OPTICAL MICROSCOPY

Sample: Iron smelting slag – Myers Wood D414s-D

Morphology:

Dense, dark grey/black slag material. Some visible vesicles, ranging in diameter from *c*.1mm to 5mm. Surfaces vary: one side smooth, no sign of ropey flow, whilst the opposite side is very uneven, possibly reflecting the surface over which the slag flowed.

Microscopy:

An iron oxide dendritic structure, mainly skeletal but some blocky features. Blocky fayalitic material (light grey) contained in a glassy phase (darker grey). A few very small iron prills observed and some evidence of blocky/angular phases (mid grey). No cracking in the sample structure noted.

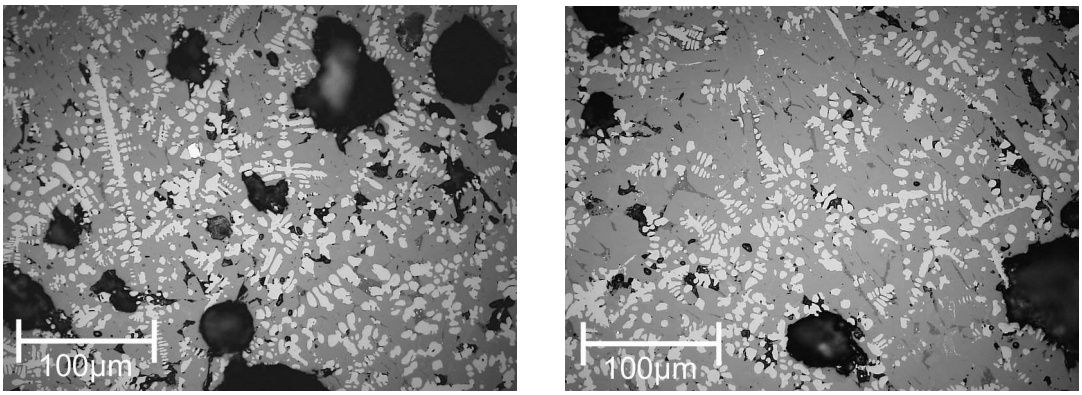


Figure 9.1: Morphological and optical microscopy data for Myers Wood iron smelting slag sample D414s-D from Appendix 55.

OPTICAL MICROSCOPY

Sample: Blast furnace slag – Rievaulx RIV 105/63-C

Morphology:

Very porous and lightweight, grey/green opaque material, lighter than RIV 111/68-A. Visible vesicles, either round (*c.*5mm in diameter) or rectangular (up to 6mm x 2mm). Signs of surface flow.

Microscopy:

No dendritic structure. An almost featureless glassy phase (mid grey) containing laths of darker grey material but no blocky/angular phases. A substantial number of small prills observed. A considerable quantity of voids in the sample structure noted, of varying sizes but with no associated cracking.

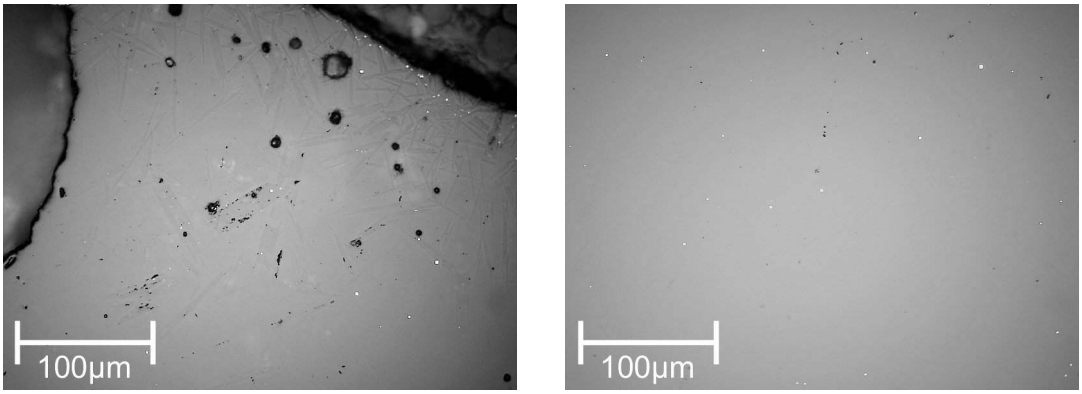


Figure 9.2: Morphological and optical microscopy data for Rievaulx blast furnace slag sample RIV 105/63-C from Appendix 55.

OPTICAL MICROSCOPY

Sample: Lead smelting slag – Grinton Smeltings GS-B

Morphology:

Dense, grey/black slag material. Very small visible vesicles (<0.5mm in diameter) throughout the body of the sample but some large voids (>5mm in diameter) on the surface. Some surface degradation with a white coloured material observed, possibly lead carbonate, and other yellow/red patches caused by iron oxide content.

Microscopy:

A considerable quantity of needles, laths and angular phases (darker grey) contained in an otherwise featureless glassy phase. Some larger blocky/angular phases (mid grey) and a large amount of small prills observed. A small quantity of voids, of varying size with some associated cracking noted.

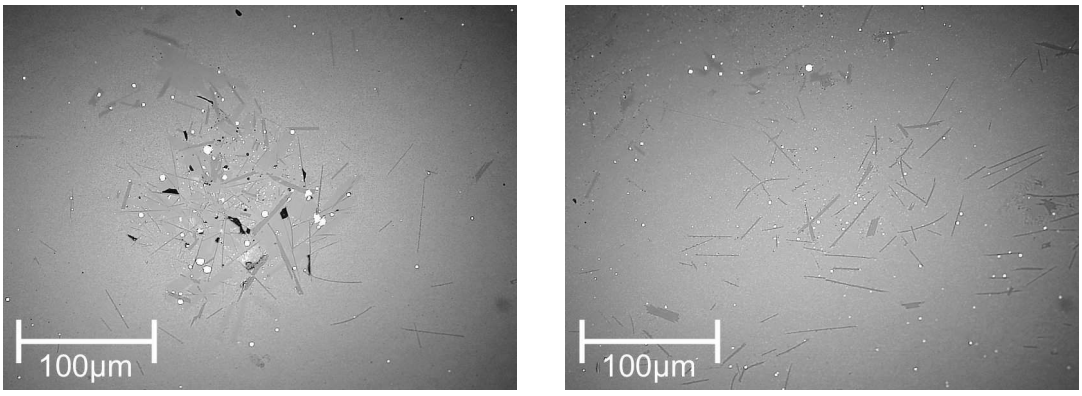


Figure 9.3: Morphological and optical microscopy data for Grinton Smeltings lead smelting slag sample GS-B from Appendix 55.

OPTICAL MICROSCOPY

Sample: Glass production residues – Hutton H4C

Morphology:

Dense, dark green translucent glassy material. A few visible vesicles, ranging in diameter from *c.*1mm to 2mm. Some surface degradation or oxidation observed.

Microscopy:

An almost featureless glassy phase containing a few blocky/angular phases (light grey). Some small voids, with no associated cracking noted.

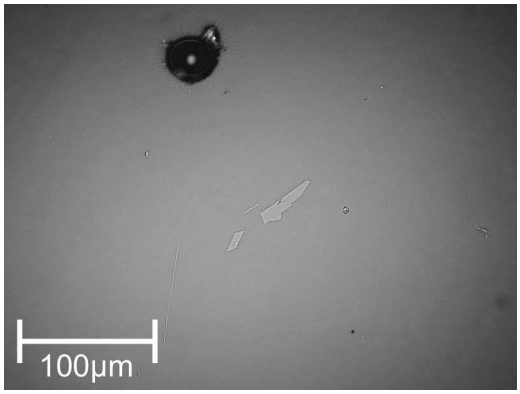


Figure 9.4: Morphological and optical microscopy data for Hutton glass production residue sample H4C from Appendix 55.

OPTICAL MICROSCOPY

Sample: Glass production crucibles – Knightons KC3

Morphology:

Dense, dark yellow/grey/blue-grey material, coarse with no sign of temper but evidence of layering. Very small visible voids, all <<1mm in diameter. Sample surface has a dark yellow/black coloration.

Microscopy:

A very porous fabric consisting of an even distribution of large grained material (light grey) interspersed with large voids (mid grey). Some very small prill-like inclusions (white) noted.

