GeoArch

Report 2013/06

Evaluation of archaeometallurgical residues from Churchills Farm, Hemyock, Devon

Dr Tim Young
30th March 2013

Evaluation of archaeometallurgical residues from Churchills Farm, Hemyock, Devon

Dr T.P. Young

Abstract

Archaeometallurgical remains from Churchills Farm, Hemyock, document two successive technologies of iron making: the non-slag tapping (slagpit) furnace and the slag-tapping furnace.

The slagpit assemblages are well preserved, in some cases probably left in situ at the end of a smelt. They consistently show evidence for the use of a grass/cereal pit packing. The more normal form of packing is of split wood, as seen on the Culmstock Road site in Hemyock. The reason behind the difference is not yet clear. The use of grass/cereal packing is well-known from the slagpit furnaces of the eastern Europe, with rare examples known from the Iron Age of Britain and the early medieval in Ireland. Numerous slagpit furnaces appear to be present, as well some more linear features containing resides from the slagpit furnaces, originally interpreted as furnaces with an external tapping/working channel, but which may prove to be linear ore roasting pits.

Later features on the site contain tapped slags, but there is currently no clear indication that these were derived from furnaces within the bounds of the excavated site.

The slag assemblage is of regional and probably national significance. Detailed analysis of the materials has a very high potential for enhancing understanding of the technologies, of the development of technology and its chronology, together with the place of the activity within its local economic context.

Contents

Methods 1

Results: description of residues 1
Non-slag tapping iron smelting 1
Furnace bottom 2
Flow slags 2
Slag 'puddles; 2
Slag tapping iron smelting 2
Smithing of iron 2
Furnace/hearth ceramic 2

Results: distribution of residues 2

Discussion 3

Assessment of potential 4

References 5

Catalogue 7

Methods

All materials were examined visually. As an evaluation, the materials were not subjected to any high-magnification optical inspection, nor to any form of instrumental analysis. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional. This project was undertaken for Dr Chris Smart, Exeter University.

The bulk slag collections were assessed through a visual inspection of all the assemblages from contexts believed to have an association with features of metallurgical origin, but only of a selection of assemblages from the pottery-rich pits, ditches and drains. Twenty seven bags of residues were examined. Brief comments about each bag are presented in Table 1.

Results: description of residues

Non-slag tapping iron-smelting

The majority of the observed residues were derived from a non-slag tapping bloomery iron smelting process.

The overall assemblage contains material which shows the relationship between several distinct forms of slag:

- the **furnace bottom** (FB). This term has been applied to large slag mass which formed in the base of a non-slag tapping furnace (e.g. Crew 1995). It is now clear, however, that the single coherent mass envisaged in the early descriptions is not the norm in such furnaces, unless the volume of slag produced during a smelt was sufficient to fill the basal pit or chamber of the furnace; otherwise a distinct stratification can be observed, with slag facies with a much closer similarity to those of slag tapping furnaces. Here the term FB is employed for the large slag mass which may occupy much, or all, of the diameter of the basal pit or chamber and which lies directly below the bloom as it forms.

As is typical for such material, the Churchills Farm FBs are porous, comprising slag films around moulds of charcoal fragments. Much of the slag is in the form of small coalesced prills. The masses are therefore rather fragile, meaning that relatively complete examples will have suffered little or no reworking.

In several examples, the outer surface of the FB was observed. This often forms a non-wetting contact with the surrounding ceramic material (lower furnace wall, pit lining, or natural into which the pit was cut). In many examples this surface showed the coalesced lobate/prilly nature of the FB very clearly, but also preserved the impression of the stems of grass- or cereal-like plants.

- **flow slags**. This term has been employed to describe slag which has flowed within a furnace, but has not been tapped from it. The Churchills Farm flow slags include some isolated prills (possibly because of sampling bias in the hand-picked collections), but are mainly substantial masses of coalesced flow lobes. The detailed morphology of the flows is usually sufficient to discriminate between these and tapped slags. The flow slags do not show any of the surficial reddening typical of tapped examples.

