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Assessment of archaeometallurgical residues from Ysgol Bro Dinefwr, Love Lodge Fields, Ffairfach, Carmarthenshire

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Abstract

The site produced two pieces of dense slag from ring-ditches together with a cake of in-situ non-metallurgical slag from a burnt cut feature [1265]. The dense slags are probably from iron-working and not diagnostic of age, except as Iron Age or younger.

The fuel ash slag cake is a rare example of preservation of fuel ash slags in-situ and is thus a significant find. Fuel ash slags are more commonly found in refuse contexts following hearth clearance. Here they are found in an elongate pit, adjacent to a stone 'wall'. The feature is very likely to be a cereal drying kiln, with the slag cake in-situ in the firebox. The slag cake is approximately 300mm by 400mm and up to 25mm thick. It had a total original weight of 1755g. The base is vitrified and frequently a diffuse boundary into sintered sandy or gravelly substrate. The slag itself is typically a highly vesicular partial melt (i.e. a buchite) with included remnant sand grains. The top of the slag cake is variously glassy, a sinter or a dull surface with partially assimilated slag droplets.

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Methods

The materials were examined visually (with a low-powered hand lens or microscope when required) and a catalogue prepared (Table 1). 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.

Stratigraphic information in this report is derived from the draft stratigraphic report.

This project was commissioned by Carmelita Troy, of Rubicon Heritage.

Results

(1166), Sample #1, 73g. *(a lower fill of ring ditch [1159])* This sample is a small slag puddle from a hearth/furnace floor. The lower surface is slightly impressed by fuel, contains inclusions (pebbles) of grey and red micaceous siltstone and has some adhering fired clay. The upper surface is smooth towards some of the margins (where the slag is rich in partially melted ceramic), but towards the centre the texture is of deeply impressed with fuel (charcoal) moulds with intervening raised blebs. The lower face is grey; the upper green towards the ceramic-rich margins but is dark and rusty towards the centre. The piece is likely to be from a smithing hearth.

(1241), Sample #1, 14g. *(a middle fill of ring ditch [1191])* This is a small rounded slag bleb, now fragmented into 3 pieces. A vesicular grey iron slag, with rusty surfaces. Probably a slag bleb from within a smithing hearth.

(1282), Sample #88, c88g (loose fragments) plus try of material from in-situ sheet. *(lower fill of 'furnace' [1265])* The sheet is well formed, it has a rough, locally friable base of sintered sand and gravel, which passes-up rapidly into a moderately dense, vesicular grey slag. The top is variable, with some glazed areas, some rough areas, and some areas of elevated sintered material. The smooth slag areas are typically rather blebby, with hemispherical projections suggestive of slag droplets frozen as they became incorporated into the main mass.

The base of the sheet is also variable; in some parts it shows a hard pale vitrified base, but in others the sintered base is more diffuse. The substrate is variably sandy or gravelly.

Internally, the slag (a buchite) varies from a pale to dark grey, and from finely to coarsely vesicular.

The slag sheet is crudely lenticular, with the central areas up to 25mm in thickness, locally dividing northwards into two distinct horizons. Approximately 50 fragments have been reconstructed into a slag sheet of approximately 300mm by 400mm and 1385g; a further 280g (90 fragments), mainly of amorphous fragments and blebs of sinter were not able to be reconstructed. In detail, the cake is rather asymmetrical, with the thickest section close to the south-eastern part of the cake (in its original orientation). The cake lay within a southeast-northwest elongated pit. The cake lay immediately east of a stone wall-like feature and divided a smaller southern section from the larger northern shallow pit.

The assemblage collected also included a small amount (90g) of loose material, bagged separately from the *in-situ* sheet. This gives a total weight of fuel ash slag from the context as 1755g.