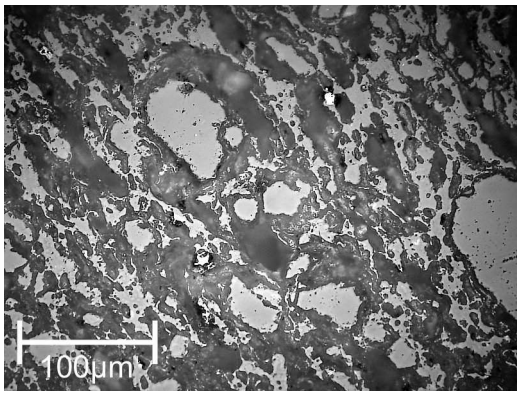
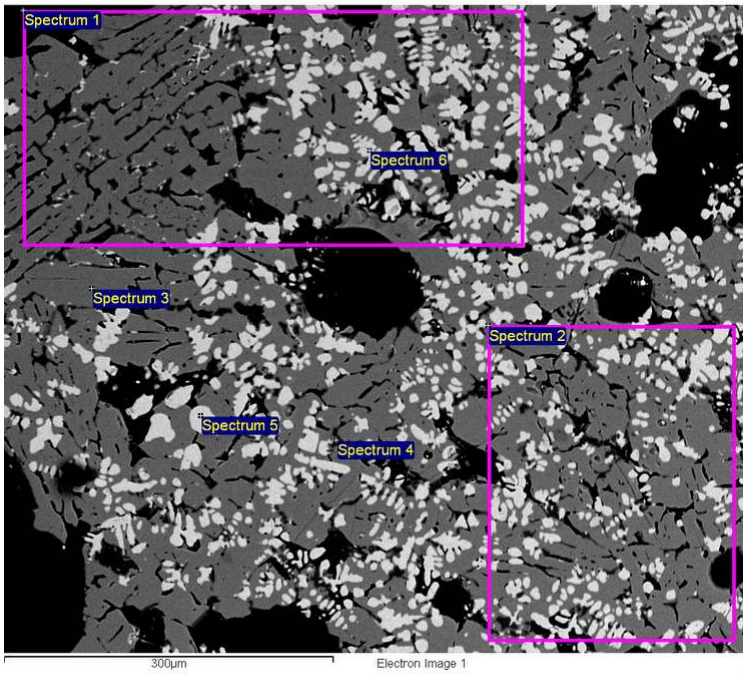


Figure 9.5: Morphological and optical microscopy data for Knightons glass production crucible sample KC3 from Appendix 55.



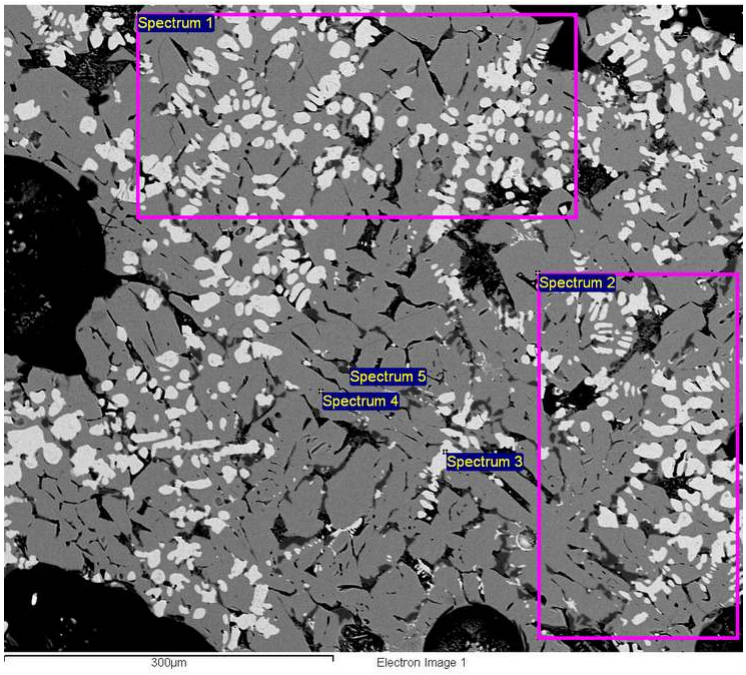


Figure 9.6: Scanning electron microscopy data for Myers Wood iron smelting slag sample D414s-D from Appendix 56: sites of interest 1 (upper) and 2 (lower).

SCANNING ELECTRON MICROSCOPY

Iron smelting slag **Sample** **Myers Wood D414s-D** **Site of Interest 1**

		Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase			Spectrum 4: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na2O	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Mg	MgO	0.2	0.1	0.3	0.2	0.0	0.3	0.4	0.0	0.7	0.1	0.0	0.1
Al	Al2O3	2.0	0.1	3.8	1.4	0.0	2.6	0.2	0.0	0.4	20.3	0.1	38.3
Si	SiO2	9.6	0.1	20.5	9.6	0.1	20.5	13.9	0.1	29.8	3.4	0.1	7.3
P	P2O5	1.3	0.1	3.0	1.2	0.0	2.7	0.4	0.0	1.0	0.2	0.0	0.5
S	SO3	0.0	0.0	0.0	0.1	0.0	0.1	n.d.			n.d.		
K	K2O	0.3	0.0	0.4	0.1	0.0	0.2	n.d.			n.d.		
Ca	CaO	0.8	0.0	1.1	0.7	0.0	1.0	0.2	0.0	0.3	0.1	0.0	0.1
Ti	TiO2	0.1	0.0	0.2	0.1	0.0	0.1	n.d.			0.4	0.0	0.7
V	V2O5	n.d.			n.d.			0.1	0.0	0.1	n.d.		
Cr	Cr2O3	n.d.			n.d.			n.d.			n.d.		
Mn	MnO	0.3	0.1	0.4	0.4	0.1	0.5	0.4	0.1	0.6	0.2	0.0	0.2
Fe	FeO	54.1	0.2	69.6	55.4	0.2	71.2	51.7	0.2	66.5	40.9	0.2	52.6
Co	CoO	0.3	0.1	0.4	0.5	0.1	0.7	0.4	0.1	0.5	0.2	0.1	0.2
Ni	NiO	n.d.			0.1	0.1	0.1	0.1	0.1	0.1	n.d.		
Cu	CuO	n.d.			n.d.			0.1	0.1	0.1	n.d.		
Zn	ZnO	n.d.			n.d.			n.d.			n.d.		
O		30.8	0.2		30.3	0.2		32.1	0.2		34.4	0.2	
Totals		100.0			100.0			100.0			100.0		

		Spectrum 5: Phase			Spectrum 6: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na2O	n.d.			n.d.		
Mg	MgO	n.d.			n.d.		
Al	Al2O3	0.7	0.0	1.4	0.4	0.0	0.8
Si	SiO2	0.2	0.0	0.4	0.1	0.0	0.3
P	P2O5	n.d.			n.d.		
S	SO3	n.d.			n.d.		
K	K2O	n.d.			n.d.		
Ca	CaO	n.d.			n.d.		
Ti	TiO2	0.2	0.0	0.3	0.2	0.0	0.2
V	V2O5	n.d.			n.d.		
Cr	Cr2O3	0.1	0.0	0.1	n.d.		
Mn	MnO	0.1	0.1	0.1	0.1	0.1	0.2
Fe	FeO	75.9	0.2	97.6	75.8	0.2	97.6
Co	CoO	0.4	0.1	0.4	0.5	0.1	0.6
Ni	NiO	n.d.			0.1	0.1	0.1
Cu	CuO	n.d.			n.d.		
Zn	ZnO	n.d.			0.1	0.1	0.2
O		22.8	0.2		22.6	0.2	
Totals		100.0			100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 2
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.6 (cont'd): Scanning electron microscopy data for Myers Wood iron smelting slag sample D414s-D from Appendix 56: site of interest 1 spectra analysis.

SCANNING ELECTRON MICROSCOPY

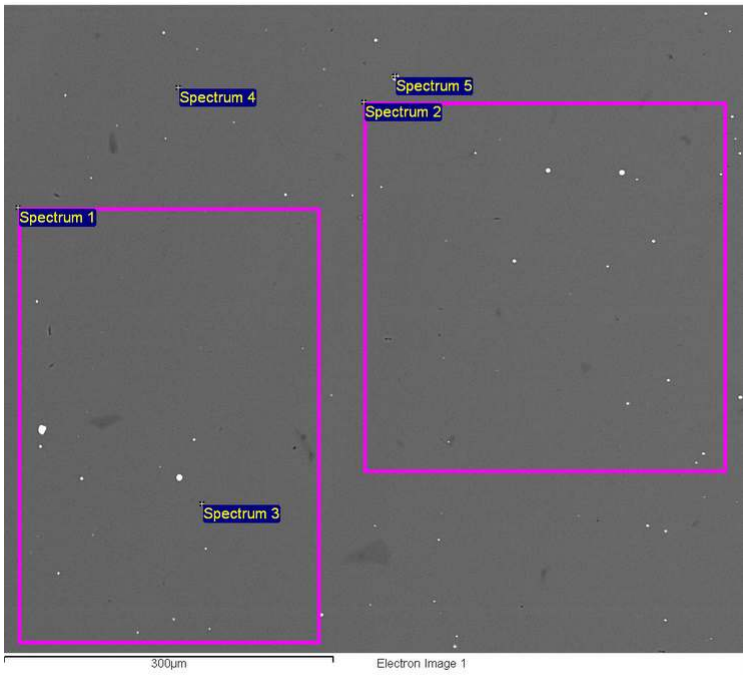
Iron smelting slag **Sample** **Myers Wood D414s-D** **Site of Interest 2**

		Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase			Spectrum 4: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na2O	0.1	0.1	0.2	0.1	0.1	0.1	n.d.			n.d.		
Mg	MgO	0.2	0.1	0.3	0.2	0.0	0.3	0.1	0.1	0.1	0.4	0.0	0.7
Al	Al2O3	1.7	0.1	3.2	2.0	0.1	3.7	0.6	0.0	1.0	0.2	0.0	0.3
Si	SiO2	9.5	0.1	20.2	9.5	0.1	20.4	0.2	0.0	0.4	13.9	0.1	29.6
P	P2O5	1.1	0.1	2.5	1.5	0.1	3.4	0.1	0.0	0.1	0.4	0.0	0.9
S	SO3	0.1	0.0	0.2	n.d.			n.d.			0.1	0.0	0.1
K	K2O	0.2	0.0	0.3	0.3	0.0	0.4	n.d.			n.d.		
Ca	CaO	0.6	0.0	0.9	0.9	0.0	1.2	n.d.			0.2	0.0	0.2
Ti	TiO2	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.0	0.3	n.d.		
V	V2O5	n.d.			n.d.			n.d.			n.d.		
Cr	Cr2O3	n.d.			n.d.			n.d.			n.d.		
Mn	MnO	0.3	0.1	0.4	0.4	0.1	0.5	0.2	0.1	0.2	0.4	0.1	0.6
Fe	FeO	55.0	0.2	70.8	53.8	0.2	69.3	75.5	0.2	97.1	52.0	0.2	66.9
Co	CoO	0.4	0.1	0.5	0.4	0.1	0.5	0.6	0.1	0.8	0.5	0.1	0.6
Ni	NiO	n.d.			n.d.			0.1	0.1	0.1	n.d.		
Cu	CuO	n.d.			0.1	0.1	0.1	n.d.			n.d.		
Zn	ZnO	0.2	0.1	0.2	n.d.			n.d.			0.1	0.1	0.1
O		30.4	0.2		30.8	0.2		22.7	0.2		32.0	0.2	
Totals		100.0			100.0			100.0			100.0		

		Spectrum 5: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%
Na	Na2O	n.d.		
Mg	MgO	n.d.		
Al	Al2O3	26.1	0.1	49.3
Si	SiO2	0.6	0.0	1.3
P	P2O5	0.1	0.0	0.2
S	SO3	n.d.		
K	K2O	n.d.		
Ca	CaO	0.1	0.0	0.1
Ti	TiO2	0.5	0.0	0.9
V	V2O5	n.d.		
Cr	Cr2O3	n.d.		
Mn	MnO	0.1	0.0	0.2
Fe	FeO	37.1	0.2	47.8
Co	CoO	0.3	0.1	0.4
Ni	NiO	n.d.		
Cu	CuO	n.d.		
Zn	ZnO	n.d.		
O		35.1	0.2	
Totals		100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 2
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.6 (cont'd): Scanning electron microscopy data for Myers Wood iron smelting slag sample D414s-D from Appendix 56: site of interest 2 spectra analysis.



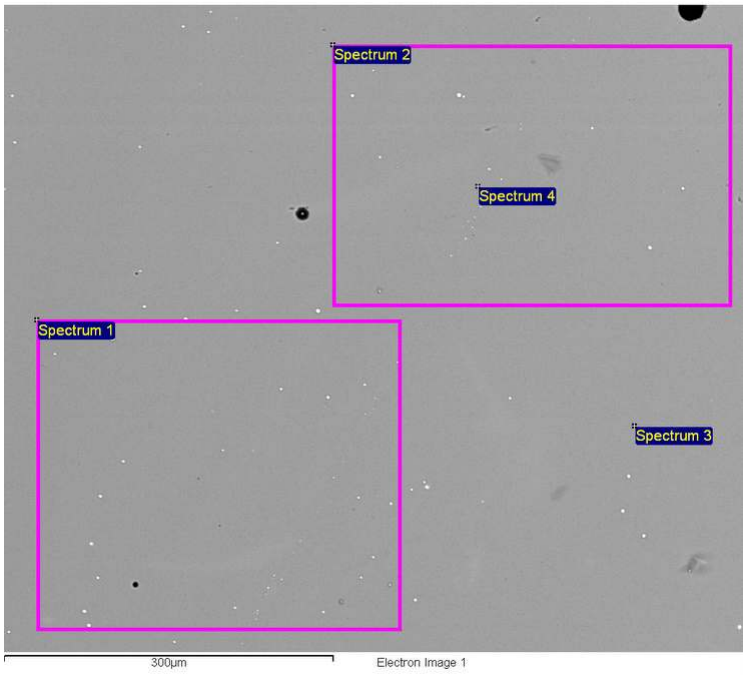


Figure 9.7: Scanning electron microscopy data for Rievaulx blast furnace slag sample RIV 105/63-C from Appendix 57: sites of interest 1 (upper) and 2 (lower).

SCANNING ELECTRON MICROSCOPY

Blast furnace slag **Sample** **Rievaulx 105/63-C** **Site of Interest 1**

		Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase			Spectrum 4: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na2O	0.1	0.0	0.2	n.d.			0.2	0.1	0.2	0.1	0.0	0.1
Mg	MgO	1.7	0.0	2.8	1.7	0.0	2.8	1.7	0.0	2.8	1.6	0.0	2.7
Al	Al2O3	10.9	0.1	20.6	11.0	0.1	20.8	11.0	0.1	20.7	11.0	0.1	20.8
Si	SiO2	22.0	0.1	47.0	22.0	0.1	47.0	21.9	0.1	46.9	22.1	0.1	47.2
P	P2O5	n.d.			n.d.			n.d.			n.d.		
S	SO3	n.d			n.d.			0.1	0.0	0.1	n.d.		
K	K2O	1.7	0.0	2.1	1.7	0.0	2.1	1.7	0.0	2.0	1.7	0.0	2.1
Ca	CaO	15.8	0.1	22.1	15.9	0.1	22.2	15.8	0.1	22.1	15.7	0.1	21.9
Ti	TiO2	0.5	0.0	0.8	0.5	0.0	0.8	0.5	0.0	0.9	0.5	0.0	0.8
V	V2O5	0.1	0.0	0.1	n.d.			n.d.			0.1	0.0	0.1
Cr	Cr2O3	n.d.			n.d.			0.1	0.0	0.1	n.d.		
Mn	MnO	1.0	0.1	1.3	1.0	0.1	1.3	1.0	0.1	1.3	1.0	0.1	1.3
Fe	FeO	2.3	0.1	3.0	2.3	0.1	2.9	2.2	0.1	2.8	2.1	0.1	2.7
Co	CoO	n.d.			n.d.			0.1	0.1	0.1	n.d.		
Ni	NiO	n.d.			n.d.			n.d.			n.d.		
Cu	CuO	n.d.			n.d.			n.d.			n.d.		
Zn	ZnO	n.d.			n.d.			n.d.			n.d.		
As	As2O3	n.d.			n.d.			n.d.			0.1	0.1	0.1
O		43.9	0.2		44.0	0.2		43.9	0.2		44.0	0.2	
Totals		100.0			100.0			100.0			100.0		

		Spectrum 5: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%
Na	Na2O	n.d.		
Mg	MgO	n.d.		
Al	Al2O3	n.d.		
Si	SiO2	0.2	0.0	0.4
P	P2O5	1.0	0.0	2.3
S	SO3	n.d.		
K	K2O	n.d.		
Ca	CaO	0.6	0.0	0.8
Ti	TiO2	n.d.		
V	V2O5	n.d		
Cr	Cr2O3	n.d.		
Mn	MnO	0.1	0.1	0.1
Fe	FeO	74.7	0.2	96.1
Co	CoO	0.3	0.1	0.3
Ni	NiO	0.1	0.1	0.1
Cu	CuO	n.d.		
Zn	ZnO	n.d.		
As	As2O3	n.d.		
O		23.3	0.2	
Totals		100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 3
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.7 (cont'd): Scanning electron microscopy data for Rievaulx blast furnace slag sample RIV 105/63-C from Appendix 57: site of interest 1 spectra analysis.

