

The early Christian martyrs Martian, Victory and Eleonora. Studies on three ceroplastic reliquaries from Portugal

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Introduction

After the rediscovery of the Roman catacombs in 1578, thousands of skeletons attributed to the first martyrs of Christianity were massively exhumed from the subterranean galleries of Rome and displayed in sumptuous reliquaries, simulating the martyrs' bodies for public veneration in churches, convents, and oratories throughout the Christian world. Covered with silk, papier-mâché, plaster, wood or wax, the skeletons from the catacombs were splendidly dressed in ceremonial baroque clothes, representing Roman legionaries or virgins, and were exhibited with the signs of martyrdom inside polychromed and gilded wooden shrines. This type of devotional receptacles, as martyrs' simulacra, began to be produced in the late 17th century and were in use till the mid-19th century.

In 2019-2020, an in-situ campaign was carried out to study three ceroplastic martyrs' simulacra belonging to different Portuguese religious and cultural institutions. This was the first in-depth scientific study performed on simulacra reliquaries made of wax in Portugal. The focus of this project was to identify the materials and the manufacturing techniques adopted by pious craftsmen to unveil their complexity from material, technical and decorative points of view. Sampling of different materials was also carried out. Fibres, dyes, wax, and metal threads were analyzed for morphological and chemical characterization using a batch of analytical techniques that included optical microscopy (OM), attenuated total reflection Fourier transform infrared spectroscopy (ATR-FT-IR), liquid chromatography coupled with diode-array detection and mass spectrometry (LC/DAD/MS), pyrolysis coupled to gas chromatography and mass spectrometry (Py-GC/MS) and scanning electron microscopy coupled with X-rays microanalysis (SEM/EDS).

This work aims to present the analytical results on the simulacrum of saint Martian from the parish Church of saint Sebastian (Óbidos), and the simulacra of saints Victory and Eleonora from the Chapel of Our Lady of Mercy from the Palace of Marquis of Pombal (Oeiras). Despite their probable Roman origin, as many other 18th and 19th century martyrs' simulacra already identified in the north and centre of Portugal, the results obtained support a probable national production.

Experimental

Technical photography: Mamiya RZ67 Pro II camera with a Mamiya-Sekor 65mm f:4 lens and a Sinar 44 sensor under 2x1000W tungsten lights. **Sampling:** samples were collected from the simulacra faces (wax and hair), vestments (fibres and metallic threads) and other decorative elements (paper). Samples collected from saints Martian, Victory and Eleonora were identified with the letter "M", "V", and "E", respectively. **OM:** Leica M205C stereomicroscope (zoom range from 7.8x to 160x), Leica DM2500M dark-field and Olympus BX41 bright-field microscopes (100x and 200x magnifications). **ATR-FT-IR:** portable Brüker Alpha spectrometer equipped with a DTGS detector and a diamond ATR module. All spectra were acquired in the absorbance mode, in the range from 4000-375 cm⁻¹, from a total of 128 scans at 4 cm⁻¹ resolution. **LC/DAD/MS:** LCQ Fleet Thermo Finnigan mass spectrometer equipped with an ESI source, an ion trap mass analyser, and a DAD detector. MS analysis: capillary temperature of 300 °C; source voltage of 5.0 kV, source current of 100.0 μA, and capillary voltage of -3.0 V in negative ion mode and 46.0 V in positive ion mode. Full MS mode (*m/z* 100–800). DAD detector in the range 190–800 nm. LC system equipped with a reversed-phase Agilent Zorbax Eclipse XDB-C18 column (C18, particle size 3.5 μm, 150 × 2.1 mm). Mobile phase: acetonitrile (A) and water acidified with 0.1% formic acid (B), with gradient 0–63% A from 0–14 min, then 63–90% A from 14–25 min and 90% A from 25–30 min. Injection volume of 20 μL. **Py-GC/MS:** Frontier Lab PY-3030D double-shot pyrolyser coupled to a Shimadzu GC2010 gas chromatographer, and to a Shimadzu GCMS-QP2010 Plus mass spectrometer. Capillary column Phenomenex Zebtron-ZB-5HT (30 m length, 0.25 mm internal diameter, 0.50 μm film thickness), with He as the carrier gas. The mass spectrometer operated from 40 to 1090 *m/z*. Each sample (~300 μg) was previously derivatised with 3 μL of tetramethylammonium hydroxide (2.5% in methanol, *v/v*). AMDIS software integrated with the NIST-Wiley database was used for analysis. **VP-SEM/EDS:** scanning electron microscope HITACHI S-3700N coupled to a Brüker XFlash 5010 SDD EDS spectrometer. Acceleration voltage of 20 kV was used for both chemical and imaging in the BSE mode under a pressure of 40 Pa in the chamber.

