

Mineralogical investigation of a Roman enamelled plate from the Liège Cathedral

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A small enamelled plate, belonging to the *Trésor de la Cathédrale de Liège*, is related to local goldsmithing production and was created at the end of the 12th century. Its champlevé enamels, opaque and of different colours (red, blue, green, white), form geometric and non-figurative patterns. At that time, Liège was a principality of the German empire with at his head a bishop who governed also a great diocese; in the XIIth-XIIIth centuries the region produces famous pieces of goldsmith's work, as for example the Stavelot Triptych hosted by the Morgan Library & Museum, New York. The style of these pieces of art is called "Mosan art", from the name of the Meuse River located nearby.

The chemical composition of the plate has been investigated by Raman spectrometry and X-ray fluorescence spectrometry (2D mapping of the major chemical elements), in order to identify the ingredients used to manufacture the glasses and the metal alloy. Analyses revealed that enamels were made of lead glass, coloured and opacified by mineral substances currently mentioned in medieval recipes (notably those described and commented by Cannella, 2006). Thus, the addition of an opacifier, calcium antimonate ($\text{Ca}_2\text{Sb}_2\text{O}_7$), to the melted glass, gave the white enamel, whereas calcined copper as pigment and tartar as opacifier gave the green one. For the blue enamel, a small amount of safre and calcium antimonate was poured in the siliceous mixture. Saffre is a deep blue pigment which was produced by alchemists by calcinating cobaltite (CoAsS) to remove arsenic and sulphur. Finally, a mixture of cuprite microcrystals (Cu_2O), iron filings and lead oxide (PbO) is responsible for the colour and the opacity of the red enamel. Regarding the metal, the plate is made of copper (with nickel as impurity) on which subsist some remnants of gilding.

References:

A.-F. Cannella (2006). *Gemmes, verre coloré, fausses pierres précieuses au Moyen-Age. Le quatrième livre du « Trésorier de Philosophie naturelle des pierres précieuses » de Jean d'Outremeuse*. Unpublished PhD Thesis, University of Liège.