GeoArch

Report 2023/14

Assessment of materials from the Cotswold Canal Missing Mile, Stroud, CCMMM/22/SME

Dr Tim Young
25th May 2023

Assessment of materials from the Cotswold Canal Missing Mile, Stroud, CCMMM/22/SME

Dr T.P. Young

Abstract

The submitted assemblage comprised 13 items weighing a total of 3.7kg deriving from 3 contexts of site CCMMM/22/SME.

Context (1000) produced a small quantity of fuel ash slag of uncertain origin.

Context (1001) yielded a small piece of prilly iron slag, together with a decomposing corroded iron piece.

Four fragments of iron slag came from context (1072). Two of these, a 1235g equant angular bock of furnace slag and a small (24g) fragment of probable furnace wall slag derive from iron smelting. The furnace slag is indicative of smelting in a style of Roman furnace widely recognised on sites around the Bristol Channel area (including large furnace informally dubbed the 'Cardiff-type'), but particularly within larger smelting operations. The other two were an almost complete smithing hearth cake (2267g) together with a small fragment from a similar cake (64g). Smithing hearth cakes of this size have been recorded relatively rarely but are indicative of the smithing of raw blooms in the second stage of iron production.

Iron production was common on the Roman sites of the Frome valley and adjacent parts of the Severn Vale, but the 'Cardiff-type' furnace has not been positively identified in this area before. The presence of the large blocks of both smithing hearth cake and furnace slag in the absence of smaller blocks of tapped slag may hint at the deliberate movement of slag for engineering purposes, as 'hard-core' or even a construction material.

Contents

Abstract 1

Contents 1

Methods 1

Results 1
- General 1
- Iron smelting slag 1
- Iron smithing slag 2
- Fuel ash slag 2
- Iron 2

Interpretation 2

Further work 2

References 3

Table 1: summary catalogue 4

Methods

All materials were examined visually, using a low-powered binocular microscope where required. The identifications of materials in this report, as an assessment during which no instrumental analysis was undertaken, are necessarily limited and must be regarded as provisional.

This assessment was conducted in May 2023 and was commissioned by Rhiannon Philp of Archaeology Wales. The materials derive from the work Archaeology England at the Cotswold Canal Missing Mile (project CCMMM/22/SME) conducted near Stroud, Gloucestershire (NGR SO 77364 07207).

Results

General

The submitted materials comprise approximately 3.7kg (13 items). Context (1000) produced a small quantity of fuel ash slag of uncertain origin. Context (1001) yielded a small piece of prilly iron slag, together with a decomposing corroded iron piece. Four fragments of iron slag came from context (1072). Two of these, a 1235g equant angular bock of furnace slag and a small (24g) fragment of probable furnace wall slag derive from iron smelting. The other two were an almost complete smithing hearth cake (2267g) from bloom smithing, together with a small fragment from a similar cake (64g).

The summary catalogue is presented as Table 1.

Iron smelting slag

Two fragments of iron smelting slag were present (both from context (1072). The smaller piece is a small piece

of dense prilly slag attached to a small area of oxidised-fired silty wall ceramic. The large block (1235g) is a substantial angular fragment of dense iron slag. The piece shows some slight evidence for internal surfaces. The surfaces of the block are locally reddened to a maroon colour and one margin is coated with secondary iron oxides (rust). There are some large voids with curved surfaces, at least some of which may be moulds of small diameter roundwood.

These characters suggest that the large block is part of the slag mass that would have filled the base and mouth of a 'Cardiff-type' iron smelting furnace of Roman age (Young 2021a). This basal slag masses have, on other sites, been characterised an apparently massive texture, a maroon surface (particularly close to inclusions of incompletely reacted iron ore) and the presence of moulds of roundwood (Young 2021a, 2201c).

Iron smithing slag

Two pieces of slag from context (1072) are from very large smithing hearth cakes. One is an almost complete example weighing 2267g, the other a small fragment (64g) of the basal surface of a similar cake.

