

SOUTHWEST RESEARCH INSTITUTE®

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CHEMISTRY AND CHEMICAL ENGINEERING DIVISION
DEPARTMENT OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY

December 21, 2017

CH2M Hill Plateau Remediation Company
2420 Stevens Center Place
Mail Stop H8-41
Richland, WA 99352

Attn: Ms. Laine Sumner

Subject:	SAF No:	F18-003
	SDG Number:	624420
	SwRI Project Number:	20859.01.00X
	SwRI Task Order Number:	171207-7
	SwRI Sample Receipt Number:	60847
	Samples Received	12.07.2017
	Fraction:	EDS-SEM and XRD Analyses

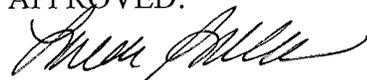
Dear Ms. Sumner:

Please find the enclosed results for the three (03) overall samples received on the above referenced date. If you should have any questions, please do not hesitate to call me at (210) 522-3242, or at radonna.spies@swri.org.

Sincerely,

Radonna Spies
Principal Scientist

APPROVED:


Michael J. Dammann
DirectorRPS: mg
Encl

Benefiting government, industry and the public through innovative science and technology

SOUTHWEST RESEARCH INSTITUTE
CLIENT: CH2M Hill Plateau Remediation Company
SwRI ROJECT#: 20859.01.00X
SwRI TASK ORDER: 171207-7
SwRI SRR: 60847
SDG: 624420
CASE: F18-003
VTSR: 12-07-2017

CHAIN-OF-CUSTODY & SAMPLE RECEIPT PAPERWORK

Total Page Count: 010001
Fraction: 1 / 1 Pages: 010001
X RD Report 06026

12/21/2017

REV.0

CH2M Hill Plateau Remediation Company		CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			010002	F18-003-002	PAGE 1 OF 1
COLLECTOR Chris Fulton CHPRC		COMPANY CONTACT SUMNER, LC	TELEPHONE NO. 376-3922	PROJECT COORDINATOR SUMNER, LC		REQUIRED TAT 15 Days	
SAMPLING LOCATION REDOX GREEN PAPER		PROJECT DESIGNATION REDOX Gallery Sampling - Other Solid		SAF NO. F18-003		ORIGINAL	
ICE CHEST NO. GWS-695		FIELD LOGBOOK NO. HNF-N-507-27	ACTUAL SAMPLE DEPTH N/A	PURCHASE ORDER/CHARGE CODE 300250		METHOD OF SHIPMENT FEDERAL EXPRESS	
SHIPPED TO Southwest Research Institute		OFFSITE PROPERTY NO. 8822		BILL OF LADING/AIR BILL NO. 7709 1862 4602			
MATRIX* A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	POSSIBLE SAMPLE HAZARDS/ REMARKS *Contains Radioactive Material at concentrations that are not be regulated for transportation per 49 CFR/IATA Dangerous Goods Regulations but are not releasable per DOE Order 458.1.		PRESERVATION None				
			HOLDING TIME 6 Months				
			TYPE OF CONTAINER P				
			NO. OF CONTAINER(S) 1				
			VOLUME 1L				
	SPECIAL HANDLING AND/OR STORAGE RADIOACTIVE TIE TO: B3FXN0		SAMPLE ANALYSIS		SEE ITEM (1) IN SPECIAL INSTRUCTIONS		
SAMPLE NO.	FILTERED	MATRIX*	SAMPLE DATE	SAMPLE TIME			
B3FXN1	N/A	OTHER SOLID	DEC 05 2017	1303	✓		

CHPRC
SRR # 60847
SDG # 624420

SwRI Prjct # 20859.01.00X
TO: 171207-7

CHAIN OF POSSESSION		SIGN/ PRINT NAMES		SPECIAL INSTRUCTIONS
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME	
Chris Fulton CHPRC	DEC 05 2017 1435	SSU-1	DEC 05 2017 1435	TRVL-18-044 ** SWRI GENERIC TESTING BOTTLE - is for EDS-SEM analyses. XRD analyses may be requested if there is sufficient crystalline material present. ** Lab shall perform the SEM analysis then wait for direction from SMR to proceed. (1) Generic Testing {No CAS}; 6010_METALS_ICP: COMMON {Antimony, Arsenic, Barium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Magnesium, Manganese, Nickel, Potassium, Silver, Sodium, Vanadium, Zinc}; 9045_pH (Non-Aqueous): COMMON {pH Measurement}; 9056_ANIONS_IC: COMMON {Chloride, Fluoride, Nitrogen in Nitrate, Nitrogen in Nitrite, Sulfate}; 9056_ANIONS_IC: COMMON (Add-on) {Bromide, Phosphorus in phosphate};
SSU-1	DEC 06 2017 0823	Malcom Chunn CHPRC	DEC 06 2017 0823	
Malcom Chunn CHPRC	DEC 06 2017 1400	FEDEX		
FEDEX		David Garcia David Garcia	12-07-2017	
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY		DATE/TIME

12/21/2017

REV.0

CH2MHill Plateau Remediation Company		CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F18-003-005	PAGE 1 OF 1
COLLECTOR Chris Fulton CHPRC		COMPANY CONTACT SUMNER, LC	TELEPHONE NO. 376-3922	PROJECT COORDINATOR SUMNER, LC	REQUIRED TAT 15 Days	
SAMPLING LOCATION REDOX CLEAN PAPER		PROJECT DESIGNATION REDOX Gallery Sampling - Other Solid		SAF NO. F18-003	ORIGINAL	
ICE CHEST NO. GWS-695		FIELD LOGBOOK NO. HNF-N-507-27	ACTUAL SAMPLE DEPTH N/A	PURCHASE ORDER/CHARGE CODE 300250	METHOD OF SHIPMENT FEDERAL EXPRESS	
SHIPPED TO Southwest Research Institute		OFFSITE PROPERTY NO. 8822		BILL OF LADING/AIR BILL NO. 7709 1862 4602		

MATRIX* A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	POSSIBLE SAMPLE HAZARDS/ REMARKS *Contains Radioactive Material at concentrations that are not be regulated for transportation per 49 CFR/IATA Dangerous Goods Regulations but are not releasable per DOE Order 458.1.	PRESERVATION None			
		HOLDING TIME 6 Months			
		TYPE OF CONTAINER P			
		NO. OF CONTAINER(S) 1			
		VOLUME 1L			
	SPECIAL HANDLING AND/OR STORAGE RADIOACTIVE TIE TO: B3FXN3 Jut 11/2017	SAMPLE ANALYSIS SEE ITEM (1) IN SPECIAL INSTRUCTIONS			
SAMPLE NO. B3FXN4	FILTERED N/A	MATRIX* OTHER SOLID	SAMPLE DATE NOV 29 2017	SAMPLE TIME 0925	<input checked="" type="checkbox"/>

CHPRC
SRR # 60847
SDG # 624420

SwRI Prjct # 20859.01.00X
TO: U71207-7

SWRI

CHAIN OF POSSESSION		SIGN/ PRINT NAMES		SPECIAL INSTRUCTIONS
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME	
Chris Fulton CHPRC	NOV 29 2017 1300	SSU-1	NOV 29 2017 1300	TRVL-18-044 ** SWRI GENERIC TESTING BOTTLE - is for EDS-SEM analyses. XRD analyses may be requested if there is sufficient crystalline material present. ** Lab shall perform the SEM analysis then wait for direction from SMR to proceed. (1) Generic Testing {No CAS}; 6010_METALS_ICP: COMMON {Antimony, Arsenic, Barium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Magnesium, Manganese, Nickel, Potassium, Silver, Sodium, Vanadium, Zinc}; 9045_pH (Non-Aqueous): COMMON {pH Measurement}; 9056_ANIONS_IC: COMMON {Chloride, Fluoride, Nitrogen in Nitrate, Nitrogen in Nitrite, Sulfate}; 9056_ANIONS_IC: COMMON (Add-on) {Bromide, Phosphorus in phosphate};
SSU-1	DEC 08 2017 0823	Malcom Chunn CHPRC	DEC 08 2017 0823	
Malcom Chunn CHPRC	DEC 08 2017 1400	FEDEX		
FEDEX		David Cooper David Daniel	12-07-2017 09:00	
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY		DATE/TIME

