

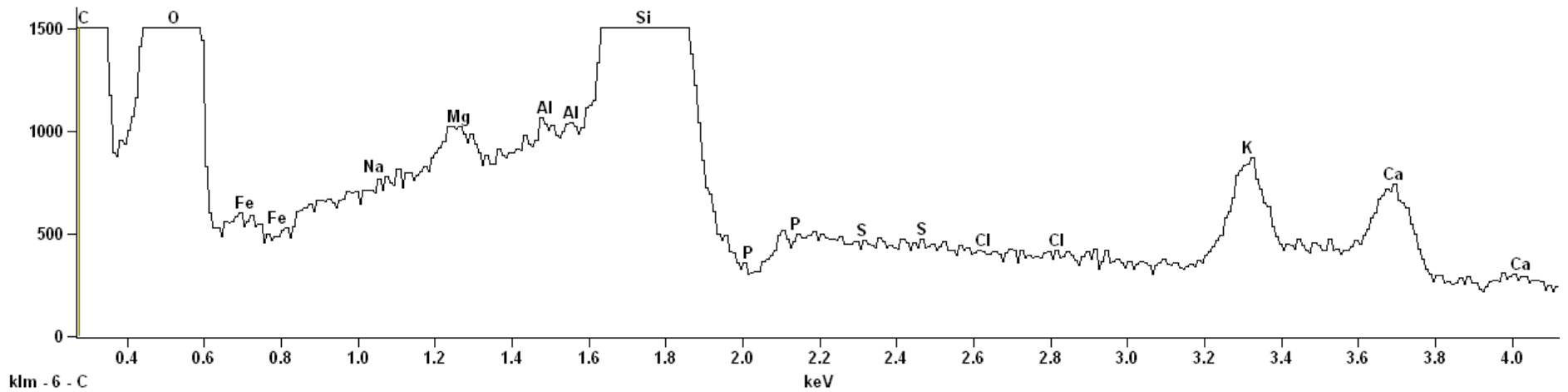
Group 4  
Norazana, Daniel K, Johan

Bed sand sample, day 1  
CFB combustion of wood chips

Project: SEMÅA-group 4

Full scale counts: 1505

IBS 30x area01



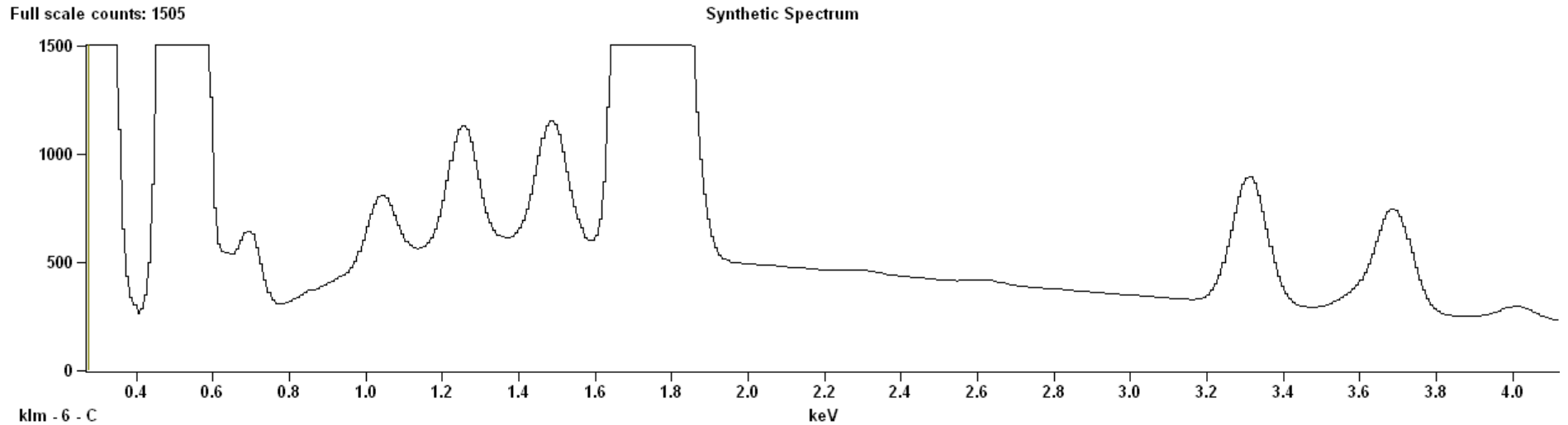
Live Time:30.0 sec.

Acc.Voltage: 15.0 kV Take Off Angle: 34.7 deg.

**Quantitative Results for: IBS 30x area01**

<b>Element Line</b>	<b>Weight %</b>	<b>Weight % Error</b>	<b>Atom %</b>	<b>Formul a</b>	<b>Compnd %</b>
<b>O K</b>	51.96S	---	65.96		---
<b>Na K</b>	0.00	---	0.00	Na2O	0.00
<b>Mg K</b>	0.29	+/- 0.02	0.24	MgO	0.48
<b>Al K</b>	0.07	+/- 0.03	0.05	Al2O3	0.13
<b>Si K</b>	44.55	+/- 0.13	32.21	SiO2	95.31
<b>P K</b>	0.00	---	0.00	P2O5	0.00
<b>S K</b>	0.00	---	0.00	SO3	0.00
<b>Cl K</b>	0.00	---	0.00	Cl	0.00
<b>K K</b>	1.38	+/- 0.08	0.72	K2O	1.66
<b>Ca K</b>	1.28	+/- 0.09	0.65	CaO	1.79
<b>Mn K</b>	0.30	+/- 0.07	0.11	MnO	0.39
<b>Fe K</b>	0.17	+/- 0.08	0.06	Fe2O3	0.25
<b>Total</b>	100.00		100.00		100.00

Project: SEMÅA-group 4



Live Time:30.0 sec.

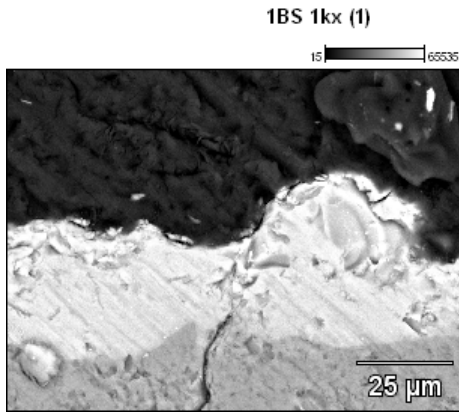
Acc.Voltage: 15.0 kV Take Off Angle: 34.7 deg.(EDS)

Take Off Angle: 0.0 deg.(WDS)