There are rare examples of birds-foot structures amongst the Churchills Farm collection; these are the product of down-wall flow of fluid slag, often from close to the blow-hole, which then spreads out as rivulets onto the floor of the furnace pit. These are indicators of free space for slag to accumulate below the FB. In other words, despite its name, the position of the main part of the FB is determined by the position of the bloom and if the basal pit/chamber is sufficiently large, then the FB doe s not extend to the floor.

Some examples of the flow slags include particularly fine flow lobes and prills penetrating between the elongate moulds of grass or cereal stems.

- **slag 'puddles'**. Further evidence of substantial flow of fluid slag into the base of the pits is provided by significant plano-convex slag cakes. These somewhat resemble smithing hearth cakes in form, but several examples show them to have developed below FBs. Most examples show evidence for associated moulds of grass or cereal stems.

Some, at least, of these slag 'puddles' show a microstructure of large bladed olivine crystals, locally up to 15-20m long. This texture demonstrates that the puddle cooled as a single unit, probably very slowly and possibly that the slag is close to a eutectic composition.

Slag tapping iron smelting

Slag from slag tapping bloomery iron smelting furnaces was only identified where it was present as tapped slag. Any internal furnace slag would not have been able to differentiated from non-slag tapping furnace slags in this assemblage.

The tapped slags were present as fragments of slag cakes. The inclined side of the base of several cakes was observed, suggesting a moderate to large size for the original cakes.

Tapslags formed a minority of the examined material, but it is likely they were under-represented in the material examined, partly because of selection against the examination of collections from 'late' contexts, and partly because much slag from late, slag-rich, pit fills was not retained after excavation.

Smithing of iron

Iron working was represented in the examined material by just a single medium-sized smithing hearth cake (SHC). This example was of a size which (during the medieval period) might have been produced either during primary smithing (bloomsmithing) or secondary smithing (blacksmithing).

Furnace/hearth ceramic

The collections contained only a fairly modest amount of hearth/furnace ceramic, but it is likely that the hand-picked nature of the collections may have led to a bias against this class of residue.

Results: distribution of residues

The collections included four broad types of assemblage classed by the nature of the producing context:

- those collected from sub-circular pits 600-700mm in diameter, which were recorded either as furnaces (presumably where clearly 'burnt') or as postholes (507, 756, 760, 777, 795, 798, 800). These assemblages are entirely residues from iron smelting in a slagpit, non-tapping, furnace. Re-examination of original context-sheets and photographs should help to resolve whether the materials were all in-situ, but at least some contexts would appear to be likely to be so (e.g. 795, 800). The style of the assemblage varies between furnace and the relationship between residue assemblage and pit size/shape should be considered.

- those collected from elongate features, recorded as probable furnaces with tapping channels (772, 781, 808). The assemblage from deposit (781) comprises a large collection of residues from slagpit iron furnaces, rather than being indicative of slag-tapping. The assemblage from context (808) is smaller, but also includes large FB fragments from slagpit furnaces. In contrast, context (772) contained a large block of slag which was probably (but not certainly) a slag tapped onto a charcoal bed.

- those collected from pits, including the pits rich in pottery (539, 616, 730). These assemblages are dominated by tapped slags, with a minor component of residues from the non-slag tapping process (at a level compatible with being residual material). In particular pit fill (730) appears to have been particularly slag-rich (although not all the slag was retained).

- those collected from late ditches and drains (509, 676, 681, 707, 882). This material comprises a mixture of residues, typically in relatively low concentrations and many of the pieces are worn.

There are reasonable grounds for interpreting all of the sub-circular features as the basal pits of 'slagpit'

furnaces (in other words non-slag tapping furnaces that terminate downwards in basal pits).

The linear burnt features mainly contain residues from slagpit furnaces, so they are not slag-tapping furnaces. Non-slag tapping furnaces with an arch and external pit are known (e.g. Young 2008g), but it is perhaps more likely, given the extreme length of the features, that they are linear ore-roasting hearths (similar to those at the Culmstock Road site in Hemyock; pers. obs). The single piece of possible tapslag from one of these features is unusual (the lobes show subsidence into a fuel bed) and it may actually be an amalgamated internal flow slag from a slagpit furnace.

