GeoArch

Report 2015/15

Archaeometallurgical residues from Cloakham Lawn, Axminster

Dr Tim Young
4th September 2015

Archaeometallurgical residues from Cloakham Lawn, Axminster

Dr T.P. Young

Abstract

Context (10048), a fill of ditch [10047], interpreted on the basis of pottery to be of 1st Century AD age, yielded a small collection (1120g) of ironworking slag, together with a total of 4195g of fired, and locally vitrified, clay.

The iron slag included three examples of smithing hearth cakes (SHCs), two with weights of approximately 300g and one fragmentary example that would have had an original weight of 360-420g. The heaviest example possessed an unusual dense upper layer with a planar haematised top.

The ceramic fragments included at least 26 fragments of block tuyères (weighing a total of 1.3kg), of unknown length, with approximately square cross section, 90-95mm across, with rounded angles of approximately 10mm fillet radius. The approximately central bore tapered, being 25-27mm at the front and wider to the rear.

The front faces of the tuyères were strongly slagged and eaten back to as much as 45° to the vertical. In most cases the slag on the face bore abundant siliceous fragments. Although some similar material was present as temper and the slag fragments may have been derived from the molten tuyère ceramic, its abundance on the face may possibly suggest it had also been used as a smithing flux.

Other ceramic fragments (26 pieces weighing 2kg) in very similar fabrics were identifiable as pieces of loom weights of typical Iron Age triangular form. These characteristically showed a perforation of approximately 12mm diameter passing through the block at 45-60° approximately 50mm from one corner. Several fragments were bulbous and rounded, possibly suggesting the lower ends of the weights were curved rather than angular.

A few smaller fragments (21 pieces weighing 223g) could not be assigned with certainty to either group.

Finally, 8 blocks weighing 457g, possessed cavities suggestive of the former presence of an organic temper. These may have been fragments of artefacts as in the two classes above, but since none of these possessed more than one smooth surface, it is equally likely they represent fragments of burnt daub.

The use of tuyères in early ironworking in Britain is unusual, but with a few recorded instances from the Iron Age. Ceramic tuyères are, in contrast, a very characteristic aspect of ironworking in the early medieval and medieval periods in Ireland (but only rarely in Britain).

Contents

Abstract 1

Methods 2

Results
- Description of the residues 2
- Distribution of the residues 2

Interpretation 3

Conclusion 3

References 3

Table 1: summary catalogue 5

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 Ed McSloy, of Cotswold Archaeology.

Results

Description of the residues

Slag (14 pieces, 1104g)

The slags are dominated by three medium-sized smithing hearth cakes (SHCs): a deformed example weighing 286g, a complete example weighing 300g and an incomplete example weighing 292g (estimated at 7%, suggesting an original weight of approximately 400g).

The three examples differ in internal texture. The 292g fragment (together with a 30g fragment) is from a neatly formed SHC with two layers of slag – an upper dense plate of slag with a haematised top, separated by a vesicular boundary from a lower dense bowl, possibly with elongate, 'bladed' olivine. The original cake was approximately 95mm in diameter and 30mm deep.

The 286g example is also dense, but the shape (plano-convex, 90x75x35mm, with a 20mm raised slag mass on one side) suggests that the cake may have been deformed during hot extraction.

The example weighing 300g is dense, and of a similar size to the 292g fragment (plano-convex, 95x100x30mm) but the internal texture is one of coalesced prills, rather than of a dense slag puddle.

Other slag fragments include thin sheets of dense slag with a ceramic contact surface and fragments of charcoal-bearing slag.

Tuyères (26 pieces, 1297g)

Twenty six fragments of a rather silty ceramic (fired clay) were identifiable as fragments of tuyères. There were no complete tuyère faces, nor were there any identifiable fragments from the rear of the tuyères. The largest fragments comprised up to 50% of the face of the tuyère, leaving some room for uncertainty about the form of the complete artefacts.

The surviving evidence suggests that the tuyères were approximately square in cross section (90x95mm), with angles between the faces in the form of a fillet of radius 15mm. The centrally-placed bore appears to have typically about 25mm close to the front fact, but widening towards the rear. One piece provides a suggestion that the bore might have been angled downwards slightly towards the front, but this was not observed in the other fragments.

The front faces of the tuyères were angled back at approximately 45° to the axis of the tuyère. It is likely that this was not the original form, but the result of erosion in the hot-zone of the furnace above the blowhole. Some small fragments suggest some tuyères suffered severe erosion on all sides of the blowhole, leaving it surround by a conical area of ceramic.

