GeoArch

Report 2012/23

Evaluation of archaeometallurgical residues from Doneraile, Co. Cork (11E071)

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20th August 2012

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Abstract

The site yielded some metallurgical residues from a wide range of contexts, suggesting that some iron-working was undertaken in the area over a wide time period – although the low level of residues recorded from many of these contexts makes it hard to exclude either residuality or intrusion in many cases.

Significant levels of residues occurred in three areas:
Field 3: the uppermost fills of the recut of the enclosure ditch c146 and a waste pit (c425)
Field 4: a smithing hearth (c303) and adjacent ditches c273, c31, and c473.
Field 5: a smithing hearth (c065) and an adjacent pit (c061).

Residues from all three areas were associated with iron-working. All three sets of residues included evidence for the use of tuyères, indicating a date of sixth century AD or later. Discussion of the assemblages is based on current understanding of the stratigraphy and dating.

The materials from Field 4 were the most abundant, totalling some 236kg out of the overall 250kg of metallurgical residues from the site (189kg from ditch c311 alone). These materials were dominated by large smithing hearth cakes (SHCs), ranging up in weight to over 4kg and with an average weight of about 1860g. A common morphology for the SHCs was to have an open proximal bowl-like form, with the top of the thin basal crust reddened by oxidation and with a more distal accumulation of porous slag within the bowl. Forms of SHC with a thicker basal crust also occurred, but these appear at present to be variants of the more common style. Most of the small SHCs in this assemblage (<850g) had an unconsolidated appearance, often being a lose, porous amalgamation of prills. This assemblage is interpreted as being the residue from primary smithing (the conversion of raw blooms or part-compacted billets, into finished iron). These materials are believed to be later medieval in age.

Although the materials from Field 3 were broadly similar, the few reasonably intact SHCs recovered were small (mean weight of the four examples was 530g. Although this is a very small sample, it provides a hint that the activity conducted nearer the defended site was secondary smithing (the end use of iron, blacksmithing). These materials may be later medieval in age, based on their occurrence in the very latest fills of the enclosure ditch.

The ironworking features in Field 5 almost certainly include a smithing hearth (c065) and the second feature (c061 is of a size to be a potential smelting furnace base, but its enclosed residues were ambiguous. These materials are undated.

Further clarification of the dating of the various relevant features is required before the tentative relationships outline above can be confirmed.

Contents

Abstract 1
Methods 1
Results 2
Interpretation 3
Evaluation of potential 3
References 3
Catalogue 4

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. The summary catalogue of examined material is given in Table 1.

This project was undertaken for Rubicon Heritage as part of the R581 Doneraile to Newtwopothouse Road Realignment Scheme.

Results

Description of residues

Smithing hearth cakes (SHCs)

The vast majority of the residues are SHCs (or fragments). SHCs form in the lower part of smithing hearths, in front of the air supply (the tuyère in this case) and below the part of the hearth where the workpiece is heated. The SHC is produced by reaction of iron and iron oxides lost from the workpiece with silicate materials melted from the face of the tuyère.

Several distinct forms of SHC are now recognised (e.g. Young 2009a, in press), but are currently the subject of on-going research. These are currently loosely termed '*conventional SHCs*' ('**conv'** on Table 2; with variably vesicular and/or charcoal-bearing lower dense sections and upper often glassy sections), '*thin crust SHCs*' ('**thin asymm'**, '**bowl'** and '**thin'** on Table 2; with a dominant skeletal texture of large olivine crystals forming a meshwork) and '*thick crust SHCs'* ('**thick'** on Table 2; with a thick, dense lower crust, often with long, bladed, olivine crystals and tubular vesicles and often with large tabular vesicles just below the upper surface of the dense layer, which may be overlain by charcoal-rich slag, sometimes with an intervening void space). In each case the 'crust' forms a distinct layer of slag accumulating at the limit of downward percolation of the slag. In some cases this coincides with the physical base of the hearth, but may more generally relate to a surface (of ash/charcoal dust) prepared by the smith. The lower part of the SHC typical forms a more-or-less regular bowl shape, above the limits of which slag may also form, piled-up on the underlying materials. Sizes of SHCs are quoted as length x breadth x height (bowl depth). Figures of length, breadth or height quoted n brackets indicates the piece was broken in that dimension and the measurement is only partial. The bowl depth, where given is always quoted in brackets.

The SHCs from Doneraile are mainly rather large. They show a spectrum of morphology from the more dense examples of well-formed SHCs, with moderately thick basal crusts, below a rather wispy, porous slag, sometimes with a smooth blown top, through to much more porous SHCs with an open internal structure and a thin basal crust. One particular morphology that is characteristic of this site is one which the proximal (tuyère) end of the SHC has an open bowl, typically less than 15mm, with bladed olivine and tubular vesicles, with an upper smooth concave surface, and with the distal side having the crust overlain by wispy, porous slags. SHCs of this type are classed as '**thin asymm'** on Table 2, whereas the more symmetrical thin-crust types are labelled '**bowl'** and indeterminate thin crust materials simply as '**thin'**. Several specimens show a prilly internal overhang on the proximal end of the SHC – this appears to be related to slag prills being flowing along the base of an overhanging tuyère.
The smaller SHCs occurring alongside the large examples in Field 4 are typically poorly consolidated, often with little or no basal crust and an internal texture of poorly amalgamated descending prills.

In contrast, the few SHCs from Field 3 are all small, with a dense, rather conventional structure. The assemblage is too small to be statistically significant, but at least provides a hint of a difference between the SHCs in the two areas.

An interesting facet of the Doneraile SHCs is that only one example shows an upper glassy layer – this is usually found on SHCs from blacksmithing in hearths with a clay wall or tuyère.

Tuyères

Over 20kg of sherds of tuyères were recovered from the site. Detailed description of the tuyères would require some reconstruction of the broken fragments (see 'Evaluation of Potential' below), but they appear to be dominantly of a slightly oval cross-section, approximately 140mm wide, probably with a slightly flattened base. Some bases show some longitudinal curvature as well. The bore is typically of 20-25mm, but one piece shows the bore expanding rapidly into a bell-shaped void near the rear face. This rear part of the tuyère has rarely been adequately described and is an interesting aspect of the present material.

A small proportion of the material shows a recoating of the front face and adjacent parts of the sides – this is a rare feature. None of the material shows additional lateral ceramic to stabilise the tuyère (as seen at Ballykilmore; Young 2009a).

The tuyère fabric was generally a fairly fine, well prepared clay with moderate temper of up to gravel grade. Firing of the tuyères had, none-the-less commonly resulted in deep cracking and failure.

Other ceramic

A small amount of low-fired gravelly clay was also recovered from the fill of Ditch c311. This may have material from the substrate of a hearth – it was certainly not as refined as the tuyère material. An origin from the metallurgical activities is only assumed – the material was not certainly associated with the rest of the assemblage.

Fragments and fines

This heading in Table 2 refers both to material present in bags of debris from the washing of the main collected assemblage and to material collected from the retents of sieved samples.

