INTERNATIONAL JOURNAL OF CONSERVATION SCIENCE
ISSN: 2067-533X Volume 7, Special Issue 2, 2016: 857-870 www.ijcs.uaic.ro

# CHARACTERISATION OF THE STUCCO DECORATIONS AT THE "SACRO MONTE DI OSSUCCIO" (16$^{TH}$-17$^{TH}$ CENTURY), COMO, ITALY

Marta CAROSELLI[1*]*, Giovanni CAVALLO[1,2], Alberto FELICI[1], Lucia ALIVERTI[1], Stefania LUPPICHINI[1], Giacinta JEAN[1], Giovanni NICOLI[1]

[1]Institute of Materials and Construction, University of Applied Sciences and Arts of Southern Switzerland, Canobbio, (Switzerland)
[2] Dept. of Earth and Environmental Sciences, University of Pavia, (Italy)

***Abstract***

*The "Sacro Monte di Ossuccio" (Como) was listed in the UNESCO World Heritage sites in 2003. The main Sanctuary was built from 1537 and consecrated in 1699. The nave is adorned with stucco attributed to Giovanni Battista Muttoni, while documentary evidence indicates that the stucco work of the inner façade was made by Agostino Silva (1628-1706). This study is part of a project that investigates the executive techniques of the plasterers from Ticino integrating the results of archival research, artistic practice and scientific investigations. In particular, the scientific investigations on 15 stucco samples have included Polarized Light Microscopy (PLM), Scanning Electron Microscope coupled with microanalysis (SEM-EDS) and Infrared Spectroscopy (FTIR). The stuccoes of the Sanctuary are characterised by different executive techniques and different types of mortar mixtures: in the stuccoes attributed to Muttoni, in most cases a thick (1-1,5 cm) finishing layer made of Mg-rich lime and calcite crystals can be observed, while in others a very thin one (200 micron) composed of a weakly hydraulic lime, without aggregates. In the composition of the angels done by Agostino Silva there is gypsum, added in the* arriccio *layer and present in traces in the finishing one.*

**Keywords:** *Stucco decoration; PLM; Artistic technique; Scientific analysis; Agostino Silva.*

## Introduction

This paper investigates the techniques and materials for the making of the stucco works in the main Sanctuary of the "Sacro Monte di Ossuccio". In particular, the remarkable stucco decorations in the inner nave of the Sanctuary can be ascribed to two different masters of similar geographical origin but belonging to two distinct periods. The stuccoes of the vault and the triumphal arch (Fig. 1A), dated to the second half of the seventeenth century [1] are attributed to Giovanni Battista Muttoni (1631-1675). Agostino Silva (1628-1706) is the author of the stucco decorations of the cartouche and of the angels of the inner façade, added around the year 1699 (Fig. 1B). Documentary traces of this intervention have been preserved, while the attribution to Muttoni is the result of a stylistic hypothesis [2].

* Corresponding author: marta.caroselli@supsi.ch

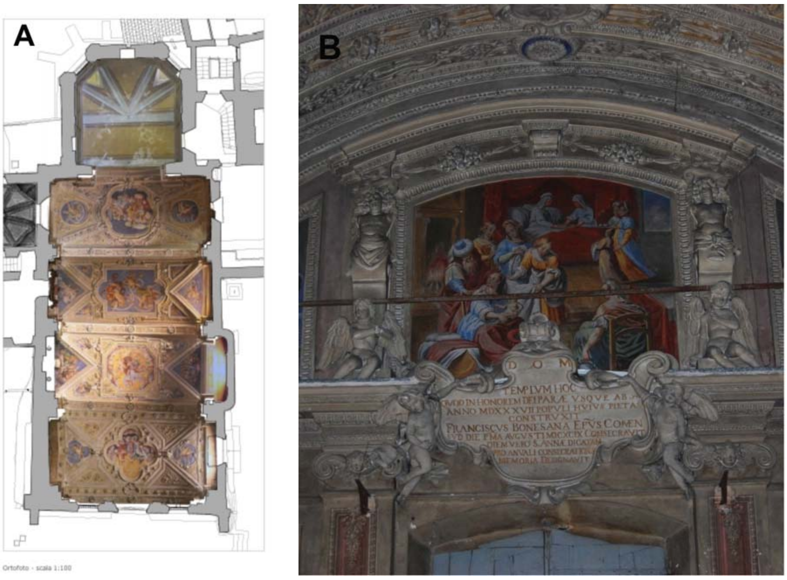


**Fig. 1.** The vault of the Sanctuary of Ossuccio, with stucco reliefs attributed to Muttoni: A) Digital image rectification - Image courtesy of Arch. Roberto Segattini; B) Stucco of the inner façade made by Agostino Silva.

The purpose of this study was to verify whether these two artists used a common *modus operandi* for the production of similar stucco elements. The availability of ready scaffolding, due to recent restoration works[1], has enabled detailed observation at a short distance, and the selection of small samples for scientific investigation. This multidisciplinary approach can lead to a better understanding of stucco decoration, placing this art in a wider cultural framework. Furthermore, the integration of the historical-artistic considerations with new scientific data could help to demonstrate the existence of "schools" and to eventually verify attributions and dating [3].

This research is part of a three-year project that sets out to study the executive techniques of the plasterers from Ticino in their homeland, in the sixteenth and the seventeenth centuries. These workers must have had special skills that contributed to spread their fame on an international level. Most of these artists would leave their region for foreign commissions during spring and summer, returning home in the winter, where they worked on the decoration of local buildings [4].

### *The "Sacro Monte di Ossuccio" and the "Madonna del Soccorso Sanctuary"*

The complex of the "Sacro Monte di Ossuccio", located on the west side of Lake Como, is one of the nine "Sacred Mountains" listed in the UNESCO World Heritage sites since 2003. It is in a panoramic position, 419 meters above the sea level, with 14 chapels built from 1635 to the end of the century. The chapels, representing the "Mysteries of the Rosary", are decorated with about 230 life-sized statues in stucco and terracotta, as if they were actors of a sacred representation. The polychrome statues inside these chapels were created by Francesco and Agostino Silva [5-7], while the interior walls were frescoed by Giovan Paolo Recchi, Francesco Torriani and Carlo Gaffuri [8].

