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Evaluation of metallurgical residues
from Lynns, Annagassan, Co. Louth
(10E329)

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Abstract

This small assemblage of material (8.9kg after washing) was dominated by slags produced during ironworking (smithing). The smithing hearth cakes (SHCs) in the assemblage were mainly small (five of the six weighing less than 500g and the other 1587g), indicating that the ironworking was probably for the end-use of iron (blacksmithing) rather than as a part of the chain of production of raw iron. Although not all the slags were identifiable to a precise process, there were no slags that were certainly incompatible with an origin in blacksmithing, and so this is likely to have been the main, or sole, metallurgical activity.

One context (F139) produced several fragments of ceramic tuyères, which form a significant element of the technology employed for smithing in early medieval Ireland.

Several contexts yielded concretions formed around pieces of iron, and in the case of material from F305 these were dominated by items with the appearance of large nails. This material is worthy of further examination (including by X-Ray images) by a finds specialist.

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Methods

All investigated materials were examined visually, using a low-powered binocular microscope where necessary. For microscopic residues a general statement of the nature of each assemblage was recorded (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

The slags present in this assemblage of variable, but typically rather poor preservation. Although some slag pieces were relatively fresh in appearance, many examples were highly weathered and fragmented. The wet ground conditions had also promoted the growth of concretions around iron artefacts, some of which show the bright blue colour characteristic of vivianite (iron phosphate).

The most significant category of material in the assemblage is formed by the smithing hearth cakes (SHCs). SHCs are formed from the reaction between material (both metallic iron and iron oxides) lost from the workpiece (typically because of the rapid oxidation of the surface of the iron at high temperature) and silicate materials melted from the face of the tuyère. If a flux (such as sand) was used by the smith to facilitate welding, then that too may contribute to the slag in the hearth. Much, if not all of the slag formed this way may accumulate as a bowl-shaped mass below and in front of the tuyère, but some slag may occur as separate, often rather amorphous, small masses (hearth slags).

The smith will need to clean the hearth on a periodic basis and this process may also generate irregular-shaped slag pieces, particularly if the slag is removed hot – when it may become torn or folded.

In the present assemblage the materials referred to as SHCs takes several forms. The most typical are small, dense, plano-convex slag masses. These small SHCs typically show a glassy upper surface (reflecting a dominance of input from the tuyère) with denser, more iron-rich slag below. In some examples the dense slag forms a concavo-convex bowl shape, with the bowl being filled with more charcoal-rich slags. The examples of this general style of cake vary between 100 and 500g in weight. At the smaller end of this range there are no complete examples, but there are numerous fragments and some possible examples of less than 100g (at which size they become very difficult to identify with certainty).

One of the more unusual small SHC examples is one from F210, probably indicative of about half of a small example, the surviving part weighing 146g. It shows a strong degree of haematization of both upper surface and sides, indicating the use of a very strong air blast, which has generated what appears to be a thin veneer of a rather fluid melt over the slag. In addition, the upper surface appears unusually planar – perhaps suggesting either that the workpiece was placed directly on it, or perhaps that the hot slag was hammered to detach it from the hearth.

The larger examples of SHCs are even more diverse, with examples with almost no slag bowl (e.g. that represented in part by 552g of fragments from F234), through large conventional SHCs (e.g. that with an original weight of about 1590g from F203), to examples with a deep, dense slag bowl (e.g. that represented by a fragment from F131).

All of the smithing residues were indicative of the use of charcoal as fuel, as would be expected for an early medieval site in this part of the country (away from any source of mineral coal).

Context F139 yielded two large sherds of **tuyères** in a very sandy fabric with large angular quartzose grits. The fabric was mainly seen in an oxidised state with both orange and maroon colours. One of these pieces was dominantly from the vitrified and slagged face of a tuyère, but the other included a section of less vitrified curved side – which suggested a radius of curvature of approximately 70mm. In neither case was the actual blowhole visible. The same context also yielded some small sherds of tuyère in a similar fabric and a crescentic slag piece which had probably formed along the lower margin of a tuyère (the fabric of which was texturally similar to the other examples but which was white in colour).

A significant proportion of the slag is **indeterminate**, but in practice it is very likely to be mainly small fragments of SHCs that cannot be identified as such, because they are too small to be able demonstrate the diagnostic features.

The collection contained a significant number of **concretions** containing iron. These were frequently simply rounded and would require X-Ray investigation to determine what is within. Examples from F305 had clearly formed around large nails. These will not be further discussed here.

No particular trends or differences were revealed in the stratigraphic distribution of the material, all of which

appears to have accumulated in 'waste' contexts, away from the actual focus of metalworking.

No archaeometallurgical residues were identified that were certainly not produced during iron smithing.

Interpretation

The identification the assemblage as having been produced during iron working (smithing) is clear, and the small size of the SHCs (all measurable SHCs less than 1600g and all but one less than 500g) indicates that the assemblage was produced during blacksmithing (i.e. secondary smithing), as opposed to primary smithing (also known as bloom smithing), employed during the production of stock iron from raw smelted blooms. The assemblage of SHCs is rather too few, however, to permit detailed comparison with the assemblages from other comparable sites.

