

# Supplementary Materials: A Multi-Analytical Protocol for Decision Making to Study Copper Alloy Artefacts from Underwater Excavations and Plan Their Conservation

Francesca Gherardi <sup>1,\*</sup> and Heather Stewart <sup>2</sup>

<sup>1</sup> Investigative Science, Fort Cumberland Laboratories, Historic England, Portsmouth, PO49LD UK

<sup>2</sup> MSDS Marine Ltd., Portsmouth, PO49LD, UK

\* Correspondence: francesca.gherardi@historicengland.org.uk

## SI 1. Evaluation of the elemental composition by pXRF, $\mu$ XRF and SEM-EDS



**Figure S1.** Brass trumpet from the Rooswijk shipwreck: (a) rim and bell; (b) pipe; and (c) beak.

**Citation:** Gherardi, F.; Stewart, H. A multi-Analytical Protocol for Decision Making to Study Copper Alloy Artefacts from Underwater Excavations and Plan Their Conservation. *Coatings* **2022**, *12*, x. <https://doi.org/10.3390/xxxxx>

Academic Editor: Antonella Rossi

Received: 16 September 2022

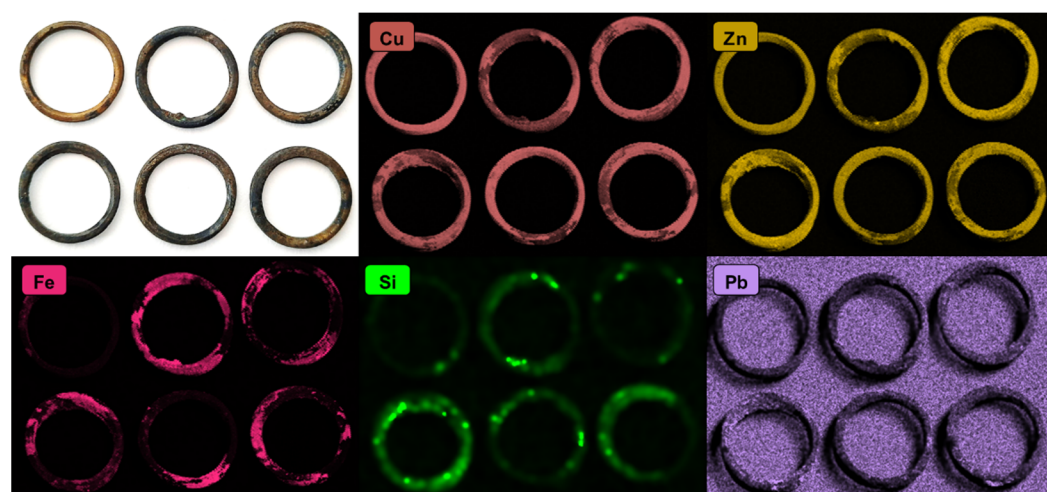
Accepted: 24 October 2022

Published: 29 October 2022

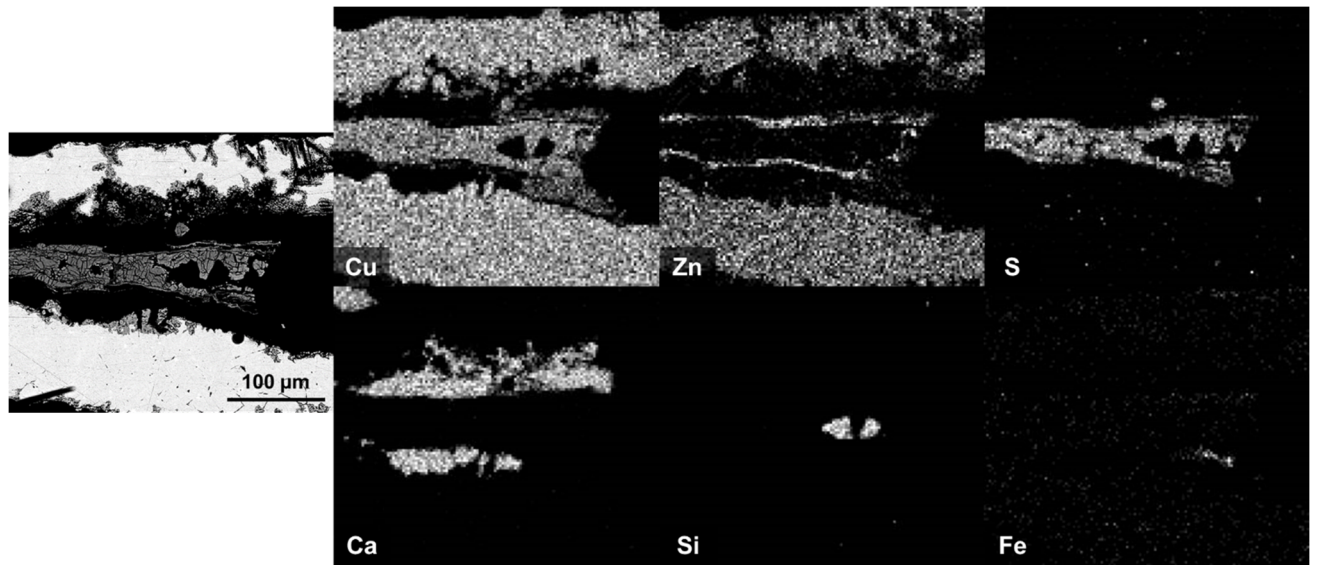
**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2022 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).



