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Assessment of archaeometallurgical residues from Dwr-y-Felin School, Neath (GGAT 677 & 716)

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Abstract

These projects produced approximately 31kg of archaeometallurgical residues and associated materials, 26.4 kg of which were from stratified Roman contexts.

The collection was dominated by residues from iron-working. These included 15.8kg of smithing hearth cakes, 6.9kg of closely related gravelly lining slags, 2.6kg of vitrified hearth lining and 1.6kg of other lining slags. A further 2kg of slags were 'indeterminate'; in practice mainly materials that were too fragmented to be assigned to one of these classes.

The smithing hearth cakes (SHCs) show a weight-frequency distribution that is very similar to those from other sites engaged in the end use of iron (blacksmithing). The Roman smithing was almost entirely undertaken with charcoal fuel – just three examples of possible coal residues within slags were identified. Some 20 Roman contexts yielded small quantities of coke or clinker, indicating the coal was being used – but perhaps mainly for non-metallurgical purposes.

The evidence for early iron production was extremely limited, with just 200g of possible bloomery iron smelting slags, of which only 14g was in a stratified Roman context.

Post-medieval/modern contexts produced a variety of materials, including more common coke and clinker, as well as small amounts of blast furnace slag, alongside residual Roman materials.

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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 (project 677) and Table 2 (project 716).

This project was undertaken for Martin Tuck of the Glamorgan-Gwent Archaeological Trust as part of the archaeological mitigation of construction of a new classroom block for Dwr-y-Felin School (GGAT projects 677 & 716).

Results

The following sections describe the residues and their distribution. Materials in the sample determined not to be, or not likely to be, of metallurgical origin (e.g. iron artefacts, concretions and natural rock) have been excluded from this descriptive section, but are listed in full in the catalogue (Tables 1 and 2).

Description of materials

Coke: these materials are highly porous, low-density, carbonaceous materials. They are the dominantly organic residues of incomplete combustion of coal. It is likely that they will be mainly residues from the use of coal, rather than deliberately manufactured coke.

A total of 230g of coke was recovered, with just 56g from contexts interpreted to be of Roman age.

Friable red clinker: this material occurs mainly in sheet-like form, up to about 40mm thick. The materials are very friable and contain a high proportion of un-fused shale fragments. It typically has a bright red colour. The material is suggestive of clinker formation during the relatively low-temperature combustion of coke. Such materials are not necessarily metallurgical in origin – but may arise from uses such coal combustion in steam boilers or during the manufacture of town gas.

A total of 202g of this facies of material was recovered, with just 20g of red-coloured clinkers certainly coming from Roman contexts.

Other clinker: these materials are more conventional clinkers, showing a higher degree of partial melting of the coal shale inclusions, indicative of higher temperature or more prolonged burning of coal. They typically show a matrix of black glass, containing pale, often bloated, partially-melted relicts of coal shale and have a maroon to purple surface colour.

Clinkers of this type may be the residues from a wide range of processes, both metallurgical and non-metallurgical. In a metallurgical context, they indicate a process where the metal contributes little to the residue, which is composed almost entirely of the fuel residue. This may be the case in much light blacksmithing work, from which forge clinkers may be almost indistinguishable from those formed in steam boilers for instance.

A total of 1217g of conventional clinker was found, of which 129g came from contexts of Roman age.

Gravelly lining slag: this facies of residue is formed of rounded masses of partially melted ceramic and stone bound by dark (usually), sandy, lining slag. In some instances the stone clasts are glazed with a thin transparent green glass and similar isolate glazed stones were found. The green glaze is indicative of involvement of only wood-ash as a flux.

This material is related to, and gradational with, the low-iron varieties of SHC described below – except that they have not amalgamated into the characteristic morphology of an SHC or tongue.

Some 6.9kg of this class of residue was recorded, approximately 23% of the overall collection.

Smithing hearth cakes (SHCs): SHCs provided the largest class of material from the collection with a total of 15.8kg.

There were 47 examples of SHCs which were complete, or sufficiently so for the original weight to be estimated. They ranged from 74g to 630g, with a mean weight of 244g.

Both the complete examples and the substantial collection of fragments showed a very wide range of morphologies and textures. At one end of the spectrum the SHCs embraced examples similar to the 'tongues' described by Young (2012a), which form as pad-like slag cakes extending forward of the blowhole and comprising an upper siliceous, often glassy, layer derived largely by melting of the hearth wall. As this slag mass reacts with iron oxides derived from the workpiece, it generates more fluid melts (of a broadly fayalitic composition) which may drip from the tongue and form pendent, descending, iron-rich, slag prills from its lower face.

In the case of the low-iron SHCs from Dwr-y-Felin, the melting of the hearth wall led not only to the formation of a viscous pad, but also to the covering of the pad by the less easily melted gravel-grade stone clasts from the hearth walls. These gravel clasts variously bloat and melt, leading to some extremely inhomogeneous textures on the upper face of these slag cakes. These tongues are closely related to the 'gravelly lining slags' described above – except that these lack the characteristic tongue/SHC morphology.

As the iron content of these tongues/SHCs rises, so the textures and morphologies tend towards more conventional SHC forms (usually oval in plan and with a plano-convex form, but sometimes concavo-convex if the dense bowl is not filled with slag, or biconvex if slag accumulates above the bowl). The fluid slags form a discrete, more-or-less well formed, lower bowl, usually with a dense crust. In some cases these bowls are filled with material similar to that of the tongues, in others a much more iron rich –slag, eventually leading to examples where the SHC comprised a very fluid slag 'puddle'.

The controls on the formation of these different forms of SHCs are very poorly understood. Most will derive from forging at different temperatures, for different lengths of time, with different sizes of work-pieces. The tasks involved in the forging operation may involve a greater or lesser involvement of forge welding. All of these factors will feed into the variety of SHCs produced during the process.

Most SHCs showed clear evidence of charcoal as fuel, but one fragment (context 2148) shows a surface coating of shale fragments, possibly derived from the use of coal fuel.

Several pieces of SHC (most notably from context 1076) show basal tool marks (expressed as steep side ridges on the base of the slag cake), where a poker has been used to manipulate or remove the slag. Many pieces show strong deformation from being removed from the hearth when hot, including being folded in half.

Vitrified hearth lining: 2.6kg of fragments of vitrified oxidised fired lining were found. The collection includes several significant pieces from the blowhole area, and

taken in conjunction with the evidence from vitrified hearth lining adhering to the end of some of the SHCs, some evidence for the blowhole can be obtained.

Interestingly evidence suggests that in some cases the blowhole was, at very least, on a 'boss'-like protrusion from the wall (e.g. context 6577; demonstrated by the convexity of the face of the wall near the area of attachment of the SHCs). Two other pieces show evidence for the sharp margins of the protrusion (contexts 1333 and 2148) which show the 'boss' may have been about 100mm across – and indeed may just possibly have been in the form of a ceramic tuyère.

Other lining slag / FAS: there was 1.6kg of material in the form of slags largely derived from the hearth lining, which did not fall into the above categories. This was mainly material analogous to the 'gravelly lining slags', but simply lacking the partially meted stone clasts.

Some lining slag pieces have a curved, sheet-like morphology, suggesting, like some of the SHCs, that they were pulled from the hearth whilst hot and plastic.

Tapped bloomery iron-smelting slag: possible bloomery iron smelting slag provided just 199g of the assemblage – and just 14g of that was in a Roman context. Some of the material in post-Roman contexts may be derived from other industrial processes as was suggested for some material from Dwr-y-Felin site 674 (Young 2013b). The material from the current site is mainly present as very small prills and lobes, and whilst consistent with an interpretation as tapped bloomery slag is not certainly so; other processes can generate fluid fayalite slags with maroon surface oxidation.

