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Analysis of a copper-alloy bowl from Hafod-Morfa Copperworks

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Abstract

The beaten copper bowl has folded rim attached by small rivets (or pins), none of which survive. The artefact has a slightly crude, artisanal, appearance, apparently with no attempt to planish the hammer marks on the lower sides of the bowl, an awkward looking planar upper part of the bowl sides, probably produced during the folding of the bowl lip and the overlying applied rim, and with somewhat misplaced rivet holes that only incompletely intersect the inner face of the applied rim.

pXRF analysis indicates that the bowl was formed of copper and the rim of brass (approximately 66% Cu / 34% Zn). The rim appears to have been attached without the use of solder and was intended to held in place by the pins (although an organic glue cannot be excluded). The applied rim is probably now held in place by corrosion. It is unclear whether the pins/rivets have simply disappeared through corrosion (perhaps they may have been ferrous?) or whether the bow is unfinished.

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Methods

The specimen was analysed at selected places 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 40s. The instrument was controlled by a PC running Bruker's S1PXRF with spectra stored as pdz files and csv files.

This assessment was conducted in December 2024 and was commissioned by Dr Rhys Morgan Black Mountains Archaeology Ltd. The materials derive from the work of Black Mountains Archaeology at the Hafod-Morfa Copperworks, Swansea.

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.

Results

The object is a composite copper alloy bowl, slightly deformed, with a diameter at the rim varying from 310mm to 322mm and a depth of approximately 70mm.

There is a crude foot ring about 130mm in diameter, slightly raised and with the body approximately planar, smooth and slightly elevated within the ring. The lower sides curve irregularly, with the 30mm below the rim being sub-vertical. The beaten bowl is fashioned rather irregularly, with dimpled hammer marks on the lower sides, but becoming planar inside the foot ring and on the subvertical section of the side. The top of the body is folded over externally, to a width of around 10mm (but variable).

The folded lip or rim is concealed (Figure 1) by a folded strip of yellower metal, approximately 975mm in length, 25mm in width and approximately 600-700µm in thickness, folded symmetrically.

This applied rim appears to have been intended to be fastened by pins or rivets – 2mm diameter holes for which lie 7mm either side of the butt join (passing the through the inner and outer sides of the applied rim and through the folded body rim below), one on a chord of 180mm to the right (viewed from the outside of the bowl), one a further chord length of 240mm (placing it just to the right of being opposite the join), another at a further chord of 240mm, which is then a 215mm chord length back to the join. The second and third pin locations on this list are positioned so that the hole to take the pin intersects the margin of the applied rim on the interior, rather than passing within its width.

There is no trace of any of the pins/rivets.

Spectra obtained from the analyses are illustrated in Figure 2. The raw net peak area values and the calibrated analyses (using the above technique) are given in Table 1. Three spots were analysed – one on the outside of the lower bowl where it has been cleaned of corrosion products, one on a clean section of the applied rim, and one over an external pin hole.

Interpretation

The analytical data indicate that the body of the bowl is formed in copper (the other recorded elements may at least in part be associated with the corrosion products present) and that the applied rim is of brass bearing approximately 34% zinc. Both body and rim are thus formed of very standard stock materials.

The analysis taken over one of the empty pin/rivet holes shows an intermediate composition suggesting it is influenced by both layers and their corrosion products. There is no indication that there is an intermediate layer of solder or other metal-bearing material. The presence of an organic glue cannot be excluded, but it seems likely that the rim was intended to be held in place principally by the pins/rivets.

The bowl appears to be of rather simple and poorly formed construction. Copper mixing bowls typically show a stout rolled rim in continuity with the body. In this instance the applied rim would have had a different colour (more yellow) than the body. This, together with the rather insecure form of attachment, suggests that it was intended to be decorative, whilst also concealing a rather irregular edge to the underlying bowl.

The finish of the bowl shows little attention to detail. The lower body is beaten, but not planished, so retains the hammer marks. The upper sides are more planar – possibly as a by-product of the hammering flat of the fold margin and of the applied rim. The holes intended to connect the rim to the body did not pass neatly through both sides of the folded brass strip, often partially 'missing' the internal side of the brass.

The fastening pins are missing – possibly having corroded away (perhaps being fashioned from a ferrous material), or the object may be unfinished. The crude fashioning of the bowl cannot be a product of being unfinished because that would need completion before the rim was applied.

For these reasons, it would seem unlikely that this bowl represents a commercial or trading product, nor was it intended to be a functional mixing bowl (the most common intention for a bowl of this size). Rather, it appears to be an artisanal piece, intended to be decorative. It may be unfinished.

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.

Figure 1: views of the nature of the bowl components. External radial (above) and oblique (below) views of the butt joint between the ends of the brass rim (the external left side has fractured at the pin hole). The folded top of the copper body is clearly visible (dark) below the fractured rim.

