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Assessment of archaeometallurgical residues from Ringaskiddy, Co. Cork (17E0641)

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Abstract

The investigated materials comprised a small collection of disparate items. A copper alloy artefact and a small assemblage of highly accreted iron artefacts showed no indication of being associated with the archaeometallurgical activity on the site and are not described in detail. A single isolated piece of glassy slag-like material is interpreted as clinker of uncertain, but most likely non-metallurgical, origin.

The most significant element of the collection was an assemblage of iron smelting slag and sinter from C38. These residues are typical of those which may accumulate in the lower part of the basal pit of a slagpit-style non-slag tapping iron smelting furnace. The closest comparative examples are of 4th- 1st century BC age ,and thus a Developed Iron Age date is most likely for the assemblage, which would have been in-situ in the basal pit of the furnace.

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Methods

All materials were examined visually, using a low-powered binocular microscope where required. As an assessment, 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.

This assessment was conducted in August 2018 and was commissioned by Abi Brewer of Mizen Archaeology.

Results

General description of the assemblage

The investigated materials comprised a small collection of four probably unrelated distinct origins (Table 1).

The only material likely to be of archaeometallurgical significance is the iron smelting slag assemblage from context (C38). The single piece of clinker from (C7) might have an archaeometallurgical origin but is more likely to derive from a non-metallurgical activity.

The submitted collections also included a single copper-alloy object and an assemblage of six iron objects. These items showed no indication of a direct association with the metallurgical activity on the site.

Iron smelting slag

Iron smelting slag was present as an assemblage from context (C38). The assemblage formed a continuum from smooth-surfaced, shiny flow slags (ranging from individual droplets and small prills, through to complexly amalgamated flows) to material of rough appearance without clear form. This continuum was divided into three for the purposes of description: smooth-surfaced flow slags (96 pieces, 552g), rough-surfaced flow slags or rough-appearing material containing flow slags (200 pieces, 300g) and lastly rough-surfaced amorphous fragments (140pieces, 336g). This material required further washing in order to be able to observe surface detail. This washing generated some 42g of debris when sieved at 100µm.

The smooth-surfaced flow slags occur in a wide range of morphology from small (<5mm) slag droplets, fine elongate prills, larger (up to perhaps 30mm by 80mm and 20mm thick) flow lobes and some examples of amalgamated flow slags. Some of the fragments show surface textures indicative of flow over and around wood or charcoal. These ‘fuel’ moulds were of limited size with contact surfaces rarely exceed 10mm by 25mm.

The rough-surfaced fragments were commonly in somewhat angular fragments. They showed a binding medium that was mainly rather pale, possibly ashy, material and yellow-brown films of hydrated iron oxides. This iron-oxide rich coating bound particles of slag, tiny fragments of charcoal, and (particularly amongst the debris from the washings) oxidised fired furnace ceramic. This material resembles that described as 'sinter' from other sites.

The material intermediate between these two extremes comprised flow slags that had penetrated into, or been subsequently coated by, the sinter. The relative location within the slag pit of the various materials is unclear, but it would appear likely that the sinter accumulated on or near the base of the slagpit, with a proportion of the flow penetrating to that level, but with some cooling higher up in the fuel bed or pit-packing.

Clinker

Context (C7) yielded a single tiny fragment of dark glassy slaggy material in a prill with one dominantly matte maroon surface and one glossy, glassy, dark surface. This item is to be identified as a fragment of clinker, the melted, or partially melted, inorganic residue from the burning of impure coal. The fragment did not, however, contain any remnants of coal shale, which commonly occurs in coal residue.

Interpretation

The isolated find of clinker is not likely to related to archaeometallurgical activity, although clinkers may be generated during blacksmithing when coal is employed as fuel (typically progressively from the later medieval period onwards, depending on local availability and trade, but commonly in rural Ireland not until the later 19th century). Many metallurgical (and other) industries of the industrial period produced clinker as waste from steam boilers. Steam boilers of agricultural machinery of the later 19th and early 290th centuries are another potential source of such material. Small quantities of clinker may also be generated in domestic settings, both in boilers and in simple domestic hearths during the burning of mineral coal. These latter sources are most likely for isolated finds in rural settings. Clinker may also have been transported into fields, not only deliberately as part of a fertiliser, but also accidentally when derived from its use in surfacing tracks and as railway track ballast.

The assemblage of iron smelting slag is more significant. The assemblage of many small fragments all consistent with an origin in the lower part of the slag pit on a non-tapping iron smelting furnace, means it is likely that were in situ within such a pit. Simple slagpit-style iron smelting furnaces employed a basal pit to collect the slag formed during smelting in an overlying shaft furnace. For simple furnaces, such a shaft would be narrow, cylindrical and perhaps up to around a metre tall. Air would have been blown into the furnace at around ground level by bellows and the iron bloom would grow just below the level of the air blast, from the reaction of iron ore and charcoal fuel fed through the top of the shaft. Combustion of material within the slagpit would provide space for the descending fluid slag waste and also for the growing bloom.