Most of the larger fragments in these assemblages were fragments of SHCs and tuyères, comparable to the material described above. A small proportion of the material would be classifiable as fines (i.e. material originally formed as fine-grained particles). The collection of the retents seems to have been at too coarse a size for collection of true microresidue assemblages. Despite the wealth of macroscopic smithing debris, there is almost no hammerscale in the collection.

The fines include slag bodies that solidified with the fuel bed of the hearth, mainly as isolated blebs and prills. These are often difficult to attribute to either smelting or smithing (in the absence of finer microresidues). In most cases here an origin in smithing is reasonably certain, but some doubt is attributed to the sample from c061, which might possibly be from smelting.

Iron and iron-containing concretions

The proportion of concretions was very small compared to many sites. The cores of most concretions observed could not be determined – and might be metallic iron or slag containing metallic iron.

Two discrete pieces of iron were observed – a short length f iron bar from the revetted fosse (c373) and a broken piece of thin sheet iron from c160.

Distribution of residues

The distribution of residue classes by context is presented in Table 2. The archaeometallurgical residues were derived from a series of geographically-related contexts. The occurrences of residues are described briefly here by feature:.

Field 3: enclosure 175
The fills of the primary ditch (c175) yielded only a very small quantity of residues: sample 24 from c207 produced 8g of tiny slag particles, but material from c168 was natural Fe-Mn panning.

The lower fills (c144/c167) of the recut (c146) also produced a few tiny fragments of probable tuyère and some flake hammerscale, but, In contrast, the upper fills (c147/c169) contained 8.3kg of iron-working resides. These residues included smithing slags broadly similar to those from Field 4, but the three complete SHCs were all at the lower end of the weight range (460-610g) and of rather conventional appearance.

Field 3: linear c124
A fill of this feature also yielded a tiny quantity of residues (less than 1g of slag and single piece of flake hammerscale).

Field 3: pit c155
This pit also produced a tiny quantity (<1g) of slag debris.

Field 3: pit c159
Possible residues from this feature were actually mineralised pieces of very thin iron sheet, but the actual form of the artefact has not been reconstructed.

Field 3 drain c376
This produced a single, small, conventional style SHC weighing 454g.

Field 3: revetted fosse c370
Submitted materials from the fosse included natural materials and a short length of iron bar (c373), but did also include a tiny fragment of vitrified clay, probably a tuyère sherd (c378).

Field :3 pit c390
This pit produced a substantial fragment of an SHC (c401) as well a tiny number of smithing microresidues (c402).

Field 3: pit c425
This pit yielded an assemblage of about 7kg of smaller slag pieces from processed sample retents. Many of the pieces were strongly accreted and not identifiable, however the assemblage included material of the classes often accumulating within smithing hearths – such as minor prills, blebs and spheroids (of the 'coffee-bean' morphology), as well as fragments from larger slag pieces and sherds from tuyères. A very small quantity of hammerscale was observed, but it is not clear whether hammerscale was largely absent, or simply not collected by the sample processing methods.

Field 4: Structure 1
Three postholes (c185, c199, c203) in structure 1 produced very small quantities of residues from processed sample retents.

Field 4: structure 3
One posthole of structure 3 yielded a single small fragment of vitrified oxidised fired clay, possibly a tuyère fragment.

Field 4 hearth 303
Fill c304 of this hearth produced a moderate assemblage of smithing microresidues including small slag particles, spheroidal and flake hammerscale, together with abundant slag spheroids.

Field 4: Ditch 311
The fill of this ditch produced 189kg of picked macroscopic residues, together with a further 3kg of material from processed sample retents. This assemblage almost entirely comprised SHCs or parts of SHCs, but in addition there were 15kg of tuyère sherds (8% of the assemblage by weight).

Field 4: Ditch 273
The lower fills of this ditch produced 20.4 kg of residues, dominantly SHCs, but including 944g of tuyère sherds (5% of the assemblage)

Field 4: Ditch 347
The fills of this ditch produced 27kg of metallurgical residues, mainly SHCs, but including 954g of tuyère sherds (4% of the assemblage).

Field 4: limekiln c327
A fill of kiln (c332) included a single large SHC fragment.

Field 5: Pits c061 and c065
Hearth c061 produced a small quantity of slag and tuyère sherds. It would appear likely from the contents, burning and size that this was a smithing hearth. The presence of tuyère indicates a *terminus post quem* of 6th century. Adjacent pit c061 (west of c065 not east, as in the prelim report) also produced a small assemblage of microresidues from iron making or iron working. These could also be smithing residues, but given the dimensions of c061 (0.4m diameter), the possibility that this might be the truncated base of a smelting furnace should also be considered.

Field 8: boundary c007
A sample retent from this feature contained a tiny amount of slag. Other samples from field 8 proved entirely natural.

Interpretation

The evidence described above indicates a major focus of iron-working in the SW part of field 4. Here, the ironworking was probably associated with hearth c303, with major dumping of slag (189kg) into ditch c311. Ditch 273 also shows 20kg of slag in its lower fills, probably indicating this was also contemporary with the iron working. Overall 236kg of residues were reported from from Field 4, out of the 263kg total collected materials from the site.

Dating of this activity is currently only through the minor occurrence of residues (12kg) in a context apparently tipped into ditch c347 from the N side (c353). Other contexts in ditch c347 contain insufficient slag to argue for a direct relationship. Upper fill c349 does also contain a significant amount of slag (11.9kg), but this material is noticeably weathered and may have been derived from slag dumps outside the ditch well after the period of activity. If the evidence from c353 is accepted, then the iron-working is likely to have been of 13th-15th century age. However, residues might have entered ditch c347 from pre-existing adjacent dumps and an earlier date for the iron-working is possible.

The work undertaken the area of Field 4 would have been the production of finished iron from raw blooms. The SHCs from ditches c311 and, c273, together with those from ditch 347 and a (?) residual example from the fill of the limekiln give an assemblage of 67 examples, with a mean estimated original weight of 1861g, with a range of 276g to 4550g. 69% of SHCs, for which the original weight could be estimated, weighed over 1000g (Table 3).

Detailed interpretation and comparison of the SHCs from the main Field 4 contexts would require further analytical investigation, but it is interesting that there is, within a spectrum of morphology, a clearly dominant type. This morphology shows the development of an open bowl with a thin crust, below the tip of the tuyère, which overhangs the bowl margin. The slag below the tuyère tip shows a dimpled blebby texture that taken in isolation would normally be interpreted as having formed the other way up. In the cases where the relationship is sufficiently well seen, it would appear the base of the tuyère lies at about 100-120mm above the base of the bowl (which presumably represents the level of hearth floor prepared by the smith before the work period), with the tuyère projecting at least 60mm in some instances (although the hearth may have retreated below the tuyère during the period of working).

In addition to this morphology, many of the cakes show a more symmetrical morphology with the blown surface less offset from the main slag accumulation. Fragments of cakes show that the development of a thick lower crust is common – probably through evolution of the above types – rather than through a different mechanism.

