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Assessment of archaeometallurgical residues from Staveley Road, Eckington, Derbyshire (SLE13 / ECSL17)

Dr Tim Young
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Abstract

The assemblage comprised approximately 61kg of archaeometallurgical residues, almost all from iron smelting in a non-slag tapping furnace.

Two slight variations on the technique were represented. The majority of the residues (approximately 90%) were recovered from the SE of the enclosure (from two sections across the enclosure ditch and from an internal pit). These showed that the basal pit of the furnace had been packed with a dense arrangement of both split- and round-wood. In these furnaces, the development of large slag cakes ('furnace bottoms') produced residues with a bowl-shaped layer of dense flow lobed slags containing moulds of the wood, overlain by a layer of open-textured, granular slag, which was in turn cut by a dished surface upon which the iron bloom may have lain. The second variation is represented by residues from pit [52], possibly interpretable as the base of a smelting furnace, which include 'furnace bottom' fragments with fewer wood moulds, but evidence for a grass/cereal pit packing. These fragments show upper surfaces with freely-flowed flow lobed tops, indicating descent of the slag into a pit well below the level of the bloom.

Despite statements in the evaluation report that smithing microresidues were recovered, the present collection contained no certain macroscopic evidence for smithing (no further micro-residue samples were submitted and samples from the evaluation were not re-examined). A single slag fragment from fill (100) of pit [37] had an ambiguous morphology and although probably a smelting slag, an origin in smithing could not be excluded.

Non-tapping furnaces are typical of the pre-Roman Iron Age, but are uncommon from the Roman period. Instead, in most areas of Britain, varieties of slag-tapping narrow shaft furnace and a flat-floored 'dome' furnace were dominant. Non-tapping furnaces were found at the site of Leda Cottages, Kent, where they were of between latest Iron Age and late Roman date. Interestingly, the Leda Cottages residues showed evidence for some use of cereals/grass as pit packing, as observed in Pit [52] at Eckington, despite this being relatively rare in British non-tapping furnaces.

The nature of ore exploited is unknown; despite a location on the Middle Coal Measures which contains claystone ores, a bog iron ore appears a more likely possibility.

Contents

Methods

All materials were examined visually, using a low-powered binocular microscope where required. As an assessment, 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 examined materials are listed in Table 1. This assessment was conducted in June 2017.

This project was commissioned by Carl Champness, of Oxford Archaeology.

Results

Description of materials

The assemblage comprises approximately 61kg of residues, almost all firmly indicative of iron smelting on a non-slag tapping bloomery furnace of the slagpit type. One piece of slag was ambiguous and might possibly have been a smithing slag. There was one small fragment of a post-medieval blast furnace slag from pit [17].

Bloomery iron smelting residues: the non-slag tapping furnaces used in Britain during the Iron Age, and subsequently to a lesser extent in the Roman and Early Medieval periods employed a combustible pit-packing in the base of the furnace. Above this level, the shaft of the furnace would receive the iron ore and charcoal fuel. The air blast was usually supplied by bellows through a blowhole (or sometimes blowholes) close to the base of the shaft. As the gravity-driven reaction proceeded in the shaft, the iron accumulated as a solid bloom in the top of the pit, with the waste material forming a liquid slag that descended into the pit. The combustion of the pit packing created space both for the descending slag and the growing bloom. The slag mass that forms below the level of the bloom is commonly known as 'furnace bottom' (FB)

In the case of the Eckington material, there were two distinct types of material that fall into the general category of 'furnace bottom':

The first of these shows a basal layer with amalgamated dense flow slag prills that have solidified around a pit packing of wood. Although dense, well-formed slag, the prills are often more vesicular than is typical. The wood was in the form of both split wood and round wood, up to 70mm wide and 200mm long. The base of this layer commonly showed distinct vertical slag prills and it was unclear whether the prills had solidified within the packing or actually reached a hard base. In contrast, the pit sides tended usually to show non-wetted lobate slag contacts, although a few specimens did show interaction of the slag with the pit wall, leading to large cobbles being embedded with the slag. The basal layer with its dense slags, is abruptly overlain by a much more open-textured layer, with the slag formed by an open network of crystals. This this texture, dubbed 'coralline' by Thomas (2000) has been observed in the gap between the bloom and the blowing wall in experimental smelts, but in this case, it appears to run below the bloom as well. The moulds of the wood packing may pass through the granular layer and are truncated at the upper surface of the slag, where there is a thin layer of more rusty appearance and chaotic texture. These slag blocks show a variable profile, but at least in some cases the upper surface of the block is inclined towards the centre of the pit. The blocks may be up to 100mm hick in the centre and as much as 240mm on the steep contacts with the pit wall.

