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Evaluation of archaeometallurgical
residues from Woodstown 6 SRP,
E2964

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Abstract

This collection comprises approximately 25kg of archaeo-metallurgical residues and related materials. Approximately 23.4kg of this material derives from stratified contexts of which 89% was examined for the assessment. Material from secure archaeological contexts was only identified in TA 1 and TA11, so this report focuses on those two trenches.

A wide variety of metallurgical processes are represented amongst the residues from TA1, including iron smelting, smithing, casting of non-ferrous materials, some at least being copper alloys, and the assaying of silver. The slags from iron smelting comprise dense vertical and horizontal flows in a type of assemblage which is extremely close to that from the furnace previously discovered in the Woodstown enclosure ditch, but which is otherwise unknown in Ireland. The iron working (smithing) slags are rather few in number, but the size of the surviving smithing hearth slag cakes is more suggestive of blacksmithing, rather than bloomsmithing. Non-ferrous metalworking is evidenced by a variety of generally small crucibles, some at least with evidence for the melting of copper-alloys, together with several examples of ceramic cupels probably used for assaying silver.

TA11 yielded a sparse assemblage of materials, most of which are associated with iron working. These included two fragments of cemented "smithing floor", although it is unclear whether these concretionary lumps were preserved in-situ or had been derived.

Small quantities of residues were also recovered from TA2 and TA6, but only from unstratified topsoil.

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Methods

This evaluation was conducted by examining a representative portion of that part of the assemblage deriving from stratified contexts. The total stratified assemblage weighed 23.4kg, of which 89% (by weight) was investigated for this assessment. The assessment included 94% of the stratified material (19.7 of 21.0kg) from TA1 and 46% of the stratified material (1.1 out of 2.4kg) from TA11. None of the other trenches produced stratified archaeometallurgical residues. None of the accompanying topsoil-derived material (F600) was examined for the assessment, but a cursory overview showed that this material contained a wide variety of materials, including not only material derived from the underlying archaeology, but also modern clinker, coal fragments and various natural materials.

All investigated materials were examined visually, using a low-powered binocular microscope where necessary. All significant materials were weighed and recorded to a database (Table 1).

As an evaluation, the materials were not subjected to any high-magnification optical inspection, nor to any other form of instrumental analysis. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

Results

TA1

This trench yielded a significant and diverse array of archaeometallurgical residues.

Smithing hearth cakes: there were relatively few complete examples of smithing hearth cakes (SHCs), and these were all small. There are eight SHCs, with an average weight of 183g. Only one small fragment, from context 2500, appears to be from a larger, albeit still moderately-sized, cake. SHC material only comprises about 18% of the residues from TA1.

Iron-smelting slags: reasonably certain smelting slags are represented in the material from TA1 by dense flowed slags. Some of these form flow-lobed flows, with a tabular morphology, extremely similar to flows of slag tapped from the furnace, and indicative of a dominantly horizontal flow. These pieces are all fairly small, and could equally be flows developed within a non-slag tapping furnace.

The second morphology of slag included here is dense lowed slag forming multiple coalesced prills. These may be typically comprised of individual prills of 50-100mm length, but only 5-8mm diameter, grouped into agglomerations of sequential flows. These materials appear to have a large or dominant component of downward flow. Some examples appear to have had their flow diverted past obstacles.

Indeterminate iron slags: this category contains all the slags which appear to be associated with iron, but which do not show the characteristic features of the previous two categories.

There are several groups of material contributing to this class, which have not been differentiated within the catalogue, mainly because they are of unclear, or gradational morphological types and typically of small fragment size. Indeed the large proportion 68% of the slag falling into this category is in part a reflection of the high degree of fragmentation in the assemblage.

Lining: this category includes technical ceramics apart from crucible. Much of the material is fired clay hearth lining.

Some material from c2529 appears to be fired clay from other classes of material. A small amount of the fired clay is likely to represent fragments of moulds. A larger quantity of fired clay forms part of a large block with a curved margin. Whilst it is possible that this is clay which has been pressed against a curved object or objects (perhaps cobbles), it is also possible that the piece represents the throat of a small crucible hearth. In this interpretation it would derive from a small pit furnace in which the top of the furnace was partially closed with clay, leaving a hole of smaller diameter than the pit for insertion and extraction of the crucible.

Some of this material is certainly from tuyères, with sherds from c2532 suggesting a tuyère face of approximately 160x120mm.

Lining slag: slags formed from the melting of ceramic material (whether lining or tuyère) without major input of metal oxides (iron or copper) have been placed in this category. Only very small amounts of such material were recorded.

