint. This permitted a better understanding of the decorative surface of this church and as a consequence, helped to determine the areas that needed to be sampled.

M-CH 022-014 Santa María de Cuevas Mission
Dr. Belisario Domínguez, Chihuahua, Mexico



Figure 12.
Photograph of the sculpture representing San Miguel Arcángel (Saint Michael Archangel). General photo showing the location of samples after samples where taken.

M-CH 033-001.E11 San Miguel Arcángel
San Jerónimo de Huejotitán, Chihuahua, México

Sampling

The number of samples to take, the determination of the appropriate area to sample and the type of sample that should be taken, will be determined by the purpose of the sampling. This is if is for research or conservation purposes. For example if the purpose for taking samples is to establish a conservation treatment, the deal sample will be the one that contains all the layers found: wood, ground, paint-layers and coating such as varnish.

Wood samples need to be at least 5 x 5 x 5 millimeters thick and need to come from an area that has not been infected by insects or fungii.

1. Digital photo general view front and back of the sculpture or painting. In case of a wall paint a photo of the general area where the sampling will take place is needed.
2. Printing of the above photograph. This photo serves as a graphic documentation of the exact area where the sample was taken. This print is an important backup, in case of lost computer data. (See figures 14 and 15)
3. Extraction of the paint, preparation or wood, which was collected in special containers.
4. Registration of the sample in the container, registrations preadsheet and printed photograph, in which the number, sampled material and all information necessary was annotated. This allows the microscopy specialist to determine the position and location of the sample.
5. Placement of a dated post-it arrow with the number of the catalogue pointing towards the tested area. (See figure 17). The post-it arrow are 8 mm wide which gives a useful scale in all images.
6. Digital photo of the area of sampling, with the post-it arrow. This permits registration of the sample number in the area of subtraction.

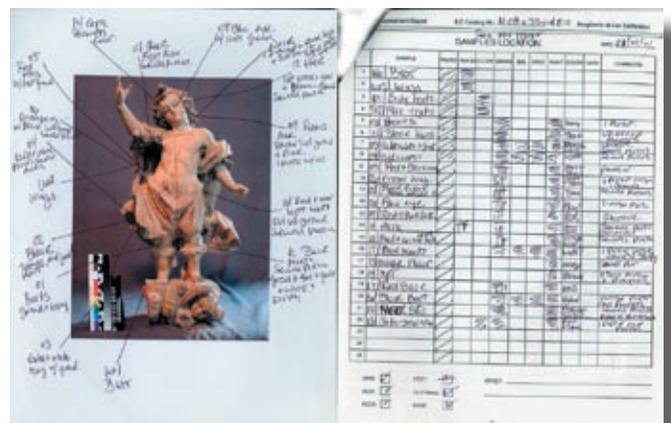


Figure 13.
Gilded sculpture of San José during sampling.

NMAH. Eor San José
Smithsonian National Museum of American History
Washington, D.C.

Figures 12, 13, 14 , 15 and 17 give examples of how sample locations can be documented.

Figure 14.
San Miguel Arcángel Sampling field documentation.
Example of the print used to document the location where the samples were taken and the sampling form where the material that was collected is described



M-CH 033-001.E11 San Miguel Arcángel
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Figure 15. General view of the Inmaculata sculpture. These photos were used as a graphic documentation showing the exact area where samples were taken.

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Documentation and Archival Storage

All photographic documents, such as overall photographs of the artifacts, photographs of the sample locations, cross-sections and SEM analysis should be processed with a digital asset management system such as Extensis Portfolio. All additional information derived from observations and analysis should be processed with something like Microsoft ACCESS. This set-up allows searching all data by keywords, making it easier to determine characteristics and comparable features of the artifacts. All data is also archived on an external hard drive.



Figure 16.
Sample archive. Paint, textile fibers, and wood samples of from each object are organized in individual boxes, and accompanied by sampling notes and microscopy file.

