GeoArch

Report 2022/15

Assessment of materials from North Tawton

Dr Tim Young
10th March 2023

Assessment of materials from North Tawton

Dr T.P. Young

Abstract

The investigated materials comprised a total of approximately 42kg (554 pieces plus fine debris). The material shows a variable degree of concretionary overgrowth and approximately 15kg of the assemblage was only able to be recorded as concretionary. 24.8kg of the assemblage was provided by identifiable archaeometallurgical residues.

The residues were probably entirely from iron smelting in a slag-tapping furnace.

Over 70% of the identifiable residues were tapslags and just 6% varieties of dense slag that probably cooled inside the furnace. Despite the low prevalence of furnace bottom slags, the evidence (particularly the abundance and form of slag 'runners' present) suggests the use of a commonly-recognised furnace-type in which a 'furnace-bottom' would commonly be generated. Other examples of this type of furnace are typically of moderate to large size, but there is no clear evidence for furnace size here.

Fragments of iron ore in the assemblage were of a fine-grained haematite-rich rock with a fine foliation. The source of this ore is not yet known.

Contents

Abstract 1

Contents 1

Methods 1

Results 1
- Concretions 1
- Iron smelting residues 1
- Iron ore 2
- Other materials 2

Interpretation 2

Further work 2

References 3

Table 1: *summary catalogue* 4
Table 1: *material by context and residue class* 9

Methods

All materials were examined visually, using a low-powered binocular microscope where required. The catalogue of submitted material is presented in Table 1.

This assessment was conducted in December 2022 and January 2023 and was commissioned by Dr Chris Smart, Exeter University.

Results

Concretions

The material showed varying degrees of adherence of concretionary material to the slag and other macroscopic material. The concretions column in the summary table includes all the lump material where the slag was too obscured for identification, or multiple pieces of residue were contained in a concretionary mass, plus all the fine debris in each bag, for that too was dominated by fragmented concretion.

The concretion was produced post-depositionally by deposition from groundwater of fluctuating oxygenation. The proportion of concretionary material in the submitted samples varied widely but was overall approximately 37% of the submitted material.

The presence of the concretionary overgrowths complicated identification of the primary materials leading to a degree of uncertainty in some cases (as indicated on Table 1).

Iron smelting residues

The smelting materials were dominated by **tapped smelting slags**, comprising 71% of the archaeometallurgical residues. The tapslags were typically highly fragmented. Very few pieces were able to contribute to understanding of the size of tapped slag cakes. Context (133) produced a fragment of a slag cake weighing 1340g which is probably the major part of a tapped slag cake. However, the adhering concretionary material obscures the details of the piece (and it even being a section from a very large smithing hearth cake, SHC, cannot entirely be excluded). Several fragments have flow lobes that were relatively small.

Several flow slag fragments suggested the presence of flat-toped **slag runners** (e.g. a 174g piece from context (118), a 136g piece from context (114) and a 415g piece from context (113) in which the runner shows a non-wetted lateral contact.

Some pieces, including some of the runner, suggest formation within the furnace. A 458g dense block from context (104) has deep feeder with a rectangular section forming its lower part. The feeder shows a sediment contact on its base, but with some non-wetted contacts on its sides. The block was later cut obliquely by a strongly blown surface with slight reddening. This combination of features is known on complete '**furnace bottoms**' from other sites (e.g. Bexhill, slag Block "7"; Young 2022, Figure 23).

Further possible furnace bottom material is suggested by a 550g block from context (114) is also suggestive of 'rodding' through material in a furnace base to facilitate tapping but is too heavily concreted for certainty. A 74g piece from context (105) may show a runner or tool mark on the base of a vesicular furnace slag, but has been classified as indeterminate.

Thin **slag sheets** were recorded from a number of contexts and made up approximately 1% of the overall assemblage. These are interpreted as deriving from the lower parts of the furnace away from any furnace bottom.

The slags recorded as **indet** (indeterminate) on Table 1 are largely too severely fragmented to be attributable to any of the other classes but also include a few larger pieces of uncertain origin.

