



Early Islamic pigments used at the Masjid-i Jame of Fahraj, Iran: a possible use of black plattnerite



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ABSTRACT

Based on micro-Raman spectroscopy (μ -Raman), micro X-ray fluorescence spectrometry (μ -XRF), X-ray diffractometry (XRD) and optical microscopy, this paper presents the results of our analytical studies on the early Islamic pigments used in the Masjid-i Jame of Fahraj, central Iran. Our investigations showed that ultramarine blue and haematite were used as blue and red pigments, respectively. Moreover, huntite was identified as white pigment with which whewellite was associated as a degradation product. Interestingly, the black paint was identified to be mainly composed of black plattnerite mixed with mimetite, hydromorphite and galena. Our geological survey at the Darreh Zanjir mine, located 35 km west of Fahraj, suggested this mine to be a possible source for supplying the black plattnerite. Accordingly, black plattnerite is suggested to be most probably used as a pigment and not to have formed as a degradation product of lead-based pigments.

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1. Introduction and historical context

The Masjid-i Jame of Fahraj is placed in the village of Fahraj, 35 km south–east of Yazd, around the central desert of Iran (Fig. 1). This mosque has a free-standing adobe structure without the familiar *iwans* and dome chambers of later Islamic mosques. There is no general consensus about the date of constructing the mosque. Attributing the mosque to the early Islamic centuries, Pirniya (1970) emphasised the structural relationships of the mosque with pre-Islamic Persian architecture. Galdieri (1973, p. 46) assigned this mosque to a period spanning from the eighth to the tenth centuries. Zipoli and Alfieri (1977, p. 76), as Finster (1994, p. 189) lately suggested, recognised the mosque as a monument of the second half of the ninth century towards the early tenth century. Thereafter, Shokoohy (1978, p. 74) attributed the mosque to the eighth century and, recently, Anisi (2007) suggested that the mosque has been constructed in the ninth century. The Masjid-i Jame of Fahraj consists of a main *mihrab* (Fig. 2a) and two other smaller *mihrabs*, a *shabistan* and an arcade around the courtyard.

The pillars of the *shabistan* are rectangular in plan and have four decorative engaged columns at each corner. There are also three decorative false relief double doors in the east wall of the *riwāq* (Fig. 2b).

As far as the painted decorations of the mosques are concerned, these decorations were mostly neglected in previous studies. Zipoli and Alfieri (1977), and then Anisi (2007), are those who have briefly described the paintings of the mosque and emphasised their importance for a more accurate dating of it. Zipoli and Alfieri (1977, p. 74) noted a red paint covering the false doors and explained a red medallion on a pillar placed in the southern side (Fig. 2c). Anisi (2007) briefly mentioned the remains of wall paintings at the mosque and attributed a particular significance to these paintings as the first example of Persian mural paintings in the Islamic era. According to our observations, the mosque's walls are covered with a mud plaster on which a delicate layer of a white paint is placed. The decorative elements of the mosque are composed of simple mud reliefs around the *mihrab* and above the arches, three false doors made of a fine clay-straw plaster on the south–east wall and, after all, traces of red, blue and black paints can be sporadically seen on the white paint, which is extensively used to whiten the mosque's walls. Here, the black paint is used to make bands along the margins of the decorative engaged columns of the pillars (Fig. 2c). Moreover, while the red paint is used to paint the medallion and the false doors (Fig. 2b), traces of the blue paint can be seen on the

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Fig. 1. Location of Fahraj village in central Iran (http://d-maps.com/carte.php?&num_car=5497&lang=en).

main *mihrab*, in the southern side of the mosque (Fig. 2a). All the painted decorations are severely damaged by the action of termites and need urgent restoration work to be preserved from further deterioration.

Despite the importance of early Islamic pigments, our knowledge of the field is scant and limited to the efforts of Wilkinson (1986, p. 115 and p. 169) who reports ultramarine blue, vermilion and red ochre in the ninth to the mid-tenth century wall paintings of Nishapur (north–east Iran). Moreover, Kostrov and Sheinina (1961) report red, brown and yellow iron oxides, orpiment, natural ultramarine blue, charcoal black and kaolin or gypsum in the seventh to the eighth century wall paintings of Panjikent (formerly Sassanid Persia and now in Uzbekistan). The current paper presents our studies on identifying the remains of pigments found at the Masjid-i Jame of Fahraj. To do so, micro-Raman spectroscopy (μ -Raman), micro X-ray fluorescence spectrometry (μ -XRF), X-ray diffractometry (XRD) and optical microscopy were used to identify the chemical and mineralogical compositions of the paints and to address the question of their provenance. Amongst the first examples of pigments used in Islamic Persia, these pigments are of significant importance for the history of the use of pigments in the Islamic lands and, particularly, in Iran. As these pigments have not been previously studied, their identification contributes to the limited body of knowledge available on early Islamic pigments.

2. Materials and methods

2.1. Samples

The wall paintings of the Masjid-i Jame of Fahraj are severely damaged and partly covered by later alterations. The paints subjected to our analytical studies comprised of white, red, blue and black (Fig. 2). Amongst the sampled paints, the white paint was predominantly used for whitening a clay-straw plaster, and the red paint was used as a plain coat on the false doors and on the medallion (Fig. 2b,c). As the medallion was severely damaged, sampling from the red paint was only performed on the false doors (Fig. 2b). The blue and black colours are only preserved as traces and were presenting no clear pattern. This may explain why these paints are not mentioned in previous studies. Traces of the blue colour are only preserved above the main *mihrab* and mostly covered with a later white coat (Fig. 2a). The black paint is recognised as a bordering element along the decorative engaged columns of the pillars. The black paint is also covered by a later white paint (Fig. 2c).

2.2. Optical microscopy

The optical properties of the pigments were studied with an Alltion BK-POLT (China) polarised light microscope (PLM). A Canon EOS Kiss x4 digital camera was used to capture photos of the

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