The large fragment shows a plano-convex shape modified by several protuberances. These are interpreted as the result of rodding with a poker, either to encourage the slag towards the base of the hearth or as an aid to slag extraction at the end of the wok period. The base is otherwise smoothly rounded and finely dimpled. The upper surface is irregular and rough, with remnants of white glassy lining contribution on top proximally. Internally, some tubular vesicles are visible in the fractured proximal end. Very fine charcoal is visible in several places.

The substantial weight of the nearly-complete cake indicates that it was produced during the working of a bloom. Smithing hearth cakes (SHCs) produced during blacksmithing rarely exceed 800g during the Roman period.

Fuel ash slag

The collection includes six fragments (53g) of variegated fuel ash slag. The slag contains some denser, white inclusions amongst the highly bloated materials. It is possible that this texture originates from partial melting of the local limestone gravel substrate.

Iron

A single (now broken into two) piece of decomposed iron (47g) derived from context (1001). The piece is extremely irregular and appears (subject to it not having been X-rayed) to be likely to be a fragment of process waste, perhaps even a small piece of semi-consolidated bloom.

Interpretation

The material is indicative of iron production employing a 'Cardiff-type' furnace (or a closely similar type) for smelting, together with the subsequent bloomsmithing.

Iron production was common on the Roman sites of the Frome valley, with the local woodlands (probably including the Cotswolds escarpment) providing charcoal for the smelting of Forest of Dean iron ores, presumably carried eastwards on the 'Perry Way', crossing the Severn near Arlingham (which passes just 1km south of the site). The 'Cardiff-type' furnace has not, however, been positively identified in this area before. This type of furnace is not well known from structural evidence; only excavations at Chesters villa (Fulford & Allen 1992) may have revealed furnaces of this type. Evidence from slag residues has been more widely noted at sites including Cardiff Castle (Young & Kearns 2011, Young 2021a), Caergwanaf (author's unpublished data), Cannop (Young 2011c, 2012b, 2013b), Alvington (Young 2009b) and Lydney (Young 2021c). Aspects of this distribution led Young (2014) to suggest that the furnace type was linked to state-controlled smelting activities, but it is unclear if it may have had wider usage.

The occurrence of SHCs of greater than 1kg has been elsewhere linked to bloom smithing (e.g. Miskin, Thomas 2000; Kingstone, Young 2012; Newyears Green, Young 2021b). The presence of protuberances and raised ridges on the bases of the bloomsmithing residues (and possibly of other large SHCs) has been noted previously (e.g. from Frocester Court, Price 2000, 4.5km SSE of the site). These features were interpreted by Allen (2009, 2010) to be tool marks from the excavation of the basal pits of non-slag tapping iron smelting furnaces and thus the slag cakes were small furnace bottoms. This is interpretation is erroneous and his examples may be added to the corpus of large SHCs from across the Severn Vale.

The presence of the large blocks of both smithing hearth cake and furnace slag in the apparent absence of smaller blocks of tapped slag may hint at the deliberate movement of slag for engineering purposes, as 'hard-core' or even a construction material (as seen at Lydney, for instance; Young 2021c). The source of the slag is likely to be a significant smelting site and although most likely to be close to the investigated location, that is not necessarily so.

Further work

Detailed laboratory investigation and elemental analysis would be capable of providing further evidence for the nature of these residues, but the limited quantities and their likely occurrence as reworked construction material reduces the archaeological utility of that information.

Consequently, no further investigation is recommended.

References

ALLEN, J.R.L. 2009. Romano-British iron-making on the Severn Estuary: towards a metallurgical landscape. *Archaeology in the Severn Estuary*, **19**, 73-79.

ALLEN, J.R.L. 2010. The alkali-metal ratio in Roman British bloomery slags. *Archaeology in Severn Estuary*, **20**, 41-45.

FULFORD M.G. & ALLEN, J.R.L. 1992. Iron making at the Chesters villa, Woolaston, Gloucestershire: survey and excavation 1987-1991. *Britannia*, **23**, 159-215.

