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Mexican Lacquer at the Victoria and Albert Museum: Analysis of Three *Bateas*

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Abstract: This study investigates the materials and techniques used in three Mexican platters, or *bateas*, from the Victoria and Albert Museum collection. Our analytical approach included the use of non-invasive techniques, such as infrared reflectography, scanning X-ray fluorescence, and digital microscopy, which informed limited but targeted sampling. Traditional pigments were identified, including indigo, carbon black, red lead, lead white, and orpiment, and materials such as dolomite, gypsum, ochres, and clay were also found. A red organic dye was seen but could not be identified. The stratigraphy of the objects was also investigated. The condition of the objects was also evaluated, and the results will be used to inform future conservation decisions. The findings add to the published knowledge of the materials and techniques of early colonial Mexican objects and can be of use in future investigations, facilitating exchanges and collaborations focused on this type of objects, which are rare in UK collections.

Keywords: Indigenous American lacquer; Mexican lacquer; *batea*; chia oil; *aje*; scientific analysis

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1. Introduction

1.1. The V&A Bateas

The collection of pre-twentieth-century Mexican furniture and woodwork held by the Victoria and Albert Museum (V&A) is small, but not insignificant in the context of the United Kingdom, where Latin American furniture is generally rare. In a recent survey, nine pieces were identified alongside a similar number of leather artefacts that are also plausibly Mexican, although focussed research would undoubtedly provide a more accurate picture [1].

Of these nine pieces, the earliest to be acquired by the South Kensington Museum (as the V&A was called until 1899) were three large wooden platters, or *bateas*, with colourful surface decoration (V&A: 156-1866, 157-1866, 158-1866; see Figure 1). These form the focus of the research presented here[1].

The *bateas* were purchased together from the Leon dealer Villa Amil for 10 shillings, 10 shillings and £1, respectively, and are of similar dimensions, colouration, and condition. The report of the purchase, number 14793, dated 22 May 1866, was prepared by J.G. Robinson (1824–1913), effectively the museum's first curator and an energetic traveller in Spain, who can be assumed to have selected the pieces himself. The report described each as a 'Circular platter or shallow wooden bowl, painted or lacquered... Spanish 17th century work,' without providing further detail, a brevity that was not unusual in museum documentation at the time. Whether Villa Amil knew the platters to be Latin American but offered them to Robinson as Spanish on the basis that they would be more attractive to potential purchasers cannot be proved, but only six years later Robinson's attribution was corrected by Juan Facundo Riaño (1829–1901), acknowledged authority on Spanish decorative arts and from 1870 the museum's Professional Referee [2]. His report from January 1872 on museum objects acquired as Spanish 'which Señor Riaño declares not to be Spanish' includes the three platters, describing them as 'Mexican or Peruvian'[2]. The museum's official attribution remained cautious—'Spanish. (Mexican?) 17th century.'—when the pieces were published for the first time shortly afterwards in the first comprehensive catalogue, *Ancient and Modern Furniture & Woodwork in the South Kensington Museum, described with an introduction by John Hungerford Pollen* (London, 1874). All three pieces were subsequently included in the landmark Special Loan Exhibition of Spanish and Portuguese Ornamental Art at the South Kensington Museum in 1881 [3] (p.124).

Figure 1. The three *bateas* sin the V&A collection. (**a**) 156-1866, height: 5.5cm, diameter: 43.0–43.7cm; (**b**) 157-1866, height: 5.4cm, diameter: 45.5–45.7cm; (**c**) 158-1866, height: 5.0cm, diameter: 42.5–43.0cm.

Although at least one of the platters was displayed during the 1960s[3], they have apparently passed an inconspicuous existence at the museum until interest in Latin American lacquer was reignited by the 2015 acquisition of *barniz de Pasto*, described elsewhere in this volume [4]. Based on generous advice from Dr Gustavo Curiel (Universidad Nacional Autónoma de México, UNAM), Dr Mitchell Codding and Monica Katz (Hispanic Museum and Library, New York, NY, USA), the *bateas*—now photographed for the first time—were published online and attributed as having been produced in Peribán (Michoacán), c.1650-1700. Over a period of ten months in 2017–2018, one of the platters, V&A 158-1866, was exhibited in the Dr Susan Weber Gallery of Furniture as part of a trail of small displays devoted to the manifold arts of lacquer entitled 'Lustrous Surfaces', drawing attention to the quality and beauty of this work, comparatively little known in the UK [5]. At the time of writing, they appear to be the only pieces of pre-1900 Mexican lacquer in a UK museum collection to have been published online, but others must surely exist.

1.2. Mexican Lacquer Tradition

Various accounts of lacquer traditions in Mexico have been published elsewhere [6–9]. In summary, it can be observed that lacquer work dating back more than two millennia was produced at various locations, including Mexica, Purépecha, and Maya in Chiapas, Coahuila, Yucatán, Morelos, and Puebla. Large quantities of lacquered gourds and 'dishes' made from a split fruit shell were made for domestic use and used as a taxation payment. With the arrival of the Spanish in New Spain and the introduction of iron woodworking tools, lacquer techniques were adapted to serve the Spanish market, with centres of production in Peribán, Uruapan and Pátzcuaro (in the modern state of Michoacán), and Olinalá (in the state of Guerrero). Local techniques and styles seem to have been developed and applied to a wide range of artefacts, including both decorative and utilitarian objects such as boxes (including those for writing materials), chests, gourd bowls (*tecomates*), cups (*jícaras*), and large wooden platters (*bateas*). *Bateas* were the most widespread lacquer product of the colonial period, and the largest examples reached 125 cm in diameter. Peribán products were 'prized for their colourful decoration and exotic medium, gaining such fame that any large, lacquered bowl was often referred to as a *peribana* into the nineteenth century'[4]. Typical motifs—ultimately derived from European prints—covering the interior surfaces include Mannerist strapwork and an eye-catching assortment of costumed figures and creatures. From the seventeenth century, the terms used to describe lacquer work included *pinturas* (paintings) and *barnices* (varnishes). As the influence of Japanese *urushi* lacquer products became more marked in the 18th century, other terms are recorded more frequently, such as *laca* (lacquer) and *maque* (from the Japanese *maki-e*).

1.3. Materials and Techniques of Mexican Lacquer

The materiality of most Indigenous American lacquer remains under-investigated. Many characterisation studies have focused on *qeros*, Andean ceremonial cups from the pre-Columbian period, and *barniz de Pasto*, an indigenous decorative technique now primarily centred in the city of Pasto, Colombia [10]. Very few studies have targeted Mexican lacquer [11–15].

While the *barniz de Pasto* technique relies on the so-called *mopa mopa* resin as the main component in the decoration, and the *de facto* binder for any pigments and dyes; the typical binders of Mexican lacquer are chia (*Salvia hispanica*) oil or *chicalote* (*Argemone munita*) seed oil and a fatty substance obtained from the *aje* insect (*coccus axin*). These were combined with pigments, dyes and bulking agents, and applied to various types of objects.

Archaeological findings and historical accounts show that early objects were as colourful and decorated as the later *bateas* [8,16,17]. One of the oldest historical records of these techniques was produced by José Antonio de Alzate y Ramírez in 1831, who refers to Joaquin Alexo de Meave [18]. More recent studies on Mexican lacquer techniques [8,19–21] suggest that different types of Mexican lacquer can be identified from the manufacturing details which were typical of individual production centres. Objects were decorated using different types of inlay techniques, such as *embutida* or *encrostada*; *recortada* (cut-out) or *rayada* (grooved); finally, *aplicada*, where brush-painted decoration is applied to the finished lacquer surface, using pigments or metallic powders mixed with seed oil [8,19,21].

As for the pigments and dyes used in the Mexican territories, historical records and scientific studies exist for other types of objects, such as manuscripts and murals. According to Haude [22], two sixteenth-century sources are particularly valuable for studying Mexican colorants. The primary resource is the *Florentine Codex*, also known as the *Historia General de las Cosas de Nueva España*, compiled by Fray Bernardino de Sahagún in Tlatelolco, Mexico, between 1575 and 1580. Important sources of information on Aztec colourants include the *Badianus Manuscript*, also known as the *Libellus de Medicinalibus Indorum Herbis*, and the *Codex Barberini*, created by two Aztec scribes in 1552 at the Colegio de Santa Cruz in Tlatelolco, Mexico [22]. Various analytical campaigns have identified some of the materials in codices and sixteenth-century maps [22], Aztec [23,24] and early-colonial codices [25,26]. A few scientific analyses have been performed on different types of objects dating back to early colonial Mexico. Garcia-Bucio [27] has compiled a list of the main pigments used in easel paintings from that period, based on their Raman spectra. Many of these pigments were also found in a study of a 1605 painting from Mexico City [28]. Cabello's thesis [29] traces the evolution of the use of some pigments from the sixteenth to the eighteenth century, while Casanova-Gonzalez [30] studied the variability of pigments used in wall paintings. These sources allow us to evaluate how the availability of pictorial materials changed during the early colonial period of Mexico. It is expected that materials traditionally used by the Aztecs gradually disappeared, replaced by imported Spanish materials [25,26].

