

# GeoArch

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Evaluation of possible  
archaeometallurgical residues from  
Llanbeblig (G2060), Phase 5

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# Evaluation of possible archaeometallurgical residues from Llanbeblig (G2060), Phase 5

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## Abstract

*The submitted material comprised six collections of magnetic residues from sieved samples and one isolated slag fragment.*

*Much of the magnetic material was natural, but all samples contained some pyrotechnological residues. Most of these pieces were low-density, glassy, vesicular slag, often occurring as rounded blebby pieces or sub-spheroidal droplets. These were attributable to being fuel ash slags. Although such fuel ash slags may be generated in metallurgical hearths, they may also be generated through the partial melting of small fragments of soil or hearth clay in other sorts of pyrotechnology – such as corn-drying kilns. Some of the fuel ash slags may have been clinker – the partially fused residue from the burning of coal. Such materials are extremely hard to distinguish in small grains, but the occurrence of grains of coal in the assemblage strengthen the likelihood that at least some of the fuel ash slag is clinker.*

*Some of the slag material was denser and better crystalline and may have been true metallurgical slag – although was identifiable with certainty. One spheroid (from c5041) was probably spheroidal hammer scale from iron-working, but other spheroids were less certainly metallurgical.*

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## Methods

All investigated materials were examined visually using a low-powered binocular microscope where necessary and were summarily described and recorded to a database (table 1). As an evaluation, the materials were not subjected 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 conducted for the Gwynedd Archaeological Trust.

## Results

The summary catalogue is presented in Table 1.

The six micro-residue assemblages are rather similar in general character. Most contain fuel ash slags, most contain material that is probably clinker and some contain coal. Samples <522> and <523> contain the material most likely to be from iron-working, but only the spheroidal hammer scale particle from <522> can be attributed to iron-working with a high degree of confidence.

Identification of tiny grains of slag material by visual inspection is notoriously difficult and imprecise, because they lack many of the morphological criteria used to identify larger pieces. Indeed, even certain differentiation from natural iron-rich minerals and crusts, manganese-rich crusts and similar materials can also be extremely difficult.

The present material includes both crystalline slags and dark glassy slags. Much of the material lies within the potential range of morphology of the fuel ash slags. This rather broad term encompasses those 'slags' formed by the partial melting of particles of soil, rock, hearth ceramic or inorganic inclusions within a fuel, under the influence of the fluxing properties (i.e. the capacity to lower the temperature at which a material starts to melt) of the alkali and alkaline earth elements (particularly potassium and calcium) that are present in many fuels.

Fuel ash slags may be generated in many circumstances, but often in metalworking hearths these materials become strongly influenced by elements such as iron – and become converted into true metallurgical slags. They are therefore particularly characteristic of non-metallurgical processes and settings – such as corn drying kilns (e.g. Young 2005, 2010a and 2010b).

Sharing many features with these fuel ash slags are a particular group of fuel ash slags in which the silicate component derives from the fuel itself – these are the slags generated from the burning of coal, which are generally known as clinker. Clinker can usually be distinguished from other sorts of fuel ash slag by density (it is usually denser), colour (often taking a maroon surface colour rather than the tan surface common on other fuel ash slags) and by frequent inclusions of bloated and vitrified coal shale. At least some of the present material shows aspects of these features, although they are not applicable with certainty at the grain size of these samples. The presence of coal fragments in some samples strengthens the likelihood that at least some of the fuel ash slags in the present material derive from the burning of coal.

## Interpretation

The assemblage lacks particularly clear evidence for iron-working (besides one single particle of reasonably certain spheroidal hammer scale), with a complete lack of any associated macroscopic iron-working slags. This makes it unlikely that iron-working was being undertaken in the immediate vicinity of the investigated area.

The residues were dominated by various forms of fuel ash slag, including probable clinkers. Such materials might derive from a wide variety of domestic and 'industrial' activities. Clinker is a common residue from 19<sup>th</sup> to early 20<sup>th</sup> century steam-driven agricultural machinery, quite apart from its widespread production in industrial processes. The possibility of contamination by intrusive materials remains a possibility with very fine-grained clinker, even in apparently well-stratified contexts.

If the clinker and coal are secure, then they suggest a Roman or medieval (or later) age for the assemblages, for significant transport of coal away from the coalfields is not seen in either the pre-Roman or early medieval periods.

## Evaluation of potential

The material has no significant potential to yield useful information through further investigation, unless any of the samples is clearly anachronistic, in which case further clarification might be required.

## References

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- YOUNG, T.P. 2010a. Fuel ash slags from corn-drying kilns, South Hook LNG Terminal. *GeoArch Report 2010/04*, 24 pp.
- YOUNG, T.P. 2010b. Fuel ash slags. P. 163 in: Crane, P & Murphy K., Early medieval settlement, iron smelting and crop processing at South Hook, Herbranston, Pembrokeshire, 2004–05. *Archaeologia Cambrensis*, **159**, 117-196.

| c    | s   | f   | label on bag        | no  | notes                                                                                                                                                                                                                                                                                  |
|------|-----|-----|---------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5023 | 502 | 516 | metalworking debris | c17 | Mixed assemblage, several pieces of probable manganese crust, two, at least, small vesicular slag fragments, one probable clinker bleb and two pieces of coal. Also several dense pieces of probable natural iron oxides and other rocks.                                              |
| 5041 | 503 | 519 | metalworking debris | c27 | 2 blebs of clinker appearance, 1 piece of coal. 2 fragments of possible grey slag, remainder probably stone. 2 pieces are thin grey sheet, one with maroon surface, but these resemble burnt iron crusts more than slag - but not certain.                                             |
| 5041 | 504 | 522 | metalworking debris | c56 | One metallic lustred small spheroid appears like true spheroidal hammer scale. Other slag fragments are possible and there are definite fuel ash slags. One dull weathered slag spheroid, various other possible slag/possible manganese crust fragments.                              |
| 5041 | 505 | 523 | metalworking debris | c80 | Assemblage dominated by a wide variety of mainly dark glassy slags - ranging from individual rounded blebs to angular fragments. Some are certainly fuel ash slag, but others are less diagnostic. No absolutely certain metalworking residues, but much of this material probably is. |
| 5056 |     | 530 | metalworking debris | c33 | Various small fuel ash-like blebs, one 2mm diameter vesicular slag sphere apparently containing sand grains, slag blister with metallic lustre and 'lumpy' surface cf. clinker and other rather undiagnostic pieces, as well as rock and possible concretion fragments                 |
| 5067 | 509 | 531 | metalworking debris | c70 | Several blebs and fragments of probable slag and clinker, 3 pieces of coal, one piece of rust, remainder mainly natural                                                                                                                                                                |
| 5067 | 509 | 532 | slag                | 1   | A fragment of a fuel ash slag. A complexly rounded, blebby, piece with tan surface locally. Shows various pale clasts embedded in dark glass, one of which is broken and is bloated and foliated. This suggests, but does not prove the piece is clinker.                              |

Table 1. Summary catalogue of material from Llanbeblig (G2060) Phase 5

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