The Sanctuary "Madonna del Soccorso", dedicated to the Assumption of the Virgin, is the fifteenth and last stage of the devotional path and the first phase of the construction of the "Sacro Monte di Ossuccio". The Sanctuary was built in medieval times to celebrate a miracle: a popular tradition indicates its site as the place where the miracle occurred. A deaf-mute girl was

[1] Restoration works by CRD restorers (Lazzate, MB, Italy), completed in June 2016.

miraculously healed after finding an antique statue of the Virgin Mary. The white marble statue is still preserved in a votive chapel annexed to the Sanctuary. The Sanctuary was transformed in its present forms starting in 1537, and was later decorated in the 17$^{th}$ century with stuccoes and fresco paintings by Salvatore Pozzi [1]. Finally, it was consecrated in 1699 [9], as reported on the epigraph above the door of the inner façade. In the seventeen century, the Franciscan friar Lorenzo Selenato transformed the Ossuccio Sanctuary in a true Sacred Mountain, starting the construction of the first three chapels [10].

## Experimental

The methodology adopted for this research has integrated the results obtained in different but complementary fields: archival research, artistic practice and scientific investigations on materials. In particular, the scientific investigations on 15 stucco samples have examined their mineralogical characterisation by Polarized Light Microscopy (PLM) and Scanning Electron Microscope coupled with microanalysis (SEM-EDS). Infrared Spectroscopy (FTIR) was also used to investigate the presence of other detectable compounds in the stuccoes.

Conservator-restorers conducted a meticulous visual investigation by examining the executive techniques in detail. In fact, the visual observation is a key focus of this research aimed at understanding how the use of different compositional layers, the signs of the working tools and the internal structure (reinforcement, supporting elements), contribute to characterise the style of these artists.

**Fig. 2.** Angel in the left altar of the nave. The author of this statue is not documented but from a stylistic point of view it can be attributed to Agostino Silva. The sample ST-OS 15 has been taken from the back of the right arm.

Moreover, these preliminary investigations were fundamental to select the areas for the collection of representative samples. In order to find differences and similarities between the two artists, the samples have been gathered from the vault (attributed to Muttoni) and from the decorations by Silva, as shown in Table 1. The last sample (ST-OS 15) was taken from the angel in the left altar of the nave, for which no archival documentation exists, though from a stylistic point of view it can be attributed to Silva (Fig. 2).

**Table 1.** List of samples.

| Sample Id. | Architectural element | Layer | Author | Analyses |
|---|---|---|---|---|
| ST-OS 01 | Fruit composition, vault | Finishing + ground | Muttoni, attr. | PLM, FTIR, SEM-EDS |
| ST-OS 02 | Leaf of the capital, vault | Finishing + ground | Muttoni, attr. | PLM, FTIR, SEM-EDS |
| ST-OS 03 | Leaf of the frame, vault | Finishing | Muttoni, attr. | PLM |
| ST-OS 04 | Leaf of decoration, vault | Finishing | Muttoni, attr. | PLM |
| ST-OS 05 | Decorated frame, vault | Finishing + ground | Muttoni, attr. | PLM |
| ST-OS 06 | Round element of frame, vault | Finishing | Muttoni, attr. | PLM |
| ST-OS 07 | Frame | Ground | Muttoni, attr. | PLM |
| ST-OS 08 | Triumphal arch | Ground | Muttoni, attr. | PLM |
| ST-OS 09 | Triumphal arch | Ground | Muttoni, attr. | PLM |
| ST-OS 10 | Cartouche, inner façade | Finishing | A. Silva | PLM, FTIR, SEM-EDS |
| ST-OS 11 | Cartouche, inner façade | Finishing + ground | A. Silva | PLM |
| ST-OS 12 | Hair of the right angel, inner façade | Finishing | A. Silva | PLM |
| ST-OS 13 | Angel wing, inner façade | Finishing + ground | A. Silva | PLM |
| ST-OS 14 | Head of the angel, inner façade | Ground | A. Silva | PLM, FTIR |
| ST-OS 15 | Body of the angel, nave | Finishing | Unknown | PLM, FTIR, SEM-EDS |

### *Analytical methods*

The samples of stuccoes were embedded in epoxy resin and thin sections were prepared according to LOGITECH standard procedures [11]. The analysis of the components of the stucco (binder and aggregates) in their stratigraphic sequence was carried out by Polarizing Light Microscopy (PLM) both in incident and transmitted light. A Zeiss Axioskop 40 microscope was used coupled with a digital camera. Each sample was described according to UNI EN 11176: 2006 [12]. Scanning electron microscopy (SEM) investigations of polished thin sections were carried out by a JEOL 6010LA microscope, equipped with an EDS (Energy Dispersive X-ray Spectrometer). Images were acquired in backscattered mode (BSE) and EDS qualitative spectra were collected at 15keV for 120s, with a working distance of 11mm.

Infrared Spectroscopy (ATR-FTIR) was also used to assess the presence of organic additives. A Perkin Elmer Spectrum One BM was used; measurements were taken in the range 4000-600cm$^{-1}$. In order to avoid contamination between the finishing and ground layers, they were carefully separated under a stereomicroscope.

## Results

The analytical protocol was aimed at getting a better understanding of the working methods and the materials of the two plasterers who worked at the Sanctuary. The visual inspection revealed that all the stuccoes are formed by two layers: the ground layer (*strato di corpo*) to create the volume and a finishing layer (*strato di finitura*) to obtain the appearance of a marble statue.

The only documentary information on the decorations has to do with the intervention of Agostino Silva, who was paid for the decoration of the internal door of the church with stuccoes in 1700 ("*per haver fatto sopra la porta grande della chiesa con stucco, e figure l'inscritione della consacrazione della chiesa*", Historical Archive of the Sanctuary of Ossuccio, "Accounts register from 1699 to 1735").