Other dense slag: this category has been used here for just a single piece of slag (58g; context 1676), which appears to comprise parallel dendrites of iron oxide (wustite?) and little else. Such materials may form as residual crusts on the interior of some industrial furnaces, but this piece was recovered from a Roman context. Identification of its origin must await further investigation.

Blast furnace or cupola slag: 109g of glassy slag and pale crystalline slag are compatible with an origin in a blast furnace (post-medieval iron smelting) were recovered. Several of these pieces appeared water-worn and all were recovered from modern contexts.

Indeterminate slag: material in this category (2kg) lacks sufficient diagnostic features to be able to be attributed to a particular class of residue. Much of this category is probably smithing slag lacking in evidence for its occurrence in an SHC morphology.

Distribution of the residues

The distribution of residue classes by context is given in Table 3.

There is a widespread background scatter of slag across the site and, at present, that appears to show little pattern. There are, in addition, several contexts with rather richer assemblages:

1. The intervallum area and in particular the makeup for the *via sagularis*: this area shows a consistent low level of slag – probably residual material incorporated into the make-up layers of the road (1.4kg). However, other sources may be present and the significant amount (1.8kg) of slag present in context 1278 (fired clay deposit part of oven 1023) is suspicious. The 1.2kg of slag present in context 1414 (a yellow silty clay) is also noteworthy.

2. The '*mansio*' area has several contexts with important assemblages, including contexts 1076, 1111, 1276, 1387 and 1502 totalling 13.8kg. This is slightly more than half of all archaeometallurgical residues recovered from stratified Roman contexts (a total of 26.4kg). This raises the likelihood of there having been a smithy in this area of the site (despite the fact that 13.8kg is still a fairly small assemblage, it is still indicative).

3. The assemblage from posthole 1008 is also noteworthy for an assemblage of almost 1kg of smithing debris.

Another observation from the residue distribution is that although coke and clinker both occur in Roman contexts (there are 20 contexts with either or both of these, totalling 56g of coke and 129g of clinker), there is no particularly strong relationship to the contexts containing other metalworking evidence. Just three slag samples apparently contained coal residues – an SHC from context 2148 with a scatter of shale inclusions, an incipient slag 'tongue' from context 1387 and a fuel ash slag from context 1844 (which is not necessarily metallurgical). Thus although coal may have been used in a minor role as a smithing fuel, it seems likely that it may have been used more frequently in other roles.

Material from context1075 may be worthy of note, since it is an assemblage that is not markedly different from other smithing assemblages on this site. The context has been provisionally labelled as pre-Roman, which in the basis of the similarity of evidence may be unlikely (although not impossible).

Interpretation

The assemblage from the site is almost entirely of residues from iron-working (blacksmithing). Other residues include some material probably from bloomery iron smelting, that was residual in later contexts, with just a single 14g piece from a Roman context (and certain identification of that as bloomery tapped slag is not possible on such a small fragment).

Post-medieval/Modern contexts produced a variety of materials including clinker (not necessarily of metallurgical origin) and a few fragments of blast furnace slag,

The majority of the assemblage was, however, of blacksmithing residues. Those found in later contexts was similar to that from stratified Roman contexts – and therefore it seems likely all the blacksmithing residues are Roman.

One parameter allowing comparison of smithing residue assemblages is the weight-frequency distribution of the SHCs. Summary statistics are presented in Table 4, where they are compared with those from other contemporary assemblages.

The Dwr-y-Felin assemblage of SHCs is very similar to those from a group of sites (Carmarthen, Crew 2003; Bulmore, Young 1999; Marsh Leys Farm, Young 2011;

Cowbridge, Barford 1996) which appear to have derived from general purpose blacksmithing activities. Comparative data from sites engaged in bloomsmithing are sparse, but evidence from sites at Kingstone, Herefordshire (Young 2012c), Cardiff Castle (Young & Kearns 2011), Dymock, Gloucestershire (Young & Kearns 2010b) and Miskin (author's unpublished data) all suggests that SHCs from bloomsmithing commonly range up to several kg in weight, with a similarly marked rise in the average weight of the SHCs. Further examples of bloomsmithing slags are probably to be found in the examples cited by Allen (2009, 2010) but which he erroneously classified as furnace bottoms from non-slag tapping bloomery furnaces. Bloomsmithing may therefore be discounted as a significant activity at Dwr-y-Felin.

The Dwr-y-Felin smithing assemblage is particularly interesting because the slag cakes span the range of morphologies of conventional SHCs, of lining slag cakes similar to those termed 'tongues' by Young (2012a), and of the irregularly-shaped gravelly lining slag lumps. These gravelly lining slags have been observed in other Roman assemblages (Caergwanaf, author's unpublished data; Caerleon Priory Field, Young 2013a; Caerleon Endowed Schools, Young & Kearns 2010a; Exeter, Young2011c; Calstock, Young 2012b; Neath, Young 2013b), but in isolation have not been able to be distinguished from residues of non-ferrous metalworking.

Insufficient Roman civilian sites have been studied in detail to allow comment on whether the occurrence of the gravelly lining slags on all these Roman military sites is of particular significance. Where these slags have been recorded previously, there has been a degree of uncertainty over whether these iron-poor residues were the result of ferrous or non-ferrous metalworking. The spectrum of compositions at Dwr-y-Felin strengthens the argument that these are iron-poor iron-working residues.

The relative paucity of evidence for coal-fuelled smithing is a slight distinction from some of the other comparative assemblages from South Wales. At site 674 at Dwr-y-Felin (Young 2013b), the general scatter of smithing debris was similar to that in the present study and mainly charcoal-fuelled, but there was a relatively late hearth that provided good evidence for coal-fuelled smithing. At Caerwent (Young 2006), the late (4th century) phase of smithing within the basilica appeared to be entirely coal-fuelled. The 2nd century smithing at Bulmore was largely coal-fuelled (Young 1999). The evidence from the blacksmithing activity on the site at Cardiff Castle (Young & Kearns 2011) also suggests the major, or sole, use of coal. Even on the late Roman rural site at Trowbridge (Young 2009a, 2009b), the smithing appeared to have been entirely coal-fuelled.

Perhaps the most similar pattern of fuel use to that of the present site within the area is the military iron working within the fortress at Caerleon (Endowed Schools field, Young & Kearns2010a; Priory Field, Young 2013a), which shows evidence for the use of a mixture of fuels, but with somewhat stronger evidence for coal use than at Dwr-y-Felin.

In cases where thorough and intensive sampling for microresidues has been undertaken within Roman military sites (e.g. Calstock and Exeter, St Loyes, Young 2012 and 2011c respectively), the pattern of distribution of hammerscale within the interior of the forts has suggested locations of ironworking that would not have been recognised on the basis of macro-residues alone. Workspaces inside the fort would have been kept clean, with macroscopic slags moved elsewhere for disposal. This should be borne in mind when interpreting the scatter of macro-residues from the internal areas at Dwr-y-Felin. Whilst it is currently assumed on the known pattern of distribution that ironworking took place outside the fort, in the '*mansio'* area, the possibility of external disposal of waste created inside, should also be considered.

Evaluation of potential

Further detailed investigation or analysis of most of the residues from the site would be unlikely to have great potential for advancing understanding of the site or its metallurgical activities.

An exception to this is the potential benefit of further investigation of the assemblage from the '*mansio*' area that includes the spectrum of slag types produced by the smithing activity. Further investigation of these would be significant, for it would allow documentation of the 'gravelly lining slags' and clarify their relationship to the more conventional SHCs. An improved understanding of the genesis of the low-iron lining slags would have enormous benefit for the interpretation of assemblages from other sites where this type of slag occurs without the diagnostic iron-rich slag types that permit its interpretation at Dwr-y-Felin.

It is therefore recommended that analysis of a small suite of slag specimens, ranging from iron-poor lining slag to iron-rich SHC should be undertaken, to define the variability and to enhance interpretation.

