A non destructive study on Albanian post-Byzantine icons

E. Franceschi[1], D. Nole[1] and L. Glozheni[2]
[1]Department of Chemistry and Industrial Chemistry, University of Genoa, Italy
[2] National Museum of Medieval Art, Korçe, Albania

Abstract

The present work aim is to study the used pigments and the painting technique used by an important Albanian iconographer, Konstantin Zographos. He was active in the second half of 18th century in Albania and Greece. Inorganic pigments were recognised by means of X-ray fluorescence and spectrophotometry techniques. These measurements allowed us to know the palette of colours used by him. Three icons have been selected and any withdraw of painting samples was not taken. From seven to eleven measurements to characterize the different pigments for each artwork have been made. The results allowed us to identify the palette of this author, which includes white and red lead, cinnabar, malachite and maybe verdigris, carbon black, gold both in leaf and powder, red, yellow and brown earth. Could be used indigo and red lacquer as well. Some other measurements should be carried out in order to ascertain the complete palette of colours used by this painter.

1. Introduction and research aims

In the National Museum of Medieval Art of Korçe (Albania) are collected many important works of various periods and artists. The execution period of these icons lies from 13th to 20th century. In this work we will try to give some help or to recognise the palette of Kostantin from Korçe. He belongs to a family of painters and was the head of a very productive workshop. He and his brother Athanasios were very active in the second half of 18th century. From their profession they took the name Zographos (from the greek "painter"). They worked in both techniques frescoes and icons decorating many churches and cathedrals in Albania (Korçe, Voskopoje, Ardenice, Vithkuq), Greece (Mount Athos, Thessaly)[1]. In this workshop took part in the end of 18th and beginning 19th century the Kostantin's son Terpo and two Athanasios' sons Naum and priest Efthymios (1792-1819)[2]. Terpo was the most productive painter following the traces of his father. He worked in wall-paintings and portable icons decorating also many churches in the Albanian and Macedonian area. Kostantin and his family created and consolidated the School of Korçe[3] that together with the School of Berat created by Onufri at 16th century represent two centres of Albanian iconography.
As we said above the identification of Kostantin's palette is very important for both art's historian and the restorer. In this article is reported the study of three Albanian post-Byzantine icons painted by him. The icons have been investigated by means of two non destructive techniques: X-ray fluorescence and spectrophotometry by visible light reflection. The information obtained from both techniques have been compared between them. It was possible to identify many inorganic pigments and the preparation's layer on wooden support.

2. The icons studied

Three icons of the painter Kostantin Zografi, who worked in 18th century, were studied. The religious scenes depicted follow the Byzantine iconographic tradition.

A. Christ Pantocrator, 114x73 cm, No 5782, painted for the church of Saint Peter, Vithkuq (Korça district) in the year 1762;

B. Three Saints, 117x73 cm, No 5789, painted for the church of Saint Peter, Vithkuq (Korça district)

C. The incredulity of St. Thomas, 54x43.5 cm, No 1775 painted for the Metropolitan church of *Burimi Jetedhenes* in Korçe . (Fig 1 A,B,C) .

The icons studied, shown below, are painted with the technique of tempera.
The conservation state of icons is generally good. The spots where we performed the analyses are indicated by numbers in the figure 1 A,B,C.

A B C

Fig. 1 Photos of the icons

3. Experimental methodology

After an accurate observation of the three icons chosen for this examination, we found the most significant points where were undertaken the non destructive measurements. The spots are indicated by numbers (fig 1). The methodologies employed were different and complementary: X-ray fluorescence spectrometry, which allows to recognise the elemental composition of the inorganic materials and spectrophotometry in the visible region, that gives an exact measure of the colour investigated. They were completely non destructive and any material sampling was withdrawn.

3.1 X-ray fluorescence spectrometry

Elemental analysis on pigments was carried out by means of a portable equipment *Lithos 3000* from *Assing*; the apparatus consists of a Molybdenum tube, a Zirconium filter and a semiconductor Si (Li) Peltier cooled detector. Spectra were recorded with a collection time from 120 to 300 s, the current tube was 300 mA and the voltage was 25 kV. A specific software was used to elaborate the experimental data.

3.2 Spectrophotometry in the visible region

A *Minolta CM-2600* portable spectrophotometer equipped with a Xenon lamp (D_{65} standard illuminant) and an integrative sphere, was used to perform the colour measurements. The light, pulsate on painted surface in correspondence of the selected spot, is reflected by the sample with an angle of 8°. It is captured by a Silicon (Li) photodiode that allows us to obtain the overall spectrum, between 400 and 700 nm with an interval of 10 nm, characteristic of the investigated point. The colour coordinates are based on CIEL*a*b* system. L* indicates lightness while a* and b* are the coordinates of chromaticity, based on the theory of the opposite colours: the coordinate +a* and -a* indicate red and green values while +b* and –b* indicate respectively the yellow and blue values.

