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Introduction

- Roman enamelled plate from the end of the 12th century, representative of the **Mosan** art, belonging to the Trésor de la Cathédrale de Liège.
- Realised in the region of Liège, when the city was the head of the ecclesiastic principality of Liège, a political creation dependent on the Holy Roman Germanic Empire⁴.
- Blue, green, red and white **champlevé enamels** forming geometric patterns.

Enamelled plate



Pigments & opacifiers



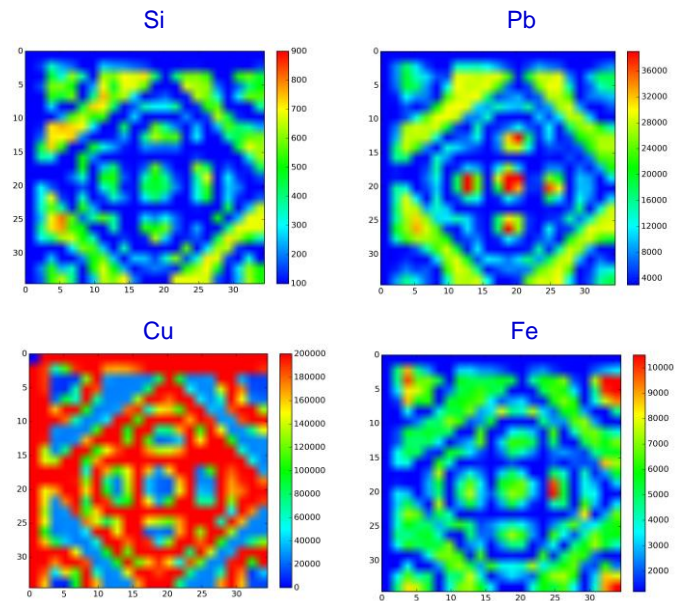
- $\text{CuO} \rightarrow \text{Cu}^{2+}$
- $\text{Fe}_2\text{O}_3 \rightarrow \text{Fe}^{2+}$
- CaCO_3



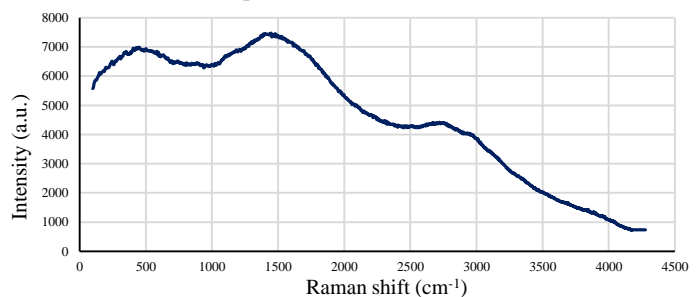
- $\text{CoO} \rightarrow \text{Co}^{2+}$
- $\text{Ca}_2\text{Sb}_2\text{O}_7$

- $\text{Cu}_2\text{O} + \text{Fe} :$
 $2\text{Fe} + 3\text{Cu}^{2+} \rightarrow 2\text{Fe}^{3+} + 3\text{Cu}$
- PbO

XRF analyses (2D mapping)



Raman spectrum (532nm) of the white enamel



Conclusions

- 12th century mosan enamelled plate created in Liège.
- Raman spectrometry and X-ray fluorescence spectrometry (XRF) analyses revealed that enamels were made of **lead glass** coloured and opacified by mineral substances currently mentioned in medieval recipes⁵, and that the plate was made of **gilded copper**.
- Pigments: **safr** (CoO, calcined cobaltite) for the blue enamel, **calcined copper** (CuO) and **hematite** (Fe₂O₃) for the green one, a mix of **cuprite** microcrystals (Cu₂O), iron filings and **lead oxide** (PbO) for the red one, and **calcium antimonate** (Ca₂Sb₂O₇) for the white one.
- Opacifiers : calcium antimonate (Ca₂Sb₂O₇) and **tartar** (CaCO₃).

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