The exception to this are a few pieces of thick crust cake with a rather small overall size, a strongly reddened top and a distribution of fine spherical vesicles through the crust. These bear some resemblance to slag cakes produced during steel production by remelting (the so-called Aristotle process), but there is no compelling evidence to make this identification.

This is a remarkable collection of SHCs with very few comparative assemblages having such a high average weight. Those that are currently known (such as Borris, and Lismore-Bushfield, see Table 3) are of early medieval age. The persistence of iron-working technology from the early medieval period through as late as the early post-medieval has been documented, with the best known later medieval iron production assemblage being that from Ballykilmore (Co. Westmeath; Young 2009 ,in press). At Ballykilmore a probable smelting furnace pit dated as 14th-15th century (^{14}C date of cal. AD1298-1371 and 1378–1407; UBA 8368) probably predated most of the primary smithing residues, which are therefore possibly slightly younger than those of the presumed age of the residues from Doneraile.

The Ballykilmore assemblage differs from that at Doneraile in several important aspects: the SHCs are rather more iron rich, they are typically smaller, including more in the more typical blacksmithing residue weight range and the associated tuyères at Ballykilmore are much larger, with secondary clay added at the side to stabilise them.

The Doneraile Field 4 assemblage has much more in common with assemblages from Lismore-Bushfield (Young 2008b) and Borris (Young 2009b). Simlarities include the overall weight-frequency statistics of the SHCs (Table 4), SHC structures and textures, as well as the size of the associated tuyères. These sites are, however, early medieval in age.

It seems clear that a 'package' of iron production techniques, including a variety of 'slagpit' style non-slag tapping smelting furnaces, the use of large ceramic tuyères for smithing and a technique entailing the production of very large slag cakes, particularly during bloom refining, became established (perhaps through introduction from outside) in the late sixth or early seventh centuries. This package then remained the stable method of iron production until the 17th century, at least in the areas of less Anglo-Norman influence, although in the post-medieval period iron increasingly became produced by the indirect process (blast furnace and finery forge) both from sources in Ireland and from outside.

It has been argued (Young 2009c) that iron production became more centralised during the medieval period, with much more of the iron reaching the end-user blacksmith being in fully refined form by the 14th century than it had been in earlier periods. It is possible that the primary smithing at Doneraile represents one such centralised source.

The occurrences of iron-working residues outside the main deposits of Field 4 are more problematic. The minor occurrences in Field 4 (in the postholes of structures 1 and 3) are of very small quantities of material and might well be intrusive.

In Field 3 there is probably sufficient material from the earlier fills of ditch c175 and its recut to suggest some early medieval iron-working somewhere nearby. The more significant deposits of residues – in pit c425 and the uppermost fills of c146 are not closely dated. The stratigraphic position of those in the recut enclosure ditch suggest an age after abandonment of the enclosure. Both occurrences could be later medieval (c425 is truncated by the post-medieval fosse). These contexts produced just four SHCs (including one probably residual example from post-medieval drain), but these were of consistently small size (450-610g), were of rather 'conventional' appearance for a small SHC (i.e. they were not the rather prilly, unconsolidated cakes that characterised the smaller components of the Field 3 assemblage). These SHCs

were more similar to examples from other sites interpreted as blacksmithing, such as Garyleagh (Young 2009c) and Coolamurry (Young 2008a).

The final component of the iron-working story is presented by two features at the northern end of field 5: c061 and c065. Of these, pit c065 was elongate, with a burnt margin and contained some smithing slag and sherds of tuyère, suggesting it was a smithing hearth, whereas pit c061 was small, sub-circular and yielded microresidue that could either be from smithing or smelting. The size of this pit is compatible with it being the truncated base of a slagpit smelting furnace (Carlin 2008, Illus. 5.2), The presence of sherds of tuyère in c065 would indicate a post-6th century date for this activity.

At Doneraile it is possible to suggest, with some caution, a possible separation of tasks. The iron-working in the western part of Field 4 represents primary smithing, whereas the much lesser amount of evidence from Field 3 hints at secondary smithing. Further dating would, however, be required to determine if these activities were actually contemporary.

Evaluation of potential

The main potential for further investigation of the Doneraile metallurgical assemblage derives from the presence of large, coherent, assemblage from a single context. Moreover, that context is arguably associated with an adjacent hearth. This provides an excellent opportunity for the characterisation of the process being undertaken here. On the available evidence that process is interpreted to be primary smithing. Further analysis would not only help to define the nature of the process, but also should be able to provide evidence to help characterise the source of the iron.

It is recommended that an analytical programme focuses on material from c311, with analysis of representative examples of the different classes and sizes of SHC, analysis of the tuyère fabric (as the silicate input to the slag system), and, in addition, analysis of the fines from both hearth c303 and pit 061.

Further work on the assemblage should also include further clarification of the morphology of the tuyères.

This report and the recommendations for further work should be reviewed in the light of scientific dating for the site as it becomes available.

References

CARLIN, N., 2008. Ironworking and production: an evaluation and assessment of the metallurgical evidence, in: N Carlin, L Clarke and F Walsh, *The Archaeology of Life and Death on the Boyne Floodplain: The Linear Landscape of the M4*, 87–112, Dublin, National Roads Authority, Wordwell.

YOUNG, T.P. 2008a. Archaeometallurgical residues from Coolamurry 7, 04E0323. GeoArch Report 2006/10. 46pp.

YOUNG, T.P. 2008b. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Lismore-Bushfield 1 (E2220). *GeoArch Report 2008/27*

YOUNG, T.P. 2009a. Archaeometallurgical residues from Ballykilmore, Co. Westmeath, E2790, GeoArch Report 2009/16, 81pp.

YOUNG, T.P. 2009b. Evaluation of Archaeometallurgical Residues from the M8/N8 Cullahill-Cashel: AR36 (E2941), GeoArch Report 2009/31, 17 pp.

YOUNG, T.P. 2009c. Evaluation of archaeometallurgical residues from the N8 Fermoy-Mitchelstown, Garryleagh, Co. Cork (E2433), GeoArch Report 2009/47, 10 pp.

YOUNG, T.P. 2012. Evaluation of archaeometallurgical residues from Ardreigh, Co. Kildare, [00E0156] . GeoArch Report 2012/08, 34pp.

YOUNG, T.P. in press. Appendix 2. Exploiting the bog: iron production and metalworking. In: P. Stevens & J. Channing (ed.) *Settlement and Community in the Fir Tulach Kingdom*. Westmeath County Council.

Table 1: Summary catalogue by box, context and sample.