12/21/2017

REV.0

CH2M Hill Plateau Remediation Company		CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST			F18-003-008	PAGE 1 OF 1
COLLECTOR Kevin Patterson CHPRC		COMPANY CONTACT SUMNER, LC	TELEPHONE NO. 376-3922	PROJECT COORDINATOR SUMNER, LC	REQUIRED TAT 15 Days	
SAMPLING LOCATION REDOX CRYSTALS		PROJECT DESIGNATION REDOX Gallery Sampling - Other Solid		SAF NO. F18-003	010004 ORIGINAL	
ICE CHEST NO. GWS-695		FIELD LOGBOOK NO. HNF-N-587.27	ACTUAL SAMPLE DEPTH N/A	PURCHASE ORDER/CHARGE CODE 300250	METHOD OF SHIPMENT FEDERAL EXPRESS	
SHIPPED TO Southwest Research Institute		OFFSITE PROPERTY NO. 9212617 8822 8822		BILL OF LADING/AIR BILL NO. 7709 1862 4602		
MATRIX* A=Air DL=Drum Liquids DS=Drum Solids L=Liquid O=Oil S=Soil SE=Sediment T=Tissue V=Vegetation W=Water WI=Wipe X=Other	POSSIBLE SAMPLE HAZARDS/ REMARKS *Contains Radioactive Material at concentrations that are not be regulated for transportation per 49 CFR/IATA Dangerous Goods Regulations but are not releasable per DOE Order 458.1.		PRESERVATION None	HOLDING TIME 6 Months		
			TYPE OF CONTAINER P/G	NO. OF CONTAINER(S) 1		
			VOLUME ± 60mL	SPECIAL HANDLING AND/OR STORAGE RADIOACTIVE TIE TO: B3FXN6		
			SAMPLE ANALYSIS SEE ITEM (1) IN SPECIAL INSTRUCTIONS			
SAMPLE NO.	FILTERED	MATRIX*	SAMPLE DATE	SAMPLE TIME		
B3FXN7	N/A	OTHER SOLID	12/05/17	1303	✓	

CHPRC SRR # 60847
SDG # 624420
SwRI Prjct # 20859.01.00X
TO: 171207-7

CHAIN OF POSSESSION		SIGN/ PRINT NAMES		SPECIAL INSTRUCTIONS	
RELINQUISHED BY/REMOVED FROM	DATE/TIME	RECEIVED BY/STORED IN	DATE/TIME	ON THE CRYSTALS THE CRCF BOTTLE WILL GO TO GEL	
Kevin Patterson CHPRC	DEC 05 2017 1435	SSU-1	DEC 05 2017 1435	** SWRI GENERIC TESTING BOTTLE - is for EDS-SEM analyses. XRD analyses may be requested if there is sufficient crystalline material present.	
SSU-1	DEC 08 2017 0823	Malcom Chunn CHPRC	DEC 08 2017 0823	** Lab shall perform the SEM analysis then wait for direction from SMR to proceed.	
Malcom Chunn CHPRC	DEC 08 2017 1400	FEDEX		(1) Generic Testing {No CAS}; 6010_METALS_ICP: COMMON {Antimony, Arsenic, Barium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Magnesium, Manganese, Nickel, Potassium, Silver, Sodium, Vanadium, Zinc}; 9045_pH (Non-Aqueous): COMMON {pH Measurement}; 9056_ANIONS_IC: COMMON {Chloride, Fluoride, Nitrogen in Nitrate, Nitrogen in Nitrite, Sulfate}; 9056_ANIONS_IC: COMMON (Add-on) {Bromide, Phosphorus in phosphate};	
	FED EX	David Garcia	David Garcia	12-07-2017 09:00	
FINAL SAMPLE DISPOSITION	DISPOSAL METHOD	DISPOSED BY	DATE/TIME		

Hammons, Jennifer L

From: Baechler, Michael A
Sent: Wednesday, December 06, 2017 5:55 AM
To: Hammons, Jennifer L; Hinojosa, Pedro; Stiles, Kyle K; Griffith, Joshua M
Cc: Sumner, Laine C; Baechler, Michael A
Subject: Sample Shipping Authorization - REDOX Gallery Sampling - Radscreens B3FXN0 and B2FXN6

All,

The following samples, associated with the subject radscreens, are authorized for transport as non-regulated material:

LOCATION	MATRIX	METHOD	SWRI	GEL	CRCF	COC
REDOX GREEN PAPER	OTHER SOLID	GRAB	B3FXN1	B3FXN2	B3FXN0(RS)	F18-003-001(CRCF) F18-003-002(SWRI) F18-003-003(GEL)
REDOX CRYSTALS	OTHER SOLID	GRAB	B3FXN7	B3FXN8	B3FXN6(RS)	F18-003-007(CRCF) F18-003-008(SWRI) F18-003-009(GEL)

Thanks,

Michael A. Baechler

Scientist, CHPRC, Contractor to the Department of Energy

Soil & Groundwater Remediation Project

Analytical Support

(509) 373-4452 Office

(509) 539-3117 Mobile



Client : CHPRC
 SwRI Project # 20859.01.00X
 VTSR: 12/07/17 09:00
 Battery Check: Y
 Cooler/Container Wipe: <150 cpm
 Total cpm-mR/h (samples): <150 cpm; <0.1 mR/hr
 (see Radioactive Material Receiving Form for more information)

SwRI SRR # 60847
 Case: CHPRC
 Sample(s) Received: Intact
 Background Check: <150 cpm (Lab 103)
 Temp.: 20.3°C (no ice) / SN # 021056
 Wipe Frisk Description: Cooler(s)-2

Southwest Research Institute

Laboratory Task Order

TO #: 171207-7 Revision: 0

Project(s): 20859.01.00X
Manager(s): SPIES, RADONNA
To Client: 12/21/17

SDG: 624420
VTSR: 12/07/17
SAF: F18-003

SRR #'s: 60847
Client(s): CH2M Hill Plateau Remediation Company

Instructions

CH2MHill Plateau Remediation Company. 300250
SAF No. F18-003

SDG 624420 is CLOSED

15-day TAT.
FINAL DATA/HARDCOPY IS DUE TO THE CLIENT ON 12/22/2017.

7 overall samples (7 containers) were received on 12/07/2017.
OUT of the 7 samples, ONLY the 3 SOLID samples are listed here.

Sample Analysis REQUIRED
EDS-SEM

PER COC _ Lab shall perform the SEM analysis then wait for direction to proceed with 6010, pH and 9056 Anions

DATA DELIVERABLE _ Summary (Narrative / Results only)
REQUESTER _ Laine Sumner

ATTACHMENT C - QC Requirements for Chemical and Radiochemical Analysis
Section 7.2.2 Sample Data Packages
Section 7.2.3 Hard Copy Deliverable format
Section 7.2.4 Final Data Package Requirements
Section 8.8 CHPRC Electronic Address

Electronic copies of all sample receipt information, COCs, priority data packages, final data packages, corrected/revised data packages, closure reports, status reports, invoices, etc. shall be sent to: mailto:CPP_Sample_Management@rl.gov

Documents Related to this task order: 233986[COC for SRR 60847], 233987[Paperwork for SRR 60847]

Deliverables --> Hard Copy: no EDD: -YES- PDF: -YES-

Test: SEM.

Holding: 180 days from CED

Section: WETCHEM

Scanning Electron Microscope Photomicroscopy

Cnt: 3

System ID	Type	Cont	Matrix	Customer ID	CED	Method Date
624420		1	Other Solid	B3FXN1	05 Dec 17	03 Jun 18
624421		1	Other Solid	B3FXN4	29 Nov 17	28 May 18
624422		1	Other Solid	B3FXN7	05 Dec 17	03 Jun 18



Sample Receipt

Southwest Research Institute

VTSR: 12/07/17

Time: 09:00:00

Project: 20859.01.00X

Sample Receipt Number: 60847

Manager: SPIES, RADONNA

Case #: CHPRC

Logged in by: DXGARCIA

Client: CH2M Hill Plateau Remediation Company

Creation Date: 12/07/17

Notes

Samples were received intact.

