

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA23FA113

ENGINE HISTORY AND NO. 4 CYLINDER SPARK PLUG EXAMINATION SUMMARY

January 2, 2025

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A. ACCIDENT

Location: North Castle, New York
Date: January 19, 2023
Time: 1729 EST
2229 Coordinated Universal Time (UTC)
Airplane: N19MT, Beech A36

B. ENGINE HISTORY AND NO. 4 CYLINDER SPARK PLUG EXAMINATION SUMMARY

IIC Timothy W. Monville
NTSB-OAS/ERA
Washington, DC

Party Coordinator Thomas Justice
Champion Aerospace
Liberty, South Carolina

Timothy W. Monville
Digitally signed by
Timothy W. Monville
Date: 2025.01.06 11:31:36
-05'00'

C. SUMMARY

On January 19, 2023, about 1729 EST, a Beech A36, N19MT, was substantially damaged when it was involved in an accident near North Castle, New York. The private pilot and one passenger were fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 personal flight.

According to the sole stockholder of the airplane (stockholder), the pilot and passenger had flown earlier that day from Cuyahoga County Airport (CGF), Cleveland, Ohio to John F Kennedy International Airport (JFK), New York, New York.

The purpose of the accident flight was to return to CGF.

After takeoff from JFK the pilot twice reported to Federal Aviation Administration (FAA) air traffic control that the airplane was experiencing poor climb performance. The controller advised the pilot that the flight could proceed to Westchester County Airport (HPN), White Plains, New York to have the issue checked out and he agreed. The flight proceeded east of HPN consistent with being on the downwind leg of the airport traffic pattern for runway 16, for the instrument landing system (ILS) runway 16 approach was in-use.

During a controlled descent, the airplane crashed on water supply land, owned by the City of New York and managed by the New York City Department of Environmental Protection.

ENGINE HISTORY AND NO. 4 CYLINDER SPARK PLUG EXAMINATION SUMMARY

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Examination of the wreckage at the accident site revealed fresh oil on the bottom of the fuselage (Figures 1 and 2). The oil was predominantly on the left side of the lower fuselage and appeared to be coming from behind the left cowl flap area. Because of the final resting position of the fuselage the oil was draining down towards the ground. Oil was also noted on the inside diameter and outlet of the lower crankcase breather line (Figure 3).



Figure 1 View of the Bottom of the Fuselage. Note the Fresh Oil Clinging to the Bottom Fuselage Skin.



Figure 2 View of the Bottom Portion of the Fuselage Near the Tailcone. Note the Fresh Oil Clinging to the Bottom Fuselage Skin.



Figure 3 View of the Outlet of the Lower Crankcase Breather Line. Oil on Finger was from the Inner Surface Immediately Adjacent to the Opening. Note the Fresh Oil.

The engine was shipped to the manufacturer's facility for formal disassembly examination which revealed erosion damage to top and outer portion of the No. 4 piston (Figure 4). At the conclusion of that examination both spark plugs from the No. 4 cylinder were secured then subsequently shipped to the manufacturer's facility for testing and examination with NTSB oversight.

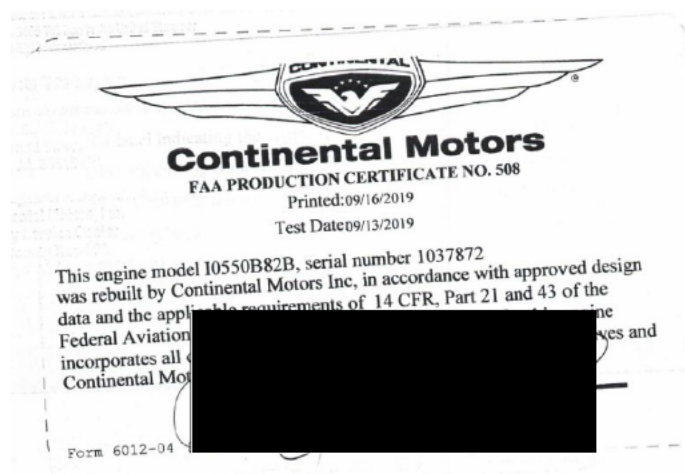


Figure 4 View Showing the Damage to the No. 4 Piston

D. DETAILS OF THE INVESTIGATION

1.0. Engine Information Since Engine was Re-Built

According to provided logbook information, the engine was "rebuilt" by Continental Aerospace Technologies and was tested on September 13, 2019 (Figure 5).



Continental Motors
FAA PRODUCTION CERTIFICATE NO. 508
Printed: 09/16/2019
Test Date: 09/13/2019

This engine model I0550B82B, serial number 1037872 was rebuilt by Continental Motors Inc. in accordance with approved design data and the applicable requirements of 14 CFR, Part 21 and 43 of the Federal Aviation Regulations. The engine incorporates all applicable Continental Motors specifications and

Form 6012-04

Figure 5 Engine Rebuilt Entry

Since being rebuilt, the engine was installed in the accident airplane on November 22, 2019 at tachometer time of 835.34 hours. Between the installation date and the last entry which was associated with an oil change, routine inspections and minor maintenance to the engine was performed.

Closer review of the maintenance records revealed that since the engine was installed in the airplane, routine servicing of the spark plugs occurred until December 9, 2021, at which time 8 new RHB32E spark plugs were installed (Figure 6). The entry did not specify which plugs were replaced.

12-9-21		601.8	Comp. test was ①68/80 ②64/80 ③72/80 ④74/80 ⑤73/80 ⑥73/80 ⑦73/80 ⑧73/80. Mag. timing good. Installed 8 new RHB32E plugs. Replaced oil filter and oil with 11 qts. of Aeroshell W80. I certify that this engine has been inspected in accordance with an Annual inspection and was determined to be in an airworthy condition. [REDACTED] AEP [REDACTED] FA
Tach-1437.1			

Figure 6 December 9, 2021 Entry

A subsequent entry dated January 18, 2022, at tachometer time of 1,462.5 indicated that the top and bottom spark plugs of the No. 4 cylinder were removed and replaced with new plugs (Figure 7).

1/18/22	627.2	627.2	Removed and replaced top and bottom spark plugs on #4 cyl. with new spark plugs - RHB32E. Removed, cleaned, and reinstalled #4 cyl. fuel nozzle. [REDACTED] AEP [REDACTED]
Tach-1462.5			

Figure 7 No. 4 Spark Plug Replacement Entry

Entries dated April 21, 2022, (Figure 8) and November 9, 2022 (Figure 9), each specified that 2 new spark plugs were installed. The April entry specified the plugs to be RHB32E, but neither entry specified which position the new plugs were installed.

Carried forward			Special Inspections, Inspections, and Repairs
4-21-22			Comp. test was ①72/80 ②74/80 ③74/80 ④74/80 ⑤74/80 ⑥74/80 ⑦74/80 ⑧74/80. Mag. timing good. Replaced 2 new RHB32E spark plugs and installed 2 new RHB32E. Replaced oil filter and oil with 11 qts. of Aeroshell W80. I certify that this engine has been inspected in accordance with an Annual inspection and was determined to be in an airworthy condition. [REDACTED] AEP [REDACTED]
Tach-1512.54/1517.24	727.24	727.24	

Figure 8 April 21, 2022 Entry

11-9-22			Comp. test was ①78/80 ②78/80 ③78/80 ④78/80 ⑤78/80 ⑥78/80 ⑦78/80 ⑧78/80. Bottoms left mag. serviced spark plugs and installed 2 new. Cleaned left side fuel injectors. I certify that this engine has been inspected in accordance with an Annual inspection and was determined to be in an airworthy condition. [REDACTED] AEP [REDACTED]
Tach-1808.6			

Figure 9 November 9, 2022 Entry

1.1 Tachometer Time At Time of Accident and Engine Hours Since Rebuilt Engine and No. 4 Cylinder Spark Plugs were Installed

The tachometer time at the time of the accident was 1,889.21 hours. Thus, the engine had accrued about 1,054 hours since being rebuilt, and about 426 hours since new spark plugs were installed in the No. 4 cylinder position.

2.0. Pilot's Operating Handbook and FAA Approved Airplane Flight Manual

2.1 Engine Limitations

According to the airplane's Pilot's Operating Handbook and FAA Approved Airplane Flight Manual (POH/AFM), the power plant limitations section specified that the maximum cylinder head temperature (CHT) value was 460°F, and aviation gasoline 100 low lead (100LL) fuel blue or 100 (green) was the minimum grade.

3.0. Spark Plug Manufacturing Information

3.1 4T Spark Plug

The spark plug from the 4T position was a Champion RHB32EF, with a date code of 1M19, indicating it was manufactured in 2019.

3.2 4B Spark Plug

The spark plug from the 4B position was a Champion RHB32EF, with a date code of 1M19, indicating it was manufactured in 2019.

4.0. Spark Plug Designation

Each spark plug was a RHB32EF plug, the following descriptors apply:

- R-resistor type plug
- H -bushing
- B-thread reach/size
- 32-heat range
- E-type of center electrode (massive)
- F-revision

5.0. Spark Plug Initial Examination Information

5.1 4T Spark Plug

Examination of the plug revealed a piece of insulator/ceramic core nose was separated and heavy deposits bridged the gaps between the center electrode and the two ground electrodes (Figure 10). The separated portion of the insulator/ceramic core nose was visible. Deposits were compacted around the inner bore of the spark plug around the insulator. Deposits were also noted around the center electrode area where the insulator was cracked, indicating factually that the plug was operating after the insulator damage occurred¹.



Figure 10 20 Power Magnification of the 4T Spark Plug

Because deposits bridged the gap between the center electrode and both ground electrodes resistance testing could not be performed.

5.2 4B Spark Plug

Examination of the plug revealed the center electrode was football shaped, and deposits were compacted in the bore of the spark plug around

¹ The deposits on the fracture surface of the core nose indicate the plug was operating after the core nose cracked. However, there is no factual way to determine if all of the deposits occurred after the crack.

the insulator. Deposits bridged the gap between the center electrode and the two ground electrodes (Figure 11).



Figure 11 20 Power Magnification of 4B Spark Plug

Because deposits bridged the gap between the center electrode and both ground electrodes resistance testing could not be performed.

6.0. Spark Plug Operational Test Protocol and Results

6.1 Spark Plug Test Protocol

Both spark plugs were tested as received three times in accordance with production procedures².

6.2 4T Spark Plug Test Results

The plug did not produce spark when tested at 180 psi air pressure at the firing end for any of the tests.

² That requires a gap between 0.018 and 0.024 inch. The gap of each plug was not changed. 100% of every plug manufactured is tested at 180 psi at the firing end, and also the resistance is tested.
ENGINE HISTORY AND NO. 4 CYLINDER SPARK PLUG EXAMINATION SUMMARY

6.3 4B Spark Plug Test Results

The plug did not produce spark when tested at 180 psi at the firing end for any of the tests.