Technical ceramic from the **furnace lining** (or just possibly from other associated metallurgical hearths) contributed approximately 5% of the assemblage. The ceramic was dominantly oxidised fired and possessed a dark superficial glassy slag layer. Only one piece provided any morphological information: a 20g piece of sandy furnace cermaic from context (104) had a concave face that might be part of a 20 to 25mm diameter blowhole.

Slags derived largely from the melting of furnace ceramic (**lining slags**) contributed 6% of the assemblage.

Iron ore

Six examples of iron ore were recorded. Context (103) yielded a 19g fragment and context (118) produced three pieces (402g). These four examples were of a very fine-grained haematitic material. This is of variable hardness, but locally with a soapy feel. The joint surfaces are harder and darker and locally reveal a fine foliation.

A single small (8g) fragment from context (105) is slightly different from the other pieces in having a fragmental microstructure.

A small fragment of tapslag from (117) carries tiny fragments of what appears to be a soft, fine-grained roasted iron ore, visually identical to the larger pieces mentioned above. Such particles are commonly found adhering to tapslags, probably because the slag flow has picked-up particles lost around the base of the furnace in its tapping area during furnace charging.

Other materials

The assemblage included a moderate quantity of natural rock, mostly as pebbles. These included, dominantly, heat-altered material. With some of the heat altered siltstones, there was some very slight residual doubt that some pieces might have been CBM, but that is considered unlikely and all the material identified as rock has been excluded from Table 2.

There was also a number of coarse-ware pottery sherds. Some were separate and accounted for individually on Table 1, but some pottery was deeply embedded in the concretions and could not be weighed separately.

Interpretation

This modest assemblage of smelting residues is consistent with those associated with a common form of Roman smelting furnace. Although Roman bloomery furnaces have typically been described as slag-tapping, recent studies have suggested that an active regime of rodding the base of the furnace was employed in order to make the slag flow and that, even so, a substantial slag block (the 'furnace bottom' may have accumulated from residual slag on the floor of the furnace. In the large 'dome'-shaped furnace at Bexley, such furnace bottoms reached 90kg in weight (Young 2022). More modestly-sized, but still substantial, furnaces are becoming well known from north of the Bristol Channel, where the so-called 'Cardiff-type' is characterised by a particularly large, internal slag puddle, that typically bears moulds of unburnt roundwood (or roundwood charcoal) and clasts of partially-reacted ore (Young 2021a, b)

The assemblage of slag typically produced by such furnaces includes furnace bottom slags, sometimes with oblique surfaces with a smoothly blown and oxidised surface that truncates internal features, slag rods, and large slag runners, as well as lobate tapped slags (tapslags). The North Tawton assemblage sits comfortably within the corpus of residue assemblages from such furnaces but does not include examples of the characteristic roundwood- and ore-bearing slags of the Cardiff type.

It is possible that such residue types have gone unrecognised (perhaps because of the pervasive accretionary coating to much of the assemblage) or were fortuitously absent from the modest collection, but it is equally likely that the North Tawton furnaces were not used in precisely the same way and/or were slightly smaller.

The nature and source of the iron ore employed requires further investigation. No potential source for a very fine-grained haematite ore has been identified in the geological literature for the area. It is perhaps likely that the source was a small orebody that did not attract attention during later post-medieval or modern exploitation.

Further work

Further investigation of the materials is recommended. Although the assemblage is too limited to produce further detailed understanding of the furnace

technology, characterisation of the residues and the ores would help to clarify the nature and provenance of the ore source. This would appear likely to be a source not previously known to have been exploited – and would thus be a significant addition to regional knowledge.

References

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

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

YOUNG, T.P. 2022. Archaeometallurgical residues from Bexhill. *GeoArch Report 2022/09*, 234pp.

