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Evaluation of archaeometallurgical
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Mitchelstown, Ballinglanna North 1,
Co. Cork, (E2414)

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Dr T.P. Young

Abstract

The assemblage from Ballinglanna North 1 is unusual in many respects and provides a unique insight into iron production on a large scale in early medieval times. Two ^{14}C dates are relevant to the iron working activity – both with calibrated ranges spanning the late 7th to mid 9th centuries. The residues are almost entirely from the smithing of iron. The smithing hearth cakes (SHCs) are large (the average weight for an SHC in the assemblage is the largest, 2854g, for any assemblage yet investigated by the author). The SHCs are of very variable weights, with no strong clustering, and with weights ranging up to 9.3kg. The high weights strongly suggest that the site was a specialist bloomsmithing operation, and with 260kg of slag recovered from the fraction excavated, the activity was clearly undertaken on a large scale. Although the weights of the SHCs were very variable, the internal textures exhibited were rather constant. Coarse, equant grains, funnel-shaped vesicles and a rather diffuse-appearing upper margin to the crust of the SHC, which passes up into a “clotted” slag texture, were all common characteristics, the recognition of which was enhanced by the similarity in the preservation of much of the assemblage. Similar textures do occur on other sites, but it was the regularity of occurrence of the texture which was unusual at Ballinglanna North. The residue assemblage is apparently homogeneous, creating an impression of a large volume of waste which ended up in various cut features. There were no certain features of metallurgical origin, which may indicate that the smithing was undertaken outside the excavated area, or just possibly, that it was conducted on waist level hearths, not the usual floor-level hearths.

The one exception to the homogeneous residue assemblage was the fill of pit [c255] which contained a small quantity of possible iron smelting slag.

Much of the assemblage (90% by weight) was recovered from the fill of a ditch running approximately parallel to the modern stream. The large quantity of large, similar, bloomsmithing slag cakes suggests a level of activity above that of typical early medieval iron production sites in Ireland, and is more reminiscent of sites in Britain some 600 years younger than Ballinglanna, when bloomsmithies adopted water power. It is possible the ditch represents a leat supplying power for water hammer (and even bellows). In such a model the slag in the ditch should be viewed as dump material entering the leat on its disuse. Unfortunately the slags on their own are not capable of distinguishing the harnessing of water power, which would require the recognition of actual structures. No water powered bloomsmithy of this period has been recognised in Ireland, but all the major components of the technology would have been available in contemporary corn mills.

Contents

Abstract	1	Interpretation	3
Methods	1	Evaluation of potential	4
Results		References	5
Description of the dense smithing slags	2	Table 1: Summary Catalogue	6
Description of the tongues	2	Table 2: Comparison of SHC assemblages	19
Description of tuyères	2	Table 3: distribution of residue classes	20
Description of the indeterminate slag	3		
Description of the iron ores	3		
Description of the flow slags	3		
Distribution of the residues	3		

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

Description of the dense smithing slags

The most abundant components of the assemblage were smithing hearth cakes (SHCs), with a total weight of 235kg (of the total assemblage of approximately 260kg). The outline statistics of the weight-frequency distribution for those SHCs which were intact, or sufficiently intact for their original weight to be estimated, are given in Table 2. The mean weight, 2854g, is the highest mean weight for an Irish SHC assemblage to date.

The larger SHCs were relatively plano-convex, but the upper surface often showed concentric rings and the friable upper slag may rise centrally above the bowl rim. The largest cakes were about 300mm in diameter, with thickness of up to 140mm (of which the bowl comprised 100mm). The development of the crust within the bowl was variable, generally it was thick, but typically the crusts appeared to show a rather moderate grain size, with apparently equant crystals, with a vesicular texture, including some large tubular/conical vesicles. The crust typically graded into more open-textured slags above. Very few of the large SHCs showed evidence for a smooth, blown patch on the top, and shiny upper surfaces were only seen in fairly small cakes. These features were so common that those SHCs showing these features are indicated by a "t" (for typical) in the catalogue (Table 1) and the facies summary (Table 3). This type of SHC represented only 1 out of 20 SHCs below 1500g, but 20 out of 28 of those over 3000g. The 29 SHCs identified as having the "typical" texture had an average weight of 4.1kg. The 36 SHCs for which this texture was not identified (which may include examples with the texture but which was not identifiable in the particular state of preservation of the sample) had an average weight of 1.8kg. Thus smaller SHCs may show rather more conventional features.

There is an occurrence throughout the assemblage of a small proportion of reddened material. Some of this is clearly from oxidation of the proximal lip of the SHC through impingement of the air blast on the top of the SHC. The reason for this is unclear – it may be because of upward growth of the slag accumulation, but equally the changing geometry of the blast produced by the erosion of the tuyère tip during use may also play a part.

Some of the reddened material shows a red (haematised?) glaze on "normal" SHC material, in some cases covering fracture surfaces in the slags. This oxidation may be happening at the extraction stage, rather than during normal use.

One slag facies which commonly shows haematisation are the dense slag flows which are generated just

below the tuyère. Not only are there flows alongside of the tuyère, but in some instances lobate flows on the proximal face of the SHC.

One well preserved SHC shows a 40mm deep bowl (in the "t" fabric described above), with 15-20mm of more open-textured slag above. At the proximal end a raised slag mass with dense prilly slags rises 70mm above the bowl top. This presumably indicates that the base of the tuyère lay at about 130mm above the base of the bowl.

Isolated sub-tuyère flowed slags are grouped with the "other smithing slags" in Table 3, as are charcoal-rich masses attached to tuyère tips.

One common feature of the SHCs at Ballinglanna is the occurrence of "tool-marks". These are developed as ridges or flanges on the underside of the larger SHCs. They are interpreted as the product of fluid slag settling into the holes created by the use of a poker, or similar tool, to lever the SHC out of the hearth while it is still hot. Where most strongly developed, these ridges can extend beyond the limits of the main slag bowl, giving the slag cake a palmated appearance in plan.

Description of the tongues

The assemblage contains several examples of slabby lining slags similar to material described elsewhere (e.g. Young 2009a) as pro-tuyère tongues. In this assemblage several examples show apparent attachment zones to tuyère faces. Of the 7 items listed in the database as tongues (not including small fragments of probable tongues), there are just 4 that mesh entirely with typical tongues (with weights of 116g, 120g, 158g and 160g), the other 4 are substantial larger (with weights of 368g, 438g and 456g). These larger masses may perhaps be better considered as lining-rich SHCs.

