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Appendix RIVM Report 711701086A/2009

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Appendix 7 and 8 of RIVM Report 71170186

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Appendix RIVM Report 71170186A/2009

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Relative oral bioavailability of lead from Dutch made grounds
The SEM/EDS analyses and photos

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Preface

This document contains the Appendices 7 and 8 of the RIVM Report 71170186/2009 “Relative oral bioavailability of lead from Dutch made grounds”, written by W.I. Hagens, N. Walraven, M. Minekus, R. Havenaar, J.P.A. Lijzen, A.G. Oomen. This RIVM report is available at the RIVM website (www.rivm.nl).

Appendix 7 contains the SEM/EDS analysis (SEM: Scanning Electronic Microscopy, EDS: Energy Dispersive röntgen fluorescence Spectrometer), of sixteen selected made grounds, performed at CORUS (IJmuiden, the Netherlands). Data interpretation was performed by N. Walraven (Geoconnect, Castricum, the Netherlands).

Appendix 8 contains the SEM photos of sixteen selected made grounds. These photos were taken by CORUS (IJmuiden, the Netherlands).

Appendix 7: SEM/EDS analyses

This appendix contains the results of the SEM/EDS analyses of the 16 selected soil samples. The SEM photos are given in Appendix 8.

Sample 1: Schoonhoven

An element map of soil Sample 1 (Schoonhoven) is given in Figure A1.

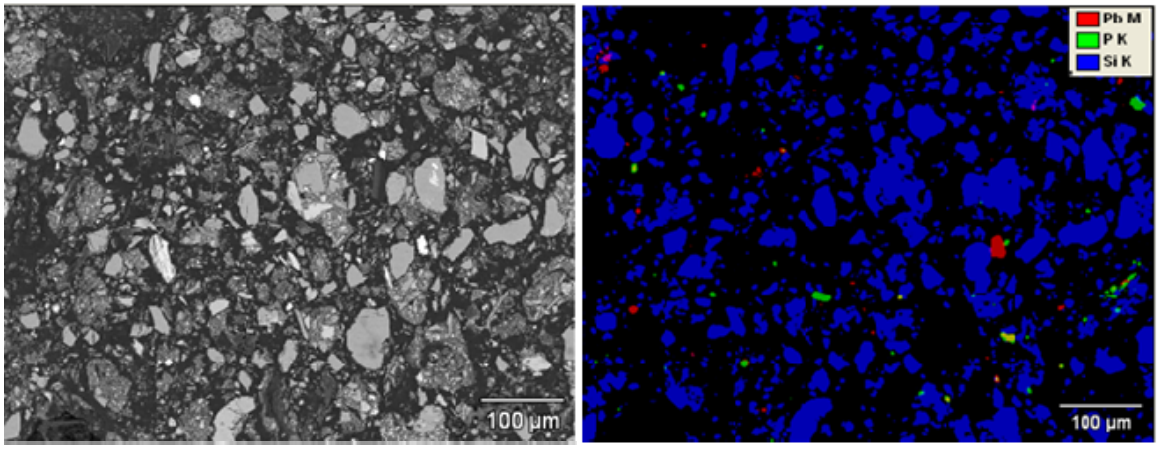


Figure A1: Element map of soil Sample 1 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A1 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are in general <10 µm in diameter, with some particles measuring up to 30 µm in diameter. A few Pb-P phases are present, with diameters ranging from <5 to 20 µm.

The diameters (in µm) and chemical compositions of the representative Pb phases in Sample 1 (Schoonhoven) are presented in Table A1.

Table A1: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 1 (Schoonhoven).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P_2O_5	S	Cl	CaO	Fe_2O_3	Pb	Pb-phase
1	1	10	<1	nd	nd	nd	nd	1	1	98	Pb, Pb oxide or Pb carbonate
2	1	15	1	2	9	-	4	12	2	68	Pb apatite
1	2	10	<1	1	8	<1	4	14	3	67	Pb apatite
3	3	10	6	11	7	nd	3	7	2	58	Pb glass/glaze with Pb apatite
4	1	15	7	36	<1	<1	<1	<1	1	56	Pb glass/glaze
3	1	5	2	5	13	nd	2	29	1	46	Pb apatite
5	2	10	<1	<1	29	nd	1	34	1	33	Pb apatite

nd=not detectable

Sample 1 mainly contains the following Pb phases: 1) Elemental Pb, Pb oxide or Pb carbonate, 2) Pb glass/glaze and 3) Pb apatite. Elemental Pb, Pb oxide, Pb carbonate and Pb glass/glaze are primary Pb phases (Table A1). Pb apatite is a secondary Pb phase. With the used SEM/EDS technique it was not possible to distinguish between elemental Pb, Pb oxide and Pb carbonate (due to the inaccuracy of the C and O analysis). The diameter of the primary Pb phases varies between 10 to 15 μm, with Pb glass/glaze being the largest particles. The diameter of the secondary Pb phases varies from 5 to 15 μm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 1 (Schoonhoven) is given in Table A2.

TableA2: Chemical composition (in wt %) of selected organic rich particles in Sample 1 (Schoonhoven).

Photo	Point	C*	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	S	K_2O	CaO	Pb
6	1	84	<1	<1	2	4	<1	<1	<1	6	1.23
6	8	81	<1	<1	1	6	<1	<1	<1	5	1.81
2	2	73	<1	1	4	15	1	<1	1	2	0.66
2	5	72	<1	1	5	16	<1	<1	1	2	0.07
3	6	70	nd	1	5	16	<1	<1	1	4	0.44
3	7	67	<1	1	6	19	<1	<1	1	1	0.11
5	11	66	nd	1	1	8	<1	<1	<1	<1	0.21

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 1.81 wt %. The highest Pb content is measured in the most C-rich organic particles.

Sample 11: Utrecht

An element map of soil Sample 11 (Utrecht) is given in Figure A2.

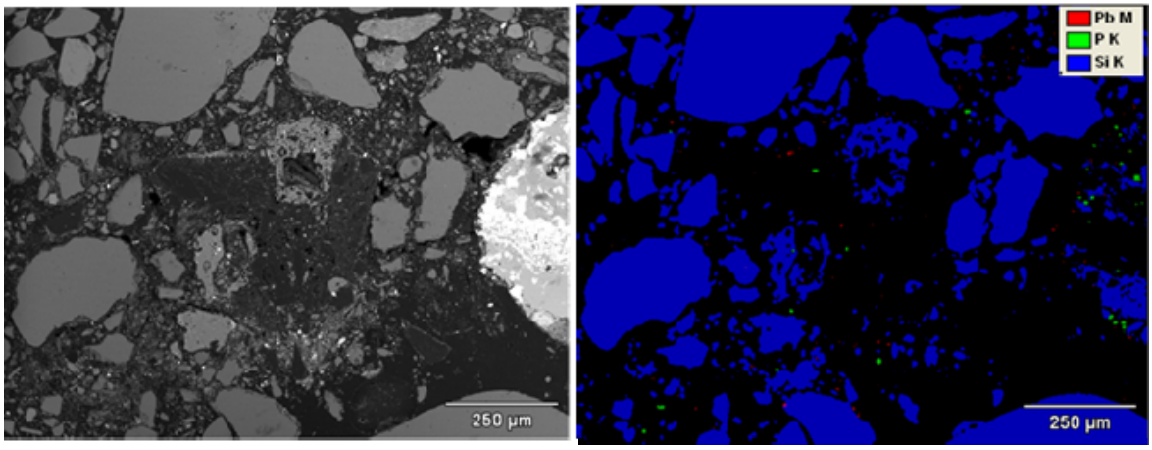


Figure A2: Element map of soil Sample 11 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A2 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are in general <10 µm in diameter, with some particles measuring up to 30 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 11 (Utrecht) are presented in Table A3.

Table A3: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 11 (Utrecht).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P_2O_5	S	Cl	CaO	Fe_2O_3	Pb	Pb-phase
8	1	10	<1	<1	16	nd	3	7	4	68	Pb-apatite
9	1	10	nd	nd	17	nd	3	6	6	67	Pb-apatite
10	1	30	1	2	19	nd	3	11	1	61	Pb-apatite
10	4	10	13	28	10	<1	3	7	7	24	Pb-apatite
11	4	10	1	1	1	11	1	2	31	5	Fe-Pb
11	1	<5	<1	1	<1	nd	<1	<1	79	4	Fe-Pb
12	1	<5	<1	1	1	<1	<1	<1	77	4	Fe-Pb
9	5	10	1	1	1	<1	<1	1	77	4	Fe-Pb

nd=not detectable

Sample 11 mainly contains the following Pb phases: 1) Pb apatite (10-30 µm) and 2) Pb bound to iron particles (<5-10 µm).

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 11 (Utrecht) is given in Table A4.

Table A4: Chemical composition (in wt %) of selected organic rich particles in Sample 11 (Utrecht).

Photo	Point	C*	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	CaO	Fe_2O_3	Pb
13[a]	6	83	<1	<1	2	9	<1	1	2	0.24
13[a]	2	82	<1	<1	2	9	<1	2	2	nd
13[a]	4	82	<1	1	3	9	<1	2	2	0.07
13[a]	9	82	<1	1	2	7	<1	2	4	0.13
13[a]	1	78	<1	<1	2	9	1	2	6	nd
13[a]	3	78	<1	<1	2	14	<1	2	1	0.06
13[a]	7	78	<1	<1	4	12	<1	2	2	0.17
13[a]	5	77	<1	<1	3	14	<1	1	2	0.18
8	6	75	<1	1	3	10	1	4	4	0.19
8	5	75	nd	1	3	10	1	4	3	0.22
13[a]	8	67	<1	1	5	20	<1	1	2	0.16
10	4	61	nd	1	5	11	4	3	3	9.38

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.24 wt % (excluding photo 10, point 4). In one organic rich particle (photo 10 point 4) a Pb content of 9.38 wt % is measured. Most likely a primary Pb phase is included in the analysis.

Sample 17: De Rijp

An element map of soil Sample 17 (De Rijp) is given in Figure A3.

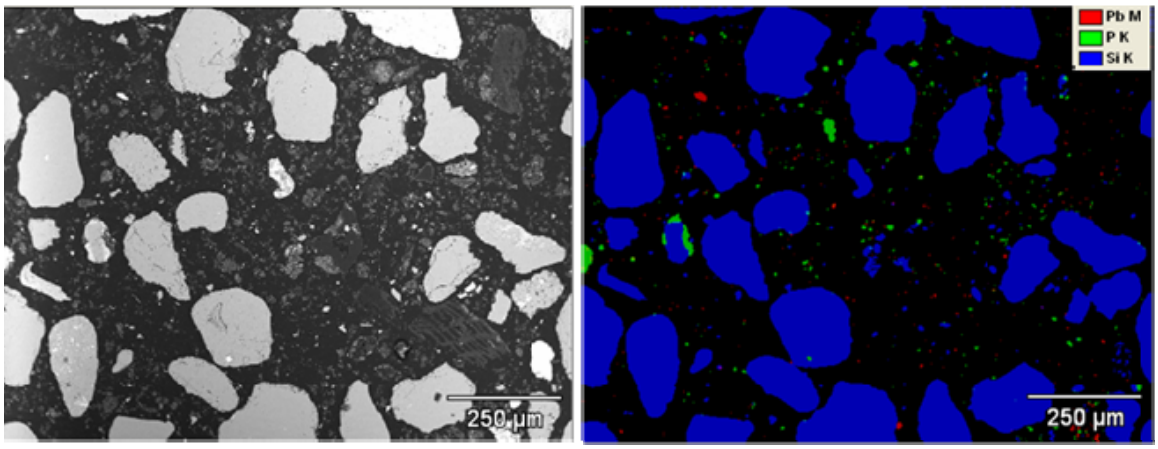


Figure A3: Element map of soil Sample 17 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A3 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are in general <10 µm in diameter, with some particles measuring up to 30 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 17 (De Rijp) are presented in Table A5.

Table A5: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 17 (De Rijp).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	Pb	Pb phase
14	1	300	5	25	<1	<1	<1	<1	1	67	Pb glass/glaze
15	1	20	5	27	<1	<1	<1	<1	2	63	Pb glass/glaze
16	1	25	2	1	11	<1	3	19	4	58	Pb-apatite
17	1, 2	170	6	34-36	<1	0-1	<1	2	2	50-53	Pb glass/glaze
18	1,2, 3	350	14	35-38	<1	<1	<1	<1	2-6	39-43	Pb glass/glaze
19	1	40	2	68	<1	<1	<1	<1	1	28	Pb glass/glaze
20	2	675	2	51	<1	<1	1	3	1	22	Pb glass/glaze

nd=not detectable

Sample 17 mainly contains Pb glass/glaze particles. The diameter of these particles varies from 20 to 675 µm. Only one Pb-apatite particle was found (25 µm in diameter).

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 17 (De Rijp) is given in Table A6.

Table A6: Chemical composition (in wt %) of selected organic rich particles in Sample 17 (De Rijp).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O_3	Pb
21	1	97	1	1	<1	1	<1	<1	<1	<1	nd
22	2	97	<1	<1	nd	1	<1	<1	<1	<1	nd
22	7	95	1	2	<1	<1	1	<1	<1	<1	0.2
22	1	93	2	3	<1	<1	<1	<1	1	<1	nd
23	4	93	<1	1	<1	1	<1	nd	1	3	nd
23	9	89	4	5	<1	<1	<1	<1	1	<1	nd
21	3	88	2	3	<1	1	<1	<1	3	1	nd
23	6	87	2	7	<1	<1	1	<1	1	2	0.16
22	5	87	2	7	<1	<1	1	<1	1	1	0.09
24	5	86	2	7	<1	<1	1	<1	1	1	0.19
22	4	85	2	9	<1	<1	1	<1	1	1	0.02
23	5	84	2	9	<1	<1	1	<1	1	1	0.08
24	4	84	2	8	<1	<1	1	<1	1	1	0.02
24	2	84	3	4	<1	<1	<1	1	5	2	0.15
22	3	83	3	10	<1	<1	<1	<1	1	2	0.25
24	3	82	2	10	1	<1	<1	<1	1	1	nd
21	2	81	3	4	<1	<1	<1	1	5	4	nd
24	1	79	2	4	1	2	<1	1	6	3	0.37
23	8	73	5	15	1	<1	<1	1	1	2	nd
22	6	66	13	17	<1	<1	<1	1	<1	1	0.07

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.37 wt %. In half of the selected organic-rich particles the Pb content is not detectable.

Sample 21: Haarlem

An element map of soil Sample 21 (Haarlem) is given in Figure A4.

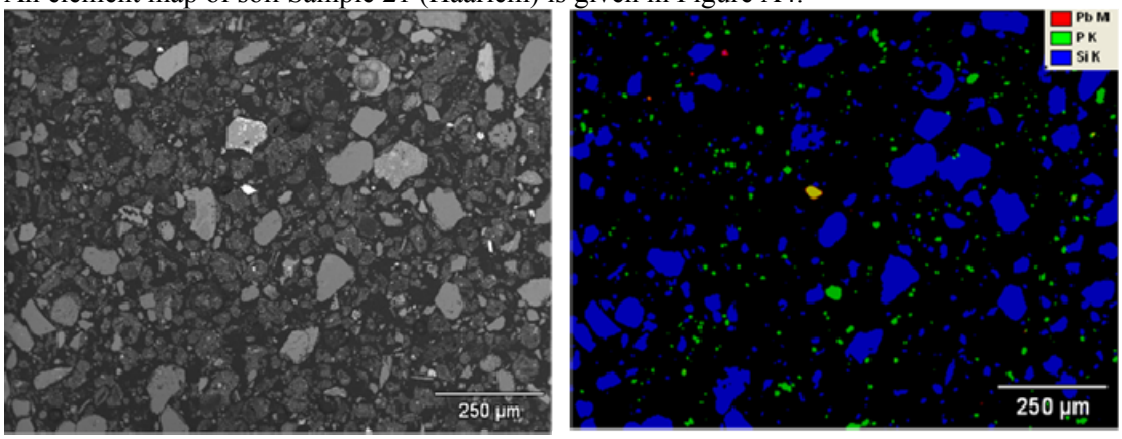


Figure A4: Element map of soil Sample 21 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A4 shows that the number of Pb phases is limited. The present Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are in general 10 µm in diameter, with some particles measuring up to 50 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 21 (Haarlem) are presented in Table A7.

Table A7: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 21 (Haarlem).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	Pb	Pb-phase
24	1	50	<1	nd	<1	nd	nd	nd	1	97	Pb, Pb oxide or Pb carbonate
24	2	50	nd	nd	nd	<1	nd	nd	1	97	
25	1, 2, 3	75	<1	0-2	<1	nd	0-2	0-1	<1	94-97	
26	1, 2	10	<1	nd	7	<1	2-3	4	1	81-84	Pb-apatite
27	1, 4	5	1-3	3-10	<1	11-12	<1	<1	0-1	70-82	Pb-S
28	1, 2, 3	30	0-3	1-9	7-8	0-1	2-3	6-8	1-4	64-77	Pb-apatite
29	1	5	2	4	nd	1	<1	1	2	70	Pb, Pb oxide or Pb carbonate
30	1	?	2	3	8	nd	3	9	2	69	Pb-apatite
29	2	<5	2	4	<1	nd	<1	<1	3	67	Pb, Pb oxide or Pb carbonate
31	1, 3	80	2	11	7	<1	3	6	2	66	Pb-apatite
30	3	?	3	9	8	<1	3	15	2	55	Pb-apatite
30	2	?	4	4	2	6	1	3	18	49	Pb-Fe-S

nd=not detectable

Sample 21 mainly contains the following Pb phases: 1) Elemental Pb, Pb oxide or Pb carbonate, 2) Pb-S, 3) Pb apatite and 4) a Pb-Fe-S phase. Elemental Pb, Pb oxide, Pb carbonate, and Pb-S (in this sample) are primary Pb phases (Table A7). Pb apatite and Pb-Fe-S are secondary Pb phases. With the used SEM/EDS technique it was not possible to distinguish between elemental Pb, Pb oxide and Pb carbonate (due to the inaccuracy of the C and O analysis). The diameter of the primary Pb phases varies between 5 to 75 μm, with Pb glass/glaze being the largest particles. The diameter of the secondary Pb phases varies from 10 to 80 μm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 21 (Haarlem) is given in Table A8.

Table A8: Chemical composition (in wt %) of selected organic rich particles in Sample 21 (Haarlem).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O_3	Pb
32	6	91	1	5	<1	<1	1	<1	1	1	nd
32	7	86	2	6	1	<1	1	<1	2	1	nd
32	2	84	2	7	1	<1	<1	<1	3	2	0.02
33	8	81	3	9	1	<1	1	<1	2	2	0.21
32	5	81	3	8	1	<1	<1	<1	2	2	0.25
33	4	81	2	8	1	<1	<1	<1	3	2	0.01
32	7	81	2	9	1	<1	<1	<1	2	2	0.31
33	10	80	3	8	1	<1	<1	1	3	2	0.27
33	4	79	3	10	1	<1	1	<1	2	2	0.32
33	8	79	2	6	1	1	<1	1	5	2	0.18
33	6	77	3	11	2	<1	1	<1	3	2	0.27
33	4	76	3	10	2	<1	<1	1	3	2	0.18
34	6	76	3	12	1	<1	<1	1	2	3	0.39
34	7	75	3	12	1	<1	<1	1	2	3	0.3
34	5	74	3	12	1	<1	<1	1	3	3	0.2
34	3	74	3	13	2	<1	<1	1	3	3	0.23
32	3	73	1	2	3	<1	<1	<1	2	18	0.37
34	2	71	3	15	2	<1	<1	1	2	3	0.4
32	1	70	8	14	1	<1	<1	1	1	3	nd
34	3	68	4	16	2	<1	<1	1	3	4	0.27
32	5	67	9	16	1	<1	<1	1	3	3	nd

* The accuracy of the C analyses with the used technique is limited; the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.39 wt %. In half of the selected organic-rich particles the Pb content is not detectable.

Sample 27: Alkmaar

An element map of soil Sample 27 (Alkmaar) is given in Figure A5.

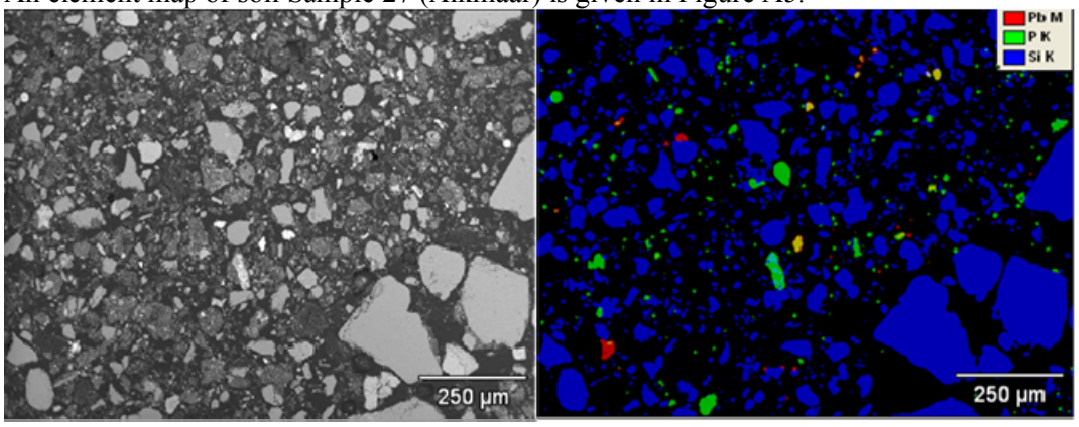


Figure A5: Element map of soil Sample 27 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A5 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). A relatively large number of Pb-P particles is present in this sample. The particles are in general around 10 µm in diameter, with some particles measuring up to 50 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 27 (Alkmaar) are presented in Table A9.

Table A9: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 27 (Alkmaar).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P_2O_5	S	Cl	CaO	Fe_2O_3	Pb	Pb phase
35	4	5	<1	<1	<1	nd	nd	<1	<1	98	Pb, Pb oxide or Pb carbonate
35	5	5	<1	1	-	nd	nd	<1	<1	97	
35	3	35	<1	<1	15	nd	2	5	2	75	Pb apatite
36	5	5	1	4	2	nd	1	13	2	73	
36	1,2,3	15	0-1	<1	16-20	nd	2-6	6-14	1-5	54-72	
37	3	5	<1	1	16	nd	4	7	1	70	
38	1,3,4	70	1-2	0-7	17-18	nd	2-3	8-10	1-3	57-68	
35	1	30	<1	<1	17	1	3	8	2	67	
36	4	5	1	6	14	<1	4	6	1	65	
35	7	5	1	3	18	1	3	7	2	63	
39	2	20	1	7	18	nd	2	14	3	52	
37	1, 2	15	5	37	nd	0-1	<1	1	3	48-50	Pb glass/glaze
35	2	30	4	12	17	nd	2	10	4	48	Pb apatite
39	1	55	5	40	nd	nd	<1	1	3	47	Pb glass/glaze

nd=not detectable

Sample 27 mainly contains the following Pb phases: 1) Elemental Pb, Pb oxide or Pb carbonate, 2) Pb glass/glaze, and 3) Pb-apatite. Elemental Pb, Pb oxide, Pb carbonate and Pb glass/glaze are primary Pb phases (Table A9). Pb apatite is a secondary Pb phases. With the used SEM/EDS technique it was not possible to distinguish between elemental Pb, Pb oxide and Pb carbonate (due to the inaccuracy of the C and O analysis).