The front faces of the tuyères varied from those with eroded shapes with a greenish glaze-like slag, to examples with thick and irregular developments of slag, particularly in the lower half of the face. Although some of the tuyère fragments showed rare inclusions of a pale siliceous rock, the slagging of several fragments was extremely rich in such grains. Although these resistate materials might have accumulated from the partial melting of a substantial section of tuyère, they might also possibly be derived from the use of coarse welding flux. The slagging disappeared rapidly to the sides of the tuyères.

The tuyères were formed from a silty paste, mostly fired to a buff colour. Deeper red oxidised colours occurred adjacent to the blowhole itself and the slagging was typically underlain by a thin zone of reduced-fired ceramic. Pale grey firing also extended locally onto the unslagged sides of the tuyères.

The maximum preserved length of a tuyère was 80mm, but there was no evidence for their original length,

Other materials

Twenty six fragments weighing 2.0kg were identifiable as fragments of triangular loom weights. No pieces showed the full thickness of a weight, nor did any preserve the full length. Some rounded fragments suggest that the lower end of the weight may have been curved, making the entire weight approximately the shape of a segment of a circle, rather than strictly triangular.

Where the bore was preserved, it was approximately 12mm in diameter and cut the sides of the weight 55-65mm from its apex. All the angles of the clay mass were filleted to varying degrees and the sides of the weights were up to 10° away from being perpendicular to the faces.

The clay of the weights was similar to that of the tuyères, but in general slightly more silty and friable.

A further 39 pieces weighing 680g were not specifically identifiable to either of the above groups. Of these, eight pieces (457g) contained voids indicative of an organic temper; none of these fragments showed morphological evidence for being fragments of either tuyères or weights and they may have been fired daub.

Distribution of the residues

The described material is all from ditch fill 10047. This is currently phased as Roman, but is mid to late 1st Century AD - with a possibility that it is just pre-conquest.

Interpretation

The slags from the assemblage are from ironworking (smithing). The weights of the SHCs may be compared with those of assemblages of Roman age, but there are few Iron Age assemblages for which equivalent metrics are available. Iron Age bloomsmithing slags from Truro (Young 2015) included three SHCs weighing from 890-1165g. Late Iron Age to earliest Roman smithing slags from Kingstone (Herefordshire; Young 2012) included a suite of SHCs from 230-636g (interpreted as probable secondary smithing slags) with outliers of 786-1025g (interpreted as probable bloomsmithing slags). Crew (1998) summarised the assemblage from Crawcwellt West, Gwynedd, as containing larger SHCs of 300-400g, together with smaller cakes of 100-150g. He attributed the larger sizes to bloom refining and the smaller ones to "the final stages of smithing". It should be noted however that the Crawcwellt furnaces, and presumably therefore the blooms, were small by typical Iron Age standards,

Roman blacksmithing assemblages typically have mean weights of less than 400g and maximum weights of 850g (e.g. SHC assemblages from Roman smithies at Neath, Carmarthen, Bulmore, Marsh Leys and Cowbridge; Young 2013, Crew 2003, Young 1999, Young 2011, Barford 1996 respectively). Roman bloomsmithing assemblages are poorly known, but several sites in the hinterland of the Forest of Dean where there was iron production also show the presence of large SHCs (e.g. Frocester Court, Thomas 2000). Other such sites in the area may have gone unrecognised; recent attempts by Allen (2009, 2010) to propose non-slag tapping furnaces from the Romano-British period around the Severn Estuary are probably erroneous, for the so-called furnace bottoms of his papers (mainly with weights less than 1kg) are extremely similar to the SHCs from bloomsmithing at Miskin and elsewhere. The site at School Road, Miskin (author's unpublished data) has an assemblage of particularly large SHCs (mostly 1.0 to 2.5kg), but this may have been a specialist site, with no secondary smithing.

The present assemblage would therefore most easily be interpreted as from secondary smithing (blacksmithing), despite overlap in SHC weights with bloomsmithing slags from North Wales.

The use of ceramic tuyères is, however, an unusual aspect of this site. The evidence for the occurrence of tuyères in the British Iron Age is complicated by several occurrences that have probably been misreported as tuyères, when they are probably simply the vitrified face of the hearth around the blowhole (most occurrences of so-called disc tuyères). In fact, tuyères need to be elongate to function and therefore any functional tuyère must be of the form reported occasionally as block tuyères. This use of 'block' is therefore redundant, and such artefacts may simply be called tuyères.

