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New Insights on Picasso's Blue Period Painting *La famille Soler*

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ABSTRACT

The study of *La Famille Soler* using non-invasive imaging, molecular, structural, and elemental analysis allowed the re-examination of changes of the work. Considered as the earliest of Picasso's versions of *Le d ejeuner sur l'herbe* by E. Manet, evidence suggests that an underlying landscape painted by Vidal in 1903 also referred to Manet's masterpiece. On the other hand, new results suggest that the cubist sketch undertaken by Picasso in 1912, prior to the current blue background, could be an uncompleted transformation of Vidal's landscape into synthetic cubism. Through study the main pigments used in the underlying compositions were successfully identified.

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Hyperspectral imaging; MA-XRF; Picasso's blue period; pigment identification; underlying composition

Introduction

La Famille Soler, presented in Figure 1, was painted in the summer of 1903, in Barcelona. This imposing family portrait (150 × 200 cm) is commonly known as the earliest of Picasso's versions of E. Manet's masterpiece *Le d ejeuner sur l'herbe* (1863) (Baldassari and Bernadac 2008; Schieder 2014), from which Picasso has made many versions, notably in 1959–1960. *La Famille Soler* and *La Vie* are the only large format paintings from Picasso's Blue Period (1903–1904) (Palau I Fabre 1979). The family portrait was originally intended to be the central part of a domestic triptych, ordered by Benet Soler (1874–1945) against unpaid invoices (Dumont 2001). The portrait of Benet Soler (State Hermitage Museum, Saint Petersburg) and the one of his wife Montserrat (Neue Pinakothek, Munich), correspond respectively to the right and left parts of the triptych. Unlike both lateral portraits, the painter did not finish the central work. The Catalan painter Sebastian Junyer-Vidal completed the painting by adding a forest landscape on the background (Kanhweiler 1947, 1948). Both painters were particularly close during Picasso's stay in Barcelona in 1903–1904.

In autumn 1912, D. H. Kanhweiler, who began representing Picasso in 1908, bought the three parts of the triptych for Benet Soler (Kanhweiler 1947, 1948). Kanhweiler paid 500 francs for the central part and paid Picasso twice this price to paint a new background over Vidal's landscape (Hollevoet-Force 2014).

The painter undertook to redress *La famille Soler* during the winter of 1912–1913 (Kanhweiler 1947). He first attempted a cubist composition (Kanhweiler

1948), partly visible by transparency of the overlying blue paint layers. The work was in the collection of the Walraff-Richartz-museum for 24 years, until its confiscation by the Nazi regime in 1937. The portrait of the Soler family was displayed at the infamous exhibition *Entartete Kunst* (Degenerate Art) inaugurated in Munich on 19th July 1937.

On 30 June 1939, the city of Li ege (Belgium) purchased *La famille Soler* through the controversial auction sale held at the Theodore Fischer gallery in Lucerne (Switzerland). Organized by the German government, this infamous sale of paintings and sculptures of modern masters owned by German museums aimed to get rid of modern artworks non-compliant with the Third Reich ideology.

To date the subject of Picasso's cubist experiments remain unknown and no assumption has been made about it since no image of the temporary cubist background exists. Although the existing black and white photograph of the painting with the woody background provides a general view of the work before Picasso's 1912 revision, this document does not deliver any information about the palette and the technique used by Vidal. These unresolved questions have recently motivated an in depth study of the artwork, through non-invasive and complementary imaging and analytical techniques. The painting was investigated using IR reflectography, X-ray radiography, Fourier transform infrared (FTIR) and Raman spectroscopies, X-ray powder diffraction, and X-ray fluorescence (XRF). Only preliminary results were reported in the catalog published for the exhibition *L'art*



Figure 1. P. Picasso, *La Famille Soler*, 1903, 150 × 200 cm, Oil on canvas, La Boverie, Liège, Belgium.

dégénéré selon Hitler (17 October 2014–29 March 2015, La Cité Miroir, Liège) (Defeyt and Strivay 2014).

Experimental

Infrared reflectography (IRR) was performed using the CEA (Centre Européen d'Archéométrie) mobile system (Hocquet et al. 2008; Strivay et al. 2016). The camera is an analogic Vidicon from Hamamatsu with infrared wavelength sensitivity up to 2 μm . Digitisation is done through a USB device and the image stitching is realized using AutoPano Pro 3.0 software from Kolor[®]. X-ray radiography was performed at the imaging service of the veterinary faculty at the University of Liège (X-ray tube Vertex Vet, Siemens, Germany used with 30 kV voltage and 100 mA current). Reprocessing of the images was done with AutoPano Pro 3.0[®].

Hyperspectral imaging (HSI) was acquired with a Specim SWIR camera, providing spectral information from 1000 to 2500 nm using pushbroom mode. In this mode, the cube is built line by line, each spatial line containing the related spectral information (scan speed of 3.72 mm/s, frame rate of 7 Hz and exposure time of 10 ms were used). In order to investigate the entire surface of the painting, the HIS set-up was moved in front of the object.

