SICKLE AUV-310 – BRONZE – LATE BRONZE AGE – SWITZERLAND

Artefact name	Sickle AUV-310
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Url	/artefacts/1354/

The object

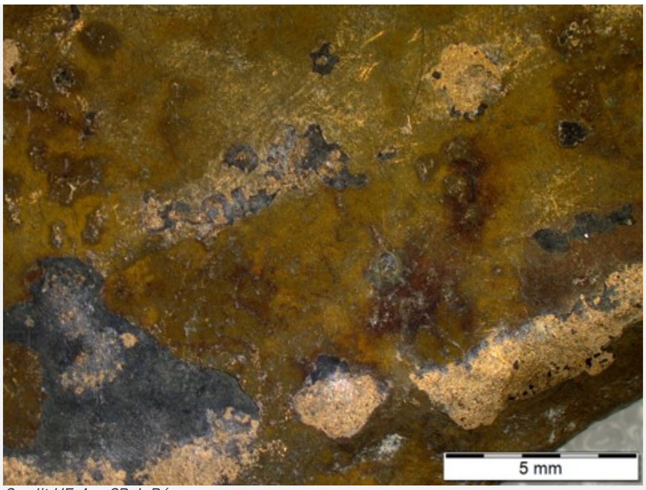
Credit HE-Arc CR, L.Rémy.

Fig. 1: Sickle (side A) with a groove on the external front side and lacunas of the corrosion layers all over the surface,

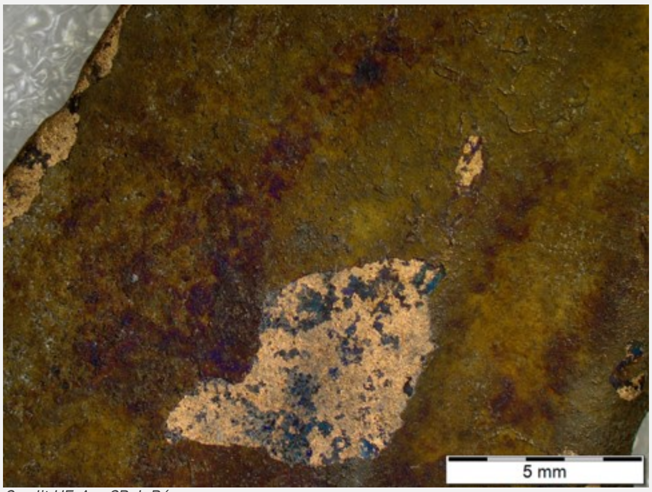
Credit HE-Arc CR, L.Rémy.

Fig. 2: Brown-yellow products (detail) on the tip of the sickle,

Fig. 3: Brown-yellow and dark-grey corrosion products and lacunas (detail) on the middle of the sickle,



Credit HE-Arc CR, L.Rémy.



Credit HE-Arc CR, L.Rémy.

Fig. 4: Brown-yellow and dark-grey corrosion products and lacunas (detail) of an area close to the tip of the sickle,

