

Multidisciplinary analysis on a marble bas-relief of unknown origin

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Abstract – The purpose of this study is to demonstrate how a disciplinary approach is an excellent tool in the field of forensic investigations, capable of answering the questions posed by the institution and obtaining as different and as much information as possible on the findings analyzed, reconstructing the history of often decontextualized artifacts. In the present work, the results of the FTIR-ATR and SEM-EDX analyses performed on micro-fragments and powders taken from a marble bas-relief, seized by the Cosenza Carabinieri Unit for the Protection of Cultural Heritage and Anti-Counterfeiting (Calabria, Italy), are reported.

I. INTRODUCTION

The importance of forensic investigations in the field of illicit trade in cultural heritage can be seen from the amount of information obtained by investigating samples through a multidisciplinary and scientific approach [1]. Every clandestine excavation is deplorable because it takes precious objects from the community and above all because it destroys an entire historical and archaeological documentation [2]. It frequently happens, in the case of forensic studies, to analyze deconstructed finds and therefore without information on the discovery, on the production techniques, the raw materials used, the iconographic style and so on [3]. The multidisciplinary approach is, therefore, necessary to obtain valuable information when unknown artefacts are brought to light. The analysis of the raw materials through archaeometric research allows, in fact, to increase the possibilities of obtaining important compositional and technical data, also relating them to possible historical-artistic and archaeological contexts, considering the stylistic connotations of the artefacts. The micro-samples analyzed in this work come from a marble bas-relief, confiscated by

the Cosenza Carabinieri Unit for the Protection of Cultural Heritage and Anti-Counterfeiting (Calabria, Italy). The samples were analyzed by Fourier transform infrared spectroscopy in Attenuated Total Reflectance (FTIR-ATR) and Scanning Electron Microscopy (SEM) with Energy Dispersive X-Ray Analysis (EDX) [4-6] to establish their compositional characteristics.

II. THE MARBLE BAS-RELIEF AND SAMPLING

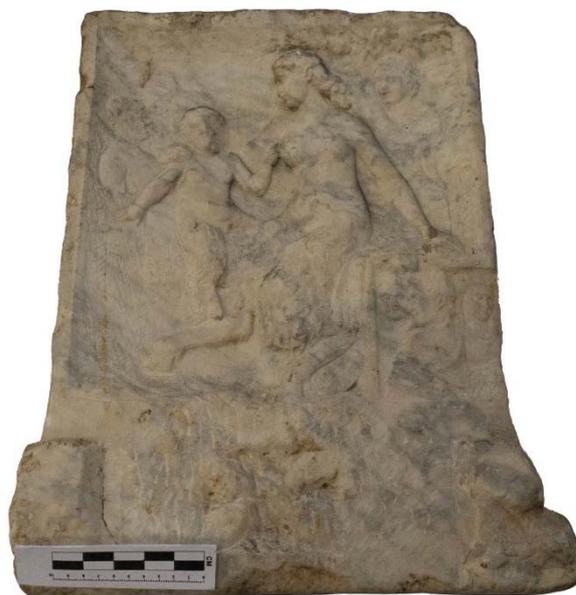


Fig.1 Bas-relief

Samples were taken from three different areas of the marble bas-relief (Figure 1), where the figures are represented on a plane.

The slab subject to sampling is represented by a single piece of marble whose front has a bas-relief rich in figures.

The back (Figure 2) of the slab looks like raw marble; the only worked part is a smooth groove in the upper part, specially shaped perhaps to make the slab adhere better to a wall probably built with stones of various sizes and thicknesses.



Fig.2 Back of the Bas-relief

This hypothesis could also justify the presence of a groove (Figure 3) in the lower side of the slab, about 4 cm long, occupied by a "grappa" consisting of a folded metal bar used to fix the bas-relief to the wall.