**Figure S2.** Copper alloy rings from the Rooswijk shipwreck (top left) and  $\mu$ XRF elemental maps showing the main elements of the alloy.

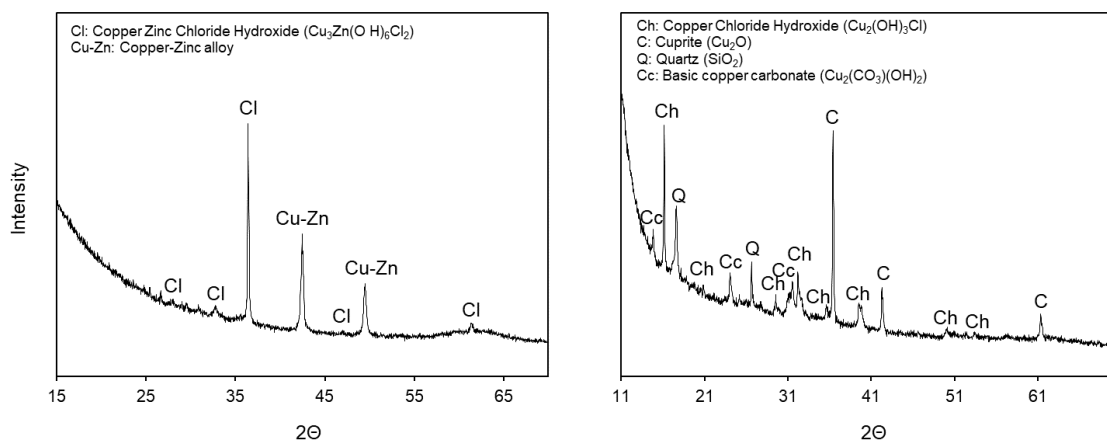


**Figure S3.** SEM image (BSE detector) (on the left) and elemental maps of a cross-section from a sample collected from the bell of a trumpet.

**Table S1.** Chemical composition (pXRF, g/100g, normalised) of different parts of a trumpet (bd = below detection).

Part	Cu	Zn	Pb	Fe	Ni	As	Ag
Rim	80 ± 5	20 ± 6	0.30 ± 0.10	0.20 ± 0.10	0.10 ± 0.10	0.10 ± 0.00	bd
Bell	76 ± 1	23 ± 1	0.70 ± 0.00	0.30 ± 0.10	0.20 ± 0.00	0.10 ± 0.00	bd
Pipe	75 ± 9	24 ± 9	0.50 ± 0.10	0.20 ± 0.00	0.20 ± 0.10	0.10 ± 0.00	bd
Beak	66 ± 7	31 ± 4	2.9 ± 1.2	0.30 ± 0.10	0.10 ± 0.00	0.20 ± 0.10	0.10 ± 0.00

## SI 2. Characterisation of corrosion layers and surface patina by FTIR spectroscopy and XRD



**Figure S4.** XRD spectra of green patina on a copper alloy thimble from the Rooswijk before desalination, with diffraction peaks indicating the presence of several corrosion products.