

# The examination of van Gogh's double painting grounds using quantitative sem/edx.

R. Haswell<sup>1</sup>, L. Carlyle<sup>2</sup>, C.T.J. Mensch<sup>1</sup>, E. Hendriks<sup>3</sup> and M. Geldof<sup>4</sup>

1 Shell Global Solutions International B.V., Amsterdam.

2. Universidade Nova de Lisboa, Portugal.

3. Van Gogh Museum, Amsterdam.

4. Cultural Heritage Agencies of the Netherlands, Amsterdam

Email [ralph.haswell@shell.com](mailto:ralph.haswell@shell.com)

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Analytical electron microscopy is an important technique for the examination of historical artefacts [1], [2], [3], [4]. In this paper we have used analytical electron microscopy to study the composition of the double grounds used by Van Gogh. At the time Van Gogh was painting, he was relying primarily on commercially prepared grounds about which very little historical information is available. This means that other sources of information, such as provided by analytical electron microscopy, are needed to help resolve questions related to chronology, technique and attribution.

Canvases primed with a double ground consisting of a layer of lead white on top of a mixture of lead white and chalk are found in a large number of van Gogh's paintings, especially from the Nuenen period, and are easily recognisable. Figure 1 is a cross-section from a paint fragment with such a characteristic double ground. The bottom layer is a mixture of lead white and chalk and is typically 100 microns thick (marked as 1 in Figure 1). The top layer is made up almost exclusively of lead white and is thinner than the first layer, usually 10 to 20 microns (marked as 2 in Figure 1). Table 1 lists the chalk fraction of the bottom layer of various double grounds from a number of van Gogh's paintings determined using SEM/EDX and standards for the analysis [5]. Most paintings examined for this study were made on similar commercially prepared canvas presumably bought by the metre from the firm J. L. Bayens & Zonen in Eindhoven when Van Gogh lived in Nuenen. This is true not only for the six Nuenen paintings: the two paintings from the Antwerp period, *Portrait of an old man* (F 205) and *Houses seen from the back* (F 260), were made from a roll of canvas shipped from Nuenen and both Paris paintings, *Skull* (F297) and *Skull* (F297a) were painted on top of Nuenen paintings [6]. For the only Arles painting included, *Blossoming pear tree* (F405), the origin of the canvas is unknown. The Hague painting, *Still life with earthenware, bottle and clogs* (F63), is also outside the Nuenen group since it is believed to be the first painting Van Gogh made in Mauve's studio at the very beginning of his career in December 1881 [7]. Examination of the results shows that the chalk fraction varies from as low as 28 for *Still life with earthenware, bottle and clogs* (F63) up to as high as 71 for *Head of a woman* (F 160) although the majority are between 50 and 70. It is interesting to note that the layer with the lowest fraction was from the painting thought to have been made in Mauve's studio in The Hague, while the others were the supposed Bayens & Zonen canvasses as well as the Arles painting.

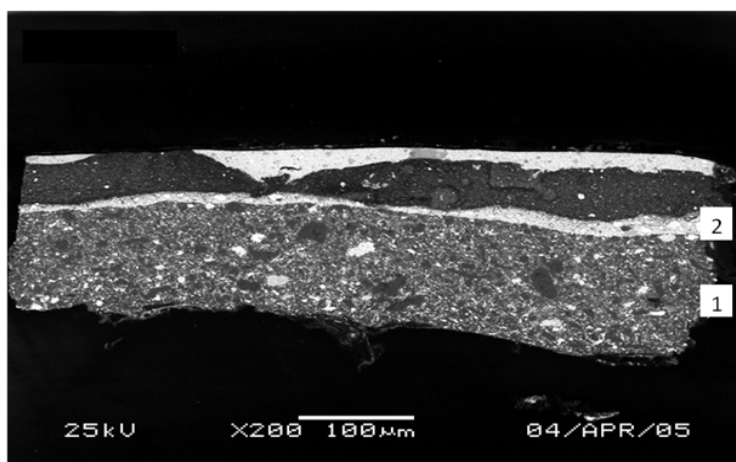
It has been possible to obtain weave density pattern matches for some of the paintings, as shown in Table 1. These were obtained from X-radiographs of paintings on canvas with the help of computer analysis [8]. Comparison of weave density pattern matches and ground composition suggests that the ground composition can vary by as much as 12 percentage points along a single bolt of canvas. By comparison the typical variation found within a single paint fragment was only 2 percentage points. A similar tight agreement is found between *Portrait of an old man* (F205) and *Houses seen from the back* (F260), which have a chalk fraction of 54 and 56 respectively. This is consistent with the fact that the two canvases are known to have been cut from adjacent positions from a commercially primed roll, as a match in their weft density pattern informs us. Further research is required to determine whether a 12% variation may be taken to show picture supports that were cut from different rolls (i.e. bolt segments) of commercially primed canvas. Equally it might reflect the variation in ground composition that occurs within a single roll due to the hand-priming

process. Only *Still life with earthenware, bottle and clogs* (F63) has a composition difference large enough to say with certainty that the commercially primed canvas came from a different source, which is in good agreement with the fact that this work falls outside the Nuenen group.

In conclusion, these initial results show that there is significant variation in the ground composition of commercially prepared canvases even when from the same bolt.

## References

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**Figure 1.** SEM backscatter image of paint fragment F260/1 showing a typical lead white/chalk double ground

JH-nr	F-nr	Title	Chalk fraction	Weave match
522	F122	<i>Avenue of poplars in autumn</i>	60	6
533	F61r	<i>Still life with bottles and earthenware</i>	62	6
648	F74	<i>Head of a woman</i>	54	6
722	F160	<i>Head of a woman</i>	71	3
920	F63	<i>Still life with earthenware, bottle and clogs</i>	28	-
933	F107	<i>Baskets of potatoes</i>	62	6
962	F44	<i>Autumn landscape with four trees</i>	62	10
970	F260	<i>Houses seen from the back</i>	56	10
971	F205	<i>Portrait of an old man</i>	54	10
1346	F297	<i>Skull</i>	59	3
1347	F297a	<i>Skull</i>	56	7
1394	F405	<i>Blossoming pear tree</i>	68	37

**Table 1.** The chalk fraction of the double ground layer found in various van Gogh paintings as determined using SEM/EDX standards analysis (fraction is in grams of chalk/100 grams of mixture).