1.4. Research Aims

This work focuses on the analysis of three V&A *bateas* in order to add to the published knowledge of the materials and techniques found on this type of object and to facilitate comparisons between the three *bateas* and early colonial Mexican objects in other collections. Our analytical approach included the use of non-invasive techniques to inform targeted sampling. Our research will be of use in future investigations and collaborations focused on Mexican lacquer objects to make comparisons with similar items and suggest possible production dates or workshops.

2. Materials and Methods

The analysis protocol used in this study saw each *batea* first being analysed using non-invasive techniques to gather evidence about the state of the surface, the elemental composition of the decorative schemes and, where possible, stratigraphic information. Within this framework, infrared reflectography and high-resolution digital microscopy were used first, followed by scanning XRF in selected areas. These three non-invasive techniques informed the sampling, followed by the preparation of cross sections where samples were suitable. The analysis of the samples by Raman spectroscopy and scanning electron microscopy coupled with energy-dispersive X-ray analysis (SEM-EDX) provided essential stratigraphic information. This protocol was found to be the most appropriate to obtain as much information as possible while limiting the extent of invasive sampling, which is always the last resort in a museum setting.

Infrared reflectography (IRR): IRR was conducted with an Apollo IR Camera (Atik Cameras Limited, Norwich, UK) sensitive to near IR wavelengths from 900 to 1700 nm. The camera is equipped with an InGaAs line array sensor with an area of 125 × 125 px. Images were acquired with a focal aperture of F11 and a focal length of 150 mm. Two tungsten lamps were positioned symmetrically at ~45° with respect to the focal axis of the camera. A 1250 nm Short Wave Pass filter (SWP), a 1250–1510 nm Bandpass filter (BP) and a 1510 nm Long Wave Pass filter (LWP) were also used.

High-resolution digital microscopy: Digital microscopy was performed with a bench-top Hirox HRX-01 digital microscope (Hirox Japan Co., Ltd., Tokyo, Japan) and an H-1020E attachment. The images were acquired with ×10, ×30, or ×90 magnification, using a polarised ring LED light and multi-focus mode. Raking light and UV illumination (SP-AC-2016UV-RL attachment) were also used. Images were processed with the HRX-01 software version 2.24 and Adobe Photoshop 24.7.0.

Scanning X-ray fluorescence (XRF): The XRF scans were carried out using a Bruker M6 Jetstream spectrometer (Bruker Nano GmbH, Berlin, Germany) equipped with a Rh-target microfocus X-ray tube and two 60 mm^2 XFlash silicon drift detectors (SDDs). The X-ray tube was operated at 50 kV and 600 µA in air. The elemental distribution maps of the table areas were collected with a 100 µm spot size, a 180 µm step size, and a dwell time of 55–75 ms/pixel. The X-ray fluorescence spectra were calibrated, fitted, and processed using the Bruker M6 Jetstream software, version 1.6.758.0.

Sampling and cross sections: A total of 19 samples across the objects were taken from pre-existing areas of loss to investigate the stratigraphy and the methods of manufacture, according to British Standards (BS EN 16085:2012—ISBN 978 0 580 70588 5) [31].

Before sampling, a careful survey was conducted to minimize the quantity of sample collected, which was never larger than 1.0 mm across, to maintain the integrity of the object. The choice of the sampling areas was determined by many factors, such as accessibility and significance. The utmost attention was given to ensure that the samples were collected while limiting any contamination.

The samples were embedded using a mixture of Alec Tiranti TM Ltd. (Conwy, UK) clear casting resin (styrene and methyl methacrylate/polyester resin, product code: 405-210) and liquid hardener (BUTANOX M-50 methyl ethyl ketone peroxide, solution in dimethyl phthalate, product code: 405-810) in the proportion 2 mL: 1 drop. This required 48 h to cure and harden. After curing, the resin-embedded samples were polished with a Struers DAP-7 grinder using Struers waterproof silicon carbide abrasive paper from 220 to 4000 Grit. The final polish was obtained with polishing cloth and Struers AP-FF alumina suspension 0.1 µm (Struers, Rotheram, UK).

Optical microscopy: A Zeiss AxioImager M2m polarised light microscope (Carl Zeiss Microscopy GmbH, Jena, Germany) was used to acquire microphotographs of the cross sections in reflected light. The images were acquired with different magnification, as needed, under visible LED light, DAPI-filtered UV light, and AF488-filtered UV light.

Raman microscopy: A Horiba XploRA spectrometer (Horiba, Kyoto, Japan) equipped with three diode lasers (532, 638 and 785 nm) and an Olympus microscope was used for all the Raman experiments carried out on the fragments. Only the ×50 objective was used, providing an overall magnification of 500. The power at the sample was always kept below 2 mW. Most measurements were performed with the 785 nm laser, although on a few occasions the 638 nm laser was also used. Total accumulation times varied between 3 s and 3 min and no spectral manipulations were used, apart from the use of the LabSpec v.6 software proprietary ICS process when needed.

Scanning electron microscopy with energy-dispersive X-ray analysis (SEM-EDX): A Hitachi TM4000Plus II tabletop microscope (Hitachi, Tokyo, Japan) with TM4000 software version 2017, 2021 was used for the acquisition of SEM Back-Scattered Electron (BSE) images in the back-scattered and secondary electron detection modes. Oxford AZtecOne 4.3 software was used for EDS analysis to generate elemental maps of the sample. Image acquisition and EDS analysis were performed at accelerating voltages of 15 kV and 20 kV, respectively, in Low Vacuum Mode (∼60Pa).

Fourier-transform infrared spectroscopy (FTIR): FTIR-ATR (Attenuated Total Reflectance) analysis was performed using a Thermo Nicolet iS10 FTIR spectrometer (Thermo Fisher Scientific, Waltham, MA, USA) combined with a Golden Gate diamond cell attachment. Three fragments from 157-1866 (samples 3 and 4) and 158-1866 (sample 6) were positioned to cover the 2 × 2 mm window. Instrument parameters were in the range of 4000–550 cm^{-1}; the number of scans was 64; and the resolution was 4 cm^{-1}. The results obtained were searched against the IRUG and in-built databases.

3. Results

The three *bateas* display similarities and differences: they have comparable dimensions, and each is carved from a single piece of wood. The reverse of two are painted in plain black, whereas 158-1866 displays a polychrome decoration on both the front and reverse. A significant amount of fluorescent disrupted varnish can be seen on 156-1866 and 157-1866 when they are examined under UV light, while 158-1866 shows a very thin surface coating in places. All painted surfaces show various amounts of *craquelure* (Figure 2).

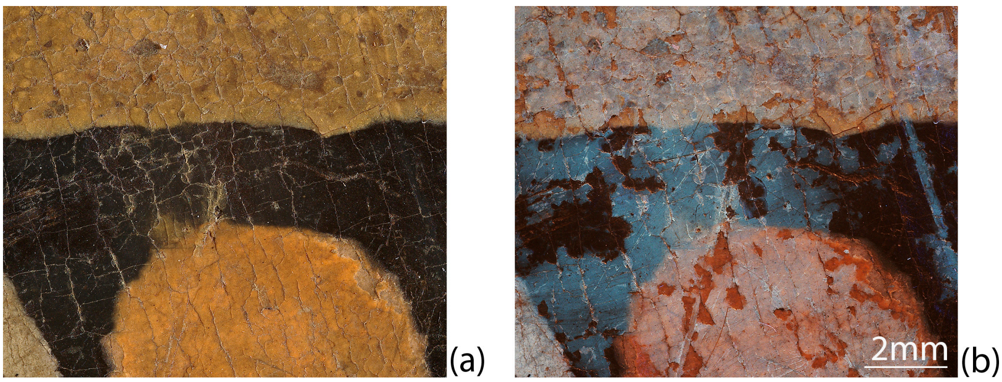

Figure 2. Detail of *batea* 156-1866 under visible (**a**) and UV (**b**) illumination, showing craquelure as well as remnants of a fluorescent natural resin varnish.

Bateas 156-1688 and 157-1866 show a similar, rather limited and muted palette, and a stylized decorative scheme (Figure 1). The third *batea* (158-1866) has a more vibrant, glossy palette, and its decoration includes small figures and creatures. Some of the details of the coloured areas appear difficult to read and may have partially changed over time. Infrared reflectography images show such details more clearly. Figure 3 shows such an example, and highlights that only the black areas are likely to contain carbon because they remain black in the infrared—this will be discussed further below.

The different areas will be discussed separately according to their colour.