3. Results and discussion

The experimental data obtained according to the above described methodology, yielded the following considerations:

1. The majority of the inorganic pigments used for obtaining the icons by the painter Konstantin Zographos when worked in different churches and periods, could be identified by coupling the data coming from X-ray fluorescence and from reflection spectra;
2. As the form of the reflectance spectra remains unchanged in many cases, while L* varies, we could

observe that the same pigment was used in a mixture both of white pigment (lead white) or black carbon. This effect allows the artist to obtain the highlights and outlines;

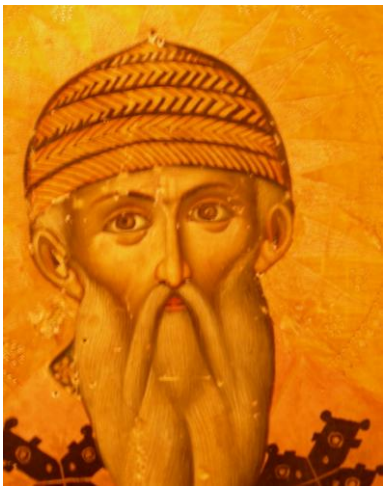
3. The complementarity of colour combinations was also observed in Zographos' paintings;
4. The results for the different icons, if grouped on the basis of the different colours, allow us to obtain the palette used by this painter;
5. As it regards the preparation layers of the different artworks, their composition was ascertained by checking and comparing the proportions of some characteristic elements as calcium, strontium, sulphur and lead which resulted similar.

4.1 Christ Pantocrator

(a) **(b)** **(c)**

Fig. 2. Particular of the Fig. 1 A

4.2 Three Saints



(a)

(b)

Fig 3. Particular of fig 1 B

4.3 Incredulity of S. Thomas

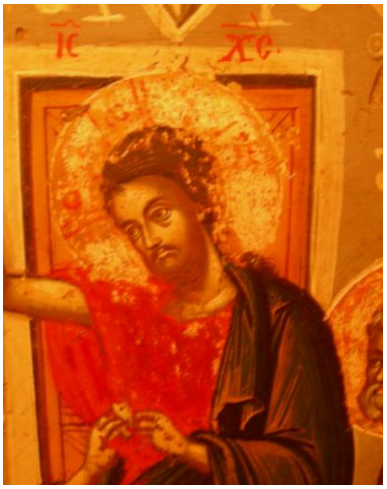


Fig 4. Particular of fig 1 C

Let see carefully the results and let try to find out some information about them.

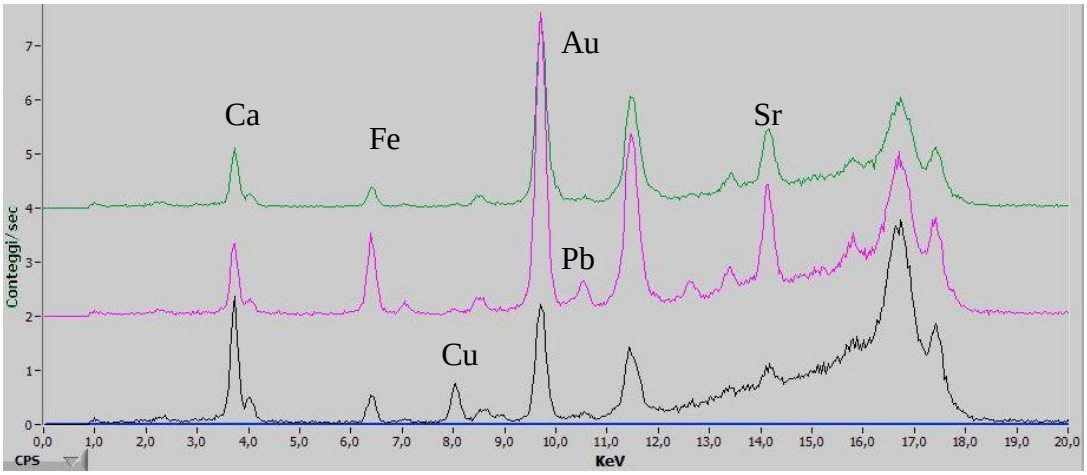


Fig 5. Comparison between XRF spectra spots 1, 1, 1 of three icons (in order bottom Incredulity of S. Thomas, middle Christ Pantocrator, top Three Saints)

In the figure 5 are reported the spectra of XRF in correspondence with the gold (see fig 1, fig 2 (a), fig 3 (a)) The leaf gold layer is clearly visible and the bolo preparation is visible too, as it results by the presence of iron. Calcium and strontium probably are relative to bolo or to the preparation layer. The effect of the organic glue, probably animal as in the case of Christ Pantocrator icon, is detectable by the presence of P and by the shape of the curve in the incoherent region of the spectrum (12-18 keV).
The gold layer in the Incredulity of S. Thomas maybe is formed by a binary alloy containing copper. The weak signal of lead comes from a thin white lead layer.

