

Supplementary materials

Analytical methods

- Optical Microscopy (OM)

Cross sections were prepared by embedding each sample within a double layer of EpoFix resin by Struers. After removal of the excess resin by polishing, using Struers abrasive cloths of progressively finer grits to expose the paint stratigraphy, the samples were observed through microscope. More specifically, samples were observed and photographed under visible and ultraviolet light using an Olympus BX51 minero-petrographic microscope equipped with an Olympus DP71 digital camera. In both cases, image acquisition and processing were performed by means of analySIS FIVE proprietary software.

The surface morphology and the cleaning processes were observed using Olympus SZX10 stereomicroscope equipped with an Olympus colour View I digital camera and an Evident DSX1000 Digital Microscopes - High-End Model under visible and razing light (Evident Europe GmbH, Italian Branch, Segrate, Milano).

- Pyrolysis-Gas Chromatography coupled with Mass Spectrometry (Py-GC/MS)

Samples were derivatized with the Thermally Assisted Hydrolysis and Methylation method (THM) using tetramethylammonium hydroxide (TMAH) in aqueous solution at a concentration of 25% by weight (Sigma-Aldrich, Milan, Italy) and micro-furnace Multi-Shot Pyrolyzer EGA/Py-3030D (Frontier Lab, Koriyama, Fukushima, Japan) coupled to a GC/MS system was used. Samples were placed into a stainless-steel cup, added with 5 μ L of TMAH solution and inserted into the micro-furnace. The pyrolysis temperature was set at 500 °C for 0.2 min, the interface temperature was 300 °C and the temperature of the GC injector was kept at 280 °C. The GC was a 6890N Network GC System (Agilent Technologies, Wilmington, DE, USA) gas chromatograph with a methylphenyl-polysiloxane cross-linked 5% phenyl methyl silicone (30 m, 0.25 mm i.d., 0.25 μ m film thickness) capillary column. The carrier gas was helium (1.0 mL/min) and split ratio was 1/20 of the total flow. The mass spectrometer coupled to the GC apparatus was a 5973 Network Mass Selective Detector (Agilent Technologies, Wilmington, DE, USA). Mass spectra were recorded under electron impact at 70 eV, scan range 40–600 m/z. The interface was kept at 280 °C, ion source at 230 °C and quadrupole mass analyzer at 150 °C. All instruments were controlled by Enhanced Chem Station (ver. 9.00.00.38) software. The mass spectra assignment was done with the Wiley 138 and NIST2008 libraries, by comparison with literature data and, in the absence of reference spectra, by mass spectra interpretation.

- High Resolution Digital Photography (Vis-D and Vis-R)

The lighting setup for visible diffuse light photography (Vis-D) involved the positioning of two 800-W Ianiro Varibeam Halogen lamps on each side of the object at a 45° angle to the surface, with the use of umbrellas.

For visible raking light photography (Vis-R), a single 800-W Ianiro Varibeam Halogen lamp was placed to the left of the object at an angle of around 15° to the surface. The photographs were captured using a Nikon D810 DSLR camera with a CMOS silicon sensor, offering a resolution of 7360 x 4912 pixels and sensitivity to light in the 380-780 nm range. Image processing, carried out by means of Adobe Lightroom and Adobe Photoshop, included a colour correction conducted by inserting a 24-colour X-Rite colourChecker Classic reference in the field of view.

- Ultraviolet-Induced Visible Fluorescence (UVF)

The paint was illuminated using two Labino UV light MPXL and UV Floodlight spot lamps with a peak emission at 365 nm. Using a Nikon D810 DSLR camera equipped with a CMOS silicon sensor and a UV-IR Cut high-pass filter (Digital Filter PECA 916), images were captured in the 380-780 nm spectral range, providing a resolution of 7360 x 4912 pixels. Image processing was performed using Adobe Lightroom and Adobe Photoshop, and non-fluorescing spectroscopic references were inserted into the field of view for calibration.

- Reflection FTIR Spectroscopy

The reflection FTIR spectra were recorded using a Bruker Optics ALPHA-II FT-IR spectrometer (Germany). The instrument was equipped with an external reflectance module with an optical layout of approximately 20°/20° geometry and a coaxial digital camera. It utilized a SiC globar source, a RockSolid interferometer, and a DLaTGS detector. For each measurement point, three spectra were averaged over a range of 7000–400 cm⁻¹, with 128 scans and a spectral resolution of 4 cm⁻¹. The obtained spectra were displayed as pseudo-absorbance spectra [$\log(1/R)$; where R is reflectance].

Materials and Suppliers

Supplier	Materials
Kremer Pigmente, Germany	Zinc white pigment Rabbit skin glue Lithopone pigment Shellac orange Iso-octane Shellsol D40 Shellsol D70
Sigma-Aldrich, UK	Propylene carbonate Benzyl alcohol n-Butyl acetate Agar-agar powder Polyvinyl alcohol 20-98 Sodium tetraborate decahydrate
Schmincke, Germany	Karmin oil 308 (Akademie oil colour)
CSGI, Italy	Nanorestore Cleaning® Polar Coating B Nanorestore Cleaning® Polar Coating G Nanorestore Gel® Dry HWR Nanorestore Gel® Dry MWR Nanorestore Gel® Peggy 5 Nanorestore Gel® Peggy 6
Bresciani, Italy	Mineral Spirits Ethanol Acetone Methyl ethyl ketone Cotton swabs Bondina TNT (40 g/m ²)
Zecchi, Italy	Stand linseed oil
Arches-Papers, France	Paper Watercolour 100% cotton (300 g/m ²)
Deffner and Johann, Germany	Blitz-Fix® sponge Hiromi Japanese Paper, Sekishu Tsuru (21,4 g/m ²) Hiromi Japanese Paper, Hosokawa-shi (40 g/m ²) Evolon CR®
BASF, Germany	Laropal K80