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Evaluation of archaeometallurgical residues from Priory Field, Caerleon

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Abstract

Archaeometallurgical remains from Priory Field include a wide background of incidental and residual material, but more significant concentrations are contained in deposits formed immediately prior to the construction of the warehouse. The significance of these deposits is uncertain (deliberate make-up, dumping from activity elsewhere in the fortress, waste from local activity…?). The residues include evidence for ironworking and copper alloy melting consistent with the manufacture and/or repair of artefacts. Later deposits also include evidence for iron smelting. This activity is important for understanding the development of the site and a programme of further work is proposed.

No material from Golledges Field has yet been assessed.

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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. This project was undertaken for Andrew Gardner, UCL.

The particular project requirements have entailed a different format from normal GeoArch assessments, and the project headings are followed for the remainder of this report.

1. Summary of each assemblage

a) Quantification and preliminary identifications

Initial sorting of the collection shows that of the approximately 45.6kg of material (>1400 pieces) submitted as being archaeometallurgical residues, some 8.4 kg (>260 pieces) were concretions formed around corroding iron; these have been removed and sent for X-radiography. The remainder of the collection has reduced, after some further cleaning, to an assemblage of 28.5kg of archaeometallurgical residues from the Priory Field investigations and 6.6kg from the riverside evaluation. No material has been examined from Golledges Field; assessment of that would need to form a part of the later phases of post-excavation analysis. The following report addresses the issue solely of the Priory Field excavations.

The assemblage contains residues from the smelting and working of iron, as well from the melting and casting of copper alloy.

b) Nature of the assemblage

The residues from the assemblage have been divided into eighteen facies of materials of potential archaeometallurgical significance:-

Slags from iron smelting:
Tapslag –slags tapped from a bloomery furnace

Slags from iron smithing:
Smithing hearth cake (SHC) – slag cakes produced during iron working (smithing)
Tongue – a type of small slag cake related to the SHC, but little iron input

Indeterminate iron slags:
Indet. Fe slag – dense, iron-rich, slags that cannot be assigned to either smelting or smithing

Residues associated with hearth/furnace structure:
Lining slag – glassy slag produced by melting of a hearth/furnace wall
Lining – ceramic from a hearth/furnace wall, oxidised- or reduced-fired, may have vitrified surface
Fuel ash slag (FAS) –vesicular, partially-melted residue; formed of substrate fluxed by fuel ash
FAS in concretion – fuel and ash concretion, showing zones of partial melting

Residues probably associated with non-ferrous metalworking:
Resinous slag – slags, often slightly maroon, with a resinous lustre, resembling melted plastic
Vitrified stone – pebbles with vitrified or glazed surfaces
Gravelly slag – slag of lining- or fuel ash- type, binding vitrified or bloated rock fragments

Crucible - ceramic crucibles used for melting non-ferrous metals for casting
Cu – copper slag, dross and corroded copper alloy blebs, probably mostly spills from melting
Lead – corroded prills of lead

Residues possibly from lime-burning:
Green glassy slag with lime – lime-rich slags, possibly residues from lime burning

Residues from the use of coal:
Clinker – slag formed from partial melting of coal residues

Possible resources:
bog ore: iron-mottled concretionary material from natural iron mineral precipitation in soil

These materials are all typical of early metalworking. The tapped smelting slags are rather few in number, but are similar to other small-scale bloomery iron smelting operations in the Bristol Channel Orefield and would be compatible with a date between the latest pre-Roman Iron Age and the late medieval period. At this stage, however, they apparently do not resemble the thick flows typical of other Roman military smelting operations in the area (e.g. Cardiff Castle, Young & Kearns 2011; Caergwanaf, author's unpublished data).

The smithing hearth cakes appear to lie within a weight range 0f 100g-600g – a size which would be entirely appropriate for blacksmithing (as opposed to bloomsmithing) during the Roman period.

Many of the fragments of hearth/furnace lining would be consistent with the iron smelting and ironworking structures required for the processes described above.

Although the materials discussed above were dominantly from processes fuelled by charcoal, a small quantity of clinker and some coal was also recovered, indicating use of coal as fuel. Most of the clinker came, however, from contexts of medieval or later age.

The abundance of fuel ash slags, gravelly slags and individual glazed pebbles is strongly suggestive of non-ferrous metalworking (although some of these materials might have been generated in non-metallurgical activities). More direct evidence of these processes comes from a small quantity of crucibles, dross and spills from the melting and casting of copper alloys. Small quantities of prills of lead may also hint that lead-working was also being undertaken. Further evidence for non-ferrous metalworking is believed to be contained in the ceramic collections where there is apparently further crucible material. The CBM materials should also be checked for any misclassified moulds and metalwork collections for offcuts, spills, semi-products etc.

One final class of materials, green glassy slags associated with a powdery (lime?) material may be residues produced during lime-burning rather than a metallurgical activity.

c) Discussion by stratigraphy

Although the archaeometallurgical residues are widely scattered (they occur in 131 contexts in the main Priory Field site and a further 17 contexts in the riverside evaluation) there several distinct occurrences that may mark the periods of production or introduction of the residues, with reworking being responsible for their occurrence in other later contexts.

(i) A very small quantity of residues occurs in the Phase 0 deposits of Area B. These are very few in number, but do indicate that some metalworking was happening from a very early point in the development of the site, although one of the pieces is a green glassy slag that may possibly be residues from lime-burning rather than a metallurgical activity.

(ii) A more significant occurrence is in the upper charcoal horizon (G3112) in Phase 0/1 of Area B. Over 5kg of residues were recovered from these contexts, suggesting that the charcoal may be waste from metalworking, rather than debris from site clearance as postulated. The lower charcoal horizon in the same area yielded only tiny amounts of residue – and is hence unlikely to be from metalworking (and therefore may indeed be clearance). These residues include materials from both iron-working and copper-alloy casting.

