GeoArch

Report 2012/28

Evaluation of archaeometallurgical residues from the Brecon to Tirley pipeline, site BRT186

Dr Tim Young

5th November 2012

Evaluation of archaeometallurgical residues from the Brecon to Tirley pipeline, site BRT186

Dr T.P. Young

Abstract

The site produced a small assemblage(4.7kg) of residues produced mainly during iron smelting in a slag-tapping furnace. A few pieces are indicative of iron smithing. The assemblage also includes a piece of iron ore which would appear to have a texture compatible with iron ores from the Forest of Dean. The assemblage would be typical of material generated during the smelting of iron in the Forest of Dean area during the Roman period.

Contents

Abstract 1

Methods 1

Results 1

Interpretation 2

Evaluation of potential..... 2

References 2

Catalogue 3

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 Network Archaeology as part of the Brecon to Tirley gas pipeline project.

Results

Description of residues

General

The assemblage as a whole is a small collection of iron slags and related materials (4.8kg; 23 original pieces, some now broken). Of the total, 3.3kg (6 pieces) was identifiable as smelting slag (of which 3kg was a single original lump), 0.8kg (3 pieces) was probably, but not certainly, smithing slag, 0.5kg (7 pieces) was indeterminate iron slag, 0.1kg (3 pieces) was furnace/hearth ling, 0.02kg a piece of iron ore and 0.02kg was a small piece of coal-fuelled slag, probably a smithing slag.

Iron smelting slags

The smelting slags were mainly pieces which showed evidence for a maroon coloured, ropey textured surface indicative of a slag tapped from the furnace.

One piece of smelting slag and one piece of the strictly indeterminate material comprised accumulations of lobate slags with maroon surfaces (from contexts 602021 and 602076). Such pieces are suggestive of flowed slags which did not come into contact with air, but cooled within the fuel bed. Such materials may form in a slag-tapping furnace, but will be the dominant waste material in non-slag tapping furnaces.

The main piece of smelting slag was a large (3kg) block from context 602049, now shattered into sixteen fragments. This mass shows a deep accumulation of slag (>105mm deep) within a steep side tapping pit. The piece is a small fragment (estimated to be less

than 20%) of the whole original tapslag cake (which would therefore have weighed at least 15kg).

Smithing hearth cakes (SHCs)

The material identified as probably being from SHCs is difficult to interpret. One 450g piece from 602111 may be an essentially complete, low density, prilly SHC. Two other pieces are probably fragments of SHCs (from contexts 602064 and 602111) but give little indication of overall size and shape.

The size of the only relatively complete SHC (450g) is on the borderline between slags produced during secondary blacksmithing (the end use of iron) and those produced during primary bloomsmithing (part of the process of iron manufacture) in the Roman period.

The material from context 602064 is too encrusted to provide evidence, but the pieces from context 602111 would appear to have been fuelled by charcoal.

Indeterminate iron slags

The material in this category is not certainly referable to either smelting or smithing. This are mostly pieces without any preserved external surface to give morphological evidence, or with any evidence for flow lobes being preserved internally.

Coal-fuelled slag

Although most of the slags show evidence for the use of charcoal as fuel, one piece (a small 20g fragment from context 602001) showed inclusions of coal residues. Coal was widely used for end-use blacksmithing (but not for the process of smelting and primary bloom smithing) in the Roman period, and later again from around the 13th century onwards.

Lining

The collection included three pieces of vitrified hearth or furnace lining. None contained any morphological evidence for a precise interpretation of origin.

Ore

The assemblage included a single piece of goethitic iron ore (20g; context 602021). The texture was largely granular, with tabular voids suggestive of now leached-out carbonate inclusions, but the granular material was locally overgrown by botryoidal layers.

The piece was mainly formed of dark, greyish goethite, but the surface was reddened – though whether by contact with ochre (the fine-grained iron oxides which often accompany the consolidated ores) or by roasting (iron ores are typically roasted in air prior to smelting) it was not possible to determine by inspection.

Distribution of residues

The distribution of archaeometallurgical residues is as small quantities of material present in a range of different contexts and context groups. There is no focus of distribution of residues – suggesting they were produced elsewhere and incorporated into deposits within the excavated area as isolated fragments. Such a pattern is probably indicative of accidental patterns of deposition, rather than a deliberate pattern of waste disposal.

The occurrence of the two major pieces of SHC within a single context may suggest a more deliberate pattern – but the evidence is very slight.

Interpretation

The evidence from the residues indicates that both iron smelting and smithing were undertaken close to the investigated area. The small quantities of residue recovered preclude detailed comment on the smelting process, however, most smelting slags are clearly from a slag-tapping furnace and the remainder are compatible with such an origin.