The petrographic analyses of the stuccoes attributed to Muttoni show that the ground layer is composed of a binder with many lime lumps, as large as 0.5cm (Fig. 3C and 3D). The frequent presence of lime lumps may be indicative of the lime binder slaking process. When lumps are abundant, slaking was most probably done through the hot-mixed lime technique [13]. In addition, lumps often contain remnants of the limestone used for lime production; such underburned particles indicate inhomogeneous and probably low calcination temperatures [14]. Radial, cauliflower-like structures inside the lime lumps (Fig. 3C and 3D) indicate Mg-enrichments in the mortar [15], thus their presence indicates the use of magnesian lime binder and dolomitic rocks as raw material. SEM-EDS analyses confirm high Mg content within the lime lump and in the binder (Fig. 4B1 and spectrum SB1). The absence of gypsum in the binder is confirmed by FTIR (Fig. 5, pink spectrum) and SEM-EDS analyses (Fig. 4B, 4B1 and spectrum SB1). The aggregate of the ground layer is composed of very coarse fragments of carbonate rocks (impure and marly limestones), sparry calcite and a minor amount of siliceous sands (quartz crystals and siliceous-rich rock fragments), mainly of medium grain size (Fig. 3B).

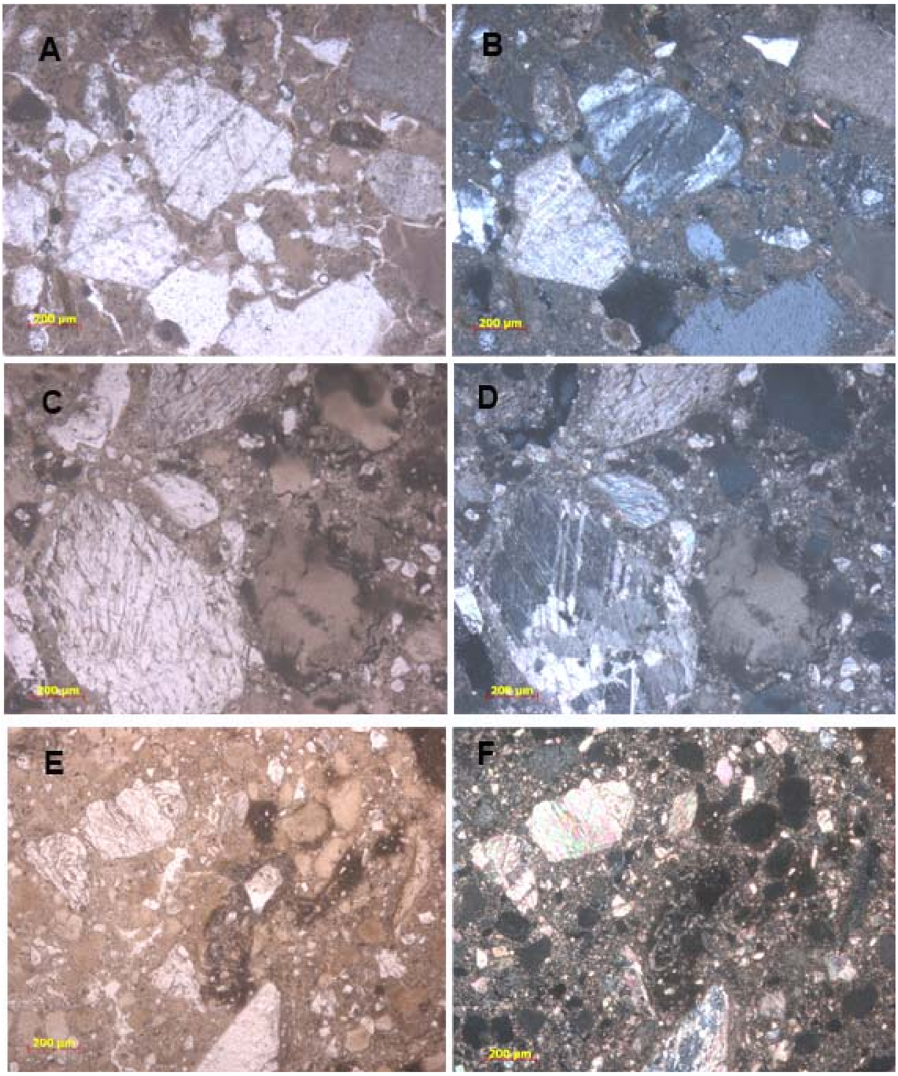


**Fig. 3.** Photomicrographs of Muttoni stuccoes, sample ST-OS 2: A) Shrinkage cracks are visible in the ground layer (PPL); B) The aggregate of the ground layer is composed of carbonate and siliceous sands of medium grain size. (XPOL); C) Large lime lumps are visible in the binder. The radial and rounded structure inside the lime lumps testifies Mg-enrichments in the mortar (PPL); D) Same image as C but under XPOL. E) The finishing layer is made of Mg-rich lime with lime lumps; F) same image as E under XPOL where lime lumps appear of grey colour. The aggregate is composed of sparry calcite and marble powder.

