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Assessment of residues from Ballacegan, Isle of Man

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Abstract

The submitted material comprised almost 5kg of sorted flotation residues and approximately 1.3kg of hand-picked material, including a substantial crucible sherd. Of this, a tiny proportion (including just 10g out of the 5kg of flotation residues) was related to archaeometallurgical activity.

The crucible fragment and a very limited number of tiny slag fragments, however, provided evidence for some metallurgical activity in the area of Trench A. This is likely to be associated with the casting of copper alloy. There was no substantive evidence for the working of iron.

The occurrence of grains of coal may be natural. A few tiny blebs (total weight <0.02g) are possibly of clinker (a slag formed from the ash content of coal) but are of uncertain identification (similar melts may be produced from other initial materials); if true clinker then they are likely to be intrusive.

Contents

Abstract 1

Contents 2

Methods 2

Description of the assemblage
- General 2
- Crucible 2
- Lining slag 2
- Fuel ash slag (FAS) 3
- Coal and coal residues 3
- Fired clay 3
- Other slag 3
- Host sediment 3

Distribution of the assemblage 3

Interpretation 3

Further work 3

References 3

Table 1: Summary Catalogue 4

Methods

All materials were examined visually, using a low-powered binocular microscope where required. As an assessment, the materials were not subjected to any high-magnification optical inspection, not to any form of instrumental analysis. It is particularly difficult for certainty in the optical identification of very coarse sand grade (1-2mm) and granule grade (2-4mm) particles. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

This assessment was conducted in April 2023. The work was commissioned by Dr Harold Mytum of Liverpool University.

In contrast to normal GeoArch practice, the large quantity of material coupled with the tiny proportion (10g; approximately 0.2% of the sieved samples) of archaeometallurgical residues meant that it was not practical to catalogue all the supplied materials. A catalogue of the relevant materials is presented in Table 1, but only general remarks are made about the containing sediments.

Description of the assemblage

General

The submitted material comprised almost 5kg of sorted flotation residues (5.45kg including plastic bags) together 1.3kg of hand-picked material including a substantial crucible sherd.

The flotation residue proved to contain less than 0.2% of possible archaeometallurgical materials.

Crucible

The single sherd of crucible (sf <27> from context (1014)) is very irregular. It extends downwards for a height of 30mm from the lip but does not quite reach the base of the vessel. The lip is slightly angular in plan but subtends an obtuse angle. It is unclear whether this is represents a corner of a triangular crucible with bowed sides or is simply deformational. The interpretation of this and other aspects of the morphology, is complicated by the plastic deformation that appears to have occurred when the vessel was hot.

The sherd shows a marked bulge on the exterior surface and the wall has separated slightly into two layers.

The fabric is quartz-rich. The wall is typically approximately 10mm thick. The upper part of the wall, both inside and out, shows a red glaze/slag indicating contamination by copper. The lower part of the interior shows instead a local grey slaggy film and small adhering globules. The outer wall appears to have sloughed downwards slightly, below which the lowest preserved section of the outer surface is grey in colour and apparently unvitrified, although it carries a thin green wood ash glaze.

Lining slag

There are seven fragments of lining slag identified amongst the flotation residues with a total weight of 7.93g. One 3.6g fragment is a rounded bleb with a small area of reddening, suggestive of copper contamination. The other fragments comprise a dark glass bearing partially-melted quartz grains. Some are flattened, suggesting they formed against a surface, perhaps a tool, but one has a particularly sandy planar face, suggesting that it formed on a sandy substrate.

Four larger fragments (total 22.4g) were present in the other collections. These were lobate, highly vesicular, and in one instance included a highly bloated piece of partially melted ceramic or stone. In one example a markedly maroon-coloured surface was preserved.

Fuel ash slag (FAS)

The term fuel ash slag (FAS) is used here for materials that are interpreted to have undergone partial melting (vitrification) through the fluxing influence of the wood ash from the charcoal fuel. Although the lining slag category (see above) might also be considered a fuel-ash fluxed slag, this category is reserved for pale (grey or cream-coloured), highly vesicular, often ‘frothy’ materials. This class was presented by just two fragments with a total weight of 0.99g.

