GeoArch

Report 2009/48

Evaluation of archaeometallurgical residues from the N18 Gort-Crusheen, Derrygarriff 2, Co. Galway (E3711)

Dr Tim Young
3rd November 2009

Evaluation of archaeometallurgical residues from the N18 Gort-Crusheen, Derrygarriff 2, Co. Galway (E3711)

Dr T.P. Young

Abstract

Archaeometallurgical residues were recovered from a single context at Derrygarriff 2. The residues were contained within context [c3], the upper fill of feature [c5], mainly at its interface with [c4], the lower fill. The total assemblage weight was approximately 10kg.The residues include a large proportion (6.4kg) of deeply vitrified and variably indurated slabs of furnace wall, together with a lesser proportion of flow slags (3kg). The flow slags are mainly in the form of large rounded flows and masses, some showing contact with large pieces of charcoal/wood. Many of the flow slag pieces show contacts with either the wall of the furnace or its floor.

The assemblage as a whole is mainly indicative of iron smelting in a non-slag tapping shaft furnace (a slagpit furnace).The materials present are dominantly those associated with the structure of the furnace, rather than slags cleared from the furnace during normal use, as more commonly found. The apparent occurrence of the residues on the interface between the lower fill of the cut with the overlying fill (described as a stiff orange-black silt clay) is strongly suggestive of the orange clay representing a collapsed furnace superstructure, of which the indurated blocks described here formed the inner face. The denser slags probably originally lay adjacent to the walls of the slag pit.

The assemblage also included two pieces (total 546g) which are probably from smithing hearth cakes. Sieving of the material washed from the slags during their cleaning also yielded a few fragments of hammerscale. This suggests a small quantity of residues from iron working (smithing) was also present in the assemblage, raising the question of whether the assemblage is a dump, or represents a more-or-less in-situ furnace.

Field photographs suggest that collapsed superstructure layer dominantly towards the NE end of the cut, where the broader cut is compatible with the location of the furnace base. The SW-narrowing extension of the cut cannot be paralleled precisely on other sites, but is suggestive of a hollow permitting access to a furnace arch. The closest parallel for a slagpit furnace with an arch would be the furnace [c397] from Derrinsallagh 4 (a furnace which is not itself dated, but ^{14}C dates from the site as a whole are apparently from the 4th century BC to 1st century AD). However, in the lack of evidence definitely tying the superstructure to the cut, it is also possible that all the material was produced elsewhere and simply dumped in this cut.

Contents

Methods

All materials were examined visually with a low powered binocular microscope. Macroscopic slag pieces were individually weighed, described and recorded to a database. The summary catalogue is given in Table 1.

The conclusions reached in this report are therefore limited by the nature of the evaluation inspection. No chemical analysis or high-powered microscope work is attempted during an evaluation.

The assemblage was supplied unwashed; the macroscopic slags were all therefore washed before inspection. The fine debris washed from the specimens was saved and sieved at 100μm in order to provide supplementary evidence on the nature of any fines present in the deposit.

Results

Description of the residues

Furnace ceramic: the fired clay occurs with varying degrees of vitrification. In several cases the vitrification comprises several zones, each10-20mm thick, indicative of relining of the furnace. Many of the pieces show vitrified faces coincident with the bounding fractures, suggesting that the walls had developed deep cracks during use.

The vitrified faces of the ceramic are typically rough, with adhering slaggy material. The only pieces which show smooth glazed surfaces are some of the small fragments which are rounded and vitrified on all surfaces, suggesting these are wall fragments that have become detached and fallen into the charge. Further suggestion of failure of the wall is provided by the abrupt termination of some individual layers in the multi-layer fragments.

Although many of the pieces show a gentle curvature, because of their irregularity it is not possible to orient these to reconstruct the furnace shape. The fragments do not appear to constitute the entire area of vitrification within the furnace.

No pieces suggestive of the furnace blowhole were found.

Flow slag: the flow slags were mainly derived from rather large flow lobes. Most of the flow slags have dull, slightly rough, surfaces, although there are a few dense shiny pieces. Many of the pieces show evidence for contact with either the furnace walls or floor.

Several of the pieces show moulds of large pieces of charcoal or wood, although there were no moulds that were sufficiently large to indicate the split wood fragments commonly seen in slagpit furnaces.