Assemblages with most SHCs in the range of 100-500g, but with rare outliers in the 1-2kg range are known from secular early medieval sites such as Blackchurch (Co. Kildare; Young & Kearns 2010) and Parknahown 5 (Co. Laois; Young 2009a) as well as on monastic sites (e.g. Toureen Peakau. Co. Tipperary; Young 2010). Sites that were involved in the production of iron display assemblages with a much higher proportion of larger SHCs, associated with the bloom refining processes (e.g. Clonfad, Co. Westmeath, Young in press, or Woodstown, Co. Waterford, Young 228, 2009b). At Woodstown, however, different parts of the settlement yielded different assemblages: Trench TA1 investigated a workshop in the south of the site and produced just eight SHCs, all very small (range 62g – 270g, mean 183g); quite a different assemblage from that from the enclosure ditch beside the northern entrance, which yielded large SHCs and iron smelting evidence.

Assemblages of relatively small SHCs with a few larger outliers can also be found in other contexts outside Ireland: a medieval urban smithy in Worcester, England, of the 11th-13th centuries produced a rather similar SHC assemblage for instance (McDonnell & Swiss 2004). The use of sub-cylindrical ceramic tuyères is however, also a typically Irish approach to smithing in the early medieval period (although related, perhaps, to the Scandinavian use of plate-like 'bellows-protectors'). Thus it could be argued, despite the rather slender dataset, that this assemblage would probably indicate the residues from smiths working in an Irish tradition. This can be compared with the situation at Woodstown, where it has been suggested that despite the iron smelting showing technological influences from outside Ireland, the iron smithing was being undertaken within an Irish tradition

Evaluation of potential

Although an interesting assemblage, the present material is rather too small an assemblage and rather too poorly preserved, to be capable of generating useful additional information from detailed analysis. Accordingly, although it is recommended that the assemblage is retained, no further analysis is suggested.

It is however strongly recommended that the iron artefacts included with the residue collection are X-Ray imaged and examined by a finds specialist.

References

- McDONNELL, J.G. & SWISS, A. 2004. Ironworking residues. pp. 368-378, *in*: H. Dalwood & R. Edwards, *Excavations at Deansway, Worcester, 1988-89: Romano-British small town to late medieval city*. CBA Research Report 139.
- Young, T.P. 2008. *Evaluation of metallurgical residues from Woodstown 6 SRP, E2964*. GeoArch Report 2008/11.
- Young, T.P. 2009a. *Evaluation of Archaeometallurgical residues from the M7/M8 Contract 1: Parknahown 5 (E2170)*. GeoArch report 2009/21. 21pp.
- Young, T.P. 2009b. *Ferrous archaeometallurgical residues from Woodstown 6*. GeoArch Report 2009/22, 66 pp.
- Young, T. 2010. *Evaluation of archaeometallurgical residues from Toureen Peakaun, Co. Tipperary (05E0257)*. GeoArch Report 2010/16, 7pp.
- Young, T.P. *in press*. Chapter 6. Exploiting the bog: iron production and metalworking *In*. N6/N52 NRA monograph.
- Young, T.P. & Kearns, T. 2010. *Evaluation of metallurgical residues from N7 Road-Widening and Interchanges Scheme: Site 48, Blackchurch, Co. Kildare (03E1607)*. GeoArch Report 2010/18, 7pp.

Table 1: Summary catalogue by context and sample.

Context	S#	Wt	No.	notes	Propn.	Orig.
F102	9	302	1	large part of medium-sized SHC. Three layers: upper dense sheet has some charcoal impressed, lower dense sheet has dimples, charcoal and pebble on base, wedge- sectioned charcoal layer between thins to zero in centre of piece.		
			38	low density bleb of lining slag		
			56	very dense smooth piece of iron rich slag with some charcoal (possibly iron inside) polished smooth exterior so presumably residual		
			148	angular fragments of grey vesicular slag - probably all SHC fragments		
			164	rather worn large fragments from conventional SHCs		
			74	rounded slag nub - possibly deformed piece of the lip of an SHC?		
F110	10	398	1 (3)	150x90x30mm, rather elongate dense SHC with lobate base, conventional vesicular crust, and charcoal impressions in upper surface	100%	398
			24	3 indeterminate scraps of vesicular, charcoal rich slag. <i>plus coarse sand washings</i>		
F126	11	90	c30	fragments from a disintegrated small SHC, glassy top, very weathered		
			12	2 small concretions, one possibly with iron inside		
F131	4	248	1(3)	small fragment of a thickish crust SHC. Crust to 25mm, upper part slightly clotted, ashy and with some charcoal. Quite finely crystalline, dense, badly weathered		
F139	12	58	2	vitrified sherds from tuyères tempered with coarse angular quartzose grit and sand, one shows 70mm radius approximately on less vitrified pale margin		
			18	6 small sherds in similar fabric		
			98	1 arcuate very dense slag apparently attached to fragment of tuyère tip, also in gritty/sandy fabric but completely white		
			6	1 fine-grained oxidised fired clay		
			56	3 concretions around iron		
			452	1 large weathered block from large SHC, dimpled base, fairly dense crust and charcoal-rich upper parts - but all rather unclear and possibly deformed		
			176	21 fragments of weathered vesicular slag of various sorts - probably all SHC fragments		
			34	2 somewhat dimpled lining slag fragments		
			130	2 dense slags with thin dimpled crusts and charcoal rich interiors - SHC fragments <i>washings rich in calcined bone</i>		
F141	17	222	1	irregular block of very charcoal rich slag of very thin crust type. Has shale pebble embedded in crust		
			24	2 scraps of dense weathered slag		
F143	16	418	1	rather conical SHC, top hollowed on one side. Bowl fairly thin, vesicular, bowl filled by charcoal-rich slag on one side only, base finely dimpled, 120x100x45mm. It is possible that the slightly odd shape reflects a more 'foot-of-wall' origin than is normal?	100%	418
			312	1? (22) probably a single disintegrated SHC of fairly conventional form - probably, but not certainly almost complete		
			96	3 charcoal rich slag fragments, probably not part of disintegrated shc <i>plus debris and washings</i>		

