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Evaluation of archaeometallurgical residues from St Patrick's Church, Armoy, Co. Antrim (CAF DSR 44)

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Abstract

The archaeometallurgical residues from Armoy are dominated by the residues from the working of iron. 63% of the 24.4kg assemblage was made up of identifiable fragments of smithing hearth cakes (SHCs) and much of the 32% that was indeterminate iron slag was probably also small fragments of SHCs and other smithing hearth slags. There were no pieces of archaeometallurgical residue which could be identified as being from any other process. The smithing residues appeared to be typical of early medieval residues from Ireland, but the assemblage as a whole was unusually proportioned, with a lack of measurable small SHCs, a preponderance of mid-sized SHCs (500-1200g) and a lack of identifiable sherds of ceramic tuyère. These features, together with the division of the collection between a very large number of contexts (205.kg of stratified resides derived from 51 contexts), suggest that the assemblage is heavily reworked and much is probably residual.

The only reasonably convincing metallurgical structure was hearth c546 of Phase 6. This hearth has similar dimensions to smithing hearths elsewhere. The large structure created over the abandoned souterrain in Phase 9 is too large to have functioned as a metallurgical hearth, being almost large enough to be an entire small smithy.

Contents

Methods

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

Results

General

The assemblage totalled 28.8kg of submitted material of which 24.4kg was true archaeometallurgical residue. 51 contexts yielded residues, of which 23 contexts yielded less than 100g, only 5 contexts yielded over 1kg, with no contexts yielding over 3kg. 15.3kg (63% of the assemblage by weight) was material identifiable as deriving from smithing hearth cakes (SHCs), with much of the 32% of the assemblage that was indeterminate probably being degraded fragments of SHCs.

Description of materials

Smithing Hearth Cakes (SHCs)
A total of 15.4kg of SHCs were identified among the material from Armoy. They were extremely variable in terms of their size and morphology. Thirteen examples were either complete or almost complete (>60%)

(Table 4). These have a mean weight of 747g (range 117g - 1233g). Three of the more complete examples weighed in excess of 1000g, but only two weighed less than 500g. Other examples were more fragmented, so that their original weight could not be determined with any certainty.

Such a weight distribution is unusual, for examples with weights below 500g are most common in almost all recorded early medieval assemblages. Those with low proportions below 500g are generally specialist iron production sites (with SHC sizes ranging up to several kilograms). The Armoy SHCs show a very dispersed distribution, with 3 of the measurable examples unstratified, one from phase 11, three from phase 9b, one example from each of phases 5, 6, 7 and 8, and with two examples from the phase 2 -4 ditch fill. The most likely scenario to explain the Armoy assemblage is that these SHCs do not represent a true assemblage, but are the occasionally preserved remnants of various smithing episodes. There may also be a high degree of residuality.

A variety of textures were represented ranging from dense well-formed 'thick crust' cakes, to 'thin crust' cakes. Also present were a number of poorly consolidated, low-density cakes, a number of iron-rich examples, and one relatively flat, oval shaped 'tongue'. One of the larger complete examples (1125g) was deformed and had probable evidence of tool marks on its base.

The majority of examples contained charcoal moulds and/or inclusions. Several examples had a thin haematite layer, identifiable as a maroon tinge formed on their upper surfaces and in one example this colour variation was visible in section.

The basic mode of formation of an SHC is broadly the same across all these morphologies – when the work-piece is placed in the hearth, it will undergo some superficial oxidation, and occasionally more serious breakage, which results in iron metal and iron oxides being lost to the hearth. Here the iron oxides will be fluxed by molten ceramic material from the hot tip of the tuyère and possibly by deliberate additions of sand flux too, with the resulting iron silicate melt forming the slag. The common origin means that SHCs typically have a bowl-like form. They generally form within small areas of contact between the slag bowl and the ceramic tip of the tuyère or the hearth wall. This zone of contact may have enhanced reaction, leading to a particularly dense slag (the burr).

The size and density of the SHC will be controlled by the amount of iron lost, the temperature the hearth is being run at, the rate of loss of the tuyère, the period of working and the way in which the smith manipulates the hearth.

Indeterminate slag
This category includes the pieces of slag that were too fragmented to identify as well as pieces that are of non-diagnostic shapes and textures. Also included here are fragments of low density slag, some of which are likely to have a relatively high fuel ash component and small fragments of flowed slag.

A large quantity (7.8kg) of material from Armoy was classified as indeterminate, mainly due to the fact that much of the material was present as very small fragments too small for precise identification.

It is very likely that much of this material is derived from smithing and may include less diagnostic fragments of SHC and slag which formed within the hearth but outside the main SHC. It may potentially include slag from within the fuel bed, slag from around the blowhole and also lining slags generated from melted ceramic.

Lining slag and Fired clay
The assemblage contains very modest quantities of both hearth lining and the siliceous slag which may be produced by its melting. In early medieval to medieval assemblages from Ireland these material are normally indicative of the use of ceramic tuyères, but the material from Armoy includes no certain tuyère sherds. This is probably indicative of the degraded and reworked nature of much of the assemblage and has been a feature of other assemblages where a high degree of residuality was inferred.

Corroded iron
Approximately 560g of corroded iron was among the material investigated. This was comprised of fragments too small for identification; concretions surrounding corroded fragments, one recognisable piece of a nail, 2 flat fragments, and one piece which maybe a small folded sheet of iron - all of which were rather heavily corroded. Other small pieces of concretionary material are also included in this category, because although they mainly comprise other materials, they form from corroding iron.

