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Material characterization of the Late Roman wall painting samples from Sinop Balatlar Church Complex in the black sea region of Turkey☆

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ABSTRACT

Two groups of Late Roman wall painting fragments (2nd–4th cent. A.D.), from Sinop Balatlar Church Complex in northern Anatolia, were analyzed in order to reveal their material characteristics, painting stratigraphy and the pigments used by optical microscopy, XRD, μ-XRF, Raman spectrometry and SEM–EDX. Two types of arriccio plasters were identified. The painting stratigraphy is variable among the two wall painting groups. The pigment palette of the wall paintings is similar to those of the other Roman wall paintings analyzed elsewhere, including calcite, yellow and red ochre, goethite, cinnabar, dolomite, green earth and carbon black. The results of this study contribute to our present knowledge about the characteristics of the wall painting materials during the Late Roman period in the context of the Black Sea region.

1. Introduction and historical background

Roman wall paintings have long attracted the interest of researchers from many aspects, with their vigorous and elaborate scenes in various architectural contexts, displaying a wide range of vivid colors. Extended in a very large geographical area, these wall paintings are still waiting to be explored in terms of material and technique and evaluated in a comprehensive manner. In the last decades, the scientific analysis of the Roman wall painting techniques and the pigments used has become a research interest on the rise. The archeometric studies of the Roman paintings have been conducted mainly in Italy [1–10], Switzerland [11,12], Spain [13–15] and England [16–18] as well as in Cyprus [19], Greece [20], Austria [21] and France [22]. However, when compared to the research conducted in the mainland Italy and Europe, archeometric studies of the Roman wall paintings found in Anatolia are still scarce, with few examples mainly from Zeugma [23,24] and Ephesus [21,25]. Given the strategic importance of Anatolia during the Roman period as a melting pot of the local and external cultural elements, more studies should be conducted to understand about the technological interactions with the mainland and the Roman provinces.

The northern part of the Anatolian peninsula, so-called the Black Sea region of Turkey, is especially significant for its key role in the expansion of the Roman Empire into Anatolia from the political, economic and cultural aspects [26]. Sinop, which is the northernmost point in Anatolia, had served as a trade center with its natural port since the Hellenistic period. Balatlar Church Complex, in the city center of Sinop, is an ancient building complex which had been in continuous occupation and used for different purposes from the Late Roman period until the early 20th century. The ongoing excavations since 2010 revealed that the building's earliest construction phase dated to the 2nd–3rd centuries as a Roman bath-*palaestra* complex. Then, it was converted into a church in the 4th–6th century and finally a Rum Orthodox monastery during the Ottoman period [27]. Balatlar Church Complex is the only survived building of ancient Sinop which can be defined in terms of its real identity other than the city wall remains [28]. It is also significant for being a prominent Late Roman building in the context of the Black Sea region.

The present study is about the material characterization of the Late Roman wall painting samples from Sinop Balatlar Church Complex, with a particular focus on the pigments used. Therefore, the paints as well as the plaster layers were characterized by different types of analytical techniques such as optical microscopy, XRD, μ-XRF, SEM–EDX and Raman spectrometry. For the first time in this study, Late Roman

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wall painting samples from the geographical context of the Anatolian Black Sea coast were analyzed. The outcomes of this study are expected to shed light on the material characteristics of the Late Roman wall paintings in the context of the Black Sea Region.

2. Experimental

During the excavation works, a great number of collapsed wall painting fragments were recovered from grids IVd and IVf in the south-western part of the complex, which might be related to the *tepidarium* of the Roman bath (Fig. 1). Fourteen wall painting fragments were selected for the analyses. These fragments are divided into two groups, according to their types of decoration and the visual characteristics of their plasters (Table 1). Group I is mostly characterized by separated areas of different widths in tones of red, brown, yellow, green and white. Some of the samples are plain, exhibiting only one color. Within this group, some of the fragments display two plaster layers (Group Ia) whereas the others display only one plaster layer (Group Ib). Group II can be characterized by traces of decorations in particular green, red and yellow, in the form of partially lost motifs (probably vegetal) and lines. The samples of this group display only one plaster layer. Both of the wall painting sample groups were most probably dated to the 2nd–4th century A.D.

All the analytical experiments were carried out using the facilities of Central Research Laboratory, functioning under Materials Research Center for Cultural Property and Artworks in Mimar Sinan Fine Arts University (MSGSU).

