



# Discovery of a painting inspired by Ancient Egypt on the reverse of *Train du Soir* (1957) by Paul Delvaux

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**Abstract** As part of the project on the technical study of the works of Paul Delvaux, a Belgian Surrealist painter known for his dreamlike and enigmatic compositions, the painting *Train du Soir* (Evening Train) from 1957 belonging to the collection of the Royal Museums of Fine Arts of Belgium (RMFAB) was studied in situ with imaging methods (high-resolution photography, infrared reflectography, X-ray radiography) and non-invasive analytical techniques (MA-XRF and Raman spectroscopy). This composition deals with one of the artist's favorite subjects, a railway station. On its reverse, a composition is hidden under a thick layer of white paint, revealed by infrared reflectography. Unlike the front painting, the composition of the reverse deals with a subject much less known to the artist: 'Ancient Egypt'. Indeed, out of all his painted work, only one oil painting represents it, *La Légende Egyptienne* (The Egyptian Legend) from 1953. In addition a Paul Delvaux's drawing book dated 1953, now belonging to the RMFAB collection, contains the sketch of the discovered painting. Considering all these elements, an understanding of the process of creation, elaboration and destruction of the painting by Delvaux will be discussed in this paper. Furthermore, a virtual colorized model will be proposed, built on the basis of the infrared reflectography, the elemental information provided by MA-XRF analysis, and the microscope examination of the painting surface.

## Abbreviations

RMFAB	Royal Museums of Fine Arts of Belgium
IRR	Infrared Reflectography
XRR	X-ray Radiography
MA-XRF	Macro-X-ray Fluorescence
RS	Raman Spectroscopy
CEA	Centre Européen d'Archéométrie (European Center for Archaeometry)

## 1 Introduction

As part of the project on the study of the technique of Paul Delvaux (1897–1994), all of his paintings belonging to the collection of the Royal Museums of Fine Arts of Belgium (RMFAB) were analyzed in situ with imaging methods (high-resolution photography, infrared reflectography (IRR), X-ray radiography (XRR) and digital microscopy) and noninvasive analytical techniques [(MA-XRF and Raman spectroscopy (RS))].

In addition to highlighting the technical details and materials reflecting Delvaux's studio practice, this project also pursues the objective of discovering lost or unpublished compositions by Delvaux beneath the pictorial layer of the paintings investigated. During his career, the artist destroyed many of his works. Later, he admitted, during an interview with Maurice Debra [1], to having destroyed too many paintings.

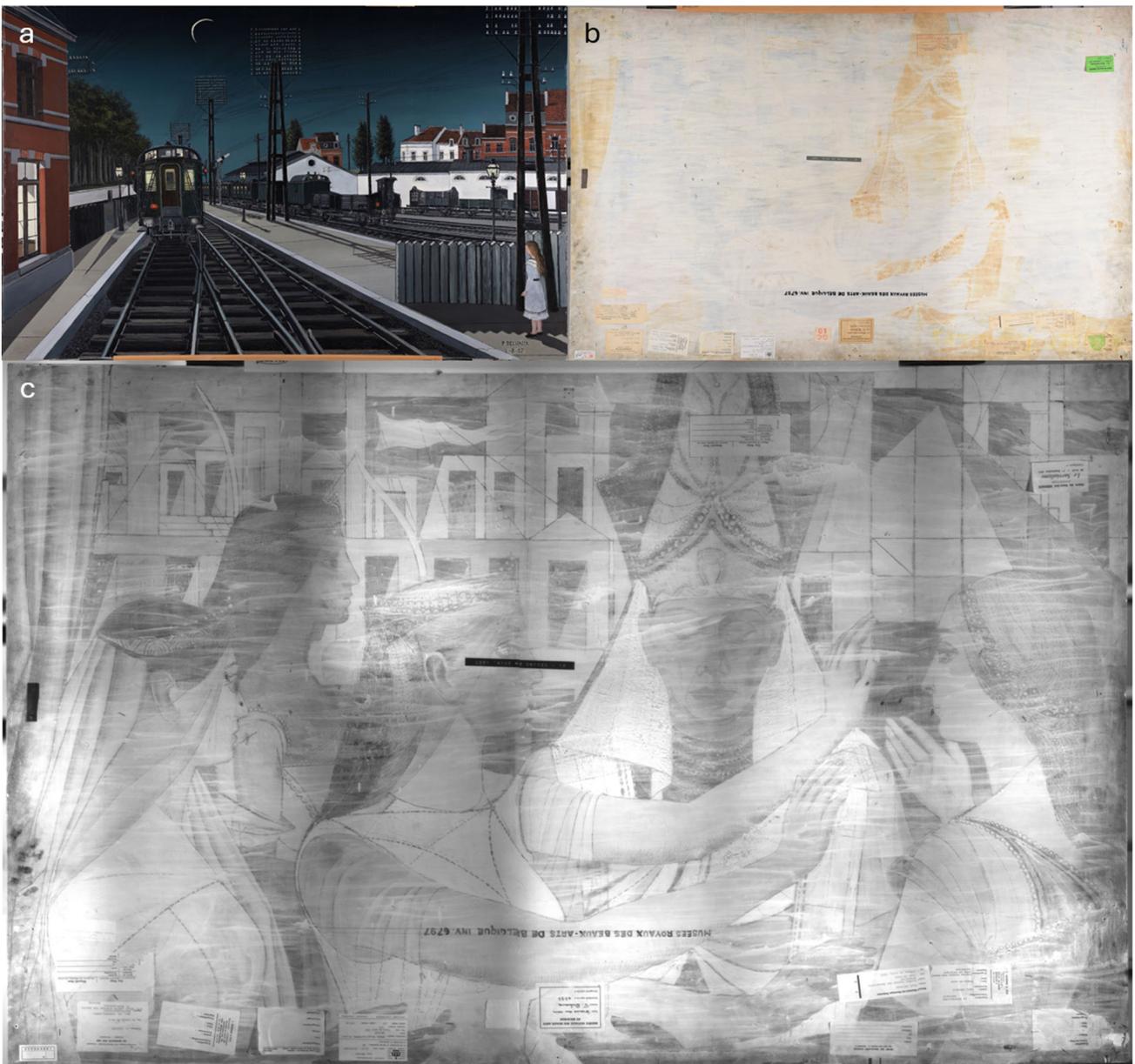
During the study of *Train du Soir* (Evening Train) (Fig. 1a), a painting dated 1957 whose composition deals with one of the artist's favorite subjects: railway station [2]. We discovered an unpublished painting by the artist not beneath the pictorial layer, but

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**Fig. 1** Paul Delvaux, *Train du Soir*, 1957, oil on wood, 110 × 170 cm, RMFAB (inv.6797), © Foundation Paul Delvaux, Sint-Idesbald : **a** photography in visible light, **b** photography in visible light of the reverse and **c** IRR of the reverse

on the reverse. Indeed, we can easily guess a composition on the reverse hidden under a layer of white paint (Fig. 1b). The IRR made it possible to reveal it (Fig. 1c). The characteristic outline of the hidden composition leaves no doubt about his author but it treats a subject much less known by the artist: Ancient Egypt. The only known painting treating the same subject is *La Légende Egyptienne* (The Egyptian Legend) from 1953 [3]. Furthermore, by looking at Delvaux's drawing books belonging to the RMBAB collection, we were able to identify a sketch of the discovered painting in a sketchbook from 1953.