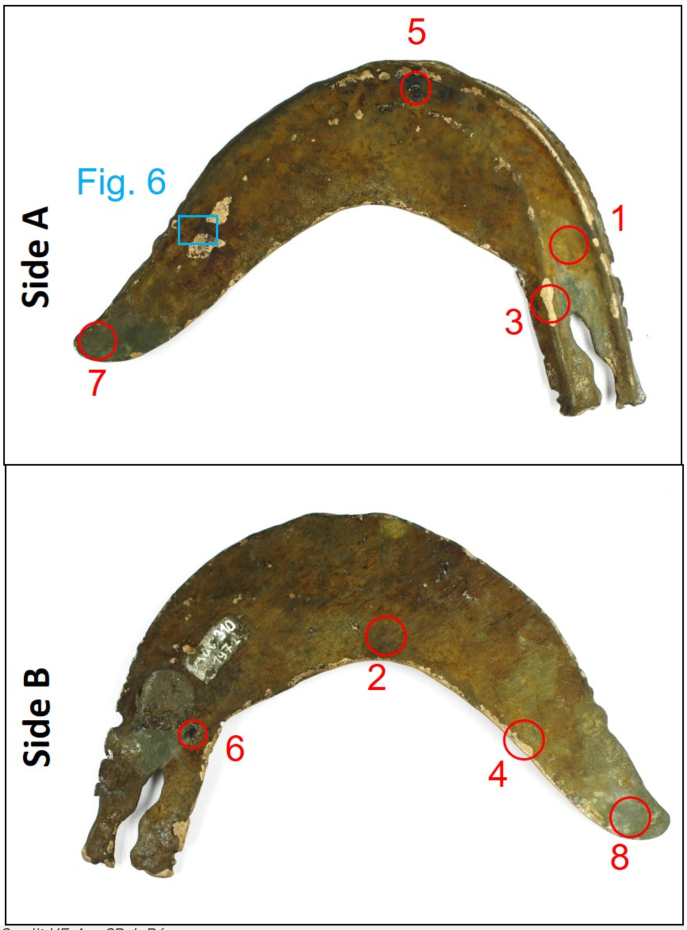
Description and visual observation

Description of the artefact	Sickle with a groove on the external front side and brown-yellow corrosion products as well as lacunas with some remains of a dark-grey underlayer (Figs. 1-4). Dimensions: L = 12.51cm; Ømax. = 3.5cm; WT = 82.54g.
Type of artefact	Tool
Origin	Hauterive - Champréveyres, Neuchâtel, Neuchâtel, Switzerland
Recovering date	Excavation in 1971
Chronology category	Late Bronze Age
chronology tpq	900 B.C.
chronology taq	800 B.C.
Chronology comment	
Burial conditions / environment	Lake
Artefact location	Laténium, Neuchâtel, Neuchâtel
Owner	Laténium, Neuchâtel, Neuchâtel
Inv. number	AUV 310
Recorded conservation data	No conservation data available, but a coating and inventory number is visible on the surface.

Complementary information

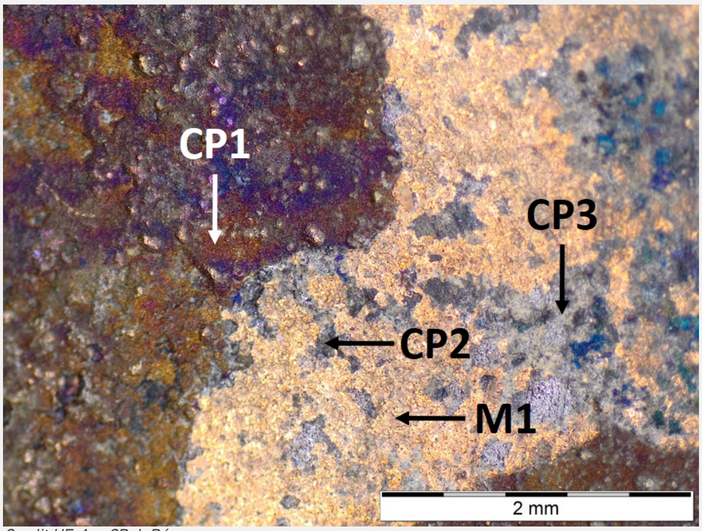
None.

Study area(s)



Credit HE-Arc CR, L.Rémy.

Fig. 5: Both sides (opposed) of the sickle with location of XRF analysis areas (red circles) and location of Fig. 6 (blue square),



Credit HE-Arc CR, L.Rémy.

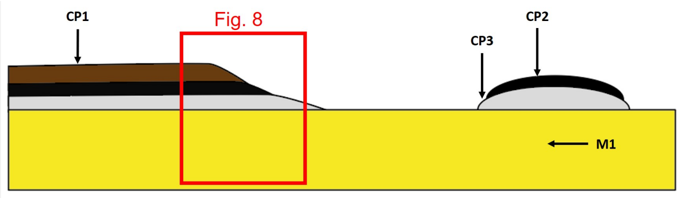
Fig. 6: Corrosion structure (detail) from Fig. 5 showing some of the documented strata in Fig. 7,

Binocular observation and representation of the corrosion structure

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

Stratum	Type of stratum	Principal characteristics
CP1	Corrosion product	Brown, pearly, thin, discontinuous, compact, brittle, very soft
CP2	Corrosion product	Black, matte, thin, discontinuous, compact, powdery, very soft
CP3	Corrosion product	Extra light grey, matte, thin, compact, powdery, soft
M1	Metal	Yellow, thick, continuous, compact, tough, very hard

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



Credit HE-Arc CR, L.Rémy.

Fig. 7: Stratigraphic representation of the corrosion structure of the sickle by macroscopic and binocular observation with indication of the corrosion structure used to build the MiCorr stratigraphy of Fig. 8 (red square),

MiCorr stratigraphy(ies) – Bi

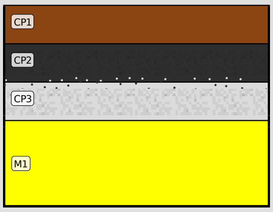


Fig. 8: Stratigraphic representation of the corrosion structure of the sickle observed macroscopically under binocular microscope using the MiCorr application with reference to Fig. 7. The characteristics of the strata, such as discontinuity, are accessible by clicking on the drawing that redirects you to the search tool by stratigraphy representation, Credit HE-Arc CR, L.Rémy.