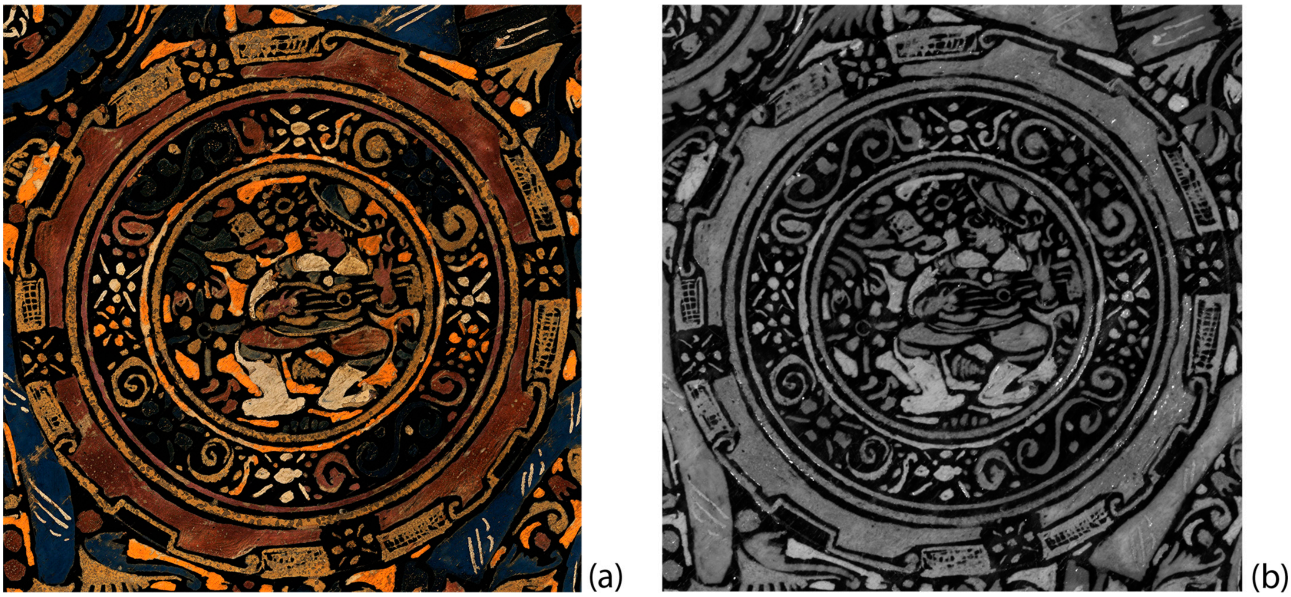

Figure 3. A detail of the central decoration of *batea* 158-1866 viewed under visible illumination (**a**) and with the infrared reflectography camera (**b**).

3.1. Black

The mapping XRF experiments reveal that the black areas are rich in iron, with small amounts of potassium, titanium, and manganese. Figure 4 shows a detail of the central roundel of *batea* 156-1866, including the relevant elemental distributions maps, and highlights the *craquelure* and the depth of the dark background's colour against the orange, white, and blue details.

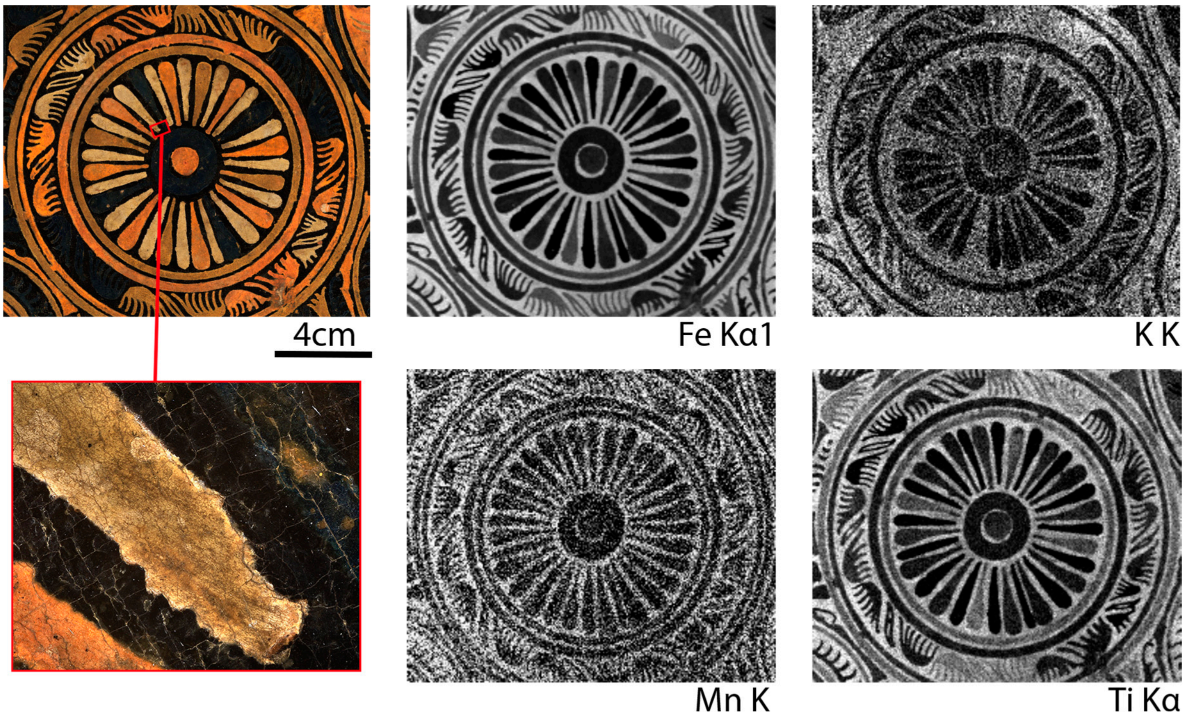

Figure 4. A detail of the central roundel of *batea* 156-1866. The elemental distribution maps show that the background primarily contains iron (Fe Kα1), potassium (K K), manganese (Mn K), and titanium (Ti Kα). A close-up within this area (see red square) shows the craquelure and the depth of the colour of the dark background against the orange, white, and blue areas.

Several samples were taken from black areas on the three *bateas* and were mounted as cross sections. The stratigraphy is consistent across the three objects, and is exemplified by sample 1 from 157-1866, shown in Figure 5. The layer structure is very simple and shows a reddish foundation layer (L1), a black layer (L2), and occasionally a varnish layer (L3). The combination of the SEM-EDX and Raman analyses shows that the foundation layer contains a reddish clay (anatase and hematite were identified by Raman), and the main component of the black layer is carbon black.

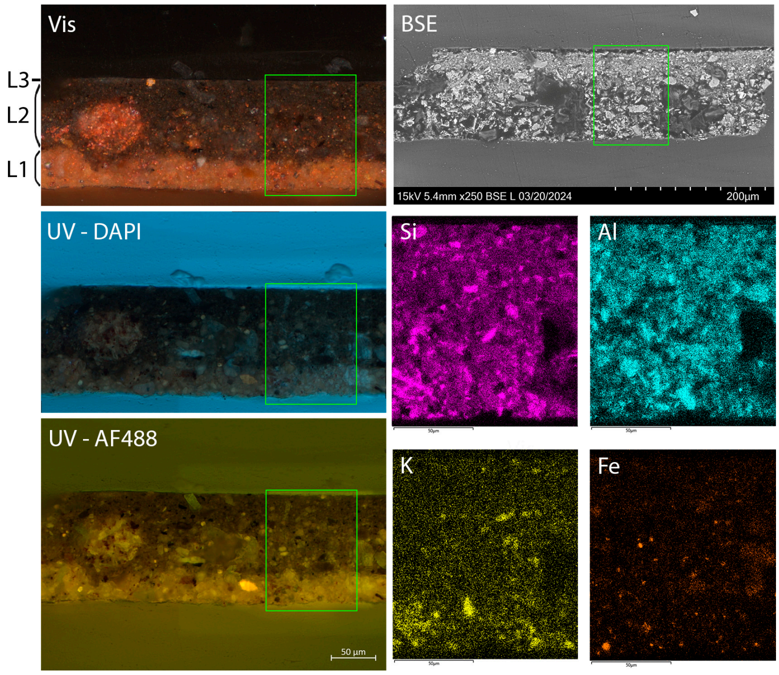

Figure 5. Representative stratigraphy of the dark background (sample 1, *batea* 157-1866). EDX analysis suggests that L1 (red foundation layer) and L2 (dark background colour) are mainly made of clay (Si Ka1, Al Ka1, K Ka1). Both layers show iron-containing red particles (Fe Ka1), and the darker colour of L2 is due to the presence of carbon black, as confirmed by Raman analysis. Note: The green square highlights the area analysed by EDX.

3.2. White

Scanning XRF analysis of the *bateas* showed that the white areas primarily contain lead and some calcium. Figure 6 shows a detail of the central roundel of *batea* 157-1866, where the white paint is made mostly of lead with some calcium, while the orange paint (discussed in Section 3.3) contains lead but not calcium. The close-up acquired with the digital microscope confirms that the lead-containing white details (blue arrow in Figure 6) are applied on an off-white foundation layer (green arrow in Figure 6).

It is important to underline that the distribution map of calcium can be misleading, as the signal of calcium emitted by the foundation layer can be unevenly shielded by heavier elements used in the decorative layer, depending on the colour and composition of the latter. However, where the lead-containing layer is missing due to loss or damage, the foundation layer is exposed, and the signal of calcium is more intense (see Figure 6, but also the following section further down).

