GeoArch

Report 2013/22

Assessment of pyrotechnological residues from Eaton Camp, Herefordshire

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30th September 2013

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Abstract

Excavation produced four fragments of pyrotechnological residue. The materials include a bloated and slagged stone fragment, two small fragments of fuel ash slag and a large block 150mm in diameter of similar slag. The materials are almost certainly non-metallurgical, but derive instead from slagging at the margins of large domestic hearths (or a similar setting).

The material can be compared with non-metallurgical fuel ash slags from other sites of Iron Age date, which generation of such slag appears linked to cultural factors – perhaps communal cooking on large permanent hearths.

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Methods

All materials were examined visually with a low-powered binocular microscope where required. As an evaluation, the materials were not subjected to any high-magnification optical inspection, not to any form of instrumental analysis. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

This project was undertaken for Peter Dorling of Herefordshire Archaeology.

Description of materials

The materials comprise three small pieces (two of friable fuel ash slag and one of a slagged and bloated rock fragment) from (3014), together with a larger block, approximately 150mm across.

The supplied materials are broadly similar in texture and composition and they may be classified as fuel ash slags (FAS). They show fragments of heat-altered stone, and probably clay, coated and bound by a dark slag, often with a somewhat maroon or violet surface colour. The slag-rich parts of the specimens show a superficial resemblance to clinker (the partially-fused residue from the burning of impure coal), but the clasts are of fine sandstone, rather than shale. The material shows characteristics of slight flow under very viscous conditions. The slag phase is highly vesicular, with the voids often elongate, possibly partly formed from the rising of the gas bubbles, but more likely as a result of their deformation during this very viscous flow. Many of the rock clasts too are moderately vesicular (bloated). On the surface cut through the largest specimen (Figure 1), the partially-melted and bloated clasts are clearly visible. The clasts show variable oxidation (from a brownish oxidised state to a slate grey reduced state), as also shown within the isolated individual slagged rock specimen.

Interpretation

Fuel ash slags are formed by the fluxing action (i.e. the lowering of the temperature at which a part of the material will melt) of the ash of the fuel (typically rich in calcium and potassium) on silicate and other materials derived from the walls of a hearth. The flux promotes the melting of the more clay-rich and calcareous materials, with much of the quartz left unmelted.

In archaeological contexts, FAS may be have been formed during metallurgical processes, but is usually only significant where no metal entered the hearth (as for instance may occur during the melting of non-ferrous metals in crucibles). Most archaeological FAS was produced, however, from non-metallurgical processes. Recent descriptions of fuel ash slags have included examples derived from cereal-drying kilns (Young 2005, 2010), burnt cob or daub (Young 2012b) and domestic hearths (Young 2005, 2012a). Most of these settings produce only small blebs of FAS, but larger sheets may originate in large domestic hearths. Such slags are particularly commonly found in Middle to Late Iron Age contexts, where they have been informally dubbed 'Iron Age grey slag' (Cowgill 2000, 2008; Cowgill *et al.* 2001; Swiss & McDonnell 2001; Young 2011). The origin of this material has been rather controversial. In contrast to some earlier interpretations, it is now clear that the slags were only ever partially-melted and became fluid at relatively low temperatures. Their formation would be particularly enhanced in hearths dug into a calcareous substrate (e.g. the calcareous sand forming the substrate into which the hearth were cut at Bornais; Young 2005,

2012a), but they have been found in a wide range of geological settings. At Eaton Camp, it is likely that partial melting of the finer-grained parts of the substrate has allowed the more refractory quartz-rich sandstone fragments to become incorporated within the slag mass. The Eaton Camp samples are less highly vesicular (making them denser) than many other examples, which probably reflects the low water -and carbonate-content of the geological materials involved.

The cultural reasons behind the particular production of these slags during the Iron Age has not yet been fully explored in the literature, but it seems likely that cultural practices led to an emphasis on communal cooking (including the use of cauldrons), at least at times, on outdoor hearths. The large communal hearths may have been kept alight almost continuously, forming an ideal environment for progressive reaction of the hearth walls with the ashes of the fuel.

Evaluation of potential

Further detailed investigation or analysis of the residues is unlikely to generate additional useful information. No further investigation is therefore recommended.

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Figure 1: Cut face through large block of fuel ash slag, showing variable oxidation, and extremely high porosity.

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