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Evaluation of possible archaeometallurgical residues from Mallin Street, Wexford (E2901)

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Abstract

The samples were variable in character. Those from c6 were likely to have been the residues from a substantial coal-fired piece of plant, perhaps a stationary steam engine. Materials from c19 were suggestive of a concretion formed from the corrosion of possible swarf from metal turning. Microresidues from the forging of iron or steel were recovered from c105, c111 and c114, but were present in fairly modest quantities.

No detailed stratigraphic report was available during the course of this assessment. The conclusions drawn and recommendations made may need revision when such information becomes available.

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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. The summary catalogue of examined material is given in Table 1. This project was undertaken for Richard Cook of the Gwynedd Archaeological Trust.

Results

Context 6:

The pyrotechnological residues from c6 are represented by three samples: #1, #12 and #16.

Sample #1 is present in two subsamples: 7.5kg of material from the retent at 0.25mm, 1mm and 5mm and a small sample of magnetic material extracted from the flot. This sample is of rather smaller grain size than the other two (although this may be in part due to its mode of collection). The assemblage is dominated by dark coloured clinkers, included abundant slagged shale fragments, together with some partially burnt coal (coke) and coal-shale fragments. The magnetic material from the flot includes clinker and coke, with many microscopic spheroids ranging in colour from dark through lilac to white. The clinkers were very variable, with some flow-lobed material, but most present either as small broken fragments or larger, crudely sheet-like pieces. The clinker is mainly finely crystalline and dark grey. There were no certain metallurgical residues present.

Sample #16 (7.25kg) mainly comprised fragments of clinker towards the coarser end of the size-range present in sample #1, being mainly in lobate masses of up to about 80mm. The clinkers were mainly mid-grey in colour and finely crystalline, often with abundant white siliceous partially melted inclusions. The sample contains a few substantial (60mm) pieces of unburnt coal.

Sample #12 (6.53kg) comprises larger (up to 180mm) clinker fragments than the other two samples. Many of these larger blocks are of strikingly flowed material, resembling material referred to as *flow slags* when of metallurgical origin. These represent the flow of a fluid melt through the fuel/ash bed. The sample also contains large pieces of highly porous, pale material with curved surfaces, of up 130mm. These are the highly bloated remains of partially-melted rock fragments. One fragment with a planar, sheet-like form, includes abundant ferruginous, rough, sintered material, probably representing accumulation of particulate materials on a firebox floor.

Context 19:

This context is represented by 11.5kg of material in sample #13. This iron-rich material is in the form of fragments of a sheet, typically of around 40mm in thickness. The lower (?) face is planar and fairly smooth, although slightly upturned close to the assume margins of the deposit. The upper (?) surface is less regular, but also approximately planar.

The material is not a slag or pyrotechnological residue, but a very compact iron pan deposit formed by precipitation of iron minerals from solution, and presumably formed in the base of a container or structure.

The dense iron oxides surround abundant porosity, much of which appears to be moulds after a now

missing component. Some pores retain remnants of a fibrous organic material. A common form of mould is of a spirally-wound sheet, with the sheet apparently up to 5mm wide and 0.5mm thick, with the spiral having 3 complete revolutions and being 15mm wide. The sheet is traversed by thin 'partitions' of secondary iron oxides and sometimes shows a correspondingly serrated margin on side. The spiral moulds superficially resemble those firmed by the weathering and dissolution of metal turnings (swarf), but do not resemble some of the details of previously described examples (e.g. Young 2011 Plate A92; from an engineering works in Glasgow). The Glasgow examples share the segmented nature of the present material, but form much less regular spirals, rarely form planispirals and rarely form spirals with as many turns. At Glasgow, even in the highly corroded material from sumps below machines the swarf was not present as moulds. It is possible that the moulds were formed by a non-metallic material – perhaps leather.

Supporting the proposition that moulds are those of metal-turning and -grinding wastes are small clumps of what appear to be weathering products of copper-alloys, suggesting the possible working of some non-ferrous alloys.

The pan layer includes some artefacts besides the mouldic material, including pieces of window glass, ceramic and (apparently) a ferrous rivet.

Context 67:

This context is represented by approximately 13 pieces (14g) of small concretions (magnetic material from sample #20). These concretions appear to have grown on iron. One broken example appears to have formed around a small square-sectioned nail (now present largely as a mould).