Some further investigation of the unusual very dense slag piece (weighing 58g) from context 1676 would also be desirable, since this piece does not correspond to any conventional class of Roman slag.

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Glossary

Blacksmithing: the working of iron and steel. Often restricted to the secondary smithing – i.e. the smithing of iron to produce or repair artefacts, as opposed to the smithing involved in the production of billets or bar iron from raw iron blooms.

Blast furnace: a tall shaft smelting furnace. Particularly used of the iron smelting blast furnace, introduced to Britain in the late 15th century and which replaced the *bloomery* furnace. The iron blast furnace differs from the bloomery in producing iron as liquid cast iron which is tapped from the base of the furnace.

Bleb: a small rounded particle or textural component, often a droplet or prill.

Bloomery: a furnace for smelting iron from ore in which iron is produced as a solid material. The bloomery process was employed mainly prior to the introduction of the later blast furnace from the late 15th century.

Bloom-refining: Usually taken as an alternative term for bloomsmithing, but may encompass techniques other than physical working (such as re-melting).

Bloomsmithing: The process of reworking a raw bloom, through repeated reheating and hammering, to reduce its content of slag, to remove unwanted inclusions and to draw out the remaining slag into elongate inclusions. The end product may be a bar or billet. Usually taken as an alternative term for *bloom-refining.*

Blowhole: A hole through a furnace or hearth wall through which air is blown.

Clinker: the partially-melted (fused) inorganic residue from the combustion of coal.

Coke: a vesicular carbonaceous residue from the burning of coal. Deliberately produced from the 18th century as a cleaner mineral fuel than coal, for coking removes the volatiles and reduces the sulphur content of the fuel.

Dendrite: a branched crystal form, often associated with rapid growth.

Fayalite: the iron-rich end member of the olivine group, Fe_2SiO_4.

Forging: the process of hot-forming a metal by beating it.

Fuel Ash Slag (FAS): slag formed by the partial melting of hearth wall or substrate under the fluxing influence of the ash (inorganic component) of the fuel. Fuel ashes are often very rich in alkali and alkali earth elements that may lower the melting point of silicates.

Lining Slag: Slag formed from the complete or partial melting of hearth or furnace lining.

Olivine: a group of silicate minerals of the form $(M^{2+})_2SiO_4$ where M can commonly be iron, magnesium, calcium (up to half the M^{2+} ions) or manganese. Includes the end-members fayalite (Fe_2SiO_4), forsterite (Mg_2SiO_4), tephroite (Mn_2SiO_4), kirschsteinite ($CaFeSiO_4$) and monticellite ($CaMgSiO_4$).

Prill: a small aggregate of a material, either a spheroidal droplet or a runnel, formed from a melted liquid and either occurring as a discrete particle or as an inclusion within another material.

Secondary smithing: see blacksmithing.

Smithing: the activity involved in forming a metal object, including, but not limited to, forging metal and joining metal by welding.

Smithing hearth cake (SHC): the slag cake formed in a smithing hearth by reaction of iron oxides lost from the workpiece with silicate material from hearth ceramic and/or fuel, below and in front of the tuyère/blowhole. They are very variable in form, but are typically plano-convex in shape (although concavo-convex and biconvex forms are common), frequently with a dense lower crust and a less well consolidated upper part. In some cases the top is formed of glassy slag.

Tap slag (or *tapped slag*, sometimes *tapslag*): slag that has been *tapped* from a furnace as a liquid to solidify outside the furnace.

Tapping: the process or act of allowing a liquid to flow from a furnace. In the bloomery process it is the slag that may be tapped; in a blast furnace both slag and iron are tapped.

Tongue: a slag mass formed from lining slag, particularly in smithing hearths, where it forms a sheet –like slag cake extending forwards from below the blow hole. The top is usually roughly planar and often glassy; the base is typically prilly and formed of more fluid slag.

Tuyère: a tube or perforated block to carry the air blast into a furnace or hearth. Early tuyères are typically ceramic. Later forms may be made of metal. Tuyères may be simply a pre-formed block to carry the blast through the hearth/furnace wall, but in many cases it protrudes into the earth/furnace to convey the blast directly to the hotzone.

Vesicle: a void or pore, usually rounded and formed as a preserved gas bubble in a solidified melt.

Wustite: an iron II oxide FeO.

Table 1: summary catalogue of archaeometallurgical residues and associated materials from GGAT project 677

Context	weight	No.	Notes
u/s	44	3	vitrified oxidised-fired lining
u/s	110	3	gravelly lining slag
	32	2	charcoal-bearing iron slag
	26	1	dense slag fragment - probably the margin of an SHC
	48	1	corrosion around iron - possibly an iron inclusion in a lining slag sheet
	<1	1	FAS fragment
u/s 2200	<1	1	coke
u/s	24	7	coke
	4	1	lime concretion
1000	24	1	clinker
1000	44	1	water-worn clast of stony blast furnace slag with glassy margin
1000	6	1	worn white blast furnace slag with glassy margin
1000	4	1	brick fragment?
1001	16	2	concretions: one on iron strip, the other on a small nail
1001	6	4	coke
	10	2	friable clinker
1002	68	13	coke
	14	2	coal

Context	weight	No.	Notes
1002	14	1	flowed clinker with shale fragments
	44	1	broken fragment of vitrified oxidised-fired lining with small part of blowhole margin, ceramic contains sandstone pebbles to 10mm
	66	4	small concretions on iron
	178	1	folded iron bar
	186	1	lump of iron-rich and slightly rusty slag with dimpled base - probably fragment of SHC
	<1	1	coke
	10	1	nodule from coal
	18	1	broken nub of lining slag
	54	1	piece of slag split from base of moderately large SHC
	46	1	concretion on iron
	50	3	worn indeterminate dense slag fragments
	98	1	broken distal end of dense tongue/SHC with glassy upper layer and denser slag below
1003	8	2	coke
	4	1	coal shale
1003	14	2	concretions
	6	1	vitrified oxidised-fired lining
	10	1	well-flowed glassy clinker with maroon surface
	102	3	rounded masses of intermediate density gravelly slag
1004	12	4	tiny weathered concretions or slag blebs
	32	2	concretions on iron artefacts - one a small nail, the other a possible hook-shaped object
	40	1	highly weathered slag lump, pale vesicular, has spheroid in attached matrix
	26	1	discoidal slag fragment with dark glassy top - probably a small fragment from an SHC
	12	1	stone
1006	36	1	dark lining slag with resinous lustre
	18	1	vitrified oxidised-fired lining
	94	5	gravelly lining slag
	62	4	dense indeterminate slag fragments
	44	12	coke
	<1	1	maroon-surfaced dense slag prill
1009	<1	1	coke

Context	weight	No.	Notes
1009	402	1	substantial SHC, surface dark and maroon - fuel clasts are however clearly charcoal, 90x105x45mm
	78	1	vitrified oxidised-fired lining, probably with partial blowhole margin, contains a large sandstone clast to 40mm
	106	1	55x80x30mm slightly dished, lining-rich SHC, lower part fairly dense, top dark and glassy.
	108	7	fragments of dense slag
	<1	1	vitrified oxidised-fired lining
	218	12	gravelly lining slag in rounded masses and fragments
	20	1	concretion on iron
1021	<1	1	coke
1029	118	1	sheet of maroon dark clinker
	<1	1	very shiny coke-like material
1030	780	14	grey-purple dense clinker
1031	122	1	large slagged piece of coal shale ; clinker
1043	<1	1	concretion
1044	60	1	gravelly lining slag in rounded nub - one end is maroon
	24	1	blebby dimpled piece of weathered dense slag
1046	10	1	blebby lining slag
1052	6	1	clinker
1053	24	2	coke
1054	6	1	coke
1065	142	1	concavo -convex SHC fragment with extremely smooth reddened upper surface, interior fine-grained and largely lacking vesicles, base microdimpled. No indication of overall SHC size but probably small - this is different to other SHC types seen. Probable charcoal inclusion
	30	1	piece of FAS - low density, one rough/one smooth surface
1073	20	1	dense slag prills with rusty accretion

