

# Evaluation of metallurgical residues from Coldfurrow, Lyonshall (LYCF04)

Dr T.P. Young

## Abstract

*The assemblages from Coldfurrow comprise approximately 11kg of material, dominantly slag but also including hearth lining, derived from iron smithing. The material was recovered from a very restricted area of the site, close to a pit with burnt sides, yielding both macro- and micro-residues from smithing, which may have been an unusual form of smithing hearth. The dominant slag type is unusual in having a granular texture, indicating little flow of the slag within the hearth. Some material from a single context was of rather larger plano-convex cakes (2.3kg) than the majority of the specimens and which might possibly be associated with bloomsmithing.*

## Contents

Distribution	.....	1
Description	.....	1
Discussion	.....	1
Conclusion	.....	2
Catalogue	.....	2

## Distribution

The recovered slags are all from a very restricted area of the site, focussed on the "smithy" pit (1561, 1573) and including the nearby ditch of the square enclosure (1511, 1517, 1523, 1526, 1531) and the adjacent section of the inner main enclosure ditch (1103, 1106). Samples from other areas (1540, 4010) did not contain slag.

## Description

The assemblages totalled approximately 11kg of slag and furnace/hearth lining.

The majority of the slag pieces were entire or fragmentary, usually plano-convex, smithing hearth cakes, with an unusual, granular fabric. These cakes ranged up to about 160mm length, 120mm width and 55mm thick, with a weight of up to approximately 1kg. These cakes ranged from classic plano-convex forms through to rather amorphous blocks, but all possessed the same granular fabric. This class of cake occurred in contexts within the inner main enclosure ditch and the square enclosure ditch (1103, 1511, 1523, 1526).

Contexts within the "smithy" pit (1561, 1573) yielded slag cakes which were smaller than the plano-convex cakes above and which were of a thin tabular shape, rather than a plano-convex form. These flattened cakes were of a similar granular fabric to the examples described above. They were typically rather rusted, suggesting a significant proportion of metallic iron inclusions. The concreted material attached to the outside of the specimens was rich in charcoal fragments and flake hammerscale.

A third form of slag cake was present in the terminal of the square ditch (1531). These cakes (one complete and three fragments) possessed a more homogeneous fabric than the previous two classes. The slag bore inclusions of charcoal and large vesicles. These features suggest that the slag had therefore been somewhat more fluid than in the previous two classes.

The complete, but broken, cake weighed 2.3kg and had a plano-convex shape measuring 190mm long by 150mm wide and a maximum of 70mm deep.

Pieces of fired hearth lining were recovered from five contexts, with much of the material showing a well vitrified face. One interesting feature was that several pieces showed a convex vitrified face. This may indicate the material was derived from the margins of the zone above the tuyere/blowhole where melting often results in a hollow being produced in the wall. The material from the "smithy" pit and the SW side of the square ditch was slightly different to the material from the N side of the square ditch and the main enclosure ditch, being in a slightly finer grained material compared with the sand-dominated lining, which fired to a pink colour, which was found in the northern areas. Whether this small sample is sufficient to suggest derivation from two different hearths is uncertain.

## Discussion

All of the identifiable slags recovered are related to the smithing of iron. The slag cakes from the "smithy" pit are small, but are linked by a granular fabric to the slightly larger and somewhat more conventional slags found in the other contexts. The concreted material in the "smithy" pit contained much flake hammerscale, supporting the attribution of this material to bloomsmithing. The granular texture of all the smaller slag cakes is unusual. It might indicate an unusual chemistry for the slag forming system, which has precluded it forming a free-flowing melt, but it might equally indicate that the smithing work was being undertaken at a fairly low temperature.

The larger slag cakes from the terminal of the square feature (1531) are also within the morphological range of smithing slags; indeed the complete cake has the most classic plano-convex form of all the slag cakes found. The textures of these pieces indicate that the slags have been more fluid, presumably reflecting that the process was undertaken at a higher temperature than for the smaller cakes. The weight of the complete cake (2.3kg) is unusually, but not impossibly, high for a plano-convex slag cake produced during bloomsmithing and is more typical of the weight of a bloomsmithing cake. In either case, the slags indicate a longer period of working and at higher temperature, than for the remainder of the assemblages, and that suggests a process involving a higher proportion of welding.

