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THE IRONWORKING RESIDUES FROM ROMSEY, HAMPSHIRE.

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Summary

Excavations in the town centre of Romsey have produced large quantities of ironworking slags. The majority of these derive from the iron smelting process. Two technologies have been used, the most characteristic being the slag block or schlackenklotz technology. The smelting slags contained significant manganese oxide percentages. The date of the deposits has not been ascertained but it is proposed that they were of post-Roman date.

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The Ironworking Residues from Romsey, Hampshire.

1 Introduction

Archaeological excavations in Romsey have produced large quantities of ironworking slag, a large percentage of which derived from the iron smelting technology described as slag block or schlackenklotz. The limited extent of most of the excavations (trial holes, watching briefs etc.) means that the distribution of the ironworking activity cannot be determined fully, but the results do have significant implications for the understanding of the development of iron smelting technology in England. The ironworking residues examined were recovered from the following sites: Narrow Lane, A1980.83, Bell Street (Site Code AN1981.126), A1984.126, A1985.10, Maxwell, Newton Lane, Romsey Abbey (Site Codes RA73, RA75, and RA79.12), Teacourt and 1986.12.

2 The Classification of the Romsey Ironworking Residues

Ironworking residues are catergorised into two broad groups, the diagnostic residues and the non-diagnostic residues (McDonnell 1986). The former are those that can be attributed to the ironworking process, while the latter may have derived from any high temperature activity. The two groups are sub-divided into residue types, and in the case of the diagnostic residues they can be ascribed either to the smelting process (the extraction of the metal from the ore) or to the smithing process (the refining of the metal (primary smithing) and the manufacture and repair of artefacts (secondary smithing)).

2.1 The Diagnostic Residues

2.1.1 The Smelting Slags

Three types of smelting slag were distinguished; complete and partial slag blocks, smelting slag and tap slag.

The slag blocks (known on the Continent as 'shlackenklotz') are believed to have been formed by allowing the slag to drop into a pit below the furnace at the end of the smelting process, prior to removal of the bloom from the furnace (Clarke 1979, Tylecote 1973). The slag therefore freezes as a slightly tapering sub-conical block, with a rounded base, narrow top, and flattened sides, giving a polygonal, rather than a smooth, sub-circular transverse crosssection. The range and mean values of the dimensions of all the complete or near complete slag blocks recovered from Romsey are given in Table 1. The smaller blocks, in particular the shallow ones, may be slag cakes, ie slag tapped or raked into a pit outside the furnace, rather than true schlackenklotz.

TABLE 1 DIMENSIONS OF ROMSEY SLAG BLOCKS

	Range	Mean
Weight (kg)	1.5 - 40.0	8.8
Major Diameter (mm)	150 - 400	227
Minor Diameter (mm)	80 - 400	173
Depth (mm)	80 - 400	153

The smelting slag was randomly shaped pieces of slag with flowed surfaces and large charcoal impressions. The morphology indicated a viscous slag that had either been raked out of or had cooled within the furnace.

There was a small quantity of the characteristic tap slag. This was probably produced accidentally, due to higher temperatures, resulting in free flowing slag. It was probably generated if furnaces were raked out while high temperatures prevailed, or due to small break-outs of slag.

The relative quantities from all the sites of each smelting slag type is shown in Table 2. This shows that at the Narrow Lane site there was roughly equal weight of slag blocks and smelting slag present, with a small amount of tap slag. This pattern was reflected at the the other sites, except for the absence of identifiable tap slag, and that at the 1986.12 site there was double the weight of smelting slag than of slag blocks.

TABLE 2 QUANTATIES OF SMELTING SLAG TYPES FROM ROMSEY (Weight kg)

	Slag Block	Smelting Slag	Tap Slag
Narrow Lane	171.5	177.6	2.8
Site 1986.12	50.1	98.8	0.0
Other Sites	30.9	32.8	0.0

2.1.2 The Smithing Slags

Less than 4kg of smithing slag was identified, but it is possible that a small amount of smithing slag was wrongly ascribed to the smelting process (the difficulties of distinguishing between slag types is discussed elsewhere [McDonnell 1986]). This quantity must be considered as a background level of smithing slag, ie it is not evidence for smithing having been practiced on the areas excavated. Clearly, the metallic iron blooms would have had to have been refined (primary smithing), but this slag is the most difficult to distinguish from some smelting slags. Also, the iron would have had to have been smithed into artefacts, but this could have taken place elsewhere, e.g. the iron 'bar' could have been traded to nearby towns as a raw material for the local smiths, cutlers etc.. It is therefore, concluded that secondary iron smithing, the production of artefacts, was not carried out in the areas of archaeological excavation.