PRICE, E. G. 2000. *Frocester: A Romano-British settlement, its antecedents and successors*. Gloucester and District Archaeological Research Group.

THOMAS, G., 2000. A chemical and mineralogical investigation of bloomery iron-making in the Bristol Channel Orefield, UK. Unpublished PhD thesis, Cardiff University.

YOUNG, T.P. 2009. *Evaluation of Archaeometallurgical residues from Alvington, Glos. (RCA08)*, GeoArch Report 2009/14, 3 pp.

YOUNG, T.P. 2011. *Evaluation of archaeometallurgical residues from the Forest of Dean Archaeological Survey, Stage 3B phase 2 (37920/37921/37923/37924)*. GeoArch Report 2011/32. 13 pp.

YOUNG, T.P. 2012. *Archaeometallurgical residues from the Brecon to Tirley gas pipeline*. GeoArch Report 2012/18, 75pp.

YOUNG, T.P. 2013. *Analysis of archaeometallurgical residues, Cannop, Glos. (Glos HER 37920)*. GeoArch Report 2013-05, 26pp.

YOUNG, T.P. 2014. Roman military control on ironmaking in South Wales. Pp. 215-226 In: B. Cech and Th. Rehren (Editors), *Early Iron in Europe*, Instrumentum Monographies.

YOUNG, T.P. 2017. *Ironworking residues from Kingswood, Gloucestershire (ACW451)*. GeoArch Report 2017/06. 93pp.

YOUNG, T.P. 2021a. *Archaeometallurgical residues from Cardiff Castle*. GeoArch Report 2021/03, 108pp.

YOUNG, T.P. 2021b. *Assessment of residues from Newyears Green (IS20NYGAR)*. GeoArch Report 2021/06, 20pp.

YOUNG, T.P. 2021c. *Analysis of archaeometallurgical residues from Lydney B North, Phase II*. GeoArch Report 2021/11, 53pp.

YOUNG, T.P. & KEARNS, T. 2011. *Evaluation of metallurgical residues from the New Interpretation Centre, Cardiff Castle, Cardiff [ST181765*]. GeoArch Report 2011/02, 27 pp.

Table 1: summary catalogue, weights in g,

Context	Item No.	Item wt.	Notes
1000	5	52	fuel ash slag (FAS), variegated grey and cream, locally buff. Has some harder white gravelly inclusions and some piece s show scattered coarse quartz.
1000	1	1	variegated FAS, similar to above items.
1001	1	19	dense prilly slag with maroon surface (locally holding sand), dimpled bases to lobes, white inclusions – indeterminate origin
1001	2	47	fragment of disintegrating mineralised iron object
1072	1	64	fragment from the base of SHC, dimples, rusty in places, base hard and smooth, exploding after washing, some pale patches suggesting lining inclusion
1072	1	2267	slightly incomplete dense deep SHC, 170 x 140 x 90mm, slightly worn; chip missing from proximal margin and larger piece from right distal end; plano-convex, modified with various protuberances (probably due to rodding) - two extending from the RHS and one smooth termination below the proximal end. Base smoothly rounded, finely dimpled, top irregular, rough, with remnants of white glassy lining contribution on top proximally, some tubular vesicles in proximal fracture and very fine charcoal visible in several places.
1072	1	1235	large equant angular fragment of furnace slag, maroon surfaced in areas, rusty in others, with hints of internal lobing in fracture; possible base shows what may be large wood moulds and there are various other large voids. Resembles ‘furnace bottom’ slag from 'Cardiff-style’ furnace
1072	1	24	weathered dimpled slag, mostly with maroon surface, but locally a dark vesicular glass with rounded white partially melted inclusions. One planar face shows contact with red silty ceramic. Furnace wall slag

GeoArch

geoarchaeological, archaeometallurgical & geophysical investigations

Unit 6,
Western Industrial Estate,
Caerphilly,
CF83 1BQ

Office: 029 20881431
Mobile: 07802 413704

E-Mail: Tim.Young@GeoArch.co.uk
Web: www.GeoArch.co.uk