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Assessment of archaeometallurgical residues from Uckington Fire Station, Glos. (37941)

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Abstract

The overall assemblage included just 2.6kg of archaeometallurgical residues. The site produced a low level of evidence for Saxon iron working (blacksmithing), of which the only large assemblage derived from pit 524 (1.7kg). Only a very few fragments of residue were recovered from contexts of supposed Roman age.

One fragment of iron ore was present, but it is possible this arrived at the site through natural agency; there was no other evidence for iron smelting.

Some of the low-iron fuel ash slags were not necessarily of metallurgical origin; they could have been produced in a cereal-drying kiln or similar pyrotechnological context.

The assemblage contained numerous degraded fragments (with a total weight of 263g) of imported (French/German) lava querns. All but one of these fragments came from a context dated as Saxon. It is not clear how secure the dating of the final item might be. The presence of imported querns might imply a Middle to Late, rather than Early, Saxon age.

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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 summary catalogue of examined material is given in Table 1.

This project was undertaken for Paul Nichols of the Gloucestershire County Council Archaeology Service.

Results

The following sections describe the residues and their distribution. Materials in the sample determined not to be, or not likely to be, of metallurgical origin (e.g. iron artefacts, concretions and natural rock) have been excluded from this descriptive section, but are listed in full in the catalogue (Tables 1).

Description of materials

Smithing hearth cakes (SHCs): SHCs provided 1.5kg of the total assemblage of archaeometallurgical residues of 2.6kg, of which 0.9kg was provided by just two reasonably intact examples (weighing 560g and 330g). These weights are well within the range recorded for SHCs from blacksmithing this period (e.g. Young 2007 and 2009)

The intact SHCs are moderately large, with a slightly transverse shape (length x breadth of 80x110mm and 70x90mm). In both cases the lower bowl is shallow but well formed. In both cases the fuel was charcoal.

Several other pieces of SHC were recovered, mostly of fairly conventional texture, but one fragment (from c373) had a slightly unusual texture, dominated by a mass of elongate of olivine crystals.

Other smithing slag: these materials included other iron-rich slags, with textures suggesting an origin in iron-working, but for which the identifiable form an SHC is lacking. The material is mainly in the form of rather blebby masses.

There is a continuum between the iron-rich slags placed in this category and the lining slags.

Lining slag: this facies of residue is formed of rounded or sheet-like masses of partially melted ceramic bound by dark (usually), sandy, glassy slag. In some cases this material becomes richer in iron, and grades into the material categorised as 'other smithing slag'; in other cases the lining slag was clearly attached to the hearth lining from which it was derived, and is therefore gradational into the 'vitrified hearth lining'.

Vitrified hearth lining: hearth lining was represented by very few pieces within the assemblage and adds little to understanding hearth morphology – although it does indicate that a blowhole rather than tuyère seems to have been employed.

Fuel ash slag: this facies of residue is typified by a pale, highly vesicular slag, in rather amorphous masses. Some rare pieces show fuel contacts, but mostly the material is highly bloated, with large irregular vesicles.

Such material has elsewhere been interpreted as residue from cereal drying kilns (Young 2005, 2010) and large domestic hearths (Young 2011) as well as being a minor component of metalworking assemblages. The small size of the present assemblage prevents determination of whether these are from a separate source to the metalworking residues or not.

Other materials: other materials were present in the collection, including a piece of lime mortar or plaster, some concretions formed on fragments of iron and a single, possibly water-worn fragment of iron ore (of a type typically found in the Forest of Dean and adjacent areas).

The most important of the 'other materials' were a series of finds of rather degraded porous 'basalt'. A total of 263g of this material was recovered mainly in the form of small fragments from 'exploded' larger lumps. The material varies from a very pale grey to a slightly more lilac hue. It is a highly porous material with irregular rounded voids, often following a marked foliation. There are common inclusions of a hard dark mineral with a hexagonal cross section, probably pseudomorphs after an original ferro-magnesian phase. There are also larger amygdaloidal inclusions of clear, green or blue quartz. The material cannot be identified precisely without petrographic inspection, but resembles the porous basalts from France and Germany commonly employed for the manufacture of millstones and quernstones (e.g. Freshwater 1996).

Distribution of the residues

The distribution of residue types by context is given in Table 2. Small amounts of residue were scattered through a large number of pits. Whether the pits interpreted as Roman that contained small amounts of residue are genuinely Roman is not known.

The only pit with a larger assemblage is 524, which contained 1.7kg out of the total residue assemblage of 2.6kg, perhaps suggesting greater proximity to the source.

Interpretation

The assemblage from the site is almost entirely of residues from iron-working (blacksmithing). The SHCs are of a typical size for blacksmithing at the period. The assemblage is too small for further detailed comment.

The presence of the lava fragments is interesting. It is assumed that they are Saxon, but they might conceivably be residual debris of Roman age.

Evaluation of potential

Further detailed investigation or analysis of the metalworking residues is unlikely to generate additional useful information.