As for the IRR and HSI methods, all the X-ray diffraction (XRD), XRF, FTIR and Raman analyses were performed *in situ* with portable instruments. XRD measurements were carried out with a system designed inhouse, using an air-cooled iMOXS-MFR X-ray tube with a Cu anode ($K_{\alpha} = 0.154060 \text{ nm}$)

(Gianoncelli et al. 2008; Hodeau et al. 2008). The applied voltage was 40 kV with a current of 700 μA . The XRF detector is a Ketek 7 mm² Silicon Drift Detector (SDD) type and the XRD diffractograms are recorded with an imaging plate digitized by a DenOptix GENDEX scanner. The XRF spectra were treated with ADMCA and PyMCA (Solé et al. 2007). The diffraction diagrams were converted into $-\theta$ or 2θ plots with Fit2D (Hammersley et al. 1996), phase identification was carried out with commercial software including a base of XRD data (Diffract-plus EVA Bruker). The acquisition time was 5 min for XRF and 20 minutes for XRD.

Macro X-ray fluorescence analyses (MA-XRF) were performed with an XRF system designed inhouse (Hocquet et al. 2008, 2011; Strivay et al. 2016). 2D elemental mappings were conducted on several areas. The positioning system was controlled through a laptop running dedicated inhouse software. The X-ray source is an MOXTEK tube with an Ag anode. The applied voltage was 35 kV and the current 130 μA . The detector is a 25 mm² Amptek SDD detector with a resolution of 132 eV at 5.9 keV. Acquisition time for point analysis was 300s per spectrum. For mapping, the pixel size was 2.2 mm² and the acquisition time was 2 s/spectrum.

The FTIR spectra were recorded in the 4000–450 cm^{-1} range with a spectral resolution of 4 cm^{-1} . The IR spectrometer is a Bruker ALPHA model equipped with a Ge crystal and a module for external reflection. The reflection module focuses the beam on the object with mirrors resulting in a beam spot of about 5 mm. The reflected part is also collected by mirrors and recorded by a DTGS detector. The software OPUS

used for controlling the ALPHA instrument performed the transformation from total reflection to absorption spectra. The IR absorption of the synthetic varnishes (based on Laropal® A81 and Paraloid® B-72 resins and Cosmolloid H80 microcrystalline wax), which were applied to the painting during conservation in 2000 (Lempereur 2000), strongly complicated the infrared bands assignment.

Raman analyses were carried out with an I-Dual-G Raman analyzer from Enwave Optronics and with an MArtA spectrometer (Vandenabeele et al. 2004). For each analyzed spot, three Raman spectra were recorded in the spectral range of 100–2700 cm^{-1} , using a diode laser with a wavelength of 785 nm (laser spot size c. 1 mm, spectral resolution of 5.67 cm^{-1}). Raman spectra were acquired with the laser power reduced at 25% (around 15 mW at the object), 10–30 s integration time and three accumulations.

Results and discussion

The results and complementary information presented in this work, allow new insights regarding the woody landscape by Vidal and Picasso's cubist composition. Indeed, on the basis of the overall results, it can be concluded that Vidal painted a wood largely inspired from Manet's painting *Le déjeuner sur l'herbe*. Concerning the cubist sketch, several pieces of evidence indicate a transformation of Vidal's wood into synthetic cubism, at an early stage of the transformation process. In addition to these findings, Picasso's 1903 and Vidal's palettes were characterized. Some of the pigments used for the cubist experiments and those contained in the current blue background were identified. While several studies on Picasso's palette have been published (Gautier et al. 2009; Casadio 2010; Casadio et al. 2012; Casadio and Rose 2013; Casadio, Muir, and Bezur 2013a, 2013b; Gual, Jiménez, and Robinson 2013; Muir et al. 2013) only a few relate to the Blue Period.

Picasso's original composition (1903)

La famille Soler depicts Benet and Montserrat Soler with their four children, from left to right Mercé, Antonita, Carles, and Montserrat, in a picnic scene (Dumont 2001). Baldassari previously showed that Picasso portrayed the Soler family using as his source a black and white studio-made picture of the whole family, reproduced in Baldassari (1994).

The degree of finishing and the bright red, green, yellow, orange, and pink colors displayed in the family portrait constitute noticeable differences with coeval portraits, which are both much closer to the Blue Period esthetic. In the family portrait, the white ground layer and the preparatory drawing of the tablecloth remain visible. In his letter about the provenance

of *La famille Soler*, dated 19 March 1948 and addressed to Jules Bosmant, Head Curator of Liège Museum of Fine-Arts, Kanhweiler wrote that Picasso did not finish the family portrait because of a lack of time (Kanhweiler 1948). Underdrawing was executed on a primed canvas with charcoal or graphite pencil. IRR did not reveal changes between the drawing and the painted picnic scene. The pigments identified in the original composition by means of XRD, XRF, and FTIR techniques are listed in Table 1. The ground layer, accessible in the preserved area of the picnic cloth, is made of oil mixed with lead white (hydrocerussite form), calcite, and barite. In white areas, a mixture of hydrocerussite, gypsum, and barite was found.

FTIR spectra highlight the presence of Prussian blue for most of the analyzed spots. As illustrated in Figure 2, irrespective of the investigated color shades, the characteristic single dominant IR band of Prussian blue arising ca. 2095 cm^{-1} can be readily identified. Prussian blue was found in combination with hydrocerussite and ultramarine in different blue spots, which were analyzed by XRD and Raman spectroscopy. The pXRF, XRD, and FTIR results showed that the green colors used for grass, the bottle of wine, and the fruits, are mixtures of chromium-based pigment(s), possibly viridian and/or chrome yellow, Prussian blue, and hydrocerussite. As shown in Figure 3, the distribution of Ca, Ba, Cr, Zn, Pb, and Fe obtained for the green area above Antonita's

Table 1. Overall pigments identified by FTIR, RS, MA-XRF, pXRF, and XRD techniques.