Coal and coke
The assemblage included a small quantity of coal, coke and possible clinker (fused inorganic coal residue). The certain fragments of coal and coke all derived from post-medieval contexts. There were no certain examples in which coal/coke had been employed for metallurgical purposes.

Iron ore
The assemblage also contained 4 chunks of weathered iron ore weighing a total of 1.8kg. The ore contains small rounded bodies of dense, shiny goethite (?), set in pale groundmass, which bears a significant amount of mica. It is unclear in hand specimen whether these are superficial bog iron ores of an unusual type or, as is more likely, iron-rich rocks from the solid geology. They are likely to be present here as entirely natural materials or materials employed structurally, rather than as of metallurgical use.

Manganese pan
2 fragments of manganese pan weighing approximately 63g were also present.

Distribution of materials

The distribution of residues by context is given in Table 1, residue classes by contexts in Table 2 and residue classes by phase in Table 3.

Small quantities of material were recovered from contexts across the site. The 20.5kg of stratified archaeometallurgical residues occurred in 51 different contexts; an average of just 400g per productive context. The maximum amount of residue recorded for any one phase of the site was just 4.3kg, from Phase 9b.

Significant concentrations appeared in the following contexts:

Some 5.5kg of metallurgical residues were recovered from 6 different fills (**271, 274, 298, 342**, **345, 395, 409, 410**) associated with the so-called furnace structure

(**C366** & **C382**) which had been rebuilt with material from the souterrain (grid B – North East section).

Approximately 2.3kg of this were fragments of SHC while the remainder was classified as indeterminate slag, small quantities of fired clay and fragments of corroded iron.

C538 (a spread in hearth cut **C546**) yielded approximately 724g of material which was composed of 1 weathered SHC (525g) and small fragments of indeterminate slag and fired clay.

Approximately 3.3kg of material was recovered from **C102** (combined fill of ditch **C103**) in the south-west quadrant of the site. Among this material were just over 2kg of SHC, one of which was particularly large, weighing 1.1kg.

C200 (garden soil – dark brown humic soil with charcoal flecks in area NW, SW, SE) yielded just over 2.2kg of material which was dominated by fragments of SHCs (2.1kg). These were directly overlying the souterrain collapse (phase 9bi) and the 'furnace' activity (phase 9b) and are likely to have originated from the underlying contexts which were disturbed during post-medieval gardening activity.

1.9kg of material was recovered from a deposit of mid-brown soil described as an agricultural horizon (**C201**). 1.5kg of this was classified as fragments of SHC.

The fill of a robber trench (**C545**) yielded approximately 2.7kg of material composed of 1.8kg of weathered iron ore and 792g of SHC.

A total of 3.9kg of material was recovered from unstratified contexts across the site.

Possible metallurgical features

The identification of poorly preserved metallurgical features that do not have a clear association with metallurgical debris is notoriously difficult. On the other hand, macroscopic slag is often not a good indicator of a hearth, unless convincingly *in-situ*, because it is typically cleared from the hearth and disposed of elsewhere. Microresidues including hammerscale may be a better indicator of feature use, but unfortunately microresidue samples were not available for this site.

At least two features uncovered during excavations at St. Patrick's church appear to provide tentative evidence for metallurgical use.

Feature C546 (Phase 6; located in grid C, south-east quadrant) was a truncated hearth measuring 1.2-1.6m in diameter by 0.18m deep, which may have been a smithing hearth. Limited evidence is provided by a fill including an SHC. This is rather large for a smithing hearth, which are typically slightly elongate, and rarely larger than 1.5m by 1.0m (Young 2010, Figure 1), but none the less the identification appears plausible.

A possible metallurgical structure was constructed over the former souterrain in Phase 9. It appears to have begun with a discontinuous cut C366 measuring 2m (north-south) and 1.5-2m (east west). This was followed by the construction of a superstructure (C382) using the dismantled stones from the souterrain. The structure consisted of a sub-circular dry-stone setting which was two or three courses in height, measuring 4m (north-south) by 2.1m (east-west). The presence of medieval glazed pottery and everted-rim ware is thought to place its construction/use to sometime in the late 12th – 13th centuries (these dates are expected to be further refined by radiocarbon dating charcoal remains). It is not certain what the feature actually was: it is not a furnace (an enclosed high temperature structure), it is too large for a smithing hearth (typically less than 1.5m by 1.2m), but at 4.0m by 2.1m it is almost large enough for an entire small smithy installation.

There is no clear evidence to suggest that any of the other features tentatively described as 'furnaces', fire settings or hearths had a metallurgical function, although such a function cannot be excluded. None of these structures shows any indications of being a true furnace (an substantially-enclosed high-temperature structure). It must be remembered that early Irish smithing hearths were generally floor level structures, blown through replaceable tuyères. These hearths little evidence in the archaeological record apart from the usually oval or sub-circular hearth cut. Even long-lived smithing hearths may not leave much additional indication and their identification is usually through the associated hammerscale-rich fills and floor surfaces.

Interpretation

The residues from St. Patrick's Church, Armoy suggest that secondary iron working (smithing) was being undertaken. There is no evidence for primary production (smelting). The presence of 1.8kg of low-grade iron ore may be completely unconnected with any metallurgical activity.

The majority of the assemblage is suggestive of blacksmithing (the end use of iron for the manufacture or repair of artefacts). The SHC weight distribution includes too few examples and is too temporally dispersed to be directly comparable with other sites. Some ironworking is likely to have been undertaken at the site from Phase 1, but there seems to be more evidence for smithing in phases 5 and 6.

The nature of the activity in Phase 9b remains unclear and the supposed hearth structure needs reinterpretation.

