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Evaluation of archaeometallurgical residues from Carnbane Industrial Estate, Newry [AE/11/114]

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Abstract

Archaeometallurgical residues from this site were largely derived from the rath ditch, which produced a small assemblage of rather indeterminate slags. Although many pieces showed evidence for fluid flow, certain discrimination between an origin in iron smelting and iron smithing was not possible. One larger fragment of slag was from the zone of interaction between slag and hearth/furnace wall, but was also of uncertain origin.

Items from fills of a souterrain were not metallurgical residues – one was natural, the other two were iron artefacts.

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Methods

All materials were examined visually with a low-powered binocular microscope where required. As an evaluation, 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. The summary catalogue of examined material is given in Table 1.

This project was undertaken for the Irish Archaeology Consultancy.

Results

C2306, C2322 (Rath ditch fill)

The materials from these contexts comprise mainly rather small fragments of slag of indeterminate origin.

Some of the materials are flow slags. These have brown or maroon upper surfaces. A maroon upper surface indicates a degree of oxidisation of the flow lobe surface – which may occur during of tapping of a smelting slag (when the slags runs outside the furnace and may interact with the external atmosphere) or may occur when slag flows develop inside the furnace close to the blowhole or tuyère front. Maroon surfaces are also commonly developed on materials produced in coal-fuelled hearths, including both simple clinkers and slags.

The occurrence of a piece of coal within the assemblage increases the possibility that coal was employed as fuel (although natural derivation of the coal is possible).

Larger slag pieces are largely absent, and it is the lack of clear evidence for the overall morphology of the slag masses that causes particular problems with the interpretation of the assemblage. One large fragment (172g) shows part of the wall contact of a large slag cake with a somewhat haematised top. Such cakes can be produced in a variety of settings where a strong air blast is employed, but the haematised top has been particularly observed in experimental in which iron has been remelted to purify or carburise it.

Other large fragments show slags with dimpled bases and internal voids above the basal sheet. Such slags might be from complex, void-rich, flowed slag, but might equally be from hearth cakes formed during smithing.

C2318, C2354 and C2357 (Souterrain 1 backfill)

One sample from Souterrain 1 was a natural stone, but the other two were iron artefacts, although neither was readily identifiable. One was a small iron disc, the other a wedge shaped piece of iron.

C1118

These materials are fragments of thin slag sheet, rich in inherited grains. Such materials are likely to have been generated on the wall of a metallurgical hearth or furnace.

Interpretation

The assemblage from the ditch fill, as described above, includes material for which an origin could not be determined with any degree of certainty. Although flowed slags are typically associated with smelting, they may also be produced in some circumstances during smithing.

Reddening of flow-lobe surfaces is typical of tapped smelting slags (as opposed to non-tapped flow slags) and of materials produced during coal-fuelled operations. Coal was recovered from the same context as the slag, but none of the slag showed conclusive evidence for coal use.

Coal was used in smithing in Ireland from the medieval period, with locations close to coal outcrops and locations supplied by sea with coal from British sources apparently first. Coal use spread widely across Ireland after the development of the canal system in the 18th and 19th centuries. Locally, the Newry canal, constructed between 1731 and 1741, was built to allow transport of coal from the Tyrone coalfield (which started to be exploited in the 17th century), particularly for the Dublin market. The materials recovered would certainly be compatible with iron-working in the later post-medieval period. Somewhat similar, although not identical, flowed slags from smithing in a late medieval to early post-medieval setting include those from Carrickmines Castle (Young 2011).

If the materials are earlier, then the higher than usual degree of oxidation of both flow lobes and slags attached to the furnace/hearth wall might be due to the use of a process, such as remelting, requiring a high air-flow. Remelting processes are currently rather poorly understood, but include techniques employed to manipulate the phosphorus and carbon contents of iron (see commented translations of Evenstad 1790 by Jensen, 1968, and Wagner, 1990; Sauder, in press).

In summary, interpretation of this small and fragmentary assemblage remains problematic. Evidence for its age might assist with the interpretation.

Evaluation of potential

This is a small assemblage, not apparently directly connected with any metallurgical structure. The interpretation of the assemblage is problematic. Further analysis of the materials might provide sufficient evidence to permit interpretation (as with the somewhat similar assemblage from Carrickmines Castle, Young 2011). Whether such improved interpretation is worthwhile from an archaeological viewpoint might depend on the age of the material. If it is likely to be post-medieval in age, then an interpretation as coal-fuelled smithing debris becomes more likely, and further investigation may add little more to understanding. If the materials were securely stratified in early medieval contexts, then further investigation might be considered worthwhile. However, it should be borne in mind that the small volume of recovered material strongly suggests this metallurgical process was not a significant or common feature of activity on the site.