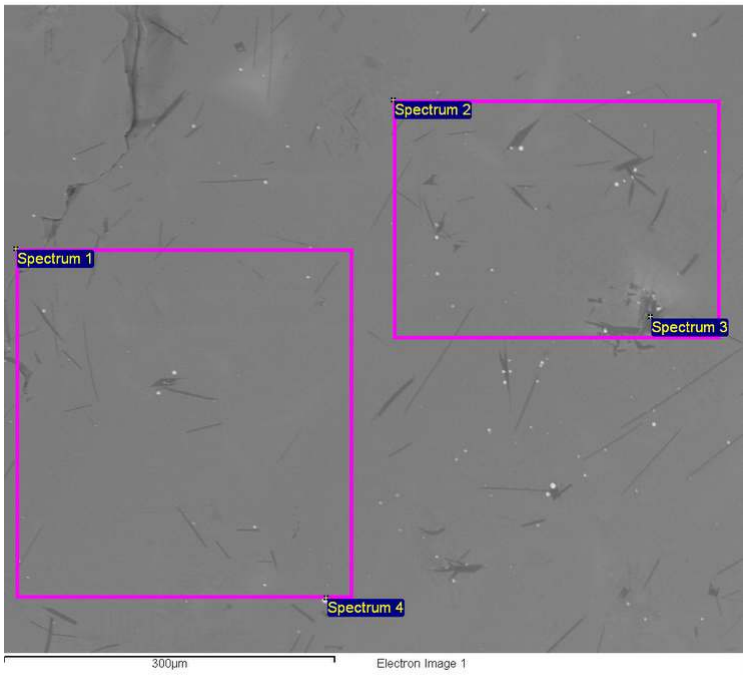
SCANNING ELECTRON MICROSCOPY

Blast furnace slag **Sample** **Rievaulx 105/63-C** **Site of Interest 2**

		Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase			Spectrum 4: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na2O	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Mg	MgO	1.7	0.0	2.8	1.7	0.0	2.8	1.6	0.0	2.7	0.8	0.1	1.3
Al	Al2O3	10.9	0.1	20.6	10.8	0.1	20.5	10.9	0.1	20.6	4.6	0.1	8.6
Si	SiO2	22.0	0.1	47.0	22.1	0.1	47.2	22.1	0.1	47.2	7.9	0.1	16.8
P	P2O5	n.d.			n.d.			n.d.			1.8	0.0	4.1
S	SO3	0.1	0.0	0.2	n.d.			n.d.			0.3	0.0	0.7
K	K2O	1.7	0.0	2.0	1.7	0.0	2.0	1.7	0.0	2.1	0.5	0.0	0.6
Ca	CaO	16.0	0.1	22.3	15.8	0.1	22.2	15.7	0.1	22.0	4.8	0.1	6.7
Ti	TiO2	0.5	0.0	0.8	0.5	0.0	0.8	0.6	0.0	1.0	0.1	0.0	0.2
V	V2O5	n.d.			n.d.			n.d.			0.1	0.0	0.1
Cr	Cr2O3	n.d.			n.d.			0.1	0.0	0.1	n.d.		
Mn	MnO	1.0	0.1	1.3	1.0	0.1	1.3	1.0	0.1	1.3	0.3	0.0	0.4
Fe	FeO	2.3	0.1	2.9	2.3	0.1	2.9	2.1	0.1	2.7	46.5	0.2	59.9
Co	CoO	n.d.			n.d.			n.d.			0.2	0.1	0.3
Ni	NiO	0.1	0.1	0.1	n.d.			n.d.			n.d.		
Cu	CuO	n.d.			0.1	0.1	0.1	n.d.			n.d.		
Zn	ZnO	n.d.			n.d.			n.d.			n.d.		
As	As2O3	n.d.			n.d.			0.1	0.1	0.1	0.1	0.1	0.1
O		44.0	0.2		43.9	0.2		44.0	0.2		31.9	0.2	
Totals		100.0			100.0			100.0			100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 3
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.7 (cont'd): Scanning electron microscopy data for Rievaulx blast furnace slag sample RIV 105/63-C from Appendix 57: site of interest 2 spectra analysis.



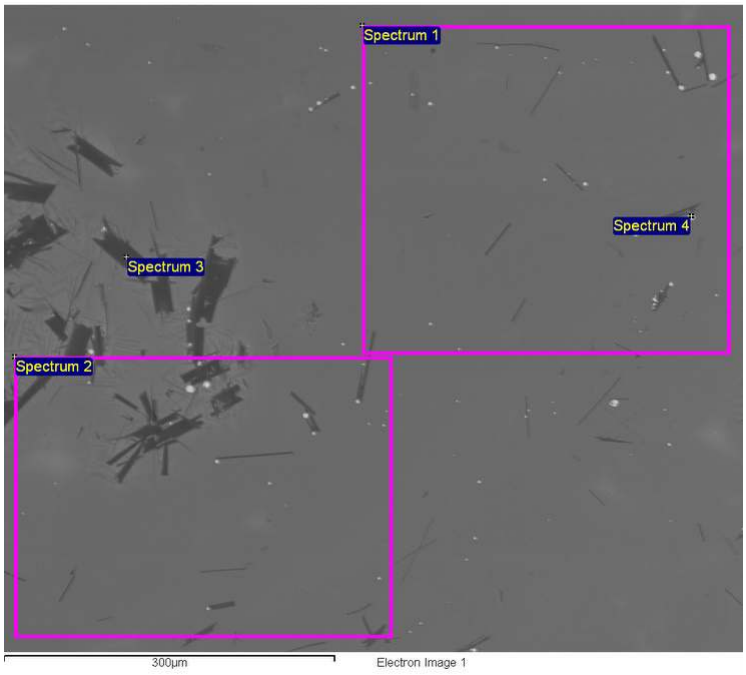


Figure 9.8: Scanning electron microscopy data for Grinton Smeltings lead smelting slag sample GS-B from Appendix 58: sites of interest 1 (upper) and 2 (lower).

SCANNING ELECTRON MICROSCOPY

Lead smelting slag **Sample** **Grinton Smeltings GS-B** **Site of Interest 1**

Element	Formula	Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase			Spectrum 4: Phase		
		Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
F		0.9	0.5	0.0	1.4	0.5	0.0	1.0	0.5	0.0	1.4	0.5	0.0
Na	Na2O	0.7	0.1	1.0	0.7	0.1	0.9	1.1	0.1	1.5	0.7	0.1	0.9
Mg	MgO	0.4	0.1	0.7	0.4	0.1	0.7	0.4	0.0	0.7	0.5	0.1	0.8
Al	Al2O3	1.6	0.1	3.0	1.7	0.1	3.2	4.1	0.1	7.8	1.2	0.1	2.3
Si	SiO2	14.5	0.1	31.0	14.7	0.1	31.3	17.6	0.1	37.6	14.6	0.1	31.2
P	P2O5	0.4	0.0	0.8	0.3	0.0	0.8	0.1	0.0	0.2	0.4	0.0	0.9
S	SO3	0.1	0.1	0.2	0.1	0.1	0.3	n.d.			0.1	0.1	0.2
K	K2O	0.6	0.0	0.7	0.7	0.0	0.8	0.9	0.0	1.1	0.6	0.0	0.7
Ca	CaO	6.6	0.1	9.3	6.6	0.1	9.3	11.3	0.1	15.8	7.2	0.1	10.1
Ti	TiO2	0.1	0.1	0.2	0.2	0.1	0.3	0.1	0.1	0.2	0.1	0.1	0.2
V	V2O5	n.d.			n.d.			n.d.			n.d.		
Cr	Cr2O3	n.d.			n.d.			0.1	0.1	0.1	n.d.		
Mn	MnO	0.1	0.1	0.1	n.d.			n.d.			0.2	0.1	0.2
Fe	Fe2O3	6.0	0.1	8.6	5.9	0.1	8.4	2.4	0.1	3.5	6.0	0.1	8.6
Co	CoO	n.d.			0.1	0.1	0.1	n.d.			0.1	0.1	0.1
Ni	NiO	0.1	0.1	0.1	n.d.			n.d.			0.1	0.1	0.1
Cu	CuO	n.d.			0.1	0.1	0.2	n.d.			n.d.		
Zn	ZnO	6.2	0.2	7.7	5.9	0.1	7.4	8.2	0.2	10.2	6.3	0.1	7.8
As	As2O3	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	n.d.		
Ag	Ag2O	0.1	0.1	0.1	0.1	0.1	0.1	n.d.			n.d.		
Sb	Sb2O3	0.2	0.2	0.3	0.2	0.2	0.2	n.d.			0.2	0.2	0.3
Ba	BaO	18.6	0.2	20.8	18.3	0.2	20.4	15.0	0.2	16.7	17.8	0.2	19.8
Pb	PbO	13.5	0.2	14.5	13.0	0.2	14.0	3.4	0.1	3.7	13.5	0.2	14.6
O		29.3	0.3		29.5	0.3		34.3	0.3		29.3	0.3	
Totals		100.0			100.0			100.0			100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 3
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.8 (cont'd): Scanning electron microscopy data for Grinton Smeltings lead smelting slag sample GS-B from Appendix 58: site of interest 1 spectra analysis.