*Quantitative results are unavailable for Synthetic Spectrum.*

***Quantitative results are unavailable for Synthetic Spectrum.***

Project: SEMÅA-group 4

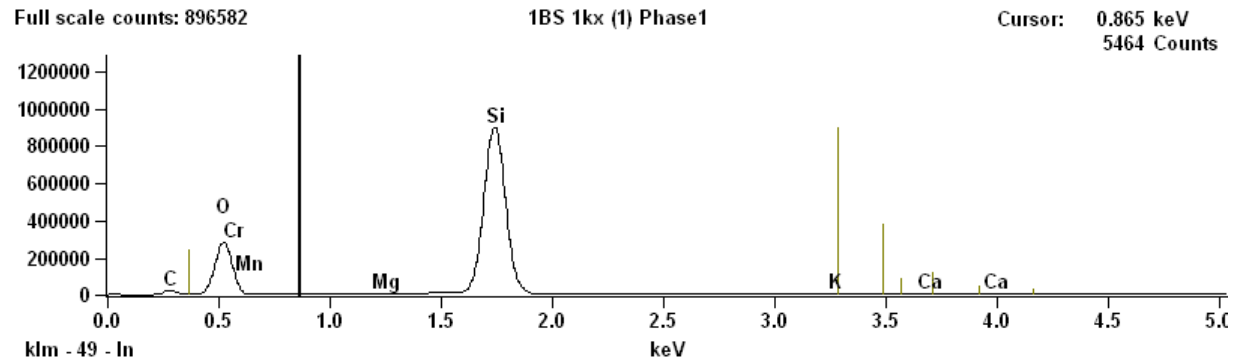
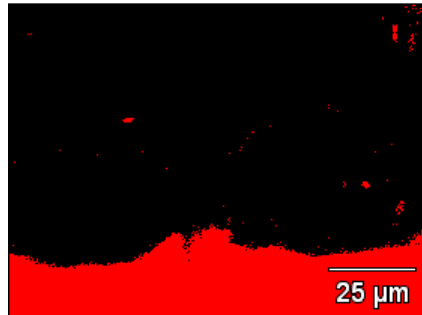


Accelerating Voltage: 20.0 kV

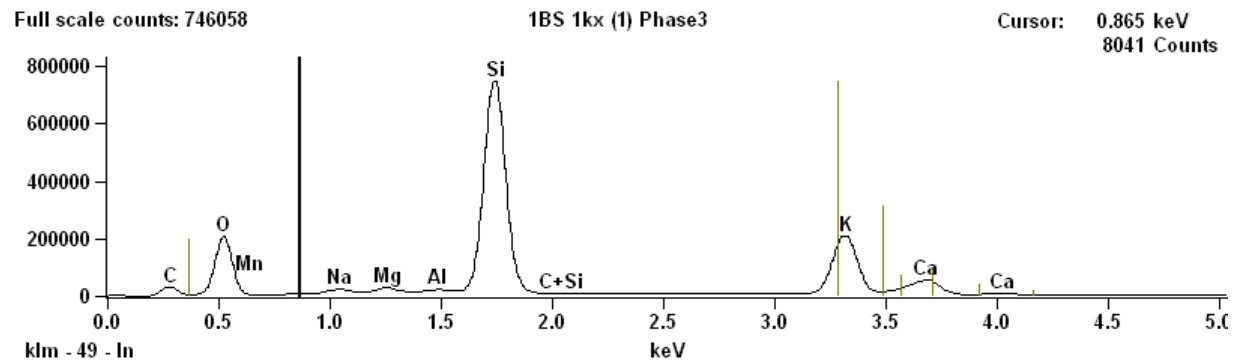
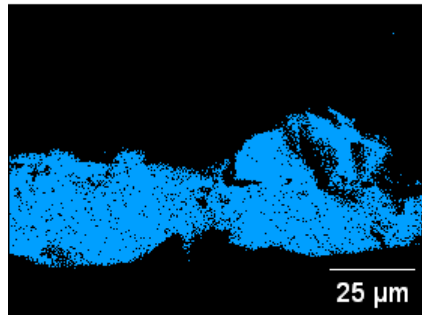
Magnification: 1000

Auto Phases From Counts

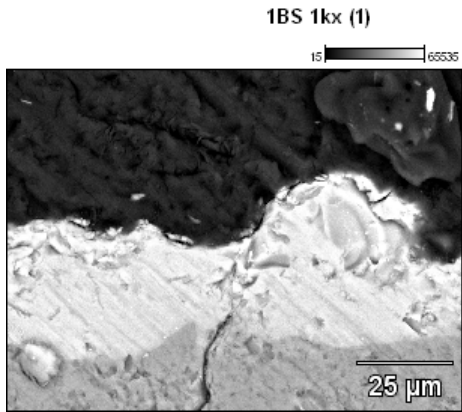
Phase1



Phase3



Project: SEMÅA-group 4

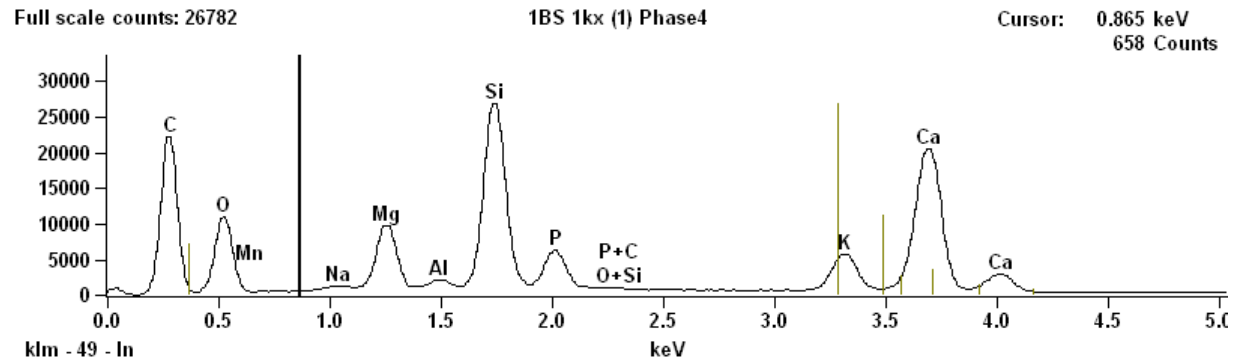
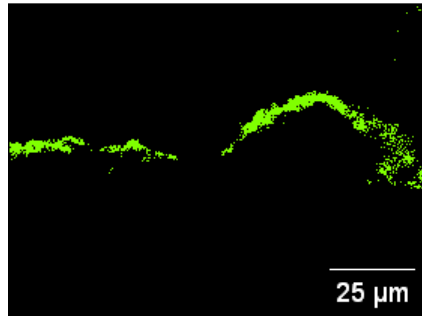