This paper presents a first understanding of the elaboration process of creation, elaboration and destruction of a painting by Delvaux. Additionally, he also discusses producing a colored model of the discovered painting. The latter is built on the basis of the IRR of the reverse, elementary information obtained by MA-XRF analysis and microscopic examination of the painted surface.

## 2 Materials and methods

High-resolution photographic documentation of the entire reverse side of *Train du Soir* was acquired using digitization system designed by the CEA [4]. For images in visible light and under ultraviolet light (induced fluorescence), a Nikon® Z7-II camera with a Z-MC 105 mm f/2.8 Nikkor® lens was used to capture images, with each close-up recording a small area of the painting (3–4 cm). The images were then assembled using PTGui software®. Infrared reflectography (IRR) was performed using an Osiris® camera sensitive in the 0.9–1.7  $\mu\text{m}$  range and halogen lamps. X-ray radiography (XRR) was performed with the use of an Oxford-Instrument® 5000 series X-ray source operating between 40 and 50 kV at 1 mA, with two flat panels from X-Ris® and Balteau NDT®. The surface of the reverse was also examined with Dino-Lite® digital microscopes at  $\times 20$ ,  $\times 50$  and  $\times 230$  magnification.

Scanning-mode XRF spectroscopy (MA-XRF) was used on the reverse to further observe the composition underlying the white paint layer and also to assist in the construction of the colored model. The device used is composed of a Moktek® Magnum X-ray source (with a Ag anode, 40 kV voltage and a current of 120  $\mu\text{A}$  and a Silicon-Drift 123SDD Amptek® X-ray detector. The scanning step was set to 1 mm with a dwell time of 300 ms with a spot size of 1 mm. The obtained spectra were processed in batch mode using PyMCA [5, 6].

In order to better understand the process of creating this composition, the sketch (Fig. 2d) was also analyzed. In addition to having been analyzed in its entirety with the MA-XRF device, it was studied with Raman spectroscopy (RS) [7, 8]. This analysis was performed with an Enwave Optronics® device (I-Dual-G portable Raman analyzer), with a 785-nm laser with power varying between 30 and 300 mW and a spectral resolution of 6  $\text{cm}^{-1}$  in the spectral domain of 100–3000  $\text{cm}^{-1}$ . For each point of analysis, three acquisitions generally lasting 30 s with a laser power of  $\approx 100$  mW and a 500  $\mu\text{m}$  spot size were carried out. The spectra were then processed using Spectragryph®.

## 3 Results and discussion

### 3.1 Unpublished composition and dating

When the IRR highlighted this composition, we wondered if it was a new composition or if it was a first draft of a finished painting. To answer this question, we must examine Delvaux's work on ancient Egypt. At the Paul Delvaux Foundation Museum in Saint Idesbald, three studies in Indian ink on paper for *Le Roi* (The King) from 1953 are on display. *L'Égyptienne* (Egyptian Woman) is also exhibited there; it is a water and ink painting on paper dated 1953 depicting a queen surrounded by these female subjects and Roman soldiers. However, these compositions are considerably different from the one discovered.

There is also *La Légende Égyptienne* (Fig. 2a), an oil on panel from 1953, where we find most of the elements of the composition discovered on the reverse of *Train du Soir*: the king wearing an Egyptian headdress decorated with a cobra, female subjects, pyramids, tomb entrances, a curtain on the left and a flag.

Thanks to the sketchbook (inv.10691) from 1953, we can affirm that the composition discovered is not a first draft of *La Légende Égyptienne* but rather a previously unpublished composition. Indeed, a sketch for the discovered composition is found on page 7 (Fig. 2d), while a sketch of *La Légende Égyptienne* is made on page 9 (Fig. 2b).

It is therefore an unpublished composition and dated 1953. In fact, it cannot be earlier than its sketch which appears in the sketchbook of 1953. Likewise, it cannot be later than the obverse of the wooden panel, *Train du Soir*, dated 1957, because it was covered with white paint to reuse the panel. And finally, all the paintings relating to Ancient Egypt are dated 1953, which confirms the year of creation of this composition.

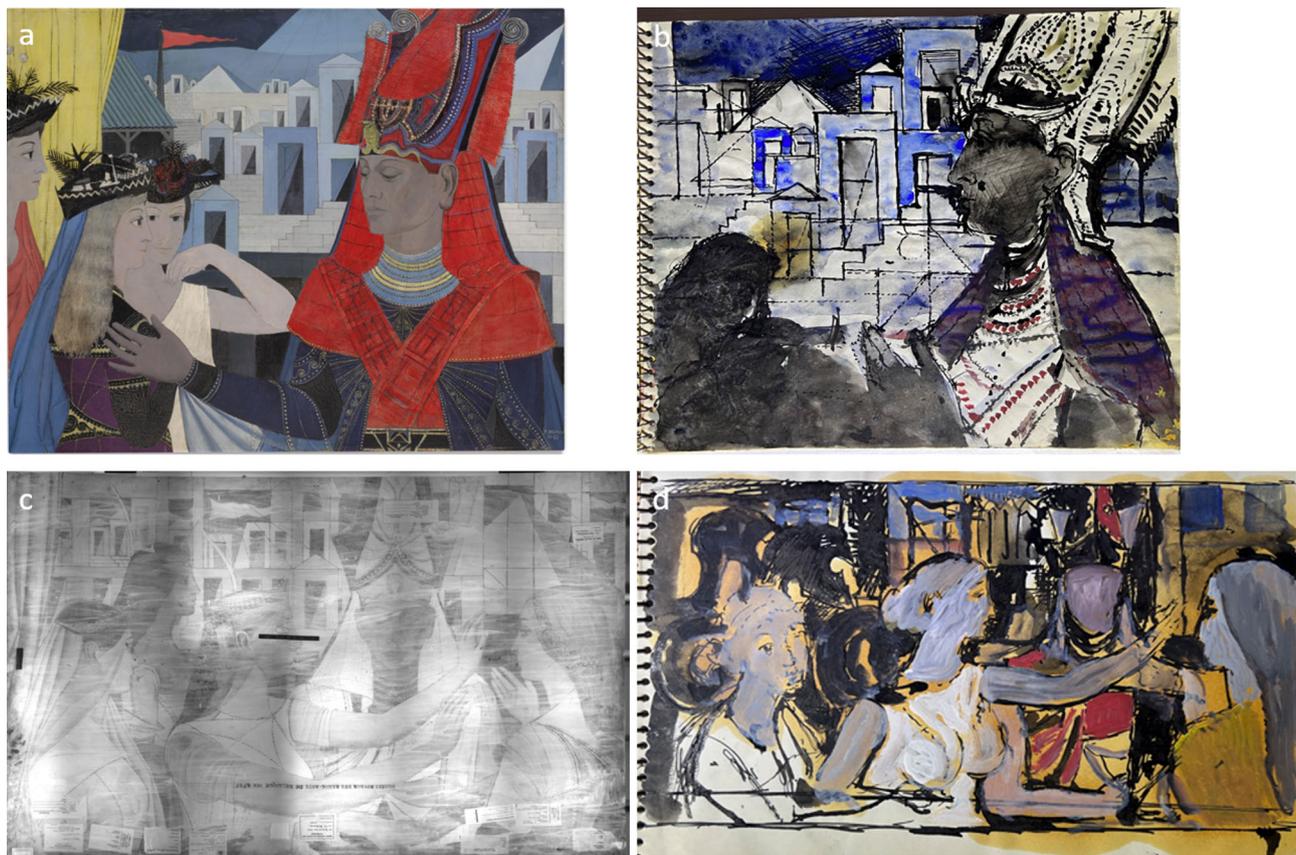
### 3.2 The sketch

Thus, the process of creating this painting began with the sketch, where the artist used various materials and tools. Some lines were drawn with a brush, while others were executed with a pen, as evidenced by the parallel micro-furrows observed in digital microscopy (Fig. 3).

