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Evaluation of archaeometallurgical
residues from Berry Ball, Devon

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Abstract

This small assemblage (6 main pieces totalling 862g) includes a single piece of clinker (coal-burning residue), but otherwise comprises pieces which possibly or certainly derive from bloomery iron smelting. The largest block (from house gully c521) bears a characteristic set of features which indicate that this originated within a non-slag tapping furnace, probably a slagpit furnace. The other fragments are not as diagnostic, but are also compatible with an origin in a slagpit furnace.

Slagpit furnaces and their slags are now becoming widely recognised in the Iron Age of the British Isles. Relatively few examples are yet known from the SW, but recent work has identified examples in Truro and at Trevelgue Head. The occurrence of isolated blocks of smelting slags in the ring ditches of roundhouses can also be paralleled at Truro.

The small piece of clinker from c515 demonstrates the use of coal as fuel. Suck clinker may be generated in metallurgical activities (e.g. in a coal fuelled smithy), but can equally be generated in coal-fired boilers (including steam engines) and even sometimes in domestic hearths. The use of coal as fuel is known, even outside the coalfields, from Roman times, but clinker is likely to be intrusive in a prehistoric context. It may derive from the spreading of domestic waste on the fields, from the use of agricultural traction engines, or even from the use of slag as a fertiliser.

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Methods

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

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

Results

The summary catalogue is presented in Table 1.

The assemblage includes a large block of slag from c521 with a very characteristic series of textures. At its base it shows a curved basal contact, with a finely blebby slag texture. The main body of the slag shows a dense grey slag forming lobate flows penetrating between the moulds of large pieces of wood or charcoal. The penetration of flows within a very coarse fuel is typical of slag flow within the basal pit of a non-slag tapping slag pit furnace. Typically the wood/charcoal fragments in such basal pits exceed 100mm and may exceed 200mm. It is uncertain whether the packing of the pit is undertaken with charcoal or with wood, but the technique is related to that seen in the later Iron Age of Eastern Europe, in which a pit packing of fresh grass or cereals was used, so there is a strong possibility that the packing of the basal pit is not representative of the main fuel employed in the furnace shaft. In some instances,

although not in this specimen, the pit packing can be seen to be undertaken in very ordered manner.

Other specimens from c521 and from c500 show a related texture, but including stacks of much smaller flow lobes. These include only much smaller charcoal fragments, and differentiation of these from tapped slag flows is not possible. However, their texture is entirely compatible with a similar origin in a slagpit furnace.

A small slag piece from c564 is a flown bleb. It has small dimples suggestive of contact with charcoal and therefore appears to have solidified within a charcoal bed. Small slag blebs and prills may be formed within the bed of almost any charcoal-fired iron working process. They are, however, most abundant in the basal pits of slagpit furnaces, often forming a high proportion of the total preserved slag (Young 2005; Dungworth in prep.)

A small fragment of clinker occurred in C515. The clinker bears abundant debris of shale fragments. Such clinkers are formed from the combustion of coal in which the inorganic component of the coal has melted. In this case the melt encloses fragments of coal shale which have not themselves been melted.

Interpretation

The identification of the largest slag block as having been produced in a slagpit furnace appears secure, with the identification of the other pieces much less certain, but compatible with a similar origin.

Slagpit furnaces appear to have been the dominant iron smelting furnace in the pre-Roman Iron Age, although the details of their development and replacement by other types remain only very poorly known. They are widespread in many parts of Europe (Pleiner 2000), although their occurrence on the British Isles has only been demonstrated relatively recently. Rather few British examples are securely dated.

The slagpit furnaces at Hartshill Copse, Berkshire (Collard *et al.* 2006) are dated through slag found in features (postholes, pits and an enclosing ditch) associated with a 5th-6th century BC roundhouse (the furnaces themselves are not yet dated; Young 2005). The Hartshill Copse site includes both assemblages of smaller residues, similar to the Berry Ball material, and a single unemptied smelting furnace within which a 34kg furnace bottom was still *in-situ* in its basal pit. Other sites in the same general area have also yielded large furnace bottoms from this type of furnace (Hanworth & Tomalin 1977).

