BRACELET LNR. 30557 – CU ALLOY – BRONZE AGE – SWITZERLAND

Artefact name Bracelet Lnr. 30557

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Url /artefacts/1096/

The object

Credit Archaeological Service Canton Bern.

Fig. 1: Bracelet,

Description and visual observation

Description of the artefact	Round hollow bracelet with lunar section and flat end. The outside face has decorative lines on the outer surface. The inner part is raw as cast.
Type of artefact	Jewellery
Origin	Möringen, Biel/Bienne, Bern, Switzerland
Recovering date	2015
Chronology category	Bronze Age
chronology tpq	----
chronology taq	----
Chronology comment	
Burial conditions / environment	Lake
Artefact location	archaeological service canton Bern, Bern, Bern
Owner	archaeological service canton Bern, Bern, Bern
Inv. number	Lnr. 30557

Recorded conservation data	Rinsed with deionised water

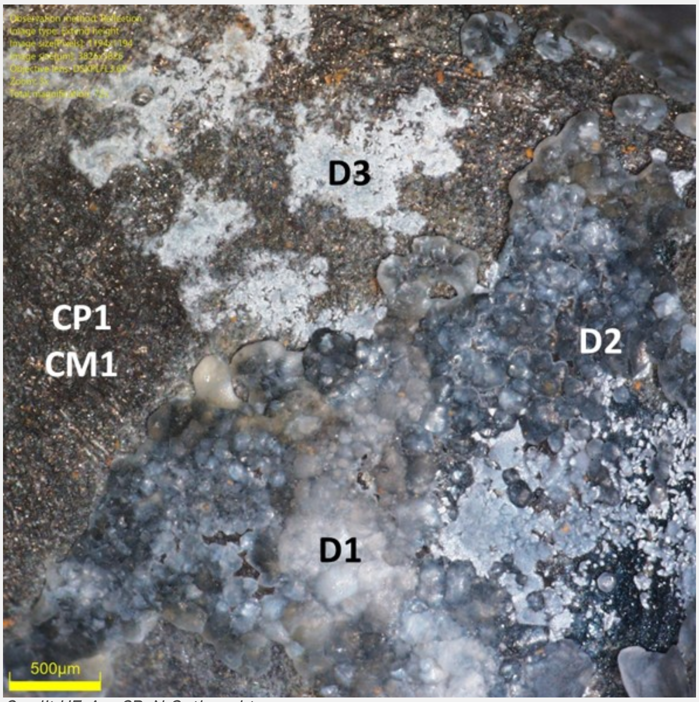
Complementary information

White crystals developed after rinsing the object.

Study area(s)

Credit Archaeological Service Canton Bern / HE-Arc CR, N.Gutknecht.

Fig. 2: Location of XRF analysis (red circles) and Fig. 3,



Credit HE-Arc CR, N.Gutknecht.

Fig. 3: Detail of the corrosion structure showing the strata documented in Fig. 4,

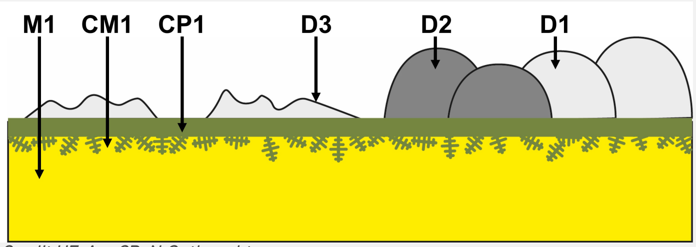
Binocular observation and representation of the corrosion structure

The schematic representation below gives an overview of the corrosion structure encountered on the bracelet from a first visual macroscopic observation.

Strata	Type of stratum	Principal characteristics
D1	Deposit	Extra light grey, medium, botryoidal microstructure, scattered, compact, hard
D2	Deposit	Grey, medium, botryoidal microstructure, scattered, compact, hard

D3	Deposit	White, thin, drusy aggregate, scattered, compact, soft
CP1	Corrosion product	Olive green, thin, discontinuous, compact, soft
CM1	Corroded metal	Layer, average ratio (50/50) between CP1 and M1
M1	Metal	Yellow, metallic, soft, dendrites microstructures

Table 1: Description of the principal characteristics of the stratum as observed under binocular and described according to Bertholon's method.



Credit HE-Arc CR, N.Gutknecht.

Fig. 4: Stratigraphic representation of the corrosion structure of the bracelet by macroscopic and binocular observation,

MiCorr stratigraphy(ies) – Bi

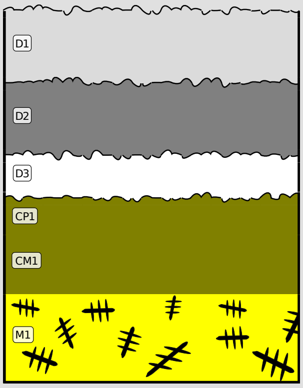


Fig. 5: Stratigraphic representation of the corrosion structure of the bracelet observed macroscopically under binocular microscope using the MiCorr application with reference to the whole Fig. 4. The characteristics of the strata are only accessible by clicking on the drawing that redirects you to the search tool by stratigraphy representation, Credit HE-Arc CR, N.Gutknecht.

Sample(s)

Description of sample	No sample has been taken. The observation and analysis were performed in a non-invasive way on the object.
Alloy	Cu Alloy
Technology	Cast
Lab number of sample	
Sample location	None
Responsible institution	None
Date and aim of sampling	

Complementary information

None.