Context	S#	Wt	No.	notes	Propn.	Orig.
F203	5	1190	1	dense SHC, top mainly planar but with central hollow, 160x(100)x60mm, base finely prilly/dimpled, slightly irregular, body dark vesicular slag but very dense, top slightly concentrically zoned with small charcoal clasts	75%	1587
		24	3	small blebby slag pieces - probably hearth slags		
		50	3	irregular indeterminate slag fragments		
		68	1	irregular piece of charcoal rich slag - possibly the margin of a low density SHC		
		20	1	concretion containing iron, rounded, non-diagnostic shape		
		4	1	small 20mm disc of corroded iron <i>plus small debris and washings</i>		
F210	7	320	1	neat dense SHC, 100x80x30mm, with slightly prill/dimpled base, smoothly lobate maroon top,	100%	320
		72	1	concretion containing iron		
		122	3	fragments of ball of charcoal rich slag with smooth surface - possibly all from same original piece <i>plus washing (mainly fine rounded gravel)</i>		
F210	18	146	1	very strange extremely dense slag cake with flat top and vertical break down centre. Top looks as if either hammered or metal left on top, top sides and onto base have been blown and have fluid maroon surface layer, base dimpled and lobate, 60x(45)x45mm.		
		112	1	part of dense but charcoal rich SHC.		
		252	1	large reddish rounded mass with charcoal accretion on surface - some slag showing but also contains iron - probably a piece of worn iron-containing SHC		
		106	1	crescentic, almost rod-like piece of charcoal-rich slag with a dimpled base		
		68	1	bowl shaped fragment - probably roughly half of a tiny SHC containing iron metal		
		82	1	part of a very dense small SHC formed of a planar upper surface below which hang prills with charcoal.		
		46	1	SHC fragment with dimpled base, thin crust and overlying charcoal-rich material		
		404	41	fragments of SHCs of various types - but mainly probably very small with maroonish dense tops and prillier below - but also some more lining-influenced material		
		6	1	small concretion with iron		
F213	21	64	1	concretion on iron		
		60	1	broken dense slag nub - uncertain origin, smooth surface		
		24	1	rusty charcoal-rich slag fragment		
F234	13	182	1	small neat SHC with lining rich glassy top, slightly concentric structure and open charcoal-rich base 85x65x30mm	100%	182
F234	15	552	7	fragmented part of charcoal-rich slag cake - appears almost zero crust. Size of original cake not determinable, but clearly large		
F304	44	74	1	irregular arcuate dense slag piece with charcoal - probably a fragment from the margin of a small SHC		
		24	1	concretion containing iron fragment		

Context	S#	Wt	No.	notes	Propn.	Orig.
F305	14	200	7	concretions around iron artefacts - at least 4 are probably large nails. Broken surfaces show development of vivianite.		
		6	2	rod-like iron fragments		
		36	3	concretions in coarse sediment not certainly on iron objects		
		212	2	highly concreted slag in two almost matching pieces with overall plano-convex shape. Probably a weathered small SHC. Slag vesicular dense in lower part and lining rich on top. 90x80x40mm approx, base slightly prilly	100%?	212
		200	1 (3)	cake with thin vesicular crust (5mm) thickening to substantial pad on one side, probably part of an SHC but overall form unclear		
		166	1	probably most of a small SHC. Too concreted to see surface features, slag dense		
		56	1	small ball of low density charcoal-rich slag		
		40	1	small mass of slag, irregularly smooth on top, prilly on base, probably part of a small SHC (or even all of one)		
		74	4	fragments of slag, mostly showing somewhat sheet like form and so probably fragments of small SHCs <i>plus debris and washings (including numerous pieces of rather eroded bone</i>		
F308	8	36	1	blebby slag with charcoal in very odd curved shape - possibly a piece removed from hearth when hot?		
		16	1	low density iron-rich concretion - possibly on slag <i>washings rich in charcoal and small slag blebs</i>		
F309	6	142	1	dense but very irregular slag in complex almost sheet form, with charcoal impressions on surface, indeterminate, but possibly hot-deformed SHC?		

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