Accelerating Voltage: 20.0 kV

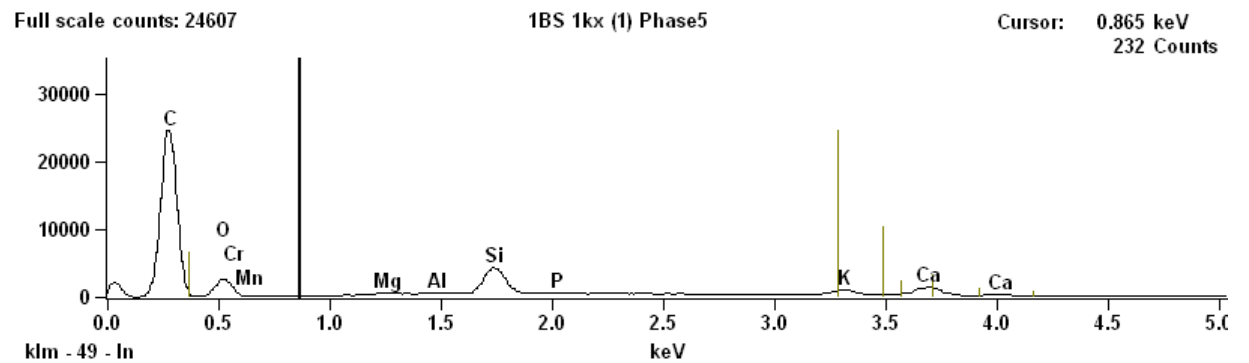
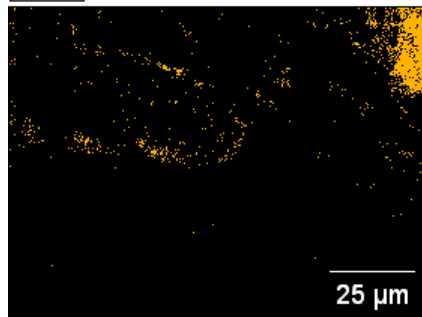
Magnification: 1000

