



*Staffordshire Hoard
Research Report 15*

XRF Analysis of Inlays in Staffordshire
Hoard Object K301

Andrew Meek

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The Staffordshire Hoard: an Anglo-Saxon Treasure
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Information about this report

This report was produced in 2013 as part of Stage 1 of the project, i.e. before fragments were joined and catalogued.

The inlay is part of catalogue number 76 – a pommel in cast silver, of cocked hat form with double sword-rings, with cast interlace and niello inlay, and mounts with cloisonné and filigree decoration.

The work was carried out in the Department of Conservation and Scientific Research in the British Museum. It is copyright Birmingham City Council.

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DEPARTMENT OF CONSERVATION AND SCIENTIFIC RESEARCH

XRF analysis of inlays in Staffordshire Hoard object K301

Science Report PR07444-4

Andrew Meek

Abstract: Staffordshire Hoard object K301 was submitted to the British Museum Research Laboratory for non-destructive analysis. The aim of this analytical project was to discover the nature of the materials used to produce the coloured inlays. All of the inlays on the object were characterised. The red inlays were found to be garnets, the blue inlays were found to be blue glass, coloured with cobalt, and the white inlay was originally clear glass. It is very likely that the blue and clear glasses used are reworked (i.e. cut into new shapes or melted and formed into new objects) Roman glass.

CSR Project no. PR07444
Staffordshire Hoard number: K301

19 February 2013

Introduction

Staffordshire Hoard object K301 was submitted to the British Museum Research Laboratory for non-destructive analysis. The aim of this analytical project was to discover the nature of the materials used to produce the coloured inlays.

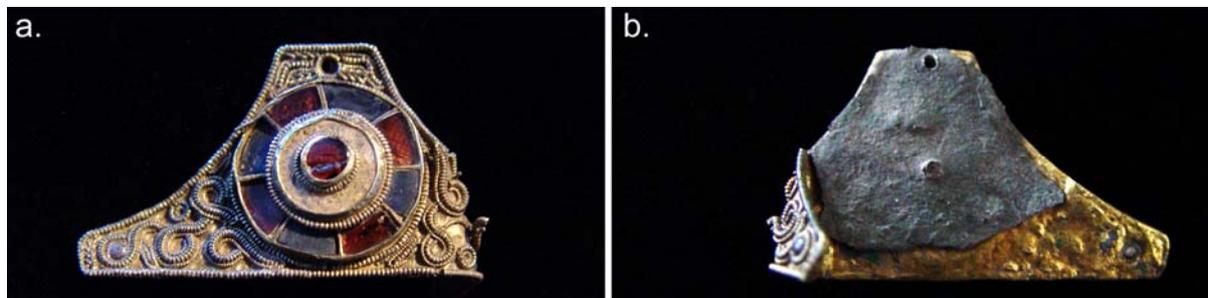


Figure 1: Pommel cap K301 (20 mm tall and originally c.40 mm wide).
(a) front (b) reverse.

Method

X-ray fluorescence (XRF)

Unprepared surfaces of the inlays were analysed qualitatively using a Bruker ARTAX spectrometer using the following operating conditions: helium atmosphere, 50 kV, 0.5 mA current, 0.65 mm diameter collimator and 400 seconds counting time.

Corning A glass standard was analysed under the same conditions. By comparing the spectra produced by analysis of the inlays with that for this glass of known composition it was possible to provide some semi-quantitative estimates for the composition of the inlays.

Results

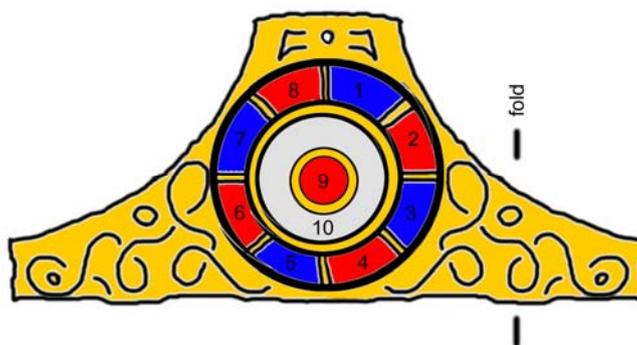


Figure 2: Diagram showing the analysed inlays on K301, see Table 1.