The later occurrences of tapped slag at present appear to occur in non-metallurgical features and the actual smelting may have taken place elsewhere nearby.

Discussion

The Churchills Farm site is important for demonstrating both non-slag tapping and slag tapping technologies of iron smelting. The later, slag-tapping, phase of activity can be dated by associated pottery and appears to be later medieval. In the current absence of dating for the earlier phase of activity, all that can be currently suggested is that it is likely to be significantly earlier in date. On the available evidence (including an apparent dearth of features dated to the 11th to 14th centuries on pottery evidence) it would seem unlikely that the succession includes a transition from one technology to the other, but the succession of technologies presumably exploiting the same natural resources would provide a very significant addition to knowledge.

Non-slag tapping iron smelting technologies have become better understood in Britain and Ireland in recent years through the large number of examples investigated in development-led projects.

The use of non-slag tapping furnaces with a basal pit (i.e. slagpit furnaces) was the normal form of iron smelting during the pre-Roman Iron Age in Britain and Ireland. Recently investigated examples from the SW of England include The Richard Lander School, Truro (Young 2008a) and Trevelgue Head (Dungworth *in* Nowakowski & Quinnell, 2011). A possible Iron Age example was also recorded on the Avon Pipeline scheme near Shaugh Prior (Young 2011b) and non-tapped smelting slags were recorded at Berry Ball (Young 2009b).

During the Roman period the main forms of iron smelting furnace were different varieties of slag-tapping furnaces. The waste from these furnaces has been widely recorded on the Blackdown Hills (e,g. Griffith & Weddell 1996).

After the Roman period, the non-slag tapping furnace reappeared in Britain and was employed for several centuries, before again being supplanted by slag-tapping technologies in approximately the 9th century. It is most likely that the Churchills Farm examples belong to this period (as probably do those from a second site in Hemyock, in Culmstock Road, pers. obs.).

The nearest well-studied early-medieval site is that at Burlescombe (Reed *et al.* 2006) where three non-slag tapping furnaces were found, dating between the late 8th and late 10th centuries. The furnace pits were large, with widest dimension of up to 800mm, and deep, with depths of up to 750mm. They contained large slag blocks (FBs) from their last smelt. The FBs were unusual in being very deep, but without great lateral extent across the slagpits. The furnaces were interpreted as being open pits with mere baffle walls between charge and bellows. This interpretation is not without problems however and various aspects may be challenged.

One of the key pieces of evidence used to suggest these furnaces lacked any significant superstructure was the low concentration of furnace ceramic in the associated waste assemblage. In fact, 79kg of lining were recovered, out of a total assessed assemblage of 1700kg (i.e. <5%). This figure was not, however, compared with data from other sites. The author's unpublished investigation of a typical Roman slag-tapping residue assemblage from Miskin (Rhonda Cynon Taff) contained just 0.6% by weight furnace lining. The early medieval slag-tapping assemblage from South Hook (Young *in* Crane & Murphy 2010) contained 3% furnace ceramic. The latter site is also significant for the state of preservation of the base of the furnaces is not dissimilar to that of the slagpits at Burlescombe. Here, the lack of surviving furnace lining adhering to the degraded rock-cut base of the furnace was not regarded as evidence for the lack of a shaft and the furnaces are interpreted as being conventional slag-tapping shaft furnaces.

Another key site for understanding the early medieval development of iron smelting technology is Ramsbury, Wiltshire (Haslam 1980), where, apparently, wide but shallow non-slag tapping furnaces were replaced by a highly unusual slag tapping furnace. The change in technology was dated to the early 9th century, but there is some doubt about this date in detail. The earlier non-slag tapping furnaces at Ramsbury are remarkable for including bowl-like cuts of very large diameter and relatively shallow depth (Furnace 2: 0.85 x 0.9 x 0.35m deep, Furnace 3: 1.1 x 1.0 x 0.3m). These seem to have produced large low-density "furnace bottoms" (up to 0.5 x 0.2 x0.2m) which were oriented transversely in the furnaces. In contrast, the non-tapping furnaces at Burlescombe were deep (Furnace 539: cut 0.75 x 0.84x 0.65 m deep, Furnace 529 0.78 x 1.10 x 0.75m, Furnace 535 0.80 x 0.45 x 0.60m) and produced much more vertically oriented "furnace bottoms".