The second variety is formed throughout of vesicular, but coherent, dense slag. The slag cake is formed by amalgamated prills, as in the first variety, but throughout the whole cake thickness. The upper surface of the cake shows flow lobes, somewhat similar to those of a tapslag, but without the reddening. The cakes contain a few, very large, wood moulds, some of which pass steeply through the thickness of the cake. The wood moulds do not indicate closely packed wood however. The sides of the cakes show fine moulds from cereal stems or grass, and these are occasionally visible on fragments of the upper surface. Impressions of cereals frequently lie of the surface of this slag sheets, which appear to have formed on the sides of the pit.

Less clearly diagnostic, but resembling FB slags from other sides are a variety of examples of thick, charcoal-rich slags, often with a prilly texture. Slags with fine amalgamated prills around charcoal are commonly encountered in FBS, often in the slag of the distal part or below the bloom.

As well as the FB material, the collection included a significant quantity (1.9kg) of furnace ceramic, with varying degrees of vitrification and failure. Many of these show a higher degree of failure than is typical, with very few pieces showing a simple vitrified stable cermaic surface. Much of the cermaic was strongly bloated. The simplest textures were reduced-fired ceramics, with multiple layers of vitrification, suggesting either repair, or flow/sloughing of cermaic down-wall.

Probable bloomery residue: a single piece of slag (480g; from (100)) showed a texture rich in very fine charcoal, overlying a more massive slag layer, which contained tubular vesicles arising of its base. Homogeneous slag with tubular vesicles is commonly seen in the lower part of smithing hearth cakes, but is also sometimes seen on furnace bottoms. In this piece the size of the original cake is not known, and an interpretation as part of the base of a FB is preferred.

Fuel ash slag: a single 210g block of slag from context (100) was a coarsely vesicular (with large, centimetre-scale, vesicles flattened in the plane of foliation of the cermaic), highly bloated, foliated, pale grey fuel ash slag. It is possible that this is simply a more strongly bloated variant of the lining slags described above, but the strong foliation and coarse vesicles are reminiscent of the type of fuel ash slag sometimes known as 'Iron Age grey slag' (Cowgill 2000, 2008; Cowgill *et al*. 2001; Swiss & McDonnell 2001; Young 2009). Such slags are one of group of closely-related fuel ash slags known from contexts such as cereal drying kilns (Young 2010a, 2015b, 2016e), domestic hearths (Young 2012a) and even cremations (Photos-Jones *et al*. 2007). The typical 'Iron Age grey slags' are probably residues from long-lived external cooking hearths and are mostly of mid-Iron Age date.

Blast furnace slag: a single small angular fragment of slag (6g) from fill (28) of pit [17] was layered, with a central zone of blue glass, bounded on either side by zones of cream-coloured crystalline slag. Such slags are typical of production in a blast furnace of post-medieval date. The slags with a ream-coloured crystalline component are most commonly encountered as residues from furnace employing a 'hot-blast' – a technique introduced progressively from c. 1830, although some cold blast coke fuelled slags may also show this colour rather than their more typical dark colours. Coke was introduced as fuel in blast furnaces in the early 18th century, but only became dominant in the last decades of that century.

Distribution of the residues

Almost all the bloomery iron smelting residue assemblage derived from a small area in the SE of the enclosure:

- 28.6kg from the enclosure ditch in evaluation trench 10
- 9.2kg from enclosure ditch in cut 80 8m to the west

- 15.8kg from pit [37] just inside the enclosure ditch between those 2 sections.

Thus, a total of 53.6kg out of the total 60.7kg (i.e. almost 90%) derives from a very small part of the SE section of the enclosure. The hand-dug sections across the enclosure ditch to immediate W and NE of this area showed no archaeometallurgical residues. This area also produced the single block of fuel ash slag that shows resemblance to the 'Iron Age grey slags'.

A ditch section (cut 30) further to the west only produced a single, slightly worn looking, slag piece (0.5kg).