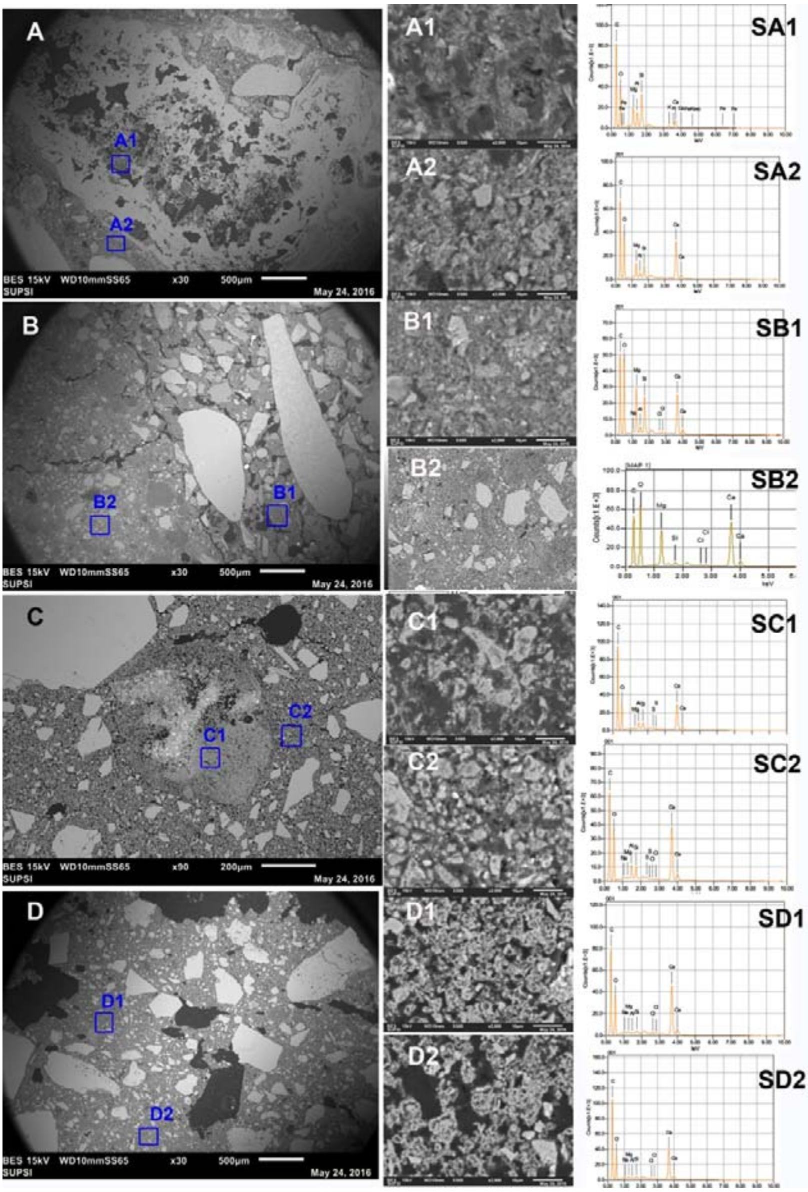


**Fig. 4.** SEM-EDS analysis: the first picture is the BSE image, next to it there are the two magnified BSE images of the sample portions indicated by the blue squared areas, and next to it there is the EDS spectrum of the same area: A) Sample STOS1. Underburned BRP with Ca-rich hydration rim; A1) BSE image of the rounded phase; SA1) Chemical elemental analysis of the rounded phase, Si and Al enrichment was detected; A2) BSE image of the binder of STOS1; SA2) Chemical elemental analysis revealing Si, Al and Mg enrichment in the binder; B) Sample STOS2 where the contact between the ground layer (right) and the finishing one (left) is shown; B1) Binder of the ground layer of STOS2. SB1) Chemical elemental analysis, revealing Si, Al and Mg enrichment of the ground layer binder; B2) BSE image of the binder of the finishing layer, sample STOS2; SB2) Chemical elemental analysis revealing Mg enrichment of the binder of the finishing layer; C) BSE image of sample STOS10 where a lime lump is shown in the centre; C1) BSE image of the lime lump; SC1) Chemical elemental analysis of the lime lump, revealing Ca rich lime lump; C2) BSE image of the binder of STOS10; SC2) Chemical elemental analysis of the binder confirming Ca-rich binder with low S content; D) BSE image of the sample STOS15; D1) BSE image of the STOS15 binder; SD1) Chemical elemental analysis revealing pure Ca binder; D2) BSE image of the STOS15 binder; SD2) Chemical elemental analysis confirming pure Ca binder.

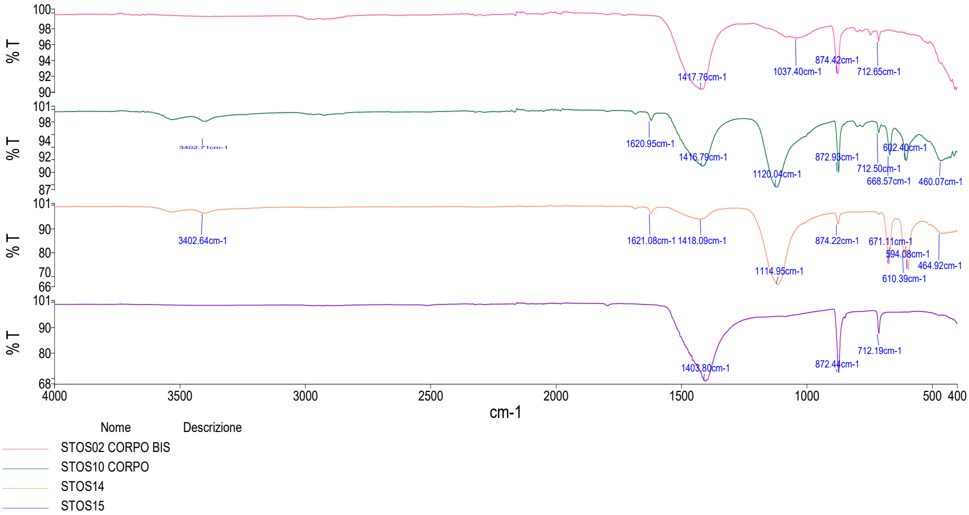


**Fig. 5.** All FTIR spectra show the presence of a large and strong band around 1403-1420cm$^{-1}$ due to the C–O stretching mode of carbonate functional group together with a sharp band at 872cm$^{-1}$ of the bending mode and at 712cm$^{-1}$. The large and strong band centered around 1114-1120cm$^{-1}$ and the small peaks at 670-680 and 602-594cm$^{-1}$, assigned to the stretching and bending modes of sulphate functional group, are present only in the two spectra of STOS10 and STOS 14. The stretching vibrations of the $H_2O$ molecules of the gypsum occurring at 3547 and 3402.64cm$^{-1}$ are also visible in these two samples.