2.2 The Non-Diagnostic Residues

The non-diagnostic residues may have been generated by any high temperature process and can only be ascribed to the ironworking process by association. There were only two residues of this type recovered from the Romsey sites. There was a small quantity of cinder1 which is usually derived from ironworking, but not always. There was also a large deposit of vitrified hearth or furnace lining on Site 1986.12, with small amounts (less than 0.3kg) on other sites. The association of the lining with smelting slag indicated it was part of the furnace structure. Also several pieces were heavily slagged.

3 Distribution of the Slag by Site

3.1 Introduction

The distribution of slag is assesed using the weight of each type recovered from each context. Each individual slag type is considered to avoid comparisons of slags with widely differing densities (e.g slag blocks and furnace lining). It is difficult to assess the distribution of slag blocks by weight since they mostly occur as single large deposits, for example the 40kg of slag block in Context 16, Trench 3 on the Narrow Lane Site was a single block. Further, none of the slag blocks were found insitu, ie in the slag-pit. They are therefore either all disturbed or were deliberately re-deposited. This may also have applied to the other slags, but the overall quantities of slag in the area clearly demonstrate that ironworking was carried out in vicinity, and that any disturbance/redeposition was very local.

3.1 Narrow Lane

The largest quantity of slag was recovered from the Narrow Lane Site. A full listing of the slags recovered by trench and context number are given in Appendix 1. No smithing slag was positively identified, but some slag was thought to be possibly smithing rather smelting slag (<5kg), and only a small amount of cinder (0.1kg) and furnace lining (0.3kg) was recorded. It was the only site on which tap slag (2.8kg) occurred. There were large deposits of slag blocks and smelting slag, of which a significant amount of the former (36%) was unstratified (Trench 0, Context 0). The major deposits occurred in Trench 2 (18% of the total weight of slag blocks plus smelting slag, Contexts 4, 7,12, 14, 15 and 16), and Trench 3 (41%, Contexts 5 and 16), Trench 3A (11%, Context 2). In the other Trenches there was less than 5% of the total weight of slag block plus smelting slag. The two larges deposists of 'ore' occurred in two of the other Trenches (Trenches 1 and 8).

The nature and function of the contexts in which the slag was recovered has not been determined. But if they are disturbance or make-up layers it is improbable that the slag had been brought in from any great distance, due to the large size of the slag blocks.

3.3 Site 1986.12

Site 1986.12 produced smelting slag and some smithing slag.

The latter was a small amount and can be considered a background level. The majority of the slag (66%, Appendix 2) was smelting slag, ie randomly shaped pieces of slag and some fragments of slag blocks, with only three deposits of complete or near complete slag blocks. There were some particularly large deposits of slag in Contexts 4, 6, 38, 39 and 50. Two types of iron ore were identified, a hematitic ore and a ferruginous sandstone. There was a large amount of furnace lining (6kg), over 50% deriving from two contexts (4 and 39), which correspond to two of the large deposists of smelting slag.

The listings for the remaining sites are given in Appendix 3.

3.4 Site A1980.83

This site produced a small amount (background level) of smelting slag (3.4kg).

3.5 Site A1984.126

A single large slag block was recovered (17kg). The absence of other slag suggests it was re-used, eg. packing etc.

3.6 Site A1985.10

Small background quantities of all slag types, except slag blocks, were recovered.

3.7 Site AN1981.126

All slag types were recovered from the site. The largest quantity being 15.0kg of smelting slag, but there were only 5 contexts containing more than 1kg, of which two contained significant amounts, Context 42 (4.0kg) and Context 121 (5.0kg), and they are considered to be above 'background levels'. There was one large (6kg) slag block (Context 209).

3.8 Maxwell Site

Background levels of smelting slag and ore were recovered.

3.9 Newton Lane Site

A background level of smelting slag was recorded.

3.10 Teacourt Site

A background level of smelting slag was recorded.

3.11 Abbey Water Site

A background level of smelting slag was recorded.

(Abbey Sites)

3.12 Site RA73

Background levels of smelting slag and hearth/furnace lining were recovered.