7.0. CT Images of Both Spark Plugs

7.1 4T Spark Plug CT Imaging

CT Imaging of the 4T spark plug confirmed the core nose was broken, and deposits were located inside the core nose where the crack occurred (Figure 12). Deposits from the center electrode and the core nose area were retained for confirmation as to material.

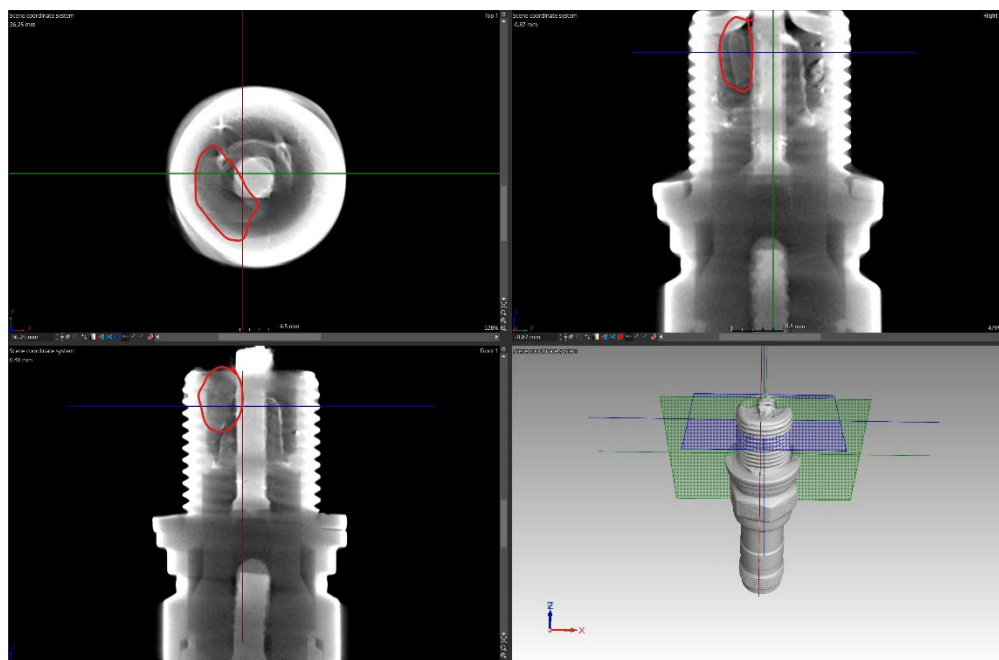


Figure 12 Annotated and Non Annotated CT Images of the 4T Spark Plug

7.2 4B Spark Plug CT Imaging

Imaging of the 4B spark plug confirmed there was a crack in the core nose insulator (Figure 13). Deposits were noted on the core nose. The center electrode was football shaped. The terminal button was correct with no defects. The core nose insulator was severely discolored with excessive combustion deposits. Deposits were taken from the center electrode and the core nose area and were retained for confirmation as to material. No piece of the core nose was missing.

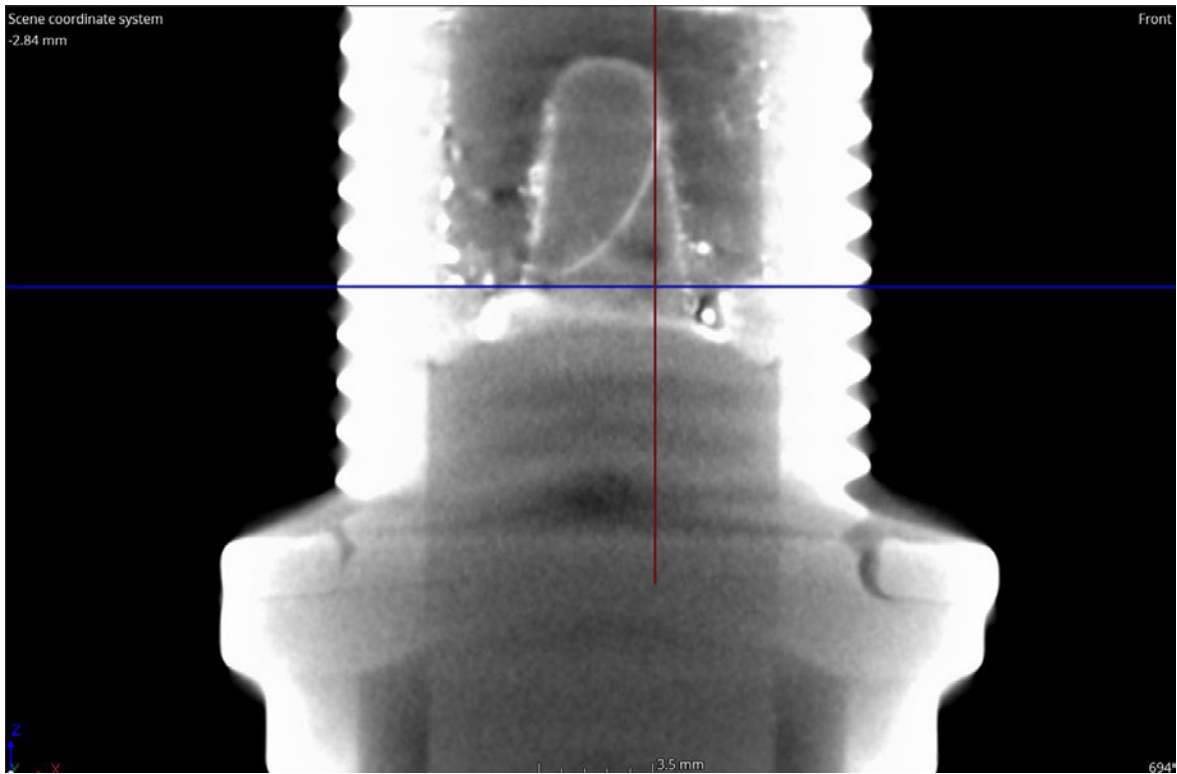


Figure 13 CT Image Showing Crack in Core Nose Insulator of 4B Plug

8.0. Disassembly of the Spark Plugs

Each spark plug was machined to allow for removal of the core assembly.

8.1 4T Spark Plug Disassembly

Following disassembly of the 4T spark plug lead deposits were noted inside where the core nose was cracked and a piece of the core nose was separated (Figure 14). Heavy deposits were noted.



Figure 14 View of the 4T Spark Plug After Disassembly Showing Fractured Core Nose

8.2 4B Spark Plug Disassembly

Following disassembly of the 4B spark plug revealed the core nose was severely discolored with excessive combustion deposits (Figure 15).

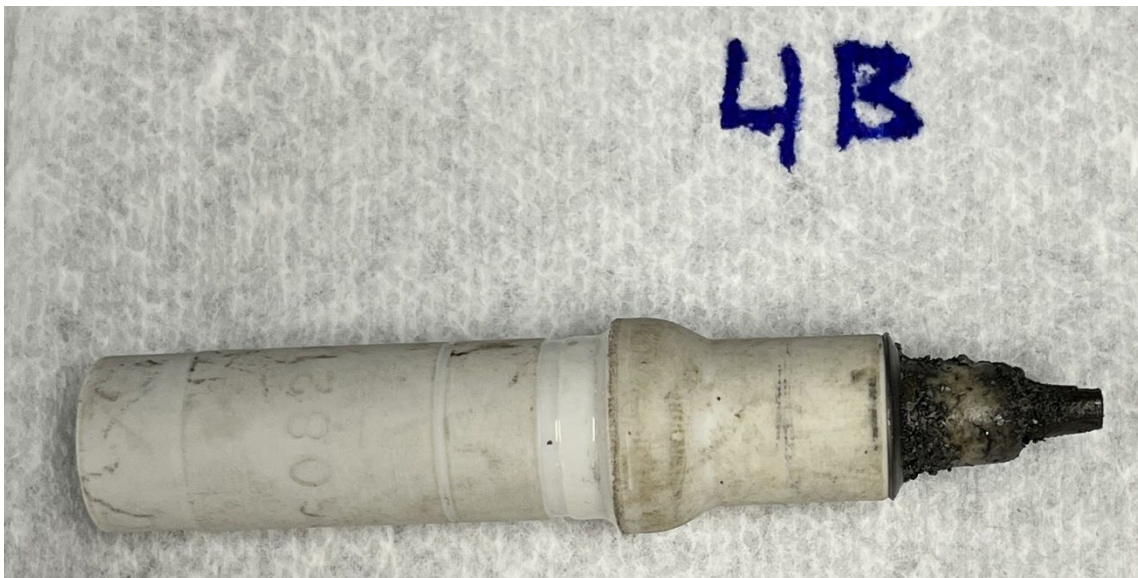


Figure 15 View of 4B Spark Plug After Disassembly Showing Heavy Deposits on Core Nose Insulator and Discoloration.

9.0. Materials Test Results (Attachment 1)

9.1 4T Spark Plug Test Results

The results of testing of material on the 4T Spark Plug at the core nose and ground electrode were positive for lead, aluminum, and nickel.

9.2 4B Spark Plug Test Results

The results of testing of material on the 4B Spark Plug at the core nose were positive for lead and aluminum, while deposits on the ground electrode were positive for lead, aluminum and nickel.

10.0. Manufacture Experience with Spark Plug Issues/Defects

10.1 Detonation

The manufacturer representative reported that detonation inside the engine is actually enough to cause the core nose to crack. Detonation inside an engine can be caused in part by a defect with the spark plug, use of an incorrect heat range, leading fouling, and the core nose being broken.

10.2 Crack in Core Nose

The manufacturer representative reported that a crack in the core nose may not cause misfiring of the spark plug. If a crack in the core nose is present and a misfire is also present, the sparkplug could get deposits from running cold.

10.3 Lead Deposits

The manufacturer representative reported that lead deposits in the well of the spark plug can form when the cylinder is running too cold. The corrective action is to get a hotter plug, which will hold the heat on the core nose longer.

11.0. PARTS RETENTION

No parts were retained. The spark plugs were shipped to the aircraft salvage facility.

Submitted by:

Timothy W. Monville
Sr. Air Safety Investigator



Report No. SEM-2024-015

Date: December 17, 2024

To: Thomas Justice
Steve Cannady

From: Nancy Bolger

Subject: **SCANNING ELECTRON MICROSCOPE (SEM) AND ENERGY DISPERSIVE X-RAY ELEMENTAL (EDX) ANALYSIS OF SURFACE DEPOSIT, SPARK PLUG**

PURPOSE

The purpose of this study was to analyze multiple surface deposits taken from a returned spark plug. Four deposit samples were examined with a scanning electron microscope (SEM) equipped with an energy dispersive X-ray (EDX) spectrometer.

RESULTS

Figures 1 through 4 present typical SEM photomicrographs and corresponding EDX analyses of the 4T surface deposit on the ground electrode.