Fed Ex tracking #:

7709 2324 5182 _ 20.3°C (no ice)

7709 1862 4602 _ 1.8°C (wet ice)

Ice Chest No:

GWS-695

GWS-703

pH Test Paper 0.0 to 13.0

Lot - 230016

Exp: 10/30/2019

See chain-of-custody as part of the SRR system for more information.

Test requirements located on Task Order.

Background CPM: <150cpm Container Wide CPM: <150cpm Total CPM: <150

System ID	Customer ID	CED	Matrix	Containers	Special Reqs.
624416	B3FK91	12/06/17	Water	1	
624417	B3FM45	12/06/17	Water	1	
624418	B3FM46	12/06/17	Water	1	
624419	B3FM47	12/06/17	Water	1	
624420	B3FXN1	12/05/17	Other Solid	1	
624421	B3FXN4	11/29/17	Other Solid	1	
624422	B3FXN7	12/05/17	Other Solid	1	

Containers: 7

Samples: 7

These documents are associated with this receipt: 233986[COC for SRR 60847], 233987[Paperwork for SRR 60847]

Thermometer: 021056

Temperature: NOTE

60847 CH2M Hill Plateau Remediation

Southwest Research Institute

010008

Traffic Report

Sample Custodian Signature: David Harris



- 1. Custody Seal Present
- 2. Chain of Custody Present
- 3. Sample Tags Not Present *N/A*
Sample Tag Numbers Not on COC
- 4. SMO Forms Present

Client: CH2M Hill Plateau Remediation Company
 Project: 20859.01.00X
 Case: CHPRC / SDG: See T.O.
 Sample Receipt: 60847
 Airbill: 770918624602,770923245182

Custody Seal #(s): N/A

Date Received	Time Received	COC Record	SMO Sample #	Corresponding		Traffic Rpt, Tags, COC Agree	Sample Condition
				Sample Tag #	SwRI #		
12/07/17	09:00:00	W18-012-193	B3FK91	N/A	624416	YES	Intact
12/07/17	09:00:00	W18-012-193	B3FM45	N/A	624417	YES	Intact
12/07/17	09:00:00	W18-012-194	B3FM46	N/A	624418	YES	Intact
12/07/17	09:00:00	W18-012-194	B3FM47	N/A	624419	YES	Intact
12/07/17	09:00:00	F18-003-002	B3FXN1	N/A	624420	YES	Intact
12/07/17	09:00:00	F18-003-005	B3FXN4	N/A	624421	YES	Intact
12/07/17	09:00:00	F18-003-008	B3FXN7	N/A	624422	YES	Intact

Lab Name Southwest Research Institute			Page 1 of 1	
Received By (Print Name) DAVID GARCIA			Log-in Date 12/07/2017	
Received By (Signature) <i>David Garcia</i>				
Case Number CHPRC		Sample Delivery Group No. N/A		SAS Number N/A
Remarks: 20859.01.00X		Corresponding		
		EPA Sample #	Sample Tag #	Assigned Lab #
1. Custody Seal(s)	<input checked="" type="radio"/> Present / Absent* <input checked="" type="radio"/> Intact / Broken	B3FK91	N/A	624416
2. Custody Seal Nos.	N/A	B3FM45	N/A	624417
		B3FM46	N/A	624418
3. Chain-of Custody Records	<input checked="" type="radio"/> Present / Absent*	B3FM47	N/A	624419
4. Traffic Reports or Packing Lists	<input checked="" type="radio"/> Present / Absent*	B3FXN1	N/A	624420
5. Airbill	Airbill / Sticker <input checked="" type="radio"/> Present / Absent*	B3FXN4	N/A	624421
6. Airbill No.	770918624602, 770923245182	B3FXN7	N/A	624422
7. Sample Tags	Present / Absent* N/A			
Sample Tag Numbers	Listed / Not listed on Chain of Custody N/A			
8. Sample Condition	<input checked="" type="radio"/> Intact / Broken* / Leaking			
9. Cooler Temperature	NOTEC			
10. Does Information on custody records, traffic reports, and sample tags agree?	<input checked="" type="radio"/> Yes / No*			
11. Date Received at Lab	12/07/2017			
12. Time Received	09:00:00			
Sample Transfer				
Fraction	InORG	Fraction		
Area #	12.13	Area #		
By	DAVID GARCIA	By		
On	12/07/2017	On		

* Contact SMO and attach record of resolution

Reviewed By <i>David Garcia</i>	Logbook No. Sample Receipt (60847)
Date 12.7.17	Logbook Page No. 10027 Sec 2 of 4

SOUTHWEST RESEARCH INSTITUTE
CLIENT: CH2M Hill Plateau Remediation Company
SwRI PROJECT#: 20859.01.00X
SwRI TASK ORDER: 171207-7
SwRI SRR: 60847
SDG: 624420
CASE: F18-003
VTSR: 12-07-2017

EDS-SEM and XRD

Results

CLIENT: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Sample Receipt Number: 60847

Page#: 1

SwRI CASE NARRATIVE

1. Three (03) samples were received for EDS-SEM and XRD Analyses:

SwRI ID	Customer ID	Matrix
624420	B3FXN1	Other Solid
624421	B3FXN4	Other Solid
624422	B3FXN7	Other Solid

Client: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Task Order Number(s): 171207-7

Unknown Material Analysis

The crystalline material found on the Redox Green Paper (B3FXN1) and within the Redox Crystals (B3FXN7) were to analyzed using EDS-SEM and XRD.

SwRI System ID	Sample ID	Sample Description
624420	B3FXN1	Redox Green Paper
624421	B3FXN4	Paper (for background)
624422	B3FXN7	Redox Crystals

EDS-SEM

Energy dispersive spectrometry x-ray fluorescence by scanning electron microscope (EDS/SEM) identifies elemental composition at a 10 to 100 micron depth. The EDS spectrograms and quantitation reports are presented in Figures 1-5. Please note that the quantitation only includes elements of atomic numbers greater than 11 (sodium and higher) and is normalized to 100%. Although the spectrograms may contain peaks for carbon, nitrogen and oxygen, their atomic numbers are less than 11, and therefore not quantified. Optical and SEM photomicrographs inlays are also presented in the EDS report to identify where measurements were taken. The larger photomicrographs are presented in Images 1-6 for reference. The backscatter SEM photomicrographs were obtained for the residue located on the Redox Green Paper and are shown in Images 5 and 6. The backscattered electrons are those 'reflected' from the surface atoms, and the intensities of the image proportional to atomic number of the elements in the sample. Thus, 'brighter' areas indicate a higher element with higher atomic numbers.

Figure 1. Silver side of the background paper (B3FXN4): primarily aluminum.

Figure 2. Green material on Redox Green Paper (B3FXN1): magnesium, sulfur, chloride, sodium, potassium and calcium

Figure 3. White material on Redox Green Paper (B3FXN): primarily sodium and chloride.

Figure 4. Bright spheres identified by backscatter SEM on Redox Green Paper (B3FXN): primarily antimony.

Figure 5. Crystalline material located in Redox Crystals (B3FXN7): Primarily calcium, sulfur, sodium and magnesium.

Client: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Task Order Number(s): 171207-7

XRD

The solid residue removed from the Redox Green Paper and the crystalline material in the Redox Crystals sample were also analyzed by X-ray Diffraction (XRD) to determine the chemical form of the major species in the sample using a random orientated mount. Each crystalline component phase in an unknown specimen produces its own powder diffraction pattern. By comparing the diffraction peak positions and intensities of the unknown material against a library of known crystalline materials, it is possible to identify the crystalline components in the unknown. The XRD diffratograms are presented in Figure 7 and 8.

Figure 7. Solid material removed from the Redox Green Paper (B3FXN1): Primarily magnesium sulfate hydrate, sodium sulfate and sodium chloride

Figure 8. Redox Crystals (B3FXN7): Primarily calcium carbonate (Calcite) with moderate amount of sodium sulfate and sodium chloride.