Sample(s)

Description of sample

Alloy Bronze

Technology None

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 handled portable X-ray fluorescence spectrometer (NITON XL5), General Metal mode, acquisition time 60s (filters: Li20/Lo20/M20).

Non invasive analysis

XRF analyses of the sickle were carried out on eight representative areas (Fig. 5). Points 1 and 2 were done on the brown corrosion layer of each side (CP1), points 3 and 4 on the yellow areas covered with black and grey corrosion products (CP2 and CP3) of each side, and points 5 and 6 on the black corrosion layer of each side (CP2), and points 7 and 8 on the grey corrosion layer of each side (CP3). All strata (soil, corrosion products, and metal) are analyzed at the same time.

The metal is presumably a tin bronze alloy with traces of Sb, As, Pb. The other elements detected are : Fe, S, Si, Zn, Al and Ag.

Results of points 1 and 2 are very similar, CP1 is rich in Fe and S, but delepled in Cu and Sn.

The results of points 3 and 4 are similarly very close, but different from those of points 1 and 2: we are closer to the residual metal but it is still covered with corrosion products containing Fe and S.

Results of point 5 indicate that again we are close to the metal surface with even less Fe and S.

Results of points 6 and 7 are very similar and are closer to the results of points 1 and 2.

Results of point 8 are closer to those of points 1 and 2 but with less S.

Elements (mass %)	Cu		Fe		S		Sn		Si		Zn		Pb		Al	
	%	+/-2σ	%	+/-2σ	%	+/-2σ	%	+/-2σ	%	+/-2σ	%	+/-2σ	%	+/-2σ	%	+/-2σ
1	44.0	0.08	23.2	0.06	24.5	0.06	5.2	0.02	0.6	0.02	0.2	0.02	1.3	0.02	0.3	0.08
2	44.5	0.07	21.2	0.06	25.9	0.05	5.0	0.02	0.7	0.02	0.1	0.01	1.3	0.02	0.5	0.07
3	63.1	0.16	11.7	0.06	16.0	0.08	6.1	0.04	0.8	0.06	0.1	0.02	1.4	0.02	<LD	<LD
4	62.4	0.12	11.7	0.06	16.4	0.07	5.9	0.03	0.9	0.05	<LD	<LD	1.3	0.02	0.4	0.12
5	66.4	0.15	1.9	0.03	13.9	0.08	9.2	0.05	1.5	0.07	0.1	0.02	4.1	0.04	0.4	0.14
6	37.5	0.12	27.4	0.09	21.5	0.08	4.8	0.03	4.9	0.09	0.1	0.02	1.0	0.02	1.8	0.15
7	37.9	0.08	28.5	0.07	23.0	0.05	4.9	0.05	2.4	0.04	1.2	0.09	0.5	0.02	0.6	0.02
8	42.7	0.17	26.5	0.12	14.7	0.1	7.2	0.05	4.0	0.12	1.6	0.2	0.6	0.02	1.2	0.03

Table 2: Chemical composition of the surface of the pin at eight representative points shown in Fig. 5, Method of analysis: XRF, UR-Arc CR.

Metal

None.

Microstructure	None
First metal element	Cu
Other metal elements	Sn

Complementary information

Rychner (1987) indicates that the metal of the object is a bronze.

Corrosion layers

The appearance of CP1 and its composition (Cu, Fe, S) seem to indicate that it is either itaite or chalcopyrite.

Corrosion form	Uniform
Corrosion type	lake patina (Schweizer 1994)

Complementary information

According to Rychner (1987), the surface of the object is covered with chalcopyrite ($CuFeS_2$).

MiCorr stratigraphy(ies) – CS

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

The corrosion structure has only been documented in binocular mode (Fig. 8).

Conclusion

The sickle is made from a tin bronze. The XRF analysis shows that the brown corrosion layer (CP1) have higher %Fe and %S and lower % Cu while CP2 is richer in %S than Fe. It would indicate that CP1 is made of copper iron sulfide like chalcopyrite (CuFeS2) as described by Rychner (1987). According to Schweizer's paper from 1994, it would mean that CP1 could be a lake patina which was generated on the metal by the presence of sulfate-reducing bacteria in the burial environment.

References

References on object and sample

Object files in MiCorr

1. MiCorr_Sickle Auv-322
2. MiCorr_Sickle Auv-313

References object

3. Rychner, V. (1987) Auvernier 1968-1975: le mobilier métallique du Bronze final Formes et techniques. In: Cahiers d´archéologie romande 37, Auvernier 6. 39-40.
4. Rapport d'examen, Lab. Musées d'Art et d'Histoire, Geneva GE, 87-194 à 87-197.
5. 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, 143-157.