The fragment of iron ore shows features compatible with an origin in the Bristol Channel Orefield (Young & Thomas 1998, 1999); an origin of the ore piece recovered in that area would appear very likely. The site lies well within the hinterland of the Dean ore resources in the Roman period as that is currently understood.

Evaluation of potential

The residues from the site occur in contexts where they are probably derived or residual and there was no evidence for associated metallurgical structures. The investigated features are apparently largely or entirely of Roman age and the residue assemblage is entirely compatible with the technology of that period. Although the occurrence of residues on this site is of interest, there is little potential for further detailed analysis to add greatly to present understanding of process, technology or the nature of the resource.

No additional investigation is therefore recommended.

References

YOUNG, T.P. & THOMAS, G.R. 1998. The cargo: iron ore analysis. pp. 105-111 *In:* Nayling, N. *The Magor Pill Medieval Wreck*, CBA Research Report 115, Council for British Archaeology.

YOUNG, T.P. & THOMAS G.R. 1999. Provenancing iron ore from the Bristol Channel Orefield: the cargo of the Magor Pill Boat. *In:* POLLARD, A.M. (ed) *Geoarchaeology: exploration, environments, resources*, Geological Society of London, Special Publication, 165, 103-121.

Table 1: Summary catalogue by box, context and sample.

context		*weight*	*number*	*notes*
602001	subsoil	58	1	very heavily accreted slag fragment - fracture shows a charcoal inclusion
		40	1	rounded lump of fired lining - possibly a wall fragment fallen into furnace/hearth; probably furnace ceramic rather than stone, but not certain
		62	1	irregular rounded fragment of dense vesicular iron slag with some fine charcoal inclusions
		4	1	sliver fractured from a lump similar to the above
		28	1	residual lump of coarsely vesicular internally lobate slag - probably a tapped slag
602001	GPS 6108132	26	1	fractured piece of vesicular and finely charcoal-rich iron slag
		16	1	oxidised fired vitrified lining, fine buff fabric, surface deeply vitrified to hard pale layer, no external slag/glaze
602001	GPS 6108132	20	1	small platy slag fragment, irregular surfaces with vesicles and coke clasts. Some botryoidal overgrowth
602001	GPS 6108147	6	1	small broken fragment of altered slag
		52	2	deeply vitrified fragments of furnace/hearth wall. Coarse sandy fabric with some large rock grains; reduced fired
602003		278	(3)	broken piece of dense, but vesicular and finely charcoal rich slag. Probably a furnace slag or SHC fragment but on diagnostic exterior surfaces present
602021		70	2	small accumulations of fine prilly slag in mass with some charcoal.
		20	2	pieces of red-surfaced goethite ore, partially botryoidal internally, but mainly finely granular with small tabular pores possibly either after a now dissolved platy mineral or fossils
602043		4	1	tiny fragment of dense slag with large rounded vesicles with a sandy rounded contact surface. Rather similar to contact in material from 602049
602049		448	10	small fragments probably fractured from below
		2590	(6)	conjoining fragments from very large slag cake. Has tap slag textured top, maroonish, vertical side 50mm deep then angling to a total of 105mm deep c. 100mm from margin. Vertical and upper side have sandy material adhering to slag, but base of trough show a more lobate charcoal contact. Internally presumably originally mainly lobate though not all is identifiable as being lobate. This is only a small part of original cake - at most 20%
		156	(3)	broken piece of 'furnace slag' rich in charcoal moulds. Has one crudely curving irregular surface - but it is unclear if this is a free or contact surface
602064		152	1	heavily accreted slag fragment, presumably had metallic iron, one curved surface can be seen - suggestive of an SHC fragment
		50	1	clean dense maroon tapslag fragment - classical in form. Possibly slightly worn
		18	1	fragment of weathered prilly slag encasing charcoal moulds, vesicular, probably a smelting lag
602076		26	1	very dense lobate slag with prills showing charcoal contacts top and bottom; surface bright metallic, not maroon, so not exposed to air
602111		450	1	130x90x60mm irregular mass of rusty, charcoal-rich slag with finely prilly convex lower surface. Upper surface includes a rounded hollow 50mm across and a small patch of smooth slag. Not certainly, but probably a low-density SHC - very porous. Probably almost complete. Small possibility of being a furnace slag lump of coincidental shape.
		188	1	piece of slag in slab-like form, basal contact shows fine microprills and charcoal moulds, top irregular smooth, slightly lobate, with possible impressions of charcoal as rounded deep dimples. Quite possibly, but not certainly an SHC fragment

GeoArch

geoarchaeological, archaeometallurgical & geophysical investigations

Unit 6,
Block C,
Western Industrial Estate,
Caerphilly,
CF83 1BQ.

Mobile: 07802 413704
E-Mail: Tim.Young@GeoArch.co.uk
Web: www.GeoArch.co.uk