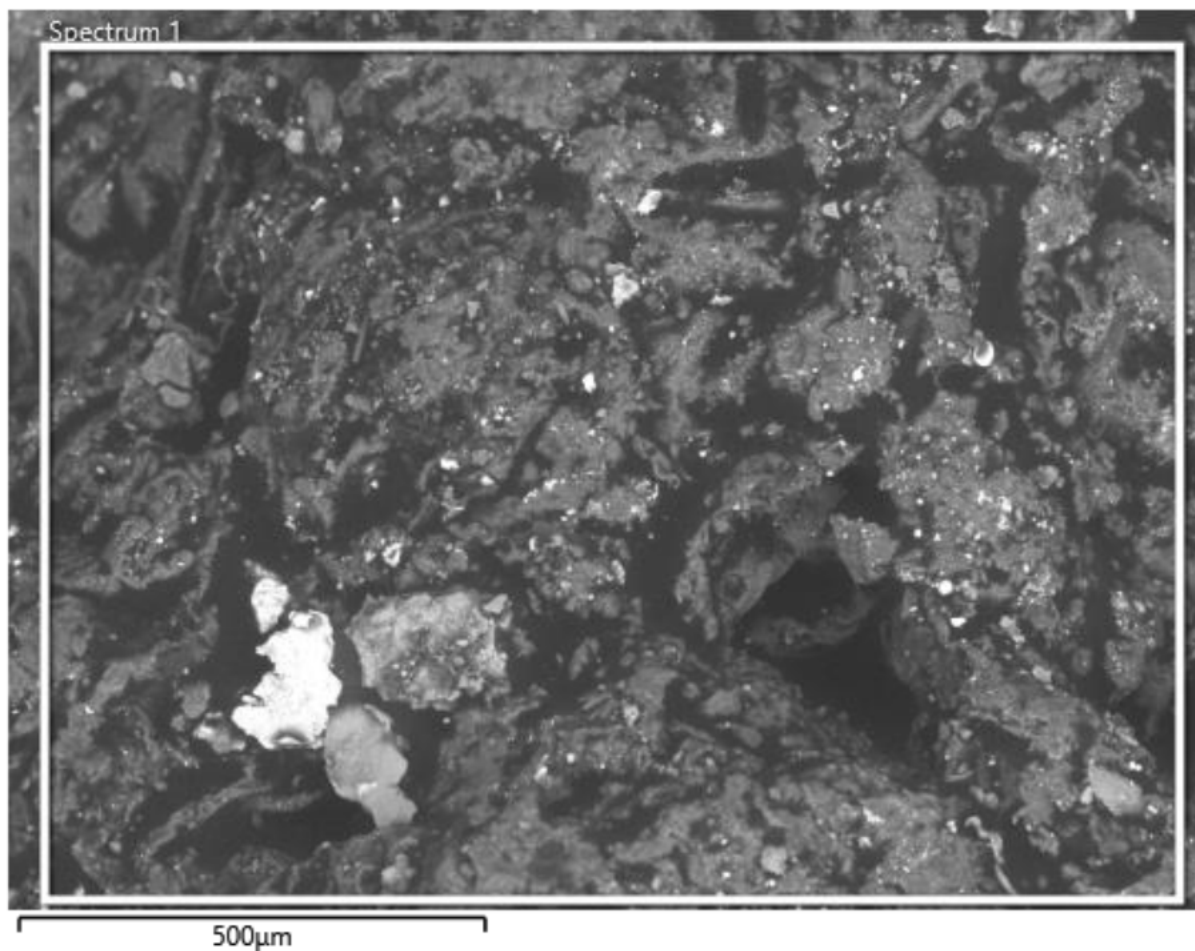
Figures 5 through 8 present typical SEM photomicrographs and corresponding EDX analyses of the 4B surface deposit on the ground electrode.

Figures 9 through 12 present typical SEM photomicrographs and corresponding EDX analyses of the 4B surface deposit on the core nose.

Figures 13 through 16 present typical SEM photomicrographs and corresponding EDX analyses of the 4T surface deposit on the core nose.

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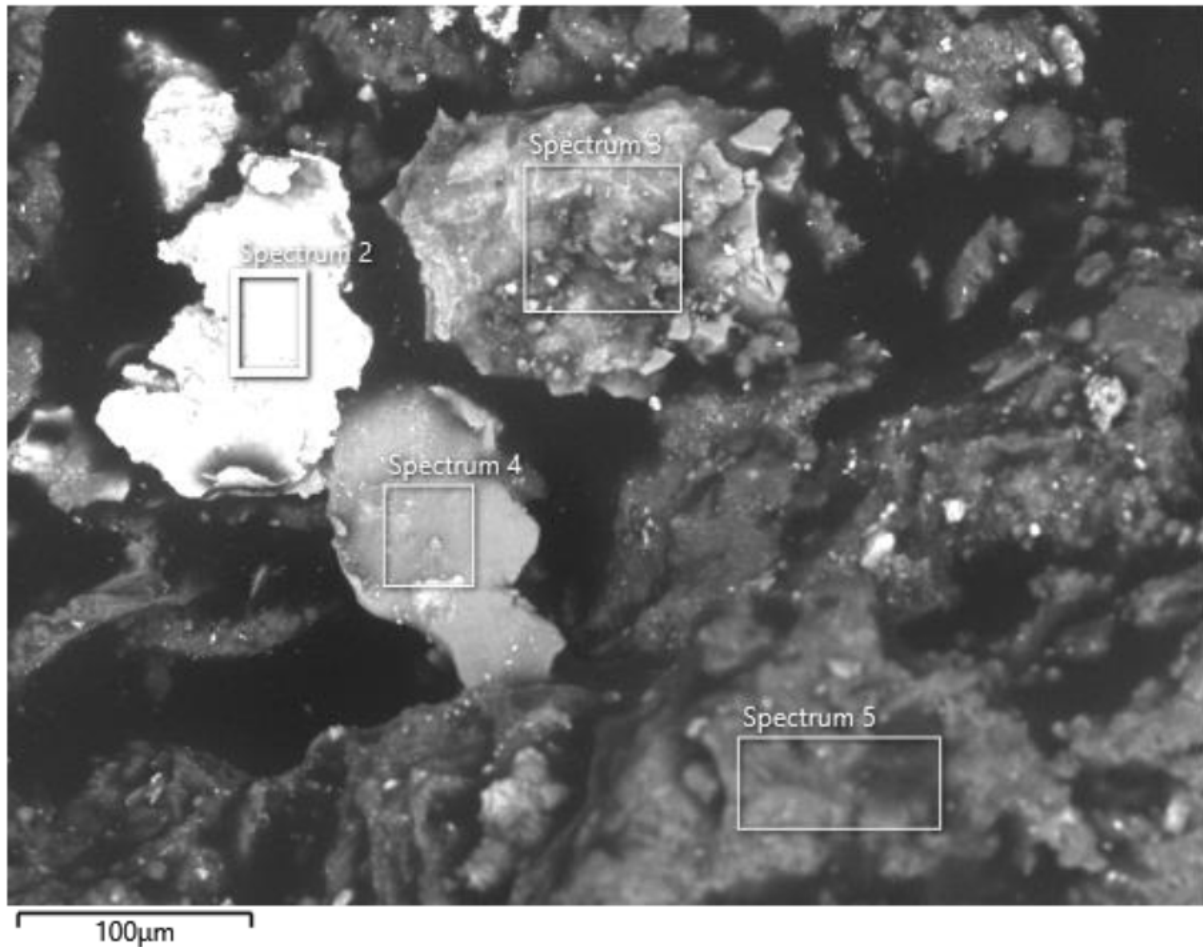
Label	C	O	Mg	Al	Si	Ca	Cr	Mn	Fe	Ni	Cu	Pb
Spectrum 1	78.51	3.43	0.48	11.16	1.66	0.03	0.04	0.03	1.14	0.92	0.91	1.69

All results in weight %

Figure 1. Typical SEM photomicrograph and EDX analysis for 4T Surface Deposit Ground Electrode, 100X magnification

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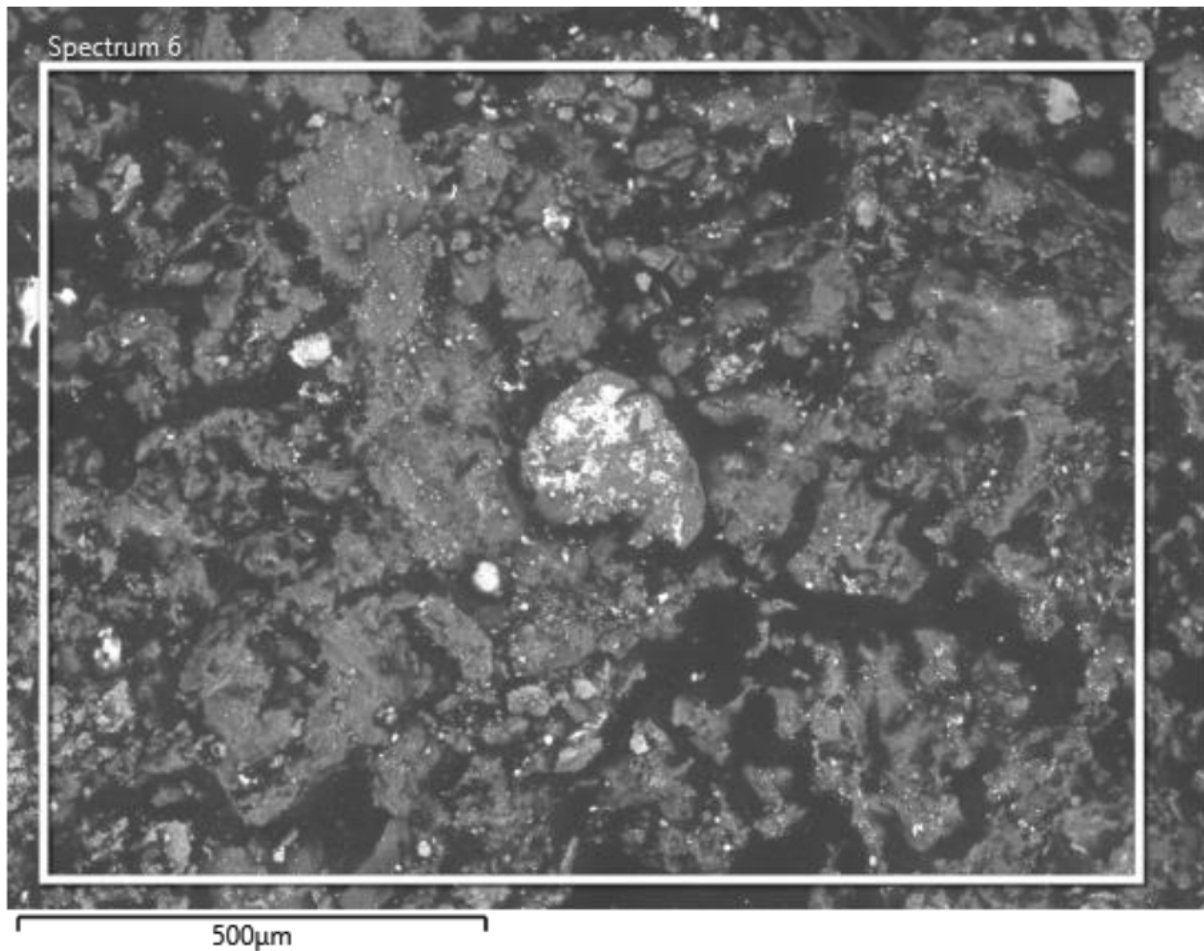
Label	C	O	Mg	Al	Si	S	Ca	Cr	Mn	Fe	Ni	Cu	Zn	Br	Sn	Pb
Spectrum 2	53.92	3.57	0.20	3.20	0.50	-	-	-	-	2.58	2.72	16.81	-	1.46	1.86	13.20
Spectrum 3	66.06	6.40	0.19	2.45	0.42	0.12	0.63	0.07	0.05	1.83	1.38	17.89	0.63	0.63	-	1.26
Spectrum 4	55.42	5.79	-	2.35	0.36	-	-	0.31	0.24	30.32	0.70	0.92	-	1.44	-	2.15
Spectrum 5	71.43	5.09	0.40	17.77	2.65	-	-	-	-	0.36	0.97	0.38	-	-	-	0.95

