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Assessment of archaeometallurgical residues from Yorkley, Gloucestershire

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Abstract

This was a small assemblage (8.8kg of residues, from 4 distinct contexts).All the residues recovered are compatible with iron production in a large non-slag tapping iron smelting furnace. Much of the residues comprises flow slags of various forms, including those forming anastomosing flows around large wood moulds, as well as more typical prills and some unusually large-lobed forms. Some more massive furnace bottom (FB) material, rich in charcoal moulds, was also present.

Although other interpretations are possible, the material most closely matched the technology observed on earlier Iron Age sites.

The presence not only of a furnace, but also a large number of associated postholes (and it is possible some of these are actually additional furnaces, without distinct heat affected rims), make this a site of regional significance. Iron Age Iron smelting is known from Dean, and clearly formed an important industry, but little is known with any certainty about the technology employed and no furnaces have been located. A site of confirmed iron production in Dean in the earlier Iron Age, with both furnaces and structures would be of national importance.

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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 examined materials are listed in Table 1.

This project was commissioned by Ed McSloy, of the Cotswold Archaeology. The project forms part of Cotswold Archaeology Project No. 5627.

Results

Description of residues

The submitted materials amounted to an overall total of approximately 8.8kg.

Bloomery iron smelting residues

Furnace bottom (FB): large blocks of FB were recovered from contexts (307), (321) and (503). FBs are slag cakes that form below the bloom in non-tapping furnaces, typically through the amalgamation of small prills, although larger bodies of molten slag may also be involved (particularly near the blowing wall). Typical FB material may therefore be internally prilly, locally granular/dense, locally charcoal-rich and locally with lobate surfaces against the pit walls. All of these textures apart from the lobate contact with the pit wall were identifiable in the present collection.

FBs tend to grade downwards into prilly flow slags with a lower degree of amalgamation, if the pit was sufficiently deep. The lower flow slags may include

those forming moulds of large wood fragments, part of the original pit-packing.

Flow slags: much of the collection comprised flow slags in various forms. Some of those from context (105) were formed of unusually large lobes, with bulbous rough surfaces and an appearance of rather viscous flow, whereas others from the same context were more conventional.

Prilly flow slags also formed a large part of the assemblage from (503), but it is unclear to what extent many of these were an integral part of a FB before fragmentation.

Some dense flow slags from (321) showed inclusions of what appeared to be carbonised straw. Straw (or cereal stems) were an alternative pit packing to split wood, but much less commonly recorded in the British Iron Age.

Hearth/furnace lining: context (321) yielded two fragments of a buff coloured sandy clay with some fine organic temper. These are likely to have been fragments of pit lining or furnace superstructure.

Distribution of residues

In Trench 1, slag was recovered from context (105) the post-pipe fill of posthole [103]. This assemblage contains residues fragments with an average weight of just 76g. The presence of small material may suggest this material became incorporated into the post-pipe fill after decomposition of the post, and may reflect material present in the then present superficial deposits.

In Trench 3, slag was recovered from context (307), the fill of possible grave (306), and from context (321), the fill of posthole [320]. In (321) the slag fragments had an average weight of just 16g, too small to have been components of the pit packing. In (307) the three pieces of slag ranged from 1.645kg to 3.015kg in weight, very substantial slag blocks.

In Trench 5 slag was found in context (503), the fill of posthole [502]. The 1.5kg of material in this context was typical of slag and other residues from the bottom of a non-slag tapping furnace. The basal section of such 'slagpits' may not necessarily show visible thermal alteration. Given the large quantity of residues from this feature, the site records should be thoroughly checked to see whether there is strong evidence this cut is a posthole, rather than a furnace.

In addition to the recovered slag, slag was also noted in the fills of five other unexcavated postholes in Trench 1, five unexcavated postholes in Trench 3 as well as the fill (305) of furnace [303], in unexcavated posthole [403] in Trench 4, and in five unexcavated postholes in Trench 5 (the project was assessment and therefore the intervention stopped at the first preserved archaeology in most instances).

Interpretation

The metalworking residues were probably all derived from bloomery iron smelting in a non-slag tapping furnace.

The amount of archaeometallurgical waste recovered from the site is relatively low, but the intervention was only an assessment. The structural evidence for iron production includes a large basal pit for a bloomery iron smelting furnace [303]. In addition, the posthole [502] produced 1.5kg of residues typical of those from the bottom of the basal pit of a non-slag tapping furnace. It is possible that this might actually be the base of another furnace. Most of the postholes on the site were not excavated, and where lacking packing stones should be considered alternatively as potential furnaces.

