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Evaluation of archaeometallurgical
residues from Cloncollig 2, Co. Offaly
NTB06, A033/E2850

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Abstract

Archaeometallurgical residues were derived from three contexts forming the middle to lower fill of a single pit (007). The residues were all derived from iron smelting in a slagpit shaft furnace. The distribution of residues through the pit suggests that they were unlikely to have been in-situ. It is likely that the pit is the basal pit of a slagpit furnace, but that its middle fills, at least, represent abandonment deposits in which slag accumulated through dumping or backfilling. A 14C date on oak charcoal from the basal layer of the furnace gave a date of 261 – 94 cal BC

The limited 14C evidence for other examples of furnaces with a similar morphology tentatively supports an early age for this furnace. Although the old wood effect is a major issue when attempting to date metallurgical processes from wood charcoal (particularly oak), the large diameter of this furnace might be seen as best paralleled in other examples ascribed an earlier Iron Age date (1st-4th century BC).

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Methods

All materials were examined visually, using a low-powered binocular microscope where necessary. All significant materials were weighed and recorded to a database (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 catalogue is presented in Table 1.

All of the listed material occurred within the fills of a single pit (007). The pit is described as being 0.57 x 0.60m and 0.32m deep, with vertical sides and a flat base.

The basal fill (006) was up to 0.11m thick and is described as containing a moderate amount of charcoal; it yielded a small quantity of slag droplets and a prill (total weight 42g).

The overlying fill (005) is described as up to 0.10m thick and as a dark silt with charcoal flecks. It contained a larger quantity (505g) of residues of types commonly associated with the base of the pit in a slagpit furnace. These materials include some having the appearance of a sinter (it is a rough, spiky agglomeration of small ore particles, charcoal and sand held together by iron oxides), some rather crude, dull, flow lobes and also dense flowed slag which may have cooled in contact with large pieces of wood .

The second of the "middle fills" (004) yielded an assemblage dominated by materials associated with the structure, including a slab of lining from close to the blowhole, a piece with "sinter-like" material attached,

and a piece with denser slags, probably a wall-foot accumulation from below the blowhole. There were also some smaller lining fragments.

The final fill of the pit (003) did not apparently yield any archaeometallurgical residues.

Interpretation

The broad interpretation of this assemblage as that produced in the basal pit of a slagpit bloomery shaft furnace is straightforward.

Such furnaces produce a variety of residue forms, depending on the relative size of the pit, together with other poorly-understood operational factors.

The basal layer of the pit during smelting (which may not be the physical base of the pit, since it may not have been completely cleared from previous smelts) may accumulate fine ore particles which have percolated down through the charge too quickly to react. These may accumulate, together with charcoal, ash, sand, ceramic fragments and other debris as a sinter-like layer on the pit floor.

The hot zone around the blowhole will generate most of the fluid slag, so down-wall flows on this side are common, and further slags may drip elsewhere from the area of the developing bloom. These may show as isolated coffee-bean like, sub-spheroidal particles, or as vertical prills within the charcoal bed, or more continuous vertical prills close to the wall, which may then spread laterally across the floor of the pit. This may result in an "elephants foot" morphology and a variety of prilly forms, typically enclosing voids corresponding to moulds of large pieces of wood.

At the end of the smelt, the pit would need to be cleaned out. The removal of the bloom might also entail the removal of any attached furnace bottom, but the fines in the base of the pit and the slags adhering to the blowing wall would need separate clearance. What appears to be present in this assemblage is small amount of original fines left behind in the pit, together with a few of the larger blocks probably thrown back in to the pit after clearance and accumulating at a higher level. It is possible that some of the large macroscopic slag pieces might just have been in-situ in the pit too, but the details of the distribution of individual slag pieces within the fill is not available.

The residues present within the pit can be compared closely with examples of residues from slagpit furnaces, both within central Ireland and also further afield. Close analogues can be found in the assemblages from Morrett Site D (Young 2005c), Cherryville (Young 2008b) and Celbridge (Young 2003b).