Description of tuyères

Small fragments of tuyères occurred widely, but there were only a five fragments which gave useful morphological data:

[c278] 50mm wide flat base
[c381] 200mm effective diameter over 60° segment
[c381] 110mm high?
[c222] 160mm diameter based on 60° segment
[c285] flat bottomed

Plus part of a tuyère margin embedded in the proximal end of a slag block:

[c222] 160 diameter based on margin in slag

If all of these observations were taken from identical objects, then the best fit for the face of the tuyère would be transverse, approximately 120mm high, 170mm wide, with a flat (or very gently curved) central zone to the base and a gently-curved top. Alternatively, there may be a variety of tuyères present, with a more circular cross section, with diameters between 110 and 200mm. Although this is a very small sample, it does appear more likely from the material that the tuyères were quite small and the 200mm diameter reflects a less-strongly curved part of a small object rather than the general curvature of a large one. None of the tuyère sherds preserves information about the bore.

Description of the indeterminate slag

The indeterminate slag category embraces several distinct slag classes, all of which lack clear morphological criteria to all interpretation. In particular this category includes fragments of vesicular slag without morphological criteria which might have allowed them to be recognised as SHC fragments had they been larger. The category also includes most slag fragments smaller than 20mm diameter.

Description of the iron ores

A very small quantity of iron ore was recovered from the residues. Two pieces of botryoidal goethite ore, with a brown dense ore with yellow cavity fills/coatings were probably fragments of bog ore. A single piece of red coloured ore appeared more homogeneous and may have been a similar material, or just possibly a claystone ironstone, that had been roasted. There was no evidence that these materials had been brought on to the site deliberately, but it may be significant that all three fragments came from the same pit [c213], which lies very close to pit [c255] which yielded possible smelting residues.

Description of the flow slags

Items categorised as “flow slags” are those slags with evidence for lobate or prilly flow, but which cannot be recognised as being sub-tuyère flows (i.e. either the low flow lobes, often with a concave top to the aggregated lobes, that shows along the underside of the tuyère, or the stacked lobate slag that occurs down the proximal side of some SHCs).

Rather this category includes flowed blebs and prills, particularly prills with a more circular cross section than the sub-tuyère flows, and prills which were clearly descending vertically.

This type of flow slag is very rare at Ballinglanna North, with the only significant occurrence being in the fill [c256] of pit [c255]. Here the prills are delicate and a sieved sample contains both prills and “coffee bean spheroids”. The “coffee bean spheroids” are droplets of slag that have cooled against a fuel particle, creating a dimple in their surface. They are typical of, but not unique to, the basal pits of slagpit smelting furnaces.

The same context contains a large block of internally prilly charcoal-rich slag.

This assemblage could be generated in a smithing hearth, but there is a possibility that it represents a smelting assemblage from the basal pit of a slagpit smelting furnace.

Distribution of the residues

The residues occur mainly in the large ditch, with a concentration close to the area of the slag-filled features to its east. The ditch appeared to have received slag-rich deposits during two phases separated by almost sterile silts. There appeared to be no significant difference between the slag assemblage of the different phases of fill in the ditch.

The adjacent features, pits [c213] and [c255] contained slag. Neither feature was recorded as showing evidence for in-situ burning, but the concentration of features in this area, close to the

maximum quantity of slag within the adjacent ditch, raised the suspicion that this might be the focus of metallurgical activity.

The fill of [c255] contained an assemblage of delicate flow slags that might possibly be a smelting assemblage. The pit was truncated by linear (furrow?) [c260] so its morphology was unclear. The fill [c256] contained large stones, so clearly was not a primary in-situ smelting residue, but might conceivably have been a mixture of a stone-rich backfill with some surviving residue.

Nearby pit [c213] also shows a stone-rich upper fill [c214], but this overlies a darker deposit [c217] that might just possibly be an in-situ context. The residue assemblage from the upper fill [c214] contained mainly identifiable smithing slags, which are supplemented by the only smithing microresidue assemblage from the site. The lower fill [c217] contained a small assemblage of rather blebby slags of indeterminate origin, together with a single piece of flow slag.

Pit [c220] was also recorded as containing slag, but none found in the collections.

Other features in the SE part of the site are interpreted as significantly post-dating the metalworking and in general contained small quantities of slag similar to that in the ditch, as did a couple of contexts associated with the post-medieval building.

In the SW of the site, west of the ditch, there were two large pits, apparently with indications of in-situ burning. A small quantity of slag was recovered from one of these structures [c268]. The undercut profile of the pit and the central pad of stones, more closely resembles a small well than any metallurgical feature (which are never so deep). It is suggested that the “in-situ” black deposit, may not have been from burning but may perhaps have been either organic material or manganese waste associated with waterlogged conditions.

Interpretation

Dating of this site hinges on two ¹⁴C dates (from the metallurgical phase), one from the primary slag dump [c338] within the ditch and the other from a deposit [c299] low in one of the SW pits (wells? – see above). The dates are very similar: [c338] = cal AD 684-784/787-827/839-864; [c299] = cal AD 664-782/789-811/847-854.

The slag from this site is dominated by SHCs of rather variable size, but of distinctive and relatively constant texture. These SHCs are typically large – the assemblage of SHCs as a whole has an average weight of 2.8kg (the highest mean weight for an assemblage yet recorded in Ireland), for those identified as having the distinctive texture the average rises to 4.1kg!

SHCs of such large size have been associated with the processes of bloom consolidation (bloomsmiting; Young 2009). The raw bloom produced in a bloomery furnace requires significant reworking in order to transform it into usable iron. Often the focus of that process is seen as closing of gaps in the bloom and the expulsion of excess slag and charcoal clasts – and indeed this is an important initial stage, but bloomsmiting also involves the reworking of the iron (typically be repeated heating and hammering to draw the iron out into bar, or more rarely, sheet form). This

working of the iron not only works to clean the iron of major impurities, but also to draw-out and align the slag inclusions, which have such a strong influence on the mechanical and forming properties of the finished iron.

There appear to be, very broadly, four styles of SHC assemblage from early medieval Irish sites (Table 2). There are those sites which appear to be concerned almost entirely with the end of use of iron (e.g. Coolamurry, Navan). Such assemblages are dominated by large numbers of small SHCs, particularly those of less than 600g and reflected by weight-frequency distributions with around 90% of the SHCs with weights below 1000g. The inclusion, even within these assemblages of a small proportion of SHCs with weights above 2000g (typically interpreted as from bloomsmithing) has been proposed (Young 2009) as representing the frequent distribution of iron to smiths in the form of unfinished iron – requiring further working before use.

A second group of sites have evidence for iron smelting as well as smithing (e.g. Gortnahown 2, Carrigoran, possibly Parknahown 5, Clonmacnoise WWS and Woodstown 6). These sites show a decrease in the proportion of SHCs at the small end of the distribution, with both more large cakes and an increase in size of the largest. The maximum SHC size varies from 3.5kgs at Gortnahown 2 up to 6.3kg at Woodstown.

A related group of sites shows no indication of the presence of iron smelting, but has evidence for a wide range of activity, suggesting that iron was processed on the site from raw bloom through to final artefact. This group includes Clonmacnoise NG and Clonfad. At Clonmacnoise smelting was demonstrably undertaken in the area (e.g. at the Clonmacnoise WWS site) and it is assumed that primary smelting took place at Clonfad, or in an adjacent area of the monastic estate.

