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Assessment of archaeometallurgical residues from Caernarfon, G2397

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Abstract

The submitted material comprised approximately 3.6kg in various fractions, all from a single context, a midden. The fine-grained material included a very small proportion of micro-residues (both flake and spheroidal hammerscale) alongside comminuted slag and hearth lining, bloated and vitrified rock fragments and a small quantity of coal. The coarser material comprised grey iron-working slag, often glassy and rich in quartz grains, commonly showing signs of deformation when hot and only rarely showing the form of typical smithing hearth cake (SHC). The coarse fraction also included several highly altered iron nails with large square heads and fragments compatible with being parts of similar items.

The slag textures and coal debris suggest that the ironworking employed both charcoal and coal as fuels. The thirteenth century appears to be the point at which significant use of coal in metallurgy recommences after a break since the Roman period. The use of coal has produced slags that are commonly glassy, commonly forming small slag nubs rather than full plan-convex smithing hearth cakes and abundant vitrified rock fragments (from shale impurities in the coal). One dense slag fragment shows numerous coke particles trapped between the slag prills, but inclusions of charcoal are more common in general.

Contents

Abstract 1

Methods 1

Results
- Iron-working slag 1
- Iron-working micro-residues 1
- Fuel 2
- Iron 2

Interpretation 2

Conclusion 2

References 2

Table 3

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 Dave McNicol of the Gwynedd Archaeological Trust.

Results

Iron-working slag

The macroscopic slags comprise the majority of the 3.5kg assemblage, with 2.3kg of large pieces and a further 1kg of comminuted slag. Much of the 62g of fine-grained magnetic separates was also comminuted slag, rather than true micro-residue.

Of the largest pieces of slag, a 257g block and a 550g block each represented a major part of smithing hearth cake (SHC). Neither was complete and the larger block represented an estimated maximum of 70% of the original SHC, which must therefore have weighed at least 790g. Two fragments (of 448g and 202g) were rather tabular in form and 50mm thick, slightly thicker than the 550g SHC fragment. This suggests that the assemblage may include parts of several SHCs of approximately 800g or more.

Several of the smaller fragments show curving surfaces with fuel dimples that extend a considerable way around the fragment – suggesting the slag was deformed (rolled) when hot.

Many of the slag pieces have adhering concretion, often containing mineralised plant and insect remains in a very good state of preservation that may be able to provide some detailed evidence for the nature of the midden matrix.

Iron-working micro-residues

A collection of material magnetically separated from the residue from sample <1>, as well as a new sample gained by collecting the matrix during rewashing of the slag specimens, both contained a significant proportion of slag flats, flake hammerscale and spheroidal hammerscale (terminology after Young 2011). These microresidues are the result of iron-working: flake hammerscale is generated by the superficial oxidation of iron when heated and spheroidal hammerscale is

the product of the melting of this oxide scale, particularly during fire welding (= hammer welding; Young 2011b).

Fuel
Although examination of the slag samples suggested that charcoal had been the dominant fuel, the fine grained residues contained numerous particles of coal, in addition to a large coal particle in the coarse fraction and the occurrence of coked particles trapped within some slag specimens (e.g. the 202g slag fragment from sample <14>).

Iron
The collections included several concretions onto iron artefacts. In at least some of these instances, the objects were large, square-headed nails. Detailed measurements were not possible because of the corrosion.

Interpretation

The residues clearly indicate an assemblage from ironworking (smithing).

The use of coal is interesting. Coal from NE Wales is known to have been exploited during the Edwardian Castle construction period with, for example, 2428 tons sent to Beaumaris during its construction in 1295, presumably mainly to support the required lime-burning (Hankinson *et al*. 2012, 20). The coal trade around the Irish Sea blossomed in the late medieval period with English and Welsh sources supplying the coastal castles and towns of Ireland. Coal was mined (on a small scale) in Anglesey too, but the earliest evidence there is currently from the 16th century.

The size of the SHCs, suggested above to be of approximately 800g or more, is compatible with the weight of examples from some of the very few later examples of contemporary measured assemblages from England. A apparently isolated medieval rural smithy assemblage from Exminster had SHCs with a maximum weight of just 482g (Young 2014) and only the largest examples from 12th century urban assemblages from Worcester (Young 2007, 2009) and Cricklade (Young 2008) weighed close to 800g (with a mean weight of only 330g). In contrast, slightly later assemblages from Worcester (McDonnell & Swiss 2004) and Burton Dassett (McDonnell 1992) comprised larger SHCs with weights of up to 1800g and with mean weights of the various assemblages of 490-550g.

Conclusion

The limited assemblage provides evidence for smithing using a mixture of coal and charcoal fuel. The distribution of coal to the Edwardian construction projects was documented and the SHCs have a weight compatible with a 13th-14th century age.

The residues form a small assemblage which would probably not yield further useful information on detailed analysis, so no further analysis is recommended. Should the midden assemblage contain larger fragments of local than those present in the material examined, then specialist provenancing of the coal (using a combination of vitrinite reflectance and micropalaeontology) might perhaps be useful.

It is recommended that the material be retained with the site archive and deposited in a suitable collection.

The collections include several pieces of iron and it is probably desirable that these are integrated with the finds collection and examined by X-radiography to determine the nature of the artefacts

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

Context	Sample	Label	Bag wt.	No.	Item wt.	Notes
10	1	fine	132	Assm.		some fragments of dense iron slag blebs and prills, many of more glassy lining slag with coarse quartz grains, some bloated stone, some gravel cemented by slag or by secondary iron oxides.
10	1	coarse	48	Assm.		exploding charcoal rich concretions representing 4 or5 iron artefacts, probably square-headed nails
10	1	coarse	262	1	262	irregularly-shaped slag cake with dimpled and finely lobate surfaces. One surface has charcoal debris. Slag vesicular with irregular cavities. Way up unclear, but it is possible that finely dimpled lobes represent tool marks
10	1	coarse	921	Assm.		assemblage of slag fragments, many glassy and gravelly, in various flows, fragments and blown lumps. Prilly slags show charcoal clasts, but also some coked inclusions. Also present is a lump of coal and various partially-melted shale fragments. A few fragments of hearth lining with slag and at least one piece of olivine/mica rich igneous rock
10	1	mag sep	62	Assm.		scale, slag flats, mainly slag fragments, some rusty debris
10			2040	1	257	much of an SHC, micro-dimpled base, large internal void (probably with large exposed olivine, but now obscure, and glassy dimpled top with very large olivine
				1	206	very weathered slag sheet with accretion of rust and mineralised plant remains
				1	108	irregular grey slag fragment with micro-dimpled base, internally prilly or massive/vesicular
				1	59	fragment of prilly, grey gravelly slag with large rounded vesicles
				1	62	irregular slag fragment, slightly exploding, excellent mineralised straw and pupae eternally
				1	104	irregular curved mass of pale, siliceous-appearing slag, possibly a fragment of an SHC rolled during extraction
				1	66	concretion on iron
				1	95	concretion on iron
				1	12	top of square headed large nail, concreted
				1	448	120x90mm and up to 50mm thick slag block. May have formed against almost planar hearth side, inclined, one end shows smoothly lobate surface at 45 to the slab
				1	550	130mm long by 60 wide and 45 thick fragment of SHC. Not more than 70%. Top smooth, slightly lobate, lower parts of bowl friable and charcoal-rich, no basal crust, but some denser lobes
?	14		202	1	202	irregular fragment from slag sheet with prilly base, dropping to plane and encompassing coke fragments, internally porous, slightly lobate on small area of preserved top, 50mm thick.

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