Coal and coal residues

Four contexts produced single tiny grains of coal, one context produced a larger 13.5g lump of coal and two yielded small droplets of possible clinker, the slag-like material generated from the melting of the inorganic component of coal (the coal ash). Certain separation of clinker from the other forms of fuel ash slags described above in grains of this small size is very difficult.

The presence of coal is not necessarily through human agency, for it may just be another facet of the geologically-diverse natural sediment (see below).

Coal was not generally transported around the Irish Sea basin for fuel before the 13th century (when it was moved in considerable quantity to aid the Edwardian campaign of castle-building; although some limited movement of coal did occur in the Roman period, Smith 1997). Any coal present as fuel debris and true clinker derived from coal burning is likely to be intrusive into any earlier sediments.

Fired clay

The separation of fired clay from natural materials of similar grain size is very difficult at a fine grain size. Two pieces were tentatively identified, one of 5.47g, the other of 0.97g. Neither piece showed indications of vitrification and neither need necessarily to be associated with metallurgy.

Two further pieces of probable fired clay were recovered from the hand-picked collections. In both case the materials were oxidised fired and well-tempered with sand and some coarser grit.

Other slag

A single tiny fragment of vesicular siliceous material, with a dominantly green colour, but locally reddened, may possibly be a fragment of copper-contaminated slag. The size and distribution of the vesicles, however, matched that of some of the rhyolite fragments, and the identification of the sub-0.01g grain as slag is dubious.

Two small (<0.01g) particles of iron-rich material were identified as possible residues. One was small particle of rusty material, that might have been derived from corrosion of an iron object (although generation as a weathering crust on an iron-bearing rock cannot entirely be excluded. The second was a single isolated piece that appeared to be flake hammerscale (FHS). This would be the sole indicator of iron-working from the site. A single piece of FHS could easily be intrusive.

Host sediment

The sediments were notable for the extreme diversity of the geological materials present. Rock types present at granule and pebble grade included granite, gabbro, microgranite, rhyolite, schist, slate, mudstone, arkose, quartzite, limestone, chert, vein quartz and sulphide concretions, in addition to the coal discussed above. Many of these lithologies were present in a very weathered state, particularly the limestones. This diversity is likely to reflect derivation from glacial deposits.

Many of the samples included a high proportion of occupation material, including charcoal, ash and bone. Both fresh and burnt bone was present, with the fresh bone typically in small irregular fragments suggestive of having passed through the gut of an animal (probably a dog) before burial. In some samples there appeared to be a close relationship between bone debris and the formation of the iron/manganese oxide particles.

The presence of abundant burnt material and charcoal in the absence of metallurgical residues makes it likely that the burnt deposits derived from the dumping of waste from non-metallurgical hearths.

The sediments were often overprinted by diagenetic iron and manganese oxides. These commonly appeared as rather amorphous concretionary materials (often in association with charcoal), soil peds, crusts and tubular concretions (formed around plant roots and/or animal burrows).

Distribution of the assemblage

The distribution of resides by context is provided in Table 1. No detailed information has been supplied on the geographical distribution or stratigraphical relationships of the contexts, so no interpretation can be drawn from the distribution.

Interpretation

The evidence for metallurgical activity at the site was very sparse. The crucible sherd and the fragments of lining slag are the only reliable indicators for the activity and suggest the casting of copper alloys. A single example of FHS is insufficient to suggest ironworking.

The scarcity of the residues suggests that working of copper alloys was presumably itself not a regular activity. The contradiction of sparse evidence for a craft activity requiring considerable expertise is likely to mean that the copper ally work was undertaken by a visiting artisan.

The evidence bears close comparison with that from Ballanorris (Young 2023), differing only in preservation of a crucible fragment rather than the mould fragments seen from that site (both forms of technical ceramic would have been required to undertake the work). It would appear likely that the two sites operated similarly within the metalworking ecosystem.