A difference in gloss and dullness is perceptible between the black lines in Fig. 3b. The artist used black ink as well as paint with a less grainy texture. It is probably the Chinese ink known to the painter's practice [9]. MA-XRF analysis identified the black pigment in the paint as carbon black of animal origin, due to the simultaneous presence of calcium and phosphorus. By superimposing the distribution of calcium and phosphorus on the photograph of the sketch, we can distinguish the areas made with ink from the areas made with paint based on carbon black of animal origin (Fig. 4) [10, 11].

As for the paint, it seems that Delvaux used oil paint and gouache. The first is remarkable since the oil stained the paper and the second due to the dullness of the color.

In addition to black and white, three colors are used in this sketch: red, blue and yellow. The red pigment is vermilion (PR106) in accordance with the presence of mercury revealed by the MA-XRF analysis (Fig. 13). In addition, the Raman spectrum, taken in the torso of the main male figure, shows narrow absorption bands located at 245, 277 and 340  $\text{cm}^{-1}$  characteristic of this pigment [10, 12, 13]. MA-XRF analysis revealed the presence of sulfur, titanium and zinc in the sketch white, which allows us to assume



**Fig. 2** **a** Paul Delvaux, *La Légende Egyptienne* (Egyptian Legend), 1953, oil on panel, 120 x 149.5cm, ©Foundation Paul Delvaux, Sint-Idesbald, **b** Page 9 of sketchbook (inv.10691) **c** IRR of the reverse of *Train du Soir*, **d** Page 7 of sketchbook (inv.10691)

**Table 1** Pigments identified in the sketch deduced from RS and MA-XRF

Color	Raman bands( $cm^{-1}$ )	Detected elements	Identified pigment(s)
Black		<b>Ca, P</b>	Carbon black (animal origin)
White	141 <i>vs</i> , 348 <i>m</i> , 506 <i>m</i> , 632 <i>s</i>	<b>S, Ti, Zn</b>	Titanium white(an.), zinc sulfide
Blue		<b>S, Ti, Zn</b>	Titanium white(an.), zinc sulfide, <i>ultramarine blue</i>
Red	246 <i>vs</i> , 277 <i>m</i> , 340 <i>s</i>	<b>Hg, S</b>	Vermilion
Yellow		<b>Cd, S, Zn</b>	Cadmium yellow (PY35)

Raman bands intensity : vs very strong, s strong, m medium and w weak. - Supposed pigments are in italics

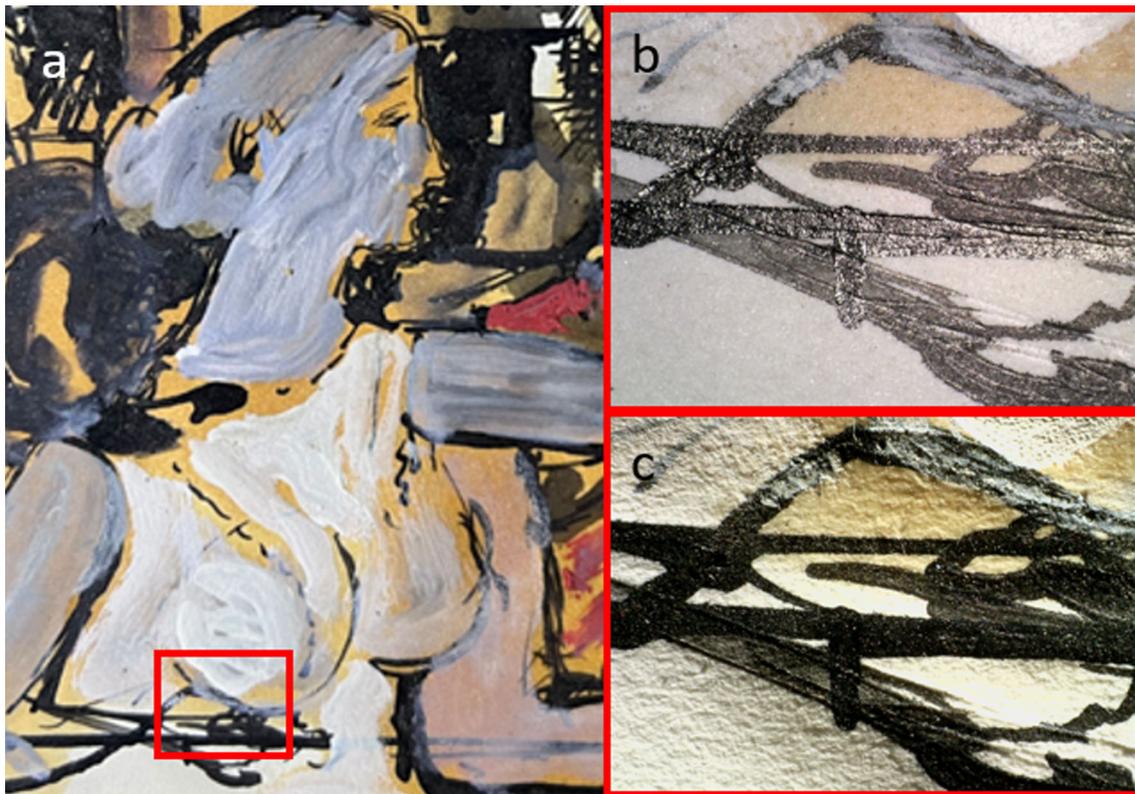
the use of titanium white (PW6) and zinc sulfide white (PW7). The Raman spectrum from the analysis of the blank shows narrow absorption bands located approximately at 140, 350, 506 and 610  $cm^{-1}$  thus confirming the use of titanium oxide in the form of anatase [10, 14]. The yellow pigment is composed of cadmium, sulfur and zinc indicating that is cadmium yellow. The presence of zinc specifies the result as cadmium yellow pigment PY35 [15]. For the blue, we can reasonably assume that it is ultramarine blue (PB29) given the absence of cobalt, copper and iron for this color. But above all, ultramarine blue was identified, by RS due to the presence of a narrow absorption band at 540  $cm^{-1}$  [10, 13, 16], in the blue which makes up page 9 of the sketchbook (Fig. 2b, Table 1) by RS.

### 3.3 Composition changes

Differences in composition are notable between the sketch and the IRR of the reverse. Indeed, in the upper left corner of the sketch, two helmeted soldiers are an integral part of the composition, while there is an additional female figure there.