Context	weight	No.	Notes
1075	2	1	coke
1075	48	3	concretions
	16	1	stone
	208	10	gravelly lining slags
	54	1	vitrified reduced-fired lining
	24	3	small fragments of dense slags
	114	1	irregular mass with dimpled base and flow lobes above- probably a fragment from a larger SHC rather than one its own right
1076	196	1	slice through coarse-grained SHC showing 3 tool marks radiating from one side, some sandy lining slag showing on small area of preserved top, core rather rotten and brown, some tool marks formed of fresher slag, at least 100mm wide and 45mm deep
	42	1	clinkery-appearing material, but possibly actually a concretion and the smooth coatings are weathering
1076	630	1	dense SHC, 120x100x70(50)mm, base irregular, microdimpled, top has central hollow (with a horseshoe of superimposed lining material), and probably fuel impressions towards margin.
	66	1	wall attachment of an SHC
	66	2	two rounded masses of intermediate density vesicular slag - hearth slags
1076	586	1	100x90x70(40)mm biconvex dense SHC, partially broken one end but all parts present, base finely dimpled, large mound of lining material on top and flowing over margins of bowl
	266	1	90x70x45mm irregular SHC with dimpled base and marginal flow lobes, top obscured
	218	1	65x90x35mm dense irregular triangular SHC with purple gravelly top, dense microprilly base
	528	1	90x145x65mm very gravelly SHC, slightly irregular but rectangular and original attitude hard to interpret, smoothly dimpled base, smooth top with gravel-rich material piled above near margins
	168	1	fragment of thin dense deeply dished SHC with basal tool-marks
	156	1	attachment of gravelly tongue to wall
	144	1	irregular gravelly, but dense, highly deformed SHC
	120	1	70x50x25mm plus concretion- small dense plano-convex SHC with maroon top
	356	5	concretions on iron - worth X-ray
	170	5	vitrified oxidised-fired lining
	382	15	gravelly lining slags and lining slags
1077	30	1	fired and slightly slagged fine grained stone - just possibly brick/ceramic but probably not

Context	weight	No.	Notes
1077	<1	1	charcoal
	6	3	coke
1077	2	1	vitrified oxidised-fired lining
	4	4	coke
	2	1	iron oxide crust - weathering of iron or iron-rich material
1077	142	1	very irregular dense slag fragment, probably part of an SHC
	254	1	charcoal-rich slag mass with dimpled base, part of an SHC but top and edges missing
	364	18	gravelly lining slags
	<1	2	coke
	<1	1	clinker
	16	1	vitrified oxidised-fired lining
	20	1	concretion
	8	2	dense slag fragments
	4	1	stone
	<1	1	potsherd
1081	154	1	small dense elongate SHC, with slightly lobate maroon top, 80x55x30mm, base obscured marginally prilly
1083	76	2	pieces of very irregular prilly clinker with admixed sand and possibly gravel
1084	60	1	slightly concavo-convex piece of dense, lining-influenced slag, top with fuel impressions, base smoothly dimpled
1084	22	6	coke
1086	6	1	coke
1086	56	2	gravelly lining slag
1086	38	1	impure coal
1088	<1	1	coke
1089	18	1	gravelly lining slag

Context	weight	No.	Notes
1089	82	1	broken mineralised iron sheet c.70x100mm
	4	1	coke
	26	1	gravelly lining slag
	20	2	white slag with skeletal growth of a platy white mineral in vugs - unusual blast furnace slag?
1091	4	1	concretion
	10	1	scrap of weathered iron slag
	2	1	claystone ironstone fragment
1095	10	1	claystone ironstone nodule
1096	274	1	reduced-fired block of curiously foliated bloated ceramic, probably a shaft fragment (strongly concave on inner face), has planar margin possibly suggesting brick like construction, foliation may indicate organic temper, but this is unclear
1099	48	4	ferricrete in gravel - probably around corroded iron
1104	140	5	gravelly lining slags, some with coal residues as well as gravel
	2	1	coke
	146	3	concretions (at least one may be on a large slag lump)
	164	3	dense slags, microprilly bases, probable charcoal moulds
1108	54	12	exploded concretionary material - formed on iron rod and sheet fragments? One piece has an included flint flake
1110	62	1	weathered SHC fragment, glazed top, internally vesicular including strange tubular vesicles that curve through 90 degrees
	12	1	sandy lining slag
	114	5	concretions
	10	1	vitrified oxidised-fired lining

Context	weight	No.	Notes
1111	322	1	biconvex mas of gravelly lining slag with a locally maroon surface, 100x90x60mm
	352	1	irregular mass with wall contact, probably a thin SHC folded back on itself, with an included (now rusty) iron lump, top glassy, base dimpled, gravelly but fairly dense
	294	1	low density, somewhat cavernous, lining-dominated SHC with odd iron-rich crown, 85x120x60(40)mm
	116	1	spikey mass of gravelly lining slag
	136	11	concretions
	74	1	small rusty plano-convex nub of slag - just possibly a very small SHC, but too accreted to see details
	84	5	vitrified oxidised-fired lining
	104	6	gravelly lining slag
	92	1	majority of small porous SHC with dark glassy, locally maroon top and base with moulds of fine charcoal - probably around 80% of cake
	48	4	small fragments of dense slags
	18	2	oxidised fired fine clay
	36	1	gravelly lining lag - probably a fragment from the side of a tongue or low-density SHC
1112	<1	1	glazed and partially-melted small pebble
1117	58	1	tongue like irregular sheet of lining slag, upper face dark glassy, lower face pale with deep fuel moulds - some still with charcoal
	<1	1	pale bloated FAS piece
1128	18	1	blebs and prills of dense slag into fine charcoal
1129	20	4	concretion with coal and coke in sandy matrix, one piece has what appears to be a wood impression
1131	<1	1	coke
1141	72	1	thickly-slagged vitrified oxidised-fired lining
	62	4	nubs of low density slag, typically purple surface, gravelly
	8	1	concretion
1142	4	1	coke
1158	40	6	concretions
	6	1	concretion with imprint of wrought iron or wood in iron oxides
1170	404	1	unusual brown, worn slag block, probably a section through the middle of a moderately large SHC with a very small basal bowl and a greater depth of charcoal-rich slag on top. Very base shows some possible grass impressions.

Context	weight	No.	Notes
1178	80	10	fragments of elongate concretion on wood (or iron?)
1189	8	2	concretion - probably corrosion crust from iron artefacts
1201	52	1	buff fired clay with reduced fired slot in surface on one side
	8	1	concretion
	104	1	irregular piece of reduced-fired clay with partially vitrified and slagged face
1226	6	2	claystone ironstone nodule
1227	6	1	bleb of lining slag
1228	50	3	gravelly lining slag
	10	1	lining slag - sand bonded by now dominantly bluish glass, charcoal moulds
1247	20	2	indeterminate scraps of dense slag
1270	8	1	bleb of lining slag
1276	492	25	gravelly and lining slag in various forms but palmate sheet most common - incipient SHC/tongue
	162	1	concretion on substantial piece of iron
	34	3	small concretions
	110	4	lining slag sheets with curved ceramic/floor contact,
	12	1	thin sheet of fired ceramic with maroon slag at one end, curved sheet. Superficial like a crucible sherd, but seems more likely to be spallled wall material
	100	7	vitrified oxidised-fired lining
	60	1	small section of wall with tiny horizontal tongue of lining slag 70mm wide, 45mm out and up to 15mm thick
	64	1	twisted fragment of thin small SHC with maroon top
	140	1	90x80x35mm irregular SHC, top is low density grey tongue, but has lower flowed lobes, part of top layer is missing
	98	1	small angular fragment of dense concavo-convex bowl with large bladed olivine
	136	1	70x85x50mm flat topped low density SHC/tongue, grey glaze top, prilly base, very slightly incomplete
	204	1	85x85x20mm, concavo-convex SHC with smooth haematised top and raised lip all around - not clear if deformed
	174	1	biconvex SHC, domed centre, smooth haematised surface flanked by raised dimpled areas, base neatly conical, 70x90x60(30)mm, charcoal