Fig. 3 Groove in the lower side of the Bas-relief

As anticipated, on the front of the slab a bas-relief with complex iconography and rich in human figures is carved entirely or in faces placed in profile. In the foreground, it is possible to recognize the silhouettes of a child and a woman depicted on a seat or a throne from which the forelimbs appear laterally, which seem to have the appearance of goats or horses. The female figure, with her face in profile and a barely hinted smile, looks down to cross that of the child who is embracing, placing his right hand on his shoulder. The left arm is stretched down with the hand resting on the armrest/seat. The child, placed to the left of the female figure, is represented half with human features and half kid (perhaps a small faun), with an arm stretched towards the woman's chest. The face, slightly in profile to the right, is not clear; the head of hair, from which the ear can be seen, appears smooth. Behind the two figures in the foreground, two others can be recognized; on

the back, a female figure perhaps depicting a putto or a child, with the mouth half open, presumably depicted in the act of holding something or crowning the woman's head or even in the act of holding a torch. The other figure is placed on the left, behind the child, with the face in profile to observe the scene. In addition to the head, only part of the torso is visible, from which a shoulder can be recognized; the rest of the body is covered with a mantle or plant elements. Particular is the square on which the woman rests her hand where three busts are depicted. One is represented with a straight gaze, the central one is placed in profile and the third is with a slightly right gaze. Among the figures that make up the iconographic group, the only ones whose features stand out best are: a) the central one, in profile and whose ear has the appearance of goats, the aquiline nose and the contemptuous gaze, wears a tunic or cloak and the head surmounted, perhaps, by a crown of leaves on a smooth hair; b) the other clearly visible figure is the one on the right, with the head turned slightly to the right and with curly hair.

The entire slab has no frame, and the original colour of the marble is visible on the back, as the front shows traces of wear and alterations of various origins. On the sides of the slab, there are traces of plaster and mortar used as a binder with the back wall on which it was placed. From preliminary observations, the marble does not appear to be "pavonazzetto" or Carrara marble, perhaps it could be a "brecciato" marble that has a beige base with light-coloured veins from brown to bright brown. The decontextualization of the object, the confusion of the elements depicted, the lack of definitive details and the iconographic and stylistic inconsistencies made the interpretation and chronological framing of the relief difficult. Further studies will be conducted to evaluate these aspects as well.

A first study conducted by a consultant appointed by the Cosenza Carabinieri Unit for the Protection of Cultural Heritage and Anti-Counterfeiting (Calabria, Italy) recognized a Roman artefact in the decorated marble. It could also be a "pastiche" deriving from a strong reworking carried out in later times on a Roman relief of which few original elements remain, or even a marble work made in the Renaissance or post-Renaissance era by a sculptor with good knowledge or reminiscence of Roman art and mythology.

In this preliminary study, three micro-samples were collected and analyzed, respectively M1, M2 and M3. These are powdery fragments, whitish to yellowish in colour, taken from lateral portions of the artefact, and not belonging to the marble bas-relief. The purpose of the study, in accordance with the requests of the interlocutors, was to characterize the materials present on the sides of the slab, almost certainly used as an adhesive or support for its adhesion to a wall.

III. METHODS AND RESULTS

The samples examined (M1, M2, M3) were first subjected to FTIR-ATR analysis to identify the mineralogical phases

and the presence/absence of organic compounds (Figures 2-4). This non-destructive analysis makes it possible to determine molecules' structure and molecular mixtures' composition. This type of analysis is a very suitable method for the investigation of cultural heritage materials due to its minimum requirements for sample preparation and its provision of high resolution. [7] The results showed the absorption bands of calcium sulphate dihydrate (gypsum, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) for sample M1. Such presence could be justified by the possible use of gypsum as a "rinzafo" to fill some empty point and/or to fix the bas-relief to the original support. In sample M2, in addition to gypsum, calcite and traces of silicates were detected. The latter suggested the use of a mixed binder. Similar is also the composition of sample M3.