Auto Phases From Counts

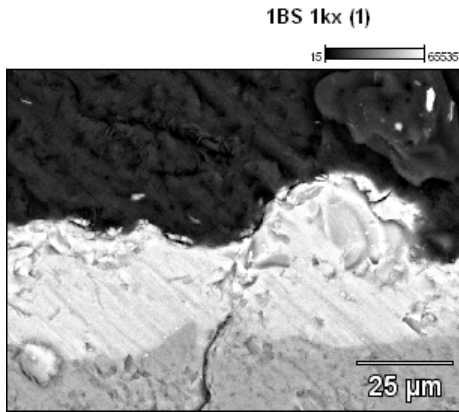
Phase4



Phase5



Project: SEMÅA-group 4

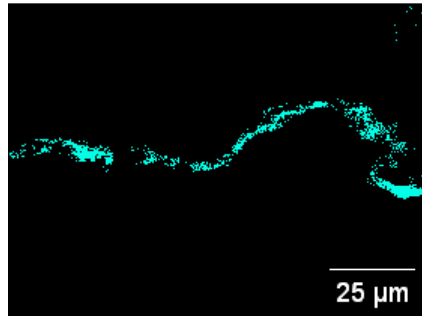


Accelerating Voltage: 20.0 kV

Magnification: 1000

Auto Phases From Counts

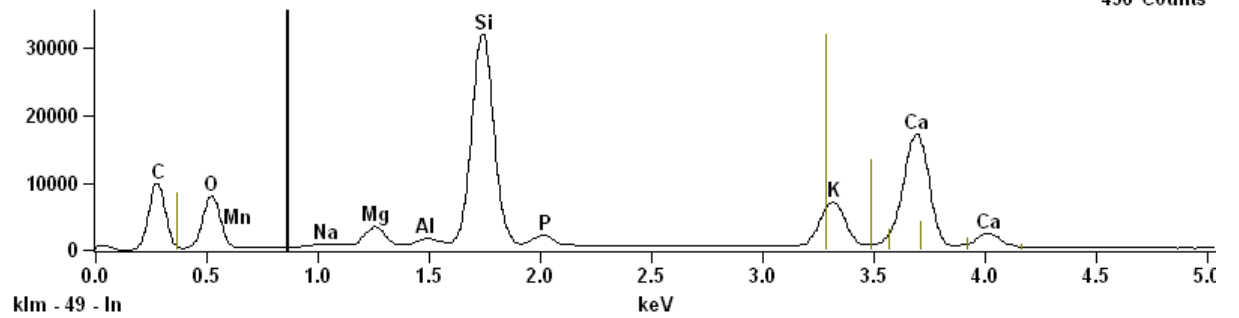
Phase6



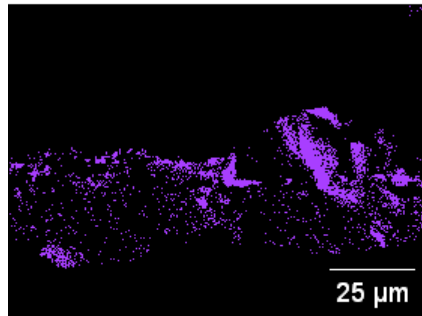
Full scale counts: 31848

1BS 1kx (1) Phase6

Cursor: 0.865 keV  
436 Counts



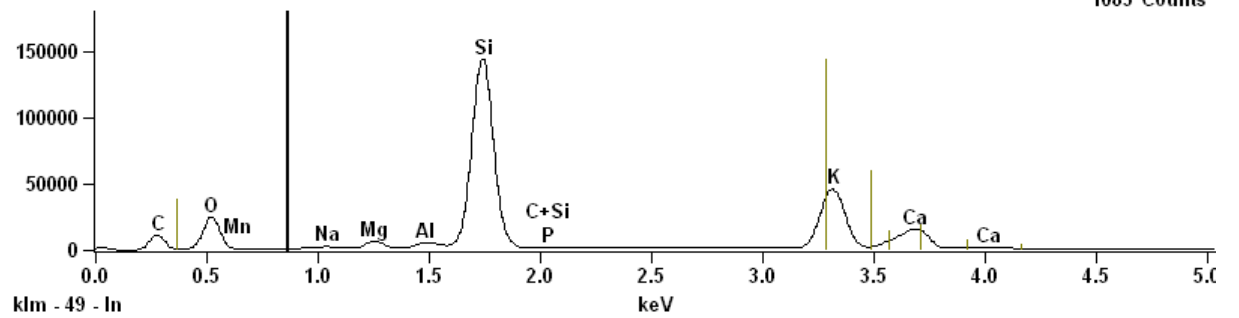
Phase7



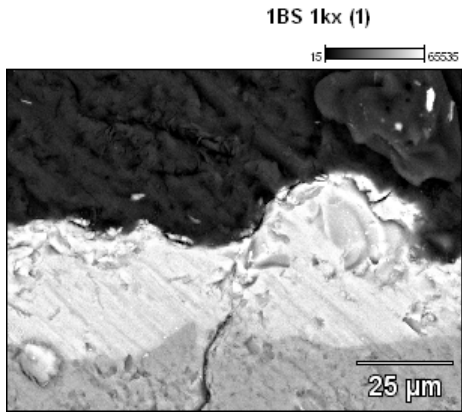
Full scale counts: 144009

1BS 1kx (1) Phase7

Cursor: 0.865 keV  
1083 Counts



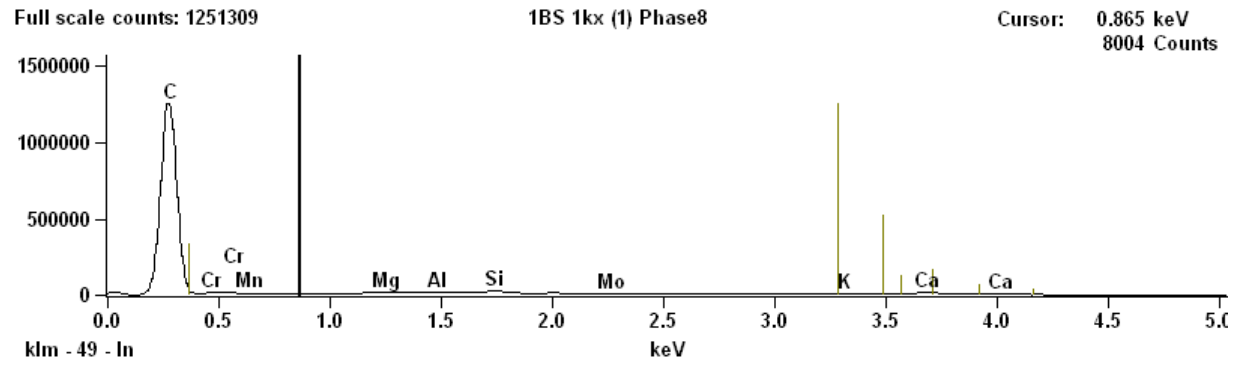
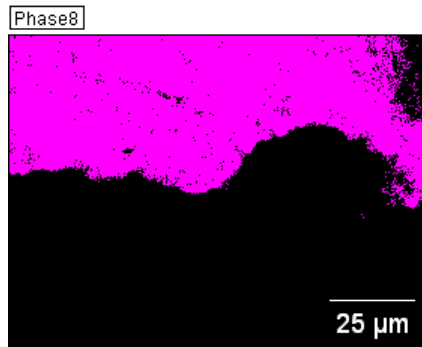
Project: SEMÅA-group 4



Accelerating Voltage: 20.0 kV

Magnification: 1000

Auto Phases From Counts



Project: SEMÅA-group 4

*Quantitative Results for: IBS 1kx (1) Phase1*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	53.04S	---	66.55		---
<i>Mg K</i>	0.05	+/- 0.00	0.04	MgO	0.08
<i>Si K</i>	46.41	+/- 0.09	33.17	SiO2	99.29
<i>K K</i>	0.33	+/- 0.01	0.17	K2O	0.39
<i>Ca K</i>	0.06	+/- 0.00	0.03	CaO	0.09
<i>Cr K</i>	0.03	+/- 0.01	0.01	Cr2O3	0.05
<i>Mn K</i>	0.08	+/- 0.01	0.03	MnO	0.10
<i>Total</i>	100.00		100.00		100.00



*Quantitative Results for: 1BS 1kx (1) Phase3*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	43.86S	---	60.34		---
<i>Na K</i>	1.66	+/- 0.01	1.59	Na <sub>2</sub> O	2.24
<i>Mg K</i>	0.94	+/- 0.01	0.86	MgO	1.57
<i>Al K</i>	0.38	+/- 0.01	0.31	Al <sub>2</sub> O <sub>3</sub>	0.71
<i>Si K</i>	32.70	+/- 0.06	25.63	SiO <sub>2</sub>	69.95
<i>K K</i>	15.31	+/- 0.04	8.62	K <sub>2</sub> O	18.44
<i>Ca K</i>	4.05	+/- 0.02	2.22	CaO	5.67
<i>Mn K</i>	1.10	+/- 0.01	0.44	MnO	1.42
<i>Total</i>	100.00		100.00		100.00

Project: SEMÅA-group 4

**Quantitative Results for: IBS 1kx (1) Phase4**

<b>Element Line</b>	<b>Weight %</b>	<b>Weight % Error</b>	<b>Atom %</b>	<b>Formul a</b>	<b>Compnd %</b>
<b>O K</b>	40.88S	---	58.68		---
<b>Na K</b>	0.60	+/- 0.05	0.60	Na2O	0.80
<b>Mg K</b>	6.32	+/- 0.05	5.97	MgO	10.47
<b>Al K</b>	0.55	+/- 0.05	0.47	Al2O3	1.04
<b>Si K</b>	16.87	+/- 0.07	13.79	SiO2	36.08
<b>P K</b>	4.58	+/- 0.05	3.39	P2O5	10.48
<b>K K</b>	4.95	+/- 0.05	2.91	K2O	5.96
<b>Ca K</b>	23.39	+/- 0.09	13.41	CaO	32.73
<b>Mn K</b>	1.88	+/- 0.06	0.79	MnO	2.43
<b>Total</b>	100.00		100.00		100.00

Project: SEMÅA-group 4

*Quantitative Results for: IBS 1kx (1) Phase5*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	43.28S	---	60.86		---
<i>Mg K</i>	1.95	+/- 0.11	1.81	MgO	3.24
<i>Al K</i>	1.42	+/- 0.23	1.18	Al <sub>2</sub> O <sub>3</sub>	2.68
<i>Si K</i>	25.49	+/- 0.26	20.42	SiO <sub>2</sub>	54.53
<i>P K</i>	2.27	+/- 0.14	1.65	P <sub>2</sub> O <sub>5</sub>	5.19
<i>K K</i>	7.20	+/- 0.14	4.14	K <sub>2</sub> O	8.67
<i>Ca K</i>	15.67	+/- 0.34	8.80	CaO	21.93
<i>Cr K</i>	1.45	+/- 0.18	0.63	Cr <sub>2</sub> O <sub>3</sub>	2.13
<i>Mn K</i>	1.26	+/- 0.23	0.52	MnO	1.63
<i>Total</i>	100.00		100.00		100.00

*Quantitative Results for: IBS 1kx (1) Phase6*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	40.90S	---	59.01		---
<i>Na K</i>	0.72	+/- 0.05	0.72	Na <sub>2</sub> O	0.97
<i>Mg K</i>	2.24	+/- 0.04	2.13	MgO	3.71
<i>Al K</i>	0.56	+/- 0.04	0.48	Al <sub>2</sub> O <sub>3</sub>	1.07
<i>Si K</i>	22.46	+/- 0.08	18.46	SiO <sub>2</sub>	48.05
<i>P K</i>	1.67	+/- 0.05	1.24	P <sub>2</sub> O <sub>5</sub>	3.82
<i>K K</i>	7.41	+/- 0.06	4.37	K <sub>2</sub> O	8.93
<i>Ca K</i>	22.37	+/- 0.10	12.88	CaO	31.29
<i>Mn K</i>	1.67	+/- 0.07	0.70	MnO	2.16
<i>Total</i>	100.00		100.00		100.00

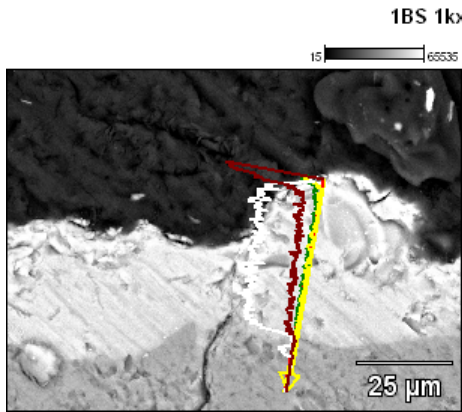
*Quantitative Results for: IBS 1kx (1) Phase7*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	43.00S	---	60.02		---
<i>Na K</i>	0.88	+/- 0.02	0.86	Na2O	1.19
<i>Mg K</i>	1.01	+/- 0.02	0.93	MgO	1.68
<i>Al K</i>	0.62	+/- 0.02	0.52	Al2O3	1.18
<i>Si K</i>	30.45	+/- 0.07	24.22	SiO2	65.15
<i>P K</i>	0.49	+/- 0.02	0.35	P2O5	1.11
<i>K K</i>	15.85	+/- 0.06	9.05	K2O	19.10
<i>Ca K</i>	6.18	+/- 0.04	3.44	CaO	8.65
<i>Mn K</i>	1.51	+/- 0.04	0.61	MnO	1.95
<i>Total</i>	100.00		100.00		100.00