Interpretation

A variety of origins for fuel ash slags have now been determined. Unlike some early proposals, more recent descriptions and discussions have focused on non-metallurgical origins. These mainly centre on settings in which persistent heat is available to partially melt a substrate, typically where alkali or alkaline earth elements are present in sufficient quantity to act as a flux and permit the partial melting to occur at relatively low temperature. In most, but not all cases, it is likely that repeated heating events progressively raised the flux content to a point where significant partial melting could occur

One setting for persistent and/or repeated heating is in cereal-drying kilns. Examples include a medieval example from the Hebrides (Young 2005) and an early medieval example from southwest Wales (Young 2010a, 2010b). In the Hebrides, the presence of a highly calcareous sand substrate may have promoted FAS formation. In both of these examples, the kilns appear to have been raked-out and the fuel ash slag was found *ex situ* as small, blebby fragments.

Fuel ash slags in thick (<100mm thick) sheets are particularly commonly found in Middle to Late Iron Age contexts, where they have been informally dubbed 'Iron Age grey slag' This suite of materials are interpreted as having formed in fire-pits, probably used for cooking, and probably kept alight for long periods of time. Such materials occur widely in, particularly, the middle Iron Age of England, but also in the late Iron Age of the Hebrides. In England many examples are known from the relatively calcareous soils of the northern England and the E Midlands (Cowgill, 2000 2008; Cowgill *et al*. 2001; Swiss & McDonnell 2001) and the Cotswolds (Young 2009, 2011). The Hebridean example (Young 2012a) was promoted by the calcareous sand substrate (as in the later cereal drying kilns at the same site described above).

A third origin has been discussed by Photos-Jones *et al* (2007), who propose that fuel ash slag formation may have been promoted by the use of seaweed as a contributing fuel in Orcadian Bronze Age cremation as a means of collecting the fine cremation residue. The resulting fuel ash slag (locally known as 'cramp') was collected, along with larger bone fragments for deposition within the cremation burial.

Yet another origin of fuel ash slags was demonstrated by Young (2010b) in describing a range of residues formed during the destruction by fire of a timber-framed Roman building. A spectrum of daub from 'fresh' material through to highly vitrified and bloated 'fuel ash slag' was identified.

This same site also produced (Young 2010b) a suite of similar fuel ash slags that may have been waste materials from lime burning.

In this instance, the position of the in-situ cake inside feature [1265] allows the exclusion of some of these possible origins. The sheet-like nature of the cake suggests this example was produced below a long-lived or repeated fire. The morphology of the enclosing pit suggests this was not a cooking fire and despite the broad spatial association with cremation activity, it would appear far more likely that the present material could represent a cereal-drying kiln (or a kiln with a similar purpose). Feature (1265) is of an appropriate size/shape/structure for such an interpretation. The feature appears to bear very close comparison to the Bronze Age cereal-drying kilns discussed by Moriaty (2014; http://irisharchaeology.ie/2011/06/corn-drying-kilns-their-bronze-age-origins/). In this interpretation, the fuel ash slag cake is restricted to the stone-bounded firebox, extending neither into the kiln itself, nor into the ash pit.

The denser slags from the ring ditches are very likely to be from iron-working. They are not diagnostic of age (except in being Iron Age or younger). They are not necessarily indicative of smithing within the immediate locality, for such materials were commonly distributed during manuring.

Conclusion

The most archaeologically-significant aspect of the assemblage is the cake of fuel ash slag. The origin of these materials has been rather controversial, but recently multiple origins have been demonstrated. The importance of the present material is that *in-situ* fuel ash slags have rarely been reported. The most likely interpretation is that the slags are contained within the fire-chamber of a cereal drying kiln. *Ex-situ* slags from cereal kilns have previously been recorded from the Hebrides (Young 2005) and southwest Wales (Young 2010a, 2010b).

Some further analysis of the fuel ash slag would be desirable, to characterise the material and to investigate the mass balance of the fluxing process within this rather well-constrained example. Very few detailed analyses of fuel ash slags have been made. Those previously undertaken on examples from cereal drying kilns have been referenced above and a further example of a prehistoric fuel ash slag of uncertain origin, but possibly from a cereal kiln, was analysed from Hucclecote (Young & Bowstead Stallybrass 2003).

It is recommended that bulk analysis of samples of slag and associated ashy sediment are undertaken, together with a small programme of microstructural investigation by SEM. A detailed proposal will be supplied separately.

The fuel ash slags should form a part of the site archive and retained for deposition in a suitable repository.

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