## Conclusion and suggested programme of further work

The slag assemblage was indicative of a range of iron smithing activities. The association of the iron working slags and smithing micro-residues with the "smithy" pit suggests that this feature might be connected with the iron-working activity, but its slightly unusual form for a low-level smithing hearth, and the fact that the slag rich fill must be a disusage rather than a usage context, means that relationship is presently unclear.

Although a low-level of smithing activity is commonplace, or even expected, on rural settlements, there are aspects of the Coldfurrow assemblages which make them worthy of more detailed research. In part, this reflects how little we really know about early blacksmithing; assemblages which beyond the limits of conventional dense plano-convex slag cakes may have much to tell us about the technology and the use of the hearth.

The co-variation in slag texture with cake size would be worthy of further investigation and documentation, with a view to determining whether the unusual granular fabric was a result of low temperature or of a poorly fluxed system. Such an investigation should involve both microstructural and chemical analytical studies of examples of the three classes of slag cake. Chemical analysis of the slags, taken together with analysis of the hearth linings, may also be able to suggest whether the larger cakes were from blacksmithing or bloomsmithing.

The textural investigations might involve preparation of polished blocks from examples of the three slag classes (total four blocks) for investigation under the SEM. The chemical analyses might include two samples from each slag class and each lining type (total ten analyses). The analytical costs would be approximately £160 for preparation of the blocks and £700 for major and trace elemental analyses. The project would require a total of three days (£480), bringing the total costing for the suggested programme to £1340.

## Catalogue

1103 595g. small irregular plano-convex smithing hearth cake, tapering to one end. 115x100x50mm

1106 Small fragment of lining (16g) as 1511/1517.

1511 c. 40 pieces of smithing debris. The largest is 100x120wide x 40 plano-convex cake. Several pieces of hearth lining are extremely sandy and fired pink. These may possibly be fired stone rather than artificial ceramic. 1603g total

1517 slab (102g) of well flowed (and relined?) hearth wall. Vitrified surface convex. Rear of specimen pink (as 1511), but texture suggests that it is an artificial lining. Irregular fragment (43g) of rusty vesicular slag with included wall material.

1523 3 incomplete granular, vesicular, plano-convex hearth cakes. Small fragment 243g. Intermediate piece 844g 120x110x55mm. Largest piece 1041g, 160x110x60mm.

1526 3 very granular hearth cakes. Not classic plano-convex. Larger one may have hammered upper surface. Probably all incomplete. 1540g total

1526 c. 6 pieces (47g) of vitrified lining as 1573/1561

1531 Large plano-convex hearth cake in two pieces (2188 and 117g). 190x150x70mm. Highly vesicular texture with charcoal moulds. Also two pieces (100 and 420g) from similar cakes.

1531 165g fragment of vesicular plano-convex cake.

1540 Not slag. 1 piece of pottery, 3 pieces of reduced fired clay and 1 piece of coal.

1561 1110g of larger pieces, 174g of smaller pieces bagged separately. Assemblage contains a few pieces of Mn-stained sandstone, but otherwise comprises smithing debris. Concreted material attached to the slag is rich in charcoal and flake hammerscale. No plano-convex pieces, rather the slags are thin and platy, with a granular texture.

1561 29g total comprising 9 pieces of slagged lining. Fabric is a red silty clay.

1561 c. 25 pieces of small slag debris, including granular materials. 1 piece of sandstone. 1 piece of fired lining.

1573 Small rusty hearth cake (238g, 115x75x50mm) with very rusty base and better-flowed protrusion, together with a similar fragment (27g). All similar to material from 1561.

1573 c. 16 pieces of variably slagged lining as 1561. Total 307g.

4010 small fragment of coked coal