### Combinations

<i>Combinations</i>	<i>Color</i>	<i>Area %</i>	<i>Combinations</i>
<i>Phase1</i>	Custom	21.20	C 1
<i>Phase3</i>	Custom	26.63	C 3
<i>Phase4</i>	Custom	2.58	C 4
<i>Phase5</i>	Custom	2.59	C 7
<i>Phase6</i>	Custom	2.12	C 8
<i>Phase7</i>	Custom	6.15	C 10
<i>Phase8</i>	Custom	38.73	C 12, C 2

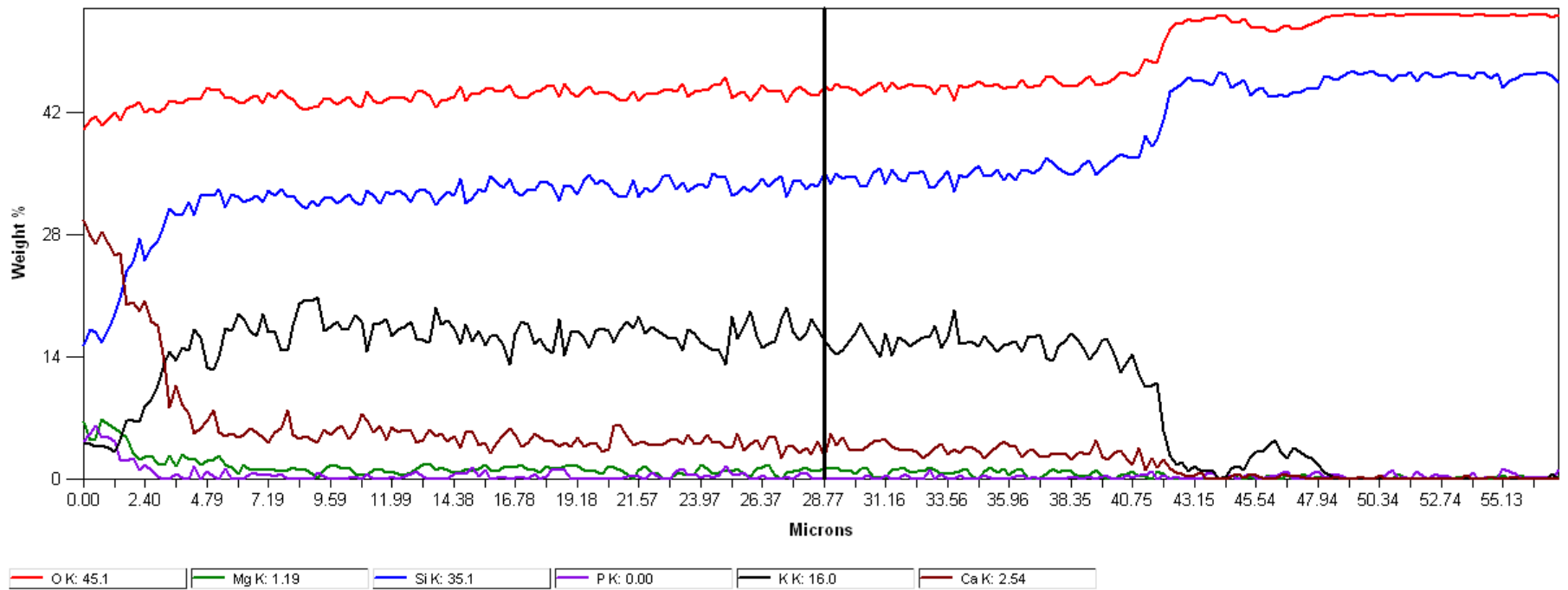
Project: SEMÅA-group 4



Accelerating Voltage: 20.0 kV

Magnification: 1000

1BS 1kx (1)Extract

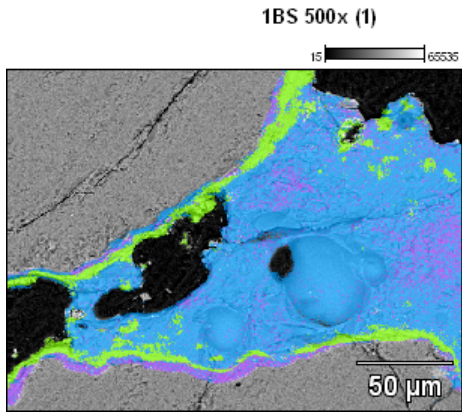


# Particle surface composition

- K reacts faster with Si forming a layer under the Ca cover
- Ca-silicates form the surface layer
- Mg and P stay on the surface



Project: SEMÅA-group 4

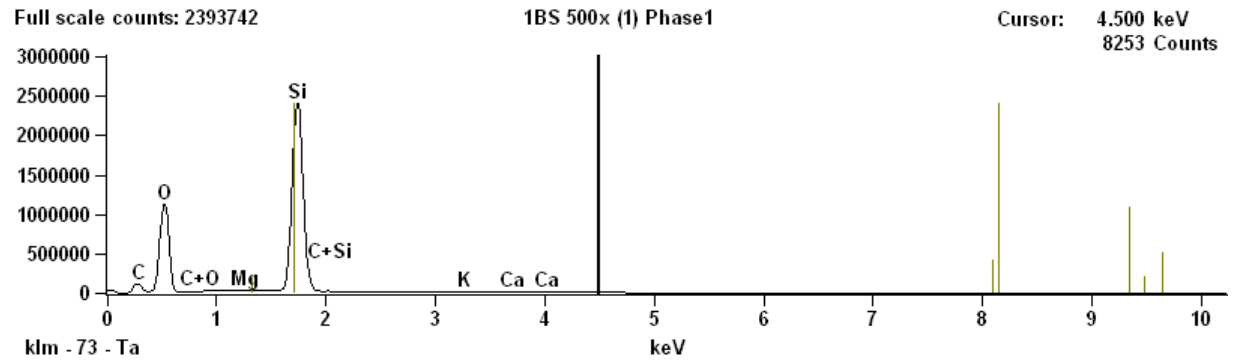
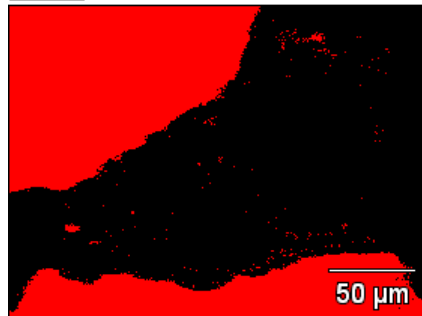