Other sites in the SW with early medieval examples of non-slag tapping furnaces, but which are less well documented, include Carhampton and Cheddar (late 10th -11th century; Rahtz 1979) in Somerset, and Clearwell Quarry (late 7th - late 9th century; Pine *et al.* 2009) in Gloucestershire.

A non-slag tapping furnace operated by having its basal pit or chamber packed with a combustible material at the start of a smelt. This initially supports the overlying charge, but once the basal zone starts to heat (particularly as a result of heat transfer via descending slag) the pit packing either combusts, or partially combusts, to create space for the descending slag.

There are two broad categories of pit packing – those formed of wood (typically either small round wood or split larger pieces) and those formed of grass or cereals. In Britain the wood packing is almost universal (in both the Iron Age and early medieval periods). Within early medieval furnaces it probably occurs at the Culmstock Road site in Hemyock (pers. obs) and it probably occurred at Burlescombe (although was not recognised as such, the report mentions, p. 103, large moulds of 'charcoal' up to 160mm in length – almost certainly actually those of wood).

The alternative packing, grass or cereals, is rather less common. A probable late Iron Age (or possibly early Roman) example has been illustrated by Paynter (2007, Fig. 4) from Leda Cottages, Kent (and examples have been observed at Hasholme, E. Yorkshire (pers. obs.), probably of (Middle?) Iron Age date.

Cereal packing has been closely studied in Denmark (e.g. Henriksen 2003; Mikkelsen 1997), where it is characteristic of the late Iron Age into the early medieval period (c. AD 100-700). In Ireland, cereal packing is rare, but has been identified in two sites, Clonfad (Young 2012a) and Camlin (Young 2011a). Both of these examples are early medieval, possibly 5th-6th centuries. In contrast the use of split timber is documented at large number of sites in Ireland, from the early Iron Age through into the late medieval period (see examples in Young 2003a, 2003b, 2005a, 2005b, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g, 2012a).

In Ireland the replacement of the non-tapping by the tapping furnace did not, in general, occur. An example of a slag tapping furnace was recorded (Young 2009b, forthcoming) from a ditch at Woodstown (interpreted as a Viking *longphort* of the later 9th century). This rare occurrence of tapping technology in Ireland may be indicative of smelters working in a foreign (Scandinavian?) tradition.

The site at South Hook, Pembrokeshire, mentioned above (Crane & Murphy 2010) includes a pair of slag tapping furnaces, dated to the 9th or 10th centuries. These show some similarities to the final Ramsbury furnace (particularly in apparently being blown from the side opposite the tapping arch). As with Woodstown, there has been some suggestion that Viking influence may be at play here too.

A second site in Pembrokeshire, that at Brownslade (Young 2012b), is poorly dated, but includes apparently early medieval evidence for slag tapping techniques as well as (possibly) non-slag tapping processes.

The broader spread of slag-tapping furnaces in southern England after the early examples at Ramsbury and possibly Clearwell Quarry, remains poorly understood. It is assumed that 11th century iron smelting would have been undertaken using slag-tapping techniques, but hard evidence is thin until the possibly late 12th century examples at Tisbury (author's unpublished data) in Wiltshire.

Assessment of potential

The Churchills Farm site is one of just a handful of sites known with well-preserved slagpit furnaces and associated residue assemblages. It is therefore certainly of regional, and probably national, significance. It has the potential to both add to the story of the development of smelting technology, but also to provide a closely constrained series of assemblages that could be investigated in considerable detail. The presence on the site of a continuing tradition of iron smelting, with later slag-tapping processes, is also of enormous significance, with great potential for enhancing understanding of technological development.