All results in weight %

Figure 2. Typical SEM photomicrograph and EDX analyses for 4T Surface Deposit Ground Electrode, 250X magnification

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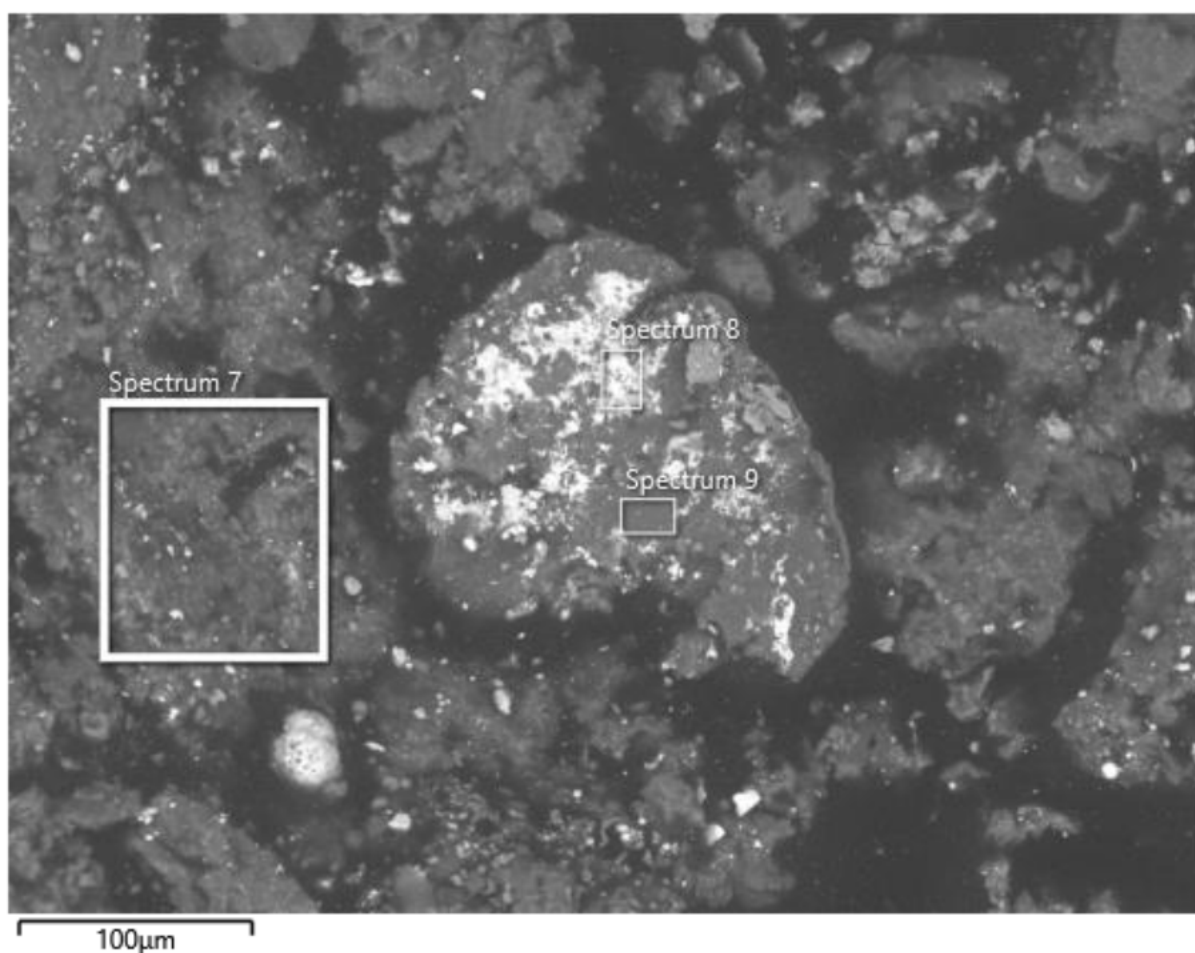
Label	C	Mg	Al	Si	S	Fe	Ni	Cu	Pb
Spectrum 6	81.50	0.43	11.89	1.63	0.06	0.95	1.55	0.40	1.58

All results in weight %

Figure 3. Typical SEM photomicrograph and EDX analysis for 4T Surface Deposit Ground Electrode, 100X magnification

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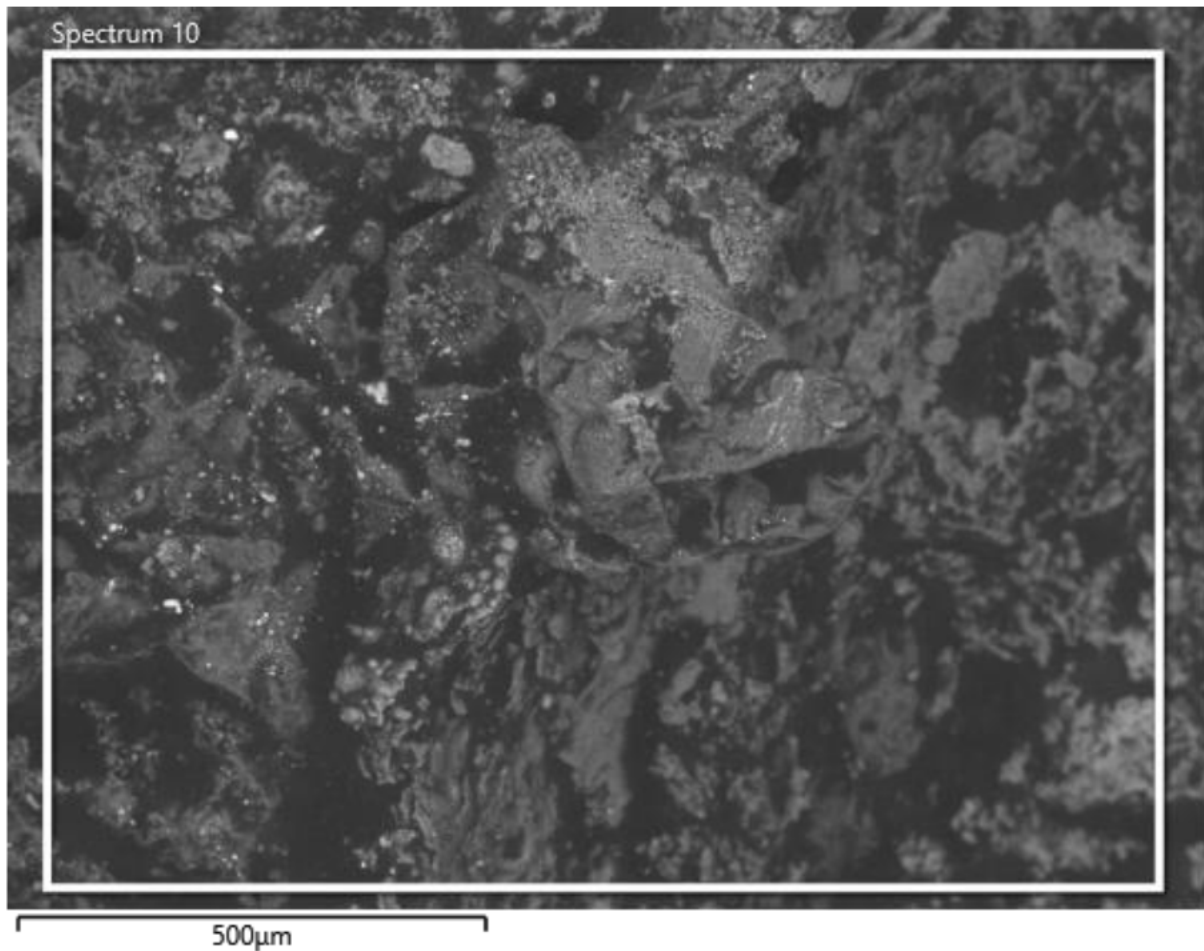
Label	C	O	Mg	Al	Si	Fe	Ni	Cu	Br	Sn	Pb
Spectrum 7	74.31	-	0.49	15.79	2.96	0.41	1.97	0.32	1.96	-	1.80
Spectrum 8	61.25	2.10	0.30	7.99	1.15	0.64	0.77	0.84	1.87	0.44	22.65
Spectrum 9	57.79	1.71	0.48	30.97	2.15	0.25	0.52	0.62	3.50	-	2.01

All results in weight %

Figure 4. Typical SEM photomicrograph and EDX analyses for 4T Surface Deposit Ground Electrode, 250X magnification

