Exploring the correlation between the metallic substances used on the gildings of Russian icons from the Benaki Museum collection and their artistic backgrounds

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Introduction

This preliminary research explores the gilding materials and techniques of 19 Russian Icons from the Benaki Museum collection using non-destructive methodology. The scope of this research was to examine the composition of metallic leaves and metallic dust pigments, as well as the methods of their application on each icon. This research is aiming to correlate the data with artists' intention, regarding the use of these gilding techniques.

The Benaki museum's collection of Russian religious art works is based on the personal collection of Antonis Benakis as well as on donations. The 19 selected icons range between the 16th and 19th century, including icons of high artistic value as well as the so called mass-produced icons of the 19th century with humbler materials. These icons selected, represent different periods and styles form the Benaki Museum collection. It has to be refereed that in Greece there is a scarce knowledge related to Russian Icons' art history and painting/gilding techniques.

Methodology

Optical and microscopic examination was used for the identification of painting and gilding techniques. Subjectively, the presence of metal leaves or metallic dust pigments, was examined as well as the color of the substrates and the methods of their application. In addition, imaging techniques of different wave lengths (VIS, IR, UV, raking light), were applied on icons in order to document the previous questions and also to identify the presence of imitation varnishes in case that other metal than gold had been used.

X-ray fluorescence examination was conducted with portable XRF in situ, so as to detect the elemental chemical composition of metal leaf alloys having been applied to halos and backgrounds and the composition of metallic dust pigments applied on the highlights on clothes. The portable XRF was «Niton XL3t GOLDD+ 980» from «Thermo scientific». It was set on "mineral" mode, and the reading was done on air for 120 seconds.

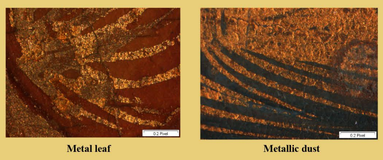
Gilding techniques and materials

Gilding techniques of the background and halos; corresponding techniques between Russia and the west

Eastern/Russian Technique	Western/Byzantine equivalent
A. Gilding with "poliment" (red earthy pigments, red ochre or "Armenian bolus" mixed with egg white, wax and soap, vodka)	**Water gilding**
B. Gilding without "poliment" (layer of light ocher, water, Russian sturgeon glue or egg white , vodka)	**Water gilding**
C. Gilding without "poliment" Mordant of oily-resinous form (linseed oil, natural resins in their solvent, led white)	**Oil gilding**

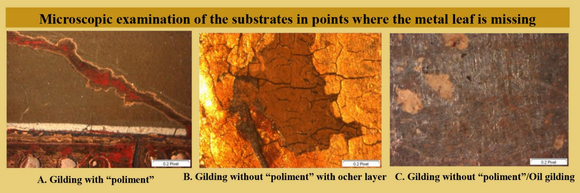
Gilded highlights on Russian icons

Gilded highlights	
Metal leaf with mordant or layer of "assist" (sticky brown substance made from garlic or beer juice)	Metallic dust mixed with binder (honey, natural resin) or "assist"



Metal leaf | Metallic dust

Microscopic examination of the substrates in points where the metal leaf is missing



A. Gilding with "poliment" | B. Gilding without "poliment" with ocher layer | C. Gilding without "poliment"/Oil gilding

Decoration of the metal leaf of the background

Sgraffito technique | Engraving | Punched decoration

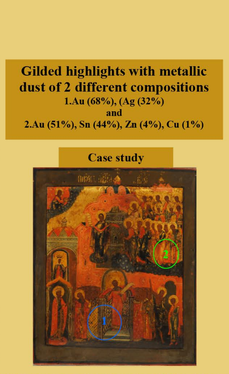
Preliminary grouping results related to the metallic leaf of the background

1. Icons with high percentage gold leaf (94-100%)

1. The Virgin of the Passion (29533) - 17th century
Gilding without "poliment" with ocher layer
Highlights with metal leaf

Gilded highlights with metallic dust of 2 different compositions
1.Au (68%), (Ag (32%)
and
2.Au (51%), Sn (44%), Zn (4%), Cu (1%)

Case study



2. Holy Protection of the Theotokos (30278) - 18th century
Gilding without "poliment" with ocher layer,
Highlights with metallic dust

3. Saint Nicklaus (25828) - 16th century
Gilding without "poliment" with ocher layer
No gilded highlights

4. Saint Nicklaus (25830)
Gilding with "poliment",
Highlights with metal leaf

Au concentrations	94%	98%	100%	100%

2. Icons with high percentage silver leaf (93-100)%

5. Scenes with the Theotokos (25829)
Gilding without "poliment/oil gilding
Highlights with metal leaf

6. The resurrection of Jesus (31437) 18th century -
Gilding without "poliment" with layer of ocher
Highlights with metallic dust

Case study

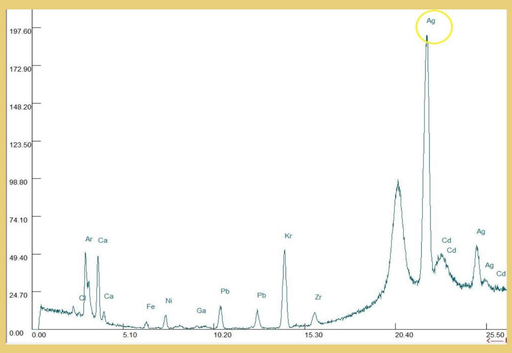
7. Saint Spyridon (31445)