Results

OM: Three typologies of textiles fibres were identified: silk, cotton and linen/hemp. Taffetas, satins, and velvets are the most common fabrics. Human hair was identified in the wigs and eyebrows of the three saints. Wood pulp was also identified in paper flowers. **LC/DAD/MS:** Natural, semisynthetic and synthetic dyes were detected: weld for yellow and green fibres; cochineal for red fibres; indigo/woad and indigoid (semisynthetic) for blue and green fibres, and mauveine (synthetic) for purple yarns. **ATR-FT-IR:** The presence of kaolinite with the OM observation of non-traditional vegetal fibres (wood pulp) pointed out that paper produced by an industrial mechanical pulping process was used for the flowers. **Py-GC/MS:** Biomarker distribution in the samples seems to point to the use of beeswax to mold the faces. **VP-SEM/EDS:** Three typologies of metal threads were identified: solid metal strips, solid metal strips wound around a fibrous core and solid metal wires. According to their composition, the metal threads can be classified as silver alloy, silver-plated silver-copper alloy (wt% Ag:Cu 97.5:2.5), doubled-sided gilded silver, doubled-sided gilded silver-copper alloy (wt% Ag:Cu 95.99:5.1), double-sided silver-plated copper and brass-plated copper threads. The "cast, drawn and rolled" production technique was mainly used in metal threads manufacture.

Final Notes

† Indigoid or Acid Blue 74, a semisynthetic dye, was invented in 1743 by the German Johann Christian Barth, while Mauveine was the first synthetic organic dye obtained accidentally by William H. Perkin in 1856. The presence of the synthetic dye along with the identification of kaolinite and paper made of wood pulp (19th century) indicate that the flower wreath and the bouquet were a later manufacture.

† The use of wax on this type of reliquaries was also an 19th century-production. However, saints Victory and Eleonora were an offer from Pope Clement XIV to Sebastião José de Carvalho e Melo (later Marquis of Pombal) between 1770-1774.

† Both results suggest that the simulacra underwent conservation works or were reconstructed after their translation to Portugal.