Non-slag tapping low-shaft furnaces producing residues of the types seen here appear first in continental Europe (Pleiner 2000), but have spread to Britain certainly by the 6th century BC (e.g. Young 2005a) and possibly rather earlier (Young 2006d). They become widespread in Britain during the Iron Age (e.g. Clogg 1999; Crew 1987, 1989, 1998; Dungworth *forthcoming*; Halkon 1997; Hanworth & Tomalin 1977; Young 2008a) where their morphology has been studied in detail and their operation modelled experimentally (Crew 1991). In Ireland, their truncated remains have usually been misidentified as so-called bowl furnaces (e.g. Scott 1990). New data from the

many recent road-schemes (e.g. Young 2003a, 2003b, 2003d, 2005c, 2006a, 2006b, 2006c, 2008b) as well as from more research-oriented excavations (e.g. Young 2005b) are beginning to allow revised interpretation of the Irish examples (e.g. Young 2003c). The furnace type is rarely found in Britain after the Roman conquest, but survives in Ireland, possibly as late as the 18th Century (Young 2006a). The reason for this survival in Ireland seems to be the furnace type's suitability for smelting the widespread bog iron ores. In Britain the use of a slag-tapping furnace becomes almost ubiquitous from the late pre-Roman Iron Age, with rock ore usage being dominant from the same period.

With such a long history of usage in Ireland, it might be expected that some pattern of evolution of slagpit furnaces would be visible in the archaeological record. At present, unfortunately, there are too few well-dated examples to recognise any such evolution. It is to be regretted that the dating of too many examples from the recent road schemes are dated by 14C dates on wood charcoal, particularly oak. As further examples become dated through other materials it is to be hoped that the situation will improve.

However, the Cloncollig furnace is large (0.55x0.60m), and it may be noteworthy that amongst the examples currently interpreted as being early in the Iron Age Cloncollig (360-90 cal. BC) appears to be one of a series of sites with relatively wide furnaces, typically 0.45-0.55m diameter, including:

- Newrath Site 35, N25 Co. Kilkenny (Eogan *pers. comm.* 2006) : 400-200 cal. BC and 350-40 cal. BC

- Morrett D, N6 Co. Laois (Young 2005c): 170 cal. BC-30 cal AD and 770-410 cal. BC for charcoal pits, 370-110 cal BC and 400-200cal BC for ringditches.

- Cherryville, Co. Kildare (Young 2008b): 400-200 cal. BC.

- Carrickmines Great, Co. Dublin (Young 2003a): 360-110 cal. BC

and also possibly Adamstown1, N25 Co. Waterford (Young 2006c) and Tullyallen 6, Co. Louth (Young 2003d).

These sites all show slag pits with diameters of 0.45-0.55m. They share a common style of residue, with two sites, Tullyallen and Adamstown, having surviving intact hearth bottoms with weights of about 20kg. Detailed interpretation of the residues from these sites is complicated by the occurrence of large furnace bottoms only on those two sites. Other sites, including Cherryville 12, yield the fine residues from the lower part of the slag pit, plus sporadic blocks of slag from adjacent to the blowing wall, but not the somewhat friable, charcoal-rich furnace bottoms.

Evaluation of potential

Further analysis of smelting slags can help to determine the nature of the ore being smelted, and if enough analyses are undertaken to be able to ascertain the original bulk slag composition then it is sometimes possible to construct a mass-balance for the smelting reaction which may permit calculation of yield and efficiency.

However, analyses taken from slag pit furnaces (e.g. Young 2008a, 2008b) reveal the slag to be extremely

heterogeneous, and establishing a bulk composition is extremely difficult for this class of furnace. Such a calculation cannot be undertaken with the sort of limited assemblage seen here.

The general appearance of the slag is typical of other smelting sites in the south Midlands, and given the geological context of the site it is extremely likely to have been smelting bog iron ore.

The site itself comprises a single furnace pit, and therefore there is no evidence that this was a particularly significant or important site. At the present state of knowledge it is not associated with any known settlement. It has been suggested (Young 2005c) that much of the early iron smelting in this area may have happened near the bogs, the source of both the iron ore and the charcoal fuel. Thus isolated occurrences of furnaces are to be expected. Smelting within settlement sites (e.g. young 2005) appears to be the exception rather than the rule.

The potential benefit from detailed additional analysis is therefore limited.

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context	sample	Label	weight	
004	002		258	vitrified lining, with possible incurve towards blowhole
			94	lining with sintery slag attached
			245	lining with either foot of wall, with sinter and elephant's foot stalagmitic slag accumulation - or it was a dripping overhang - former seems more likely
			53	3 small pieces vitrified lining
			15	2 rough slag blebs
005	003	Slag	73	4 pieces of dense, mainly horizontal prill, resembles poor wetting of large wood fragments, but no very large contacts survive
			152	slab of sintery material, with poorly formed lobes
			63	dust and small fragments
005	003	metallic debris whole sampled charcoal removed	217	1 or 2 dense blebs, but mainly broken up sinter
006	004	metallic debris	42	mainly slag blebs - includes amazing multiple coffee bean - about 16 spheroids in this, plus 1 large prill

Table 1. Summary Catalogue

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