The iron artefacts from the fill of souterrain 1 would be worth X-radiography to facilitate their identification.

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Glossary

Blacksmithing: the working of iron and steel. Often restricted to the secondary smithing – i.e. the smithing of iron to produce or repair artefacts.

Bloom: the crude iron block formed by iron smelting in a bloomery. It may contain voids and inclusions of slag and charcoal. It will require some degree of reworking (bloomsmithing) and/or refining before the iron can be used by a blacksmith.

Bloom refining: the conversion of a raw bloom to useable metal. Often accomplished by bloom smithing, but other techniques, such as remelting, may sometimes have been employed.

Bloom smithing: the smithing of a bloom – often by folding and welding, to convert it into usable iron. Sometimes called primary smithing.

Burr: the zone of interaction between slag and the hearth or furnace wall just below the tuyère/blowhole. Typically seen as a dense lunate slag, with attached highly indurated ceramic, forming a protuberance on the margin of an SHC or FB.

Flow slag: smelting slags that have flowed within the smelting furnace, typically into the basal pit of a slagpit furnace, but have not flowed out of the furnace. Flow slags may include various morphologies: individual slag spheroids, isolated vertical prills, horizontal flows/prills, birds-foot structures.

Furnace bottom (FB): a rather poorly-defined term for the main slag mass formed during iron smelting in a non slag-tapping furnace. If the basal part of the furnace is shallow this may be dense, but if the bottom is deep then a rather low density FB, formed of coalesced prills, is more common. Slag escaping incorporation into the main FB forms flow slag lower in the pit.

Primary smithing: see bloom smithing

Secondary smithing: see blacksmithing.

Slagpit furnace: a variety of non slag-tapping smelting furnace in which a pit for slag collection lies below the base of the shaft. Slag pits are commonly packed with organic material prior to smelting – which is typically split wood in NW Europe, but may be of cereals or grass (particularly in eastern Europe). Flow slags form where slag descends into the pit and a furnace bottom may form across the top of the pit. This is the dominant form of early iron smelting furnace in Ireland.

Smithing hearth cake (SHC): the slag cake formed in a smithing hearth by reaction of iron oxides lost from the workpiece with silicate material from hearth ceramic and/or fuel, below and in front of the tuyère/blowhole. They are very variable in form, but are typically plano-convex in shape (although concavo-convex and biconvex forms are common), frequently with a dense lower crust and a less well consolidated upper part. In some cases the top is formed of glassy slag.

Tapping: allowing slag (in the context of a bloomery) or metal (in the context of some other furnace types) to flow from the furnace to cool and solidify outside the furnace. Slag tapping bloomeries have an advantage in being easier to clean and refurbish between smelts compared with non-tapping varieties. They may also (depending on slag viscosity and quantity) assist with a high degree of bloom-slag separation.

Tapslag: smelting slags which have been tapped – i.e. permitted to flow out of the furnace.

Table 1: summary catalogue by context. Assm = sieved residue assemblage.

c	s	w	n	description
1118	211	1.63	assm	fragments of thin irregular sheet of slightly gravelly dark slag
2306	586	312	bag 1/2	
		936	bag 2/2	
		20	1	angular lump of coal
		190	24	cavernous slags with thin brittle films around voids - some clearly charcoal moulds, others more rounded. Some pieces show internal lobe-like forms
		128	11	gradational with above - pieces dominated by lobes - some with thin skins, some grading to true dense flow slags
		172	5	gradational with above (1 piece actually certainly joins), pieces have broad smooth flow lobes on top, brownish lobe surfaces (not haematised)
		134	1	spike with somewhat smooth lobed top, spike 60mm long and 30mm long at its base - unclear if this is a basal flow or a tool mark fill
		98	1	granular slag with irregular outer surface to mass and internal large crude voids (probably after fuel)
		312	3	large pieces of slag with dimpled or prilly bases, internally similar to material above - top marked by fracture showing coarsely crystalline material in more or less continuous layer presumably below an original void
		172	1	interesting piece of slag - suggests flat bottom sediment contact with deeply undercut side. Vertical wall and horizontal crust define a deeply hollowed top which is intensely haematised and smooth. Wall 13mm thick expanding downwards, crust 10mm, bowl 35mm; shows cavity with haematite locally tipping over onto top of wall. Upper part of wall has some sweeping internal contacts - perhaps suggesting haematised skins below blowhole now buried in slag: could well be from an Aristotle-like furnace?
2318	616	618	bag	iron wedge 90mm long, 30x20mm at one end 40x10mm the other; highly accreted, main lump 410g
2322	450	6.6	1	fragment of very slightly maroon-surfaced flow slag, one well developed lobe with dimpled base, parts of others
2354	499	18	1	corroding iron disc, c.7mm thick and 20mm across
2357	473	44	1	decomposed igneous rock pebble

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