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Report 2009/20

Evaluation of Archaeometallurgical
residues from the M7/M8 Contract 1:
Cuffsborough 5 (E2199)

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Abstract

The material from Cuffsborough 5 comprised two quite distinct assemblages. Approximately 22kg of residues were associated with the "smithy" and 4kg from ditch C53.

Archaeometallurgical residues from the "smithy" supported the field identification of this structure. Some of the layers within the supposed building were deposits of "smithing floor" – a layered build up of slag fragments, hammerscale (spheroidal and flake), coal dust and clay. Such deposits accumulate in the smithy through normal use and repair. These contexts were accompanied by a significant quantity of slag, mostly in rather amorphous lumps, in part representing "smithing slags" and in part fractured pieces of "smithing hearth cakes" (SHCs). Few complete smithing hearth cakes were found, and these, together with the evidence from the fragments suggest that the SHCs were generally of less than 400g. The assemblage contained a significant quantity of iron fragments, including some artefacts (nails), but also pieces which were probably off-cuts or other detritus (both bar and sheet iron). Coal was ubiquitous, both as a component of the floor assemblage, but also as clasts within slags and clinkers. Vitrified hearth lining was also present in the assemblage, including at least one possible tuyère fragment. The use of coal in smithing agrees with other evidence that this site is post-medieval.

The second assemblage derived from the fill of ditch C53. This assemblage included fragments from moderately large dense SHCs, some slags from iron smelting in a slag pit furnace and some other large, but indeterminate slag blocks. These materials were associated with charcoal, but there were no finds of coal. The assemblage also included a worked flint. This assemblage is not diagnostic of age, but if the early Iron Age 14C date is confirmed, the presence of SHCs here will be interesting for smithing residues have not been well attested on other Iron Age sites in the area

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Methods

All investigated materials were examined visually, using a low-powered binocular microscope where necessary. All significant materials were summarily described and recorded to a database (Table 1). As an evaluation, the materials were not subjected to any high-magnification optical inspection, nor to any other form of instrumental analysis. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

Results

1. Materials associated with the smithy

1a. Smithing Hearth Cakes (SHCs)

The assemblage contained rather few examples of complete SHCs. Such is not unexpected when dealing with deposits from inside a smithy, where slag lumps would not normally be allowed to accumulate. SHCs which were reasonably intact weighed 420g, 334g, between 240 and 380g, 185g, 177g, 125g and possibly 107g. The mean weight of this tiny assemblage is thus between 250 and 270g. The rather poor representation of SHCs may also be partly due to the use of coal fuel, which promotes more irregular hearth slags.

1b Smithing slags

Most of the smithing slags were in the form of rounded, sometimes twisted pieces of slag. In some cases these may be part of a fragmented SHC, but more commonly seem to have been individual slag lumps. As commented above, the development of slag lumps rather than a coherent SHC is commonly seen in coal fuelled hearths.

1c Smithing Floor

The variably-cemented deposits which accumulate on the floor of the smithy are known as “smithing floor”. The main components, besides the background sediment, include hammerscale (both flake, oxidised iron which flakes off the surface of the workpiece, and spheroidal, liquid slag expelled from the workpiece, particularly during forge welding), clay (from hearth repairs/damage as well as possibly as a flooring or walling material), stone fragments, iron fragments, coal debris and slag.

1d Technical ceramics

The sherds of hearth ceramic recovered from the site are insufficient to reconstruct their form. All the sherds could have come from either tuyères or a clay wall. Only one showed indications of a curved tuyère margin (from c58/59), but even this was not quite certain, and was certainly not able to provide data on tuyère size.

1e Iron

The “smithing floor” and other deposits contained many pieces of iron. Some of these were artefacts, including several nails of different size and function. Most pieces are probably “off-cuts” and other debris, including pieces of thin sheet, a blade-like fragment and some approximately ½ inch square rod.

1f Coal

Coal was abundant in the collections, most visibly in small fragments a few 10s of mm across, but dominantly as sand-grade grains which dominant much of the smithing floor material. Much of the coal present as this comminuted debris appeared visually to be of reasonable quality. Some of the slags, however, showed a very high level of uncombusted shaley material, suggesting that the coal may have been quite dirty.

2. Material from c5

2a. Iron smelting residues

The collection included a 276g block of slag bearing moulds of large wood or charcoal fragments. Such slags are typical of the basal pits of slagpit iron smelting furnaces, which were packed with large pieces of wood (probably) before smelting.

A further two pieces of slag also contained large fuel moulds and were probably alsos smelting slags. One of these was a 478g somewhat rounded mass of slag, possibly from higher in the furnace and possibly deformed during hot extraction.

There were also a few smaller pieces of flow slag – formed from the solidification of slag trickles descending through the fuel into the pit.

There were various indeterminate dense iron slags from the same context which may also have been smelting slags.

2b. Smithing residues

Residues from iron smiting include 5 fragments from moderately large SHCs, which had deep dense slag bowls. The original size of the SHCs is difficult to estimate because of the degree of fragmentation, but

original weights of around 2kg may be suggested by some of the material.