The fourth group of sites (e.g. Borris, Lismore/Bushfield 1 and Ballinglanna North 1) shows little or no sign for the end-use of iron, such that the proportion of SHCs below 500g falls below 20%. They show a very high proportion of SHCs above 1000g – typically 60% or more. These sites appear to have been specialist bloomsmithing sites. The sites show little similarity in terms of what is known of the context of the metalworking, although the residues at Borris also occurred mainly in a large ditch (which gave a 14C date on animal bone from its lower fills of 7-8th century and 9-10th century for a bone from its upper fill). Lismore/Bushfield 1 yielded most of its SHCs from a single undated pit associated with a ringfort containing a 6th-7th century cemetery. Of the three sites, not only are the SHCs larger at Ballinglanna, but there also appears to be much more slag in total. At Borris, although multiple smithing hearths were located close to a major linear ditch, the slag recovered amounted to approximately 200kg from 100% excavation of 105m of the ditch, compared with the approximately 15% excavation of the 65m length of ditch at Ballinglanna which yielded 235kg.

Despite their differences, these sites indicate a degree of specialisation within the *chaîne opératoire* of iron production. The geographical segregation of bloomsmithing from both smelting and the end use of the iron is something which is seen not uncommonly. Various factors may drive the segregation: in some instances it may be a need to spread the load of charcoal production across the countryside, in some instances (particularly in the later medieval period) it

may reflect the adoption of new technologies for the hammers, either *olivers* (mechanical treadle hammers) or water-powered hammers, but it may frequently reflect the use of a fixed permanent forge, often near habitation, for the smithing, while the smelting moved through the woodlands, following the charcoal production.

In this instance, the reasons behind the focusing of bloomsmithing on this one locality are unknown. However, it may be significant that the segregation appears more extreme in this case than elsewhere. The large size of the SHCs suggests that large blooms, or pieces of blooms, were being worked on a regular basis. The possibility that the ditch was associated with a water-powered hammer should be considered. No other site in Ireland (or probably in western Europe) has evidence of such technology at this period, but that does not mean it did not exist. The early adoption of water power for corn mills in Ireland means that the major components of the technology were well-established.

If the ditch is functionally related to the metalworking, then the filling of the ditch by slag is unlikely to be contemporary. Slag-rich fills might indicate primary dumping into a disused ditch, secondary clearance involving the levelling of slag dumps into the ditch on the abandonment of the site or possibly collapse of slag into the ditch. The latter interpretation was adopted by the author for a medieval water-powered bloomery in the English West Midlands (Cinder Mill, Chorley, Shropshire), where it is believed that decomposition of a timber lining to the tail-race allowed collapse of the adjacent slag dumps into the watercourse (author's unpublished data). On the other hand there are examples where metalworking has taken place within a ditch (e.g. Navan, Woodstown 6). At Woodstown iron smelting was undertaken within the butt-end of one of the segments of one of the major enclosure ditches and the ditch was rapidly filled with smithing waste, possibly following clearance of an adjacent smithy.

The detailed interpretation of the features to the east of the ditch is not possible at the current level of information. There is a slight hint that [c255] might have been a smelting furnace, but the lack of smelting slags from the other features might imply that if it is a furnace it is not coeval with the other features on the site. The pit [c213] might be an elongate smithing hearth, but the evidence is far from clear.

The large pits to the west of the ditch are more likely to have been wells than to have been directly associated with the metalworking.

Evaluation of potential

The slags from Ballinglanna are of enormous significance, representing largest scale specialist early medieval bloomsmithing operation yet found. The similarity of texture of a large proportion of the material has the potential to allow recognition of slag from a particular process technology, which can feed back into recognising that process at other sites. The apparent level of homogeneity in the assemblage is remarkable, and will allow closer interpretation than for more mixed assemblages.

It is recommended that a full analysis of a suite of SHCs is undertaken, to characterise the large "typical" bloomsmithing slags and establish their genetic relationship to the smaller SHCs.

Whether the bloomsmithing operation was entirely manual, or whether it had a component of water power is not known. The answer to that fundamental question must come, if possible, from the interpretation of the archaeological features. If water-powered, the site would be unique in Ireland at the current level of understanding.

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<i>sample</i>	<i>context</i>	<i>feature</i>		<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
37	1	topsoil		184	3	indeterminate dense slags		
57	2	transference layer		28	1	small scrap of blebby slag		
78	2	transference layer		180	2	dense dimpled slags in rounded masses		
				6	1	lobe of glassy slag		
				242	2	lobate prilly dense slag masses from tuyère area		
123	2	transference layer		140	6	slag scraps		
173	2	transference layer	t	436	1	thick crust SHC fragment		
				344	17	slag scraps of all types		
124	6	cleaning over slot 6		116	1	slightly gravelly small tongue, dark top		
12	19	cleaning of patch of burning		1425	13	SHC fragments		
				288	15	dense flows and blebs and accumulations of lobed material		
				86	1	possible tiny SHC 65x50x15mm	100	86
				160	1	75x70x40mm tongue (most of thickness is a raised lump on top)		
				270	11	slag fragments		
294	129/130	ditch c126, slot 4	t	5560	1	SHC, (200)x(250)x140mm, with bowl 80mm, with up to 60mm thick crust in centre, upper layers concentrically-ridged, piled high near centre. Proportion is approximate - a maximum value	60	9267
			t	324	1	"coralline" upper part of SHC		
				322	6	slag fragments		
294	130	ditch c126, slot 4		1065		block from slightly deformed thick thin crust SHC		
				158	1	60x100x40mm, small tongue, dark glassy top with gravelly material stuck on (most of thickness), dense, dimpled below		
			t	486	1	block from centre of medium-sized thick crust SHC	30?	1620
				122	1	dense vesicular slag		
				198	1	charcoal-rich slag fragment		
				102	1	slag sheet with dimples on top and pendent prills below - too dense for a tongue fragment?		
				100	1	vesicular slag		
			t	962	1	block from moderate crust SHC		
295	131	ditch c126, slot 4		186	17	vesicular, open-textured, rusty weathered slag fragments		
				28	1	dense slag nub		
				56	1	thinnish SHC crust fragment		
				272	1	piece from proximal side of fairly thin crust SHC		