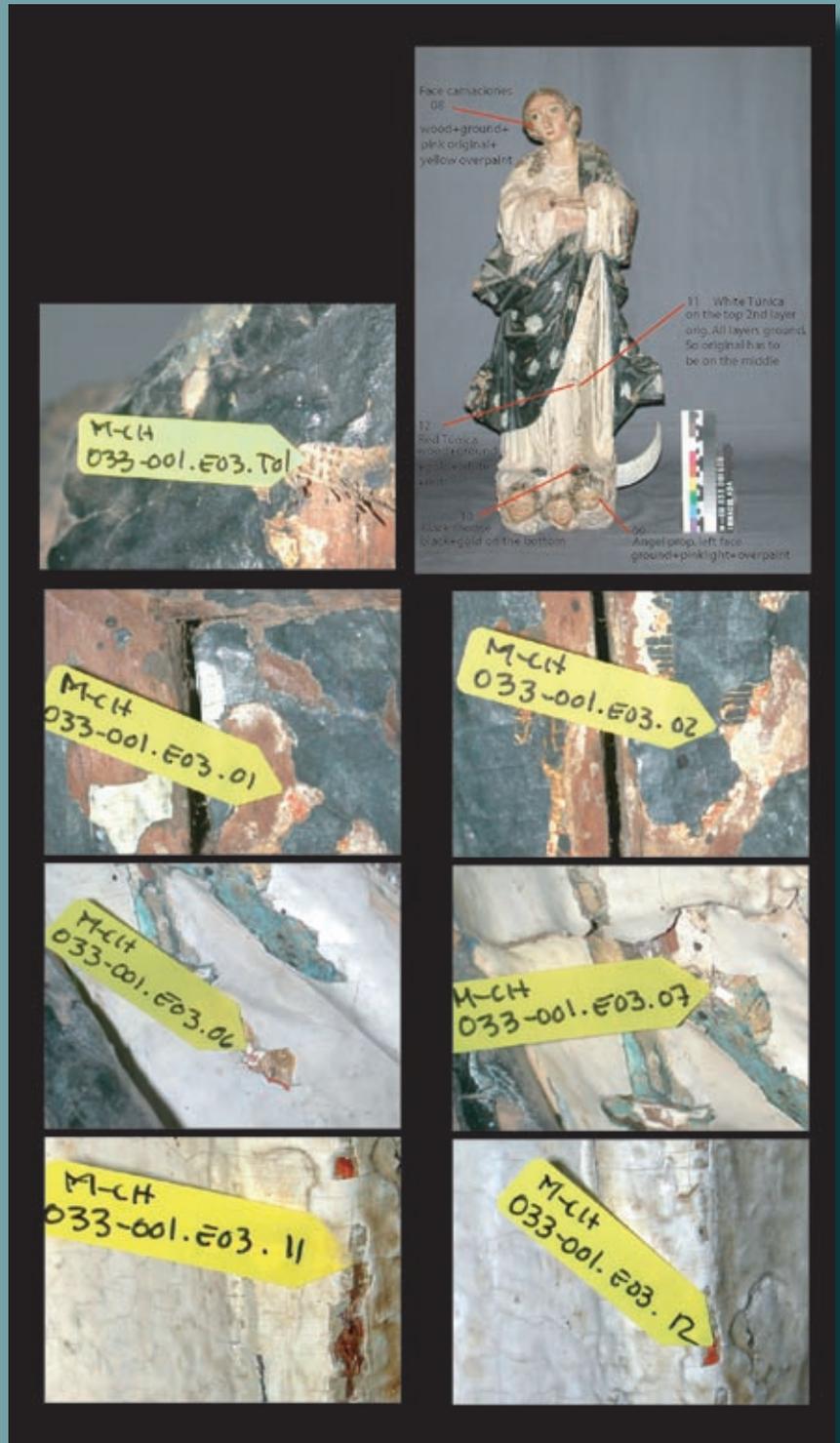


Figure 17.

General view and details of the Inmaculata sculpture sample locations. These photos were organized in Adobe Illustrator to obtain a graphic documentation showing the exact area where samples were extracted. This permits microscopy experts to understand the position of the sample before embedding.

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Equipment and Material for Sampling

Registry and documentation

Paper forms to capture information (annexed to this bulletin)

Portable printer

Laptop Computer

Blank CDs for photo recording

Permanent Marker

Digital camera

Sampling

Alltech Glass 12 xs 32s

Post-it Arrows

Scalpel handles No.5 and No.3

Scalpel blades 15"

Magnification loupe

Small paper yellow envelopes for wood samples

Material for on-site conservation

Stucco

Spatulas

Rabbit skin glue

Gelatin

Watercolors

Brushes

Optional equipment

Stable portable table

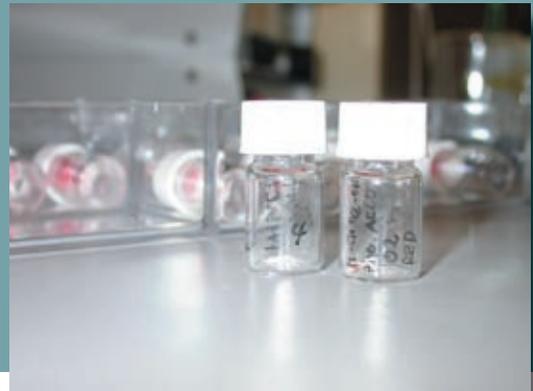
Scaffold

Ladders

Light or lamp



Figure 18. Alltech Glass 12 x 32 and scalpels



Conclusions

The sampling process presented in this document is the result of exhaustive fieldwork and also based on the experience gained during the Imagineria de Las Californias project. The need to respond the demands of the experts involved in the technical analysis helped design this sampling method as well.