Pb apatite is clearly the dominant Pb phase. The diameter of the Pb-apatites varies between 5 and 70 µm. The diameter of Pb, Pb oxide or Pb carbonate is approximately 5 µm, and the diameter of the Pb glass/glaze particles is 15 to 55 µm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 27 (Alkmaar) is given in Table A10.

Table A10: Chemical composition (in wt %) of selected organic rich particles in Sample 27 (Alkmaar).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O_3	Pb
37	7	84	1	5	<1	<1	1	<1	4	2	nd
39	4	80	1	4	2	<1	1	<1	2	1	7
38	7	73	4	16	1	<1	1	1	1	3	nd
39	6	72	2	15	<1	<1	1	<1	5	3	nd
37	9	71	4	17	1	<1	<1	<1	2	3	0.27
35	8	69	3	18	1	<1	1	1	2	3	0.17

* The accuracy of the C analyses with the used technique is limited; the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.27 wt % (excluding photo 39, point 4). In one organic rich particle (photo 39, point 4) a Pb content of 7 wt % is measured. Most likely a primary Pb phase is included in the analysis.

Sample 29: Leiden

An element map of soil Sample 29 (Leiden) is given in Figure A6.

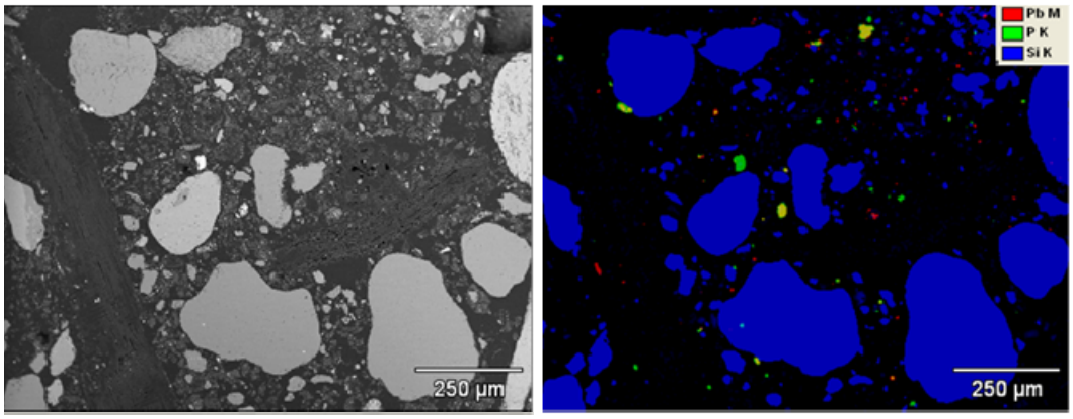


Figure A6: Element map of soil Sample 29 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A6 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). A relatively large number of Pb-P particles is present in this sample. The particles are in general around 10 µm in diameter, with some particles, mainly the Pb-P particles, measuring up to 40 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 29 (Leiden) are presented in Table A11.

Table A11: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 29 (Leiden).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P_2O_5	S	Cl	CaO	Fe_2O_3	Pb	Pb phase
40	1	25	<1	<1	16	<1	3	5	<1	72.9	Pb apatite
41	2	5	11	33	1	5	24	9	7	8.6	Pb glass/glaze
42	1	15	73	2	nd	0	15	nd	nd	8.5	

nd=not detectable

Sample 29 mainly contains the Pb phases Pb glass/glaze and Pb-apatite (Table A11), with Pb apatite being the particles with the largest diameter (up to 40 µm).

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 29 (Leiden) is given in Table A12.

Table A12. Chemical composition (in wt %) of selected organic rich particles in Sample 29 (Leiden).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O_3	Pb
43	1	94	<1	2	<1	<1	1	<1	1	<1	nd
43	2	92	1	2	<1	<1	1	1	2	1	0.07
44	2	86	2	6	<1	<1	1	1	1	1	0.15
44	3	86	2	7	<1	<1	1	1	1	1	nd
45	1	80	2	9	1	<1	1	1	3	2	0.29
44	1	80	1	5	1	2	<1	1	5	3	nd
45	2	80	3	12	1	<1	<1	<1	1	2	0.01
43	5	77	2	14	<1	<1	<1	<1	2	2	nd
43	3	75	2	17	<1	<1	<1	<1	1	2	nd
43	4	74	3	15	1	<1	<1	1	1	2	0.14
45	3	58	1	10	<1	<1	<1	<1	24	1	nd

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.29 wt %. The Pb content of half of the measured organic rich particles is not detectable.

Sample 33: Delft

An element map of soil Sample 33 (Delft) is given in Figure A7.

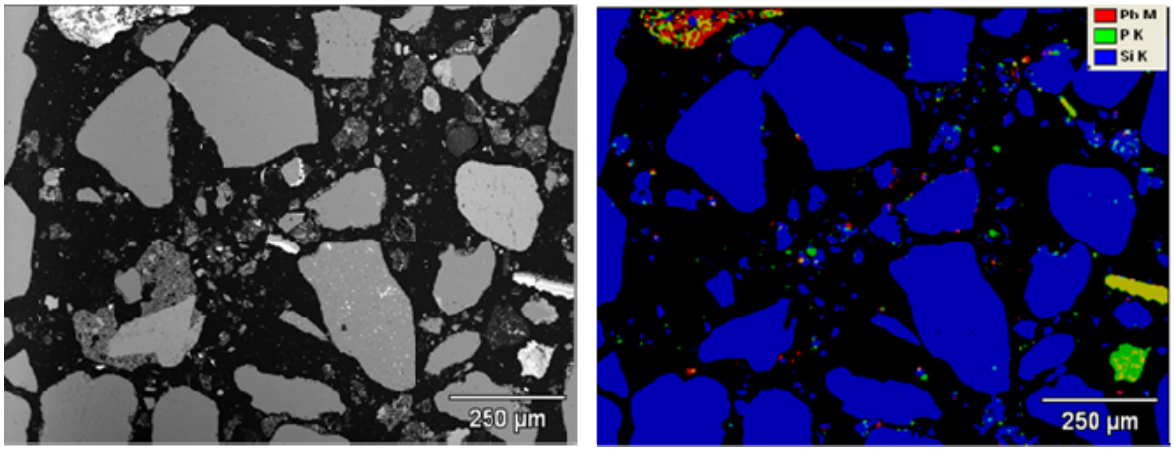


Figure A7: Element map of soil Sample 33 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A7 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). A relatively large number of Pb-P particles is present in this sample. The particles are in general around 10 µm in diameter, with some particles, mainly the Pb-P particles, measuring up to 250 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 33 (Delft) are presented in Table A13.

Table A13: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 33 (Delft).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	Pb	Pb phases
46	1,3,4	35	nd	nd	nd	nd	nd	<1	3-4	94-95	Pb, Pb oxide or Pb carbonate
46	2	15	nd	nd	nd	nd	<1	<1	4	93	
47	4	10	nd	nd	<1	nd	<1	1	4	93	
47	3	5	<1	<1	1	nd	2	1	9	85	Fe-Pb
48	2	Vein (75)	1	nd	<1	<1	7	<1	9	82	Fe-Pb
48	1	Vein (75)	<1	0	<1	3	4	<1	5	82	Fe-Pb
49	1	40	<1	0	8	nd	4	6	4	78	Pb-apatite
50	1	25	<1	nd	9	nd	3	11	1	73	
51	1	20	<1	1	7	<1	3	10	<1	73	
52	1	375	1	34	nd	nd	<1	1	2	43	Pb glass/glaze
53	1	2.8 mm	1	38	<1	<1	1	2	1	32	

nd=not detectable

Sample 33 mainly contains the following Pb phases: 1) Elemental Pb, Pb oxide or Pb carbonate, 2) Pb glass/glaze, 3) Pb veins in Fe and 4) Pb apatite. Elemental Pb, Pb oxide, Pb carbonate, Pb

glass/glaze and Pb veins in Fe are primary Pb phases (Table A13). Pb apatite is a secondary Pb phase. With the used SEM/EDS technique it was not possible to distinguish between elemental Pb, Pb oxide and Pb carbonate (due to the inaccuracy of the C and O analysis). The diameter of the primary Pb phases varies between 10 μm to 2.8 mm, with Pb glass/glaze being the largest particles. The diameter of the secondary Pb phases varies from 20 to 40 μm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 33 (Delft) is given in Table A14.

Table A14: Chemical composition (in wt %) of selected organic rich particles in Sample 33 (Delft).

Photo	Point	C*	Al_2O_3	SiO_2	P	S	Cl	K_2O	CaO	Fe_2O_3	Pb
54	5	96	<1	<1	<1	<1	1	<1	1	1	0.12
55	1	95	1	1	<1	1	<1	<1	<1	<1	0.1
56	2	93	1	2	<1	1	<1	<1	2	<1	0.54
55	4	92	<1	3	<1	<1	1	<1	1	1	0.04
54	1	92	1	2	<1	1	<1	<1	2	1	nd
56	1	91	2	3	<1	<1	<1	<1	1	<1	0.27
54	3	89	1	3	<1	<1	1	<1	3	1	0.57
55	2	87	1	3	<1	<1	1	1	4	1	0.02
54	2	83	1	2	<1	1	<1	1	9	1	1.02
56	3	83	2	6	<1	<1	1	1	4	1	0.88
57	2	69	6	16	<1	<1	<1	1	3	1	0.32
57	1	60	8	19	<1	<1	<1	1	4	4	0.46

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 1.02 wt %. The Pb content of only one measured organic rich particle is not detectable.

Sample 43: Den Haag

An element map of soil Sample 43 (Den Haag) is given in Figure A8.

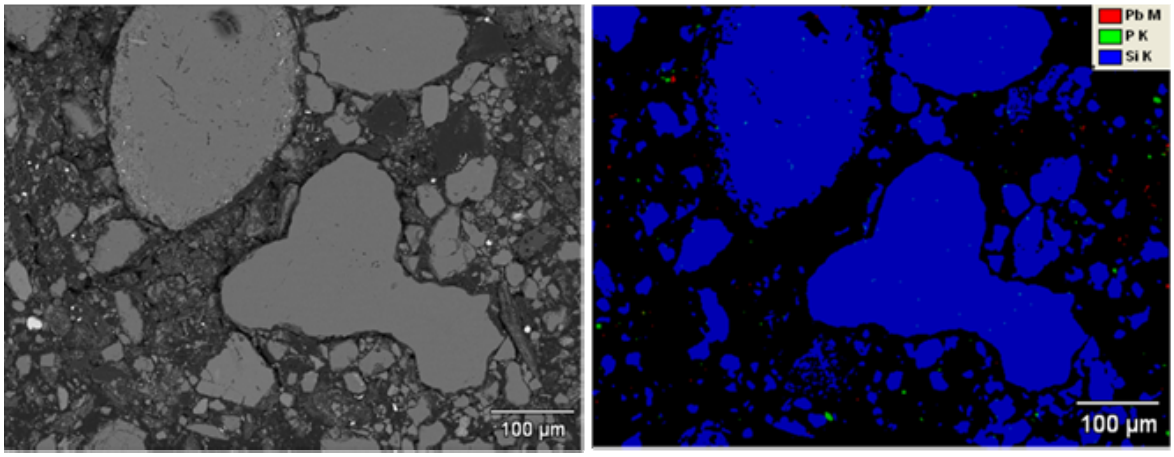


Figure A8: Element map of soil Sample 43 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A8 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are all <10 µm (diameter).

The diameters and chemical compositions of the representative Pb phases in Sample 43 (Den Haag) are presented in Table A15.

Table A15: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 43 (Den Haag).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	Pb	Pb phase
58	1	20	<1	1	<1	11	<1	1	nd	85	Pb-S
59	1	5	1	2	<1	12	<1	<1	nd	81	Pb-S
60	1	200	<1	<1	<1	22	1	2	nd	69	Pb-S
59	2	80	<1	<1	8	1	2	5	16	68	Pb apatite
61	1	40	5	4	2	12	1	2	7	66	Pb apatite
62	1-5	90	0-1	0-3	8-11	<1	2-3	5-6	16-20	58-63	Pb apatite

nd=not detectable

Sample 43 mainly contains the Pb phases Pb-S and Pb-apatite (Table A15). Pb can be a primary Pb phase and/or a secondary Pb phase. The diameter of the Pb-S particles varies from 5 to 200 µm. Pb apatite is a secondary Pb phase, with particle diameters ranging from 40 to 90 µm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 43 (Den Haag) is given in Table A16.

Table A16: Chemical composition (in wt %) of selected organic rich particles in Sample 43 (Den Haag).

Photo	Point	C*	Al_2O_3	SiO_2	P	S	Cl	K_2O	CaO	Fe_2O_3	Pb
63	3	96	<1	1	<1	<1	1	<1	1	<1	0.45
64	2	95	<1	1	<1	1	<1	<1	<1	1	0.11
63	4	93	<1	1	<1	<1	1	<1	1	1	0.2
65	2	93	1	2	<1	<1	1	<1	1	2	0.03
66	6	91	1	2	<1	<1	1	<1	2	1	0.42
65	1	91	<1	2	<1	1	<1	<1	<1	4	0.22
66	4	90	1	2	<1	<1	1	1	3	1	0.19
66	3	88	<1	5	<1	<1	1	<1	1	2	nd
66	1	86	1	4	<1	<1	1	1	3	2	0.61
65	3	85	1	9	<1	<1	<1	<1	1	1	0.1
64	6	84	2	7	<1	<1	1	1	2	1	0.11
66	2	83	1	2	<1	<1	<1	1	6	3	0.96
65	4	82	1	5	<1	1	<1	1	3	2	1.38
64	7	81	1	5	1	1	<1	<1	3	4	0.47
63	1	79	3	8	<1	<1	<1	1	3	2	0.34
64	3	76	1	19	<1	<1	<1	<1	1	2	nd
64	4	73	7	12	<1	<1	<1	<1	1	1	2.48
63	2	71	3	16	<1	<1	<1	<1	2	2	0.32
66	5	56	1	2	<1	<1	<1	<1	2	33	nd

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 2.48 wt %.

Sample 45: Rotterdam

An element map of soil Sample 45 (Rotterdam) is given in Figure A9.

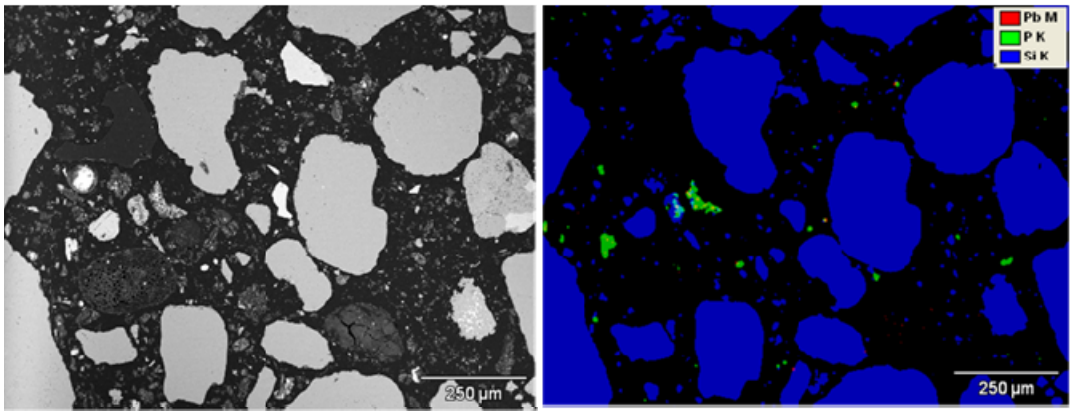


Figure A9: Element map of soil Sample 45 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A9 shows that Sample 45 contains only a limited number of Pb containing particles The particles are all <10 µm (diameter).

The diameters and chemical compositions of the representative Pb phases in Sample 45 (Rotterdam) are presented in Table A17.

Table A17: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 45 (Rotterdam).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	Pb	Pb phase
67	1	125	<1	<1	<1	nd	5	<1	<1	92	Pb, Pb oxide or Pb carbonate
68	1	50	5	27	nd	<1	<1	<1	2	63	Pb glass/glaze
69	1	95	10	17	<1	nd	<1	4	4	58	

nd=not detectable

Sample 45 mainly contains the Pb phases, 1) elemental Pb, Pb oxide or Pb carbonate and 2) Pb glass/glaze (Table A17). These are all primary Pb phases. With the used SEM/EDS technique it was not possible to distinguish between elemental Pb, Pb oxide and Pb carbonate (due to the inaccuracy of the C and O analysis). The diameter of the primary Pb phases varies between 50 to 125 µm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 45 (Rotterdam) is given in Table A18.

Table A18: Chemical composition (in wt %) of selected organic rich particles in Sample 45 (Rotterdam).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O_3	Pb
70	2	96	<1	<1	<1	1	<1	<1	1	1	0.07
71	2	96	<1	1	<1	1	<1	<1	<1	1	0.03
72	2	94	1	2	<1	<1	<1	<1	1	<1	0.01
73	1	93	1	3	<1	<1	<1	<1	1	1	0.05
73	3	92	1	3	<1	<1	1	<1	1	1	0.07
74	3	91	1	2	<1	<1	1	<1	2	1	0.01
74	2	90	1	4	<1	<1	1	<1	1	1	nd
70	3	89	1	2	<1	<1	1	<1	3	2	nd
75	1	87	<1	3	1	1	<1	<1	3	4	nd
74	1	86	1	3	1	<1	<1	1	3	3	0.32
71	1	84	1	3	2	<1	1	<1	2	6	nd
71	3	83	3	7	<1	1	1	1	2	2	nd
73	4	81	3	10	<1	<1	<1	1	1	2	0.06
73	2	81	2	6	1	1	<1	1	3	2	0.11
72	3	80	3	11	1	<1	<1	1	1	2	0.05
71	4	77	4	12	1	<1	<1	1	1	2	nd
70	1	74	4	15	<1	<1	<1	1	1	2	nd
71	5	74	6	13	1	<1	<1	1	1	3	0.04
72	4	73	4	14	1	<1	<1	1	2	2	0.13
72	1	72	4	16	1	<1	<1	1	3	2	0.27
72	5	70	5	18	1	<1	<1	1	1	2	0.03

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.32 wt %.

Sample 51: Schiedam

An element map of soil Sample 51 (Schiedam) is given in Figure A10.

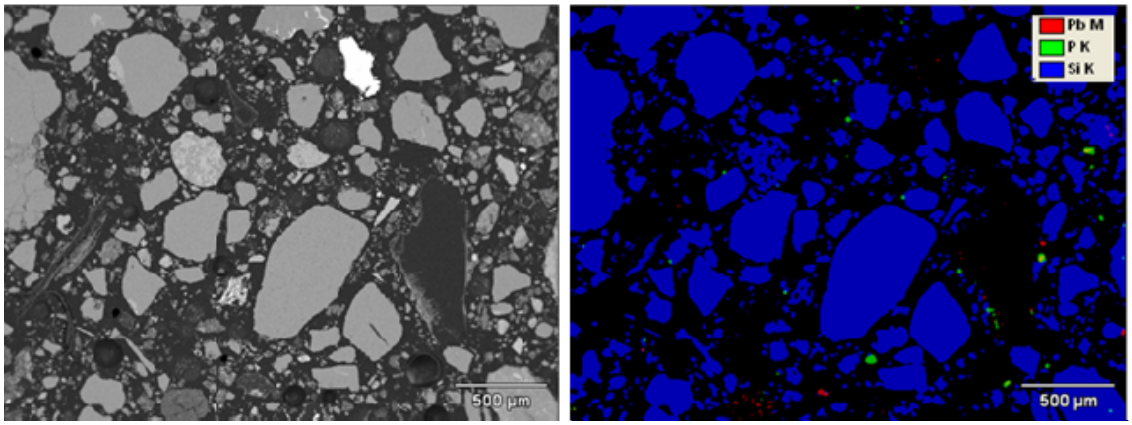


Figure A10: Element map of soil Sample 51 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A10 shows that the Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are predominantly <10 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 51 (Schiedam) are presented in Table A19.

Table A19: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 51 (Schiedam).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	Pb	Pb phases
76	1,2,3	10	4	<1	7	0-1	2-3	4	3-4	71-75	Pb-apatite
77	1	50	1	2	1	10	3	4	3	69	Pb-S
78	1	50	5	35	<1	<1	<1	1	2	51	Pb glass/glaze

Sample 51 mainly contains the following Pb phases: 1) Pb glass/glaze, 2) Pb-S and 3) Pb-apatite. Pb glass/glaze are primary Pb phases. Pb apatite is a secondary Pb phase. Pb-S can be both a primary or secondary Pb phase. The diameter of the Pb phases varies from 10 to 50 µm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 51 (Schiedam) is given in Table A20.

Table A20: Chemical composition (in wt %) of selected organic rich particles in Sample 51 (Schiedam).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O^3	Pb
79	3	94	1	2	<1	1	<1	<1	1	1	0.05
80	1	89	1	2	<1	1	<1	<1	5	1	0.08
81	1	86	1	5	1	<1	1	1	2	2	0.31
79	1	85	1	7	<1	<1	<1	1	3	1	0.16
79	4	85	2	4	1	<1	<1	<1	4	2	0.36
82	1	84	2	3	<1	<1	<1	1	6	1	nd
83	2	74	4	13	<1	<1	1	1	6	1	0.26
79	2	68	13	16	<1	<1	<1	<1	1	1	nd

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.36 wt %.

Sample 53: Groningen

An element map of soil Sample 53 (Groningen) is given in Figure A11.

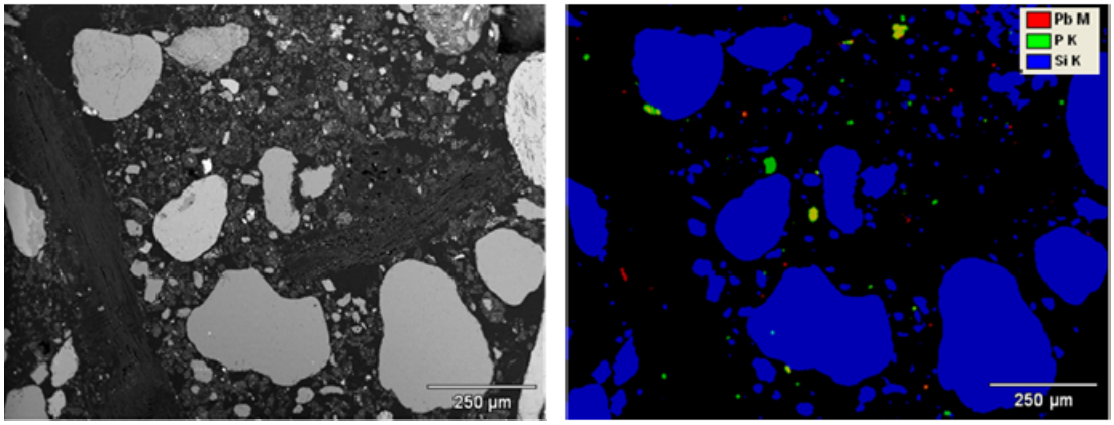


Figure A11: Element map of soil Sample 53 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A11 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). A relatively large number of Pb-P particles is present in this sample. The particles are in general around 10 µm in diameter, with some particles, mainly the Pb-P particles, measuring up to 45 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 53 (Schiedam) are presented in Table A21.