<i>sample</i>	<i>context</i>	<i>feature</i>	<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
?	134	silting in ditch between dumps	170	12	dense flow slags		
			72	6	tuyère sherds		
			92	1	elongate dense flow?		
			20	3	lining-influenced blebby slags		
			506	1	large slag block with smoothish top and irregular below - possibly from area in front of tuyère?		
			522	6	SHC fragments		
			408	13	other slag fragments		
79	162	modern layer c162	46	1	vitrified tuyère sherd		
			232	5	slag pieces		
			196	1	finely prilly brown slag lump		
131	214	pit c213		assm	slag flats, spheroidal and flake hammerscale, slag debris, tuyère sherd		
133	214	pit c213	294	2	heavily slagged tuyère tips		
			274	5	pieces of tongue material, glassy blebby mainly dark		
			692	5	dense rusty slag fragments - probably all SHC		
			10	1	iron ore fragment - possibly a roasted claystone		
			34	3	dense flowed maroon horizontal prills		
			36	2	low density impressed slags		
			12	1	rusty slag fragment		
148	214	pit c213	46	2	iron ore pieces, brown goethite, botryoidal with yellow filled voids		
			428	1	possible small, almost spherical SHC, 70x70x60	100	428
			498	4	SHC fragments, all may be from small examples		
			108	4	slag scraps		
			48	2	poor blebby prills		
150	214	pit c213	1040	1	100x120x110mm mass with charcoal-rich sides and slightly prilly top, has stone embedded into upper? surface		
			592	1	dense highly rusted slag - probably a thick crust SHC fragment		
			100	1	dense maroon-surfaced blown bowl lip		
			20	1	slag bleb		
147	217	pit c213	32	1	corrosion around iron nail		
			4	1	neat flow lobe		
			192	25	irregular rusty slag blebs		
151	217	pit c213	348	14	small slag pieces with heavy sandy accretion		

<i>sample</i>	<i>context</i>	<i>feature</i>		<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
134	222	ditch 376	t	3140	15	thick crust SHC fragments		
				166	3	deeply vitrified tuyère sherds		
				1680	23	pieces of vesicular slag from the upper part of SHCs		
				164	3	low density glassy maroon lobate material		
				20	1	sherd from side of tuyère		
				94	5	dense dark maroon slag flows		
				426	14	slag scraps		
143	222	ditch 376		1570	1	SHC with tool marks on base, deformed, has softer base, then crust, then more porous upper, possibly c60%	60	2617
				812	1	piece from medium-sized dense SHC with tubular vesicles in thick crust, strongly deformed	70?	1160
				256	1	conventional SHC fragment		
				1180	1	fragment of large conventional SHC, with upstanding lining slag on top		
				424	1	flange from margin of a thin crust SHC - original must have been large		
				1240	1	part of moderately thick crust SHC		
				1085	16	SHC fragments		
					+bits			
				162	2	dense flow slag sheets		
143	222	ditch 376	t	748	1	fragment from centre of SHC with 70mm deep bowl, all crust, but slightly more vesicular than typical		
			t	1430	1	120x110x80mm large slag block with enormous tool marks in vesicular slag, edge of bowl shows on one margin, but not clear if this is going into or out of the piece-so maybe almost entire SHC, or maybe tool marks were external to the main bowl		
			t	818	1	block from centre of thick crust SHC - crust to 50mm vesicular slag on top		
			t	530	1	block from margin of thick crust SHC		
				674	1	piece shows bowl-like material 30mm deep with 65mm of more open slag on top, including lots of red tuyère fragments, this is just the high-piled edge of much larger SHC		
				156	1	part of probably fractured and failed tuyère tip. Like others has coarse white inclusions of tabular shape, mainly white quartz but some other siliceous materials too, set in a very sandy fabric		
				66	1	rounded ball with "wasps nest" texture (cf Ballykilmore)		
			t	1215	6	thick crust SHC sherds		
				80	1	dense flow slag		
				604	10	various slag fragments		
				96	2	fragments of strongly-lobate lining-influenced slag		
143	222	ditch 376	t	2780	1	(140)x(140)x100mm small, but deep thick crust SHC , slightly concentric top gradational fill to bowl,	50	5560
			t	1390	1	thick crust SHC fragment , slightly more vesicular than typical, crust to 40mm with up to 45mm of material on the top		
			t	1085	1	thick crust SHC fragment broken and rejoined during extraction		
			t	1165	1	thick crust SHC fragment crust to 45mm		
				116	1	SHC fragment		

<i>sample</i>	<i>context</i>	<i>feature</i>		<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
143	222	ditch 376	t	1050	1	thick crust SHC fragment, crust piled high with irregular slags		
				1990	1	large block from rather thin slag bowl with horizontal flow lobes extending out near rim, inside rough		
			t	620	1	thick crust SHC fragment		
				126	2	tuyère fragments		
				64	5	dense flow prills		
			t	403	4	thick crust fragments		
				150	1	possible small SHC 70x60x25mm	100	150
				92	1	possible fragment of similar dense SHC - but these may just be small flow puddles		
				302	23	indeterminate slag fragments		
143	222	ditch 376	t	2950	1	200x(150)x100mm (of which bowl 50mm) part of large SHC with hollow blown smooth glassy centre and strongly raised lip, maximum of 60% probably less	60	4933
			t	1650	1	block from centre of very thick crust SHC		
				973	1	edge of deeply hollow-topped SHC, dense shiny (unusual for this site) with large blade-like tool mark extending 100mm outside SHC		
			t	354	1	pair of tool marks from edge of SHC		
			t	332	5	SHC fragments		
159	222	ditch 376	t	1465	6	SHC fragments with thick crust		
				836	5	other SHC fragments		
				76	6	tuyère sherds		
				452	17	small slag pieces - mainly rounded blebs		
				54	3	blebs of dimpled lining slag		
				186	3	dense slag in lobate flows - 1 set shows curve of tuyère base on the top		
				368	1	lump of charcoal-rich slag with impressions on surface, lining slag influenced on surface - probably large tongue 60x60x90mm		
				112	1	fragment of charcoal-rich slag with very slightly flowed base - probably from below the tuyère		
159	222	ditch 376	t	716	22	slag fragments		
				1010	9	fragments of thick crust SHCs		
				22	2	tuyère sherds		
			t	996	1	part of thick crust cake (110)x(120)x60mm (of which bowl 30mm) very little slag on top of crust in depressed bowl, base smooth	30	3320
				324	1	95x75x40mm (of which bowl 30mm) possible small SHC with edges missing (though could be smaller part of irregular larger one) tool marks on base	60	540
				438	1	dense prilly mass with sheet of glass through centre - probably a dense form of tongue 70x90x70mm		
				244	3	dense slag fragments with rounded maroon blown surfaces - probably from blowing lip of dense SHCs		
				346	1	SHC fragment		
				146	1	porous slag with one smooth blown surface		
				314	6	rounded dense slag blebs, probably flow lobes from below tuyère		

