GeoArch

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Analysis of a metal artefact

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Abstract

The submitted item, a decorated elongate pyramidal hollow artefact (probably a needle case) formed of bright metal, was analysed to determine whether it was of silver or a base metal.

Non-destructive analysis by pXRF was undertaken. The results were outside the range for which the machine had been calibrated and must there be regarded as at best only semi-quantitative. The analysis showed that the item is in a lead-tin alloy (pewter), with trace levels of iron and copper. Silver was below detection.

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Methods

Analysis of the metal forming a small object (probably a needle case) was requested by WYAS, with the work commissioned by Zoe Horn. The analysis was undertaken in January 2024.

The specimens were analysed on a semi-quantitative basis using a Bruker Tracer III-SD portable X-Ray fluorescence spectrometer (instrument belonging to the Department of Archaeology, Cardiff University). The instrument was operated with the Bruker 'yellow' filter (300µm Al + 25µm Ti), at 40kV and 9.60 µA, with a filament current of 189 µA, for 60s. Two areas were analysed, on different faces of the broad end of the object, in order to cover as much of the incident X-Ray beam as possible.

The instrument was controlled by a PC running Bruker's *S1PXRF* with spectra stored as pdz files and csv files. The output was converted for measurement of net peak areas in Bruker's Spectra (*Artax*) software (Table1).

Calibration of the results was obtained through linear correlation with the net peak areas with those recorded by Nicholas & Manti (2014) on a series of copper alloy standards, using exactly the same instrument and settings. The raw net peak area values are provided in Table 1 and the calibrated analyses (using the above technique) are given in Table 2.

These measurements will be of low accuracy because of the irregular sample geometry, the superficial nature of the analysis and, particularly, because the analysed material was of a different composition to the materials used to generate the calibration. The numerical values should therefore be viewed as a very crude approximation to the composition of the metal composition.

Results

The net peak areas are provided in the upper part of Table 1. The modelled composition is provided in the lower part of the table.

The compositions appear to be pewter, an alloy of lead and tin. Typical pewters have tin present in significantly greater amount than lead, but here the values appear rather even. Considerable caution should be taken in using that value in detail, but it seems likely that this is a relatively lead-rich pewter.

References

NICHOLAS, M & MANTI, P. 2014. Testing the applicability of hand held portable XRF to the characterisation of archaeological copper alloys. In J. Bridgland (ed) *ICOM-CC 17th Triennial Conference Preprints, Melbourne, 15–19 September 2014*. Paris: International Council of Museums.

Table 1: net peak areas and modelling of metal composition

Element	Fe	Cu	Zn	Ag	Sn	Pb
peak	K12	K12	K12	K12	K12	L1
net peak areas						
area 1	13600	17527	184	1462	243217	413262
area 2	34108	18041	337	1299	295691	533082
% using Cu alloy calibration						
area 1	0.40	0.51	0.00	0.10	28.03	29.27
area 2	1.01	0.53	0.01	0.09	34.07	37.76
% normalised						
area 1	1	1	0	0	48	50
area 2	1	1	0	0	46	51

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