Context	weight	No.	Notes
1278	306	1	contorted mass - probably an entire SHC. Burr region shows coarse structure and smooth dished haematised surface. Distally it is all torn to strips and no sizing is possible
	296	13	gravelly lining slag fragments
	74	1	irregular gravelly tongue - pebbles on top, pale dimpled base
	78	1	dished tongue like concavo-convex sheet with dimpled base
	94	1	most of transverse tongue, dark sandy or maroon top variable, base pale dimpled with one rusty lump, internally very sandy
	36	2	lining slag sheets, appear to have been peeled from substrate
	142	7	fragments of vesicular denser slags - include several from same hollow mass, of dense slag with 'coralline' core.
	288	1	possible SHC, very heavily accreted on top with rusty mass, lower part appears to be formed by large, almost tapslag like flow lobes, but pale, dimpled base
	312	1	most of a dense SHC, 90x80x50mm, well-formed base, upper part slightly cavernous below glazed, dimpled top
	184	1	small dense SHC, 75x65x35mm, very dense, top is haematised, surface puddle, lower part dimpled
	34	1	dense rounded slag lump
1316	6	1	ironstone
	4	1	concretion
1320	30	1	concretion
	8	1	lining slag bleb
1332	180	2	100x80x45(35)mm, two conjoining fragments of conventional SHC weighing around 250g, thin weathered lower crust, remainder rich in charcoal moulds, charcoal deeply impressed in top, base microdimpled, no burr preserved
	220	5	concretions
	6	1	gravelly lining slag fragment
	30	1	vitrified oxidised-fired lining
	114	1	dense plano-convex lump of slag, possibly SHC, smooth maroon top partially obscured by accretion, microdimpled/microprilly base, with probable charcoal moulds
	54	1	smooth maroon top, microprilly base with charcoal moulds, internal texture has coarse bladed olivine to 15mm with tubular vesicles -a good puddle. Only small fragment so SHC form not known
	12	1	lining / FAS slag fragment
1333	194	1	proximal part and wall attachment of small conventional SHC - 60mm wide, 75mm preserved. Base prilly with charcoal, top smooth and maroon in centre, damaged elsewhere, but has charcoal inclusions, broken section shows dense bowl 20mm, dense low down becoming vesicular upwards, has well-developed lower prilly collar just in front of wall, wall appears to overhanging, original weight probably around 250g
	18	1	oxidised fired vitrified lining, one margin is curved, turns rearwards and is not slagged - all the characteristics of a tuyère - if so it is approximately 100mm diameter if regular
	72	4	gravelly lining slag in mainly rounded lumps

Context	weight	No.	Notes
1338	132	5	exploded corroded lump of iron, approximately triangular 70x70x20mm, iron may be slightly smaller, no clear form - may be raw iron fragment
	16	1	concretion
	220	10	gravelly lining slags, stones may be green glazed, interior may be various colours - highly vesicular to non-vesicular, surface grey with resinous lustre to maroon, evidence for charcoal contacts
	128	3	dense blebby slags, details obscured b y accretion
1338	14	1	green glazed reduced fired ceramic - not dissimilar in appearance to brazing coat
1338	8	2	coke
1346	4	1	irregular fragment of FAS / lining lag
1387	218	1	mass of fresh black glassy slag attached to wall below blowhole. Contact semicircular, laterally planar but convex vertically (undercut below blowhole?). Slag rich in partially-melted gravelly clasts and some fuel residues, base finely prilly, with some development of horizontal sheets
	6	1	small fragment broken from above
	220	11	other fresh black slag pieces, identical to material in SHC above. This material contains probable coal residues
1414	246	1	block of dense but resinous lustre prilly slag, probable top obscured by accretion - may be irregular SHC/tongue
	194	8	vitrified oxidised-fired lining
	154	10	sheets of lining slag, some with slight rear ceramic veneers, many curved - appear possibly to have been peeled from wall?
	474	29	gravelly and/or blebby lining slags
	142	4	irregular masses of dense iron slag - probably hearth slags
	8	1	concretion
1417	178	1	highly weathered piece, just possibly natural, but suggestive of corrosion around void left by corrosion of sheet iron 80x35x3mm?
1439	14	3	iron pan with small slag and coal inclusions
	26	1	fragment of charcoal-rich slag
1440	6	1	dense slag prills flown around fine charcoal

Context	weight	No.	Notes
1494	142	1	conventional dense SHC, 80x70x35mm, top mainly smooth maroon, base largely obscured by rusty material but partially prilly, with pale coarsely fayalitic prills
	90	4	gravelly lining slag, some showing a moderate degree of flowage
	8	1	angular fragment of clinker
	6	1	small fragment of weathered vesicular iron slag
	<1	1	vitrified oxidised-fired lining
1502	1330	59	gravelly lining slag fragments
	440	14	oxidised vitrified lining
	334	1	SHC, glassy top and dimpled base, now very strongly deformed with distal flow lobes in a vertical orientation, good dense SHC, probably all present
	104	1	small biconvex SHC with charcoal moulds in upper face, well formed bowl, 50x70x40(20)mm
	90	1	approximately half a small SHC with deep charcoal impressions in top and small dimples on base, internally has large vitrified broken sandstone block as well as small blebs of more assimilated material, olivine is coarse and bladed around sandstone clast, probably related to the gravelly materials, but this is part of neat SHC, fragment 70x(40)x30mm
	126	2	concretions - larger one is worth X-ray
	196	3	good iron slags in small tabular rounded masses - each could be a proto-SHC, but this is not certain, hearth slags
	160	1	slab of oxidised vitrified lining from around blowhole, showing repair of blowhole area
	188	1	part of small SHC and associated lining slag -all deformed and folded when hot. SHC shows angular sandstone gravel and strongly bladed fayalite in body, top hidden, base lobate/prilly with lining influenced slags
	214	1	block of slag that is rather cuboidal - probably an SHC folded in half and fused. Appears to have smooth top, at least proximally and dimpled base, fuel contacts appear to be charcoal
	110	1	rather square SHC, 50x80x35(20)mm, top smooth glassy, base dimpled - all very lining influenced, some possible rusty blebs on base
	220	1	squarish block of gravelly lining slag, probably formed down wall of the blowhole rather than in front, base smoothly lobate with a rusty surface, top glassy with gravel, proximal end is orthogonal and haematised around lip, 80x90x35mm
	130	1	attachment of glassy SHC with fired lining near blowhole, SHC maroon glassy top and maroon, dull lobate base, wall appears to arch-in over top of SHC
	196	1	large slab of vitrified sandy lining, with small tongue-like stub below blowhole, wall appears vertically convex around blowhole
	208	4	sheets of lining slag, strongly folded during removal - probably all taken from wall, and they are not tongues
	90	1	inclined piece of lining lag with an oblique wall contact at one end, an incomplete tongue
	42	1	rounded nub of dense vesicular slag - just possibly an SHC margin
	74	1	irregular mass of slightly rusty dense slag - of uncertain character
	2	1	lining slag fragment
	36	1	concretion on rod like iron piece
	12	1	small concretion
	18	1	small fragment of dense vesicular slag
	152	3	large concretions on iron - worth X-ray