A considerable proportion of the residue assemblage was residual in post-Phase 9 deposits.

The SHC weight distribution is based on too few examples to be directly compared with that from other sites. In particular, the assemblage is very narrow in its weight range (with 58% of the SHCs being between 500 and 100g and only 17% below 500g). The relative paucity of small SHCs is unusual. In no described assemblage of SHCs is there a distribution similar to that seen in the limited material from Armoy. It seems most likely that the Armoy assemblage is substantially skewed from its original composition by taphonomic processes, or by identification issues produced by the preservational style. An additional problem with the Armoy material is that is does not constitute a single assemblage, but includes material from a prolonged history of perhaps as much as 800 years of intermittent ironworking.

General comparison may be made with other early medieval sites which have been interpreted as being involved with secondary smithing including the monastic site at Toureen Peakaun (Co. Tipperary) as well secular sites at Deerpark Farm (Co. Antrim) and Blackchurch (Co. Kildare).

Toureen Peakaun (Young 2010) produced a rather similar degraded SHC-dominated slag assemblage, with a similar weight -range for the SHCs (range 104 – 1160g, mean 479g), but with ten of the sixteen SHCs (63%) weighing less than 500g. One further major difference was that 13% of the Toureen Peakaun assemblage was formed of tuyère fragments. The lack of tuyère fragments at Armoy is probably due to the reworking of the material leading to preferential destruction of the ceramic components.

Deerpark Farm (Bayley pers. comm.) and Blackchurch (Young & Kearns 2010) both show a bimodal SHC weight distribution. The lighter mode includes SHCs in the 100-500g range, with the heavier mode including material between 500 and 1000g. In both cases there is a 'tail' of heavy examples, with weights ranging up to 3100-3300g at Deerpark Farm (with no examples between 1200 and 3100g) and up to 2450g at Blackchurch. Most of the Armoy SHCs correspond to the range of the heavier mode on these two sites. The significance of the bimodal distribution is currently uncertain; it may relate to a difference in activity or it may relate to a difference in the frequency of hearth clearance. Both modes lie within the range of SHC size attributed to blacksmithing activities.

Evaluation of potential

The nature of the material as a low density of blacksmithing residues, largely unassociated with metallurgical features and displaying uncertain degrees of residuality, means that it has little potential for yielding useful additional information through further analytical studies. No further analysis of the material is therefore recommended at this time.

Further consideration of the nature of the supposed hearth over the souterrain is advised, and re-evaluation of the associated residue assemblage ight be possible following such an exercise. Should environmental samples be available for relevant contexts, their examination for hammerscale is also advised.

References

YOUNG, T. 2010. Evaluation of archaeometallurgical residues from Toureen Peakaun, Co. Tipperary (05E0257). *GeoArch Report 2010/16*, 7pp.

YOUNG, T.P. & KEARNS, T. 2010. Evaluation of metallurgical residues from N7 Road-Widening and Interchanges Scheme: Site 48, Blackchurch, Co. Kildare (03E1607). *GeoArch Report 2010/18*, 7pp.

Table 1: summary catalogue

area	*grid*	*context*	*context description*	*weight (g)*	*description*	*% of orig.*	*find*
AR04		101	cultivated soil	28	fragment of high fired clay with occasional quartz inclusions		
AR04	N/S wall	101	cultivated soil	13	fragment of indeterminate slag, slightly flowed upper surface with maroon tinge		
AR04	topsoil	101	cultivated soil	44	1 flat fragment of iron		156
AR04	topsoil	101	cultivated soil	52	1 fragment of indeterminate slag		156
AR04	topsoil	101	cultivated soil	58	3 fragments of corroded iron with small quantities of slag and clay attached		156
AR04		101	cultivated soil	278	possible fragment of low density, poorly consolidated SHC, frequent charcoal moulds		
AR04		102	combined fill of ditch C103: (phases 2-4)	8	small fragment of indeterminate slag		231
AR04		102	combined fill of ditch C103: (phases 2-4)	114	dense fragment of indeterminate slag		164
AR04		102	combined fill of ditch C103: (phases 2-4)	29	1 fragment of indeterminate slag, blebby upper surface, occasional charcoal moulds in base; 1 small run of slag		48
AR04		102	combined fill of ditch C103: (phases 2-4)	3	small fragment of indeterminate slag		229
AR04		102	combined fill of ditch C103: (phases 2-4)	42	fragment of blebby indeterminate slag with occasional quartz inclusions		146
AR04		102	combined fill of ditch C103: (phases 2-4)	55	fragment of indeterminate slag, fused with quartz on one side		128
AR04		102	combined fill of ditch C103: (phases 2-4)	700	sub-circular SHC (118x128x47mm), flowed textures on upper surface with central depression, contains multiple charcoal moulds and inclusions	100%	262
AR04		102	combined fill of ditch C103: (phases 2-4)	86	fragment of low density vesicular slag		44
AR04		102	combined fill of ditch C103: (phases 2-4)	257	fragment of dense slag with dimpled texture on one surface		208
AR04		102	combined fill of ditch C103: (phases 2-4)	274	fragment of low density, poorly consolidated SHC, multiple charcoal moulds		78
AR04		102	combined fill of ditch C103: (phases 2-4)	1110	1 dense SHC	90%	56
AR04		102	combined fill of ditch C103: (phases 2-4)	240	fragment of clay rich slag with occasional organic moulds on one surface;		9
AR04		102	combined fill of ditch C103: (phases 2-4)	140	6 fragments of indeterminate slag		9
AR04		102	combined fill of ditch C103: (phases 2-4)	22	7 fragments of bone		109
AR04		102	combined fill of ditch C103: (phases 2-4)	4	fired clay		236
AR04		102	combined fill of ditch C103: (phases 2-4)	16	2 fragments of low density vesicular slag with charcoal moulds		282
AR04		102	combined fill of ditch C103: (phases 2-4)	77	4 fragments of low density, clay rich slag		
AR04		102	combined fill of ditch C103: (phases 2-4)	31	fragment of indeterminate slag with charcoal and wood inclusions		147