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Technical photography

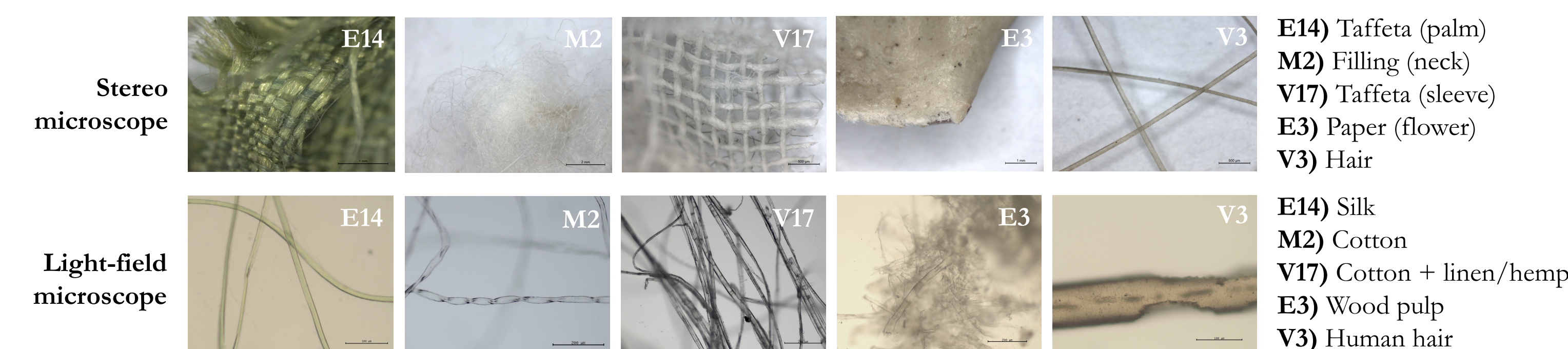


Simulacrum of saint martyr Martian, Church of saint Sebastian (Óbidos, Portugal). Luís Piorro | DGPC



Simulacra of saints martyrs Victory (left) and Eleonora (right), Palace of Marquis of Pombal (Oeiras, Portugal). Luís Piorro | DGPC

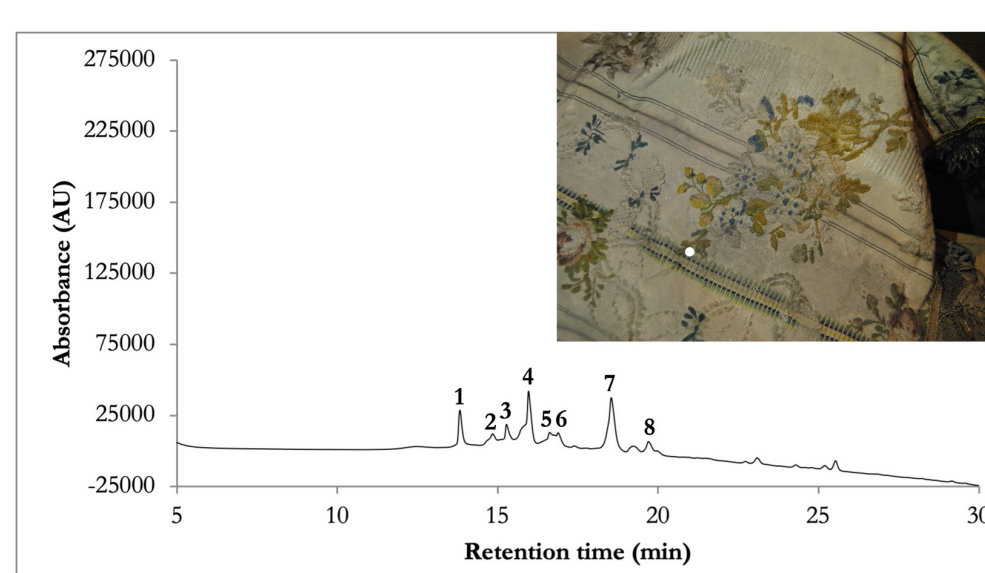
OM - Textile fibres and hair



- E14 Taffeta (palm)
- M2 Filling (neck)
- V17 Taffeta (sleeve)
- E3 Paper (flower)
- V3 Hair
- E14 Silk
- M2 Cotton
- V17 Cotton + linen/hemp
- E3 Wood pulp
- V3 Human hair