<i>sample</i>	<i>context</i>	<i>feature</i>		<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
				70	4	low density flow lobes from tuyère area		
				134	1	60x60x20mm dense sheet of slag with smooth top and impressions on base, one broken end, could be a dense tongue or could be a small SHC in its own right	100	134
159	222	ditch 376	t	2025	1	(160)x(100)x100mm SHC with thin (5mm) distinct outer crust, entire bowl filled with quite vesicular slag becoming more vesicular up, culminating in coralline top, no more than 40% - this could be related to thin crust types	40	5063
			t	688	1	SHC fragment		
			t	1335	1	(150)x(130)x80mm (of which bowl 70mm) crust to 40mm. Concavo-convex, variable amount of rough slag in bowl, small tool marks on base		
				208	1	irregular lump of SHC material, has flown lobate edges to lower "crust" - so could be entire small SHC, but could be lump from margin of a larger cake		
159	222	ditch 376		740	1	semi-conical slag attached to skim of tuyère front. Top concentric, clinkery, base a series of crude flow lobes directed horizontally back under tuyère - neatness increasing to top, tuyère probably c 160mm diameter. Mass 75x120x80mm, top probably tipped 45 degrees into hearth, tuyère face inclined forward 70 degrees to horizontal		
				120	1	small tongue - lining slag sheet dimpled glassy top, lobes on base, 80x50x35mm		
			t	1565	5	SHC fragments - all fairly deep bowl		
			t	470	2	SHC fragments - probably similar but not so much seen		
				666	5	slag lumps with dimpled surfaces - some may be SHC fragments, but others seem to be nubs		
			t	236	1	twisted margin of small SHC with smooth top		
159	222	ditch 376		1985	1	dense crust to 60mm with tubular vesicles in lower part, more granular slag to 60mm on top, (110)x(140)	60?	3308
				1230	1	block of wide SHC with dense crust to 45mm, overlain by thin layer with elongate unroofed voids (lobes?)		
				682	1	dense crust to 35mm with open textured slag on top		
				654	1	dense crust to 35mm		
				268	2	SHC fragments		
				136	1	maroon surfaced slag with very variable density, hanging from margin of tuyère		
174	222	ditch 376		22	1	perfectly flown, mirror-finish slag sheet		
174	222	ditch 376		368	1	100x100x20mm plano-convex SHC with glassy top and gravel - could be classed as a flat tongue, base slightly lobate but neat	100	368
			t	1020	1	110x130x80mm (of which bowl 60mm) slightly incomplete SHC with moderately thick crust and porous upper	100	1020
				250	11	tuyère sherds	100	300
				300	1	90x95x30mm conventional dense SHC with smooth dimpled top and rough base	100	300
				442	11	slag fragments probably from SHC		
				298	6	smooth skinned dense slags, 1 good lip, others parts of flows		
				4	1	delicate descending prill of dense reddish slag		
				60	2	complex dimpled and lobate maroon dense slag sheets		

<i>sample</i>	<i>context</i>	<i>feature</i>	<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
			238	13	high- to low-density blebs and flowed sheets with dimples		
174	222	ditch 376	246	1	tuyère sherd c 160mm diameter from 60° slice		
			t 3460	2	broken proximal end of large thick crust cake (proportion is maximum)	60	5767
			t 782	1	thick crust SHC fragment		
			226	4	SHC fragment		
296	222	ditch 376	t 8085	1	335x280x80mm SHC has slightly depressed top becoming more marked to proximal end, triangular in plan widest near proximal end, upper surface slightly concentrically ringed, with very thin layer on top of crust, base has slight hint of multiple low points along axis	100	8085
129	256	pit c255	156	assm.	fine-scale flow slag assemblage - could be smelting but these are very fine films, prills and coffee beans		
152	256	pit c255	478	1	block of charcoal-rich slag with lobes and prills on base		
152	256	pit c255	328	63	small pieces of dense, brittle, flow slags in delicate arrangements		
155	261	linear c260	182	1	SHC fragment		
			26	4	slag scraps		
158	265	linear c264	28	3	slag scraps		
160	265	linear c264	26	1	tuyère sherd		
			24	1	indeterminate slag fragment		
251	275	fill of slot trench c274	t 1570	1	140x140x80mm (of which bowl 60mm) SHC, bowl deepens to proximal side as top lifts likewise	100	1570
170	277	possible firepit c268	78	2	lobate glassy material like tongue but in small pieces		
			56	2	slag scraps		
			310	64	dense flow slags in blebs. Prills and flows		
			710	c150	slag scraps		
			122	2	dense lobate slags		
			532	6	open textured slags, some show hints of flow lobes		
			t 812	6	SHC fragments		
			44	1	tuyère sherd		
85	278	ditch 376 1st dump	5430	1	large thinnish crust SHC, slightly twisted and with upper parts corroded, but otherwise intact 180x280x140mm	100	5430
287	278	ditch 376 slot 8, 1st dump	200	1	forward inclined tuyère fragment with flat base over 50mm		
			t 3205	1	large wide SHC with coralline top and two separate lobes to bowl, 250x200x60mm	100	3205

<i>sample</i>	<i>context</i>	<i>feature</i>	<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
			t 2245	1	large piece of thick crust bowl, crust to 40mm, coralline on top		
			568	2	SHC fragments		
287	278	ditch 376 slot 8, 1st dump	t 2830	1	190x140x90, pc cake top possibly lobed, crust 35, lumpy base	75%	3773
			3720	1	large SHC strongly deformed on extraction, multiple tool marks on base - looks like 65% of large SHC with open bowl with partial coralline fill. But could be laterally compressed, 290x160x140mm	65	5723
			534	1	block from somewhat thin crust SHC		
			64	1	SHC fragment		
287	278	ditch 376 slot 8, 1st dump	t 1205	1	margin of a typical SHC with large tubular vesicles in lower half of 40mm crust. Strongly raised rim of coralline slag to cake with two very large tool marks exiting under distal edge		
			t 1830	1	160x(160)x100mm dense SHC with thick crust to 50mm, open crystalline slag on top	85	2153
			644	1	deformed granular slag mass - upper part of an SHC		
			280	1	irregular slag lump containing piece of tuyère		
			t 2320	1	large block of SHC with very thick crust (80mm) irregular micro-blebby top, base smooth on side to dimpled at bottom, (130)x(150)x100mm proportion difficult to assess	60?	3867
			90	1	rounded slag nub with gravel		
			302	1	part of slag mass from tuyère tip		
181	285	layer (W of ditch)	456	1	flat bottom tuyère face with large tongue attached, 110x90x50mm tongue appears very oblique to tuyère		
			t 390	1	thick crust SHC fragment		
			58	4	slag scraps		
			366	2	SHC fragments		
			28	4	corroded and fragmented piece of sheet iron		
202	309	void	1315	1	SHC, basal 25mm has tubular vesicles, upper 60mm of bowl fill is more irregular, both both layers characterised by very coarse crystals - top slightly lobate	70	1879
218	309	void (top layers of ditch?)	t 1020	2	large piece of broken SHC		
			52	4	tuyère sherd		
			1035	9	SHC fragments		
205	314	cut c313	676	1	very weathered slag block		
			534	1	SHC crust that seems to have been fractured and blasted, 120 (80)x35mm slightly dish-topped, base microprilly, crust to 30mm, remelted crust flown down sides in places		
			206	1	dense with reddish flow lobes		
			100	1	dense with reddish flow lobes		
			216	1	dense with reddish flow lobes		
			8	1	vitrified ceramic		