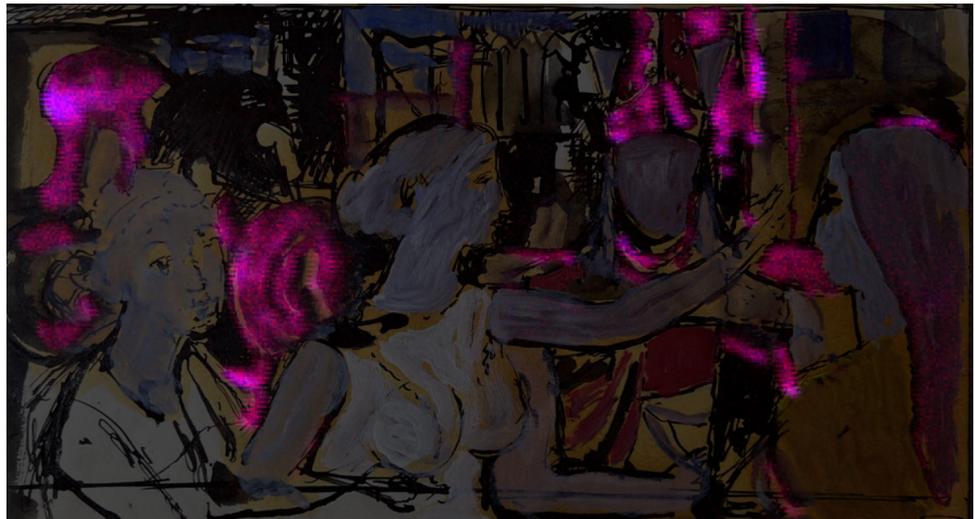
As mentioned in the literature [17] and as we have already encountered during our study of the painter’s technique [18], the absence of soldiers in the IRR actually results from a change in composition made during the pictorial execution.

Indeed, photography under raking light highlights the relief generated by the different layers of paint (Fig. 5a). Certain relief lines, highlighted in red (Fig. 5b), do not correspond to the outline of the IRR composition. These are probably the soldiers present in the composition of the sketch. The female figure, which was absent in the sketch, was in the initial composition a helmeted soldier.



**Fig. 3** a Female figure in white dress, digital microscopy : b  $\times 20$  and c  $\times 20$  in raking light

**Fig. 4** Calcium and phosphorus distribution of the sketch (in pink)



These soldiers are not visible with the XRR (Fig. 5d) because they were probably made with carbon black, in accordance with the practice of Delvaux [18], a pigment composed of light elements making it invisible to this imaging technique [19]. They are also not visible in the IRR (Fig. 5c) because they are in a too deep pictorial layer [20].

The disappearance of the soldiers from the composition is not the only change in the latter. In the upper left corner for example (Fig. 5), we see that the curtain covers part of the decor; it was not part of the sketch and was not part of the initial composition of the panel either.

To create the colored model, we used the IRR, allowing us to keep the final composition of the painting. In addition, since this technique reveals the preparatory drawing, the location of the shadows of the composition can be observed due to the use of a cross-hatching technique by the artist (Fig. 6).

**Fig. 5** Upper left corner of the reverse: **a, b** photographs in raking light, **c** IRR, **d** XRR



### 3.4 Colorized model

In order to determine the colors of this composition, we carried out microscopic examinations of the cracks in the layer of white paint, thus revealing the underlying color, as illustrated in Fig. 7. Thanks to IRR and MA-XRF analysis, the observed color is attributed to the corresponding element of the composition.

The color of certain elements of the composition could not be observed due to the absence of cracks. Certain colors have therefore been assumed from the composition of *La Légende Egyptienne*. The latter differs in their transparency in the colorized model (Fig. 8).

Overall, the colors of this composition are faithful to those intended in the sketch. This is particularly noticeable in the clothing of the male figure and in the predominance of blue in the decor.

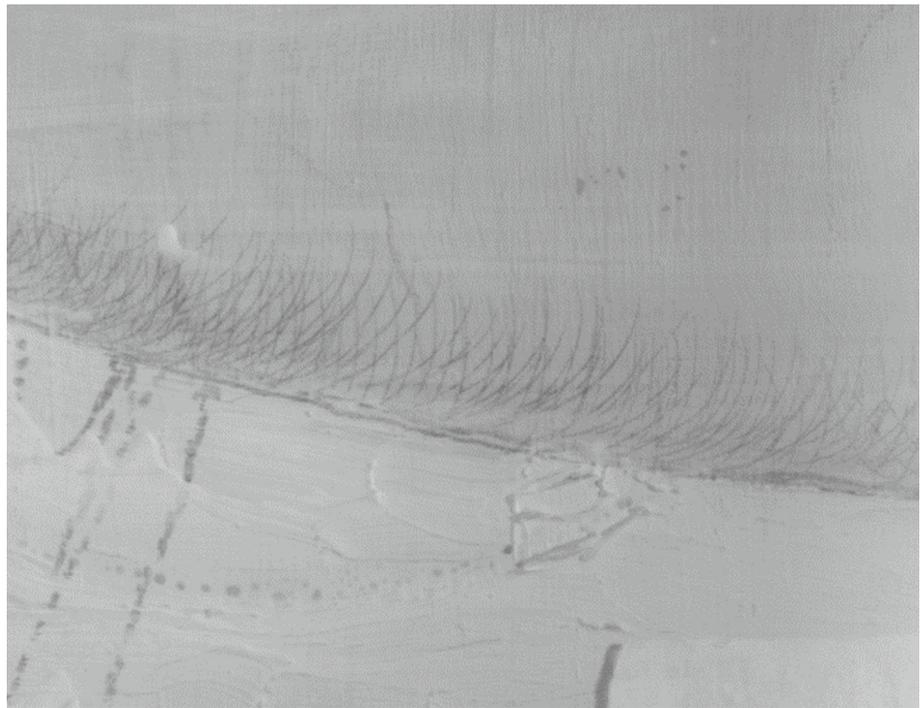
The flesh tones of the characters also respect the sketch plans, in particular with a darker shade for the skin of the male figure compared to that of the female figures.

In the sketch, the skin of the male figure has a purplish flesh tones, while that of the female figures is gray, as illustrated in Fig. 9. Analyses reveal that the skin of the female figure in a white dress is composed of pigments such as titanium white (in the form of anatase), zinc sulfide and carbon black. For the male figure, the same pigments are used, with the addition of vermilion.

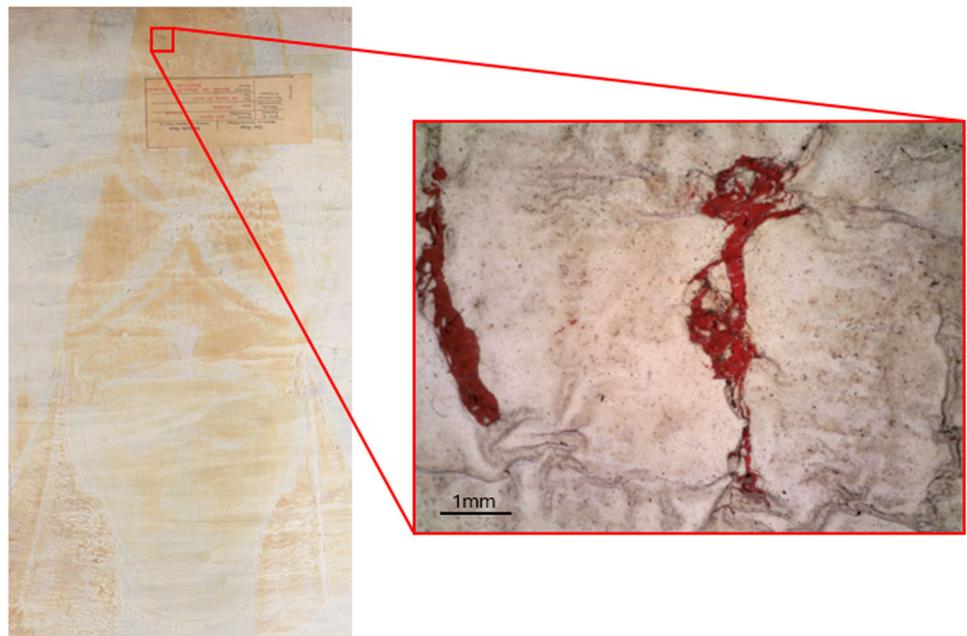
Thus, the observation of a purple flesh tone in the discovered composition (see Fig. 10) is in agreement with what was predicted in the sketch. In addition, it is similar to the color of the flesh in the composition *La Légende Egyptienne*.

