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Assessment of archaeometallurgical residue from Bishopsland, Co. Kildare, 13E155

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Abstract

The site has produced two small collections of iron production residues, 3kg from the base of probable slagpit iron smelting furnace and200g from a nearby gully fill. The two collections are likely to have originated in the same process, and their geographical proximity suggests they are probably related.

The assemblage is currently undated, and the basic slagpit furnace type was employed Ireland for a very long period. The site is set in an area without known early iron production, although a site just 1600m SE has provided evidence for smithing and just possibly melting during the early medieval period.

Methods

The materials were examined visually (with a low-powered hand lens or microscope as required). As an evaluation, the material was 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.

The assemblage derives from archaeological works at the Ballymore Eustace Water Treatment Plant

This work was commissioned by Maeve Tobin, of the Irish Archaeological Consultancy.

Results

Distribution of the residues

The material comprises assemblages from two contexts, the fill of a curvilinear gully (c127; 4 pieces of residue, weighing 200g) and the fill of a furnace pit (c86; 8 pieces of residue, weighing 3.0kg). The material from the two contexts was broadly similar; both were residues compatible with bloomery iron-making in a non-slag-tapping 'slagpit' furnace.

Fill c86 of pit c85 is very likely to be associated with an iron smelting furnace. It should be noted, however that the pit shape given in the Preliminary Report (Delaney 2013) is unusually elongate (1.21m by 0.54m; far too elongate for a simple slagpit furnace pit) and the pit is described as showing a heat-affect stone lining. These features are slightly unusual and might indicate that the furnace was of a more complex design than a simple slagpit furnace. Equally, the possibility that the pit was not an iron smelting furnace, but a cereal drying kiln or similar structure, that simply was used for waste disposal from a nearby furnace; disused kilns on the Iron Age site at Cherryville, Kildare (Young 2006a, 2007) were used in this way.

If the feature is indeed an iron smelting furnace, its strongly elongate shape may suggest a merged slagpit and external working hollow (e.g. Derrrinsallagh, Young 2008b). The location, apparently truncated by the terminal of ditch c35 is also interesting, for ditch terminals (e.g. Woodstown, Young 2009) and the ends of quarry pits (Grange 2, F. Walsh pers. comm.) have been used to provide an elevated position for charging furnaces (in which case the stratigraphic relationship of furnace and ditch might not be quite as envisaged). In neither of those quoted cases was the furnace a simple slagpit (a slag tapping furnace at Woodstown and an arched non-slag tapping furnace at Grange).

The assemblage of material from the furnace pit is a collection of large slag fragments which together would not constitute the entire slag quantity left in the slagpit at the end of a smelt. It is therefore likely that the pit was cleared and these pieces represent components of a backfill.

Description of the residues

The summary catalogue of material is presented in Table 1.

The material from c86 is a coherent, if incomplete, suite of residues from a slagpit style of non-slag tapping iron smelting furnace. The suite includes three pieces with amalgamated flow slag lobes that have solidified between large pieces of wood (now moulds), and which would have formed in the lower part of the pit. Another piece shows an agglomeration of flow lobes in the angle between the pit floor and wall and fifth derives from higher on the pit wall, with a slag rich in the moulds of finer fuel charcoal. One large fragment of porous slag shows transition from the coarse wood moulds into the finer fuel moulds. All these seven pieces could potentially be fragments from the slag produced in a single smelt.

The final piece from c86 is slightly more problematic. It is fragment of a dense slag sheet, with a base fused not underlying sandy clay, an internal structure with tubular vesicles passing through a texture of elongate olivine crystals and an irregular rusty upper surface with elevated arcuate ridges and the impressions of fine charcoal. These characteristics indicate the slag formed a liquid puddle, through which volatiles rose (through the vesicles), possibly due to the heating of the substrate. Such textures can be developed in a slag puddle on the base of the slagpit of a smelting furnace, but very similar textures can also be formed by slag puddles in smithing hearths. Discrimination of the two may be achieved either through the bulk morphology (although this piece is too small for such determination), or by chemical analysis and comparison with the composition of the associated smelting slags.

The collection from c127 comprises two pieces of flow slag, one flap of lining slag suggesting flowage of melted wall material onto an ashy hearth/furnace floor and one small piece of somewhat haematised flow slag. The normal flow slags are again interpretable as residues from a slag pit furnace. The haematised fragment probably formed close to the air blast, most likely in a smelting furnace, but an

origin in a smithing hearth cannot be excluded. The lining slag fragment is not indicative of originating process.