Color	Identified pigments
<i>Original composition</i>	
Background	Lead white (hydrocerussite), Calcite, Barite
White	Lead white (hydrocerussite), Gypsum, Barite
Blue	Lead white (hydrocerussite), Gypsum, Barite, Prussian blue, Ultramarine, vermilion
Red	Lead white, vermilion, Cd yellow, Prussian blue
Yellow	Cr yellow, Cd yellow, Barite, Prussian blue
Green	Lead white (hydrocerussite), Calcite, Viridian, Prussian blue, Ultramarine, vermilion, Lithopone
Orange	Lead white (hydrocerussite), Calcite, vermilion, Cd yellow, Prussian blue
Brown	Lead white (hydrocerussite), Calcite, vermilion, Iron oxide (s), Cd yellow, Prussian blue
Carnation	Lead white (hydrocerussite), vermilion, Gypsum, Barite, Prussian blue
<i>Vidal's landscape</i>	
White	Lead white
Red	vermilion
Yellow	Massicot
Not visible	vermilion, Zinc white, Cu As based pigment, Pb based pigment, Cd yellow, Cr based pigment
<i>Cubist sketch</i>	
Whitish shadow	Lead white
Brownish blue	Prussian blue, Zinc white, Cr based pigment, vermilion
Not visible	Cd yellow, Cu As based pigment
<i>Current background</i>	
Blue	Prussian blue, Ultramarine, Lead white (hydrocerussite and cerussite)
Greenish blue	Prussian blue, Ultramarine, Cr yellow, Viridian, Lead white (hydrocerussite and cerussite), Gypsum
Brownish blue	Prussian blue, Lead white (hydrocerussite and cerussite)
Overpaint	CuPC blue, Ultramarine, Zinc white
Signature	vermilion

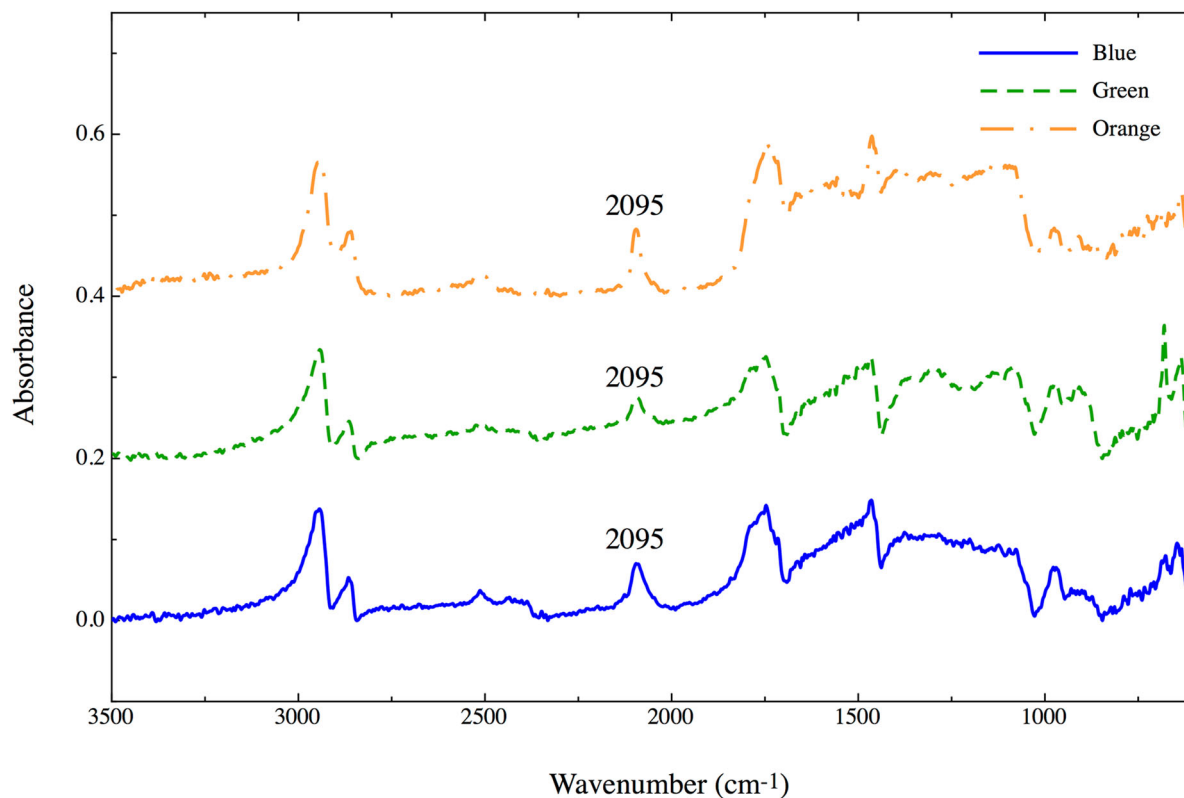


Figure 2. Infrared spectra recorded for dark blue in Carles' right sock (in green), green of grass (in blue) and orange fruit (in red). The characteristic IR absorption of Prussian blue ca. 2095 cm^{-1} can be readily identified, irrespective of the color of the analyzed spot.