Table A21: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 53 (Groningen).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P_2O_5	S	Cl	CaO	Fe_2O_3	Pb	Pb phase
84	1	15	<1	4	1	<1	<1	nd	2	85	Pb, Pb oxide or Pb carbonate
85	1,2	15	0-1	0-2	7-8	nd	2-3	2	2	82-84	Pb-apatite
86	1	10	1	2	8	nd	4	4	2	79	Pb-apatite
87	1	20	<1	<1	16	<1	3	6	1	72	Pb-apatite
88	1	10	<1	1	18	<1	3	12	2	62	Pb-apatite
88	4	<5	7	21	12	<1	4	8	3	40	Pb-apatite
89	1	10	1	6	70	nd	<1	11	7	4	Pb-apatite
84	2	?	3	2	3	7	nd	49	26	4	?

nd=not detectable

Sample 53 mainly contains the following Pb phases: 1) Pb, Pb oxide or Pb carbonate and 2) Pb-apatite. Elemental Pb, Pb oxide and Pb carbonate are primary Pb phases (Table A21). Pb apatite is a secondary Pb phase. With the used SEM/EDS technique it was not possible to

distinguish between elemental Pb, Pb oxide and Pb carbonate (due to the inaccuracy of the C and O analysis). The diameter of the Pb phases varies between <5 to 20 μm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 53 (Groningen) is given in Table A22.

Table A22: Chemical composition (in wt %) of selected organic rich particles in Sample 53 (Groningen).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O_3	Pb
90	9	88	1	3	<1	<1	1	1	3	1	0.08
90	8	87	1	3	<1	<1	1	1	3	2	0.07
84	7	87	1	4	<1	<1	1	<1	3	2	0.17
91	6	87	1	2	1	<1	<1	1	5	2	0.14
91	7	85	2	8	<1	<1	1	1	2	1	0.07
90	3	84	1	2	1	<1	<1	1	6	3	0.08
91	3	84	2	6	<1	<1	<1	1	3	1	0.12
90	2	84	1	2	2	<1	<1	1	5	4	0.05
90	6	84	1	2	<1	<1	<1	1	6	3	0.14
90	4	84	2	9	<1	<1	<1	<1	2	1	0.04
84	4	81	<1	<1	<1	1	nd	<1	9	5	0.73
84	6	81	1	3	1	2	1	1	6	4	0.27
91	5	79	2	12	<1	<1	<1	1	2	2	0.02
90	1	79	2	6	1	<1	<1	1	6	3	0.19
91	2	79	2	5	1	<1	<1	1	6	5	0.45
91	1	77	3	11	1	<1	<1	1	3	3	0.17
90	7	74	3	16	<1	<1	<1	1	2	2	0.1
84	5	74	1	1	1	1	<1	3	10	6	nd

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.73 wt %. In only 1 of the eighteen samples the Pb contact was not detectable.

Sample 59: Zutphen

An element map of soil Sample 59 (Zutphen) is given in Figure A12.

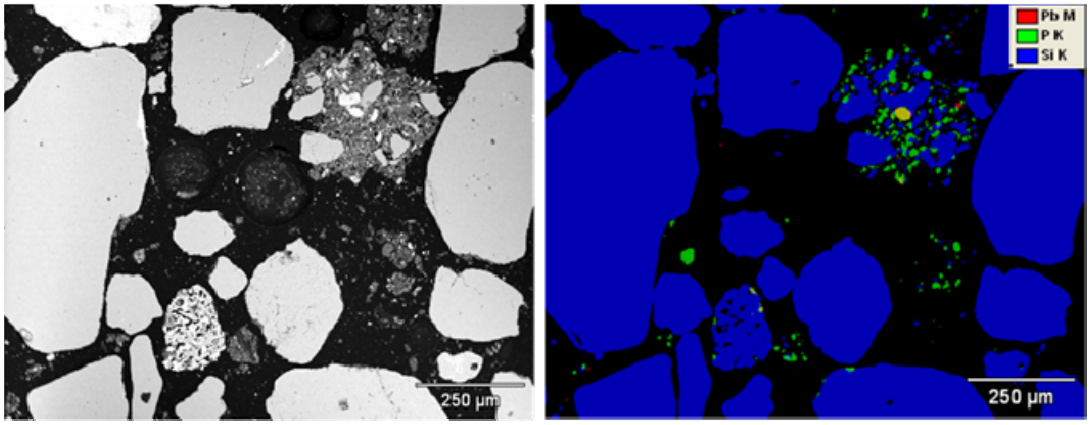


Figure A12: Element map of soil Sample 59 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A12 shows that Sample 59 only contains a limited number of Pb containing particles The particles are in general <10 µm in diameter, with some large Pb-P particles (up to 45 µm).

The diameters and chemical compositions of the representative Pb phases in Sample 59 (Zutphen) are presented in Table A21.

Table A23: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 59 (Zutphen).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	Pb	Pb phase
92	1,2,4, 5,6	55	<1	<1	0-1	0-1	nd	0-1	0-1	94-99	Pb, Pb oxide, Pb carbonate
93	1-10	215	0-2	0-2	1-7	1-7	0-4	0-9	0-3	66-98	Pb-apatite
94	2	40	<1	nd	1	nd	<1	1	1	96	Pb, Pb oxide, Pb carbonate
94	1	40	1	<1	4	<1	2	4	1	86	Pb-apatite
92	3	5	<1	<1	7	<1	3	6	2	78	Pb-apatite
96	1	5	<1	1	7	1	3	5	1	75	Pb-apatite
94	3	25	1	nd	11	<1	2	19	1	64	Pb-apatite
99	1	40	2	1	9	1	2	15	11	55	Pb-apatite
98	1	10	1	7	nd	3	45	nd	6	32	Pb glass/glaze
97	1	5	2	54	<1	<1	1	2	1	30	Pb glass/glaze
97	2	5	2	57	<1	<1	1	2	1	28	Pb glass/glaze
95	1	5	1	26	nd	2	38	nd	1	27	Pb glass/glaze

nd=not detectable

Sample 59 mainly contains the following Pb phases: 1) Elemental Pb, Pb oxide or Pb carbonate, 2) Pb glass/glaze and 3) Pb apatite. Elemental Pb, Pb oxide, Pb carbonate and Pb glass/glaze are primary Pb phases (Table A12). Pb apatite is a secondary Pb phase. With the used SEM/EDS technique it was not possible to distinguish between elemental Pb, Pb oxide and Pb carbonate (due to the inaccuracy of the C and O analysis). The diameter of the primary Pb phases varies between 5 to 55 μm, with Pb, Pb oxide or Pb carbonate being the largest particles. The diameter of the secondary Pb phases varies from 5 to 215 μm.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 59 (Zutphen) is given in Table A24.

Table A24: Chemical composition (in wt %) of selected organic rich particles in Sample 59 (Zutphen).

Photo	Point	C*	Al_2O_3	SiO_2	P	S	Cl	K_2O	CaO	Fe_2O_3	Pb
100	3	91	1	3	<1	1	<1	<1	2	1	0.1
101	1	90	1	4	<1	<1	1	<1	2	1	nd
100	1	88	1	6	<1	<1	1	<1	1	1	0.18
101	5	87	2	4	<1	<1	<1	<1	4	1	0.24
100	9	86	2	7	<1	<1	1	<1	2	1	nd
100	4	85	2	8	<1	<1	<1	<1	1	1	0.2
101	3	82	2	10	<1	<1	<1	<1	1	2	0.02
101	6	81	3	9	<1	<1	1	1	3	2	0.11
100	5	80	3	11	<1	<1	<1	1	1	3	0.15
100	10	80	3	11	<1	<1	<1	<1	2	2	nd
100	6	79	2	10	<1	<1	1	<1	3	2	1.02
100	2	79	3	12	<1	<1	<1	<1	2	2	0.11
100	7	79	2	12	<1	<1	<1	<1	2	3	nd
100	8	69	4	19	<1	<1	<1	1	3	2	0.07
101	4	68	8	16	<1	<1	<1	2	2	2	nd

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 1.02 wt %.

Sample 63, Nijmegen

An element map of soil Sample 63 (Nijmegen) is given in Figure A13.

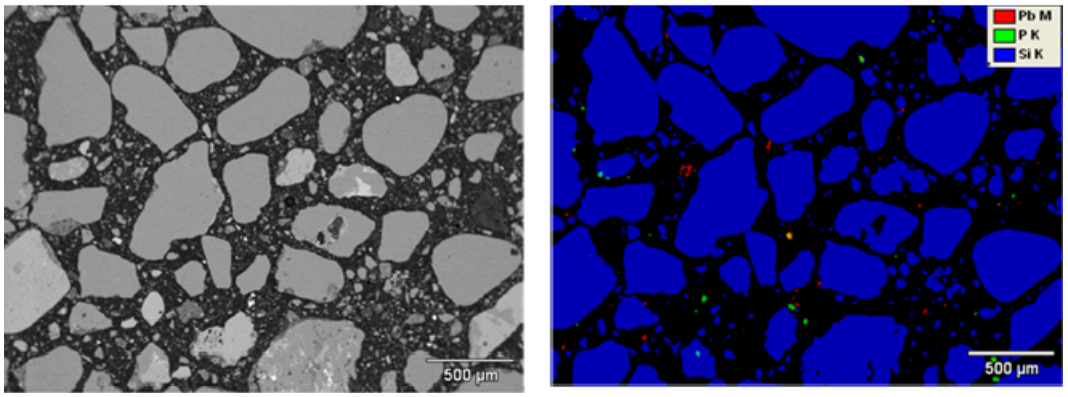


Figure A13: Element map of soil Sample 63 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A13 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are in approximately 10 µm in diameter, with some particles measuring up to 40 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 63 (Nijmegen) are presented in Table A25.

Table A25: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 63 (Nijmegen).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	PbO	Pb phase
102	1,2	75	nd	nd	nd	nd	nd	0-3	0-1	95-99	Pb oxide
103	1	135	<1	nd	nd	<1	<1	<1	nd	99	Pb oxide
104	1,3,4	100	<1	nd	nd	0-1	<1	0-1	nd	95-98	Pb oxide
105	1, 2	20	<1	nd	nd	<1	nd	<1	<1	96-97	Pb oxide
106	1	20	nd	nd	<1	nd	nd	<1	1	97	Pb oxide
107	1	2	<1	nd	nd	nd	nd	<1	<1	96	Pb oxide
107	2, 3	2	<1	0-1	nd	nd	nd	<1	nd	95-96	Pb oxide
108	1, 2	135	<1	nd	nd	nd	0-1	nd	nd	94-96	Pb oxide
109	1	30	nd	nd	nd	nd	nd	3	nd	95	Pb oxide
109	2,3	195	nd	nd	<1	nd	<1	0-3	<1	93-95	Pb oxide
110	1	25	<1	1	nd	<1	nd	1	<1	93	Pb oxide
111	1,2,3	110	<1	<1	nd	0-2	0-1	0-2	0-1	86-93	Pb oxide
112	1, 2	55	<1	nd	nd	nd	nd	1-2	nd	91-92	Pb oxide

nd=not detectable

Sample 63 mainly contains the Pb phase Pb oxide[1]. The diameter of the Pb oxides varies from 2 to 195 µm. Some Pb oxides show dissolution holes (e.g. photo 104 and photo 111) .

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 63 (Nijmegen) is given in Table A26.

Table A26: Chemical composition (in wt %) of selected organic rich particles in Sample 63 (Nijmegen).

Photo	Point	C*	Al_2O_3	SiO_2	P	S	Cl	K_2O	CaO	Fe_2O_3	Pb
113	1	97	<1	1	nd	1	<1	<1	<1	<1	nd
114	1	97	1	1	<1	1	<1	nd	<1	nd	0.14
115	1	95	1	1	nd	1	<1	<1	1	<1	0.11
116	1	94	<1	<1	nd	1	<1	<1	2	nd	0.29
117	2	92	1	1	<1	1	<1	<1	3	<1	0.61
118	1	92	1	1	nd	1	<1	<1	4	<1	0.54
117	1	91	1	2	<1	1	<1	<1	3	nd	0.38
119	1	90	1	3	<1	1	<1	<1	2	1	0.29
120	1	87	1	2	<1	<1	<1	<1	6	<1	1.28
120	2	86	1	3	<1	<1	<1	<1	7	1	0.67
117	3	81	2	8	nd	<1	1	<1	5	1	0.15
116	2	72	<1	<1	<1	1	<1	3	16	nd	3.55

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 3.55 wt %.

[1] In Sample 63 CORUS was able to determine that the Pb particles were Pb oxides. With the used technique it is mostly not possible to distinguish between elemental Pb, Pb oxides and Pb carbonates. However, due to the large diameter of the Pb oxides, it was possible in Sample 63.

Sample 69, Maastricht

No Pb containing particles were found in Sample 69. Also the Pb content of the organic rich particles was quite low (compared with the other studied samples, Table A27).

Table A27: Chemical composition (in wt %) of selected organic rich particles in Sample 69 (Maastricht).

Photo	Point	C*	Al_2O_3	SiO_2	P	S	Cl	K_2O	CaO	Fe_2O_3	Pb
121	2	96	<1	1	<1	1	<1	-	<1	1	nd
122	2	95	1	2	nd	1	<1	<1	<1	<1	nd
123	1	95	1	2	<1	1	<1	<1	<1	1	nd
123	2	93	1	2	<1	1	<1	<1	<1	1	nd
123	7	93	1	4	<1	<1	<1	<1	<1	1	nd
122	1	93	1	2	<1	<1	<1	<1	<1	1	0.16
123	3	91	<1	3	nd	1	<1	<1	1	2	nd
121	4	91	1	3	<1	1	<1	<1	<1	1	nd
122	3	91	2	3	<1	1	<1	<1	<1	1	0.04
121	3	90	1	3	nd	1	<1	<1	<1	2	nd
121	5	90	1	5	nd	<1	<1	<1	<1	1	0.07
122	4	90	1	3	<1	<1	<1	<1	3	2	nd
122	5	86	2	7	<1	<1	1	<1	1	2	nd
121	1	86	2	6	<1	<1	<1	<1	1	1	nd
121	6	82	2	9	<1	<1	<1	1	<1	2	0.23

* The accuracy of the C analyses with the used technique is limited; the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 0.23 wt %. In only 4 of the 15 particles the Pb contact was detectable.

Sample 71, Maastricht

An element map of soil Sample 71 (Maastricht) is given in Figure A14.

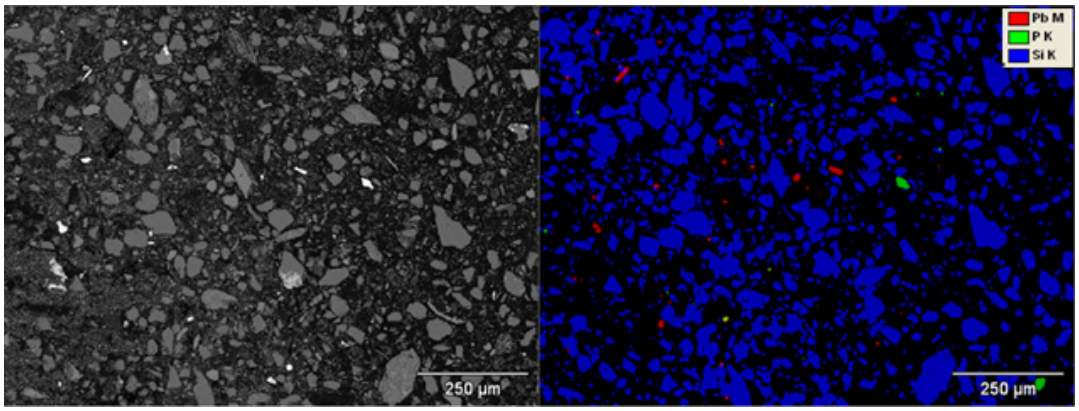


Figure A14: Element map of soil Sample 71 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A14 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are in general <10 µm in diameter, with some particles measuring up to 45 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 71 (Maastricht) are presented in Table A28. The Pb containing particles in Figure A14 were hard to find with the point measurements. Most likely these are remnants of glazed ceramic materials.

Table A28: Size and chemical composition (in wt %) of representative Pb phases in Sample 71(Maastricht).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P	S	Cl	CaO	Fe_2O_3	Pb	Pb fase
124	1	5	<1	1	<1	<1	<1	<1	<1	98	Pb, Pb oxide or Pb carbonate
125	1,2,3	40	5	29-30	<1	<1	<1	4	<1	59-60	Pb glass/glaze
126	1	25	5	30	<1	<1	<1	4	<1	59	Pb glass/glaze
127	1	10	5	35	<1	<1	<1	4	1	53	Pb glass/glaze

The dominant Pb containing particles in this sample are Pb glass/glaze (Table A28). The diameter from these particles varies from 10 to 40 µm (Table A28).

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 71 (Maastricht) is given in Table A29.

Table A29: Chemical composition (in wt %) of selected organic rich particles in Sample 71 (Maastricht).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O_3	Pb
128	2	98	<1	1	nd	1	<1	<1	<1	<1	nd
129	2	97	<1	1	nd	1	<1	<1	<1	<1	nd
130	1	97	1	1	nd	1	<1	<1	<1	<1	nd
131	2	97	<1	1	nd	1	<1	<1	<1	<1	nd
132	3	97	<1	1	<1	1	<1	<1	<1	<1	nd
128	1	96	<1	1	<1	1	<1	<1	<1	<1	0.01
133	2	93	2	3	<1	<1	<1	<1	1	1	0.03
131	5	93	1	4	nd	1	<1	<1	<1	1	nd
134	2	93	1	1	nd	1	<1	<1	3	<1	0.11
133	3	92	2	3	<1	1	<1	<1	1	1	nd
131	1	92	1	3	nd	1	<1	<1	2	1	nd
128	3	92	1	4	<1	<1	1	<1	<1	1	nd
133	4	90	2	6	<1	<1	<1	<1	<1	1	nd
132	2	89	<1	1	nd	1	<1	<1	8	nd	0.07
132	1	89	1	5	<1	<1	1	<1	1	1	0.32
133	4	87	2	5	<1	1	<1	<1	3	1	nd
134	3	86	1	2	<1	1	<1	1	9	<1	0.08
134	1	86	2	4	<1	2	<1	1	4	<1	0.08
131	4	86	1	3	nd	3	1	<1	6	<1	nd
131	3	83	3	10	<1	<1	<1	<1	1	1	0.11
130	2	83	4	8	<1	<1	<1	1	1	1	0.19
133	1	76	1	3	<1	6	1	<1	10	1	nd
130	3	72	5	15	<1	2	<1	1	3	1	0.02
129	1	71	2	14	nd	9	<1	<1	<1	<1	1.62

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

The Pb content of the selected organic rich particles varies from not detectable to 1.62 wt %. In more than half of the measured organic rich particles the Pb content was not detectable.

Sample 77, Echt Susteren

An element map of soil Sample 77 (Echt Susteren) is given in Figure A15.

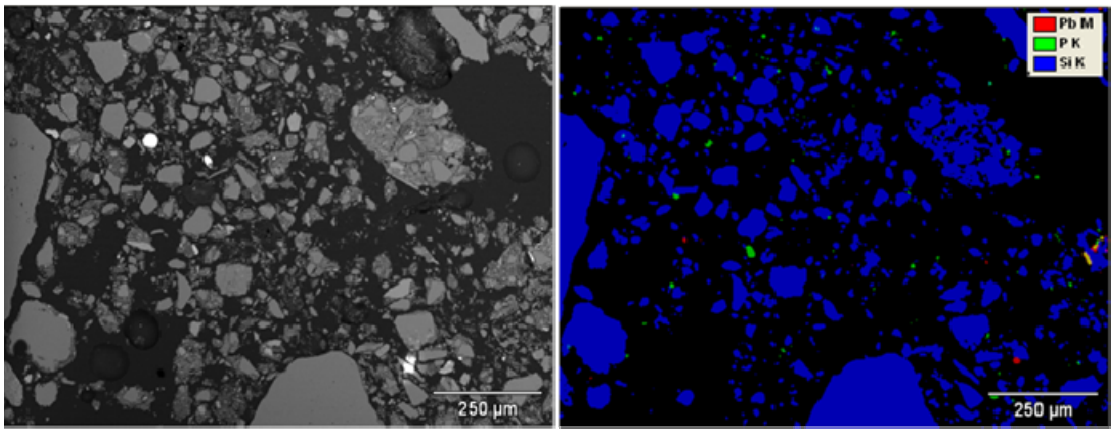


Figure A15: Element map of soil Sample 77 (red=Pb; green=P; blue=Si; yellow=Pb+P; purple=Pb+Si; light blue=P+Si).

Figure A15 shows that Pb containing particles are finely dispersed throughout a silicate rich matrix (mainly sand). The particles are in general <10 µm in diameter, with some particles measuring up to 20 µm in diameter.

The diameters and chemical compositions of the representative Pb phases in Sample 77 (Echt Susteren) are presented in Table A30.

Table A30: Diameter and chemical composition (in wt %) of representative Pb phases in Sample 77 (Echt Susteren).

Photo	Point	Diameter (µm)	Al_2O_3	SiO_2	P_2O_5	S	Cl	CaO	Fe_2O_3	Pb	Pb phase
135	1	?	<1	<1	<1	<1	<1	3	1	95	Pb, Pb oxide or Pb carbonate
136	1	40	<1	<1	<1	<1	<1	11	1	65	Ca-P
137	1	20	8	25	<1	1	<1	<1	<1	64	Pb glass/glaze
138	1	20	5	35	<1	<1	<1	<1	<1	52	Pb glass/glaze
139	1	55	7	36	<1	<1	<1	1	1	47	Pb glass/glaze
140	1-5	250	10-38	14-59	0-1	nd	<1	0-5	1-7	7-32	Pb glass/glaze
141	2	10	7	8	2	nd	<1	4	7	31	Pb glass/glaze
141	3	5	27	40	<1	<1	<1	1	2	25	Pb glass/glaze
141	1	5	11	17	<1	<1	<1	2	3	21	Pb glass/glaze
142	1	70	9	74	<1	nd	<1	<1	<1	12	Pb glass/glaze

nd=not detectable

Sample 77 mainly contains Pb glass/glaze particles. The diameter from these particles varies from 5 to 250 µm. Some Pb, Pb oxide or Pb carbonate and Pb-apatite particles were found.

When primary Pb phases dissolve, dissolved Pb can adsorb to organic matter. The chemical composition of selected organic rich particles in Sample 77 (Echt Susteren) is given in Table A31.

Table A31: Chemical composition (in wt %) of selected organic rich particles in Sample 77 (Echt Susteren).

