

Evaluation of slag from Tullyallen 6, Co. Louth (00E00944)

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Abstract

The Tullyallen furnace was 0.47m x 0.50m and 0.18m deep. It had vertical, to very slightly undercut sides. It contained an ashy lower fill with slag prills, above which lay an in-situ tabular slag cake up to 0.08m thick. The cake weighs approximately 11.2kg. One edge of the cake shows a greater degree of slag flowage than the remainder, and also a greater degree of slag interaction with the wall (although a large burr is not present). The opposite side of the furnace shows a decrease in intensity, and possibly absence of the subsoil reddening. The main slag cake extends approximately 60% of the width of the furnace towards this side. This side would therefore have been opposite the side of the furnace with the blowhole(s). The slag cake contains evidence for quite large pieces of charcoal (or just possibly wood).

The material is characteristic of a particular iron-smelting process, which is largely restricted to the latest Bronze Age and earlier pre-Roman Iron Age in Britain, but which appears to have had a much longer history in Ireland. Slags of this kind are associated with what is commonly known as a "bowl furnace", but the understanding of this furnace type is poor, and a reinterpretation of the furnaces as low-shaft slag-pit furnaces appears plausible.

The Tullyallen example presents the complete slag assemblage present in the base of the furnace, and therefore provides an ideal example in which to investigate the details of an iron-smelting slag of this class.

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Description

Furnace

The furnace was represented by a pit with vertical to slightly undercut sides. It was sub-circular, 0.47 x 0.50m, and 0.18m deep. There was considerable reddening of the natural on the margins of the furnace, but this appears not to have extended to the base. The reddening was more intense on one side of the furnace than the opposite side.

Slag

The total weight of slag from the furnace is approximately 17.5kg. Approximately 10% of the slag was present, mainly as small pieces, above the main slag mass. The main block comprised 64% of the assemblage. The lower part of the furnace, below the main mass yielded the remaining 26% of the slag.

The principle slag piece is a single block of slag (Figure 1), which although slightly fractured by

compaction, appears to be in-situ within the furnace. The cake fragments have a total weight of 11.2kg. The cake has concavo-convex profile, and extends for some 60% of the furnace width away from the blowing wall. The cake does not have a pronounced "burr", such as is often found below the blowing hole where the reaction between wall and charge leads to etching back of the wall and formation of a dense slag mass. It does however show two areas of attached lining material, on either side of the central crack. The area between these two attachment areas is not well preserved and it is unclear whether this might indicate two blowholes. The area between the two preserved attachment sites shows the greatest degree of flowage of slag, with lobes of slag descending between large voids (indicative of the presence of large pieces of charcoal or wood). The remainder of the slag mass is formed of porous slag with abundant voids from enclosed charcoal, with the base forming closely packed descending blebs and prills.

Below the main slag cake was the charcoal-rich context 122 (sample #114). This deposit yielded a further 4.6kg of slag, dominated by dense prills (285 pieces, totalling 4405g, forming 95% of the assemblage from this context, 26% of the total slag). The dense prills show a form indicative of vertical descent from between large pieces of charcoal, with subsequent horizontal flowage for those prills reaching the base. The larger pieces with particularly large charcoal-voids are similar to the textures seen in the main slag cake close to the blowing wall. It seems likely that much of this material may have been derived from more liquid slags descending close to the wall on the blowing side of the furnace.

A minor slag type from this context is a very low-density brownish slag, often intimately associated with

a pale ash, containing abundant very small charcoal particles. The significance of this slag type is currently unknown, but similar material has been observed in other assemblages from this type of furnace (e.g. Celbridge).

In addition to the furnace material, a single piece of slag was recovered from the adjacent ring-ditch (context 113). This small fragment of slag (35g, 45 x 30 x 25mm) is not entirely diagnostic. The piece is crudely tabular, dense, with a lower face showing the impression of fine-grained charcoal. The upper face is partly irregular and partly extremely smooth. There is no evidence for flow lobes. The most likely interpretation is that this is a small piece of slag cake from blacksmith's hearth. Although very likely to be from iron-working, this is however, not certain, and some non-ferrous metalworking process can produce very similar looking slags.

Discussion

The Tullyallen furnace is important for it has in-situ slag and therefore provides a link between furnace morphology and slag type. The furnace type is apparently what has been described extensively in Ireland as a "bowl furnace" (Pleiner 2000, Scott 1990).

Detailed investigation may help to elucidate the actual nature of the smelting process, but some issues can already be identified.

Firstly, the accumulation of slag in a pit at least 180mm deep below the blowhole (and potentially rather more to allow room for the bloom), does not tally with the concept of a bowl furnace, but rather conforms to a slag pit furnace (Figure 2). Secondly, the voids left by now-disappeared fuel demonstrate that much of the fuel in the lower part of the furnace was present in comparatively large pieces (perhaps up to 100 x 40 x 40mm); this is rather larger than might be expected and raises the question of whether this is genuinely fuel or whether it represents a slag-pit filling separate from the main fuel. A third feature of the operation of these furnaces is that the surviving slag cake indicates that the bloom would have been formed above the level of the surviving archaeology; this indicates that a considerable superstructure must have accompanied the pit. Finally, the evidence from elsewhere indicates that the pits were normally cleared of slag after use (unlike the deep pit furnaces of the iron age of Eastern Europe, which appear to have been operated until the pit was full of slag and then abandoned); Tullyallen is unusual in having the residues from its last smelt left in-situ. The complete normal clearance of furnaces may, in turn, may have implications on the nature of the superstructure.

