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X-RAY FLUORESCENCE ANLAYSIS OF EARLY ANGLO-SAXON GLASS BEADS FROM MARKET LAVINGTON, WILTSHIRE

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Summary

Eighteen early Anglo-Saxon beads of various colours were analysed using non-destructive X-Ray fluorescence analysis (XRF). This allowed the identification of colourants and opacifiers.

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X-ray fluorescence analysis of Anglo-Saxon glass beads from Market Lavington, Wilts

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X-ray fluorescence analysis (XRF) was carried out on the unprepared surfaces of 18 beads. A narrow collimator was used (1mm diameter) and the rhodium tube was run at 35kV and 200mA. The presence or absence of elements was noted (see Table).

Various factors combine to make the interpretation of XRF spectra from unprepared glass samples a complex matter. Iron and copper were found in nearly all the beads examined. Iron oxides are present of most archaeological glasses, often having strong colouring effects although other oxides may have been added to hide or mitigate these effects. However, in many cases, high iron levels at the surface of artefacts may be a result of contamination during burial. The ubiquity of copper in coloured Anglo-Saxon glass beads has been noted before (Bayley 1987); copper oxides can be used to colour glass red, orange, blue/green or green. Calcium and strontium are also likely contaminants from the burial environment, although calcium oxide (lime) is normally present in archaeological glasses. Strontium may have been introduced by the presence of skeletal material nearby.

Amongst the trace elements, cobalt is normally difficult to detect as, when present, it is nearly always at very low levels in archaeological glasses. In XRF analysis, the presence of iron K-beta peaks means it is difficult to accurately evaluate cobalt levels. However, cobalt is thought to be the most significant colourant amongst blue glasses at this time.

In many of the translucent clear or lightly-tinted beads, relatively few elements could be detected using XRF. During the Anglo-Saxon period, transparent glasses are generally primarily composed of lighter elements and rarely contain heavy elements, which are normally seen in opaque and strongly-coloured glasses. Although a vacuum was applied in most cases, it is difficult to detect sodium and aluminium using XRF since they have very low energy peaks.

It is very difficult to analyse the smaller polychrome examples, since the beam size of the XRF system is too large to analyse separate colours precisely or reproduceably. Data from similar colours on monochrome beads helps in the interpretation of spectral data from polychrome beads.

1) Translucent beads

A segmented bead (SF368), in which the glass has a very pale, clear appearance, was found to have a significant gold content. This demonstrates that gold leaf was included in its manufacture (as was noted visually). This 'gold-in-glass' bead seems to have a very high manganese content, which could explain the clearness of the glass, since manganese is an excellent clarifier. High levels of manganese suggest deliberate addition.

Comparable examples are known from Sewerby, Yorkshire and from other Migration Period cemeteries (Hirst 1985, 66). It is not possible to comment on whether this bead is likely to be a Roman survival or a newly-manufactured example, on the basis of analysis.

A large spotted bead (SF100) is made of translucent blue glass, although now coated with a grey corrosion product. There are slight traces of cobalt present in the blue glass, otherwise nothing unusual is detectable. The large grey spots on this bead are lead- and tin-rich and must therefore be made of tin-opacified leaded glass. The spots may originally have been yellow or white.

Two other blue translucent beads have detectable levels of antimony (SF62 and SF493). This is unusual in the Anglo-Saxon period; the glass may be reused Roman glass or of Mediterranean origin or the beads may be Roman themselves. However, two blue translucent beads from Dunadd, Argyll were found to contain traces of antimony so a wide range of possible sources may be suggested (Bayley 1984).

2) Opaque beads

The site produced several dark opaque-red/brown cylindrical beads (eg SFs 5115, 5116 and 5117). Despite all appearances, SF5116 is made of a translucent greenish glass, whose corrosion products happen to mimic opaque red glass. On abrading a small area, a white powdery corrosion product is first encountered and then the pale, slightly sugary surface of a green glass. The white streaks and patches on this bead are areas which were abraded during excavation, conservation etc. Since calcium was noted during the XRF analysis of this bead, the white layer may be a lime-rich deposit. The other large apparently opaque-red cylindrical bead from this context (SF5117) appears to be a translucent orange-brown glass with swirls of yellow/white glass in the surface. However, this impression too may be erroneous. Light shining through the sides of the bead may be coloured since it must pass through layers of dark red corrosion products - the glass may be very lightly coloured. It was difficult to analyse the bulk of the glass and the yellow/white trailed glass seperately, but the decorative swirls are likely to be made of tin-opacified glass (see Table). A final small red bead from this context (SF5115) also appears to be opaque (opacified by the copper oxide), but the opaque appearance is also enhanced by surface corrosion.