Photo	Point	C*	Al_2O_3	SiO_2	P_2O_5	S	Cl	K_2O	CaO	Fe_2O_3	Pb
139	3	86	2	7	<1	nd	1	<1	1	1	nd
136	3	68	7	18	<1	<1	<1	1	1	3	nd

* The accuracy of the C analyses with the used technique is limited, the C content is therefore semi-quantitative. nd=not detectable.

There were hardly any organic matter particles found with a SiO_2 content <20%. The Pb content of the selected organic rich particles (with SiO_2 <20%) were not detectable.

Appendix 8: SEM photos

Sample 1: Schoonhoven

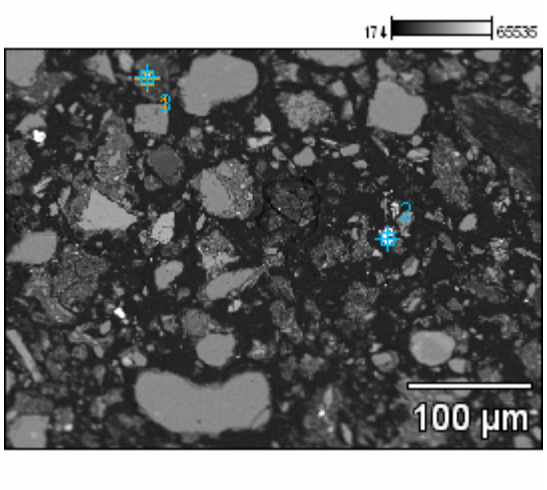


Photo 1.

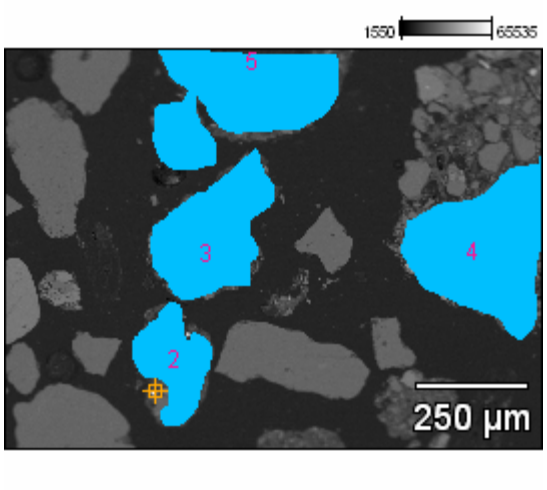


Photo 2.

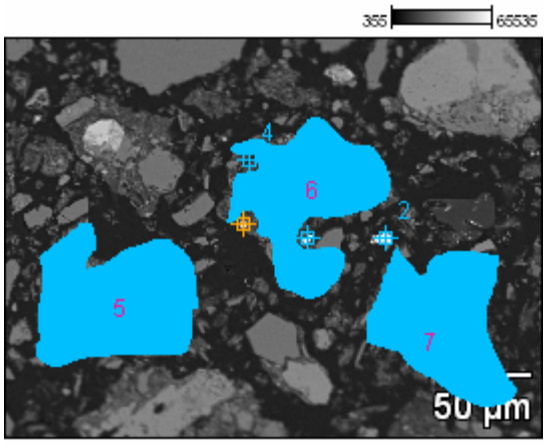


Photo 3.

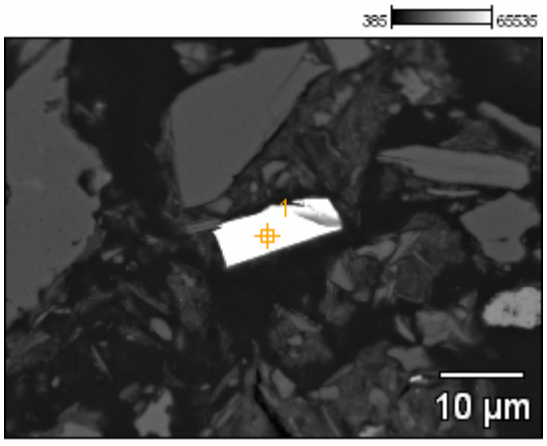


Photo 4.

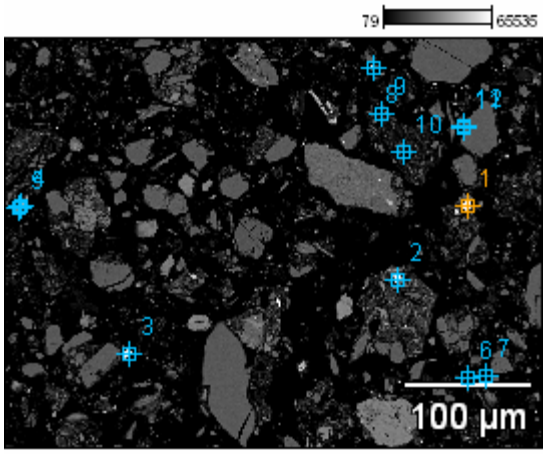


Photo 5.

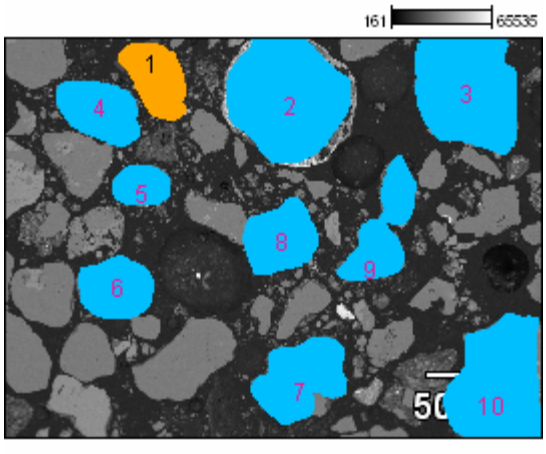


Photo 6.

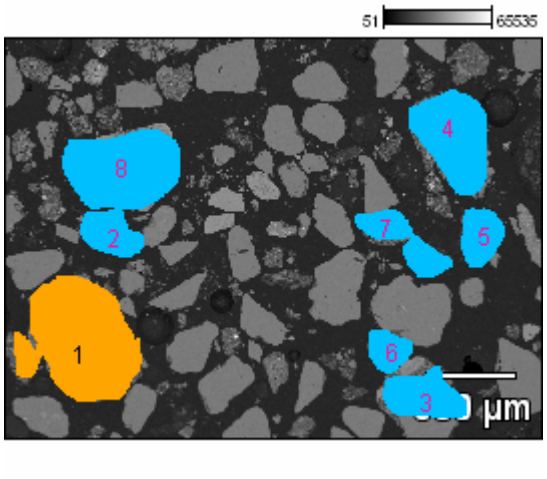


Photo 7.

Sample 11: Utrecht

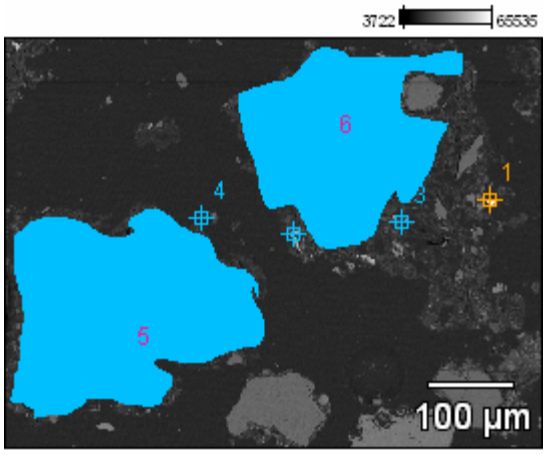


Photo 8.

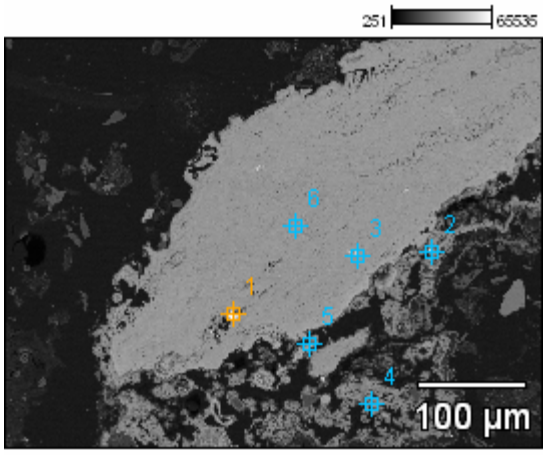


Photo 9.

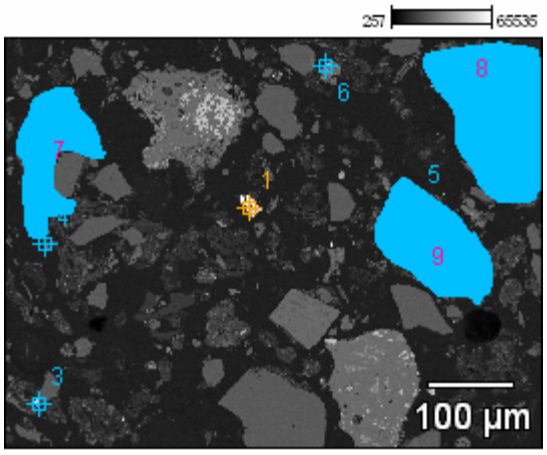


Photo 10.

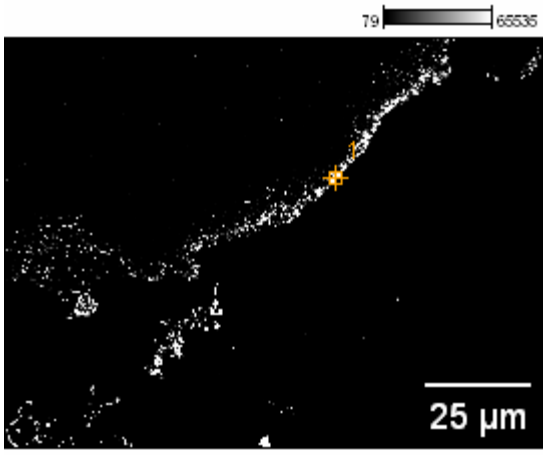


Photo 11.

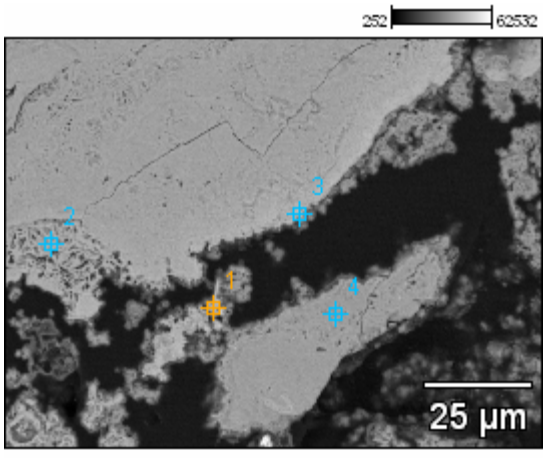


Photo 12.

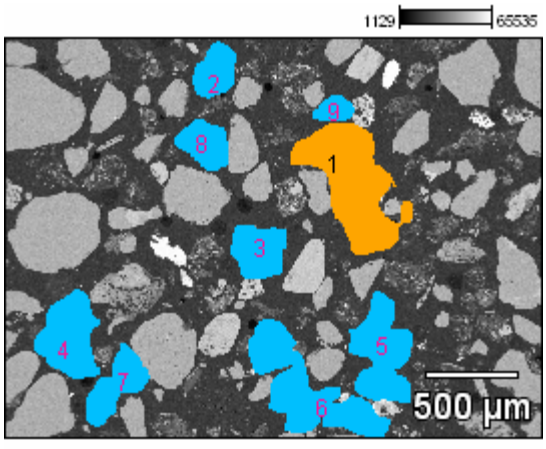


Photo 13[a].

Sample 17: De Rijp

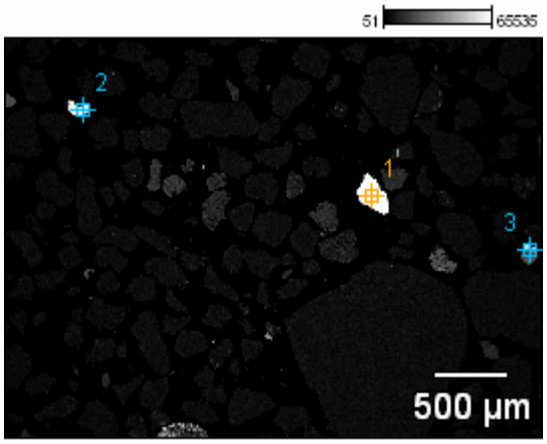


Photo 13[b].

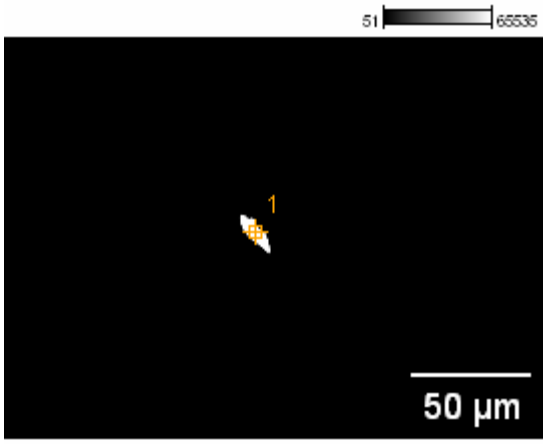


Photo 14.

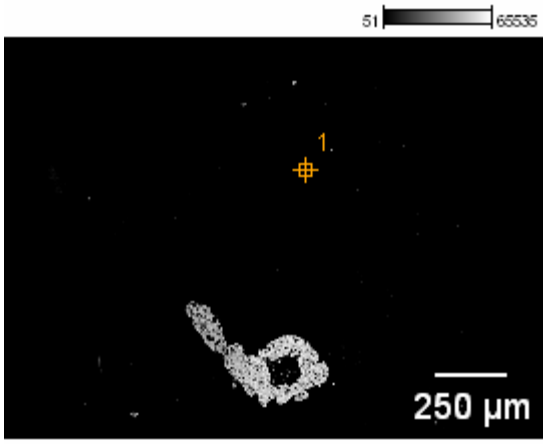


Photo 15.

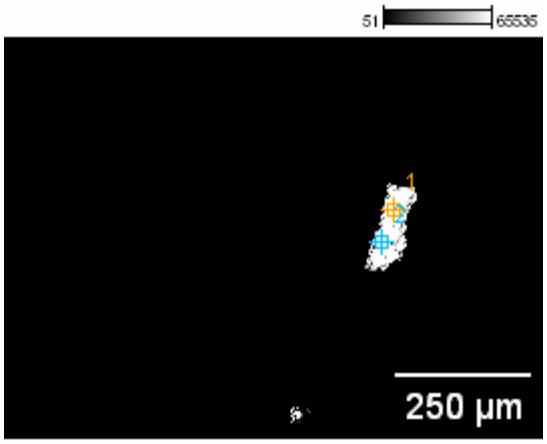


Photo 16.

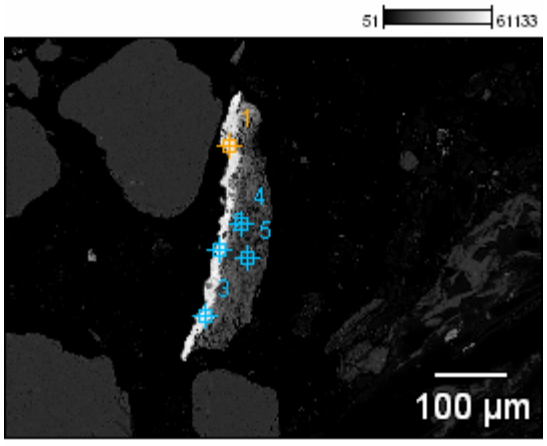


Photo 17.

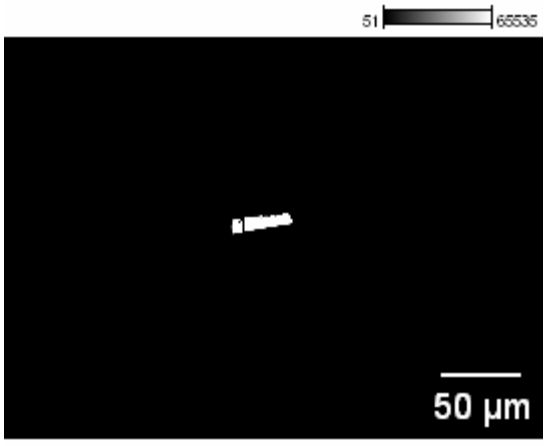


Photo 18.

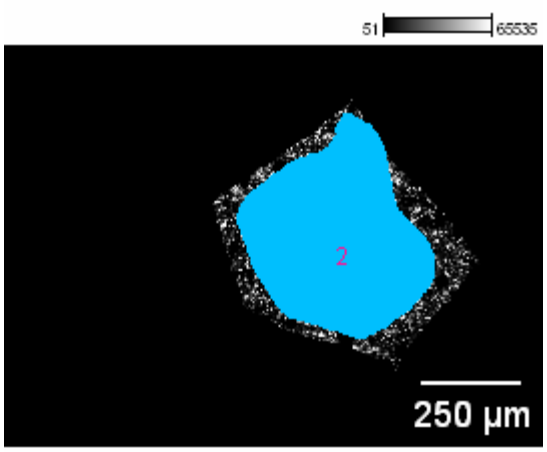


Photo 19.

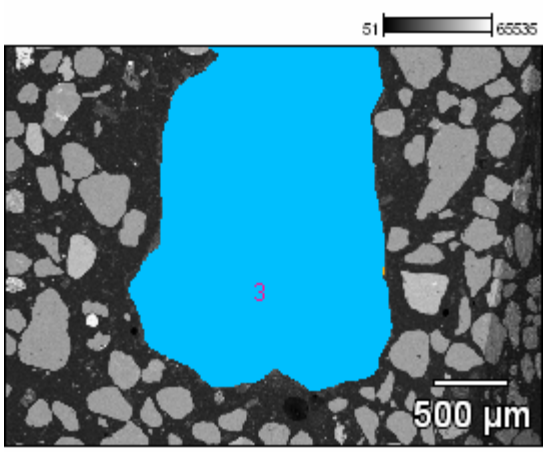


Photo 20.

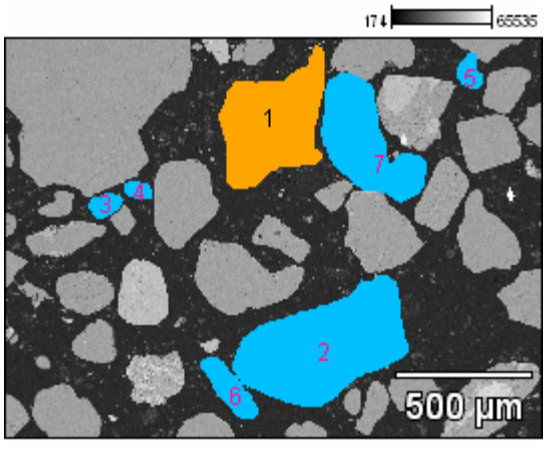


Photo 21.

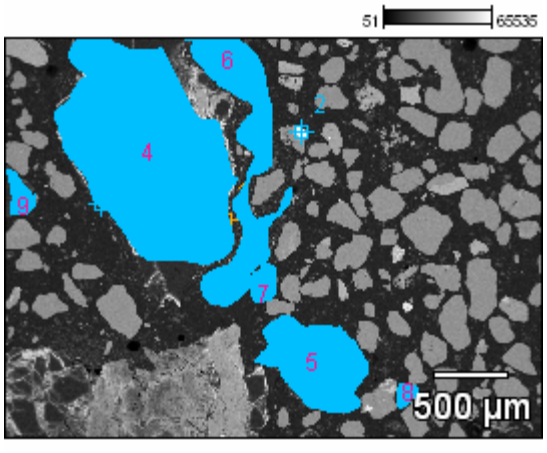


Photo 22.

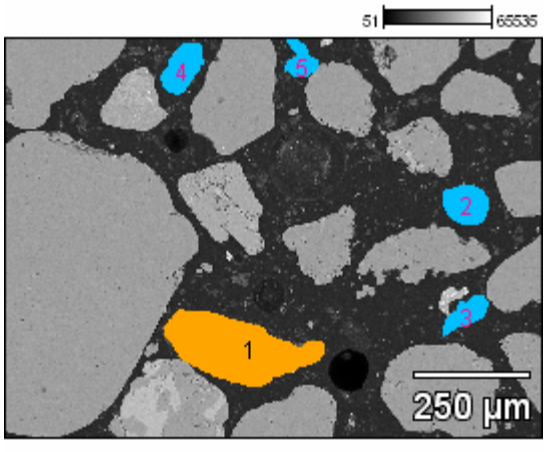


Photo 23.

Sample 21: Haarlem

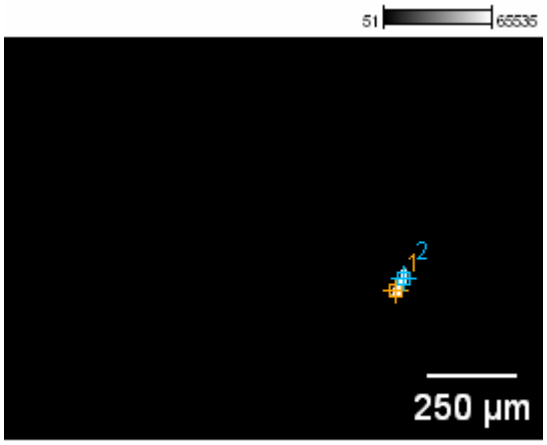


Photo 24.

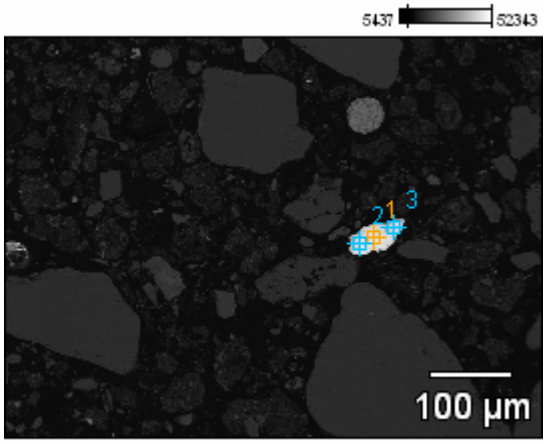
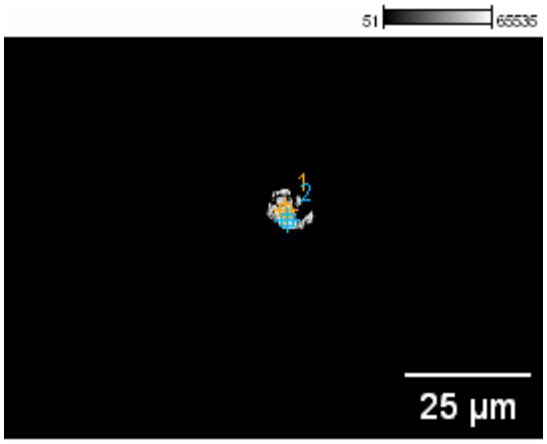


Photo 25.



