EVIDENCE FOR THE PRODUCTION AND USE OF OPAQUE RED GLASS IN ROMAN BRITAIN

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Recent work on two sites has produced new evidence about opaque red glass and its use in Roman Britain. The first site is Elms Farm, Heybridge, 60km north-east of London, and the second site is Chapel Street, Chichester, on the south coast south-west of London.

HEYBRIDGE

Heybridge is a late Iron Age and Roman settlement, 13ha of which were excavated in the early 1990s. A notable find came from Context 3676, within a pit on the northern edge of the settlement, provisionally dated to the mid or late 1st century AD. This find was a strip of opaque red glass (SF 173; L. 21mm) with a rectangular cross section (12 x 3mm) (Fig. 1). The surface striations suggest that it had been cut or broken from a longer strip that had been drawn down from a larger-sectioned block of molten glass. It is obviously not a finished object.

A small piece of glass was removed from a corner of the strip, mounted in a resin block, ground and polished, and examined with a scanning electron microscope (SEM). An energy-dispersive X-ray spectrometer attached to the SEM was used to analyse the composition of the glass. Although the glass appears homogeneous to the naked eye, the back-scattered electron image (Fig. 2) shows small-scale variations in composition, with lighter tones indicating areas where the average atomic number is greater. The features can be interpreted in the light of the average composition of the glass (see Table 1). The small bright areas are crystals of cuprite (copper oxide) that grew in a dendritic form in the glass melt as it cooled. They give the glass its red colour and its opacity. Surrounding them is lead-rich glass, which is not homogeneous. The cuprite dendrites have formed in areas that look darker grey. This appearance is due to a slightly lower lead and copper content than is found in the paler zones farther from the crystals. The formation of the cuprite crystals has depleted the copper in the glass, and it is possible that the variation in lead content influenced where the crystals formed.

Fig. 1 Strip of red glass with surface striations from Heybridge (scale is in millimetres); photo © English Heritage

Fig. 2 Back-scattered electron image of a sample of the red glass strip from Heybridge, showing cuprite crystals in a matrix of inhomogeneous lead-rich glass; photo © English Heritage

Three areas of the sample seen in Figure 2 were analysed, and the mean elemental composition, calculated as wt% oxides, is given in the first column in Table 1. These values are plotted in Figure 3, with the mean composition of 19 analyses of bright ‘sealing-wax’ red enamels from Roman objects carried out by Julian Henderson. The composition of the Heybridge strip shows it to be typical of this common kind of Roman enamel. The red glass would have been made by melting soda-lime-silica cullet and adding copper and lead, probably as oxides.

The glass strip is most likely, therefore, to be raw enamel, part of a craftsman’s stock of materials. It is thus evidence for enamelling at Heybridge, although there is no evidence for determining what types of objects were decorated in

Acknowledgment. I thank Sarah Paynter for her help with the mounting and analysis of the glass samples.
Table 1: Analytical data for the red glass samples (wt%)

<table>
<thead>
<tr>
<th></th>
<th>Heybridge Enamel Strip</th>
<th>Chichester Crucible 2</th>
<th>Chichester Crucible 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na&lt;sub&gt;2&lt;/sub&gt;O</td>
<td>9.1 ± 0.4</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>MgO</td>
<td>0.6 ± 0.1</td>
<td>0.4 ± 0.1</td>
<td>0.3 ± 0.1</td>
</tr>
<tr>
<td>Al&lt;sub&gt;2&lt;/sub&gt;O</td>
<td>1.8 ± 0.1</td>
<td>4.6 ± 0.1</td>
<td>3.3 ± 0.1</td>
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<tr>
<td>SiO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>45.7 ± 0.3</td>
<td>24.7 ± 0.1</td>
<td>19.6 ± 0.2</td>
</tr>
<tr>
<td>K&lt;sub&gt;2&lt;/sub&gt;O</td>
<td>0.2 ± 0.0</td>
<td>0.6 ± 0.1</td>
<td>0.5 ± 0.1</td>
</tr>
<tr>
<td>CaO</td>
<td>3.6 ± 0.1</td>
<td>0.6 ± 0.1</td>
<td>0.3 ± 0.0</td>
</tr>
<tr>
<td>TiO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>0.2 ± 0.0</td>
<td>0.2 ± 0.0</td>
<td>0.2 ± 0.0</td>
</tr>
<tr>
<td>FeO</td>
<td>0.6 ± 0.0</td>
<td>1.4 ± 0.2</td>
<td>1.1 ± 0.1</td>
</tr>
<tr>
<td>CuO</td>
<td>10.4 ± 0.5</td>
<td>18.1 ± 3.8</td>
<td>18.7 ± 1.1</td>
</tr>
<tr>
<td>PbO</td>
<td>23.8 ± 0.5</td>
<td>52.3 ± 4.3</td>
<td>57.9 ± 1.0</td>
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<tr>
<td>SrO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>nd</td>
<td>nd</td>
<td>0.2 ± 0.0</td>
</tr>
<tr>
<td>SbO&lt;sub&gt;3&lt;/sub&gt;</td>
<td>1.0 ± 0.3</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>MnO</td>
<td>0.6 ± 0.1</td>
<td>nd</td>
<td>0.7 ± 0.3</td>
</tr>
<tr>
<td>AgO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>nd</td>
<td>0.3 ± 0.0</td>
<td>nd</td>
</tr>
</tbody>
</table>

No. of analyses: 3, 3, 4

Notes:
- nd = not detected
- Much of the copper was present as cuprite (Cu₂O₃) rather than as cupric oxide (CuO), which the analytical software assumes.
- Much of the silver was present as metallic silver rather than as the oxide, which the analytical software assumes.

