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Assessment of archaeometallurgical residues from Caernarfon, G2454

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Abstract

This assemblage comprised approximately 430g of archaeometallurgical residues, together with three small samples of microresidues.

The residues from contexts (9206), (9208) and (9210) were almost entirely indicative of ironworking (blacksmithing) employing charcoal as fuel. The macroscopic residues (from (9206)) comprised fragments of smithing hearth cakes (SHCs) and smaller fragments of similar slag (probably, but not certainly, also from SHCs). The larger fragments provided some suggestion that the SHCs had originally been small (probably originally less that 150g in weight), and as such an origin in secondary smithing (blacksmithing; associated with the end use of iron), rather than in primary smithing (part of the process of iron-production) seems likely. Washing of the macro-residue pieces generated a small quantity of fine-grained flake hammerscale. The microresidue samples were mainly of within-hearth particles, although a very small amount of hammerscale was noted.

The microresidues from context (1803) are mainly small spheroidal droplets of fuel ash slag/clinker composition. There was no certain hammerscale. Such an assemblage is not necessarily indicative of metalworking, but can be generated in other high-temperature fires where reaction occurs between the fuel ash and the hearth substrate.

Contents

Abstract 1

Methods 1

Results
- Description of Residues
  - Macroscopic smithing slags 1
  - Microscopic smithing slags 2
  - Other microresidues 2
- Distribution of residues 2

Interpretation 2

Further work 2

References 2

Methods

The material described here derives from an evaluation in Caernarfon, G2454, conducted by Gwynedd Archaeology. This project was commissioned by Stuart Reilly and Bethan Jones.

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 macroscopic residue specimens were supplied with some matrix still adhering. These were further washed and the matrix sieved at 90µm to permit checking for microresidues.

Results

Description of residues

The submitted materials amounted to approximately 430g (15 pieces; context 9206, sample 02) of macro-residues and three small samples of micro-residues (c1803 sample 01; c9208 sample 17; c9210 sample 18).

Where identifiable the materials were either certainly or probably from ironworking (smithing).

Macroscopic smithing residues

There were 15 pieces of macroscopic residue comprising dense iron slag with secondary accretion. The accretion contained particles of charcoal with a few tiny fragments of flake hammerscale and showed external moulds of a straw-like material.

The larger slag fragments showed morphological evidence for being fragments of smithing hearth cakes (SHCs): they showed convex, fuel-dimpled bases, a lower layer of dense iron slag and an upper layer of siliceous partially melted gravelly debris, with, locally, a concave partially glassy upper surface. The largest fragments were only 60mm in maximum dimension, so reconstruction of the size of the original SHCs was not possible, but the fragments all appeared to be from

small cakes with a maximum thickness of approximately 35mm.

The upper layers of the larger fragments contained partially melted gravel with a grain size of up to approximately 5mm. This is rather coarse for a smithing flux, and derivation from partial melting of the hearth wall (or tuyère) would appear a more likely origin.

The base of the SHC fragments is formed of a dense iron slag, with well-formed lobes and prills and a very shiny, non-wetted, surface. These features would indicate that the slag was well-fluxed by the hearth lining to produce a very fluid melt.

Four of the pieces showed an intense red-brown colouration to the accretion suggesting corrosion of metallic iron and one fragment appear to be the mineralised crust from an iron fragment solely preserved as a mould.

Microscopic smithing residues

The washings from the macroscopic slags of context (9206) produced very small quantities of fine flake hammerscale. Similar material was rare in the processed samples, perhaps because of the use of coarser mesh in sieving.

Sample <3> from (9208) contained seven fragments, apparently of comminuted slag debris. There was one rounded particle of possible natural origin and one spherical particle with a metallic lustre and a diameter of approximately 1.5mm. This was probably a slag droplet, but surface inspection did not exclude the possibility it was spheroidal hammerscale.

Sample <4> from (9210) contained a small number (thirteen) of sub-spherical slag droplets of diameter less than 2mm. These appeared solid droplets and were thus probably not spheroidal hammerscale, but within hearth slag droplets. There were also eight particles of flake hammerscale, a small fragment of prilly iron slag and two fragments of thicker flake hammerscale (or slag flats).

Other microresidues

Sample <1> from (1803) contained 23 sub-spherical droplets of 3mm diameter or less. These showed a variety of surface colours and lustres, with most being suggestive of a low density fuel-ash composition, a few were denser and maroon (i.e. of clinker appearance) and with only three with a crystalline grey surface.

Several of the particles showed coalesced multiple droplets.

There were also five particles of irregular slag, three of pale fuel ash slag and two of a slightly darker grey colour.

Although residues such as these may be produced during metalworking, it is also possible that they may be produced solely by interaction of fuel and hearth substrate in non-metallurgical contexts.

Distribution of residues

The residues derived from two separate areas of the project:

Trench 18 – context (1803) represents the burnt mound. The residues were not necessarily indicative of metalworking and, given the context, are likely not to be. They probably represent interaction of ash and substrate in a non-metallurgical hearth or fire.

Trench 92 – this trench contained a cluster of cut features (including [9205], with in-situ burning and fill (9208) and [2009] will fill (9210)), overlain by deposit (9206) which contained the macro-residue assemblage near its base where it overlay [9205].

Interpretation

The small amount of micro-residue from (1803) may well relate to the burning associated with burnt mound. The assemblage is not indicative of process and is not necessarily indicative of a metallurgical process. A non-metallurgical origin appears most likely. Spheroidal particles have been documented, for instance, within ash from cereal-drying kilns at medieval site of Bornais, S. Uist (Young 2005); similar material has also been observed within ashy residues of uncertain origin from the Bishops' Palace Bangor (Young 2016). The possible significance of spheroidal droplets in feeding the fuel ash slag in an early medieval cereal-drying kiln near Llandeilo has also been noted (Young 2015).

The assemblages from Trench 92 are indicative of ironworking, probably the end use of iron (blacksmithing). The limited archaeometallurgical residues from the site imply the existence of a smithy nearby, and the in-situ burning in [9205] may indicate it took place there – although there is no direct evidence to make that link. The size of the assemblage means little can be interpreted about the details of the smithing undertaken. The presence of the slag suggests that this complex of features is no earlier than Iron Age in date.

Further work

The potentially prehistoric of the material gives the assemblage of ironworking residues some added significance, but the small size of the assemblage and the fragmentary nature of the SHCs means that further investigation would be unlikely to generate additional useful information.

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