Image 1. Optical photomicrograph of residue on Redox Green Paper (B3FXN1)

Client: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Task Order Number(s): 171207-7



Image 2. Optical photomicrograph of residue on Redox Green Paper (B3FXN1 – higher magnification)

Client: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Task Order Number(s): 171207-7



Image 3. Optical photomicrograph of Redox Crystal sample (B3FXN7)

Client: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Task Order Number(s): 171207-7

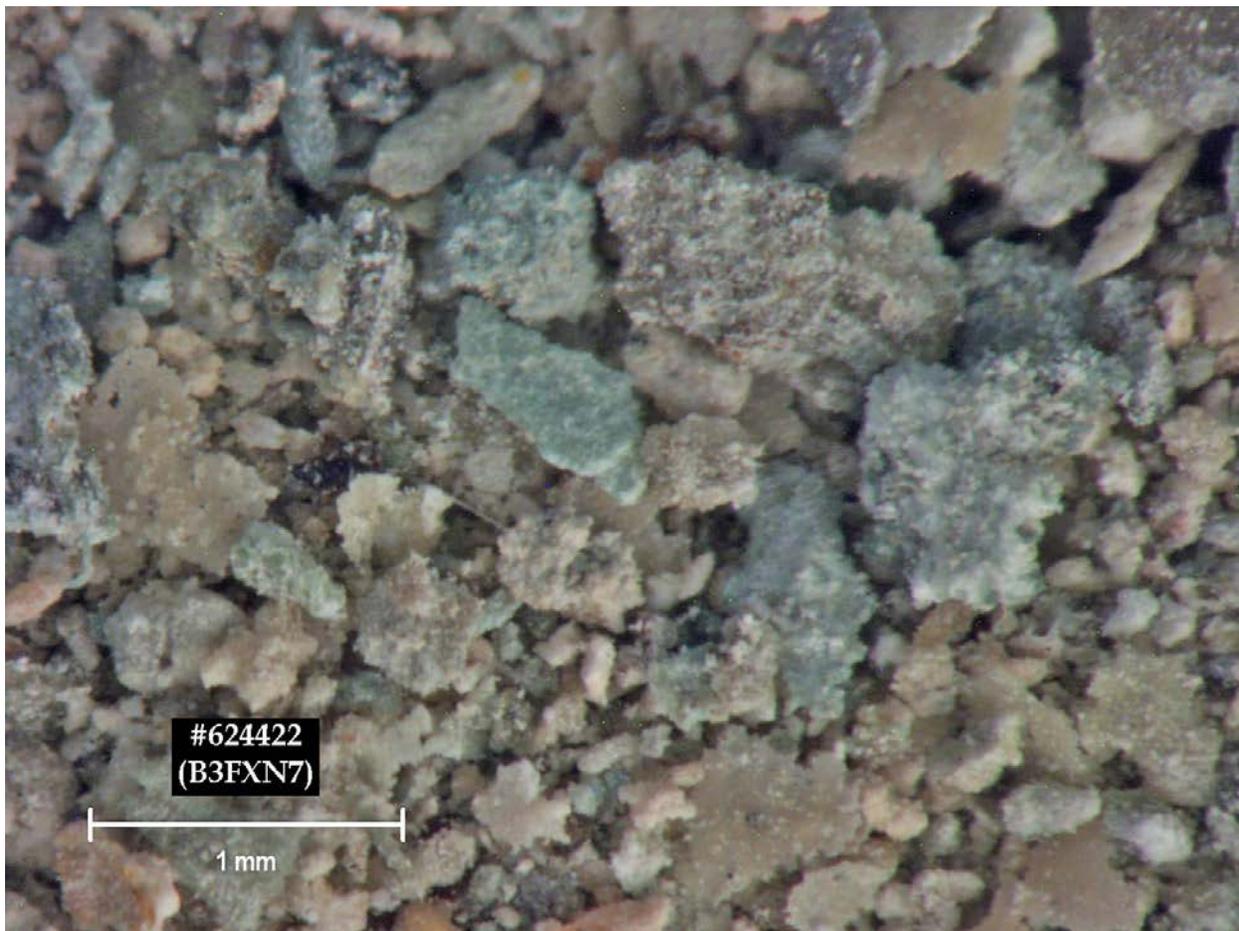


Image 4. Optical photomicrograph of Redox Crystal sample (B3FXN7) – higher magnification

Client: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Task Order Number(s): 171207-7

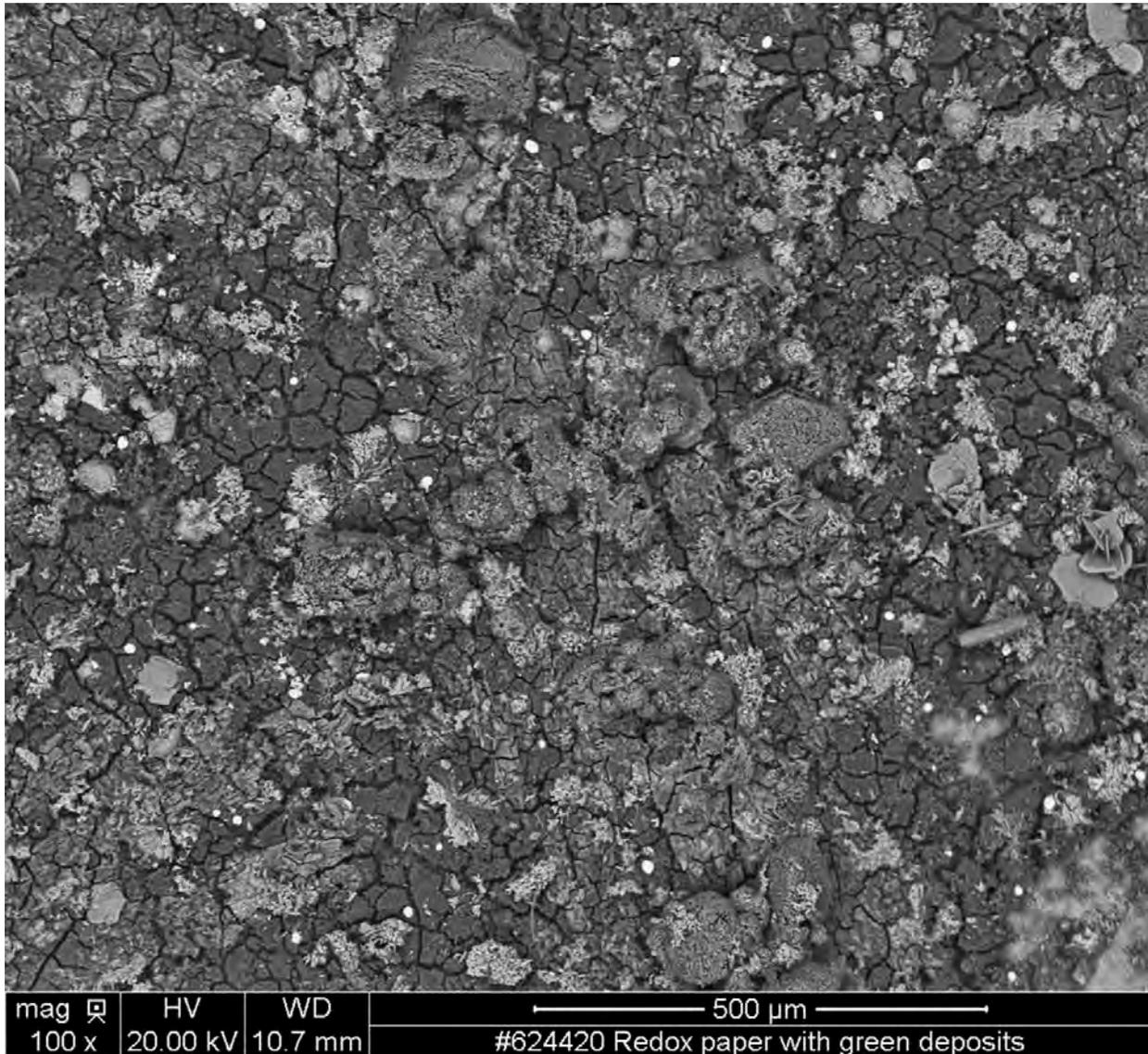


Image 5. Backscatter SEM photomicrograph of residue on Redox Green Paper (B3FXN1)