	494	1	slightly broken large SHC, top green with 'micaceous' olivine. Interior largely void with coralline coarse olivine, basal crust well-formed but thin, 110x110x60(35)mm, base rough centrally, overlain by finely dimpled green slag towards margin with outer edge of cake slightly lobate, top is convex - possibly suggest opening up of central voids by lifting of the top
	272	1	well-formed SHC, top green with ‘micaceous’ olivine but with deeply impressed by fuel including large print of wood. Large cavities below top layer - so shows similarity to 494g specimen, 70x95x45(35)mm
	304	1	irregular slag block - probably a folded SHC, all details obscured
	242	1	broken fragment of a rather irregular dense SHC with a highly indurated basal conical sediment contact, upper part more porous
	558	1	large SHC formed from the amalgamation of separate cakes, top slab is very glassy, 130x90x75mm
	202	1	part of a dense conventional SHC, (60)x75x35mm, well-formed dense bowl, overlain by slightly vesicular slag with irregular partially-haematised top
	122	1	part of an irregular dense SHC similar to 202g piece, dished haematised top, possibly tool-marked base?
	130	1	large fragment of tongue like mass - but probably down wall of the blowhole not in front as appears to have ceramic contact, glassy top
	82	1	small dished SHC, top obscured but marginally maroon, base with charcoal moulds, 60x60x25mm
	126	1	part of a deformed irregular SHC with smooth haematised top, dense, probably from a small SHC
	90	1	distal end of tongue of gravelly slag, angular clasts to 20mm, smooth top, dimpled base
	186	1	distal part of an irregular dense SHC with glassy top and dense irregular base
1506	24	1	mass of lining slag on oxidised fired vitrified lining
	20	1	gravelly lining slag
	46	1	tongue like mass of FAS/lining slag in ashy concretion
1550	74	1	fragment from a tongue-like mass, slightly concavo-convex sheet of gravelly lining slag, base has fuel dimples but no clear clasts, top is dark glassy with maroon surface and lots of highly bloated pale clasts
1551	156	1	tongue-like mass of lining slag adhering to wall veneer. Base of the wall veneer is horizontal and deeply undercut - hints at the base of block tuyère? Mass is 100mm wide, 35mm deep below its upper glassy surface. Roughly 10mm of upstanding slagged wall above this, tongue protrudes 30mm and undercuts face by 35mm, base has abundant charcoal moulds, top slightly gravelly
	38	1	vitrified oxidised fired lining
	28	1	dimpled vitrified ball of gravelly ceramic
	8	1	blebby pale lining slag, gravelly with charcoal moulds
	100	1	irregular mass of gravelly lining slag, dark glazed probable top, but very irregular
1555	6	1	blebby sandy variegated lining slag mass
1676	58	1	unusual very dense slag which looks as if it is almost entirely parallel wustite dendrites
1708	24	2	vesicular lobed-surfaced slag, maroon surface, probably SHC fragment, broken

Context	weight	No.	Notes
1731	38	1	piece of pale grey reduced fired clay
	8	1	concretion on elongate iron object
1779	2	1	clinker or bloated FAS
1822	66	1	mass of lining/FAS slag, lots of sandy and partially-melted material associated with both dark and green glasses, some stone clasts, irregular shape, low density
1844	28	1	broken lump of gravelly FAS - comprising pale bloated clasts set in dark glassy matrix, fuel clasts present and probably coal residues, rather unusual low density variant on FAS
2148	326	1	80x80x40mm discoidal slag piece, base rusty and slightly accreted, not a probably prilly surface, upper face irregular, covered in abundant fragments of shale
	78	1	two joining (recent break) fragments of vitrified oxidised fired lining, edge of the piece is curving and slopes to wall reminiscent of tip of tuyère, curve suggestive of 100mm diameter tuyère or boss
5001	342	1	highly worn discoidal dense slag, probably a central fragment from a large SHC, but no detail visible
	26	1	lobate/blabby mass of lining slag, resinous lustre with maroon surface, possibly a flowed clinker
	16	1	vitrified oxidised fired, but pale, lining
	14	1	small fragment of tapslag with narrow flows
	32	1	flowed viscous mass of lining slag with maroon surface
	40	1	well slagged vitrified oxidised-fired lining
	54	2	rounded masses of gravelly lining slag
	68	1	nub of charcoal-rich dense slag with dimpled surface - prilly SHC?
	12	2	claystone ironstone fragments
	6	1	concretion
5006	6	1	grey glazed vitrified and bloated pebble

Table 2: summary catalogue of archaeometallurgical residues and associated materials from GGAT project 716

Context	weight	No.	Notes
u/s	42	3	iron concreted pebbles
	184	1	dense tap slag flow
	26	1	gravelly lining slag
	2	1	clinker
	2	1	coal shale
	1	1	small chip of slightly vesicular black glass (post med??)
6000	1	1	coke
	52	2	lining slag
	6	2	vitrified oxidised-fired lining
6023	16	1	fragment of highly vesicular clinker with maroon surface and abundant white included grains
	4	1	mineralised iron - probably the head of a nail on a square shank
6027	16	1	gravelly lining slag, sandy, with bright purple surface, probably rather altered to give strange colour
6030	16	4	fragment of iron slag with abundant small charcoal moulds - possibly one piece originally
	148	5	gravelly lining slag, one piece has accreted charcoal
	42	2	stones
6042	14	1	dark glass - green translucent, irregular some flow-banding
6044	1	1	clinker coated vitrified shale
	1	1	vesicular reddish-purple clinker
6045	4	3	coke

Context	weight	No.	Notes
6045	28	14	coke
	20	9	coal/coal shale, not certainly burnt
	1	1	charcoal-rich slag fragment
6045	116	1	part of broken 'tongue', dark gravelly top, slag with resinous lustre below with prominent fuel (charcoal) moulds, some oxidised lining attached to contact end
	1	1	bright reddish clinker fragment
6049	28	2	oxidised vitrified and slagged lining
	6	1	mineralised iron
	2	1	burnt shale
	18	1	gravelly lining slag with purple surface
6053	16	1	bleb of gravelly lining slag
	8	1	vitrified oxidised-fired lining
6066	6	1	vitrified oxidised-fired lining
	1	1	rotten sandstone?
	24	1	very unusual slag, flow lobes like a tapped slag, maroon surface with fine wrinkles, but internally a pale green glass with flow banding - probably a blast furnace slag?
6067	1	1	coke
	6	2	coal
6070	44	1	sheet of vesicular iron slag, thin, with accreted stones on top, hearth slag?
6089	496	18	lining slag, generally blebby and often gravelly
	50	3	vitrified lining, rather leached
	84	2	lining slag, blebby, attached to veneer of wall ceramic - in one case probably rather organic-rich (grass?)
	90	6	natural pebbles
	220	3	natural pebbles with attached iron concretion - possibly artefacts in two cases (one blebby, one possible thin sheet)

Context	weight	No.	Notes
	126	6	fragments of charcoal -rich vesicular iron slag
	238	4	denser iron slag, formed of prills, in one case these form non-wetted contact with planar surface
	42	1	vesicular low density iron slag attached to stone or veneer of wall ceramic
6095	10	1	vitrified oxidised-fired lining
6096	22	1	dark iron slag with abundant charcoal moulds, one side shows some pale glaze
6110	2	1	vitrified oxidised-fired lining
6110	316	1	slightly concavo-convex SHC-like mass, but formed of gravelly lining slag, top dark with pebbles included, base pale, resinous lustre, some rust, charcoal-rich, top has very dark slag between stones
	36	1	irregular platy, blebby flow of moderately dense slag - hearth slag?
	48	1	slightly flowed gravelly slag with dark surface, locally maroon
6182	12	3	brick red clinker on shale fragments
	16	1	blebby clinker
	164	1	sheet like mass of reddish clinker, top shows some poorly developed lobes
6182	2	1	coal
	6	1	burnt shale
	1	1	coke
	4	1	coal shale
6183	4	1	rounded nub of shaley coal, possibly slightly burnt
6197	2	1	coke