<i>sample</i>	<i>context</i>	<i>feature</i>	<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
			t 592	1	probable proximal end of SHC with thick crust		
			t 498	3	SHC fragments with fairly thick crust		
			492	1	probable open-textured SHC fragment		
			818	22	assorted slag fragments		
205	314	cut c313	400	1	very fine grained thick crust SHC fragment with smooth blown top		
			t 2230	9	thick crust SHC fragments		
			233	1	thin crust SHC fragment - thin crust, then coralline interior		
			116	1	dense SHC fragment with smooth blown maroon top		
			274	1	90x65x40mm, possible small dense SHC	100	274
			164	4	indeterminate slag fragments		
219	329	pit c328	1840	1	(180)x(110)x60mm thick crust SHC irregular on top, bowl 45mm	50	3680
220	337	ditch c382, slot 6, 2nd dump	1505	1	SHC, rather weathered so probably light, 190x180x100mm (of which bowl 50mm) slightly dished top with charcoal holes, base irregular, raised on proximal side with even slope into bowl	100	1505
222	338	ditch c382, slot 6, 1st dump	1285	1	130x160x65mm slightly dished-topped very neat SHC, top smooth, base smooth, both with some organics	100	1285
			648	1	block from thin crust SHC		
259	338	ditch c382, slot 6, 1st dump (underwater)	t 7425	1	(230)x(230)x140mm (of which bowl 90mm) very large SHC with thick crust, possibly concentrically-structured on top	90	8250
			1140	1	fairly conventional SHC with deeply dimpled material on bowl, rising to include small 45° angled crust fragment within raised proximal area	70	1629
			t 1055	1	140mm thick SHC, bowl 55mm, above is open crystalline material, thick crust SHC centre		
			224	2	twisted dimpled slag sheet fragments		
			174		bits		
273	338	ditch c382, slot 6, 1st dump (underwater)	3660	1	dense bowl to 60mm, 40 mm charcoal rich slag, 30mm rusty slab with dimples and green glass on top (170)x170x130mm	75	4880
			2050	1	170x140x70mm SHC with conventional crust 20mm thick, overlain by charcoal-rich material with rusty, ashy dimpled top with green glass at proximal end - a really good double layer cake	100	2050
273	338	ditch c382, slot 6, 1st dump (underwater)	4490	1	very thick crust SHC with crudely and coarsely lobate top (to judge by raised dividers?) 190x210mm fragment 100mm thick, plano-convex	75	5987
273	338	ditch c382, slot 6, 1st dump (underwater)	t 1075	1	(130)x(120)x90mm (of which bowl 60mm) SHC with deep bowl and raised proximal side	40	2688
			t 554	1	SHC fragment		
			132	1	curved block of lining slag with large inclusions		
			54	7	dense flow slags		

<i>sample</i>	<i>context</i>	<i>feature</i>		<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
				252	12	tuyère sherds, vitrified and some heavily slagged - one appears to show flow slags below		
				28	1	low density maroon slag lobe		
				328	6	SHC fragments		
				594	37	indeterminate slag fragments		
223	339	ditch c382, slot 6, 2nd dump	t	998	1	70mm deep plano-convex cake - all crust of typical type, top has wispy raised hollow lobes and charcoal impressions, base rough	40	2495
				896	1	rounded end of incredibly dense slag with large rounded voids, top dimpled and possible dimples on end too. Reminiscent of the really dense blocks at Clonfad		
				846	1	slab from centre of cake with thinnish crust and high-piled dense slag - total 60mm thick		
			t	912	3	SHC fragments with fairly thick crusts		
				172	2	lining slag in prilly dimpled blocks - probably tongue fragments		
				58	1	dimpled slag lump - probably SHC fragment		
				578	19	open-textured coarsely crystalline slag fragments - probably upper parts of SHCs		
265	339	ditch c382, slot 6, 2nd dump	t	2055	1	looks like half a biconvex SHC, base is normal tubular-vesicular crust to 50mm, upper is strongly inclined slab of rough material - may have stopped there not arched over, leaving rest of bowl open? 40% is maximum	40	5138
				142	1	fragment from crust of small SHC with very large bladed olivine in crust		
				70	4	slag scraps		
230	341	linear c340		630	1	10mm crust with 60mm irregular slag on top - probably from near the margin of a large SHC, planar dimpled base, internally the upper layers are prilly - so may be from just below tuyère?		
			t	342	1	fragment from end of fairly conventional cake, could be from small cake		
				82	1	lobate dense slag from near tuyère		
256	359	linear c372	t	684	1	edge of thick crust SHC (110)x(90)x55mm	40	1710
				102	1	dense lobate slag attached to tuyère margin		
				22	1	slag fragment		
				86	1	concretion around iron		
254	371	linear c370	t	1375	1	thick crust SHC fragment , crust to 40mm, but deformed so proportion not clear		
				398	1	20mm bowl overlain by 50mm of porous slag, possibly just proximal end of SHC		
				622	1	possible double layer SHC, but very weathered		
263	381	ditch c382, slot 6, 1st dump	t	2855	1	large block of vesicular slag, no real features - possibly a hot deformed SHC?		
				2790	1	SHC with medium thickness crust grading up into large thickness of "coralline material", top of cake missing, 180x190x80mm looks a bit deformed	80	3488
				110	1	vesicular slag lump		
				106	1	vesicular slag lump		
				178	1	vesicular slag lump		

