VOTIVE FIGURE OF A BAT IVB4168 – GILDED BRASS – MODERN TIMES

Artefact name Votive figure of a bat IVb4168

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The object

Fig. 1: Votive figure of a bat, front (left) and back (right) view, *Credit HE-Arc CR, N.Gutknecht.*

Description and visual observation

Description of the artefact	The object represents a bat-like figure holding and chewing a rope (Fig. 1). There are remains of a surface gilding. The object has a red-brown adherent layer where the gold has flaked off with a heterogenous green and white loosely bound layer on top. Dimensions: Length = 110 mm; Width = 73mm; Height = 25mm; WT = 60g.
Type of artefact	Votive figure
Origin	Costa Rica
Recovering date	Unknown, acquisition in 1970
Chronology category	Modern Times
chronology tpq	----
chronology taq	----
Chronology comment	20th century (fake)

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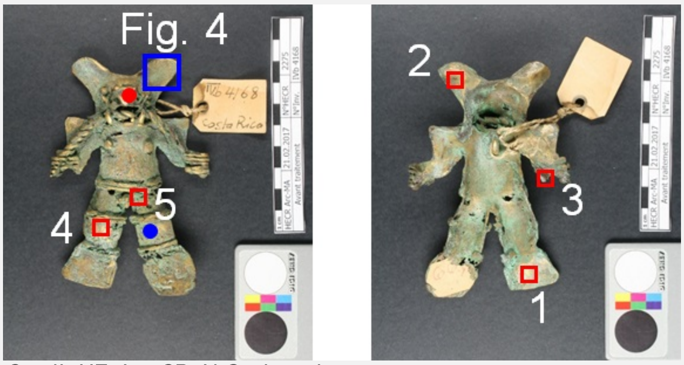
Burial conditions / environment	Unknown
Artefact location	Museum der Kulturen, Basel
Owner	Museum der Kulturen, Basel
Inv. number	IVb4168
Recorded conservation data	Not conserved

Complementary information

Nothing to report.

Study area(s)

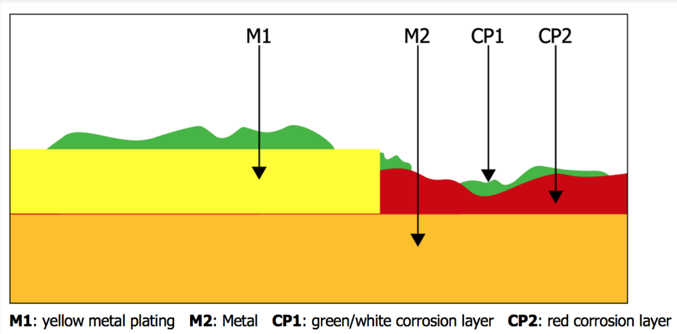


Credit HE-Arc CR, N.Gutknecht.

Fig. 2: Bat figure, front (left) and back (right) view with location of XRF analyses (red squares), FTIR analysis with sampling (blue point) and SEM-EDS analysis (red point),

Binocular observation and representation of the corrosion structure

The schematic representation below gives an overview of the corrosion layers encountered on the object from visual macroscopic observation.



Credit HE-Arc CR, N.Gutknecht.

Fig. 3: Stratigraphic representation of the bat in cross-section by macroscopic observation,

Fig. 4: Location of the areas 1 and 2 used to build the MiCorr stratigraphies of Figs. 5 and 6,

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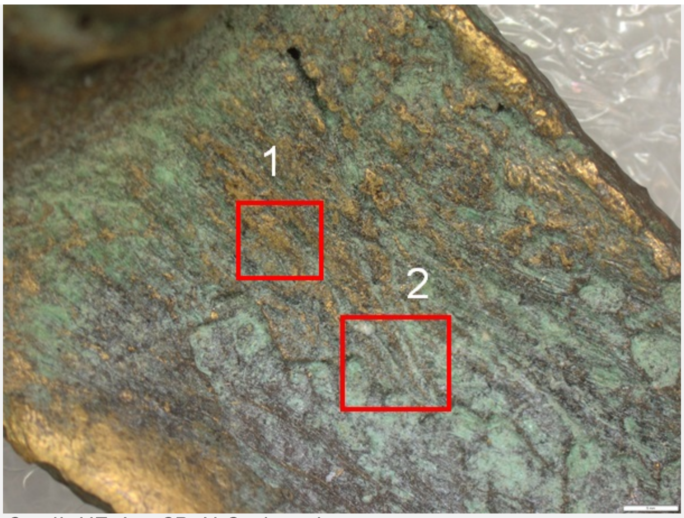

Credit HE-Arc CR, N.Gutknecht.

MiCorr stratigraphy(ies) – Bi

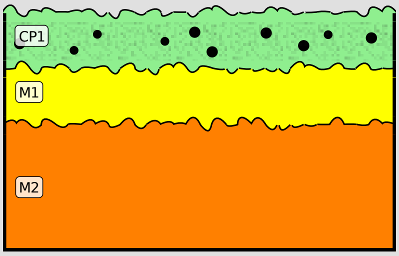

Fig 5: Stratigraphic representation 1 from Fig. 4 using the MiCorr application. The characteristics of the strata are only accessible by clicking on the drawing that redirects you to the search tool by stratigraphy representation, Credit HE-Arc CR, N.Gutknecht.

