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Assessment of archaeometallurgical residues from Cefn Graianog, G1598 (2012-13)

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Abstract

The material was almost entirely residues from bloomery iron making in a non-slag tapping furnace. The assemblages from contexts (25) and (28) were rich in the fine-grained residues from the basal pit of a 'slagpit'-style furnace, with flow slags, slag spheroids and the ferruginous sediment that accumulated on the floor of such a pit (probably including slag, ore dust and charcoal debris in a ferruginous cement).

Assemblages such as this are usually recovered in situ from abandoned furnace pits, but in this case there is apparently no surviving structural evidence or a furnace and it is possible that the slag was incorporated into a workshop floor. The composition of the assemblage indicates, however, that the residues were unlikely to have been transported far.

Non-slag tapping furnaces occur in the pre-Roman Iron Age, were supplanted by slag tapping technology in most of Romanised Britain, but were reintroduced in the early medieval period, before being replaced by slag tapping again in the 9th/10th centuries AD. It is possible that they continued in use during the Roman period in parts of Wales, and certainly did so outside the empire in Ireland. There are no current criteria on which to distinguish the age of residues from such furnaces.

Ironworking (smithing) was evidenced by the occurrence of hammerscale (both in flake and spheroidal forms) in all three sampled contexts (most commonly in context (6)).

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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 examined materials are listed in Table 1.

This project was commissioned by Iwan Parry of the Gwynedd Archaeological Trust.

Results

Iron smelting residues

The majority of the supplied material was residue from the smelting of iron. The material included mainly flow slags, both as individual thin prills and as more coalesced multiple flows. Some of the blocks of coalesced flow slags resembled examples of tapped slags. The blocks were always small in size and the flows did not show the surficial oxidation typical of tapped material (in which the surface of the slag typically oxidised on contact with air). The flow slags may all be attributed to a non-slag tapping process with reasonable confidence.

Vitrified furnace lining was present in small quantities, as were flowed slags apparently produced by the melting of the lining.

As well as typical, smooth-surfaced flow slags, there were prills of dull, rough surface texture that appear to have flowed into the basal ferruginous sediment of the furnace.

These basal deposits were also found as discrete fragments, comprising slag and charcoal debris in a ferruginous matrix. By comparison with material from elsewhere (e.g. Young 2008b) the matrix is likely to contain ore particles in addition to the visible components.

Smithing microresidues

There was a small quantity of hammerscale (both flake and spheroidal; varieties) present in the matrix of all the samples, but most abundantly in sample <5> from

context (6). The type of fine flake hammerscale present is very unlikely to have been produced during smelting, or even during the initial stages of bloom compaction (Young 2011b).

Interpretation

The residues are indicative of bloomery iron-smelting in a non-slag tapping furnace.

Non-slag tapping furnaces may have had a simple basal pit, into which the slag descended during the smelt, or they may have had a frontal arch to permit clearance of the slag (and probably the bloom) after the smelt.

Simple slagpits with no arch, or an unpreserved high-level arch, are common in the smelting furnaces of Iron Age Britain and Ireland (Carlin 2008; Dungworth 2011; Young 2003a, 2003b, 2005a, 2005b, 2006, 2011a, 2013). Examples are also known from the early medieval period (Haslam 1980; Pine *et al.* 2009; Rainbird & Young in prep.; Reed *et al.* 2006; Young 2015).

Arched furnaces may have had their arch below ground level, as is common in the 'sunken shaft furnaces' of the Iron Age of the East Midlands of England (e.g. Jackson & Ambrose 1978) or as occasionally seen on a smaller scale elsewhere (e.g. Derrrinsallagh, Co. Laois, Ireland; Young 2008c), or may have an only slightly sunken base, with an essentially above-ground arch (well-known from numerous examples from the Iron Age of North Wales; Crew 1987, 1989, 1991, 1998, 2009; also from early medieval Ireland, Hull & Taylor 2006).

