INTERNATIONAL JOURNAL OF CONSERVATION SCIENCE

ISSN: 2067-533X Volume 6, Issue 1, January-March 2015: 45-50 www.ijcs.uaic.ro

CHARACTERIZATION OF SERPOTTAS' STUCCOS BY MEANS OF SIMULTANEOUS THERMAL ANALYSIS: PRELIMINARY RESULTS

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Abstract

In this paper the Simultaneous Thermal Analysis (STA), i.e. thermogravimetric and differential thermal analysis, was used as a diagnostic tool to better understand the matter composition of some very valuable artworks the Serpottas' stuccoes in Palermo. Particularly the STA was used in order to exclude the presence of an unusual calcium-bearing magnesium carbonate, and the thermal data were also used to quantify the magnesite to calcite ratio. The latter was investigated in order to evaluate the amount of magnesium in the lime used as binder as during 17th and 18th century in Sicily magnesium rich lime was indicated as the most valuable binder probably because this kind of lime has a higher plasticity. The data obtained in this work are not conclusive but indicate a way to contribute to the comprehension of this unique work of art composition.

Keywords: *Serpotta; Stuccoworks; Simultaneous Thermal Analysis; Magnesium lime*

Introduction

During the Baroque period, movement plasticity of figures and groups of figures assumed a great importance as a main characteristic of baroque art is the sense of movement, energy, and tension. The research of such artistic value results in a widespread use of strong contrasts of light and shadow in order to enhance the dramatic effects of sculptures. The most valuable material for sculpture was white marble, as artist can obtain polished and finely carved surfaces; on the other hand it was quite expensive, especially in the region where there were no available quarries [1, 2].

In the stucco technique, artists used mortars instead of marble, as these materials were quite cheaper than marble and lime plasters can be easily moulded in every shape [3].

The plastic art of stucco is considered one of the most important expressions of the baroque decorative art in Sicily and the Serpotta's family rises above the others stucco artist. Particularly Giacomo (1656–1732) is considered the outstanding member of the family. His methods for creating the illusion of perspective and his asymmetrical arrangements of two or more independent decorations proved highly influential to German artists of the Rococo period. His statues appear to be falling from air and not attached to the wall, even though all the figures, cupids, draperies, and garlands are on the same plane as the wall. He is credited with raising Sicilian stuccowork from a craft to an art [4].

His father Gaspare and his son Procopio were valuable artists too, even if less skilled and

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innovative than Giacomo. They often worked together.

The extraordinary patrimony of oratories and churches decorated by the Serpotta's school in Palermo was seriously damaged during the Second World War and then by the earthquake in 1968. The recovery of such valuable artworks started with the work of Donald Garstang [5] and continued in a demanding project, called "Progetto Serpotta", a recovery intervention on ten Serpottas' sites, designed by the Soprintendenza BB CC (Monuments and Fine Arts Office) of Palermo [6].

This work starts from the results obtained within the "Progetto Serpotta". Aim of the project was the restoration of the extraordinary stucco's artworks moulded by Giacomo Serpotta and his co-workers from the end of 17th to the beginning of 18th century. Aim of the present work is also to take a unique opportunity for an analytical investigation on the constitutive materials of stuccoes as in mostly cases they were so damaged that sampling was allowed without prejudice to their state of conservation.

In previous papers by the same authors [6, 7] mineralogical petrographic analysis, performed by means of both optical microscopy on thin sections and X ray diffractometry, evidenced a masterly use of binders, lime and plaster, to fulfil the needs of workability and hardening time of each layer of mortar. Furthermore, the presence of magnesium compounds lime was related to the use of magnesic lime [7-9].

In this work STA (Simultaneus Thermal Analysis) was performed on stucco samples in order to quantify the calcite magnesite ratio in the different layers. Aims of such study are on one hand to extend the knowledge pertaining to the matter of stuccoes, on the other hand to find a key to the proper attribution of artworks to the different artists of the Serpotta's School, who used to work in the space of seventy years over three generations. In particular, works of certain attribution to Giacomo, Procopio and Gaspare Serpotta are compared with works of uncertain attribution.

Materials and Methods

The stucco works were made by superimposing one upon another mortars layers of different thickness and composition [3, 7-9] (Fig. 1): i) the outer layer, A, is a sort of skin, a few millimetres thick, made of magnesic lime as binder and marble powder as aggregate; the bulk layer beneath, B, can be many centimetres thick and is made of various components, including both lime (magnesic and calcic) and plaster as binders and quartz, limestone, crushed brick and charcoal slack as aggregates; a third layer, C, is present only in the works of large size as the inner bulk mortar round the wooden skeleton and is made of plaster as binder and various aggregates including gypsum.