Accelerating Voltage: 15.0 kV

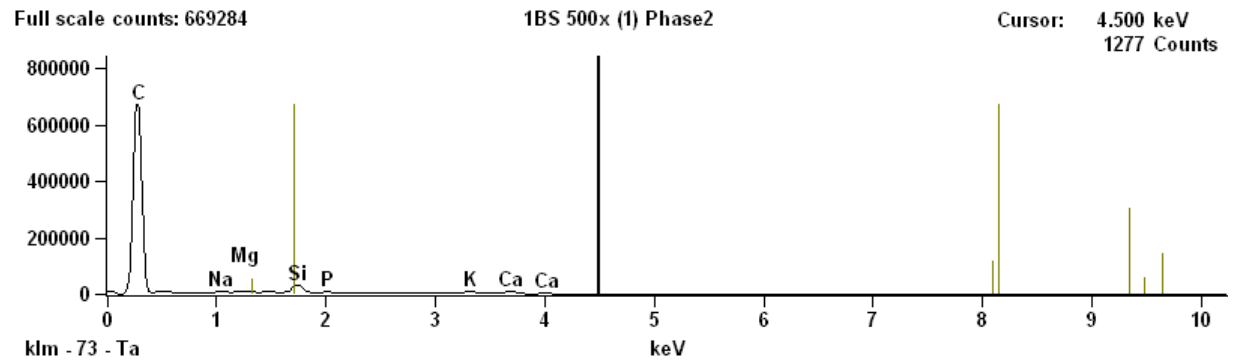
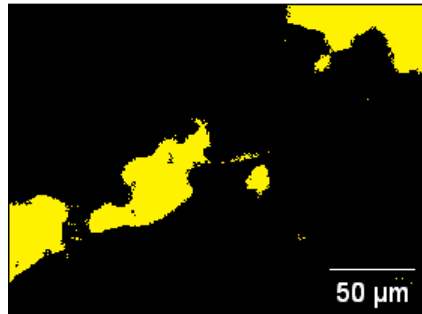
Magnification: 500