3.13 Site RA75

This site produced nearly 5kg of smelting slag from 4 contexts, but it is considered to be background levels or re-used slag.

3.14 Overall Distribution

The iron smelting activity was concentrated on the Narrow Lane Site and Site 1986.12. Sites within a hundred metres to the east of Narrow lane, e.g. Teacourt, Newton Lane, Abbey Water etc produced only background levels of slag. To the north is the site of the Abbey, which again has only produced small quantities of slag. It is therefore considered that the irom smelting activity was located in the present Narrow Lane area.

4 Analyses of Slag Samples

4.1 Samples ROMNL/2 and ROMNL/3 from the Narrow Lane Site

An unstratified broken slag block was selected for analysis, it weighed 5.2kg, and had a maximum surviving diameter of 180mm and a depth of 110mm. It had broken from a block estimated to have similar dimensions to the largest one recovered from the site (weight 40kg). It had fractured on the upper and basal surfaces, but the 'sides' were present, and had a 'tap or flowed' appearance with rivulets of slag present. In cross-section the slag was fined grained with no apparent cooling surfaces (iron oxide layers) present. There were small (<3mm in diameter) vesicles present throughout, but they were larger (5mm in length) close to the (side) outer surfaces. The block tapered, similar to the complete example, but the 'way-up' could not be determined.

A vertical section was cut from the block fragment, and two areas were mounted and examined. The first (Sample ROMNL/3) was the central portion of the block, and the second (Sample ROMNL/2) from closer to the side surface of the block.

4.1.1 Sample ROMNL/3

The mineral texture was uniform, massive silicate (about 65% volumetric) and fine dendritic iron oxide (15%), some of which was orientated, in a glassy matrix (25%). The section was finely vesicular. The massive silicate indicates that the slag had cooled slowly, as would be expected for a large volume.

The bulk analyses (Table 3) were fayalitic, with significant but low manganese oxide contents and low potash and lime contents. The alumina contents were high in relation to the percentage of the other alkali oxides.

The silicate phase analyses (Table 4, SIL1 and SIL2) confirmed the presence of fayalite containing manganese oxide. The three glass phase analyses gave differing results, except in the high phosphorus pentoxide contents. GLASS1 totalled only 77.2% and had a high silica and low iron oxide (wustite) contents. GLASS2 also had a low total (74.1%) but was high in iron oxide (wustite) and low in silica (relative to GLASS1), and was very low in the glass forming oxides, calcium and potassium GLASS3 totalled 103.4% and had a typical glass composition. The iron oxide analyses (FEOX1-3) were consistent, and were rich in titania, indicative of a spinel structure.

4.1.2 Sample ROMNL/2

The mineral texture of Sample ROMNL/2 was the same as ROMNL/3, (massive silicate and fine iron oxide dendrites in a glassy matrix).

The bulk analyses (Table 5) were similar to those obtained for Sample ROMNL/3, with an average manganese oxide content of 1.3%, and was low in lime and potassium oxide. The analyses differed slightly in their alumina and silica contents, Sample ROMNL/2 was lower in alumina (mean=4.5%), and higher in silica (mean=27.4%), (values for ROMNL/3 were 5.4% and 26.7% respectively).

The silicate phase analyses (Table 6) were fayalitic containing manganese oxide and magnesium oxide. The glass phase had a typical composition, but had a high sulphur content (1.0%). The iron oxide analyses contained less than 5% minor oxides, the titania content was high (0.8%), and the elemental iron percentage was close to the magnetite level, (93.3% and 94.4%).

4.1.3 Comparison Between Samples ROMNL/3 and ROMNL/2

The mineral textures of both samples were the same, (massive silicate with fine iron oxide dendrites in a glassy matrix). The bulk analyses were similar particularly in the manganese oxide contents, which confirms the slags as smelting slags (McDonnell 1986). The silicate and iron oxide phase analyses were consistent between samples, but the glass phase showed typical compositional heterogeneity.

The general summary can, therefore, be that the two samples had the same mineralogical and chemical composition. This implies full miscibility and similar cooling conditions throughout the slag block.