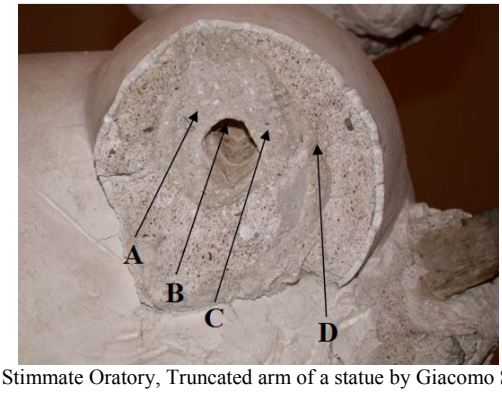

Fig. 1. Stimmate Oratory, Truncated arm of a statue by Giacomo Serpotta.
A,B,C: sequence of the different stucco layers; D: mould of the wooden skeleton.

The artists modify the composition of the different layers according to the needed behaviour of the fresh mortar in order to obtain the required workability and the desired surface appearance [7, 8].

Samples were collected in eight churches and oratories, were Giacomo Serpotta, his brother Giuseppe and his son Procopio gave their artistic services, together or separately. The samples were then divided in the three or two constitutive layers by means of sharp blades under a microscopic lens.

A portion of the sample was grinded to a very fine powder for XRD (X-ray diffractometry) analysis and another portion was softly grinded by means of a wooden pestle in a ceramic mortar. The fragments coming from the latter operation were sieved separating the portion smaller than 0.063mm; this procedure is recommended in order to allow a separation between binder and aggregates [9, 10].

XRD was performed by means of an ItalStructures APD 2000, equipped with a CuKα radiation, in the 2θ range 4-60°, on powdered samples, after separation of the different layers of mortar.

STA was carried out in a simultaneous thermal analyzer Netzsch STA 409, in static air at heating rate of 10°C/min in the range 30°-1000°C.

Results and discussion

Identification of crystalline phases

All samples were analyzed by means of XR diffractometry in order to evidence the presence of crystalline components. By way of example, in Table 1 the mineralogical composition of two multilayer samples, SM1 from Oratorio di S. Mercurio and SCA07 from the Church of S. Caterina d'Alessandria respectively, is reported, the samples represent the average composition of the stucco layers.

Table 1. Mineralogical composition of stuccoes**.**
The relative aboundance of the crystalline phases is indicated by the number of crosses.

Sample		author	calcite	magnesite	dolomite	anhydrite	gypsum	quartz
SM06	A	Giacomo	+++++	+				
	B		++++	traces	+++		+	++
	C					traces	++++	traces
SCA07	A	Procopio	++++	+			++	
	B		+			+	+++++	

The presence of other compounds, such as crushed bricks and charcoal slack were evidenced by means of microscopic observation on thin sections [7, 8].

It is worth mentioning that for many samples the interpretation of XRD data was uncertain, due to the presence of peaks fitting the pattern of hydrocamagite, $(Mg_{0.92}Ca_{0.08})CO_3 \cdot 3H_2O$, a calcium bearing magnesium carbonate found in sediment of lakes with high concentration of magnesium and calcium in water. This is due to the fact that the main peaks of this mixed calcium magnesium carbonate are partially superimposed to those of magnesite [10]. As the amount of magnesite within the mortar is quite low in most cases, the XRD patterns show only the main peaks of magnesite, that are the ones mostly superimposed to hydrocamagite ones.

The doubt was resolved by means of simultaneous thermal analysis in favour of the presence of magnesite. Hydrocamagite has two endothermic decomposition steps, the first due to the loss of hydration water from 200 to 450°C with a peak around 425°C, at a second one due the decarbonation at around 600°C [10]. On the contrary magnesite presents only the latter one. As shown in figure 2 the only remarkable peak is the one related to the decarbonation of magnesite,

whereas the gravimetric effect due to the loss of hydration water characteristic of hydrocamagite is not present. In the diagram it is possible to observe the presence of some hydrated salts responsible for the weight loss between 120 and 200°C [11, 12].

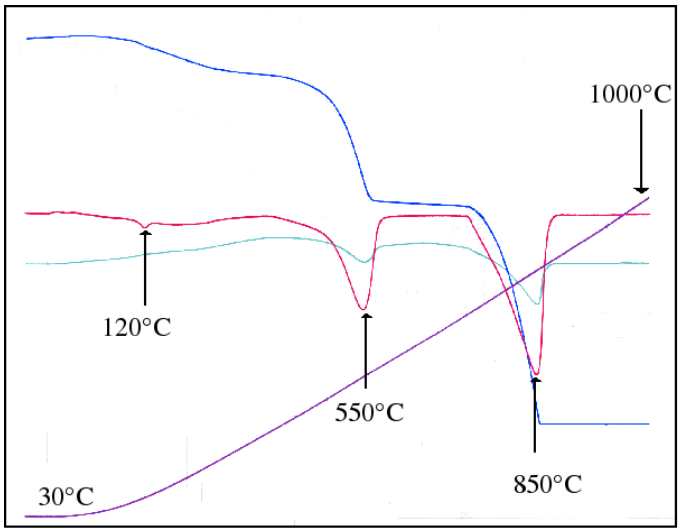

Fig. 2. STA plot of SC05 (Santa Cita Oratory) sample (layer A).

