Appendix F

UQMP Laboratory Reports

Appendix F UQMP Laboratory Reports

UQMP
UQ Materials Performance
Materials and metallurgical consulting, testing and research

Phone +61 7 3365 6123
Fax +61 7 3365 6124
Email enquiries@uqmp.com
Web www.uqmp.com

Frank White Bldg, Cooper Rd, The University of Queensland
St Lucia Qld 4072 Australia

UQMP is a registered business of UniQuest Pty Ltd (ACN 010 529 898)

LABORATORY TEST REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C01680.12

Prepared for: Hayley Worthington, ALS Environmental

Prepared By: Fiona Jones

Date: 23rd December 2014
Reissue: 26th July 215

Sample Description:		**Dust Gauge Sample #**	**Date Exposed**	**Date Collected**	**UQMP #**
	1	Carrington Dust Gauge	17/10/14	14/11/14	UQMP # 13079
	2	Tighes Hill Petri Dish	14/11/14	15/11/14	UQMP # 13080

Method Ref: Internal UQMP methods.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

One sample was supplied as washings from a dust fallout gauge deposit whilst the other was a loose deposit in a petri dish. The dust fallout gauge deposit was filtered onto a membrane filter and the loose deposit was mounted directly onto conductive carbon tape. Both samples were examined by stereomicroscopy to check for particle distribution and general appearance and then analysed by Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM/EDS). There is insufficient deposit for both samples to analyse further by X-Ray Diffraction.

2. RESULTS

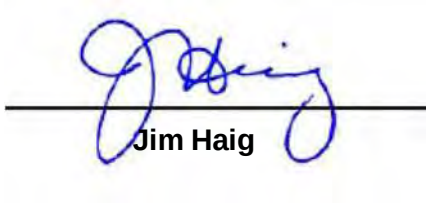
A table of results is attached. Appendix A Section 3 attached presents the table of results of the combined microscopy observations. Section 3.2 contains the particle identity legend.

Appendix B Section 4 presents the colour picture micrographs of the Stereo microscopy images.

Appendix C Section 5 displays the Illustrative SEM photomicrographs and spectra taken of the overall areas of the Insoluble matter.

Appendix D Section 6 attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of Applied Materials Characterisation and Performance



Jim Haig

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

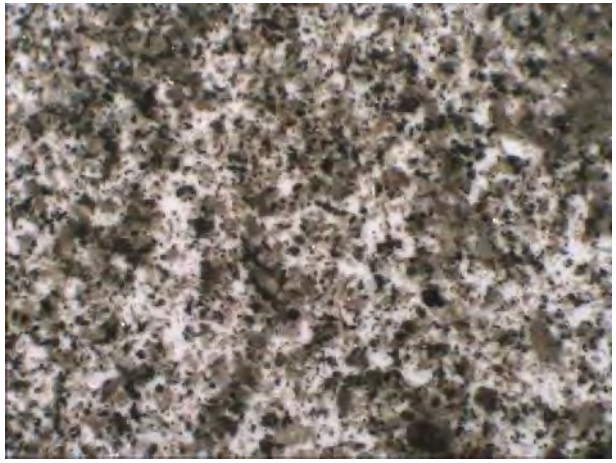
PARTICLE IDENTITY		PERCENTAGE (Projected area basis)	
	SAMPLE #	UQMP # 13079	UQMP # 13080
	SAMPLE ID	*Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14)*	*Tighes Hill Petri Dish (Exposed: 14/11/14, Collected: 15/11/14)*
	PARTICLE TYPE		
BLACK	COAL	10	5
	SOOT	5	tr
	BLACK RUBBER DUST	5	tr
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**75**	**90**
	MINERAL DUST (type = Fly Ash)		
	MINERAL DUST (type = Cement Dust)		
	MINERAL DUST (type =glassy)		
	GLASS FRAGMENTS		
	COPPER SLUDGE		
	P/S SLIME & FUNGI	tr	
	INSECT DEBRIS	tr	tr
	PLANT DEBRIS (General)	5	5
	PLANT DEBRIS (type = plant char)		
	PLANT DEBRIS (type =)		
GENERAL ORGANIC TYPES	WOOD DUST		
	FIBRES (type = Miscellaneous)		
	STARCH		
	PAINT		tr
	PLASTIC FRAGMENTS		
	RED RUBBER DUST		
COMMENTS			

3.2 PARTICLE IDENTITY LEGEND

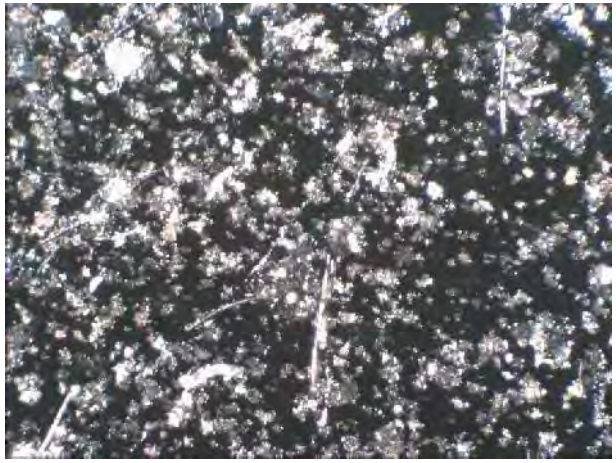
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

4. APPENDIX B

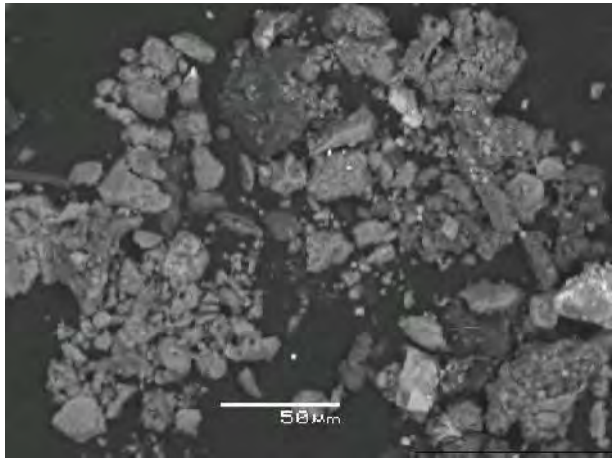
4.1 TABLE OF STEREOMICROSCOPY PICTURE MICROGRAPHS



StMPM1. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. The majority of the sample was observed as mineral dust.

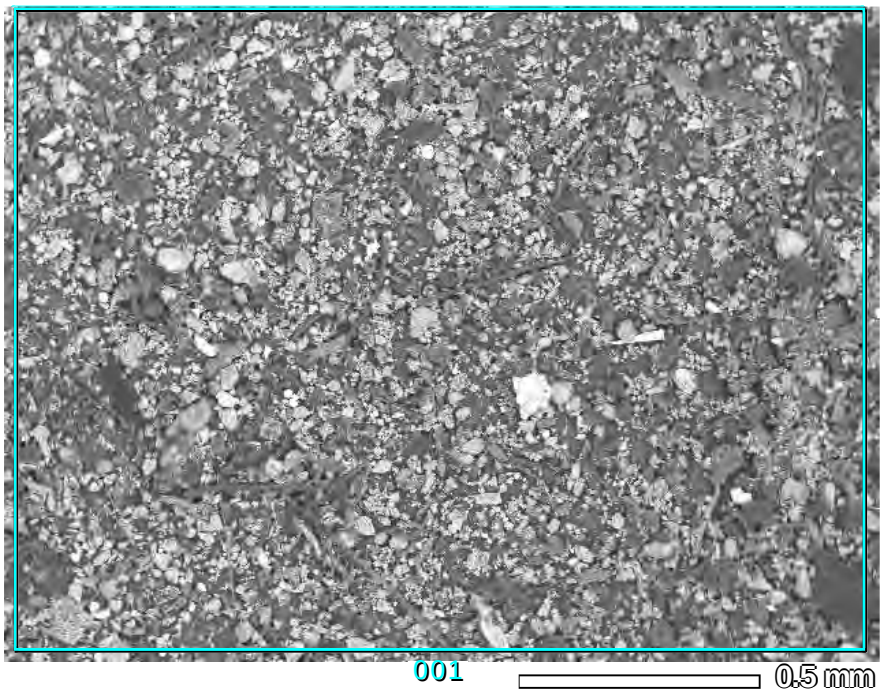


StMPM2. Tighes Hill Petri Dish (Exposed: 14/11/14, Collected: 15/11/14), UQMP # 13080. An image of the deposit mounted on conductive carbon tape. The black area scattered throughout the image is the exposed carbon tape.

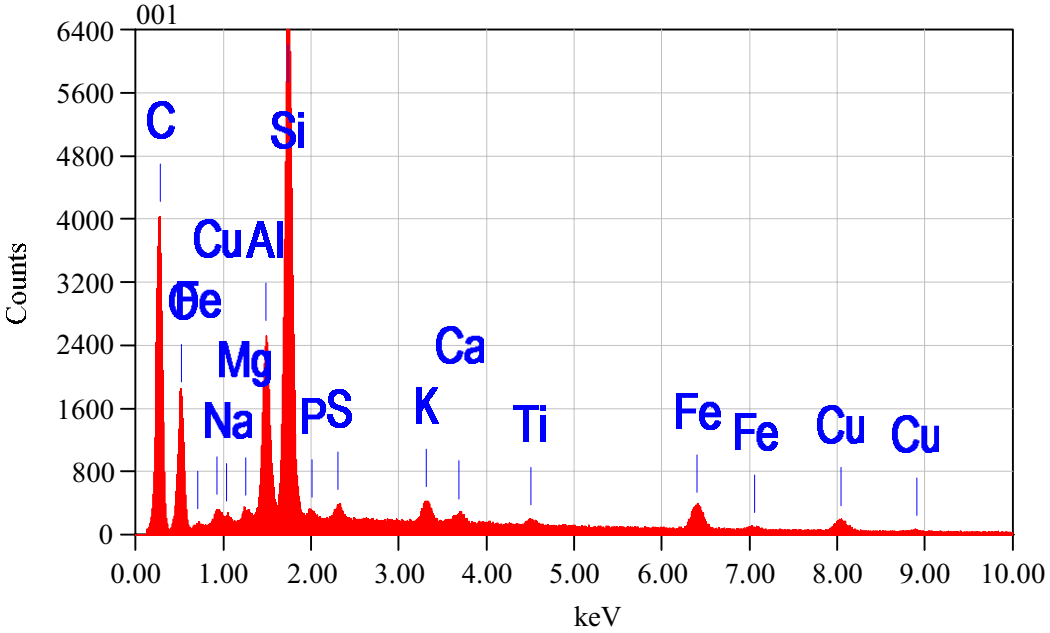


StMPM3. Tighes Hill Petri Dish (Exposed: 14/11/14, Collected: 15/11/14) UQMP # 13080. An SEM/BSE image at 500 times.

5. APPENDIX C
5.1 SEM/BSE IMAGE AND SEM/EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

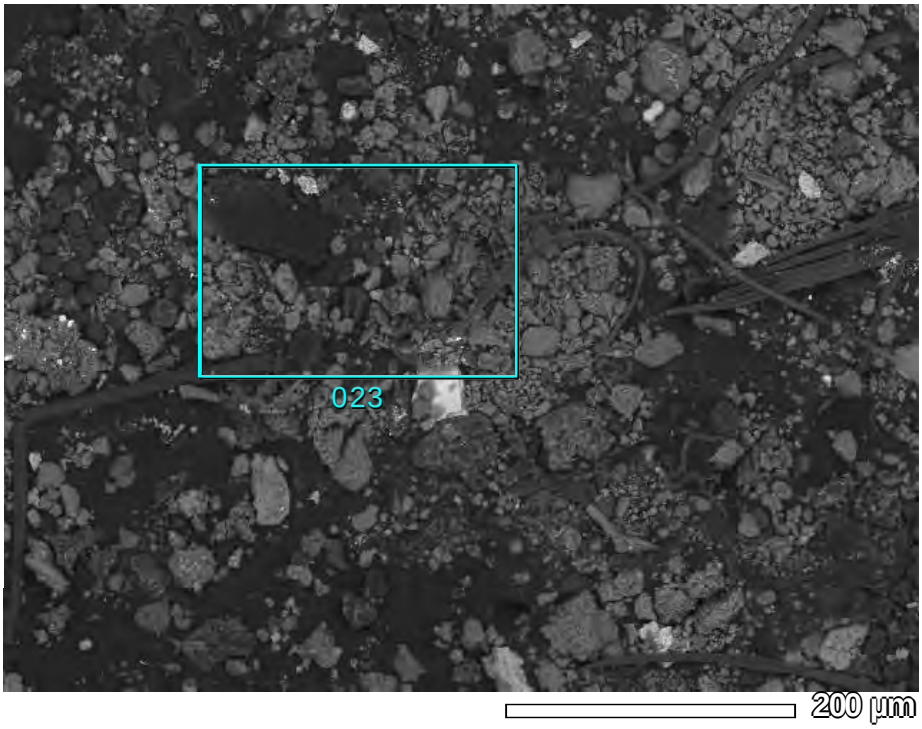


PM1. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

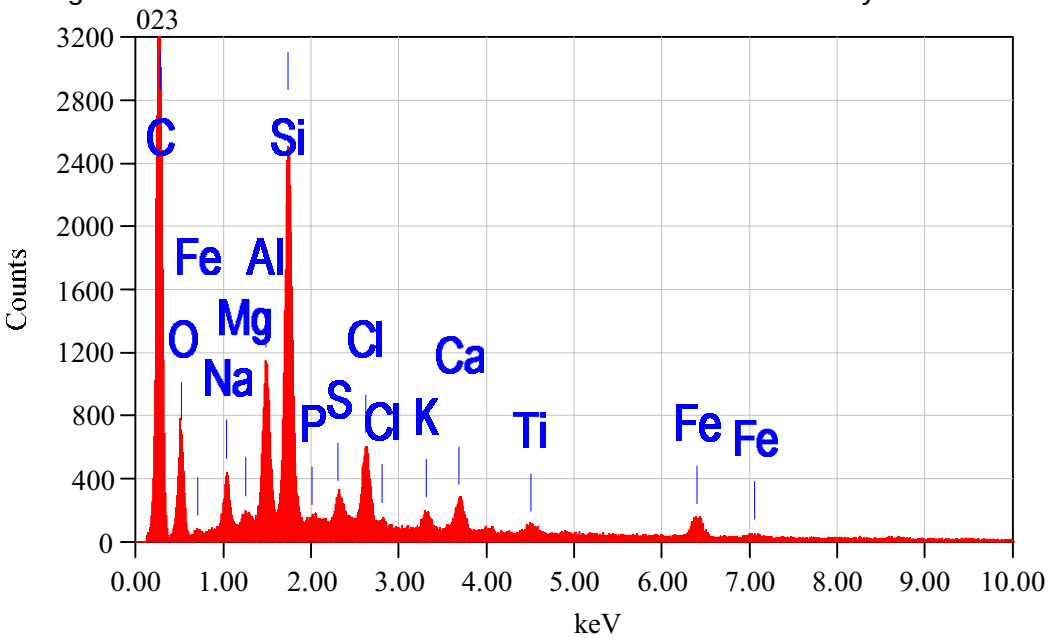


EDS1. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. The SEM/EDS spectrum of the overall area is rich in carbon, silicon, aluminium the balance of the elements are considered trace. The SEM/EDS spectrum is consistent with the microscopy observations of a deposit consisting mostly of mineral dust with a minor organic component comprised of coal, soot, rubber dust, plant debris and insect debris. The trace amounts of copper, sulfur and phosphate can be attributed to the copper sludge.

5.2 SEM/BSE IMAGE AND SEM/EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT



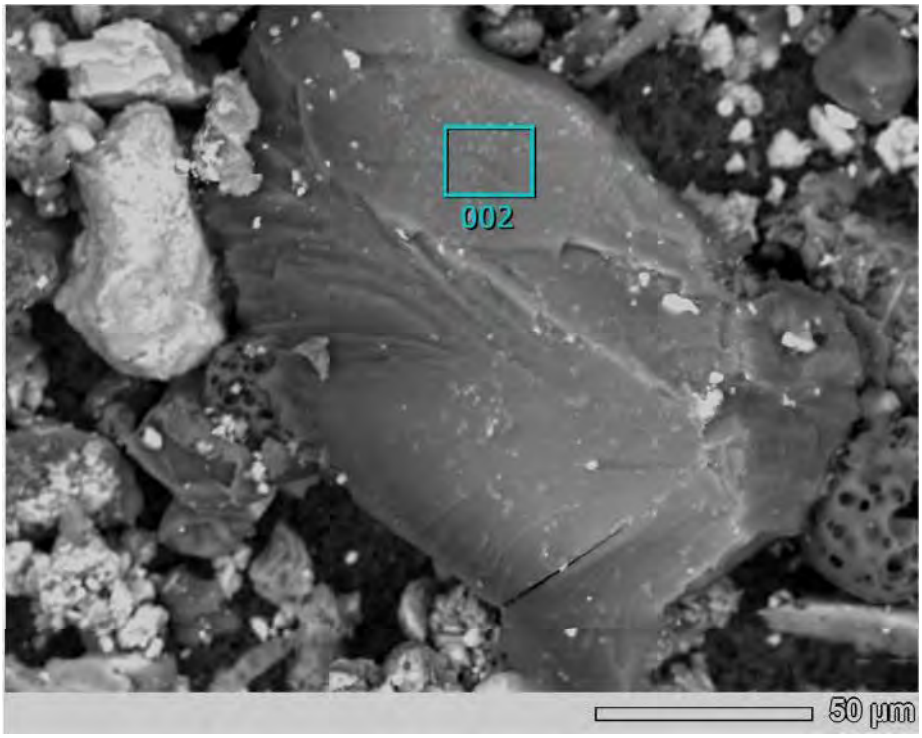
PM2. Tighes Hill Petri Dish (Exposed: 14/11/14, Collected: 15/11/14), UQMP # 13080. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



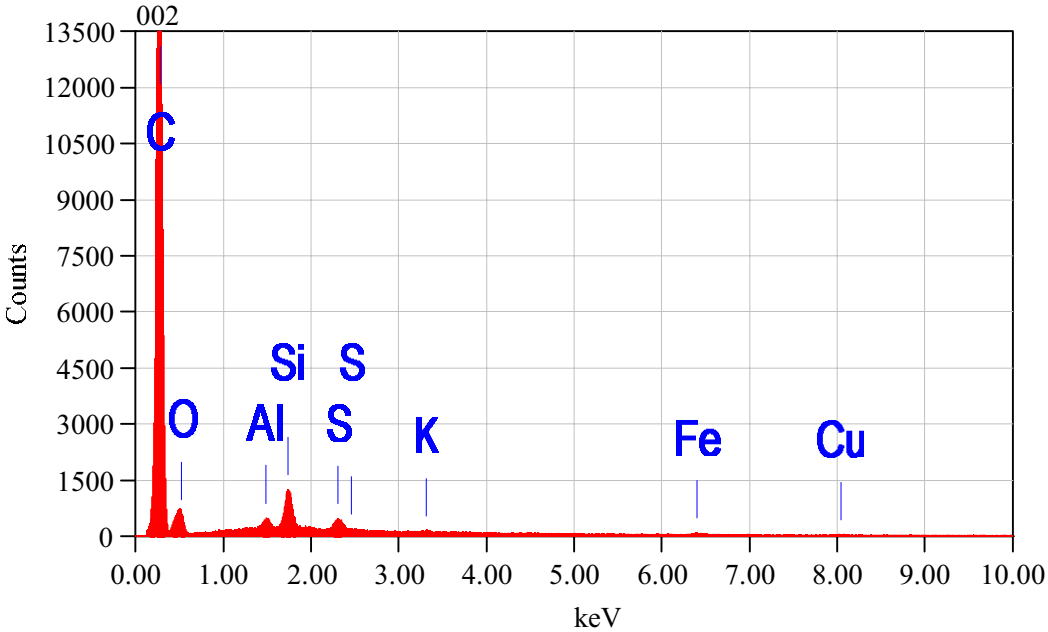
EDS2. Tighes Hill Petri Dish (Exposed: 14/11/14, Collected: 15/11/14), UQMP # 13080. The SEM/EDS spectrum of the area selected is rich in carbon, aluminium and silicon with minor amounts of sodium and chloride, the balance of the elements are trace level. The majority of the deposit was found to contain mineral dust note the elevated aluminium and silicon peaks with the carbon of the deposit allocated to plant debris, coal and traces of soot, rubber dust and insect debris.

6. APPENDIX D SEM/BSE IMAGES AND SEM/EDS SPECTRA OF TYPICAL PARTICULATES COMMON TO THE DEPOSIT

6.1 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A COAL PARTICLE

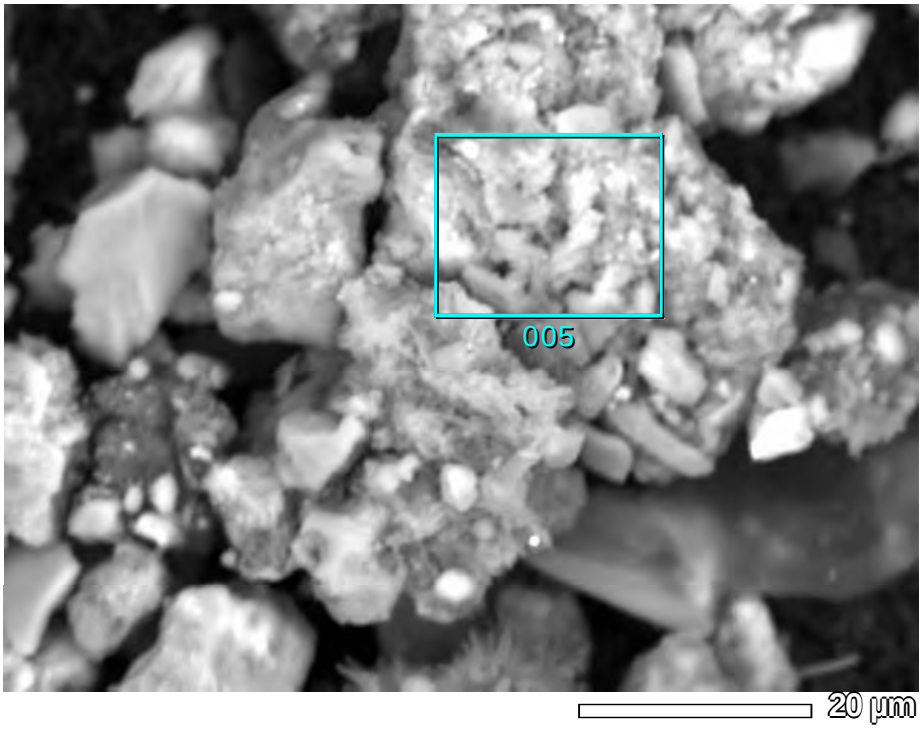


PM1. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. An SEM/BSE image of a particulate annotated with 002 is selected for SEM/EDS analysis.

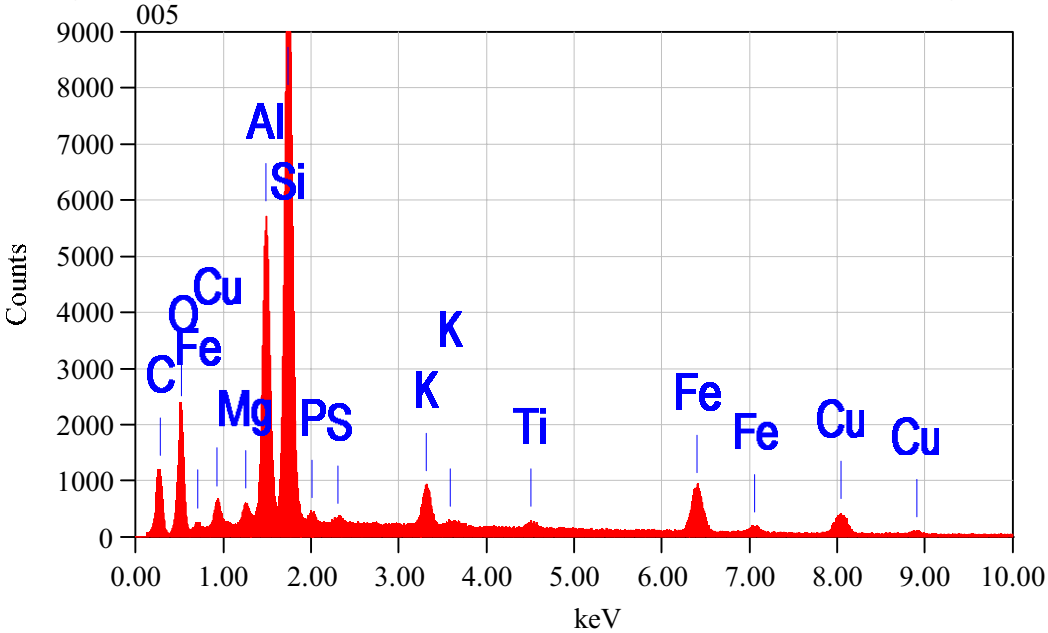


EDS1. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. The SEM/EDS spectrum of the particle annotated with 002 shows elevated levels of carbon with trace amounts of aluminium, silicon, sulfur, potassium, iron and copper. The particle morphology and the elemental profile is typical of a low ash coal. The traces of copper are consistent with copper sludge contamination.

6.2 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF AFELDSPAR PARTICLE

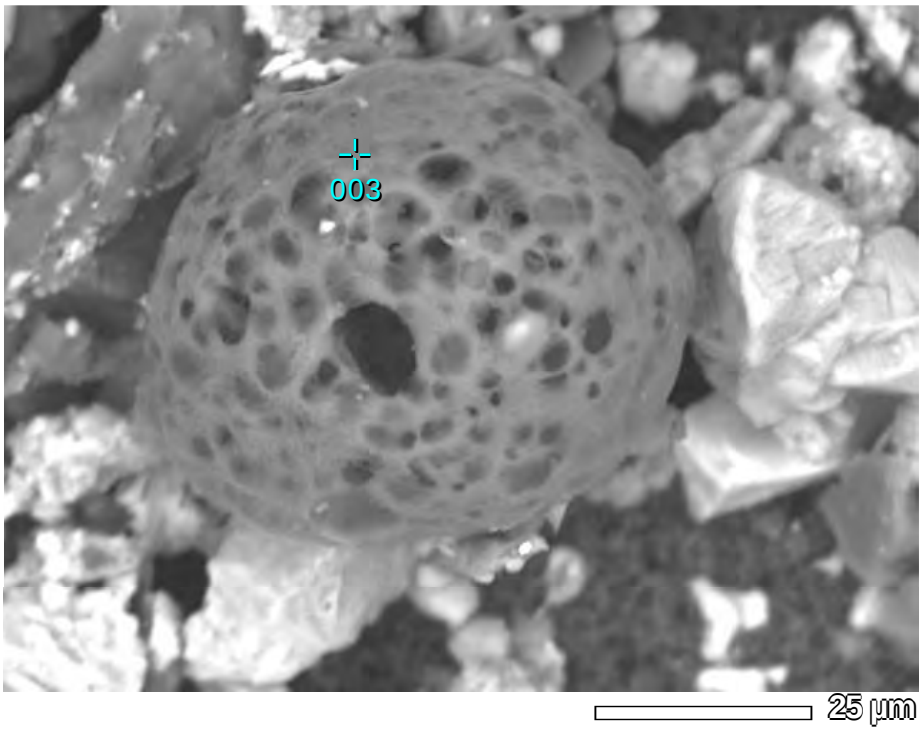


PM2. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. An SEM/BSE image of a particulate annotated with 005 is selected for SEM/EDS analysis.

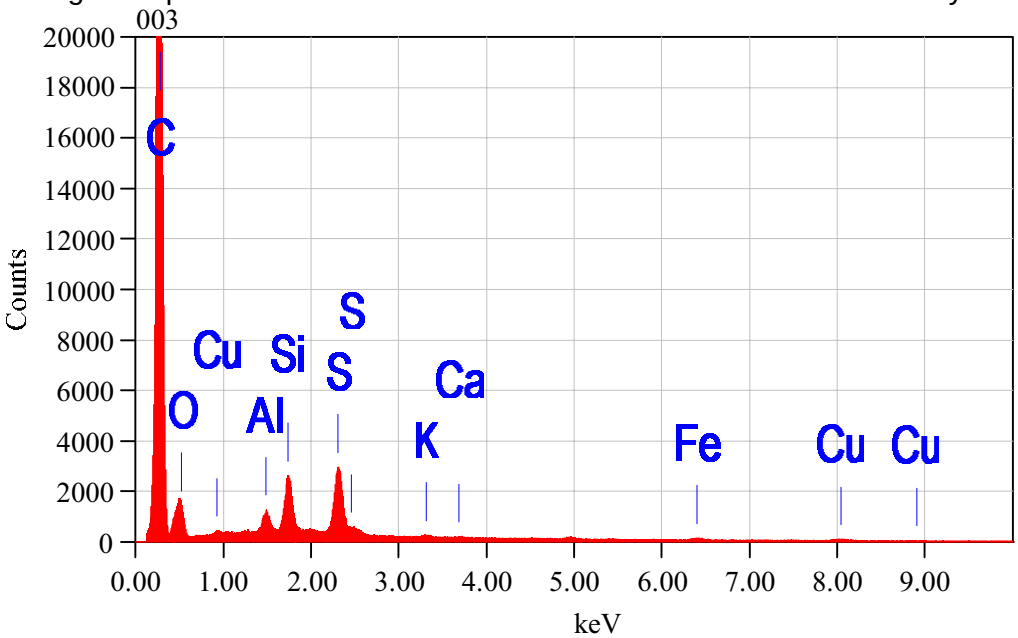


EDS2. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. The SEM/EDS spectrum of the particle annotated with 005 displays major peaks of aluminium and silicon with minor amounts of potassium, iron and copper and trace amounts of the balance of the elements. Copper sludge is present again as a trace contaminant. The spectrum is characteristic for aluminosilicate rich mineral dust most likely feldspar.

6.3 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A SOOT PARTICLE

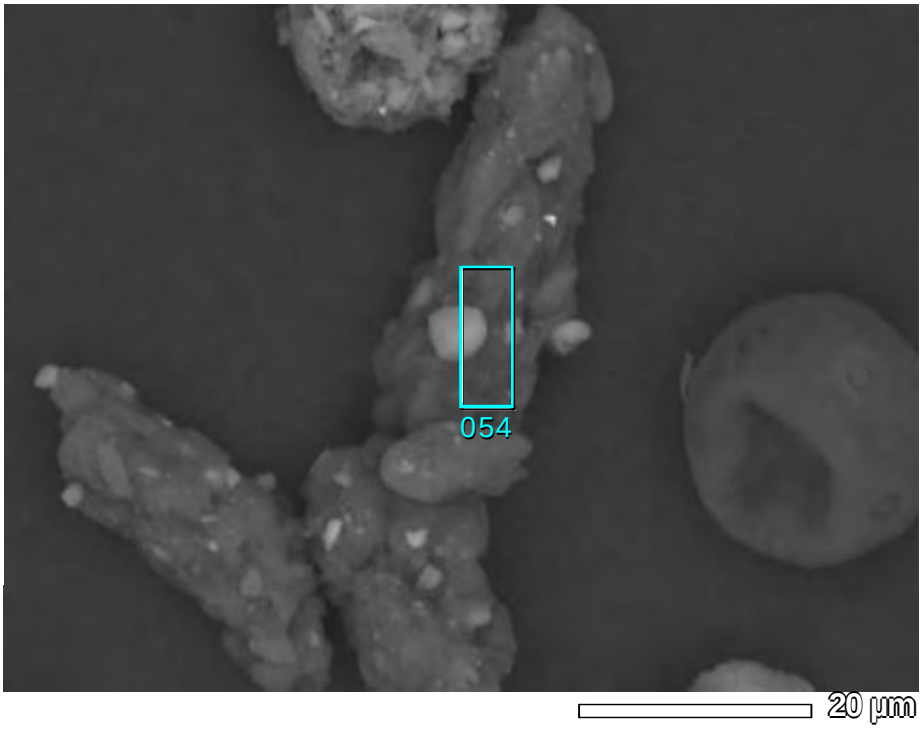


PM3. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. An SEM/BSE image of a particulate annotated with 003 is selected for SEM/EDS analysis.

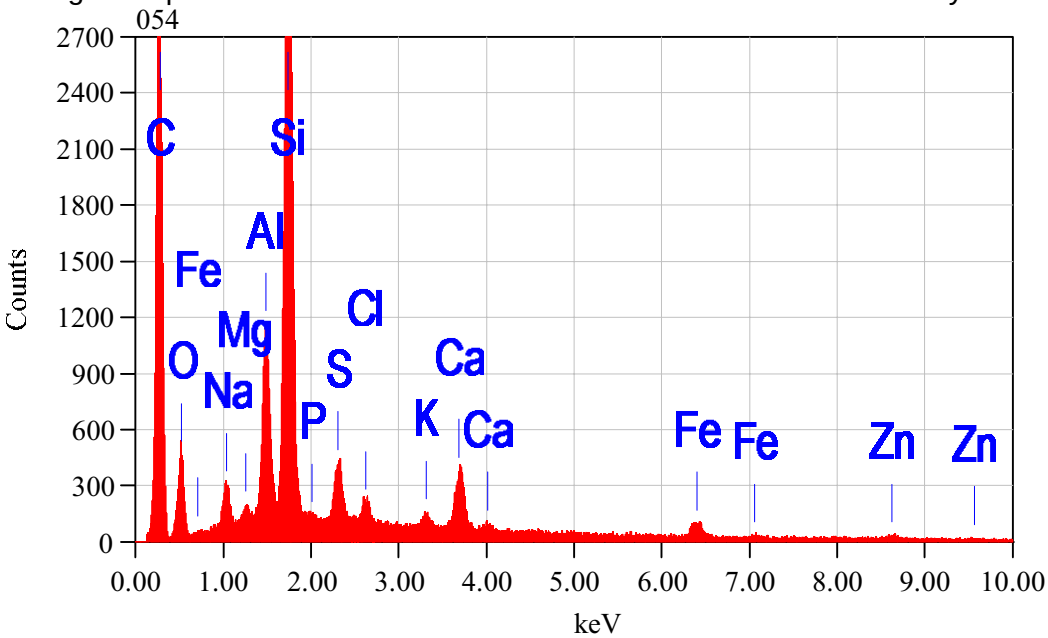


EDS3. Carrington Dust Gauge (Exposed: 17/10/15, Collected: 14/11/14), UQMP # 13079. The SEM/EDS spectrum of the particle annotated with 003 shows a predominance of carbon with minor amounts of aluminium, silicon and sulfur the balance of the elements are at trace levels. The SEM/EDS spectrum and 'lacey' particle appearance is consistent with soot.

AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A RUBBER DUST PARTICLE



PM4. Tighes Hill Petri Dish (Exposed: 14/11/14, Collected: 15/11/14), UQMP # 13080. An SEM/BSE image of a particulate annotated with 054 is selected for SEM/EDS analysis.



EDS4. Tighes Hill Petri Dish (Exposed: 14/11/14, Collected: 15/11/14), UQMP # 13080. UQMP # 13080. The SEM/EDS spectrum of the particle annotated with 054 shows elevated levels of carbon, aluminium, silicon with minor and trace amounts of the balance of the elements. The sausage shape structure and SEM/EDS elemental profile is characteristic of rubber dust.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF A DUST FALLOUT GAUGE DEPOSIT AND LOOSE DUST DEPOSITS BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C01680.13

Prepared for: Hayley Worthington, ALS Environmental

Author: Fiona Jones

Date: 11th February 2015

Sample Description:

	Dust Gauge Sample #	UQMP #
1	Dust Gauge Islington 12/12/14	UQMP # 13143
2	Carrington Petri 17/12/14	UQMP # 13144
3	Mayfield East Petri	UQMP # 13145
4	Islington Brush	UQMP # 13146
5	Stockton South Brush	UQMP # 13147

#Method Ref: Internal AMCP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

One sample was supplied (Sample 1) as washings from a dust fallout gauge deposit and the remaining samples as a loose dust deposit in a petri dish. The dust gauge deposit sample was filtered onto a membrane filter, whilst the loose dust deposits were mounted directly onto carbon tape and examined by stereomicroscopy to check for particle distribution and general appearance. The samples were then examined by Scanning Electron Microscopy with Energy Dispersive Spectrocopy

2. RESULTS

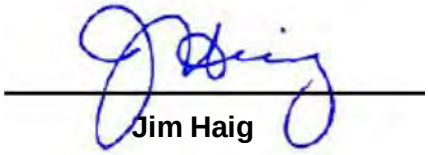
Appendix A attached presents the table of results of the combined microscopy observations.

Appendix B presents colour picture micrographs of the stereomicroscopy images.

Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. Some of the deposits were very sparse and the resulting spectra displayed erroneous levels of carbon, this has been noted during the discussion of each spectrum. .

Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of UQ Materials Performance



Jim Haig

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13143	UQMP # 13144	UQMP # 13145
	SAMPLE ID / **PARTICLE TYPE**	*Dust Gauge Islington 12/12/14*	*Carrington Petri 17/12/14*	*Mayfield East Petri*
BLACK	COAL	5	tr	tr
	SOOT	tr	tr	tr
	BLACK RUBBER DUST	tr		
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**95**	**90**	**95**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Salt)		5	5
	MINERAL DUST (type =calcium sulphate)		5	tr
	MINERAL DUST (type =alumina)			tr
	COPPER SLUDGE	tr	tr	tr
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	tr	tr
	PLANT DEBRIS (General)	tr	tr	tr
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr		
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS			Insufficient particles for a useful Stereomicroscopy image	Insufficient particles for a useful Stereomicroscopy image

3.2 TABLE OF COMBINED MICROSCOPY RESULTS APPENDIX A

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13146	UQMP # 13147	
	SAMPLE ID	*Islington Brush*	*Stockton South Brush*	
	PARTICLE TYPE			
BLACK	COAL	5	5	
	SOOT	tr	10	
	BLACK RUBBER DUST	tr		
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**95**	**50**	
	MINERAL DUST (type = Fly Ash)	tr		
	MINERAL DUST (type = salt)	tr	tr	
	MINERAL DUST (type = alumina)	tr		
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	5	
	PLANT DEBRIS (General)	tr		
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr	30	
	STARCH			
	PAINT		tr	
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

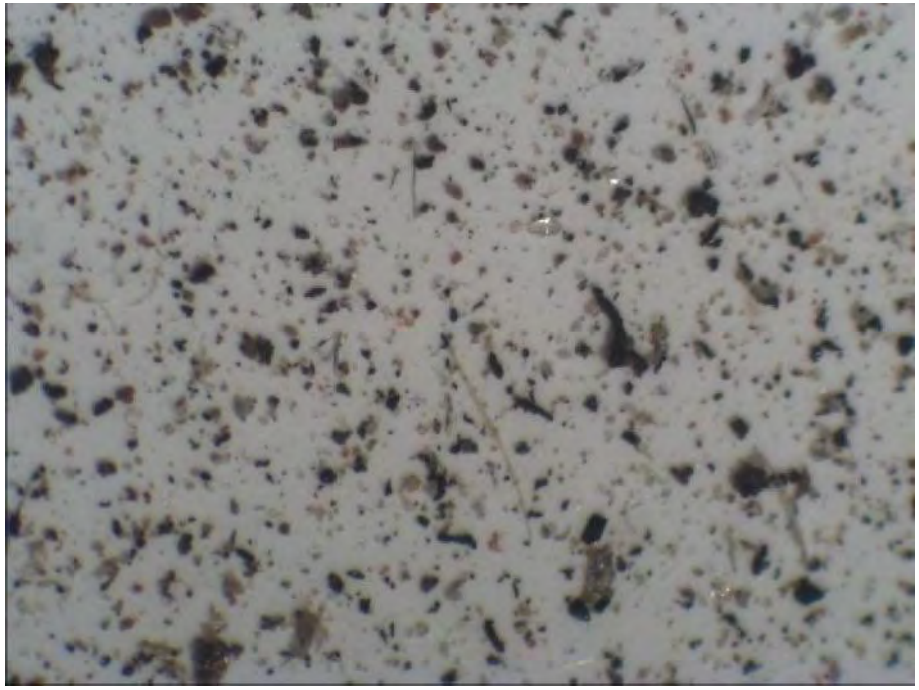
3.3 PARTICLE IDENTITY LEGEND

APPENDIX A

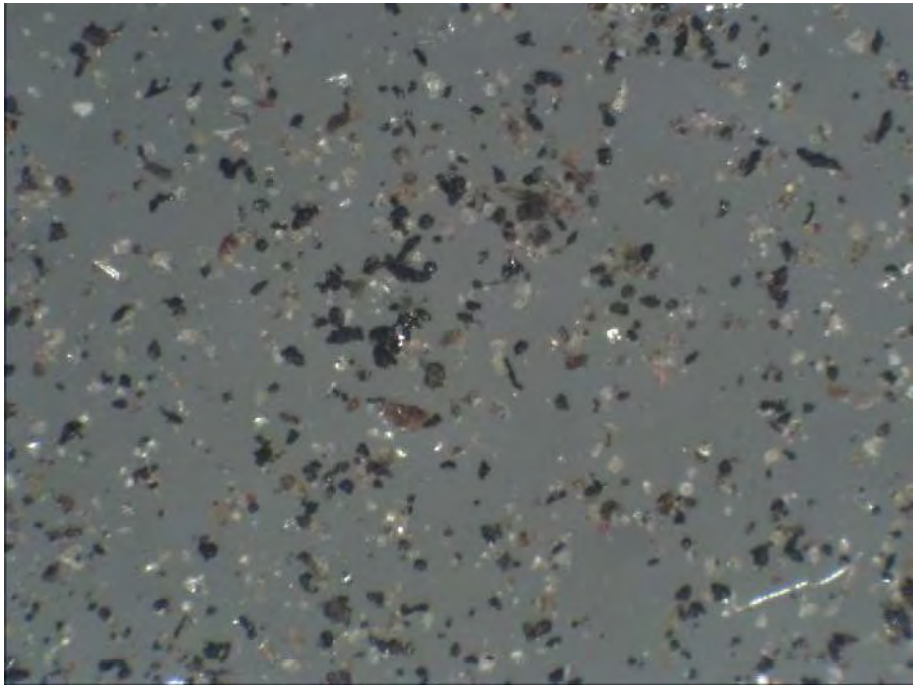
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

4. APPENDIX B

4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS



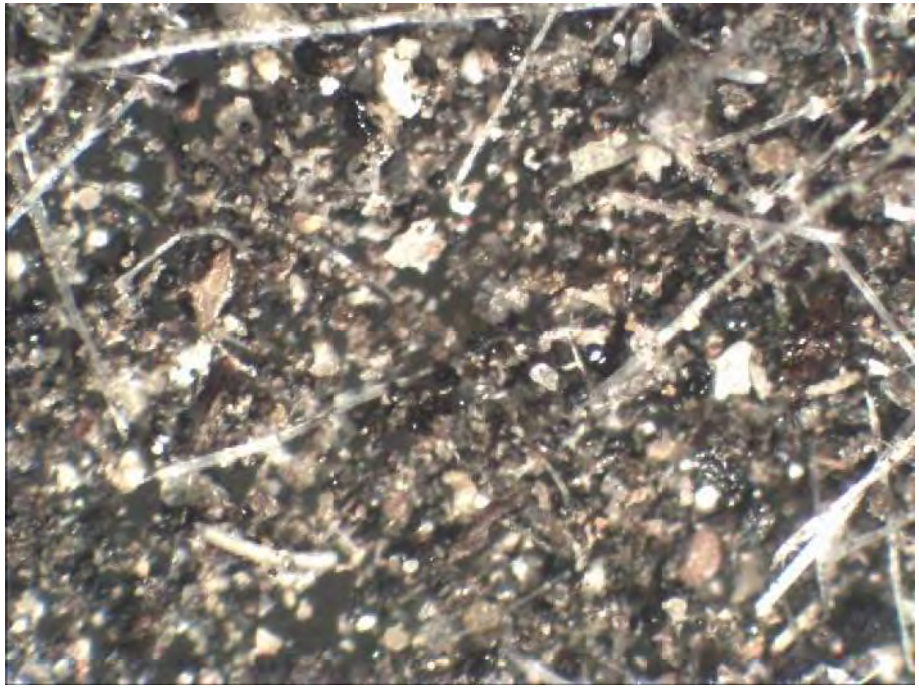
StMPM1. Dust Gauge Islington 12/12/14, UQMP # 13143



StMPM4. Islington Brush, UQMP # 13146.

4.2 STEREOMICROSCOPY PICTURE MICROGRAPHS

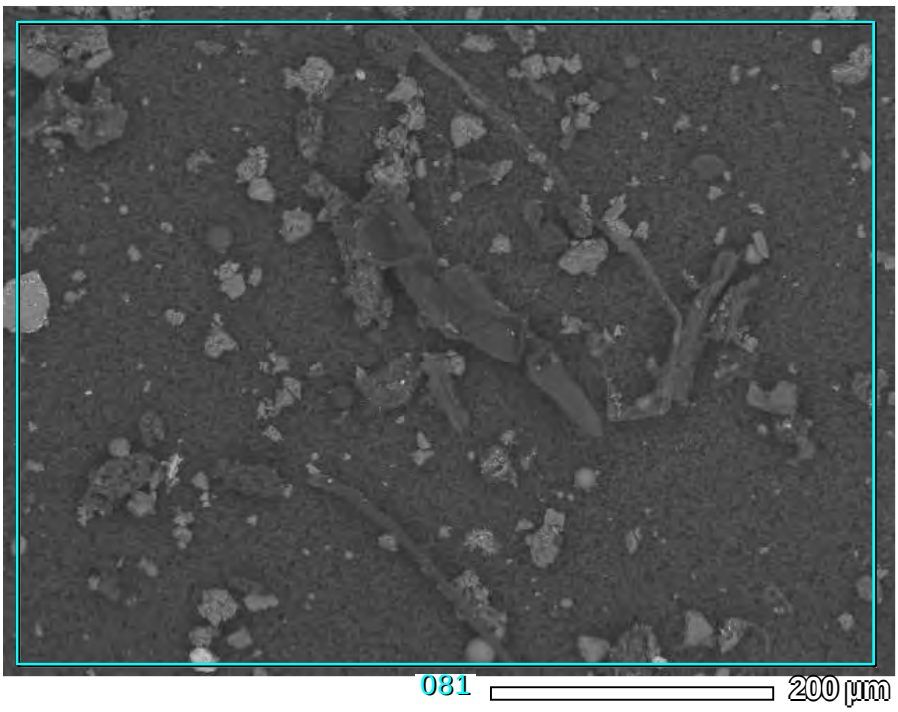
APPENDIX B



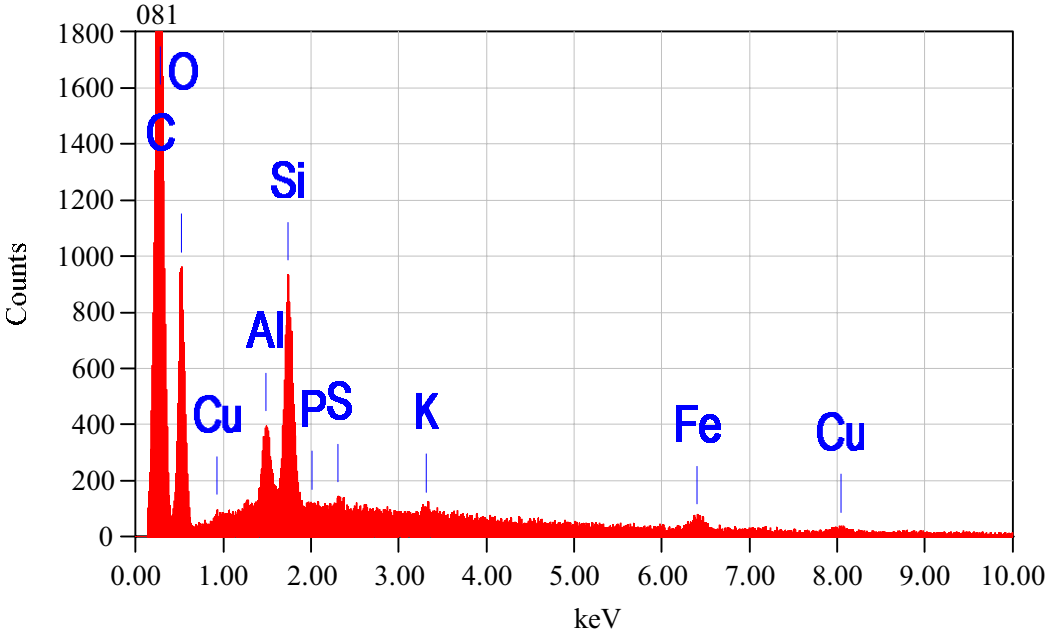
StMPM5. Stockton South Brush, UQMP # 13147.

5. APPENDIX C

5.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

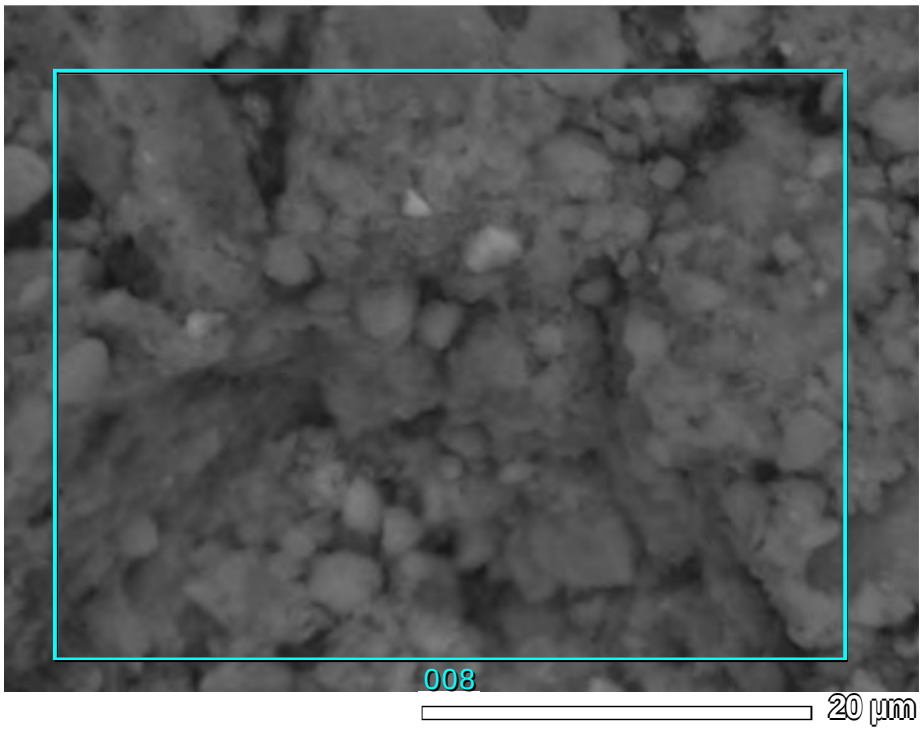


PM1. Dust Gauge Islington 12/12/14, UQMP # 13143. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

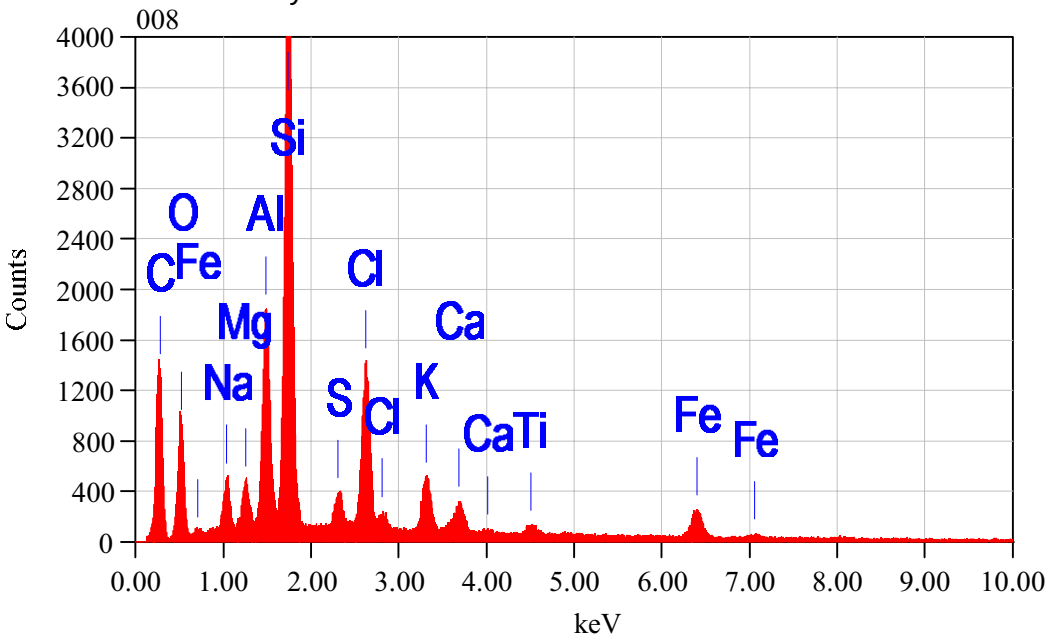


EDS1. Dust Gauge Islington 12/12/14, UQMP # 13143. The SEM/EDS spectrum of the overall area is rich in carbon, silicon and aluminium with trace amounts of copper, phosphorous, potassium, iron and sulfur. The deposit was sparsley populated with particulates, the elevated carbon is erroneous as it represents a major amount of exposed filter. Carbon contributors were minor and included traces of coal, soot, rubber dust, fibres and insect and plant debris. Traces of copper sludge are also present. Stereomicroscopy observations found the deposit to consist predominantly of aluminosilicate rich mineral dust.

5.2 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

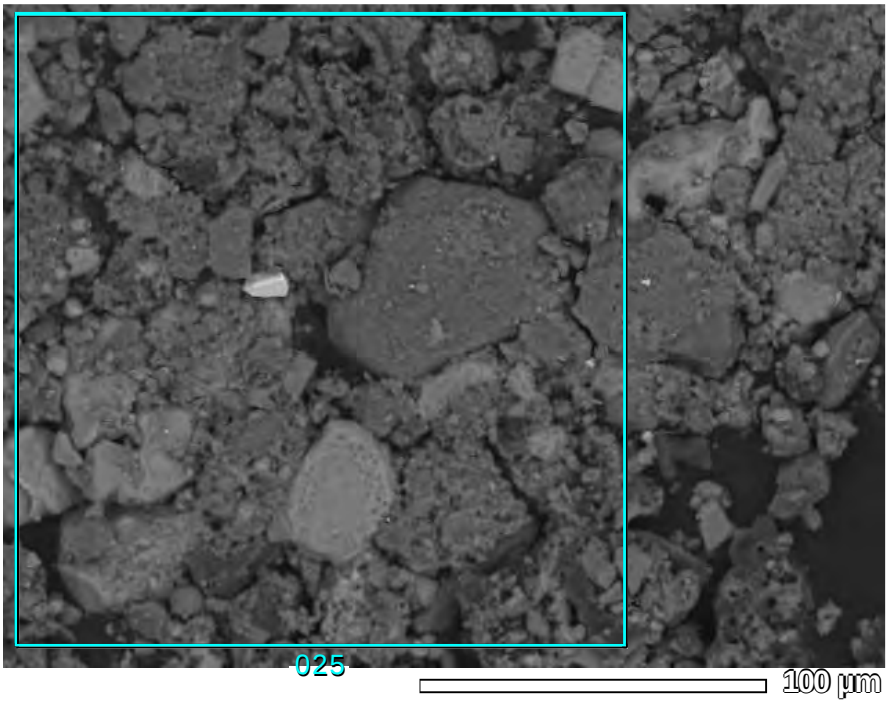


PM2. Carrington Petri 17/12/14, UQMP # 13144. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

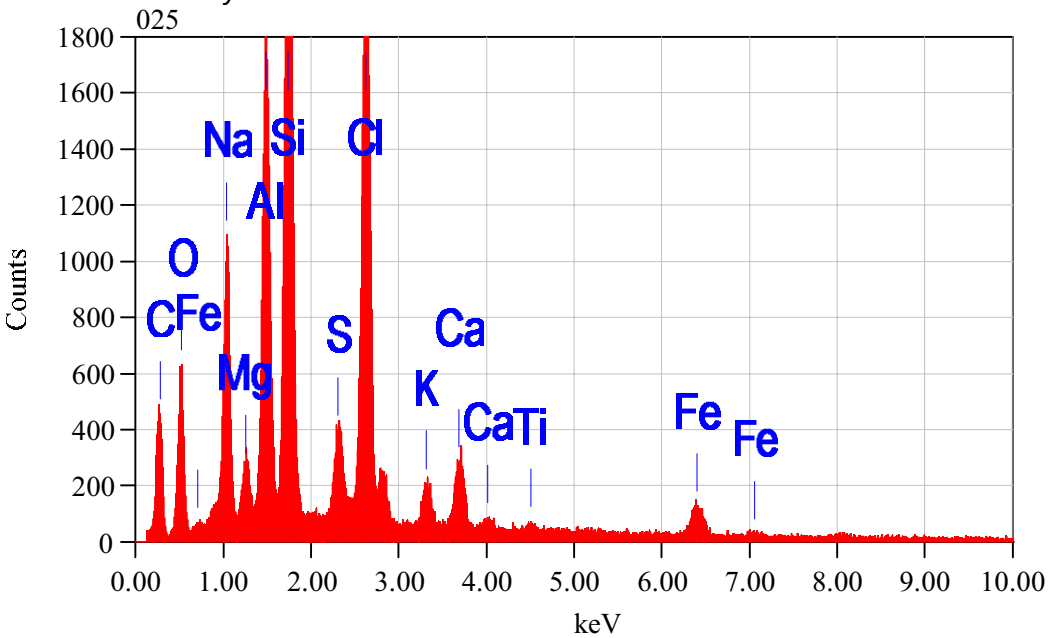


EDS2. Carrington Petri 17/12/14, UQMP # 13144. The SEM/EDS spectrum of the overall area is rich in carbon, aluminium, silicon and chloride with trace amounts of sodium, magnesium, sulfur, potassium, calcium, titanium and iron. Microscopy observations show the deposit to conisist mostly of aluminosilicate rich mineral dust with trace amounts of sodium chloride and calcium sulfate. The organic contributors were considered as trace level and included coal, soot and traces of insect and plant debris.

5.3 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

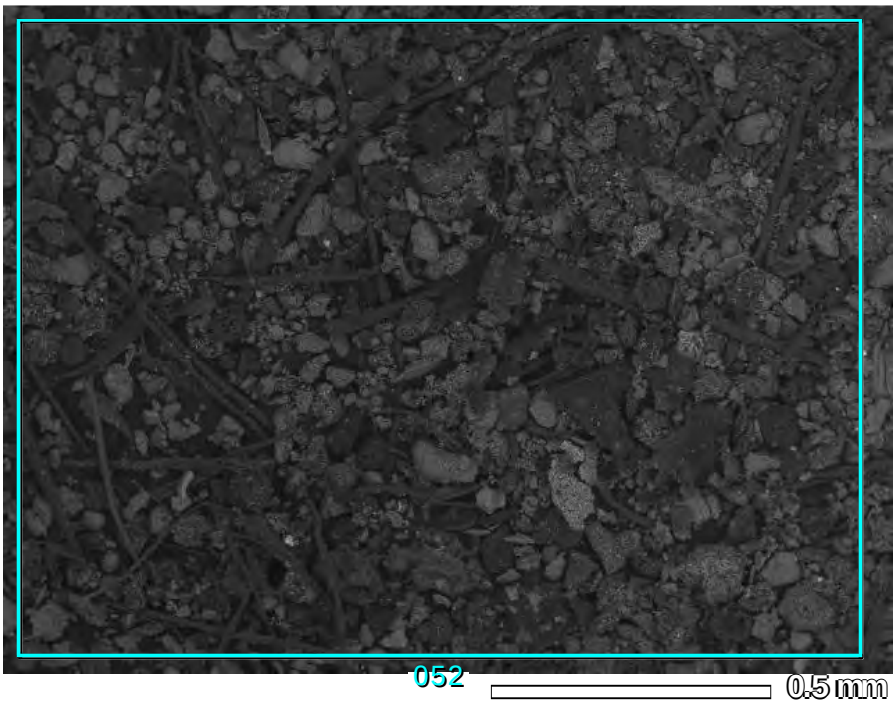


PM3. Mayfield East Petri, UQMP # 13145. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

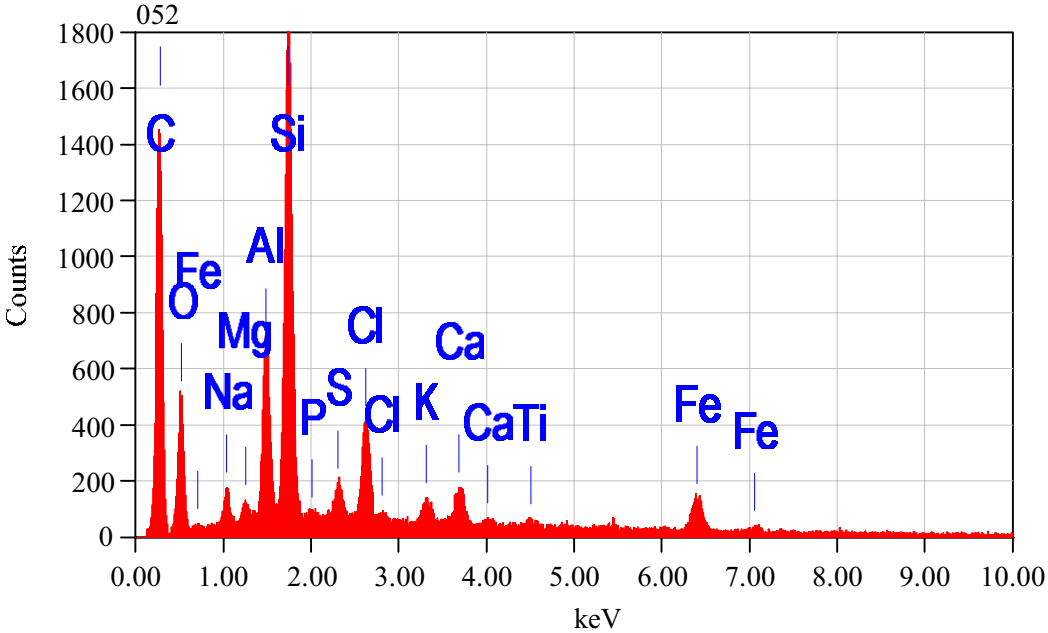


EDS3. Mayfield East Petri, UQMP # 13145. The SEM/EDS spectrum of the overall area is predominantly sodium, aluminium, silicon and chloride with traces of magnesium, sulfur, potassium, calcium, titanium and iron. The desposit consisted mostly of aluminosilicate rich particles with minor amounts of salt and traces of calcium sulfate the organic component included trace amounts of coal, rubber dust, insect and plant debris.

5.4 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

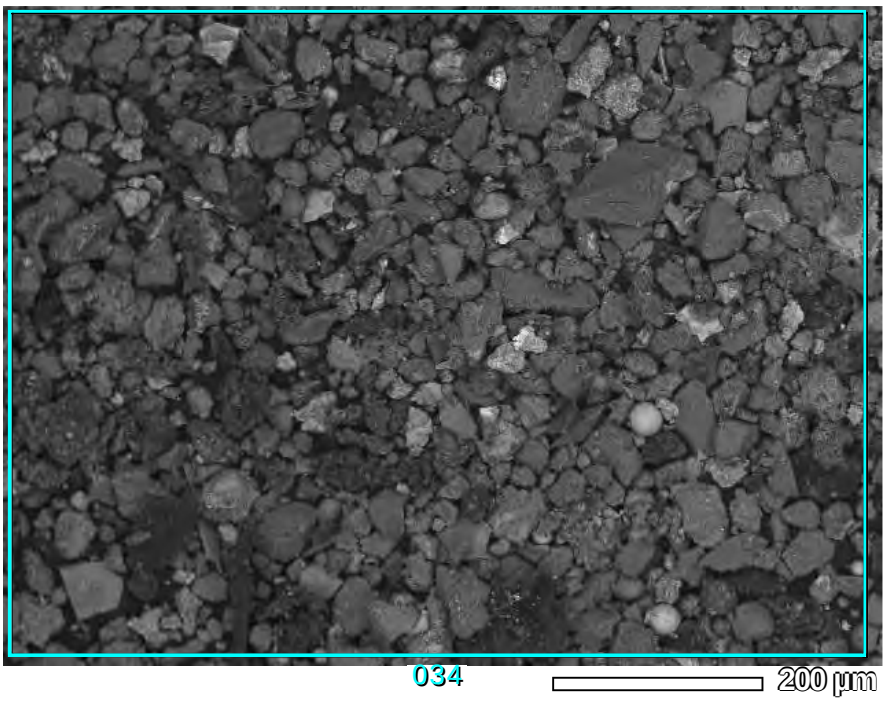


PM5. Stockton South Brush, UQMP # 13147. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

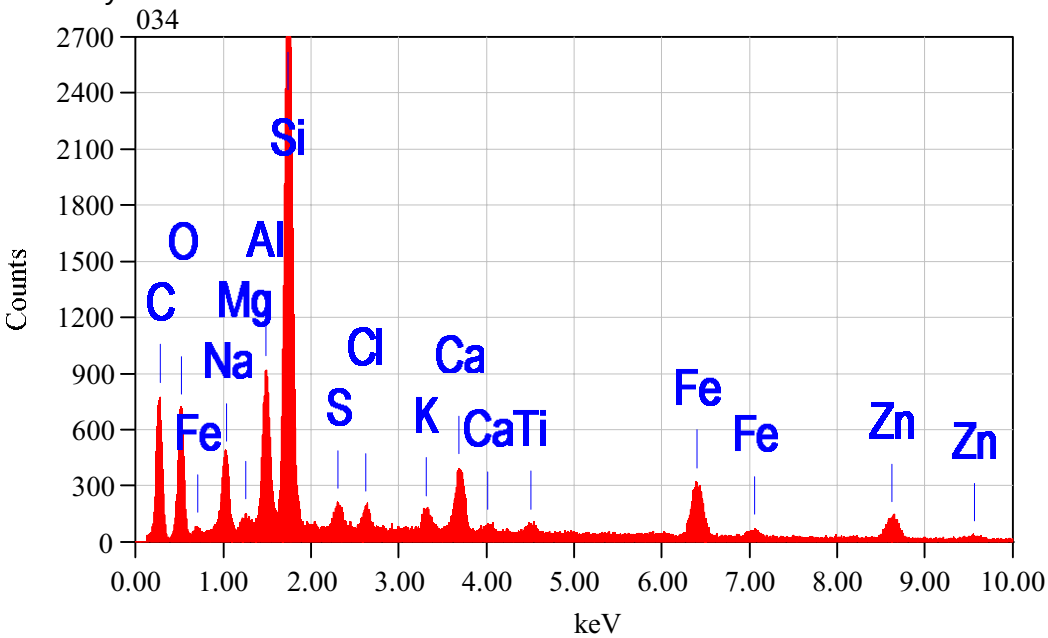


EDS5. Stockton South Brush, UQMP # 13147. The SEM/EDS spectrum of the overall area is rich in carbon, silicon, aluminium, copper, phosphorous and sulfur. The EDS analysis confirms the microscopy observation of a predominance of fibres and aluminosilicate rich mineral dust.

5.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



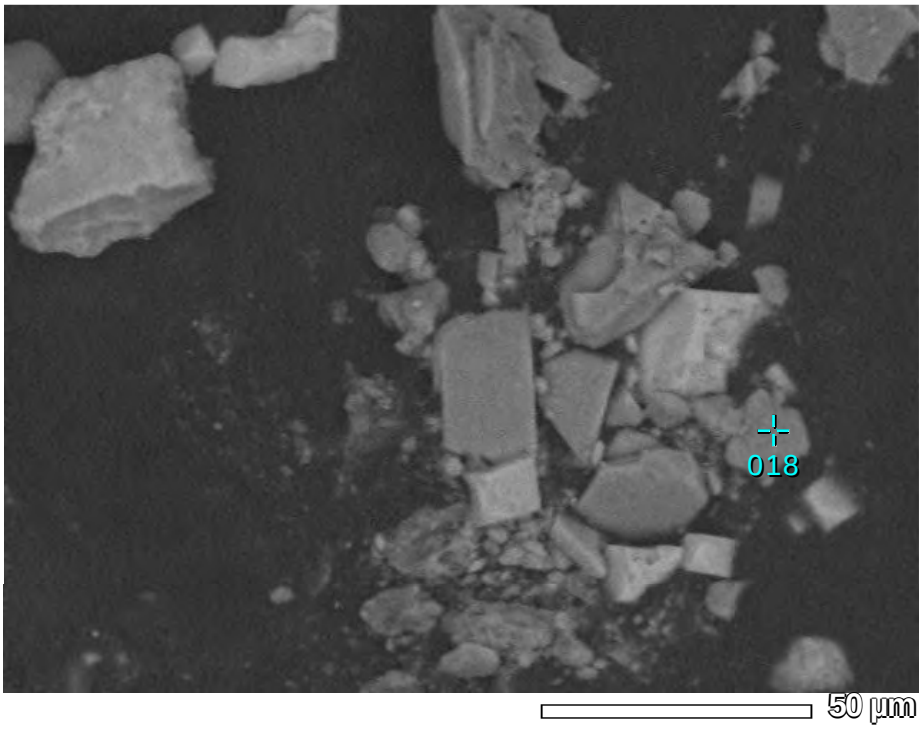
PM4. Islington Brush, UQMP # 13146. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



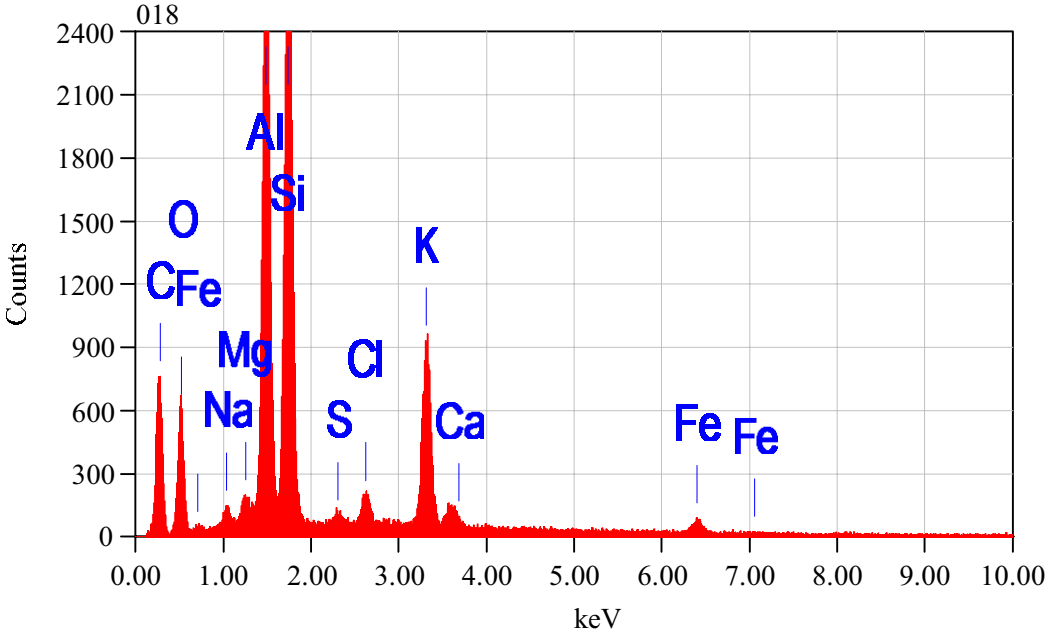
EDS4. Islington Brush, UQMP # 13146. Aluminium and silicon are the significant peaks of the SEM/EDS spectrum with minor amounts of sodium, chloride, calcium, iron and zinc and trace levels of the balance of the elements. The microscopy observations correspond well with the spectrum results of a deposit rich in aluminosilicate mineral dust with minor amounts of sodium chloride, calcium sulfate and trace amounts of a zinc rich mineral dust. The minor carbon consisted of minor amounts of coal traces of black rubber dust, soot and plant and insect debris.