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
box1					
313	11	1244	7	tuyère sherds, including some resurfaced material	
		968	1	very poorly consolidated SHC - a mass of poorly linked prills around fine charcoal with just small areas of a basal dimpled crust, top wispy material incorporates large (60mm) delicate rounded voids, (130)x160x100mm.	968
		3010	1	very irregular SHC, 280x220x120mm, shallow bowl (80mm) at one end, slightly dished fill with smoothed surface to wispy slag, then irregular lumpy-based flange with somewhat concentric top and rectangular outline, base has several rounded lumps adhering - unclear if penetration of slag into base or pre-existing slag lumps	3010
		550	1	poorly consolidated strongly asymmetric oval SHC, plano-convex, blebby/prilly charcoal rich slag, 130x110x55mm	550
		2005	1	90% of asymmetrical SHC, medium (20mm) crust bowl with smooth interior dished surface at one side and probable lateral extension where bowl infilled by more wispy material. The base of this expansion is cracked, base mainly smooth, hard, microdimpled - but regions of escaped small-scale prills too	2222
		994	1	proximal region of lip of SHC with smooth bowl interior, crust 10-20mm, with marked overhang in friable material, base hard and ridged	
		922	1	fragment of rim of open smooth-bowled SHC with flat-topped overhang, crust to 25mm with tubular vesicles, base locally slightly blown? and in places has adhering clay	
		1310	1	unusual piece of SHC, hard broadly-lobed base, biconvex, wispy top, dense so must have good crust (hidden), - possibly a flange similar to ones described above? Very irregular so cake size not determinable - probably not an object in its own right ,but just possible	
		3295	19	fragments of thin crust style SHCs - some showing open smooth-interiored bowl	
		556	1	odd fragment, moderately thick crust bowl from SHC, passing up into large smooth-surfaced void, dense above that then up-facing prills - its this an odd development below tuyère or a folded open-topped bowl?	
		1320	1	deformed block from margin of a medium crust SHC with open bowl at one end, filled with wispy material at the other - cake size not determinable though probably >3kg	
		544	1	rounded end to SHC with crust to 30mm overlain by friable charcoal-rich coralline material	
		392	1	SHC fragment with broadly lobate dense base to 30mm crust well developed tubular vesicles	
		464	1	SHC bowl fragment with medium crust (20mm), bowl partially filled with fired clay fragments	
		126		bag of bits	
box 2					
313	11	3165	1	large-bowl shaped SHC, shows smooth surfaced concave blast area in a typical medium/thick crust cake, 210x(180)x100mm, crust only c10mm on edge with large tabular vesicles above, but presumably much thicker in middle(good for sampling) c. 85%?	3724
		2785	1	smooth blast area proximally, irregular wispy charcoal-rich top elsewhere, (200)x(220)x70mm, c65%	4285
		2078	1	large friable SHC with coalesced lobe-like texture, irregular so proportion uncertain but probably near complete, 170x200x100mm	2078
		1285	1	rather friable SHC, thinnish crust with tubular vesicles into overlying 'coralline' material, locally deformed? Smooth top, 140x190x110mm, base microdimpled, probably slightly folded	1285
		1020	1	fragment of smaller version of the 'blown bowl' SHCs above, (130)x170x80mm, 70%?, crust to 15mm	1457
		1090	1	large piece of a friable SHC similar to others here, proportion uncertain	
		872	1	fragment from dense thick crust SHC, unlike others in this collection, crust to 40mm, with rounded vesicles, top smooth, dimpled, 65 deep, c. 70% of small cake	1246
		674	1	poorly consolidated prilly SHC, very porous between prills, probably essentially entire, 150x130x75mm	674
		490	1	poorly consolidated prilly SHC with very rusty top, 130x100x60mm	490

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
		782	1	unusual SHC with smooth-blown proximal flange, passing into charcoal-rich material above, highly oblate, open flowed base, 140x140x100mm, possibly formed above stone hearth side - may just have connected with other more distal slags	782
		630	4	tuyère sherds	
		696	1	small piece of the blown section of an SHC similar to the examples above -crust of coarse olivine to 25mm below blown surface	
		1280	1	rather friable SHC, broken on one edge where large carbonised fragment cuts right across (minimum size 100x40mm). 190x(140)x70mm, wispy top, probably smooth on fractured end, base microdimpled	see * below
		612	1	SHC fragment with crust 25mm, overlain by wispy charcoal-rich material, rounded cake end - so size original uncertain, 140x(70)x60mm	
		592	1	irregular SHC fragment, but similar to others except has basal lobes/tool marks/retained clasts	
		582	1	SHC fragment with well-developed base of flattened flow lobes, charcoal-rich top, original size uncertain	
		2610	10	SHC fragments, similar to above, with a moderate crust where present	
		48	assemblage	small bag of fragments	
		564	1	fragment from burr of SHC, with smooth-blown proximal end, burr deep, rounded with very long tubular vesicles	
box 3					
313	11	4235	1	large complete SHC, no smooth surface, but otherwise similar to those in that suite, 270x240x90(5o)mm, bowl filled with charcoal-rich slag with hints of smooth surface buried on one edge, base well-formed	4235
		1285	1	wispy/prilly/porous SHC, dished top, rather nebulous base because of prills, 160x190x80mm	1285
		846	4	tuyère sherds	
		1190	1	* conjoins truncated example above with stick on fracture (overall 240x190x80mm)	2470
		446	1	important piece, shows steeply-dipping smooth blown area, 20mm crust, dropping 80mm at 70mm in from blown margin with flat lying prills (with inverted appearance!) above - indicating slag drips chilled on planar base of tuyère	
		1125	1	large piece of side of SHC with slag dipping 90mm down 110mm in, crust c20mm, overlain by porous slag to planar overhanging top	
		6380	9	large pieces of SHC with partial smooth blown tops, none indicative of overall size	
		338	1	SHC fragment with planar top over a dense bowl, has large probably unroofed void at top with 'micaceous' shiny lining, away from this there are deep dimples, crust to 30mm, overall size at best probably only moderate, but not estimatable, base shows several different rounded lobe-like curves	
		658	1	friable charcoal-rich mass, possibly a deformed small SHC, 130x90x80(40)mm	658
		872	1	small flat but biconvex friable SHC, charcoal-rich, 140x130x60(30)mm	872
		264	1	prilly SHC fragment incorporating fired clay from hearth side	
		220	1	porous vesicular SHC burr fragment	
		414	1	prilly SHC with firmer slab-like top, broken and proprtion uncertain, but possibly effectively whole, 110x110x60mm	414
		1080	3	irregular SHC fragments showing prilly textures leading to high degres of flowage	
		66	assemblage	bag of bits	
		1125	4	variable SHC fragments	
box4					
313	11	1735	4	tuyère sherds	
		3285	1	c80% of concavo-convex SHC with funnel-shaped smooth top over wispy/blebby slag. Bowl probably has moderate crust in the centre (not seen) 210x(170)x100mm	4106
		1500	1	c.70% of SHC with moderate crust and bowl filled and piled with wispy porous slag, 170x(130)x75mm	2143

