7th Balkan Symposium on Archaeometry
Athens, 22-25 September 2020, University of West Attica

POSTER SESSION

"Pigments identification in paintings by from J. F. Mücke, using Raman spectroscopy: an arts/science project"

Theodore Ghanetsos[1,*], Igor Lukacevic[2], Ante Matanic[2], Nikolaos Laskaris and Stella Mouzakiotou

*Corresponding author: E-mail :ganetsos@uniwa.gr , Tel.:++302105381443

[1] University of West Attica, Laboratory of non-destructive techniques, Petrou Ralli & Thevon 250, Egaleo, Greece

[2] Department of Physics, University J. J. Strossmayer, Osijek, Croatia

University of West Attica, Applied Science,
Laboratory of non-destructive techniques, Athens, Greece

Department of Physics, University J. J. Strossmayer,
Trg Ljudevita Gaja 6,
31000 Osijek, Croatia

Abstract

"Vukovar landscapes" is a series of oil on canvas paintings made in mid-19th century by an unknown author [1]. Only one of the landscapes is signed, by Joseph Franz Mücke, a royal painter of Habsburg dinasty, presumably ordered by count Emmerich Josef Eltz as a decoration for his Manor in Vukovar, Croatia. Of all candidate authors, Mücke is the only one who was known to live in Vukovar in the period the landscapes were made. One of the clues toward the discovery or confirmation of the true author could be given by comparing the painting pigments used in signed and unsigned landscapes.
Raman spectroscopy with 785 nm laser is used to identify the pigments used for the signed painting "The Gardens". Raman analysis reveals the author's palette [2]. For blue colours indigo pigment was found with addition of calcite for lighter hues. Green colours contain malachite with possible mixture of other earth pigments, like terre-verte. Orange-brown colours are obtained using either a mixture of red lead, red earth and yellow earth pigments or terra umbra. All earth pigments contain traces of quartz. Elemental analysis, like XRF, is proposed for complete

1. Introduction

"Vukovar landscapes" is a series of oil on canvas paintings made in the mid-19th century by an unknown author. Only one of the landscapes is signed, by Joseph Franz Mücke, a royal painter of Habsburg dynasty, presumably ordered by Count Emmerich Josef Eltz as a decoration for his Manor in Vukovar, Croatia. (Figure 1)
Of all candidate authors, Mücke is the only one who was known to live in Vukovar in the period the landscapes were made. However, certainty requires more evidence. One of the clues could be given by comparing the painting pigments used in signed and unsigned landscapes. If they are the same, then the unsigned landscape is more probably painted by the same painter. [4]

Fig. 1 Eltz Manor — once a castle — is now the location of the Vukovar City Museum.

Fig. 2 Raman experiment of "Vukovar landscapes" painting in Eltz Manor, Vukovar, Croatia.

2. Experimental work

We used the portable DeltaNu Rockhound portable Raman Spectrometer. (Figure 2). Fluorescence is a common problem in Raman Spectroscopy and a longer excitation wavelength is the answer. Under conditions where fluorescence is generated, it may be intense and can overshadow the Raman features. Fluorescence emission stems from sample molecules or trace impurities that absorb the laser excitation and emit a broad background at the same energies as the Raman scattering .One way to eliminate or reduce the fluorescence emission is to select a laser excitation wavelength that does not have enough energy to excite molecular fluorescence. The Advantage of 785 nm reduces competing fluorescence interference in compounds through this process. It uses a 785nm excitation laser to reduce the fluorescence signature in paintings that show strong fluorescence at shorter wavelengths.

A total of 13 landscapes were analyzed (one signed landscape named "Gardens" and 12 unsigned) during their exhibition in Eltz Manor by permission from Gallery of Fine Arts in Osijek and City Museum in Vukovar, both in Croatia. As paintings were mounted on the walls during the exhibition, the portability of spectroscopy equipment was an essential feature. Some paintings were positioned at the height of over 2 meters, requiring us to use ladders. From each painting we sampled the spectrum at several points that contain the same colors as on the signed landscape. (Figure 4)

3. Raman characterization

Raman spectroscopy with 785 nm laser is used to identify the pigments used for the signed painting "The Gardens". Raman analysis reveals the author's palette [2].
For blue colours (figure 3) indigo pigment was found with addition of calcite for lighter hues. Green colours contain malachite with possible mixture of other earth pigments, like terre-verte. Orange-brown colours are obtained using either a mixture of red lead, red earth and yellow earth pigments or terra umbra. All earth pigments contain traces of quartz.

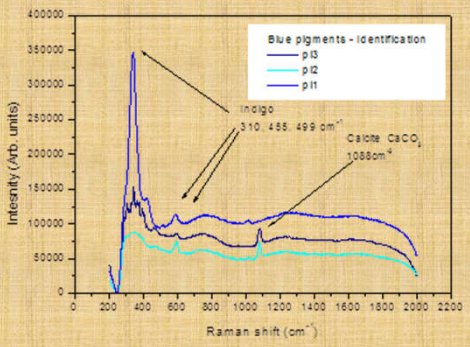

Fig. 3 Raman spectrum for blue colours. Raman peaks of calcite and indigo

Fig. 4 A photograph of "Gardens" landscape with sampling points.

4. Conclusions

"The Gardens" Raman analysis reveals the author's palette. For blue colours indigo pigment was found with addition of calcite for lighter hues. Green colours contain malachite with possible mixture of other earth pigments, like terre-verte. Orange-brown colours are obtained using either a mixture of red lead, red earth and yellow earth pigments or terra umbra. All earth pigments contain traces of quartz. Elemental analysis, like XRF, is proposed for complete characterization of Mücke's palette.
As two colors in a painting can look the same to the human eye, their reflective spectral signatures can reveal differences in the visual part of electromagnetic spectrum. These differences, or lack of them, can be used to give answers looked for by art historians and collectors interested in cultural heritage.

Acknowledgments
T.G. would like to express special thanks to the University J. J. Strossmayer, Croatia for his stay in Osijek during this collaboration and experimental work.

References

1. O. Švajcer, Peristil, 16/17 (1973–74), 169–180.
2. I. M. Bell, R. J. H. Clark, and P. J. Gibbs, Spectrochim. Acta A 53 (1997) 2159−2179.
3. L. Burgioa, R. J. H. Clark, and R. R. Hark, PNAS 107 (2010), 5726–5731.
4. I. Lukacevits, Searching for the Author of "Vukovar Landscapes", Ocean Optics.