6. APPENDIX D

6.1 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF FELDSPAR

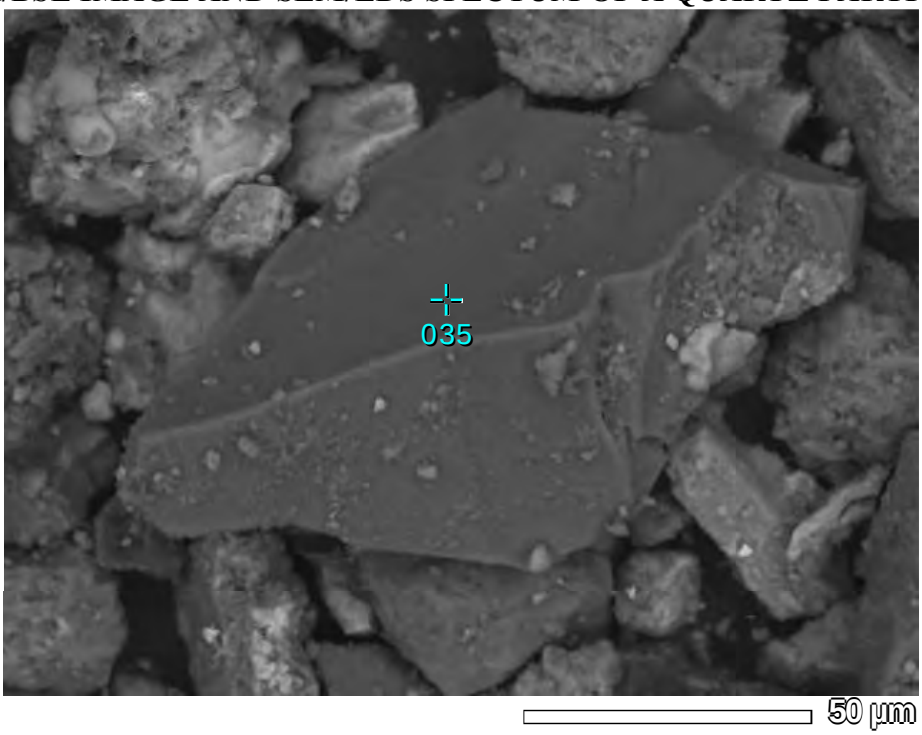


PM1. Carrington Petri 17/12/14, UQMP # 13144. An SEM/BSE image of a particulate annotated with 018 is selected for SEM/EDS analysis.

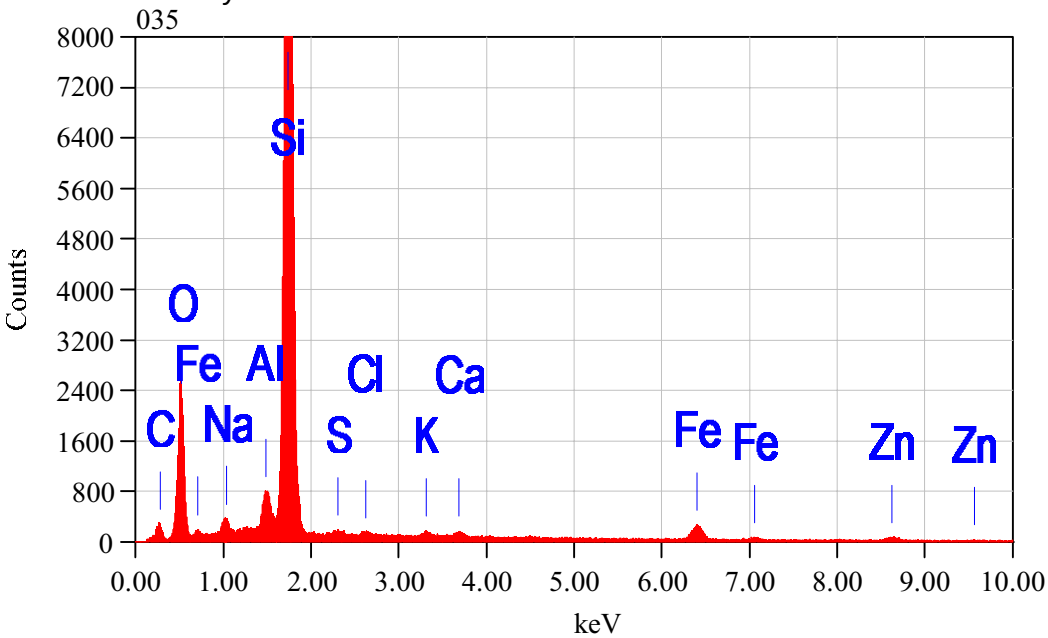


EDS1. Carrington Petri 17/12/14, UQMP # 13144. The SEM/EDS spectrum of the particle annotated with 018 displays elevated levels aluminium, silicon and potassium with minor amounts of carbon and trace amounts of sodium, magnesium, sulfur, choride, calcium and iron. The spectrum displays a profile consistent with an aluminosilicate rich mineral dust most likely a feldspar. The minor carbon peak is the interaction with the exposed conductive carbon tape to the right of the particle.

6.2 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A QUARTZ PARTICLE

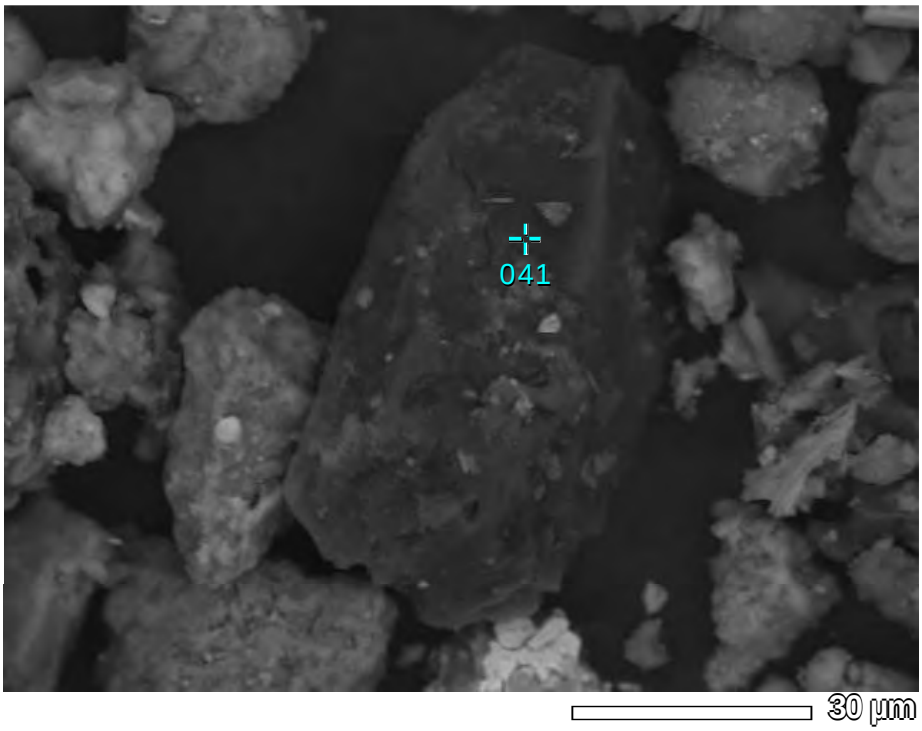


PM2. Islington Brush, UQMP # 13146. An SEM/BSE image of a particulate marked with 035 is selected for SEM/EDS analysis.

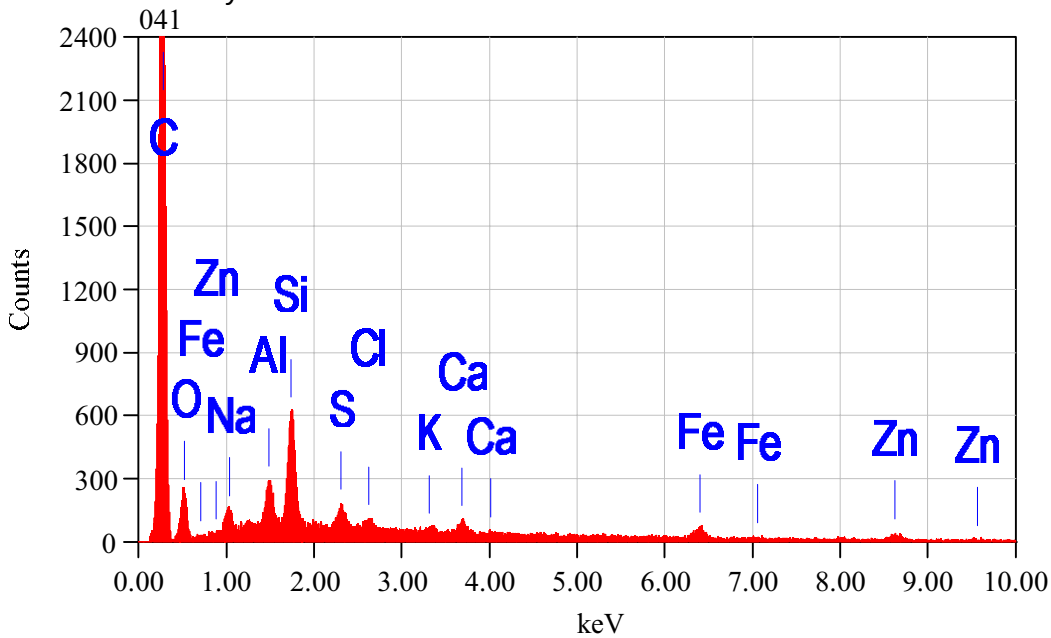


EDS2. Islington Brush, UQMP # 13146. The SEM/EDS spectrum of the particle marked with 035 shows elevated levels of silicon with trace amounts of sodium, aluminium, sulfur, chloride, potassium, calcium, iron and zinc. The spectrum and particle morphology is typical of quartz.

6.3 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A COAL PARTICLE

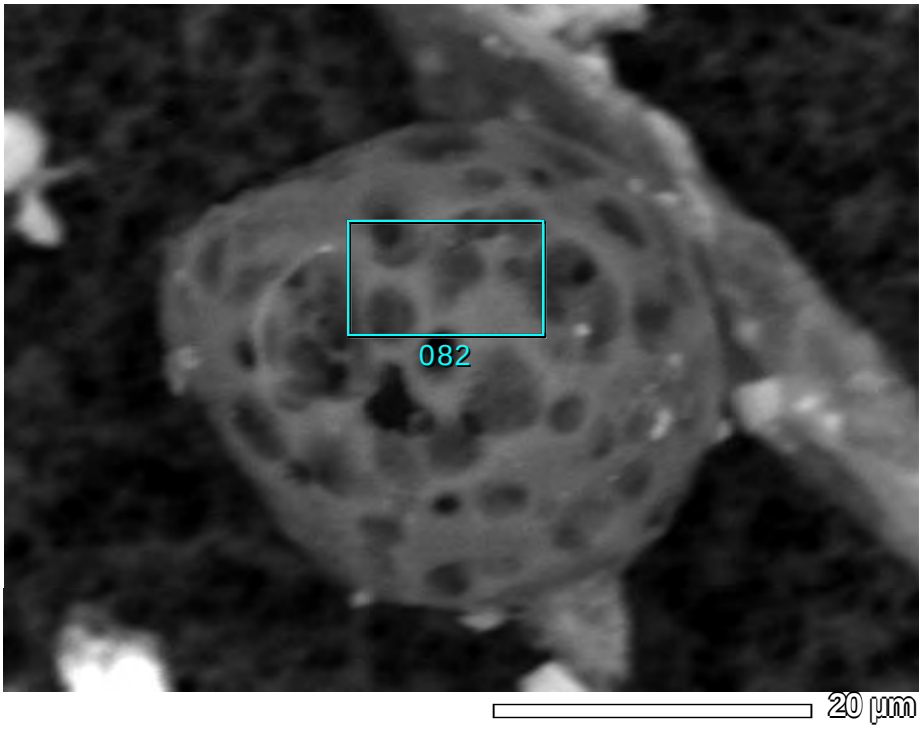


PM3. Islington Brush, UQMP # 13146. An SEM/BSE image of a particulate annotated with 041 is selected for SEM/EDS analysis.

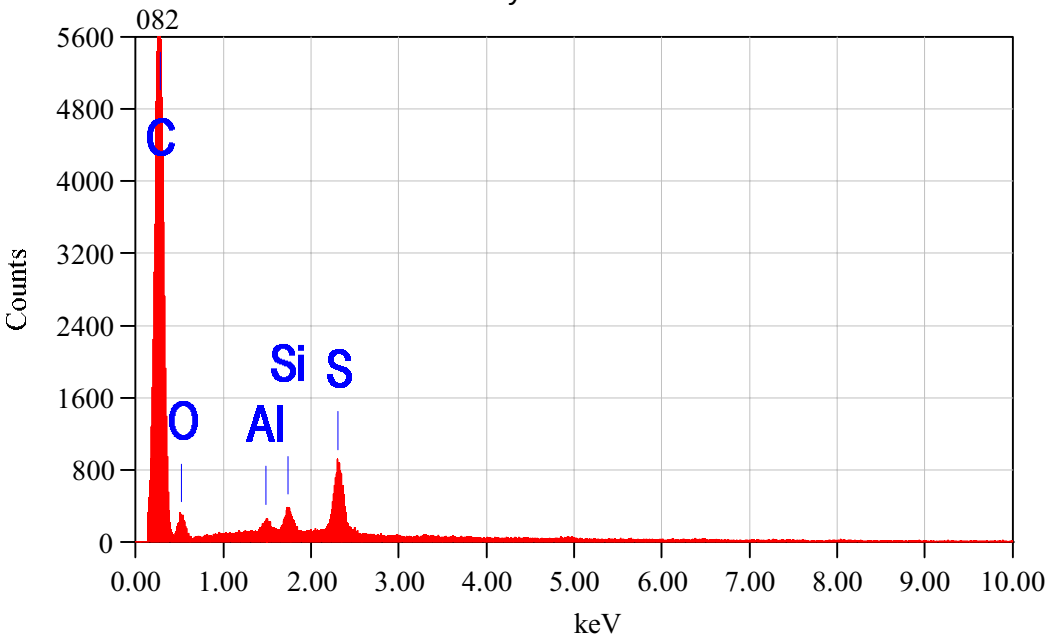


EDS3. Islington Brush, UQMP # 13146. The SEM/EDS spectrum of the particle annotated with 041 shows elevated levels of carbon, with trace amounts of sodium, aluminium, silicon, sulfur, chloride, potassium, calcium, iron and zinc. Some of the trace particles including sodium, zinc, chloride and potassium are most likely trace contaminants from surrounding particles. The balance of the elemental profile is characteristic for coal.

6.4 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A SOOT PARTICLE

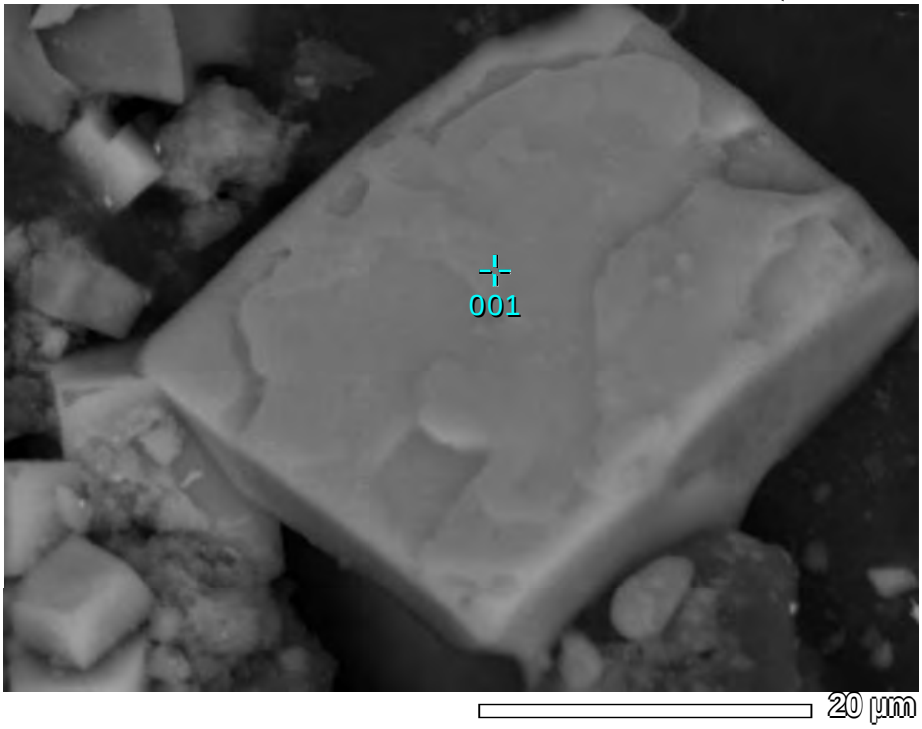


PM4. Dust Gauge Islington 12/12/14, UQMP # 13143. An SEM/BSE image of a particulate annotated with 082 is selected for SEM/EDS analysis.

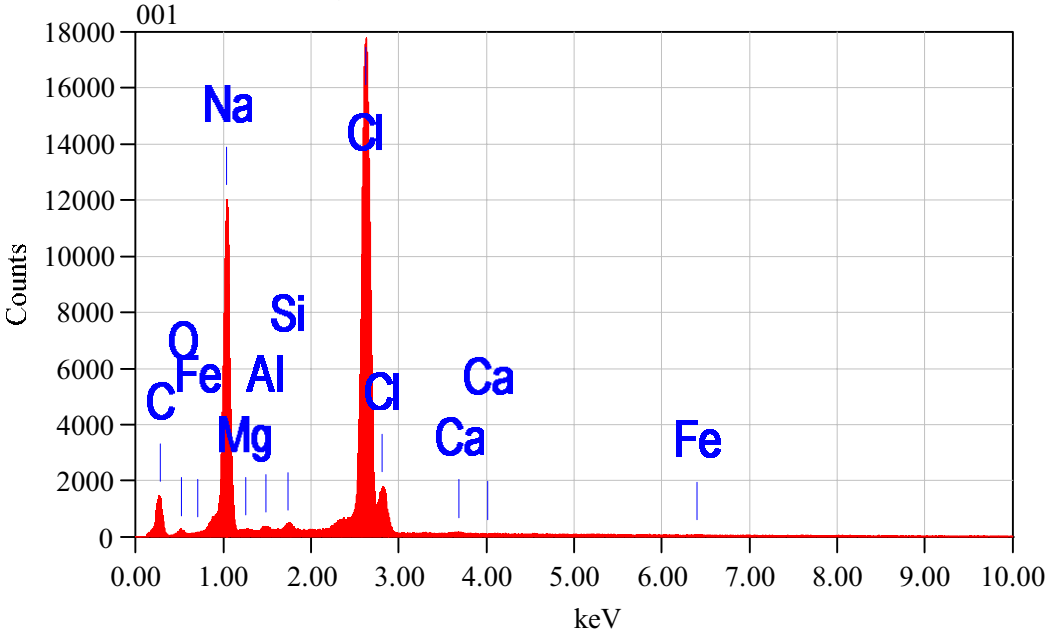


EDS4. Dust Gauge Islington 12/12/14, UQMP # 13143. The SEM/EDS spectrum of the particle annotated with 082 display a predominance of carbon with minor amounts of sulfur and traces of aluminium and silicon. The lacey particle morphology and the elements present and intensities of the peaks are characteristic of soot.

6.5 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF HALITE (ROCK SALT)



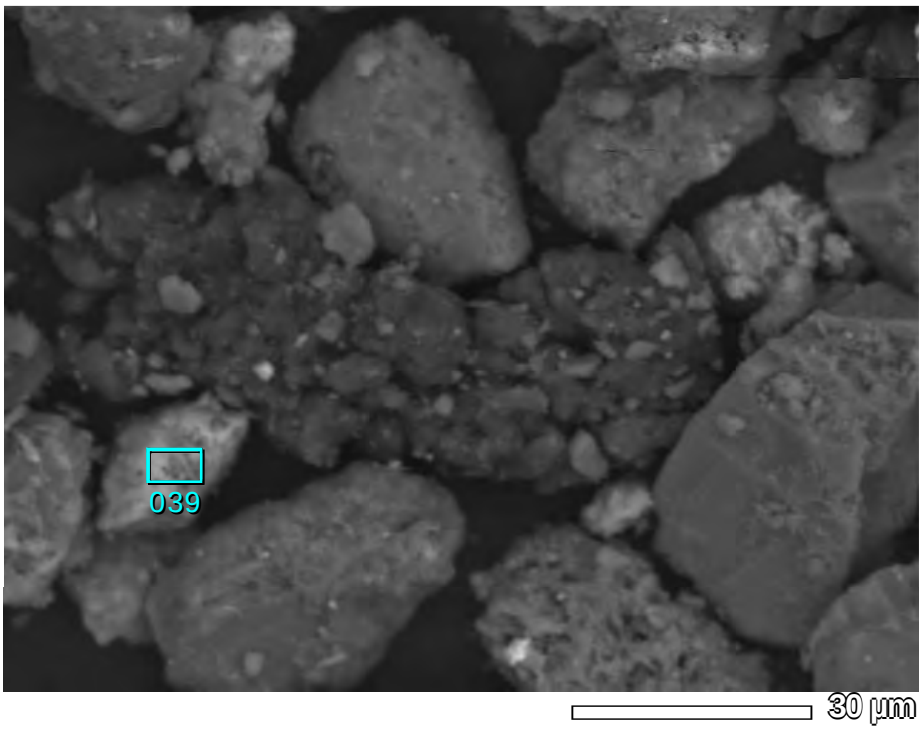
PM5. Carrington Petri 17/12/14, UQMP # 13144, An SEM/BSE image of a particle annotated with 001 and selected for SEM/EDS analysis.



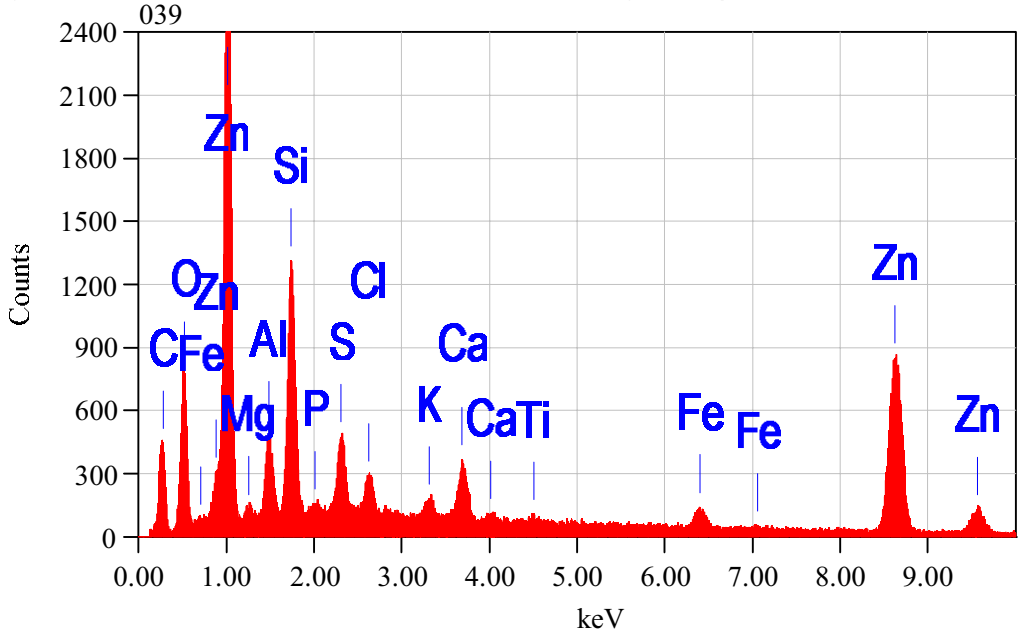
EDS5. Carrington Petri 17/12/14, UQMP # 13144, The SEM/EDS spectrum of the particle annotated with 001 shows a predominance of the elements sodium and chloride with only traces of the balance of the elements. The profile is consistent with halite or rock salt which commonly contains impurities of other elements.

6.6 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A ZINC RICH PARTICLE

Appendix D



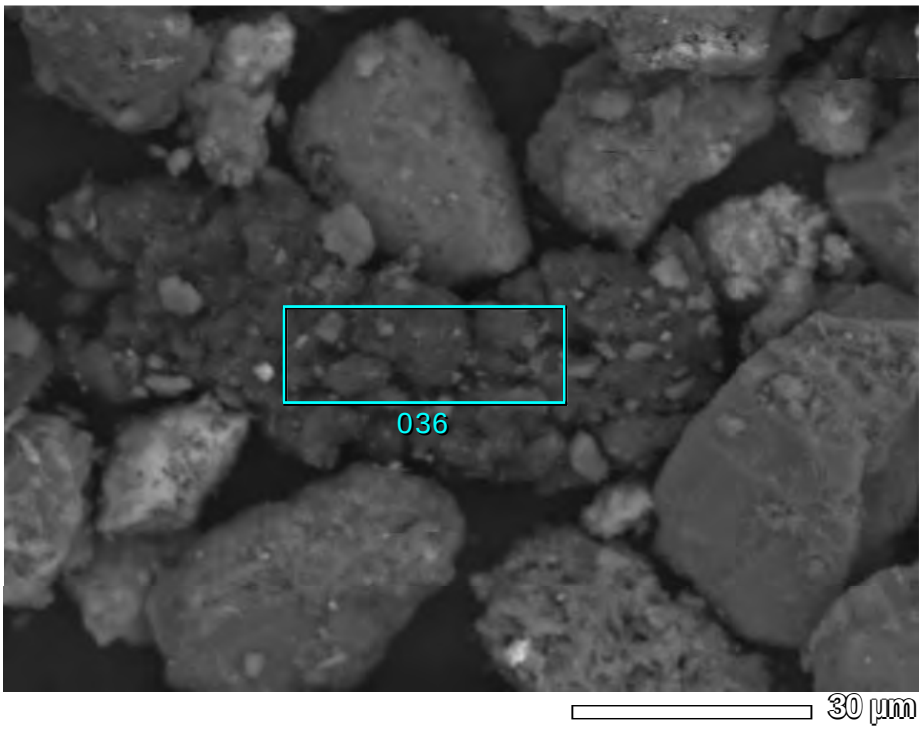
PM6. Islington Brush, UQMP # 13146. An SEM/BSE image of a particle area annotated with 039.



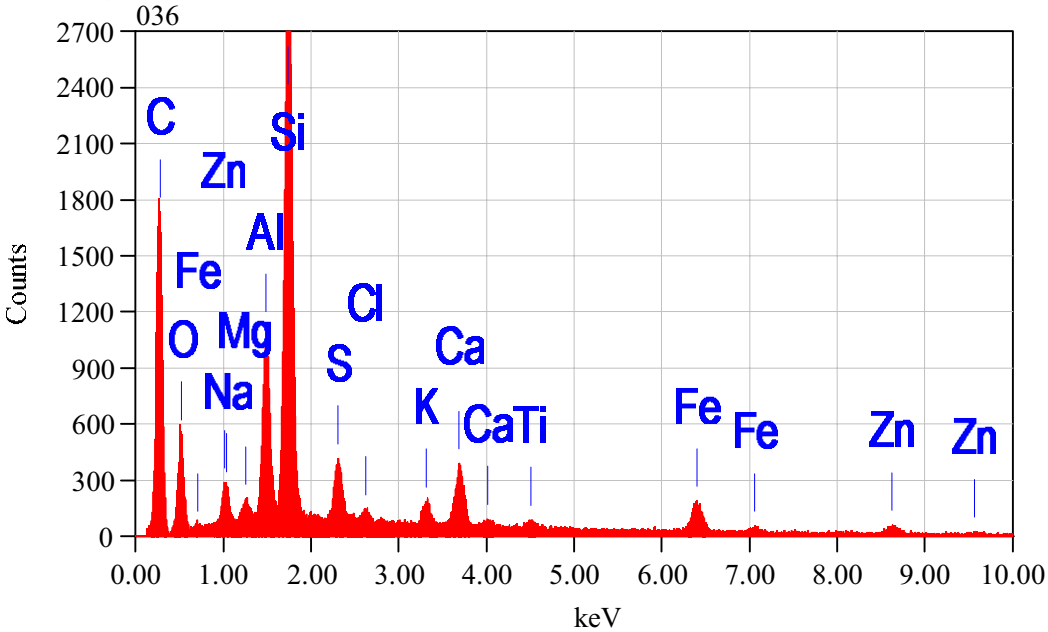
EDS6. Islington Brush, UQMP # 13146. The SEM/EDS spectrum is rich in zinc and silicon, with minor amounts of aluminium and sulfur and traces of magnesium, phosphorous, potassium, calcium and iron. This zinc rich particle is possibly Willemite which contains around 59% zinc with the chemical formula Zn_2SiO_4.

6.7 SEM/EDS SEPCTRUM AND SEM/BSE IMAGE OF A RUBBER DUST PARTICLE

Appendix D



PM6. Islington Brush, UQMP # 13146. An SEM/BSE image of a particle marked with 036 selected for SEM/EDS analysis.



EDS6. Islington Brush, UQMP # 13146. An SEM/EDS spectrum of the particle marked with 036 displays elevated peaks of carbon, aluminium and silicon with minor amounts of calcium and traces of sodium, magnesium, sulfur, chloride, potassium, calcium, titanium, iron and zinc. The SEM/EDS elemental profile is consistent with a rubber dust. Rubber dust consists mostly of a rubber elastomer with aluminosilicate rich mineral dust fillers.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials and metallurgical consulting, testing and research

Phone +61 7 3365 6123
Fax +61 7 3365 6124
Email enquiries@uqmp.com
Web www.uqmp.com

Frank White Bldg, Cooper Rd, The University of Queensland
St Lucia Qld 4072 Australia

UQMP is a registered business of UniQuest Pty Ltd (ACN 010 529 898)

LABORATORY TEST REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.01

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 16th April 2015

Sample Description:	**Dust Gauge Sample #**	**Date Exposed**	**Date Collected**	**UQMP #**
1	Mayfield East	12/12/2014	09/01/2015	UQMP # 13173

Method Ref: Internal AMCP method.
AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The sample was supplied as washings from a dust fallout gauge deposit. The sample was filtered onto a membrane filter and examined by stereomicroscopy to check for particle distribution and general appearance.

2. RESULTS

A table of results is attached. Appendix A attached presents the table of results of the combined microscopy observations.
Appendix B attached presents illustrative SEM photomicrographs and spectra taken of the Insoluble Matter.
Appendix C displays the SEM EDS spectra and SEM/BSE photomicrographs of a typical overall area with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.
Appendix D includes the SEM/BSE images and SEM/EDS spectra of typical particles of the deposit.

Signed for and on behalf of Applied Materials Characterisation and Performance

Jim Haig

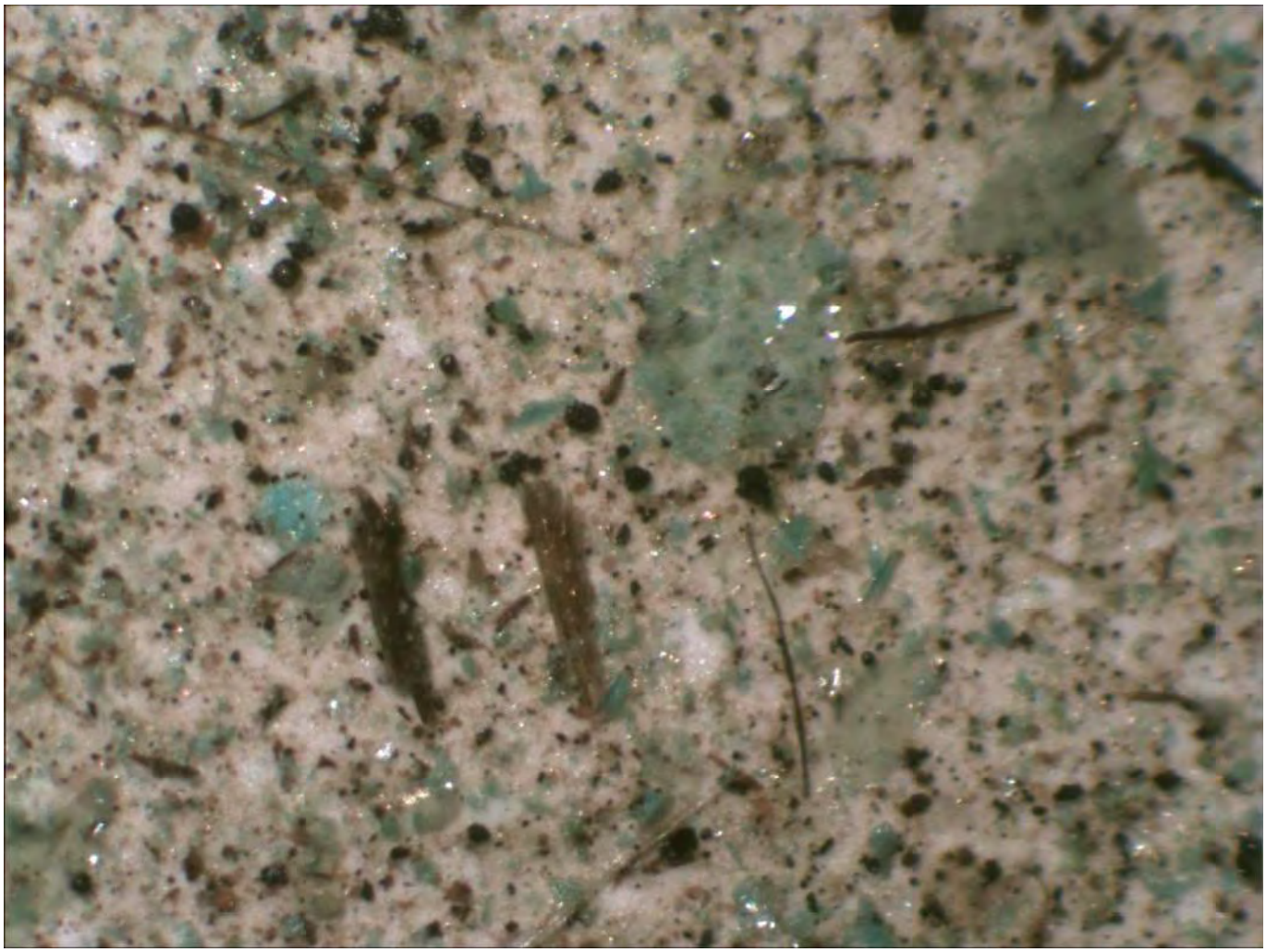
3. TABLE OF RESULTS APPENDIX A

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)
	SAMPLE #	UQMP # 13173
	SAMPLE ID **PARTICLE TYPE**	*Mayfield East*
BLACK	COAL	10
	SOOT	2
	BLACK RUBBER DUST	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**18**
	MINERAL DUST (type = Fly Ash)	
	MINERAL DUST (type = Cement Dust)	
	MINERAL DUST (type =glassy)	
	GLASS FRAGMENTS	
	COPPER SLUDGE	30
	P/S SLIME & FUNGI	30
	INSECT DEBRIS	tr
	PLANT DEBRIS (General)	10
	PLANT DEBRIS (type = plant char)	
	PLANT DEBRIS (type =)	
GENERAL ORGANIC TYPES	WOOD DUST	
	FIBRES (type = Miscellaneous)	
	STARCH	
	PAINT	
	PLASTIC FRAGMENTS	
	RED RUBBER DUST	
COMMENTS		

3.1 PARTICLE IDENTITY LEGEND

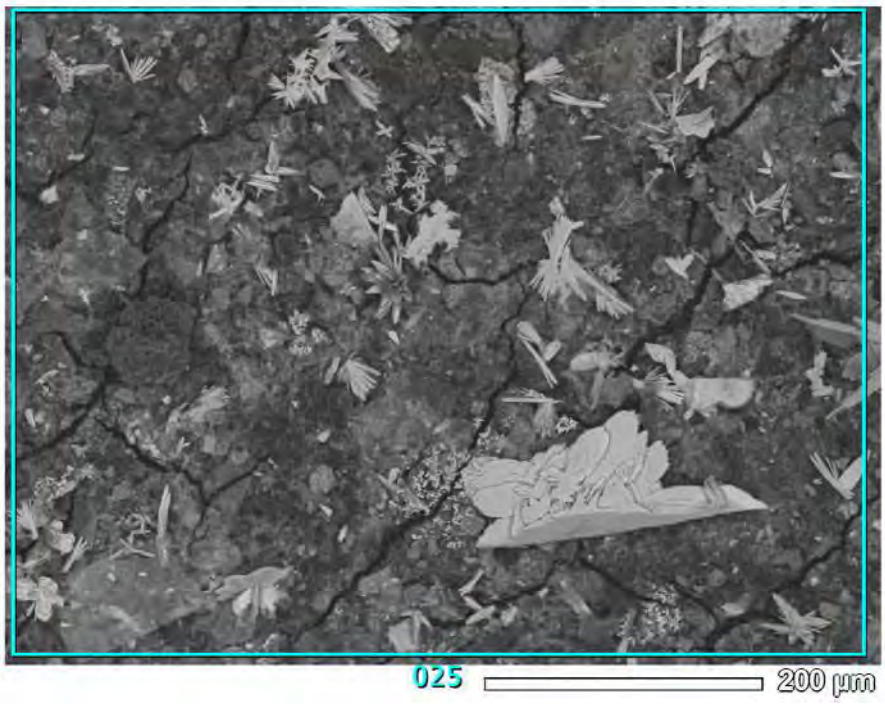
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

4. APPENDIX B. STEREOMICROSCOPY PICTURE MICROGRAPH

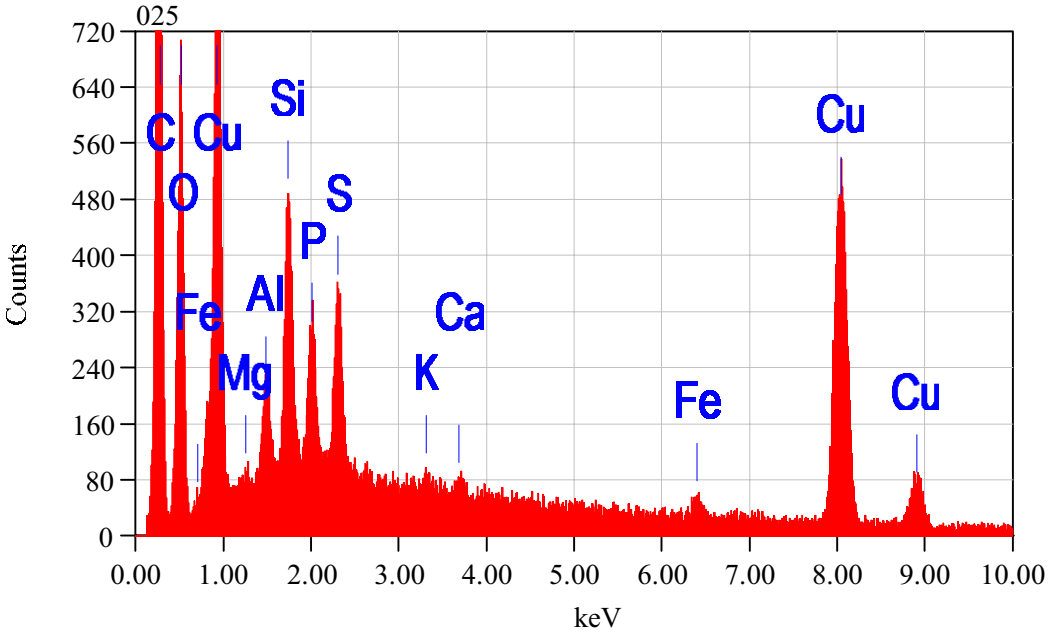


StMPM1. Mayfield East, UQMP # 13173. A stereomicroscopy image of a typical area of the deposit, note that the majority of the particles are encapsulated in polysaccharide slime and copper sludge the green to blue particles.