head (the little girl wearing pink), which is regarded as a surviving area of the original background, supports the use of similar pigments, probably mixed with

ultramarine and lithopone. The reddish brown shades, such as those depicting Antonita's hairs, mainly involve vermilion and iron oxide(s). The yellowish

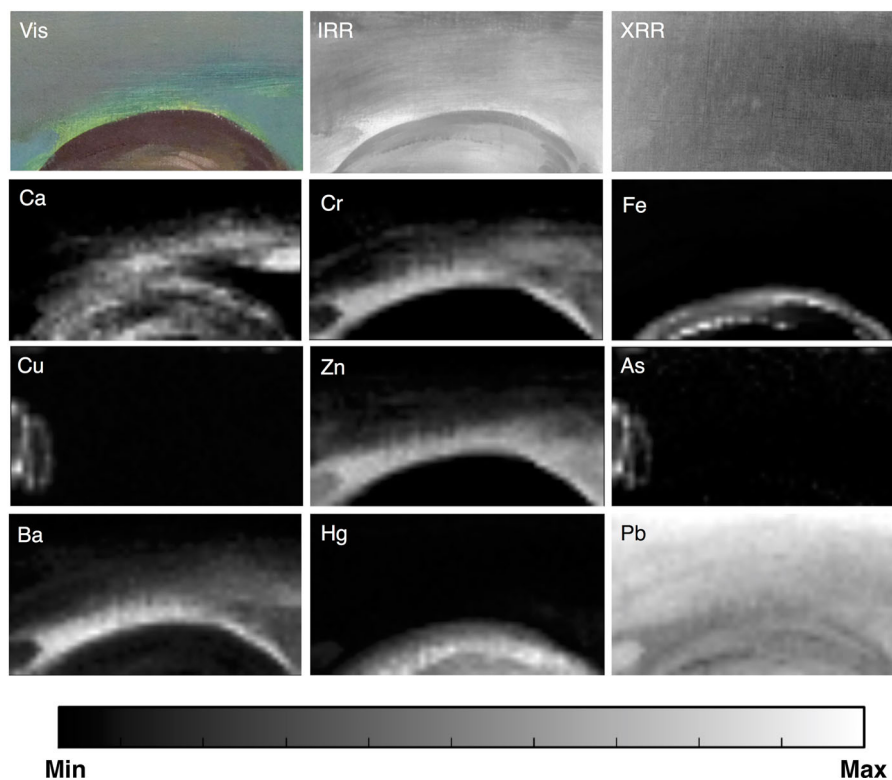


Figure 3. XRF maps recorded for the top of Antonita's head (the girl wearing pink) and the area above ($100 \times 54\text{ mm}$). Visible light image, IR reflectography, and X-ray radiography details and the distribution of Ca, Cr, Fe, Cu, Zn, As, Ba, Hg, and Pb are illustrated. White levels correspond to peak surface in arbitrary units.

brown shades e.g. Benet Soler's jacket and the dog's paws, as well as the orange found in fruits and Soler's cravat are based on vermilion, hydrocerussite, and cadmium yellow. Hydrocerussite, vermilion, gypsum, barite, and Prussian blue were identified in flesh tones. In conclusion, the palette used for portraying the Soler family is consistent with the pigments identified from emblematic Picasso's blue period paintings, such as *The Old Guitarist* (1903–1904) and *La vie* (1903) (see Revealing Picasso Conservation Project, Art Institute of Chicago, <http://www.artic.edu/collections/conservation/revealing-picasso-conservation-project> and Gual, Jiménez, and Robinson 2013).

Background with landscape by Vidal (1903)

According to Richardson (1992), it was Benet Soler who commissioned Vidal to transform the uniform blue background central part of the triptych, supposedly painted prior by Picasso, because the tailor did not like it. Contrary to the report in the painter's biographer, the letter from Kahnweiler to Bosmant (Kahnweiler 1948) indicates that the Catalan painter completed the background at Picasso's behest. This insight suggests that Junyer Vidal and Picasso may have agreed on how to finish this large format painting. The Director of Liège Museum of Fine-Arts, Jacques Ochs, received a black and white picture of *La famille Soler* with Vidal's landscape, as an attachment to a letter from Kahnweiler dated 7 April 1948: 'La famille Soler de Picasso, avec le fond clairière de forêt peint

par Sebastian Junyer' (The Soler family of Picasso, with the wood landscape background painted by Sebastian Junyer), was written with black ink, on the back of the picture.

The picture of the painting in its earlier state is presented in Figure 4. This archive document, first reproduced in Zervos (1932), displays the characteristic woody vegetation found in the Catalan painter's landscapes, where trees are overly long, thin, and twisted. One example of landscape painted by Vidal is shown in Figure 5. Vidal's hand is especially recognizable in the roots of the tree lying at the Montserrat Soler's right side (Figure 1). By comparing the current version of the work (Figure 1) and the archival image (Figure 4), one can see that the large brownish green brushstrokes, above Benet Soler's left shoulder, belong to the former background version.