area	*grid*	*context*	*context description*	*weight (g)*	*description*	*% of orig.*	*find*
AR04		102	combined fill of ditch C103: (phases 2-4)	95	fragment of indeterminate slag with multiple charcoal inclusions		42
AR04		104	wall within cut C105	29	2 fragments of fired clay		296
AR04		122	fill of gully C123	34	1 fragment of fired clay with frequent quartz inclusions; 1 small fragment of oxidised fired clay; 1 fragment of quartz; 1 bone fragment		
AR04		122	fill of gully C123	17	1 ceramic fragment, approx. 1cm thick near base		
AR05		122//127?	fill of gully	273	fragment of weathered SHC, fairly large charcoal moulds on upper surface		27
AR04		126	furnace deposit	105	clay and charcoal rich concretion surrounding corroded iron		23a
AR04		126	furnace deposit	41	6 fragments of indeterminate slag		23a
AR04		132	charcoal rich deposit	123	1 fragment of heavily fired, bloated clay with some slag incorporated		
AR04		132	charcoal rich deposit	102	5 fragments of indeterminate slag and fired clay		
AR04		132	charcoal rich deposit	96	1 fragment of iron rich slag, occasional hammerscale inclusions; 1 fragment of low density, clay rich slag		
AR04		133	hearth deposit within C103	37	4 fragments of fired clay; 3 fragments of bone		
AR04		133	hearth deposit within C103	333	3 fragments of amygdaloidal basalt		61
AR04		133	hearth deposit within C103	11	4 fragments of oxidised fired clay		51
AR04		133	hearth deposit within C103	5	1 fragment of glassy slag		54
AR04		133	hearth deposit within C103	0.3	hammerscale		50
AR04		136	hearth deposit	87	fragment of low density indeterminate slag, multiple small charcoal moulds		88
AR04		136	hearth deposit	11	2 fragments of indeterminate slag		98
AR04		137	gully cut	218	fragment of dense weathered slag, possible SHC crust		93
AR04		142	fill of C141	55	small fragment of indeterminate slag		169
AR04		152	fill of C151	43	2 fragments of fired clay		
AR04		152	fill of C151	7	oxidised fired clay		

area	*grid*	*context*	*context description*	*weight (g)*	*description*	*% of orig.*	*find*
AR04		154	skeleton within grave-cut C153	25	fragment of low density indeterminate slag		203
AR04		154	skeleton within grave-cut C153	47	small iron rich fragment with clay and small quantity of slag		114
AR05	D	155	general graveyard soil to south of bank	6.3	1 small fragment of indeterminate slag		
AR04		155	general graveyard soil to south of bank	110	fragment of indeterminate slag with occasional charcoal moulds		269
AR04		155	general graveyard soil to south of bank	19	manganese pan		234
AR04		169	fragmentary remains of a burial	16	2 fragments of fired clay, occasional quartz inclusions		278
AR04		172	skeleton associated with C171	28	fired clay and charcoal concretion		302
AR05		184	loose brown fill of cut C196, associated with C176	351	small thick crust SHC (in two pieces), (99x77x33mm), maroon tinge through the section and upper surface	100%	
AR05		200	garden soil - dark brown humic soil with charcoal flecks	19	1 fragment of weathered indeterminate slag		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	34	fragment of clay rich indeterminate slag		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	39	5 fragments of corroded iron, the largest is flat 45x23x9mm		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	36	1 fragment of blebby indeterminate slag		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	575	fragment of dense thick crust SHC, multiple small charcoal moulds on base (109x95x41mm)		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	378	fragment of thin crust SHC, lower bowl approx. 1cm thick, clay and charcoal rich upper fill		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	32	weathered fragment of indeterminate slag		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	297	fragment of dense thick crust SHC (dense material on upper surface), burr		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	160	fragment of small iron rich SHC - haematite rich rust on upper surface		

area	grid	context	context description	weight (g)	description	% of orig.	find
AR05		200	garden soil - dark brown humic soil with charcoal flecks	8	2 fragments of indeterminate slag		
AR05		200	garden soil - dark brown humic soil with charcoal flecks	700	fragment of dense thick crust SHC, (130x71x43mm) charcoal moulds on base	60%	
AR05	D	200	garden soil - dark brown humic soil with charcoal flecks	2	fragment of flowed slag		204
AR05	D	201	mid-brown soil agricultural horizon	550	1 possible irregular shaped SHC, rough clay rich upper surface with occasional charcoal moulds; 1 smaller fragment of clay rich indeterminate slag		811
AR05	D	201	mid-brown soil agricultural horizon	72	fragment of clay rich indeterminate slag		811
AR05 AR04		201	mid-brown soil agricultural horizon	26	3 fragments of quartz rich high fired clay		
AR05 AR04		201	mid-brown soil agricultural horizon	34	fragment of dense indeterminate slag		
AR05		201	mid-brown soil agricultural horizon	226	fragment of very weathered dense indeterminate slag		
AR05		201	mid-brown soil agricultural horizon	950	fragment of SHC, multiple charcoal moulds and clay (119x96x84mm)	100%	
AR05		201	mid-brown soil agricultural horizon	63	1 fragment of indeterminate slag; 1 thin slag crust		
AR05	C	203	dark occupational horizon	21	1 fragment of low density slag and clay, possible coal inclusion?		
AR05		203	dark occupational horizon	58	fragment of weathered indeterminate slag		359
AR05		203	dark occupational horizon	23	2 small fragments of clay rich indeterminate slag		
AR05		203	dark occupational horizon	21	fragment of indeterminate slag		
AR05		233	natural subsoil = 100	15	fragment of blebby slag with charcoal moulds		
AR05		250	stone setting	74	4 fragments of indeterminate slag		533
AR05		261	charcoal flecked orange clay - loam =201	195	7 fragments of indeterminate charcoal rich slag		
AR05		262	dark red/brown soil, redeposited during gardening	164	1 fragment of dense flowed slag		
AR05	D	271	dark grey/orange cindery upper fill within the souterrain	27	fragment of fired clay, very frequent quartz inclusions, highly vitrified on one surface and slumped slightly at one end		