Crucibles: the assemblage contains three types of crucibles in the broad sense: small thin-walled

crucibles, medium-sized "D" shaped crucibles and small cupels.

The thin-walled crucibles appear to be the dominant form represented. They are extremely thin-walled and therefore unlike most early medieval crucibles from Ireland (there are, for instance, no examples in Comber 2004 with such thin walls). The assemblage requires careful recording (both analysis to determine use, prior to any conservation or cleaning, and then reconstruction, where possible, and drawing), but provisionally comparative material might be sought in Scandinavia, where thin-walled "thumb" crucibles are common. A possible analogue from Ireland would be the crucible from High Island, Co. Galway (probably 10th century; Young 2006a), which was compared to material of integral lidded crucibles from Dunadd, Scotland (Lane & Campbell 2000; Type D, illustration 4.48, no. 187) of 7th-10th century date. None of the Woodstown sherds gave evidence for a lid. Irish finds of pinched crucibles of this general type include material from Ballinderry II crannog (Hencken 1942), Carraig Aille II (O'Riordáin 1949) and Correnearry (Davies 1942). The type is also known from the Brough of Birsay, Orkney (Curle 1982). One explanation of the abundance of such small crucibles might be that they were preferentially employed in the working of precious metals, particularly silver.

The larger crucibles, "D" shaped in plan and roundedly "bag-shaped" in profile are much more similar to the well-known Irish early medieval forms, although again detailed recording following reconstruction will be necessary to confirm the parallels. One relatively well preserved large example appears to have been approximately 65mm tall and 50mm wide, whereas a smaller example is 30mm tall and 34mm wide.

The ceramic cupels are represented by 7 sherds from c2529 and these derive from several different original cupels. This is a slightly higher proportion of the overall assemblage than that from the earlier Woodstown excavations, where only 2 out of 65 crucible sherds belonged to cupels (Young 2006b). The cupels are quite diverse in shape, from almost disc-like forms through to slightly taller varieties, but require further detailed recording.

Iron: this category only includes iron fragments that have been placed in the slag collection, so does not reflect the true abundance of iron objects in the assemblage. The material from this trench comprised only tiny scraps (of which one, from c2529, was possibly a nail).

Cu-slag: only a single bleb of Cu-slag (apart from material attached to crucibles) was identified. This was from c2587, where it was associated with crucible sherds bearing Cu-residues.

TA2

The collections contained 13 objects identified by the excavators as slag or other metallurgical materials, all from topsoil. These have not been examined in more detail.

TA6

This trench yielded 3 objects identified by the excavators as slag or other metallurgical material. One was a small scrap of indeterminate slag, another a piece of corroded iron; the third was not examined.

TA11

This trench yielded a small quantity of archaeometallurgical residues. All the identifiable materials were associated with iron working and all the materials were compatible with that origin.

Smithing hearth cakes: there were three small SHCs or SHC-like objects amongst the stratified material from this trench. One was a slab-like SHC, the other two have been classed as “tongues” – a related morphology, typically with a very low iron content in their upper parts. All three objects have low weights, compatible with their origin in smithing (or even, just possibly, in the use of a hearth during non-ferrous metalworking).

Indeterminate iron slags: this category of material appears to be less abundant than in TA1. However, this may in part be a bias introduced by the higher proportion of material from TA11 that was not-examined in detail. It is also possible that a significant part of the indeterminate iron slags from TA1 may have been smelting slags; a group of material apparently absent in TA11.

Lining: the lining material includes some sherds which are probably from tuyères, but most of the material is not diagnostic. The topsoil yielded a larger fragment of a tuyère face.

Lining slag: this material is again a fairly low proportion of the assemblage and is largely undiagnostic of process.

Floor: two lumps of material from c2556 were concretionary masses of hammerscale, sand and charcoal. Such materials are frequently considered to be indicative of the secondary cementation of hammerscale accumulating on the smithy floor, particularly around the anvil. However two other origins are also known to occur: firstly concretion growth in dumped hammerscale material (particularly where small iron fragments corrode and the secondary oxides produce local cementation) and secondly formation within water containers used for cooling the smith's tools or for quenching steel during hardening.

Interpretation

The two assemblages from TA1 and TA11 are distinct (despite some possible bias introduced by different degrees of detailed inspection).