The more massive dense slag pieces were probably associated with the blowing wall of the slagpit.

There were just two pieces indicative of vertical prills, and no good cross-floor flows. Small blebs and prills were entirely absent.

Smithing hearth cakes (SHCs): the assemblage contained two slag cakes which appear to be SHCs. One was a complete plano-convex slag cake, with somewhat lobate margins, weighing 264g, roughly circular in plan, 85mm in diameter and 40mm thick. The other was incomplete (approximately 70% surviving), plano-convex with a central dense slag "puddle", weighing 282g (c. 400g originally), probably originally about 90mm in diameter and 35mm thick.

Microresidues: the washings from the macro-residues were sieved to provide a sample of microresidues. The microresidues retrieved were mainly small slag fragments and droplets, together with some small, rounded, highly magnetic material, that may be iron ore; all indicative of iron smelting.

Alongside this material, however, there was also a small quantity of flake hammerscale, indicative of iron working.

Distribution of the residues

The assemblage was all retrieved from a single context [c3], described as the upper fill of [c5] comprising stiff orange and black silty clays.

Interpretation

The evidence from the residues is dominantly for iron smelting. The flow slags are typical of slags from the basal pit of a slagpit furnace (a low-shaft smelting furnace, which is non-slag tapping, instead the slag flows down from the reaction zone and accumulates in the basal pit). The furnace fragments are all compatible with an origin in the shaft of such a furnace.

The presence of some residues from iron-working (smithing) in the same assemblage can be paralleled at a few other sites, but poses problems for the interpretation.

It is tempting to see the coincidence of the distribution of the fired clay of [c3] with the wide end of cut [c5] as suggesting the original location of the shaft of the furnace at that end (the NE) of the cut. The recorded location of the major fired/vitrified ceramic blocks below the bulk of [c3] would be entirely compatible with the collapse of the furnace shaft.

The flow slags are mainly slag materials that formed along the walls of the furnace and which might not necessarily be cleared from the furnace between smelts – so they too might be relatively in-situ in the collapsed furnace.

It is certainly noteworthy that the assemblage does not include any of the fine-grained flow slags (prills, blebs and spheroids) that normally abound within the slagpit after use, but which are relatively easily cleared between uses. Equally, there are no pieces of the characteristic prilly, charcoal-rich, "furnace bottoms" that form a major slag block immediately below the bloom. These too will be removed from the furnace between uses, perhaps, in some cases, being removed in a single block with the iron bloom.

The smelting slag assemblage can, however, be interpreted in an alternative way. Since the materials recovered (the blocks of slagged /vitrified wall and the wall-associated flow slags) are intimately associated with the structure of the furnace, any repair of the furnace involving clearing of these materials must be a major overhaul and rebuilding of the structure. Such repairs would be undertaken sporadically to keep the furnace functioning properly. The material described here (and the silty clay of [c3]) could therefore be viewed as the debris produced during the overhaul of a furnace – and thus not in-situ at all.

The distinction between these deposits as a collapsed furnace and as debris from the reconstruction of a furnace elsewhere, must rest on whether the cut [c5] can be identified as a furnace cut – or whether it is simply a pit.

The "tadpole" shape of [c5] in plan cannot be precisely paralleled elsewhere, but is suggestive of a slagpit furnace, with an elongate "working hollow" giving access to the slagpit via a furnace arch. Although arched furnaces are commonly associated with slag tapping, arches were also employed for clearing non-tapping furnaces, and possibly for the removal of the bloom too.

A good example of such a furnace was recovered from Derrinsallagh 4 ([c397]; Young 2008d), but suggestions of arches have also been made at other sites: Derrinsallagh 3 (Furnace C819 and working hollow C640; Young 2008b), Derryvorrigan 1 (Young 2008c) , Cappakeel West and Morrett (Young 2005). All of these sites are dated to

between the 3rd Century BC and 1st Century AD. In N Wales, Iron Age furnaces with arches, although not normally sunken into the ground, have been described by Crew (1987, 1989, 1998) and their use reconstructed (Crew 1991).