Analysis by MA-XRF reveals the presence of mercury and chromium in the composition of this color (Figs. 14, 15). The presence of mercury indicates the use of vermilion, while chromium, without the presence of cobalt, cannot be associated with a blue pigment.

**Fig. 6** Cross-hatching in the right arm of the female figure raising her arms



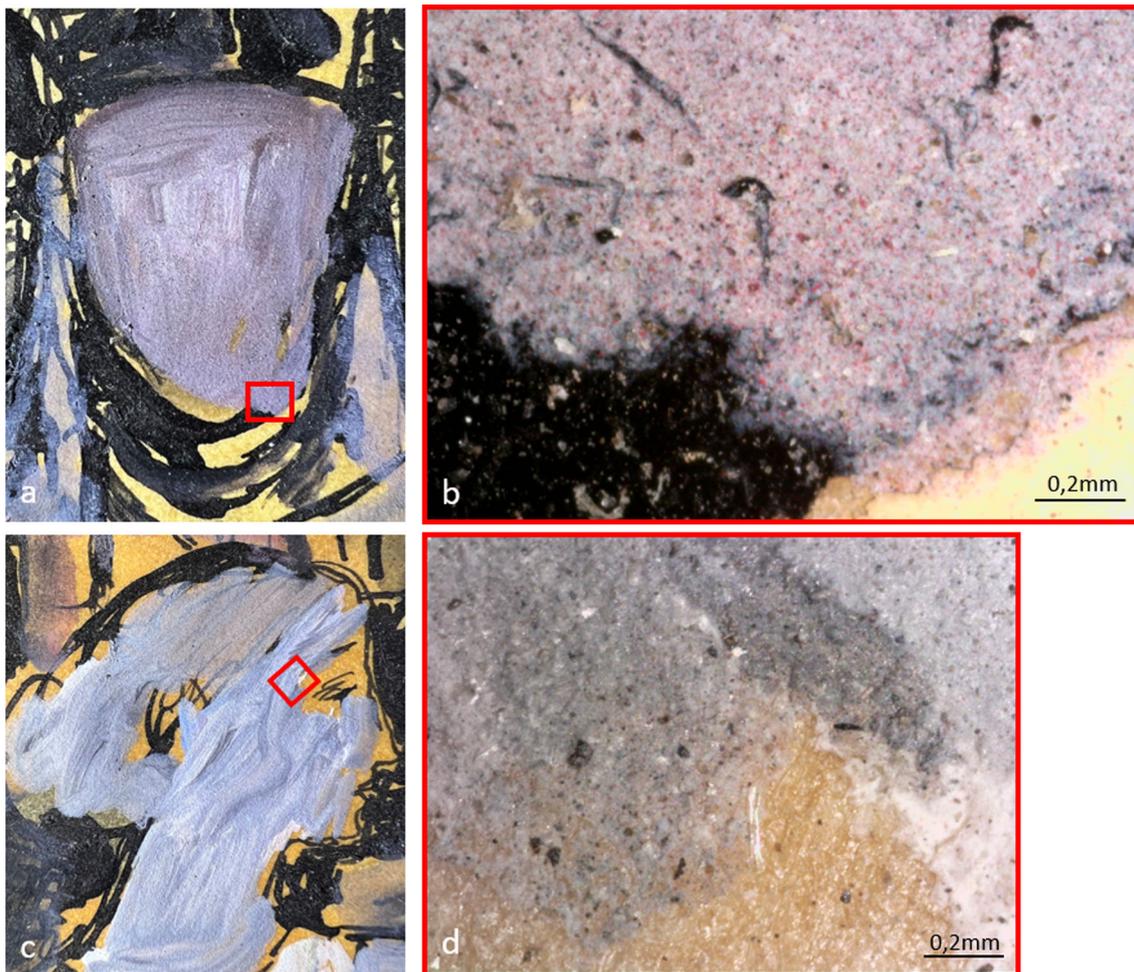
**Fig. 7** Visible photograph of the main male figure on the reverse of *Train du Soir* and digital microscopy observation of the red zone at magnification  $\times 50$



Assuming that the blue used is ultramarine blue, similar to the sketch and other paintings by artist [18], then the chrome could come from a chrome green pigment, also observed in his practice [18].

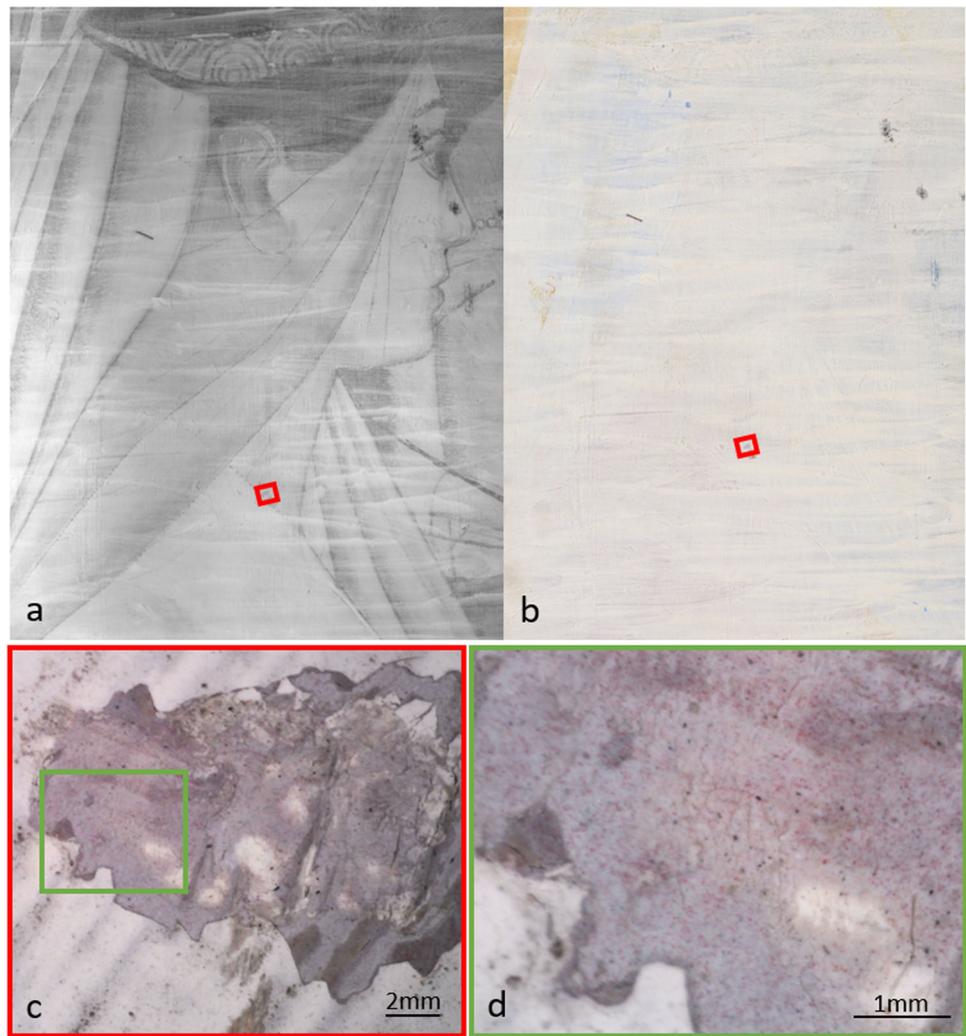
The flesh tones of the male figure and that of the female figures differ, whether in the colorized model or in the painting *La Légende Egyptienne*. However, MA-XRF analysis shows that they are composed of the same elements. To verify our hypothesis concerning the mixture of three pigments for flesh tones, vermilion, ultramarine blue and chrome green, a simulation was carried out. As shown in Fig. 11, using an equal concentration of vermilion and ultramarine blue, but changing the concentration of chrome green in the mixture results in a brown color and a raspberry color. By adding white to this result, we manage to recreate the flesh tones observed in the two compositions.