5. APPENDIX C. AN SEM/BSE IMAGE AND SEM/EDS SPECTRUM OF A TYPICAL OVERALL AREA OF THE DEPOSIT



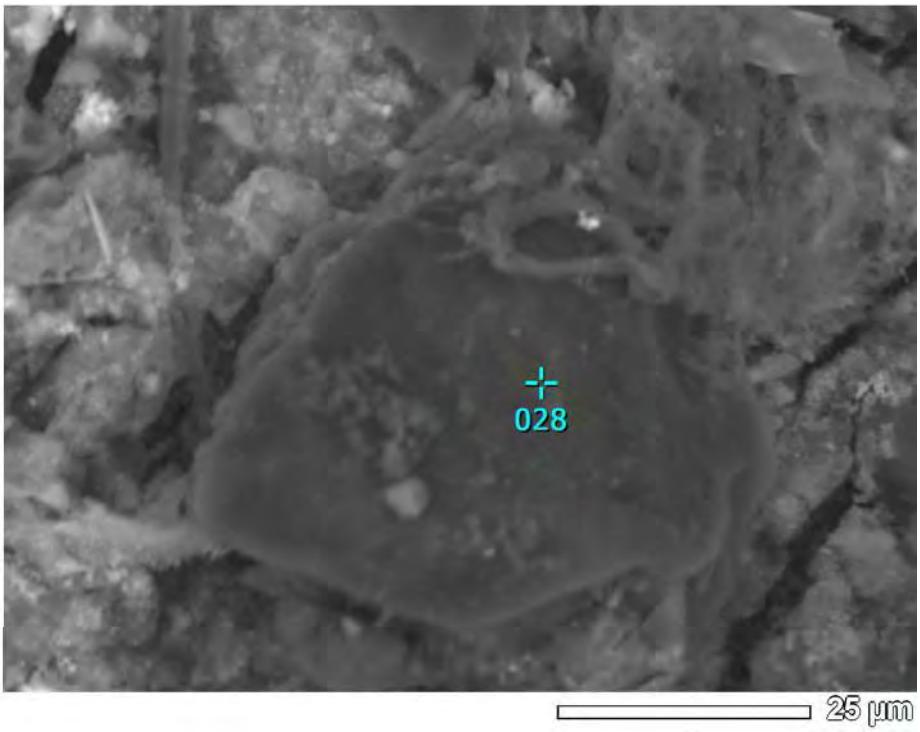
PM1. Mayfield East, UQMP # 13173. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



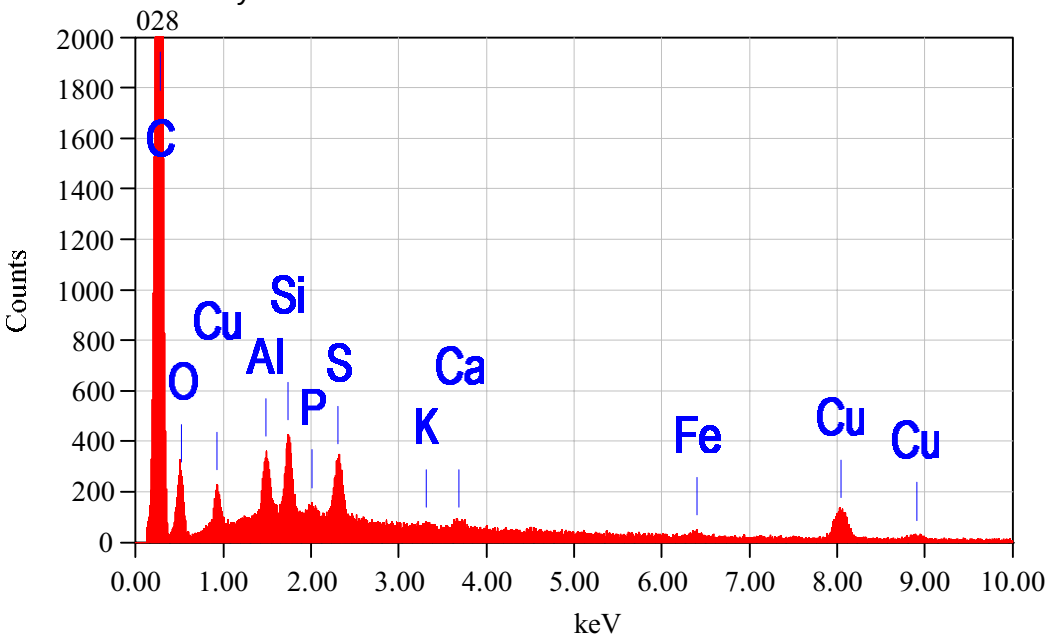
EDS1. Mayfield East, UQMP # 13173. The SEM/EDS spectrum of the overall area is rich in carbon, silicon, aluminium, copper, phosphorous and sulfur. The EDS analysis confirms the microscopy observation of a polysaccharide slime and copper sludge encased deposit, a few free particles were observed on the surface.

6. APPENDIX D. SEM/BSE IMAGES AND SEM/EDS SPECTRA OF COMMON PARTICLE TYPES.

6.1 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A COAL PARTICLE.

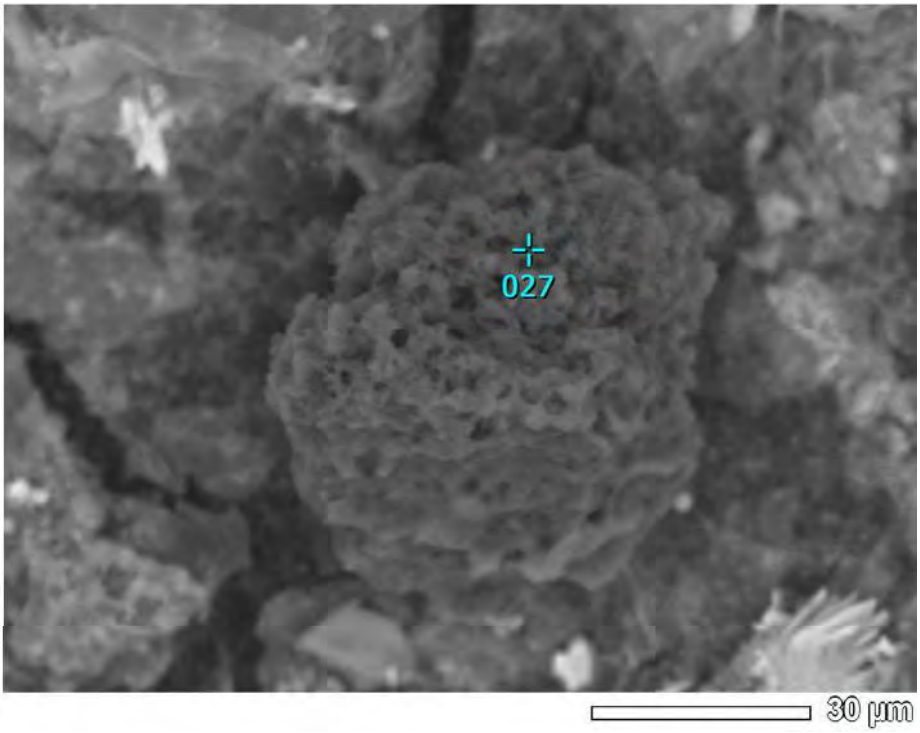


PM1. Mayfield East, UQMP # 13173. An SEM/BSE image of a particulate annotated with 028 is selected for SEM/EDS analysis.

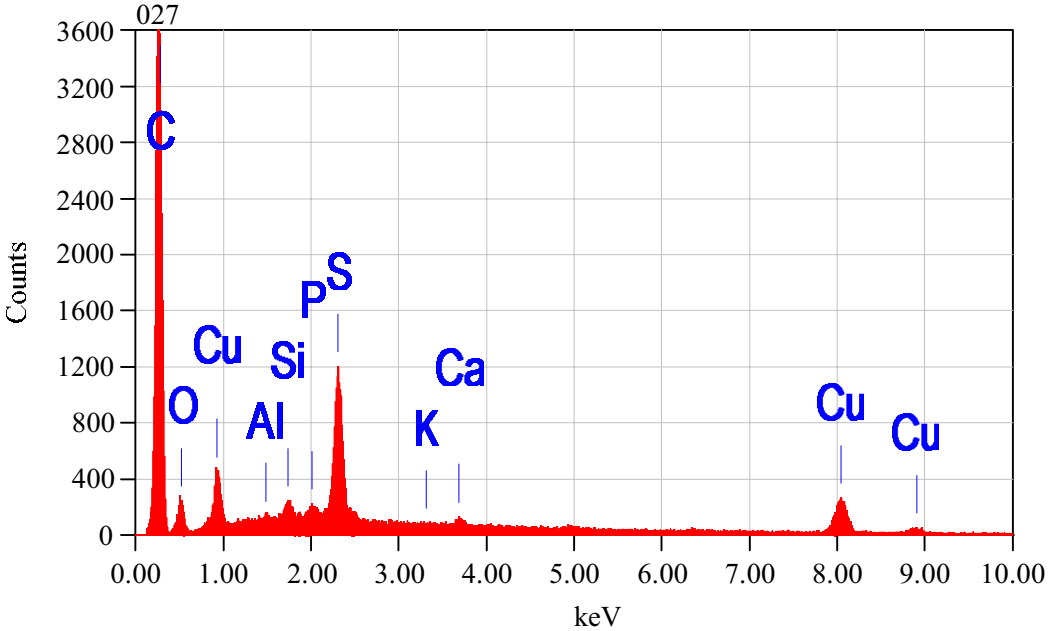


EDS1. Mayfield East, UQMP # 13173. The SEM/EDS spectrum of the particle annotated with 028 shows elevated levels of carbon with minor amounts of aluminium, silicon, sulfur and copper with trace amounts of the balance of the elements. The SEM/EDS spectrum is typical of a coal particle with a minor amount of copper sludge contamination.

6.2 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A SOOT PARTICLE.

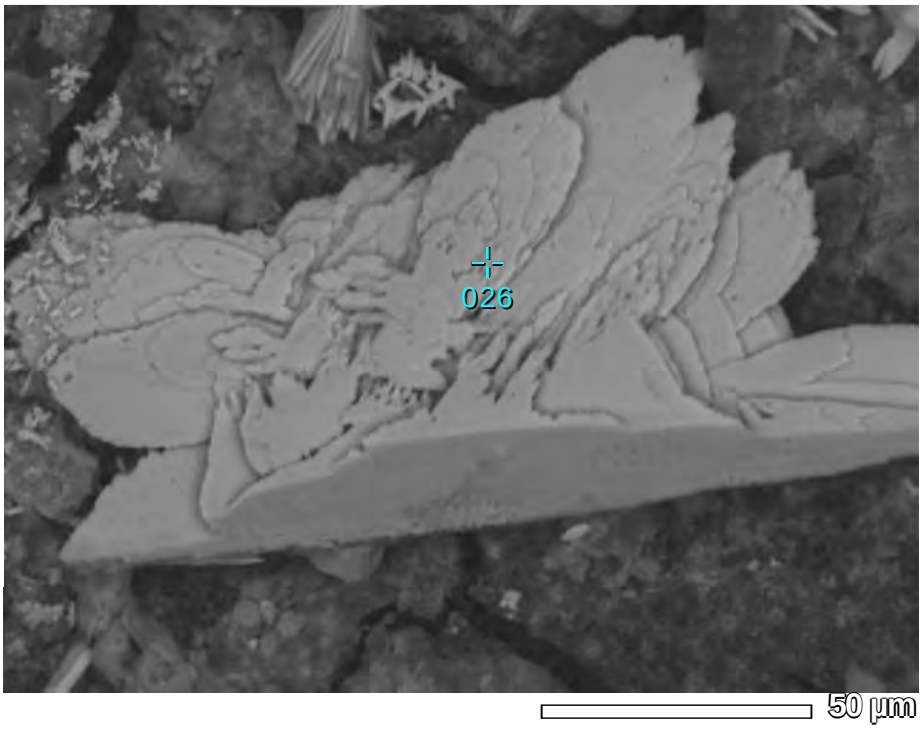


PM2. Mayfield East, UQMP # 13173. An SEM/BSE image of a particulate annotated with 027 is selected for SEM/EDS analysis.

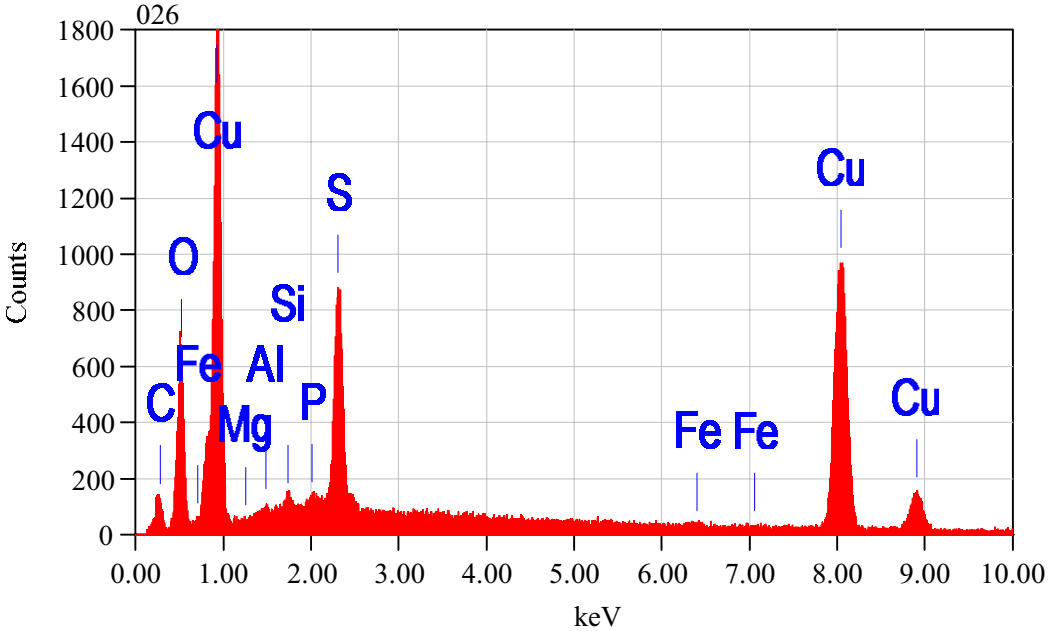


EDS2. Mayfield East, UQMP # 13173. The SEM/EDS spectrum of the particle annotated with 027 shows elevated levels of carbon with minor amounts of sulfur and trace amounts of aluminium, silicon, potassium, calcium and copper. The elemental profile and lacey particle morphology is typical of soot.

6.3 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A COPPER SLUDGE PARTICLE.



PM3. Mayfield East, UQMP # 13173. An SEM/BSE image of a particulate annotated with 026 is selected for SEM/EDS analysis.



EDS3. Mayfield East, UQMP # 13173. The SEM/EDS spectrum of the particle annotated with 026 displays a predominance of copper and sulfur. The spectrum is indicative of copper sludge mostly as copper sulfate.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials and metallurgical consulting, testing and research

Phone +61 7 3365 6123
Fax +61 7 3365 6124
Email enquiries@uqmp.com
Web www.uqmp.com

Frank White Bldg, Cooper Rd, The University of Queensland
St Lucia Qld 4072 Australia

UQMP is a registered business of UniQuest Pty Ltd (ACN 010 529 898)

LABORATORY TEST REPORT

Subject: **EXAMINATION OF A DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. CO2204.02

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 22nd April 2015

Reissued 22nd July 2015 (Sample Dates included in the results section)

Sample Description:

	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Mayfield West Dust Gauge	09/01/2015	06/02/2015	UQMP # 13239

Method Ref: Internal AMCP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The sample was supplied as washings from a dust fallout gauge deposit. The sample was filtered onto a membrane filter and examined by stereomicroscopy to check for particle distribution and general appearance. The sample was very sparsely populated with particulates.

2. RESULTS

A table of results is attached. Appendix A presents the table of results of the combined microscopy observations.

Appendix B displays illustrative SEM photomicrographs and spectra taken of a typical overall are of the Insoluble Matter. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Appendix C demonstrates some of the particulate types of the deposit.

Signed for and on behalf of Applied Materials Characterisation and Performance

Jim Haig

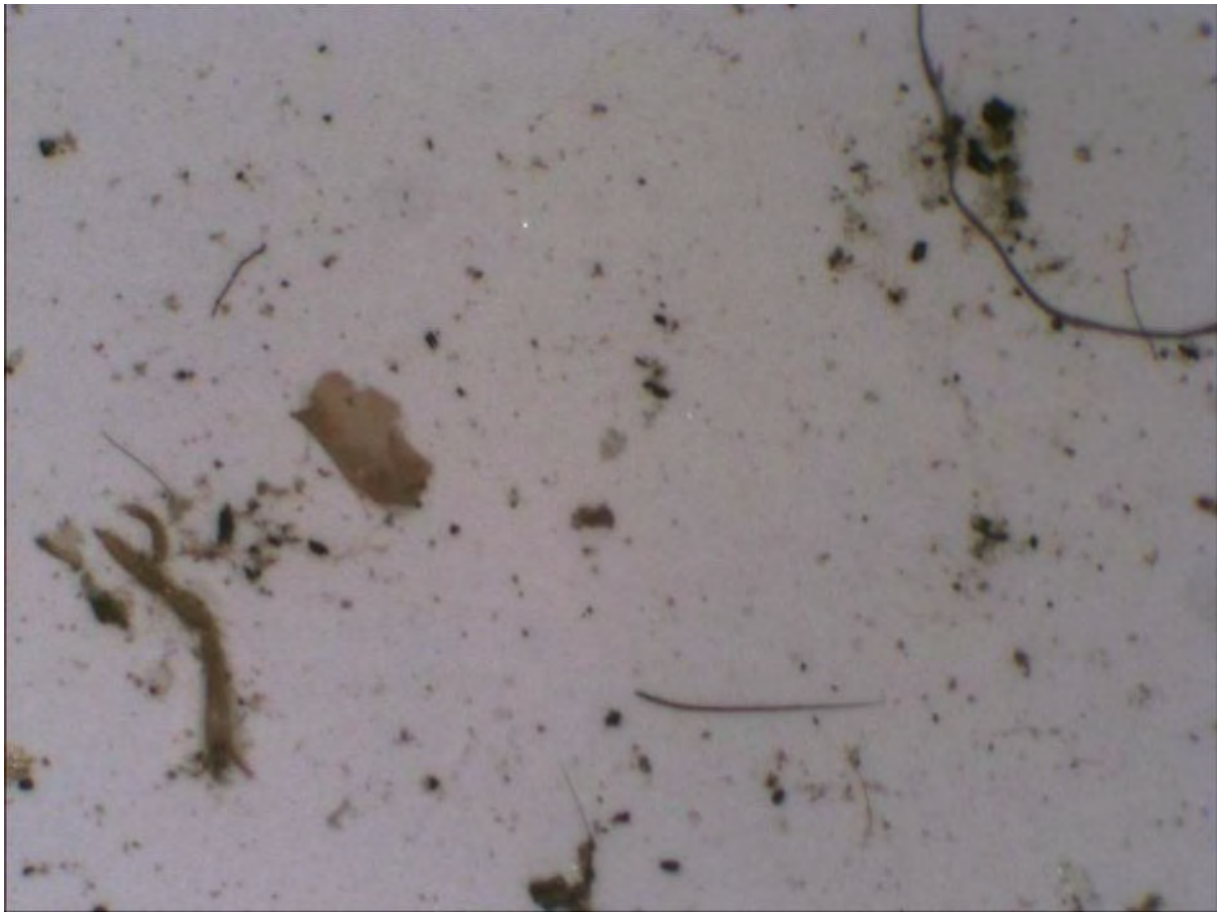
3. TABLE OF RESULTS APPENDIX A

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)
	SAMPLE #	UQMP # 13239
	SAMPLE ID / **PARTICLE TYPE**	Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15)*
BLACK	COAL	5
	SOOT	tr
	BLACK RUBBER DUST	tr
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**95**
	MINERAL DUST (type = Fly Ash)	
	MINERAL DUST (type = Cement Dust)	
	MINERAL DUST (type =glassy)	
	GLASS FRAGMENTS	
	COPPER SLUDGE	tr
	P/S SLIME & FUNGI	
	INSECT DEBRIS	tr
	PLANT DEBRIS (General)	tr
	PLANT DEBRIS (type = plant char)	
	PLANT DEBRIS (type =)	
GENERAL ORGANIC TYPES	WOOD DUST	
	FIBRES (type = Miscellaneous)	
	STARCH	
	PAINT	
	PLASTIC FRAGMENTS	
	RED RUBBER DUST	
COMMENTS		The deposit was very sparsely populated with particulates.

3.1 PARTICLE IDENTITY LEGEND

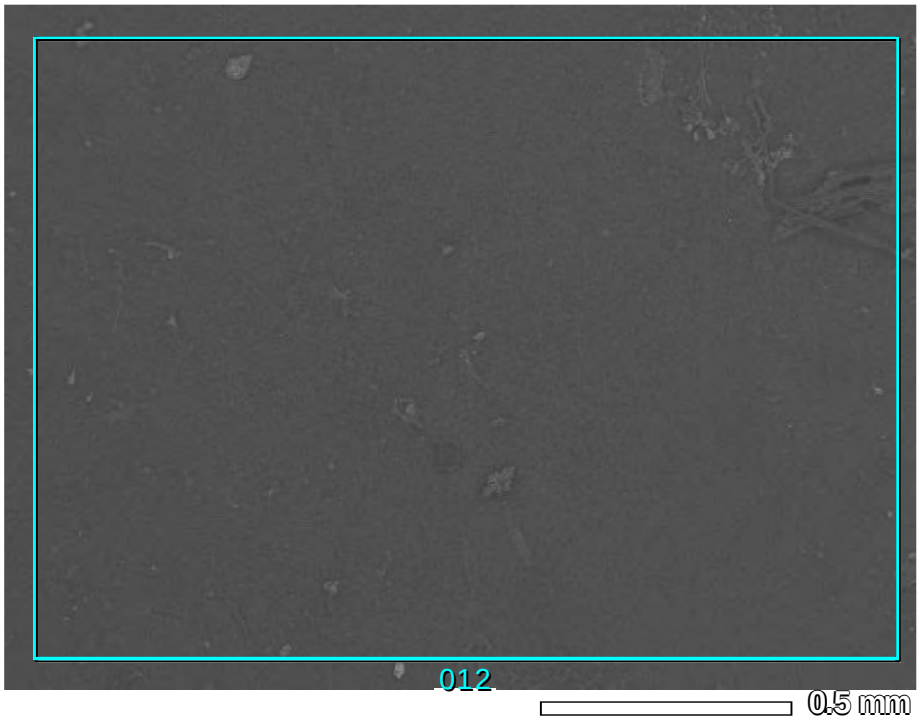
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well-developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black.
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

3.2 STEREOMICROSCPY PICTURE MICROGRAPH

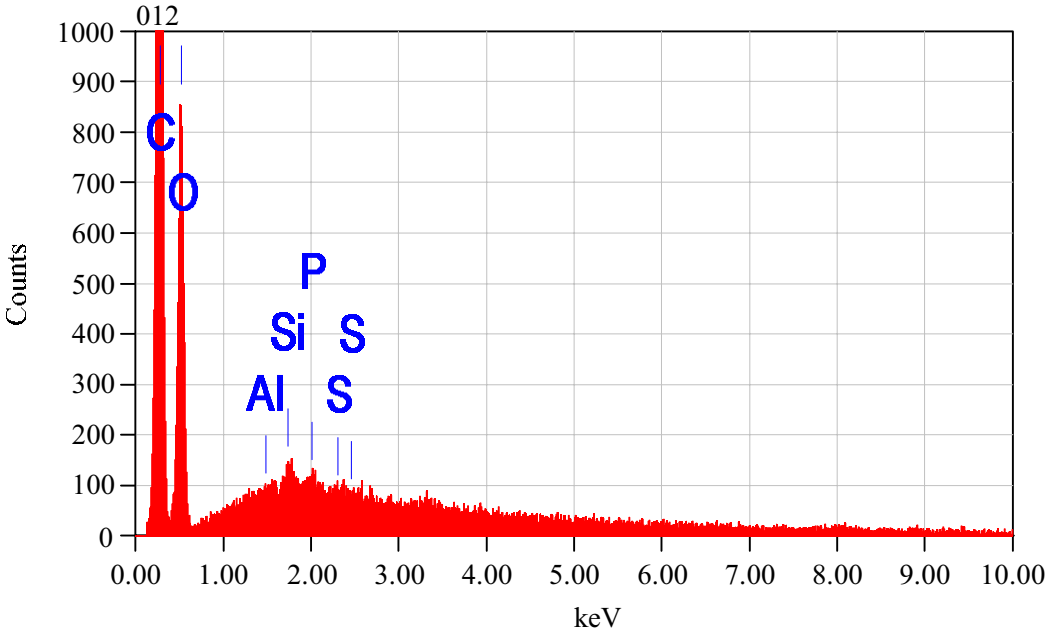


StMPM1. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15)*, UQMP # 13239. The deposit was very sparsely populated with particulates, note the degree of exposed filter.

4. APPENDIX B AN SEM/BSE IMAGE AND SEM/EDS SPECTRUM OF A TYPICAL OVERALL AREA OF THE DEPOSIT



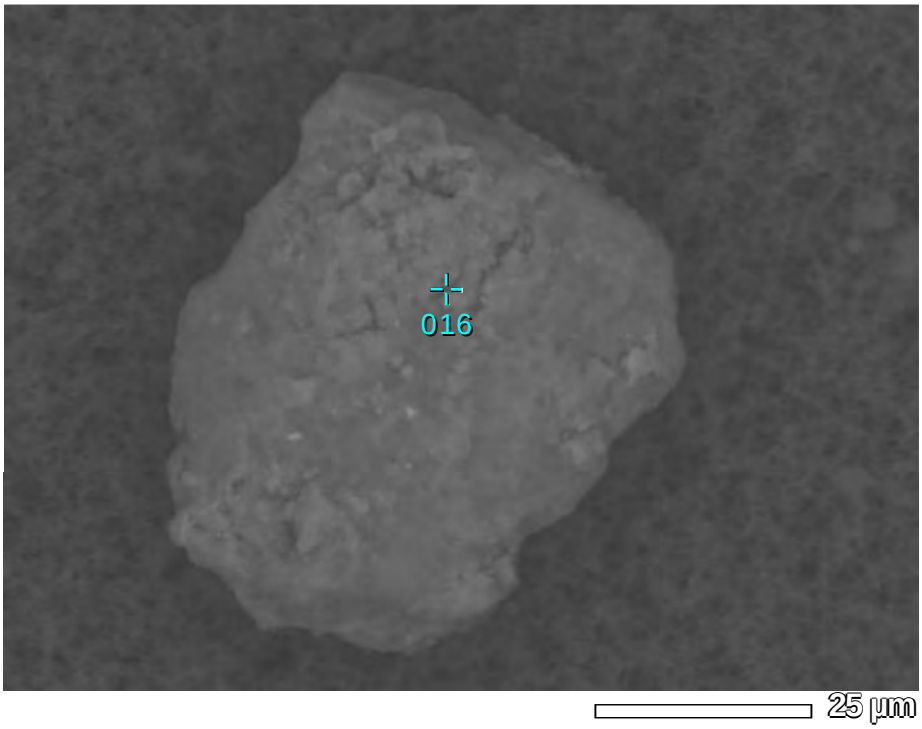
PM1. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15),* UQMP # 13239. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



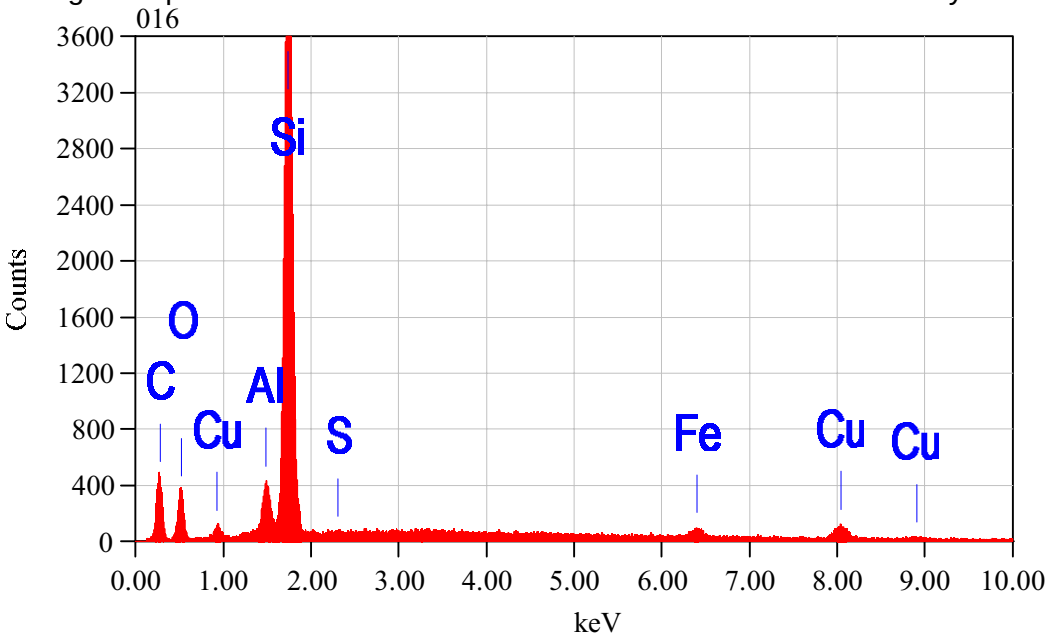
EDS1. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15),* UQMP # 13239. The SEM/EDS spectrum of the overall area is rich in carbon with only traces of aluminium, silicon phosphorous and sulfur. The elevated carbon is representative of the filter and not of the deposit. The microscopy noted a predominance of aluminosilicate rich mineral dust with only minor to trace levels of an organic component. Coal was observed in minor amounts with only traces of soot, rubber dust and insect and plant debris.

5. APPENDIX C

5.1 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A QUARTZ PARTICLE.

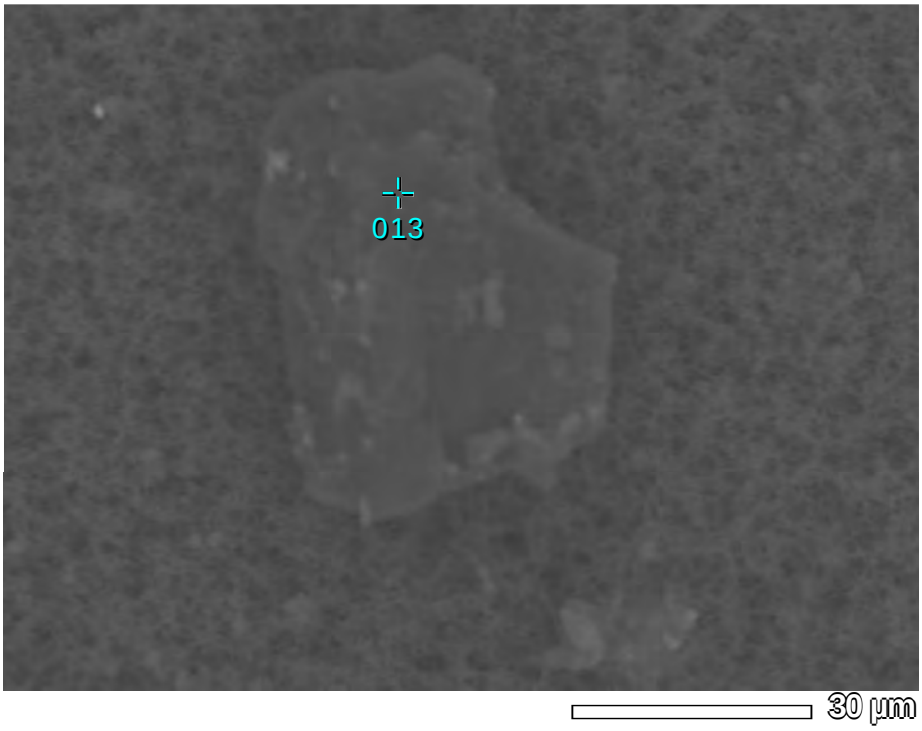


PM1. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15)*, UQMP # 13239. An SEM/BSE image of a particulate annotated with 016 is selected for SEM/EDS analysis.

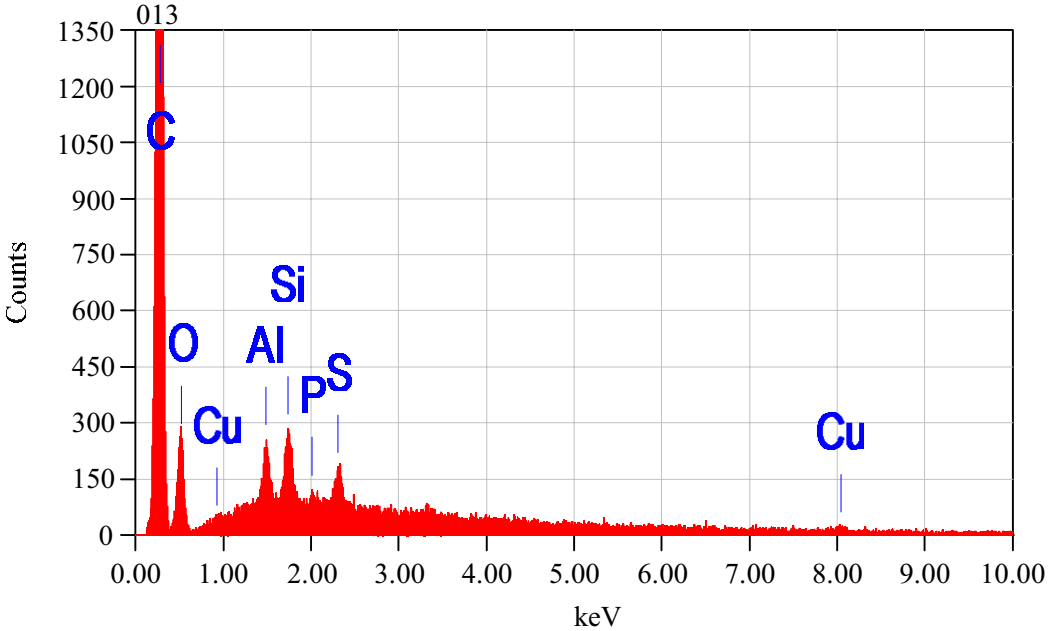


EDS1. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15*), UQMP # 13239. The SEM/EDS spectrum of the particle annotated with 016 shows elevated levels of silicon with trace amounts of carbon, copper, iron and aluminium. The spectrum is typical of a quartz particle.

5.2 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A COAL PARTICLE.