Client: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Task Order Number(s): 171207-7

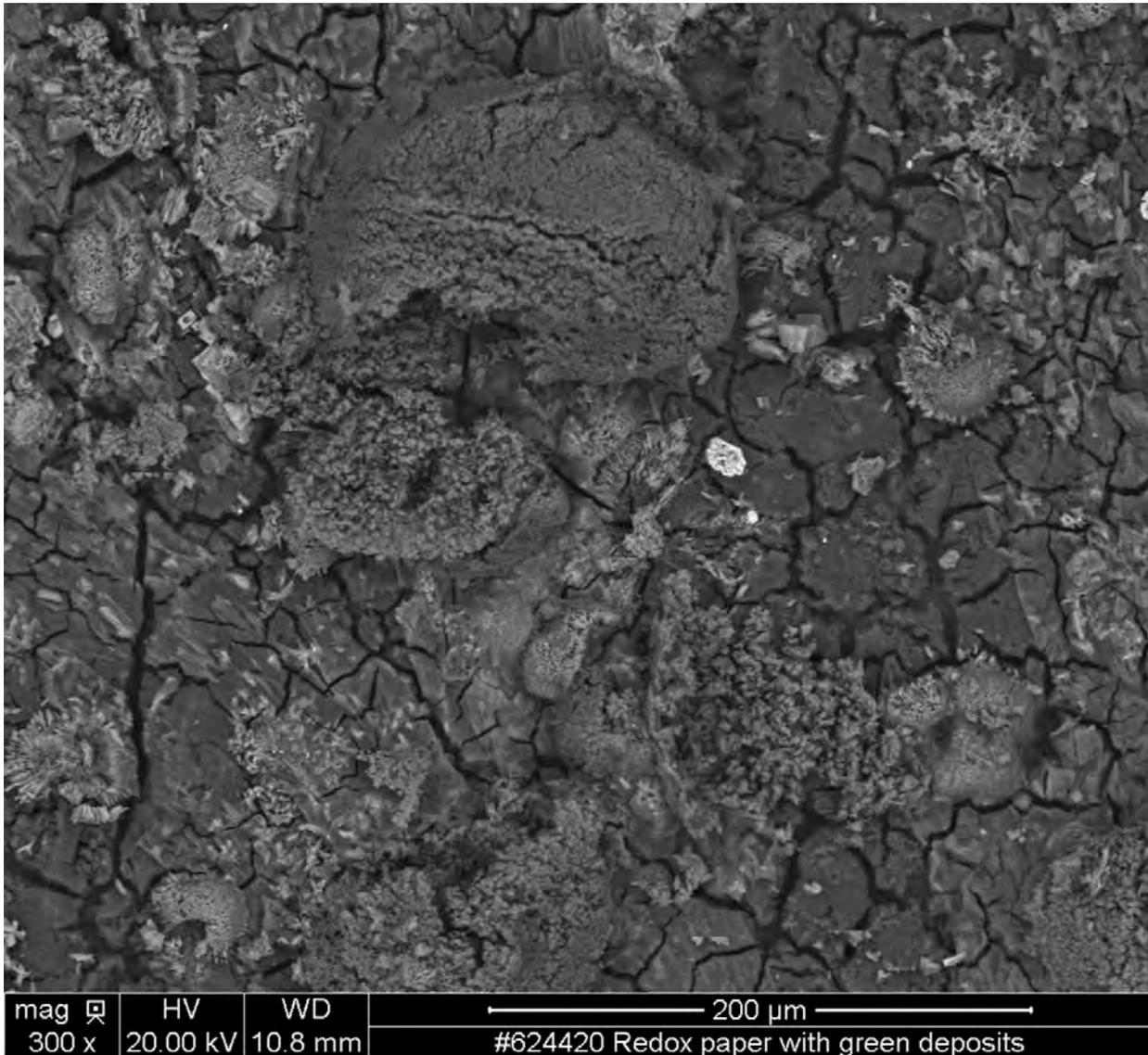


Image 6. Backscatter SEM photomicrograph of residue on Redox Green Paper (B3FXN1) – higher magnification

Client: CH2M Hill Plateau Remediation Company

SDG: 624420

SwRI Project Number: 20859.01.00X

SwRI Task Order Number(s): 171207-7

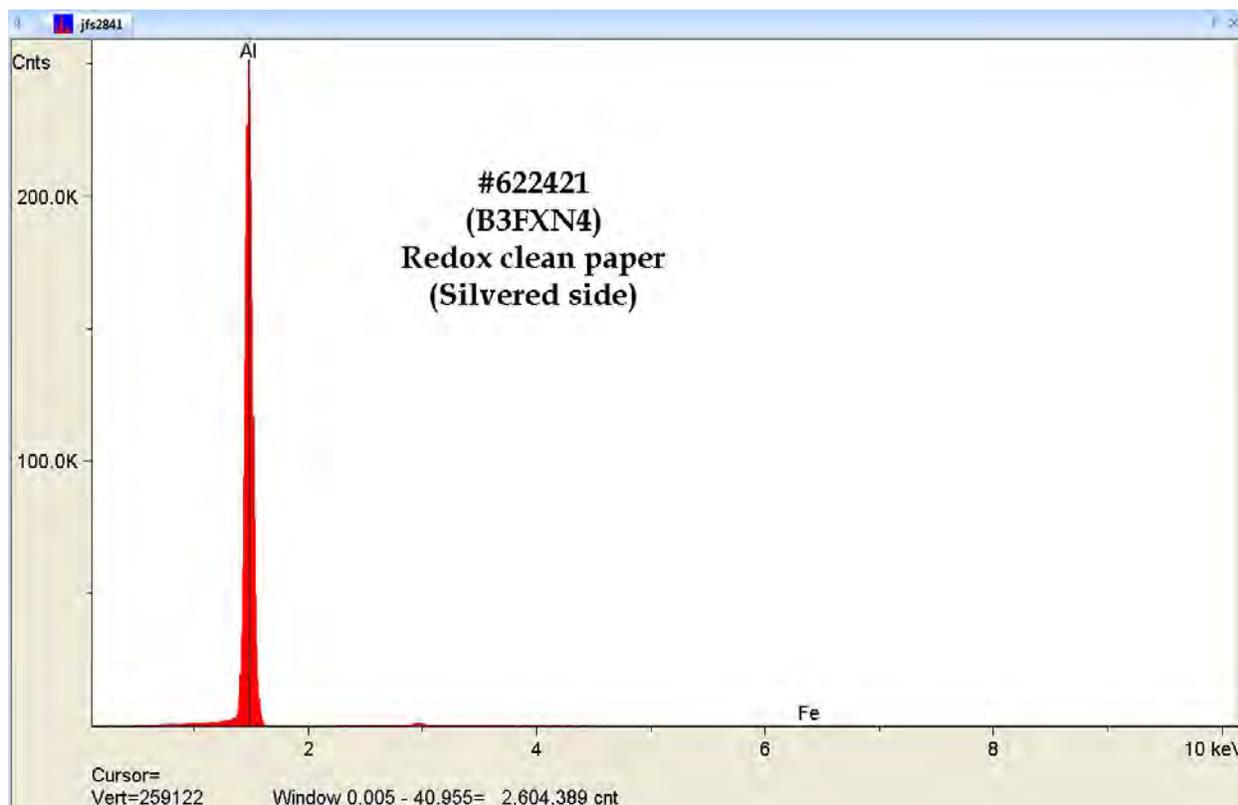
"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his/her designee, as verified by the following signature. This report shall not be reproduced except in full without the written approval of SwRI."