The combination of the HIS, IRR, and XRR imaging techniques allowed analysis of technical information on Vidal's background unavailable from historic sources. The generated images provided a more clearly visible landscape. By comparing the HS image of the Vidal's landscape (Figure 6), with the background in the Manet's work, one can see that the skyline (right above Montserrat's head) and the principal trees present quite obvious similarities in terms of position and orientation. The pigments that can be reasonably associated to Vidal's palette are given in Table 1. The open cracks affecting the 1913 blue background reveal thick yellow brushstrokes from the skyline beneath it. The bright yellow shade, possibly based on massicot,



Figure 4. Anonymous, black and white photograph of *La famille Soler* with Vidal's woody landscape, 1903–1912, 15 × 21 cm, Special Collections, Getty Research Institute (Los Angeles).



Figure 5. Example of woody landscape by Sebastià Junyer i Vidal, title and date unknown, Private Collection.

see Raman spectra in [Figure 7](#), and the impasto technique used to depict the skyline, which would have granted an overall impression of depth to the landscape. The brightness and the yellow shade of Vidal's skyline support the hypothesis that *Le déjeuner sur l'Herbe* was a direct reference.

Vidal's background remains visible on the full length of the upper edge. This preserved painted band with a width of approximately 1 cm was discovered during the 2000 conservation campaign, after removing from the upper edge a strip of Kraft paper that had been added prior to the 1913 blue background (Lempereur 2000).



Figure 6. Infrared hyperspectral image acquired with a Specim SWIR camera, providing spectral information from 1000 to 2500 nm and using pushbroom mode. Colors correspond to intensity at 1100, 1500, and 2000 nm.

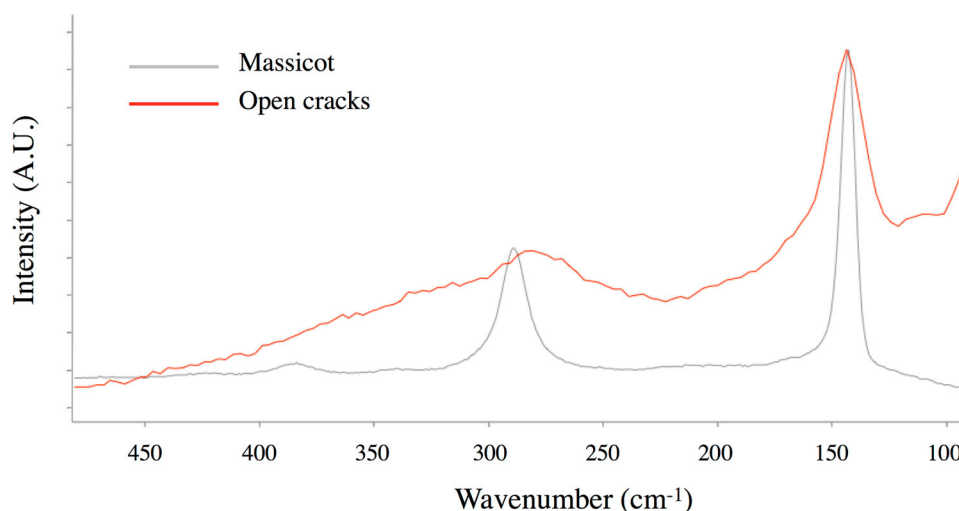


Figure 7. Raman spectrum of the yellow skyline beneath the current blue background, partly visible through cracks (in red), and massicot pigment (in gray).

The paper removal unveiled Vidal's white, green, and red brushstrokes, from which lead white and vermilion were identified. Study of the overall landscape beneath Picasso's 1913 blue background with XRF (mapping and individual spots) allowed the identification of various inorganic pigments, commonly found in twentieth century painters' palettes.

As seen in XRF maps presented in Figure 8, trees belonging to Vidal's landscape are indicated by the distribution of Cu, As, Zn, Hg, and Pb in the associated pigments, which indicates copper-arsenic pigments such as emerald and/or Scheele's greens, admixed with zinc white and lead-based pigment(s), like lead white and massicot. The area surrounding the trees are rich in cadmium yellow and contain copper-arsenic based pigment(s) as well. XRF results also suggest the presence, to a lesser extent, of chromium-based pigment(s).

Cubist sketch by Picasso (1913)

In 1913, whereas the cubism originally developed with Braque in the preceding years had grown in popularity, Picasso was already exploring a novel artistic style, which art historians called later synthetic cubism (Daix 2007). In 1948, Kanweiler wrote to Bosmant that Picasso had first intended to paint a background in the cubist manner, pointing out visible remnants of it. According to the art dealer, the painter renounced the initial project because of the impossibility of reconciling his new style with his former one (Kanweiler 1948).

Due to the transparency of the current overlying uniform blue background, a few lines from the cubist composition attempted by Picasso in 1913 can be observed under visible light. The complementary imaging techniques applied on *La famille Soler* highlighted further hidden details, and supplementary elements belonging to the former cubist background were unveiled, i.e. the cubist feature lying on the right

side of Carles's head appearing in the IRR as a darker rectangular surface. The achievement of a more comprehensive overview of the cubist layout allow the formulation of the first hypothesis about its subject. As illustrated in Figure 9, the basis of the main cubist figure, partly visible above Montserrat's head, superimposes the skyline from Vidal's landscape (the related brushstrokes appearing black in the IRR). Conversely, the vertical cubist lines which can be perceived in the hyperspectral image shown in Figure 6, seem to be aligned with the tree trunks depicted by Vidal. In the same way, the cubist features discovered thanks to the IRR and HSI methods in the upper left side of the painting, seem to evoke the crown of the main tree. In light of these findings, the idea of Vidal's landscape as the subject of the cubist composition has emerged. Did Picasso, who said that there was no cubism without subject (Palau I Fabre 1979), attempt to transpose his friend's landscape into synthetic cubism?