There are, however, some certain uses of tuyères in the British Iron Age. Several fragments of probable tuyères, interpreted as having had an elliptical (150x100mm) cross section were recovered from a Middle Iron Age iron production site at Truro (Young 2008, 4-5). These tuyères were probably, but not certainly, employed at the site in smithing hearths, not in the smelting furnaces. Tuyères of much closer form to the present examples were found at the Middle Iron Age copper smelting site at Domgay Lane, Four Crosses (Young 2010). These fragments indicate a tuyère with a flat base 120mm wide, vertical sides and rounded angles. The form of the top of the tuyère is uncertain, but was possibly more rounded.

In contrast, tuyères are extremely rare from Roman metalworking sites, being only relatively common on iron-smelting sites in SE England where tuyères with twin bores are found.

Ceramic tuyères (although largely with an oval-cross section) are much more widely associated with a technology introduced into both eastern England and Ireland early in the early medieval period. Their use did not persist in England, but in Ireland they form a major component of ironworking residue assemblages though into the post-medieval period.

The occurrence of the tuyères together with large triangular loom weights provides some further evidence for craft activity in an Iron Age, rather than Romanised, style.

Conclusion

The residues, both slags and tuyères, form a small but very important assemblage of Late Iron Age character. The materials should be retained and deposited with the site archive, so that may remain accessible for future studies.

Although the materials have this high level of importance, their occurrence as a small assemblage of debris isolated from the originating metallurgical features, reduces their potential for yielding additional information of benefit to the current project. Therefore, no further analysis is recommended at this time.

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 the Severn Estuary*,
20, 41-45.

BARFORD, P.M. 1996. The metalworking debris from Bear Barn and the Bear Field. Pp. 205-209 in: J. Parkhouse & E. Evans, *Excavations in Cowbridge, South Glamorgan, 1977-88*. BAR, British Series, 245pp.

CREW, P. 1998. Excavations at Crawcwellt West, Merioneth, 1990-98: A late prehistoric upland ironworking settlement. *Archaeology in Wales*, **38**, 22-35.

CREW, P. 2003. Slags and other iron-working residues. pp. 333-340 in: H. James, *Roman Carmarthen: Excavations 1978-1993*. Britannia Monograph Series 20, Society for the Promotion of Roman Studies 2003.

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. 1999. Iron-working residues from Bulmore. Geoarch Report 99/01. 3pp.

YOUNG, T.P. 2008. Archaeometallurgical residues from Richard Lander School (RLS04) and Truro College (TCF05). GeoArch Report 2007/22. 31pp. & 10 plates.

YOUNG, T.P 2010. Archaeometallurgical residues from Domgay Lane, Four Crosses, Powys. GeoArch Report 2010/23, 51 pp.

YOUNG, T.P. 2011.Metallurgical Residues, p. 112-114 and Appendix IV, p. 178-180 in: M. Luke & Preece, T. *Farm and Forge: late Iron Age/Romano-British farmsteads at Marsh Leys, Kempston, Bedfordshire*. East Anglian Archaeology, Report No. 138, 198 pp.

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

YOUNG, T.P. 2013. Assessment of archaeometallurgical residues from Dwr-y-Felin School, Neath (GGAT 677 & 716). GeoArch Report 2013-11, 31pp.

YOUNG, T.P. 2015. Assessment of archaeometallurgical residues from Truro EDC (2014). GeoArch Report 2015-13. 15pp.