An important assemblage is from pit [52] - quite possibly a furnace pit. This had 49 pieces of slag weighing 4.9kg (but was only half-sectioned). The pit, originally interpreted as a posthole, had vertical fire reddened sides, and was 0.3m in diameter and 0.3m deep. The slags indicated the use of a very slightly different technology to the large collection of material from the SE of the enclosure (see above)

A single piece of post-medieval blast furnace slag was recovered from pit [17] to the east of the enclosure during the evaluation.

Interpretation

The dominant residues were from iron smelting in a non-tapping bloomery furnace. Such residues may be produced in spectrum of furnace morphologies (see Young 2016d, Figure 11), ranging from narrow cylindrical furnaces (e.g. Crew 1998, 2009), through types that we likely to have been more bottle-shaped (e.g. Young 2016b), to types that are commonly described as 'dome furnaces' (e.g. Young in prep; Lewis *et al.* 2013). These varieties all require the use of an organic pit-packing within the pit/lower chamber of the furnace at the start of the smelt. This group of furnaces are commonly known as the 'slagpit' furnaces. They include varieties both with, and without, evidence for an arch to provide external access into the basal pit.

The non-tapping furnaces were largely replaced during the Roman period by a variety of slag-tapping furnaces, with a similar range of morphology from narrow cylindrical furnaces to large domed types, all with some provision for at least part of the slag produced during a smalt to be tapped from the furnace.

In most British examples of the 'slagpit' furnaces, the basal pit carried a pit-packing of split- or round-wood. A smaller number show a pit packing of grass/cereal stems. Such occurrences of cereal packed (or partially cereal packed) include examples from the Iron Age (e.g. Folly Court, Wokingham, Young in prep.), the Roman period (e.g. Leda Cottages, Paynter 2007, Fig 4) and the early medieval period (e.g. Clearwell Quarry, Paynter 2002; Yorkley, Young 2015a; Churchills Farm Hemyock, Young 2016a).

The Eckington material shows evidence for the use of wood pit-packing in the material from SE corner of the enclosure, but of a mixed packing (probably dominated by cereals/grass) in the material from pit [52].

The size of the furnace(s) represented by the residues rom the SE part of the enclosure is not known with any certainty. The slag blocks mostly appear to suggest formation in a slag pit with a central flat floor of c. 200mm diameter, inclined sides, and an overall pit diameter of approximately 500mm. Some pieces hinted at a somewhat steeper side, so it is possible that furnace pits varied in profile, or perhaps that the furnaces were not symmetrical. There was no certain furnace recognised in this area, although pit [92] was of an appropriate size.

On the western side of the enclosure, pit [52] appeared to represent the basal pit of a slagpit furnace. It was 0.3m in diameter and 0.3m deep, with some lateral heat reddening. The slightly deeper profile, together with the cereal packing, may be what allowed the slag cake to retain flow structures on its surface, since it was able to form well below the bloom and its subjacent slag.

The present material is therefore unusual in being both an example non-tapping technology that on present evidence is likely to date from the Roman period, and in the case of pit/furnace [52], being a variety of non-tapping furnace employing cereal/grass packing alongside some wood. rather than the more common simple wood packing. The closest parallel for the slag assemblage is probably that from Leda Cottages, Kent (Paynter 2007; Keys 2006).

The iron smelting aspect of the site is without any local parallel. The local solid geology is the lowest part of the Middle Coal Measures, and although a local claystone ironstone is a potential ore for the activity, such ores were not generally smelted in the Roman period. The site lies in a small valley which drains the area of Eckington Marsh (centred on SK 419781); a location which might be suitable for the generation of a bog iron ore.

If the fuel ash slag block from context (100) is to be equated with the 'Iron Age grey slag', then it too may represent the survival of Iron Age cultural practice. However, it is far from certain that this identification is appropriate and it might have been generated as a severely-failed furnace wall. If it is FAS from a non-metallurgical context, then the thickness of the piece suggests it would be from a floor-level hearth, rather than from a cereal-drying kiln.

Further work

Further archaeometallurgical work on the bloomery iron-making residues is desirable in order to:

1. clarify, if possible, the nature of iron ore resource being exploited.
2. to investigate the likely productivity of the operation
3. to investigate whether there were differences in the output from the two styles of furnace.

A programme of work to address these questions will be proposed. This programme will entail both bulk chemical and microstructural analysis of representative residues, together with chemical analysis of potential local iron ores.

No further work is proposed for the other classes of material recovered. It is unlikely that further analysis of the single FAS block would shed additional light on its origin.

