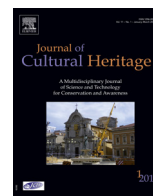




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Original article

## Pigment characterization of drawings and painted layers under 5th–7th centuries wall mosaics from Ravenna (Italy)

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### ABSTRACT

The results of a multi-analytical investigation on preparatory drawings below three late antique wall mosaics in Ravenna (Italy) are reported and discussed. Examinations were made on two *sinopiae* in mosaic substrates detached from the apse of the basilica of St. Apollinare in Classe and on the undercoloring characterizing some finds of wall mosaics coming from the basilicas of St. Agata Maggiore and St. Croce. Due to the historic and archaeological relevance of the finds, the research was carried out mainly through noninvasive techniques, such as fiber optics reflectance spectroscopy (FORS) and energy dispersive X-ray fluorescence spectrometry (EDXRF). Analyses by Fourier transform infrared spectroscopy (FTIR) and Raman micro-spectroscopy ( $\mu$ Raman) were only performed on incoherent material and small loss particles in the interstices among the *tesserae*. In some selected painted area, visible-induced infrared luminescence (VIL) was employed to verify if Egyptian blue was used and how was distributed, if present. By comparing the results obtained with the different techniques, a proposal about the nature of the pigments was formulated: the pigments employed to make the *sinopiae* from St. Apollinare in Classe are iron-based pigments, while the analyses of the undercoloring show a more complex character, where the use of a broader palette of pigments was recognized (red ochre, green earth, Egyptian blue).

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### 1. Research aims

The study of preparatory drawings under the mosaics suffers from a significant lack of information concerning materials (i.e. pigments and base and surface plasters) and techniques employed, since only few case studies have been considered with a scientific multi-analytical approach [1,2]. A correct and specific terminology for describing these preparatory drawings is a matter of discussion, too.

This paper focuses on the characterization of the pigments employed in two *sinopiae* found in the wall of the apse mosaic of the basilica of St. Apollinare in Classe (Ravenna, Italy) and in the

undercoloring of five fragments of wall mosaics from the excavations of the basilicas of St. Agata Maggiore and St. Croce (Ravenna, Italy), dated back to the 5th–7th century.

The word *sinopia* – deriving from a type of high quality red ochre (sinoper) [3: p.349–350] – came to mean the red under-ketch of fresco paintings. In mosaics, the *sinopiae* were employed since the Classic era and the term refers to the drawing painted on the architectural surface of both floor or wall mosaic, localized on the masonry or on the base plaster (*arriccio*), in strict analogy with wall paintings; more specifically, the underdrawing is the drawing traced on the setting bed [4–9 for wall mosaics and 10 for floor mosaics]. In this work, the terms *sinopia* and underdrawing are used to indicate two different drawings discovered under the apse mosaic in St. Apollinare in Classe basilica (Classe, Ravenna, Italy).

On the other hand, a more peculiar use of pigments for the mosaic substrate is the presence of the undercoloring (or painted backgrounds), coloured areas on the setting bed with two specific aims: to define the areas of different colours and to lower the bright hue of the bedding [4–8,10]. Generally, it often survived only in

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**Fig. 1.** *Sinopiae* and painted backgrounds under investigation: a: sinopia on brick-wall from St. Apollinare in Classe; b: underdrawing on *arriccio* from St. Apollinare in Classe; c: undercoloring among the tesserae – fragment from St. Agata Maggiore; d: undercoloring among the tesserae – fragment from St. Croce.

traces and is recognizable among the interstices of the tesserae and inside the impressions left by lost tesserae through a deeper visual analysis.

In this paper, we report the results of the analyses of the undercoloring found in five mosaic fragments from the archeological excavations in St. Agata Maggiore and one from St. Croce basilica (Ravenna, Italy).

In spite of their artistic significance and many attested occurrence of mosaic *sinopiae* and undercoloring [6 – see entry “underdrawings”; 8 – see note 1 and references therein], only a few archaeometric characterizations can be found in the literature about their composition and methods of manufacturing. This paper reports results on very interesting pieces of mosaics from Ravenna, the most important western site for the Byzantine mosaic art, in a panorama with only a few scientific investigations of mosaic *sinopiae*.

A recent work [1] reports the results of a multi-analytical study of a unique finding concerning the use of an extraordinary refined polychrome *sinopia* of a mosaic floor dated to the 4th century B.C. in Lod (near Tel Aviv, Israel). Executed by employing a fresco technique and by using not only common pigments, but also a valuable one like cinnabar, it is considered to be not a merely sketch, but an extraordinary work attesting the wealth and the social position of the patron who commissioned the work.

For the Italian area, recent studies [2] have revealed the presence of traces of painted backgrounds in a small group of mosaics from Pompeii, Rome, Privernum and Palermo. An interesting case is the one concerning a mosaic found in a house under the church of St. Susanna in Rome depicting Poseidon and a nymph [2]. Here, a polychrome painted layer was found on the setting bed, in addition to traces of a surface painting finishing (typical of the *opus vermiculatum* technique). This study indicates the practice of mixing pigments and the use of high quality materials (cinnabar and Egyptian blue). A noninvasive approach was employed to characterize an underpainting of fragments of glass mosaics from Rome with areas of different colors (red and light brown) by means of videomicroscopy and EDXRF identifying iron-based pigments [11].

In this work, a multi-analytical approach, mostly noninvasive, aimed at identifying the pigments used for the realization of *sinopiae* and undercoloring of Byzantine mosaics in Ravenna (Italy) is presented; the techniques and the materials of the Byzantine wall mosaics in Ravenna were extensively studied but this is the first case of characterization of preparatory drawings.

## 2. Materials and methods

The first *sinopia* from St. Apollinare in Classe is a brownish-red drawing executed directly on a brick-wall dated back to 6th century AD. The drawing represents a decorated frame with a central cross on whose sides are facing peacocks, flower baskets and other floral elements (Fig. 1a). This *sinopia* was found under the still existing wall mosaic decorating the apse (in correspondence of a mosaic with a completely different iconography) during the restoration work carried out between 1970 and 1973 [12]. The drawing refers to a previous and never accomplished iconographic program. The second artifact from the basilica of St. Apollinare in Classe is a greyish brown underdrawing representing a sheep (Fig. 1b), possibly ascribable to a restoration work dated to the 7th century AD, intended to repair a detachment of the original mosaic decoration [13]. According to the remarkable importance of these finds, they were removed from the original site and exposed in the National Museum in Ravenna [14] (fragments with peacocks – inventory number 1181; fragment with sheep – inventory number 11810).

Furthermore, five archaeological mosaic fragments have been examined. Four of them were unearthed in the basilica of St. Agata (one of the fragments is shown as an example on Fig. 1c), during an excavation carried out in the perimeter of the apse; these finds probably belonged to the wall mosaic originally decorating the apse (5th–6th century AD) [15]. Despite their small size, the presence of undercoloring (ochre, green, greyish purple and bluish black) was clearly detected, placed both in the narrow spaces between adjacent tesserae and inside the impressions left by lost tesserae. The fifth fragment (Fig. 1d) coming from the basilica of St. Croce (5th–6th century AD) [16,17] is characterized by the presence of relevant traces of red and greyish green painted backgrounds placed

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