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Assessment of archaeometallurgical residues, Trequite Farm, Cornwall

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Abstract

This report assesses the significance of four representative slag pieces from the slag-rich fill (c310) of a pit.

Three pieces were smithing hearth cakes (SHCs), in two cases entire, in the third representing about 80% of the original cake. The two entire cakes were rather similar, being well-formed plano-convex cakes with rough lower surfaces and smooth upper surfaces, slightly lobate margins and deep fuel impressions in the upper surface. Below the upper layer there were large internal voids. The two cakes differed in weight, being 1460g and 550g.

The slightly broken example was a flatter, thinner, SHC, with an estimated original weight of approximately 390g. It too had an upper surface deeply dimpled by contact with the charcoal fuel, but its base was more irregular than the other examples, possibly because the slag had flowed slightly more. The proximal end of the cake showed a siliceous, glassy, slag coating with abundant derived grains and also some adhering blebs of pale fuel ash slag.

The fourth piece was a fragment from a very porous, slag mass about 65mm thick. The top had a slightly lobate and wispy morphology formed from a thin smooth skin of slag over the porous interior. The main body of slag was formed of small slag prills intermixed with small shale fragments. The identification of this piece is less certain and whilst it is most likely to be smithing slag, there is a light possibility it is from bloomery iron smelting.

The slag pieces are very well-preserved. This suggests they were deposited into the waste deposit soon after formation – in turn suggesting close proximity to the smithy itself. Although three of the slags can be attributed to formation during smithing, a detailed interpretation of process is not possible on this small sample. The SHCs fall within the weight range of typical SHCs of the medieval period, it is not certain whether they represent primary smithing of raw blooms, secondary smithing (the end use of iron; blacksmithing), or even a bloom remelting process.

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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 Andrew Hood, Foundations Archaeology.

Results

All four of the pieces described below derive from context C310 at Trequite Farm (TFC12).

1) A large well-formed, plano convex, SHC (150mm x 145mm x 55mm). The bowl has a rough lower surface, probably a contact with ash/charcoal dust with some sand. The upper 10mm of the sides is lobate and smooth, grading around into a smooth but dimpled top. There are large cavities visible just below the upper surface. The upper surface very gently domed. This cake resembles a remelting cake in overall morphology. The cake weighs 1460g.

2) A fairly flat, plano-convex SHC (110mm x 140mm x 40mm). The base rough and slightly irregular, probably indicating a contact with charcoal dust/ash. The top is formed of smooth-surfaced slag, but highly irregular with dimples and wisps probably rising into the overlying fuel. There are deep cavities below the upper surface in places. There are some possible sub-vertical tool-marks around on edge, produced during extraction from the hearth. The proximal raised lobes show a brown surface. The upper surface becomes rougher near the distal margin. The cake weighs 550g.

3) C.80% of a flat, dense, very slightly concavo-convex SHC. The base is irregular, in places showing sub horizontal flowed sheets. The margins are similarly formed of poorly flowed, rounded, thin lobes. The upper surface is smooth proximally with a dark glassy surface with inherited sand, but this grades rapidly into a duller surface with deep dimples and lobes with underlying cavities. The broken surface shows some thin tubular vesicles in dense, possibly manganiferous bowl fill, below a thin porous layer associated with the dimpled top. A dark proximal glass bears superficial blebs of pale melt (or partial melt) - essentially a fuel ash slag. The fragment weighs 314g (suggesting the original SHC weighed approximately 390g).

4) This is probably a fragment from a sheet of porous slag comprising coalesced prills. The top is smooth, but irregularly lobate. The slag comprises prills of slag with abundant shale/slate flakes and zones of highly bloated ceramic. This slag originates either from a hearth or furnace highly contaminated by shale fragments from the substrate (shillet?) or from a hearth using very low grade coal fuel. The fragment weighs 128g and measures 85mm x 75mm x 35mm.