Principal Scientist

12/21/17

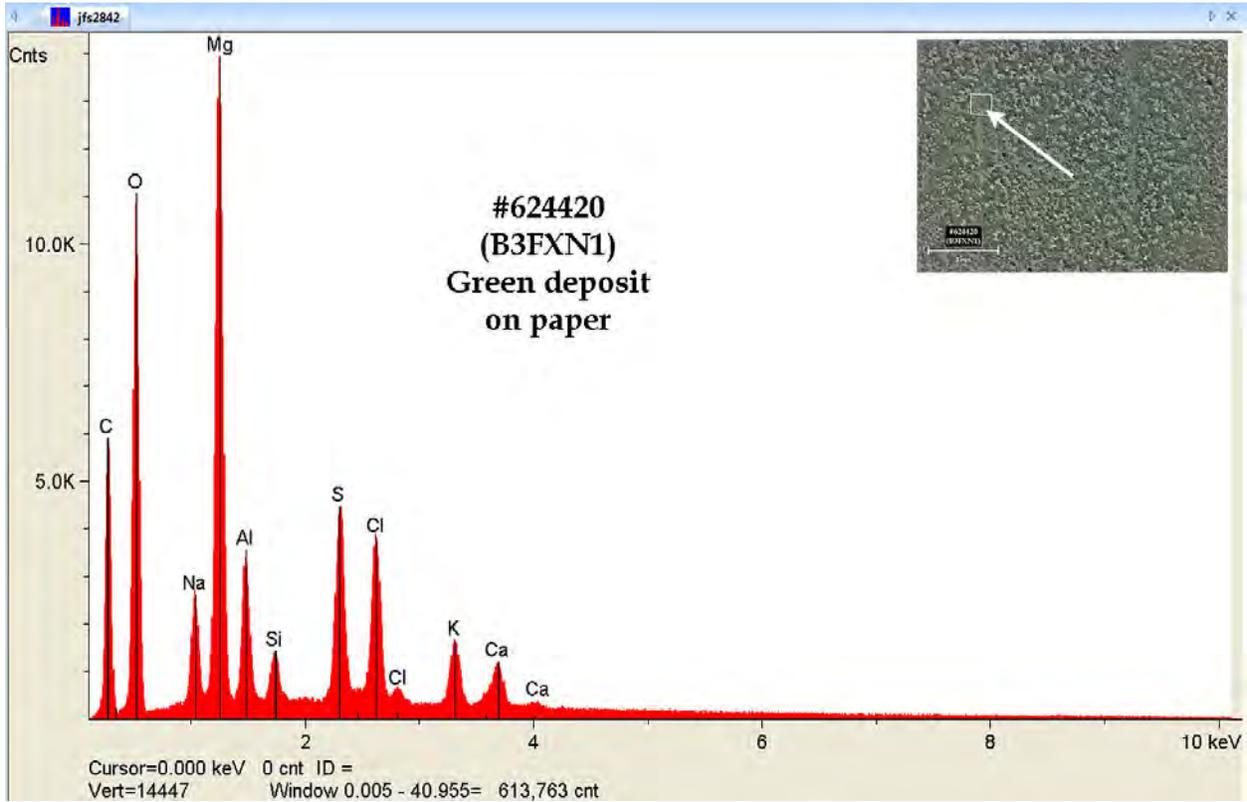
Date



Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	
Al	Ka	7,167.45	99.83	99.64	wt.%	
Fe	Ka	7.86	0.17	0.36	wt.%	
			100.00	100.00	wt.%	Total

kV 20.0
 Takeoff Angle 23.0°
 Elapsed Livetime 300.0

Figure 1. EDS results for B3FXN4 (paper background - silver side)

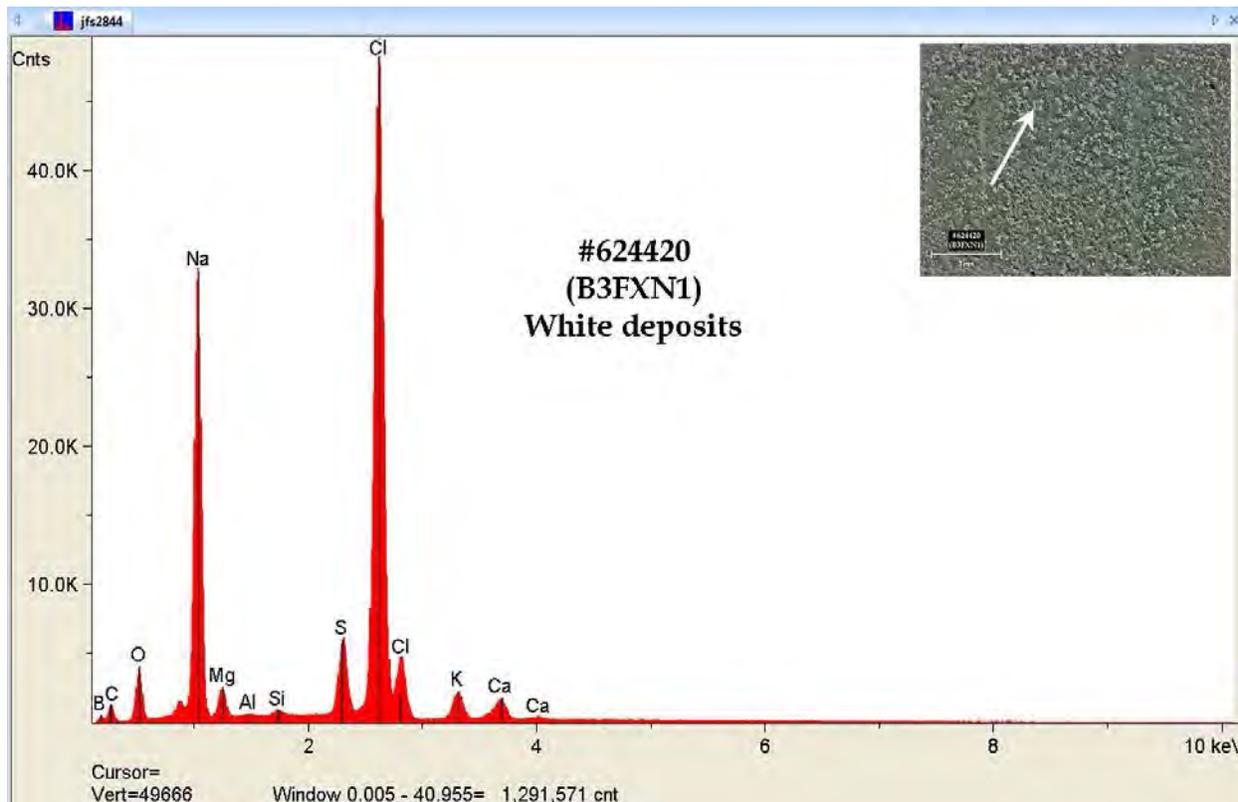


Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	
Na	Ka	61.18	8.91	7.30	wt.%	
Mg	Ka	363.88	41.73	36.14	wt.%	
Al	Ka	84.46	13.94	13.40	wt.%	
Si	Ka	29.46	4.29	4.30	wt.%	
S	Ka	135.71	12.66	14.47	wt.%	
Cl	Ka	119.14	11.18	14.12	wt.%	
K	Ka	50.92	4.35	6.06	wt.%	
Ca	Ka	34.82	2.95	4.22	wt.%	
			100.00	100.00	wt.%	Total

kV 20.0
Takeoff Angle 23.0°
Elapsed Livetime 300.0

Note: Quantified results do not include elements with Z<11 (Na).