Auto Phases From Counts

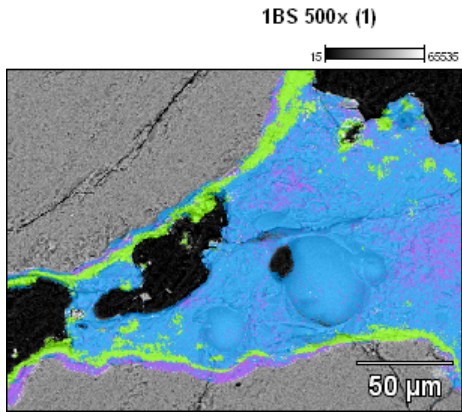
Phase1



Phase2



Project: SEMÅA-group 4

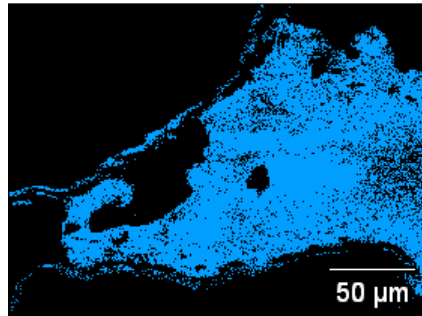


Accelerating Voltage: 15.0 kV

Magnification: 500

Auto Phases From Counts

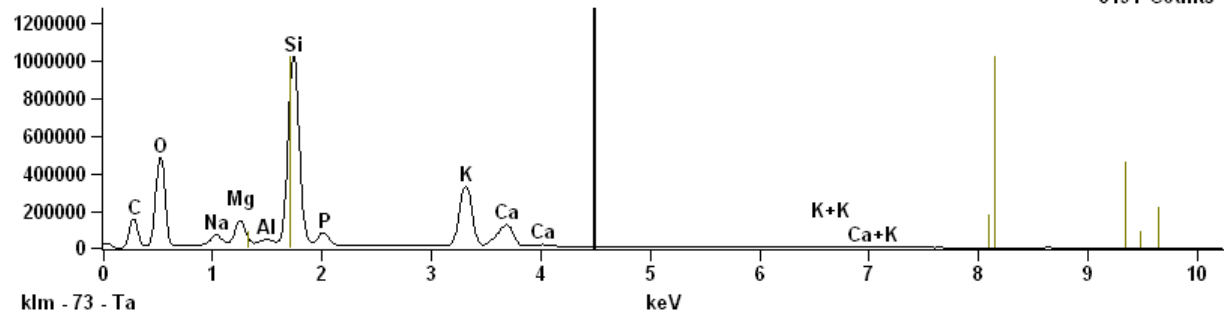
Phase3



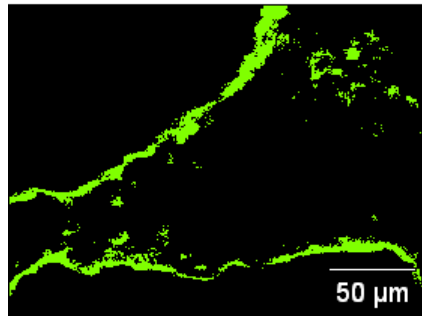
Full scale counts: 1017790

1BS 500x (1) Phase3

Cursor: 4.500 keV  
8191 Counts



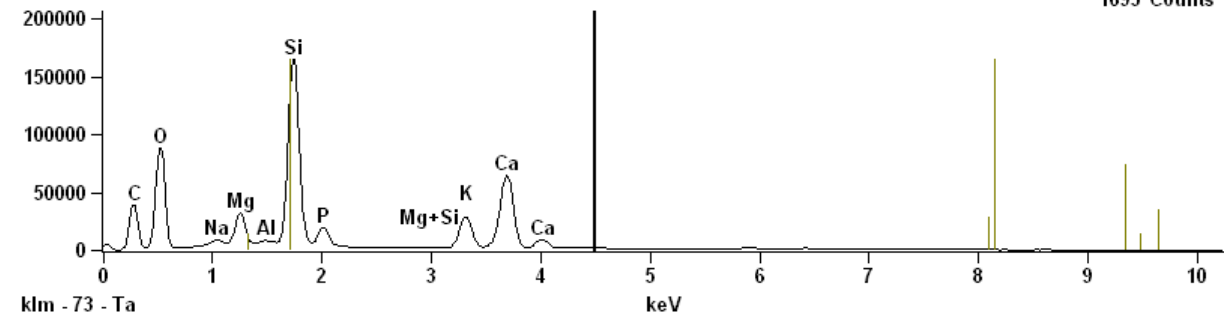
Phase4



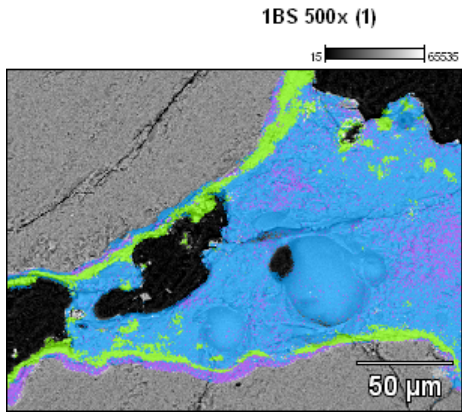
Full scale counts: 164442

1BS 500x (1) Phase4

Cursor: 4.500 keV  
1695 Counts



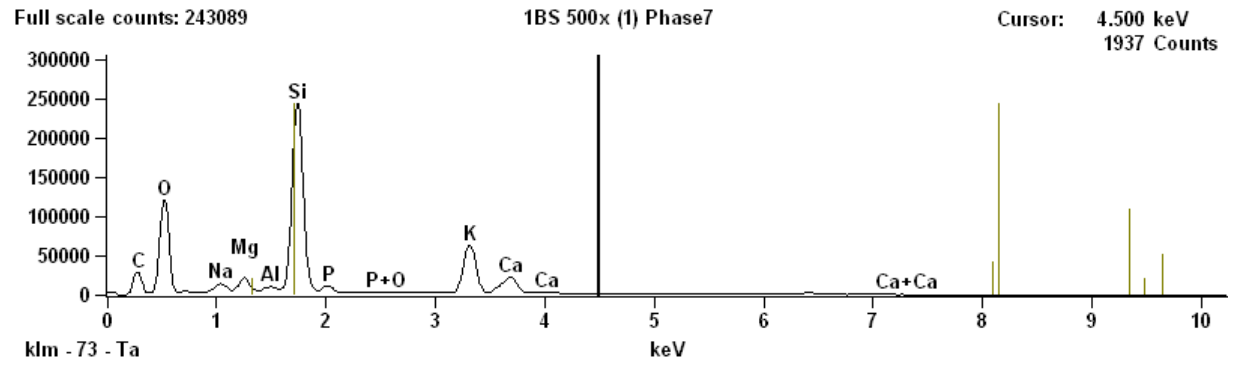
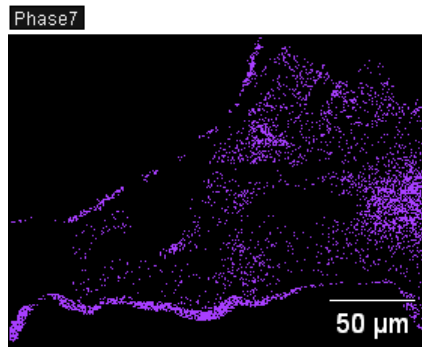
Project: SEMÅA-group 4



Accelerating Voltage: 15.0 kV

Magnification: 500

Auto Phases From Counts



Project: SEMÅA-group 4

*Quantitative Results for: 1BS 500x (1) Phase1*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	53.17S	---	66.62		---
<i>Mg K</i>	0.04	+/- 0.00	0.03	MgO	0.06
<i>Si K</i>	46.59	+/- 0.09	33.25	SiO2	99.68
<i>K K</i>	0.09	+/- 0.01	0.05	K2O	0.11
<i>Ca K</i>	0.10	+/- 0.01	0.05	CaO	0.14
<i>Total</i>	100.00		100.00		100.00

Project: SEMÅA-group 4

*Quantitative Results for: 1BS 500x (1) Phase2*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	42.69S	---	59.45		---
<i>Na K</i>	2.31	+/- 0.11	2.24	Na <sub>2</sub> O	3.12
<i>Mg K</i>	3.27	+/- 0.07	3.00	MgO	5.42
<i>Si K</i>	24.70	+/- 0.10	19.60	SiO <sub>2</sub>	52.85
<i>P K</i>	3.27	+/- 0.11	2.35	P <sub>2</sub> O <sub>5</sub>	7.49
<i>K K</i>	10.87	+/- 0.11	6.20	K <sub>2</sub> O	13.10
<i>Ca K</i>	12.89	+/- 0.13	7.17	CaO	18.03
<i>Total</i>	100.00		100.00		100.00

Project: SEMÅA-group 4

*Quantitative Results for: IBS 500x (1) Phase3*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	42.19S	---	58.91		---
<i>Na K</i>	2.06	+/- 0.01	2.00	Na2O	2.78
<i>Mg K</i>	2.88	+/- 0.01	2.65	MgO	4.78
<i>Al K</i>	0.36	+/- 0.01	0.30	Al2O3	0.68
<i>Si K</i>	26.28	+/- 0.05	20.91	SiO2	56.23
<i>P K</i>	2.33	+/- 0.01	1.68	P2O5	5.33
<i>K K</i>	16.62	+/- 0.05	9.50	K2O	20.02
<i>Ca K</i>	7.28	+/- 0.02	4.06	CaO	10.19
<i>Total</i>	100.00		100.00		100.00

Project: SEMÅA-group 4

*Quantitative Results for: IBS 500x (1) Phase4*

<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	41.97S	---	59.41		---
<i>Na K</i>	1.15	+/- 0.02	1.13	Na <sub>2</sub> O	1.55
<i>Mg K</i>	3.42	+/- 0.02	3.18	MgO	5.66
<i>Al K</i>	0.39	+/- 0.02	0.33	Al <sub>2</sub> O <sub>3</sub>	0.73
<i>Si K</i>	22.17	+/- 0.05	17.88	SiO <sub>2</sub>	47.43
<i>P K</i>	3.07	+/- 0.02	2.24	P <sub>2</sub> O <sub>5</sub>	7.02
<i>K K</i>	6.99	+/- 0.03	4.05	K <sub>2</sub> O	8.42
<i>Ca K</i>	20.86	+/- 0.06	11.79	CaO	29.18
<i>Total</i>	100.00		100.00		100.00

Project: SEMÅA-group 4

*Quantitative Results for: 1BS 500x (1) Phase7*

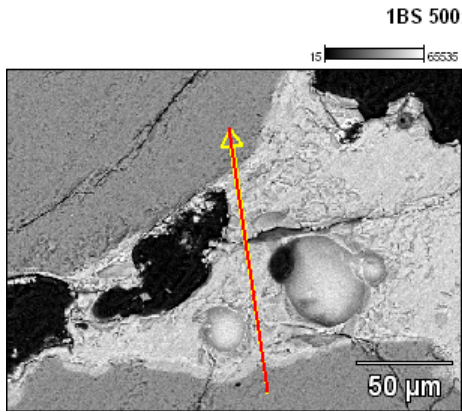
<i>Element Line</i>	<i>Weight %</i>	<i>Weight % Error</i>	<i>Atom %</i>	<i>Formul a</i>	<i>Compnd %</i>
<i>O K</i>	43.30S	---	59.76		---
<i>Na K</i>	2.10	+/- 0.02	2.01	Na <sub>2</sub> O	2.83
<i>Mg K</i>	1.88	+/- 0.02	1.71	MgO	3.11
<i>Al K</i>	0.37	+/- 0.02	0.30	Al <sub>2</sub> O <sub>3</sub>	0.70
<i>Si K</i>	29.47	+/- 0.06	23.17	SiO <sub>2</sub>	63.04
<i>P K</i>	1.43	+/- 0.02	1.02	P <sub>2</sub> O <sub>5</sub>	3.28
<i>K K</i>	15.34	+/- 0.05	8.67	K <sub>2</sub> O	18.48
<i>Ca K</i>	6.11	+/- 0.03	3.37	CaO	8.55
<i>Total</i>	100.00		100.00		100.00