The outer layer (finishing) is made of magnesium-rich lime (Fig. 4B, 4B2 and spectrum SB2) with millimetric lime lumps characterised by isotropic optical behaviour. The aggregate is composed of sparry calcite crystals and marble powder (Fig. 3E and 3F). The two layers (*strato di corpo* and finishing) were made with a “*fresco su fresco*” technique, namely the application of the finishing while the ground layer was still wet. Shrinkage cracks are frequently observed in both layers (Fig. 3A).

In other stuccoes attributed to Muttoni, such as the fruit composition, for example (sample ST-OS 01, shown in figure 6A, 6B and 6C), the finishing layer is very thin, 2 mm thick and composed of magnesian lime, without aggregate.


**Fig. 6.** Samples stuccoes: A) Detail of the fruit composition from which the apple shown in 6B fell down; B) Detached fruit from which the sample ST-OS 01 was taken. C) Image of the sample ST-OS-01.

The appearance of the binder is very heterogeneous (Fig. 7D) that could be attributed to the use of a dolomitic lime mortar [15, 16]. In the same sample, the binder of the *strato di corpo* is a weakly hydraulic magnesian lime and the aggregate percentage is lower if compared with the other samples of the vault (Fig. 7C). The hydraulicity of the binder derives from the burning of impure and marly limestones [17], such as the one shown in figure 7B. In fact, SEM-EDS analyses of the rounded phases in the binder-related particle shown in Fig. 7A reveal an enrichment of Si, Al and Fe (Fig. 4A, 4A1 and spectrum 4SA1), while around the particle a carbonated hydration rim, rich in Ca and Mg is present (Fig. 4A, 4A2 and spectrum 4SA2). A low amount of S, detected only on the surface of the finishing layer by SEM-EDS, can be explained by the formation of sulphates, as a result of secondary degradation processes. Indeed, the damaged state of conservation of this decorative element can be well observed macroscopically, in figure 6A and 6B.

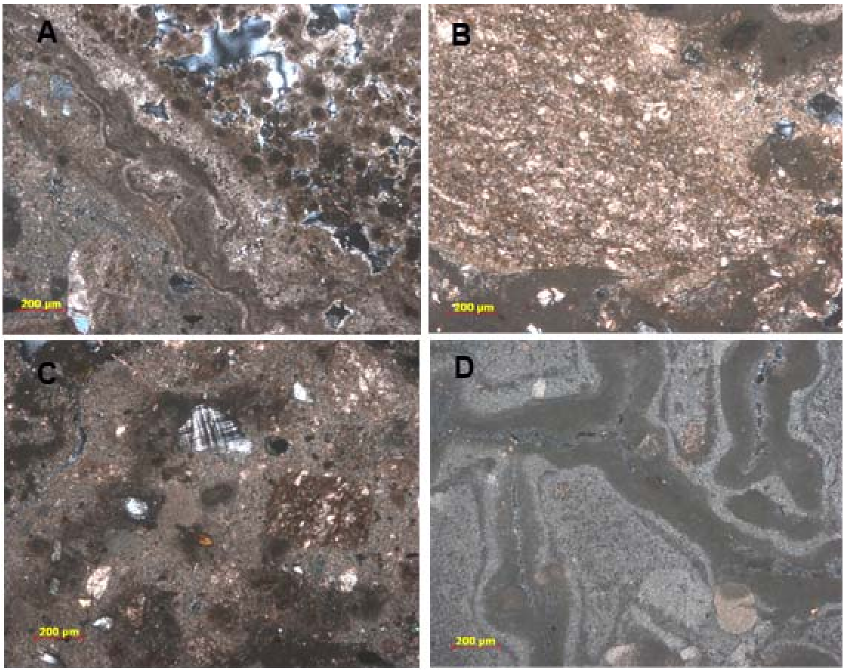


**Fig. 7.** Photomicrograph of the sample ST-OS 01 (XPOL): A) Same underburned particle shown in figure 4A with rounded brown hydraulic phases. Around the particle a Ca-rich hydration rim with high birefringence is present; B) A partially burnt impure limestone that gives a weak hydraulicity to the binder; C) The binder of the *strato di corpo* is inhomogeneous with low aggregate content; D) The finishing layer do not present aggregate addition. The microstructural appearance of the binder is dominated by areas with different optical density.

On the contrary, for the angels and the cartouche of the inner façade (by Agostino Silva) the gypsum has been added to the lime intentionally, especially in the *strato di corpo*, as shown by FTIR analysis (Fig 5, yellow and green spectra). A small amount of S has also been detected by SEM-EDS (Fig. 4C1 and 4C2 and spectra SC1 and SC2). This internal layer is made of a mixture of Ca-based lime and gypsum, in order to rapidly obtain the typical projecting elements of the stucco decorations [18]. Furthermore, the gypsum additive reduces the formation of shrinkage cracks, even using, as in this case, a low percentage of aggregates (Fig. 9A). The frequent presence of large particles of anhydrite (Fig. 9B) can derive from the raw material or it can be evidence of the use of high temperature gypsum or the results of uneven temperatures within the gypsum cooking chamber. The aggregate is mostly composed of coarse fragments of impure or chert limestone, with low content of fine siliceous sands (Fig. 9A).