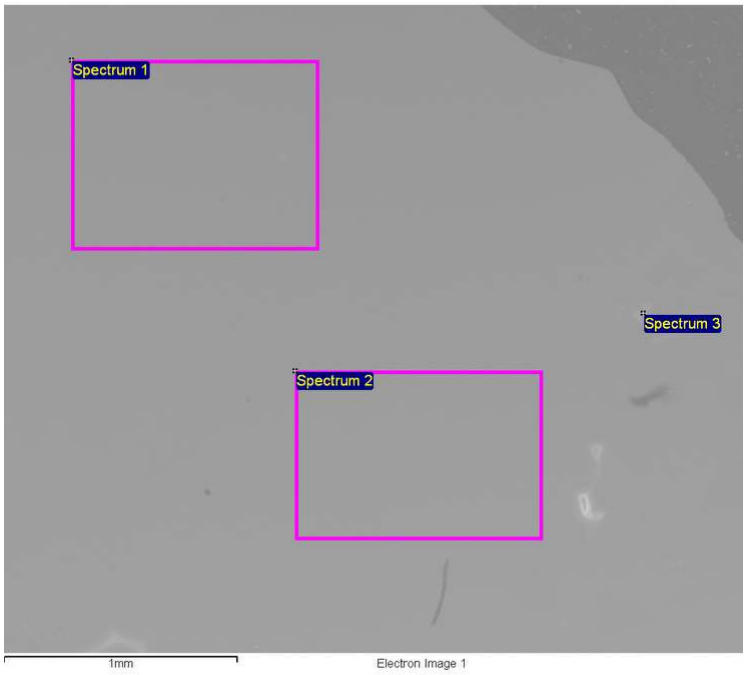
SCANNING ELECTRON MICROSCOPY

Lead smelting slag **Sample** **Grinton Smeltings GS-B** **Site of Interest 2**

Element	Formula	Spectrum 1: Area Weight%	Weight% sigma	Compound%	Spectrum 2: Area Weight%	Weight% sigma	Compound%	Spectrum 3: Phase Weight%	Weight% sigma	Compound%	Spectrum 4: Phase Weight%	Weight% sigma	Compound%
F		1.5	0.5	0.0	1.8	0.5	0.0	n.d.			0.7	0.5	0.0
Na	Na2O	0.7	0.1	0.9	0.7	0.1	1.0	1.6	0.1	2.1	0.2	0.1	0.3
Mg	MgO	0.4	0.1	0.6	0.4	0.1	0.7	0.7	0.1	1.1	0.1	0.1	0.1
Al	Al2O3	1.5	0.1	2.9	1.6	0.1	2.9	0.3	0.0	0.6	0.3	0.0	0.5
Si	SiO2	14.5	0.1	31.0	14.5	0.1	30.9	17.9	0.2	38.2	3.3	0.1	7.1
P	P2O5	0.2	0.0	0.5	0.4	0.0	0.8	n.d.			0.1	0.0	0.2
S	SO3	0.1	0.1	0.3	0.1	0.1	0.3	n.d.			8.1	0.1	20.3
K	K2O	0.7	0.0	0.8	0.6	0.0	0.8	0.2	0.0	0.2	0.2	0.0	0.2
Ca	CaO	6.6	0.1	9.3	6.6	0.1	9.3	20.4	0.2	28.6	2.2	0.1	3.1
Ti	TiO2	n.d.			n.d.			n.d.			n.d.		
V	V2O5	n.d.			n.d.			n.d.			n.d.		
Cr	Cr2O3	n.d.			n.d.			n.d.			n.d.		
Mn	MnO	0.1	0.1	0.1	0.1	0.1	0.1	n.d.			n.d.		
Fe	Fe2O3	5.8	0.1	8.3	5.7	0.1	8.2	2.5	0.1	3.6	3.0	0.1	4.3
Co	CoO	n.d.			0.1	0.1	0.1	0.1	0.1	0.1	n.d.		
Ni	NiO	n.d.			n.d.			n.d.			n.d.		
Cu	CuO	0.1	0.1	0.1	n.d.			n.d.			0.1	0.1	0.2
Zn	ZnO	5.7	0.1	7.1	6.0	0.1	7.4	13.9	0.2	17.3	2.2	0.1	2.8
As	As2O3	0.1	0.1	0.1	n.d.			0.1	0.1	0.1	n.d.		
Ag	Ag2O	n.d.			n.d.			n.d.			n.d.		
Sb	Sb2O3	0.4	0.2	0.5	0.1	0.2	0.1	n.d.			n.d.		
Ba	BaO	18.9	0.2	21.1	18.6	0.2	20.8	3.4	0.1	3.8	5.5	0.2	6.1
Pb	PbO	14.0	0.2	15.1	13.9	0.2	15.0	4.8	0.2	5.2	50.4	0.4	54.3
O		28.9	0.3		29.0	0.3		35.1	0.3		23.7	0.3	
Totals		100.0			100.0			100.0			100.0		

Processing option : Oxygen by stoichiometry (Normalised)   n.d. = not detected
Number of iterations : 3
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.8 (cont'd): Scanning electron microscopy data for Grinton Smeltings lead smelting slag sample GS-B from Appendix 58: site of interest 2 spectra analysis.



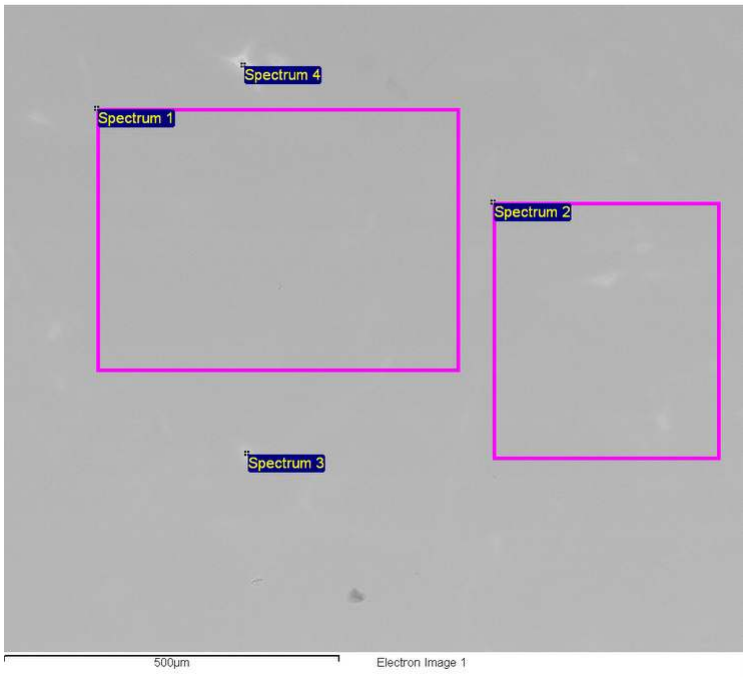


Figure 9.9: Scanning electron microscopy data for Hutton Common glass production residue sample H4C from Appendix 59: sites of interest 1 (upper) and 2 (lower).

SCANNING ELECTRON MICROSCOPY

Glass working residues **Sample** **Hutton Common slag H4C** **Site of Interest 1**

		Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na_2O	1.6	0.1	2.2	1.7	0.1	2.2	2.3	0.1	3.1
Mg	MgO	1.3	0.1	2.1	1.3	0.1	2.1	1.6	0.1	2.7
Al	Al_2O_3	1.6	0.1	3.1	1.6	0.1	3.1	1.9	0.1	3.7
Si	SiO_2	29.7	0.2	63.6	29.8	0.2	63.7	31.4	0.2	67.2
P	P_2O_5	0.9	0.1	2.1	0.8	0.1	1.9	1.0	0.1	2.4
S	SO_3	0.2	0.0	0.4	0.2	0.1	0.5	0.2	0.0	0.4
Cl		0.7	0.0	0.0	0.6	0.1	0.0	0.6	0.1	0.0
K	K_2O	3.7	0.1	4.4	3.8	0.1	4.5	3.0	0.1	3.6
Ca	CaO	13.8	0.1	19.3	13.9	0.1	19.4	10.9	0.1	15.2
Ti	TiO_2	0.2	0.1	0.3	0.1	0.1	0.2	0.1	0.0	0.2
V	V_2O_5	n.d.			n.d.			n.d.		
Cr	Cr_2O_3	0.1	0.1	0.1	0.1	0.1	0.1	n.d.		
Mn	MnO	0.3	0.1	0.4	0.2	0.1	0.2	0.1	0.1	0.2
Fe	Fe_2O_3	0.9	0.1	1.3	1.1	0.1	1.6	0.7	0.1	0.9
Co	CoO	0.1	0.1	0.1	n.d.			n.d.		
Ni	NiO	n.d.			n.d.			n.d.		
Cu	CuO	n.d.			n.d.			n.d.		
Zn	ZnO	n.d.			0.1	0.1	0.1	n.d.		
O		45.0	0.2		45.0	0.2		46.3	0.2	
Totals		100.0			100.0			100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 3
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm^3): 2.25
Detector efficiency : Calculation

Figure 9.9 (cont'd): Scanning electron microscopy data for Hutton Common glass production residue sample H4C from Appendix 59: site of interest 1 spectra analysis.

