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Evaluation of archaeometallurgical residues from Victoria Street, Bristol

(revised version)

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Abstract

The archaeometallurgical residue assemblage is sparse but varied. Medieval contexts (127, 167, 309, 239?, 444) produced charcoal-fuelled blacksmithing slags. The quantities are small, but indicative of a smithy nearby. Some later dense slaggy clinkers may be coal-fired blacksmithing slags (165, 222), although are equally likely to have been formed in the pipe kiln on the site. Low density clinkers from post-medieval contexts (222 and 341) may be industrial residues, but might also have an origin in smaller domestic fires. Context 206 has a complex ceramic piece which may be kiln furniture. There is a single piece of Cu-alloy slag from medieval context 238. Contexts 311 and 432 yielded blocks of iron ore. There is no known iron smelting in this area, nor is it likely that the ore is immediately local; the mechanism of transportation of the ore to the site remains unknown, but may be natural. Burnt coal residues (coke) were recovered from two medieval contexts (300, 412).

This report is a revised version of GeoArch Report 2006/20 of December 2006, to incorporate micro-residues submitted for investigation after delivery of that report. Those microresidues appear to be coal residues rather hammerscale.

Contents

Abstract 1

Methods 1

Results
- Smithing slags 1
- Hammerscale 1
- Clinker 2
- Iron Ore 2
- Copper-alloy slag 2
- Glass waste?..... 2
- Ceramic kiln furniture 2

Interpretation 2

Evaluation of potential..... 2

References 3

Catalogue 4

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.

Results

Smithing slags

Charcoal-fuelled smithing slags are represented by smithing hearth cake (SHC) fragments from c127 and c444. That from c127 is likely to represent about 70% of the original SHC, suggesting an original weight of approximately 420g. Such a weight is well within the normal range of SHCs produced during blacksmithing. Small pieces of probable smithing slag were recovered from c167 and c309.

Hammerscale

Few of the samples submitted as possible hammerscale appear to contain true hammerscale. The micro-residues contain fragments of clinker and the associated small spheroidal particles do not have the high sphericity and metallic lustre that is typical of most spheroidal hammerscale; they are therefore likely to be droplets of clinker. The material that appears like flake hammerscale in some of the microresidues also lacks the lustre of true flake scale, and may possibly also be simply a coal residue.

Accordingly the "hammerscale" samples are likely to be wholly or mostly residues from burning coal rather than from metalworking.

Clinker

Clinker is the slaggy residue from the burning of coal, and may commonly include partially vitrified shale (derived from the shales commonly intimately associated with coal seams and commonly contained within coal fuels). The high levels of inorganic material within coal may generate significant quantities of clinker even in processes with no additional input component. Thus certain distinction of clinker from different processes may be extremely difficult.

In this assemblage c222 and c341 yielded fairly typical low density clinker with abundant fragments of shale. Such materials could be formed in almost any coal-fired hearth, from a large domestic fire through to an industrial processes.

Denser clinkers, including dense material that must have fully liquid, were recovered from c165 and c222. Although such materials are likely to be iron-rich, they are typical not only of coal-fuelled iron-working, but also of industrial scale uses of coal (since coal may contain enough iron to generate a fluid slag at sufficiently high temperature).

Material from c300 and c412 has been identified as coke. Such material is not necessarily indicative of the use of deliberately coked fuel (particularly given the early age of these specimens); it is probable that these residues represents incompletely combusted coal, and therefore represent residue rather than fuel.

Iron Ore

Two pieces of goethite/haematite iron ore were recovered, from c311 and c432. The larger piece (from c432) is rather worn but appears to have both massive and botryoidal textures, that from c311 is a dense crust with a botryoidal texture. The piece from c311 appears to show a contact with a red sandstone to the rear.

C222 yielded a large iron concretion, broken into several pieces. This material would not be suitable for use as an iron ore; it occurs as concretionary growths within a host sediment (in this case probably within a coal seam). It was probably discarded as waste when the coal was fed to the kiln.