Figure 2. EDS results for green deposits on B3FXN1

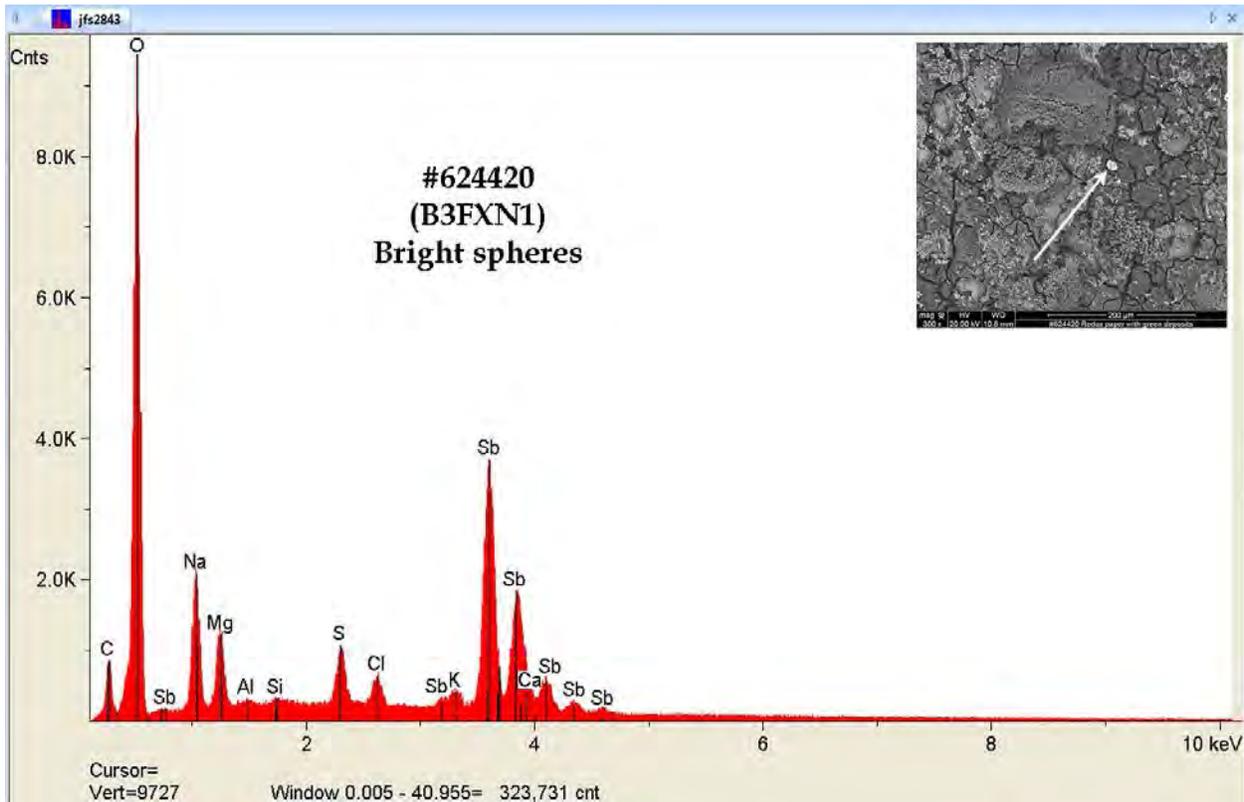


Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	
Na	Ka	802.84	44.48	34.69	wt.%	
Mg	Ka	52.22	3.65	3.01	wt.%	
Al	Ka	1.79	0.09	0.08	wt.%	
Si	Ka	12.58	0.46	0.44	wt.%	
S	Ka	182.74	4.50	4.90	wt.%	
Cl	Ka	1,717.59	42.70	51.36	wt.%	
K	Ka	75.14	2.44	3.24	wt.%	
Ca	Ka	54.45	1.68	2.29	wt.%	
			100.00	100.00	wt.%	Total

kV 20.0
 Takeoff Angle 23.0°
 Elapsed Livetime 300.0

Note: Quantified results do not include elements with Z<11 (Na).

Figure 3. EDS results for white deposits on B3FXN1



Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	
Na	Ka	47.69	43.33	22.07	wt.%	
Mg	Ka	28.56	21.05	11.34	wt.%	
Al	Ka	2.01	1.15	0.69	wt.%	
Si	Ka	2.51	1.11	0.69	wt.%	
S	Ka	26.08	7.14	5.07	wt.%	
Cl	Ka	13.85	3.43	2.69	wt.%	
K	Ka	7.16	1.53	1.33	wt.%	
Ca	Ka	3.35	0.70	0.62	wt.%	
Sb	La	117.61	20.57	55.50	wt.%	
			100.00	100.00	wt.%	Total

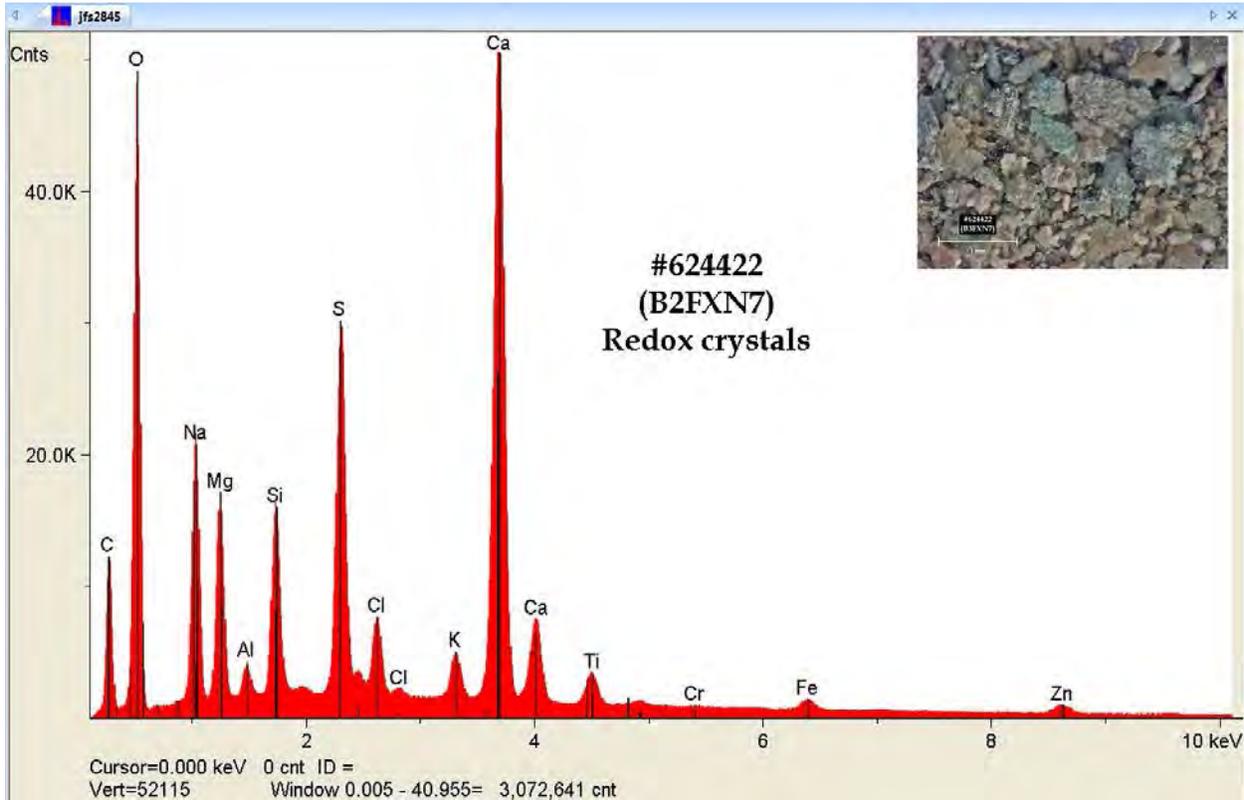
kV 20.0

Takeoff Angle 23.0°

Elapsed Livetime 300.0

Note: Quantified results do not include elements with Z<11 (Na).

Figure 4. EDS results for bright spheres (as observed by backscatter SEM) on B3FXN1



Elt.	Line	Intensity (c/s)	Atomic %	Conc	Units	
Na	Ka	225.51	17.72	12.47	wt.%	
Mg	Ka	243.66	14.80	11.01	wt.%	
Al	Ka	37.36	1.86	1.54	wt.%	
Si	Ka	253.10	9.67	8.32	wt.%	
S	Ka	566.19	15.87	15.58	wt.%	
Cl	Ka	121.80	3.52	3.82	wt.%	
K	Ka	78.84	1.93	2.31	wt.%	
Ca	Ka	1,199.40	30.41	37.30	wt.%	
Ti	Ka	56.12	1.73	2.53	wt.%	
Cr	Ka	1.95	0.06	0.10	wt.%	
Fe	Ka	23.08	0.86	1.47	wt.%	
Zn	Ka	21.10	1.34	2.68	wt.%	
Ba	La	7.67	0.21	0.88	wt.%	
			100.00	100.00	wt.%	Total

kV 20.0
 Takeoff Angle 23.0°
 Elapsed Livetime 500.0

Note: Quantified results do not include elements with Z<11 (Na).