The pigments identified through analytical techniques that can be reasonably considered as present in the cubist sketch, are listed in Table 1. During this time, Picasso experimented with Ripolin colors, high-quality oil-based house paints in the first two decades of the twentieth century. Such paints have previously been identified from Picasso's cubist paintings, i.e. *Souvenirs du Havre* 1912 (Andral, Raeburn, and Gautier 2011). However, the XRF mapping indicates the use of lead white-based paints to trace the white visible cubist lines, lying above Montserrat's head. The identification of lead is not compatible with the use of house paints from Ripolin, since they did not contain lead white (Casadio 2010).

Blue background by Picasso (1913)

The Kraft paper, partly removed in 2000, was present prior to the painting of the blue background. Because

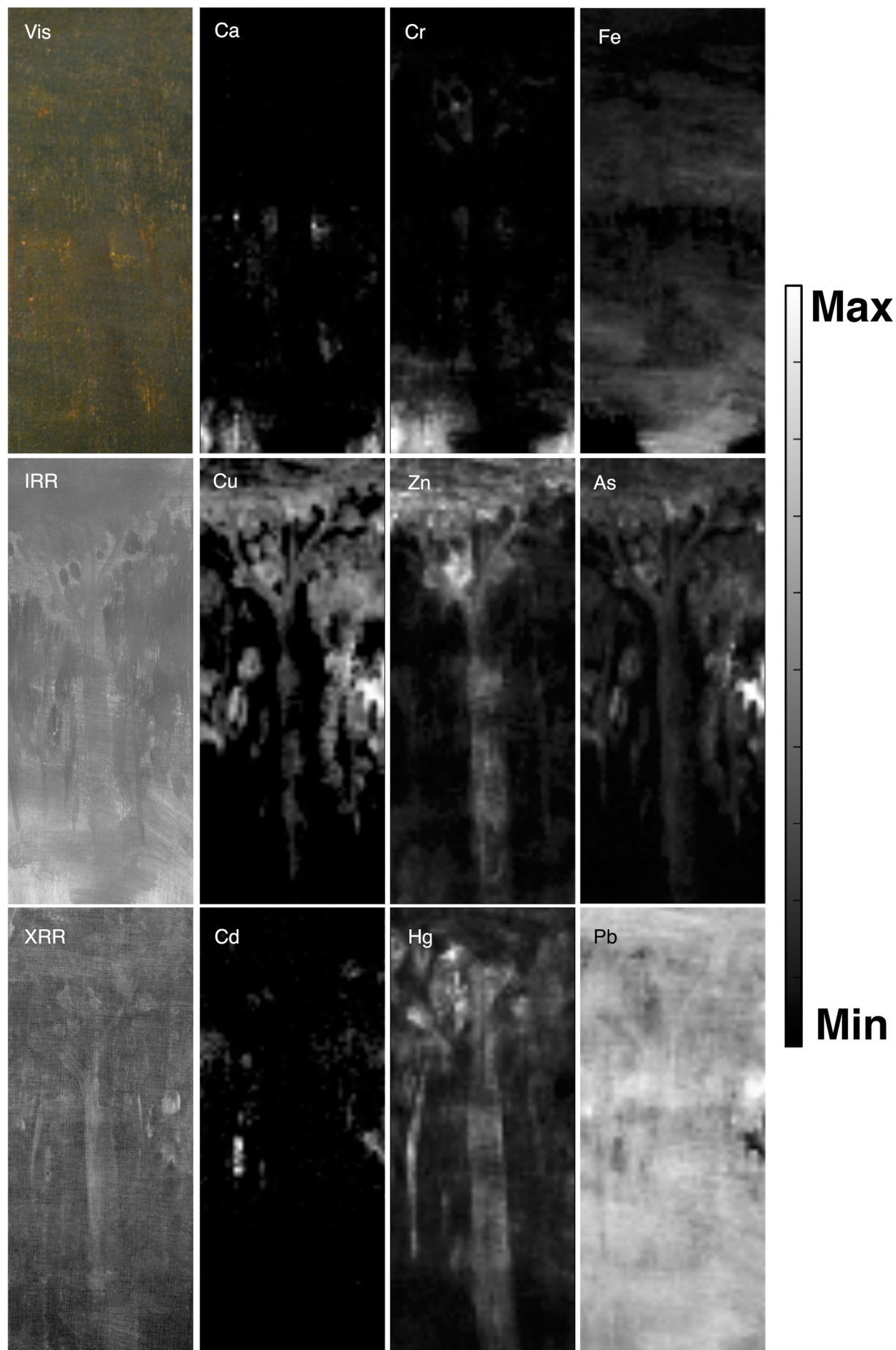


Figure 8. XRF maps recorded in a region on the right side of Benet Soler's face, (84 × 204 mm). Visible light image, IR reflectography and X-ray radiography details and the distribution of Ca, Cr, Fe, Cu, Zn, As, Cd, Hg, and Pb. White levels correspond to peak surface in arbitrary units.