Non-slag tapping furnaces occur in the pre-Roman Iron Age, were supplanted by slag tapping technology in most of Romanised Britain, but were reintroduced in the early medieval period, before being replaced by slag tapping again in the 9th/10th centuries AD. It is possible that they continued in use during the Roman period in parts of Wales, and certainly did so outside the empire in Ireland. Unfortunately, there are no criteria yet by which the slags from these variants of the non-tapping furnace may be differentiated, nor is it possible currently to distinguish Iron Age and early medieval examples of the technology.

The occurrence of flow slags with both dull and shiny surfaces, slag spheroids, charcoal-rich ferruginous sediments, fine lining debris and spiky 'sinter' (probably of fine slag and ore particles) can be most closely paralleled with finds inside abandoned furnaces on some Irish sites (e.g. Celbridge, Young 2003a; Morrett Site 'D', Young 2005b), but somewhat similar fines assemblages have been found on some Britsh Iron Age sites (e.g. the northern furnaces at Twinyeo , Devon, Young 2013). The significance of the fine scale residues from the basal pits at these sites may be that smelting at these sites produced modest volumes of slag compared with the pit volume, and that the pit was sufficiently deep that its base lay well below the bloom and immediately associated slag.

The presence of only fine-scale residues from the slagpit precludes identification of any organic pit packing. Such a packing is usually of split wood (e.g. Carlin 2008; Rainbird & Young in prep.; Young 2005a, 2008a, 2008b) but is occasionally of cereal straws or grass (e.g. Mikkelsen 1997; Young 2015).

Conclusion

The site shows evidence for iron smelting of between pre-Roman Iron Age and early medieval date, using a non-slag tapping furnace of 'slagpit' type. The occurrence of the residues in assemblages of primary aspect, suggests that, if these were not recovered from furnaces, then they must have been derived from an area receiving the residues during clearance at the end of each smelt. The co-occurrence of hammerscale suggests that other stages of iron-production or iron-working were also undertaken in the immediate vicinity of the sampled contexts.

The residues are significant evidence and as such should certainly be retained with the site archive. It is recommended that a programme of detailed analysis is undertaken in order to clarify the nature of the residues and to provide evidence for the nature of the resources being exploited (analysis phase proposal submitted separately).

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Table 1: summary catalogue. Assm. = assemblage of small fragments.

Context	Sample	Label	Bag wt.	No.	Item wt.	Notes
6	5	magnetic material	11	Assm.		mainly stone, one magnetic prill and moderate FHS
6	5	residue ceramic/burnt natural	7	Assm.		mainly fired clay, possibly altered by panning, one piece shows vitrified surface
6	5	residue	124	Assm.		flow slag and bottom sediment fragments. Material doesn't look as fresh as <7>
25	6	coarse 1/2	1015	Assm.		flow slag prills, including some moderately large tapslag like pieces, plus pit bottom charcoal-rich sediment, lining slag prills, one large rough slag piece looks to have been squeezed with tongs or bar
25	6	coarse 2/2	111	Assm.		small assemblage of small fragments of prill and pit floor sediment, with one small chip of vitrified lining
25	6	hammerscale	<1	2		2 flakes of flake hammerscale
25	6	magnetic from residue	31			mainly sand etc. with some flake hammerscale
25	6	slag from residue	115			small pit floor and prill fragments
28	7	vitrified material	92	16	84	vitrified lining
				1	6	fragment of flow lobe of pale slag with large bladed olivine
28	7	slag from residue	199	Assm.		fines assemblage with broken prills, slag spheroids, sintery basal material, fragments of vitrified wall
28	7	coarse	254	Assm.		fines assemblage with broken prills, slag spheroids, sintery basal material, coarser than material from residue
28	7	coarse 2/3	1185	Assm.		assemblage of larger prill fragments, many amalgamated into mass of sub-15mm (mainly c.6mm) wide flows, lots of pit floor sediment, some charcoal.
28	7	coarse 1/3	1255	Assm.		assemblage of larger blocks including four good flow slag sheet fragments, three fragments of dull flows (one ridged) in the basal sediment, one block of compacted charcoal debris, five small fragments and one larger concavo-convex block of porous slag, plus two denser blocks of prilly slag (one maybe from floor, one possibly from FB?)
28	7	magnetic material	10	Assm.		powdery brown material with rare pieces of possible flake and at least one spheroid hammerscale

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