In addition to the archaeometallurgical work, a programme of targeted dating would be extremely useful, to assess the relative age of the residue-rich deposits within the enclosure ditch [131], the pit [37] and the probable furnace [52].

References

COWGILL, J. 2000, Assessment report on the slags recovered from the excavations at Billingley Thorpe, Thurnscoe, South Yorkshire (BDT99). Archive report produced for Northern Archaeological Associates.

COWGILL, J. 2008, Report on the slag and associated finds from Normanton Industrial Estate (NOI 06). Archive report produced for West Yorkshire Archaeology Service

COWGILL, J, MACK, I., and McDONNELL, G., 2001, Report on the slags and related material from Grange Park, Courteenhall, Northamptonshire (GPC 99). Publication report produced for Birmingham University Field Archaeology Unit.

CREW, P. 1998. Excavations at Crawcwellt West, Merioneth, 1990-98: A late prehistoric upland ironworking settlement. *Archaeology in Wales*, **38**, 22-35.

CREW, P. 2009. *Iron working in Merioneth from prehistory to the 18th century.* Darlithiau Coffa Merfyn Williams Memorial Lectures No. 2, Snowdonia National Park/Plas Tan y Bwlch, Maentwrog. 40pp.

KEYS, L. 2006. The iron slag. Pp 3-16 in: L Keys & R Shaffrey Small finds from Leda Cottages, Westwell, Kent (ARC 430 01/83+200). Channel Tunnel Rail Link, Specialist Archive report.

LEWIS, J., CRABB, S. & FORD, S., 2013. Bronze Age urns, Iron Age iron smelting and Saxon charcoal production at Sadler's End, Sindlesham, Wokingham, Berkshire pp. 1-34 *in:* S. Preston (ed.) *Iron Age production sites in Berkshire, Excavations 2003 – 2012*, Thames Valley Archaeological Services, Monograph 16.

PAYNTER, S., 2002. Iron-working slag. Pp. 6-7 in: A. Holmes. Clearwell Quarry Extension, Stowe Hill, Gloucetershire. Oxford Archaeology, unpublished report.

PAYNTER, S., 2007. Innovations in bloomery smelting in Iron Age and Romano-British England, pp. 202–210*, in:* S La Niece, D Hook and P Craddock (eds), *Metals and Mines. Studies in Archaeometallurgy* (London).

PHOTOS-JONES, E., BALLIN SMITH, B., HALL, A.J. and JONES, R.E. 2007. On the intent to make cramp: an interpretation of vitreous seaweed cremation 'waste' from prehistoric burial sites in Orkney, Scotland. *Oxford Journal of Archaeology*, **26**, 1–23.

SWISS, A.J. & McDONNELL, G. 2001, Report on the Analysis of 'Iron Age Grey' Slag from the Conoco Site at Killingholme, Lincolnshire, CNK00. Archive report produced for Humberside Field Archaeology.

YOUNG, T. 2005. Site Activities: slag and related materials. pp. 174-176. *In:* Niall Sharples (ed.), *A Norse Farmstead in the Outer Hebrides. Excavations at Mound 3, Bornais, South Uist*. Oxbow Books, Oxford.

YOUNG, T.P. 2009. Evaluation of possible archaeometallurgical resides from Malmesbury, Wiltshire. *GeoArch Report 2009/15*, 2pp.

YOUNG, T.P. 2010a. Fuel ash slags from corn-drying kilns, South Hook LNG Terminal. *GeoArch Report 2010/04*, 24 pp.

YOUNG, T.P. 2010b. Fuel ash slags. P. 163 in: Crane, P & Murphy K., Early medieval settlement, iron smelting and crop processing at South Hook, Herbranston, Pembrokeshire, 2004-05*. Archaeologia Cambrensis*, **159**, 117-196.

YOUNG, T.P. 2011. Possible archaeometallurgical residues pp. 89-90 *in*: M. Collard & T. Havard. The prehistoric and medieval defences of Malmesbury: archaeological investigations at Holloway, 2005-2006. *Wiltshire Archaeological & Natural History Magazine*, **104**, 79-94.

YOUNG, T.P. 2012a. The slag. pp. 289-295 *In:* Niall Sharples (ed.) *A Late Iron Age farmstead in the Outer Hebrides Excavations at Mound 1, Bornais, South Uist*. Oxbow Books.

YOUNG, T.P. 2012b. Evaluation of archaeometallurgical residues and associated material from Tai Cochion & Trefarthen Roman settlement, Anglesey (G1632-T, G1632). *GeoArch Report 2012/20*, 12pp.