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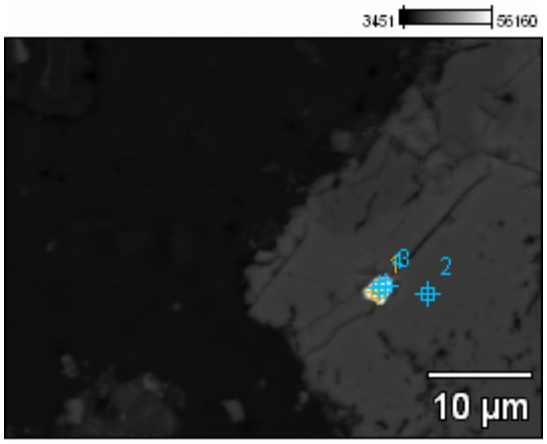

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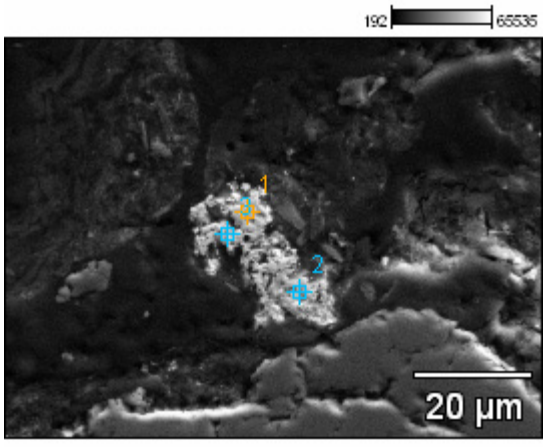

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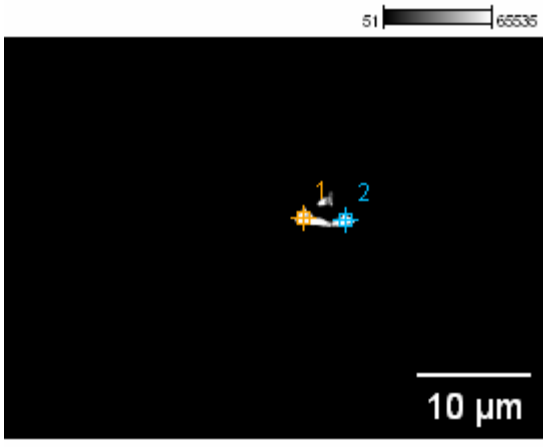

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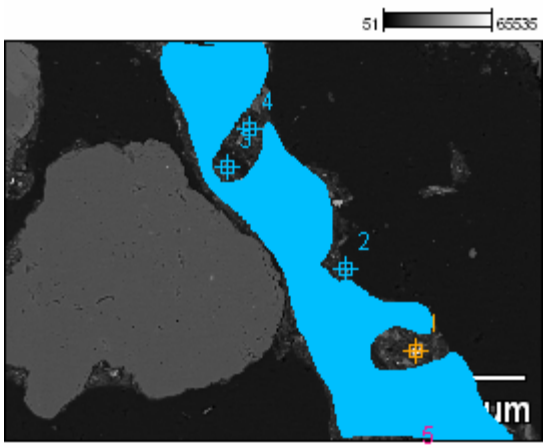

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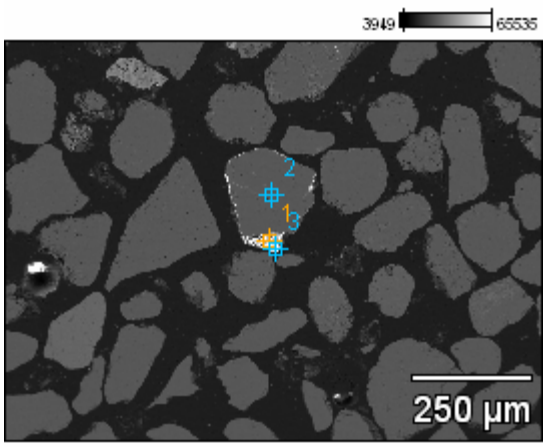

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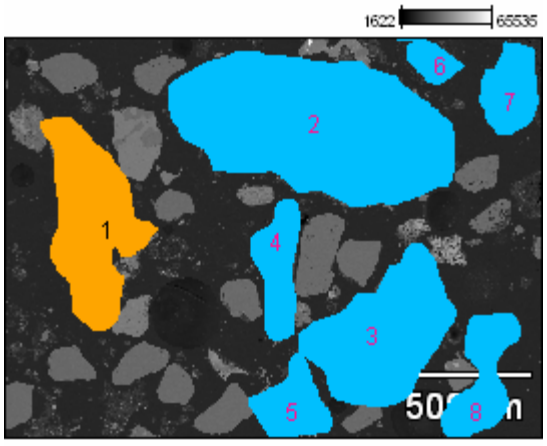

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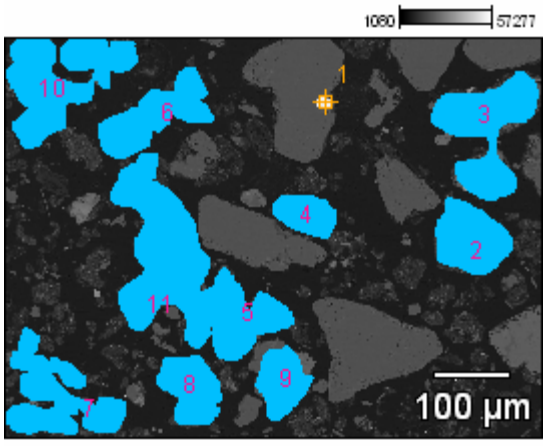

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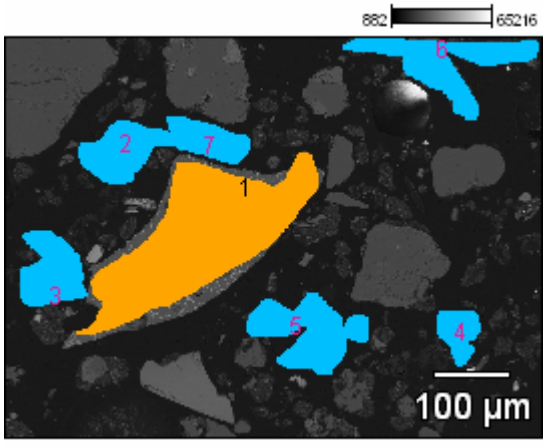
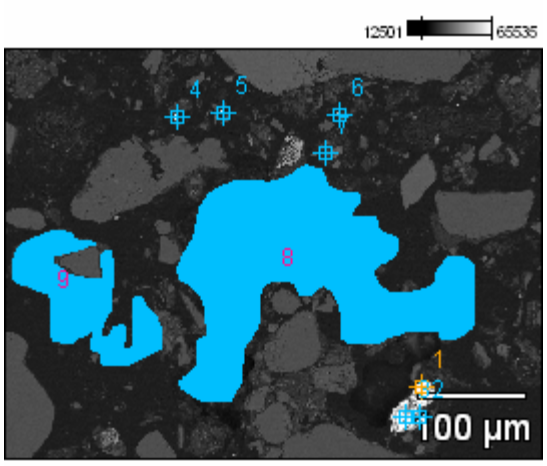


Photo 34.

Sample 27: Alkmaar



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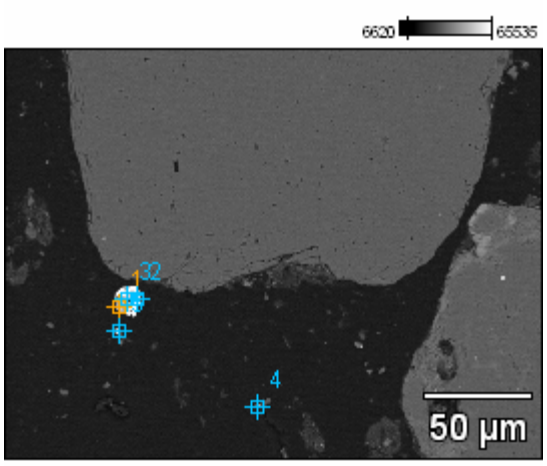

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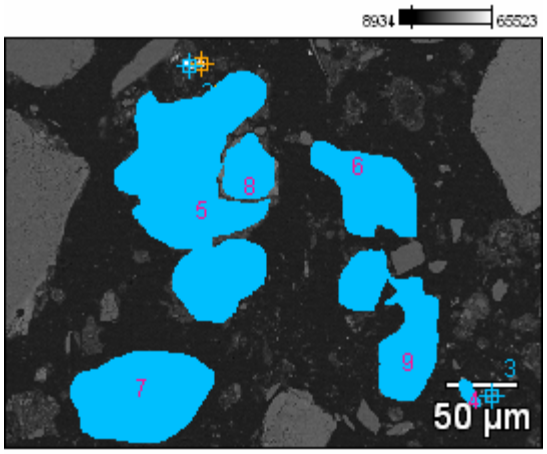

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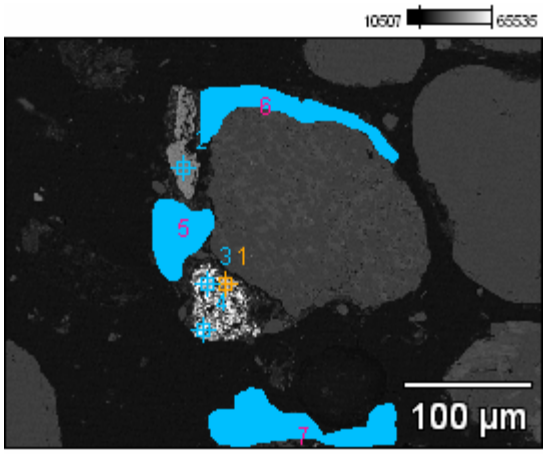

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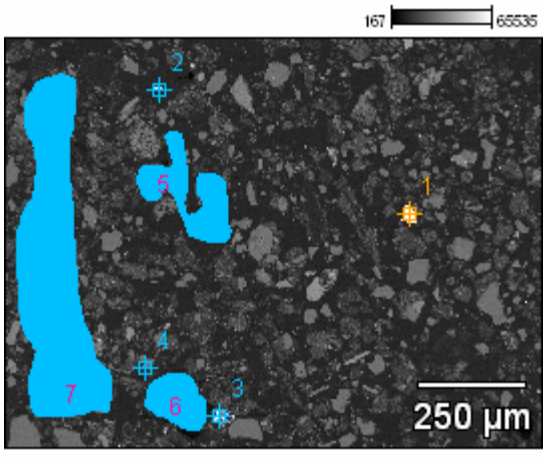
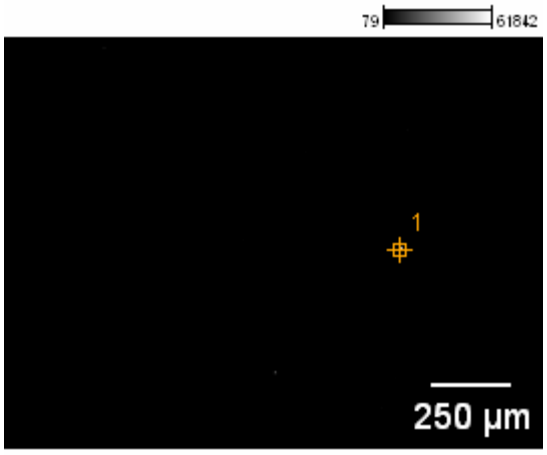


Photo 39.

Sample 29: Leiden



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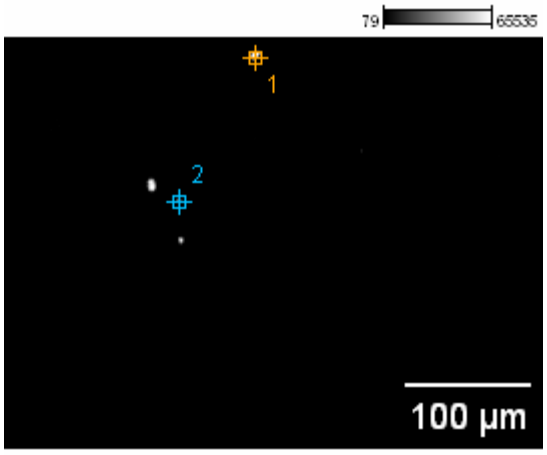

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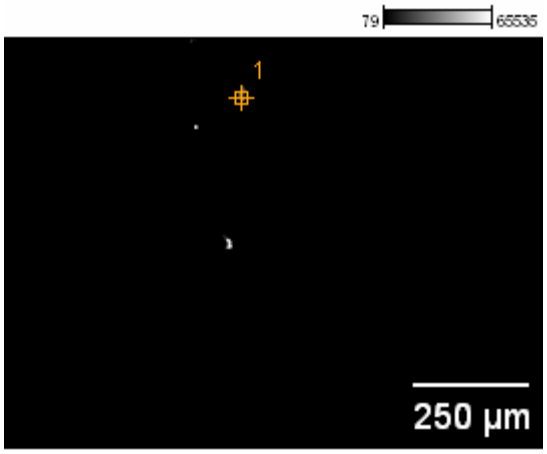

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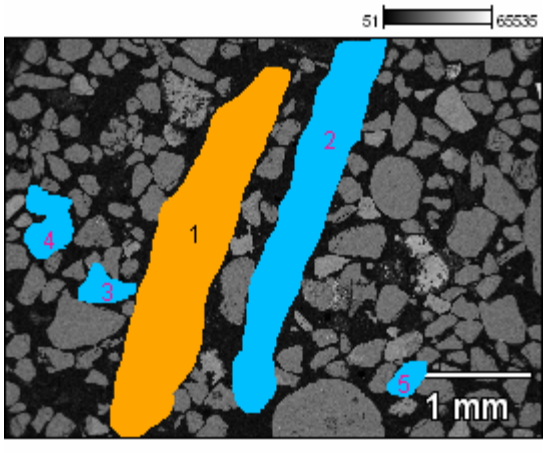

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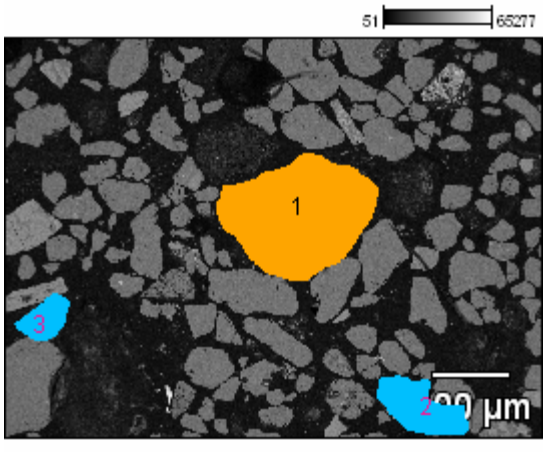

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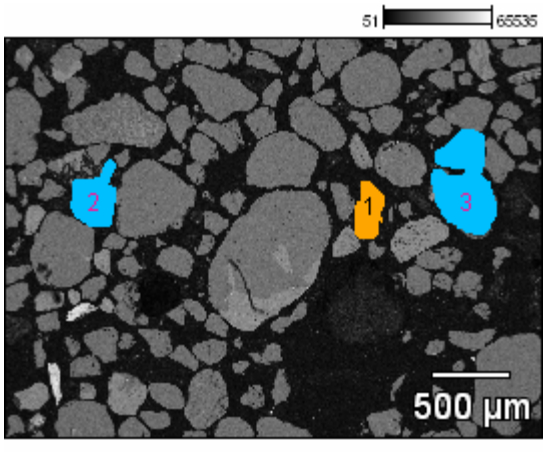
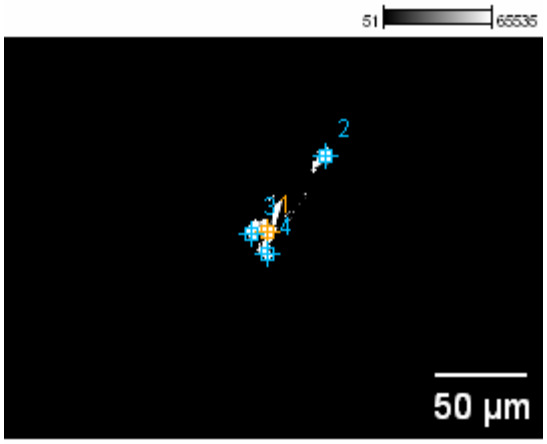


Photo 45.

Sample 33: Delft



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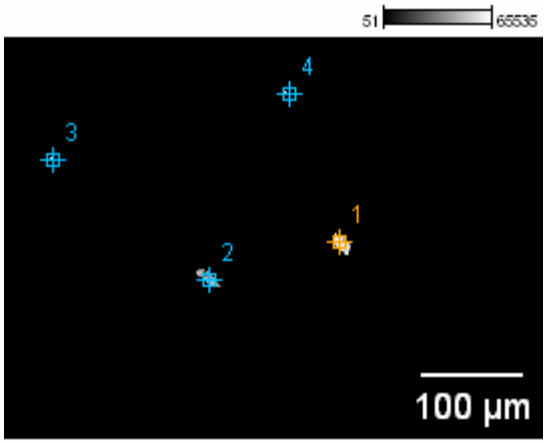

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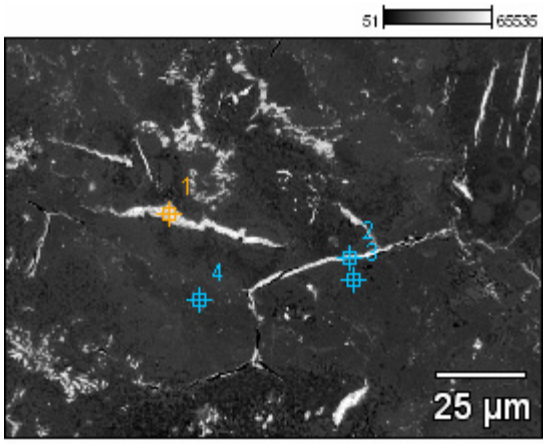

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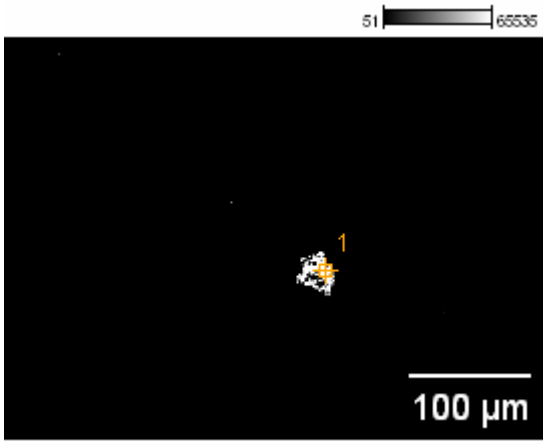

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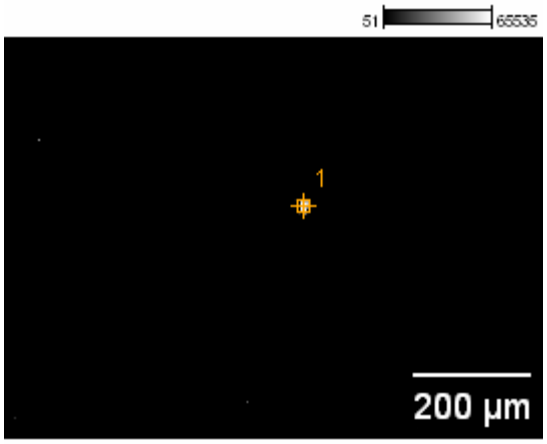

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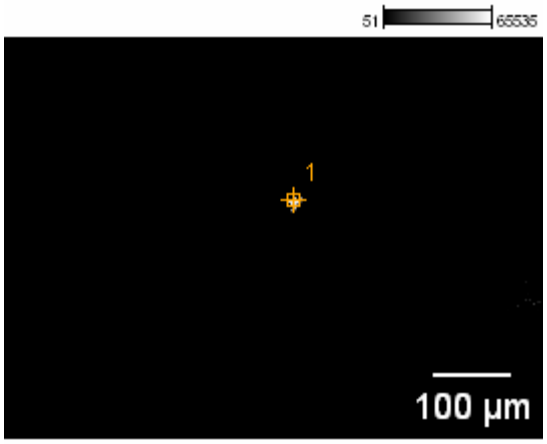

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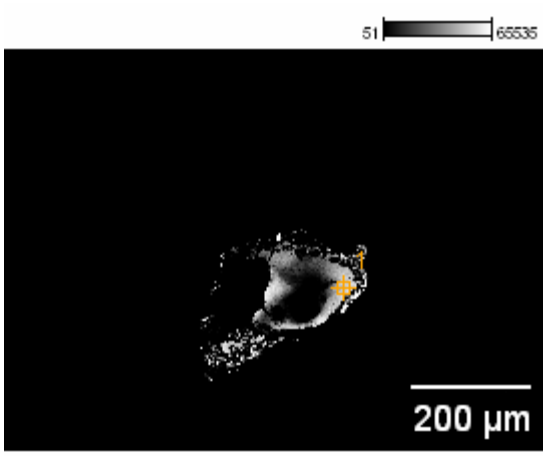

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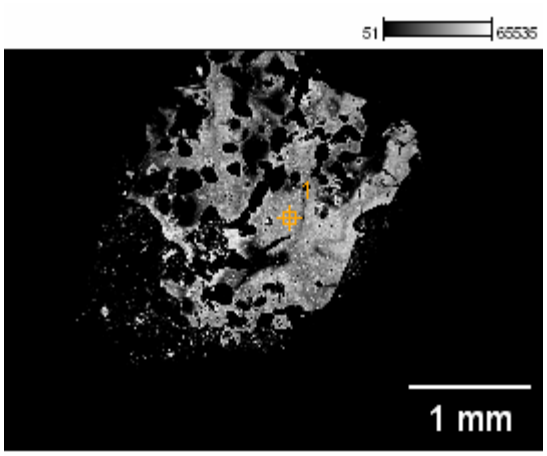

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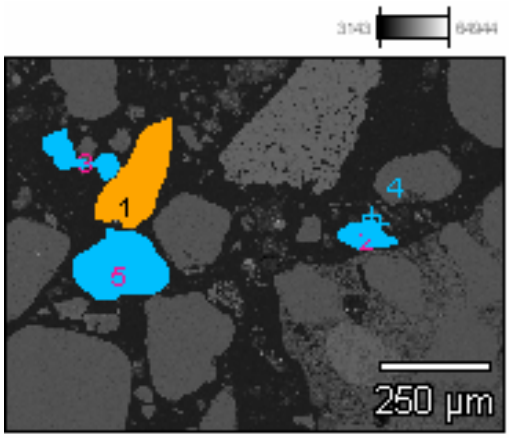

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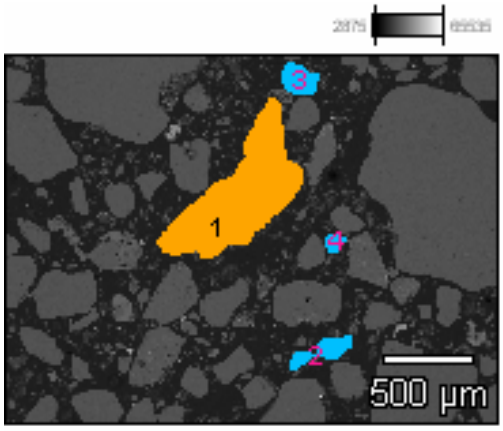

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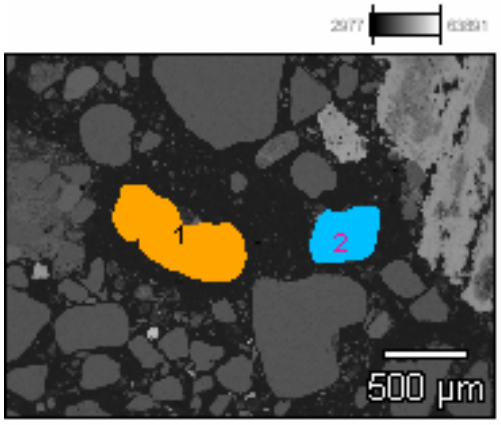

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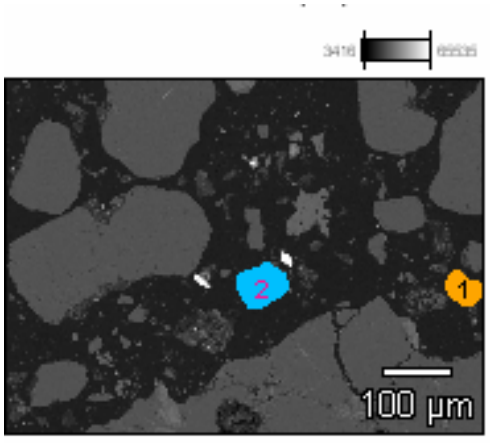
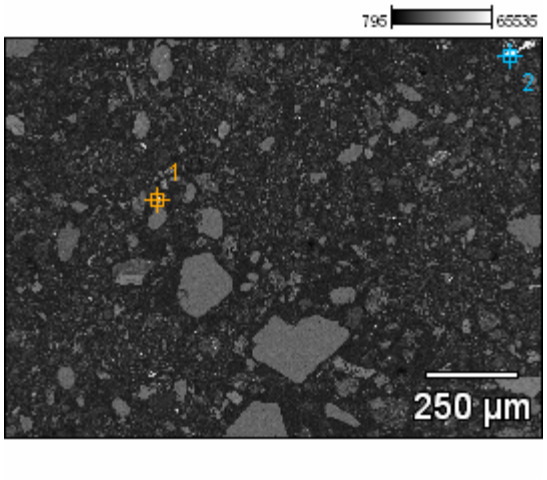


Photo 57.