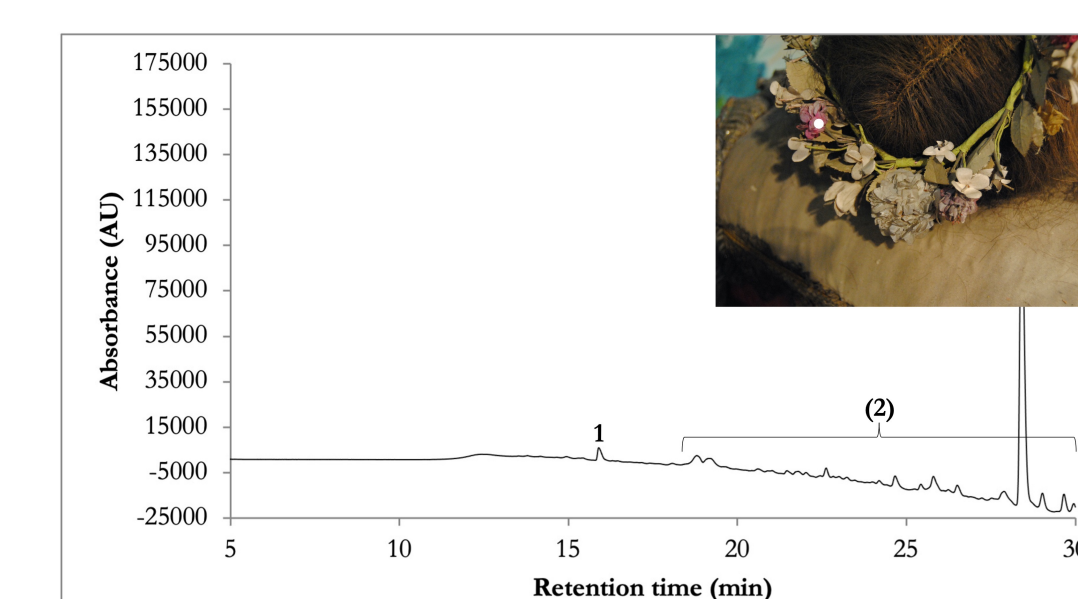
LC/DAD/MS – Dyes

Indigoid (Acid Blue 74) + Weld



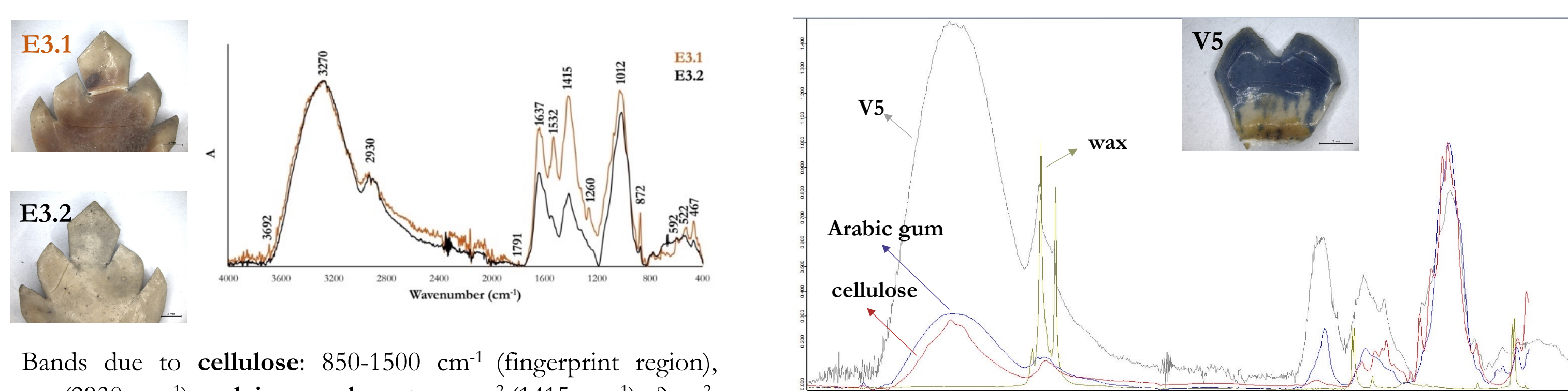
Chromatographic profile of sample M28 (dark green - embroidery). **Indigoid:** (1) and (2) peaks exhibiting maximum absorbance at 600 nm and fragment ions at *m/z* 443 and 421; **Weld:** (3) Luteolin-di-glucoside, (4) Luteolin-glucoside, (5) Apigenin-glucoside, (6) Luteolin-glucoside, (7) Luteolin and (8) Apigenin