TA1 produced evidence for a wide range of metallurgical activities. Iron smelting is evidenced by dense flows, very similar to those forming a rather larger assemblage recovered from a furnace within the enclosure ditch at Woodstown (Young 2006b). Detailed analysis of the material from the enclosure ditch is still on-going at the time of writing, but the slags are distinct from those produced in the “normal” Irish slagpit shaft furnace. It remains unclear whether these dense flows were actually tapped from the furnace, or whether they represent a different approach to a non-slag tapping furnace. In either case they suggest a different iron smelting technology to that identified elsewhere in Ireland at this period. The possibility must be considered that it reflects an introduced technology and comparison with some of the contemporary furnaces in Norway, in particular, may be valuable.

The evidence for iron working (smithing) includes a collection generally very small SHCs. Unfortunately the collection of these is very small, so detailed statistical comparison with the assemblage from the enclosure ditches is not possible. Table 3 shows that the heaviest of the eight SHCs from TA1 was 270g, whereas 40% of the assemblage from the earlier excavations weighted over 500g. Of those eight SHCs four weigh between 200 and 300g; this was also the modal class for the previous assemblage. The evidence therefore tentatively suggests that blacksmithing (producing small SHCs) occurred on both sites, but that bloomsmithing (refining) may not be evidence in TA1. This is slightly curious if both smelting and blacksmithing occurred here, but it is possible that smelting slags in TA1 are derived, since they occur in very small quantities. That iron smelting was being undertaken somewhere in the area is suggested by the similar levels of relative abundance of smelting slags in the first and second slot trenches and in the external “path”.

Non-ferrous metalworking is indicated by finds of crucibles from many contexts, but concentrated in c2529, the secondary fill of slot trench c2531. In the absence of detailed analysis little comment can be made on the nature of the metals being worked, although some larger crucibles contain Cu-residues and the cupels are indicative of silver assaying. The abundance of sherds of very small crucibles with rather light vitrification and slagging may be indicative of silver working, but this should be confirmed by analysis.

The assemblage examined from TA11 contains no evidence for either iron smelting or non-ferrous metalworking. The entire assemblage could be compatible with smithing. Given the evidence for rotary grinding stones in this area, it is quite conceivable (although not provable from the slags), that this area was devoted to the finishing of edge tools.

Evaluation of potential

The collection from the SRP is quite small, but none-the-less has a high degree of significance and potential. The evidence is compatible with trenches TA1 and TA11 having located two workshop areas with different specialisations.

The influence of “background” input of residues from adjacent working areas is hard to evaluate, but is suggested, particularly in TA1 but small quantities of iron smelting residues.

The iron smelting is particularly interesting, for its similarity to the material recovered from the enclosure ditch strengthens the argument for the iron smelting at Woodstown having been undertaken in an alien tradition. This is being currently investigated using the larger assemblage from the enclosure ditch, but supporting analytical data from the TA1 material would be of great benefit.

The non-ferrous metalworking is also significant. The presence of both the cupels and the small crucibles provides a suggestion that silver working was being undertaken here. Further analysis (of both the residues upon, and forms of, the crucibles) would be highly desirable. This would enable comparison both with the emerging picture of non-ferrous metalworking in the bulk of Ireland and with the detailed work currently being undertaken on material from Viking Dublin.

Given the significance of the assemblage and the desirability of considerable further research upon it, retention of the assemblage in full is recommended.

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Table 1: Summary catalogue of material by storage location and context.