Such a large size of SHC is usually, particularly at the early age suggested for this feature, indicative of bloomsmithing rather than end-use blacksmithing. Bloomsmithing is the process of working down the raw bloom from smelting, to form a billet or bar, and eliminating much of the included slag.

Interpretation

Smithy

The material described above clearly identify the deposits as being associated with a coal fuelled smithy. The materials apparently indicated no use of charcoal. The introduction of coal as a fuel for smithing is diachronous, with local adoption within coalfields typically being earlier than further afield.

There is no database of dates with which to compare this site, which lies about 10km NW of the nearest point of the Leinster Coalfield. Griffith (1814) describes the use of coal from the coal field in rural industries, but it is clear that much of the expansion of coal production had been driven by the development of these canal system around the turn of the 18th/19th centuries. Since this site lies outside the actual coalfield, a data flowing this expansion (i.e. 19th century) would be more likely than one before.

No detailed stratigraphic description of the smithy structure was available, and it appears that the supplied samples were very small quantities of the excavated deposits. Deposits of “smithing floor” can be very useful indicators of the internal layout of smithies, using either direct sampling of hammerscale on a regular pattern or indirect measurement using magnetic susceptibility measurements of the excavated surface (Mills & McDonnell 1992). In this instance, where it appears such techniques were not employed during excavation, the internal layout can be investigated using the layout of features. Raised hearths (typical on post-medieval sites, though not necessarily in use in this instance) may be represented by a solid plinth, or by paired walls, often adjacent to an internal division behind which the bellows were placed. The anvil may be represented by a cut feature (to take the wooden block on which the metal anvil would be mounted), or simply by a gap in the build-up of “smithing floor” deposits corresponding to the position of the block. Other common features in smithies would be a water container (for cooling tools) and possibly a supporting frame for the bellows.

Such details would be interesting, of able to be reconstructed from the archaeological record, for little is known about early modern smithies in Ireland. One key piece of evidence here is that the assemblages contained significant pieces of vitrified clay, with a hint in at least one instance that these were fragments from tuyères. Ceramic tuyères are well-documented on late medieval to early post-medieval sites; Ballykilmore, (Young 2009b) produced evidence for the use of very large tuyères in conjunction with floor-level hearths into the early post-medieval period, although the later phases of smithing there were not well-dated. The smithing at Ballykilmore appeared geographically focussed, and it is possible that a smithy lay just west of the excavated area.

Apparently rather similar large diameter tuyères were employed at Mucklagh (Young 2008), where, as at Ballykilmore, gravel embedded in the bases of SHCs suggested a floor-level hearth. The dating evidence at Mucklagh suggested 18th-19th centuries. Both Mucklagh and Ballykilmore employed charcoal as fuel. At Mucklagh there was a substantial assemblage of 66 SHCs, with a range from 98 to 1206g, with a mean of 373g.

Clonfad (Young 2009a) has also produced evidence of floor-level hearths of 17-18th century age, but these appeared to be external ephemeral hearths, and were located in hollows over earlier ditches.

At Cuffsborough 5, the presence of vitrified clay and a vitrified sandstone block, hints that the ceramic tuyères were used in a structure at least partially employing stone; thus a raised hearth is an interesting possibility (although stone blocks placed below the tuyères were recorded from early medieval smithing contexts at Clonfad (Young 2009a).

The timing of the end of the use of ceramic tuyères in Ireland is interesting. They eventually become supplanted by the use of cast-iron tuyères, but this change is completely undated. Cuffsborough must, however, be one of the youngest sites yet with evidence for the use of a ceramic tuyère.

Early Ironworking

The earlier ironworking, as evidenced by the material from c5, comprised both iron smelting and smithing, presumably bloomsmithing. The slags are not themselves datable, but do not contradict the ¹⁴C date from the deposit. Slagpit furnaces appear to have been the dominant furnace type employed in pre-industrial Ireland, although subtle differences between furnaces of different periods are becoming known, they are not determinable from slag material such as this.

The main interest from this phase of iron working is probably in the smithing slags, which are suggestive of substantial SHCs, although none is complete. The production of large SHCs during bloomsmithing in the early medieval period is well documented, but there is currently little good evidence for earlier smithing residues.

The SHCs indicate that both parts of the process of iron production, smelting and bloomsmithing, were undertaken here. The small assemblage does not give any indication of the likely scale of the activity.

Evaluation of potential

The material from the Cuffsborough 5 smithy is a potentially interesting assemblage from a poorly-known site-type. The persistence of a smithing technology with roots in the Iron Age well into the early modern period is an interesting issue in Irish archaeometallurgy. The present assemblage is, however, small and is probably not capable of addressing some of the interesting questions.

The material does form a good suite of materials (tuyère, slag, coal, hammerscale and iron fragments) for which detailed analysis would reveal relationships and process details. Such investigations would have enhanced potential for useful research outcomes if they hang on a good quality of site understanding. The available level of stratigraphic detail and understanding of variation within the structure would be worth bearing

in mind when determining any future investigation of the residues.