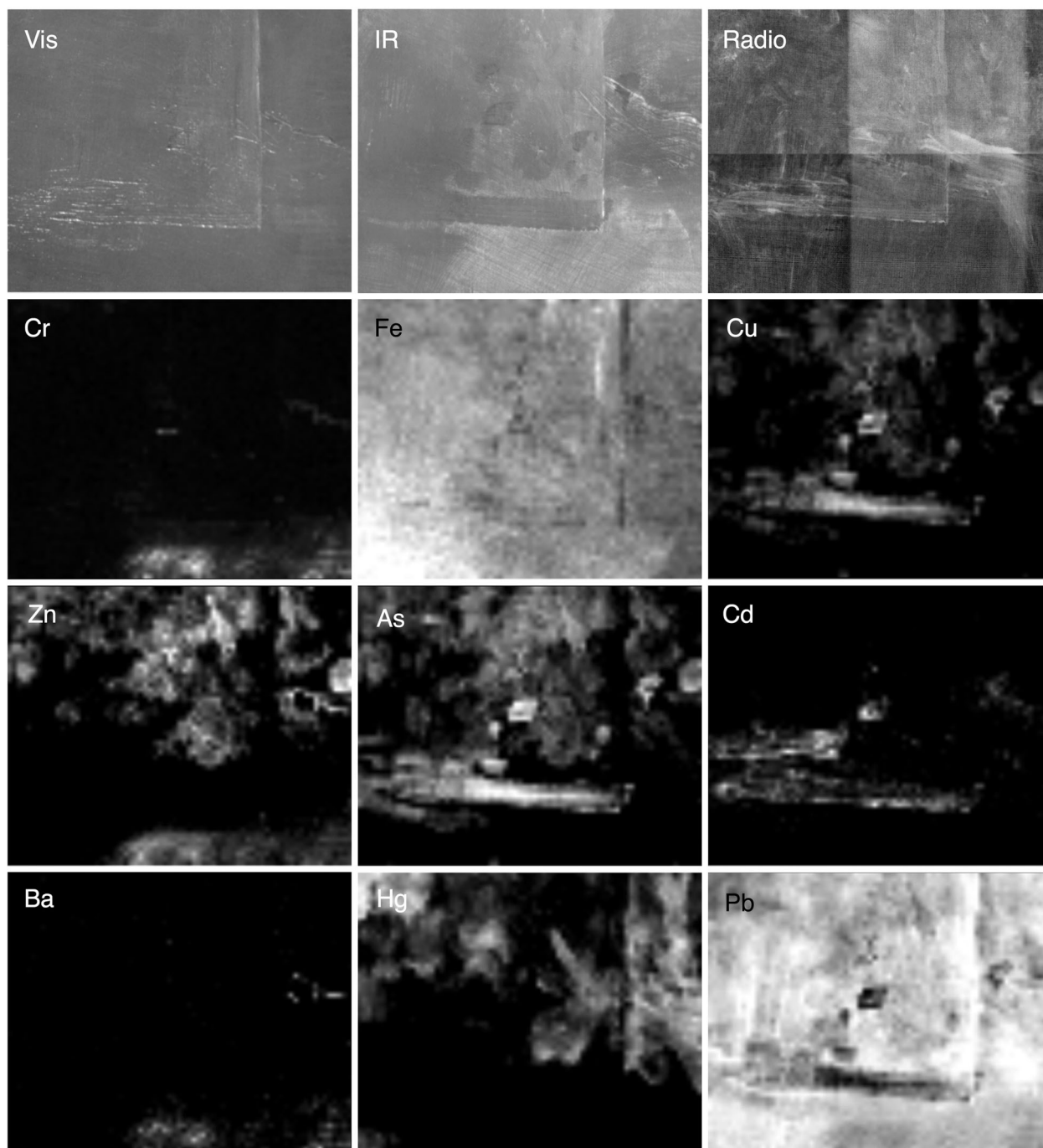


Figure 9. XRF maps of the cubist lines above Mrs Soler's head (140 × 114 mm). Visible light image, IR reflectography, and X-ray radiography details and distribution of the Cr, Fe, Cu, Zn, As, Cd, Ba, Hg, and Pb are illustrated. White levels correspond to peak surface in arbitrary units.

the strips were necessarily applied post lining, one can conclude that *La famille Soler* had already been lined, when Picasso undertook the uniform background in 1913. The early lining of the work and the trimming of the canvas edges mentioned in the condition report in 2000 indicate that the painting could have been cut from the original stretcher in 1912, in order

to facilitate the transportation of the large format painting from Barcelona to Paris.