All cross sections taken from white areas confirm that an off-white foundation layer is present, followed by a dense white layer and occasionally by a varnish layer. The Raman and SEM-EDX analyses confirmed that the foundation layer is made of dolomite ($CaMg(CO_3)_2$) and the dense white layer contains a mixture of clay and lead white (Figure 7).

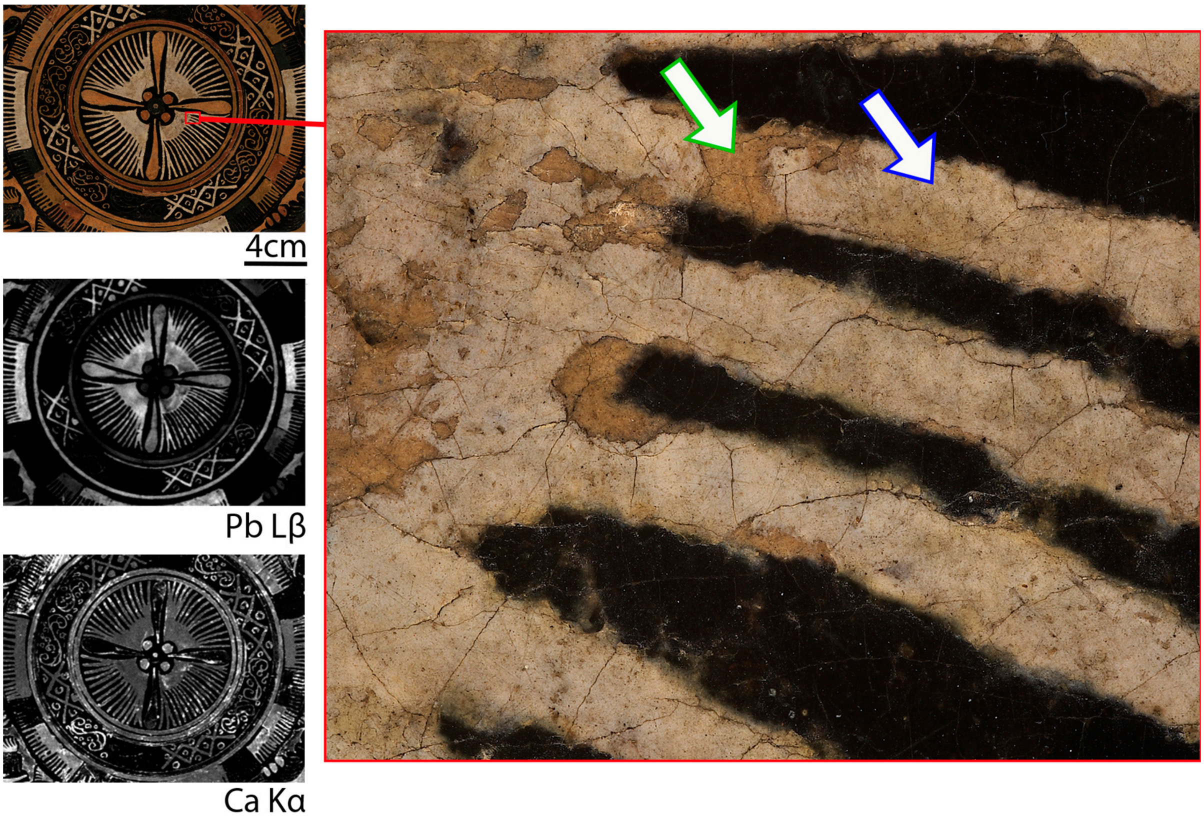

Figure 6. A detail of the central roundel of *batea* 157-1866, including lead and calcium distribution maps (Pb Lb and Ca Kα). The blue arrow marks the lead-containing white decorative layer which is applied on an off-white foundation layer (green arrow). Note how the signal of calcium from the foundation layer is more intense where the lead-containing layer is missing due to loss or damage.

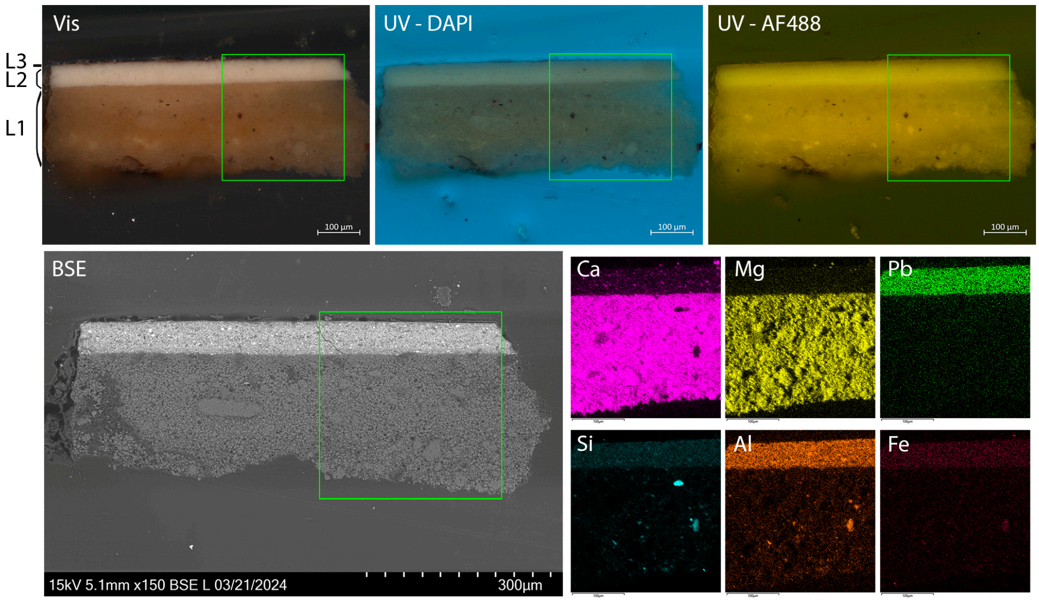

Figure 7. Sample 9, taken from 158-1866, is shown as a representative of the stratigraphy of the white decorative layer. Layer 1 is an off-white foundation layer (L1), layer 2 is the white surface colour (L2), and layer 3 is a thin, uneven layer of varnish/dirt (L3). EDX analysis suggests that L1 is mainly made of calcium (Ca Kα1) and magnesium (Mg Kα1-2) and a clay (Fe Kα1, Si Kα1 and Al Kα1 were detected too) and L2 is mainly made of lead (Pb Mα1) and a clay. Note: The green square marks the area analysed by EDX.

3.3. Orange

Orange is one of the dominant colours in the *bateas*. The scanning XRF analysis showed a strong signal for lead and the presence of calcium (Figure 8). The cross sections taken from these areas show a consistent stratigraphy across the three objects, exemplified by sample 2 from 156-1866, as shown in Figure 9: a white foundation layer is present (L1), followed by an orange layer (L2) and occasionally a varnish layer (L3). The Raman and SEM-EDX analyses confirmed that the foundation layer is made of dolomite, and the orange layer contains a mixture of clay, lead white, and red lead.

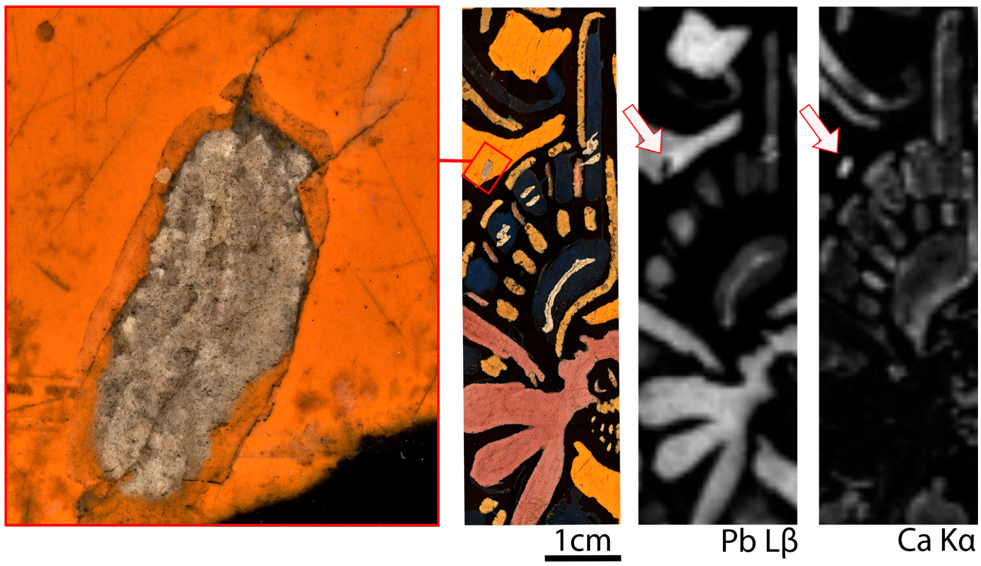

Figure 8. A detail of the orange decoration of *batea* 158-1866, including lead and calcium distribution maps (Pb Lb and Ca Kα1). The red arrows mark an area of loss in the orange layer, which reveals the Ca-containing ground. The same area is also shown close up in the red square.