Quantification of calcite magnesite ratio

The results of STA analysis were also used to evaluate the proportion of calcite and magnesite.

The ratio between these two carbonates could be an indicator of the use of a specific dolomitic lime, and can be related to the amount of marble sand used for the preparation of mortar, so that it could be indicative of the recipe of each single artist. The ratio between calcite and magnesite, both for layer A and layer B are plotted in Figs. 3 and 4.

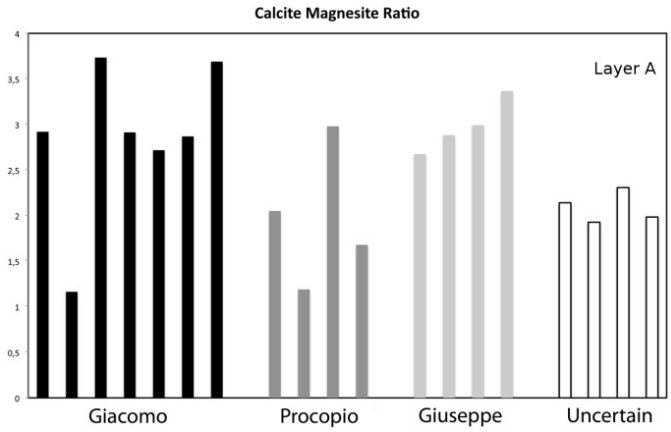

Fig. 3. Weight percentage ratio of calcite and magnesite in samples by different artists in layer A samples.

As can be observed by the plots of figure 3, the calcite magnesite ratio of layers A of each stucco artist present a wide range of composition, superimposing one to the other. The small amount of data doesn't allow a statistically significant differentiation of authors.

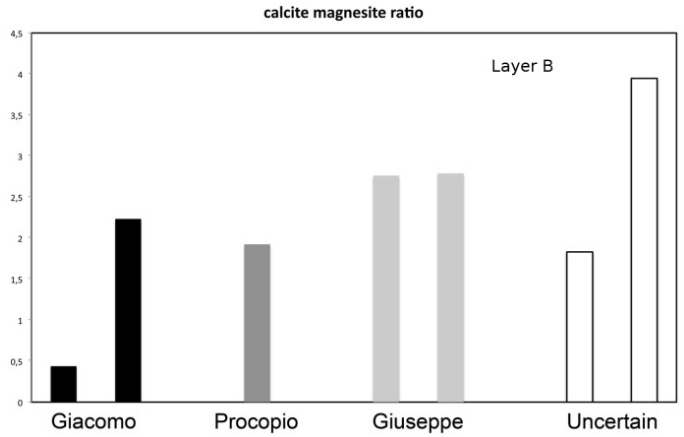

Fig. 4. Weight percentage ratio of calcite and magnesite in samples by different artists in layer B samples.

On the other hand it's possible to note that the calcite magnesite ratio of Giacomo's samples are quite high and uniform; the only exception is a sample coming from the frame of a window, instead of the others that come from statues, putto and other figurative elements, so the difference in matter composition could be due to the fact that the artefact from which the sample comes from is quite simpler than the others. The Giuseppe samples have the more constant ratio, quite similar to the Giacomo's one. The Procopio samples, instead, present a wide range of variability, particularly one sample has the same calcite magnesite ratio of the ones from the other artists, two have a very low value of the ratio and one is intermediate.

The few data of calcite magnesite ratio of B-layer samples cannot give significant data.

Conclusions

In this paper the Simultaneous Thermal Analysis was performed in order to better understand the material composition of a unique cultural heritage: the Serpottas' stucco.

The STA allowed identifying magnesite instead of other magnesium carbonate not distinguishable by means of XRD due to the low amount of magnesium carbonate.

The stucco were analyzed in order to find a way to distinguish between the authors in case of uncertain attribution. Unfortunately the results of STA do not evidence marked differences between the different artists of Serpotta's school, so that, at this moment, they aren't useful for the attribution of artworks.

Even if no final indication can be achieved by the data presented in this paper it is possible to note that Giacomo's samples have an almost constant calcite magnesite ratio, similar to the Giuseppe's ones, whereas Procopio samples present a very large variation in composition.

We think however that the extension of STA to larger number of samples, statistically significant, could probably give more satisfactory results as some indication has been obtained even with a very small number of STA data. Moreover a more precise quantification of magnesite and calcite can be achieved performing STA in CO_2 enriched atmosphere [13].

More significant clues can be derived by microscopic observation of thin sections.

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Received: August, 22, 2014
Accepted: February, 23, 2015