Interpretation

The majority of the material can be identified as being from iron smelting with a high degree of confidence. The material is characteristic of the slagpit style of furnace – that is to say a shaft furnace with a pit below the base of the shaft to accumulate the slag formed during a smelt. The pit was filled with a combustible material before the smelt (in this case, as in most Irish examples, spilt wood), which eventually burnt away once hot slag started to descend during the reaction, creating space both for the slag and for the growing iron bloom. After the smelt the pit could either be cleaned by removing the slag through the furnace top, or through an arched opening in its side or pit (e.g. Derrinsallagh, Young 2008b).

Three pieces are less securely attributed to iron smelting (the lining slag and the superficial haematised flow slag from c127 and the slag sheet fragment from c86). None of these pieces is certainly from another process.

Unfortunately, the slagpit furnace remained in use in Ireland for a very long period – from the start of the Iron Age until late in the medieval period, so the residues themselves are particularly indicative of age. The morphology of furnaces may sometimes be more indicative of age. Variations in morphology include the variations in the presence/absence of the arch, the location of the arch, the shape of the shaft (sub-cylindrical to bottle-shaped) and in the presence and morphology of an external pit/working hollow, and in the size and shape of the basal pit, but in this instance there is little detailed information.

The assemblage of slag from c87 represents just a part of the likely total slag content of the pit at the end of a smelt. In examples where the pit contents survived intact (i.e. they were not cleaned out after the last smelt conducted in the furnace), the total slag quantity ranges from around 16 to 22kg (16kg Camlin 3, Young 2011; 17.5kg Tullyallen 6, Young 2003; 19kg Adamstown 1, Young 2006b; 21kg Derrinsallagh 4, Young 2008b; 21.5kg Derrivorigan 1, Young 2008a). Thus, if this material is from a single smelt, it is likely to comprise only approximately 15% of the original slag in the furnace. It is not clear, however, whether this assemblage actually does represent a small part of the slag production of the final smelt in the furnace, or merely pieces of slag which became deposited into the cleaned pit on its later disuse.

The area of the present discovery is not one that has been previously recognised as a particularly significant area for iron production, being elevated above the major iron producing areas of western Co. Kildare (particularly seen through numerous sites around Kildare and those discovered along the route or the M7 westwards) and northern Kildare (with multiple sites discovered along the M4). However, recent evidence of probable early medieval age from Britonstown (Young 2013), just 1600m to the east of the present site, included probably early medieval iron working (smithing), with possible evidence for smelting. The possibility exists therefore that there may have been developments of bog iron ore in the valley below the site.

Evaluation of potential

The assemblage is currently undated and therefore it is difficult to comment fully on its significance. The setting is, however, different from most known iron smelting sites in the Kildare area and so detailed analysis of the chemical composition (and hence some characterisation of the likely ore source) would be desirable. A small programme of analysis of this material is therefore recommended. This geographical significance may be enhanced if any programme of scientific dating establishes the age of the furnace.

The material is sufficiently significant that its retention by NMI is strongly recommended.

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Table 1: Summary Catalogue

Context	Sample	Weight (g)	Notes
127	47	104	flow slag, dense, moderately coarse grained in large lobes, with multiple lobes showing contacts with wood packing. Many surfaces shows shiny surfaces with a metallic lustre, others (the wood contacts mainly) are dull grey. Individual flow lobes are small.
		44	flow of dark glassy lining slag, forming flap at probably a high angle to the wall, the base shows ashy adhering material; the slag is verging on the texture of fuel ash slag here. The upper surface is, in contrast, a very dark glass. The adhering ceramic is sandy with a few large angular quartzo-feldspathic clasts
		16	complex flow slag, pale grey ,coarse, passing around what are probably small charcoal moulds
		38	fragment of complex flow slag. One side shows a maroon surface to its flow lobes, and the same areas show a tendency to break into a granular rather than a smooth surface
86	33	456	piece from the floor/wall angle and shows non-wetted dense flows with a brilliantly metallic lustre, locally with a slightly reddened top with flow-lobed surface; the piece is 65mm thick and has a prilly base and large wood contacts.
		750	fragment includes a transition from a small-charcoal-dominated texture to a coarser flow slag.
		1025	dominated by small fuel moulds and shows a contact with a pale grey pit wall
		42	flow slag with v large wood impression
		26	flow slag with fuel impressions
		190	dense well flowed slag with well-formed prills around large wood moulds
		330	dense well flowed slag with well-formed prills around large wood moulds. one mould is suggestive of split wood with one external curved face, 25-30mm across and 85mm long. other contacts are less complete but suggestive of larger wood pieces
		162	piece is a very dense basal crust with tubular vesicles, and elongate olivine to 20mm. The base is a clay contact, the top has irregular raised lobes and arcuate ridges, it is rusty and bears fine charcoal impressions. The ceramic is sandy with rounded quartz granules and angular chert(?) fragments.
		135	debris and soil

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