YOUNG, T.P. 2015a. Assessment of archaeometallurgical residues from Yorkley, Gloucestershire. *GeoArch Report 2015-24,* 5pp.

YOUNG, T.P. 2015b. Fuel ash slags from Ysgol Bro Dinefwr, Llandeilo, Carmarthenshire. *GeoArch Report 2014-32,* 20pp.

YOUNG, T.P. 2016a. Archaeometallurgical residues from Churchills Farm, Hemyock, Devon. *GeoArch Report 2015-31,* 77pp.

YOUNG, T.P. 2016b. Archaeometallurgical residues from Tolgarrick Farm, Truro, Cornwall. *GeoArch Report 2016-19,* 17pp.

YOUNG, T.P. 2016c. Archaeometallurgical residues from Fleet Hill Farm, Finchampstead, Berkshire. *GeoArch Report 2016-35,* 111pp.

YOUNG, T.P. 2016d. Ironworking residues from Tregurra, Truro, Cornwall. *GeoArch Report 2016-38,* 125pp.

YOUNG, T.P. 2016e. Pyrotechnological residues from Bornais, Mounds 2 and 2a. *GeoArch Report 2016-39,* 23pp.

YOUNG, T.P. in prep. Archaeometallurgical residues from Folly Court, Wokingham, Berkshire. *GeoArch Report 2017-09.*

Table 1: Summary catalogue of material. Abbreviations use: FB furnace bottom'; FAS fuel ash slag. Weights in g.

context	bag wt	item wt	item no	notes
sle13				
box 22218				
12	11035	11035	1	incomplete furnace bottom, with much gravel adhering to sides; basal part shows sub-conical dense slag full of large moulds (largest 200mm length of 60mm round-wood (or semi-round wood)); upper 40mm (on edge) is an open-textured 'coralline' slag, with slight dished upper surface (corresponding to bloom?); unclear if triangular-sectioned against back wall of pit, 240mm deep with top at 45 degrees, or top flat in conical pit 170mm deep; modest burr area shows zones of secondary reduction around wood/charcoal rather than being dense; top of wood-rich zone shows zone flow lobes, best developed on distal side.
12	60	60	1	fragment of box-stone weathered fine-grained sandstone
12	5060	232	1	weathered dense flow slag around wood moulds
		800	1	dense flow slag from pit floor/side, in sheet with lobate contact and hints of low lobes on part of top; very vesicular
		1975	4	open-textured coralline slag in curved sheets with slightly prilly bases; resembles upper part of slag cake of 11035g above, potentially from same or similar cake
		1815	1	block of more conventional prilly, charcoal rich FB material; suggests cake >120mm thick, but no clear structure or margins
		180	8	small fragments of charcoal-bearing slag (one is a small spall from the large FB on its own)
28	6	6	1	small angular slag fragment with central duck egg green glass, bounded by cream-coloured crystalline layers; post-medieval blast furnace slag; texture suggests this is a hot-blast slag, so most likely post-1830.
box 22219				
12	3320	754	4	dense amalgamated flow slags around wood; one piece has substantial split timber at least 60mm wide
		138	1	spalled fragment of charcoal-bearing slag with rusty concretion around iron - closely resembles proximal lip on 11035g piece, but does quite join
		440	12	smaller pieces of coralline slag, with some possible wood mould edges and small prills
		712	1	block of very porous iron slag with modified charcoal moulds, not obviously 'coralline' but possibly so internally