**Fig. 8** Colorized model of the reverse



**Fig. 9** **a** Face of the male figure, **c** face of the female figure in a white dress, **b**, **d** digital microscopy x230

**Fig. 10** Female figure raising her arms from the back of *Train du Soir*: **a** IRR, **b** photography and digital microscopy : **c**  $\times 20$ , **d**  $\times 50$



### 3.5 Reuse painting

Unsatisfied with this composition, Delvaux therefore “destroyed” it by covering it with a white paint layer. The MA-XRF analysis carried out on the edge of the panel reveals that this paint is composed of barium, sulfur and zinc (Fig. 12) indicating the use of the white pigment lithopone.

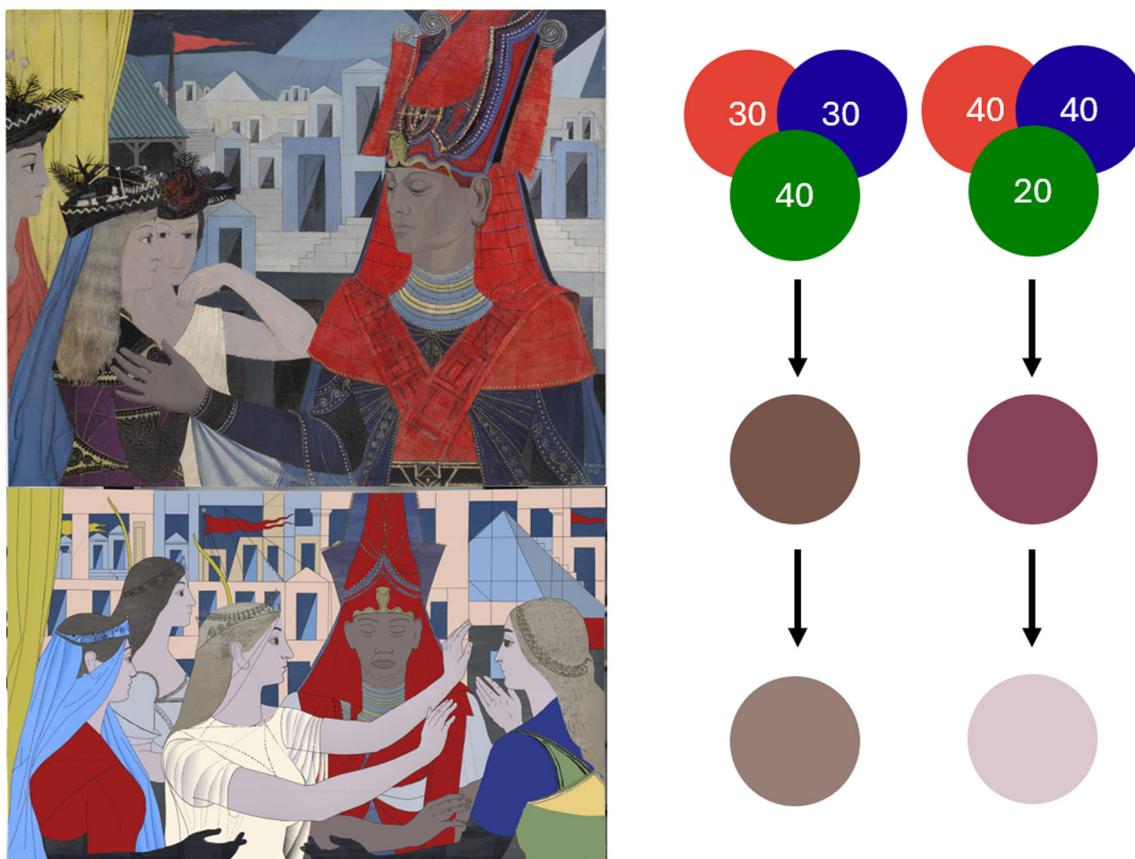
He then used the reverse of the panel to execute his painting *Train du Soir* from 1957. This is not the first reuse that we have observed at Delvaux. The painting *La voix publique*, from 1948, is also a reused panel [18]. However, for the latter, it is a double composition, and Delvaux painted his final composition over the previous one.

We can therefore affirm that Delvaux practices reuse in two ways: by covering the painting with a paint and using the other side of the support, or by painting a new composition over the existing painting.