This way. The work would have been carried out either by an artisan who lived and worked at the site, or perhaps by a craftsman who travelled around in search of business. Although the enamelled was certainly intended for use at Heybridge, it may not have been made there. Specialized commodities, such as enamelled glass, that were used in small quantities would almost certainly have been manufactured in a specialized workshop. The tradition of using opaque red enamel was well established in Britain in the pre-Roman Iron Age, so raw enamel must have been readily available to late Iron Age craftsmen. It is therefore quite likely that the strip of enamel was made in Britain, where enamelling continued to be a relatively common decorative technique, but it could also have been produced almost anywhere else in the Roman Empire.

Chichester

In the 1970s, excavations of 1st-century AD contexts at Chapel Street, Chichester – the Roman town of Noviomagus Reginorum – produced fragments of about 30 small hemispherical crucibles containing opaque red glass (Fig. 4). These were interpreted as evidence for enamelling, on the basis of qualitative analyses that detected major amounts of copper and lead in the red glass. Associated finds were flat-bottomed crucibles, which the initial report suggested could also have been used in glassmaking, possibly for fritting. Subsequent re-analysis showed that these crucibles had been used as parting vessels, to separate silver from gold. Because some of the Chichester crucibles were definitely associated with metallurgy, and because recent work has shown that red glass in crucibles from Xanten was a by-product of silver refining, the red glass in the Chichester crucibles was re-analysed to see if it was deliberately produced, or if it was a metallurgical by-product.
Opaque Red Glass in Roman Britain

Small fragments of glass were removed from some of the crucibles and, as before, examined and analysed using a SEM. Figure 5 shows a typical back-scattered electron image with the sandy crucible fabric at the bottom. The small and large mid-grey ovals just above the crucible are bubbles in the red glass. The glass itself appears white, as it contains much more lead than the Heybridge enamel (see Table 1), and the pale grey dendritic crystals are cuprite (copper oxide), which makes the glass red. At first glance, this structure appears broadly similar to the Heybridge enamel (Fig. 2), but the glass in the Chichester crucibles has extra features, indicated by arrows in Figure 5: two-phase droplets of copper-silver alloys. These were found not only near the glass-crucible interface, but throughout the glass.

The analytical data for glass from two crucibles are given in Table 1. The very low levels of alkali and alkali earth elements demonstrate that these glasses are lead-silicate slags rather than alkali-silicate glasses with added copper and lead. These bulk analyses were carried out on areas that appeared to be free of metal droplets, but silver was still detected. It was present either in solution in the glass or as droplets too small to resolve in the SEM. The glass composition was quite different from Iron Age or Roman red enamel, but it was comparable to the glassy slags in the silver-refining crucibles from Xanten (see Figure 3).

It has thus been shown that the glass in the crucibles from Chichester is not deliberately made red enamel, as was originally thought. Instead, it is a by-product of silver refining. The association of the crucibles containing red glass with parting vessels is then logical, as both are debris from processes carried out by a goldsmith or silversmith. The workshop where these activities occurred is most unlikely to have had any association with enamelling, since Romano-British enamel was applied only to copper alloys and not to precious metals.

DISCUSSION

The result of these investigations is no net change in the number of sites where it is known that enamelling was practiced in Roman Britain. Chichester must be removed from the list, but Heybridge is a definite addition. To those interested in glass, the latter is more satisfactory than most other enamelling sites, as the common finds there are clay moulds designed to produce champlévé fields in the copper alloy objects being cast. The vessel moulds from Castleford are good examples. Cool and Price have suggested that glass tesserae from other parts of the settlement at Castleford may have been intended for use as enamel, while 'crude lumps of green enamel' from London are almost the only other finds from Roman Britain that have been identified as raw enamel.

As a postscript, it should be noted that although high-lead red glassy slags containing minor amounts of silver, such as the glass in the crucibles from Chichester, were apparently not used as enamel in Roman Britain, recent work has shown that early medieval objects from Britain and Ireland, dating broadly to the 6th to 11th centuries, were enamelled with red glass that has this type of composition (see Figure 3).

ENDNOTES

1 M. Atkinson, 'Elms Farm, Heybridge,' Current Archaeology, 12, no. 12, 1995, 452–8.
8 Hughes [note 3]; Henderson [note 2].
9 Rehren and Kraus [note 7].

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