<i>sample</i>	<i>context</i>	<i>feature</i>	<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
			22	2	vesicular slag lump		
263	381	ditch c382, slot 6, 1st dump	1935	1	140x140x80mm (of which bowl 30mm) thick crust cake with irregular crust, crystal terminations on upper surface, tool mark on base	50?	3870
			816	1	140x110x70mm (of which bowl 40mm) transverse SHC with smooth top in strange folds to create flat hollow - very fluid, almost like tap slag on top, conventional below, microdimpled base	100	816
			730	1	block from centre of fairly thick crust SHC, microdimpled base, coralline top, proportion unknown		
			858	1	folded block of grey homogeneously vesicular and coarsely crystalline slag		
			302	1	centre of small dense SHC with blown top		
			372	1	thin crust fragment		
			286	1	grey vesicular slag		
			14	1	grey vesicular slag		
263	381	ditch c382, slot 6, 1st dump	1915	1	150x110x100mm (of which bowl 50mm) biconvex cake with slag piled high. Bowl has coarse crystalline top, plano-convex form, probably some deformation	80	2394
			812	1	block from centre of large thick crust cake		
			302	1	nub, half prilly slag, half porous		
			468	1	deformed SHC with very coarse grained thick crust with porous slag above		
			382	1	block from small thickish crust SHC		
			370	1	vesicular grey slag		
			1065	1	130x100x70mm probably complete SHC, but deformed	100	1065
			788	1	block with lobate top above crust which rest on more charcoal rich material		
			42	1	oxidised fired ceramic		
263	381	ditch c382, slot 6, 1st dump	608	1	slag attached to lower face of 200mm diameter tuyère (to judge by 60 degree part here). All oxidised fired, just turns pale in outer layer on the side, blowhole not preserved, some appearance of curving out to bulbous tip, but may be artefact		
			352	1	SHC fragment		
			132	1	65x80x20mm, small SHC or dense tongue, plano-convex, glass lobed black top	100	132
		t	1425	1	very deep SHC, 160 diameter originally, 120mm deep, 60mm bowl, flat pad of lining slag on proximal side hints at contact with stone?	45?	3167
		t	3095	1	SHC with thick dense plano-convex bowl, with hollow raised lobes on top. 180x160mm fragment, bowl 50mm thick with up to 40mm thick pile of slag on top at proximal end and up to 10mm locally on base. Tubular vesicles, smooth blown top to lobes where seen	75?	4127
263	381	ditch c382, slot 6, 1st dump	t 1390	1	thick crust SHC, base rather diffuse into crust (50mm?) top of crust planar with crystal terminations, raised slag on one side but top of cake not seen	70?	1986
			t 446	1	crust to 35mm, piled high on top, deformed		
			1300	1	170x120x100mm (of which bowl 50mm) apparently biconvex SHC with slightly lobate base and charcoal rich top		
			368	1	fragment from the base of charcoal-rich slag cake, base strongly prilly		
			344	1	110x80x30mm small SHC with dished smooth top partly infilled proximally, microprilly base, maroon	100	344

<i>sample</i>	<i>context</i>	<i>feature</i>		<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
				136	1	SHC margin fragment		
			t	504	1	thick crust SHC with slightly lobate top, also has extra thin crust adhering to part of base		
			t	636	1	medium sized cake fragment with tubular vesicles		
				194	1	intensely blown lip to bowl - maroon surface, surface curves somewhat around edge of piece hinting it may not have been part of main bowl?		
263	381	ditch c382, slot 6, 1st dump	t	2685	6	fragments of typical type of thick crust SHCs, crusts variable up to 60mm		
				578	1	fragment of thick crust SHC showing dense flow-lobed upper layer - possibly from near tuyère or may be remelted?		
				2400	8	open textured slag fragments - most probably either top or edge of larger SHCs		
				472	1	rounded dense lump of slag		
				140	6	slag fragments		
263	381	ditch c382, slot 6, 1st dump		3685	3	SHC broken into 3 pieces, 230x230x75mm, slightly irregular crust to about 25mm with rather little fill in most of the big bowl, rise of charcoal-rich slag on one margin provides hint of blowing direction	100	3685
				90	3	scraps of slag		
263	381	ditch c382, slot 6, 1st dump	t	714	1	thick crust SHC lump		
			t	1385	1	large lump from centre of thick crust SHC, crust to 50mm		
				304	1	irregular lump, partly prilly		
			t	800	1	thick crust SHC fragment, crust to 60mm		
				1900	1	160x170x70mm, slightly palmate slag because of large underside tool-marks. Probably a standard SHC but blown hard and covered over most of upper surface in very unusual maroon glaze	100	1900
			t	954	5	fragments of thick crust SHCs		
263	381	ditch c382, slot 6, 1st dump	t	2100	1	(160)x(150)x85mm, thick crust plano-convex base 50mm thick with tool marks on base, little on top	70	3000
				1205	2	(100)x160x50mm small SHC with fracture surface suggesting very coarse bladed crystals	70	2008
				302	1	lip from large SHC		
				224	1	dense slag lump		
				1105	1	120x120x70mm very irregular SHC, maybe deformed	100	1105
				458	1	SHC fragment		
				10	1	slag scrap		
263	381	ditch c382, slot 6, 1st dump	t	1260	1	130x140x70mm fragment, crust 30mm, tool-marks on base, some raised lumps on top, flat wide SHC, proportion difficult to assess	40	3125
			t	2040	1	thick crust (to 60mm) raised bubbly lip around SHC, rough base with large tool marks (130)x(120)x90mm	50	4080
			t	694	1	cake margin fragment, top with "blisters", thick crust below		
			t	428	1	margin of cake, rather similar to item below, but probably deformed		
			t	670	1	part of SHC margin, crust thins from 25mm to 0 towards edge, lip is gently dimpled, top missing internally but shows coarse coralline with large equant olivine crystals		

<i>sample</i>	<i>context</i>	<i>feature</i>		<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
			t	670	1	part of SHC margin, crust thins from 25mm to 0 towards edge, lip is gently dimpled, top missing internally but shows coarse coralline with large equant olivine crystals		
				402	1	block with 10mm thick tubular-vesicular crust overlain by 60mm of more irregularly textured slag		
263	381	ditch c382, slot 6, 1st dump		2955	1	curious block with very thick crust 60mm, with overlying rubbly open-textured slag possibly pushed off and to one side during extraction, proportion not determinable		
				764	1	slab with proximal margin of moderately dense SHC, with this continuation of main crust continuing up towards tuyère attachment.		
				1315	3	open-textured SHC material, two probably broken margins, from centre of SHC		
263	381	ditch c382, slot 6, 1st dump	t	2530	1	massive block from centre of thick crust SHC		
				470	1	irregular 5mm crust around bowl with highly vesicular material inside		
			t	680	1	thick crust cake fragment		
				98	1	prilly slags attached to base of tuyère, descending to flat surface		
			t	750	1	fragment of thick crust SHC, broken and reheated and covered in maroon glaze		
			t	996	4	thick crust SHC fragments		
				246	1	rounded brown slag lump		
				434	11	slag fragments		
263	381	ditch c382, slot 6, 1st dump	t	5035	1	crust to 40mm with very large tubular vesicles, bowl fairly open, large quantity of material on proximal side rising 70mm above bowl top, this area has horizontal layers of rather prilly slag, upper surface of bowl with irregular smooth depressions and blisters in the superficial slag layer, with a top layer of 15-20 mm, base finely microdimpled - a very instructive piece	70	7193
			t	2025	1	160x(120)x100mm (of which bowl 70mm) thick crust SHC with irregular material in lumps on smoothish top	80	2531
263	381	ditch c382, slot 6, 1st dump	t	3485	1	(170)x(150)x140mm (of which bowl 110mm) SHC with incredibly thick crust which appears to have been two, roughly equal usage cycles, proportion difficult to assess - 50% is probably a maximum figure. Top rough.	50	6972
				550	8	SHC fragments		
276	381	ditch c378 slot 7			assm.	some magnetic slag fragments but no hammerscale		
272	384	ditch c382, slot 6, 1st dump (underwater)		258	1	slagged side of large tuyère with part of face, suggests 110mm height for tuyère		
				1000	1	block from centre of large SHC with multi-focus crust to 20mm overlain by 50mm of porous open charcoal-rich slag		
				884	1	saucepan-shaped slag block, possibly whole squeezed SHC	100	884
				706	1	worn block from centre of thick crust SHC, tool marks on base		
				346	1	(60)x(90)x35mm probably 70% of small conventional SHC	70	494
				156	1	fragment from small conventional SHC		
				130	1	rounded slag lump - possibly tip of conical SHC?		

