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# REVEALING THE MATERIALS AND PRODUCTION TECHNIQUES OF EUROPEAN HISTORICAL COPPER-BASED SEAL MATRICES

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Seal matrices have been used in many civilizations across the globe since several millenniums. In Europe, during late medieval and early modern periods, they were made of a resistant material such as metal, most of the time copper-based alloys, and were an essential item of official documents, acting as personal signatures. The matrices accompanied the sigillants throughout his life, as they carried it often on their belt, visible for everyone (Vilain 2015). Those objects remained totally undocumented until very recently. Our work contributes to lift the fog on the technical landscape of seal matrices production by looking at materials and techniques in presence. Our study brings his attention to the collections kept at the French National Archives institution and at the Fine Arts Museum of Lyon which constitute a unique corpus of objects from the 13th c. to the 17th c., mostly French, but also Italian.

More than four hundred objects have been analysed using a recently developed portable XRF protocol for copper-based alloys analysis (Heginbotham and Solé 2017). In addition, more than one hundred of them have been carefully documented at a micro scale in order to determine the engraving techniques. Finally, cross sections have been obtained from six broken seal matrices; allowing to reveal the manufacturing process of the objects.

Thus, this study provides and discuss new data on an exceptional ensemble of European Medieval and Early Modern copper-based seal matrices. First, although a wide range of alloys are documented, two groups of objects are identified based on the lead content, questioning the alloys quality and the production costs. Second, a clear evolution of engraving techniques is highlighted with three different successive know-how involved between the 13th c. and the 17th c. Finally, identical patterns could be drawn between French and Italian productions, questioning a potential transborder practice. Not only these results provide insights into historical seal matrices production, but they also contribute to document medieval and early modern copper-based workshops.

## References

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