All 10 inlays were analysed qualitatively using XRF. The positions of these inlays are shown in Figure 2 and the results of the analysis can be found in Table 1.

Table 1: Summary table of qualitative XRF analysis results for each of the inlays in K301. Elements in brackets were recorded as very small peaks and are therefore present in low quantities.

Inlay no.	Elements present in inlay	Interpretation
1	(Al), Si, K, Ca, (Ti), Mn, Fe, Co, (Ni), Cu (Pb), Sr, (Sb)	Blue glass coloured with cobalt. Possible traces of antimony and lead suggest the reuse of opaque glass as a colouring material
2	(Al), Si, Ca, (Cr), Mn, Fe, (Y)	Garnet, iron-rich, probably of the almandine type
3	(Al), Si, K, Ca, (Ti), Mn, Fe, Co, (Ni), Cu (Pb), Sr, (Sb)	See inlay 1
4	(Al), Si, Ca, (Cr), Mn, Fe, (Y)	See inlay 2
5	(Al), Si, K, Ca, (Ti), Mn, Fe, Co, (Ni), Cu (Pb), Sr, (Sb)	See inlay 1
6	(Al), Si, Ca, Fe	See inlay 2
7	(Al), Si, K, Ca, (Ti), Mn, Fe, Co, (Ni), Cu (Pb), Sr, (Sb)	See inlay 1
8	(Al), Si, (Ca), Fe	See inlay 2
9	Al, Si, Ca, Mn, Fe, (Y)	See inlay 2
10	(Al), Si, K, Ca, (Ti), (Mn), Fe, Cu, (Pb), Sr, Sb	Clear glass, antimony decoloured

Discussion

Red inlays

The XRF spectra for each of the red inlays suggest that they are garnets. More specifically, the high iron levels detected suggest that they are garnets of the almandine type.

Blue inlays

The XRF results suggest that the blue inlays are made from a soda-lime-silica glass with significant levels of calcium ($\text{Ca} \geq 5\%$). The levels of potassium (K) present are too low to suggest that this is a potassium-based glass and it is therefore likely to have either been produced using a soda-rich plant ash or mineral (natron) as its main alkali source. The use of natron glass is consistent with the vast majority of Anglo Saxon glass so far analysed, so it is suggested that this is the type of glass seen in the blue inlays (see Freestone *et al.* 2008).

The presence of small quantities of lead (Pb) and antimony (Sb) in these glasses may suggest that they were produced by adding lead-antimonate opacified blue glass to a transparent and lightly coloured base glass to produce transparent blue glass. Elevated lead levels are common to Roman blue glasses and may suggest their use as cullet (i.e. remelting, mixing and working to produce a new glass composition) (Freestone *et al.* 2008; 37).

White inlay

The XRF spectrum of this inlay is similar to those found for the blue inlays. It is also a soda-lime-silica glass with significant levels of calcium (Ca, c.5%). For the same reasons as noted for the blue glasses, it is suggested that this is a natron-based glass.

Its white appearance is due to fracturing and the glass was originally clear. The presence of antimony suggests that this was a purposeful addition as a decolouring agent to counteract the unwanted colours contributed by iron oxide present in the raw materials.

Antimony decoloured glass is found in Britain during the Roman period, until the mid-fourth century AD (Foster and Jackson 2010; 3074). Its use in K301 may represent the

reworking (i.e. cutting into new shapes or melting and forming into new objects) of Roman vessel glass, or perhaps a bead, or a new importation from the Continent.

Conclusions

All of the inlays on the object were characterised. The red inlays were found to be garnets, the blue inlays were found to be blue glass, coloured with cobalt, and the white inlay was originally clear glass. It is very likely that the blue and clear glasses used are reworked (i.e. cut into new shapes or melted and formed into new objects) Roman glass.

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19 February 2013

References

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Freestone, I., Hughes, M. J. and Stapleton, C. P. 2008. 'The Composition and Production of Anglo-Saxon Glass' *In*: Evison, Vera I. *Catalogue of Anglo-Saxon Glass in the British Museum*, British Museum Research Publication **167**, London: British Museum Press, pp. 29-46.



Staffordshire Hoard Research Reports

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