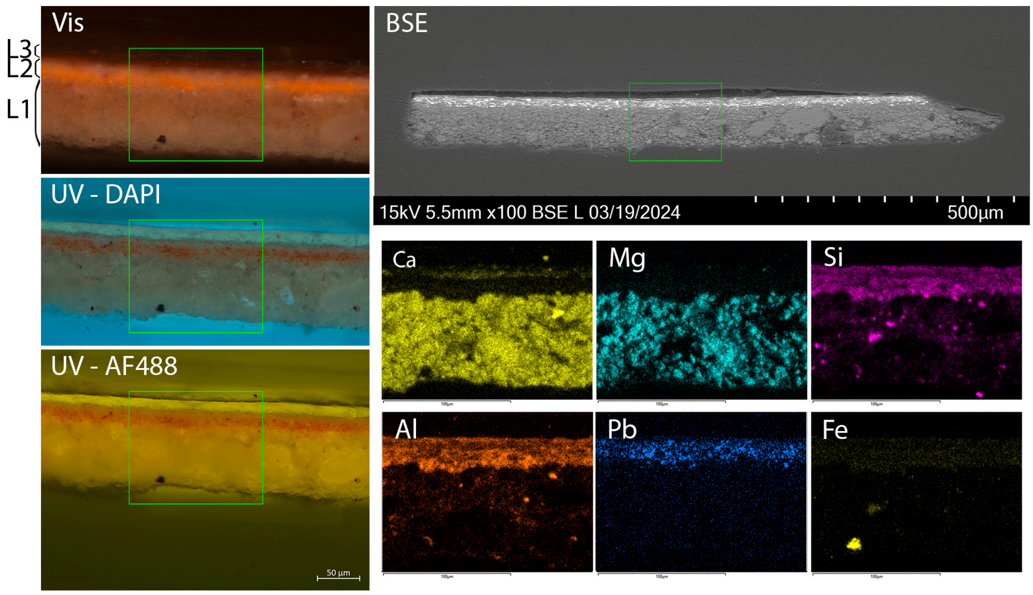

Figure 9. Representative stratigraphy of the orange decorative layer (sample 2, *batea* 156-1866): layer 1 is an off-white foundation layer (L1), layer 2 is the orange surface colour (L2), and layer 3 is a thick layer of varnish (L3). EDX analysis suggests that L1 is mainly made of calcium (Ca Kα1), magnesium (Mg Kα1-2), and some clay. Clay is the main component of L2 (Fe Kα1, Si Kα1, Al Kα1, and traces of Ti Kα1 were detected) together with lead (Pb K), which is responsible for the orange colour. Note: The green square marks the area analysed by EDX.

3.4. Red and Maroon

Red and/or maroon details are only present on two of the *bateas* (157-1866 and 158-1866, see close-ups in Figure 10). Scanning XRF experiments show that lead, calcium, and titanium are the main elements present, and close examination of the objects suggests that calcium is present in the foundation layer(s) (Figure 8).

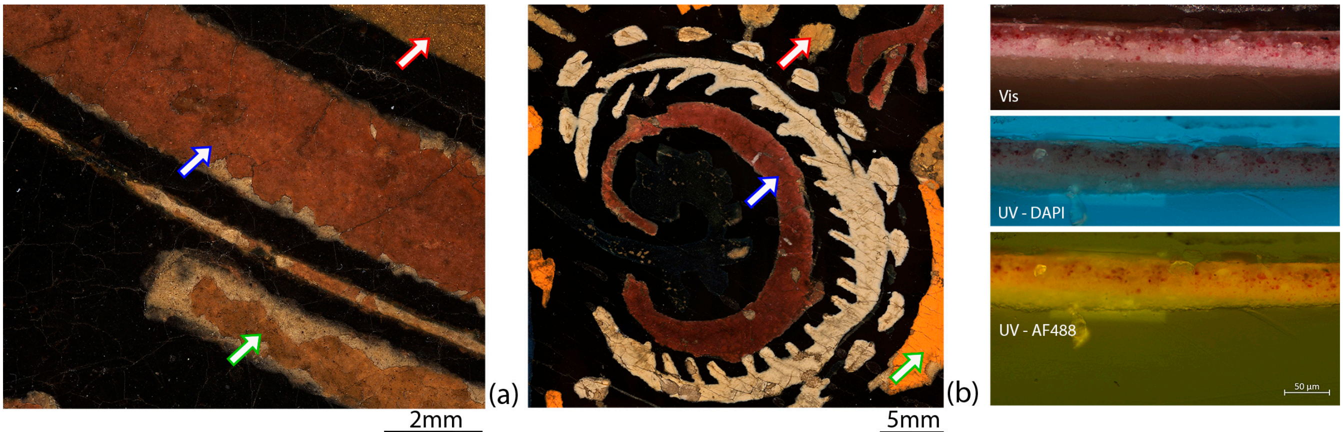

Figure 10. Details of *bateas* (**a**) 157-1866 and (**b**) 158-1866 showing the maroon-coloured decoration (blue arrows) versus the orange (green arrows) and yellow (red arrows) ones. The cross section of sample 6 from 158-1866 (shown on the right-hand side), viewed under visible and UV illumination, shows that a rich crimson material is responsible for the colour.

Figure 10 also shows the cross section of a sample taken from a maroon area (sample 6, 158-1866). The results from the optical microscopy, EDX analysis, and Raman spectroscopy support the hypotheses made after the XRF experiments: two main layers can be distinguished. The bottom one is the foundation layer made primarily of dolomite ($CaMg(CO_3)_2$). The maroon decorative layer is not homogeneous and contains silicon, aluminium, iron, and lead. A few inclusions were identified as anhydrite (calcium sulfate $CaSO_4$). Finely divided particles of lead white can be seen in higher concentration at the bottom and, very thinly, at the top of the decorative layer. The middle of the decorative layer shows a high amount of crimson particles, which are coloured with an unidentified red organic dye. The FTIR analysis of a loose fragment from this sample was inconclusive due to the overwhelming signal from the inorganic components.

3.5. Yellow

A dull, ochre-like yellow colour is present on all three *bateas* (red arrows, Figure 10), and as for the other coloured decoration, it is applied on an off-white layer of dolomite (see Figures 6, 8 and 10). The relevant scanning XRF and SEM-EDS maps show that arsenic and sulfur are the predominant elements, and orpiment was confirmed by Raman analysis. Silicon, aluminium, iron, potassium, and titanium can also be seen (see the XRF maps in Figure 4), suggesting the presence of yellow ochre.

Samples taken from yellow areas and mounted as cross sections reveal a simple stratigraphy with an off-white, dolomite foundation layer, a yellow decorative layer, and occasionally a surface varnish layer.

3.6. Blue and Green

The three *bateas* show different shades of blue and green, reflecting the composition of the blue decorative elements.

Batea 156-1866 shows dark-blue decorative areas (Figures 11a and 12a); 157-1866 shows green decorative elements (Figures 11b and 12b); and *batea* 158-1866 shows two different shades of blue on the front (Figures 11c and 12c,d) and green decorative elements on the back (Figures 11d and 12e). The mapping XRF experiments showed that arsenic is present in the green areas (Figure 11). The relevant samples mounted as cross sections showed a simple stratigraphy, with a foundation layer which is either white (dolomite) or reddish (a hematite-containing clay), and a blue or green layer where the blue material is always indigo, and the yellow material is always orpiment (both identified by Raman). In two of the samples (taken from 157-1866 and 158-1866) indigo and orpiment are mixed, while in a third the green colour is obtained by overlaying indigo over orpiment (Figure 12).

The bulking material in the blue or green pigments is always clay, and in some cases lead white and sulfates are also found (gypsum, $CaSO_4{\cdot}2H_2O$, and anhydrite, $CaSO_4$, were identified by Raman).