The assemblages of residues from both technologies are in a suitable state of preservation for detailed analytical work. The thrust of such analyses should be to document in some detail the slag chemistry within the slagpit residues (and hence attempt to document the smelt history, if possible). Careful reconstruction of the nature of the slagpit residues as a whole would then permit investigation of the productivity of the furnaces through description of their mass balance (using the methodology of Thomas & Young 1999a, 1999b).

Careful investigation of the nature of the slagpit packing has proved a useful tool in Denmark, but similar work has not yet been attempted in the UK; this assemblage provides an ideal opportunity for such an investigation. In Denmark, where the packing has often been shown to be of cultivated cereals rather than wild grass or reeds, such investigation (e.g. Henriksen 2003; Mikkelsen 1997) has helped address questions of seasonality, not only in iron-making, but in agriculture, as well as also addressing questions such as weeds amongst crop species.

As well as providing detailed information on the slagpit furnaces, a detailed comparison of the slags from the slagpit and slag-tapping furnaces may also help understanding of the change from one technology to the other. Such technological transitions are best understood within the context of utilisation of a single set of natural resources, as is likely to be the case here.

The recommended approach to the further investigation of the residues would be to isolate one of the better preserved and most complete slagpit assemblages and to analyse multiple samples to try to understand the nature of slag generation, flow and cooling with the pit (with the aim of trying to enhance understanding of the smelting cycle).

This detailed investigation should then be supplemented by further samples from the other occurrences of the slagpit furnace slags to try to understand the variation present within the assemblage. The tapped slags also require investigation through a suite of analyses of selected specimens.

For both groups of material the mass balance process is aided by having materials from as close to a single process as possible, so coherent suites of slags and furnace materials from individual contexts are preferred.

The analytical approach used should include both mineralogical/microstructural investigations by scanning electron microscope (backscattered electron imagery plus EDS/WDS microanalysis) and bulk chemical composition including both major and trace elements.

All of the detailed analytical investigation needs to be supported by a through re-assessment of the various metallurgical structures and contexts to ensure that the maximum amount of evidence can be drawn from the excavations.

References

CRANE, P. & MURPHY, K., 2010, Early medieval settlement, iron smelting and crop processing at South Hook, Herbranston, Pembrokeshire, 2004–05. *Archaeologia Cambrensis*, **159,** 117-196 . [ISSN 0306-6924]

CREW, P. 1995. *Bloomery iron smelting, slags and other residues*. Historical Metallurgy Society, Archaeology Datasheet No. 5.

GRIFFITH, F & WEDDELL, P. 1996. Ironworking in the Blackdown Hills: results of recent survey. *Mining History*, **13**, 27-34.

HASLAM, J. 1980. A middle Saxon iron smelting site at Ramsbury, Wiltshire. *Medieval Archaeology*, **24**, 1-68.

HENRIKSEN, P.S. 2003. Rye cultivation in the Danish Iron Age - some new evidence from iron-smelting furnaces. *Vegetation History and Archaeobotany*, **12**, 177-185.

HULL, G & TAYLOR, K. 2006. Archaeological sites on the route of the N21 Castleisland to Abbeyfeale road improvement scheme, Co. Kerry. *Journal of the Kerry Archaeological and Historical Society*,Series 2, **6**, 5-59.

MIKKELSEN, P. 1997. Straw in slag-pit furnaces. *In:* L. Nørbach (ed), *Early Iron Production: archaeology, technology and experiments*. Technical Report 3, 63-6.

NOWAKOWSKI, J. & QUINNELL, H., 2011. *Trevelgue Head Cornwall: The Importance of CK Croft Andrew's 1939 Excavations for Prehistoric and Roman Cornwall.* Cornwall County Council, Truro.

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).

PINE, J., ALLEN, J.R.L. & CHALLINOR, D. 2009. Saxon iron smelting at Clearwell Quarry, St Briavels, Lydney, Gloucestershire. *Archaeology in the Severn Estuary*, **20**, 9-40.