Sample 43: Den Haag



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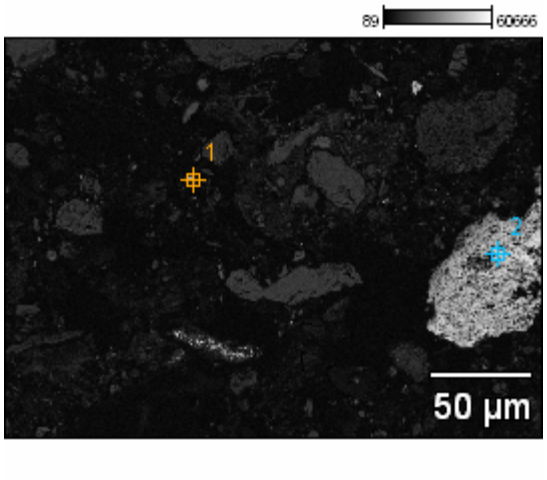

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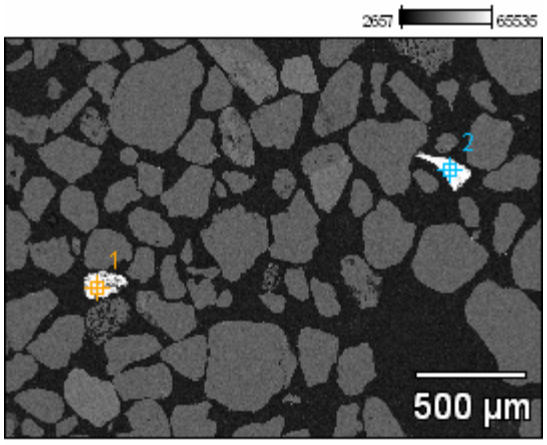

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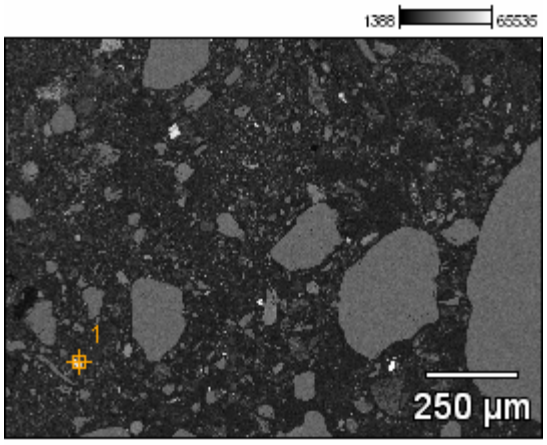

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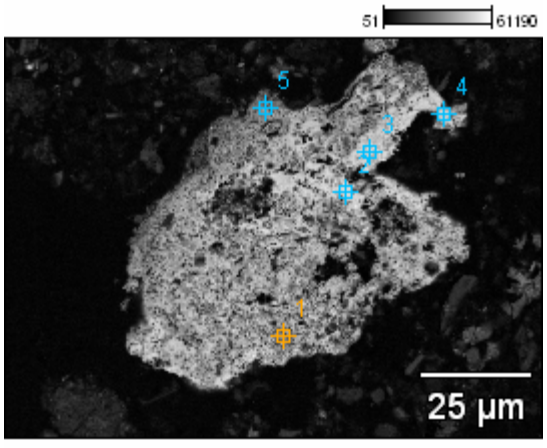

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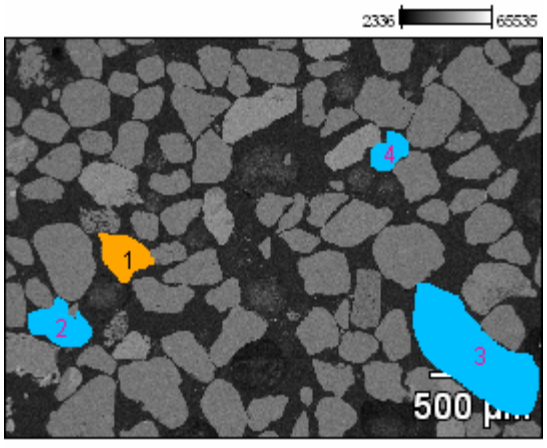

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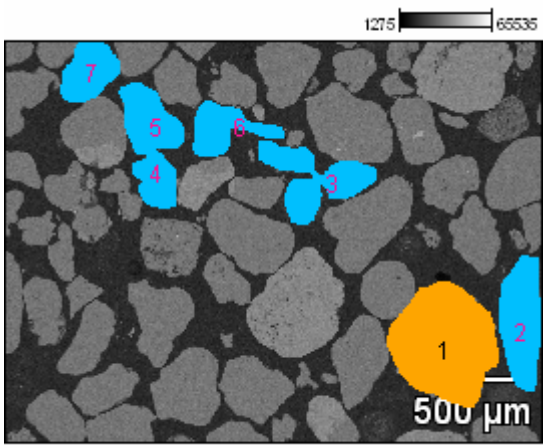

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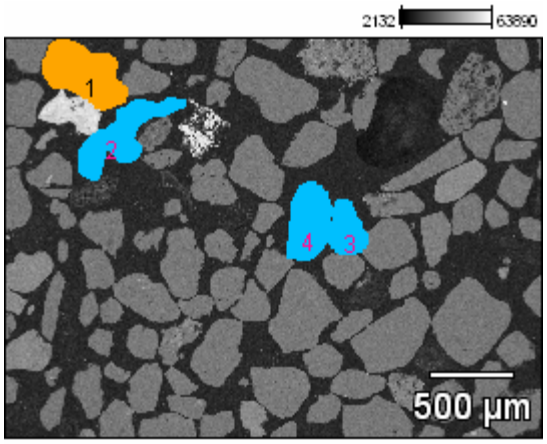

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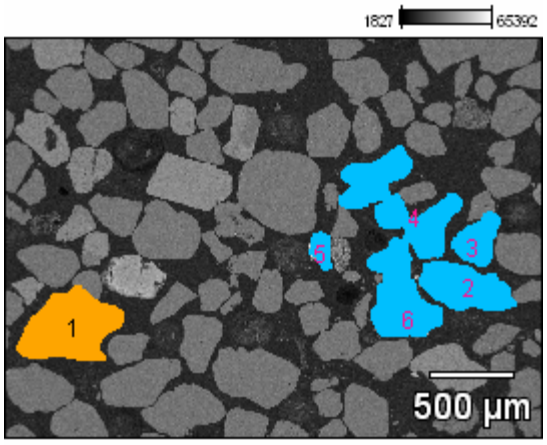
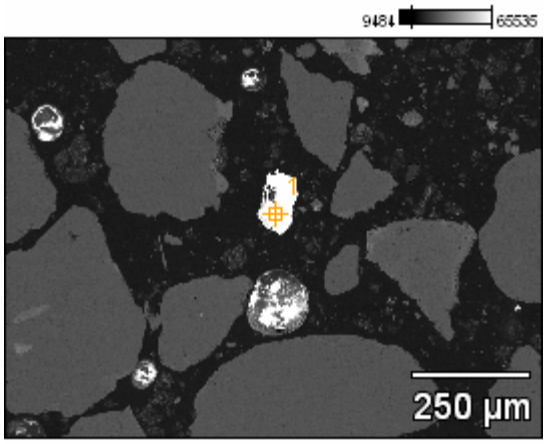


Photo 66.

Sample 45: Rotterdam



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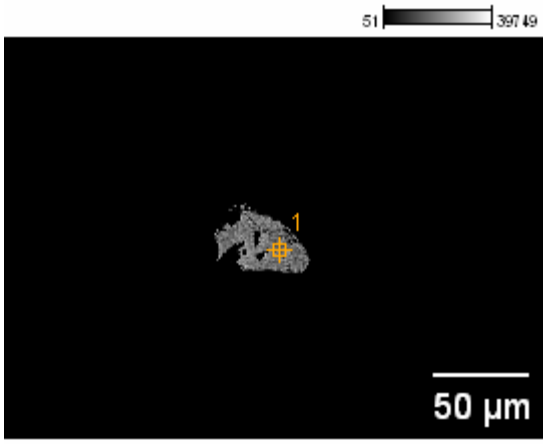

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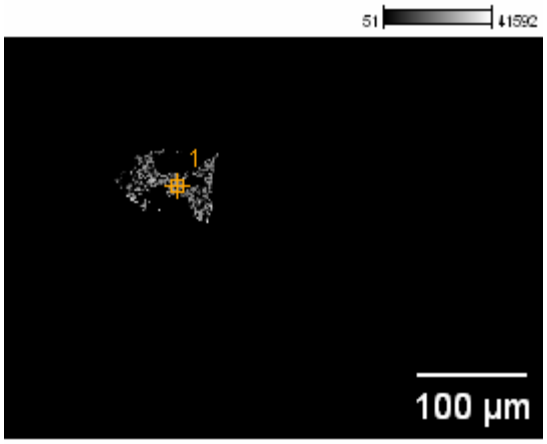

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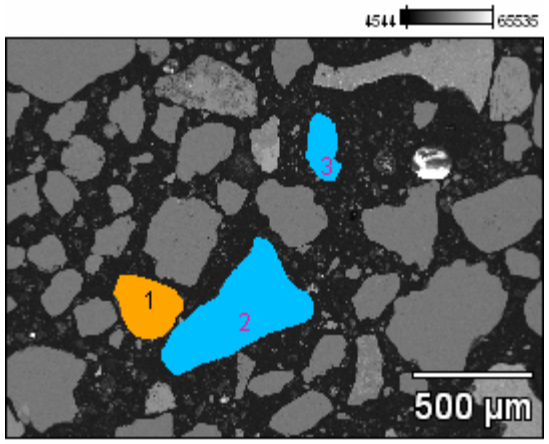

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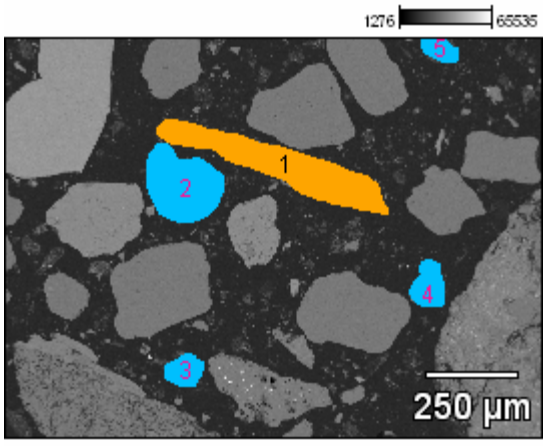

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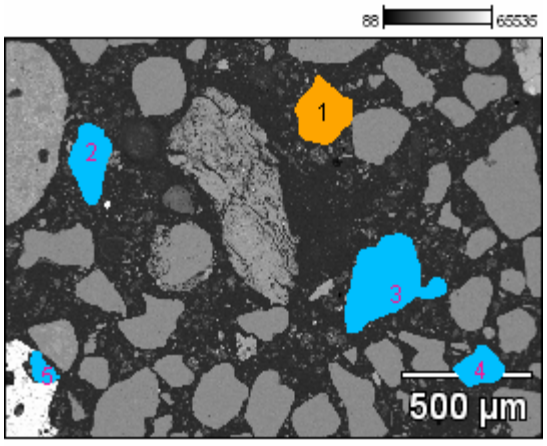

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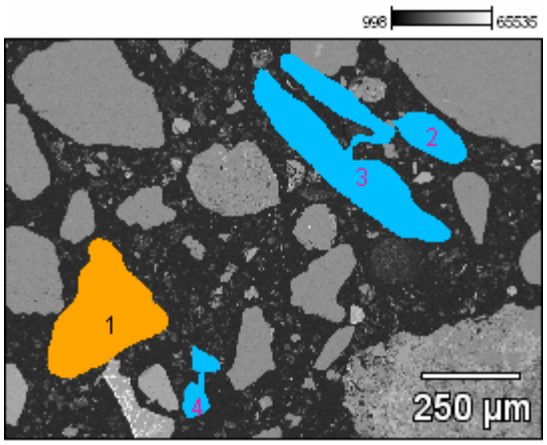
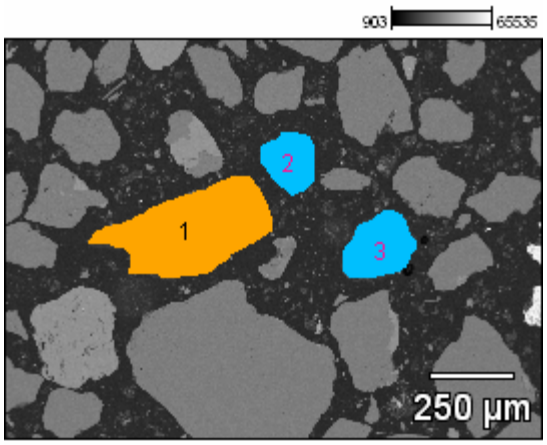


Photo 73.



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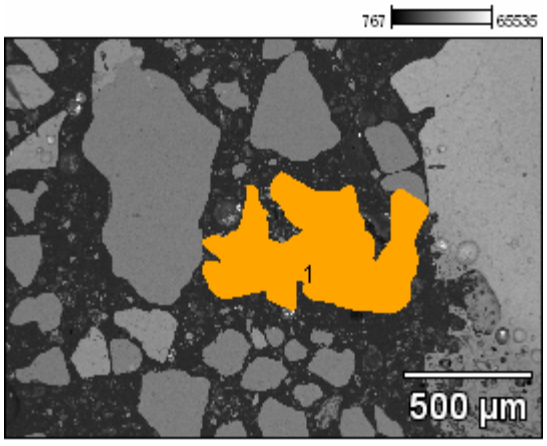
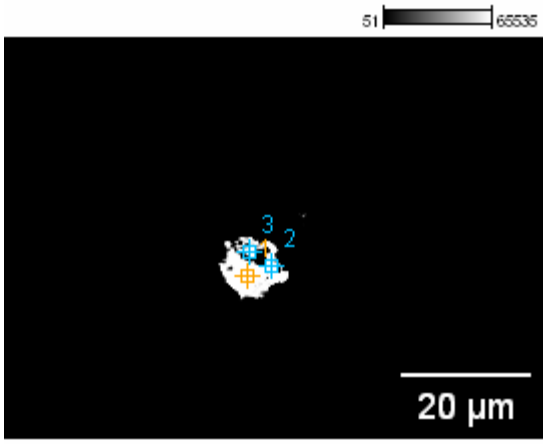


Photo 75.

Sample 51: Schiedam



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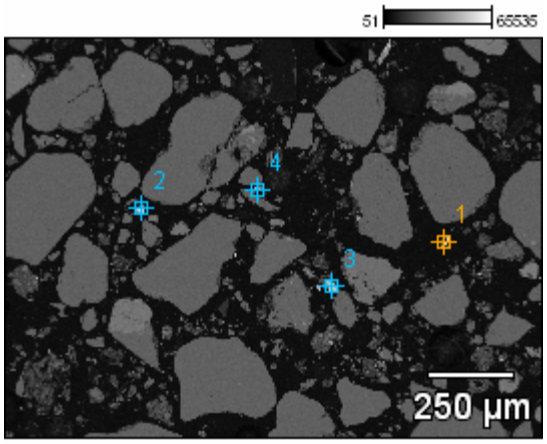
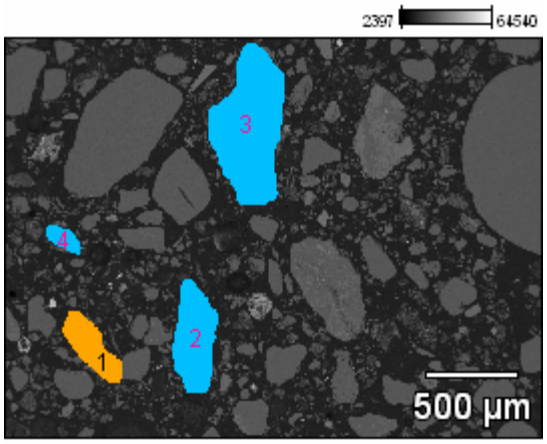


Photo 77.

Photo 78.



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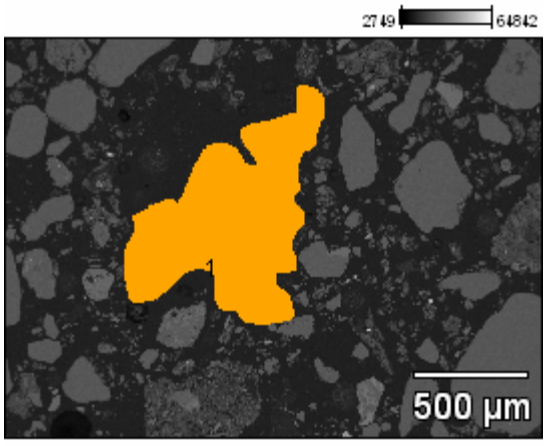

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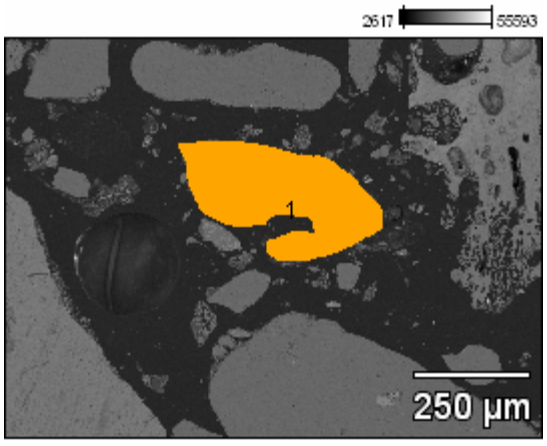

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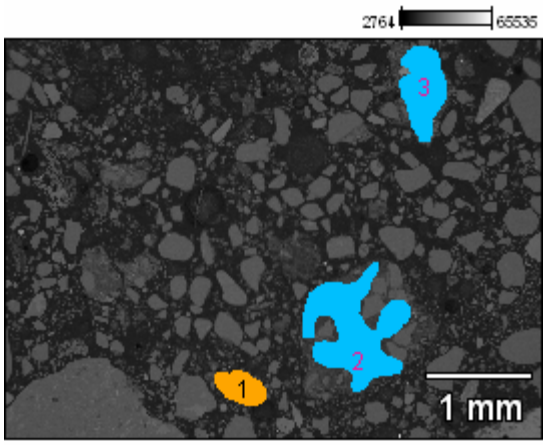

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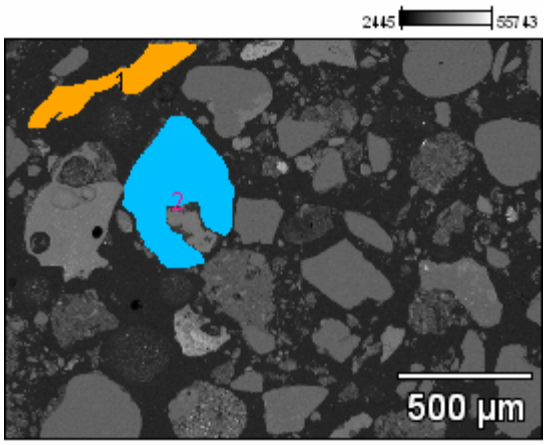


Photo 83.

Sample 53: Groningen

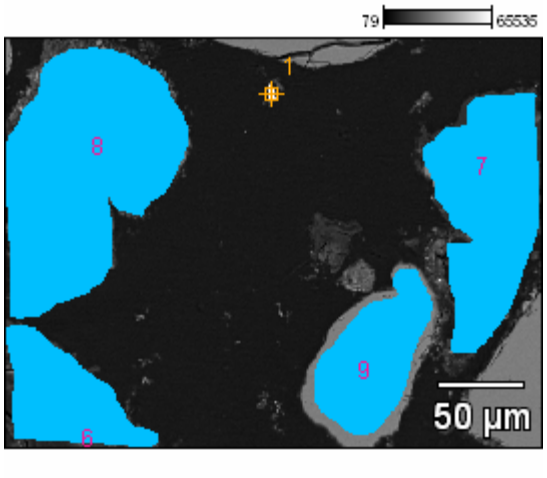


Photo 84.