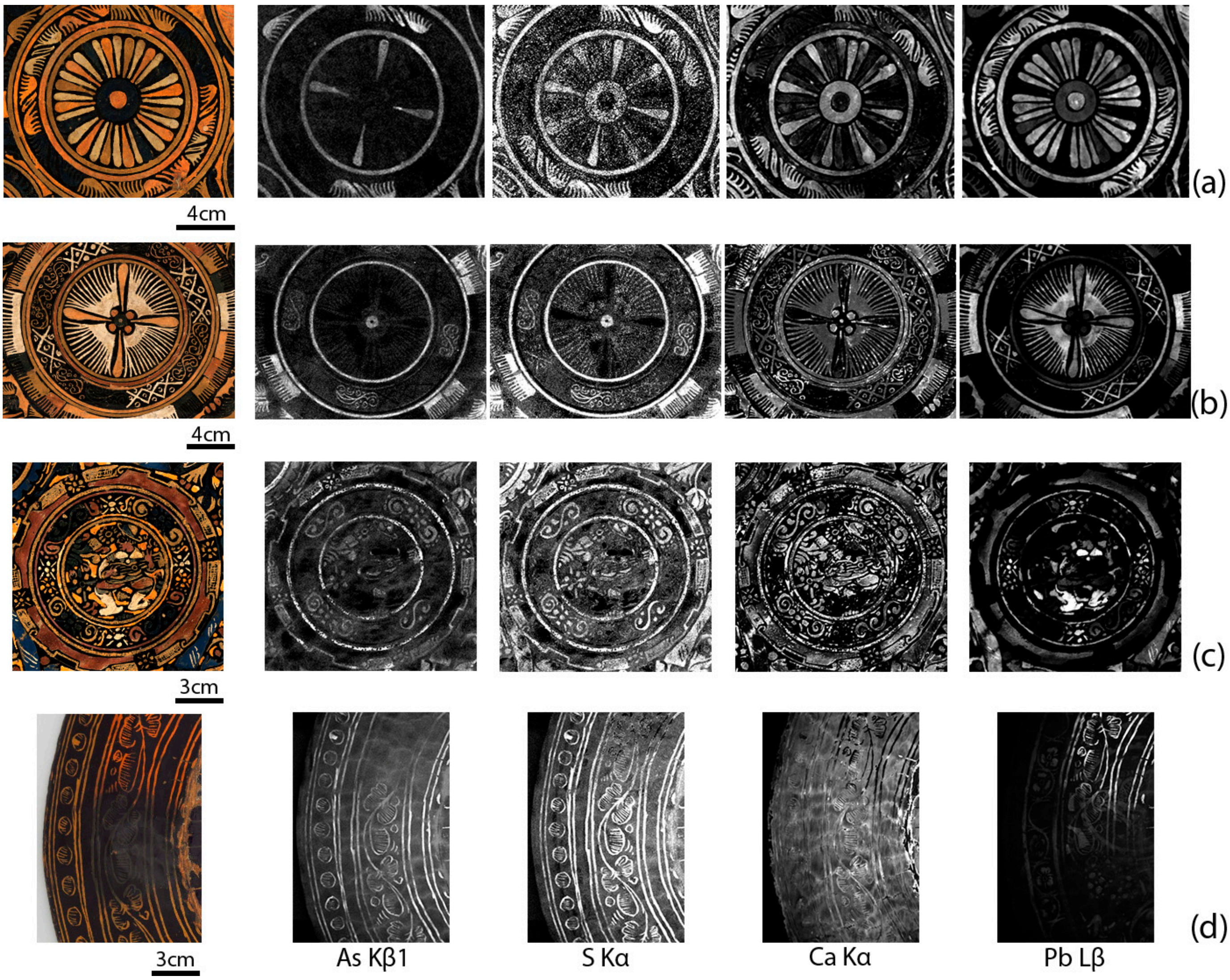

Figure 11. Elemental distribution maps of arsenic (As Kb1), sulfur (S Kα), calcium (Ca Kα), and lead (Pb Lb) for details of 156-1866 (**a**), 157-1866 (**b**), and 158-1866 front (**c**) and back (**d**), drawing attention to the composition of the green, blue, and dark-blue areas.

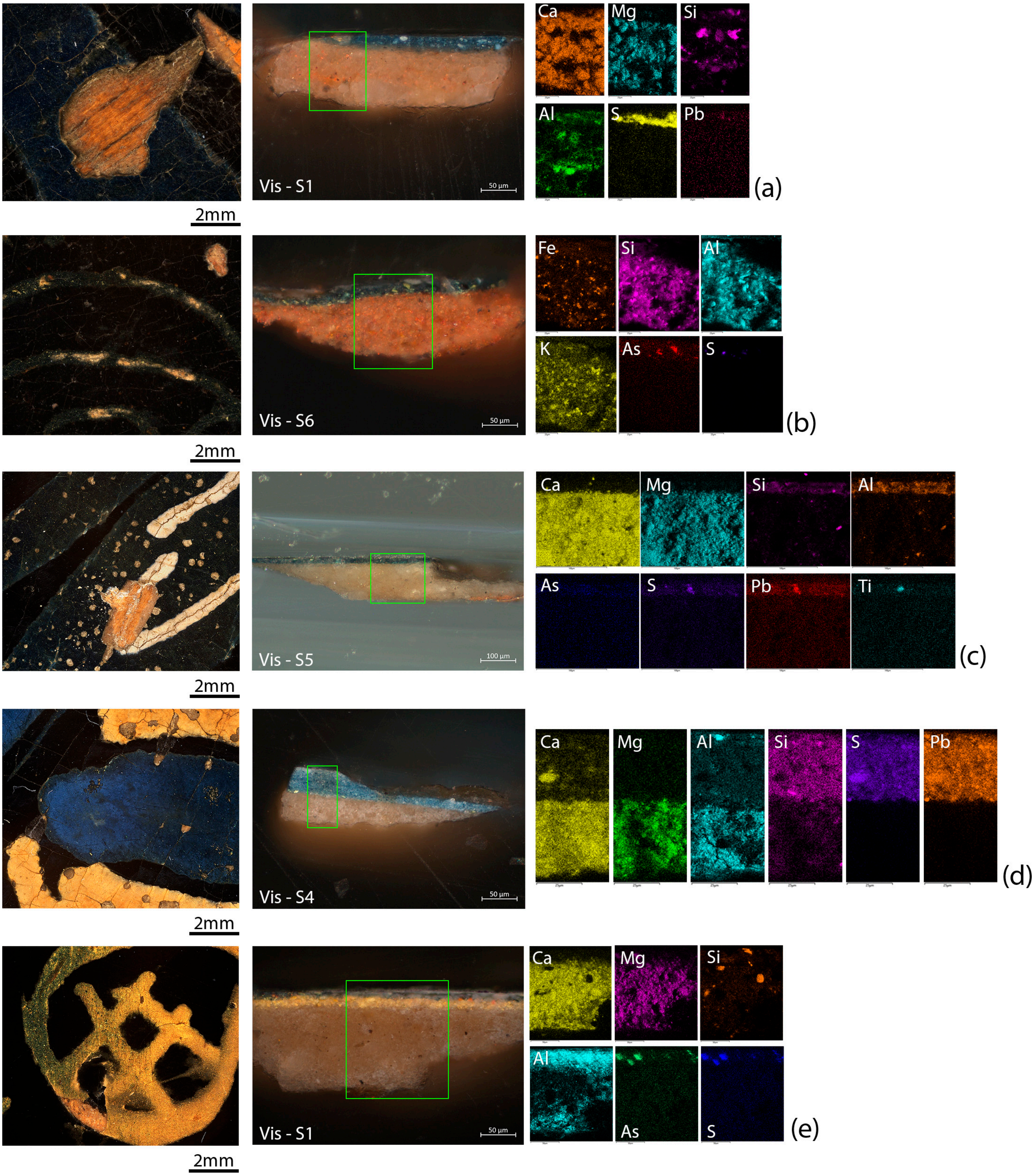

Figure 12. From left to right: detail of a representative portion of the blue/green surface with a relevant cross section under visible illumination and EDX maps of selected elements. 156-1866 (**a**), 157-1866 (**b**), and 158-1866 front (**c**,**d**) and back (**e**). Note: The green squares mark the area analysed by EDX. The following X-ray emission lines were selected: Al Kα1, As Kα1, Ca Kα1, K Kα1, Mg Kα1-2, Pb Mα1, S Kα1, Si Kα1, Ti Kα1.

4. Discussion

4.1. On the Materials and Manufacture of the V&A Bateas

The examination of the cross sections, coupled with the information derived from the visual examination of the objects and from the digital microphotographs, confirmed interesting aspects of the manufacturing technique of the *bateas*. FTIR analyses of three loose fragments of paint were conducted to obtain additional molecular information, especially for the organic materials present, but only overwhelming inorganic components could be detected (clays, carbonates and sulfates).

The results of the analyses reveal a relatively restricted palette found (with one exception) in all three *bateas*: carbon black, indigo, red lead, lead white, orpiment, and an unidentified red organic colourant. The last is found only on 157-1866 and 158-1866. Dolomite is found in the foundation layer under the coloured decorative scheme, while a red clay is the main component of the foundation for the black background areas. Other materials, such as white clay, ochres, and sulfates, are often found as extenders or bulking agents. In one case, fragments of diatomaceous earth were found in the reddish foundation layer of batea 157-1866 (see Figure A2). The pigments and dyes used conform to the range of materials available at the time in Mexico, and match what is recorded in the literature (see Section 1.3).

Figure 13 shows a schematic of the objects' stratigraphy: they appear to have been primed with a reddish foundation layer made of a red ochre or a deliberate mixture of a white clay and hematite, which was then covered with a uniform layer of carbon-based black lacquer (Figure 5). The latter was then incised according to the desired decorative plan, and the incisions were filled with an off-white layer of dolomite, devised to provide a reflective background for the coloured decoration to be applied on top of (Figure 7). This explains why all samples from the black areas display a reddish ground, while the coloured decoration is characterised by a dolomite foundation layer. In some of the samples, traces of the red ground can be seen under the off-white foundation layer (Figure 12c, sample 5). Figure 14 shows additional details where the red foundation layer is visible.