Mauveine



Chromatographic profile of sample M_F1 (flower wreath = bouquet): (1) **Ellagic acid** and (2) Several peaks exhibiting maximum absorbance at 550 nm which can tentatively be identified as **mauveine**

ATR-FT-IR – Flowers



Bands due to **cellulose:** 850-1500 cm⁻¹ (fingerprint region), ν_{C-H} (2930 cm⁻¹); **calcium carbonate:** $\nu_{CO_3^{2-}}$ (1415 cm⁻¹), $\delta_{CO_3^{2-}}$ (872 cm⁻¹); **protein:** $\nu_{C=O}$ (1637 cm⁻¹), δ_{N-H} e ν_{C-N} (1532 cm⁻¹), ν_{C-N} e δ_{N-H} (1300-1200 cm⁻¹); and **kaolinite (aluminossilicato):** $\nu_{Si-O-Al}$ (3692, 522 cm⁻¹), $\delta_{Si-O-Si}$ (467 cm⁻¹).

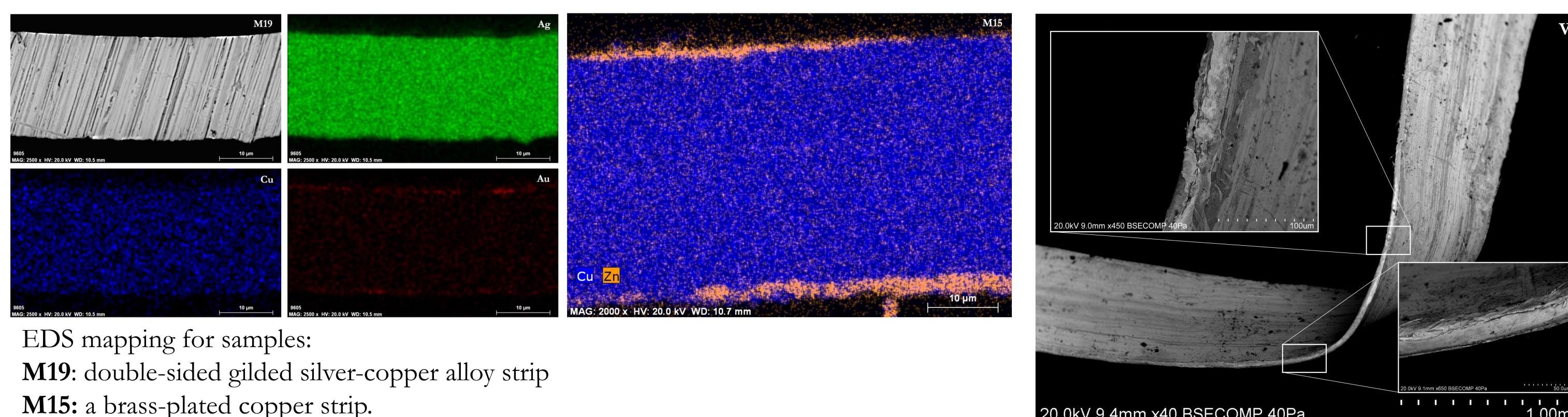
Tentative assignment of sample V5: **cellulose, wax and Arabic gum** by Brüker Opus software (data collection and analysis program). The petal, with a waxy appearance, was collected from the crown of saint Victory.

Py-GC/MS – Waxes

Saint	ID	Composition
Martian	M1	Beeswax
Victory	V24	Beeswax

Samples exhibit a chromatographic profile compatible with the presence of beeswax: simple distribution of odd-numbered n-alkanes, peaking at C27; Lignoceric acid as major fatty acid in the range C22-C34; long-chain palmitic wax esters; long-chain fatty alcohols.

VP-SEM/EDS – Metal threads



EDS mapping for samples: **M19:** double-sided gilded silver-copper alloy strip **M15:** a brass-plated copper strip.

BSE image of the "cast, drawn and rolled" production technique (double-sided gilded silver alloy strip).