RAHTZ, P. 1979. *The Saxon and Medieval Palaces at Cheddar: excavations 1960-62*. British Archaeological Reports, 65, xv & 411p.

REED, S.J., JULEFF, G. & BAYER, O.J. 2006. Three late Saxon iron-smelting furnaces at Burlescombe, Devon. *Proceedings of the Devon Archaeological Society*, **64**, 71-122.

THOMAS, G.R. & YOUNG, T.P. 1999a. A graphical method to determine furnace efficiency and lining contribution to Romano-British bloomery iron-making slags (Bristol Channel Orefield, UK). *In:* YOUNG, S.M.M., BUDD, P.D., IXER, R.A. and POLLARD, A.M. (eds). *Metals in Antiquity*, British Archaeological Reports International Series, **792**, 223-226. Archaeopress, Oxford.

THOMAS G.R. & YOUNG, T.P. 1999b. Bloomery furnace mass balance and efficiency. *In:* POLLARD, A.M. (ed) *Geoarchaeology: exploration, environments, resources*, Geological Society of London, Special Publication, 165, 155-164.

YOUNG, T.P. 2003a. Evaluation of slag from Celbridge Site 5, County Kildare (01E0306). *Geoarch Report 2003/07*

YOUNG, T.P. 2003b. Is the Irish iron-smelting bowl furnace a myth? A discussion of new evidence for Irish bloomery iron making. 4pp. *GeoArch Report 2003/09*

YOUNG, T.P. 2005a. Metallurgical Residues from Clonmacnoise, Part 1: Evaluation of material from the waste water treatment works (02E1407). *GeoArch Report 2005/08*. 29pp.

YOUNG, T.P. 2005b. Evaluation of archaeometallurgical residues from the Heath-Mayfield N7 development (03E0151, 03E0966, 03E0461, 03E0603, 03E0633, 03E0679, 03E0602, 03E0635). *GeoArch Report 2005/12*. 28pp.

Young, T.P. 2008a. Archaeometallurgical residues from Richard Lander School (RLS04) and Truro College (TCF05). *GeoArch* Report 2007/22. 31pp. & 10 plates

YOUNG, T.P. 2008b. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derrinsallagh 1 (E2177). *GeoArch Report 2008/21.*

YOUNG, T.P. 2008c. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derrinsallagh 3 (E2179). *GeoArch Report 2008/22*. 11pp.

YOUNG, T.P. 2008d. Evaluation of archaeometallurgical residues from the M7/M8 Contract 2: Derrinsallagh 4 (E2180). *GeoArch Report 2008/23*.

YOUNG, T.P. 2008e. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derryvorrigan 1 (E2193). *GeoArch Report 2008/26*.

YOUNG, T.P. 2008f. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 3: Clonrud 4 (E2167). *GeoArch Report 2008/30*.

YOUNG, T.P. 2008g. Detailed recording of furnace C397, Derrinsallagh 4 (E2180), M7/M8 Contract 2. *GeoArch Report 2008/34*, 10pp.

YOUNG, T.P. 2009a. Ferrous archaeometallurgical residues from Woodstown 6, *GeoArch Report 2009/22*, 66 pp.

YOUNG, T.P. 2009b. The Iron Slag, p. 121-123, *in:* P. Manning & H. Quinnell, Excavation and field survey at the Iron Age hillfort of Berry Ball, Crediton Hamlets. *Proceedings of the Devon Archaeological Society*, **67**, 99-132.

YOUNG, T.P., 2011a. Archaeometallurgical residues from the N7 Castletown to Nenagh scheme, Camlin 3 (E3580), Co. Tipperary. *GeoArch Report 2011/23*. 62 pp.

YOUNG, T.P. 2011b. Archaeometallurgical residues from field D5, near Porthworthy, Shaugh Prior, Devon (Avon SWW Pipeline). *GeoArch Report 2011/41*. 23 pp.