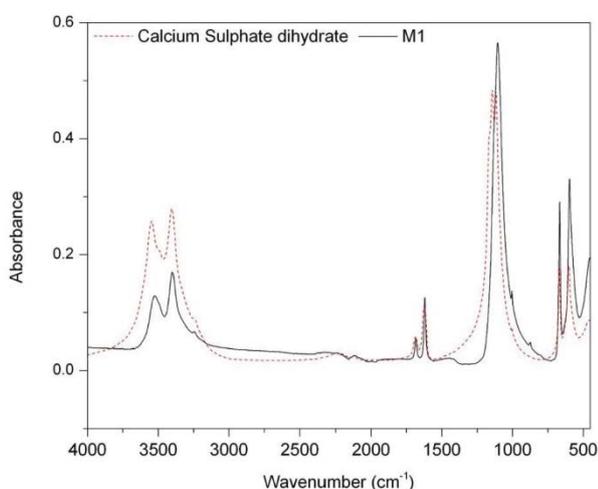


Fig. 4 IR spectra – sample M1 and comparison with literature data

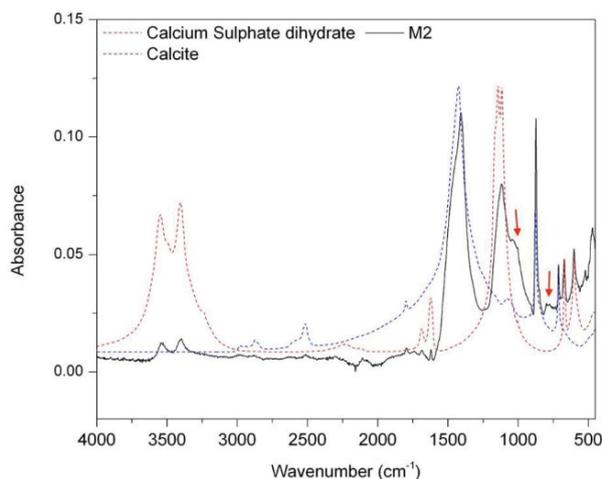


Fig.5 IR spectra - sample M2 and comparison with literature data

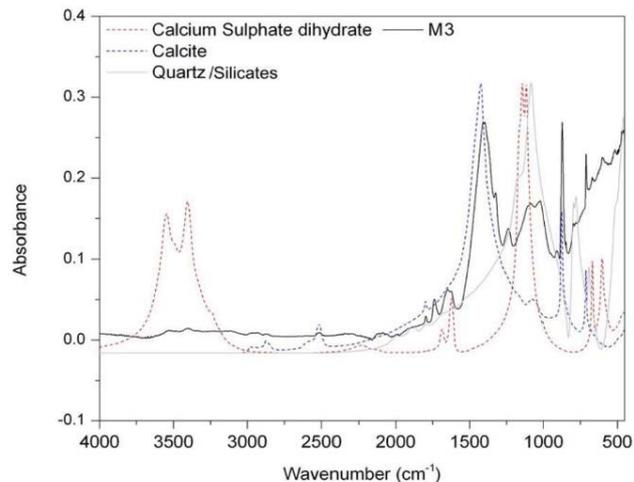


Fig. 6 IR spectra – sample M3 and comparison with literature data

Samples were further investigated by SEM-EDX; the latter was conducted only on M2 and M3. For the M2 sample, two analyses were performed in SPOT mode and two in AREA mode. This technique allows the investigation of the surface microstructure in the desired detail and offers the chemical composition of the examined area. [8] SEM-EDX confirmed the results obtained by FTIR-ATR. Specifically, elements linked to calcite (Ca-binder), and silicates (i.e. Si, Al, Mg, K, Ti, and Fe) were identified. The presence of Fe would justify the yellowish colour of the sample (Figure 6).