The material from the early part of the site is an important extension to current knowledge of distribution of early ironworking. The assemblage is small, so the benefit of further investigation is rather limited, but it does contain examples of smithing slags which have been rather elusive on other Iron Age sites in the area.

References

- GRIFFITH, R. 1814, *Geological and mining report on the Leinster coal district*. Dublin. xxiv + 135pp.
- MILLS, A & McDONNELL, J.G. 1992. The identification and analysis of the hammerscale from Burton Dassett, Warwickshire. *Ancient Monuments Laboratory Report 47/92*.
- YOUNG, T.P. 2008. Evaluation of archaeometallurgical residues from Mucklagh, Co. Offaly, NTB06, A033/E2845 GeoArch Report 2008/07. 8pp.
- YOUNG, T.P. 2009. Archaeometallurgical residues from Ballykilmore, Co. Westmeath, E2798, GeoArch Report 2009/16, 81 pp.
- YOUNG, T.P. 2009. Archaeometallurgical residues from Clonfad 3, Co. Westmeath (A001: 036 E2723), GeoArch Report 2009/16, 173 pp.

C	sample #	weight	description
1	27	26	dense lobate flow slag
4	5	50 8	ferricrete with iron rusty fragment broken from above?
6	3	295 805 302 3 188 478 276 58 92	2 joining pieces of dense thick crust SHC, 2 thick crust SHC pieces heavily encrusted with sand - possibly joined prior to encrustation, charcoal in encrustation 18 pieces of dense iron slag, mainly in rounded lumps flint - scraper dense slag with large charcoal, broken angular block strange part rounded slag ball with large charcoal fragments - possibly from burr region of smelting furnace, but may be deformed block of pit slag with large wood on base and long rounded section above 3 piece of flow slag odd irregular low density slag in rounded lump with flat side
6	32	259 496	dense, well formed burr from large SHC, attachment 90mm wide and 50mm deep 13 pieces of iron slag. Including 1 piece from a denser, but thin, SHC crust
6	33	269 305 85 58	small fragment of large thick crust SHC 14 low density slag fragments dense fragment of concreted iron small fragment of dense slag crust
7	1	2994 30 5 373 420 17 1373 565 52 24	137 pieces of smithing floor - mostly slag- or iron-cored concretions - very rich in coal dust 4 pieces of coal nail - possibly horseshoe nail fines and soil 110x100x40 small, dense, rusty flat biconvex normal SHC 6 pieces of coal 49 pieces of smithing slag, mainly rounded nubs, but some SHC fragments 17 pieces of ferricrete and corroded iron 3 pieces of stone 2 pieces of ceramic, one is probably vitrified brick or clay, the other is probably slagged fuel dirt
7	8	59 144 2317 185	6 pieces coal 4 pieces of rusted iron slag, floor, fines possible SHC, very dense

38	6	306	6 pieces vitrified ceramic
		57	well flown dense slag nub
46	24	102	5 pieces of vitrified ceramic
		7	coal
		46	2 pieces of iron in floor
		1164	44 pieces of iron slag in floor material and cemented floor
46	26	39	shale-rich clinker
		192	50-80% of small dense SHC with large coal inclusion
		33	two pieces of ferricrete on iron
		283	6 pieces of fairly dense hearth slag nubs
58/59	16	273	8 pieces of vitrified ceramic - probably, but not certainly, tuyère. Has coal attached
		137	4 pieces of iron - 2 nails, one square-sectioned bar, 1 sheet fragment
		177	small dense SHC?
		125	small dense slag bun - possible SHC very small
		33	12 piece coal
		1492	slag and fines, 43 pieces of slag, variably encased in smithing floor
62	29	334	dense small SHC 70x75x50
		639	various hearth slags , some contorted
63	28	265	dense prilly mass attached to fired sandstone, contains lots of included coal
		24	rounded slag nub
		88	low density clinker mass
69	30	33	2 pieces of ferricrete on iron
74	31	196	7 pieces of indeterminate iron slag
		24	slagged ceramic, probably tuyère tip, possibly with blowhole margin
77	17	107	burr with slag, possibly a tiny SHC
		101	burr from SHC
		561	c20 pieces of smithing floor-encrusted slag with coal and fines
77	20	2686	large block of well-layered smithing floor
77	23	1491	smithing floor - in large lumps down to fines
78	18	1554	20 pieces of slaggy smithing floor, with some quite fluid slags mixed up in usual accretionary material
		54	coal

78	19	57 100	fired stone? (just possibly brick) coal in c30 pieces plus dust
82	22	271 2	7 pieces of ferricrete on iron including a very large nail, accretion very rich in spheroidal and flake scale and slag fragments coal
83	21	3 312	coal 10 pieces of ferricrete on iron - mainly thin sheet - possible blade in one?
93	25	502	9 pieces of iron slag, one is a dense SHC fragment

Table 1: Summary catalogue of residues by context and sample.

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