Copper-alloy slag

C238 yielded a small rounded nub of dark glassy slag, possibly a melted pebble, with adhering coal residue and copper alloy corrosion.

Glass waste

A small piece provisionally identified as glass waste was recovered from c324. It comprises two small glass fragments in a possible mortar matrix. Although an industrial origin of this piece is possible, it is by no means certain.

A small prill of glassy slag from c239 was identified by the excavators as glass slag, but is probably a metallurgical (iron-working?) slag.

Ceramic Kiln Furniture

C206 yielded a large ceramic fragment, which appears to be part of an open-sided ceramic box. It has an adhering dark material which is likely to be fuel residue and the piece is interpreted as kiln furniture.

Interpretation

The archaeometallurgical residue assemblage is sparse but varied. Medieval contexts (c127, c167, c309, c239?, c444) produced charcoal-fuelled blacksmithing slags. The quantities are small, but indicative of a smithy nearby. There is also Cu-alloy slag from medieval context c238 (a context which also produced pieces of copper-alloy casting moulds).

The clinkers are not easily identified to a precise mode of origin. Some dense slaggy clinkers might be coal-fired blacksmithing slags (c165, c222), although they might equally have been formed in another industrial context, such as the pipe kiln, but low-density clinkers (c341, c412) and coked coal debris (C300) are just as likely to be domestic.

Context c206 has a complex ceramic piece which may be kiln furniture.

C311 and context c432 yielded blocks of iron ore, although the rounding of one piece might suggest a water-worn surface. Neither context would appear to have a firm date at present. The known potential origins for iron ore material of this sort would be deposits at Ashton (6km WSW of the site), Brandon Hill (1.5km WNW) and Clifton (3km NW) associated with the eastern limb of the Clifton anticline, or those of Hanham (5km E), localities near Downend (7km ENE) and Temple Cloud (15km SSE) associated with the N-S fault system through the coalfield (Kellaway and Welch 1993). There are no known sources in the immediate area, and the bedrock geology of the site would not normally be expected to contain iron ore. Derivation might have been through natural processes or by human activity. Early exploitation of some of these ore sources is known, and larger scale extraction took place in the 19th century, but there is no evidence of iron smelting recorded from this part of Bristol to the author's knowledge. Iron ores from the Bristol area were also historically used to produce paint (Cantrill *et al.* 1919).

The archaeometallurgical assemblage therefore indicates a low-level of deposition of waste from both ferrous and non-ferrous metalworking in the medieval period. The smithing hearth cakes apparently date from the 11th-14th centuries and were from a charcoal-fuelled forge. Coke pieces from c412 date to the 15th-16th century, and the copper alloy slag from c238 also suggested the medieval use of coal as fuel (11th-15th century). Post medieval evidence indicates the use of coal-fired hearths, probably mainly associated with the pipe-kiln.

Evaluation of potential

The low-level of archaeometallurgical residues means that the assemblage has fairly low potential to add significantly to understanding of the site through further investigation. There is little to suggest that metalworking was undertaken within the excavated area, although metalworking must have taken place close-by in the medieval period.

The occurrence of iron ore fragments is very interesting, although the material may have arrived on the site by natural processes, since there is no

evidence for iron mining or smelting in this part of Bristol. They may possibly indicate an unknown iron ore source in the area. Chemical analysis of the iron ore might be able to shed further light on its provenance, although rather few of the iron ores of the Bristol area have yet been analysed in detail.

References

Cantrill, T.C., Sherlock, R.L. & Dewey, H. 1919. *Special reports on the mineral resources of Great Britain. Vol. IX - Iron ores (contd.) - Sundry unbedded ores of Durham, East Cumberland, North Wales, Derbyshire, The Isle of Man, Bristol District and Somerset, Devon and Cornwall*. Memoirs of the Geological Survey.

Kellaway G.A. and Welch F.B.A., 1993. *Geology of the Bristol District*. Memoirs of the Geological Survey of Great Britain. London: Her Majesty's Stationery Office.