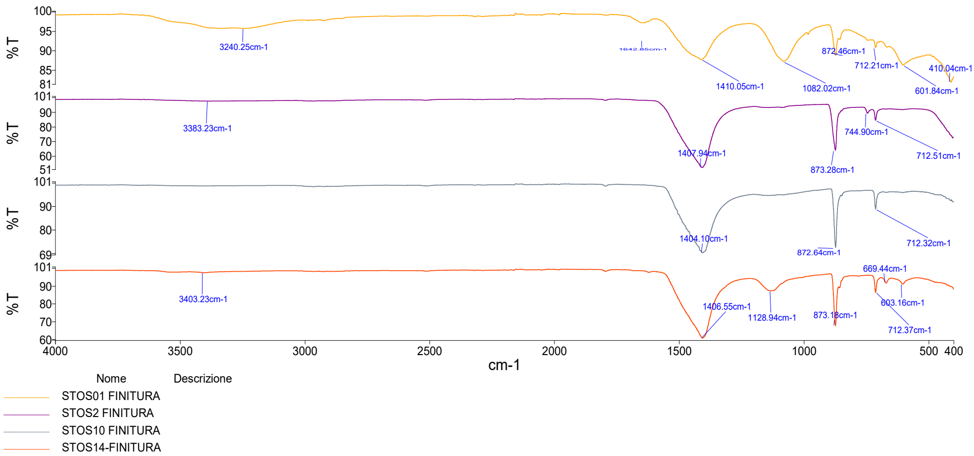


**Fig. 8.** FTIR spectra. All the finishing layers show a predominant presence of carbonate (peaks around 1400cm$^{-1}$ 872-873cm$^{-1}$ and 712cm$^{-1}$). Low amount of gypsum is present in the samples STOS01 and STOS14 (1109cm$^{-1}$, 669cm$^{-1}$, 596cm$^{-1}$). The shift of the peak from 1100 to 1080cm$^{-1}$ only in the sample STOS01 could be justified by the formation of epsomite together with gypsum.

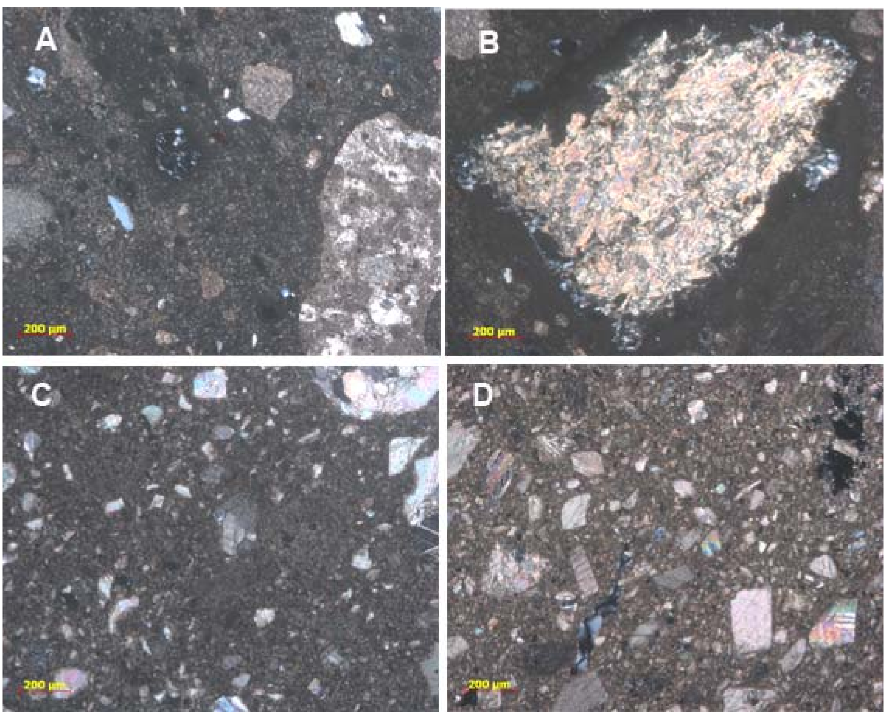


**Fig. 9.** Photomicrograph of stuccoes by Silva (XPOL): A) Sample ST-OS10. The binder is made of lime and gypsum in the *strato di corpo* layer. No shrinkage cracks are observed even if a very low aggregate content is present; B) Sample ST-OS11. Large particle of anhydrite with high birefringence is shown in the centre; C) Sample ST-OS 14. Finishing layer with lime binder and aggregates composed of calcite and marble fragments, fine grain size, well sorted; D) Sample ST-OS 15. Lime binder with homogeneous textural characteristics. The aggregate is composed of calcite and marble fragments with medium and fine grain size, well sorted. This sample has similar petrographic characteristic to the Agostino Silva finishing layer shown in image 9C.

For the finishing layer, Agostino used a Ca-rich lime binder, in which the gypsum was found occasionally and only in traces (Fig. 8, grey and red spectra). The fine finishing layer was directly applied on the still wet *strato di corpo*, as there is not an interface between the two layers. Thus, it may not have been intentionally added, but it can derive from the underlying layer, as contamination or caused by dissolution and recrystallization processes. The aggregate is composed of sparry calcite and marble fragments, mostly of fine grain size, well sorted (Fig. 9C).

The sample ST-OS 15 is characterised by a lime binder with homogeneous calcium carbonate microcrystalline texture. The aggregate is composed of sparry calcite and marble fragments with fine and medium grain size, well sorted (Fig. 9D). The petrographic observations are confirmed by the FTIR spectrum that shows only calcium carbonate (Fig. 5, purple spectrum) and SEM-EDS analyses that has detected only Ca within the binder (Fig. 4D, 4D1 and 4D2 and spectra SD1 and SD2), confirming the absence of Mg.

## Discussion

The difference between the two *stuccatori*, Muttoni and Silva, can be observed in the raw materials used, in the executive techniques and in the artistic features obtained. Separated by a few decades, the two decorative stucco cycles display relatively similar stylistic characteristics. However, in the stuccoes by Agostino Silva it is possible to find some typical traits of the dynamism of Baroque sculpture [19], absent in Muttoni's decorations, which appear strongly anchored to the tradition of the late Mannerist era.

While the iconographic content and the single elements of the frames are substantially similar, the differences are evident in the comparison of the figures. In particular, the angels by Silva show fluency in the treatment of the drapery and fine grace of movements (Fig. 2 and 10), while those by Muttoni are characterised by massive and static bodies (Fig. 11A and 11B). Silva's style seems to be dictated by great freshness and rapid realization [20], while the Muttoni reliefs appear more rigid. Unfortunately, it is difficult to assess the treatment of the surface finishing due to numerous layers of whitewash applied over time (Fig. 10) that have essentially erased the differences and homologated the two "hands".

**Fig. 10.** Finishing layer of an angel by Silva brought to light after whitewash removal during restoration work. In this case the surface appears more homogeneous and compact if compared to that of Muttoni shown in the next figure.