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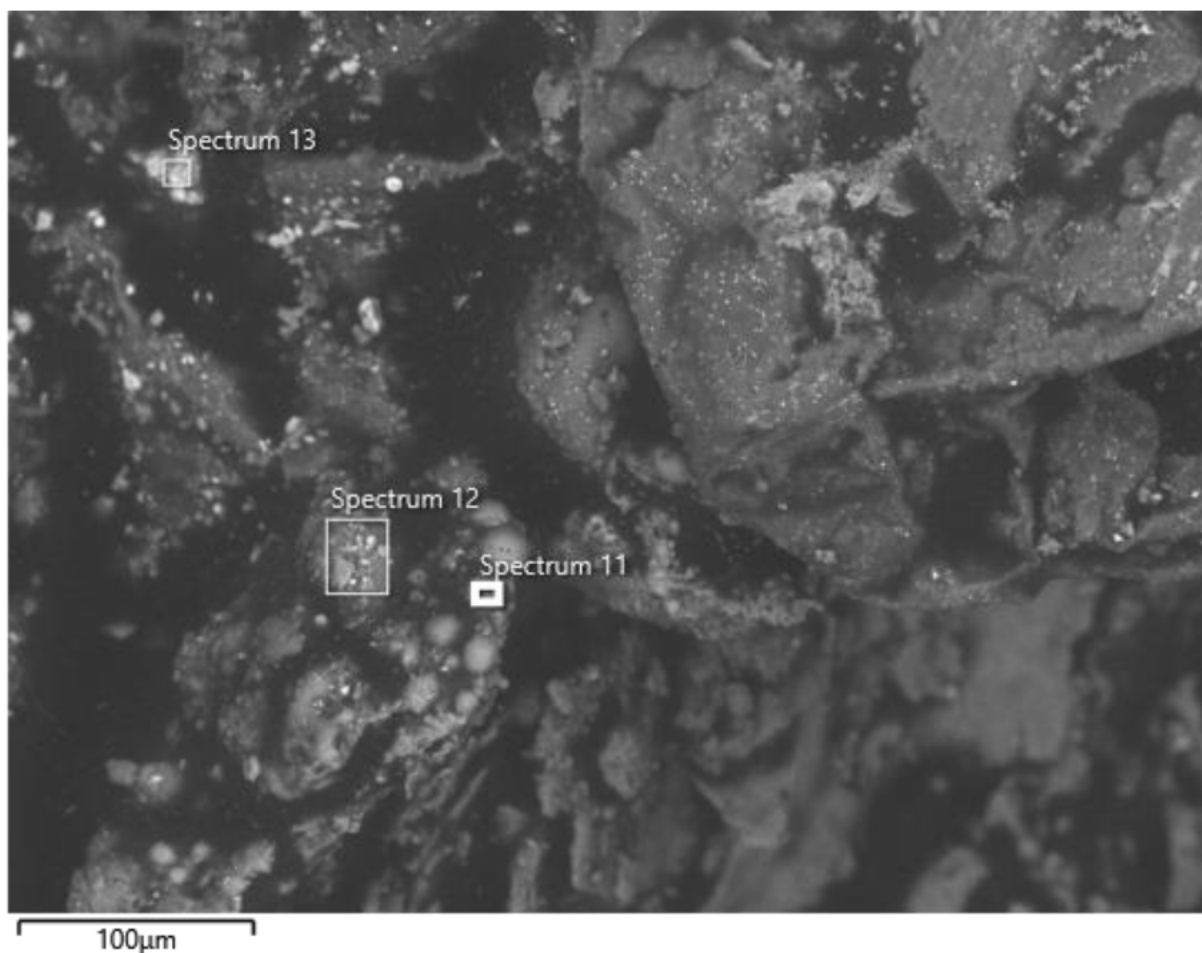
Label	C	Mg	Al	Si	Cr	Mn	Fe	Ni	Br	Pb
Spectrum 10	79.77	0.40	7.71	1.25	0.20	0.20	0.31	7.05	1.23	1.90

All results in weight %

Figure 5. Typical SEM photomicrograph and EDX analysis for 4B Surface Deposit Ground Electrode, 100X magnification

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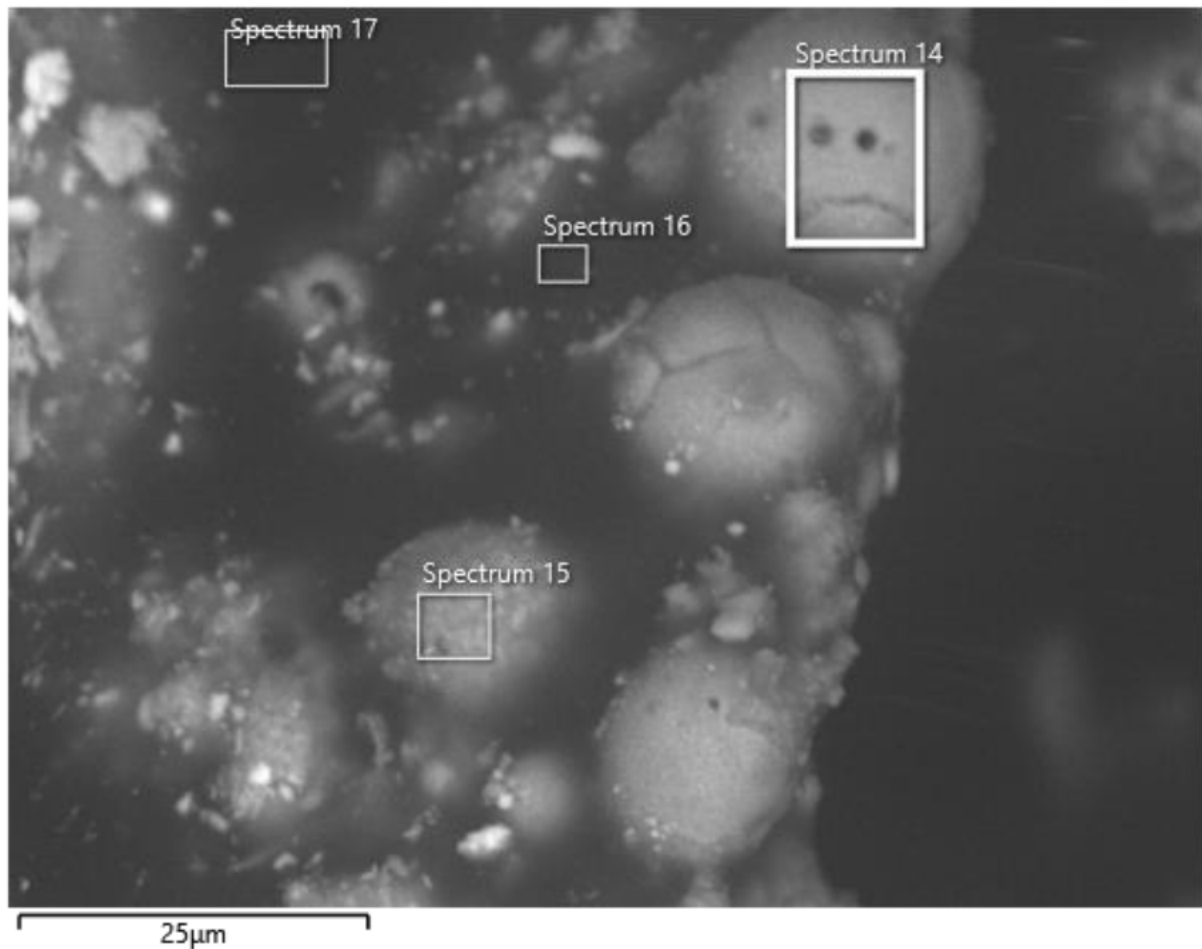
Label	C	O	Mg	Al	Si	Ti	Cr	Mn	Fe	Ni	Cu	Br	Sn	Pb
Spectrum 11	56.18	7.63	-	3.70	0.48	-	0.15	0.18	0.29	30.14	-	-	-	1.24
Spectrum 12	66.61	6.92	0.22	2.81	0.63	0.19	1.03	0.72	2.68	10.41	1.37	2.03	0.08	4.30
Spectrum 13	57.69	2.09	0.25	3.24	0.52	-	0.11	-	0.30	1.51	0.36	3.22	-	30.72

All results in weight %

Figure 6. Typical SEM photomicrograph and EDX analyses for 4B Surface Deposit Ground Electrode, 250X magnification

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Processing option: All elements analyzed (Normalized)

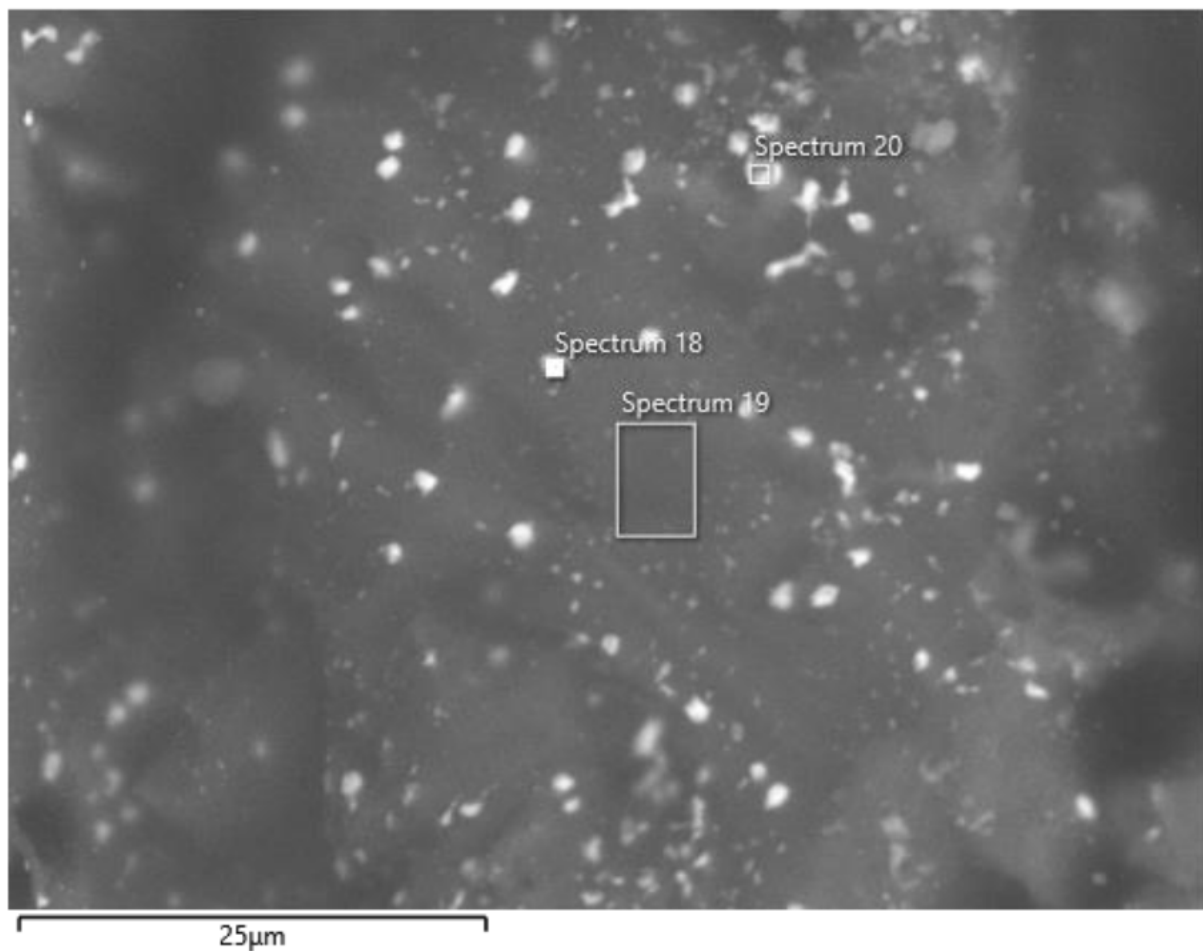
Label	C	O	Al	Si	S	Ti	Cr	Mn	Fe	Ni	Cu	Br	Pb
Spectrum 14	53.60	5.91	3.11	0.44	-	-	0.12	0.12	0.27	35.44	-	-	0.99
Spectrum 15	57.95	7.05	2.92	0.52	-	0.15	0.84	0.61	0.60	27.09	-	0.77	1.50
Spectrum 16	84.87	-	1.28	0.24	0.06	0.06	0.29	0.26	0.33	11.16	-	0.63	0.81
Spectrum 17	93.66	-	0.93	0.17	0.08	0.04	0.21	0.16	0.66	3.00	0.20	0.27	0.62