8. Saints Kosmas and Damianos (31436)

9. Saints Helen and Constantinos (31441)

Mass-produced icons of the 19th century—Gilding without "poliment"/oil gilding and no gilded highlights

Ag concentrations	93%	97%	100%	100%	100%



XRF silver leaf of icon no. 8

Revealing of the limits of the silver leaf and the spot of overlapping of the 2 leaves
Width of silver leaf: 10,0 cm or 9,5 cm including overlapping

(IR) | Racking light

3. Icons with gold/silver alloy (apx. 55-45%)

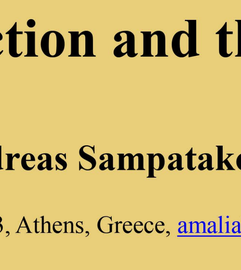
Identification of different metal leaf for the halos

Cu (82%), Ag (11%), Au (7%)

Gilded highlights with metal leaf

Gold Imitation varnish

Case study



10. Hodegetria (40157) - 18th/beginning of 19th century
Gilding without "poliment" with layer of ocher
Highlights with metal leaf

11. Harrowing of hell (31356) - 19th century
Gilding with "poliment"
Highlights with metallic dust

Case study

12. St. Hemolaus, Michael and John the Russian (25832)
Gilding without "poliment" with layer of ocher
Highlights with metallic dust

Gilded highlights with metallic dust of 3 different compositions

1. St. Hermolaos
Au (67%), Zn (31%), Cu (1%), Ag (1%)
2. St. Micahel's clothes
Ag (88%), Cu (9%), Zn (3%)
3. St. John the Russian's clothes
Au (94%), Ag (3%), Zn (3%

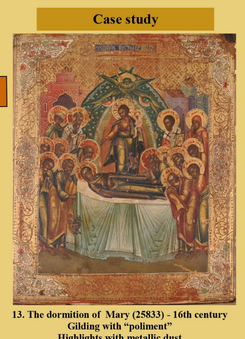
Au/Ag concentrations	54-46%	53-47%	58-42%

4. Icons with significant percentages of less precious metals (Cu, Zn, Sn)

Gilded highlights with metallic dust of 2 different compositions

1. On clothes 99,9% Au
2. On the virgin's shroud
Ag (54%), Zn (30%), Cu (16%)

Case study



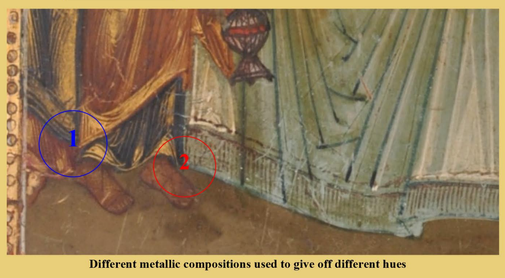
13. The dormition of Mary (25833) - 16th century
Gilding with "poliment"
Highlights with metallic dust

14. Saint Charalambos (23758) - 18th century—
Gilding with poliment" ,gilding with ocher layer
Highlights with metal leaf

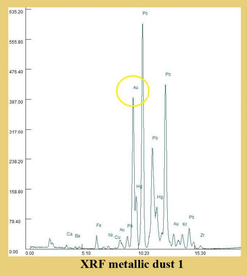
15. Harrowing of Hell (3006) - 17th century
Gilding with "poliment"
Highlights with metallic dust

16. Feast of the cross (25784)
Gilding with "poliment "
No highlights

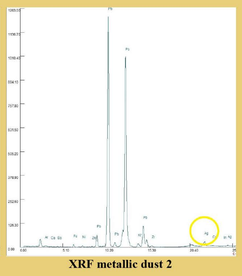
concentrations	Au (80%, Zn (18%)	Au (81%), Sn(16%)	Original leaf: Au (73%), Zn (24%) Original & subsequent leaf Cu (49%),(Au 47%)	Cu-Ag (53-47%)



Different metallic compositions used to give off different hues



XRF metallic dust 1



XRF metallic dust 2

Conclusions

- The limited sample of 19 icons that was examined, indicated that on earlier icons (before the 17th century), it is most likely that high purity gold was used on metal leaves, whereas in later icons, that also include mass-produced icons, the use of silver leaf and gold/silver leaf alloys were preferred. Furthermore, in later icons small percentages of copper, zinc and tin can be found in their alloys.
- The 6 icons that use metallic dust pigments on their gilded highlights, demonstrate a great differentiation of their elemental compositions. This phenomenon is probably related to the methods of producing the metal dust by collecting and grinding the remains from the metal leaf application on backgrounds.
- Out of 7 icons that use metal leaf on their gilded highlights, they all perform different composition of these metal highlights, compared to the composition of the metal leaf on the background and halos. The only exception is icon No. 4 that has pure gold leaf both on the background and the gilded highlights.

This preliminary material research of the 19 icons from the Benaki museum collection indicated that gilding on Russian icons, in some cases, is not just a simple adherence of metal. It appears that the differentiations in the compositions of metal leaves of the background and the metallic substances of the highlights play a part in the creation of different hues and highlights. This hypothesis is highlighted by the identification of two or even three different metallic dust pigments in the same icon. It is very likely that these phenomena are related to the style and the mannerisms of the artists or hagiographic schools/workshops of production.

Russian hagiographers probably had, depending on the situation and époque, at their disposal a large variety of metal leaves and metallic dust pigments that used as a color pallet and tonal pluralism.

Acknowledgments

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