TABLE 3 SAMPLE ROMNL/3 BULK ANALYSES (Weight Percent)

	B1	B2	B3	B4	B5
Na2O	0.5	0.2	N.D	0.1	0.1
MgO	0.5	0.5	0.4	0.1	0.5
Al2O3	5.1	5.7	4.7	6.6	5.2
SiO2	26.4	26.9	27.3	25.5	27.6
P2O5	0.6	0.7	0.3	0.5	0.6
S	0.1	0.1	0.1	0.1	0.2
K2O	0.7	0.8	0.3	1.8	1.6
CaO	1.1	1.4	0.8	1.6	1.5
TiO2	0.2	0.3	0.3	0.5	0.3
V2O5	N.D	0.3	0.1	N.D	0.1
Cr2O6	N.D	N.D	N.D	N.D	N.D
MnO	1.6	1.2	1.5	1.1	1.2
FeO	63.1	62.2	60.3	61.8	61.5
CoO	0.4	0.4	0.4	0.7	0.3
NiO	0.2	0.2	0.1	0.2	0.2
Total	100.5	100.9	96.6	100.6	100.9

N.D. - Not Detected

TABLE 4 SAMPLE ROMNL/3 PHASE ANALYSES (Weight Percent)

	SIL1	SIL2	GLASS1	GLASS2	GLASS3	FEOX1	FEOX2	FEOX3
Na2O	N.D	N.D	0.7	0.9	1.1	0.1	0.2	N.D
MgO	0.5	1.5	N.D	0.2	0.1	0.3	N.D	0.2
Al2O3	0.5	0.6	9.8	10.8	16.7	0.7	0.5	0.9
SiO2	29.1	30.3	49.1	27.2	37.7	1.0	0.9	1.0
P2O5	N.D	N.D	3.2	3.3	4.3	N.D	N.D	0.1
S	N.D	0.1	0.2	0.4	0.7	N.D	N.D	0.1
K2O	N.D	N.D	1.1	0.4	9.5	0.1	N.D	N.D
CaO	0.2	0.1	3.6	0.4	7.6	0.2	0.1	N.D
TiO2	N.D	N.D	0.4	0.1	0.6	0.8	0.9	0.9
V2O5	N.D	N.D	0.2	0.1	N.D	0.1	0.1	0.1
Cr2O6	N.D	N.D	N.D	N.D	N.D	N.D	0.1	0.2
MnO	1.6	2.1	N.D	0.1	0.3	0.2	0.3	0.3
FeO	67.4	66.3	8.9	30.2	25.1	95.8	95.0	94.7
CoO	0.1	0.4	N.D	N.D	0.1	0.3	0.2	0.6
NiO	0.3	0.2	N.D	N.D	N.D	0.4	0.2	0.2
Total	99.7	101.6	77.2	74.1	103.4	100.0	98.5	99.3

TABLE 5 SAMPLE ROMNL/2 BULK ANALYSES (Weight Percent)

	B1	B2	B3	B4	B5
Na2O	0.2	N.D	N.D	N.D	N.D
MgO	0.9	0.4	0.3	0.8	0.3
Al2O3	3.8	4.3	3.9	4.5	5.8
SiO2	29.0	26.6	27.6	27.4	26.2
P2O5	0.3	0.5	0.5	0.9	0.5
S	0.2	N.D	0.1	0.2	0.2
K2O	0.5	0.2	0.4	0.1	0.1
CaO	0.8	1.1	0.7	0.8	0.8
TiO2	0.2	0.4	0.3	0.2	0.2
V2O5	N.D	N.D	N.D	0.1	0.1
Cr2O6	0.1	N.D	N.D	0.1	N.D
MnO	1.6	1.4	1.2	1.4	1.0
FeO	64.4	60.5	62.9	61.1	63.9
CoO	0.3	0.6	0.2	0.3	N.D
NiO	N.D	0.3	0.3	0.2	0.2
Total	102.3	96.3	98.4	98.1	99.3

TABLE 6 SAMPLE ROMNL/2 PHASE ANALYSES (Weight Percent)

	SIL1	SIL2	GLASS	FEOX1	FEOX2
Na2O	N.D	N.D	0.2	0.1	N.D
MgO	1.7	1.8	0.3	N.D	N.D
Al2O3	0.3	0.3	14.9	0.5	0.4
SiO2	30.6	30.2	38.2	1.0	1.0
P2O5	N.D	N.D	5.7	0.3	N.D
S	N.D	N.D	1.0	N.D	N.D
K2O	N.D	N.D	6.9	0.1	N.D
CaO	0.1	0.2	8.6	0.2	N.D
TiO2	0.1	N.D	0.3	0.8	0.8
V2O5	N.D	N.D	N.D	0.1	0.2
Cr2O6	N.D	0.1	N.D	0.1	0.1
MnO	2.1	2.1	0.4	0.2	0.3
FeO	66.0	65.8	21.2	93.3	94.4
CoO	0.1	N.D	0.1	0.7	0.1
NiO	0.4	0.2	0.2	0.4	0.4
Total	101.4	100.7	98.0	97.8	97.7

4.2 Sample ROM12/1. Site 1986.12; Layer 6

Morphological Identification: Fragment of slag block.