<i>location</i>	<i>context</i>	<i>find</i>	<i>TA</i>	<i>bag/label</i>	<i>weight</i>	<i>notes</i>
bag 19	2500	s592	TA1	1	3510	216g 5 pieces possibly from SHCs, 26g 6 small tuyère sherds, 328g dense prills and flows, mostly small scale but certainly compatible with smelting 30 pieces
bag 19	2500	s592	TA1	2	1960	210g 95x80x40mm small SHC slighted twisted, good compact; 180g 80x65x35mm small SHC, possibly slightly incomplete, charcoal-rich top, 656g 9 other SHC fragments, 16g tuyère sherd, 58g 4 dense prill fragments, 16g iron artefact, remainder as other samples
bag 19	2500	s592	TA1	4	1690	230 g of good dense, but small SHC fragments, reminder mainly low density slags, 1 tuyère sherd, 1 large block of wall-attached slag
bag 19	2500	s592	TA1	5	2225	172g poor quality flow lobes, 136g partially vitrified lining, 80g possible poor lining dominated SHC fragments, 6 blocks 758g of rubbly hearth/furnace base material, not proper SHC, remainder mainly low density slags of various amorphous kinds
bag 19	2500	s592	TA1	5	310	low density slags in various amorphous and blebby forms, some even almost prilly
bag 19	2500	s592	TA1	6	1910	268g 5 pieces of dense SHC material, one from a medium sized cake, 78g 2 pieces of fired clay, 106g 9 pieces of dense flows and prills, some slagged and vitrified gravel
bag 19	2500	s592	TA1	7	2220	602g stone, 158g 13 pieces of dense flown prills, many multiple, 104g 3 tuyère sherds, remainder variable blebby amorphous, sometimes even prills, low density slags, no good SHC fragments in this bag
bag 19	2500	s704	TA1	1	112	low density lobe or dimpled slags, often with lining influence, 1 green-glazed pebble
bag 19	2500	s704	TA1	2	320	collection of mainly low density slags, 1 large lining influenced block, 2 iron artefacts (32g), some fired clay
bag 19	2500	s704	TA1	3	24	2 indeterminate iron slag pieces
bag 19	2500	s704	TA1	4	12	stone and ?bone fragments in slag
bag 19	2500	s704	TA1	5	312	86g block of probable tap slag, 22g 2 small prilly lobed fragments, 140g extremely dense magnetic rounded block, remainder blebby low density
bag 19	2500	s704	TA1	6	138	mainly low density slags, several pieces probable vitrified lining
bag 19	2500	s704	TA1	7	84	1 piece of dense slag, probably from SHC, 1 sherd of tuyère
bag 19	2500	s704	TA1	8	138	scrappy mainly blebby slags, some irregular spheroids, some lining related material
bag 19	2500	s704	TA1	9	12	3 pieces of blebby slag from within charcoal bed
crucible box	2500	3	TA1	cruc frag	1	crucible fragment, probably originally similar to other material but deeply vitrified on all faces including breaks so must have fallen onto hearth
crucible box	2500	11	TA1	cruc frag	1	1 piece broken in 2, base from similar thin walled crucible to above pieces, feels slight harder and vitrification slightly more yellow,
crucible box	2500	12	TA1	cruc frag	1	sherd from near base to rim of small crucible in same fabric, lip become out-turned across piece suggesting a pouring lip, nothing visible inside, externally light green glaze with very few red spots and a brownish slag near base
crucible box	2500	13	TA1	cruc frag	2	base of crucible, small drip of red/purple slag on very base, nothing visible internally, probably same fabric and style as others
crucible box	2500	14	TA1	cruc frag	2	rounded base of crucible markedly thicker than other material, but otherwise similar on fabric and gentle glaze

<i>location</i>	<i>context</i>	<i>find</i>	<i>TA</i>	<i>bag/label</i>	<i>weight</i>	<i>notes</i>
bag 3	2503	s709	TA1	1	230	crude mass of flowed slag resting on fired clay - probably from hearth floor below tuyère
bag 3	2503	s709	TA1	2	214	
bag 3	2503	s709	TA1	3	104	
bag 3	2503	s709	TA1	4	24	
bag 3	2503	s709	TA1	5	8	
bag 3	2503	s709	TA1	6	94	
crucible box	2503	7	TA1	cruc frag	1	green-grey crucible sherd. Light external vitrification, slight red spots
crucible box	2503	9	TA1	crucible sherd	<1	tiny sherd as above 2503 material
bag5	2504	s715	TA1		38	c10 pieces of weathered friable brown charcoal-rich slag with stones
bag9	2529	s710	TA1	1	408	30 g of fired clay pieces -possibly mould, 28g 7 sherds of cupel, 1 of crucible, 224g dense lobate slag puddle in ash below further flowed slags - could be a smelting slag but inconclusive, reminder mainly crudely lobate low density slags
bag9	2529	s710	TA1	2	2	
bag9	2529	s710	TA1	3	2	
bag9	2529	s710	TA1	4	512	
bag9	2529	s710	TA1	5	2	
bag9	2529	s710	TA1	6	2	
bag9	2529	s710	TA1	7	30	
bag9	2529	s710	TA1	8	2	
bag9	2529	s710	TA1	9	1	
crucible box	2529	2	TA1	3/4 whole crucible and assoc soil	18	D-shaped crucible with straight edge and two corners preserved on lip, other side to base only. 30mm tall, 34mm wide, external pale green transparent glaze, with a few red patches.
crucible box	2529	3	TA1	tuyère	246	not a tuyère, flat fired clay slab with one end showing part of a hole c200mm in diameter, which is curved into the slab too. One adjacent faces shows hints of similar internal surface. Surfaces seem dense and better fired than rest of clay. If this is a real shape then it could be the mouth of a crucible furnace, if there are multiple surfaces then maybe it is clay applied to surface of boulders?
crucible box	2529	3	TA1	tuyère	440	associated fired clay debris, some of this is almost pure sand with a only a little place clay to bind it
crucible box	2529	8 to 34	TA1	26 bags of frags plus 2 tiny nodules		fragments suggest a slightly thicker based crucible than most of the material, and possibly more quartz-rich, needs restoration to be confident about size, shape, even the number of vessels present. Suggest a rather larger, maybe broader crucible than the others, glaze redder than most of the above material, also some isolated red glass lumps in ash.
crucible box	2529	42	TA1	clay poss from inside crucible		thin piece of sandy green clay with lots of organic temper - probably an unfired crucible sherd