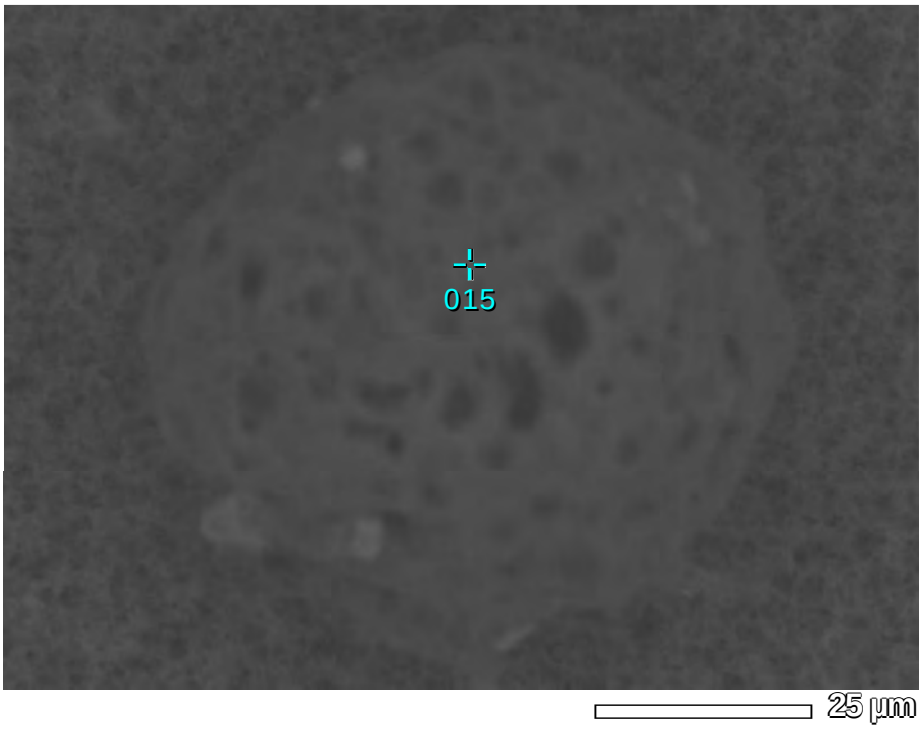


PM2. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15)*, UQMP # 13239. An SEM/BSE image of a particulate annotated with 013 is selected for SEM/EDS analysis.

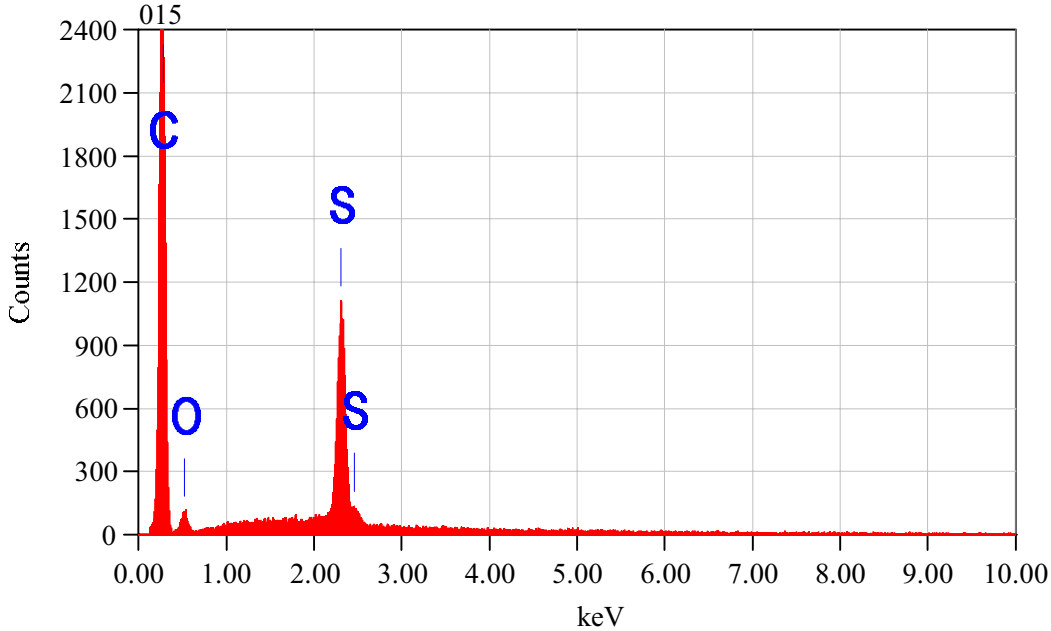


EDS2. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15)*, UQMP # 13239. The SEM/EDS spectrum of the particle annotated with 013 shows elevated levels of carbon with minor amounts of aluminium, silicon and traces of phosphorous, sulfur and copper. The SEM/EDS spectrum displays an elemental profile typical of coal.

5.3 AN SEM/BSE IMAGE AND SEM/EDS SPECTRA OF A SOOT PARTICLE.



PM3. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15)*, UQMP # 13239. An SEM/BSE image of a particulate annotated with 015 is selected for SEM/EDS analysis.



EDS3. Mayfield West Dust Gauge *(Exposed: 09/01/15, Collected: 06/02/15)*, UQMP # 13239. The SEM/EDS spectrum of the particle annotated with 015 consists of two predominant elements carbon and sulfur. The lacey particle morphology and spectrum are indicative of a soot particle.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials and metallurgical consulting, testing and research

Phone +61 7 3365 6123
Fax +61 7 3365 6124
Email enquiries@uqmp.com
Web www.uqmp.com

Frank White Bldg, Cooper Rd, The University of Queensland
St Lucia Qld 4072 Australia

UQMP is a registered business of UniQuest Pty Ltd (ACN 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF A DUST FALLOUT GAUGE DEPOSIT AND LOOSE DUST DEPOSITS BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.05

Prepared for: Hayley Worthington, ALS Environmental

Prepared By: Fiona Jones

Date: 20th April 2015

Reissued: 23rd July 2015 (Sample Dates included in the results section)

Sample Description:	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Tighes Hill, Dust Gauge Deposit	06/02/15	06/03/15	UQMP # 13286
2	Stockton South Brush	06/03/15	06/03/15	UQMP # 13287
3	Roxburgh Street, Stockton Brush	06/03/15	06/03/15	UQMP # 13288
4	Mayfield East Brush	06/03/15	06/03/15	UQMP # 13289
5	Ferndale St, Tighes Hill Brush	06/03/15	06/03/15	UQMP # 13290
6	Forbes St, Carrington Brush	06/03/15	06/03/15	UQMP # 13291
7	Wickham Brush	06/03/15	06/03/15	UQMP # 13292
8	Phillips St, Hamilton North Brush	06/03/15	06/03/15	UQMP # 13293
9	Tighes Hill, Brush	06/03/15	06/03/15	UQMP # 13294
10	Islington Brush	06/03/15	06/03/15	UQMP # 13295
11	Mayfield West Petri	18/02/15	20/02/15	UQMP # 13296
12	Ferndale St Tighes Hill Petri	18/02/15	20/02/15	UQMP # 13297
13	Waratah Petri	18/02/15	20/02/15	UQMP # 13298
14	Islington Petri	18/02/15	20/02/15	UQMP # 13299
15	Kerr St Mayfield Petri	05/03/15	06/03/15	UQMP # 13300
16	Selwyn Street Tighes Hill Petri	05/03/15	06/03/15	UQMP # 13301

1. INTRODUCTION

One sample was supplied as washings from a dust fallout gauge deposit. The dust gauge sample was filtered onto a membrane filter whilst the petri dish samples were mounted directly onto carbon tape and examined by stereomicroscopy to check for particle distribution and general appearance.

2. RESULTS

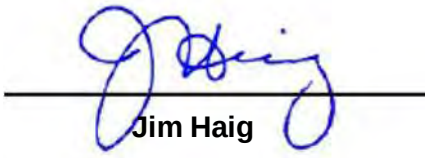
Appendix A attached presents the table of results of the combined microscopy observations.

Appendix B presents colour picture micrographs of the stereomicroscopy images.

Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. Some of the deposits were very sparse and the resulting spectra displayed erroneous levels of carbon, this has been noted during the discussion of each spectrum.

Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of Applied Materials Characterisation and Performance



Jim Haig

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13286	UQMP # 13287	UQMP # 13288
	SAMPLE ID / **PARTICLE TYPE**	*Tighes Hill Dust Gauge Deposit (Exposed: 06/02/15, Collected 06/03/15).*	*Stockton South Brush (Exposed: 06/03/15, Collected: 06/03/15).*	*Roxburgh Street, Stockton Brush (Exposed 06/03/15. Collected 06/03/15).*
BLACK	COAL		5	10
	SOOT	tr	2	10
	BLACK RUBBER DUST		tr	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**50**	**68**	**65**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =alumina)			
	GLASS FRAGMENTS			
	COPPER SLUDGE	20		
	P/S SLIME & FUNGI	30		
	INSECT DEBRIS			5
	PLANT DEBRIS (General)		20	
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr	5	10
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS		The deposit was encapsulated in polysaccharide slime and copper sludge.		

3.2 TABLE OF COMBINED MICROSCOPY RESULTS

APPENDIX A

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13289	UQMP # 13290	UQMP # 13291
	SAMPLE ID / **PARTICLE TYPE**	*Mayfield East Brush (Exposed: 06/03/15, Collected: 06/03/15).*	*Ferndale St, Tighes Hill Brush (Exposed: 06/03/15, Collected: 06/03/15).*	*Forbes St, Carrington Brush (Exposed: 06/03/15, Collected: 06/03/15)*
BLACK	COAL	tr	5	5
	SOOT	tr	Tr	
	BLACK RUBBER DUST	tr	tr	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**95**	**80**	**90**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Halite)	5	5	5
	MINERAL DUST (type = Alumina)	tr		tr
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS		tr	
	PLANT DEBRIS (General)		5	
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST		tr	
	FIBRES (type = Miscellaneous)	tr	5	tr
	STARCH			
	PAINT	tr	tr	tr
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

3.3 TABLE OF COMBINED MICROSCOPY RESULTS

APPENDIX A

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13292	UQMP # 13293	UQMP # 13294
	SAMPLE ID **PARTICLE TYPE**	*Wickham Brush (Exposed: 06/03/15, Collected: 06/03/15.)*	*Phillips St, Hamilton North Brush (Exposed: 06/03/15, Collected: 06/03/15)*	*Tighes Hill, Brush (Exposed: 06/03/15, Collected: 06/03/15)*
BLACK	COAL	20	tr	tr
	SOOT	2	tr	tr
	BLACK RUBBER DUST	tr		tr
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**73**	**80**	**90**
	MINERAL DUST (type = Cement Dust)		tr	
	MINERAL DUST (type = Halite)	tr	10	tr
	MINERAL DUST (type = alumina)	tr		tr
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS		tr	
	PLANT DEBRIS (General)	5	5	
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST	tr	5	10
	FIBRES (type = Miscellaneous)		tr	tr
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				Very Sparse

3.4 TABLE OF COMBINED MICROSCOPY RESULTS

APPENDIX A

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13295	UQMP # 13296	UQMP # 13297
	SAMPLE ID **PARTICLE TYPE**	*Islington Brush* (Exposed: 06/03/15, Collected: 06/03/15)	*Mayfield West Petri* (Exposed: 18/02/15, Collected: 20/02/15)	*Ferndale St, Tighes Hill Petri* (Exposed: 18/02/15, Collected: 20/02/15)
BLACK	COAL	10	5	10
	SOOT	5	tr	5
	BLACK RUBBER DUST			tr
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**55**	**75**	**65**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	10		tr
	PLANT DEBRIS (General)	20	20	20
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)			
	STARCH			
	PAINT			tr
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

3.5 TABLE OF COMBINED MICROSCOPY RESULTS

APPENDIX A

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13298	UQMP # 13299	UQMP # 13300
	SAMPLE ID **PARTICLE TYPE**	*Waratah Petri (Exposed: 18/02/15, Collected: 20/02/15)*	Islington *(Exposed: 18/02/15, Collected: 20/02/15)*	Kerr St, Mayfield Petri *(Exposed: 05/03/15, Collected: 06/03/15)*
BLACK	COAL	10	5	tr
	SOOT	tr	tr	tr
	BLACK RUBBER DUST	tr	tr	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**60**	**90**	**70**
	MINERAL DUST (type = Halite)	20	5	20
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	tr	tr
	PLANT DEBRIS (General)	10	tr	10
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST		tr	tr
	FIBRES (type = Miscellaneous)	tr		tr
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

3.6 TABLE OF COMBINED MICROSCOPY RESULTS

APPENDIX A

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)
	SAMPLE #	UQMP # 13301
	SAMPLE ID	Selwyn Street, Tighes Hill Petri *(Exposed: 18/02/15, Collected: 20/02/15)*
	PARTICLE TYPE	
BLACK	COAL	10
	SOOT	tr
	BLACK RUBBER DUST	10
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**50**
	MINERAL DUST (type = Halite)	20
	MINERAL DUST (type = Cement Dust)	
	MINERAL DUST (type =glassy)	
	GLASS FRAGMENTS	
	COPPER SLUDGE	
	P/S SLIME & FUNGI	
	INSECT DEBRIS	tr
	PLANT DEBRIS (General)	10
	PLANT DEBRIS (type = plant char)	
	PLANT DEBRIS (type =)	
GENERAL ORGANIC TYPES	WOOD DUST	
	FIBRES (type = Miscellaneous)	
	STARCH	
	PAINT	
	PLASTIC FRAGMENTS	
	RED RUBBER DUST	
COMMENTS		

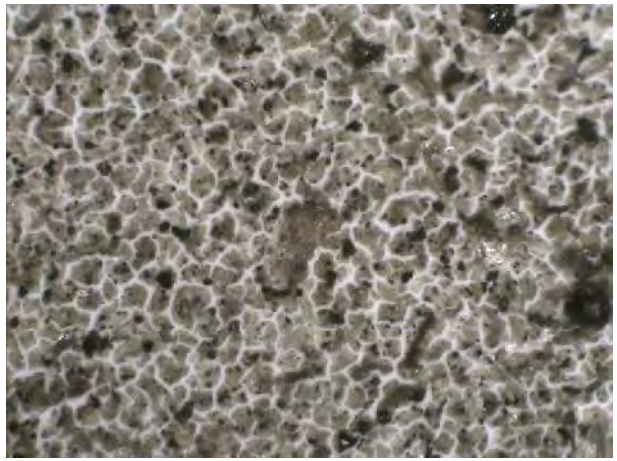
3.7 PARTICLE IDENTITY LEGEND

APPENDIX A

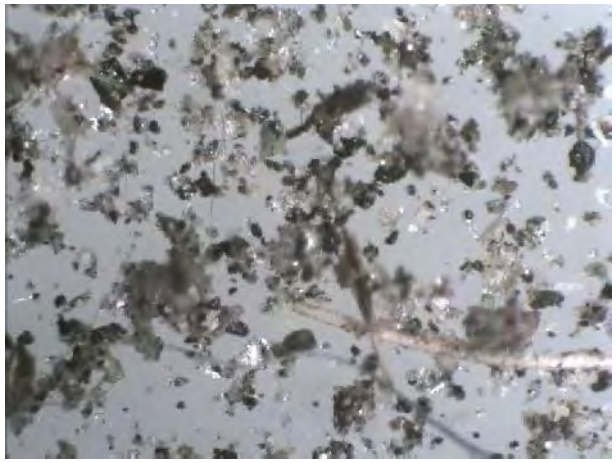
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

4. APPENDIX B

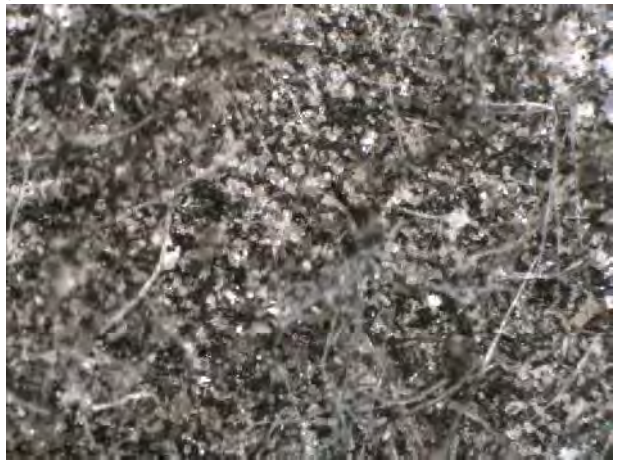
4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS



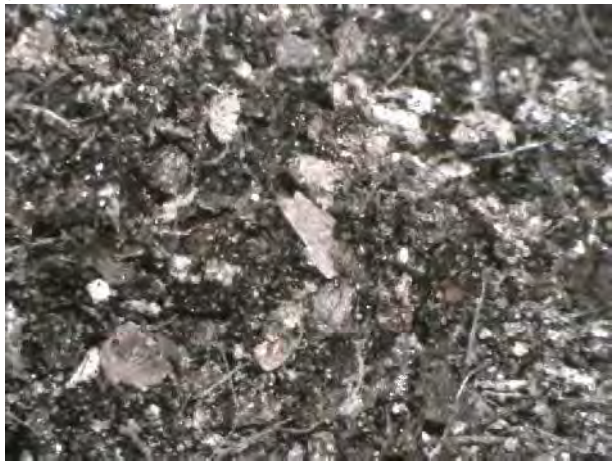
StMPM1. Tighes Hill Dust Gauge Deposit (Exposed: 06/02/15, Collected 06/03/15), UQMP # 13286



StMPM2. Stockton South Brush, Petri Dish (Exposed 06/03/15. Collected 06/03/15), UQMP # 13287



StMPM3. Roxburgh Street, Stockton Brush (Exposed 06/03/15. Collected 06/03/15), UQMP # 13288.



StMPM4. Mayfield East Brush (Exposed 06/03/15. Collected 06/03/15), UQMP # 13289.

4.2 STEREOMICROSCOPY PICTURE MICROGRAPHS

StMPM5. Ferndale St, Tighes Hill Brush (Exposed 06/03/15. Collected 06/03/15), UQMP # 13290.

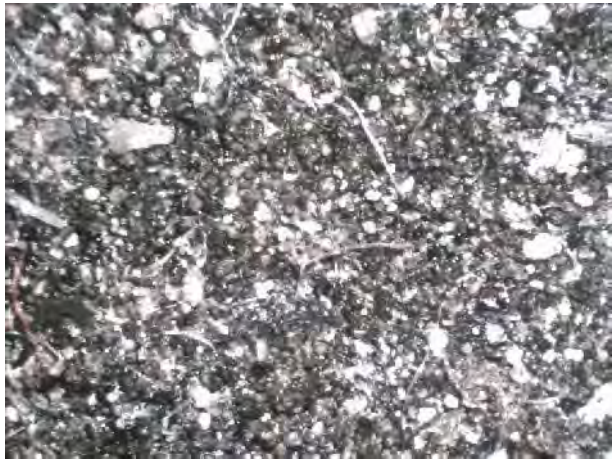
StMPM6. Forbes St, Carrington Brush (Exposed 06/03/15. Collected 06/03/15), UQMP # 13291

StMPM7. Wickham Brush (Exposed 06/03/15. Collected 06/03/15), UQMP # 13292.

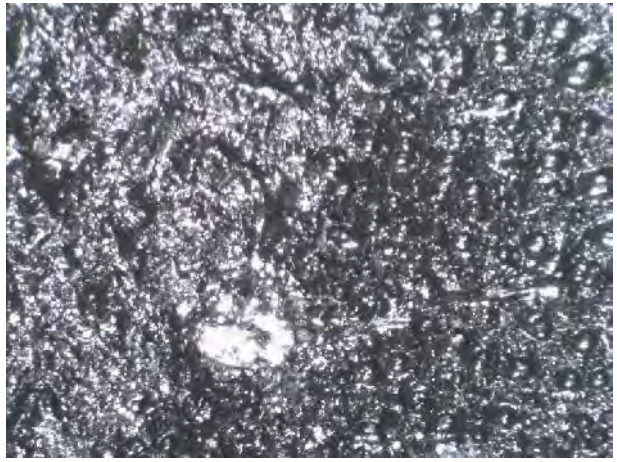
StMPM8. Phillips St, Hamilton North Brush (Exposed 06/03/15. Collected 06/03/15), UQMP # 13293.

4.3 STEREOMICROSCOPY PICTURE MICROGRAPHS

StMPM9. Tighes Hill, Brush (Exposed 06/03/15. Collected 06/03/15), UQMP # 13294.



StMPM10. Islington Brush (Exposed 06/03/15. Collected 06/03/15), UQMP # 13295.

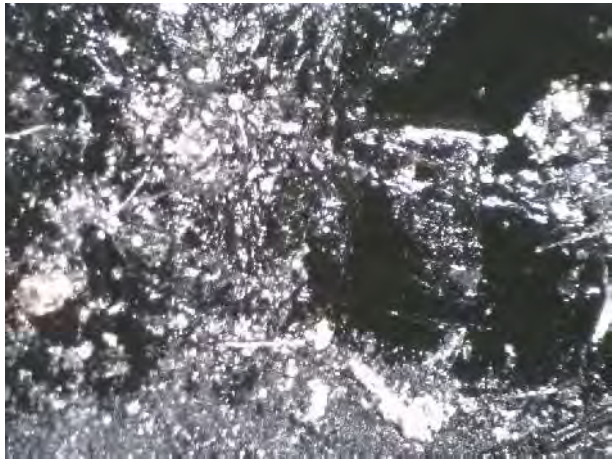


StMPM11. Mayfield West Petri (Exposed 18/02/15. Collected 20/02/15), UQMP # 13296.

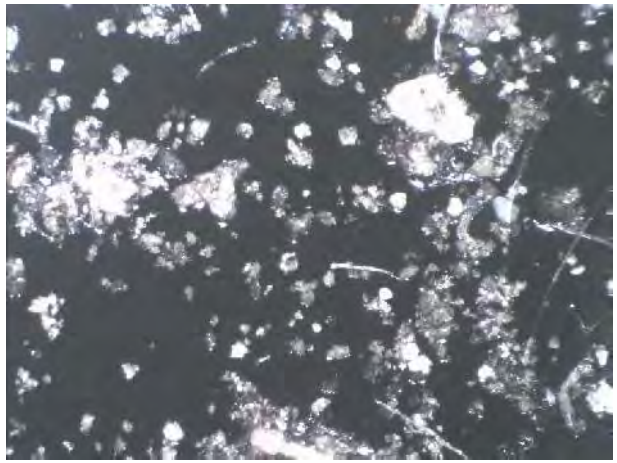
StMPM12. Ferndale St, Tighes Hill Petri (Exposed 18/02/15. Collected 20/02/15), UQMP #13297

4.4 STEREOMICROSCOPY PICTURE MICROGRAPHS

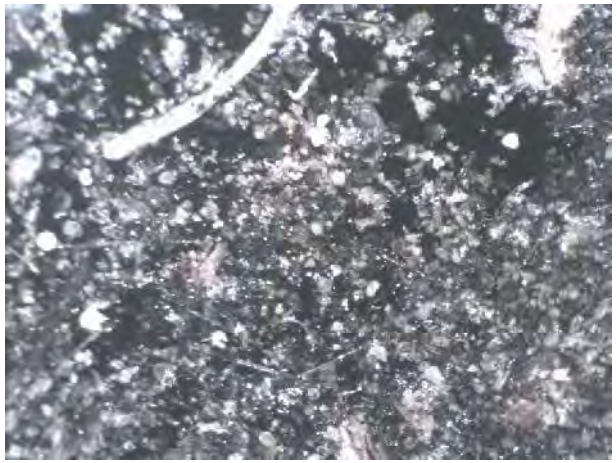
StMPM13. Waratah Petri (Exposed 18/02/15. Collected 20/02/15), UQMP # 13298.



StMPM14. Islington Petri (Exposed 18/02/15. Collected 20/02/15), UQMP # 13299



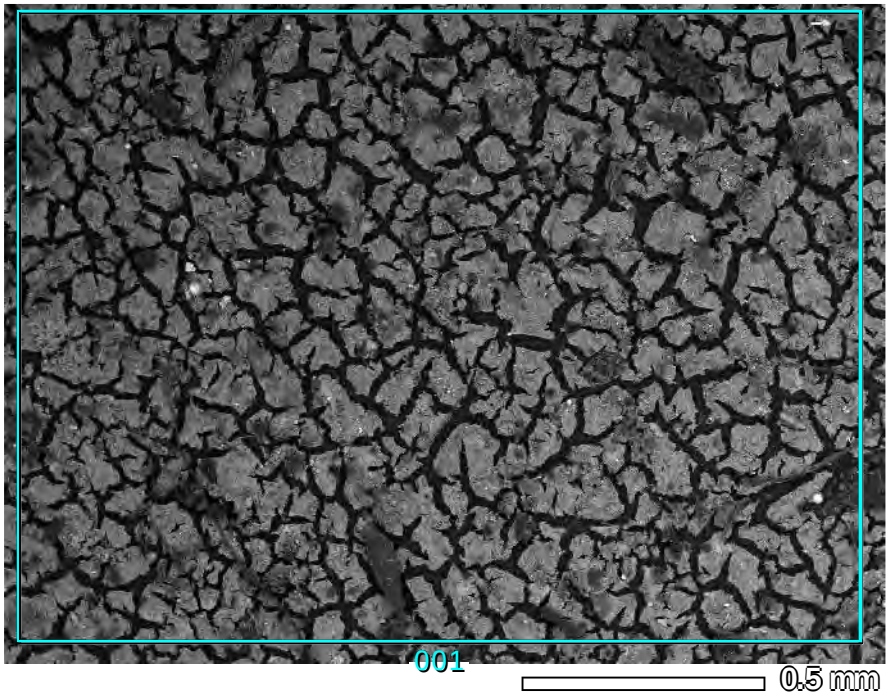
StMPM15. Kerr St, Mayfield Petri (Exposed 05/03/15. Collected 06/03/15), UQMP # 13300.



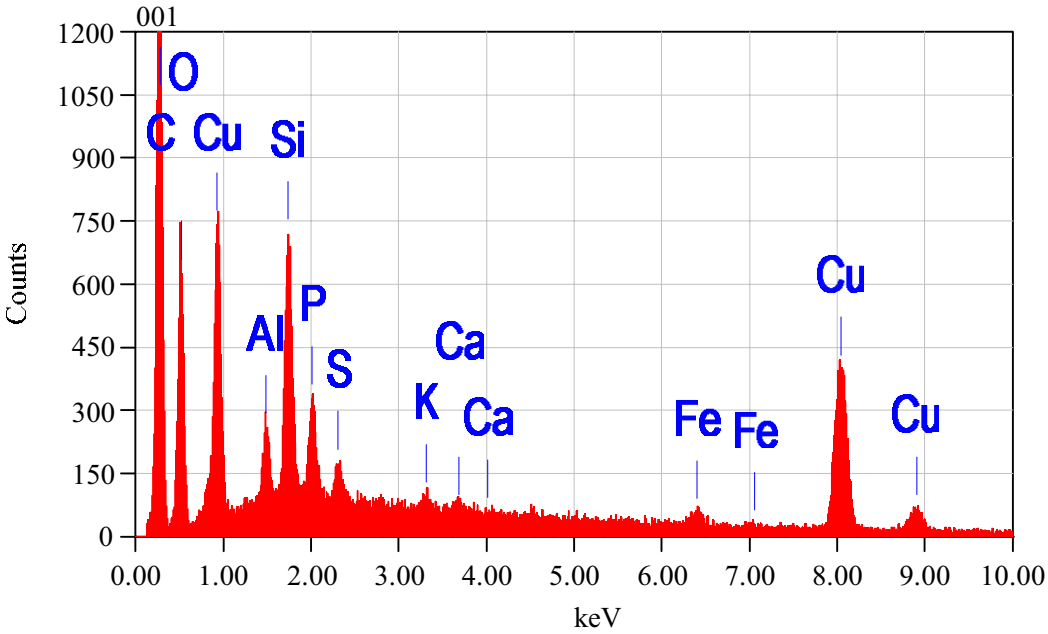
StMPM16. Selwyn Street, Tighes Hill Petri (Exposed 05/03/15. Collected 06/03/15), UQMP # 13301

5. APPENDIX C

5.1 SEM/BSE IMAGE AND SEM/EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT



PM1. Tighes Hill Dust Gauge Deposit *(Exposed: 06/02/15, Collected 06/03/15), UQMP # 13286*. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



EDS1. Tighes Hill Dust Gauge Deposit *(Exposed: 06/02/15, Collected 06/03/15)*, *UQMP # 13286*. The SEM/EDS spectrum of the overall area is rich in carbon, silicon, aluminium, copper and phosphorous the balance of the elements are considered trace level. The EDS analysis confirms the microscopy observation of a polysaccharide slime and copper sludge encased deposit, only a few particles are visible on the surface.

5.2 SEM BSE IMAGE AND SEM/EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

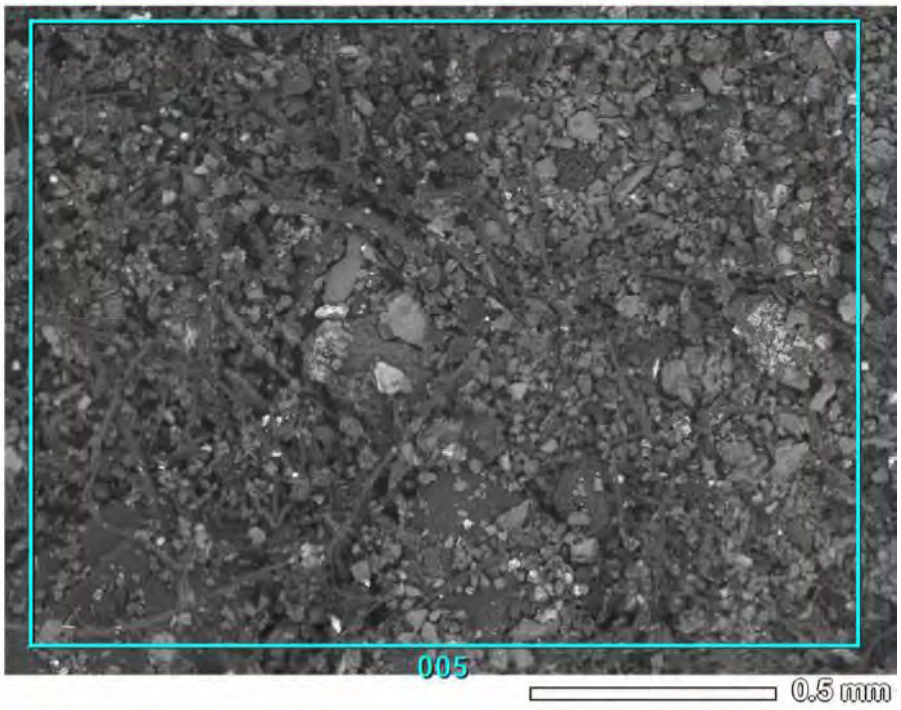
An overall area was not possible as insufficient particles were present.

PM2. Stockton South Brush *(Exposed: 06/03/15, Collected: 06/03/15).*

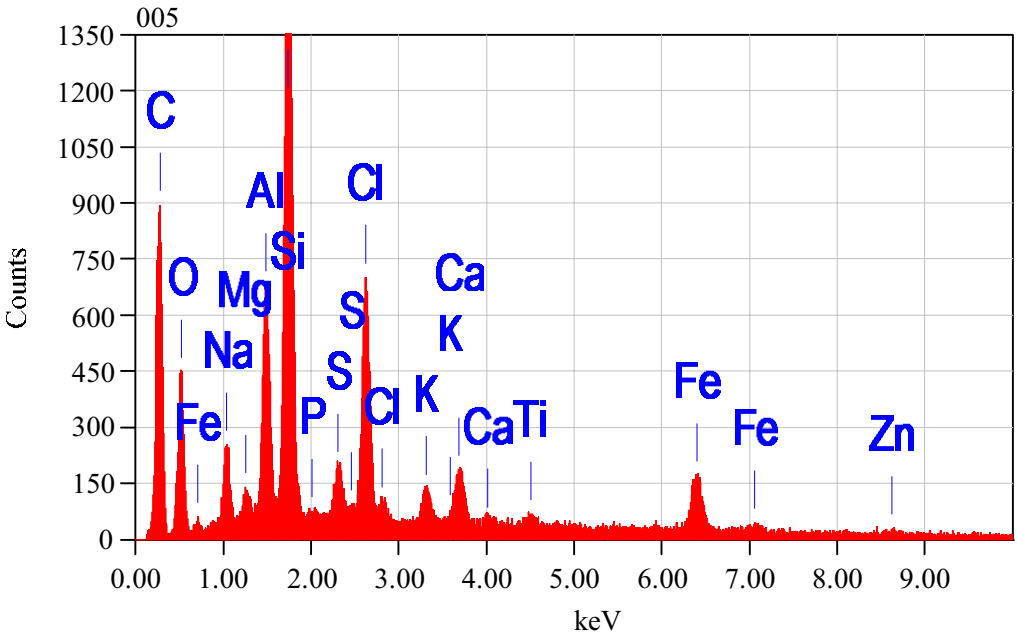
An SEM/EDS spectrum was not performed due to insufficient particles.

EDS2. Stockton South Brush *(Exposed: 06/03/15, Collected: 06/03/15.*

5.3 SEM/BSE IMAGE AND SEM/EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

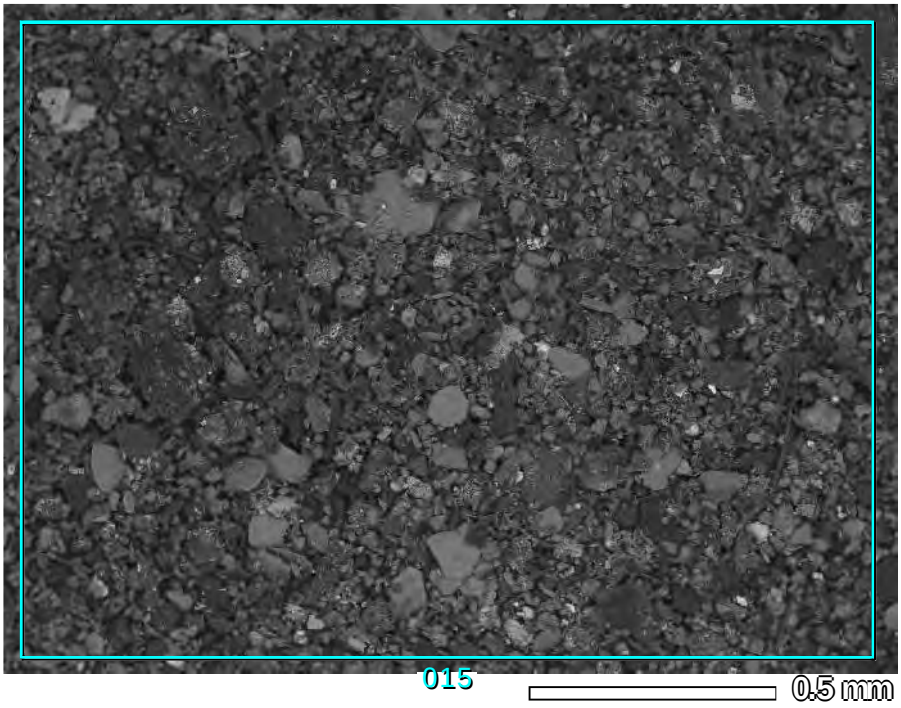


PM3. Roxburgh Street, Stockton Brush *(Exposed: 06/03/15, Collected: 06/03/1*5) UQMP # 13288. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

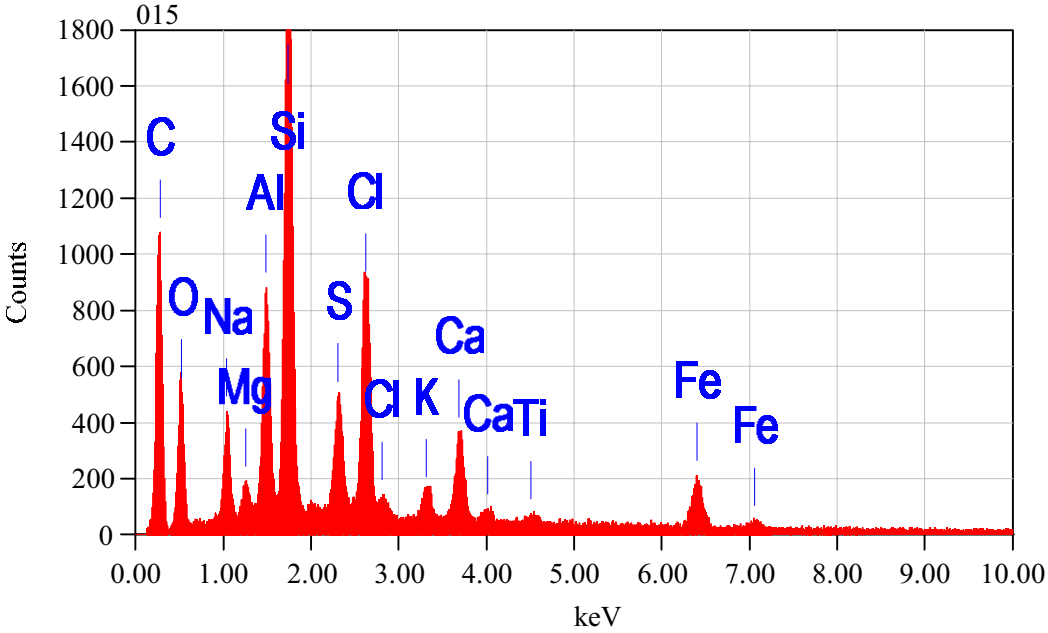


EDS3. Roxburgh Street, Stockton Brush *(Exposed: 06/03/15, Collected: 06/03/1*5) UQMP # 13288. The SEM/EDS spectrum of the overall area consists predominantly of carbon aluminium and silicon with minor amounts of chloride and iron the remaining elements are at trace levels. The major particulate was aluminosilicate rich mineral dust with the organic component consisting of minor amounts of coal, soot, insect debris and fibres.