Description: Broken fragment of a slag block, estimated weight 16kg. In cross-section it was similar to the example from the Narrow Lane Site, being finely vesicular with no charcoal inclusions.

Mineral Texture: Rounded globular iron oxide dendrites with euhedral/massive silicate in a small amount of glass matrix.

Bulk/Phase Chemical Composition: Only one area was analysed for comparative purposes. The results (Table 7) show that the slag contained a higher manganese oxide content than Samples ROMNL/2 and 3, which confirmed the slag as a smelting slag. The bulk analysis reflected the high free iron oxide content and the low glass percentage observed in the optical study, ie it was low in alumina, lime and potash. The phase analyses showed the expected segregation of the oxides, although the manganese oxide content of the free iron oxide phase was higher than usual.

Conclusions: Sample ROM12/1 had a similar mineral texture, but different chemical composition to Samples ROMNL/2 and 3. It displayed the expected slowly cooled mineral texture, (massive silicate). It was rich in iron oxide, (the smelting process was not, therefore, very efficient) and in manganese oxide. The percentage of glass (and glass forming oxides) was very low.

TABLE 7 SAMPLE ROM12/1 BULK AND PHASE ANALYSES (Weight %)

	B1	SIL	GLASS	FEOX
Na_2O	0.3	0.1	1.0	N.D
MgO	0.5	0.2	N.D	N.D
Al_2O_3	2.8	0.1	17.7	0.8
SiO_2	17.0	27.4	43.2	1.2
P_2O_5	0.7	0.4	3.1	N.D
S	N.D	0.1	0.1	N.D
K_2O	0.4	0.1	14.1	N.D
CaO	0.8	0.8	3.7	0.1
TiO_2	N.D	0.1	0.2	0.3
V_2O_5	N.D	N.D	N.D	N.D
Cr_2O_6	N.D	N.D	N.D	N.D
MnO	3.3	4.7	0.5	1.4
FeO	75.4	67.0	15.1	94.3
CoO	0.2	0.4	0.2	0.3
NiO	0.2	0.1	0.1	0.3
CuO	N.D	N.D	N.D	N.D
Total	101.6	101.5	99.0	98.7

4.3 Sample ROM12/2 Site 1986.12; Layer 24

Morphological Identification: Fragment of slag block

Description: A fragment of a large slag block. It had a similar morphology to Sample ROM12/1 but also contained silica/lining inclusions evidence of the reaction between furnace lining or the tapping-pit sides and the slag.

Mineral Texture: Fine iron oxide dendrites in massive silicate with a small amount of glass matrix present.

Bulk/Phase Composition: Only two areas and the silicate and glass phase were analysed (Table 8). The bulk analyses are characterised by low levels of manganese oxide and variable

FeO/SiO2 ratios. The alkali contents are similar to those of ROMNL/2 and 3 rather than ROM12/1, and the percentages of potash and lime are virtually equivalent, which is contrary to most other analyses in which the lime content is significantly greater than the potash. The iron oxide content is low reflecting the low abundance of free iron oxide dendrites observed in the optical study. The silicate phase was also low in manganese oxide, the glass phase was characterised by the high potash percentage.

The low manganese oxide content and the higher silica content was probably due to take up of silica by the slag due to the reaction with the furnace lining or pit wall.

Conclusions: The fragment of slag block was morphologically similar to the other examples, but showed evidence of a slag-lining(?) reaction. The mineral texture displayed the massive silicate form, expected of slow cooled slags. The presence of fine iron oxide dendrites, usually associated with rapid cooling probably derived from the low level of free iron oxide present in the slag, preventing massive growth.