Discussion

The site provides evidence for ironmaking, apparently in a very large, non-slag tapping furnace. Furnace [303] was not excavated, but the site description and photographs indicate a furnace with an internal deposit of 0.80m by greater than 0.54m in plan, surrounded by a heat affected halo up to 250mm wide (reduced internally, oxidised externally for most of width). Most examples of non-tapping furnaces of such a large size fall into one of two periods – the early to mid-Iron Age, or to the early medieval period (mostly 8th- 9th centuries).

The largest early medieval non-slag tapping furnaces, including those at Ramsbury (Haslam 1980), Culmstock Road, Hemyock (Rainbird & Young in press; Young 2014) and Burlescombe (Reed *et al.* 2006) all show the common feature of a replaced and renewed ceramic lining forming a chord across the furnace pit on its blowing wall (which may have been almost planar). This raises the possibility (as originally proposed by Reed *et al.* 2006) that the furnace superstructure only comprised the blowing wall, and the furnace may have been worked manipulatively, as in the post-medieval 'Catalan' smelters. In contrast, simple slag pit furnaces of the southern British early medieval rarely exceed 0.5m diameter. Such furnaces are known from the Forest of Dean area at Clearwell Quarry (Pine *et al.* 2009).

The apparently oval outline of the large furnace pit and lack of a planar ceramic blowing wall, suggest rather that this example may be of Iron Age date. There currently appear to be two forms of very large Iron Age furnace:

- simple slagpit-style furnaces with basal pits commonly oval to sub-circular up to 1m across (though commonly reduced by a placed lining), , including those in the unpublished section of the Hartshill Copse site (Young 2005a). In general, furnaces with pits >0.6m in diameter, in both Britain and Ireland, appear to be of the 4th century BC or earlier, with the period of 400BC to 50BC more typically characterised by furnaces of 0.4-0.6m (or even smaller) diameter (e.g. see discussions in Young 2006, 2011).

- possible dome furnaces, with an oval, flat floor and a very wide mouth, with examples at Wokingham (authors unpublished data) being 1.2m in length and 1.0m wide. This furnace is tentatively dated to the 3rd century BC on the basis of initial pottery investigation. An example at Sindlesham dated to cal. 183-51BC was 1.45m by 1.35m (Lewis *et al.* 2013). The Sindlesham furnace was apparently later than adjacent simple slagpit furnaces.

The residues from these two furnace types, although subject to much current research, are not so far readily recognisable.

The apparent presence of carbonised straw associated with some of the fragments from context (321) is interesting. The large wood moulds present in much of the material suggest the use of a pit-packing of split wood, the usual technology in the British Iron Age (e.g. Carlin 2008). Pits may also be packed with cereals (as is the case in the Danish Iron Age, e.g. Mikkelsen 1997; Henriksen 2003). This is rarely seen in Britain, but 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 also been observed at Hasholme, E. Yorkshire (pers. obs.), probably of (Middle?) Iron Age date. In the early medieval period, cereal packing is present in the non-slag tapping furnaces at Churchills Farm, Hemyock (Young 2015).

The presence of slag in the fills of possible graves is interesting - but the similarity in size of charcoal-production pits recorded on iron smelting sites in the Irish Iron Age to graves should be noted (e.g. Young 2005b, 9).

Further work

The material from the assessment has indicated that the site might be of national significance. Clarification of the age of the site by spot 14C dating would be desirable to further advise the decision-making process for the appropriate future management of the site and development. The discrimination of an Iron Age from early medieval date would be of great utility in this.

All the residues should form of the deposited archive for the site for permanent retention.

Should further work be indicated on the site, then a high priority should be given to the investigation of the metallurgical structures, with careful excavation with appropriate specialist advice and input to maximise data recovery.

The small collection of residues from the assessment is not, in itself, worthy of any further detailed analysis at this stage; analysis should be reserved for the outcome of any further detailed investigation.

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Table 1: summary catalogue. Assm = assemblage, FB = furnace bottom, weights in gram.

context	label	sample weight	item weight	item number	notes
105	slag	1855	1620	10	flow slags with unusually broad, apparently viscous slag lobes, with bulbous rough surfaces, around large fuel moulds
			220	14	more conventional flow slags in small dense pieces, amalgamations, fuel moulds etc
307	bag 1/2	4660	1645	1	large irregular block of charcoal-rich dense slag, including very large moulds
			3015	1	large dense rusty block, probably corroding iron in dense FB slag
307	bag 2/2	2405	2405	1	probable side of FB, very dense, raised lip? Orientation not certain
321	slag	270	130	7	dense flow slags, two of them show carbonised straw
			132	9	dense FB material with fuel moulds and coalesced prills
			6	2	two fragments of buff coloured sandy clay, with some organic temper
503	slag	1525	92	6	dense flow slag prills, some amalgamated
			1433	assm	fragmented furnace bottom material – prills, granular slag and charcoal-rich slag

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