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
		2895	1	complete SHC with open concavo-convex bowl with smooth-blown interior and with wide flange to one side. Base marked by transverse ridges/grooves below flange - does this show extraction or formation over steps in hearth floor? Base of bowl interior shows an angular lump - presumably an incorporated broken crust fragment (excellent piece worth illustrating?) 250x210x90mm	2895
		574	1	block of dense SHC crust to 25mm with smooth-blown top curving up into side with overhang and 'inverted' blebby contact - suggesting tuyère overhang of 60mm, bowl 100mm deep. Slag coarse bladed olivine with tubular vesicles	
		1240	1	block of open SHC bowl with smooth blown interior. Very thin crust, overhang of wispy material, bowl 130mm radius and 90mm deep. Bottom of overhang sharp - almost like tide line resting upon now removed contents, but presumably this is not the case.	
		3965	8	large fragments from thin crust SHCs, where a crust is developed shows tubular vesicles and bladed olivine, up to 80mm twigs in one piece, some pieces show piled low-density lobe structures with large rounded interior vesicles	
		1655	1	unusual probable SHC. Lower part includes (distal?) well-developed flow lobes, very poorly developed microprilly lower surface, upper surface and bulk of body is of poorly consolidated charcoal-rich material, presumably complete, 190x160x90mm	1655
		486	1	probably complete, small poorly-consolidated SHC, slightly concavo-convex, 120x100x50mm, smoothish top at one end, upper moderately dense slab, lower slightly microprilly, all charcoal-rich	486
		186	assemblage	bag of bits	
		532	1	fragment from lip of SHC with smooth-surfaced inner bowl with tubular vesicles, which actually overlies some more charcoal rich slag	
		632	1	fragment from margin of SHC with medium crust and bowl filled by friable charcoal-rich slag	
box 5					
313	11	2595	16	tuyère sherds	
		2705	1	large prilly SHC, 180x200x110mm, very poorly developed crust (locally absent) bounds prilly mass with moderately large charcoal, top wispy unconsolidated, very slightly dished. Sides steep	2705
		1041	1	large mass of very friable charcoal rich slag - ore charcoal bound by slag, locally undulating smooth surface on top, 170x160x100mm fragment	
		938	1	90% of a miniature version of the large friable SHCs with smooth blown end, poorly developed in some respects but essentially similar, 110x150x60mm, distal end shows lip as stack of flow lobes	1042
		672	1	large part (possibly even all) of an unconsolidated prilly SHC with carbonised straw in core. Base shows well-developed prills, top undulating but smooth thin layer	672
		1395	7	fragments of SHCs with thin crusts	
		2565	4	fragments of SHCs with thick crusts, up to 40mm, bladed olivine, usually abrupt top to puddle, but sometimes gradational (rapidly) to 'coralline' texture near margins	
		792	1	part of margin of moderate SHC with open bowl and concentrically-ridged narrow rim, thin crust at most, probably slightly deformed, proportion not known possibly around 50%	
		116	assemblage	bag of bits	
		84	3	fragments showing well-developed flow lobes - still SHC material though	
		498	1	fragment from rim of open bowl SHC, outside has broadly lobate morphology, thin crust	
		850	1	block from margin of large SHC with moderate crust, irregularly lobate/stepped outer surface, wispy in bowl	
		104	1	fragment from lip of SHC with delicate crust with smooth-blown interior	
		358	1	irregular SHC fragment with moderate crust and wispy textures	
box 6					
313	11	4550	1	good example of SHC with smooth-blown proximal end, piled high distally, 250x220x120(90)mm	4550
		3300	1	large wide friable SHC with deeply dimpled/wispy top, base well-formed fairly smooth, plano-convex, 230x270x100(80)mm	3300

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
		1810	1	large SHC fragment with large flat, smoothish top on one side, (170)x190x70mm, crust poorly developed, contains a 100mm long twig, 80%	2263
		796	2	substantial SHC fragments in usual style with smooth-blown top	
		3320	6	SHC fragments, similar to more complete material but original size not determinable	
		644	1	c75% of small SHC, poorly developed crust, porous above, planar charcoal-rich top, 130x(110)x55mm	859
		312	1	mass of well developed large prills with voids between - possibly a small porous SHC, 110x80x60mm	312
		120	1	slightly haematised large flow lobe with charcoal impressions on base (cf. very rough tap slag)	
		308	2	tuyère sherds	
box 7					
313	11	1998	10	tuyère sherds	
		1710	1	190x140x65(35)mm complete elongate SHC, crude concentric pattern on raised wispy top, base irregular multi-lobed with poor possible tool marks, distal margins with hint of wispy flowage	1710
		3620	1	240x200x120mm, large SHC, probably thin crust with wispy appearance, broadly plano-convex but with some raised patches of wispy material on top, base neatly rounded but with broad lobes (poor toolmarks?) on proximal side	3620
		2340	1	200x170x80mm, mainly plano-convex SHC with top of smoothed wisps, base irregular, formed of poorly-developed prilly broad lobes	2340
		490	1	110x130x65mm, asymmetric poorly-consolidated small SHC, barely-linked prills with smoothed wispy top	490
		1760	6	pieces of thin crust SHCs of typical type for this site	
		1765	1	distal half of SHC with open smooth-interiored bowl and distal high pile of wispy charcoal-rich slags and flow lobes extending from distal bowl lip. 180x(150)x110(50)mm, base shows some rounded broad lobes, crust to 30mm with lower 10mm having tubular vesicles. Fresh break so other part probably in collection. estimated 65%	2715
		1280	1	strange block of slag with prilly base, smoothed top and irregular sides, probably part of SHC similar to the 2340g piece above	
		236	1	lump of irregular gravelly fired clay, variably buff/reddish	
		58	assemblage	bag of bits	
		1005	1	large block of thicker crust SHC of uncertain size, crust to about 20mm with quite dense irregular bowl fill	
		894	1	section from a deep SHC with a moderately -thick well developed crust and dense bowl fill, raised charcoal-rich material on top (probably only c. 20%)	
		778	1	part of thin crust SHC with open thin bowl, but with denser earlier small puddle adhering at an angle to the base	
		900	3	smaller thick crust fragments with little evidence for SHC size	
		624	1	fragment from lip of very fractured or lobed dense SHC	
box 8					
313	11	2878	21	tuyère sherds	
		196	1	low grade ore with quartz	
		2865	1	complete linguoid SHC with concentric top and tiny area of glaze, 190x190x90(50)mm, biconvex, top irregular, base well formed - good example of large simple SHC for analysis?	2865
		1835	1	part of SHC with proximal flat-topped puddle and distal wispy material raised above flat surface, edges of flat also raised; 190x(170)x70mm, c. 70%	2621
		1210	1	(115)x150x90(60)mm, dense but porous plano-convex SHC with adhesions above and below, probably c. 70%	1729
		1305	1	part of biconvex SHC , dense but porous as item above - also probably c70%	1864
		584	1	piece from dense but porous SHC - appears very fresh	
		3345	10	fragments of thin crust SHCs with friable bowl fills, but with little to add to overall description	
		906	3	fragments of fairly thick crust, irregularly-based SHCs with very prominent angular toolmarks	