TABLE 8 SAMPLE ROM12/2 BULK AND PHASE COMPOSITION (Weight %)

	B1	B2	SIL	GLASS
Na2O	N.D	0.5	0.3	0.5
MgO	0.3	0.4	1.2	N.D
Al2O3	4.7	5.8	N.D	17.4
SiO2	29.1	33.7	30.3	34.0
P2O5	0.6	0.8	0.3	1.0
S	0.1	0.2	0.1	0.1
K2O	1.3	1.5	N.D	6.7
CaO	1.2	1.8	0.2	1.8
TiO2	0.1	0.3	N.D	0.8
V2O5	0.1	0.1	N.D	N.D
Cr2O6	N.D	N.D	0.1	N.D
MnO	0.6	0.7	0.7	0.1
FeO	60.7	49.2	67.0	38.6
CoO	0.5	0.2	0.2	0.3
NiO	0.2	0.2	0.3	0.2
CuO	0.2	N.D	0.2	N.D
Total	99.7	95.4	100.9	101.5

4.4 Sample ROM12/3. Site 1986.12; Layer 4

Morphological Identification: Smelting Slag

Description: A randomly shaped piece of slag that displayed the morphology of smelting slag, ie large charcoal impressions, flowed surfaces etc., but was not part of a slag block.

Mineral Texture: Rounded globular iron oxide dendrites and euhedral/massive silicate in a small amount of glassy matrix.

Bulk/Phase Chemical Composition: The bulk analyses (Table 9) are equivalent to those obtained for Sample ROMNL/2 and 3, in particular in manganese oxide content, but they do differ in the FeO/SiO2 ratio. Sample ROM12/3 being richer in iron oxide. The phase anlyses do differ from previous examples, particularily in the presence of a significant alumina content in the silicate phase. The glass phase contained a high potash percentage but no (significant) lime content. The iron oxide phase had a typical analysis. A fourth phase (GLASS(?), Table 9) was analysed, and was primarily alumina and iron oxide, forming an iron oxide rich hercynite. The spinel structure being confirmed by the high percentage of titania present in this phase.

Conclusions: Sample ROM12/3 was chemically and mineralogically similar to the analysed samples of slag blocks. It is therefore probable that this sample is a fragment of a broken block or represents residual smelting slag removed from the furnace, eg by breakout or by some form of tapping, which resulted in its different morphology.

TABLE 9 SAMPLE ROM12/3 BULK AND PHASE COMPOSITION (Weight %)

	B1	B2	B3	SIL	GLASS	FEOX	GLASS?
Na2O	0.4	0.2	0.2	0.5	1.0	0.1	N.D
MgO	0.5	0.6	0.7	1.0	N.D	N.D	N.D
Al2O3	5.1	4.9	4.5	7.9	18.0	0.5	42.5
SiO2	16.0	17.1	18.2	23.2	49.6	0.7	1.3
P2O5	0.3	0.5	0.8	0.1	0.5	N.D	N.D
S	0.1	N.D	0.1	N.D	0.2	N.D	N.D
K2O	0.9	0.7	0.9	N.D	17.6	0.1	N.D
CaO	0.6	0.9	0.6	0.3	0.2	0.1	0.1
TiO2	0.3	0.4	0.3	0.3	0.2	0.5	1.1
V2O5	N.D	N.D	N.D	N.D	N.D	N.D	0.2
Cr2O6	0.1	0.1	N.D	N.D	N.D	0.1	0.2
MnO	1.7	2.0	1.7	2.8	0.2	0.9	0.9
FeO	63.7	72.0	68.4	60.6	7.4	94.4	49.2
CoO	0.4	0.3	0.3	0.2	N.D	0.6	N.D
NiO	0.2	0.2	0.1	0.2	0.1	0.2	0.2
CuO	N.D	N.D	N.D	N.D	N.D	0.1	N.D
Total	90.3	99.9	96.8	97.1	95.0	98.3	95.7

4.4 SampleROM12/4 Site 1986.12; Layer 38

Morphological Identification: Smithing Hearth Bottom?

Description: A typical hearth bottom with dimensions of:

Weight	0.440kg
Major Diameter	115mm
Minor Diameter	85mm
Depth	45mm

It had an agglomerated texture and a depression in the upper surface. In section it was vesicular at the edges and contained a large number of charcoal inclusions.

Mineral Texture: It had a varied texture, the silicate ranged from lath to massive, the free iron oxide from globular dendritic to massive, in a glassy matrix.