area	*grid*	*context*	*context description*	*weight (g)*	*description*	*% of orig.*	*find*
AR05	D	271	dark grey/orange cindery upper fill within the souterrain	7	1 small fragment of indeterminate slag		411
AR05		271	dark grey/orange cindery upper fill within the souterrain	43	1 concretion surrounding fragment of corroded iron; 1 fragment of iron rich slag with occasional quartz inclusions		
AR05		271	dark grey/orange cindery upper fill within the souterrain	70	1 fragment of small SHC, 72x43x16mm	60%	
AR05		271	dark grey/orange cindery upper fill within the souterrain	122	2 fragments of dense slag, probable fragments of SHC		
AR05		271	dark grey/orange cindery upper fill within the souterrain	160	12 fragments of indeterminate slag		
AR05		271	dark grey/orange cindery upper fill within the souterrain	49	small fragment of relatively dense crystalline slag, dimpled base with charcoal and clay on upper surface		
AR05		271	dark grey/orange cindery upper fill within the souterrain	6	fragment of fired clay vitrified on one surface with multiple quartz inclusions		423
AR05		271	dark grey/orange cindery upper fill within the souterrain	23	3 fragments of corroded iron		
AR05		271	dark grey/orange cindery upper fill within the souterrain	152	2 fragments of dense slag		
AR05		271	dark grey/orange cindery upper fill within the souterrain	60	7 small fragments of blebby slag; 1 fragment of charcoal		
AR05	D	271	dark grey/orange cindery upper fill within the souterrain	3	fragment of quartz rich fired clay, vitrified in one area		408
AR05		271	dark grey/orange cindery upper fill within the souterrain	44	2 fragments of indeterminate slag, one quite dense		
AR05	D	271	dark grey/orange cindery upper fill within the souterrain	26	2 fragments of crystalline slag - indeterminate		
AR05	D	271	dark grey/orange cindery upper fill within the souterrain	233	9 fragments of indeterminate slag		
AR05	B	271	dark grey/orange cindery upper fill within the souterrain	48	7 fragments of corroded iron		
AR05	B	271	dark grey/orange cindery upper fill within the souterrain	89	11 fragments of indeterminate slag, occasionally blebby		
AR05		271	dark grey/orange cindery upper fill within the souterrain	12	1 fragment of indeterminate slag, blebby base		

area	grid	context	context description	weight (g)	description	% of orig.	find
AR05	D	271	dark grey/orange cindery upper fill within the souterrain	3	2 fragments of quartz rich fired clay		410
AR05	B	274	loose rubble infill in souterrain C229	327	fragment of slag with quartz rich clay attached		
AR05	B	274	loose rubble infill in souterrain C229	254	fragment of dense, iron rich slag - possible SHC		
AR05	B	274	loose rubble infill in souterrain C229	67	fragment of low density indeterminate slag		
AR05		298	dark layer in the middle of the souterrain	42	1 fragment of dense vesicular slag, flowed on upper surface		
AR05	D	298	dark layer in the middle of the souterrain	67	1 fragment of quartz rich lining and slag		569
AR05	D	298	dark layer in the middle of the souterrain	251	fragment of SHC, rounded base with hollow depression in upper surface		545
AR05	D	298	dark layer in the middle of the souterrain	174	2 fragments indeterminate slag, 1 small charcoal inclusion, rusty appearance		591
AR05		298	dark layer in the middle of the souterrain	100	2 fragments of low density indeterminate slag, occasional charcoal; 1 small fragment of blebby slag		592
AR05	D	298	dark layer in the middle of the souterrain	11	1 small fragment of indeterminate slag with small charcoal inclusion		
AR05		298	dark layer in the middle of the souterrain	820	1 roughly plano-convex SHC, clay and charcoal rich upper surface (137x93x59mm)	80%	515
AR05	B	298	dark layer in the middle of the souterrain	41	fragment of clay rich indeterminate slag		
AR05	D	298	dark layer in the middle of the souterrain	64	fragment of indeterminate slag and clay		576
AR05		298	dark layer in the middle of the souterrain	28	small fragment of blebby slag with oxidised fired clay attached and small charcoal inclusion		497
AR05	D	298	dark layer in the middle of the souterrain	10	fragment of blebby slag		577
AR05		298	dark layer in the middle of the souterrain	8	fragment of indeterminate slag		594
AR05	D	298	dark layer in the middle of the souterrain	75	fragment of flowed slag		
AR05		298	dark layer in the middle of the souterrain	42	2 fragments of slag, one has flowed upper surface and blebby base		576
AR05		298	dark layer in the middle of the souterrain	242	2 fragments of low density vesicular slag with multiple charcoal moulds		486
AR05	D	310	charcoal deposit	156	concretion formed around iron of uncertain form but perhaps folded sheet - recommend x-ray		739
AR04		320	deep garden soil	4	4 fragments of coke		
AR05		323	same as C317 - garden soil under cobbling C297	12	4 fragments of corroded iron		