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
		1725	5	fragments of SHCs with rather thick crusts up to 30mm with either smooth interiors or wispy bowl fills	
		114	2	flowed slag fragments	
		56	assemblage	bag of bits	
box9					
313	11	46	assemblage	bag of bits	
		3665	1	95% complete large irregular cake with proximal blown surface, 250x200x120mm, very odd shape, probably deformed on extraction with distal end moved down	3858
		2535	1	large wispy SHC with slight biconvex form and blown smooth distally in small area, overall shape linguoid, 220x180x100(60)mm	2535
		1715	1	large part of a prilly SHC, 200x(130)x90, overall proportion not clear - apparently a thin crust linking the missing part to a thicker slag at the preserved end	
		1835	9	tuyère sherds	
		1990	1	highly piled SHC with slightly blown wispy top, base well-formed but irregular, 180x130x100(40)mm	1990
		742	2	proximal fragments from SHCs with thin smooth-blown bowl sides	
		3280	6	fragments of very unusual cake, presumably SHC, type in which well-formed base is corrugated or lobed, upper part also with oddly laminated/foliated lobes - this needs re-examination	
		298	1	small discoidal SHC with flat top with dimpled charcoal, overlain by more friable charcoal-rich material, 95x90x40(20)mm	298
		204	1	tip of a small plano-convex SHC with dense slag to top, very neat and dense, no clues to original size	
		866	1	very dense SHC fragment, smooth-blown dished top and sides. Very coarse large equant olivine - cf. Aristotle cake? C. 70% if regular	1237
		4080	14	fragments of SHCs of typical form - up to medium crust, often rather prilly if unconsolidated, no clues to overall size	
		626	1	fragment of a small thick crust cake, crust to 40mm, biconvex cake with dense layer top overlain by more accretionary material, size unknown	
box10					
313	11	1320	bulk	bag of fine debris - much of this is ceramic	
		1855	1	part of large wide SHC, (140)x220x85mm, crust to only 15mm, mostly rather friable slag, c.75%?	2527
		1575	1	well preserved large SHC, (140)x170x105mm (40mmon top-55mm bowl- up to 30mm pendent lumps, crust to 25mm, main cake slightly biconvex with smooth top, 95%	1658
		1400	1	essentially complete SHC, main crust to 20mm overlain by more porous material, has dense pendent lobes, 160x150x80mm with the deepest part proximally, has localised smooth blown top	1400
		1540	1	probably c80%of large friable SHC, 200x200x100mm, concavo-convex shape but irregular and hard to orientate	1540
		1195	1	large fragment from broken thick-crust SHC; crust apparently to 100mm	
		870	5	fragments from SHCs with very large bladed olivine to smoothish surface, maximum crust thickness only 20mm	
		1270	1	fragment of thick crust SHC with local smooth top, no more than 30%, internally rich in rounded vesicles despite density, crust to 45mm below smooth topped area, but internally very variable	>4kg
		3000	17	fragments from large porous SHCs	
		2720	7	SHC fragments with moderate to thick crusts	
		190	10	small SHC fragments	
		2095	20	tuyère sherds	
		1840	5	slag masses, mainly porous, with tuyère attachments, 1 has large porous SHC side with flat base of tuyère 60mm above the bowl top - bowl crust being 15mm, bowl seen to 50mm but thickening at fracture	
		84	1	possible low grade ore fragment	

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
		292	1	indeterminate corroded slag fragment	
		384	2	irregular slag sheet fragments - possibly torn SHC crusts?	
Box 11	Box				
147	5	8	2	tuyère sherds	
371	14	454	1	small neat dense SHC, 100x80x45mm, slightly biconvex in irregular way, surface not well preserved - so few details observable - apparently contains metallic iron	454
		2050	5	cemented limestone/sand breccias	
374 (error?)	7	1400	2	large SHC crust fragments similar to the dominant thin crust types in the ditch, both worn, crust up to 20mm	
		756	7	tuyère sherds - one with good wood ash glaze on side	
		348	1	possibly incomplete small rather lobed SHC, 90x105x50mm, irregular, porous	348
		276	1	dense toolmarked slag with charcoal impressions on top - probably SHC, 120x70x30mm	276
		826	3	SHC fragments showing a thick crust	
		330	1	SHC fragment, basal charcoal-rich material overlain by strongly curved crust 8-30mm thick, with large, well-developed, olivines protruding from upper surface	
		638	1	irregular slag lump with lobes protruding from various faces, probably not a discrete SHC	
		628	7	weathered porous slag fragments	
274	7	988	2	fragments from the centres of thick crust SHCs, vesicular dense crusts to about 30mm, overlain by as much again of more porous material	
		1410	1	50% of thick crust SHC, basal crust 20mm, then void with some dense material above, before top of more porous material, 190x(110)x80(55)mm	2820
		734	1	Smaller fragment from very similar SHC to 1410g piece above, crust around 45mm	
		902	1	large slab from base of thinnish crust cake, with porous slag above, dense basal hard smooth surface interrupted by two sub-horizontal prodded tool marks	
		606	1	block from centre of SHC, base shows non-wetted tiny prills - almost like those of a grass-filled smelting pit, overlain by dense crust, locally to 20mm but impersistent, then porous material with smoothed dark top	
		1830	12	fragments from thinnish crust SHCs	
373	16	332	1	concreted iron bar, starting to explode, 85x20x20mm	
		1060	2	natural concretion of limey gravel	
410	18	68	1	small concretion	
		246	1	fragment of SHC basal crust to 20mm	
378	15	34	1	vitrified oxidised ceramic - probably a tuyère sherd	
348	19	284	1	concretion - possibly slag with iron or just iron	