All results in weight %

Figure 7. Typical SEM photomicrograph and EDX analyses for 4B Surface Deposit Ground Electrode, 1500X magnification

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Processing option: All elements analyzed (Normalized)

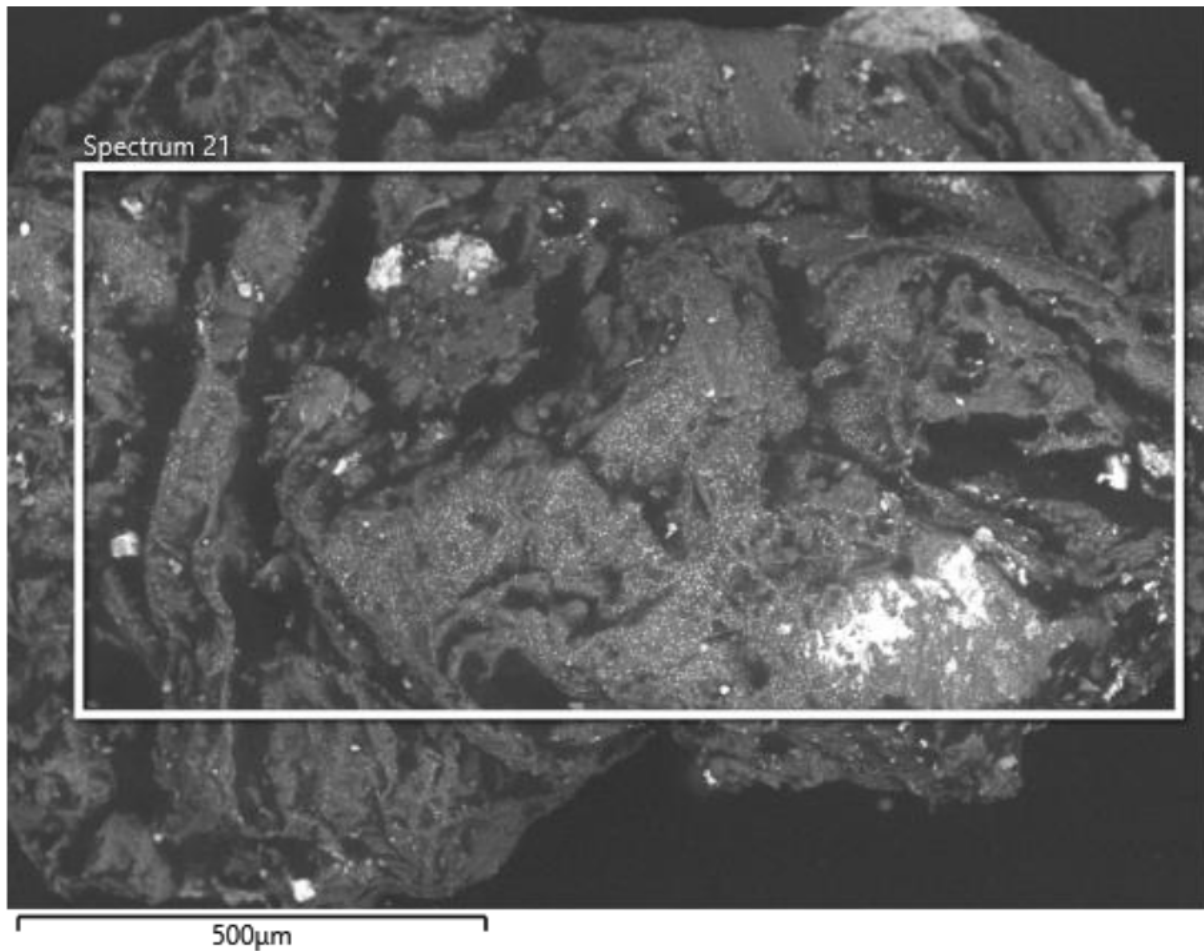
Label	C	O	Mg	Al	Si	Mn	Fe	Ni	Cu	Br	Pb
Spectrum 18	45.82	6.45	1.21	24.56	5.39	-	-	1.01	0.42	-	15.14
Spectrum 19	58.34	2.83	0.48	18.90	18.40	-	-	0.69	-	-	0.36
Spectrum 20	47.38	9.52	1.70	22.79	3.06	0.07	0.19	1.44	0.58	2.91	10.37

All results in weight %

Figure 8. Typical SEM photomicrograph and EDX analyses for 4B Surface Deposit Ground Electrode, 2000X magnification

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Processing option: All elements analyzed (Normalized)

Label	C	Mg	Al	Si	Fe	Ni	Br	Pb
Spectrum 21	78.83	0.43	13.44	3.12	0.38	0.17	0.96	2.68

All results in weight %

Figure 9. Typical SEM photomicrograph and EDX analysis for 4B Surface Deposit Core Nose, 100X magnification

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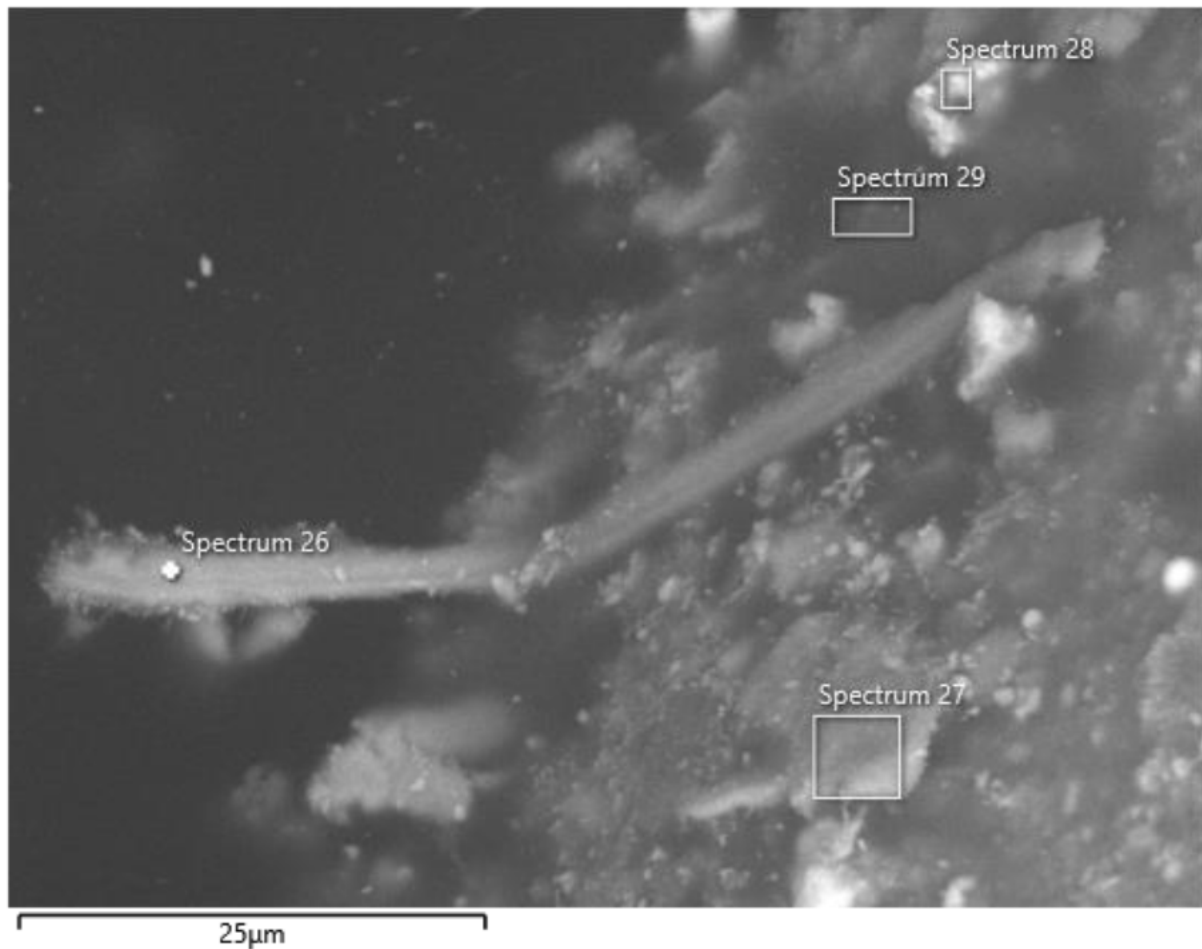
Label	C	O	Mg	Al	Si	S	Cr	Mn	Fe	Ni	Cu	Br	Pb
Spectrum 22	64.96	3.73	0.23	8.00	0.99	-	0.06	-	1.69	0.27	1.74	3.54	14.78
Spectrum 23	83.16	-	0.57	10.70	1.28	0.06	-	0.08	0.65	0.19	0.44	2.08	0.79
Spectrum 24	65.19	2.53	0.60	24.36	5.91	-	-	-	0.22	0.30	-	-	0.88
Spectrum 25	70.58	2.92	-	4.47	0.77	-	-	-	12.88	0.17	1.35	1.84	5.02

All results in weight %

Figure 10. Typical SEM photomicrograph and EDX analyses for 4B Surface Deposit Core Nose, 250X magnification

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Processing option: All elements analyzed (Normalized)