This type of furnace is implied by slags from other regions, most notably East Yorkshire (Clogg 1999, Halkon 1997), but also other parts of Britain (e.g. the author's unpublished examination of a latest Bronze Age assemblage from near Newbury, Berks.). These occurrences are characterised by very large slag cakes (10-70kg), generally showing the impressions of large pieces of charcoal. The British examples are mainly from the pre-Roman Iron Age, although the Yorkshire examples may possibly extend into the Roman period.

A full discussion of the implications of Tullyallen 6 and other sites under investigation by VJ Keeley Ltd has been prepared as a separate document, which should be read in conjunction with this evaluation. The sites of Tullyallen, Celbridge and Carrickmines (2 sites) have

enormous potential for being the basis of a re-evaluation of the technology of bloomery iron-making in Ireland.

Recommendations

This is a very important assemblage of slag, since it may help in bridging the gap between assemblages of slag debris, fragmented during the clearing of the furnace after smelting, and the reconstruction of the process.

It is recommended that as full an analysis of this material should be conducted as possible. Because of the completeness of the assemblage, this site may have the potential to be a yardstick by which analyses from others may be judged. A suggested analytical programme is as follows:

1. cut complete section through the main slag mass.
2. categorise internal textures and sample (perhaps 6 representative areas to be sampled and analysed).
3. assess representative materials from flows and prills on lower part of furnace and sample (perhaps 4 representative samples to be analysed).
4. investigate the minor slag types present in the lower part of the pit and any inclusions within the main slag mass in a search for remnants of ore (perhaps 2 representative samples to be analysed).
5. chemical analysis of the slag fragment from the ring ditch to confirm whether it is from iron-working.

References

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Figure 1. The reconstructed main slag cake from Tullyallen 6, superimposed on a sketch of the furnace remains.

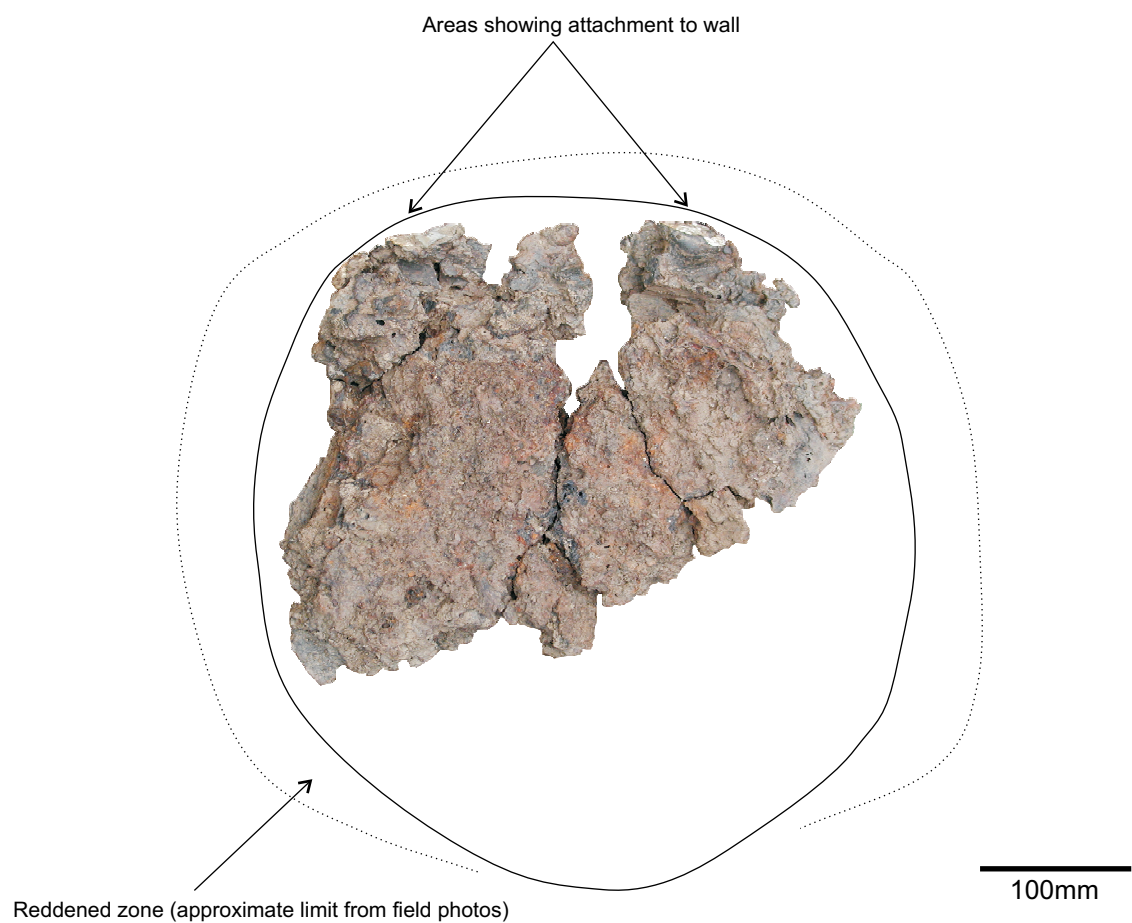


Figure 2. Schematic cross-section of the Tullyallen furnace reconstructed as a low-shaft furnace with a slag-pit.