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
		518	1	upstanding lip of strongly haematised slag with steep wall below, bowl filled with blebby slags, probably from a large SHC of the type seen in the ditch , but rather deeper	
box12					
313	8	914	total	assemblage of slag and tuyère debris, fresh, similar to that in ditch, only oddity is a piece of blebby slag with a strong black glaze on upper surface - presumably from in front of tuyère	
274	6	1870	1	irregular SHC, upper dished bowl, apparently attached to, or leaking, more flowed material forming a plate extending from the lower part of bowl, 200x180x70mm; main bowl c160mm diameter, dished top, possibly not leak - maybe just lower crust, top smooth with charcoal impressions, base dense, microdimpled, irregularly lobate on extension	1870
		1760	1	90% of rather weathered dense deep bowl-shaped SHC - crust must be thick in core (150)x(160)x110mm	1956
		1750	1	90% variant on thin crust SHC with blown patch - has central dense blown patch with wings either side - at least one of which has a blown top too. 240x160x70mm, irregular overall shape	1944
		138	1	tuyère sherd	
		1565	1	80% of dense SHC with very irregularly tool-marked base, 150x(140)x80mm, crust to at least 40mm, plano-convex, top blebby	1956
		724	3	medium thickness SHC crust fragments	
		802	1	worn slag piece in which a very coarse grained dense base passes up into a highly vesicular top. Unfortunately no real clue as to how much is missing on edges and above	
312	9	618	total	assemblage, with slag fragments, blebs and sheets, tuyère sherd, fired gravelly clay and dense iron rich cherty rock, some thin sheets that might be slag flats or slag spalled from stone surface?	
66	1	250	13	tuyère sherds	
		82	1	rusted slag sheet, thin, charcoal impressions on top - probably thin crust SHC fragment	
332	10	1055	1	large piece of SHC, rather conventional-looking thick crust to 35mm, dimpled porous slag on top, base neat, well formed, 180x(100)x60mm, tubular vesicles, c55%	1918
144	2	486	1	broken weathered smallish thin crust SHC fragment, charcoal-rich throughout, well-formed base but effectively no crust, slightly 'smoothed' top	
		1305	6	fragments of thinnish crust SHCs	
		488	1	rounded slag lump of uncertain origin - very weathered	
		256	9	smaller slag fragments	
168	4	2735	total	many pieces of Fe-Mn pan	
167	3	390	1	cf. 802g SHC piece from c274, but basal crust finer grained, similarly highly vesicular top	
		434	1	block from centre of thin crust SHC with toolmarks on base	
		302	1	100x(75)x40mm, large part of small dense rather conventional SHC - perhaps 50%ish	604
		278	1	100x(60)x40mm, part of a small conventional SHC - 60%	463
		608	1	strange elongate cake - possibly complete SHC, 150x80x65mm, roughly plano-convex	608

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
		1295	8	small SHC fragments with thickish crusts	
		2012	39	small pieces of porous and/or thin crust SHC types	
		454	1	irregular somewhat SHC-shaped lump with dense microdimpled base and impressions on top - but could be just part of a larger piece, irregular	
Box 13					
349	12	322	2	fragment from SHC with flat red top and raised edges. Contains small spherical vesicles amongst some large equant fayalite. A rather odd piece that might possibly be an Aristotle cake. (80)x(65)x35mm	
		482	1	probable chert block, one planar face one with odd mottle texture	
		146	1	tuyère angle sherd	
		614	1	130x110x60mm concavo-convex (slightly) very weathered SHC, weight will be low, surface details obscured	614
		3235	1	broken deep, thick crust style SHC, (140)x170x95mm, crust to 40mm, bowl piled high with rather blebby upper layer, base very well formed with some possible toolmarks c85%	3806
		2195	1	central section of a large moderately thick crust SHC with bowl filled and top overlain by charcoal rich slags, (130)x(150)x115mm, crust to >30mm, bowl c65mm deep, c60%	3658
		752	1	most of elongate SHC with flat charcoal-rich top, base concealed, 145x115x55mm, edges knocked but essentially complete	792
		1180	1	large slab of charcoal-rich slag with planar base- presumably SHC pulled from stone-floored hearth	
		452	1	irregular, essentially complete SHC, 120x95x50mm, possible toolmarks on base, top flat, concealed, large internal void, vesicular slag	452
		552	1	fragment from large thick crust SHC	
		478	1	flattish weathered SHC, probably mostly complete, 130x(95)x55mm, proportion hard to judge - possibly c. 90%	531
		282	1	obscured but probably a dense rounded stone rather than slag	
		418	1	irregular charcoal-rich porous slag slab	
		186	1	highly weathered margin from large SHC	
		252	1	moderately thick crust SHC fragment with rounded protrusions on base	
		290	1	rounded concretion - probably on corroded iron	
		32	1	indeterminate slag fragment	
Box 14					
353	13	394	1	flattish SHC, strongly prilly base, upper part rather platy - possibly because of flat charcoal clasts, some clasts are large. Top possibly missing, but essentially complete, 100x115x45mm.	394
		1000	1	heavily-accreted piece of thick crust SHC, bowl c60mm deep with crust 30mm, at least 200mm wide, accretion obscures detail	
		3170	1	heavily accreted slag lump, probably large SHC, charcoal-rich area exposed	
		40	15	bag of indeterminate slag and accretion fragments	
		468	6	vitrified oxidised ceramic tuyère fragments	
		812	1	probably c60% of flat topped oval SHC, rather weathered (115)x130x55mm, prominent toolmarks on base, top shows exposed large rounded vesicles, so top missing	1353
		1040	1	large dense block of possible iron ore - appears a conglomerate of fine-grained pieces, has one smooth, rusted? surface	
		1050	1	large accreted fragment of thick crust SHC, (150)x(120)x60mm crust to 30mm, long bladed fayalite, details obscured	
		1030	1	heavily accreted SHC fragment, probably from a large cake but all obscured	
		2225	5	heavily accreted SHC fragments - all possibly from large, or thick crust cakes, but details obscure	
		330	1	heavily accreted tuyère/lining slag fragment	

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
		430	1	accreted and overgrown charcoal-rich slag block	
		32	1	prilly slag nub	
		32	1	charcoal-bearing and vesicular slag fragment	
Box 16					
426	51 (retent)	1855	assemblage	assemblage of small slag fragments, coarser microresidues and abundant tuyère sherds. Traces of flake hammerscale, many small prills, and coffee bean spheroids. Accretionary material fairly clean	
426	55 (retent)	2415	assemblage	assemblage of slag fragments and tuyère sherds in a brown accretionary matrix rich in fired material (ash…) and charcoal fines, but not microresidues. Lacks fine flowed material seen in 51	
426	55 (retent)	2755	assemblage	slightly larger pieces than in bag above, all very weathered and accreted so no details recordable	
313	36 (retent)	696	assemblage	fresh material, mostly small bodies - coffee beans, prills, other flow slags, platy pieces and tuyère sherds. There are some fragments from larger slag cakes, but mostly this seems like small residues	
312	35 (retent)	770	assemblage	lots of small fresh prills, blebs and coffee beans, larger pieces mainly slag debris from larger pieces	
360	52	10	2	small piece of fired clay and lining slag stored in water	
359	20	3285	1	somewhat weathered large biconvex square SHC with accreted gravel, 180x170x90(40)mm	3285
	collection of small samples				
274	33	50	15	vitrified ceramic fragments - probably tuyère sherds	
402	40 (retent)	<1	3	two tiny platy slag fragments (not FHS), 1 SHS	
207	24 (retent)	8	c25	mainly slag fragments, 1 probable slag flat	
62	7 (retent)	46	assemblage	large collection of small rusty particles, slag debris, spheroids, charcoal etc - no hammerscale seen	
274	33 (retent)	72	assemblage	52g prilly slag fragment, 16g concretion, c15 pieces of small slag debris - mainly blebby, some spheroids, plenty of evidence for lining influence on slags	
313	36	34	c20	oxidised fired and slagged clay - presumably tuyère	
304	34 (retent)	40	assemblage	nice collection of fines and small slag blebs - abundant spheroids, some SHS, some FHS, slag pieces mainly rather amorphous sintery pieces - so corroded iron is possibly present.	
156	13	<1	6	tiny slag fragment - including 2 tabular particles not FHS	
204	25 (retent)	18	assemblage	slag fragments plus probable natural piece	
290	32	4	2	vitrified oxidised clay - tuyère?	
312	35	12	assemblage	2g piece of pale gravelly clay, remainder is finer and strongly oxidised - tuyère debris	
391	56	10	1	convoluted piece of gravelly lining slag - probably tuyère front	
350	48 (retent)	<1	2	tiny lining slag grains	
138	9 (retent)	<1	2	slag fragment and single FHS	
23	4 (retent)	<1	5	slag and stone	
160	14	8	assemblage	fragmented very thin sheet iron object	