<i>location</i>	<i>context</i>	<i>find</i>	<i>TA</i>	<i>bag/label</i>	<i>weight</i>	<i>notes</i>
bag 14	2530	s699	TA1	1	22	
bag 14	2530	s699	TA1	2	77	fired and slagged clay
bag 14	2530	s699	TA1	3	12	
bag 14	2530	s699	TA1	4	284	dense slag lump from base of a cake with down rounded protuberance - probably an SHC
bag 14	2530	s699	TA1	5	2	
bag 14	2530	s699	TA1	6	116	
bag 14	2530	s699	TA1	7	46	
bag 14	2530	s699	TA1	8	62	
bag 14	2530	s699	TA1	9	6	
bag 14	2530	s699	TA1	10	26	
bag 14	2530	s699	TA1	11	1390	136g approximately half a small SHC, 182g probably most of wide flat SHC, 92g SHC fragment, 212g rounded rusty slag lump, might be SHC, 200g block of low density slag with flow lobed top - probably low density tap slag but could be SHC, 20g multiple dense flows probably tap slag, 262g 6 pieces of crudely lobate low density slag incorporate in amorphous blocks, 12g tuyère sherd, 250g 4 pieces indeterminate iron slag
bag 14	2530	s699	TA1	12	30	
crucible box	2530	3	TA1	cruc frag	1	grey green sherd, very thin, no obvious external vitrification, possibly a dark internal residue
crucible box	2530	30	TA1	cruc frag	4	sherd from near base of grey-green fabric, quite thin, little vitrification, has a few spots of adhering dark slag, internal uncleaned
crucible box	2530	33	TA1	poss slag / furnace piece	16	flat sheet of dense fayalitic slag, with one side curled over, concave side shows draw down texture with large fayalite visible, flat surface shows very smooth external surface. Could be a smelting flow or top of an SHC
bag 18	2532	s708	TA1	bag3	1450	198g small dished SHC, 232g small SHC, 100 tap slag, 72g SHC fragment, 24g tap slag, 110g 2 tuyère sherds (160x120?mm), remainder indeterminate mainly low density material, 5g crucible sherd, very heavily vitrified and some slag, quite a large crucible
bag 18	2532	s708	TA1	bag2	342	
bag 18	2532	s708	TA1	bag1	274	
bag 8	2537	s705	TA11	1	8	
bag 8	2537	s705	TA11	2	6	
bag 8	2537	s705	TA11	3	6	
bag 8	2537	s705	TA11	4	4	
bag 8	2537	s705	TA11	5	2	vitrified ceramic with black glaze
bag 8	2537	s705	TA11	6	22	corroded lump of slag in gravel and sand
bag 8	2537	s705	TA11	7	4	

location	context	find	TA	bag/label	weight	notes
bag 8	2537	s705	TA11	8	2	
bag 8	2537	s705	TA11	9	4	
bag 8	2537	s705	TA11	10	2	
bag 8	2537	s705	TA11	11	12	
bag 8	2537	s705	TA11	12	6	
bag 8	2537	s705	TA11	13	4	
bag 8	2537	s705	TA11	14	4	
bag 8	2537	s705	TA11	15	2	
bag 8	2537	s705	TA11	16	6	
bag 8	2537	s705	TA11	17	22	
bag 8	2537	s705	TA11	18	16	
bag 8	2537	s705	TA11	19	28	
bag 8	2537	s705	TA11	20	18	
bag 8	2537	s705	TA11	21	20	
bag 8	2537	s705	TA11	22	20	
bag 8	2537	s705	TA11	23	4	
bag 8	2537	s705	TA11	24	6	
bag 8	2537	s705	TA11	25	8	
bag11	2538	s706	TA11	1	2	
bag11	2538	s706	TA11	2	146	
bag11	2538	s706	TA11	3	108	
bag11	2538	s706	TA11	4	10	
bag11	2538	s706	TA11	5	214	2 pieces of crude tongue, each 78g, rest also lining dominated - 6 pieces
bag11	2538	s706	TA11	6	40	
bag11	2538	s706	TA11	7	58	
bag10	f2539 TA11	1	TA11		4	rounded charcoal and ash-rich slag ball or concretion
bag10	f2539 TA11	2	TA11		1	weathered slag droplet