Thin-section investigation of the lava fragments could be undertaken to improve understanding of their origin.

References

FRESHWATER, T. 1996. A Lava Quern Workshop in Late Saxon London. *London Archaeologist* **8** (2):39–45

YOUNG, T.P. 2005. Site Activities: slag and related materials. pp. 174-176. *In:* Sharples, N (ed.), *A Norse Farmstead in the Outer Hebrides. Excavations at Mound 3, Bornais, South Uist*. Cardiff Studies in Archaeology, Oxbow Books, Oxford.

YOUNG, T.P. 2007. Evaluation of archaeometallurgical residues from Willow Street and Mill Street, Worcester. *GeoArch Report 2007/12*. 10pp.

YOUNG, T.P. 2009. Evaluation of archaeometallurgical residues from 35 Mill Street, Worcester *GeoArch Report 2009/33*, 9pp.

YOUNG, T.P. 2010. Fuel ash slags. P. 163 *in:* Crane, P & Murphy K., Early medieval settlement, iron smelting and crop processing at South Hook, Herbranston, Pembrokeshire, 2004–05. *Archaeologia Cambrensis*, **159,** 117-196 .

YOUNG, T.P. 2011. Possible archaeometallurgical residues pp. 89-90 *in* : M. Collard & T. Havard. The prehistoric and medieval defences of Malmesbury: archaeological investigations at Holloway, 2005-2006. *Wiltshire Archaeological & Natural History Magazine*, **104**, 79-94.

Glossary

Blacksmithing: the working of iron and steel. Often restricted to the secondary smithing – i.e. the smithing of iron to produce or repair artefacts, as opposed to the smithing involved in the production of billets or bar iron from raw iron blooms.

Bleb: a small rounded particle or textural component, often a droplet or prill.

Blowhole: A hole through a furnace or hearth wall through which air is blown.

Fayalite: the iron-rich end member of the olivine group, Fe_2SiO_4.

Fuel Ash Slag (FAS): slag formed by the partial melting of hearth wall or substrate under the fluxing influence of the ash (inorganic component) of the fuel. Fuel ashes are often very rich in alkali and alkali earth elements that may lower the melting point of silicates.

Lining Slag: Slag formed from the complete or partial melting of hearth or furnace lining.

Olivine: a group of silicate minerals of the form $(M^{2+})_2SiO_4$ where M can commonly be iron, magnesium, calcium (up to half the M^{2+} ions) or manganese. Includes the end-members fayalite (Fe_2SiO_4), forsterite (Mg_2SiO_4), tephroite (Mn_2SiO_4), kirschsteinite ($CaFeSiO_4$) and monticellite ($CaMgSiO_4$).

Prill: a small aggregate of a material, either a spheroidal droplet or a runnel, formed from a melted liquid and either occurring as a discrete particle or as an inclusion within another material.

Smithing: the activity involved in forming a metal object, including, but not limited to, forging metal and joining metal by welding.

Smithing hearth cake (SHC): the slag cake formed in a smithing hearth by reaction of iron oxides lost from the workpiece with silicate material from hearth ceramic and/or fuel, below and in front of the tuyère/blowhole. They are very variable in form, but are typically plano-convex in shape (although concavo-convex and biconvex forms are common), frequently with a dense lower crust and a less well consolidated upper part. In some cases the top is formed of glassy slag.

Vesicle: a void or pore, usually rounded and formed as a preserved gas bubble in a solidified melt.

Table 1: summary catalogue of archaeometallurgical residues and associated materials from Uckington, by bag. Assm. = assemblage

Context	Wt (g)	No.	Description
48	14	5	lime, vesicular, with moulds of ?grass stems
48	4	1	lining slag ball
56	6	assm	lava; material similar to that from 371 and 373 but with slightly larger, irregularly rounded cavities
72	64	1	large fragment of vitrified hearth wall, ceramic grades from reduced to oxidised across rear of piece, suggesting proximity to blowhole, glass dark, sandy forming an accumulation of lobes on one side, possibly just above blowhole
81	78	6	fragments of FAS in irregular coarsely vesicular lumps, outside locally glassy, smooth in crude lobes, internally sandy with large irregular rounded voids
	1	3	small FAS fragments
	36	1	weathered fossiliferous limestone/calcareous mudstone
81	134	1 (7)	exploded part of medium SHC, crust to 30mm, grey slag where not stained by rust, small vesicles particularly near top
83	46	1	broken rounded lump of lava. Has rounded irregular vesicles, showing some foliation. Matrix bears some dark shiny inclusions
243	18	2	very weathered dense vesicular slag fragments, quite probably SHC fragments. One appears to have a piece of flake hammerscale adhering
260	24	1	locally iron-rich, glassy, vesicular lining slag, possibly from smithing, with attached ferruginous concretion with a water snail
277	128	2	fragments of coarse FAS. Larger piece is part of a twisted sheet, large internal voids, outside just possibly a fuel contact
342	4	2	highly mineralised iron fragments in thin sheets or scales, with matrix of mineralised ?charcoal
349	18	assm	mass of fragments of sandy lining slag, dark glass mainly, but much is bleached.
350	92	1	iron oxide cemented coarse sand in the form of a very irregular iron pan/concretion
351	28	4	sandy lining slag with dark glass, passing into fine khaki melt. Some of this has maroon surface and resembles clinker, but there is no coal shale - probably formed from the melting of a different material. All in complex blebby vesicular masses
	2	2	indurate brown mudstone with dark clasts