5.4 SEM/BSE IMAGE AND SEM/EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

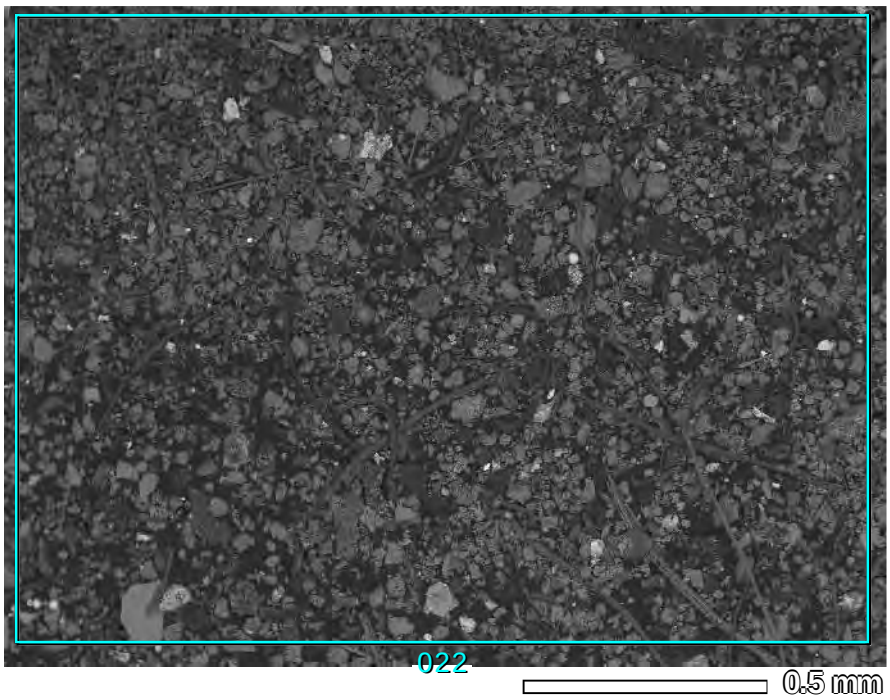


PM4. Mayfield East Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13289. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

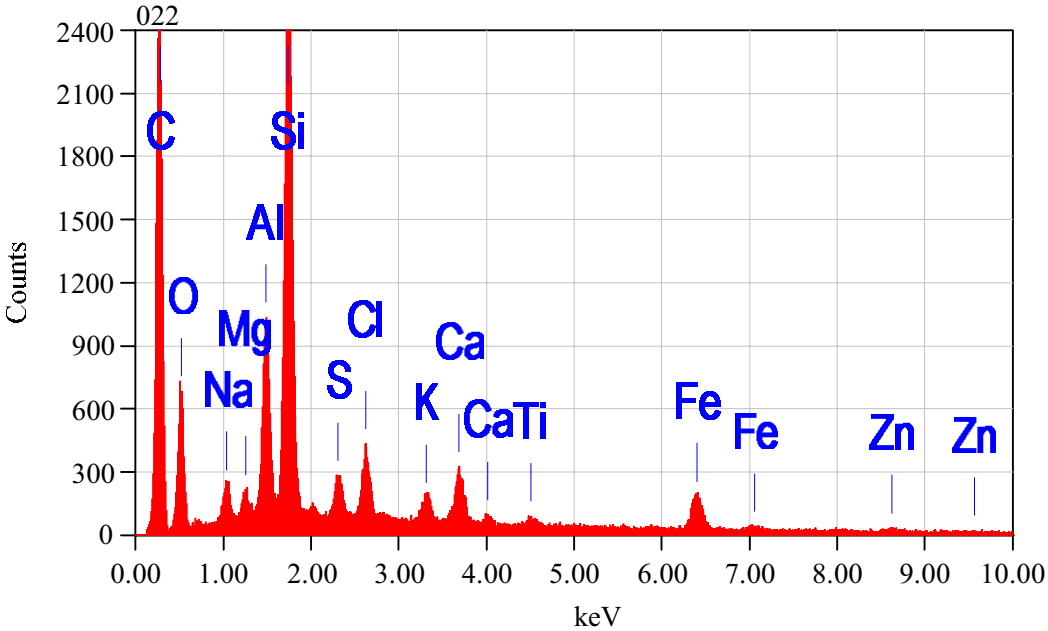


EDS4. Mayfield East Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13289. The SEM/EDS spectrum of the overall
area is rich in carbon, aluminium, silicon, sodium and chloride with minor amounts of calcium and iron and trace levels of the remaining elements. Inorganic mineral dust was the predominant particle type consisting mosly of aluminosilicate rich types with a minor amount of halite and traces of alumina. The organic particulates were observed at trace levels and included coal, soot, rubber dust, fibres and paint.

5.5 SEM/BSE IMAGE AND EDS SPECTRUMOF AN OVERALL AREA OF THE DEPOSIT

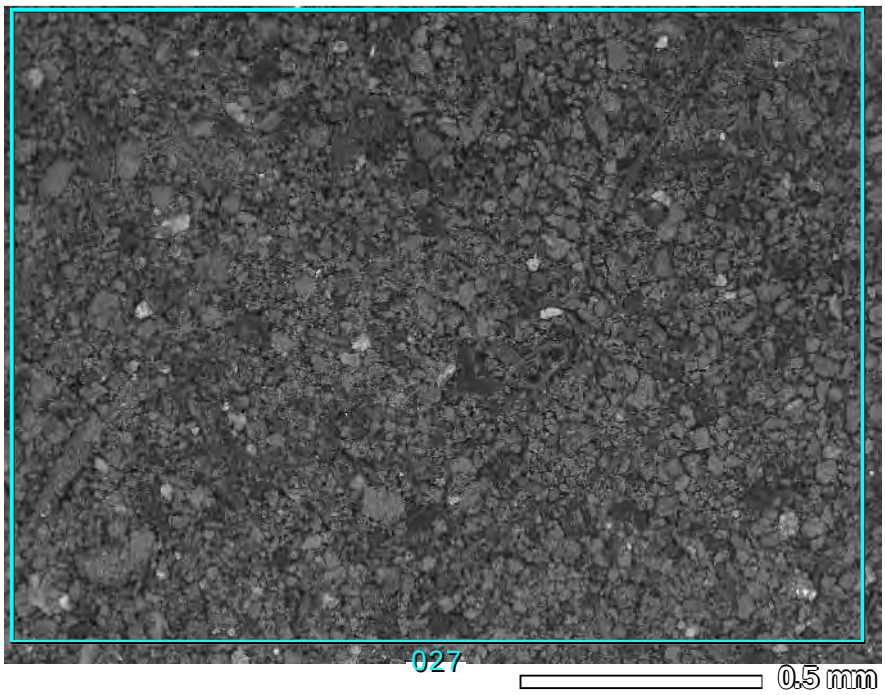


PM5. Ferndale St, Tighes Hill Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13290. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

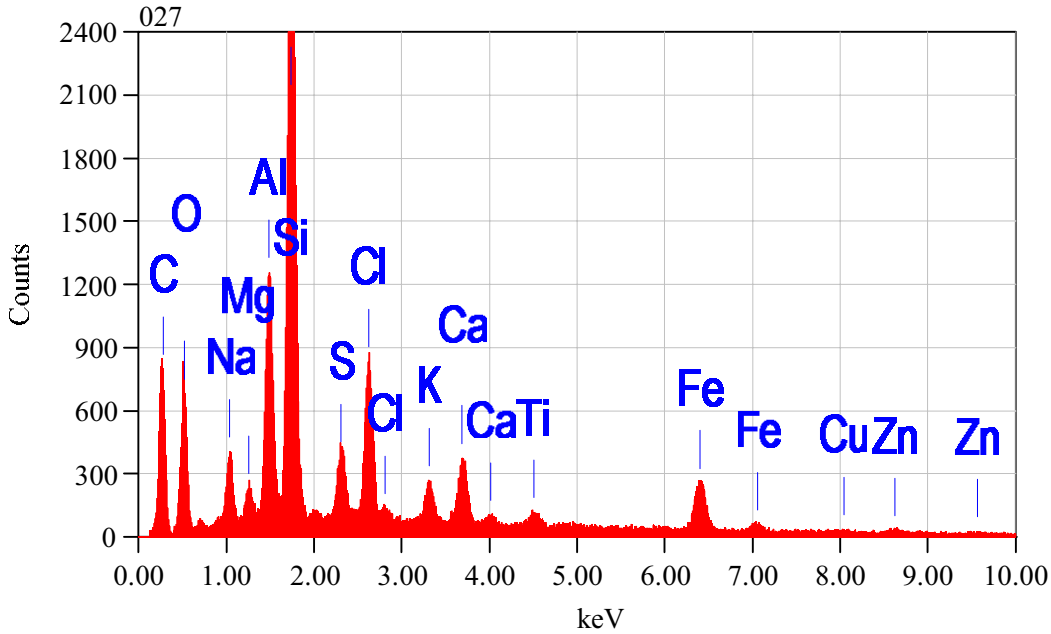


EDS5. Ferndale St, Tighes Hill Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13290. The SEM/EDS spectrum of the overall area is rich in carbon, silicon and aluminium with minor amounts of sulfur, potassium, calcium, iron, sodium and chloride the remaing elements are trace level. Aluminosilicate based mineral dust is the dominant particle type whilst the organic component consisted of a number of particles at trace level and included coal, soot, rubber dust, fibres and paint.

5.6 SEM/BSE IMAGE AND EDS SPECTRUMOF AN OVERALL AREA OF THE DEPOSIT

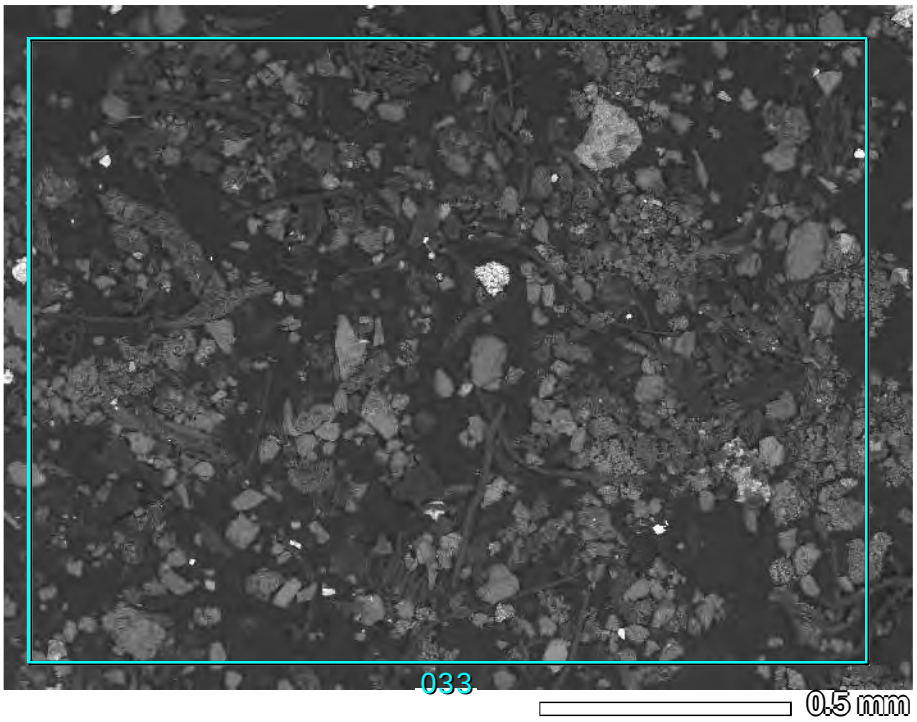


PM6. Forbes St, Carrington Brush *(Exposed: 06/03/15, Collected: 06/03/15*), UQMP # 13291. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

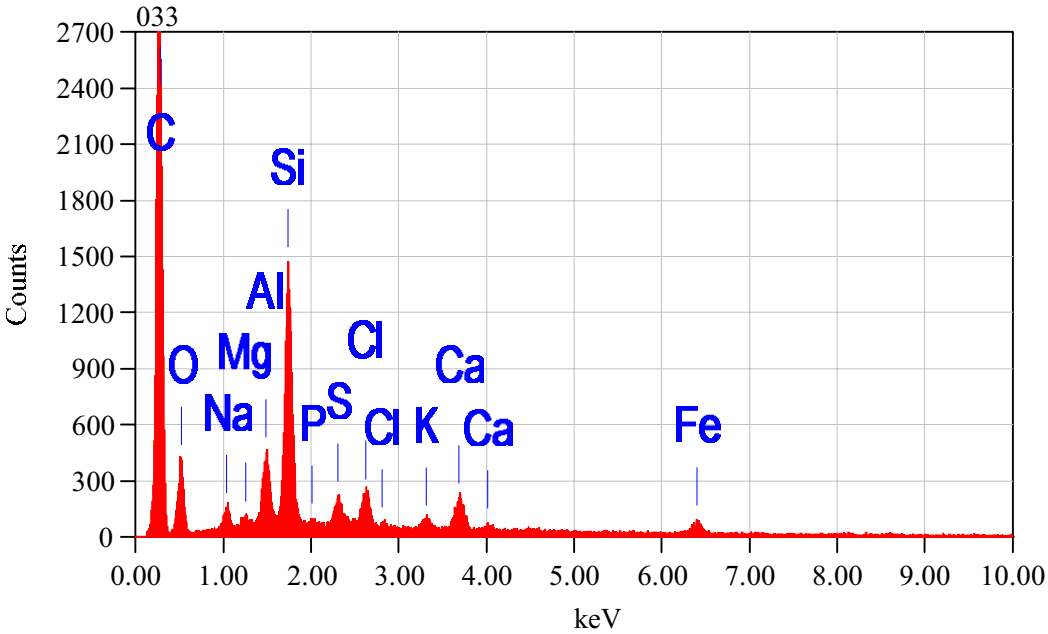


EDS6. Forbes St, Carrington Brush *(Exposed: 06/03/15, Collected: 06/03/15*), UQMP # 13291. Aluminium, silicon, carbon and chloride are the major elements of the spectrum with minor amounts of sodium, calcium and iron and trace amounts of the balance of the elements. Aluminosilicate based mineral dust and halite are the major particle types with organic contributions from coal and traces of fibres and paint.

5.7 SEM/BSE IMAGE AND EDS SPECTRUMOF AN OVERALL AREA OF THE DEPOSIT

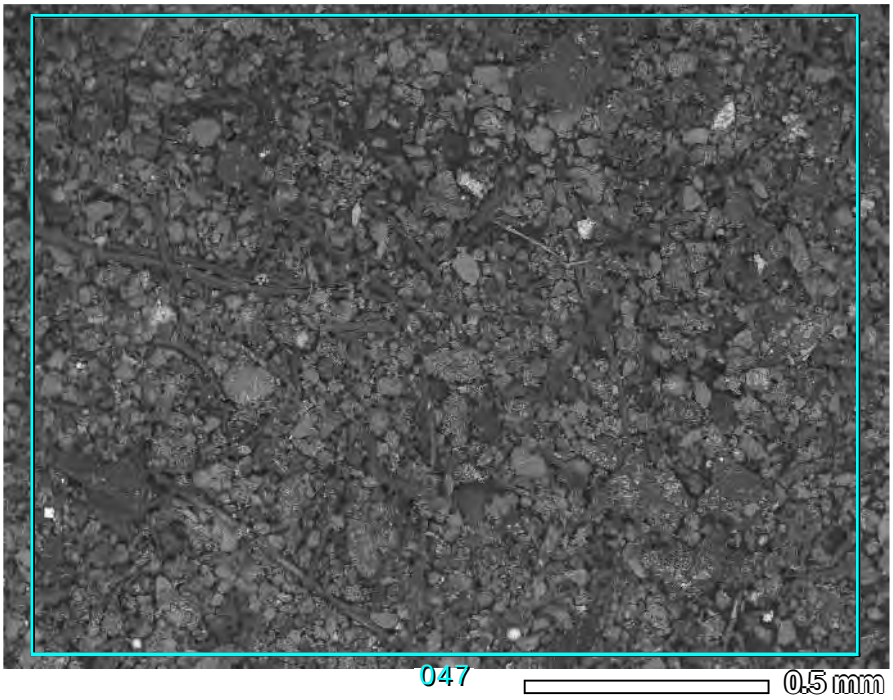


PM7. Wickham Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13292**.** An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

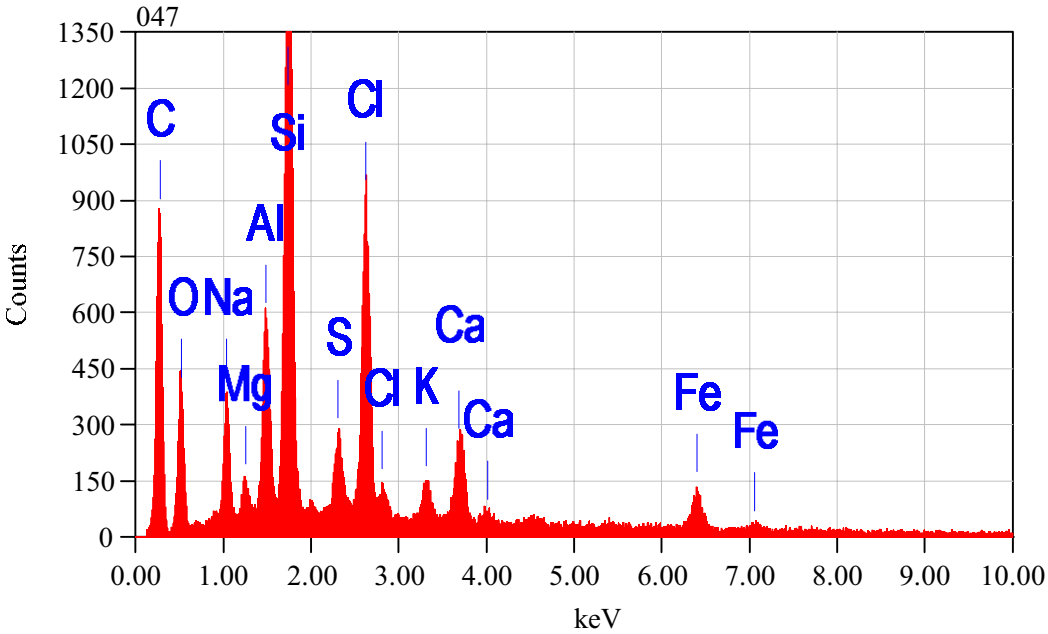


EDS7. Wickham Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13292**.** The SEM/EDS spectrum of the overall area is rich in carbon and silicon with minor amounts of magnesium and trace amounts of the balance of the elements. The elevated carbon reflects the exposed carbon tape and is not representative of the sample. Minor amounts of coal, plant debris, soot and wood dust were observed by stereomicroscopy with the majority of the sample being aluminosilicate based soil or rock dust.

5.8 SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

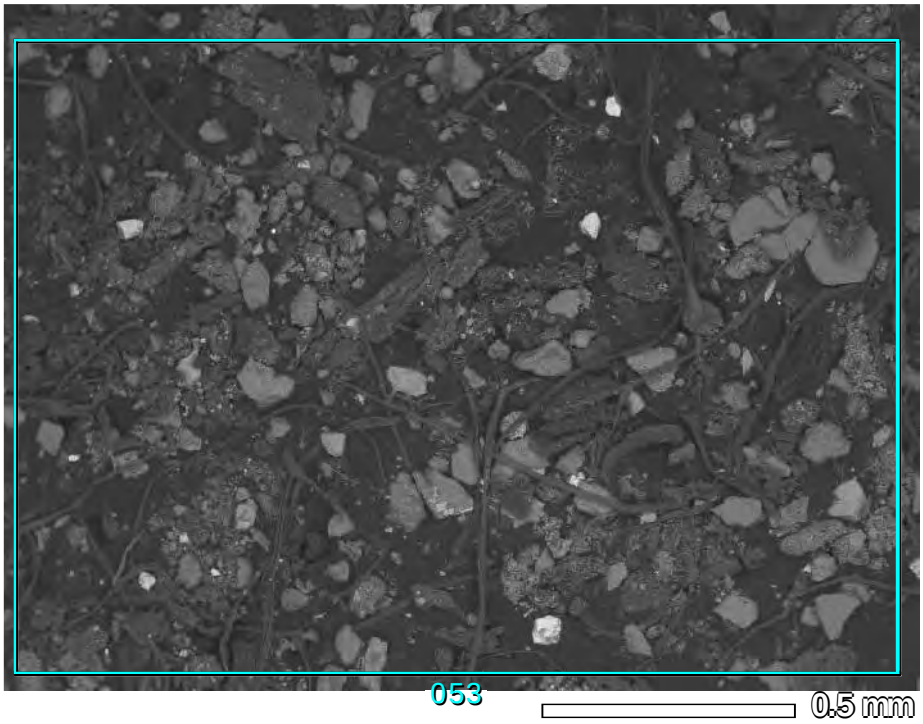


PM8. Phillips St, Hamilton North Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13293. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

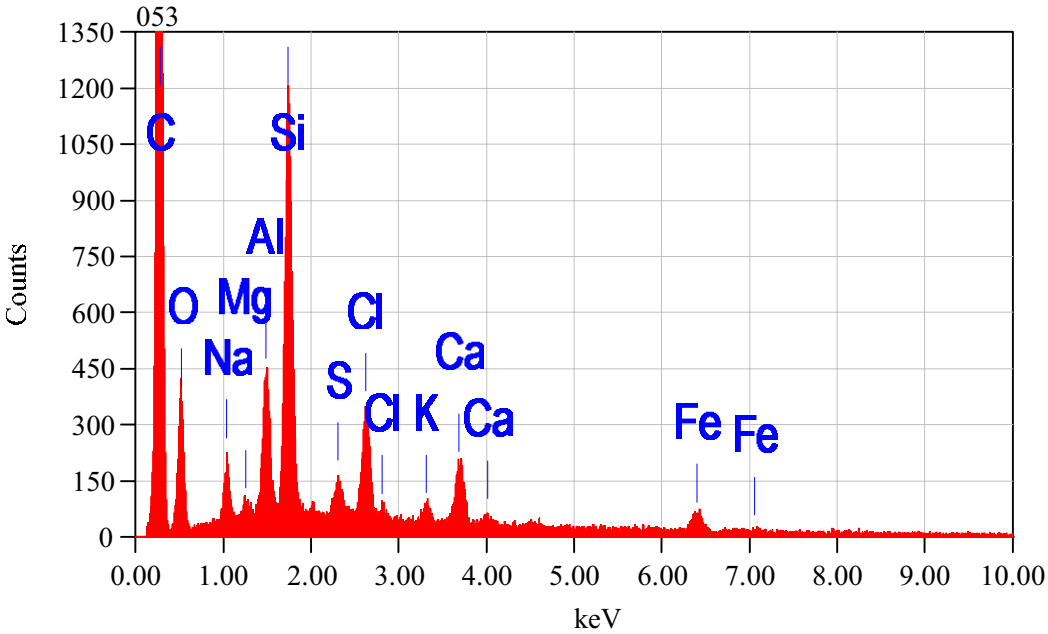


EDS8. Phillips St, Hamilton North Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13293. Carbon, aluminium, silicon and chloride are the predominant elements of the SEM/EDS spectrum with minor amounts of sodium, calcium and iron, the remaining elements are at trace levels. The SEM/EDS analysis confirm the microscopy observations and note the predominance of aluminium and silicon based mineral dust with an organic component of minor amounts of plant debris, wood dust and traces of coal, soot, fibres and insect debris.

5.9 SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

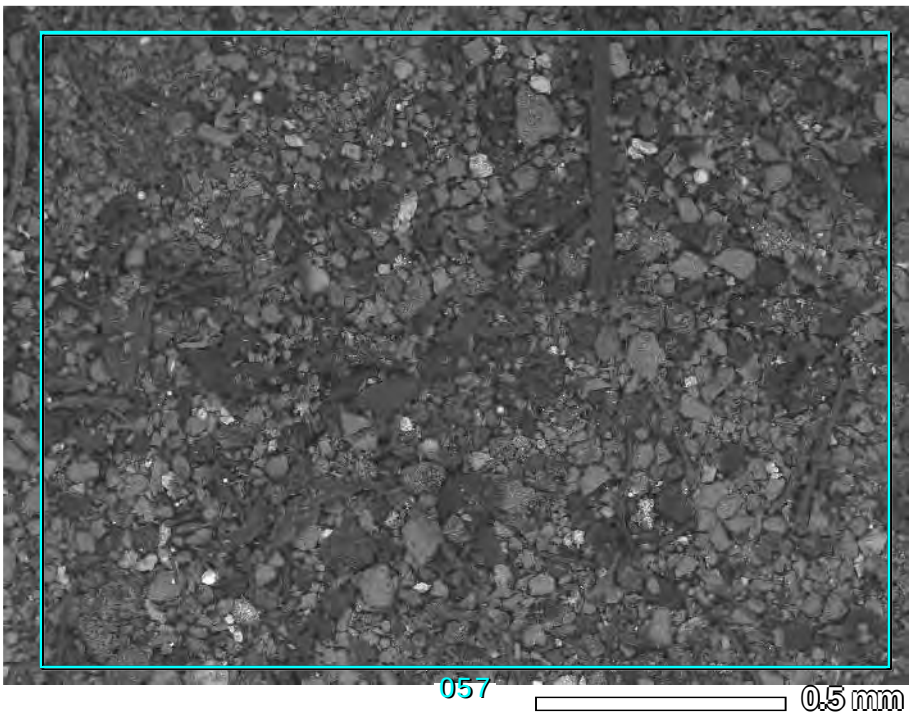


PM9. Tighes Hill, Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13294. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

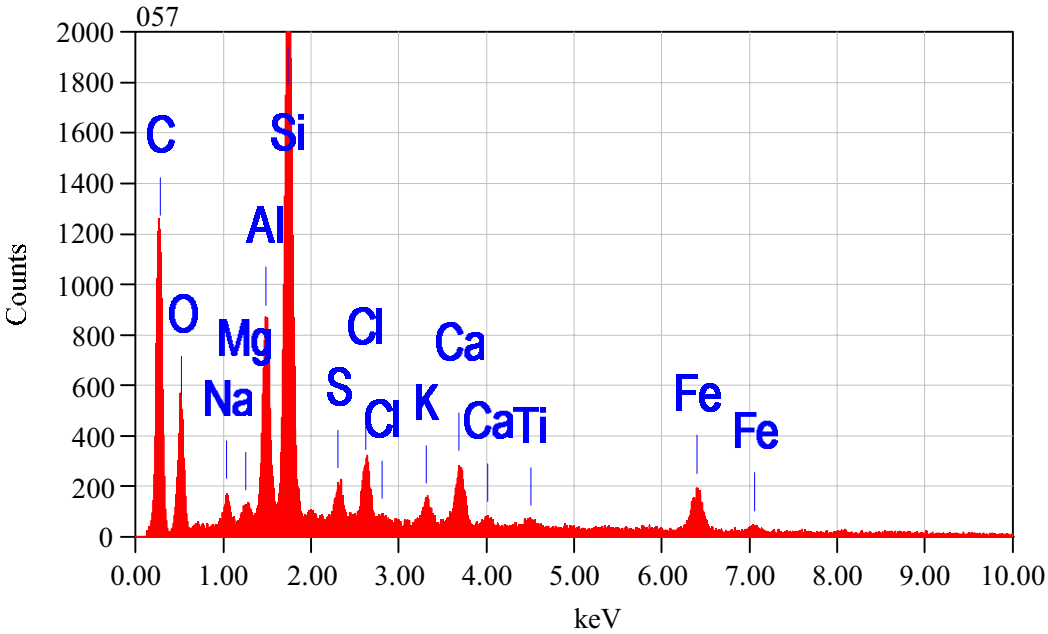


EDS9. Tighes Hill, Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13294. The SEM/EDS spectrum of the overall area is rich in carbon, sodium, magnesium, aluminium, silicon, chloride and calcium with trace amounts of magnesium, potassium and iron. The deposit consisted of few particulates and as a result the carbon tape was not evenly dispersed with particulates therefore the elevated carbon contains contributions from the exposed carbon tape. Carbon contributing particles included minor amounts of wood dust and traces of coal, soot, rubber dust and fibres. Major particle types were aluminium and silicon based mineral dust traces of halite, alumina and iron rich particles were also noted.

5.10 SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT



PM10. Islington Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13295. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



EDS10. Islington Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13295. The SEM/EDS spectrum of the overall area is rich in carbon, aluminium and silicon with trace amounts of the balance of the elements. Organic particulates were a major contributors and included coal, soot, insect and plant debris the balance of the particulates were soil or rock dust.

5.11 SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

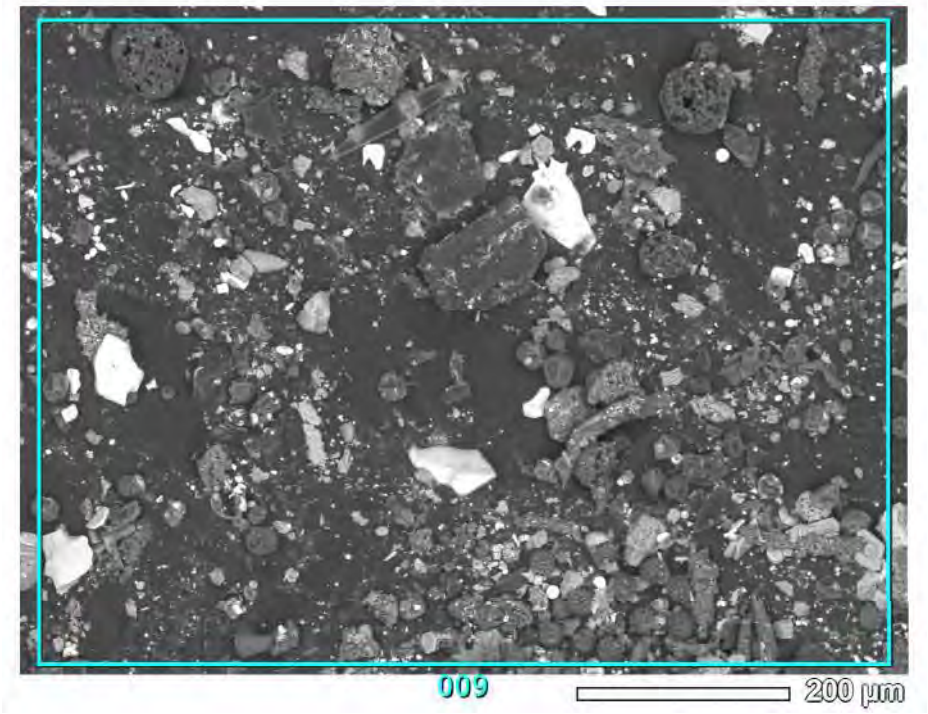
An overall area was not possible as insufficient particles were present.

PM11. Mayfield West Petri *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP # 13296.

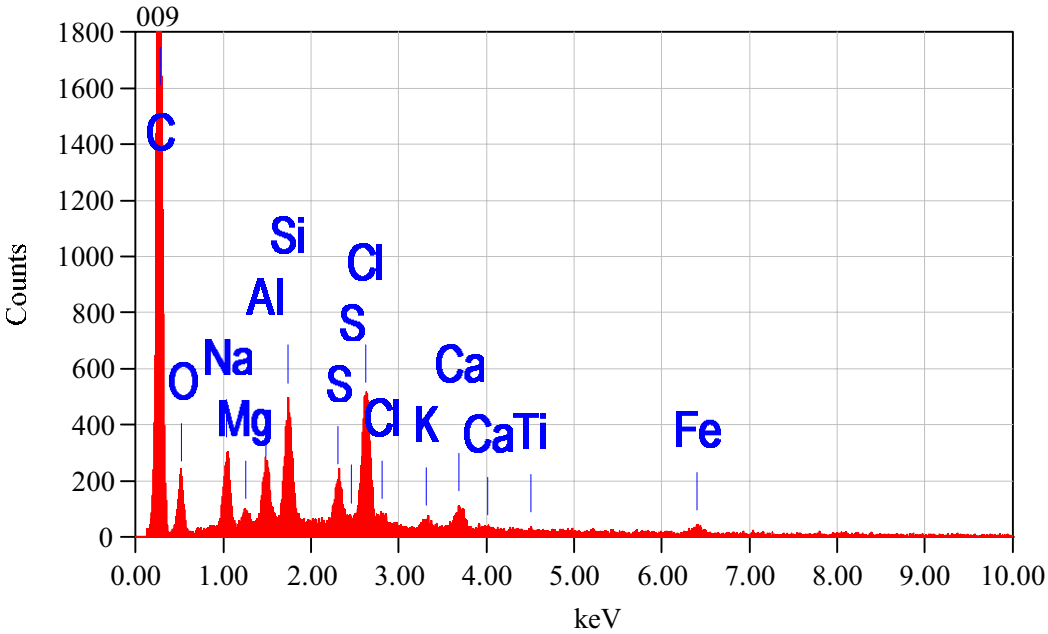
Insufficient particles available for SEM/EDS analysis

EDS11. Mayfield West Petri *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP # 13296.

5.12 SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

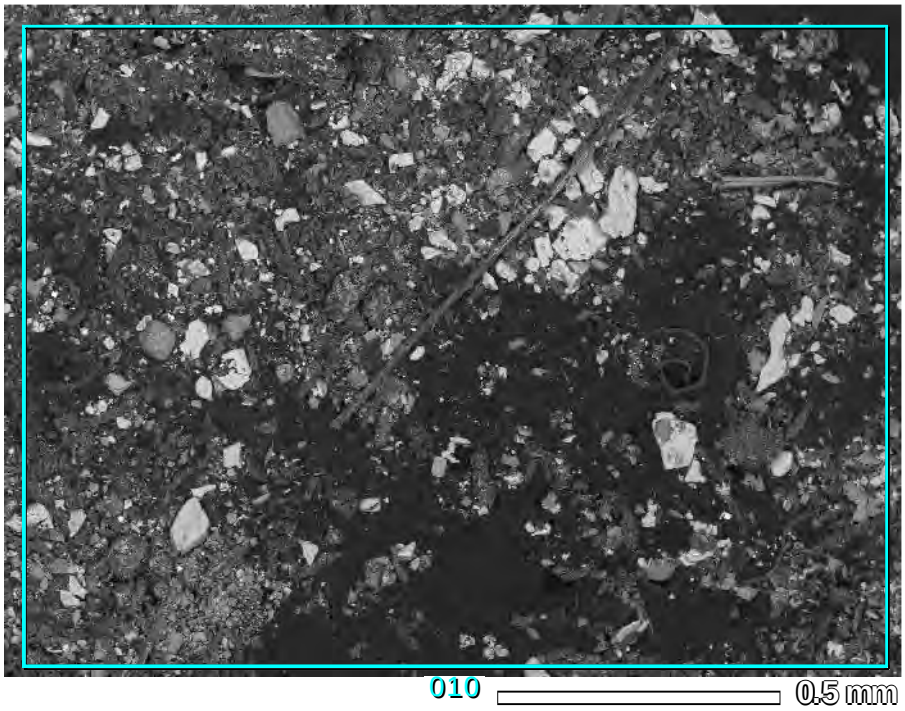


PM12. Ferndale St, Tighes Hill Petri *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP 13297. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

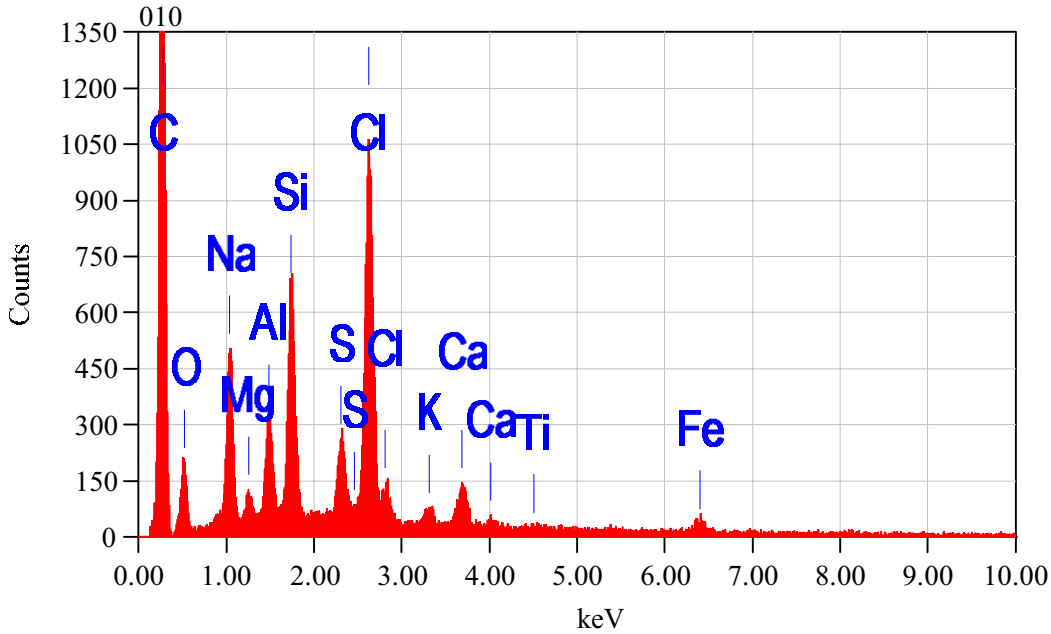


EDS12. Ferndale St, Tighes Hill Petri, *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP 13297. The SEM/EDS spectrum of the overall area is rich in carbon with minor amounts of sodium, aluminium and chloride and trace amounts the balance of the elements. The deposit contained only a few particulates and the carbon tape was not evenly dispersed with particulates therefore the elevated carbon contains contributions from the exposed carbon tape. Carbon contributing particles included minor amounts of coal, soot and plant debris with traces of black rubber dust, paint and insect debris. Major particle types observed by stereomicroscopy were aluminium and silicon based mineral dust.