2.1. Loss on ignition

The loss on ignition analysis was carried out on both arriccio and intonaco plasters in the case of sufficient amounts available. The plasters were finely ground in an agate mortar. 1 g of each sample was placed in a porcelain crucible which was exposed to increasing temperatures. The samples were initially heated in an oven at 105 °C for 4 h, then ignited at 550 °C and 1050 °C in a muffle furnace for 30 min and 5 min respectively. After each heating, the samples were cooled in a desiccator and weighed by a precision balance. From the weight differences, the humidity, the content of bound water, the organic matter and the calcium carbonate content were determined.

2.2. Petrography

The cross-sections of the wall painting samples were prepared using a mold where the samples were placed and filled up with epoxy resin. After 24 h, the samples were cut from the molds in rectangular form. The surfaces of the samples were smoothed with a polisher (Metkon Forcipol 300-1V machine). Then, they are washed in ultrasonic bath for 20 min and dried in an oven for ca. 4 h. The samples were then stuck to the microscopic slides with epoxy and then cut with a Geoform machine to obtain the thick sections. The thin sections were prepared by grinding the thick sections down to ~30 μm, with Geoform machine. A Nikon SMZ 1000 stereomicroscope (1–8×), equipped with a digital camera and a Nikon Eclipse 50iPOL polarizing microscope (2.5–4×) were employed for the observation and photography of the thick and thin sections. The binder/aggregate fractions and the aggregate types were determined by examining thick sections under the stereo microscope. The types of rock fragments and minerals were mainly identified from the thin sections by polarizing microscopy.

2.3. Color analysis

The color coordinates of the wall painting samples were measured in the CIELab system by a Konica Minolta CM-700d/600d spectrophotometer, using an observer angle of 10° and D65 illuminant. Each sample was measured at three points on the surface and the average of the measurements was expressed in L, lightness, a and b, chromaticity coordinates. Some of the colored areas could not be measured due to theirinsufficient width.

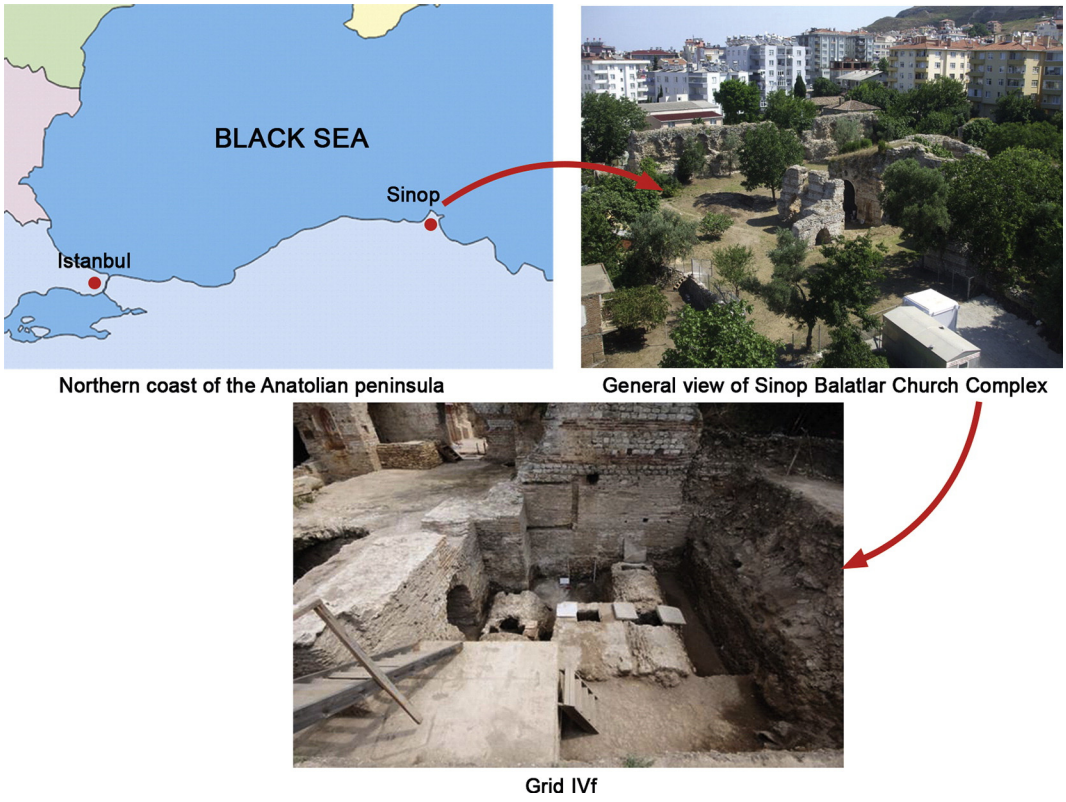

Fig. 1. The location of Sinop and the images of Sinop Balatlar Church Complex.