Bulk and Phase Chemical Composition: The analyses (Table 10) reflected the presence of massive iron oxides, which are higher oxides, possibly hydrated, thus giving low total values. The bulk analyses are characterised by an absence (ie below minimum detectable limits) of manganese oxide and the overall levels of glass forming (alkali oxides) is low, both are characteristic of smithing slags. The potash percentage is higher than the lime, which is unusual. The silicate phase analysis confirms it as fayalite. The glass analyses shows no unusual oxide percentages, although the phosphorus level is low. The iron oxide analyses contains a significant silica level, but the titania content was below detectable level, which contrasts with the iron oxide phase in Samples ROM/NL 2 and 3.

Sample ROM12/4 Summary: The slag had a morphology, mineral texture, and chemical and phase composition of a typical smithing hearth bottom. In particular the absence of manganese oxide distinguishes this sample from the examples of smelting slag analyses.

TABLE 10 SAMPLE ROM12/4 BULK AND PHASE ANALYSES (Weight %)

	B1	B2	B3	B4	B5	SIL	GLASS	FEOX
Na2O	0.6	0.4	0.5	0.3	0.6	0.4	0.4	N.D
MgO	0.1	0.2	0.2	0.5	N.D	0.5	0.1	N.D
Al2O3	2.5	3.4	2.5	1.8	0.9	N.D	3.0	0.5
SiO2	20.8	32.9	21.4	24.7	19.3	29.5	48.2	2.6
P2O5	0.4	0.3	0.1	0.3	0.3	0.3	0.6	N.D
S	0.1	0.1	0.1	0.1	N.D	0.1	0.2	0.1
K2O	0.8	1.5	1.1	0.7	0.8	N.D	0.6	N.D
CaO	0.7	1.0	1.0	0.6	0.8	0.4	0.8	0.1
TiO2	0.2	0.4	0.1	0.2	0.1	0.1	0.1	N.D
V2O5	0.1	N.D	0.1	N.D	0.1	N.D	N.D	0.1
Cr2O6	0.1	N.D	N.D	0.1	N.D	N.D	N.D	N.D
MnO	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
FeO	59.5	53.6	61.6	64.2	63.9	69.5	33.3	77.9
CoO	N.D	0.1	0.1	0.1	0.3	0.2	0.1	0.3
NiO	0.4	0.2	0.3	N.D	0.3	0.3	0.2	0.3
CuO	N.D	N.D	N.D	0.1	N.D	N.D	N.D	0.2
Total	86.3	94.1	89.2	93.7	87.4	101.3	87.6	82.1

4.6 Sample ROM12/5. Site 1986.12; Layer 30.

Morphological Identification: Iron Ore (Type 1).

Description: Boxstone type of ore, with iron enriched outer layer. In cross-section the core was blue-grey with some red veining prsent. The outer skin showed variation in colour, but was predominantly red or orange. Qualitative anlyses were made using X.R.F, and show that the ore contained minor concentrations of Al, Si, P, S, K, Ca and Mn. The outer skin contained higher levels of all these elements (except Mn), which may have been due to their absorption into the surface (iron hydroxides?) from the surrounding soil.

4.7 Discussion of Results

The slag blocks and smelting slag was morphologically distinct, but there was great difficulty in identifying smithing slag (either primary or secondary). The largest slag block indicated that the pit into which the slag was made to run was 400mm in diameter and 400mm deep. The analyses of the samples showed that the smelting slags contained between 0.6 - 3.3% MnO, with an inter-sample mean of 1.7%. This clearly distinguished them from the sample of smithing slag in which the manganese content was below the detectable level. In general the mineral texture of the slag block samples showed that they were low in free iron oxide, indicating an efficient smelting process. The silicate phase was usually massive indicating a slow cool which is in accordance with expectations, due to the large mass of slag in a block.

5 Conclusions

The examination of the residues from Romsey has shown that there was an iron smelting industry in the area of the present Narrow Lane. There were two major types of smelting slag the slag blocks and the smelting slag. This suggests the presence of two different types of technology, or a local variation of the slag block type. The European spatial distribution of slag blocks ('schlackenklotz') extends from Poland through North Germany into Scandinavia with a limited appearance on the eastern coast of England (from Kent to Lincolnshire). Romsey, therefore, represents the most western deposit of this slag type so far identified, but still a coastal location. The date of the slag block industry in England has not been ascertained, Clough (Pers Comm.) argues for an Iron Age date, but the evidence is very tentative and a post-Roman date is argued for, on the basis of the spatial distribution, and the estimated dates of some of the blocks.

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