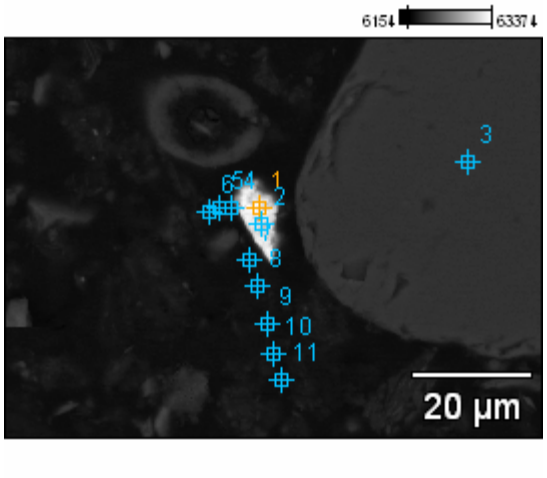


Photo 85.

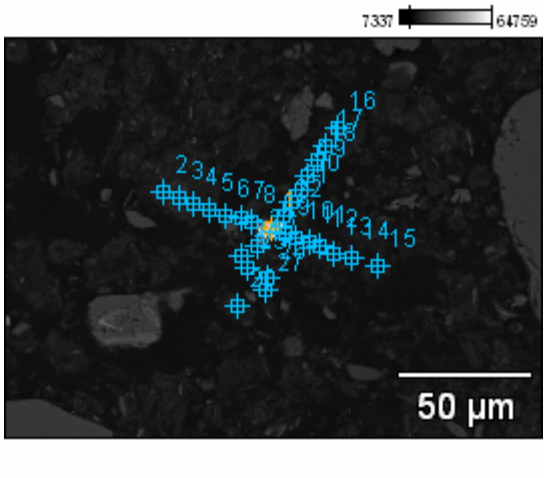
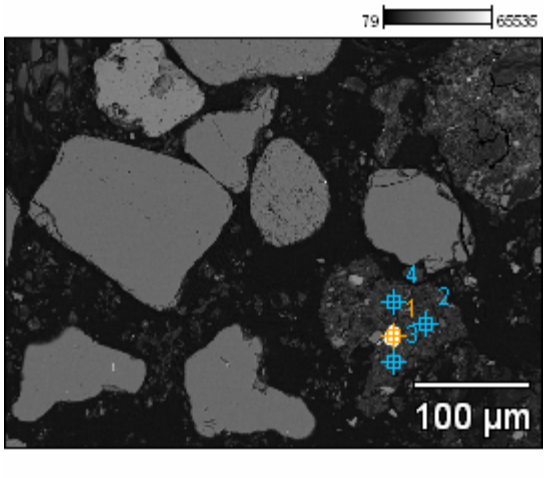


Photo 86.



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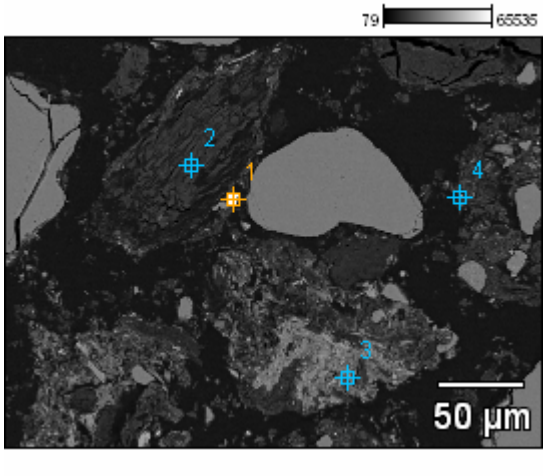
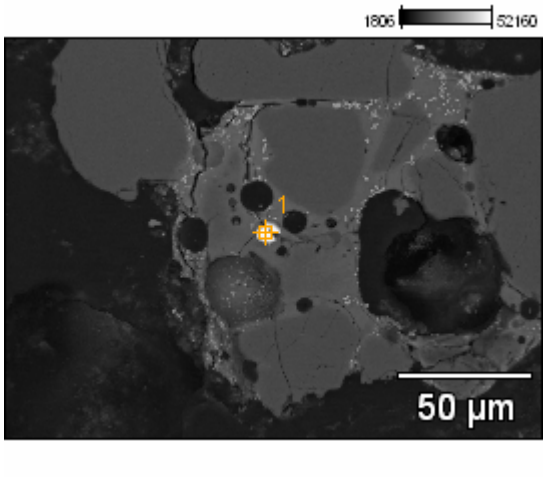


Photo 88.



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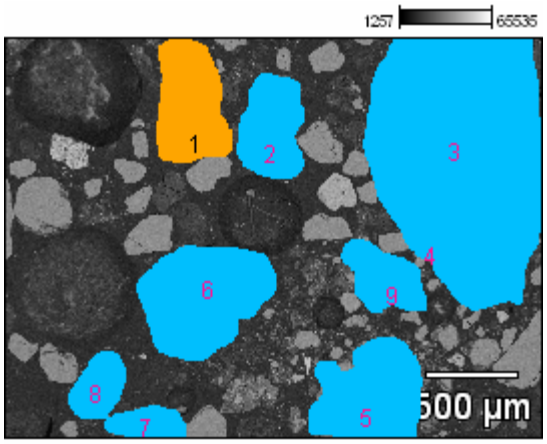

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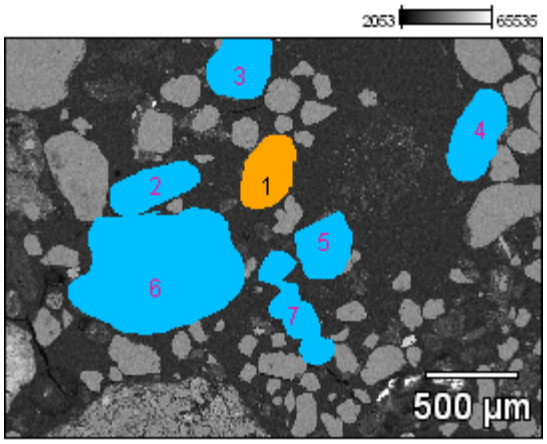


Photo 91.

Sample 59: Zutphen

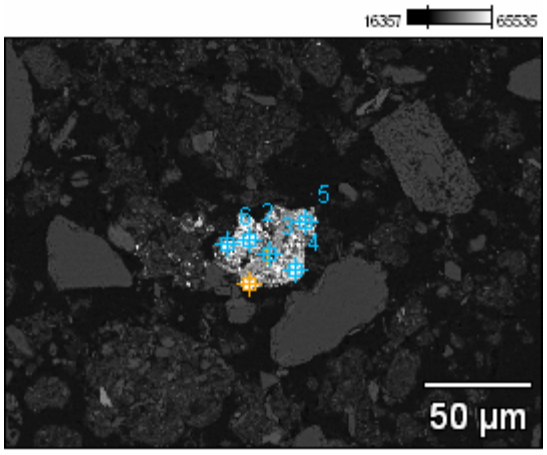
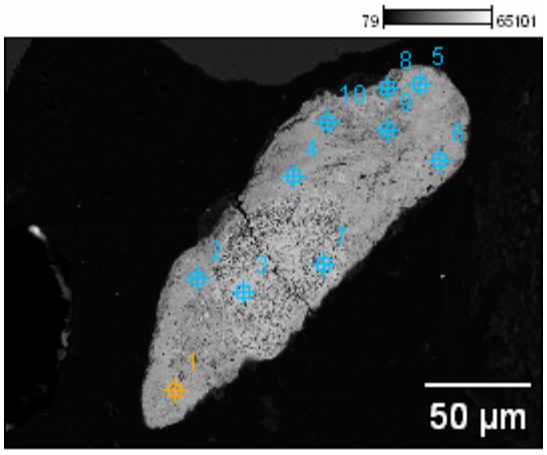


Photo 92.



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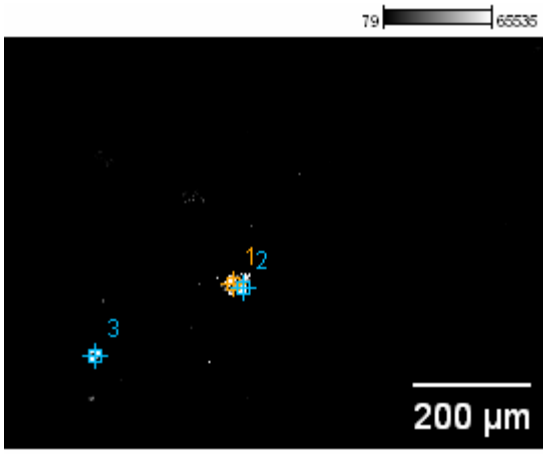
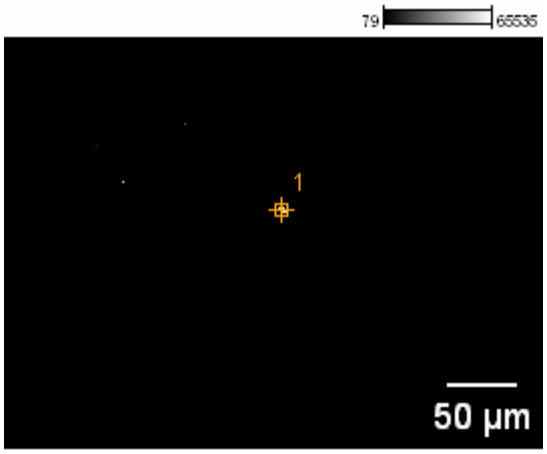


Photo 94.



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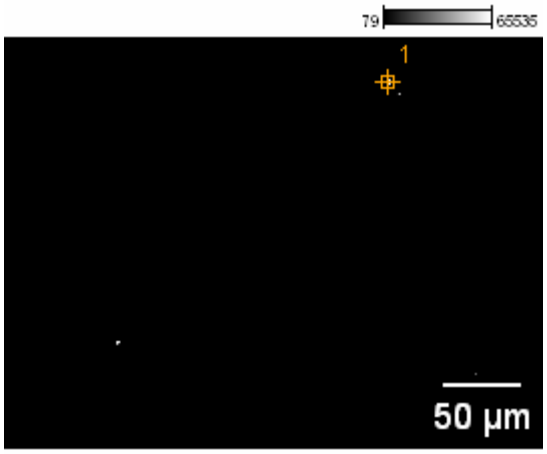

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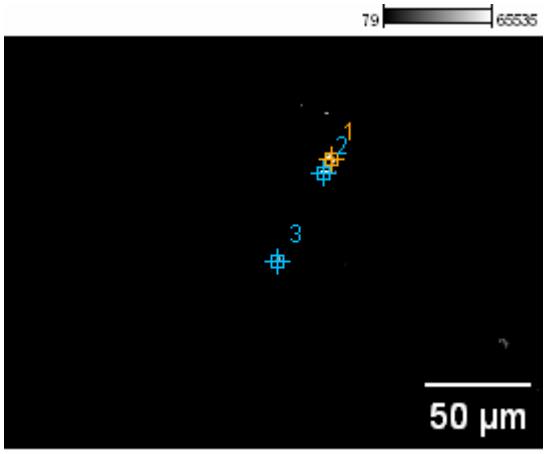

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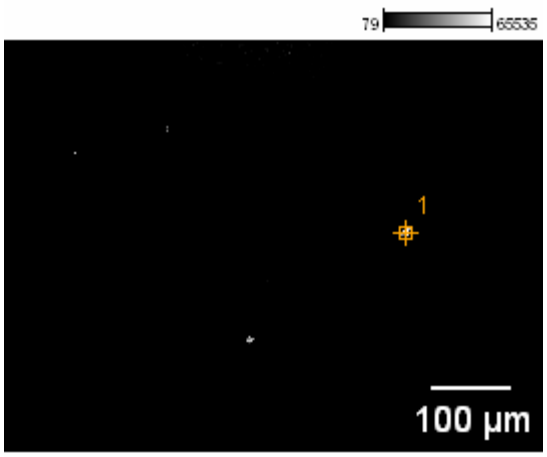
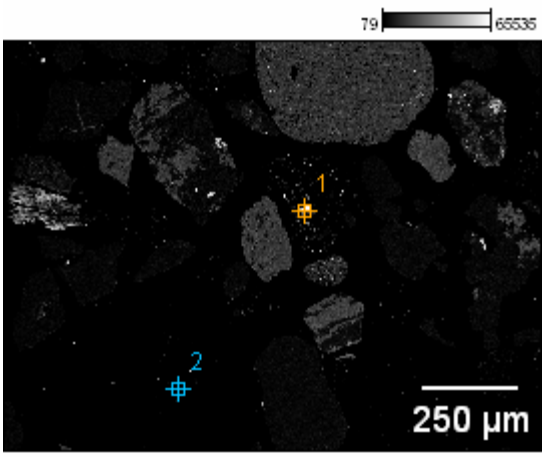


Photo 98.



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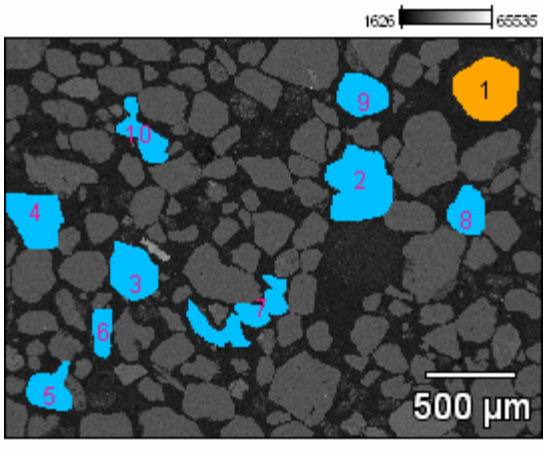


Photo 100.

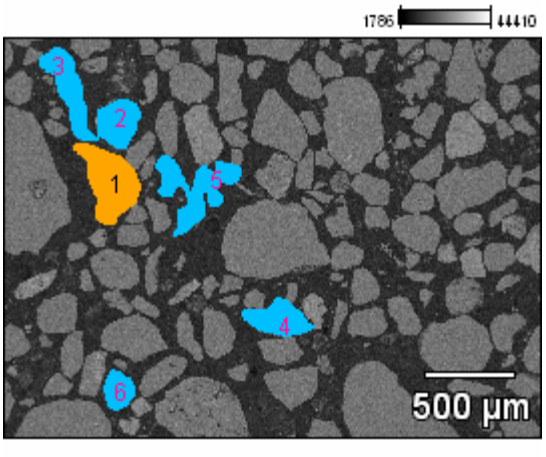


Photo 101.

Sample 63: Nijmegen

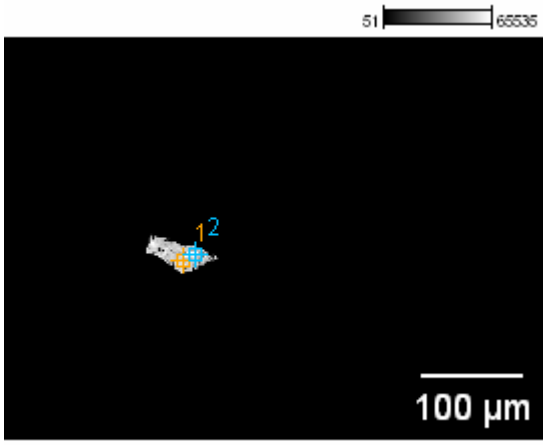
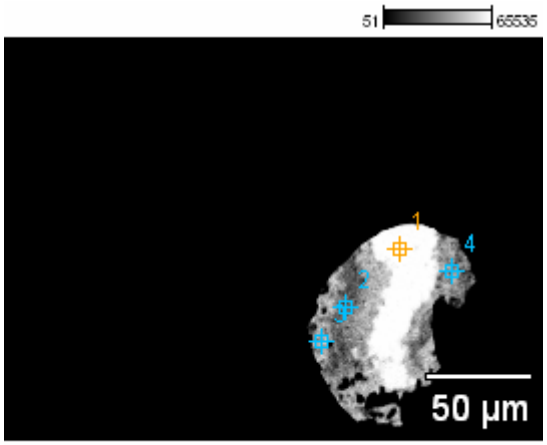


Photo 102

Photo 103



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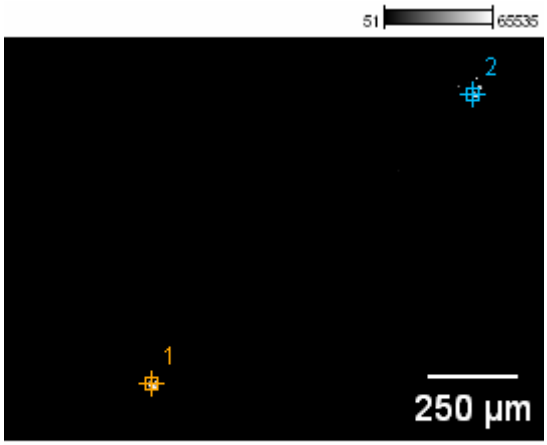

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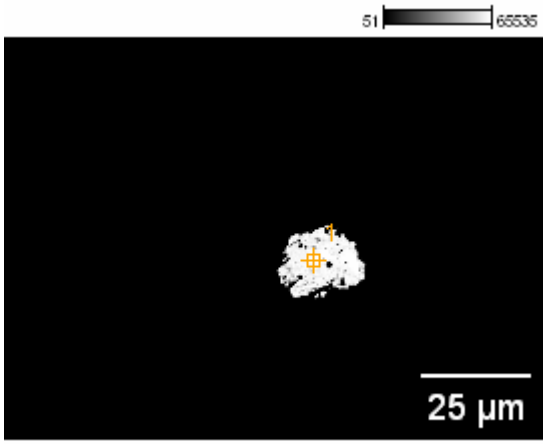

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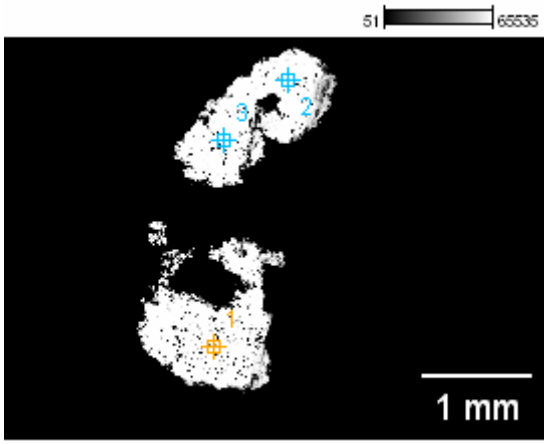
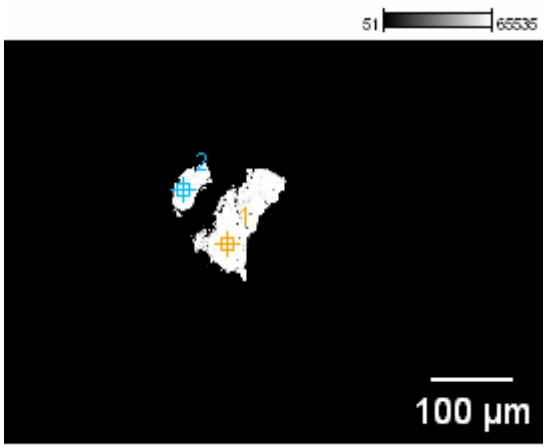


Photo 107



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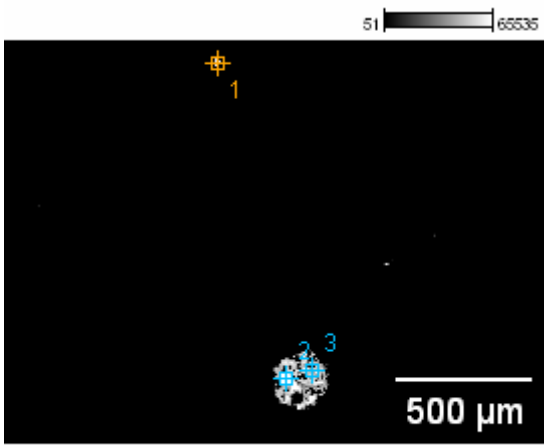
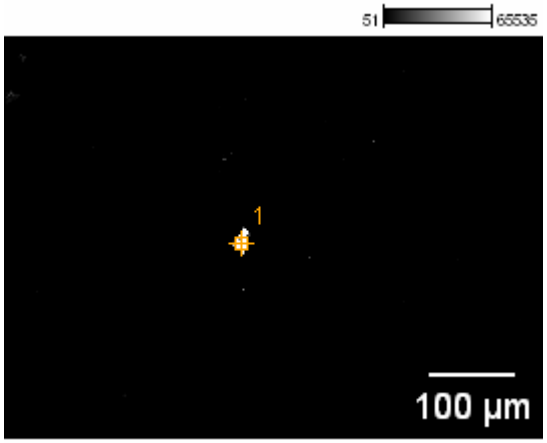


Photo 109



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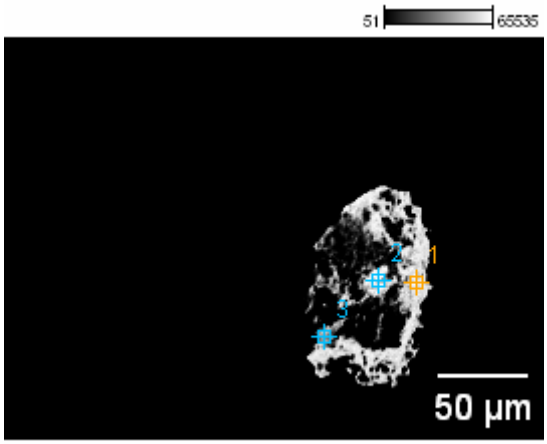

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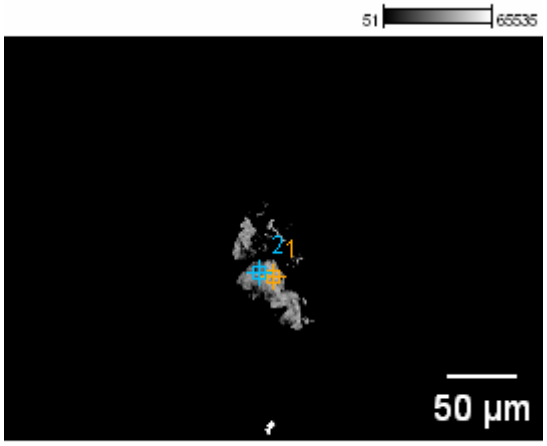

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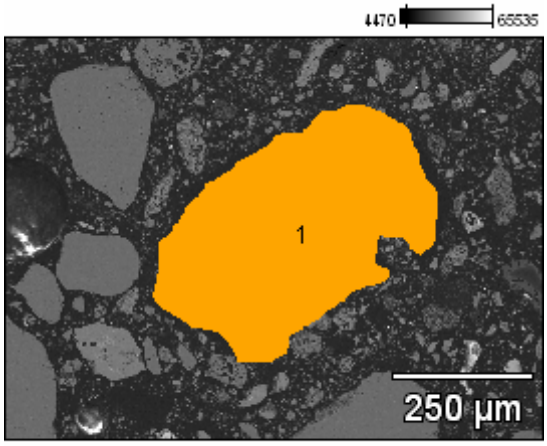
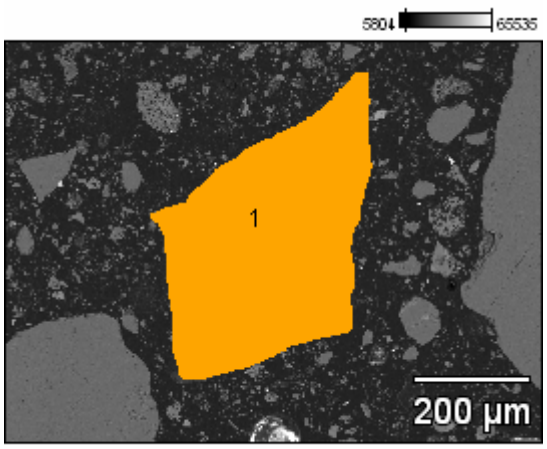