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

Table 1. Catalogue of materials from North Tawton submitted for investigation, grouped by submitted bag. Assm = assemblage of small pieces/dust, SHC = smithing hearth cake

Context	Item wt.	Item no.	Item description
101	150	4	tapslag-like material
103	2	1	pottery
	18.6	1	roasted iron ore
	110	1	equant mass of lining slag
	60	2	burnt stones
	58	3	dense slags, probably tapslags
	534	26	concretionary material, variable density
	12	assm	debris
104	68	2	burnt stones
	22	1	vitrified oxidised fired lining
	28	1	concretion containing pale grey pottery sherd
	240	3	blocks of lining slag
	2	1	pottery
	432	7	tapslag-like material
	938	assm	concretionary including much fine debris
104	2105	21	concretionary material (plus debris)
104	274	5	tapslag-like material
	82	2	very irregular flowed dense slags
	330	8	concretionary material
	1005	11	red, probably burnt sandstone (or possibly sandy brick).
	26	assm	debris
104	16	4	dark pottery - probably recently broken single sherd (base)
104	714	6	tapslag type material
	250	4	slag sheets, probably from ceramic substrate? One is rolled, one has stalactites, but largest are only gently curved
	510	2	large blocks of lining slag with burr-like oxidised lining to rear
	98	1	red sandstone-like material

	80	3	very irregular slag fragments, details obscured by concretion
	8	assm	debris
104	458	1	dense slag block; lower part has deeper slag feeder with rectangular section, sediment contact on lower part, some non-wetted contacts on sides. Block is later cut obliquely by a strongly blown surface with slight reddening.
	432	1	block of tapslag-like material, flow apparently 100mm wide and 30mm thick, comprises rather small runnels as far as can be seen
	136	3	pieces of slag with dark smooth surface, largest piece is on a reduced ceramic block, others less clear
	20	3	fine, grog-rich oxidised fired ceramic
	20	1	oxidised fired sandy material, one surface is grey and concave - just possibly a fragment of a 20-25mm diameter blowhole
	24	3	concretion mainly comprising large charcoal fragments
	1455	assm	concretionary material containing some large stone pieces, grading down to fine debris
105	2135	20	tapslag-like material, some show very flat-topped flows (or flow lobes) so slag must have been very fluid
	8	1	appears to be roasted bog ore? Red material is in large 'peds' similar to some of the secondary concretion
	128	1	red feldspathic sandstone/ceramic - as seen in (104)
	44	1	well-gritted oxidised-fired furnace ceramic
	206	5	fractured stones, some slightly heat altered
	166	5	rather equant chunks of lining slag
	26	1	vitrified and lagged reduced fired lining
	500	1	concretionary material apparently on blebby slag with curved surface - could be a furnace slag or open-textured SHC?
	58	1	concretionary material on vesicular slag
	74	1	rather void-rich slag, possibly slag lying above a tool mark on base?
	52	1	wide thin sheet of slag - base of polished appearance, so probably the base of a flow with a large void above - but not certain
	118	2	concretionary material on rather irregular slag cores
	70	assm	debris
107	948	assm	concretionary material with large stones and abundant charcoal grading down to fine debris
107	1698	assm	concretionary material with large stones and abundant charcoal grading den to debris
107	398	8	tapslag-like material
	280	2	concretion-coated dimpled flows - probably flowed through fuel bed
	40	1	low density slag, probably a nub of lining slag
	222	2	blocks of vitrified lining
	640	2	large blocks of concretion-coated slag with apparently blebby convex bases, hint of flow lobs on margins suggest these may be tapslags, but other possibilities exist and concretion precludes distinction

	738	assm	charcoal-rich concretion grading down to fine debris
107	66	4	concretionary material
	2	1	highly porous slag fragment
113	90	2	broken length of slag runner, good concavo-convex cross section, partially encased in concretion
	124	4	dense concretions
	20	1	vitrified oxidised fired furnace lining
	112	1	dense slag fragment, possibly central section of small SHC rather than of slag flow?
	906	36	tapslag-like material
	30	assm	debris
113	1315	26	tapslag-like material
	415	1	thick block of tapslag to 65mm, base has well-formed runner overlain by main slag, one side is a non-wetted contact - so this could be from a tapping channel or tap arch side
113	514	16	tapslag-like material
	136	1	thin tapslag flow, over running narrow runner
	26	1	vitrified oxidised-fired lining
	84	2	dense concretion
	248	1	large block of lining slag/failed wall
	4	1	thin sheet of lining slag
	14	assm	debris
113	110	3	vitrified oxidised fired lining, largest piece 80mm square and both the two larger pieces are perfectly planar
	24	2	convoluted lining slag
	58	1	fragment of dense planar slag sheet
	144	7	concretionary material, larger pieces dense
	86	1	irregular nub of slag with tool mark on base
	766	19	tapslag-like material
	38	assm	debris
114	114	4	dense skags in concretion, main morphology is vertically descending blebs and lobes
	16	1	lining slag bleb with iron clast
	1100	35	dense slags in concretion, main morphology is tapslag-like. Surface metallic, dark, commonly single layer of lobes with base either descending prills or sediment contact.