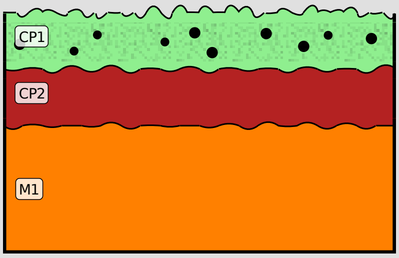

Fig. 6: Stratigraphic representation 2 from Fig. 4 using the MiCorr application. The characteristics of the strata are only accessible by clicking on the drawing that redirects you to the search tool by stratigraphy representation, Credit HE-Arc CR, N.Gutknecht.

Sample(s)

Description of sample	No sample from the metal was cut. Only a sample of the green corrosion product was taken for FTIR analysis (Fig. 2).
Alloy	Gilded brass
Technology	Cast, gilding (electroplating?)
Lab number of sample	
Sample location	None
Responsible institution	Denkmalpflege und Archäologie des Kantons, Luzern
Date and aim of sampling	2017, chemical analyses

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Complementary information

Nothing to report.

Analyses and results

Analyses performed:
XRF (on the object) with portable X-ray fluorescence spectrometer (NITON XL3t 950 Air GOLDD+ analyser, Thermo Fischer®), FTIR-ATR (on corrosion products), SEM/EDS (on the object).

Non invasive analysis

Metal

The metal is a gilded brass (Table 1) containing traces of Fe and Pb. Brass was not used by the pre-Columbian metalsmiths (Scott 2000 and Hosler 1994) who worked with copper, arsenic copper or bronze. If ancient, the only possibility would be the use of brass imported by the Spanish conquistadors. Until 1500 the manufacture of brass with more than 28% zinc was not feasible (Craddock 2009). As regards pre-Columbian surface enriching technology, the following gilding techniques can be expected (Scott 2000):
- depletion of copper on a copper/gold alloy (tumbaga)
- gold foil, fusion gilding, electrochemical plating

Elements mass % / Area	Cu	Zn	Au	Fe	Pb	Ag	Sn	Ni	Cr
1 (back)	64.1	28.5	7.1	0.06	0.02	0.03	0.02	0.02	0.07
2 (back)	64.5	31.4	4.0	0.05	0.04	0.02	0.02	0.02	<
3 (back)	65.3	29.3	5.1	0.08	0.1	0.04	0.03	0.02	0.04
4 (front)	64.8	28.6	6.4	0.13	0.04	0.03	0.03	<	<
5 (front)	66.3	26.9	6.4	0.16	0.3	0.03	0.03	0.03	<

Table 1: Chemical composition of the metal of the bat. Method of analysis: hand held XRF, mode precious metal, 60s. 1 and 2 were done in the chamber of the XRF but not 3, 4 and 5, credit MiCorr_HE-Arc CR, C.Degrigny.

Microstructure None

First metal element Cu

Other metal elements Zn

Complementary information

Nothing to report.

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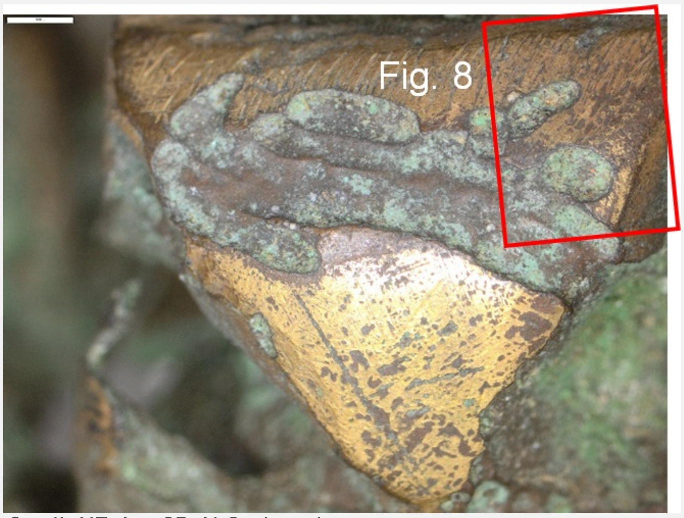
Corrosion layers

The metal seems to have been heavily attacked (acid dissolution). There are several perforations on the lower part of the object, and where the gold layer is absent the surface is unevenly pitted by corrosion (Figs. 1, 2 and 7). The submetallic core is not visible from the surface.
There are two corrosion products (Figs. 7 and 8). The red one (CP2) has a submetallic brightness and is opaque, non-magnetic, compact, hard and adherent. It is very thin (less than a few microns thick) and only appears where the gold layer has been lost. The EDX spectrum (Fig. 9) shows that it is a Cu- and O rich product, probably cuprite (Cu_2O).
The light green to white corrosion product (CP1) has a waxy consistency and is thin, translucent, non-magnetic, powdery and very soft. It is very loosely bound. It is distributed on the whole object (front and back) as disparate clumps. It is mainly located on the cavities and irregularities of the surface. FTIR analyses (ATR mode) of both green and white areas of CP1 have similar spectra and were identified as copper nitrate (Fig. 10).