Table 1: Macroscopic residues from Victoria Street, Bristol.

Context	*Label*	*Weight (g)*	*Notes*
127	slag	292	dense block of charcoal rich slag, probably about 70% of a small dense SHC
165	slag	46	dense clinkery slag, with layer of flow lobes on base. Upper part has shale chips. Very dense for a clinker so must be well flown
167	slag	45.6	dense dark slag apparently attached to corroding iron lump. Corrosion obscures relationships but this is probably a smithing slag fragment, adhering sediment is a shell-rich clay
206	slag	180	this appears to be part of an oblique, open side ceramic piece, with a slightly botryoidal black coating and strange iron-rich alteration. This could be part of a kiln structure or kiln furniture perhaps
222	slag	876	large iron concretion in several pieces, from within a coal seam. Probably originally sulphide
222	slag	27.8	dark brown-purple surfaced clinker bearing abundant pale vitrified shale fragments
222	slag	126	2 pieces of well flown clinkery slag. These could be coal-fired smithing slags, one fairly regular in a dished form with good slag, the other much richer in shale fragments
238	Cu al slag	12.55	small nub of sandy glassy black slag, possibly a melted lining or pebble fragment, with sand obvious on outside. Some adhering coal residue, some Copper alloy corrosion attached and in hollows and some rusty patches.
239	glass slag	21.34	prill of dense variegated white-blue-black glassy slag bearing abundant quartz grains
300	clinker	3.92	dirty coke from coal residue
309	slag	33.36	dense nub of vesicular grey slag, locally with maroon surface. Possible sand inclusions. Probably a smithing slag
311	slag	13.59	piece of dense goethitic ore crust, botryoidal on face, has small area of red sandstone attached to rear
324	glass waste	1.96	thin dark glass, highly altered. Not clear if waste or burnt? Looks as if incorporated in mortar along with a clear green glass fragment
341	slag	19.6	2 pieces of clinker. Both have shale fragments but also very fine debris resembling sand - but unclear if this is also coal dirt
412	clinker	2	12 pieces of coal residue (coke) plus dust
412	clinker	3.27	corroded iron, probably a bent small nail, with adhering coke residue
432	slag	846	very dense piece apparently of haematite iron ore. Outside is smoothed so texture unclear, but may include both botryoidal and massive components.
444	slag	152	fragment of altered and accreted shc. Lots of adhering and/or accreted charcoal

Table 2: Microscopic residues from Victoria Street, Bristol.

Context	*sample*	*label*	*notes*
165	2	hammerscale	stone, some slag, lots of pale sheets - like flake hammerscale, but probably shale, lots of spheroids
200	4	hammerscale	strongly magnetic stone, lots of elongate concretionary material, some shiny slag pieces cf. flake hammerscale
200	4	Fe residue	lots elongate concretionary material, burnt stone
222	6	hammerscale	slaggy material associated with fired stone (iron rich particles) and shale, some slag spheres, probable coal burning residue
222	6	hammerscale	stone, some slag, lots of pale sheets - like flake hammerscale, but may be shale, lots of spheres, lots of larger clinker fragments, some white pieces of uncertain origin (shale?)
222	6	hammerscale	large spheroids of clinker - 1 attached to white vitrified material
364	9	hammerscale	mainly burnt shale
367	8	hammerscale	burnt stone, fired clay, shale
382	11	hammerscale	burnt stone, shale, some slag
383	10	hammerscale	burnt stone, fired clay, shale, rare slag particles
411	15	hammerscale	burnt stone, some slag, some elongate tubular concretions, all looks ashy
454	14	hammerscale	burnt stone (including lots of shale), slag, and quite a lot of shiny material like flake hammerscale, but paler.
454	14	hammerscale	mainly stone, some slag, one sub-spheroidal particle
454	14	ferric residue	burnt stone, white material (fired stone?), rare spheroids
496	18	hammerscale	burnt stone, fired clay

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