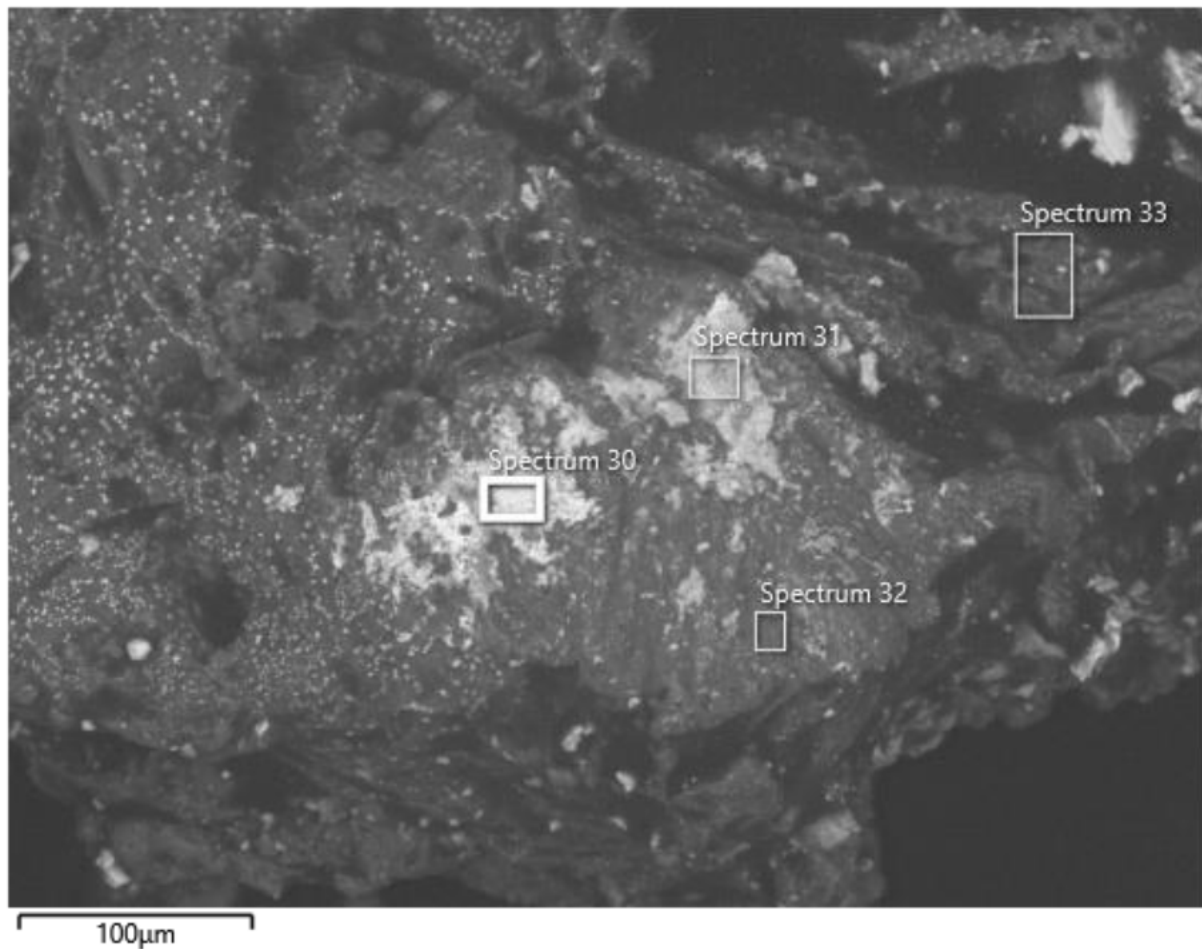
Label	C	O	Mg	Al	Si	S	Cr	Mn	Fe	Ni	Cu	Br	Sn	Pb
Spectrum 26	67.00	6.92	-	3.07	0.53	0.06	0.20	0.20	19.47	0.14	0.46	1.02	-	0.93
Spectrum 27	61.00	4.93	-	8.37	1.21	-	-	-	8.61	0.44	9.81	1.88	0.21	3.54
Spectrum 28	66.80	3.22	0.16	4.09	0.67	-	-	-	10.93	0.25	5.19	1.28	0.16	7.25
Spectrum 29	78.63	2.69	0.16	4.30	0.73	-	-	-	8.13	0.14	0.66	0.61	-	3.94

All results in weight %

Figure 11. Typical SEM photomicrograph and EDX analyses for 4B Surface Deposit Core Nose, 2000X magnification

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Processing option: All elements analyzed (Normalized)

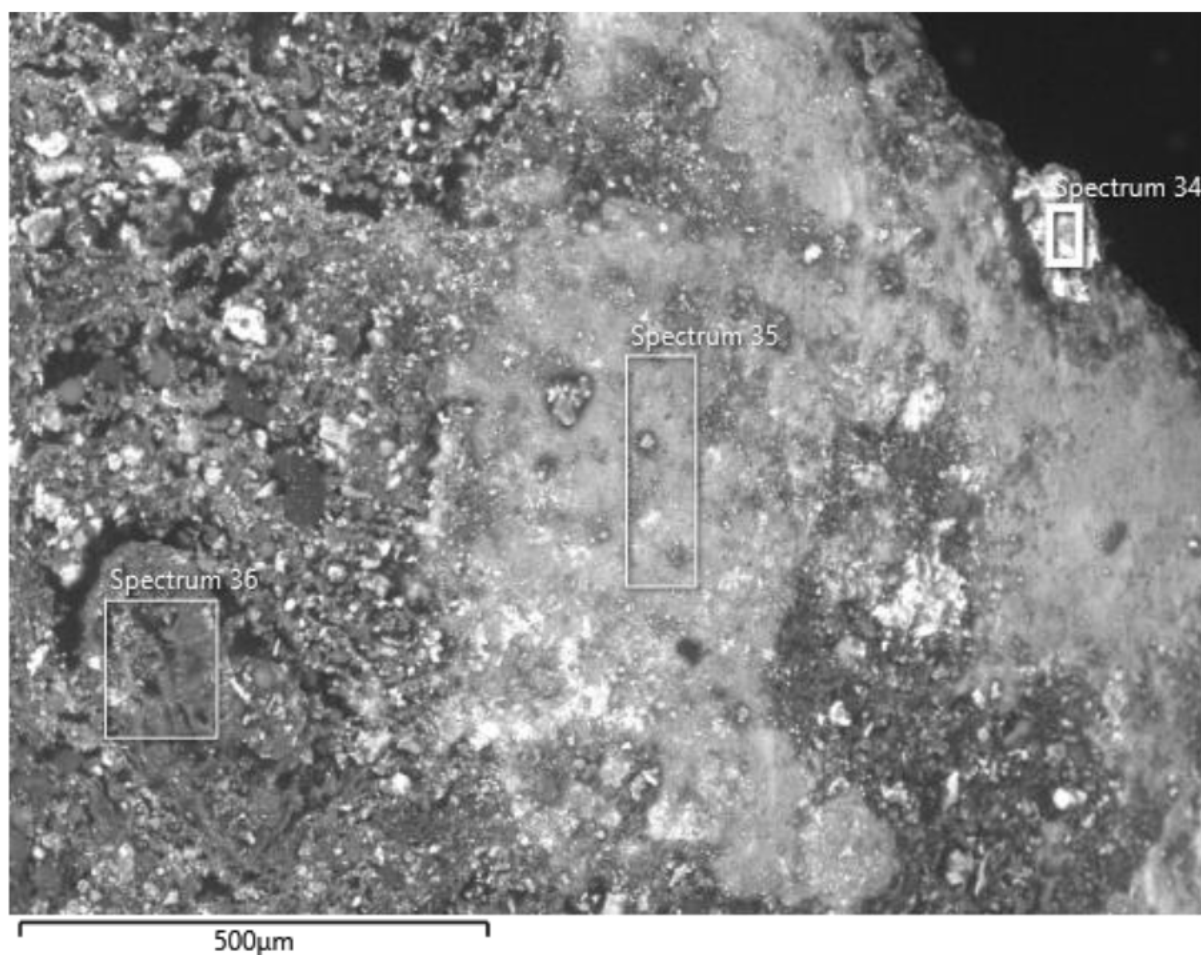
Label	C	O	Mg	Al	Si	Cr	Fe	Ni	Cu	Zn	Br	Pb
Spectrum 30	50.43	2.01	-	3.71	0.79	-	0.62	0.27	0.94	0.14	7.20	33.90
Spectrum 31	61.13	2.65	0.14	3.81	0.66	0.06	1.84	0.83	0.83	0.15	5.48	22.42
Spectrum 32	50.62	2.02	0.50	34.44	4.53	-	0.15	0.31	0.58	-	4.45	2.40
Spectrum 33	70.33	3.29	0.83	17.00	4.53	-	0.11	0.22	0.38	-	2.03	1.29

All results in weight %

Figure 12. Typical SEM photomicrograph and EDX analyses for 4B Surface Deposit Core Nose, 250X magnification

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Processing option: All elements analyzed (Normalized)

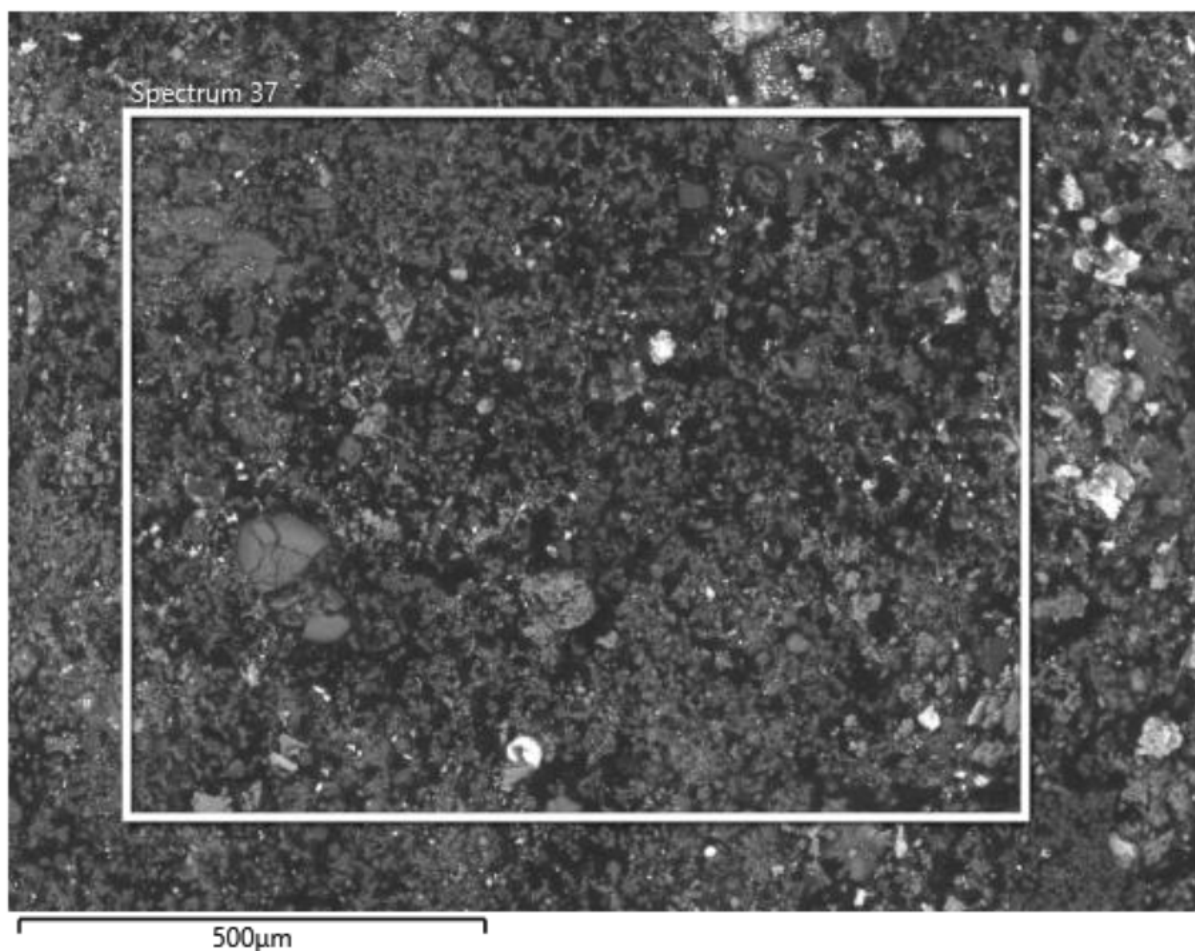
Label	C	O	Na	Mg	Al	Si	Ca	Cr	Mn	Fe	Ni	Cu	Zn	Br	Pb
Spectrum 34	53.07	6.34	-	-	0.66	0.24	-	0.13	0.15	0.33	9.68	-	-	0.79	28.61
Spectrum 35	58.24	6.14	0.22	0.10	3.49	0.61	0.30	0.17	0.11	4.51	3.72	-	4.07	2.89	15.44
Spectrum 36	65.43	3.65	-	0.42	14.93	2.15	-	0.06	0.11	1.35	4.31	0.28	0.22	2.08	5.01