area	grid	context	context description	weight (g)	description	% of orig.	find
AR05		331	dark brown sub-rectangular deposit	1	coal		
AR05	NW	331	dark brown sub-rectangular deposit	17	small fragment of slag, pale green glazed appearance on one surface		
AR05	NW	331	dark brown sub-rectangular deposit	1	fired clay		
AR05		331	dark brown sub-rectangular deposit	1	coke		
AR05	NW	331	dark brown sub-rectangular deposit	2.6	coke		
AR05	NW	331	dark brown sub-rectangular deposit	1	coke		
AR05	NW	331	dark brown sub-rectangular deposit	1	coke		
AR05	NW	331	dark brown sub-rectangular deposit	0.1	coal		
AR05		342	packing/levelling above souterrain	990	dense SHC rough textured upper surface, convex base (130x100x63mm)	100%	
AR05	B	345	loose dark brown stoney infill in souterrain	18	fragment of indeterminate slag with frequent charcoal moulds		
AR05	B	345	loose dark brown stoney infill in souterrain	18	2 fragments of indeterminate slag		
AR05		345	loose dark brown stoney infill in souterrain	213	1 fragment of dense slag (192g); 1 smaller fragment of dense slag		350
AR05		345	loose dark brown stoney infill in souterrain	77	small fragment of dense slag with flat upper surface		6343 ?
AR05		345	loose dark brown stoney infill in souterrain	20	2 fragments of flowed slag		251
AR05	B	345	loose dark brown stoney infill in souterrain	19	nub of flowed slag		561
AR05	B	345	loose dark brown stoney infill in souterrain	1.5	2 fragment of indeterminate slag		
AR05		345	loose dark brown stoney infill in souterrain	20	numerous tiny fragments of slag		
AR05		353	stone setting aligned NE/SW	424	1 fragment of probable SHC, dimpled upper and lower surfaces with occasional charcoal moulds on upper		
AR05		353	stone setting aligned NE/SW	590	1 small dense SHC, multiple charcoal inclusions and moulds on base (100x76x55mm) possibly contains some metal	100%	482
AR05		353	stone setting aligned NE/SW	96	fragment of dense iron rich slag		
AR05	C	355	brown/orange deposit across most of excavated area	640	SHC, blebby protrusion from base with frequent small charcoal moulds, partially flowed upper surface with depression in centre	100%	

area	*grid*	*context*	*context description*	*weight (g)*	*description*	*% of orig.*	*find*
AR05	A	355	brown/orange deposit across most of excavated area	53	2 fragments of clinker		493
AR05		355	brown/orange deposit across most of excavated area	1	fired clay		
AR05	C	355	brown/orange deposit across most of excavated area	188	fragment of dense slag, quartz rich upper surface, charcoal and other organic impressions on base (possibly straw)		
AR05	A	362	dark brown sandy loam	10	1 natural stone		
AR05		362	dark brown sandy loam	175	natural stone		
AR05		362	dark brown sandy loam	544	3 probable fragments of dense SHC		
AR05		362	dark brown sandy loam	57	1 fragment of low density vesicular slag		
AR05		362	dark brown sandy loam	245	1 fragment of indeterminate slag		
AR05		362	dark brown sandy loam	73	2 fragments of indeterminate slag - possibly SHC		
AR05		365	fill of test-trench	0.7	small fragment of slag		
AR05	NW area	372	lignite rich mottled layer	30	fragment of highly vesicular slag, slight maroon tinge on upper surface		
AR05	NW area	372	lignite rich mottled layer	106	fragment of vesicular slag with occasional charcoal moulds		574
AR05	NW area	372	lignite rich mottled layer	476	1 possible low density SHC, poorly consolidated		566
AR05		377	fill of gully C407	234	fragment of dense, plano-convex, thin crust SHC (91x53x17mm)		728
AR05	B	395	dark brown stoney fill within souterrain	35	1 fragment of indeterminate slag, small charcoal inclusions in base		
AR05	B	395	dark brown stoney fill within souterrain	16	weathered fragment of fired clay		
AR05	B	395	dark brown stoney fill within souterrain	48	2 fragments of dense flowed slag		
AR05		395	dark brown stoney fill within souterrain	289	4 fragments of indeterminate slag with large (20-30mm) charcoal moulds		
AR05	D	409	very loose grey/brown material with stone inclusions, in souterrain	34	fragment of indeterminate slag, smooth upper surface		
AR05	D	409	very loose grey/brown material with stone inclusions, in souterrain	51	fragment of flowed slag with upper lobed texture		
AR05		410	mid/light brown material with stone inclusions, in souterrain	28	2 small fragments of indeterminate slag, both contain tiny charcoal inclusions		