5.13 SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

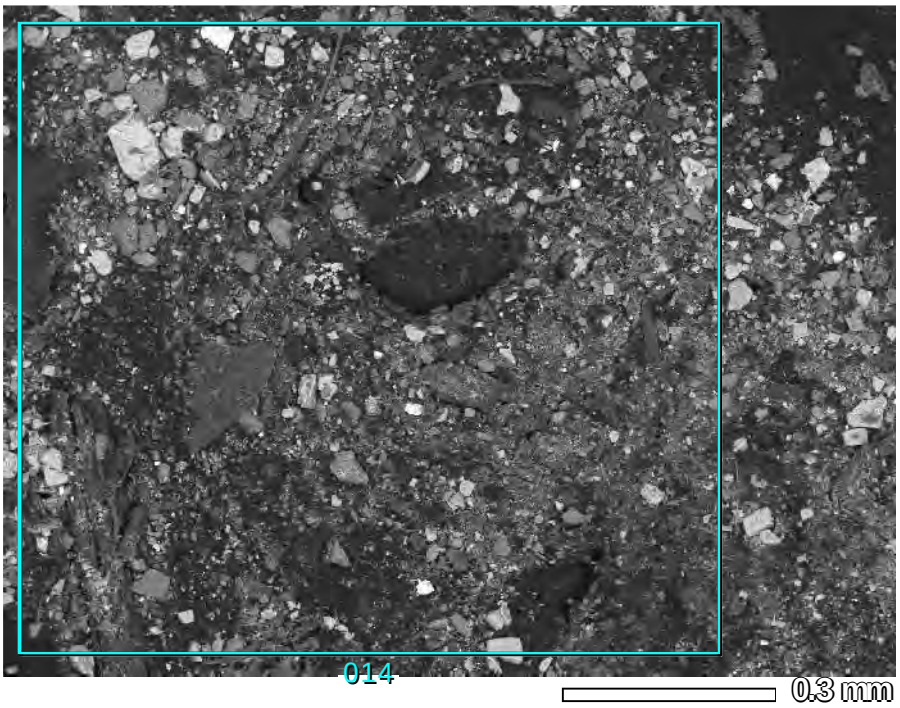


PM13. Waratah Petri *(Exposed: 18/02/15, Collected: 20/02/15)*, UQMP 13298. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

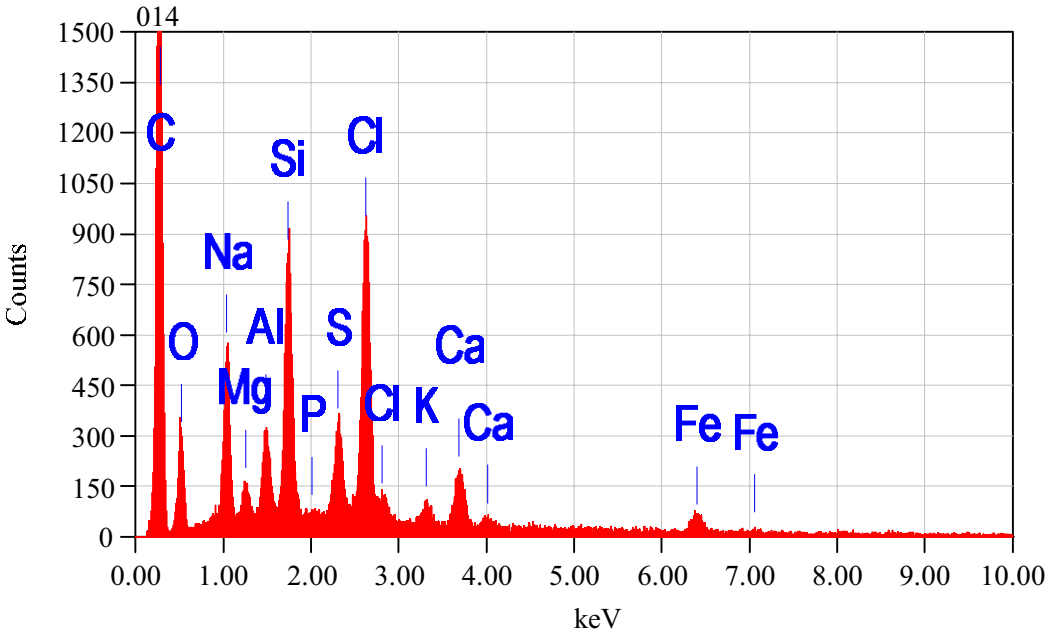


EDS13. Waratah Petri *(Exposed: 18/02/15, Collected: 20/02/15)*, UQMP 13298. Carbon, sodium, silicon and chloride are the predominant elements where the elevated carbon is mostly from the exposed carbon tape and is not representative of deposit. Dominant particle types include aluminium and silicon based mineral dust and halite with the organic component consisting of coal, soot, black rubber dust, fibres, plant and insect debris

5.14 . SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

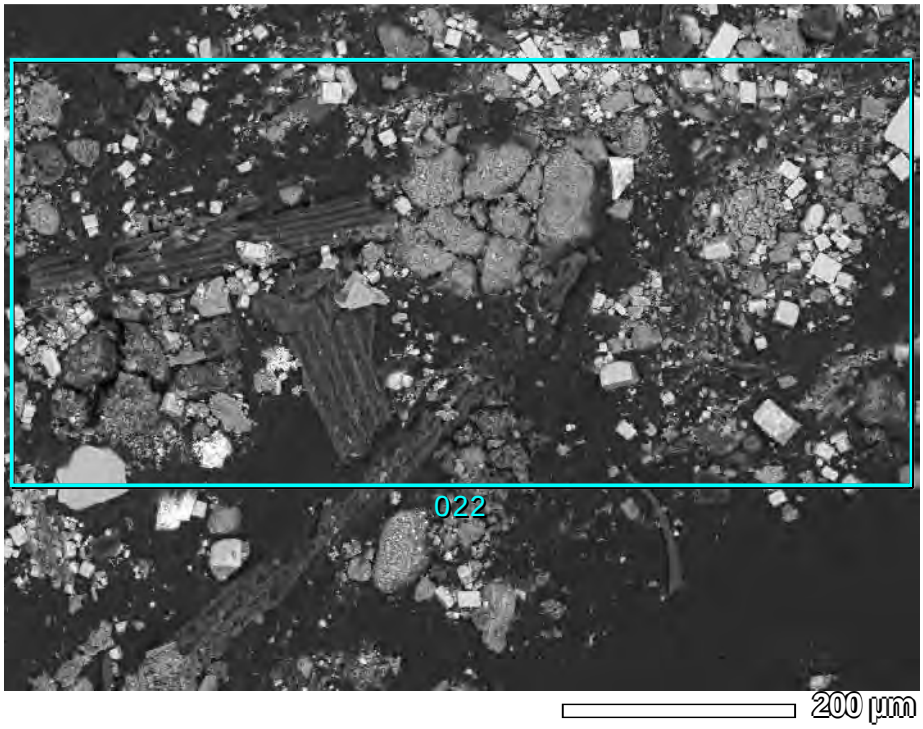


PM14. Islington Petri *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP 13299. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

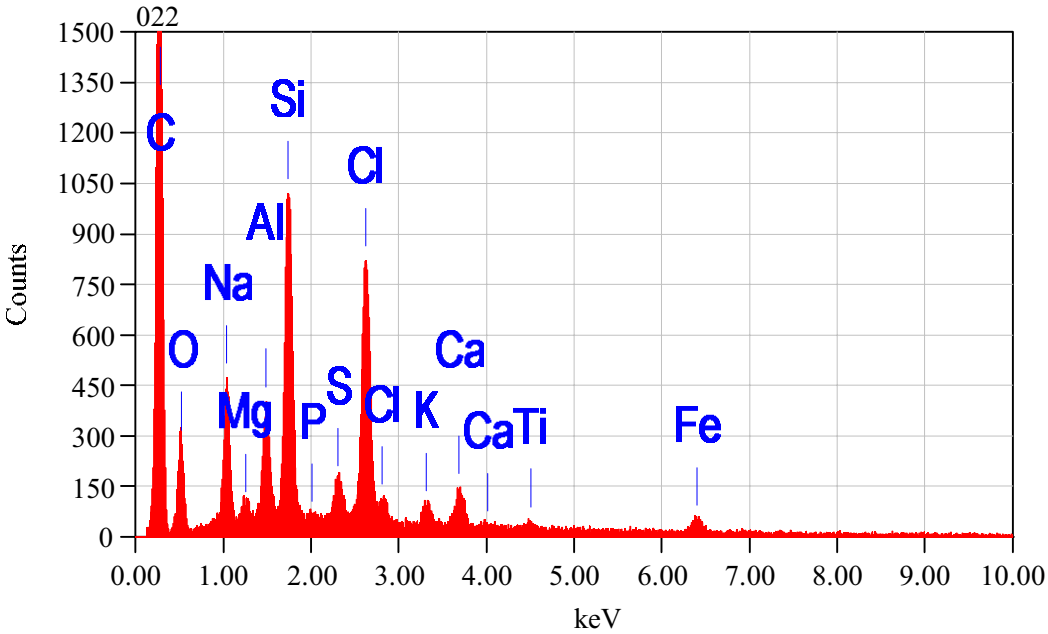


EDS14. Islington Petri *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP 13299. The SEM/EDS spectrum of the overall area is rich in carbon, sodium, aluminium, silicon, chloride and calcium with trace amounts of the remaing elements. The deposit contained few particulates and as a result the carbon tape was not evenly dispersed with particulates therefore the elevated carbon contains contributions from the exposed carbon tape. Carbon contributing particles included minor amounts of coal and traces of soot, rubber dust and fibres. Major particle types were aluminium and silicon based mineral dust and halite.

5.15 SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT

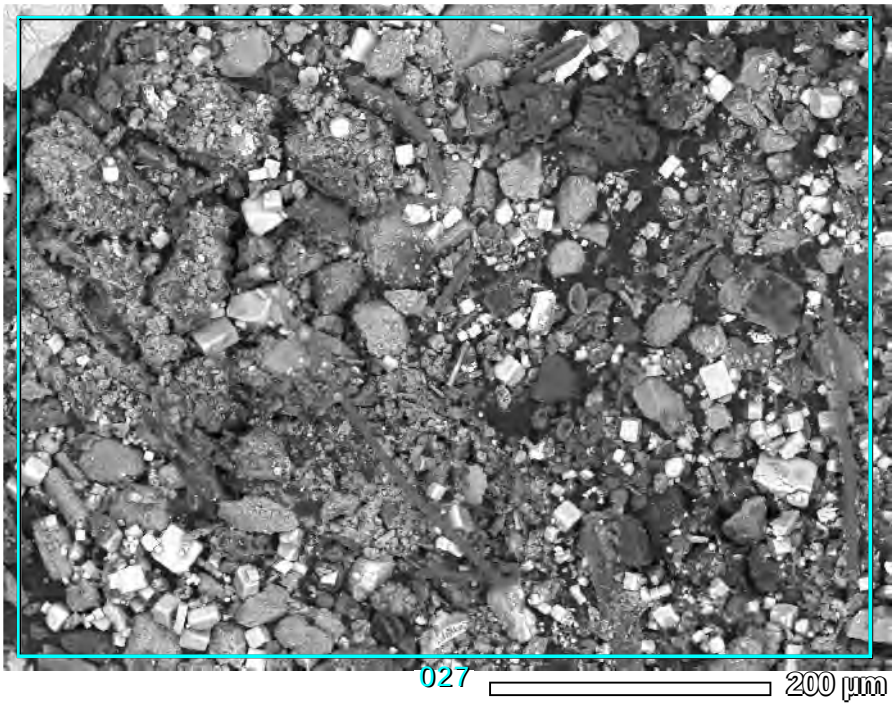


PM15. Kerr St, Mayfield Petri *(Exposed: 05/03/15, Collected: 06/03/1*5), . UQMP 13300. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

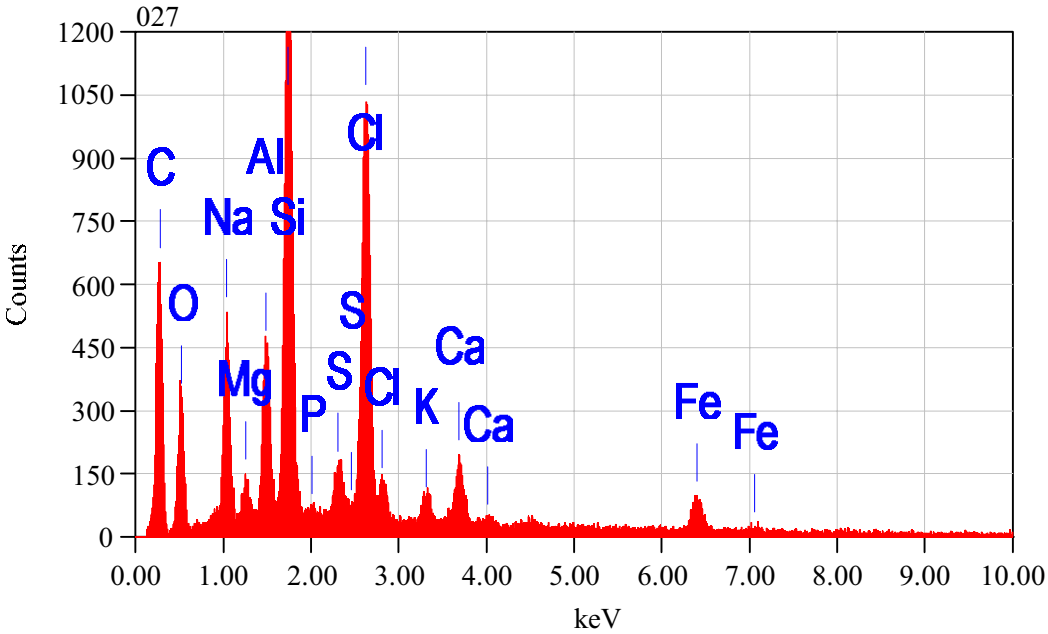


EDS15. Kerr St, Mayfield Petri *(Exposed: 05/03/15, Collected: 06/03/1*5), UQMP 13300. The SEM/EDS spectrum of the overall area is rich in carbon, sodium, silicon and chloride with minor amounts of aluminium and traces of the balance of the elements. The elevated carbon peak incorporates carbon from the exposed carbon tape and is not entirely representative of the deposit. Aluminium and silicon based mineral dust and halite were the predominant particle types with organic particulates consisting of minor amounts of plant debris and traces of coal, soot, fibres and insect debris.

5.16 SEM/BSE IMAGE AND EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT



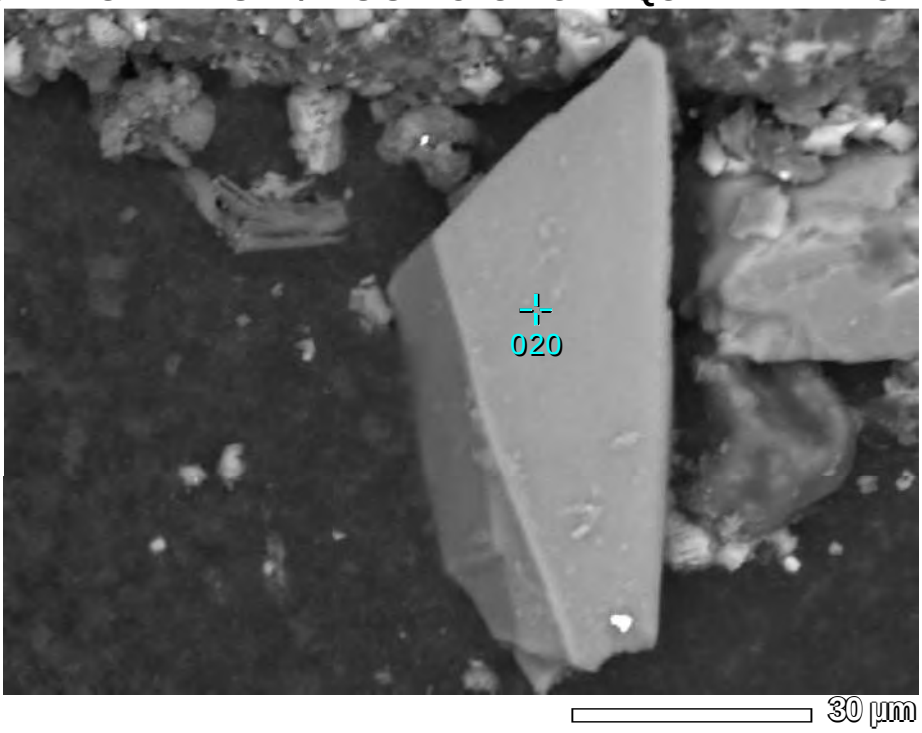
PM16. Selwyn Street, Tighes Hill Petri *(Exposed: 05/03/15, Collected: 06/03/1*5), UQMP 13301. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



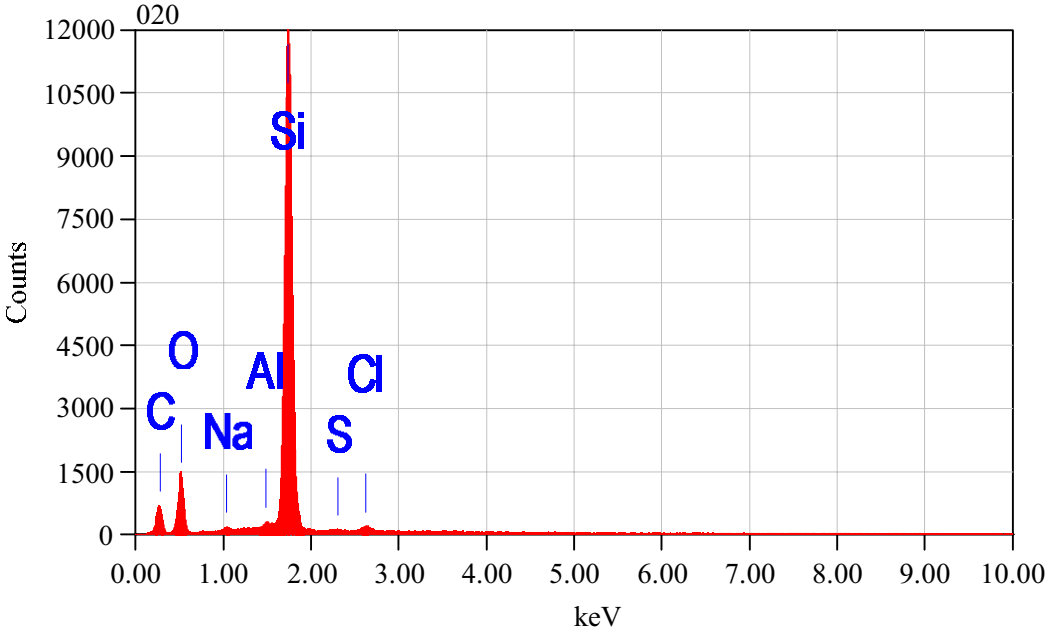
EDS16. Selwyn Street, Tighes Hill Petri *(Exposed: 05/03/15, Collected: 06/03/1*5), UQMP 13301. The SEM/EDS spectrum of the overall area is rich in carbon, sodium, aluminium, silicon and chloride the balance of the elements are trace levels. A minor organic component was observed as particulates of coal, soot, rubber dust, and plant and insect debris. Mineral dust composed of aluminium and silicon and halite (sodium chloride) were the major particle types

6. APPENDIX D

6.1 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A QUARTZ PARTICLE.

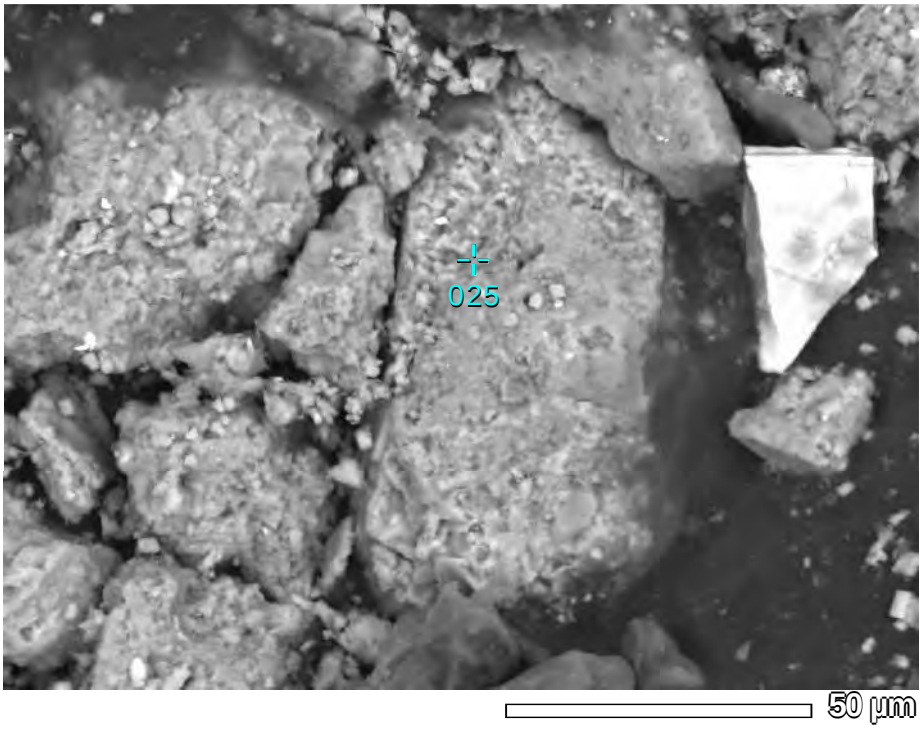


PM1. Islington Petri *(Exposed: 18/02/15, Collected: 20/02/15*), UQMP # 13299. An SEM/BSE image of a particulate annotated with 020 is selected for SEM/EDS analysis.

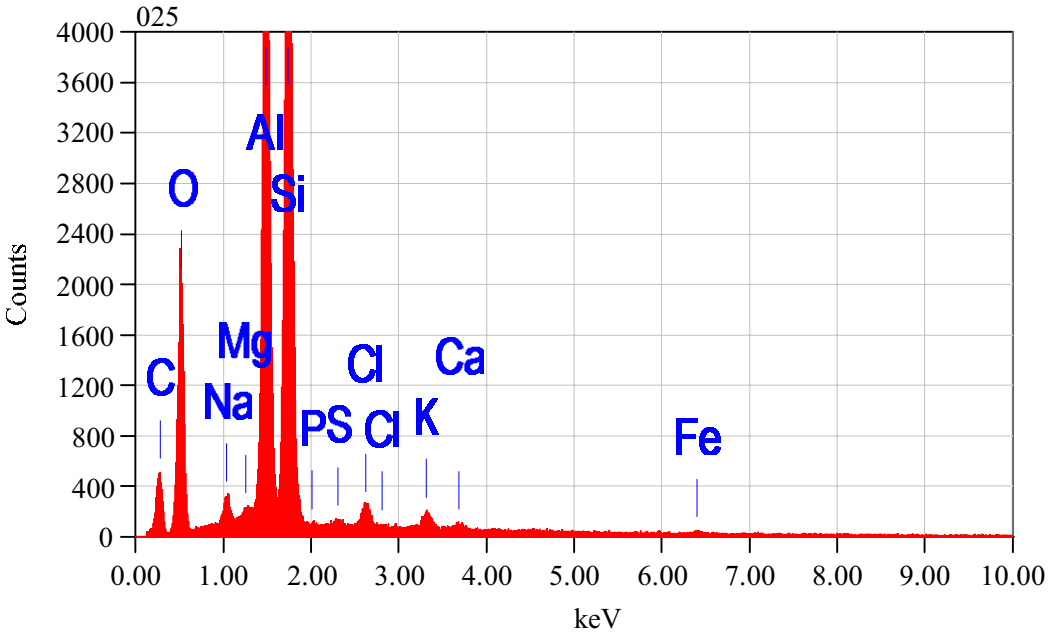


EDS1. Islington Petri *(Exposed: 18/02/15, Collected: 20/02/15*), UQMP # 13299. The SEM/EDS spectrum of the particle annotated with 020 displays a predominance of silicon with only traces of sodium, chloride, sulfur, aluminium and carbon. The SEM/EDS spectrum is typical of Quartz which has the chemical formula of SiO_2

6.2 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A MINERAL DUST PARTICLE.

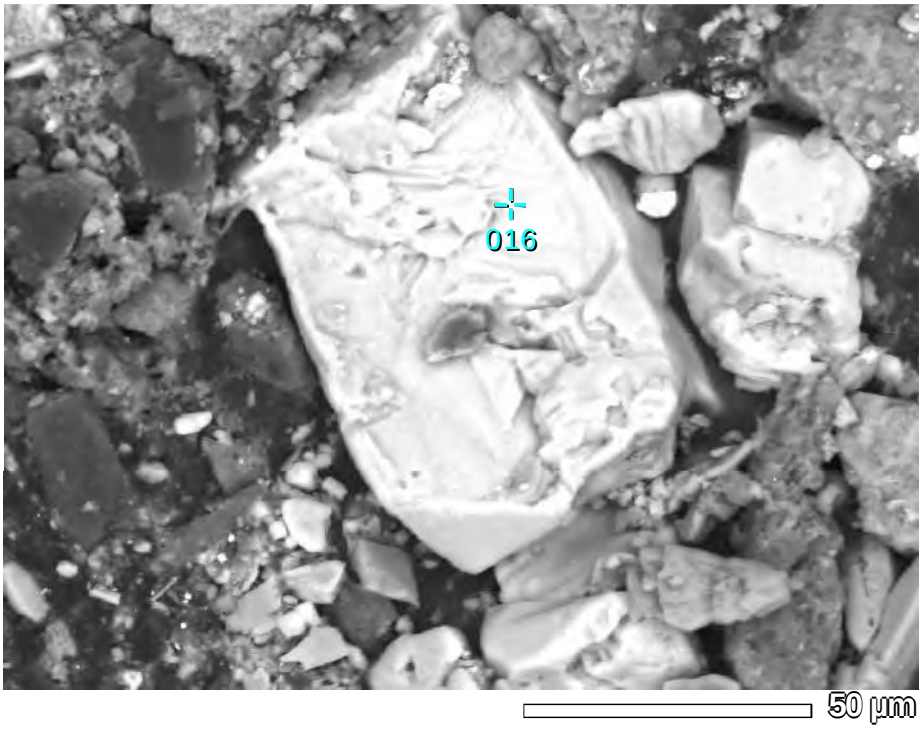


PM2. Kerr St, Mayfield *(Exposed: 05/03/15, Collected: 06/03/15*), UQMP # 13300. An SEM/BSE image of a particulate marked with 025 is selected for SEM/EDS analysis.

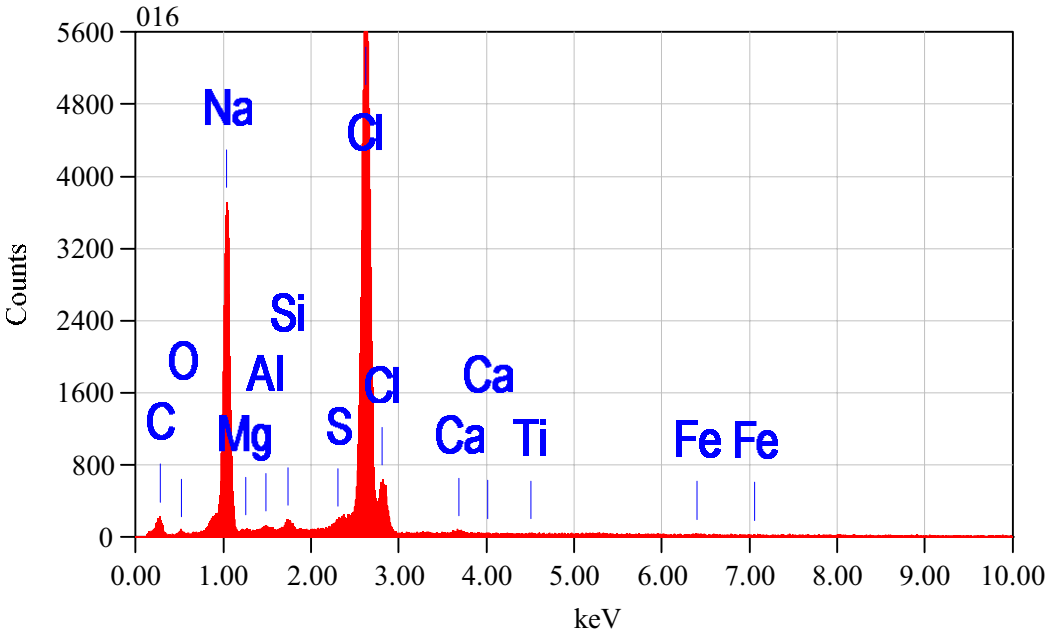


EDS2. Kerr St, Mayfield *(Exposed: 05/03/15, Collected: 06/03/15*), UQMP # 13300. The SEM/EDS spectrum of the particle marked with 025 shows elevated levels of aluminium and silicon with trace amounts of the balance of the elements. The particle is a characteristic aluminosilicate rich mineral dust a very common particle type among all the deposits.

6.3 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A HALITE PARTICLE.

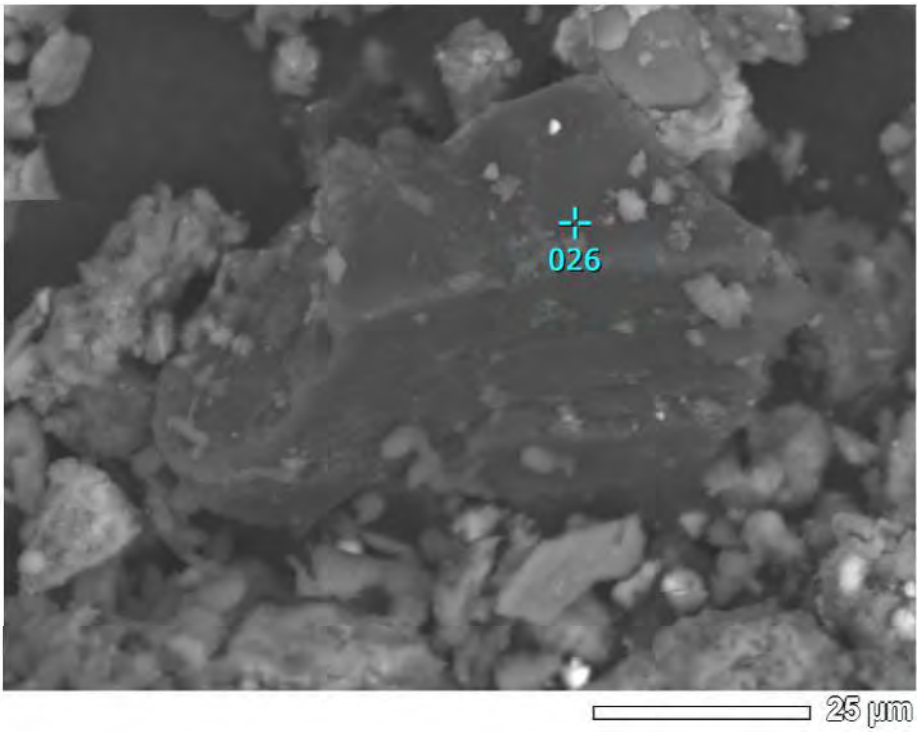


PM3. Islington Petri *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP # 13299. An SEM/BSE image of a particulate annotated with 016 is selected for SEM/EDS analysis.

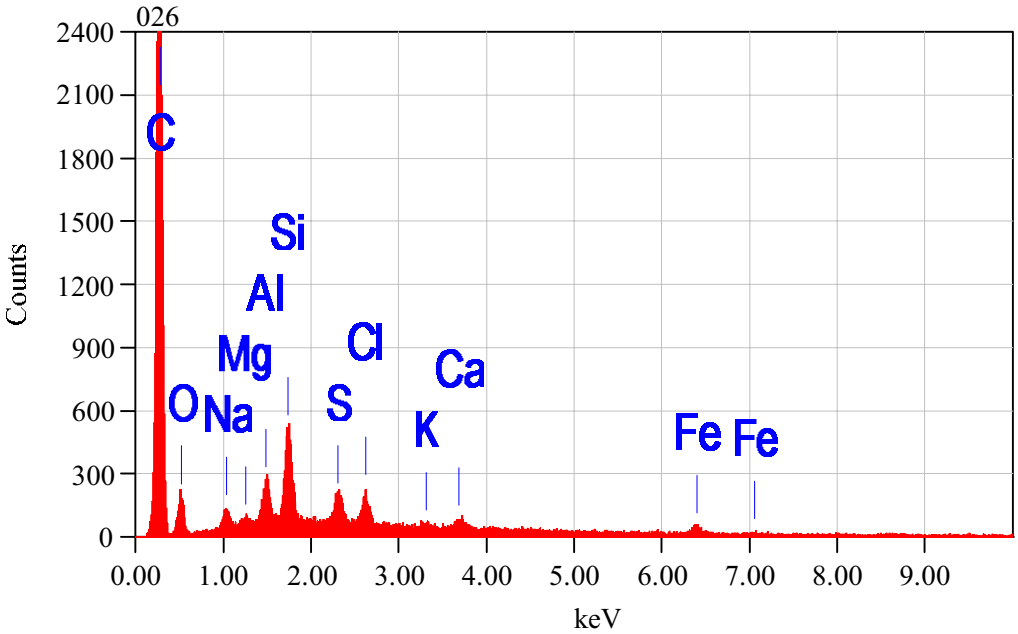


EDS3. Islington Petri *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP # 13299. Sodium and chloride are the dominant elements with only traces of magnesium, aluminium, silicon sulfur, calcium, titanium and iron. The SEM/EDS elemental profile is characteristic for Halite (sodium chloride). Halite commonly exists in the cubic habit and commonly contains impurities such as calcium, magnesium sulfates and calcium and magnesium chlorides.

6.4 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A COAL PARTICLE.