All results in weight %

Figure 13. Typical SEM photomicrograph and EDX analyses for 4T Surface Deposit Core Nose, 100X magnification

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Processing option: All elements analyzed (Normalized)

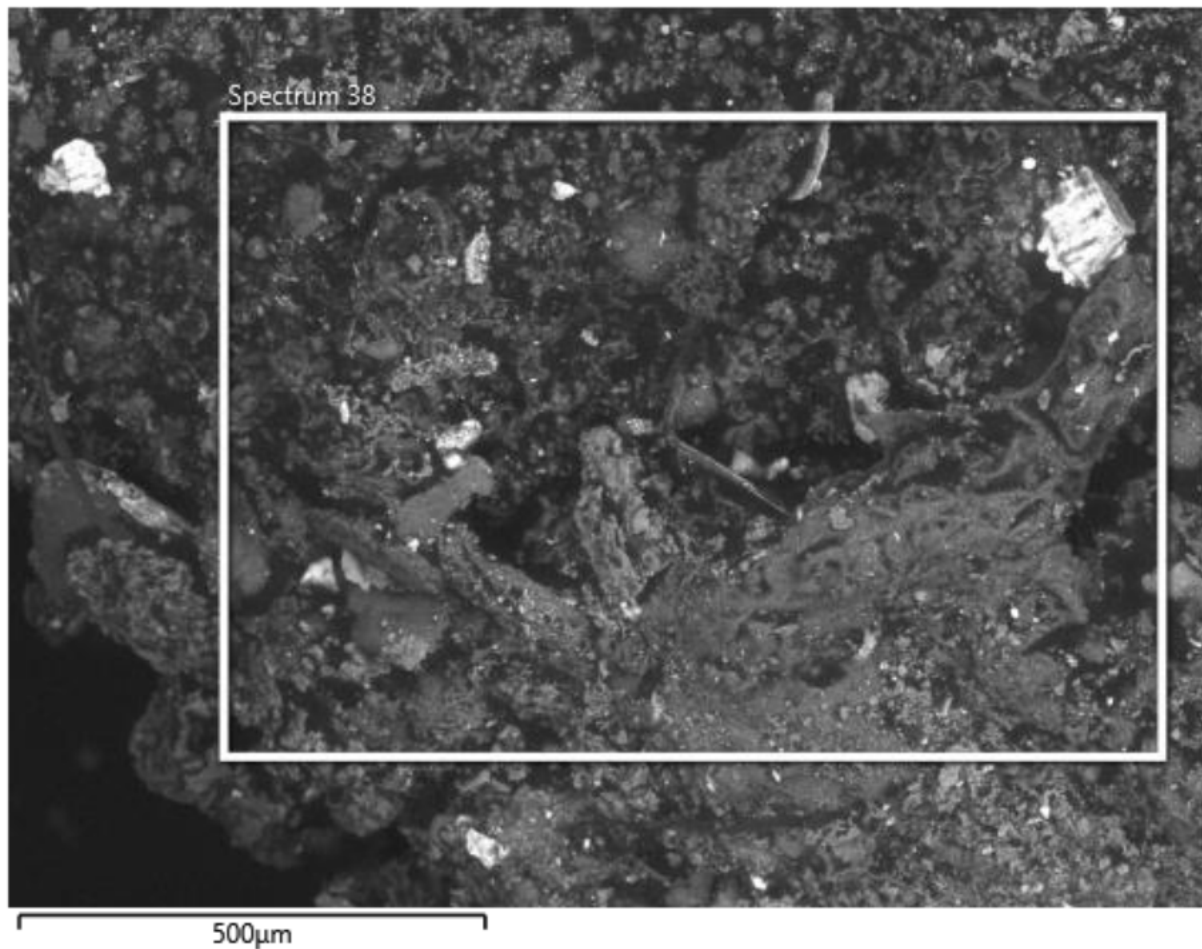
Label	C	O	Mg	Al	Si	Ca	Cr	Mn	Fe	Ni	Zn	Br	Pb
Spectrum 37	75.32	6.48	0.18	6.00	0.66	0.20	0.17	0.09	1.13	3.34	0.12	4.03	2.28

All results in weight %

Figure 14. Typical SEM photomicrograph and EDX analysis for 4T Surface Deposit Core Nose, 100X magnification

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Processing option: All elements analyzed (Normalized)

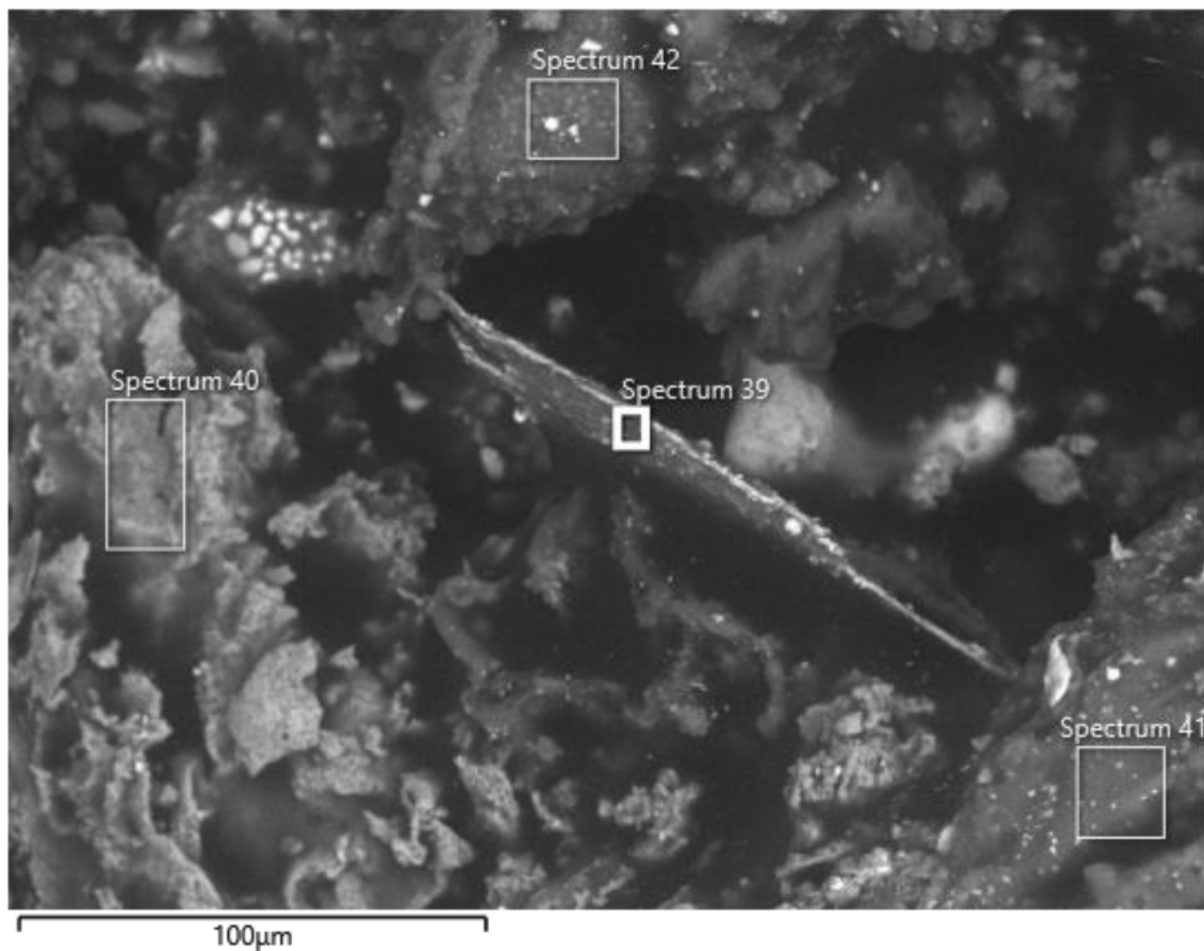
Label	C	Mg	Al	Si	Cr	Mn	Fe	Ni	Cu	Br	Pb
Spectrum 38	75.57	0.47	9.65	1.25	0.10	0.11	0.73	4.56	0.48	3.44	3.65

All results in weight %

Figure 15. Typical SEM photomicrograph and EDX analysis for 4T Surface Deposit Core Nose, Fracture, 100X magnification

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Processing option: All elements analyzed (Normalized)

Label	C	O	Mg	Al	Si	Cr	Mn	Fe	Ni	Cu	Br	Sn	Pb
Spectrum 39	54.36	3.47	0.19	3.47	0.43	-	-	4.25	3.39	19.44	1.38	0.70	8.91
Spectrum 40	68.48	-	-	1.28	0.14	0.29	0.74	-	25.67	-	0.57	-	2.83
Spectrum 41	62.76	1.86	0.21	26.11	4.93	-	-	0.15	0.42	0.19	2.61	-	0.77
Spectrum 42	58.69	8.63	1.05	20.44	1.42	-	-	0.55	1.66	1.06	3.78	-	2.72

All results in weight %

Figure 16. Typical SEM photomicrograph and EDX analyses for 4T Surface Deposit Core Nose, Fracture, 500X magnification

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