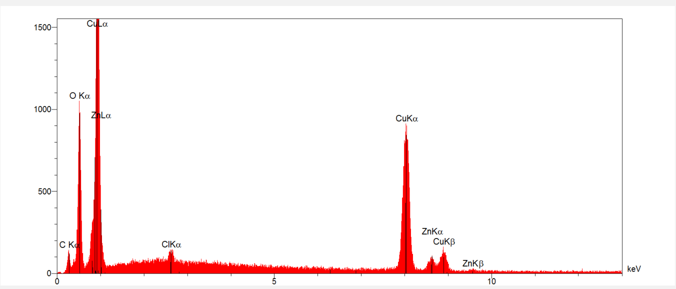


Credit HE-Arc CR, N.Gutknecht.

Fig. 7: Binocular image of the nose of the bat showing detail of Fig. 8,

Credit HE-Arc CR, N.Gutknecht.

Figs. 8: SEM images of the metal on the nose of the bat. The blue point represents the area for the EDS point analysis (Fig. 9),



Credit HEI Arc, S.Ramseyer.

Fig. 9: EDS analysis of the red corrosion product. Method of analysis: SEM-EDS, Lab of Electronic Microscopy and Microanalysis, Néode, HEI Arc,

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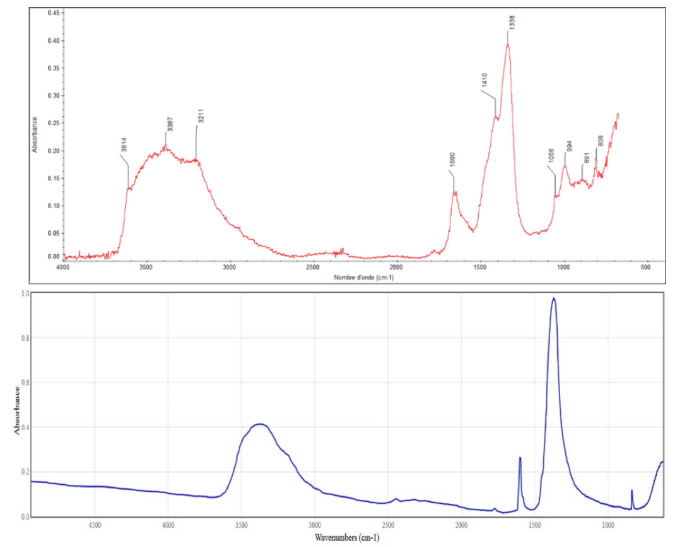

Fig. 10: FTIR spectrum (ATR mode) of the white corrosion product product (top), and of synthesized copper nitrate ($Cu(NO_3)_2 * 3H_2O$) (bottom),

Credit HE-Arc CR, L.Brambilla (top) and COBLENTZ SOCIETY (bottom).

Corrosion form	Pitting
Corrosion type	Artificial

Complementary information

Nothing to report.

MiCorr stratigraphy(ies) – CS

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

Corrected stratigraphic representation: none.

Conclusion

For a long time the only brass used in the Americas was imported from Europe after the Spanish reached its shores in 1492. Pre-Columbian metalsmiths only produced copper, arsenic copper, bronze and copper-silver-gold alloys (tumbaga) (Hosler 1994). Brass with a zinc content superior to 28% (as is the case here) is an alloy that could only be achieved from 1500 and onwards (Cradock 2009). We can then rule out that the artefact was made from early recycled European brass.
FTIR analysis of the green/white corrosion product suggests that it is a copper nitrate, a highly water soluble corrosion product that cannot be found in an archaeological context. However, it has been recorded on artificially patinated copper alloys (Scott 2000; Craddock 2009).
The dissolution of the metal and the subsequent formation of the patina is most likely the result of a forced attack with concentrated nitric acid. The holes and pits in the metal are unnatural for a natural corrosion process which would produce a stratified, adherent and thick corrosion crust (Craddock 2009). The copper nitrates could have formed over time from residual acidic solution that was left on the surface.The lack of an archaeological context, the

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modern alloy composition and the presence of copper nitrates on the unnaturally pitted surface suggest the object being a forgery made in modern times.

References

References on object and sample

1. Scott, D. (2000) A review of gilding techniques in ancient South America. In: T. Drayman-Weisser (ed.) Gilded Metals: History, Technology and Conservation. London, Archetype Publications, 203-222 & 250-251.
2. Hosler, D. (1994) The sounds and colors of power – the sacred metallurgical technology of ancient west mexico. Massachusetts Institute of technology, 171.

References on analytic methods and interpretation

3. Craddock, P. (2009) Scientific Investigation of Copies, Fakes and Forgeries. Butterworth-Heinemann, London, 148, 349-351 & 365.
4. McEwan, C (ed.) (2000) Precolumbian Gold – Technology, style and Iconography. British Museum, London.

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