

## Lab Report XRF 422

### ARTAX

# The Characterization of Historical Pigments by Micro-XRF Spectrometry

#### Historical Pigments

The date of the first synthesis or use of most historical pigments is known. Therefore the production dates of paintings and other colored objects can be put into chronological order. Certain pigments were used after a certain date (post quem), while others disappear before a certain date (ante quem).

The palette of inorganic color agents contains a great number of different compounds with exact stoichiometric compositions. Each pigment is characterized by its color and elemental composition. Some pigments have natural as well as synthetic origins. In addition to the analysis of the main components, the exact definition of the trace elements and contamination indicates whether a pigment is artificially synthesized or of natural origin, i.e. mineral pigments.

#### Coloring of Copperplate Engravings

One of Albrecht Dürer's (1471-1528, Fig. 1) most impressive works is the so called Copperplate Passion. The print "Peter and John heal the lame person" is part of this work.

Colored copperplate engraving is a rare form of art. The coloring shown here (Fig. 2) was apparently done by Georg Mack (signature GM) in the 16<sup>th</sup> century. Upon close examination of a further print of the copperplate engraving (Fig. 3) a different coloring is evident.

In this paper the chronological order of these colorings will be examined through the characterization of pigments using the Micro-XRF-spectrometer ARTAX.

#### Methods

The ARTAX was set up using the following test parameters:



Figure 1: Albrecht Dürer, self portrait, 1498, Museo Nacional del Prado, Madrid

- low-power X-ray tube, 30 W, Mo-target
- excitation:  $U = 45 \text{ kV}$ ,  $I = 600 \mu\text{A}$
- measuring time: 100 s at each point.

#### Results

The  $\mu\text{XRF}$  tests on the copperplate engraving shown in Fig. 2 led to the definite identification of a number of pigments, which were in general use during the 16<sup>th</sup> century (Table 1). In contrast to this the pigments used in the second coloring (Fig. 3) were first synthesized in the 19<sup>th</sup> century.

Table 1: Pigments on copperplates in Figure 2 and 3

Pigments Fig. 2		Chemical formula
1	ochre	$\text{Fe}_2\text{O}_3 \cdot x \text{mH}_2\text{O}$
2	azurite	$2\text{CuCO}_3 \cdot x \text{Cu(OH)}_2$
3	white lead	$\text{PbCO}_3 \cdot x \text{Pb(OH)}_2$
4	gold	Au
5	vermillion	HgS
6	red lead	$\text{Pb}_2\text{O}_4$
7	malachite	$\text{CuCO}_3 \cdot x \text{Cu(OH)}_2$
8	calcite	$\text{CaCO}_3$
Pigments Fig. 3		Chemical formula
9	chrome green (since 1809)	$\text{Cr}_2\text{O}_3 \cdot x \text{mH}_2\text{O}$
10	zinc oxide (since 1824)	ZnO

## Conclusion

Pigments on the colored prints of the copper-plate "Peter and John heal the lame person" by Albrecht Dürer were characterized by using the Micro-XRF-spectrometer ARTAX. It can be proven, that one copy was colored in the late 16<sup>th</sup> century by Georg Mack, while the coloration of a second print took place in the 19<sup>th</sup> century.

## Bibliography

O. Hahn, D. Oltrogge and H. Bevers, Coloured prints of the 16<sup>th</sup> century - non destructive analysis on colorated engravings from Albrecht Dürer and contemporary artists, submitted to Archaeometry 2003.

## Acknowledgements

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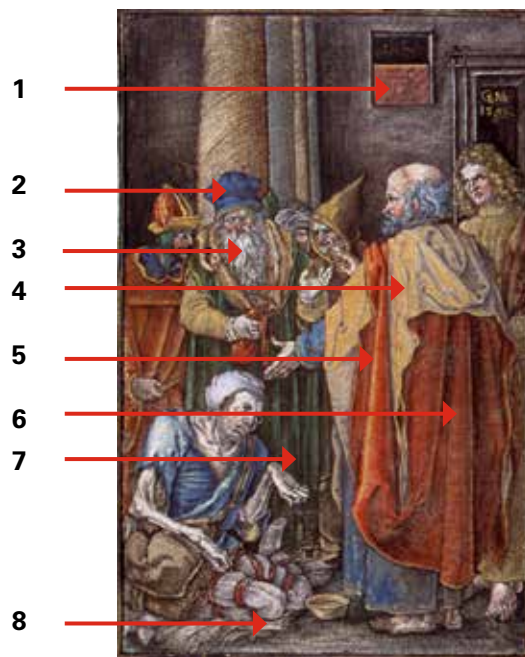


Figure 2: Colored print of the 16<sup>th</sup> century

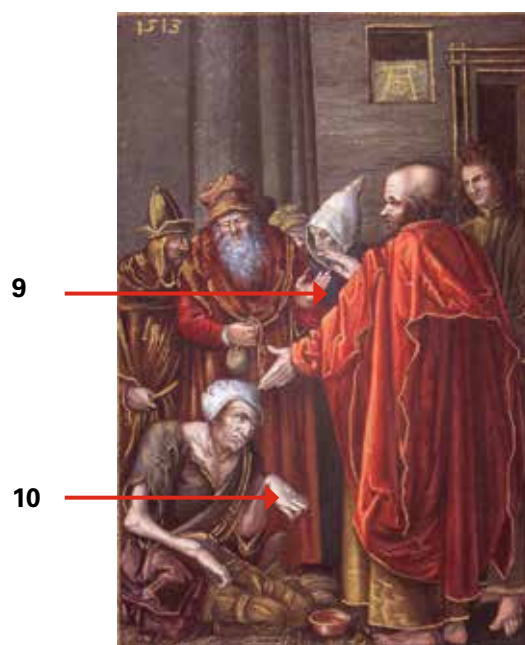


Figure 3: Colored print of the 19<sup>th</sup> century

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