<i>location</i>	<i>context</i>	<i>find</i>	<i>TA</i>	<i>bag/label</i>	<i>weight</i>	<i>notes</i>
bag12	2542	s703	TA11	1	62	curved slab of vitrified lining, one edge showing rollover of glass - possibly a tuyère face but quite large- could be furnace lining
bag12	2542	s703	TA11	2	18	
bag12	2542	s703	TA11	3	16	
bag12	2542	s703	TA11	4	60	vitrified tuyère/lining
bag12	2542	s703	TA11	5	10	
bag12	2542	s703	TA11	6	88	lumpy mass of vitrified lining and gravel
bag12	2542	s703	TA11	7	30	
bag12	2542	s703	TA11	8	8	part or most of poorly developed slabby SHC
bag12	2542	s703	TA11	9	154	
bag12	2542	s703	TA11	10	36	
bag12	2542	s703	TA11	11		
bag12	2542	s703	TA11	12	26	
bag12	2542	s703	TA11	13	10	
bag12	2542	s703	TA11	14	8	
bag12	2542	s703	TA11	15	60	
bag12	2542	s703	TA11	16	40	
bag12	2542	s703	TA11	17	64	
bag12	2542	s703	TA11	18	12	indeterminate iron slag
bag12	2542	s703	TA11	19	70	
bag12	2542	s703	TA11	20	102	
bag12	2542	s703	TA11	21	18	
bag12	2542	s703	TA11	22		
bag12	2542	s703	TA11	23	86	
bag12	2542	s703	TA11	24	22	
bag12	2542	s703	TA11	25	22	
bag12	2542	s703	TA11	26	62	
bag12	2542	s703	TA11	27	26	
no number	2544	s719	TA11		38	lumpy lining slag mass
no number	2553	s718	TA11		2	indeterminate slag

<i>location</i>	<i>context</i>	<i>find</i>	<i>TA</i>	<i>bag/label</i>	<i>weight</i>	<i>notes</i>
bag17	2556	s717	TA11	1	22	concretion ?smithing floor
bag17	2556	s717	TA11	2	10	
crucible box	2556	2		poss slag	228	dense lump of smithy floor with charcoal, sand, scale etc. seems too dense just for this and probably cored on piece of iron. Moderately magnetic
no number	2563	s723	TA11		26	indeterminate slag lump
no number	2569	s721	TA11		6	indeterminate slag
no number	2586	s722	TA1		24	5 pieces of lining-related slag debris
crucible box	2586	2	TA1	cruc frag	1	sherd broken in 2 from lip of thin walled crucible. Grey-green fabric, strongly curved, slightly out-turned, possible dark internal residue
crucible box	2586	3	TA1	lip	7	side of crucible very similar to 2529-2. Slight external vitrification, pale green, internally slightly reddened, D-shaped or triangular form
crucible box	2586	4	TA1	cruc frag	2	fragment from base of small crucible, externally quite strongly vitrified, pale green transparent, interior slagged with some green corrosion showing, small patch of quartz rich slag attached to outside
crucible box	2586	1	TA1	complete crucible		crushed but largely present triangular bag shaped crucible 65mm tall by 50mm wide, fabric appears paler than other examples, but may be adhering ash as this is not cleaned? Despite label only a very short length of rim is preserved
bag6	2587	s714	TA1	1	4	Cu-slag bleb
bag6	2587	s714	TA1	2	12	indeterminate iron slag scraps , small sherd of crucible
crucible box	2587	2	TA1	cruc frag	6	sherd suggestive of crucible maybe 45mm tall. Thin walled, but has lip-ward thickening internal residue, streaking green where damaged.
crucible box	2587	3	TA1	cruc frag	1	very neat well formed thin rim sherd of the usual fabric, vitrified externally gently, internal surface not cleaned, but no obvious residues