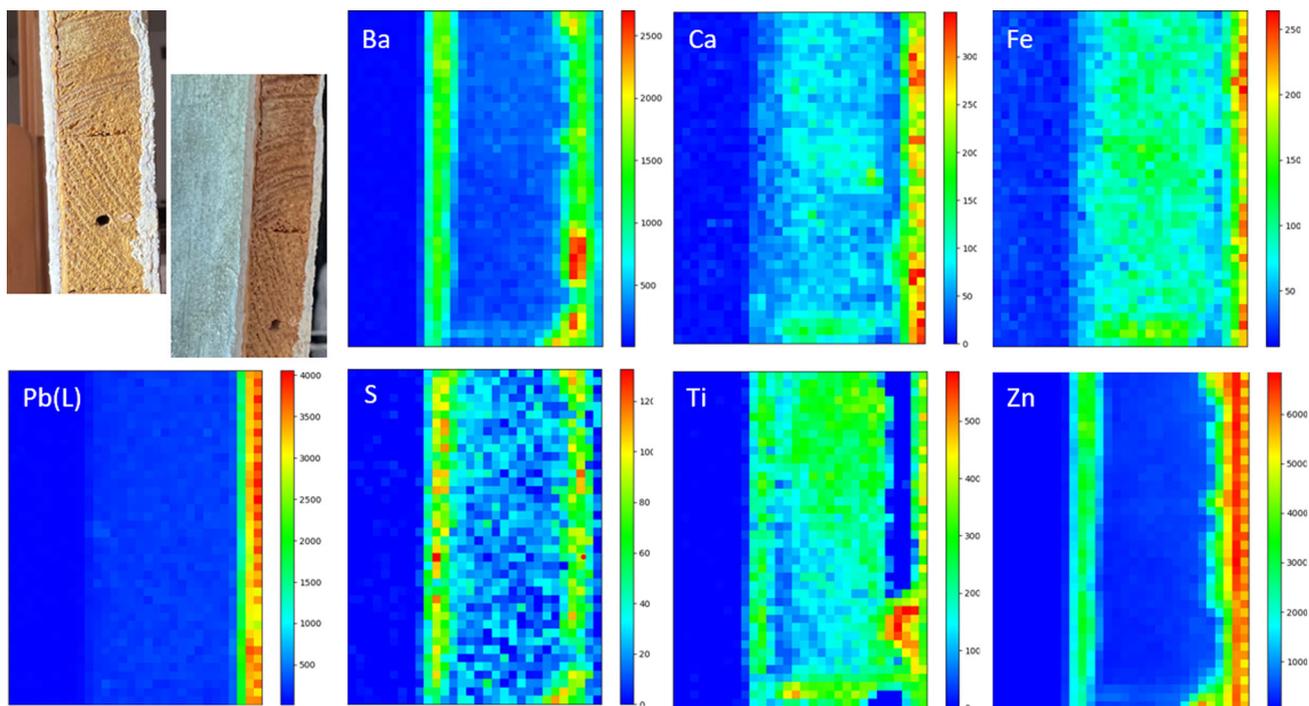
## 4 Conclusion

The development of the composition discovered on the reverse of *Train du Soir* began with the creation of a sketch made with pen and brush, ink and paint. The color palette of this sketch is limited, only primary colors appear.

When Delvaux undertook his painted composition, as far as the colors were concerned, he remained fairly faithful to those of his sketch. He also has it with the elements of composition. Initially, the soldiers in the sketch were clearly present, and there were no curtains to the left of the composition. It was only afterward that the composition changed, making it a little more similar to the composition of *La Légende Egyptienne*.



**Fig. 11** Left : comparison between *La Légende Egyptienne* (above) and the colorized model (below), right : Simulations of mixing pigments: vermilion, ultramarine blue and chrome green at different concentrations



**Fig. 12** Area studied by MA-XRF and resulting elemental maps (Ba, Ca, Fe, Pb(L), S, Ti, Zn)

This composition ultimately did not convince the artist who covered it with a layer of white paint in order to hide it and be able to reuse the panel to create a completely different composition on the reverse. This is a second process of reuse of work by the artist. Indeed, in *La voix publique*, the artist concealed the first composition by painting the final composition over it.

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**Author's contribution** DS, HS, CD and ED realized the in situ measurements. DS, CD and ED have interpreted the results of the analysis. ED has realized the colorized model. All authors have read and agreed to the published version of the manuscript.

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**Data Availability statement** The manuscript has associated data in a data repository 'The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request'.

#### **Declarations**

**Conflict of interest** The authors declare that they have no conflict of interest.

#### **Appendix: MA-XRF results**

See Figs. [13](#), [14](#), [15](#).