Figure 5. EDS results for "bulk" Redox Crystals (B2FXN7)

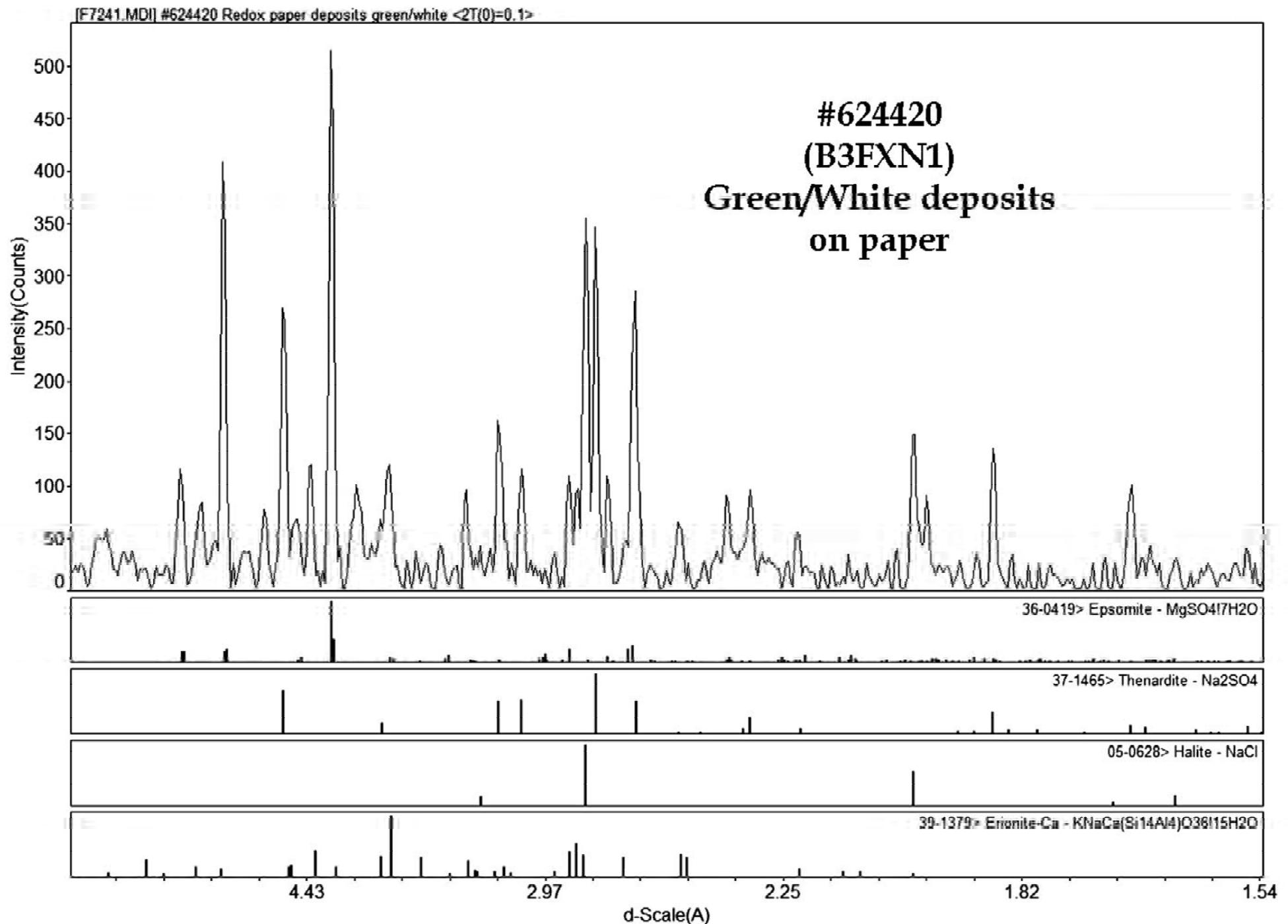


Figure 6. XRD results for "bulk" solid material removed from B3FXN1

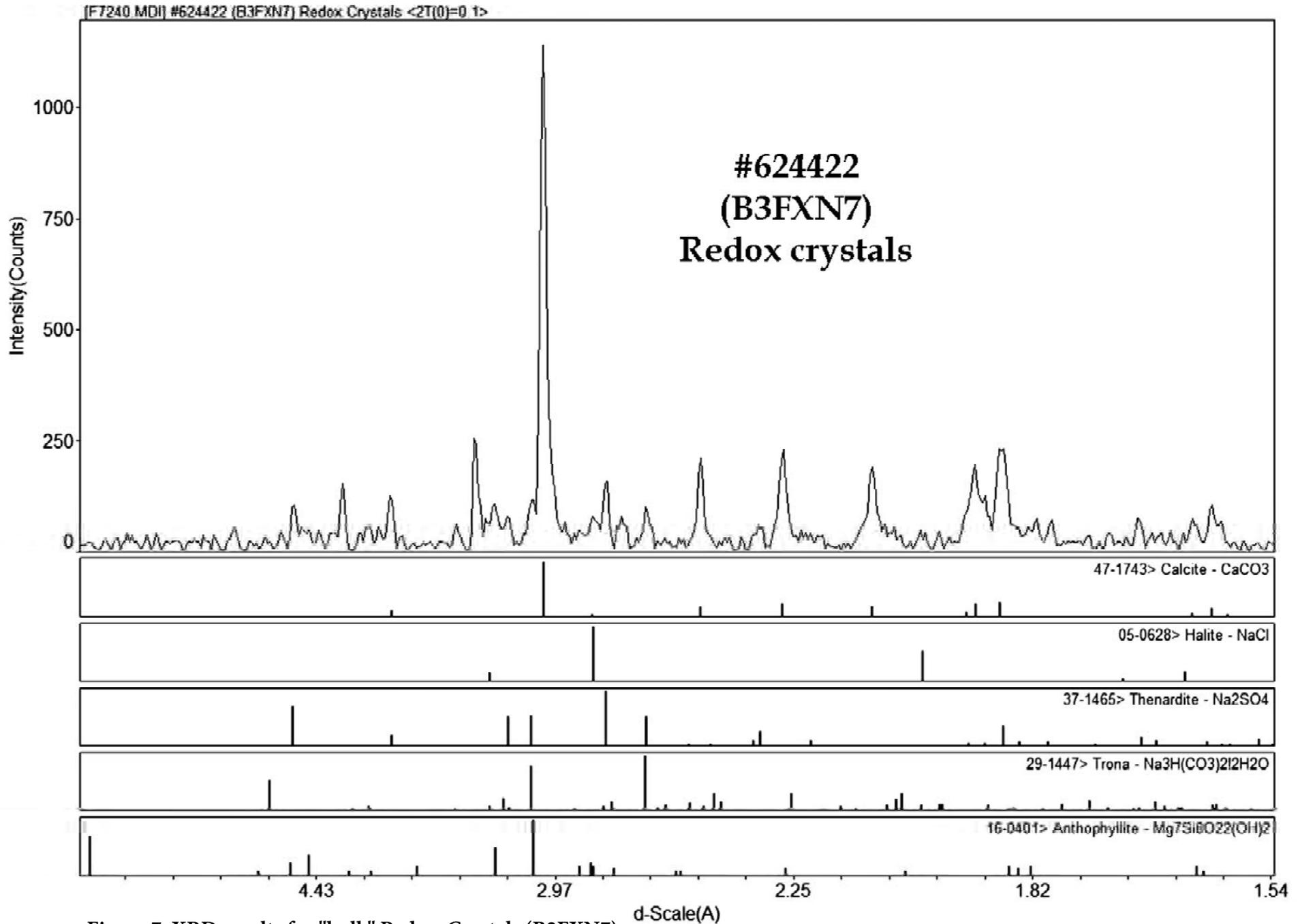


Figure 7. XRD results for "bulk" Redox Crystals (B2FXN7)