The presence of large blocks of vitrified furnace superstructure is not common (thereby contributing to the myth of the bowl furnace). Examples of material broadly similar to the present collection are known from Cherryville (where the slabs of vitrified furnace had been dumped into features F4 and F5, although these features were not necessarily themselves metallurgical; Young 2008a) and Cappakeel West (Young 2005), both of Iron Age date.

The presence of the macro- and microscopic evidence for smithing is potentially problematic if the structure represents an in-situ smelting furnace. However, Crew (1998) has noted instances where disused smelting furnaces were employed as hearths for smithing the blooms produced in other furnaces. The SHCs are of fairly small size (262 and 400g), and although Iron Age smithing assemblages are currently not well known, it seems that the size of SHC produced during bloomsmithing in the Iron Age may have been quite modest. Crew's evidence from N Wales suggests sizes of <500g for that area.

In summary, it would appear likely, although not certain, that the deposit represents a collapsed iron-smelting furnace. The morphology of the cut suggests there may have been a sub-circular shaft furnace over the wider end of the cut, with the narrow section allowing access, below ground level, to a furnace arch into the slag pit for clearance and or bloom removal. This style of furnace is known from other sites of the 4th – 1st centuries BC. The location of the site, close to a bog, suggests that local bog iron ore would have been smelted.

Evaluation of potential

The slags from the furnace are a rather incomplete suite of residues from the smelting process, so have limited potential to allow full description of the chemistry of the smelting. In addition, the possibility that the assemblage may represent material dumped during refurbishment of a furnace elsewhere on the site also slightly reduces confidence in the homogeneity of the assemblage.

On this basis no further analysis of this material is recommended. The assemblage is unusual however, so it is recommended for retention.

References

CREW, P. 1987. Bryn y Castell Hillfort – a Late Prehistoric Iron Working settlement in north-west Wales. *In:* SCOTT, B.G. & CLEERE, H. (eds) *The Crafts of the Blacksmith*. 91-100.

CREW, P. 1989. Crawcwellt West excavations 1986-1989. A late prehistoric ironworking settlement. *Archaeology in Wales*, **29**, 11-16.

CREW, P. 1991. The Experimental Production of Prehistoric Bar Iron, *Historical Metallurgy*, **25**, 21-36

CREW, P. 1998. Excavations at Crawcwellt West, Merioneth, 1990-98: A late prehistoric upland iron-working settlement. *Archaeology in Wales*, **38**, 22-35.

YOUNG, T.P. 2005. Evaluation of archaeometallurgical residues from the Heath-Mayfield N7 development (03E0151, 03E0966, 03E0461, 03E0603, 03E0633, 03E0679, 03E0602, 03E0635). *GeoArch Report 2005/12*. 28pp.

YOUNG, T.P. 2008a. Archaeometallurgical residues from Cherryville Site 12, Kildare Bypass. 01E0955 *GeoArch Report 2007/24*. 33pp

YOUNG, T.P. 2008b. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derrinsallagh 3 (E2179). *GeoArch Report 2008/22*. 11pp.

YOUNG, T.P. 2008c. Evaluation of Archaeometallurgical residues from the M7/M8 Contract 2: Derryvorrigan 1 (E2193). *GeoArch Report 2008/26*.

YOUNG, T.P. 2008d. Detailed recording of furnace C397, Derrinsallagh 4 (E2180), M7/M8 Contract 2. *GeoArch Report 2008/34*, 10pp.

Wt (g)	*No.*	*Notes*
178		fines from washing slag, not all archaeometallurgical
264	1	probable SHC, plano-convex, lobate margin, gravel on base, 85x85x40mm
282	1	c70% of probable SHC, flat-topped dense puddle, some clay on rather prilly base, (70)x90x35mm
2512	26	larger pieces of dense flow slag and associated massive slags
518	18	smaller pieces of dense flow slag
5567	24	larger blocks of indurated furnace lining
822	50	smaller fragments of structural ceramic

Table 1: summary catalogue of residues from [c3]

GeoArch

geoarchaeological, archaeometallurgical & geophysical investigations

54 Heol y Cadno,
Thornhill,
Cardiff,
CF14 9DY.

Mobile: 07802 413704
Fax: 08700 547366
E-Mail: Tim.Young@GeoArch.co.uk
Web: www.GeoArch.co.uk