<i>location</i>	<i>context</i>	<i>find</i>	<i>TA</i>	<i>bag/label</i>	<i>weight</i>	<i>notes</i>
no number	2588	s720	TA1		102	indeterminate iron slag in small pieces, tuyère sherd
bag2	2609	s711	TA1	1	398	62g small classic tongue, green glassy top, lobate base, 12g tuyère/lining sherd, 90g 2 pieces of tap slag, 114g dense rounded block - possibly crude SHC, remainder low density partially lobate and indeterminate material
bag2	2609	s711	TA1	2	154	
crucible box	2609	2	TA1	cruc frag	2	out-turned lip on angle in wall, probably a pouring lip, thin wall, shows marked external reddening on glaze on one side of the angle, internally a little rusty residue
bag4	2610	s713	TA1		44	scrappy slag detritus, iron object and stone
crucible box	2610	3	TA1	cruc frag	<1	tiny grey green slightly vitrified thin-walled crucible sherd
crucible box	2610	4	TA1	cruc frag	1	tiny sherd as above, but has much more external brick red spotting
no number	600	s716	TA6	1	18	indeterminate slag
no number	600	s716	TA6	2	2	
no number	600	s716	TA6	3	4	exploding iron fragment
bag 13	600	s698	TA11			59 items from 600 - topsoil TAII
bag 15	600	s555	TA1			62 items from 600 - topsoil TA1

<i>location</i>	<i>context</i>	<i>find</i>	<i>TA</i>	<i>bag/label</i>	<i>weight</i>	<i>notes</i>
bag16	600	s712	TA2	1		
bag16	600	s712	TA2	2	14	
bag16	600	s712	TA2	3		
bag16	600	s712	TA2	4	4	
bag16	600	s712	TA2	5		
bag16	600	s712	TA2	6		
bag16	600	s712	TA2	7	8	
bag16	600	s712	TA2	8		
bag16	600	s712	TA2	9		
bag16	600	s712	TA2	10		
bag16	600	s712	TA2	11	6	
bag16	600	s712	TA2	12	22	
bag16	600	s712	TA2	13	8	
bag7	600		TA1			6 bags classed as vitrified material, quick look suggests mixture of all sorts - furnace lining, corroded iron and stone
no number	600	s725	TA11	106		large sherd from face of tuyère/blowhole

Table 2: Summary of securely stratified archaeometallurgical residues from TA1 and TA11 by class and context.

context		SHC	Indet. Fe-slag	Iron smelting	lining	lining slag	crucible	crucible no.	iron	floor	Cu- slag	Total seen	unseen	Total	% seen
TA1															
2609	spread, overlies 2610, cut by 2531	176	120	90	12	0	2	1	0	0	0	400	154	554	72%
2610	spread, cut by 2531 (relationships of table not confirmed by text)	0	30	0	0	0	2	2	4	0	0	36	0	36	100%
2586	primary fill of 2531	0	0	0	0	24	10	4	0	0	0	34	0	34	100%
2587	primary fill of 2531	0	9	0	0	0	8	3	0	0	4	21	0	21	100%
2530	main fill of slot trench 2531	906	512	236	89	0	5	2	0	0	0	1748	322	2070	84%
2529	secondary fill of 2531 above 2530	0	454	0	716	0	77	38	2	0	0	1249	447	1696	74%
2500	fill of second slot trench 2647 (recut of 2531)	1920	11103	930	374	0	7	5	48	0	0	14382	0	14382	100%
2503	floor surface, over floor 2511 and 2504	0	230	0	0	0	2	2	0	0	0	232	444	676	34%
2504	spread of burnt material inside area of 2531, covered by floor 2503	0	38	0	0	0	0	0	0	0	0	38	0	38	100%
2588	spread	0	101	0	0	0	1	1	0	0	0	102	0	102	100%
2532	spread - external "path"	502	709	124	110	0	5	1	0	0	0	1450	0	1450	100%
Total weight		3504	13306	1380	1301	24	119	59	54	0	4	19692	1367	21059	94%
Percentage		18%	68%	7%	7%	0%	1%		0%	0%	0%				
TA11															
2537	spread	0	22	0	2	0	0	0	0	0	0	24	212	236	10%
2538	fill of pit 2581, 0.2x0.32x0.27	156	0	0	0	68	0	0	0	0	0	224	364	588	38%
2539	upper fill of feature 2557, 0.62x0.59x0.15	0	5	0	0	0	0	0	0	0	0	5	0	5	100%
2542	spread, also fills pit 2582, 0.66x0.52x0.21	154	108	0	210	0	0	0	0	0	0	472	696	1168	40%
2544	fill of posthole? 2554	0	0	0	0	38	0	0	0	0	0	38	0	38	100%
2553	spread	0	2	0	0	0	0	0	0	0	0	2	0	2	100%
2556	primary fill of feature 2557, 0.62x0.59x0.15	0	0	0	0	0	0	0	0	250	0	250	10	260	96%
2563	fill of posthole? 2616	0	26	0	0	0	0	0	0	0	0	26	0	26	100%
2569	uppermost fill of pit 2584	0	6	0	0	0	0	0	0	0	0	6	0	6	100%
Total weight		310	169	0	212	106	0	0	0	250	0	1047	1282	2329	45%
Percentage		30%	16%	0%	20%	10%	0%		0%	24%	0%				
Overall totals												20739	2649	23388	89%