<i>sample</i>	<i>context</i>	<i>feature</i>	<i>weight</i>	<i>no</i>	<i>notes</i>	<i>propn</i>	<i>orig</i>
			266	6	dense slag with flow lobes and dimples in various shapes		
			142	4	slag fragments		
272	384	ditch c382, slot 6, 1st dump (underwater)	528	1	proximal end of very thin crust SHC, crust to 5mm, overlain by deep layer with platy olivine crystals exposed, proximal end rusty with concentric rings of smooth blebby slag		
		t	1365	1	large block from SHC with crust to 40mm overlain by 50mm open slag, broken in hearth and upper slag moved on extraction, proportion not identifiable		
			1055	1	100x120x70mm, steep-sided SHC with charcoal-rich body and slightly lobate top	100	1065

Table 1: summary catalogue by context and sample. "t" = typical SHC texture, assm = microresidue assemblage from sieving

	Coolamurry	Navan	Gortnahown 2	Moneygall	Carrigoran	Parknahown 5	Trumra 4	Clonmacnoise (NG)	Woodstown 6	Clonmacnoise (WWS)	Clonfad	Borris (AR36)	Lismore/ Bushfield 1	Ballinglanna North 1
SHC count	41	17	90	22	18	89	57	258	140	38	381	88	23	65
SHC min. wt		60	78	114		86	92	54	68		60	154	426	86
SHC max. wt	2588	2990	3450	1800	3866	2898	3163	7815	6310	5540	11000	7440	4390	9267
SHC mean wt	386	507	519	527	553	567	727	762	1060	1087	1302	1618	1737	2854
% <500g	83%	82%	67%	55%	72%	70%	47%	52%	40%	39%	30%	22%	4%	17%
% <1000g	95%	88%	91%	95%	89%	84%	75%	78%	71%	68%	61%	41%	39%	22%
% >1000g	5%	12%	9%	5%	11%	16%	25%	22%	29%	32%	39%	59%	61%	78%
% >3000g	0%	0%	2%	0%	6%	0%	2%	3%	7%	8%	9%	16%	13%	42%
Modal 100g interval	100- 200	100- 200	100- 200	200- 300	100- 200	400- 500	100- 300	200- 300	200- 300	300- 400	300- 400	200- 300	500- 600	300- 400

Table 2. Comparison of SHC assemblages, ordered by mean SHC weight.

Assemblages ordered by mean SHC weight.

Coolamurry from Young, 2008a; Navan Site 1 from Young 2007; Gortnahown 2 from Young 2009f; Moneygall from Young 2008b; Carrigoran from Young 2006; Parknahown 5 from Young 2009c; Trumra 4 from Young 2008d, Clonmacnoise New Graveyard site from the author's work in progress; Woodstown from Young 2009d; Clonmacnoise Waste Water Scheme from Young 2005; Clonfad from Young 2009a; Borris (AR36) from Young 2009e, Lismore/Bushfield 1 from Young 2008c, Ballinglanna North 1 this study.

The assemblages from Coolamurry, Navan, Moneygall, Carrigoran and Parknahown are interpreted as being dominantly blacksmithing residues. The assemblages from Gortnahown, Carrigoran, Trumra, Clonmacnoise, Woodstown, Clonfad, Borris, Lismore/Bushfield and Ballinglanna North are interpreted as including bloomsmithing residues.

	SHC t	SHC	tongue	lining slag	smith	indet. slag	tuyère	flow slag	total
278	13635	10960	0	0	582	90	200	0	25467
338	10109	13601	0	132	0	992	252	82	25168
381	39653	34077	0	0	400	3006	650	0	77786
384	1365	4805	0	0	0	0	666	0	6836
{5005} primary dump total	64762	63443	0	132	982	4088	1768	82	135257
{5006} large dump [c222]	46782	18504	926	150	2224	2898	1062	1000	73546
{5007} intermediate silting [c134]	0	1028	0	20	0	408	72	262	1790
129/130	5884	0	0	0	0	322	0	0	6206
130	486	2027	158	0	0	522	0	0	3193
131	0	328	0	0	0	214	0	0	542
337	0	1505	0	0	0	0	0	0	1505
339	3965	2520	172	0	0	70	0	0	6727
{5008} secondary dump total	10335	6380	330	0	0	1128	0	0	18173
Ditch context void 314	3320	2867	0	0	0	840	8	522	7557
214 (pit [c213])	0	3350	274	0	0	176	294	82	4176
217 (pit [c213])	0	0	0	0	0	540	0	4	544
256 ([pit [c255])	0	0	0	0	0	634	0	328	962
{4001} metallurgical pits total	0	3350	274	0	0	1350	294	414	5682
261 (linear [c260])	0	182	0	0	0	26	0	0	208
265 (linear [c264])	0	0	0	0	0	52	26	0	78
{4002}?plough furrows total	0	182	0	0	0	50	26	0	258
230 (linear [c340])	342	630	0	0	82	0	0	0	1054
254 (linear [c370])	1375	1020	0	0	0	0	0	0	2395
256 (linear [c372])	684	0	0	0	102	22	0	0	808
329 (pit [c328])	0	1840	0	0	0	0	0	0	1840
{6001} & {6002} drainage total	2401	3490	0	0	184	22	0	0	6097
275	1570	0	0	0	0	0	0	0	1570
285	390	366	456	0	0	58	0	0	1270
structure total	1960	366	456	0	0	58	0	0	2840
{3001} pits ([c277] pit c268)	812	0	0	78	0	1298	44	432	2664
1	0	0	0	0	0	184	0	0	184
2	436	0	0	0	242	698	0	0	1376
6	0	0	116	0	0	0	0	0	116
19	0	1511	160	0	0	558	0	0	2229
162	0	0	0	46	0	232	0	196	474
309	1020	2350	0	0	0	0	52	0	3422
unstratified & misc. total	1456	3861	276	46	242	1672	0	196	7801
overall totals	131828	103471	2262	426	3632	13812	3326	2908	261665

Table 3: distribution of residue classes by context and context groups/subgroups. Possible fragments of iron ore and iron metal are excluded from this summary. SHC t = SHC with "typical" texture

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54 Heol y Cadno,
Thornhill,
Cardiff,
CF14 9DY.

<i>Mobile:</i>	07802 413704
<i>Fax:</i>	08700 547366
<i>E-Mail:</i>	Tim.Young@GeoArch.co.uk
<i>Web:</i>	www.GeoArch.co.uk