The form of the crucible remains uncertain although a triangular shape is perhaps most likely (compare, for instance, with the better-preserved examples from Gussage All Saints, illustrated by Spratling 1979, Figure 99). The concentration of deformation close to the rim of the piece is also reminiscent of the form illustrated by Spratling and scribed by Bayley & Rehren 2007 to having been heated from above (in a tradition extending back into the Bronze Age). In the present example, the highly siliceous fabric more closely resembles that of refractory vessels intended to be heated from below and indeed some glazing extends down to the lowest point preserved on the sherd/

Further work

Analysis of the surface of the crucible sherd by pXRF would aid determination the copper alloy being worked but is not of high priority.

References

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Table 1: summary catalogue of archaeometallurgical residues and coal identified from the submitted materials. Weights in g. Assm = assemblage. Labels edited for brevity and spelling.

project	trench	context	sample	label	l wt	l no	notes
BC12	A2/5	1025	198	conglomerate	1	1	small piece of probable lining slag
BC12	A2		202	Draw #201 Layer A slag	3.6	1	rounded bleb of lining type slag, one small area is reddened suggesting copper contamination
BC12	A2		203	Draw #201 Layer B slag cong	0.16	1	flake of lining slag, has a planar attachment surface so may have spalled from workpiece or tool
BC12	A2		207	Draw #203 layer A burnt material slag non mag	0.25	1	FAS bleb
BC12	A2		207		5.47	1	possible fired clay - dispersed sand grains in finer matrix, orange-grey
BC12	A2		214	Draw #204 Layer A magnetic material	0.16	1	small fragment of dark sandy lining slag
BC12			215	Draw #204 Layers B,C,D magnetic material	<0.01	1	vesicular lining slag fragment
ditto				ditto	<0.01	1	small concretion fragment with some laminated secondary iron oxides - just possibly artefact rust
BC13	A	1003		slag	1.24	1	Green glazed sandstone pebble
ditto				ditto	4.31	1	Possible complex lining slag or volcanic rock
BC13		1014	217	slag/cong	0.97	1	possible pottery/fired clay, has fine sand dispersed through a finer matrix
BC13		1014	247	slag?	3.01	1	thin sheet of lining type slag, one side suggests this has been peeled from a sandy substrate
BC13		1014	<27>	crucible fragment	24.57	1	very irregular crucible sherd, slightly angular lip, outside which is large bulge. Fabric separating slightly, very quartz-rich, grey exterior near base where not overlain by sloughed glaze. Lower internal wall shows small melt blebs, but red subsides (covers most of outside). 30mm high, wall 10mm except by bulge where much thicker
BC13	A	1014		slag	8.30	1	Lobe of highly bloated FAS including probable bloated lithic
ditto				ditto	11.79	1	Possible fired clay
BC13	A	1038		unknown	1.25		Possible coarsely tempered fired clay
BC13	A	1045		slag	8.05	1	Deformed lobes of very low density lining slag, partly surfaced with maroon, partly dark glass with crystals. Clinkery
ditto				ditto	1.75	1	Lobe of low density lining slag, 1 side planar, the other possible impressed by cylindrical object
BC12	B2		591	Draw #712 layer F magnetic material	<0.01	1	single fragment of FHS
BC12	B2		601	Draw #703 layer A bloom (non-mag)	0.74	1	possible FAS
BC12	B2	6063	605	Draw #708	<.01	1	coal
BC12	B2		609	Draw #707 layer G glassy slag (mag)	<.01	assm	material very small but appears to have two types of material - firstly a glossy black material with porous structure - could be coke/bone, second includes some small blebs and droplets of what looks like clinker
BC12	B2		617	Draw #702 layer G	<.01	1	coal
BC12	B2		624	Draw #721 layer H magnetic	<.01	1	single fragment of lining slag
BC13	B2		647	Draw #725 layer A conglomerate, burnt mat, slag?	5.18	assm	mixed stones, tiny shiny fragments are coal
BC13	B2		665	Draw #726 layer M magnetic material	<0.01	1	single grain of vesicular material that could possibly be copper slag, but might be reddened rhyolite
BC13	B2		674		0.08	1	tiny laminated particle of uncertain nature - could be foliated slag, pitchstone or even coal?
BC13	B2		674	Draw #730 layer A glassy Slag?	<0.01	2	tiny fragments of slag/clinker
BC13	B1	General clean			13.45	1	Rounded lump of weathered or partly burnt coal

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