The matrix of the concretions contains coarse sand and coal (although less coal than similar material from context 78). It also contains organic material, in the form of partially mineralised fragments of wood and an organic material with a smooth, dark surface layer (leaf, bark?).

Context 78:

This small assemblage (magnetic material from sample #23) contains approximately 35 fragments (22g) of ferruginous concretions, presumably formed around small fragments of iron - the iron oxides binding sand, coke and coal dust. One core is fine iron strip, 5mm wide and less than 0.5mm thick, one is a possible rectangular nail shank, 3mm x 2.5mm and several are fragments of pin-like round nails with 3mm diameter shaft and 6 mm diameter heads angling on to the shaft. Most of this former ferrous material is now present as moulds.

A separate bag of material (approximately 460g) from the same context was entirely of fuel residues – including some fresh coal, but mostly burnt and coked or slightly clinkery, present mostly as <20mm pieces.

Context 105:

This sample (magnetic material from sample #86) was approximately 90% stone, but also contained slag/clinker debris, flake hammerscale, spheroidal hammerscale, other spheroids and some coal.

Context 111:

This sample (12g of magnetic material from sample #95) contained stone, fishbones, some coke, a few slag or dense clinker fragments and a few spheroids of clinker or hammerscale.

Context 114:

This was represented by 17g of magnetic material from sample #92. The densest piece was a fragment of nail head. There was also a rounded dimpled piece of probable iron slag. The finer material was mainly stone, coke and rarer charcoal, but with a moderate proportion of slag/clinker debris, including many spheroids (some certainly spheroidal hammerscale) and also some moderately good flake hammerscale amongst the more dubious tabular material.

Interpretation

Interpretation of the material is hampered by the lack of a stratigraphic report available at the time of writing.

The submitted samples fall into several groups:

- Firstly, material from c6 is clinker in particularly large fragments. The large size of the fragments and the evidence for a very fluid 'slag', suggests that these clinkers were generated in a particularly large coal-fuelled hearth. There is no evidence that this was directly metallurgical and it appears likely that these clinkers may have been generated in the firebox of a large boiler, probably from a stationary engine, but given the location a marine engine is also possible. Other sorts of coal-burning plant might generate similar clinkers (kilns, gas works...), but it is unlikely that clinkers would have been generated on this scale in a domestic or small-scale industrial hearth.

- Secondly, the concretionary material from c19 is suggestive of accumulation of wastes from metal turning. This conclusion is not certain, because the 'turnings' are present entirely as moulds rather than preserved objects. This material contains no fuel waste (in contrast to all the other submitted samples).

- Thirdly, there are the assemblages from the concretions of contexts c67 and c68. These concretions are formed around small pieces of iron. These iron pieces may largely be nails or tacks, but in one case in c78 was a small piece of strip of similar dimensions to the possible swarf in c19. It is not clear whether the nails and tacks represent a potential product from the metallurgical activity, or whether they were simply artefacts from another process or structure.

- Finally, the residues from contexts c105, c111 and c114 contain a small proportion of iron-working microresidues (flake hammerscale and spheroidal hammerscale), alongside many other types of clast. These materials are indicative of the hot-working of ferrous materials. The presence of fishbones in these contexts indicate that the site of accumulation was not solely associated with metallurgy.

The materials thus provide evidence for both hot-working (forging) of ferrous materials (evidenced by the micro-residues in c105, c111 and c114) and probably of machining (swarf in c19 and possibly c78).

The clinkers from c6 probably provide evidence for substantial coal-fuelled plant, possibly a steam engine.

Evaluation of potential

The element of the assemblage with the most significant questions posed by the assessment is the concretionary material from c19. Interpretation of this material may be aided by detailed microscopic investigations. Such work would attempt to confirm/refute the suggestion that the planispiral moulds are those of metal swarf. Any additional work conducted on this material should, however, be subsequent to a thorough review of any additional evidence that might be gained from the stratigraphic context.

Other samples within the collection have little potential to provide additional useful data and do not require further investigation. The large clinker masses from c6 are unusual, but analysis rarely assists with the interpretation of coal-burning residues. However, this recommendation might need to be reviewed in the light of any further questions posed by the stratigraphic context of c6.

References

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