context		bag wt	item wt	item no	notes
			1240	1	large FB block with thin layer of coralline slag on top (10mm) then passes into lower zone with dense flow prills around wood moulds; 40-80mm thick; base has non-wetted prills around moulds of up to 50x40 x>80mm
	12	6955	6925	1	strange FB fragment; shows denser base and some areas on sides - but these don't join evenly, as if they have been disturbed during extraction maybe; dense textures not well seen; core of cake is rich in modified charcoal moulds giving a very unusual cavernous appearance; charcoal typically less than 12 mm and separated by porous slags (probably vesicular, but locally coralline) with some prilly terminations; 220x250x130mm; curvature hints at 300mm flat base with inclined sides - but far from certain.
	12	2365	2320	1	large piece from base of FB; lower 35mm strongly lobate around wood moulds, upper 65mm more granular, passing into poorly-preserved rusty upper surface; moulds include split wood >150mm long and round-wood up to 50mm diameter.
ecsl17					
box sl01					
	35	550	494	1	slightly worn-looking block of FB with one slightly prilly side and some large charcoal/wood inclusions
			50	7	fragments of iron pan, mostly present as rather amorphous dark cement between pebbles, but there are also two fragments of small tubular concretions
	38	2580	2530	1	Large block of FB; approximately 100mm thick in middle, thinning for 160mm towards margin (where 50-60mm thick) as base rises; top slightly dished and cross cuts the end of a large wood mould present high on the margin; most of the wood is flat, but at last one piece inclined; somewhat open-textured porous slag throughout.; base has large, slightly pendent prills, little sign of a dense contact, but prills well-formed; possibly would have been further wood below?
			40	1	small fragment of porous slag with wood moulds
	38	2910	2880	1	230mm wide slab, forming base to bowl (with adhering clay), and gently inclined non-wetted slag side. Lots of mostly slightly-inclined wood around margin, but overlain by granular ('coralline') slag (possibly that is the texture of the slag between the moulds too); the centre of the base shows a slightly redder slag with rounded voids, that maybe more strongly lining influenced; too irregular for clear diameter estimate; cut in gravel, so irregular stones sticking into slag both on base and lower side; angle of side suggests even if flat base only 200mm wide, pit must be 500mm wide or more
			22	6	small slag fragments

context	bag wt	item wt	item no	notes
box sl02				
53	2540	2430	1	large fragment from side of FB with tapslag-like top, penetrated by large round-wood moulds, one 50mm diameter and >170mm long, others slightly smaller; base of piece is coarsely lobate against sides of pit, becoming more finely lobate on base; several distinct areas appear to show grass impressions, suggesting a mixed pit-packing
		40	6	dense flow slag prills
		52	4	dense slag, mostly showing hint of grass moulds
53	2430	1870	23	dense amalgamated flow slags in well-formed lobate forms around large wood moulds; similar to material in large 2430g block above
		138	9	dense flow slag prills
		138	3	dense slag in sheets up to 10mm thick, probably from parallel to margin of bowl, with cereal impressions on both faces, and with a small degree of flow lobing visible
		28	1	unusual flow slag piece - an elongate flow with a wood impression on one side and cereal impressions on the other
		198	1	irregular fragment of charcoal-rich slag
		36	1	soft silty ceramic, green-grey, with thin coating of iron slag flowed down one side
box sl03				
97	1695	1695	1	block of charcoal-rich slag; charcoal medium (up to 60mm), one narrow end has small area of free prills, but way-up is not determinable
100	2425	1770	13	amalgamated dense flow slags, locally with free prilly margins and small areas of non-wetted surface, all with large wood moulds
		88	1	complex, multilayer lining slag
		74	1	greenish, slightly glassy on surface possibly, multiple parallel lobed flow slag prill, elongate.
		480	1	trough-like fragment of charcoal-rich slag in upper part (fine charcoal) and denser slag with tubular vesicles in lower part; unclear if this is from burr area or is the base of a large SHC; if SHC shows possible tool marks on case, 90x90x60mm deep fragment
100	2040	364	3	complex blocks of furnace lining/layered lining slag
		358	1	thin slab of FB margin - non-wetted slightly flowed lobes on outside, medium-sized charcoal impressions on the inside

context	bag wt	item wt	item no	notes
		1170	5	variable slags, some amalgamated flow slags, others richer in finer charcoal, but all slightly porous and cindery in appearance, possibly because of lining input in some cases?
box sl04				
100	2060	680	7	amalgamated flow slag with large wood moulds
		628	1	large block of flow slag with large mould moulds showing non-wetted surface (pit base?) curving into greenish grey ceramic - (pit side?)
		210	1	block of pale greenish grey fuel ash slag similar to IA grey - probably just a block of strongly bloated wall in this context - but could be IA Grey
		198	2	rounded lumps of dense slag with fine charcoal
		140	2	frothy-appearing, some moulds fine enough for straw iron slag with fine charcoal
		76	1	corroded lump of charcoal rich material, unclear if iron-bearing slag or simply iron concretion with slag
		26	1	elongate multiple parallel-lobed prill of flow slag, greenish surface but metallic lustre to fracture
		94	1	flow slag with tapslag-like surface with very slight reddening (or browning), flowing over large wood moulds - presumably front edge of FB
100	2030	704	1	chaotic block of low-density lining-related iron slag, with inclusions of sandstone pebbles, surface of slag is rusty.
		210	2	amalgamated flow slag fragments with large wood moulds, one has non-wetted surface, the rest is non-lobate internally
		1105	1	block of ferruginous/rusty FB; probably inclined base; 80-100mm thick, with clay and other debris impacted on top; internally, dense and massive (though rusty surface precludes detailed observation)
100	1830	386	3	very dense amalgamated flow slag with flows around wood moulds and with tapslag-like surfaces (non-reddened)
		88	1	low density green glassy amalgamated flow slag around wood moulds
		260	2	complex deeply vitrified lining masses
		348	1	angular block of slag rich in fine charcoal moulds
		734	7	iron slag with some signs of flow and with large wood moulds; all shows open porous texture.
box sl05				
123	1815	592	1	large block of vitrified wall, representing a 'scoop' worn in the wall near the blow hole
		72	2	vitrified wall fragments
		18	7	small fragments, probably of vitrified wall