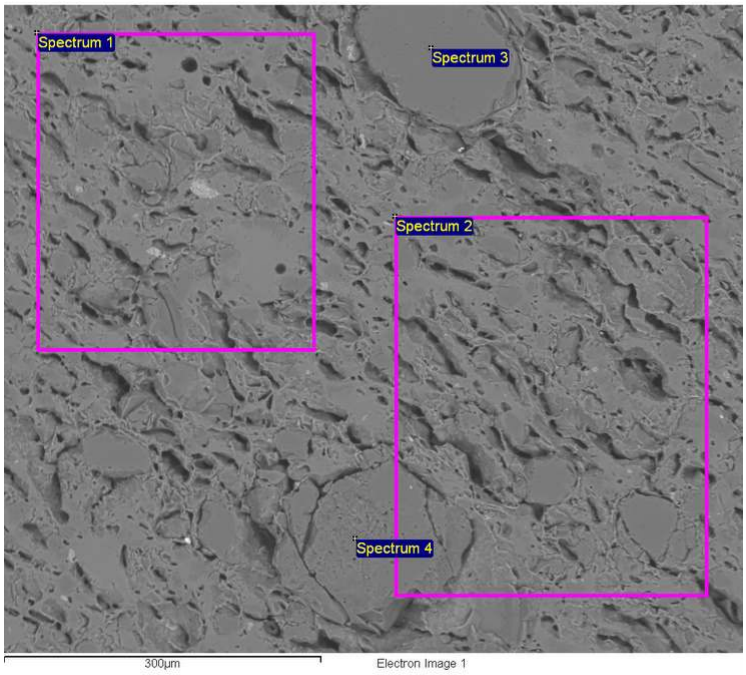
SCANNING ELECTRON MICROSCOPY

Glass working residues **Sample** **Hutton Common slag H4C** **Site of Interest 2**

		Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase			Spectrum 4: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na2O	1.6	0.1	2.2	1.7	0.1	2.3	2.3	0.1	3.1	2.0	0.1	2.7
Mg	MgO	1.3	0.1	2.2	1.3	0.1	2.2	1.6	0.1	2.7	1.5	0.1	2.5
Al	Al2O3	1.7	0.0	3.2	1.6	0.0	3.1	1.9	0.1	3.5	1.7	0.1	3.3
Si	SiO2	29.8	0.1	63.7	29.8	0.1	63.7	31.1	0.2	66.5	30.3	0.1	64.7
P	P2O5	0.9	0.1	2.1	1.0	0.1	2.3	1.1	0.1	2.5	1.0	0.1	2.3
S	SO3	0.2	0.0	0.5	0.2	0.0	0.4	0.2	0.0	0.5	0.2	0.0	0.5
Cl		0.7	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0
K	K2O	3.7	0.1	4.4	3.6	0.1	4.4	3.1	0.1	3.7	3.3	0.1	4.0
Ca	CaO	13.6	0.1	19.0	13.5	0.1	18.8	11.2	0.1	15.7	12.4	0.1	17.4
Ti	TiO2	0.2	0.0	0.3	0.2	0.0	0.3	0.2	0.0	0.3	0.2	0.0	0.3
V	V2O5	n.d.			n.d.			n.d.			n.d.		
Cr	Cr2O3	0.1	0.0	0.1	n.d.			n.d.			n.d.		
Mn	MnO	0.2	0.1	0.2	0.2	0.1	0.3	0.1	0.1	0.1	0.2	0.1	0.3
Fe	Fe2O3	1.0	0.1	1.4	1.0	0.1	1.4	0.6	0.1	0.8	0.9	0.1	1.2
Co	CoO	n.d.			0.1	0.1	0.1	n.d.			n.d.		
Ni	NiO	n.d.			n.d.			n.d.			n.d.		
Cu	CuO	n.d.			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
Zn	ZnO	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
O		45.1	0.2		45.1	0.2		46.1	0.2		45.5	0.2	
Totals		100.0			100.0			100.0			100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 3
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.9 (cont'd): Scanning electron microscopy data for Hutton Common glass production residue sample H4C from Appendix 59: site of interest 2 spectra analysis.



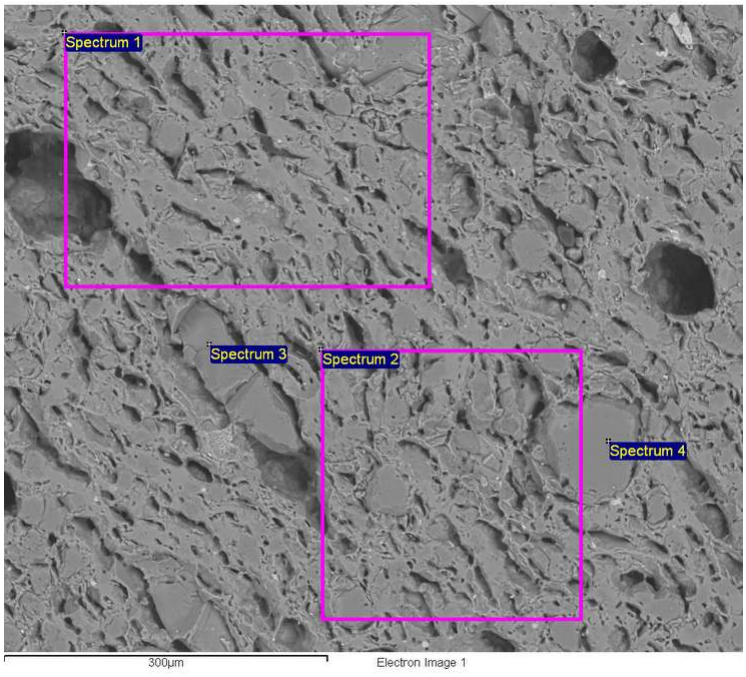


Figure 9.10: Scanning electron microscopy data for Knightons glass production crucible sample KC3 from Appendix 60: sites of interest 1 (upper) and 2 (lower).

SCANNING ELECTRON MICROSCOPY

Glass working crucibles **Sample** **Knightons KC3** **Site of Interest 1**

		Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase			Spectrum 4: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na2O	0.2	0.0	0.2	0.1	0.0	0.2	n.d.			n.d.		
Mg	MgO	0.5	0.0	0.8	0.4	0.0	0.6	n.d.			0.1	0.0	0.1
Al	Al2O3	9.8	0.1	18.6	8.9	0.1	16.9	n.d.			n.d.		
Si	SiO2	34.7	0.1	74.1	35.8	0.1	76.7	46.8	0.1	100.0	46.8	0.1	100.0
P	P2O5	0.2	0.0	0.5	0.2	0.0	0.5	0.1	0.0	0.3	0.1	0.0	0.1
S	SO3	n.d.			n.d.			n.d.			n.d.		
K	K2O	2.4	0.0	2.9	1.8	0.0	2.2	n.d.			n.d.		
Ca	CaO	0.2	0.0	0.3	0.2	0.0	0.3	n.d.			n.d.		
Ti	TiO2	0.7	0.0	1.2	0.5	0.0	0.8	n.d.			n.d.		
V	V2O5	n.d.			n.d.			n.d.			n.d.		
Cr	Cr2O3	n.d.			n.d.			n.d.			n.d.		
Mn	MnO	n.d.			n.d.			n.d.			n.d.		
Fe	Fe2O3	1.6	0.1	2.3	1.5	0.1	2.2	0.1	0.0	0.1	0.1	0.0	0.1
Co	CoO	n.d.			n.d.			n.d.			n.d.		
Ni	NiO	n.d.			n.d.			n.d.			n.d.		
Cu	CuO	n.d.			0.1	0.1	0.1	n.d.			n.d.		
Zn	ZnO	n.d.			n.d.			0.1	0.1	0.1	n.d.		
As	As2O3	0.1	0.1	0.1	0.1	0.1	0.1	n.d.			n.d.		
Zr	ZrO2	n.d.			n.d.			n.d.			n.d.		
O		50.4	0.2		50.7	0.2		53.4	0.1		53.3	0.1	
Totals		100.0			100.0			100.0			100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 3
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.10 (cont'd): Scanning electron microscopy data for Knightons glass production crucible sample KC3 from Appendix 60: site of interest 1 spectra analysis.