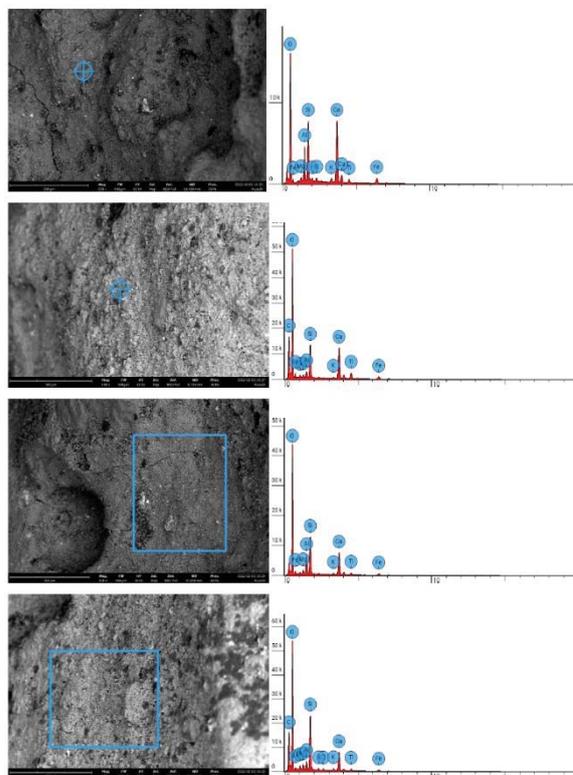


Fig. 6. SEM-EDX – sample M2

For M3, several points were analyzed in SPOT mode based on the slight colour difference: yellowish brown for the M3_a portion and darker for the M3_b (Figure 7). The results also in this case confirm the FT-IR investigations. The yellowish-brown colouration is probably linked to the presence of silicates mixed with iron oxides and hydroxides, evident especially in the portion of the sample M3_b, which has a darker colouration and an increased amount of iron. [9-12]

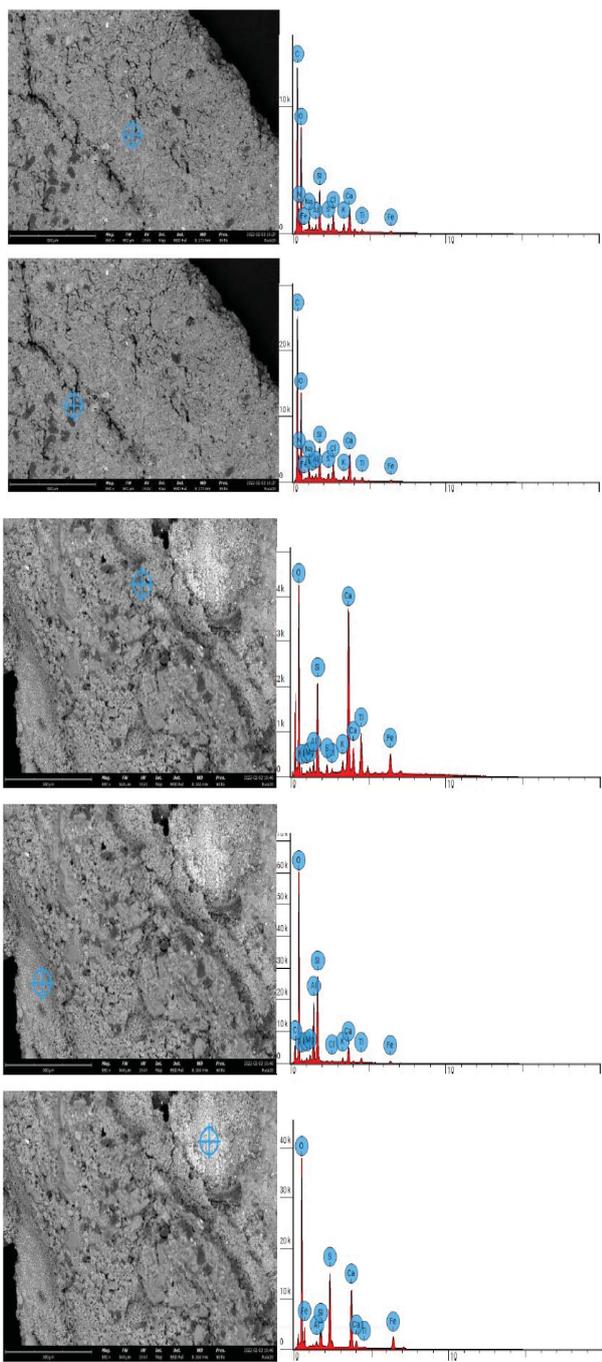


Fig.7 SEM-EDX – sample M3

IV. CONCLUSION

In this study, three micro-samples taken from lateral portions of the marble bas-relief were examined. M1 is a gypsum bonding mortar. M2 and M3 are lime-based binders containing pigmented compounds characterized by silicate minerals mixed with iron oxides/hydroxides. The results obtained do not show any chemical or mineralogical markers that can be traced back to the provenance of the raw materials. Historical-archaeological research is underway to identify the iconography of the artefact, useful for providing more details on the artefact of unknown origin made difficult by different elements and confused both iconographic and stylistic.

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