Table 1: summary catalogue, CLAD14 RAMM 14/02

label	context	sample wt	item wt	item no	notes
slag	10048	1120			
			292	1	70% of a (95)x(65)x30mm brittle fractured plano-convex SHC; flat slightly haematised top; dense, 10mm thick, vesicle-free upper plate of slag; 20mm thick bowl below also dense, possibly bladed; vesicles on boundary between the two layers; blebs of lining slag on neatly rounded base; top smooth but very slightly dimpled.
			30	1	A fragment from margin of SHC as above; bladed olivine, haematised top; slightly irregular base without true dimples.
			300	1	A 95x100x30mm, plano-convex SHC; formed of a dense mass of coalesced prills; deeply dimpled on top, slightly dimpled on base; slight charcoal impressions on top.
			286	1	A slightly irregular SHC, uplifted lump of slag to one side may be deformation; 90x70x35mm main dense mass, 20mm high raised area to one side
			110	3	Thin sheets of dense slag, with probable ceramic/sediment contact on one face, other side smooth to very slightly lobate.
			20	6	Small fragments, including some wispy pieces, possibly from around charcoal moulds.
			66	1	Dense rusty slag fragment; flat top; slightly prilly internally; has attached charcoal-bearing slag at one end - possibly an SHC fragment or other smithing slag.
fired clay	10048	2910			
vitreous slag	10048	1285			
					Tuyères (total 26 pieces, 1297g)
			258	2	Conjoining fragments of tuyère. Asymmetry suggest right side of tuyère; 45mm top to mid bore, probably 45mm to base but not well preserved; top receded to 40mm behind face of bore; bore c27mm diameter; centre of bore to vertical edge 47mm. Top angle has 15mm diameter fillet, base probably the same; paste silty with large angular cherty clasts to15mm long axis. some dark red flecks; mainly buff, but grey surface below slag on lower face and curving onto base; maximum preserved thickness 80mm; face has glossy glassy slag with broad dimples; not very granular even towards base.
			225	2	Conjoining fragments of highly slagged tuyère tip.
			74	2	Conjoining fragments of nose of tuyère; face oblique to bore; face coated in quartzose fragments to 8mm; bore c30mm.
			126	1	Tuyère fragment with slightly tapering bore, 25mm at narrow end; no faces but sides 45 and 47mm from bore; angle between sides not preserved; bore striated as if tool twisted.
			85	1	Piece very similar to 126g piece above, but less of bore preserved.
			85	1	Strongly-slagged section of tuyère face, with part of bore, but very little ceramic attached to slag; bore c25mm; face oblique to bore.
			47	1	Small fragment of nose of tuyère with small quarter cone shaped ceramic preserved round bore; very heavily slagged; bore 22mm.
			70	1	Part of slagged tuyère face, face angled, corner fillet 20mm radius
			204	14	Fragments of vitrified/slagged tuyère as above
			123	1	Quarter of tuyère face (lower left?); vertical side seems to pass into curved base rather than fillet and flat; side of tuyère appears curved too in plan - so may be angular truncated rugby- ball shape? Centre of bore probably 45mm from line of side and just 35mm above base; appears to be slightly inclined downwards.
			76	1	Angle of tuyère side with 140° angle rather than fillet, few further details.

label	context	sample wt	item wt	item no	notes
					loom weights (26 pieces, 2000g)
			83	1	Bulbous piece of buff-brown fired clay with possible trumpet-shaped opening partially preserved.
			21	1	Small rounded buff silty fragment
			186	1	Large block of silty buff-brown with sides at fractionally less than 90° and 13mm fillet
			108	1	Block as above, large face is slightly curved with ridge across, fillet7mm
			22	1	Small fragment as above with 12mm fillet
			135	1	c12mm fillet, 85° angle, hole starts 37mm above base, at approximately 45°
			65	1	Hole starts 37mm above base at approximately 60° to side; fillet approximately 12mm.
			126	1	Top corner of weight; hole starts 55mm and 65mm from corner, 20mm above base; hole 12mml sides 100° and 85° to base; fillet 8mm on one side almost angular the other
			118	1	Hole 36mm above base c 10mm fillet, side a fractionally over 90°
			39	1	Rounded corner; sides at 120°, both at just over 90° with base
			110	1	100° angle with 10mm fillet
			92	1	110° angle with 10mm fillet
			235	1	Large bulbous mass, side straight passes into rounded end; 55mm preserved thickness; c60mm radius of curvature on rounded end
			32	1	100° angle with 10mm fillet
			118	1	100° angle with 15mm fillet
			28	1	90° angle with 10mm fillet
			246	5	Fragments with a rounded face - possible weights
			236	5	Fragments with one flat face, probably weights but might be tuyère
					Uncertain (29 pieces, 680g)
			162	14	Oxidised fired scraps with a foliation,
			46	3	Mostly oxidised fired silty fragments, uncertain origin
			15	4	Mostly reduced fired silty fragments, uncertain origin
			457	8	Blocks with apparent remnants of organic temper, 2 have a flat face, one has a curved ace. Although all might be from weights, none shows definite characters and all might be simple daub

GeoArch

geoarchaeological, archaeometallurgical & geophysical investigations

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

Office:	029 20881431
Mobile:	07802 413704
Fax:	08700 547366
E-Mail:	Tim.Young@GeoArch.co.uk
Web:	www.GeoArch.co.uk