SCANNING ELECTRON MICROSCOPY

Glass working crucibles **Sample** **Knightons KC3** **Site of Interest 2**

		Spectrum 1: Area			Spectrum 2: Area			Spectrum 3: Phase			Spectrum 4: Phase		
Element	Formula	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%	Weight%	Weight% sigma	Compound%
Na	Na2O	0.2	0.0	0.2	0.2	0.0	0.3	n.d.			n.d.		
Mg	MgO	0.5	0.0	0.8	0.5	0.0	0.8	0.1	0.0	0.1	n.d.		
Al	Al2O3	10.2	0.1	19.3	9.2	0.1	17.3	0.7	0.0	1.3	n.d.		
Si	SiO2	34.5	0.1	73.8	35.6	0.1	76.1	46.1	0.1	98.5	47.0	0.1	100.6
P	P2O5	0.2	0.0	0.6	0.2	0.0	0.5	0.1	0.0	0.3	0.1	0.0	0.3
S	SO3	n.d.			n.d.			n.d.			n.d.		
K	K2O	2.0	0.0	2.4	1.8	0.0	2.1	0.1	0.0	0.1	n.d.		
Ca	CaO	0.3	0.0	0.4	0.3	0.0	0.4	n.d.			n.d.		
Ti	TiO2	0.4	0.0	0.6	0.4	0.0	0.7	n.d.			n.d.		
V	V2O5	n.d.			n.d.			n.d.			n.d.		
Cr	Cr2O3	n.d.			n.d.			n.d.			n.d.		
Mn	MnO	n.d.			0.1	0.0	0.1	n.d.			n.d.		
Fe	Fe2O3	1.7	0.1	2.4	1.6	0.1	2.3	0.1	0.1	0.2	n.d.		
Co	CoO	n.d.			n.d.			n.d.			n.d.		
Ni	NiO	n.d.			n.d.			n.d.			n.d.		
Cu	CuO	0.1	0.1	0.1	n.d.			0.1	0.1	0.1	n.d.		
Zn	ZnO	n.d.			n.d.			n.d.			n.d.		
As	As2O3	0.1	0.1	0.1	0.1	0.1	0.1	n.d.			n.d.		
Zr	ZrO2	n.d.			n.d.			n.d.			n.d.		
O		50.5	0.2		50.7	0.2		53.2	0.2		53.5	0.1	
Totals		100.0			100.0			100.0			100.0		

Processing option : Oxygen by stoichiometry (Normalised) n.d. = not detected
Number of iterations : 3
Sample is polished.
Sample is coated with Carbon - thickness (nm): 15.0, density (g/cm3): 2.25
Detector efficiency : Calculation

Figure 9.10 (cont'd): Scanning electron microscopy data for Knightons glass production crucible sample KC3 from Appendix 60: site of interest 2 spectra analysis.

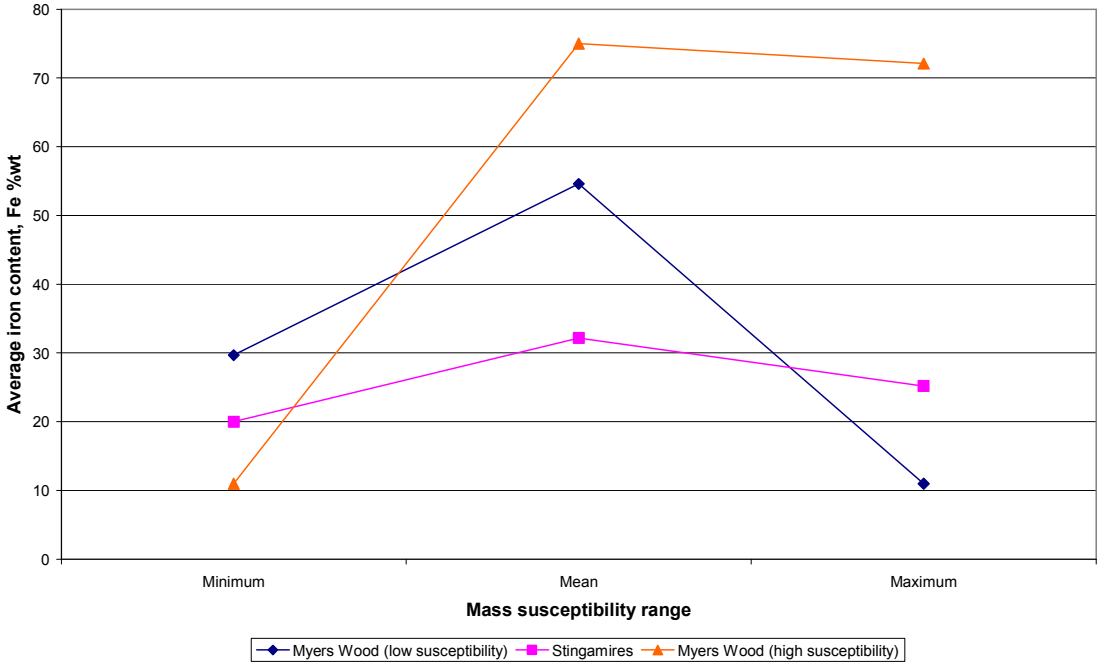


Figure 9.11: Iron smelting slag: average iron content variation with magnetic susceptibility.

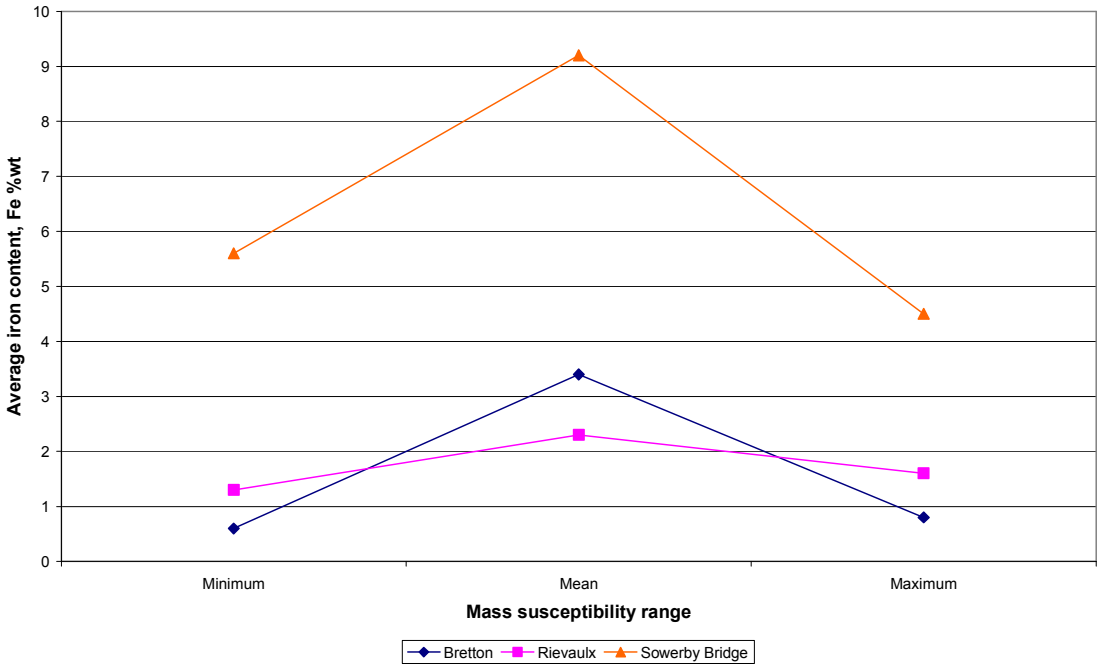


Figure 9.12: Blast furnace slag: average iron content variation with magnetic susceptibility.