Context	Wt (g)	No.	Description
371	5	1	Lava - irregular black inclusions, some voids
373	104	assm	well-indurated fine matrix with hard dark inclusions. Slightly violet colour. Possibly a highly altered lava fragment.
373	28	1 (and bits)	dense pale grey slag fragment. Bears some rounded vesicles, texture a matt of elongate olivine - probably a eutectic texture. Angular piece form SHC (though hearth steel-making might be a possibility too)
374	78	1	fragment of botryoidal goethite iron ore, probably broken from a larger piece that was worn somewhat smooth on margins, probably part of a vein 15-25mm thick with irregular, possibly fragmental contacts on each side, botryoids typically up to 6mm
	342	1	fragment of a large cake of charcoal-rich iron slag - could be furnace slag, or more likely, part of a large porous SHC,
	6	2	fragments of sandy fuel ash slag with reddened surfaces.
382	20	1	twisted blebby sheet of lining slag, very sandy and dark on one side, has surficial iron oxide coat on the other
403	40	assm	exploded mass of lava. one piece has large aggregate (amygdale?) of transparent quartz of 4mm or so grain size.
451	2	1	dark sandy glass, to khaki fine, lining slag
525	560	1 (2)	SHC, 80x110x70(25)mm, low well-formed dimpled bowl with upper layer (possibly second cake), inclined, grey glassy irregular top
	186	27	pale lining slag/FAS, some in blebby sheets, but mostly rather fragmented
	184	13	dense blebby and prilly hearth slags
	34	1	ferruginous weathered SHC fragment
	<1	1	hollow slag droplet
	20	5	vitrified lining slag material in very sandy blebs. Sand is grey and angular
526	56	2	concretions on iron pieces- worth X-ray?
	330	1	70x90x50(20)mm, SHC with well developed grey bowl and rather diffuse rusty upper mass - probably slightly inclined, distal edge has been broken off very little weight missing
	74	1	fragment from SHC with well-formed lower pale crust and deeply dimpled glassy top - from the margin of a cake - but does not join the fragment above
	112	3	vitrified lining, main large piece has a very thick slump of lining slag on face - probably from very near blowhole
	16	8	slag fragments
528	2	1	part of fossil ammonite

Context	Wt (g)	No.	Description
528	34	1	dense lump of lining slag with maroon surface, possible stone inclusions? One side mainly black glaze, other side of piece haematised - formed near blowhole
	10	3	FAS/lining slag, in one case attached to oxidised fired lining plus gravel and concretionary silt
529	30	1	slag lobe, dense, with large internal voids and coarse texture, finely dimpled base, top missing, possbily slightly worn
	42	assm	fragmented blebby lining slags, some attached to oxidised fired ceramic. In at least one case the ceramic is sufficiently sandy to have supplied the sand
	24	1	dense slag lump, weathered, vesicular, quite possibly an SHC fragment
529	62	assm	fragmented lava with black inclusions

Table 2: Summary of weights of material by type and context. Total weight in grams.

Context	Notes	Metallurgical residues					Other				*Total residue*
		SHC	smithing slag	lining slag	lining	FAS	lime	lava quern	Iron/ concretion	ore	
48	Saxon, upper fill pit 47			4			14				*4*
56	Saxon, uppermost fill of pit 55							6			*0*
72	R-B/Med, fill of large shallow cut 71				64						*64*
81	Saxon, Upper fill of pit 80	134				79					*213*
83	Saxon, lower fill of pit 80							46			*0*
243	Saxon, uppermost fill, pit 242	18									*18*
260	Roman, uppermost fill of pit 258		24								*24*
277	undated, uppermost fill of ditch 251 terminus					128					*128*
342	Saxon, fill of pit 339								4		*0*
349	Saxon, burnt layer in pit 345			18							*18*
351	Saxon, uppermost fill of pit 345			28							*28*
371	Saxon, fill of pit 368							5			*0*
373	Saxon, fill of pit 368	28						104			*28*
374	Saxon, uppermost fill of pit 368	342				6				78	*348*
382	Saxon, uppermost fill of pit 381			20							*20*
403	Roman, fill of ?burnt pit 401							40			*0*
451	Roman, fill of pit 450			2							*2*
525	Saxon, fill of pit 524	594	184	206							*984*
526	Saxon, fill of pit 524	404	16		112				56		*532*
528	Saxon, fill of pit 524			44							*44*
529	Saxon, uppermost fill of pit 524	24	30	42				62			*96*
	Totals	*1544*	*254*	*364*	*176*	*213*	*14*	*263*	*60*	*78*	*2551*

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