Photo 113



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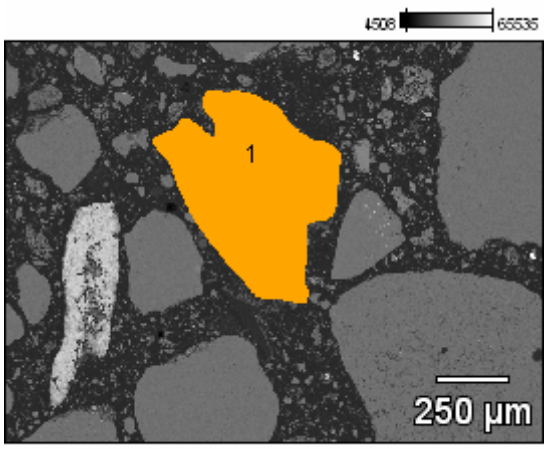


Photo 115

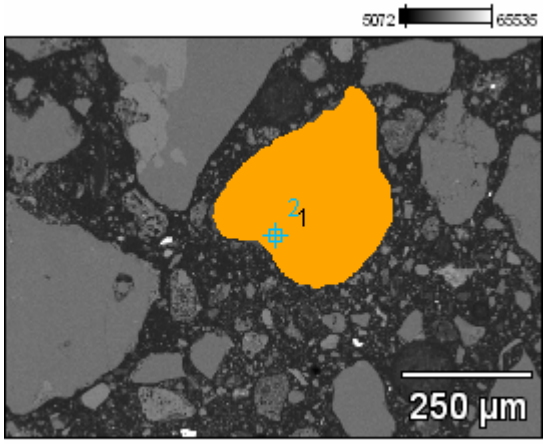


Photo 116

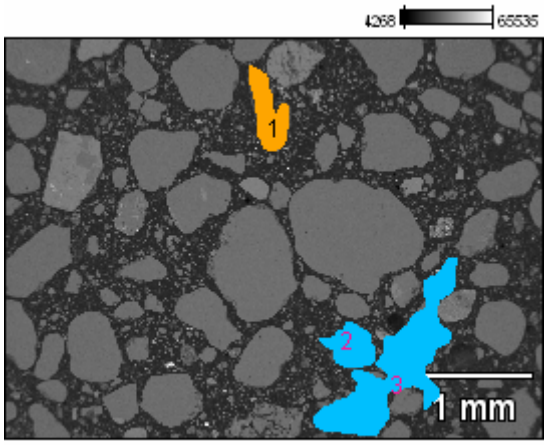


Photo 117

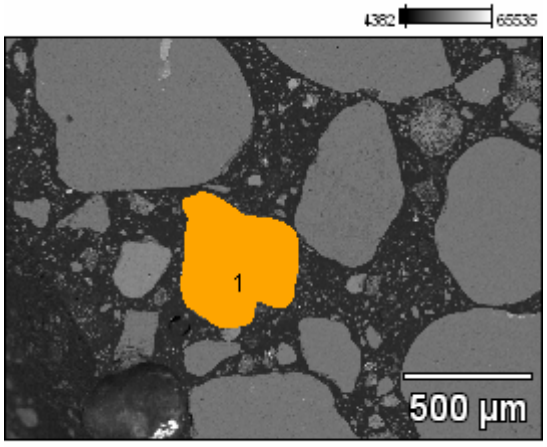


Photo 118

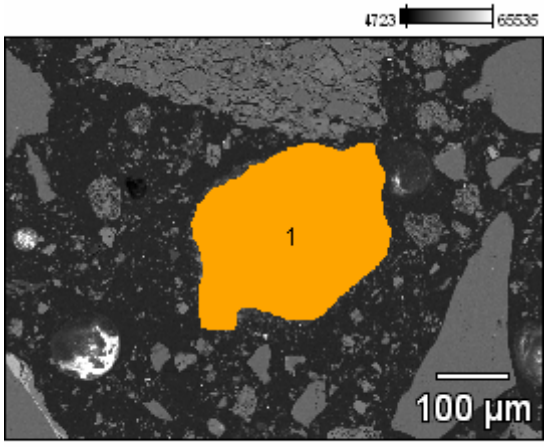


Photo 119

Sample 69: Maastricht

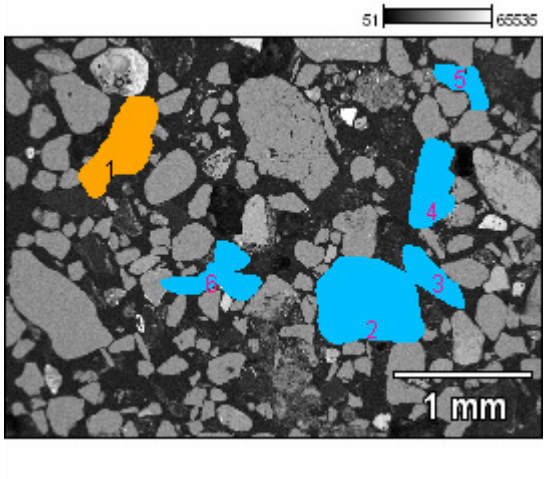


Photo 121

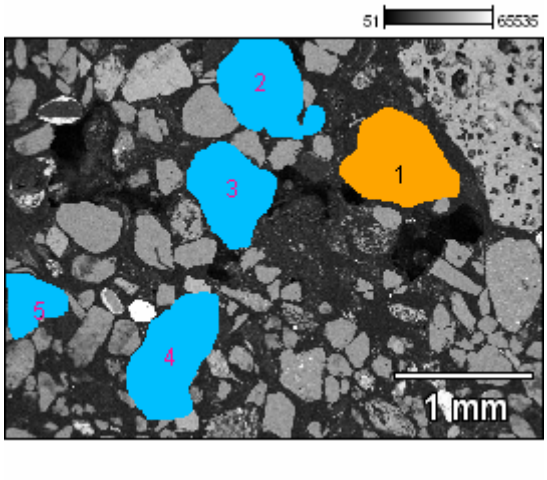


Photo 122

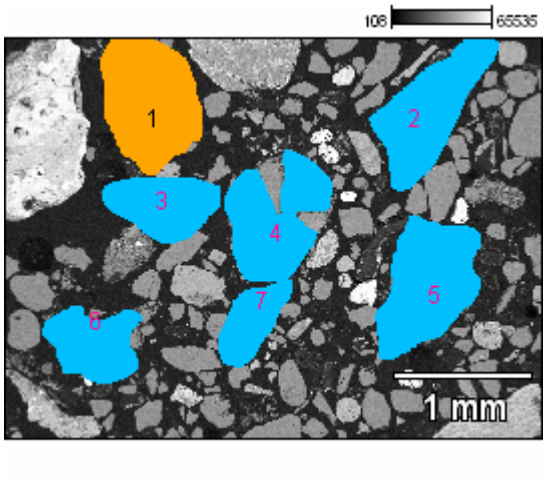


Photo 123

Sample 71: Maastricht

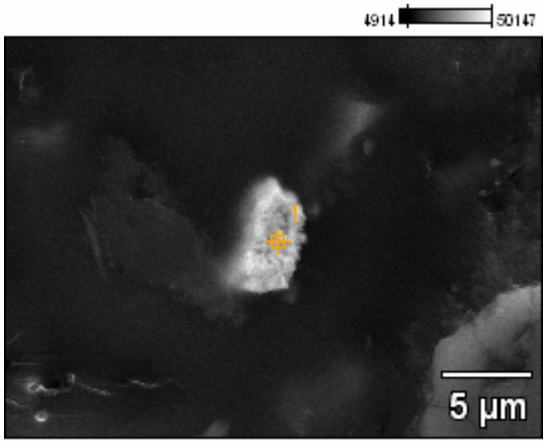


Photo 124

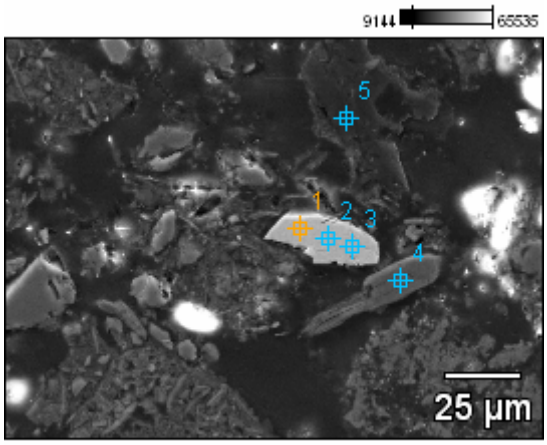


Photo 125

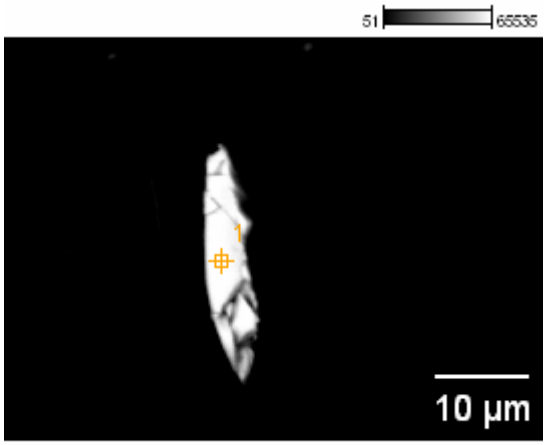


Photo 126

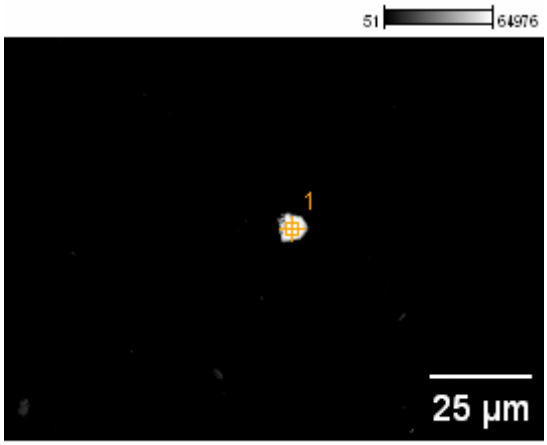


Photo 127

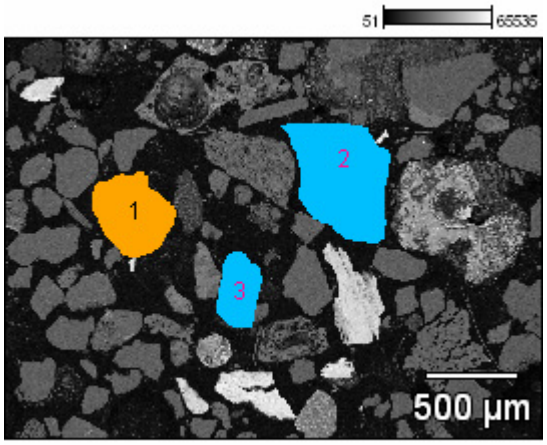


Photo 128

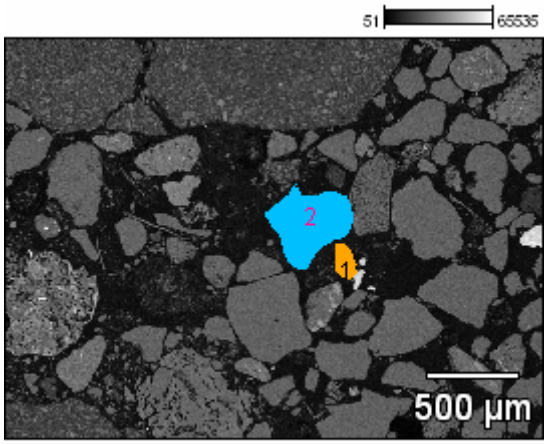


Photo 129

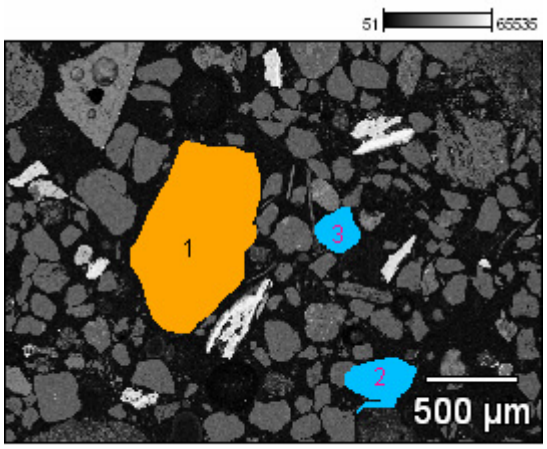


Photo 130

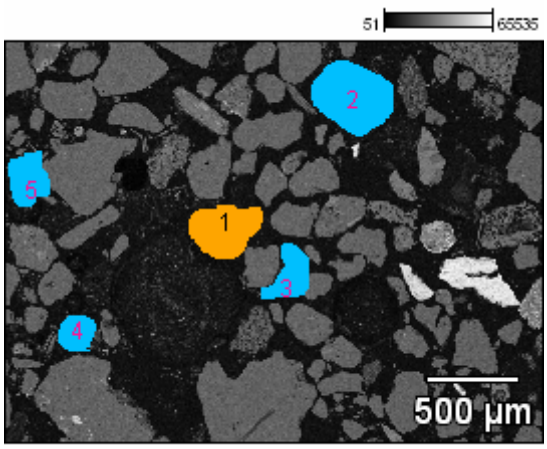


Photo 131

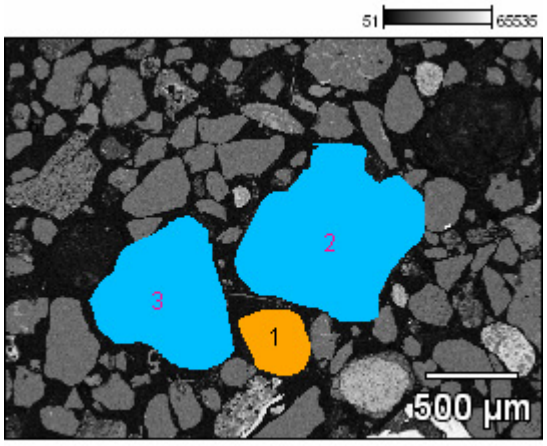


Photo 132

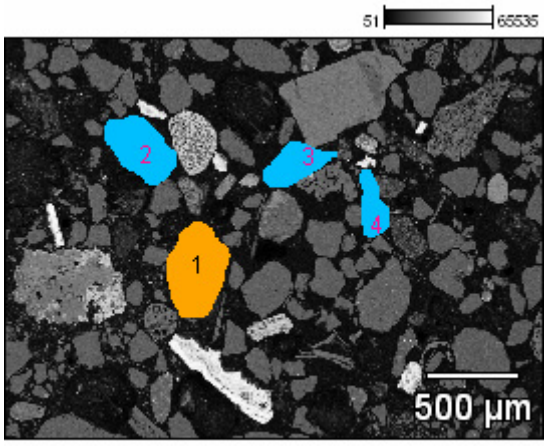


Photo 133

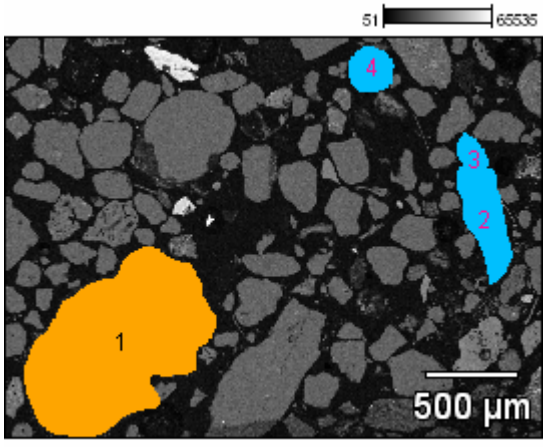


Photo 134

Sample 77: Echt Susteren

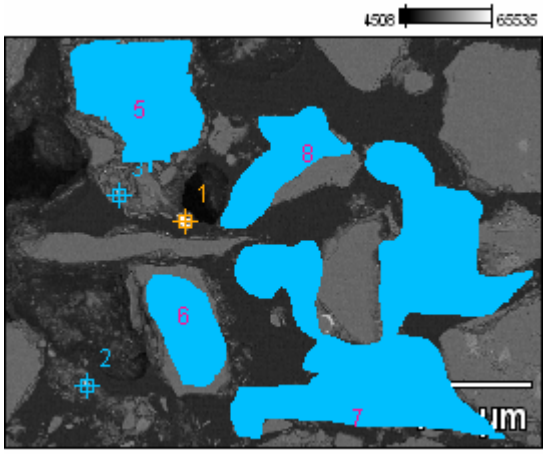


Photo 135

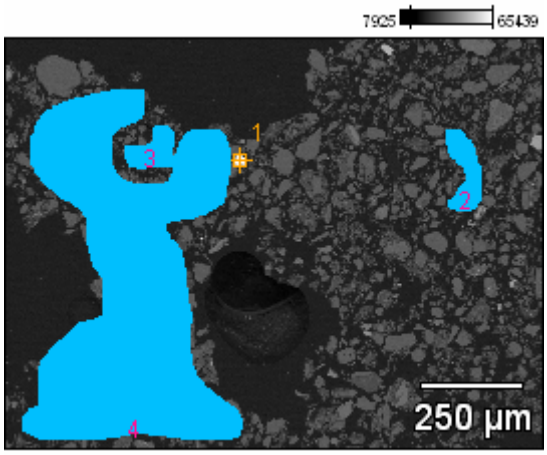
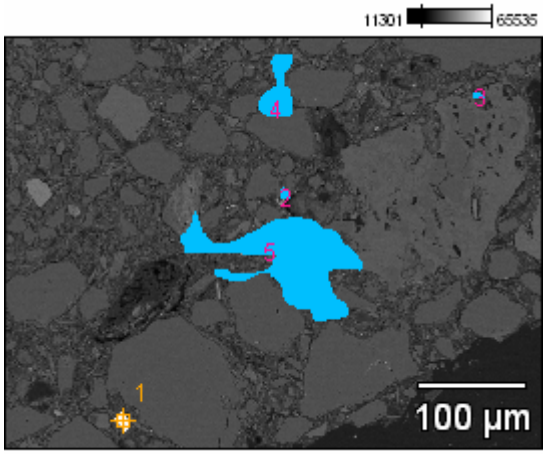


Photo 136



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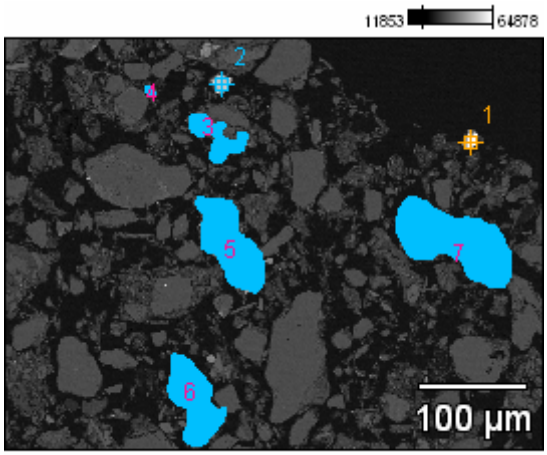

Photo 138

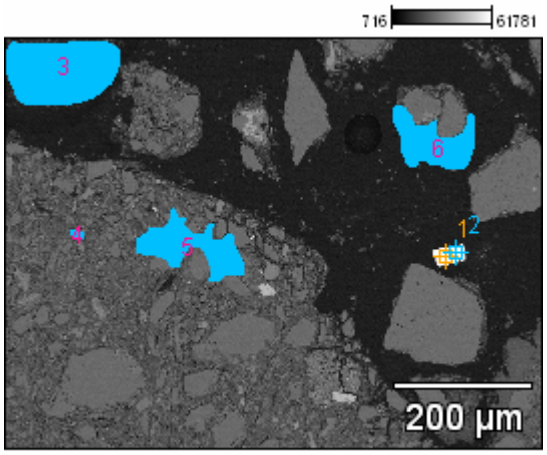

Photo 139

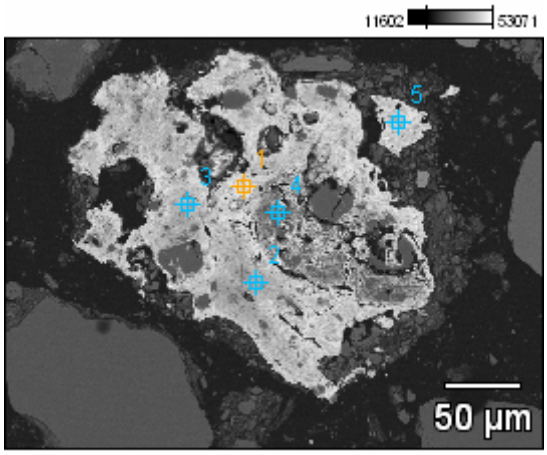

Photo 140

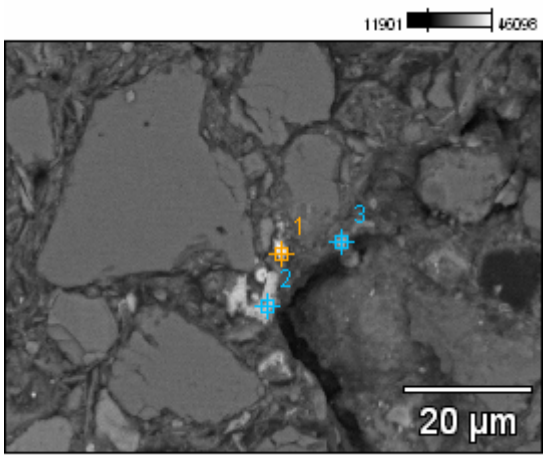

Photo 141

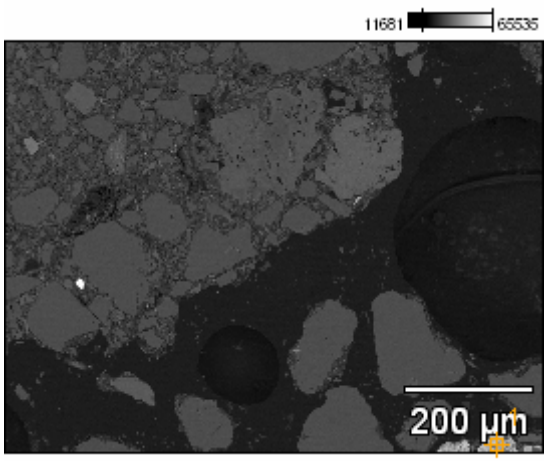

Photo 142

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