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A multidisciplinary study of Roman painted plasters from Roman villa in Ponti Novi (Sabina area, Lazio, Italy)

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ABSTRACT

A multidisciplinary approach has been used to investigate painted plasters coming from a Roman villa in *Ponti Novi* (*Sabina* area, Rieti, Lazio, Italy): both the plasters and the pigments have been analyzed by different techniques. In particular, optical microscopy, colorimetry, X-ray diffraction, chemical and granulometric analysis, have been performed on the *opus arenatum* layers of the plasters, while X-ray diffraction and μ-Raman spectroscopy have provided information on the pigments. Paleopalynological and opal analysis have also performed on the silt component of the mortar. The presence of clear imprints of *incannucciata* on the first preparatory layer of the plaster has been also observed on the larger part of the investigated samples. The experimental results have allowed to obtain interesting information on the materials and techniques used for the realization of the plasters and paints.

1. Introduction

The wall paints investigated come from the archeological site close to *Ponti Novi*, which is located in the river Tiber valley (*Sabina* area, Rieti, Lazio, Italy) (Fig. 1). The archeological findings of this site are preserved in the Magliano Sabina Museum and have been studied in the frame of a research project aimed at the reconstruction of the dynamics of Roman settlement in the *Sabina* (Colosi et al., 1999, 2001).

The settlement of *Ponti Novi* is cited for the first time by Antonio Pagani (1894) who reports about important Roman ruins near the San Lorenzo in Catiliano church and suggests to identify this site with the *massa malliana*, a landed estate owned by *gens Manlia*. The name of Magliano Sabina could derive from this toponym, which is largely cited in the library of the Farfa Abbey (*fundus mallianus*). In 1932 Palmegiani (1932) reported on findings in this area, and in '80s a local archeological group found a marble bust from the 2nd century AD and some fragments of channeled columns. Anyway the larger part of the remains from the *Ponti Novi* site has brought back to light in 2000 during excavations for the close highway.

The archeological findings of this site include several fragments of thin pottery of imperial and late-imperial (1st - 5th century AD), common ceramic, *dolia* and amphora, marble plates with mouldings, and a large number of colored marbles for valuable paving. The kind of found materials seems to suggest that the *Ponti Novi* establishment represents the typical model of lowland imperial villa, characterized by a very luxurious residential zone, generally with peristyles enriched with statues, but mainly devoted to an agrarian production function (Colosi and Costantini, 2004). The long life of the settlement was surely expedited by its optimal position along the main communication routes and by the closeness of a commercial port on the Tiber river (Sternini, 2004).

About one hundred plaster fragments with various sizes come from *Ponti Novi*. They are characterized by a white background painted with different decorative schemes. As the plaster fragments were occasionally found during excavation, it is not possible to clarify if they come from discharged materials or from breakdown of a building. Anyway the stylistic investigation seems to indicate that they belong to the same decoration scheme and in turn to the same wall. As will be forward discussed, this hypothesis could be confirmed by the presence of visible imprints coming from a reed structure (*incannucciata*) on the first preparation layer of the plasters.

The white background, the ordinary realization, the geometrical partition of the wall using large bands surrounded with thin lines and the repetition of plant motifs are typical features of the 2nd century AD, when this kind of decorations start to be observed in the less prestigious rooms and then in all the villa (Falzone, 2007). Various stylistic comparisons, particularly with some plasters from Ostia presenting circular motifs with dotted petals and plant *candelabra* (Falzone, 2004, Fiore, 2004; Tomei, 1996), allow to date the fragments of *Ponti Novi*

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Fig. 1. A schematic map of Italy, showing the location of Rome, the *Sabina* area and the River Tiber.

between the end of the 1st and the 2nd century AD. The most of the materials found on the site can be assigned to this period that in turns corresponds to the period of maximum extension of the villa.

Due to the notable value of the *Ponti Novi* plaster fragments for what concerns the decorative motif and the technical realization, it has been decided to investigate them from both an archaeometric and paleoenvironmental point of view. The aim of this research is the characterization of the background plaster and pigments, the reconstruction of the techniques, shading light when possible on the source of the used materials.