Context	weight	No.	Notes
6226	14	1	concretion on nailhead
	4	1	concretion
	8	2	coal/coal shale
	1	1	coke
	1	1	vitrified shale, red
6227	120	1	iron mottled concretion 'bog iron ore'
	1	2	mineralised iron - one probable nail head, the other square-sectioned rod- probably nail shank
6240	4	1	coke
6245	6	1	coke
	2	1	fragment of mineralised head of nail/rivet/stud
6255	1	1	fired shale/coke
6258	28	1	slagged shale
	16	1	thin sheet of dense slag with maroon surface, rather irregular in shape, smooth top in concave zones
6259	1	1	bleb of indeterminate slag, hollow
	1	1	reddish clinker with shale
6277	20	1	fractured piece of clinkery slag with shale inclusions
6280	4	4	coke
6422	2	1	reduced fired coarse quartz-rich ceramic
6437	8	1	lining slag bleb - at least one inclusion appears to have leaf-like organic inclusions - probably temper
	2	1	coal shale

Context	weight	No.	Notes
6438	1	1	tiny fragment of red clinker
6443	196	3	ferricrete of pebbles including ironstone nodules
6444	6	2	coke
	10	1	vitrified oxidised-fired lining
	2	1	ironstone crust
	6	1	ironstone crust
	24	1	gravelly lining slag
	1	1	broken iron oxide crust with moulds of organic material?
6445	1	1	coke
6448	156	1	triangular mass of dark gravelly slag with local maroon surface - possibly a poor SHC, 80x80x40mm
	54	2	blebby masses of gravelly lining slag
	2	3	pale lining slag debris
	42	1	mass of pale lining slag attached to veneer of oxidised wall ceramic
6453	18	1	2 pebbles joined by thin slag layer
6479	282	1	almost complete, somewhat multilayer, mass of gravelly lining slag, 110x80x60mm, top glassy, base has lots of charcoal,
6508	18	1	vitrified oxidised-fired lining
	54	1	mass of gravelly lining slag
6533	36	1	gravelly lining slag with a very bright maroon surface, pale interior
6537	26	1	mass of gravelly lining slag
6547	1	1	coke

Context	weight	No.	Notes
6557	190	1	concavo-convex tongue-like mass in gravelly slag with iron-rich base (with some accreted material). Could possibly be classed as a poor SHC, 80x60x50mm
	1	1	slightly slagged mudstone with somewhat purple colour
	1	1	either fired or concreted quartz rich sediment
6577	278	1	complete slag mass of gravelly lining slag - excellent example - shows convex protrusion of lining in area of blowhole, 70x80x70mm
6588	34	1	gravelly lining slag
	4	7	exploded fragment of slagged red shale
6598	18	1	rotten sandstone, possibly heated
6621	20	1	mass of gravelly lining slag
6773	74	1	slag fragment with convex lobate base, fractured top, one end is ceramic contact, the other is a fracture, probably an SHC wall contact
6958	108	1	concretion, possibly on iron - needs X-ray
7059	12	1	vitrified oxidised-fired lining

Table 3: Summary of residue classes by context (weight in g)

Context	Area	Context notes	Provisional age	coke	friable red clinker	other clinker	gravelly lining slag	SHC	lining	other lining/FAS	TS	other dense	blast furnace slag	indeterminate slags	*total*
677 u/s				8			110	26	44	1				32	*221*
716 u/s				1		2	26				184		1		*214*
1000		Machine clearance finds				24							50		*74*
1001		Topsoil		4	2										*6*
1002		Subsoil		16		14		338	44	18				50	*480*
1003	Intervallum	Finds in topsoil over (*via sagularis*) 1004		2		10	102		6						*120*
1004	Intervallum	Internal road (*via sagularis*)	Roman					26		40					*66*
1006	Intervallum	Mid brown silty clay deposit		44			94		18	36	1			62	*255*
1009	Rampart	Fill of posthole 1008	Roman	1			218	507	79					109	*914*
1021	Rampart	Mid brown silty clay	Roman	1											*1*
1029	Intervallum	Upper fill of 1026, orange-brown silty clay. Pit group 1038	Modern	1		118									*119*
1030	Intervallum	Upper fill of 1025, dark brown/black silty clay loam	Modern			780									*780*
1031	Intervallum	Lower fill of 1026, dark brown/black silty clay loam. Pit group 1038	Modern			122									*122*
1044	Trench 2 ditch	Ditch fill, clay between 1043 and 1045 Trench 2	Roman				60							24	*84*
1046	Trench 2 ditch	Ditch fill	Roman				10								*10*
1052	Intervallum	Charcoal rich clay deposit (? fuel oven 1023)	Roman			6									*6*
1053	Intervallum	Clay and pebble deposit between oven 1007 and 1052	Roman	24											*24*
1054	Intervallum	Dark grey-brown silty clay deposit . Pit group 1037	Modern	6											*6*
1065	Intervallum	Charcoal rich clay deposit (? fuel oven 1023)	Roman					142		30					*172*
1073	Extramural	Shallow depression -possible posthole/rooting (fill 1073)	Natural											20	*20*
1075	Extramural	Sandy clay subsoil occupation level	Pre-Roman	2			208	114	54					24	*402*
1076	Extramural	Dark brown silty clay deposit, near mansio	Roman?				382	3078	170					66	*3696*

Context	Area	Context notes	Provisional age	coke	friable red clinker	other clinker	gravelly lining slag	SHC	lining	other lining/FAS	TS	other dense	blast furnace slag	indeterminate slags	*total*
1077	Extramural	General finds number between road 1061 and the mansio		11		1	364	396	18	30				8	*828*
1081	Extramural	Clay deposit fill of 1085	Modern					154							*154*
1083	Extramural	Stone deposit, mansio?	Roman			76									*76*
1084	Extramural	Clay loam, post-med ditch fill	Post-med	22				60							*82*
1086	Extramural	Clay and loose stone deposit (mansio area)	Post-med	6			56								*62*
1088	Extramural	Stone linear, wall?	Post-med	1											*1*
1089	Extramural	Stone spread wall?	Post-med	4			44						20		*68*
1096	Extramural	Pebble and silty clay deposit	Roman						274						*274*
1104	Extramural	Clay deposit over NW/SE road 1061	Post Roman	2			140							164	*306*
1110	Extramural	Stone linear near mansio	Roman?					62	10	12					*84*
1111	Extramural	Charcoal rich clay between 1061 and 1110	Roman?				256	1134	102					48	*1540*
1112	Extramural	Cut for drain 1103	Modern							1					*1*
1117	Intervallum	Charcoal rich clay	Roman							59					*59*
1128	Intervallum	Timber slot	Roman											18	*18*
1131	Intervallum	Fired clay charcoal and stone	Roman	1											*1*
1141	Extramural	NW/SE road same as 1061	Roman						72					62	*134*
1142	Extramural	Clay deposit overlying road 1141	Roman	4											*4*
1170	Intervallum	Clay deposit underlying 1053 (ovens area)	Roman					404							*404*
1201	Intervallum	Light brown clay deposit	Roman						104						*104*
1227	Intervallum	Dark brown silty clay underlying 1006	Roman							6					*6*
1228	Intervallum	Finds number (area between 1101 and oven 1052)	Roman				50			10					*60*
1247	Extramural	Finds number for clay silts between road 1061, post-med drain and excavation edge	Post Roman											20	*20*
1270	Extramural	Posthole/ditch/depression (fill 1271)	Roman							8					*8*
1276	Extramural	Clayey sand and stone, walling/structure part of 'mansio'	Roman				492	816	112	170					*1590*
1278	Intervallum	Fired clay deposit part of oven 1023	Roman				296	1336		36				176	*1844*
1320	Extramural	Clay deposit under foundation 1100	Roman							8					*8*
1332	Extramural	Mixed stone and sediments within depression 1331	Roman				6	348	30	12					*396*
1333	Extramural	Orange brown silty clay and cobble deposit	Roman				72	194	18						*284*
1338	Extramural	Mid brown grey silty clay deposit overlying 1337	Roman	8			220			14				128	*370*