context	bag wt	item wt	item no	notes
		900	1	lip of dense cake similar to the material from (53); large wood moulds on interior; non-wetted chilled surface on outside, with angular re-entrant suggesting chilling against a stone; upper lobate face just lightly browned.
		32	1	small tube of slag, running from charcoal-bearing material, through a zone with adhering ceramic, into tube with clean non-wetted surface; 55mm long, 16mm diameter; unclear if this is a slag rod like the Roman ones, or simply a leak into a hole in the subsoil
		110	3	angular flow slag lumps, with granular textured slag
		78	1	slightly flowed slag on piece of grey reduced wall
		4	1	small rusty nub - iron fragment?
123	760	444	2	amalgamated flow slag lumps around medium-sized charcoal/wood lumps
		194	1	rather chaotic mixture of iron slag and lining slag - probably from flow of wall material into charcoal bearing FB material
		114	2	conjoining fragments of deeply vitrified wall; ceramic strongly bloated and apparently in striated lumps below external vesicular slag
box sl06				
123	6680	1145	1	block of charcoal-rich slag, mostly medium-sized, but on one face has split wood with shrinkage cracks >100mm long and 30mm wide
		416	1	block of amalgamated flow slag with some large wood moulds, large charcoal lumps and a non-wetted flow-lobed contact
		1025	1	block of amalgamated flow slag with parallel wood packing to 160mm in length; one side has pendent flow lobes, but unclear if a true base
		480	1	amalgamated flow slag block, has a strongly convex non-wetted surface and large wood moulds
		212	1	convex block of vitrified lining, green strongly dimpled glaze, with one side with 90-degree angle (vitrification up crack probably more likely then genuine bend in face)
		200	1	amalgamated flow slag between large wood moulds
		936	1	similar to 480g piece above - strongly convex non-wetted surface; very large wood moulds to 140mm
		1390	1	rounded corroded mass, has charcoal-bearing slag at one end but much of this is iron
		390	1	amalgamated flow slag around large wood moulds, pendent non-wetting flows on base
		160	2	complex, multilayer lining slags
		160	1	slag lump (flow slag?) containing sandstone pebble
		132	1	charcoal-bearing slag with resinous surface, so possibly high lining content

Table 2: summary of material class by context. Abbreviations: FB furnace bottom; FAS fuel ash slag; BFS blast furnace slag. Weights in g.

context		FB	indet slag	lining/ lining slag	FAS	BFS	pan	stone	*total residue*
sle13									
12	Upper fill of enclosure ditch [131] in Trench 10	28566						60	*28566*
28	Fill of pit [17] which contained C17 pottery					6			*6*
ecsl17									
35	Upper fill of enclosure ditch [131] in Cut 30	494					50		*494*
38	Upper fill of pit [37]	5472							*5472*
53	Fill of pit [52], possible furnace	4894		36					*4930*
97	Fill of posthole [92]	1695							*1695*
100	Middle fill of pit [37]	8929	480	712	210				*10331*
123	Upper fill of enclosure ditch [131] in Cut 80	8036		1168					*9204*
total		*58086*	*480*	*1916*	*210*	*6*	*50*	*60*	*60698*

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geoarchaeological, archaeometallurgical & geophysical investigations

Unit 6,
Western Industrial Estate,
Caerphilly,
CF83 1BQ

Office: 029 20881431
Mobile: 07802 413704

E-Mail: Tim.Young@GeoArch.co.uk
Web: www.GeoArch.co.uk