We have taken into account 17 samples, with different size, dimensions, morphology and decoration of the surface. Different analysis, as optical microscopy, X-ray diffraction (XRD), chromatic, chemical and granulometric analysis, have been performed on the layers of the plaster samples. Interesting results have been obtained from both the morphological studies of the reed imprints and the analysis on the vegetal microremains found in the plaster mortar. Finally, XRD and μ-Raman spectroscopy have been applied for the characterization of the pigments used in the surface paintings. These techniques are largely used in archeological research as they provide structural and molecular information which allow a complete characterization of the artworks (Schreiner et al., 2004; Vandenabeele et al., 2007). In particular, μ-Raman spectroscopy has received an increasing interest as it allows to obtain compositional information without consuming large amount of sample material and not requiring sophisticated and expansive preparation of the plaster.

The coupling of different techniques and methodologies, with a joint scientific and historical approach, has allowed to obtain interesting findings on the used materials and the construction and painting methods.

1.1. Experimental details

17 samples of painted plasters have been selected at the Magliano Sabina Museum among the large set of fragments from Ponti Novi. They present different size, weight (see Table 1), morphology and decoration of the surface. A chromatic analysis was performed under transmitted light according the Munsell system (Munsell, 1999). One side of the samples has been prepared for optical microscopy by smoothing it with fine grain sandpaper.

1.1.1. Chemical analysis

In order to point out the presence of organic matter and total carbon present in the sample, the two layers of *opus arenatum* have been separately calcined in a muffle at 650 °C for 1 h (Feigl, 1989). The amount of carbonates (binder) has been quantitatively measured by dissolving the plasters in a solution of 10% hydrochloric acid (chemical weathering) and determining the weight of chalk consumed by the acid.

For the charcoal analysis, 100 mg of material per charcoal were weighed on the analytic scale and pulverized in an electric Fritsch Pulverisette mortar grinder (with an onyx mortar). The material was then transferred to Teflon crucibles and dissolved in 8 ml of concentrated HF and 2 ml of concentrated $HC1O_4$. The crucibles were placed on and bath set at 200 °C until they were "dried out." The residue was left to cool at room temperature, then 2 ml of concentrated HNO_3 was added. Finally, the preparation was raised to a known volume with deionized water. The standard comparison solutions for the various constituent species, which were investigated with an ICP-OES system (Perkin Elmer Plasma 40), were prepared from solutions acidified with HNO_3 (0.1%) containing 1000 ppm of each analyzed species. The standards used are certified by Inorganic Ventures, Inc., Lakewood (USA), series NJ08701–ISO 9001-2000, with concentrations of 997 ± 3 g/ml, the pozzolan are certified of conformity CE EN 131239 by Cava Lapillo e Pozzolana Sutri (Italy).

1.1.2. Granulometric analysis

The component with particle size equal or minor of 2 mm in the two layers A and B was analyzed by the Mériaux method. (Mèriaux, 1957) The particle diameters of sand, silt and clay were determined by weighting 30 g of each sample, which have been tested for a 24 h sedimentation after treatment in H_2O_2 at 36%. Then the samples are passed through a column of 13 sieves with mesh diameters from 1.25 mm to 0.05 mm. The sieves are mechanically vibrated for 10 min, allowing to separate the particles. The weight of sediment retained on each sieve is measured and converted into a percentage of the total sediment sample and in a cumulative percentage.

1.1.3. Paleopalynological analysis

For each sample, the granulometric fraction attributable to silt was separated and used for the extraction of fossil pollens, through the method of enrichment (Guillet and Planchais, 1969). This method is generally used for sediment with a low content of fossil pollens. In particular, the gravimetric separation of pollens and spores in the silt sediment was obtained through dispersion and homogenization in a saturated solution of potassium iodide and mercuric iodide in water (Thoulet solution), with density in the range 1.9–2.1 g/ml. The resulting concentrated sample is then mounted on a slide for analysis with an optical microscope (James Swift). It's worthwhile to consider that paleopalynological analysis in archeological sediments containing vegetal microremains can be particularly complex compared to traditional applications, as drilling in ancient forests or uninhabited areas (Dimbleby, 1985), and the results obtained can be difficult to understand. This is because the microbiological activity of the vegetal microremains can led to oxidation processes.

1.1.4. μ-Raman spectroscopy

No sample preparation was required for the Raman analysis and the measurements were carried out in air, directly on the different samples of painted plaster. μ-Raman spectra were collected on samples at room temperature in the back-scattering geometry with a Dilor XY spectrometer equipped with a monochromator (grating 1800 lines/mm), a liquid