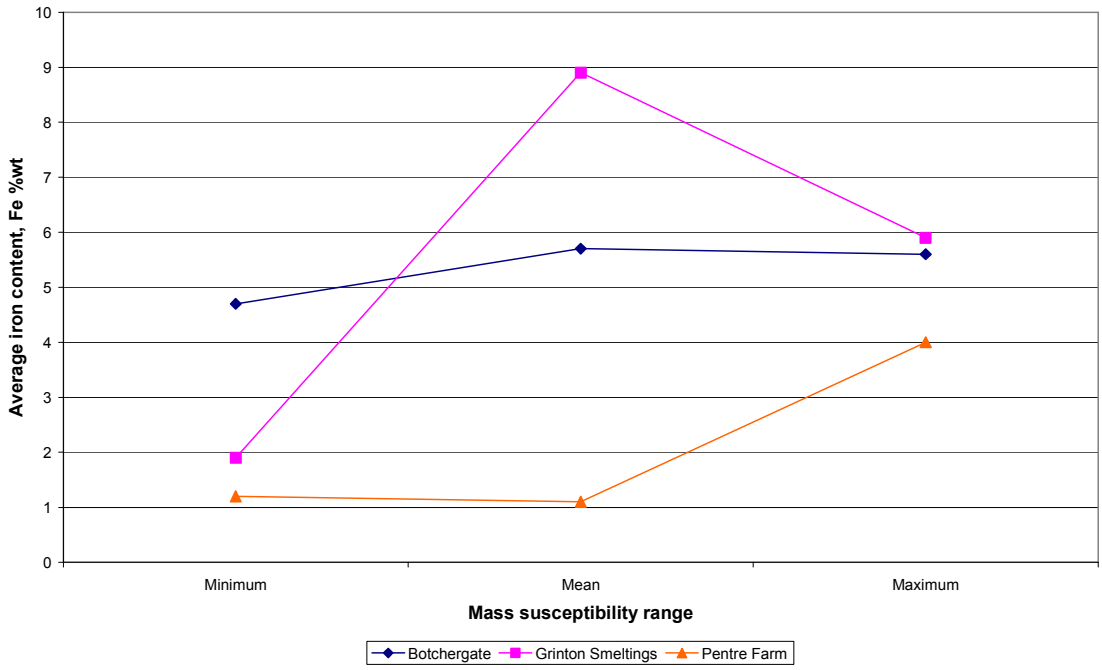


Figure 9.13: Lead smelting slag: average iron content variation with magnetic susceptibility.

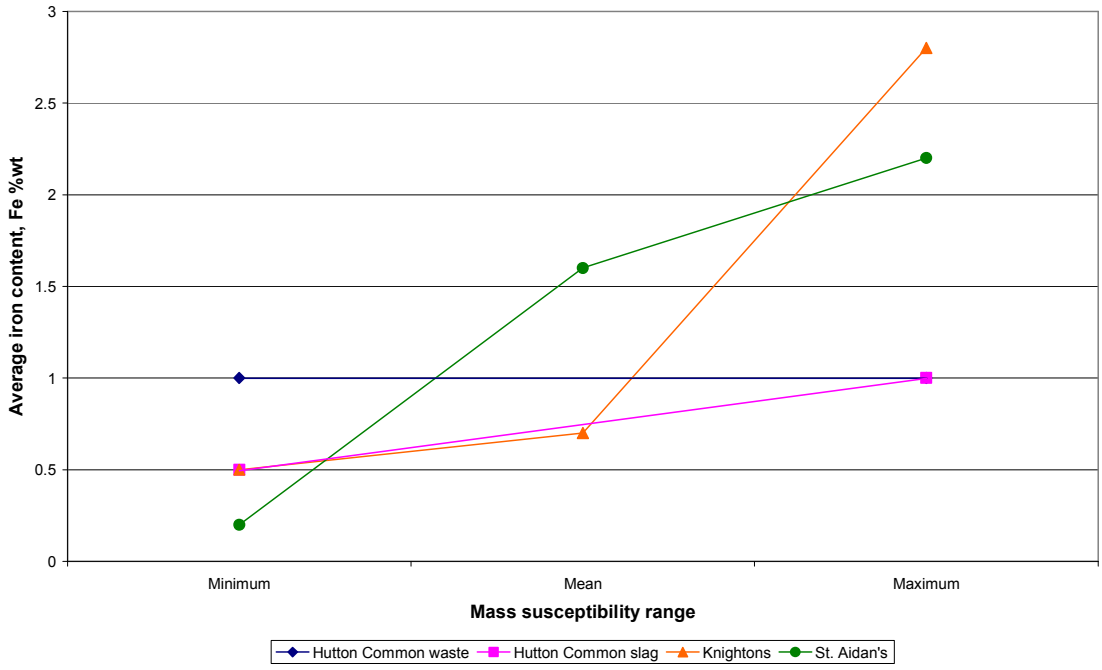


Figure 9.14: Glass production residues: average iron content variation with magnetic susceptibility.

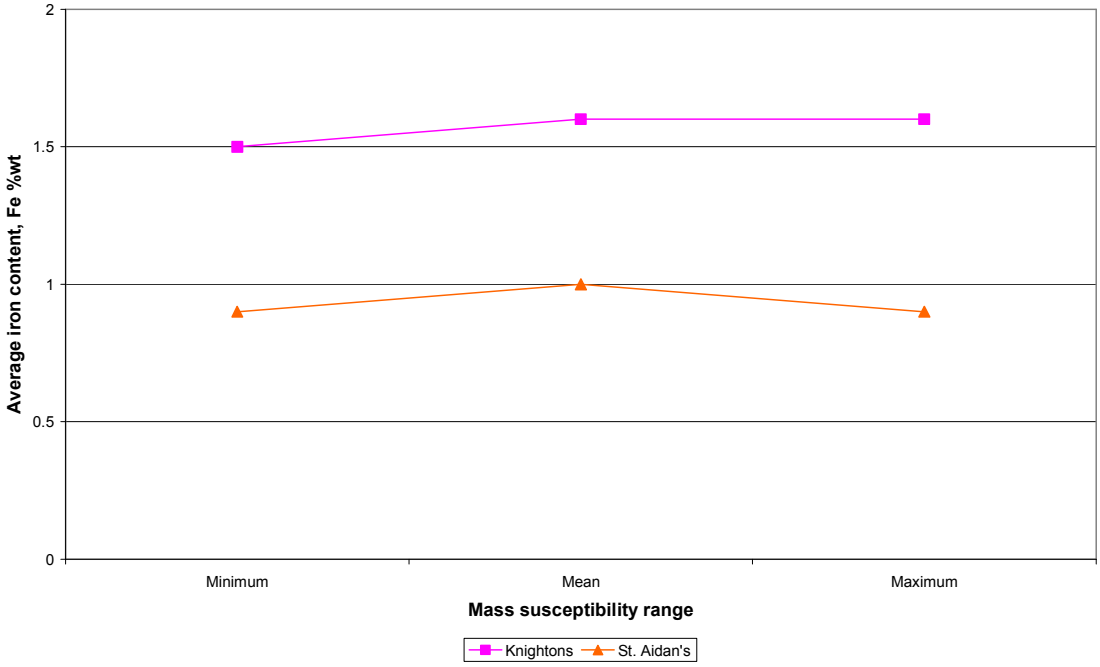


Figure 9.15: Glass production crucibles: average iron content variation with magnetic susceptibility.

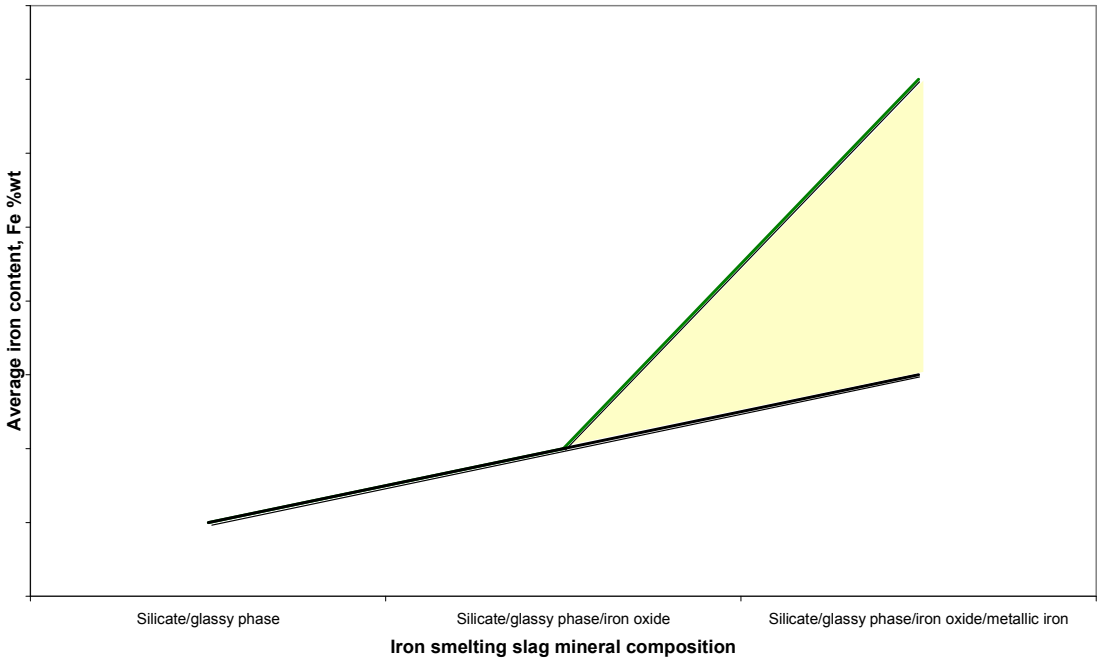


Figure 9.16: Iron smelting slag: average iron content predicted variation with mineral composition.