The melon bead SF357 is so thickly encrusted with pale corrosion products and other debris that it has a very pale green colour. However in a lightly-cleaned area, a fairly strong blue-green colour can be seen. The surface is crystalline, suggesting a faience composition, rather than true glass. Not only does the bead have this unusual texture, but it is also a much more delicate shape than other melon beads of the Anglo-Saxon period (eg at Sewerby, Hirst 1985, 66; Dover, Evison 1987, 58) and a different source is likely. Iron, tin and copper were detected; both tin and copper may have caused opacity and copper may have effected the colouring.

For SF5121, it proved difficult to find significant differences between spectra from mainly translucent green areas and those from areas dominated by white trailing. The bead has high levels of lead, iron and tin so the trail is likely to be tin-opacified.

A large opaque white bead (SF455) is probably not made of glass; it is most likely to be a bone or antler product (however, appropriate structures could not be seen under a microscope), or a mineral material such as meerschaum (Evison 1987, 60). Meerschaum is a form of magnesium silicate found in alluvial deposits and in veins (eg in Asia Minor and Spain). It is a soft mineral (therefore easily carved), light and opaque white or greyish-white (Read 1970, 410).

References

Bayley J 1984 'Examination and analysis of some glass beads from Dunadd, Argyll' Ancient Monuments Laboratory report 4184.

Bayley J 1987 ' Qualitative analyses of some of the beads' in Evison 1987; 182-189.

Evison V I 1987 'Dover: Buckland Anglo-Saxon cemetery' Historic Buildings and Monuments Commission for England, Archaeological Report no 3.

Hirst S 1985 'The Anglo-Saxon Inhumation Cemetery at Sewerby, East Yorkshire' York University Archaeological Publications 4.

Read H H 1970 'Rutley's Elements of Mineralogy' (26th edition).

Table 1: Market Lavington beads, non-destructive XRF analysis

SF	Type	Area	Fe	Cu	Zn	Pb	Sn	Sb	Au	Others	Comments
SF95 5113	plain tr green	whole bead	x	?	-	-	-	-	-	?Sb	
SF95 5120	tr green with decor	tr green	x	x	-	x	x	-	-	?Sr	
		white zigzag	xx	x	-	x	xx	-	-	Mn Ca	white = tin-op
SF95 5117	tr red with trails	mostly body	x	x	-	xx	x	-	-	Mn Ca	
		trail (wh/yellow)	xx	x	-	xx	tr	-	-	Mn	tin-op
SF95 5121	tr green with trails	mostly body	x	x	-	x	?	-	-	Sr Ca Si	
		mostly trail	x	?	-	x	x	-	-	Sr Ca	tin-op?
SF95 5116	large dk red with trail	body	x	x	-	xx	x	-	-	Mn Ca	
		white?	x	x	-	x	x	-	-	Mn Ca	
SF95 5115	small red opaque	body	tr	tr	-	-	-	-	-	Ca?	
SF5002	blue ring	body	tr	?	-	-	-	-	-	Co?	
SF100	large blue with spots	tr blue	tr	tr	-	x	-	-	-	?Co Sr	
		spots	x	x	-	xx	x	-	-	Sr Mn Ca	
SF100	small red with decor.	body	x	x		x	?			Sr Ca Mn?	
SF25	small red with decor.	red	x	x	-	x	x	-	-	Sr?	
		trail	tr	tr	-	x	tr	-	-		

Table 1 (cont)

SF	Type	Area	Fe	Cu	Zn	Pb	Sn	Sb	Au	Others	Comments
SF357	large opaque	whole	x	x	-	-	x	-	-	Ca	
SF62	small blue translucent	whole	xx	xx	?	xx	-	xx	-	Sr Ca++	Sb-decolorised
SF479	long transl. blue	whole	tr	tr	-	?	-	-	-	-	
SF493	long transl. blue	whole	x	x	-	-	-	x	-	Ca?	
SF368	segmented transl.	whole	xx	x	-	-	-	-	x	Mn++ Sr Ca	gold and glass mix
SF58	blue crushed	whole	?	x	-	?	-	-	-	Ca?	
SF158	brown crushed	whole	x	x	-	-	-	-	-	Ca	
SF455	large white opaque	whole	x	x	-	-	-	-	-	-	non-glass

The silica content is not noted, as it is assumed to be present in all glasses.

Key:

x present
xx detected at high levels
tr trace
\- not detected