(iii) Some of the deposits of the later stages of construction of the warehouse are also rich in metallurgical residues in the areas of Rooms 1 and 4. These residues are of similar character to those of (ii) above, with both iron and copper-alloy working residues, but have a greater preponderance of intact smithing hearth cakes. Context c714 in the eastern wall contains a single piece of tapped iron smelting slag – the earliest evidence here for iron smelting (two tiny fragments from c2090 of Phase 2 are the only other pieces of evidence for smelting prior to demolition of the warehouse).

(iv) deposits associated with the use of the warehouse contain very little archaeometallurgical residue. Phase 2+ deposits in rooms 1, 2, 6 and 7 do contain very small quantities of residues.

(v) Later deposits contain sporadic, and typically smaller quantities of archaeometallurgical residues. From Phase 3?/3+ iron smelting slags become a small but persistent component of the assemblage. There are no metallurgical residues from Phases 5 or 6. Iron smelting tapslags are particularly prominent in the subsoils of G100. The tapslags are the most durable of the residue types and so commonly become concentrated in residual assemblages. It is known, however, that iron smelting was undertaken on a moderately large scale in Caerleon in the medieval period, so these materials may be of that period.

2. Contribution to research

a) General Site research questions

The distribution of archaeometallurgical residues in the Priory Field site has proved to be rather unexpected. The only contexts yielding more than 1kg of material are contexts referred to phases 0/1 or 1. These show a range of activities associated with the working of iron and copper alloy (but not iron smelting). Some of these contexts are (e.g. in Room 4) currently interpreted as make-up or levelling deposits, whereas charcoal-rich deposits (upper charcoal horizon) in Area B have been suggested only as site clearance.

As part of unravelling the significance of the early metalworking, the metalworking needs to be fully characterised (ferrous / non-ferrous / other pyrotechnological processes). In particular, the various low-iron slags need to be investigated to differentiate copper working, lead working and lime burning (and possibly other processes, as yet unidentified).The evidence from the residues needs to be compared with

artefact evidence from the same (and related) contexts to determine what might have been manufactured. At an early stage in the development of the fortress considerable metallurgical activity must have been directed towards the constructing and equipping the buildings, quite apart from the on-going demands of the legion and its other activities. Metallurgical activity on the site of the forum-basilica in Caerwent has been proposed (Young 2006) as being associated with construction project itself; comparison between the two sites might be instructive.

The major research question must therefore be whether the residues from the northern part of the site are simply dumps of material from activity elsewhere (whether as deliberate levelling material during construction or through earlier use of the ground as dumping space) or whether metalworking was being undertaken in this general area prior to the construction of the warehouse. Small-scale metalworking of various sorts is widely known across the fortress, but the major centres currently appear to be in *Insulae* XVIII (the *fabrica* on the Endowed Schools' Field; Young & Kearns 2010, Guest & Young 2009) and probably XIX. Material from the *fabrica* site represents the same range of activities as seen at Priory Field. Answering this question will depend as much on refining understanding of the stratigraphy as it does investigation of the residues.

Amounts of archaeometallurgical residues in deposits post-dating the construction of the warehouse are very low and are probably either residual or incidental. These later materials offer little to the understanding of the development of the site and, because of their potential residuality, they also offer rather little with regard to the understanding of broader issues of metalworking within the fortress either.

b) Finds / other research questions

The assemblage is small and lacks direct association (in the current state of understanding at least) with metallurgical structures, so only has limited potential for enhancing the wider aspects of Roman metalworking. There are, however, some interesting possibilities because of the early date of the pre-warehouse metalworking. This is likely to be somewhat earlier than most occurrences in Caerleon, so detailed characterisation of the residues may be important. Some facets of this include: did the early phase include metallurgical use of coal? What are the early crucibles like? What was the provenance of the iron ore being smelted in the early phases, compared to that used later?

One potential broader research question that would be addressable with the Priory Field assemblage concerns the interpretation of the fuel ash slags and the gravelly slags. These facies have also been observed on other Roman military sites (e.g. Caergwanaf) but their full significance has not been determined. Careful analysis of these slags should reveal whether they have been contaminated by the material being worked – and what material(s) that was.

3. Description of final report

The final catalogue should include a full quantified listing of all archaeometallurgical residues from the site. Reporting will include detailed description and discussion of all the classes of residue, with the results of the scientific analyses. The discussion of the residues would address the following issues:

1. The nature of the early metalworking phase
2. The scientific evidence for the variety of tasks being undertaken in the early phase
3. The evidence for the provenance of the iron ore being smelted in Roman Caerleon

A publication report would probably include a summary of this work, with a table of contexts and facies, rather than the full archive catalogue.

4.Estimate for final report

Priory Field

Preparation of the final report would include the following tasks with regard to Priory Field:

Completion of full catalogue of residues	4 days	£1200
Portable XRF triage of slags to look for Cu and Pb working	1 day	£300
Chemical analysis of selected iron smelting slags for provenance study	5 @ £85	£425
Chemical analysis of selected FAS/glassy slags	5 @ £85	£425
SEM investigation of non-ferrous slags (if required)	4@£180	£760
Data collation and reporting	2 days	£600
Total		£3710

Golledges Field

In addition, assessment of the residues from Golledges Field is still required. This is likely to be in the order of 1-2 days work (i.e. up to £600). It is not yet known whether there would be any implications from this for additional analytical investigation.

5. Secondary work required

No secondary work would be required.

6. References

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