SCMRE has identified this sampling method as the most suitable, however, researchers and conservators from institutions in different parts of the world have their own techniques that can respond to their needs and preferences. We hope that this could provide a basic guideline and can be adapted to the needs of a good sampling process.

Information about embedding paint and varnish samples for microscopy can be found at the Journal of the American Institute for Conservation fall/winter 2004, volume 43, number 3 page 205-226

Article name: [Efficient New Methods for Embedding Paint and Varnish Samples for Microscopy](#) by Melvin J. Wachowiak JR.

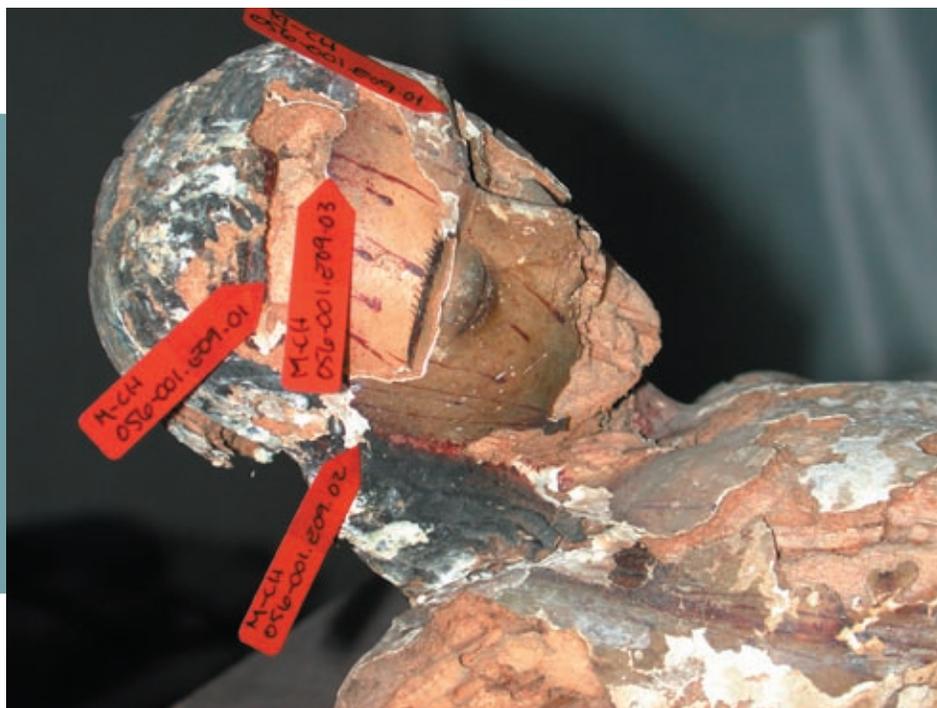


Figure 19
Photograph of a late 17th century Crucifijo showing samples location

M-CH 033-001.E09 Crucifijo
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Sculptures
Paintings
Wall Paints

Sampling Method

For further information contact

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&
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Forms