area	*grid*	*context*	*context description*	*weight (g)*	*description*	*% of orig.*	*find*
AR05	E passage	410	mid/light brown material with stone inclusions, in souterrain	6	1 fragment of flowed slag; 1 slag spheroid		867
AR05	D	423	mottled orange-brown silty loam	1.6	indeterminate slag		
AR05	NW	456	fill of C455	228	tongue of slag, pebbly upper surface, multiple fragments of quartz on base (90x69x20mm)		
AR05	NW	456	fill of C455	13	2 small gravelly concretions		
		460	sub-adult/adult skeleton aligned E-W	52	1 fragment of indeterminate slag; 1 concretion surrounding fragment of corroded iron		
AR05	D	467	dark brown soil around and under stones C466	6	coke		
AR05	D	477	fill of cut C476	31	1 fragment of oxidised fired clay with occasional quartz inclusions; 1 fragment of weathered indeterminate slag		770
AR05	C	503	fill of C504 - black linear feature	37	1 natural quartz rich concretion		
AR05	C	535	cut of 'robber trench' filled by C522, C637 and C612	1874	4 chunks of weathered iron ore		
AR05	C	535	cut of 'robber trench' filled by C522, C637 and C612	338	2 low density weathered pieces of SHCs		
AR05	C	535	cut of 'robber trench' filled by C522, C637 and C612	204	2 fragments of SHC		
Ar05	C	535	cut of 'robber trench' filled by C522, C637 and C612	250	1 fragment of dense SHC		
AR05	C	535	cut of 'robber trench' filled by C522, C637 and C612	32	2 concretions surrounding corroded iron		
AR05	C	538	furnace bottom of hearth cut C546	34	1 small fragment of indeterminate slag; fragment of fired clay with small stone attached		
AR05	C	538	furnace bottom of hearth cut C546	525	weathered SHC (132x81x53mm)		
AR05	C	538	furnace bottom of hearth cut C546	146	7 fragments of indeterminate slag		
AR05	C	538	furnace bottom of hearth cut C546	19	2 fragments of fired clay		
AR05	C	560	fill of linear cut C559	29	2 fragments of indeterminate slag		
AR05	C	560	fill of linear cut C559	124	1 fragment of blebby slag		

area	*grid*	*context*	*context description*	*weight (g)*	*description*	*% of orig.*	*find*
AR05		639	fill of cut C638 in ditch C103	27	fragment of clay and charcoal rich slag		
AR05	A	711	fill of cut C710	3.6	1 fragment of corroded iron, probable nail		
AR05	A	711	fill of cut C710	27	fragment of low density slag with quartz rich fired clay on one side		
AR05		769	fill of C768	60	1 fragment of weathered indeterminate slag, occasional charcoal inclusions		
AR05	A	252/355		137	1 fragment of dense weathered indeterminate slag, clay and occasional charcoal on base		440
AR05	D	508?	compact mid brown/pink levelling/occupation layer	33	1 fragment of dense indeterminate slag with small quantity of oxidised fired clay attached		
AR05	D	508?	compact mid brown/pink levelling/occupation layer	55	fragment of indeterminate slag, small organic moulds in base		
AR05		709?	grey sandy loam, fill of cut C708	43	fragment of slag and clay, abundant organic material embedded in one side (possible wood or straw)		
Unstratified material							
AR04		U/S		11	fragment of low density indeterminate slag		253
AR04		U/S		69	possible fragment of small SHC, (74x51x20mm), dimpled base texture, rough upper surface with charcoal moulds		28
AR04		U/S		44	fragment of low density slag with high ash component		32
AR04		U/S		475	SHC with upper central depression (108x98x33mm); 1 small fragment of slag, possible from SHC	90%	37
AR05	A	U/S		675	fragment of SHC, rounded base, rough upper surface with some clay	90%	
AR05	D	U/S		473	fragment of thick crust SHC, multiple charcoal moulds on upper surface (130x70x36mm)	70%	
AR05	NW area	U/S		1125	deformed SHC, possible tool marks on base	100%	
AR05		U/S		27	1 fragment of indeterminate slag; 1 fragment of coke; 1 fragment of fired clay		
AR05	D	U/S		2	tiny fragments of vesicular slag		
AR05		U/S		14	1 fragment of flowed slag		
AR05		U/S		16	1 fragment of dense indeterminate slag with small quantity of oxidised fired clay attached		
AR05		U/S		9	1 fragment of indeterminate slag		
AR05		U/S		49	2 fragments of clay rich indeterminate slag; 1 fragment of blebby slag		
AR05		U/S		38	1 fragment of weathered indeterminate slag with frequent charcoal inclusions and moulds		
AR05	SW area	U/S		50	1 fragment of low density slag, frequent charcoal moulds and inclusions on upper surface		
AR05		U/S		74	nub of indeterminate slag with a 20x10mm charcoal mould		547

area	*grid*	*context*	*context description*	*weight (g)*	*description*	*% of orig.*	*find*
AR05	D	topsoil		8	2 fragments of slag		
AR05		topsoil		10	1 small fragment of blebby slag		
AR05		topsoil		710	1 fragment of possible lining slag; 12 fragments of indeterminate slag		