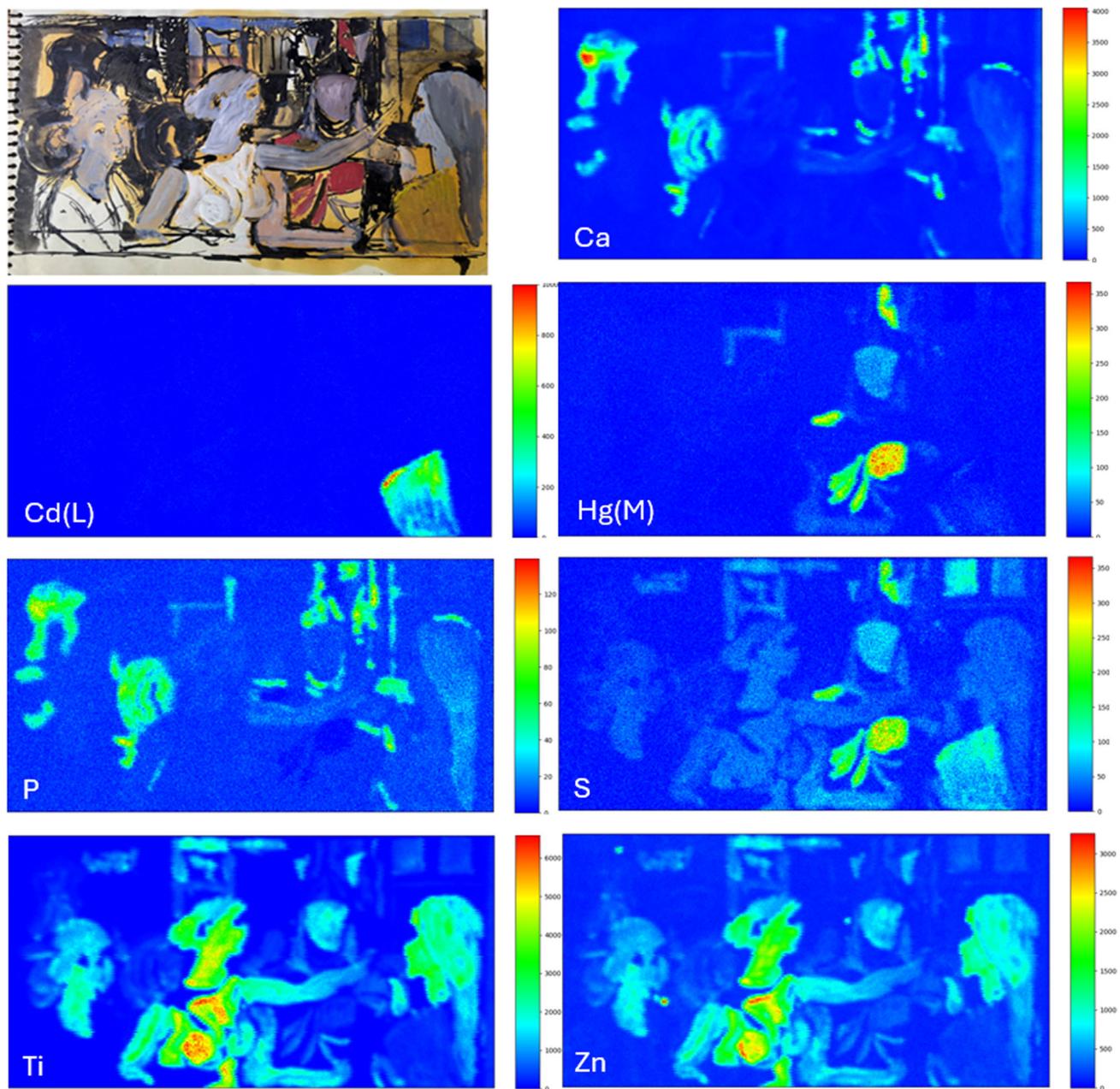
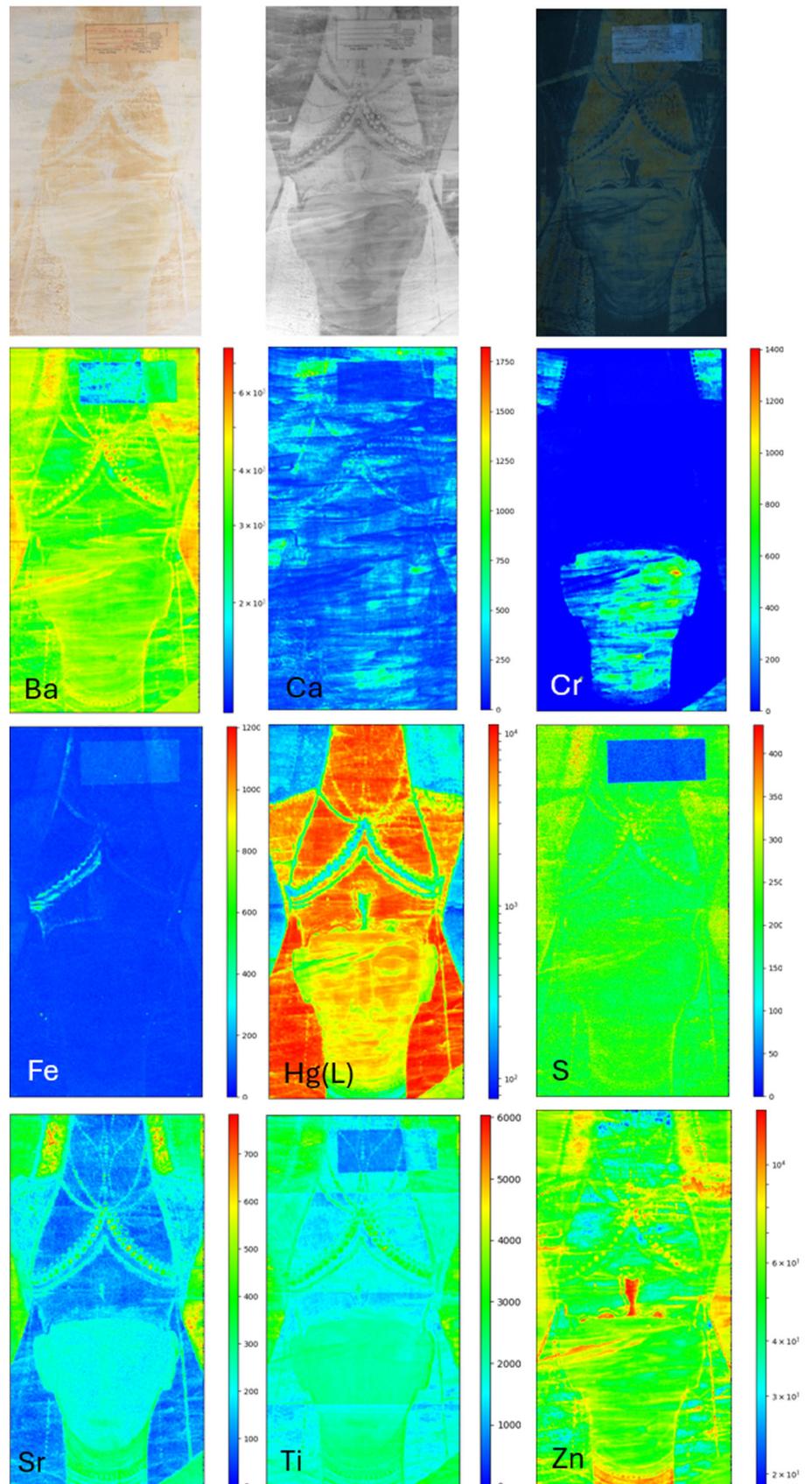
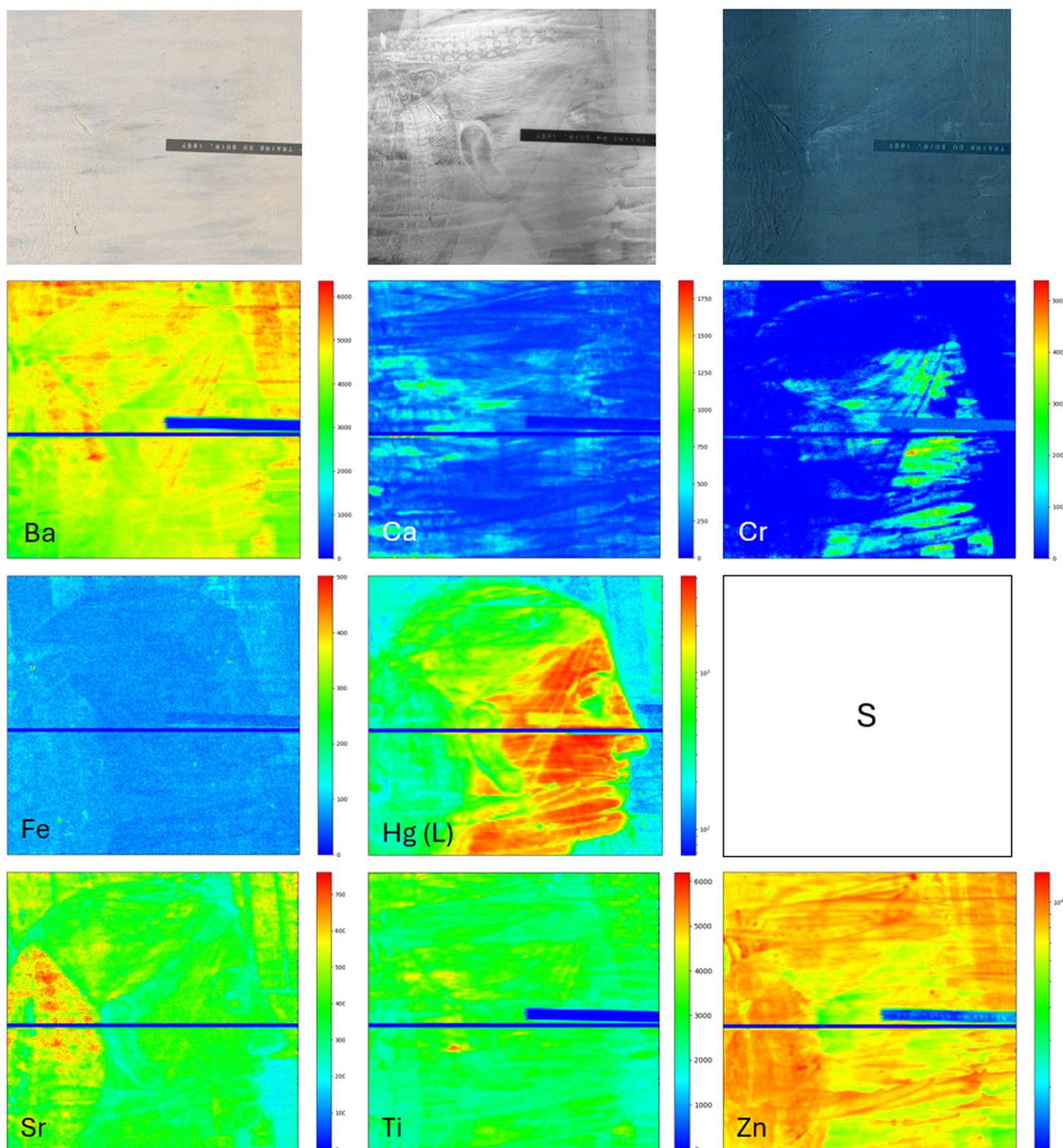


Fig. 13 Area studied by MA-XRF and resulting elemental maps (Ca, Cd, Hg, P, S, Ti, Zn)

**Fig. 14** Area studied by MA-XRF (visible, IRR and UV) and resulting elemental maps (Ba, Ca, Cr, Fe, Hg (L), S, Sr, Ti, Zn)





**Fig. 15** Area studied by MA-XRF (visible, IRR and UV) and resulting elemental maps (Ba, Ca, Cr, Fe, Hg (L), Sr, Ti, Zn)

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