These stylistic differences are matched by a similar diversity of production procedures and raw materials. The two artists have employed different binders, to suit their individual technical and expressive needs. In particular, the scientific investigations have revealed the presence of burned gypsum in the mixtures of Silva, used as additive to prevent cracking during the drying phase, to allow for faster setting and thus quicker execution, because gypsum sets rapidly without getting completely hard. In fact, the gypsum additive extends the time of complete curing of the mortar due to its temporary superficial softness, so the artist can correct and improve the details of reliefs, even a few days after its application. However, the presence of gypsum can cause a substantial decrease of durability in time, due to its solubility in water. In fact, in case of water infiltrations, or condensation or rising damp, the mortars are more susceptible to degradation phenomena [22].

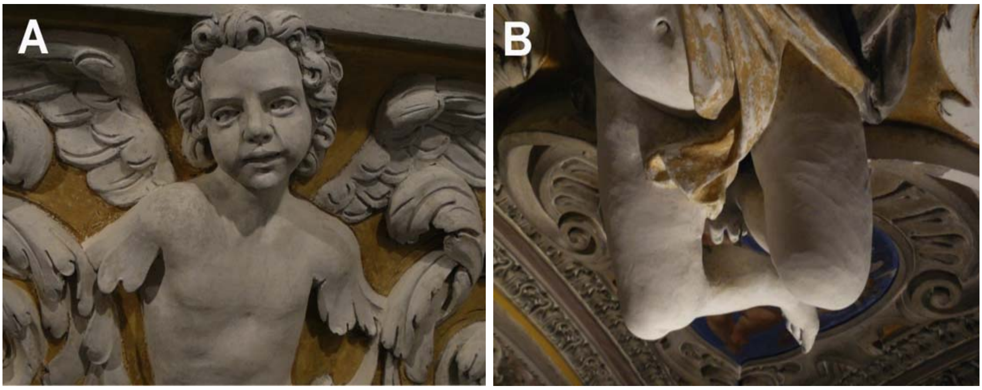


**Fig. 11.** The angels of the vault by Muttoni: A) **C**haracterised by a more rigid appearance; B) Detail of legs of an angel with raked lighting, showing the surface treatment of stuccoes by Muttoni in which the imprint of the sticks used for finishing the sculpture is visible.

The stuccoes by Muttoni display a large mortar thickness; nevertheless, the characterisation of the constituent materials reveals a lack of gypsum. However, considering the extreme compactness of the stucco, the presence of small percentage of organic additives, not identified, cannot be ruled out. Furthermore, our results show that Muttoni used a Mg-rich and weakly hydraulic lime, while Silva used an almost pure Ca-lime, evidence of different raw materials for binder production [23]. The comparison with others case studies, where Agostino Silva has used a magnesian lime [24-27], suggests that the use of Ca-based lime was probably due to local and temporary availability of the raw material and not to specific technical choices. The aggregate of the ground layer used by the two artists is very similar, probably collected from a local alluvial deposit, but there is a consistent variation in B/A ratio. The possibility of using scarce quantities of aggregate by Silva can be explained by the gypsum addition.

Both artists used only fine calcite grains as aggregate for the finishing layer. In the larger fragments it was possible to observe the polysynthetic deformation of lamellae typical of marble, but in the smaller fraction it cannot be determined and therefore it cannot be established with certainty whether the aggregate was obtained from the grinding of a calcite vein or by using marble powder.

## Conclusions

The analytical survey of the stucco decorations of the Sanctuary of the "Madonna del Soccorso" at the "Sacro Monte di Ossuccio" permits characterisation of the artistic techniques of two *stuccatori* from the same area: Giovan Battista Muttoni and Agostino Silva. The comparison between the compositional data of their works of art and their artistic style proved to be effective for the distinction of characteristics and materials.

In particular, the composition of the binder could shed a light on some uncertain attributions. According to documentary sources, Agostino Silva worked on the cartouche of the inner façade. This can be now confirmed by the similar composition and stratigraphy of the stucco decorations observed in other case studies of works by the same artist. For example, in the ground layer, gypsum was detected together with lime. The reason behind this choice can be attributed to the particular style of Agostino Silva, who emphasizes the illusionistic use of stucco typical of Baroque tastes. The presence of gypsum can be also due to a specific need for quick execution of the internal layer of the stucco, reflected in the choice of this master who was capable of working very fast. The different executive technique of Muttoni does not include the use of gypsum, while working with large mortar thickness. Furthermore, the raw materials chosen by the two artists were different: Muttoni used Mg-rich weakly hydraulic lime, while Silva has used Ca-based lime.

The particular chemical and mineralogical compositions of the analysed samples, in addition to some differences in patterns and shaping, together with the documentary evidence, make it possible to distinguish the elements done by the two different artists and to attribute the controversial angel of the nave to Agostino Silva.

## Acknowledgements

The authors would like to thank Dr. Giulio Scocchi (ICIMSI SUPSI) for SEM-EDS analysis. The research work was carried out with the funds of FNS, Switzerland. We especially thank CRD restorers, the "Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Como, Lecco, Monza e Brianza, Pavia, Sondrio e Varese",, Arch. Valentina Minosi and Arch. Roberto Segattini. The authors are grateful to Marco Leoni for the important suggestions.

## References

[1] G. Mollisi, *Salvatore Pozzi a Bironico*, **Arte e Storia**, **38(**8), 2008, pp. 70-90.

[2] G. Mollisi, *I Pozzi di San Rocco. Nuove scoperte e nuove proposte di studio per la decorazione della chiesa luganese*, **Arte e Storia, 26**, 2005, pp. 94-114.

[3] L. Rampazzi, B. Rizzo, C. Colombo, C. Conti, M. Realini, U. Bartolucci, M.P. Colombini, A. Spiriti, L. Facchin, *The stucco decorations from St. Lorenzo in Laino (Como, Italy): the materials and the techniques employed by the "Magistri Comacini"*. **Analytical Chimica Acta, 630**(1), 2008, pp. 91-100.

[4] S. Della Torre, T. Mannoni, V. Pracchi, **Magistri d'Europa. Eventi, relazioni, strutture della migrazione di artisti e costruttori dei laghi Lombardi**, Atti del Convegno Como 23-26 Ottobre 1996, Nodo libri, Como, 1997.