Analyses and results

Analyses performed:

Non invasive approach

- XRF with handheld portable X-ray fluorescence spectrometer (NITON XL3t 950 Air GOLDD+, Thermo Fischer®). General Metal mode, acquisition time 60s (filters: Li20/Lo20/M20).

- Raman spectroscopy: it is performed on a Renishaw VIRSA Raman Analyser spectrometer equipped with a 785nm laser, the laser power employed is 1mW with 15 acquisition time of 1s.

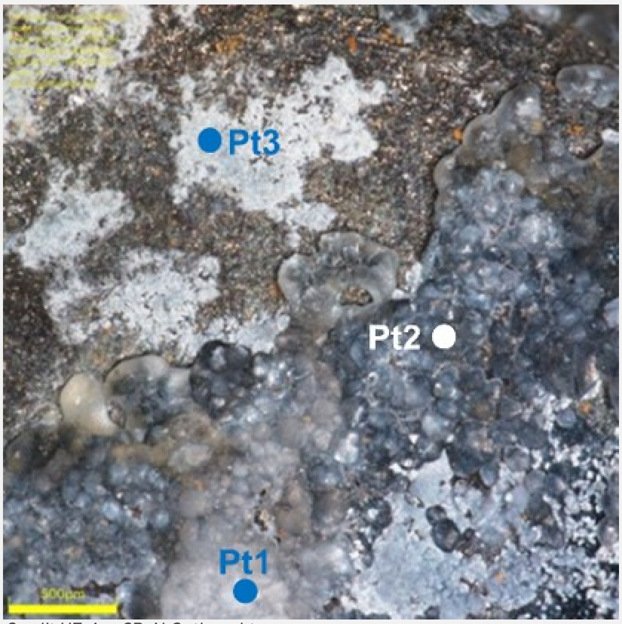
Non invasive analysis

The XRF analysis was carried out without sampling. All strata, from soil and corrosion products to metal, are analyzed at the same time. The metal is presumably a copper-tin alloy with some lead, while Si probably originates from the burial environment.

Elements (mass %)	1	σ	2	σ
Cu	81.9	0.5	83.1	0.7
Sn	10.2	0.1	9.8	0.1
Pb	1.9	0.03	1.4	0.03
Si	1.9	0.1	1.7	0.2
Fe	1.5	0.03	1.3	0.03
S	0.2	0.03	/	/

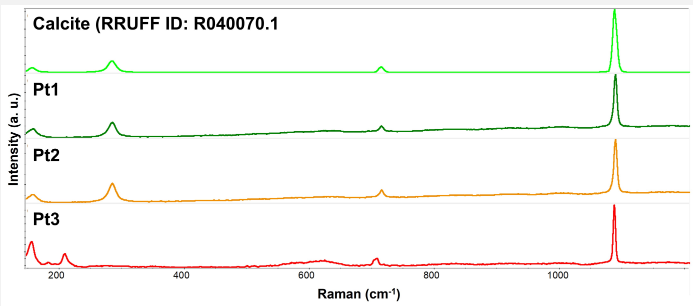
Table 2: Chemical composition of the surface of the bracelet at two representative points shown in Fig.2. The results are rounded up to 1 number after the comma.

Raman spectroscopy was performed on different surface deposits (D1, D2 and D3). The hypothesis was that it could be a development of corrosion products since it was only observed after drying and storage. Nevertheless, the Raman spectra of the three crystal types (D1/Pt1, D2/Pt2 and D3/Pt3) correspond well to the reference spectra of calcite (Fig. 7). It appears to be a deposit from the burial environment (lake) with different levels of crystallisation.



Credit HE-Arc CR, N.Gutknecht.

Fig. 6: Location of the Raman analysis,



Credit HE-Arc CR, N.Gutknecht.

Fig. 7: Raman spectra reference for calcite (RRUFF ID=R040070.1) and points 1, 2 and 3 located in Fig. 6,

Metal

The composition of the metal is assessed from XRF in table 2: it should be a leaded bronze.

Microstructure	Dendritic structure
First metal element	Cu
Other metal elements	Sn, Pb

Complementary information

None.

Corrosion layers

CP1 (data not shown) was matched with cuprite (CuO_2) through Raman spectroscopy.

Corrosion form	None
Corrosion type	None

Complementary information

None.

MiCorr stratigraphy(ies) – CS

Synthesis of the binocular / cross-section examination of the corrosion structure

None.

Conclusion

The bracelet is a tin bronze probably with some lead. It appears to be covered with copper oxide (cuprite) and various types of crystals attributed to calcite from the lake burial condition.

As this object comes from a lake environment, it was expected that a lake patina (copper iron sulphide - chalcopyrite) would be found and that the white products would be a sulphate deterioration of the chalcopyrite. However, the description of the corrosion structure does not correspond to any of the lake patinas documented in Schweizer's publication (Schweizer, 1994) or in the MiCorr database. We can therefore exclude the hypothesis of deterioration of the lake patina from observation alone.

The white crystals are deposits from the lake environment and were present prior to the drying of the object, but were only documented afterwards.

References

1. Schweizer, F. (1994) Bronze objects from Lake sites: from patina to bibliography. In: Ancient and historic metals, conservation and scientific research (eds. Scott, D.A., Podany, J. and Considine B.B.), The Getty Conservation Institute, 33-50.