Occasionally, the dolomite foundation layer is partially contaminated by the reddish one, possibly due to excessive 'digging' during the incision phase (Figure 12a, sample 1).

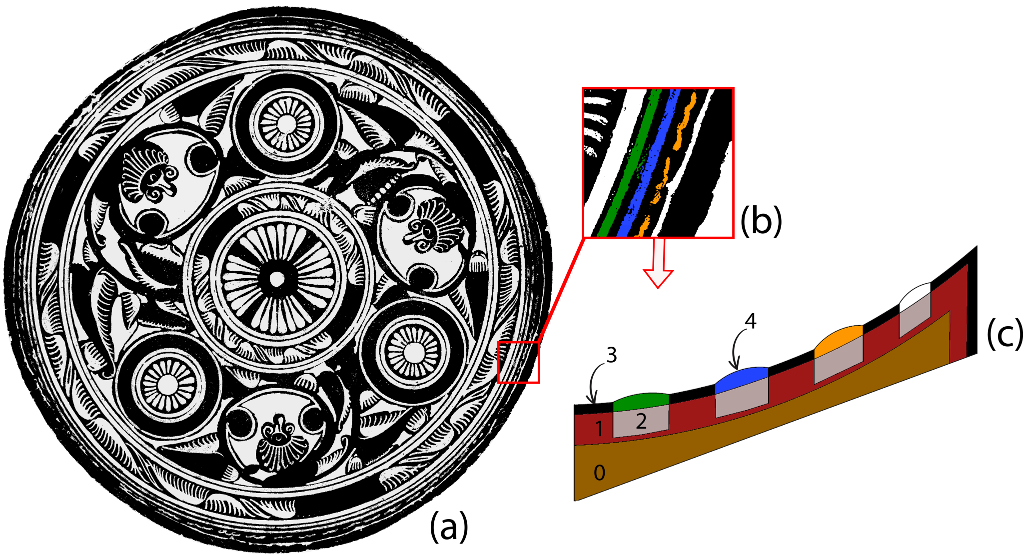

Figure 13. Schematic of the stratigraphy of *batea* 156-1866: (**a**) highlights the black background with the engraved decoration in white; (**b**) shows a detail of the decorated border including coloured decoration; (**c**) is a representative stratigraphy showing the wood substrate (0), the reddish preparation layer (1), the dolomite-filled engraving (2), the black background (3), and the coloured decoration (4).

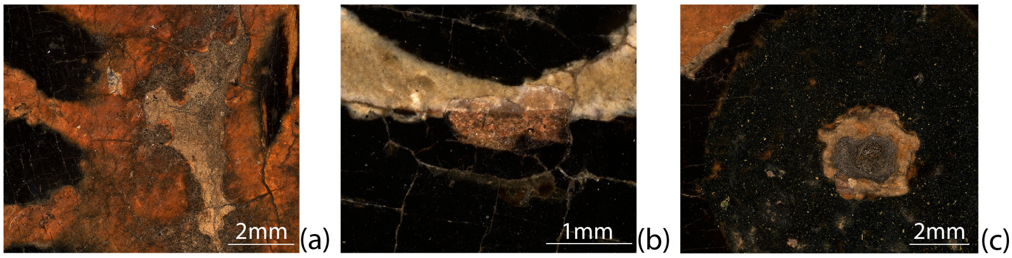

Figure 14. Details of areas of loss showing the off-white foundation (**a**) and the red foundation (**b**) on *batea* 156-1866, and both foundations on *batea* 157-1866 (**c**).

This stratigraphy is in agreement with the previously published literature, as discussed in Section 1.3.

Although the materials and techniques are similar, there is a clear difference in the appearance of the three *bateas*. *Bateas* 156-1688 and 157-1866 show a duller, more muted palette, while *batea* 158-1866 shows more vibrant, glossy colours. As the pigments and dyes identified on the three objects are the same, the difference in appearance is likely to be due to the amount of binding medium, as well as to the different state of conservation of the *bateas*. Extensive sampling to support additional organic analysis based on genomics investigation could not occur at this stage, but it is hoped that it will become possible in the future.

An additional difference is the use of colour gradients in 158-1866, which contrasts with the use of simple block colours in 156-1866 and 157-1866. The reverse of 158-1866 shows how blue and yellow paints partially overlap to create a colour gradient that goes from yellow to green to blue (Figure 15). This can be seen in the relevant cross section and XRF map (Figure 12e and Figure 11d, respectively).

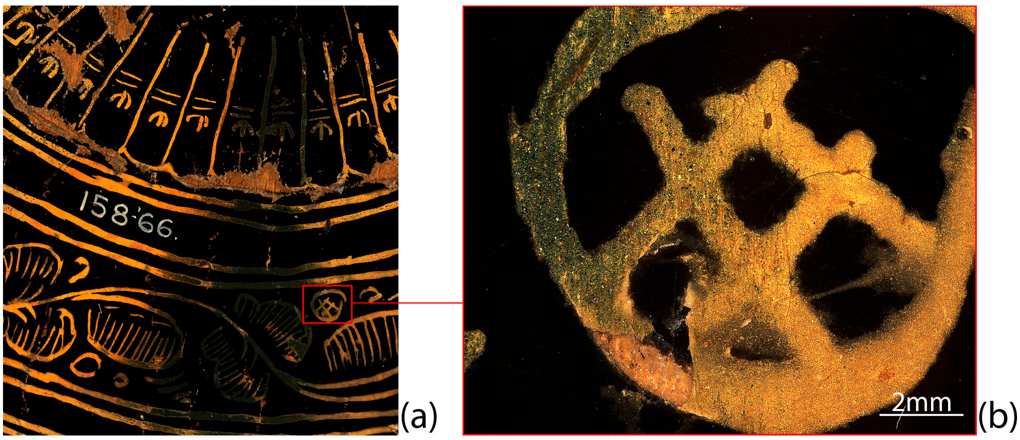

Figure 15. (**a**) Example of colour gradient seen on the reverse of *batea* 158-1866 with a red square marking (**b**) a close-up showing the transition from yellow to green.

4.2. Conservation Issues

The careful examination of the decorated surfaces using high-resolution digital microscopy also provides clues on the condition of the *bateas*:

- *Craquelure* can be seen on most surfaces (Figure 2);
- Chipped paint exposes the dolomite foundation layer in the painted areas, as well as the reddish foundation layer of the black background areas (Figure 14);
- Some of the areas of loss have been filled with colour to minimise the visual disruption to the damaged surface (Figure 16);
- UV light reveals areas where a non-original natural resin varnish is still present (Figure 2);

- Pitting can be seen in many of the coloured areas, especially the areas that have been decorated with a lead-containing pigment. Some of the pitted areas show that a dotted discolouration is present, but the pictorial layer is still adhered (Figure 17a); others show partial (Figure 17b) or full detachment (Figure 17c) where the coloured layer has been lost. The appearance of these areas suggests that metal soaps may have formed over time; these are known to have a disruptive effect on the appearance and integrity of certain types of pigmented layers [32–36].

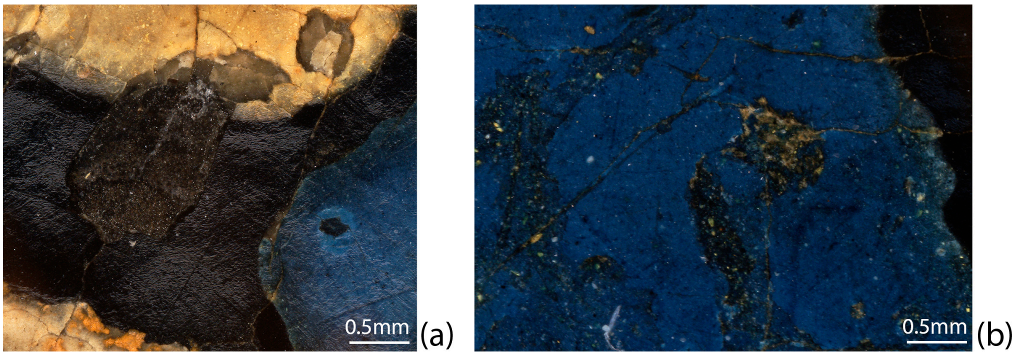

Figure 16. Details of areas where loss of the pictorial layer has been retouched with (**a**) black or (**b**) dark-blue paint to mask damage.

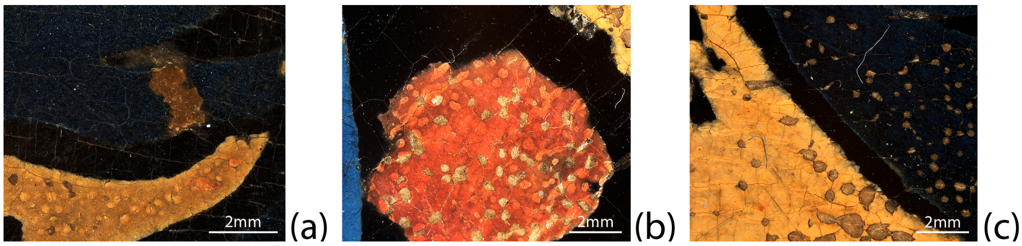

Figure 17. Degrees of pitting seen on the *bateas*: (**a**) a dotted discolouration can be seen in the yellow decoration of *batea* 156-1866, but the pictorial layer is still well adhered; (**b**) area showing both the dotted discolouration and the loss of paint in *batea* 158-1866; (**c**) full detachment of the pitting in *batea* 158-1866.