The most common mode of use of slagpit furnaces is to pack the basal pit with a combustible material that is quite distinct from the well-sorted fine charcoal employed as fuel. Most commonly the pit packing is of round or split wood in large pieces, more rarely the packing is of cereals or grasses. Evidence for the nature of the pit-packing is commonly provided by the moulds formed by the descending flow slag. In this instance the flow slags showed contacts only with very small pieces of wood/charcoal, compatible with the likely size of the fuel. The furnaces would be cleared of slag after smelting, to prepare them for re-use. The absence of larger slag pieces, more typical of the upper parts of the pit assemblage, may be indicative of at least a partial clearance having been undertaken before the furnace was abandoned.

The average fragment weight for this assemblage was just 4.7g. This parallels the assemblages grouped as 'Type 1' of Young (2005) from the sites of Cappakeel W, Morett D and Ballydavis 2 on the N7 development in Co. Laois (Young 2005 and unpublished data). These examples have somewhat insecure 14C dates, but the furnaces appear to be Iron Age (possibly 5th-2nd century BC) in date, although the spread of unpublished 14C dates indicates some early medieval activity on the same sites. Other examples of slagpit slag assemblages dominated by fine isolated prills and small amalgamated flows (rather than the large amalgamated flow slag blocks commonly encountered) from sites in the midlands include the supposed Iron Age furnace [1796] at Camlin 3, Co. Tipperary (Young 2011), the undated furnaces at Celbridge (Young 2003) and the 3rd-4th century BC furnaces at Cherryville, Co. Kildare (Young 2006, 2008). In addition to yielding fine-scale flow slags, the assemblages from all these sites (with the exception of Camlin) also contained sinter. Further south, similar assemblages have been recorded from Ballydavid, Co. Kilkenny (site AR26) on the M8-N8 scheme (Young 2009a) which appears to have been of 3rd to 1st century BC age.

Ballykeoghan Site 6-9, on the N9-N10 scheme, Co. Kilkenny (Young 2009b), produced two furnaces with somewhat similar assemblages in their basal levels, but with furnace [043] also containing a full slag assemblage in its upper fill. This allows reconstruction of the overall style of slag assemblage associated with this smelting technology, with the upper levels of the pit showing clear evidence or a split wood pit packing. This furnace contained a total of 18.279kg of residues, of which 1790g were fine-grained residues (flow slags and sinters) from the basal levels. This furnace was not dated scientifically but was suggested to be of Iron Age date on the basis of its morphology.

It would appear that the majority, if not all, of the sites with closely comparable assemblages date to within the 'Developed Iron Age' (4th – 1st centuries BC; Becker *et al*. 2008). Iron smelting furnaces of this period dominantly shows basal pits of 400mm diameter or greater. They commonly show little sign of a close association with other settlement evidence and were probably located close to the natural resources they required (bog iron ore and woodland).

Further work

The significant part of the submitted collection is the residue assemblage from the iron smelting from context (C38). This material would be capable of yielding further information from detailed analysis,

particularly in terms of characterising the likely composition and origin of the iron ore employed. The assemblage does not constitute the entire slag production from a smelt, so would not be capable of providing evidence on yield or production.

Whether such work should be commissioned would depend on the utility of such additional information to the archaeological interpretation of the site as a whole. That this furnace appears to be an isolated occurrence (no related slags were recovered from other features on the site, raisin questions about its relative dating), and that there does not appear (on the basis of the supplied information) that there is any scientific absolute dating for the feature, and that iron smelting does not appear to have been a major activity on the site may mean that any information from further analysis would only have a very limited ability to add to the interpretation of the site and therefore that further analysis might be an effective use of resources.

The artefacts supplied should be investigated by an artefact specialist with experience in the relevant periods. The iron artefacts are likely to require X-radiographs before such work could be undertaken.

Iron Age iron smelting slags are not common and it is recommended that the slag assemblage form C38 is deposited with the site archive.

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Table 1: summary catalogue of materials retrieved as archaeometallurgical residues and metallic finds, listed by context. Weights in grams.

context	find	S wt	I wt	I no.	notes
C7			4.24	1	irregular prill of dark slag, probably from the margin of a larger sheet-like piece, with variegated dark/maroon surface on one face and dark glassy veneer on the opposite
C38		1230			assemblage of slag from slagpit furnace
			552	96	prills and flow slag with clear flow surfaces
			300	20	flow slags with rough surface and rough material containing flow slag
			336	140	rough, often granular material
					plus 42g of washings
C67	find #19		0.72	1	tapered thin copper alloy piece; 26mm long, maximum 6mm width, approximately 1.5mm maximum thickness.
C266			154	6	iron artefacts with heavy accretion (1: possibly accretion only; 2: tapering narrow rod 58mm long, possibly nail; 3: curved iron bar, 100mm x 15mm x 4mm; 4: headed rod?, 46mm long, 12mm wide with 17mm diameter 'head, possibly nail; 5: headed rod, 48mm long, 12mm wide with 17mm diameter 'head, possibly nail; 6: tapering curved rod, bent into hook shape, 100mm long.)

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