[5] S. Gavazzi Nizzola, M.C Magni, *Una traccia per Francesco Silva stuccatore ticinese,* **Arte Lombarda, 17**(37), 1972, pp. 86-95.

[6] S. Gavazzi Nizzola, M.C Magni, *Contributo all'arte barocca ticinese: Agostino Silva da Morbio Inferiore*. **Arte Lombarda, 19**(40), 1974, pp. 110-129.

[7] S. Gavazzi Nizzola, M.C Magni, *Aggiunta al catalogo dei Silva stuccatori morbiesi. Nuove attribuzioni e considerazioni*, **Archivio storico ticinese** (Bellinzona)**, 136**, 2004, pp. 309-326.

[8] P. Gatta Papavassiliou, **Il Sacro Monte di Ossuccio. Guida alle Cappelle**, Editoriale Giorgio Mondadori Editore, Gorle (BG), 1996

[9] A. Bolzani, **Cenni storici artistici sull'insigne Santuario della Madonna del Soccorso sopra Isola (lago di Como)**, Ed. A. Guzzetti, Milano, 1870.

[10] D. Pescarmona, *Precisazioni storiche sul Sacro Monte di Ossuccio*, **Il restauro della prima cappella del Sacro Monte di Ossuccio, 1**, Quaderni della Fondation Carla et Leone Montandon, Como, 2004.

[11] * * *, **Logitech, Application Note - Thin Section Preparation**. http://www.logitech.uk.com/media/111820/2012_thin_section_preparation_web.pdf. [Accessed: 20-May-2016].

[12] * * *, **Cultural Heritage – Stone Materials – Descrizione petrografica di una malta,** UNI EN 11176: 2006.

[13] K. Callebaut, K. Van Balen, *Dry-slaked lime: an alternative binder for restoration mortars*. **Proceedings of the International workshop on Urban Heritage and Building Maintenance VII**, Zurich, 2000, pp. 65-72.

[14] J. Elsen, *Microscopy of historic mortars, A review.* **Cement and Concrete Research**, **36**(8), 2006, pp. 1416-1424.

[15] A. Diekamp, J. Konzett, W. Wertl, R. Tessadri, P. W. Mirwald, *Dolomitic lime mortar – A commonly used building material for medieval buildings in Western Austria and Northern Italy,* **Proceedings of the 11th International Congress on Deterioration and Conservation of Stone,** 15–20 September 2008, Torun, Poland, Volume I (*Editors:* J.W. Lukaszewicz and P. Niemcewicz), 2008, pp. 597–604.

[16] E. Pecchioni, F. Fratini, E. Cantisani, **Atlas of Ancient Mortars in Thin Section Under Optical Microscope**, Kermes quaderni, Nardini Ed., Firenze, 2014.

[17] J. Elsen, K. Van Balen, G. Mertens, *Hydraulicity in Historic Lime Mortars: a Review*, **Historic Mortars Conference HMC2010 and RILEM TC 203-RHM Final Workshop** 22-24 September 2010, Prague, Czech Republic, 2011, pp. 129-145.

[18] C. Arcolao, **Le ricette del restauro. Malte, intonaci, stucchi dal XV al XIX secolo**, Marsilio, Venezia, 1998.

[19] S. Langé, G. Pacciarotti, **Barocco alpino. Arte e architettura religiosa del Seicento: spazio e figuratività,** Jaca Book, Milano, 1994.

[20] L. Aliverti *Conoscenza delle pratiche costruttive storiche degli edifici in area lombarda: i manufatti in stucco*, **Pratiche costruttive storiche: manufatti in stucco e strutture lignee di copertura in edifici lombardi** (Editor: V. Pracchi), Nodo libri, Como, 2008, pp. 20-91.

[21] * * *, *L'Arte dello Stucco*. **Atti del convegno conclusivo del progetto Interreg IIIA**, Campione d'Italia, 21 Novembre 2006, Como.

[22] C. Natali, G. Lorenzini, *Le ricette degli stucchi in Italia settentrionale dal XV al XX secolo. Il rapporto tra le indicazioni contenute nella letteratura architettonica con le indagini da laboratorio,* **Lo Stucco. Cultura, Tecnologia, Conoscenza. Atti del convegno**

**Bressanone**, 10-13 luglio 2001 (Editors*:* G. Biscontin G. Driussi), Edizioni Arcadia Ricerche, Venezia, 2001, pp. 219-243.

[23] L. Fieni, *Calci lombarde: produzione e mercati dal 1641 al 1805*, **All'insegna del Giglio**, Firenze, 2000.

[24] G. Cavallo, M. Caroselli, L. Aliverti, A. Felici, G. Jean, G. Nicoli, S. Luppichini, *Research on 17th c. stucco decorations by the Silva family workshop in the Basilica Santa Maria dei Miracoli in Morbio Inferiore (Tessin).* **Proceedings of HMC2016 Historic Mortars Conference**, 10-12 October 2016, Santorini, Greece. (in press), 2016.

[25] G. Cavallo, D. Biondelli *The Use of Magnesian Lime in Historical Mortars in Tessin Canton, Switzerland: Microscopical Features and Microanalytical Evidences,* **Proceedings VII Congresso Associazione Italiana di Archeometria**, 22-24 Febbraio, Modena, 2012, pp. 720-729.

[26] L. Folli, R. Bugini, *Le ricette degli stucchi in Italia settentrionale dal XV al XX secolo. Indagini scientifiche sui materiali.* In: Biscontin G, Driussi G (a cura di). **Lo Stucco. Cultura, Tecnologia, Conoscenza**, Atti del convegno Bressanone, 10-13 luglio 2001. Edizioni Arcadia Ricerche, Venezia, 2001, pp. 207-218.

[27] C. Natali, G. Lorenzini, *Degradi e metodi di conservazione dello stucco. Analisi del progetto per l'oratorio Imbonati di Cavallasca*. **Arkos** 1, 2000, pp. 50-58.

*Received: August, 14, 2016*
*Accepted: September, 25, 2016*