5. Conclusions

This work collates the analysis results of three Mexican *bateas* from the V&A collection. Bearing in mind that the materiality of Mexican lacquer remains under-investigated and a larger number of objects should be studied in order to collate a statistically significant corpus of results, the materials and techniques characterised in this study are in agreement with the literature in the public domain.

Traditional materials were identified, including indigo, carbon black, red lead, lead white, orpiment, dolomite, gypsum, clay, and various ochres. The composition of the binders and the identity of a red organic dye could not be identified, but it is hoped that a more extensive sampling campaign in the future will provide conclusive results on this matter.

The stratigraphy is relatively simple and includes a reddish foundation layer applied to the substrate, which is then covered with a black layer. Incisions are created where the decoration is to be applied, and then are filled with an off-white layer of dolomite, and finally with the coloured decoration.

The presence of fragments of diatomaceous earth within the orange foundation layer of one of the bateas is intriguing and raises the question of whether the presence of this material is an exception, or if this is a relatively common component that until now had simply not been recognised in samples from other objects.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/heritage7090219/s1, Supplementary Material S1: Spanish translation of this paper.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Representative Raman spectra of the main pigments and dyes identified in this study are shown in Figure A1.

Figure A2 shows a selection of SEM images of cross section 5 from *batea* 157-1866 where fragments of what appears to be diatomaceous earth can be seen. To the authors' knowledge, the presence of diatomaceous earth has not been reported before in Mexican lacquer objects. It is unclear if this occurrence is deliberate or accidental, and we are drawing attention to it to document the finding for future reference.

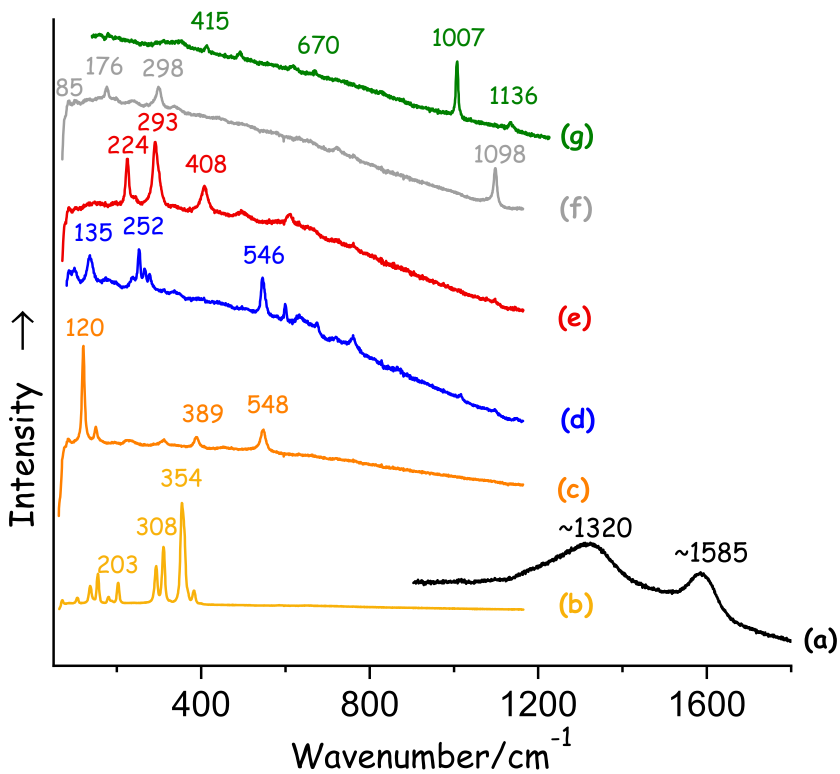

Figure A1. Representative Raman spectra of the most common pigments and dyes identified on the three *bateas*: (a) carbon black; (b) orpiment; (c) red lead; (d) indigo; (e) hematite; (f) dolomite; (g) gypsum.

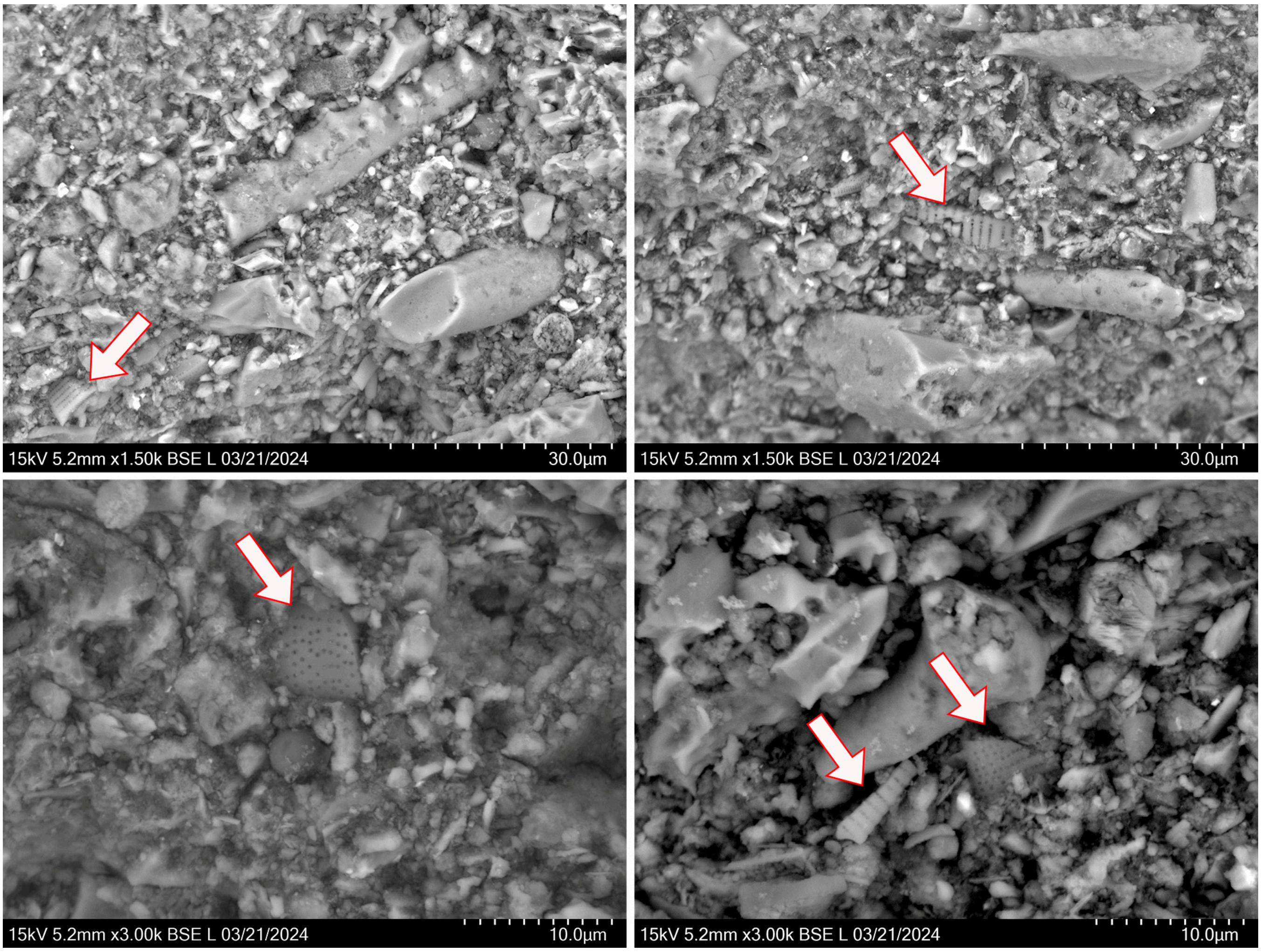

Figure A2. SEM images of the reddish foundation layer of sample 5 from *batea* 157-1866, showing fragments resembling diatomaceous earth.

Notes

[1] Details about the three *bateas* can be found online on the following web pages (accessed on 23 June 2024):
- 156-1866: https://collections.vam.ac.uk/item/O368760/platter
- 157-1866: https://collections.vam.ac.uk/item/O368759/platter
- 158-1866: https://collections.vam.ac.uk/item/O368758/platter

[2] V&A Museum Registered file MA/1/R741/1 (Reg. Pa. 37495/1871).

[3] A Furniture Collection findings list records that 158-1866 was displayed in gallery 74 in January 1964.

[4] Exhibition label from Spain and the Hispanic World—Treasures from the Hispanic Society Museum & Library, at the Royal Academy of Arts, London 21 January–10 April 2023.

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