ANCIENT MONUMENTS LABORATORY

REPORT

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TITLE Report on slags examined at Verulamium Museum, St. Albans, Herts, on 10 November 1980

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ARCHAEOMETALLURGY GROUP, UNIVERSITY OF ASTON IN BIRMINGHAM.

Report on slags examined at Verulamium Museum, St. Albans, Herts on 10th November 1980.

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Excavation: Verulamium 76.1 (Changing Rooms).

(Box AA-FM)

AA Cinder
AC(5) Cinder with a highly vitrified surface.
AH Smithing Slag, - non magnetic.
AL Fuel ash slag but with a high iron content.
ED " " "
DT Not slag - burnt chalk?
EP Burnt clay with attached cinder.
ER Fuel ash slag
FJ Iron object.

FO 1 fragment of burnt clay.
1 flint fragment + attached nail
3 fragments of furnace lining.

Furnace lining:
The best example has the internal face covered by a thin black vitreous layer. The exterior face shows red burnt clay where it has fractured from the mass of the furnace structure.
Slag:
Three samples have been taken to Aston. The first is an incomplete smithing bottom, measuring 10cm x 7cm (incomplete) x 3cm deep. It is non-magnetic, and has a typical agglomerated appearance.

* The codes used are those of the excavation layer or feature numbers. The code is followed by a description of the material in each bag, and includes a fuller description of the slags. The dimensions of hearth bottoms or buns is as follows:
Major diameter (cms) x minor diameter (cms) x depth (cms)

The second sample is a 'typical' piece of the remaining slag (see later).

The third sample is similar to a Fuel Ash Slag, though corrosion products do suggest that it may have been associated with non ferrous metallurgy.

The bulk of the slag is not typical of smithing slag in that it is non magnetic. Magnetism is expected from two sources in the smithing process. Principally from the inclusion of pure iron, (or alloys of iron) in the slag derived from the bloom or worked tool. Secondly due to the presence of magnetite, associated with hammer scale. In many cases the common "agglomerated" appearance of smithing slag is absent.

Some of the smaller pieces may be heavily corroded iron objects, for example the piece marked by a white chalk dot could be an object.

FL Several fragments of poorly burnt clay.
1 iron object (?)
1 smithing bottom

Smithing Bottom:
This example measures 8cm x 8cm x 5cm deep. It is weakly magnetic over parts of its surface. The upper surface is covered by an intermittent vitreous layer.

FM 15 fragments of furnace lining/fuel ash slag.
2 smithing bottoms plus other smithing slag pieces.

Smithing Bottoms and slags:
One of the bottoms is incomplete the other measures 10cm x 9 cm x 3cm deep. From the apparent density of all the slags they contain a high percentage if iron, though not in a magnetic form.

JV 1 fragment of fuel ash slag.
1 piece of slag

Slag:
The slag would be better described as 'cinder', since it is highly gassed and would appear to have a high silica content.

QK 4 fragments of fuel ash slag and or furnace lining.
1 piece of cindery slag.
1 smithing bottom.

Slag:
The cinder/slag is similar to that in JV., though in this case it is weakly magnetic. The smithing bun measures 10cm x 8cm x 6cm deep. It is weakly magnetic. The upper exterior surface shows an agglomerated appearance, while the lower surface has impressions of fibrous organic material.

BOX JQ-RE

JQ Iron object
NT Smithing slag - not magnetic (removed to Aston)
OG 1 piece of fuel ash slag.
1 piece of smithing slag (?) It has a high iron content, and could be a highly slagged bloom fragment.
PD Fuel ash slag, - metallic grey vitreous surface - possibly non-ferrous.
PY Furnace lining with attached slag.
QB Slag - has an upper 'run' surface but internally shows smithing slag characteristics.

QK Two smithing hearth bottoms both weakly magnetic.
dimensions 8.5cm x 6.5cm x 5cm deep.
7 cm x 4 cm (incomplete) x 3.5cm deep.
The exposed section in the broken sample shows the charcoal as the lowest layer of the smithing bottom. (This sample has been taken to Aston).

QM Two smithing buns.
dimensions 6 cm x 4 cm x 3 cm deep.
4.5cm x 5 cm x 2 cm deep.
Both samples are non magnetic, though have a relatively high density.

RE 5 fragments of fuel ash slag
2 " " furnace lining.
3 small fragments of smithing slag.
1 smithing bun
1 fragment of furnace lining with attached fuel ash slag, the corrosion products etc. suggest it could be the result of lead working.