	1155	22	dense masses of concretion (presumably cored on slag), charcoal and sediment -rich. Largest block (550g) shows a basal zone with large charcoal fragments, overlain by denser material with incomplete hole or channel - probably suggesting rodding through debris in furnace base?
	102	7	reduced fired (grey or brownish) furnace ceramic with vitrified and slagged surfaces
	24	2	pink extremely sandy fired cermaic or substrate
	110	assm	debris, rich in charcoal
114	160	2	slagged and vitrified oxidised fired lining (bright pink in one, possibly so in second)
	1475	17	tapslag-like material in concretion, thin sheets, dark tops
	872	11	mostly dense concretionary material
	94	assm	debris, rich in charcoal
115	2000	24	tapslag-like material, slightly more weathered that some other parts of the assemblage
	432	1	slag block with upper part of tapslag, lower more chaotic, perhaps falling into fuel bed
	206	1	concretionary mass, perhaps with wall contact on one side
	152	1	concretion with large iron inclusion
	88	assm	debris
117	156	2	concretion containing rather platy slags, not typical tapslags
	42	1	concretionary material
	90	4	tapslag-like material
	14	4	vitrified oxidised fired lining
	4	assm	Debris
117	524	1	very dense block of vitrified furnace wall. Lobate lining slag on interior, ceramic largely encrusted by accretion. Flowage has produced some unusual elongate vesicles in interior slag
	112	3	small fragments of tap slag. One shows inclusions of fine grained soft iron ore on base.
	50	1	concretionary lump containing iron and slag fragments
	64	3	soft burnt porous sandstone
	20	1	concretion probably on slag
	18	1	vitrified oxidised lining
118	1195	31	tapslag-like material
	398	6	blocks with slagged face and/or accumulation on furnace ceramic
	176	4	low density grey glassy lining slags
	402	3	roasted low grade ore
	82	1	slag prill broken in 3 resting on loose red sandy sediment
	8	1	charcoal in concretion

	322	12	concretionary material
	4	1	red ceramic
	26	1	dense slag fragment -bleb or runner?
	62	assm	debris
118	1055	12	tapslag-like material
	968	11	concretionary material
	174	1	flat topped plano-convex flow/runner, or just possibly SHC but unlikely
	534	2	lumps of concretion each containing a large piece with a rough curving base - could be hearth bottom or SHC conceivably, but most likely irregular-based tapslag flow
	68	assm	debris
127	1033	assm	blocks of pale ashy sediment rich in charcoal, slightly concretionary but not the same colour as in the slag-rich deposits
133	1340	1	80mm block, forming part of a plano-convex mass. This is probably the distal end of a tapslag cake but the concretionary material adhering makes this slightly uncertain and it could just be part of a large SHC with flowage on the top (less likely)
	64	3	charcoal-rich concretion

Table 2: summary of distribution of material classes by context (excluding rock). Weights in g.

Context	tapslag	sheet	runner	'FB'	indet	lining slag	lining	ore	concretion	pottery
101	150									
103	58					110		19	546	2
104	1852			458	548	750	62		4886	46
105	2135	52			632	166	70	8	188	
107	398				922	40	222		3450	
113	3637	58	505		198	276	156		434	
114	2575				114	16	286		2231	
115	2432								446	
117	202	156					556		116	
118	2358		174		534	176	402	402	1428	
127									1033	
133	1340								64	
total	*17137*	*266*	*679*	*458*	*2948*	*1534*	*1754*	*429*	*14822*	*48*

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