Table 2: Distribution of residue classes by context

context	*context description*	*phase*	*SHC*	*other smith*	*Indet.*	*Lining slag*	*Fired clay*	*iron*	*coke/ coal*	*bog ore*	*Total*	*Total residues*
101	cultivated soil	10	278		65	28		102			*473*	*371*
103	combined fill of ditch C103: (phases 2-4)	2 to 4	1646		876	317	4				*2843*	*2843*
104	wall within cut C105	6					29				*29*	*29*
122	fill of gully C124	8					51				*51*	*51*
122//127?	fill of gully	8	273								*273*	*273*
126	furnace deposit	6			41			105			*146*	*41*
132	charcoal rich deposit	6		96			225				*321*	*321*
133	hearth deposit within C103	6				5	48				*53*	*53*
136	hearth deposit	6			98						*98*	*98*
137	gully cut	?6	218								*218*	*218*
142	fill of C141	1			55						*55*	*55*
152	fill of C151	9a					50				*50*	*50*
154	skeleton within grave-cut C153	10			72						*72*	*72*
155	general graveyard soil to south of bank	10			116						*116*	*116*
169	fragmentary remains of a burial	10					16				*16*	*16*
172	skeleton associated with C171	?10						28			*28*	*0*
184	loose brown fill of cut C196, associated with C176	8	351								*351*	*351*
200	garden soil	11	2110		131			39			*2280*	*2241*
201	mid-brown soil agricultural horizon	5	1500		395		26				*1921*	*1921*
203	dark occupational horizon	8			123						*123*	*123*
233	natural subsoil = 100	0			15						*15*	*15*
250	stone setting	8			74						*74*	*74*
252/355		8			137						*137*	*137*
261	charcoal flecked orange clay - loam =201	5			195						*195*	*195*
262	dark red/brown soil, redeposited during gardening	11			164						*164*	*164*
271	dark grey/orange cindery upper fill in the souterrain	9b	192		684		39	114			*1029*	*915*
274	loose rubble infill in souterrain C229	9b	254		394						*648*	*648*
298	dark layer in the middle of the souterrain	9b	1071		837	67					*1975*	*1975*
310	charcoal deposit	6						156			*156*	*0*
320	deep garden soil	11							4		*4*	*0*
323	same as C317 - garden soil under cobbling C297	11						12			*12*	*0*
331	dark brown sub-rectangular deposit	9c			17		1		7		*25*	*18*
342	packing/levelling above souterrain	9b	342								*342*	*342*
345	loose dark brown stony infill in souterrain	9b			387						*387*	*387*
353	stone setting aligned NE/SW	6	1014		96						*1110*	*1110*
355	brown/orange deposit across most of excavated area	7	640		188		1		52		*881*	*829*
362	dark brown sandy loam	8	617		302						*919*	*919*
365	fill of test-trench	12			1						*1*	*1*
372	lignite rich mottled layer	6	476		136						*612*	*612*
377	fill of gully C407	3	234								*234*	*234*
395	dark brown stony fill within souterrain	8			372		16				*388*	*388*
409	loose grey/brown with stone inclusions, in souterrain	8			85						*85*	*85*
410	mid/light brown with stone inclusions, in souterrain	8			34						*34*	*34*
423	mottled orange-brown silty loam	9			2						*2*	*2*
456	fill of C455	12		228				13			*241*	*228*
460	sub-adult/adult skeleton aligned E-W	10			26			26			*52*	*26*

context	*context description*	*phase*	*SHC*	*other smith*	*Indet.*	*Lining slag*	*Fired clay*	*iron*	*coke/ coal*	*bog ore*	*Total*	*Total residues*
467	dark brown soil around and under stones C466	3 to 4							6		*6*	*0*
477	fill of cut C476	6			16		16				*32*	*32*
508?	compact mid brown/pink levelling/occupation layer	6			88						*88*	*88*
535	cut of 'robber trench' filled by C522, C637 and C612	9a?	792					32		1874	*2698*	*792*
538	furnace bottom of hearth cut C546	6	525		180		19				*724*	*724*
560	fill of linear cut C559	10			153						*153*	*153*
639	fill of cut C638 in ditch C103	6			27						*27*	*27*
709?	grey sandy loam, fill of cut C708	12			43						*43*	*43*
711	fill of cut C710	12			27			4			*31*	*27*
769	fill of C768	1			60						*60*	*60*
U/S	Unstratified		2817		1048		13		1		*3879*	*3878*
	totals		***15350***	***324***	***7760***	***417***	***554***	***631***	***70***	***1874***	***26980***	***24405***

Table 3: Residue classes by phase (g).

Phase	*SHC*	*other smith*	*Indet.*	*Lining slag*	*Fired clay*	*iron*	*coke/ coal*	*bog ore*	*Total*	*Total residues*
0			15						*15*	*15*
1			115						*115*	*115*
2 to 4	1880		876	317	4		6		*3083*	*3077*
5	1500		590		26				*2116*	*2116*
6	2233	96	682	5	337	261			*3614*	*3353*
7	640		188		1		52		*881*	*829*
8	1241		1127		67				*2435*	*2435*
9A	792				50	32		1874	*2748*	*842*
9B	1859		2302	67	39	114			*4381*	*4267*
9C			19		1		7		*27*	*20*
10	278		432	28	16	156			*910*	*754*
11	2110		295			51	4		*2460*	*2405*
12		228	71			17			*316*	*299*
u/s	2817		1048		13		1		*3879*	*3878*
total	***15350***	***324***	***7760***	***417***	***554***	***631***	***70***	***1874***	***26980***	***24405***
% of residue	63%	1%	32%	2%	2%					

Table 4: stratigraphic distribution of >60% complete SHCs

Context	Original SHC wt.	Context description	Phase
271	117	dark grey/orange cindery upper fill within the souterrain	9b
184	351	loose brown fill of cut C196, associated with C176	8
u/s	528		
353	590	stone setting aligned NE/SW	6
355	640	brown/orange deposit across most of excavated area	7
u/s	676		
102	700	combined fill of ditch C103: (phases 2-4)	2 to 4
u/s	750		
201	950	mid-brown soil agricultural horizon	5
342	990	packing/levelling above souterrain	9b
298	1025	dark layer in the middle of the souterrain	9b
200	1167	garden soil - dark brown humic soil with charcoal flecks	11
102	1233	combined fill of ditch C103: (phases 2-4)	2 to 4

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