YOUNG, T.P. 2012a. Appendix 3 -. Exploiting the bog - iron production and metalworking, pp. A3.1 – A3.60 *In:* P. Stevens & J. Channing, *Settlement and Community in the Fir Tulach Kingdom*. National Roads Authority and Westmeath County Council.

YOUNG T.P. 2012b. Archaeometallurgical residues from Brownslade, pp. 158-159. *In:* P. Groom, D. Schlee, G. Hughes, P. Crane, N. Ludlow & K. Murphy. Two early medieval cemeteries in Pembrokeshire: Brownslade Barrow and West Angle Bay. *Archaeologia Cambrensis*, **160**, 133-203

YOUNG, T.P. forthcoming . Metalworking at Woodstown. *In:* I. Russell and M. F. Hurley (eds). *Woodstown. A Viking Age Settlement in Co. Waterford*. Waterford County Council.

Table 1: Summary list of observations made on selected assemblages.

Context	Nature	Bag	Notes
507	fill of 'posthole' [506], 700mm in diameter		slags similar to those from (781) but less numerous. Some evidence for cereal packing.
509	upper fill of ditch [508]		worn material. At least some of this material seems to be tapped slag – it has large lobes and a hint of reddening
539	Pit	bag 1	Fresh slag. A few piece of charcoal-rich material, some certain tapslag fragments and most pieces (95%) are possibly/probably tapped. No certain in non-slag tapping fragments
539	Pit	bag 2	mixed assemblage, but with large tap slag block
539	Pit	bag 3	large blocks of tapslag
616	fill of pit with pottery		contains good tapslag
676			poor assemblage of probable non-tapping pieces
681	ditch fill	1 of 5	very large FB fragments, with very fine lobes on chilled margin
707	lower fill of drain [705]		most pieces appear dense, non-tapping slags, possibly some tapslag but not certain. Worn material, all rather weathered
730	large slag-filled pit		This is just a small part of the collection – the rest was dumped. Very good tapslag in moderately large blocks
756	[756] is furnace cut		large FB fragment, most of the FB, suggests this is a furnace not a p/h as logged
760	fill of truncated 'hearth' furnace [758]		poorly preserved birds-foot flow slag and possible FB fragments
772	[771] cut 3m long by 0.4m wide		tapslag in slightly disrupted flow - tapped into charcoal?
777	truncated furnace [776] (not p/h)		non slag-tapping assemblage
781	fill of furnace [778]	bag 1	fragments of dense basal flow, mainly fine flow lobes with probable cereal stalk impression. Some appear to form dense bladed puddle. Most of fragments are low density, charcoal-rich material. Just a few fragments of badly altered furnace ceramic
781	fill of furnace [778]	bag 2	excellent material, well-lobed basal puddle with cereal impressions, plus some low density charcoal-rich slag
781	fill of furnace [778]	bag 3	good FB fragments, one shows relationship of basal puddle to overlying slag. Cereals in some
781	fill of furnace [778]	bag 4	mainly low density FB material
795	fill of furnace [794], similar size to [756] at c. 650mm diameter	bag 1	probably entire contents of furnace pit. Rather weathered and too dirty for detailed comment, but similar to other non-slag tapping assemblages.
795	fill of furnace [794]	bag 2	has very tap slag-like flows, which are worthy of description

Context	Nature	Bag	Notes
798	fill of furnace [789]		probable porous FB fragment and large lobate flow, probably basal flow of slagpit furnace but has overall shape of a tapped slag - not in individual rivulets
800	fill of furnace [799]		large intact rather porous FB, fallen apart. Formed of coalesced prills. No basal flow, No evidence for packing
808	fill of cut near [778] (expected to be tapping channel)		large FB
808	fill of cut near [778] (expected to be tapping channel)		single large FB fragment
882	fill of probable late feature		medium sized SHC and tapslag block
	(unlabelled bag - ?big pit)		mainly tap slag but some nice basal puddle material with cereal impressions
	(unlabelled bag -)		good mix of tapslag and material with cereal impressions

GeoArch

geoarchaeological, archaeometallurgical & geophysical investigations

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

Office: 029 20881431
Mobile: 07802 413704

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