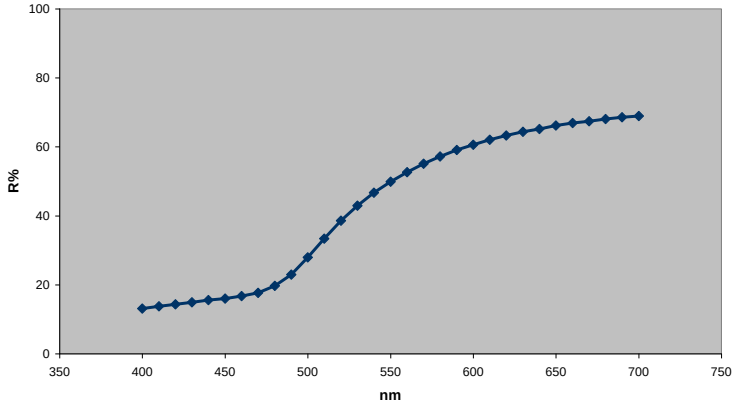


Fig6. The colorimetric spectrum reveals the superficial gold leaf.

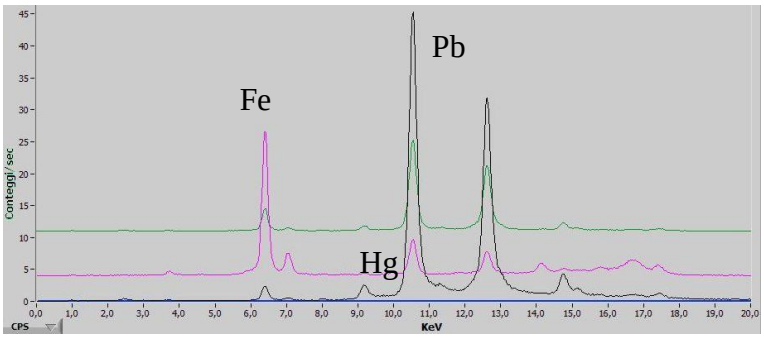


Fig 7. Comparison between XRF spectra spots 2, 2, 8 of three icons (in order bottom Incredulity of S. Thomas, middle Christ Pantocrator, top Three Saints)

In the case of Christ Pantocrator the pigment used is brown earth; particular effects are to ascribe to the presence of Hg which reveals that the painter used also cinnabar on the Christ's hair. The layer of white pigment (white lead) is clearly shown. The massive presence of lead in the major part of the spots show that the white lead has been used as "a base" for spreading the colours[4] Some of the gypsum used in preparation layer is also visible. The peaks highness of iron decreases in other icons. For example comparing the spots 2,3 8 and 9 coming from down (fig 1 C) there are not differences between them where the principal components of the pigments are lead and iron, but in different proportions. Probably combining white lead and ochre Fe_2O_3. For the light colour of Christ's arm also white lead with a few amount of iron oxide was used. If we take a look at the icon, the colours are different. For the dark colour of the window the artist has used black carbon. Our instrument is not sensible to recognise light elements as carbon, but the missing of phosphorus permit us to think that the bone or ivory black have not been used. The spectrophotometric curve also shows for the entire spectrum a very low reflectance value, that can be explained with the addition of black carbon to the inorganic pigments (fig 9). The grey colour of the house was obtained by a mixture of white lead $2PbCO_3\,Pb(OH)_2$ and the mentioned black carbon. It was used for the shadows and outlines. Incarnate were obtained using white lead with light tones of ochre.