Context	Area	Context notes	Provisional age	coke	friable red clinker	other clinker	gravelly lining slag	SHC	lining	other lining/FAS	TS	other dense	blast furnace slag	indeterminate slags	*total*
1346	Extramural	Linear stone scatter in clayey silt	Roman?							4					*4*
1387	Extramural	Linear deposit of stone - wall structure mansio related?	Roman					444							*444*
1414	Intervallum	Yellow silty clay	Roman				474	246	194	154				142	*1210*
1439	Extramural	Yellow clay loam deposit	Roman											26	*26*
1440	Extramural	Yellow brown sandy loam deposit	Roman											6	*6*
1494	Extramural	Dark brown clay deposit	Roman			8	90	142	1					6	*247*
1502	Extramural	Orange/brown silty clay deposit. Iron waste -slag in deposit similar to ditch 1481 fill (i.e. 1076)	Roman				1640	3800	796	430				288	*6954*
1506	Extramural	Cleaning context southern corner site (same as 1494)	Roman				20		24	46					*90*
1550	Extramural	Grey-brown clay	Roman				74								*74*
1551	Intervallum	Yellow brown clay deposit	Roman				128		38	164					*330*
1555	Recess	Grey clay deposit, fill	Roman				6								*6*
1676	Intervallum	Mid brown silty clay fill levelling up/oven debris	Roman									58			*58*
1708	Intervallum	? decayed turf deposit underlying 1707	Roman					24							*24*
1731	Intervallum	Spread of oven clays and charcoal	Roman						38						*38*
1779	Intervallum	Gravel surface	Roman							2					*2*
1822	Intervallum	Fill of pit 1840	Roman				66								*66*
1844	Intervallum	Clay deposit overlying surface 1841	Roman				28								*28*
2148	Intervallum (section)	Light brown clay with yellow/grey hue, Fe stained, fill of pit 1712	Roman					326	78						*404*
5001	Trench 5 extraction pit	Dark brown clay loam and gravel upper pit fill	Roman				54	342	124	58	14				*592*
5006	Trench 5 extraction pit	Sandy clay fill of pit 5036	Roman							6					*6*
6000		External works unstratified finds number		1					6	52					*59*
6023	Intervallum	Clay deposit between *via sagularis* and rampart	Roman		16										*16*
6027	Intervallum	Clay deposit in pit 6025	Roman				16								*16*
6030	Intervallum	Clay deposit in pit 6025	Roman				148							16	*164*

Context	Area	Context notes	Provisional age	coke	friable red clinker	other clinker	gravelly lining slag	SHC	lining	other lining/FAS	TS	other dense	blast furnace slag	indeterminate slags	*total*
6042	South strip	Clay loam topsoil - playing field	Modern										14		*14*
6044	East strip	Subsoil similar to 6046				2									*2*
6045	South strip	Clay and stone deposit. General soil build up	Post-Roman	32	1		116								*149*
6049	Internal	Clay deposit, pit 6512	Roman				18		28						*46*
6053	Internal	Clay and pebble deposit	?Post Roman				16		8						*24*
6066	Intervallum	Clay deposit with pebbles and sandstone, same as 6067	Roman/Post Roman						6				24		*30*
6067	Intervallum	Clay deposit with pebbles and sandstone, same as 6066	Roman/Post Roman	1											*1*
6070	Internal	Metalled surface adjoining the *via sagularis*	Roman											44	*44*
6089	Intervallum	Clay deposit with pebbles, charcoal and slag within *via sagularis* make-up	Roman				496		50	126				364	*1036*
6095	Intervallum	Deposit making up part of the *via sagularis*	Roman						10						*10*
6096	Intervallum	Clay deposit within *via sagularis*	Roman											22	*22*
6110	Internal	Silty clay deposit, fill of gully 6111	Roman				48	316	2					36	*402*
6182	Extramural	Unstratified finds number extramural area	Mixed, Post Med/Roman	1	176	16									*193*
6197	Extramural	Greyish orange silty clay deposit	Roman	2											*2*
6226	Extramural	Grey clay deposit	Roman	1	1										*2*
6240	Extramural	Grey-brown clay deposit	Post-Med	4											*4*
6245	Extramural	Grey clay deposit	Roman	6											*6*
6255	Extramural	Charcoal rich clay deposit	Roman	1											*1*
6258	Extramural	Charcoal rich silty clay deposit	Roman			17									*17*
6259	Extramural	Stone fill in ditch 6284	Post-Med		1									1	*2*
6277	Extramural	Brownish-orange silty clay deposit fill of ditch 6284	Post-Med			20									*20*
6280	Internal	Clay deposit	Roman	4											*4*
6422	Internal	Brown-grey clay deposit with pebbles.	Roman?						2						*2*
6437	Internal	Clay and stone fill of ditch 6578	Post Roman							8					*8*
6438	Internal	Sandy clay deposit fill of posthole 6439	Post-Med		1										*1*
6444	Internal			6			24		10						*40*
6445	Intervallum	Mid grey-brown silty clay deposit	Post Roman	1											*1*
6448	Internal	Charcoal deposit in ditch 6514	Roman				54	156		44					*254*

Context	Area	Context notes	Provisional age	coke	friable red clinker	other clinker	gravelly lining slag	SHC	lining	other lining/FAS	TS	other dense	blast furnace slag	indeterminate slags	*total*
6479	Intervallum	Sandy clay fill of pit 6035	Roman					282							*282*
6508	Internal	Dark brown silty clay underlies road 6059	Roman				54		18						*72*
6533	Internal	Dark brown silty clay deposit	Roman				36								*36*
6537	Internal	Silty clay fill of a gully 6746	Roman				26								*26*
6547	Intervallum	Metalled surface	Roman	1											*1*
6557	Internal	Lower deposit of 6059 *via sagularis*	Roman			1		190							*191*
6577	Internal	Wall/structure. Linear platform of stone	Roman					278							*278*
6588	Internal	Light brown grey sandy clay	Roman		4		34								*38*
6621	Internal	Stone and silty clay, fill of posthole 6620	Roman				20								*20*
6773	Internal	Mid greyish brown deposit (? occupation layer)	Roman?					74							*74*
7059	Intervallum	Dark brown, pebbly, silty clay deposit with charcoal	Roman?						12						*12*
			totals	*230*	*202*	*1217*	*6892*	*15755*	*2600*	*1585*	*199*	*58*	*109*	*1962*	***30809***

Table 4. Weight distribution of SHC assemblage from Dwr-y-Felin, with selected comparative assemblages.Weights in g.

		Blacksmithing only				***With bloomsmithing***		
	Dwr-y-Felin Neath 677 & 716 This project	Carmarthen Crew 2003	Bulmore Young 1999	Marsh Leys Farm Young 2005 & 2011b	Cowbridge Barford 1996	Plot 331, Kingstone Young 2012c	Cardiff Castle Young & Kearns 2011b	Dymock Young & Kearns 2010b
No. of SHCs	47	136	?	30	?	15	5	10
Min weight	74	100	127	60	175	230	193	112
Max weight	630	820	770	824	700	1035	1090	3885
Average weight	244	227	270	333	403	565	626	1032
% of SHCs with weight:								
<500g	89%	94%	?	77%	?	47%	40%	60%
<1000g	100%	100%	100%	100%	100%	93%	80%	86%
>1000g	0%	0%	0%	0%	0%	7%	20%	14%
>3000g	0%	0%	0%	0%	0%	0%	0%	0%

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