### Combinations

<i>Combinations</i>	<i>Color</i>	<i>Area %</i>	<i>Combinations</i>
<i>Phase1</i>	Custom	40.25	C 1
<i>Phase2</i>	Custom	11.76	C 2
<i>Phase3</i>	Custom	34.62	C 3, C 12, C 8
<i>Phase4</i>	Custom	6.59	C 4
<i>Phase7</i>	Custom	6.79	C 13

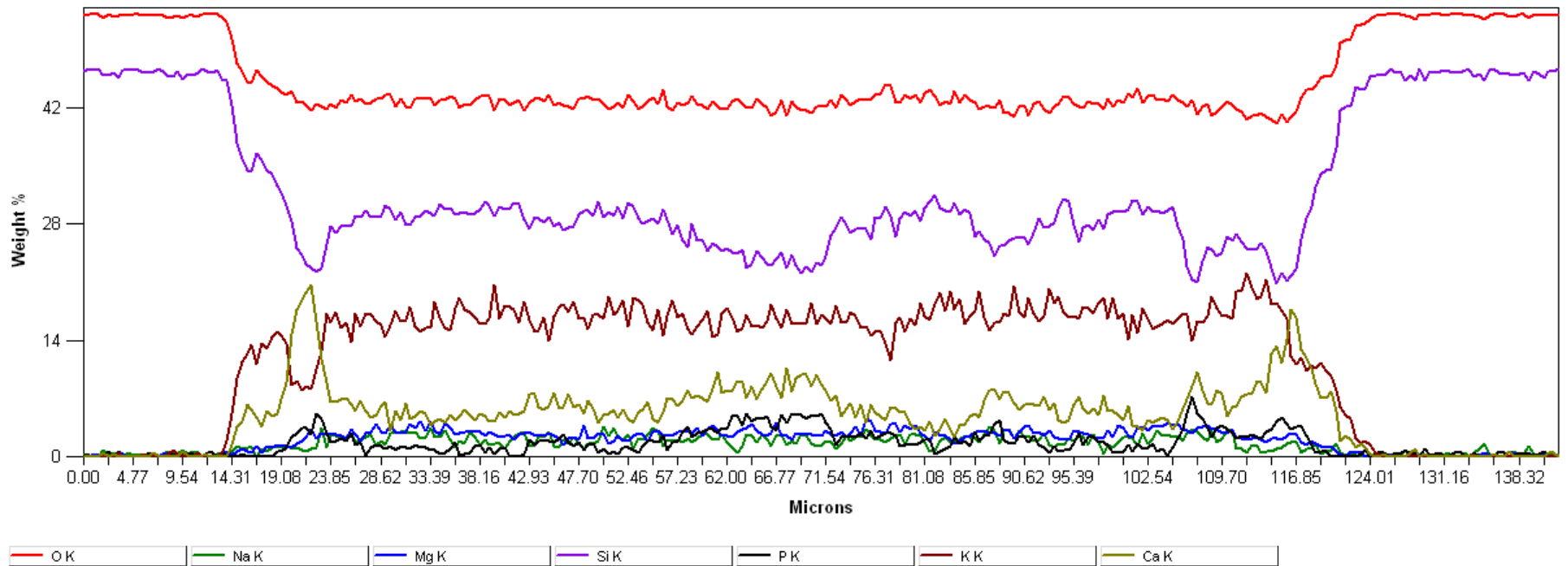
Project: SEMÅA-group 4



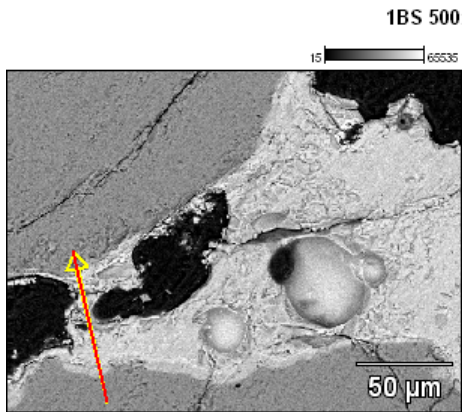
Accelerating Voltage: 15.0 kV

Magnification: 500

1BS 500x (1)Extract



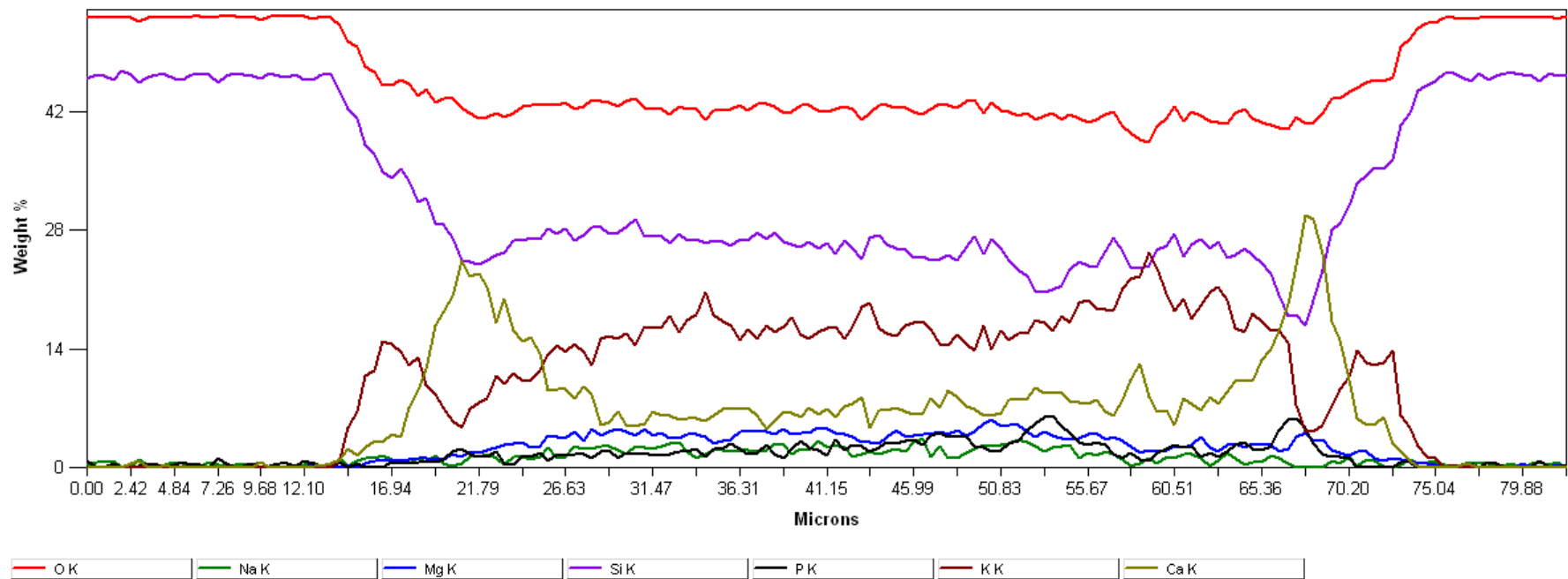
Project: SEMÅA-group 4



Accelerating Voltage: 15.0 kV

Magnification: 500

1BS 500x (1)Extract



# Glue summary

- The sand particles are covered by two layers
  - First layer: Closest to the particle: K, Si
  - Second layer: Ca, Si
- The glue consists of the first layer elements with some Na, P and Mg