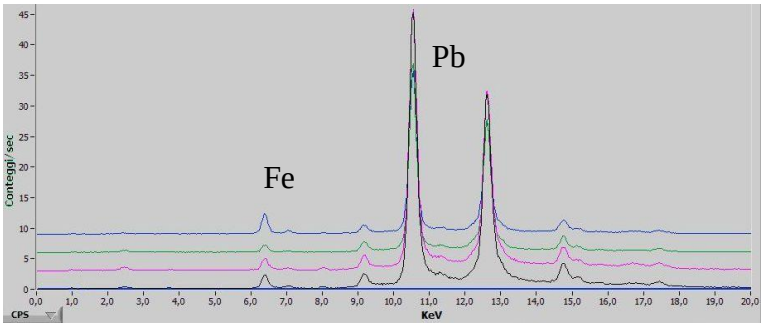


Fig 8. Comparison between spots 2, 3, 8 and 9 in Incredulity of St. Thomas

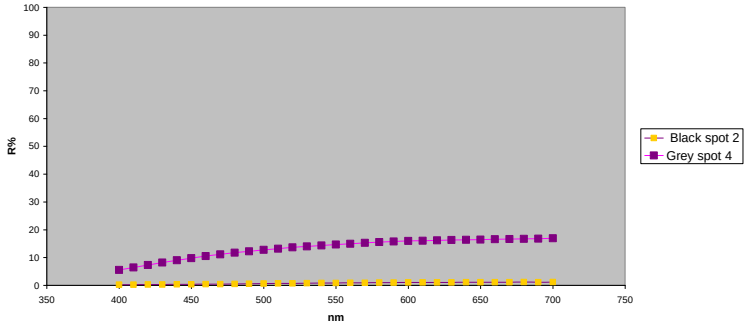


Fig 9. Different hues obtained adding black carbon

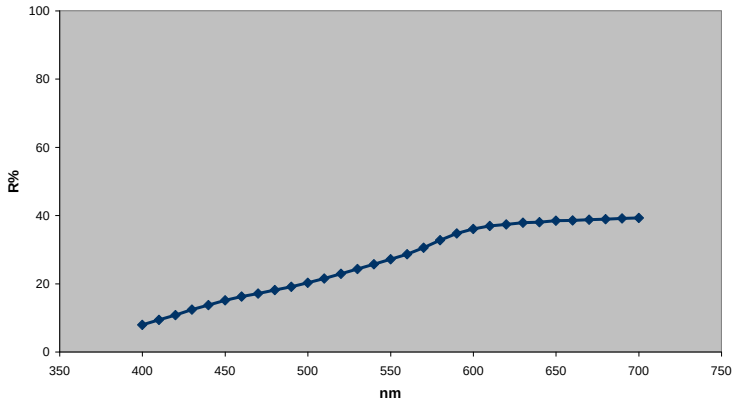


Fig 10. The spectrophotometric curve shows the reflectance of two pigments white lead and brown earth in the incarnate of Christ (spot 3 fig 1 A)

The red colour such as the brilliant red of the clothes of S. Thomas, Christ and S. Charalambis in spots 5, 4 and 4 respectively is cinnabar HgS. The red of disciple Matthew (spot 7, fig 1 C) and S. Peter (spot 5 fig 1 A) clothes are different. Probably the first hue was obtained by using a lacquer. The second one could be minium.

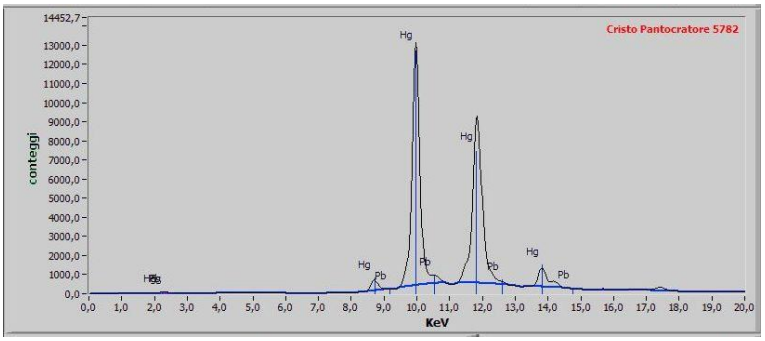


Fig 11. The red colour of the cloth of Christ is principally obtained by using cinnabar; the light ornaments are obtained using white lead.

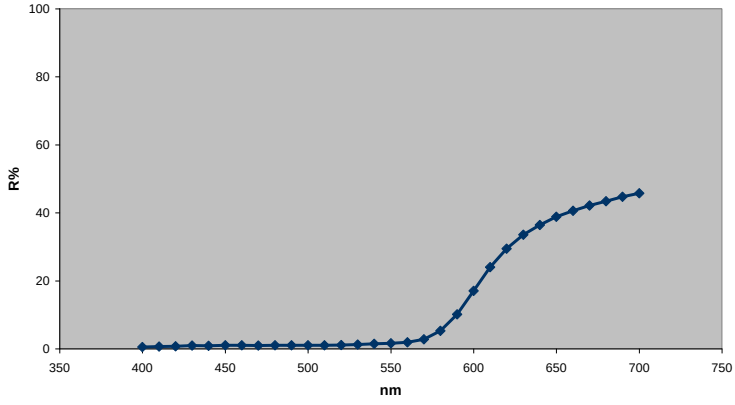


Fig 12. The red colour of the cloth of Christ is principally obtained by using cinnabar