Context	Sample	Wt (g)	Number	Notes	Original SHC wt.
391	54 (retent)	4	6	5 iron slag fragments and 1 piece of almost white vesicular FAS	
17	2 (retent)	2	assemblage	stones	
200	22 (retent)	10	5	one piece vitrified ceramic, rest stones	
162	16	<1	2	stones	
333	38 (retent)	<1	11	10 stones, 1 FHS	
160/161	15 (cremation)	1	4	stones	
147	11 (retent)	<1	6	3 fragments of glassy lining slag, 3 FHS	
11	1	1	1	natural gravelly concretion	
186	19	<1	assemblage	stone, some slag, 1 FHS	

Table 2: summary of residue class by context and sample

				SHCs thin asymm.	bowl	thin	thick	conv	charc	prill	Indet.	tuyère	coarse clay	frags & fines	iron obj/ concretion	**total**
11	1	f8	middle fill of hearth 003													
17	2 (retent)	f8	fill of post-med field boundary 006													
23	4 (retent)	f8	fill of field boundary 007								<1					***<1***
62	7 (retent)	f5	fill of pit 061											46		***46***
66	1	f5	fill of hearth 065			82						250				***332***
138	9 (retent)	f3	fill of linear 124											<1		***<1***
144	2	f3	fill of ditch recut c146 of c175 (=c167)			1791					744					***2535***
147	5	f3	fill of ditch recut c146 of c175									8				***8***
147	11 (retent)	F3	fill of ditch recut c146 of c175											<1		***<1***
156	13	f3	fill of pit c155 with in situ burning											<1		***<1***
160	14	f3	fill of pit c159												8	
160/1	15	f3	fill of pit c159													
162	16	f3	fill of pit c159													
167	3	f3	fill of ditch recut c146 of c175 (=c144)			2446	1685	1642								***5773***
168	4	f3	fill of ditch c175													
186	19	f4	fill of ph f185 str 1											<1		***<1***
200	22 (retent)	f4	fill of ph 199 in str 1											<1		***<1***
204	25 (retent)	f4	fill of ph 203 in str 1											18		***18***
207	24 (retent)	f3	fill of ditch c175											8		***8***
274	6	f4	fill of ditch c273			1870	4127					138				***6135***
274	7	f4	fill of ditch c273			5108	5170				638	756				***11672***
274	33	f4	fill of ditch c273									50		72		***122***
290	32	f4	fill of ph c289 str 3									4				***4***
304	34 (retent)	f4	fill of hearth c303											40		***40***
312	35 (retent)	f4	fill of ditch c311											770		***770***
312	35	f4	fill of ditch c311									12				***12***
312	9	f4	fill of ditch c311											618		***618***
313	8	f4	fill of ditch c311											914		***914***
313	11	f4	fill of ditch c311	55318	10568	52008	22525	5357	3916	15934	3093	15318	236	2022		***186295***
313	36 (retent)	f4	fill of ditch c311											696		***696***
313	36	f4	fill of ditch c311									34				***34***
332	10	f4	fill of limekiln 327					1055								***1055***
333	38 (retent)	f4	fill of limekiln 327											<1		***<1***
348	19	f4	fill of defensive ditch 347	518											284	***518***
349	12	f4	fill of defensive ditch 347				7008				614	3192			290	***10814***
350	48 (retent)	f4	fill of defensive ditch 347											<1		***<1***
353	13	f4	fill of defensive ditch 347				4275			394	5506	798		40		***11013***
354	20	f4	fill of defensive ditch 347				3285									***3285***

				SHCs thin asymm.	*bowl*	*thin*	*thick*	*conv*	*charc*	*prill*	*Indet.*	*tuyère*	*coarse clay*	*frags & fines*	*iron obj/ concretion*	***total***
360	52	f4	fill of defensive ditch 347									10				***10***
371	14	f3	fill of drain 376 cut into top of moat					454								***454***
373	16	f3	fill of revetted fosse 370												332	
378	15	f3	fill of revetted fosse 370 (=373)									15				***15***
391	54 (retent)	f4	fill of ditch 347											4		***4***
391	56	f4	fill of ditch 347									10				***10***
402	40 (retent)	f3	fill of pit 390											<1		***<1***
410	18	f3	fill of pit 390 (c401)				246								68	***246***
426	51 (retent)	f3	fill of c425 (metalworking waste pit)											1855		***1855***
426	55 (retent)	f3	fill of c425 (metalworking waste pit)											5170		***5170***
				55836	***10568***	***63305***	***48321***	***8508***	***3916***	***16328***	***10595***	***20595***	***236***	***12273***	***982***	**250481**

Table 3: Weight-frequency statistics for various subsets of the SHCs

	Ditch 311	Ditches 311 and 273	All field 4	All field 3	All material
count	50	57	67	4	71
Min. wt.	298	276	276	454	276
Max. wt.	4550	4550	4550	608	4550
Average wt.	1934	1892	1861	532	1786
No of examples:					
<500	6	8	10	2	12
<850	11	13	18	4	22
<1000	14	16	21	4	25
>1000	36	41	46	0	46
>3000	9	9	12	0	12
% of examples:					
<500	12%	14%	15%	50%	17%
<850	22%	23%	27%	100%	31%
<1000	28%	28%	31%	100%	35%
>1000	72%	72%	69%	0%	65%
>3000	18%	16%	18%	0%	17%

Table 4: Comparison of the SHC assemblage from Field 4 with those from other sites

Site	Garryleagh	Coolamurry	Ardreigh	Ballykilmore	Borris	Lismore-Bushfield	Doneraile
County	Cork	Wexford	Kildare	Westmeath	Tipperary	Laois	Cork
Age	13th -14th	12th -13th	medieval	Late med	7th-10th	6th – 7th	medieval
minimum	84	62	92	94	154	426	276
maximum	802	2588	2665	4033	7440	4390	4550
% <500g	76%	80%	69%	47%	22%	4%	15%
% <850g	100%	93%	88%	67%	36%	26%	27%
% >1kg	0%	5%	9%	27%	59%	61%	69%
% >3kg	0%	0%	0%	10%	16%	13%	18%
mean	316	386	495	1022	1618	1737	1861
count	25	41	32	30	88	23	67
smelting?	no	no	trace	yes	no	no	no
Ref.	*Young 2009c*	*Young 2008a*	*Young 2012*	*Young 2009a & in press*	*Young 2009b*	*Young 2008b*	*This report*

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