Figure 2: pXRF spectra from a composite bowl from Hafod-Morfa Copperworks.

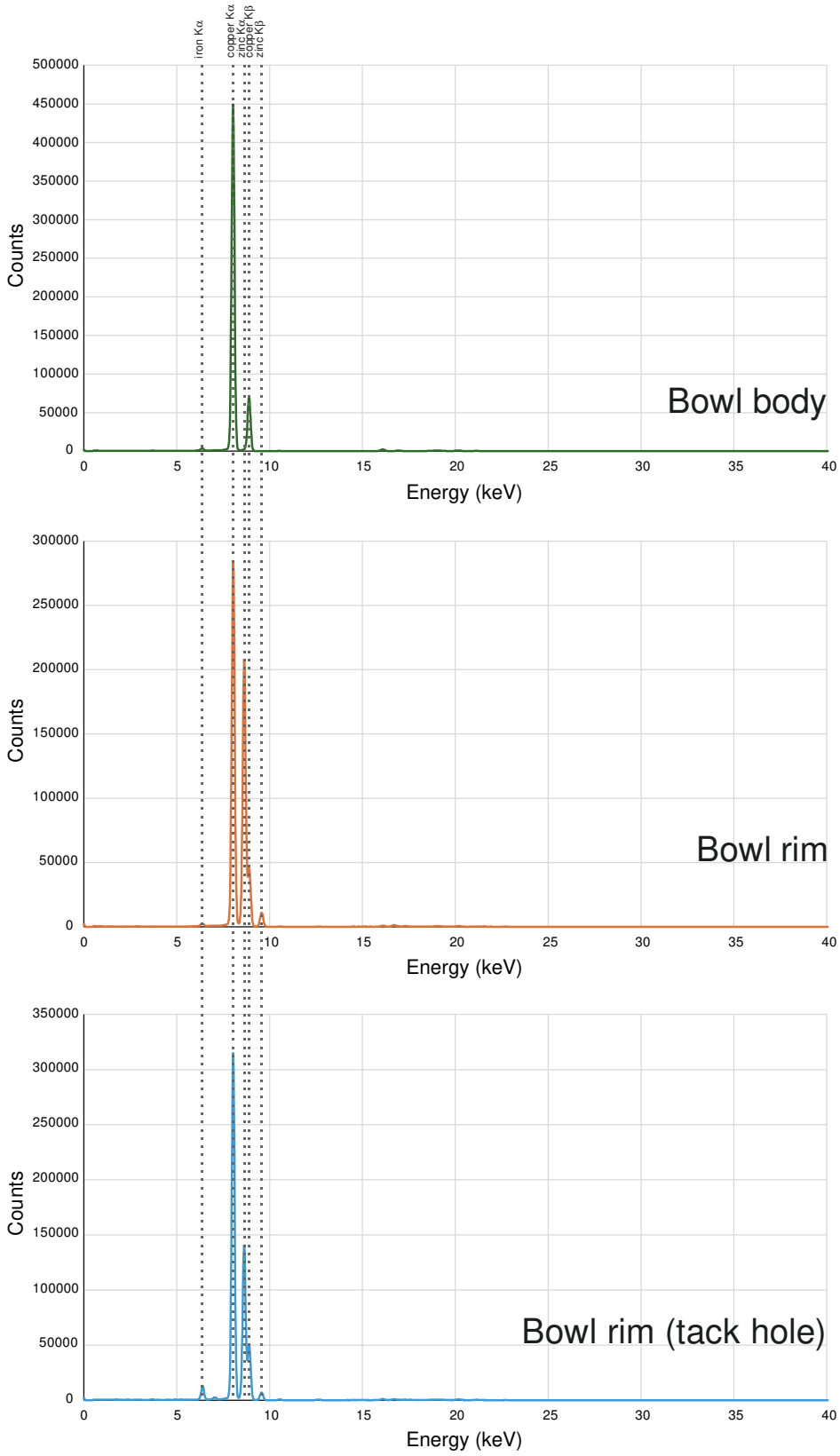

Table 1: analytical data obtained by pXRF on selected locations on the bowl.

Site	Net peak areas						Estimated composition				
	Fe K12	Ni K12	Cu K12	Zn K12	Pb L1	Pb M1	Fe	Ni	Cu	Zn	Pb
bowl rim	15881	343	2679375	1992888	3599	313	0.4%	0.0%	65.4%	34.0%	0.2%
bowl side	23272	4249	4221925	9959	3087	165	0.6%	0.1%	99.0%	0.2%	0.2%
hole	107633	1296	2957854	1350974	8139	425	2.7%	0.0%	73.3%	23.4%	0.5%

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