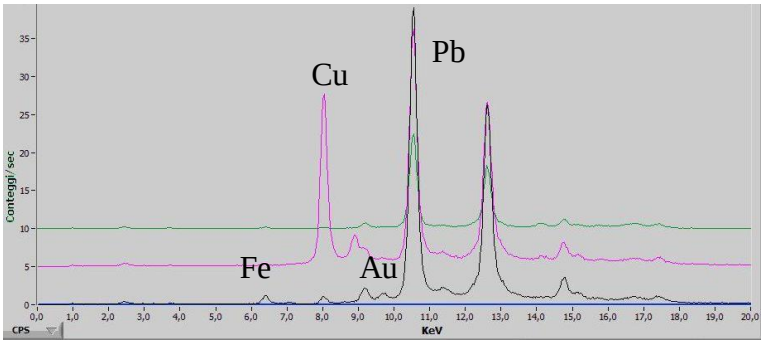


Fig 13 . Comparison between XRF spectra spots 6, 7, 5 of three icons (in order bottom Incredulity of S. Thomas, middle Christ Pantocrator, top Three Saints)

The green pigments could be copper salts like verdigris, produced according to Dionysos of Phourna, putting the copper inside vinegar conserving it a warm ambient[5]. Another pigment very used as well is malachite $CuCO_3$ $Cu(OH)_2$.
The transparency globe representing the universe is obtained by using a green pigment containing a copper salt probably malachite. The reference curve of malachite and the curve of our pigment are similar. Low reflectance of malachite is due to black carbon. Gold is used in stars and planets representation (fig 2 (c)), in the cloths of Christ (fig 13) in powder.

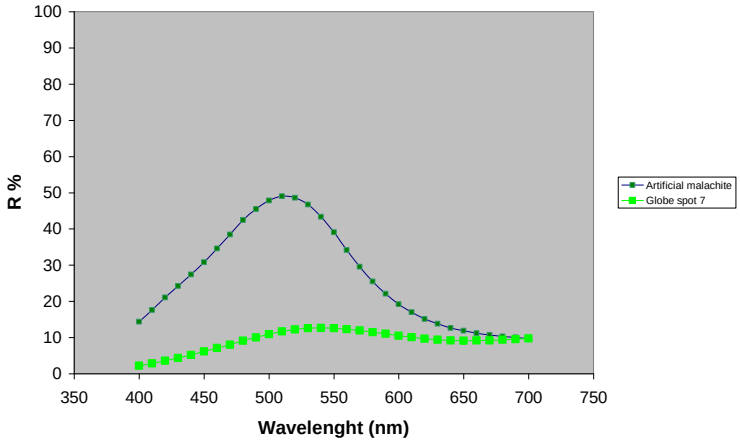


Fig 14. Comparison of curves shows using of malachite

The fluorescence spectra are exactly the same for the spots 9 and 10 (fig 1 A) reveal the use of red pigments (ochre and cinnabar) together with small amounts of green or blue copper based pigments. White lead was used under the colours and in highlighted parts. Likely a blue organic pigment as indigo was given in the Christ cloth.
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Conclusions

The most important thing is that the methods we used are non destructive and can give information to identify inorganic pigments. The painter has used a variety of organic and inorganic pigments. Some of them have been identified even if the spectra interpretation become difficult because of instrument limit. He used pigments as white and red lead, cinnabar, malachite and maybe verdigris, carbon black, gold both in leaf and powder, red, yellow and brown earth. Could be used indigo and red lacquer as well. The preparation layer was made of sulphate of calcium $CaSO_4$ $2H_2O$. Fe comes from bolo and over it the gold was applied. XRF method allowed us to know partially the Zographos palette. To deepen more the knowledge about this question many other measurements have to be performed. This

will be necessary for the conservation or restore of these icons.

References

[1] Icons from the Orthodox Communities of Albania, Kapon Editions, Thessaloniki, 2006, p. 22
[2] Icons from the Orthodox Communities of Albania, Kapon Editions, Thessaloniki, 2006, p. 146
[3] Percorsi del Sacro: Icone dai Musei albanesi, Mondadori Electa, Milano, 2002
[4] N. Civici, Journal of Cultural Heritage 7 (2006) 339-343
[5] E. Sendler, Immagine dell'invisibile, Edizioni San Paolo, Milano, 2001