Table 3: List of weights in g of smithing hearth cakes from TA1.

62
114
180
198
200
210
232
270

183 average

Table 4: List of crucible fragments extracted from the general catalogue (Table 1).

context	find	bag/label	weight	notes
2500	3	cruc frag	1	crucible fragment, probably originally similar to other material but deeply vitrified on all faces including breaks so must have fallen onto hearth
2500	11	cruc frag	1	1 piece broken in 2, base from similar thin walled crucible to above pieces, feels slight harder and vitrification slightly more yellow,
2500	12	cruc frag	1	sherd from near base to rim of small crucible in same fabric, lip become out-turned across piece suggesting a pouring lip, nothing visible inside, externally light green glaze with very few red spots and a brownish slag near base
2500	13	cruc frag	2	base of crucible, small drip of red/purple slag on very base, nothing visible internally, probably same fabric and style as others
2500	14	cruc frag	2	rounded base of crucible markedly thicker than other material, but otherwise similar on fabric and gentle glaze
2503	7	cruc frag	1	green-grey crucible sherd. Light external vitrification, slight red spots
2503	9	crucible sherd	<1	tiny sherd as above 2503 material
2529	s710	4	28	7 sherds of cupel, 1 of crucible
2529	2	3/4 whole crucible	18	D-shaped crucible with straight edge and two corners preserved on lip, other side to base only. 30mm tall, 34mm wide, external pale green transparent glaze, with a few red patches.
2529	8 to 34	26 bags of frags plus 2 tiny nodules		fragments suggest a slightly thicker based crucible than most of the material, and possibly more quartz-rich, needs restoration to be confident about size, shape, even the number of vessels present. Suggest a rather larger, maybe broader crucible than the others, glaze redder than most of the above material, also some isolated red glass lumps in ash.
2529	42	clay poss from inside crucible		thin piece of sandy green clay with lots of organic temper - probably an unfired crucible sherd
2530	3	cruc frag	1	grey green sherd, very thin, no obvious external vitrification, possibly a dark internal residue
2530	30	cruc frag	4	sherd from near base of grey-green fabric, quite thin, little vitrification, has a few spots of adhering dark slag, internal uncleaned
2532	s708	bag3	5	crucible sherd, very heavily vitrified and some slag, quite a large crucible
2586	2	cruc frag	1	sherd broken in 2 from lip of thin walled crucible. Grey-green fabric, strongly curved, slightly out-turned, possible dark internal residue
2586	3	lip	7	side of crucible very similar to 2529-2. Slight external vitrification, pale green, internally slightly reddened, D-shaped or triangular form
2586	4	cruc frag	2	fragment from base of small crucible, externally quite strongly vitrified, pale green transparent, interior slagged with some green corrosion showing, small patch of quartz rich slag attached to outside
2586	1	complete crucible		crushed but largely present triangular bag shaped crucible 65mm tall by 50mm wide, fabric appears paler than other examples, but may be adhering ash as the specimen has not been cleaned this is uncertain? Despite label only a very short length of rim is preserved
2587	s714	2	1	small sherd of crucible
2587	2	cruc frag	6	sherd suggestive of crucible maybe 45mm tall. Thin walled, but has lip-ward thickening internal residue, streaking green where damaged.
2587	3	cruc frag	1	very neat well formed thin rim sherd of the usual fabric, vitrified externally gently, internal surface not cleaned, but no obvious residues
2609	2	cruc frag	2	out-turned lip on angle in wall, probably a pouring lip, thin wall, shows marked external reddening on glaze on one side of the angle, internally a little rusty residue
2610	3	cruc frag	<1	tiny grey green slightly vitrified thin-walled crucible sherd
2610	4	cruc frag	1	tiny sherd as above, but has much more external brick red spotting

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