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Sculptures



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Condition Assessment Report

SCULPTURES

Date _____

GENERAL DATA

Project Name: _____

Theme _____

Author _____

Owner/ Mission _____

Dimensions _____ Catalog No. _____

Inscriptions _____

Location _____ Period _____

DESCRIPTION _____

Eyes _____ Ears _____ Nose _____

Hair _____ Hands _____ Chin _____

Feet _____ Base _____ Face hair _____

INTERVENTIONS

Overpaint

Oil Temple Colors _____

Tempera Gold Paint No. Layers _____ Interventions Records

Members replaced _____

Location _____

Observations _____

SUPPORT

Hard wood Soft wood Other plant _____ Insect attack

Canvas Cracks

Location _____ Location _____

Adhesion _____ Dimensions _____

No. Members Lost _____

Location _____

Observations _____

GROUND

Thin Thick

Cohesion _____

Adhesion to support _____

Cracks

Location of losses _____

Location _____

Dimensions _____

Observations

PAINT

Technique _____

Cohesion _____

Oil Temple Gold Leaf

Tempera Gold Paint

Adhesion to ground _____

Location of losses _____

Cracks

Location _____

Dimensions _____

Observations

COATING

Natural Resin Wax Oil Other

Oxidation _____

Appearance _____

Observations

DOCUMENTATION

Site Photo Studio Photo Video

35 mm slide Digital Photo 35 mm Color print

Photo Studio Documentation

Date _____

Film _____

ASSA _____

Film No. _____

Photo No. (at start) _____

Photo No. (at finish) _____

Front

Right

Back

Left

3/4 L

3/4 R

Face

Ears

Hands

Feet

Clothing details

Unusual detail

Clothing design

Comments _____



PROPOSED TREATMENT

Fumigation Treatment _____

Isolated Layer Type _____

Consolidation Treatment _____

Replacement Of Members Treatment _____

Cleaning Treatment _____

Filling Ground Losses Treatment _____

Isolated Layer Type _____

Reintegration Treatment _____

Coating Protection Type _____



SAMPLES LOCATION

DATE _____

	SAMPLE	PHOTO	WOOD	CLOTH	GRUND.	BOL	GOLD	PAINT	COLOR	VARN.	COMMENTS
1		D F									
2		D F									
3		D F									
4		D F									
5		D F									
6		D F									
7		D F									
8		D F									
9		D F									
10		D F									
11		D F									
12		D F									
13		D F									
14		D F									
15		D F									
16		D F									
17		D F									
18		D F									
19		D F									
20		D F									

HAIR

FEET

OTHER _____

FACE

CLOTHING

NECK

BASE



Paintings



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GROUND

Thin Thick

Cracks

Adhesion to support _____

Cohesion _____

Location of losses _____

Observations _____

PAINT

Technique _____

Cohesion _____

Oil Temple Gold Leaf

Adhesion to ground _____

Tempera Gold Paint

Location of losses _____

Cracks

Observations _____

COATING

Natural Resin Wax Oil Other

Oxidation _____

Appearance _____

Observations _____

SAMPLES LOCATION

DATE _____

	SAMPLE	PHOTO	WOOD	CLOTH	GRUND.	BOL	GOLD	PAINT	COLOR	VARN.	COMMENTS
1		D F									
2		D F									
3		D F									
4		D F									
5		D F									
6		D F									
7		D F									
8		D F									
9		D F									
10		D F									
11		D F									
12		D F									
13		D F									
14		D F									
15		D F									
16		D F									
17		D F									
18		D F									
19		D F									
20		D F									

HAIR

FEET

OTHER _____

FACE

CLOTHING

NECK

BASE



Wall Paints



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DECORATIVE SURFACES

Date _____

GENERAL DATA

Project Name: _____

Theme / Subject _____

Author / Artist _____

Site Name _____

Construction Period _____ Site Catalog No. _____

Inscriptions _____

Location _____

DESCRIPTION _____

Decorative surface location

North wall

West wall

South wall

Celing

East wall

INTERVENTIONS

Overpaint

Oil Tempera Colors _____

Matt Paint Gold Paint No. Layers _____ Interventions Records

Strappo **Stracco** _____

Observations _____

SUPPORT

Wall

Stone Adobe Mix Stone -Adobe Wood Brick

Structure stabilization _____ **Cracks**

Localization of losses _____ Location _____

_____ Dimensions _____

Observations _____

GROUND

Arriccio

Thin Thick

Adhesion to support _____

Location of losses _____

Cohesion _____

Cracks

Location _____

Dimensions _____

Observations _____

Intonaco

Thin Thick

Adhesion to support _____

Location of losses _____

Cohesion _____

Cracks

Location _____

Dimensions _____

Observations _____

PAINT

Technique _____

Oil Temple Gold Leaf

Matte Paint Gold Paint

Location of losses _____

Cohesion _____

Adhesion to ground _____

Cracks

Location _____

Dimensions _____

Observations _____

COATING

Natural Resin Wax Oil Other Oxidation _____

Appearance _____

Observations _____

DOCUMENTATION

Site Photo Studio Photo Video

35 mm slide Digital Photo 35 mm Color print

Comments _____

PROPOSED TREATMENT

Superficial Support cleaning

Treatment _____

Paint Layer protection

Type _____

Support consolidation

Treatment _____

Uncovering test

Treatment _____

Cleaning

Treatment _____

Filling Intonaco Losses

Treatment _____

Paint Layer consolidation

Type _____

Reintegration

Treatment _____

Coating Protection

Type _____

SAMPLES LOCATION

	SAMPLE	PHOTO	SUPPORT ARECCIO	INTONACO	BOL OR IMPRIMATURA	GOLD	PAINT	COLOR	COATING VARN.	COMMENTS
1		D F								
2		D F								
3		D F								
4		D F								
5		D F								
6		D F								
7		D F								
8		D F								
9		D F								
10		D F								
11		D F								
12		D F								
13		D F								
14		D F								
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