Smithing bun: Not magnetic, no definative shape.
dimensions 6.5cm x 5.5cm x 4cm deep max.

BOX RS/RT - TB

RS/RT A crucible fragment and iron object were rebagged
2 sherds of fuel ash slag.
2 " " furnace lining.
C 15 sherds of semi burnt clay
2 fragments of smithing slag.

RT Several fragments of an iron object or bar were rebagged
Fragments of burnt clay plus attached slag.
Clinker
Fuel ash slag plus furnace lining
On some surfaces of the furnace lining a very glossy black/green vitreous layer occurs.

SD Fuel ash slag, and one fragment of furnace lining. The fuel ash slag was covered in parts with a black vitreous layer similar to that in RT.

SS 1 piece of furnace lining, with (?) possible tuyere mould (rebagged)
Smithing slag.

ST Fuel ash slag and furnace lining. The latter having the black vitreous layer present.

SU 1 fragment of fuel ash slag.

SX Two fragments of fuel ash slag and furnace lining.

TA Note: card in the back says "bottom of furnace".
C 20 fragments of fuel ash slag/furnace lining.
5 " " smithing slag.
1 small hearth bottom (incomplete)
1 large " "

Dimensions of smithing bottoms.

small bottom: 7cm x 5.5cm x 3cm max depth, weakly magnetic. An agglomerated appearance. On the underside, a large number of charcoal impressions were present.

Large bottom: 10cm x 9 cm x 4.5cm deep. Non magnetic, a partially vitrified upper surface, and a central depression. The depression would appear to result from the hearth bottom being used again in that the walls of the central depression developed at a later stage on a normal hemispherical hearth bottom.

TB Fuel ash slag.

Box FO-GS

FS Two fragments of cinder and fuel ash slag.

FT Fuel ash slag and attached slag (magnetic)
Smithing slag.

FW 1 small fragment of cinder.

GB 1 fragment of fuel ash slag.
Several small fragments of cinder/slag.
1 small smithing bun,
Smithing bun 7cm x 6cm x 3cm deep. Non magnetic.
Vitrified in parts, with a high fuel ash content,
giving a cindery appearance.

GH 1 fragment of smithing slag and fuel ash slag.

GK 1 fragment of furnace lining.
Several fragments of cinder.

GL Small fragment of Smithing bun.

GL(2) Fuel ash slag and furnace lining.

GM(4) Part burnt clay/sand.

GS Fuel ash slag (vitrified black and red).

Conclusions

The material falls into four main categories. Firstly Fuel Ash slag, this can be associated with any industrial heating process, and could also be associated with domestic hearths. The second group is Furnace Lining, though terms 'furnace' the material could derive from any clay lined industrial hearth or furnace. Selected samples should be subjected to X-ray Fluorescence, (not available at Aston, but both the A.M.Lab and the department of Archaeological Sciences, Bradford University, have sets). X.R.F. could determine whether the linings were associated with ferrous or non-ferrous metallurgy. The third and fourth categories are the slags themselves. The third group comprises the smithing bottoms, both complete and incomplete, and the smithing buns. The fourth group comprises indeterminate slag lumps and pieces of clinker etc.

In the third category (smithing bottoms and buns) the measurements show that the major diameter of the bottoms is between 7-10cm, the minor diameter 7-9cm (with three exceptions, one of which is incomplete). The depths of the bottoms tend either to be about 3cm or about 5cm. The largest was 6cm deep but it is thought that the upper level of slag was superimposed. The smithing buns are more varied in their dimensions. The general smithing slag characteristics occur though the slags are only weakly magnetic. This indicates a lack of pure iron or magnetite present in the slags, which must therefore consist principally of extruded tap slag. This may be indicative of the making of bloom iron, and not working iron objects. From impressions on the bases of the

hearth bottoms charcoal was used as fuel. The slags in group 5 are similar in texture and characteristics to those of group 4. The difference being that they have no form. The clinkers are due to a higher amount of fuel ash being present in the slag.

In conclusion therefore the slags indicate a ferrous smithing process being carried out on the site. The similarity in the hearth bottoms suggest that they derive from one hearth, a phase of hearths. It is probable that bloom iron was worked on the site, and only a limited amount of reworking of iron occuring.

Several samples have been taken to Aston for further detached study. Should this study provide further significant information it will be forwarded to you as soon as possible together with a full chemical analysis.

If there are any further points that need clarification please contact me at Aston University.