Discussion

Notwithstanding the possibility that piece (4) might originate from iron smelting, the assemblage is indicative of iron-working (smithing). Smithing has been crudely divided into primary smithing, the working of raw bloom iron into a usable form, and secondary smithing, the end-use working of iron. The formation of slag in the smithing hearth is due to rapid oxidation of the hot iron in air with subsequent reaction of the iron oxides with silicate-rich material derived from melting of the hearth walls. Despite much research the a close interpretation of SHC morphology and chemistry with the tasks undertaken by the smith (forming, welding and heat-treating the iron) has not been achieved.

In recent years, a quite separate set of processes has been identified – those entailing remelting of bloom iron. This has been variously undertaken to homogenise the bloom, to manipulate its phosphorus content and to manipulate its carbon content. A late survival of such a remelting process was described by Evenstad in the late 18th century (Jensen 1968; Wagner 1990) in Norway.

In the face of a lack of good theoretical basis for classifying SHCs by composition, morphology or texture, it has been useful to categorise SHC assemblages by examination of their weight-frequency distributions (e.g. .Young 2012, for an intensively investigated assemblage).

For British medieval SHC assemblages there are relatively few examples (Table 1). For most blacksmithing assemblages of 13th century or older age, the maximum SHC weight is significantly less than 1kg. Heavier SHCs than this is usually indicative of primary smithing processes.

After the 13th century there are some assemblages with maximum SHC weights above 1kg, for which there is no evidence for a connection with primary smithing. It has been argued that in some cases (e.g. Young 2009b) heavier SHCs may be indicative of the trading of unfinished bloom iron, which required final processing by the end-user smith.

The presence in the present assemblage of a cake of around 1.5kg is suspicious, but not conclusive (given the age) evidence for bloom processing (primary smithing).

Assessment

The well-preserved nature of these specimens suggests direct deposition of these residues, rather than any significant degree of reworking or residuality. This is likely to suggest that the smithy is very close. The good quality of the preservation would also mean that if detailed analytical investigation of material from the site should become indicated in the future, the quality of the material would be suitable for such work.

The significant of piece (4) is currently uncertain – it probably just indicates smithing in a ground level hearth with unstable sides, but might just be a residue from iron smelting.

A fuller interpretation of the slag assemblage could be made through quantification and measurement of the entire assemblage, to enable more detailed comparison with assemblages such as those in Table 1. The matrix of the pit fill should also be examined for micro-residues.

Finds of medieval smithies are rather rare and thus worthy of full investigation when found. Examples of medieval bloomsmithing sites are even rarer than blacksmithing sites, and no medieval iron smelting is yet known from Cornwall (to the authors knowledge). Although the most likely interpretation of the present assemblage is that it fits within the small body of later medieval smithing assemblages and is purely from blacksmithing, but other interpretations are possible. Care should be taken to determine the nature of the smithing on the present site to assist with determination of its significance. A poorly-preserved medieval village smithy would have local significance, but well-preserved examples would be regionally or even nationally significant, depending on preservation and the processes represented.

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	Worcester 35 Mill St	Worcester Willow St	Prior Park Cricklade total	Worcester Deansway (period 8)	Worcester Deansway (period 9)	Burton Dassett
Date	12th	12th	11th-15th	11th – 13th	13th-15th	14th- 15th
SHC count	23	28	17	61	32	60
SHC min. wt	74	86	156	168	144	130
SHC max. wt	782	770	794	1490	1800	1670
SHC mean wt	233	327	329	492	499	550
% <500g	91%	82%	82%			
% <1000g	100%	100%	100%			
% >1000g	0%	0%	0%			
% >3000g	0%	0%	0%			
Modal 100g interval	100-200g	100-300g				

Table 1: Comparitive British blacksmithing SHC assemblages.

Worcester 35 Mill St from Young 2009a; Worcester Willow St from Young 2007; Prior Park, Cricklade from Young 2008; Worcester Deansway from McDonnell & Swiss 2004. Burton Dassett from McDonnell 1992;

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