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Ancient Monuments Laboratory
Report 51/95

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Summary

A section from a small glass vessel fragment was examined using electron microscopy and energy-dispersive X-ray analysis. The translucent pale green body was a soda glass. It was decorated with a trail of tin-opacified lead-rich soda glass, in which lead-tin oxide crystals dominated over tin oxide, producing an opaque yellow colour.

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Analysis of a fragment of decorated Saxon vessel glass from Westminster Abbey, London

Catherine Mortimer

Previous analytical work (Mortimer 1993) has been carried out on grozing debris from eleventh century contexts at the 1986 excavations of the dorter undercroft at Westminster Abbey.[1] A small fragment of vessel glass was also found at the site, in a context spot-dated to 1050-1150 (Context 368, SF 40). This is thought to be a piece of mid- to late-Saxon glass, because of its pale green translucent colouration and good preservation. The fragment has opaque yellow trails on it. Compositional analysis of the vessel glass and of the trail allows this fragment to be compared with other mid-late Saxon material.

A small section was cut from the sample so as to include a portion of the trail. The sample was mounted in epoxy resin, polished to 1μ, carbon-coated and analysed using an energy-dispersive X-ray analysis system (Oxford Instruments ISIS) attached to an electron microscope (Leica Cambridge S440i). Analysis was carried out using the default ZAF calculations at 15kV, 1000pA, 50 seconds live counting time. The analytical results are shown below. Corning glass standard A was analysed under the same conditions and this indicated that the analytical technique gave acceptable answers for the vessel glass matrix, although the magnesia (MgO) values calculated may be a little high and the alumina and lime (Al_2O_3 and CaO) values a little low. Analysis of the trail material was more complex, as the layer is heterogeneous, but approximate values are given here.

Oxide	Saxon glass WST86, 368, Δ40		Corning standard A	
	Translucent pale green	Opaque yellow	EDX analysis	Standard values
Na_2O	17.4	10.2	14.5	14.52
MgO	1.5	0.7	3.2	2.81
Al_2O_3	2.1	1.2	0.6	1.01
SiO_2	65.7	36.3	65.5	66.56
P_2O_5	0.6	0.9	0.4	na
SO_3	1.4	na	nd	na
K_2O	1.1	1.8	3.1	2.93
CaO	6.6	1.6	4.6	5.3
TiO_2	nd	nd	1.0	0.8
MnO	0.6	tr	1.1	1.18
FeO	1.3	0.5	1.2	Fe_2O_3 =1.09
CuO	na	tr		
SnO_2	na	10.4	na	0.3
PbO	na	25.1	na	0.1

na = not analysed, nd = not detected, tr = trace

Analysis showed that the vessel was made from a soda-lime-silica glass. Many similar compositions have been found in other mid-late Saxon vessel material (*eg* Sanderson *et al* 1984). This composition, with it's low amount of magnesia, is comparable to Sayre and Smith's 'Roman' type of soda glass (1961) which is thought to be based on the use of a mineral soda source, natron (hydrated sodium carbonate) and can be contrasted with the high magnesia contents of some later soda glasses. The 'Roman' type of soda glass does not necessarily imply a Roman source for the glass artefact or the use of Roman glass as cullet.

The cross-section of the trail showed many crystals of lead-tin oxide. When viewed using the back-scattered electron detector, these were very bright, reflecting the high atomic number of the compound. Many of these crystals were quite large and clustered together in groups 10-20μ long, but a fine bright 'mist' in some areas suggests that there are lots of smaller crystals, probably of the same composition, also present within the glass. Three other types of structure were occasionally also observed in the trail - rather darker grey crystals of tin oxide, dark rounded 'bubbles' (containing mostly sodium, calcium and silica) with lead-tin oxide crystals within them, and very dark, parallel-sided crystals, containing mainly sodium, calcium, silicon and oxygen.

The overall or bulk $PbO:SnO_2$ ratio calculated for the trailed glass is greater than 1:1. This gives the trail it's yellow colouration, because of the dominance of yellow lead-tin oxide (probably $PbSnO_3$) crystals; a ratio of *c.* 1:1 would have resulted in many more white SnO_2 crystals (Freestone *et al* 1990;275). Antimony-opacified glasses were often used in the Roman period, but tin-opacified glasses are normal for the post-Roman period (*eg* Rooksby 1962).

References

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1. Details about the circumstances of discovery were provided by Peter Mills and John Shepherd, Museum of London