Regarding Picasso's 1913 background, FTIR, RS, MA-XRF, pXRF, and XRD results led to the identification of a large number of pigments and fillers, listed in [Table 1](#). Because Vidal's landscape is beneath the current background, only some of the pigments can be attributed

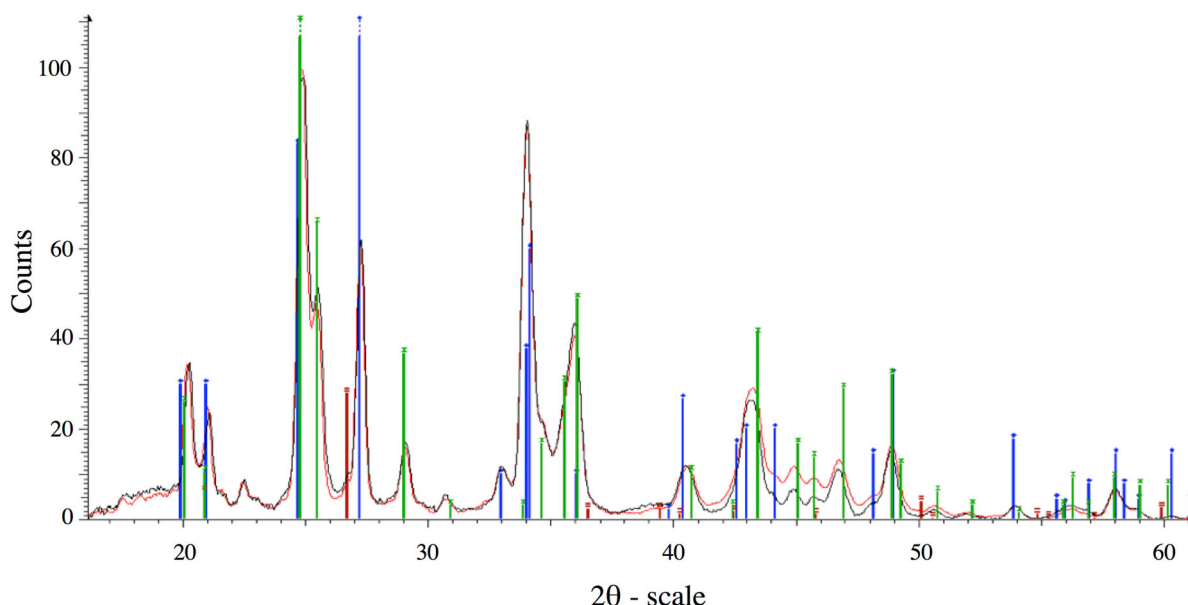


Figure 10. XRD diffractograms of the current blue background obtained from two different locations (in black and red), which indicate the presence of hydrocerussite (in blue) and cerussite (in green).

with certainty to the surface paint layers: Prussian blue, ultramarine, viridian, chrome yellow, lead white, and gypsum. Indeed, XRF maps, conducted in different zones in the background, outlined the presence of vermilion, a copper-arsenic-based pigment, and cadmium yellow in the underlying woody vegetation. As a consequence these pigments are more probably from the hidden landscape. Note however that the 1913 signature, in the left upper corner of the painting, is made using vermilion admixed with lead white. On the basis of the XRF maps, shown in Figures 8 and 9, it was concluded that the overall blue color of the 1913 background primarily results from Prussian blue, ultramarine, and lead white. Both forms of lead white, namely cerussite and hydrocerussite, were identified by XRD from different spots in the current background (see Figure 10).

This combination of pigments seems to have been admixed with viridian and/or chrome yellow in the locations exhibiting greener blue shades, although such chromium pigment(s) were also identified in the paint layers present beneath the visible blue surface.

The use of house paints with fast drying properties would have been convenient for repainting the large background of the family portrait, in a short time. However, the high lead content of the top layers, revealed through XRF maps, make it unlikely that Picasso used Ripolin colors.

In certain places, the current background exhibits a brownish blue color, which is rich in Prussian blue and lead white. The observed brown shade could be the result of pigment degradation processes. The fading of Prussian blue, induced reduction of the iron ions contained in the pigment could explain the dull shades in some areas. Indeed, when employed in light shades or in combination with white pigments,

Prussian blue tends to lose colour more rapidly than when pure, and to turn green. The degradation of Prussian blue can be diagnosed by FTIR spectroscopy, through the presence of a weak IR absorption $c. 2150 \text{ cm}^{-1}$ (Samain 2012), but this band was not observed in FTIR spectra recorded for *La famille Soler*. Copper phthalocyanine blue combined with zinc white was exclusively identified in the overpaints dated to conservation treatments. It was not possible to identify the paint layers at the origin of the calcite and barite detection.

Conclusions

The combinations of pigments identified in the 1903 original composition confirmed the abundance/predominance of Prussian blue admixed with vermilion on Picasso's Blue Period palette, already known from analytical studies conducted on other paintings from this period.

The non-invasive imaging and analytical techniques employed in this study provided new insights into the previous versions of the painting but also showed their limitations and the continued need to employ cross sections, to provide information on underlying compositions. Regarding Vidal's landscape, material evidence gathered through the use of complementary scientific methods, support the hypothesis of a woody background referring to *Le déjeuner sur l'herbe* by Manet. Furthermore, the XRF maps characterize Vidal's palette. The combination of the MA-XRF, IR-HSI, XRR, and IRR images enabled, for the first time, an assumption about the subject of Picasso's cubist sketch, which is the transformation of Vidal's landscape into synthetic cubism. However, it also appears that Picasso abandoned the project before completing the

transformation process. XRF maps of the overall background surface would certainly improve our understanding of the pigment distribution in successive paint layers and could provide further complementary information on the underlying compositions.

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