At the Richard Lander School, Truro, Cornwall, slags from slagpit furnaces are associated with several of the Late Iron Age roundhouses, including much material in the ring ditches (particularly House 5), but also with a possible furnace (with associated cache of iron ore) in House 1 (Young 2006a, b).

The slags from Berry Ball can also be compared with the "slag lumps with impressions of charcoal (SLIC)" and the "flow slag" facies recorded by Dungworth (forthcoming) from the middle to late Iron Age site at Trevelgue Head (Cornwall).

The furnaces described by Crew (1987, 1989, 1998) from the late Iron Age of North Wales (Bryn y Castell and Crawcwellt) appear to have had less well-developed slagpits than some of the examples from

southern England, but none-the-less were probably operated in similar way (Crew 1991).

Slagpit furnaces are also known from Humberside, where they are particularly represented by slag dumps containing furnace bottoms with weights of up to 74kg (Clogg 1999; Halkon 1997).

Similar furnaces have also now been recognised widely within the Iron Age and later periods in Ireland (Young 2003), with the associated slags being extremely similar to those from Berry Ball. In Ireland the slagpit furnaces survive in use well beyond the Iron Age, in contrast to Britain where they become replaced by other forms of furnace from the latest Iron Age onwards.

The two examples of Iron Age slagpit furnaces from the SW that are relatively well-known (Truro and Trevelgue Head) are both located adjacent to their likely ore sources. In the case of the Richard Lander School Truro, this is likely to have been the gossan later exploited by East Wheal Falmouth in the 19th century and at Trevelgue it was probably the vein system passing through the headland. In contrast the ore source for the Berry Ball smelting is unknown. There are no nearby iron ore sources noted in the geological literature (Dines 1956), although gossan was noted by Dines at mines (Wheal Anna Maria and Lawrence Mine) in the Teign Valley 9km south of Berry Ball and haematite was formerly worked for paint near Moretonhampstead 13km southwest. It is possible that other sources lie closer to Berry Ball, but which are too insignificant to have received recent attention.

Evaluation of potential

The identification of the use of a slagpit furnace is extremely important. Relatively few occurrences are yet known in the SW, with those recorded (Truro, Young 2006a, b; Trevelgue Head, Dungworth *forthcoming*) being located on, or extremely close to, iron ore sources; a situation apparently not applicable to Berry Ball. The provenancing of the ore employed at Berry Ball would, therefore, be of considerable interest.

Although single analyses of smelting slags cannot, in isolation, give precise provenancing information, an analysis of the smelting slag would be able to provide general information on the type of iron ore being employed here. However, detailed provenancing of the ore to a precise location would not currently be possible, because of a lack of petrographic and geochemical data from the potential geological sources.

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<i>Site</i>	<i>Context</i>	<i>Weight (g)</i>	<i>Notes</i>
TEC98	500	34+2	2 pieces of dense vesicular slag with coarse crystal texture. Large piece forms flow lobe stack, with small lobes, both pieces show inclusion of small charcoal fragments. Most likely both are smelting slags
CTE99	515	12	Irregular clinker fragment bearing abundant coal shale debris
TEC98	521	560 226 22	Large block with basal micro-prilly/dimpled contact which diverges into dense flow lobes between very large wood pieces. 135x90x70mm Irregular block with flow lobes resting on fired gravelly substrate. Lobes small and have small charcoal moulds associated, 75x60x40mm 4 fragments, probably broken from above two pieces
TEC98	564	6	Irregular bleb of dense slag, has dimples suggestive of charcoal contact on all sides - most likely to be bleb from within the base of a non slag-tapping smelting furnace

Table 1. Summary Catalogue

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