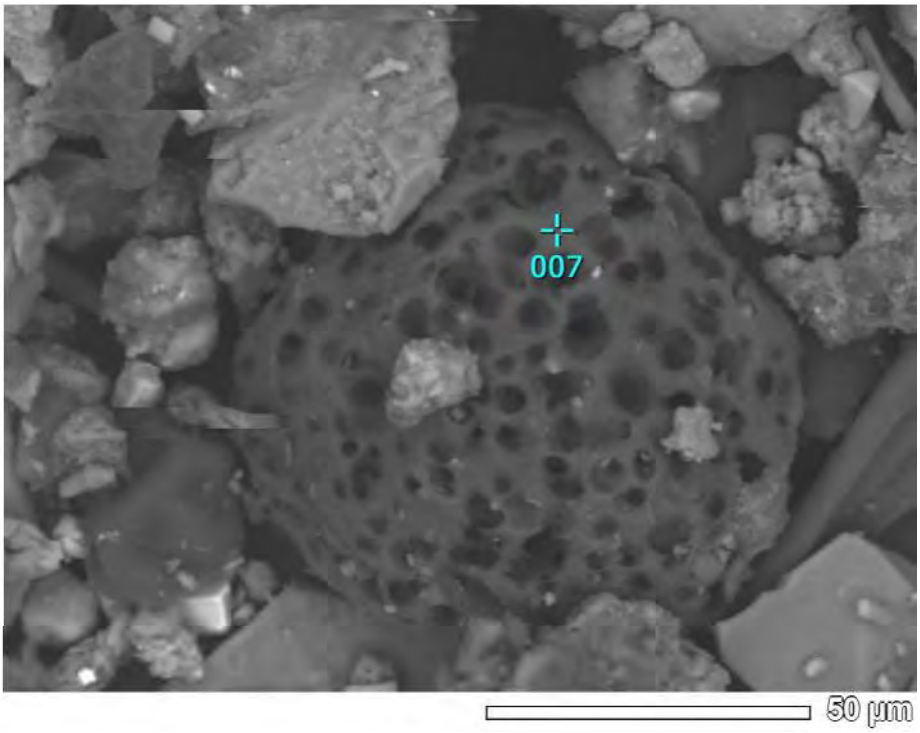


PM4. Ferndale St, Tighes Hill Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13290. An SEM/BSE image of a particulate annotated with 026 is selected for SEM/EDS analysis.

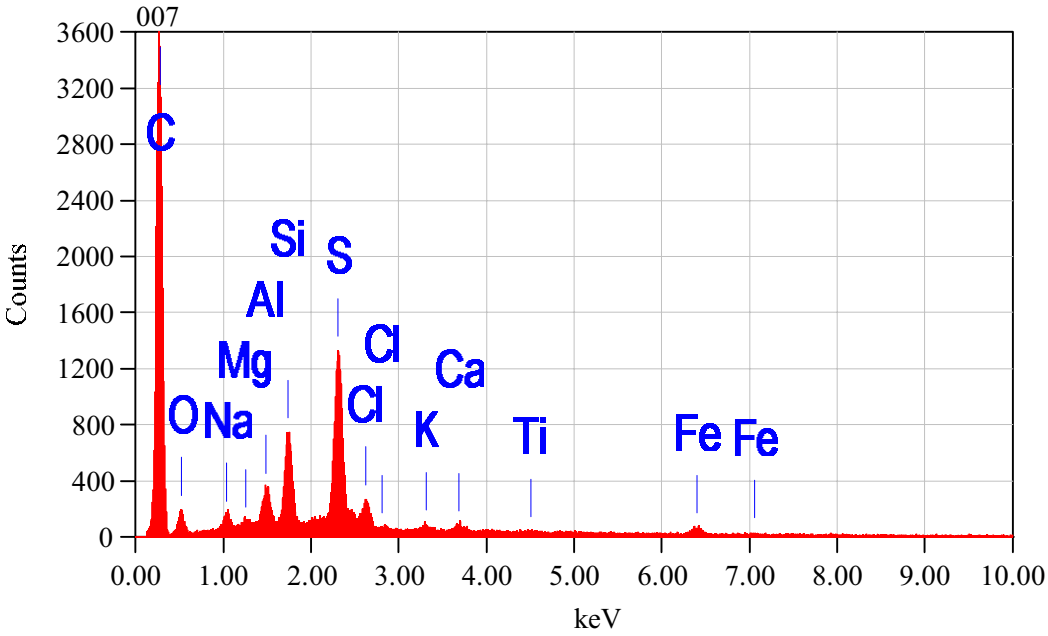


EDS4. Ferndale St, Tighes Hill Brush *(Exposed: 06/03/15, Collected: 06/03/1*5), UQMP # 13290. The SEM/EDS spectrum of the particle annotated with 026 consists predominantly of carbon with minor amounts of aluminium, silicon and sulfur there are traces of sodium, magnesium, potassium, calcium and iron. The particle is sharply angular and the SEM/EDS spectrum is charcetistic for coal.

6.5 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A SOOT PARTICLE.

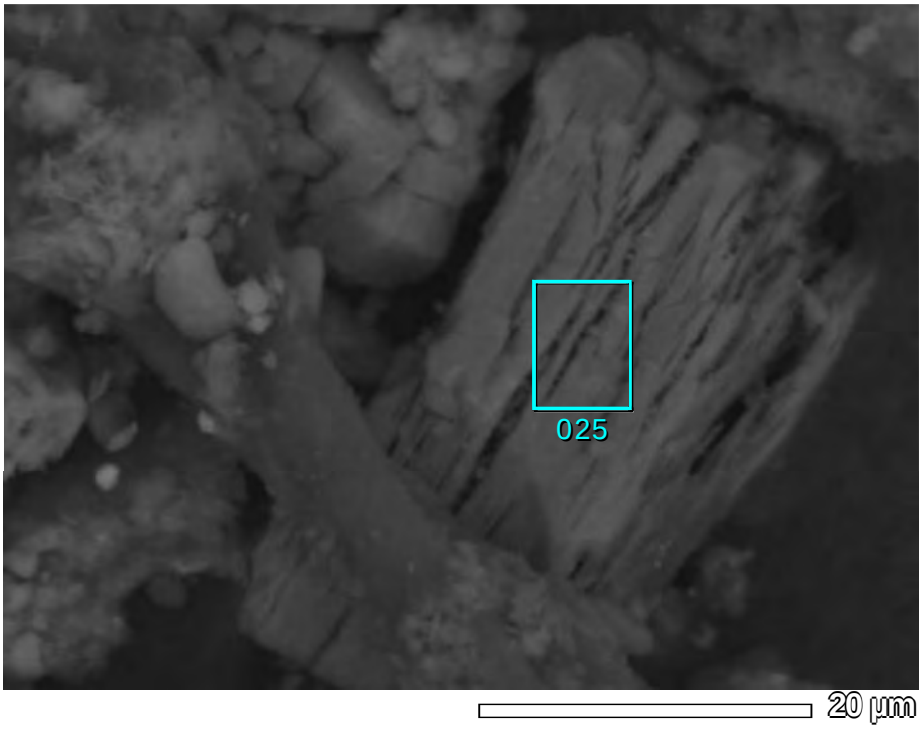


PM5. Roxburgh Street, Stockton Brush *(Exposed: 06/03/15, Collected: 06/03/1*5) UQMP # 13288. An SEM/BSE image of a particulate annotated with 007 is selected for SEM/EDS analysis.

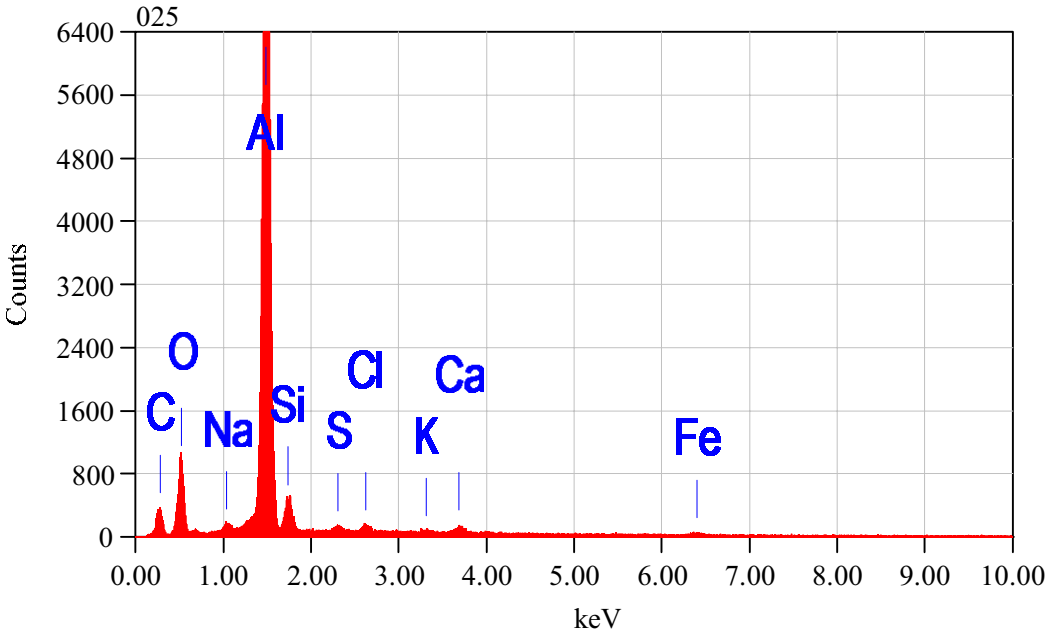


EDS5. Roxburgh Street, Stockton Brush *(Exposed: 06/03/15, Collected: 06/03/1*5) UQMP # 13288. The SEM/EDSspectrum of the particle annotated with 007 is typical of soot particle note the lacey particle morphology and the elevated carbon and minor amounts of aluminium, silicon and sulfur and the remaining trace which are characteristic elements of soot.

6.6 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF AN ALUMINA PARTICLE.

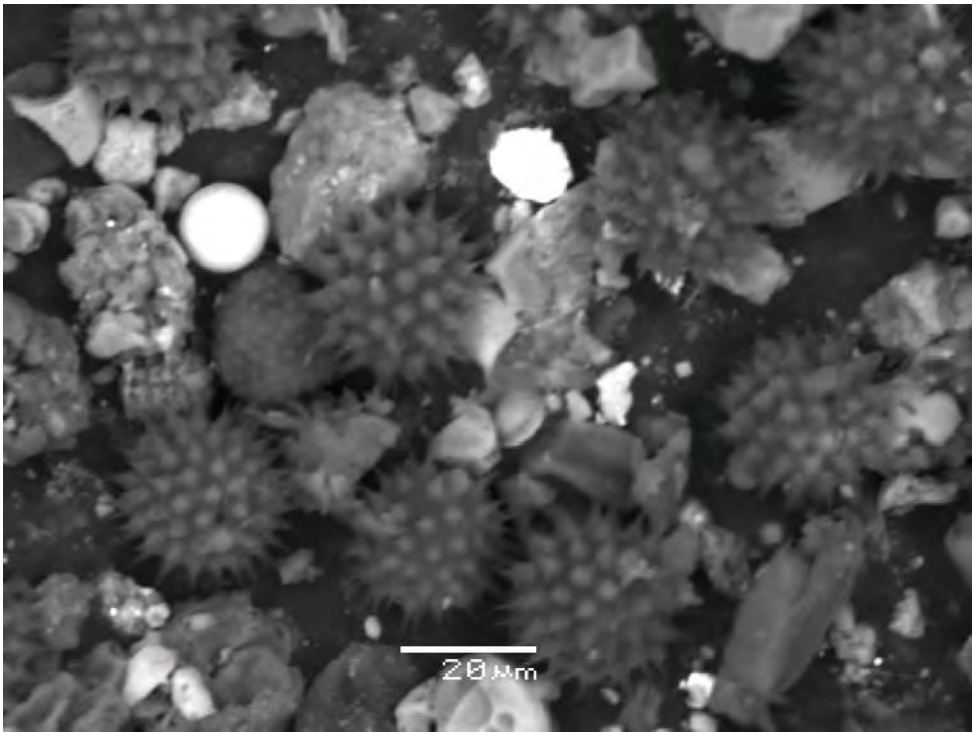


PM6. Roxburgh Street, Stockton Brush *(Exposed: 06/03/15, Collected: 06/03/1*5) UQMP # 13288. An SEM/BSE image of a particulate annotated with 025 is selected for SEM/EDS analysis.

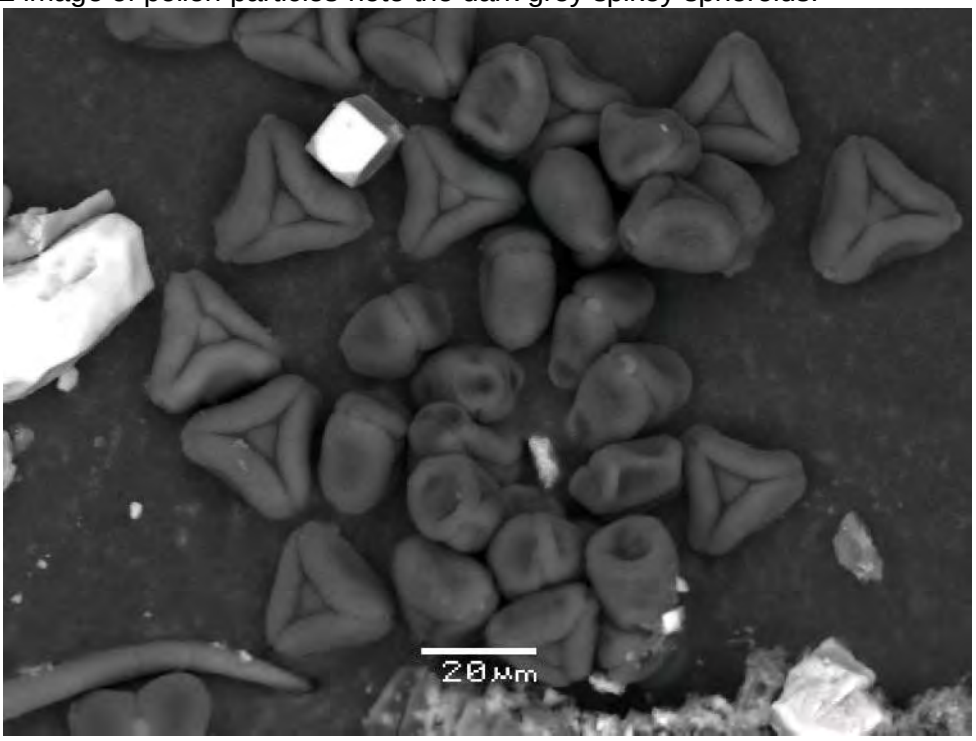


EDS6. Roxburgh Street, Stockton Brush *(Exposed: 06/03/15, Collected: 06/03/1*5) UQMP # 13288. The predominance of the aluminium in the SEM/EDS spectrum is typical of alumina as is the parting of the particle and the tapering hexagonal dipyramids which are often rounded into barrel shapes. Corundum Al_2O^3 is often observed as hexagonal crystal.

6.7 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF POLLEN PARTICLES.



PM7. Ferndale Street, Tighes Hill Petri *(Exposed: 18/02/15, Collected: 20/02/1*5), UQMP # 13297 An SEM/BSE image of pollen particles note the dark grey spikey spheroids.



PM8.. Kerr St, Mayfield *(Exposed: 05/03/15, Collected: 06/03/1*5) UQMP # 13300. An SEM/BSE image of pollen particles and a cubic halite particle in the top slightly left of the centre of the image.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject:	**EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**
UQMP Project No.	C02204.06
Prepared for:	Hayley Worthington, ALS ENVIRONMENTAL
Prepared By:	Fiona Jones
Date:	22nd June 2015

Sample Description:		**Sample #**	**Date Exposed**	**Date Collected**	**UQMP #**
	1	Waratah Dust Gauge	06/03/15	07/04/15	UQMP # 13398
	2	Warabrook Petri	08/04/15	08/04/15	UQMP # 13399
	3	Stockton South Petri	08/04/15	08/04/15	UQMP # 13400
	4	Stockton North Petri	08/04/15	08/04/15	UQMP # 13401

#Method Ref:	Internal UQMP method. AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples were supplied as a washing from a dust fallout gauge deposit and three loose deposits in petri dishes. The dust gauge sample was filtered onto a membrane filter and then all samples were examined by stereomicroscopy to check for particle distribution and general appearance.

2. RESULTS

Appendix A attached presents the table of results of the combined microscopy observations.
Appendix B presents colour picture micrographs of the stereomicroscopy images.
Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. Some of the deposits were very sparse and the resulting spectra displayed erroneous levels of carbon, this has been noted during the discussion of each spectrum. Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of UQ Materials Performance

Fiona Jones

Fiona Jones

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13398	UQMP # 13399	UQMP # 13400
	SAMPLE ID / **PARTICLE TYPE**	*Waratah Dust Gauge (Exposed: 06/03/15 Collected:07/04/15)*	*Warabrook Petri (Exposed: 08/04/15 Collected: 08/04/15)*	*Stockton South Petri (Exposed: 08/04/15 Collected: 08/04/15)*
BLACK	COAL	5	10	15
	SOOT	5		5
	BLACK RUBBER DUST	5	tr	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**75**	**50**	**65**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	30	5
	PLANT DEBRIS (General)	10	10	10
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)			
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS		All deposits were sparsley populated with particulates.		

3.2 TABLE OF COMBINED MICROSCOPY RESULTS

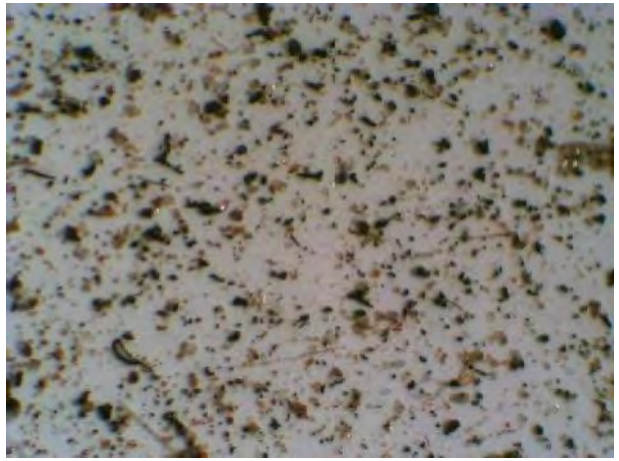
PARTICLE IDENTITY		PERCENTAGE (Projected area basis)
	SAMPLE #	UQMP # 13401
	SAMPLE ID	*Stockton North Petri (Exposed: 08/04/15, Collected: 08/04/15)*
	PARTICLE TYPE	
BLACK	COAL	10
	SOOT	10
	BLACK RUBBER DUST	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**60**
	MINERAL DUST (type = Fly Ash)	
	MINERAL DUST (type = Cement Dust)	
	MINERAL DUST (type =glassy)	
	GLASS FRAGMENTS	
	COPPER SLUDGE	
	P/S SLIME & FUNGI	
	INSECT DEBRIS	tr
	PLANT DEBRIS (General)	20
	PLANT DEBRIS (type = plant char)	
	PLANT DEBRIS (type =)	
GENERAL ORGANIC TYPES	WOOD DUST	
	FIBRES (type = Miscellaneous)	tr
	STARCH	
	PAINT	
	PLASTIC FRAGMENTS	
	RED RUBBER DUST	
COMMENTS		The deposit was sparsley populated with particulates.

3.3 PARTICLE IDENTITY LEGEND

Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

4. APPENDIX B

4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS



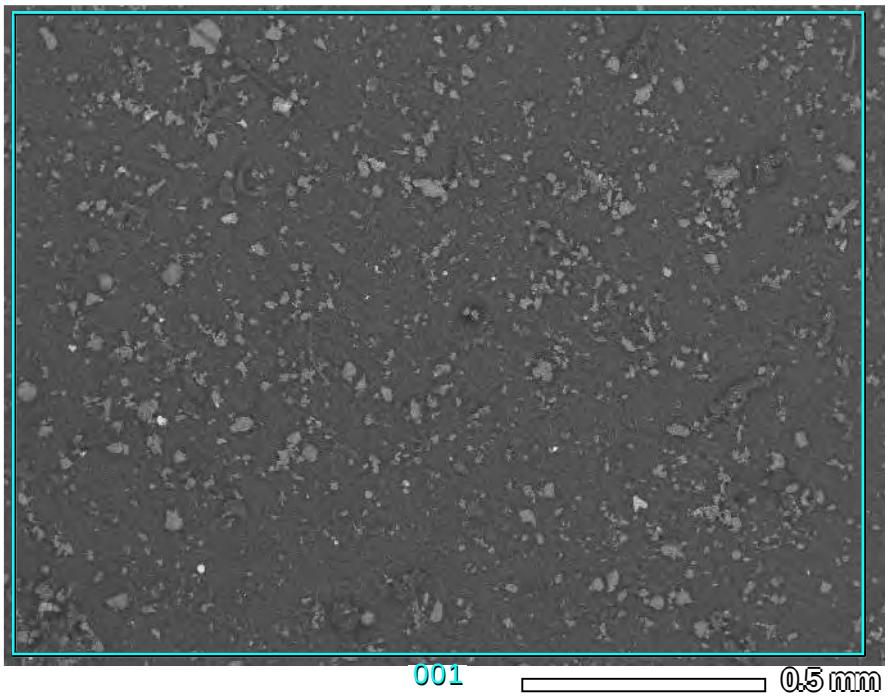
StMPM1. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398

StMPM2. Warabrook Petri *(Exposed: 08/04/1, Collected: 08/04/15)*, UQMP # 13399

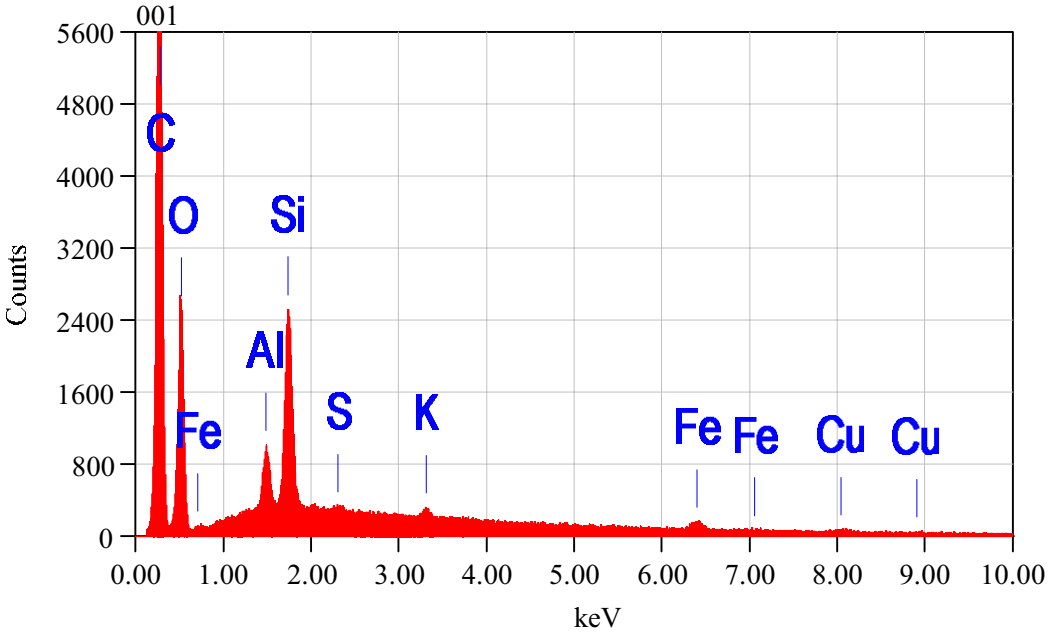
StMPM3. Stockton South Petri *(Exposed: 08/04/15, Collected: 08/04/15)*, UQMP # 13400.

StMPM4. Stockton North Petri *(Exposed: 08/04/15, Collected: 08/04/15)*, UQMP # 13401.

5. APPENDIX C
5.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

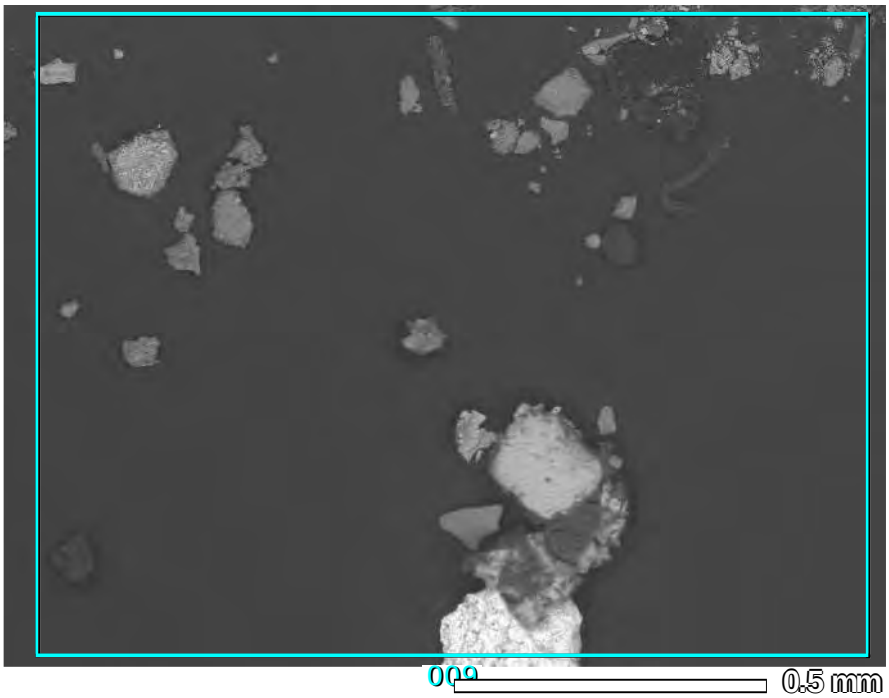


PM1. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

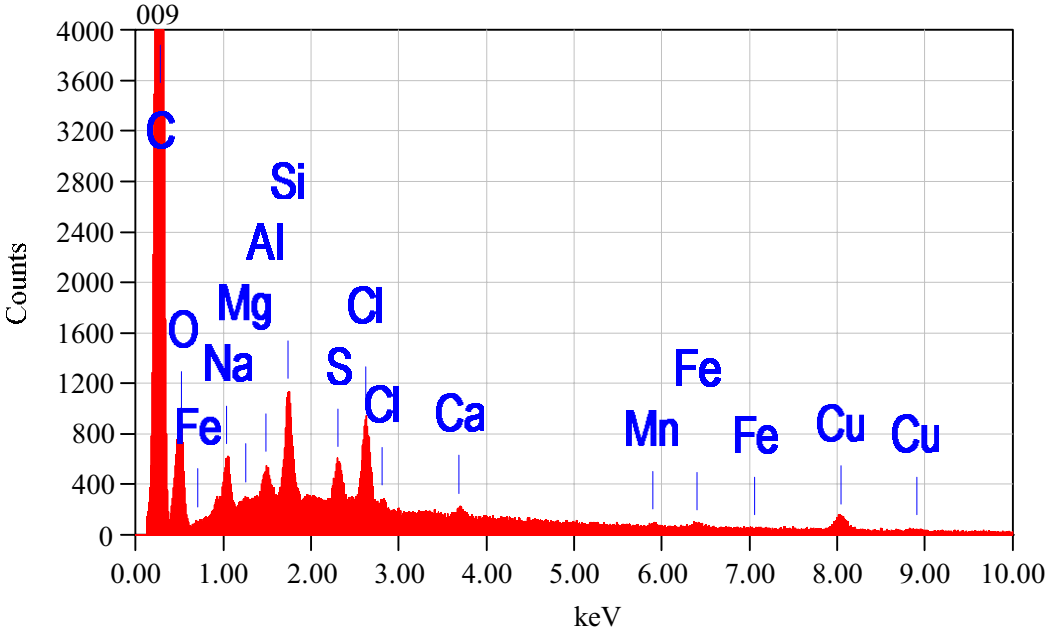


EDS1. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398. The SEM/EDS spectrum of the overall area displays a predominance of carbon with minor amounts of aluminium and silicon and traces of the balance of the elements. The elevated carbon reflects the degree of exposed filter due to the sparse deposit. The stereomicroscopy observations noted a predominance of mineral dust with a minor organic component consisting of coal, rubber dust, plant debris and traces of insect debris. Traces of copper sludge are also present in the spectrum, note the copper and sulfur peaks.

5.2 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

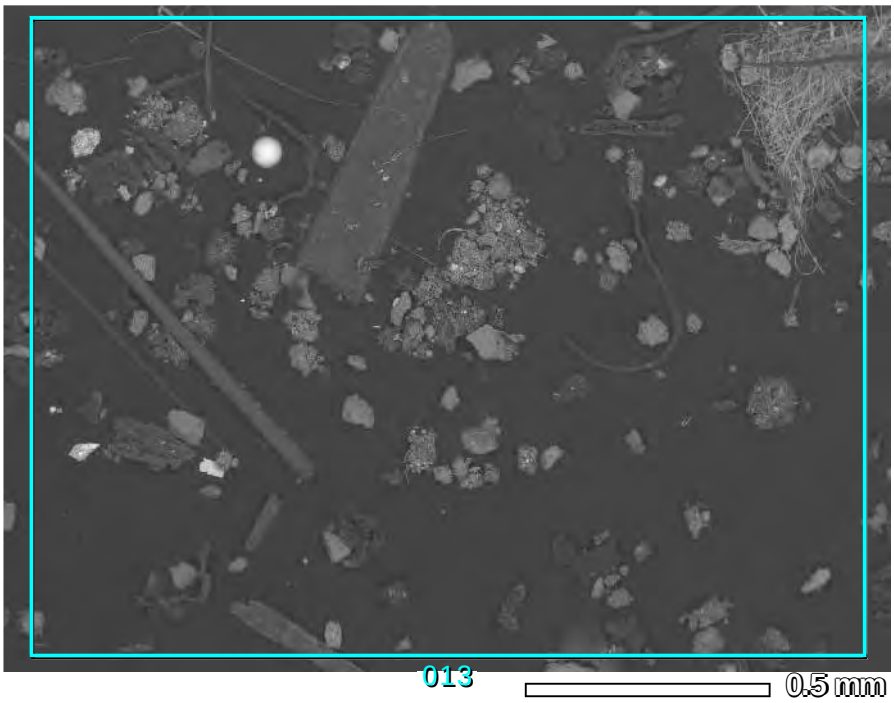


PM2. Warabrook Petri *(Exposed: 08/04/15, Collected: 08/04/15)*, UQMP # 13399. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

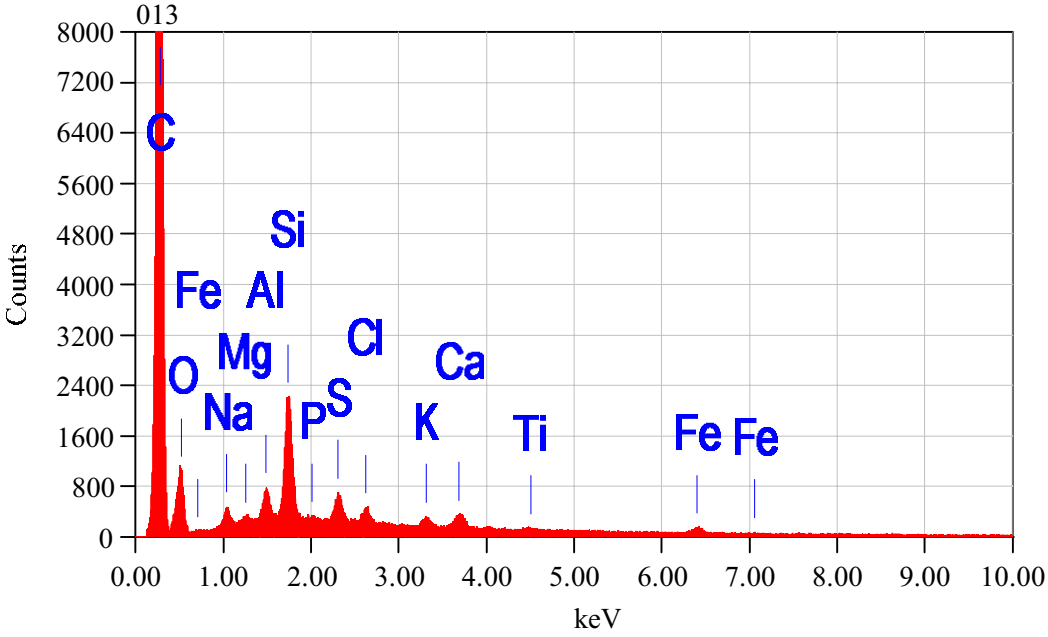


EDS2. Warabrook Petri *(Exposed: 08/04/15, Collected: 08/04/15)*, UQMP # 13399. The elevated carbon represents the exposed carbon tape as very few particles were present to cover the area examined. Stereomicroscopy observation found that half of the sample consisted of mineral dust whilst the remainder of the deposit was organic and included coal, insect and plant debris with traces of rubber dust.

5.3 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

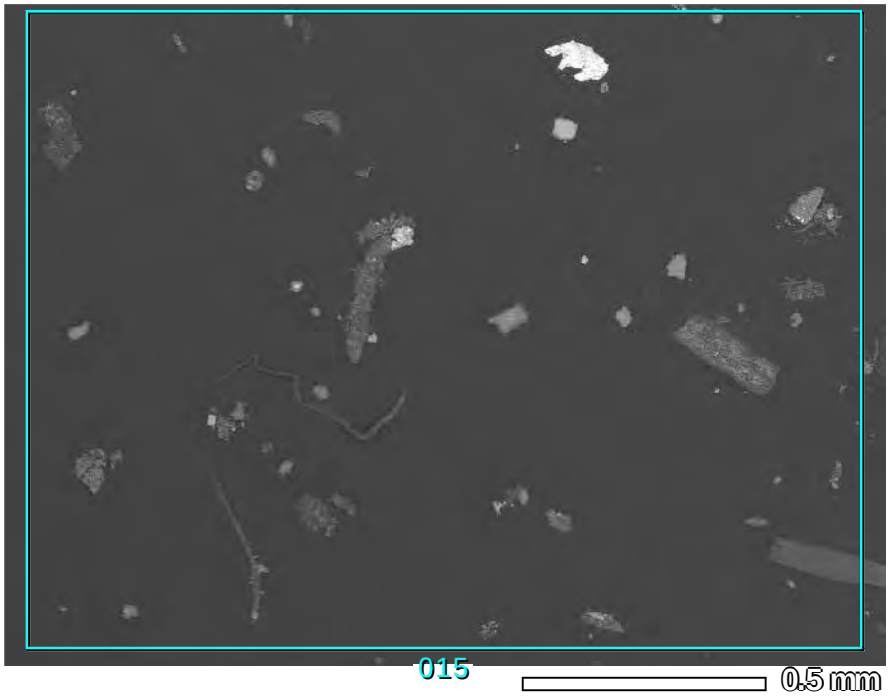


PM3. Stockton South Petri *(Exposed: 08/04/15, Collected: 08/04/15)*, UQMP # 13400. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

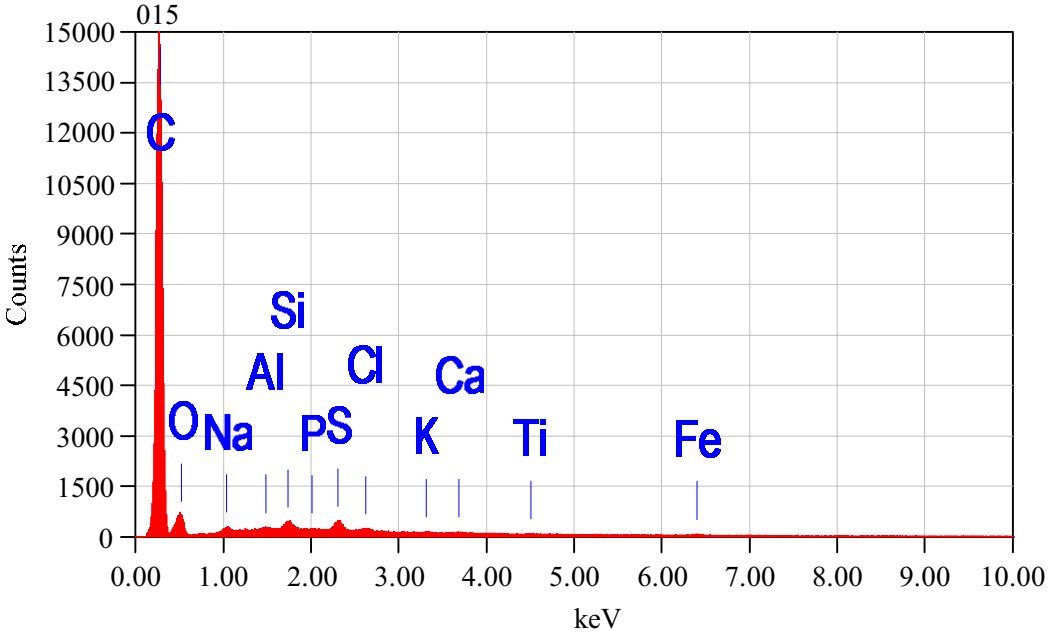


EDS3. Stockton South Petri *(Exposed: 08/04/15, Collected: 08/04/15)*, UQMP # 13400 *(Exposed: 08/04/15, Collected: 08/04/15*. The elevated carbon is erroneous and represents the exposed carbon tape as the particulate coverage was sparse. Stereomicroscopy observation found that the majority of the deposit was mineral dust with a minor organic component of coal, soot and plant and insect debris.

5.4 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



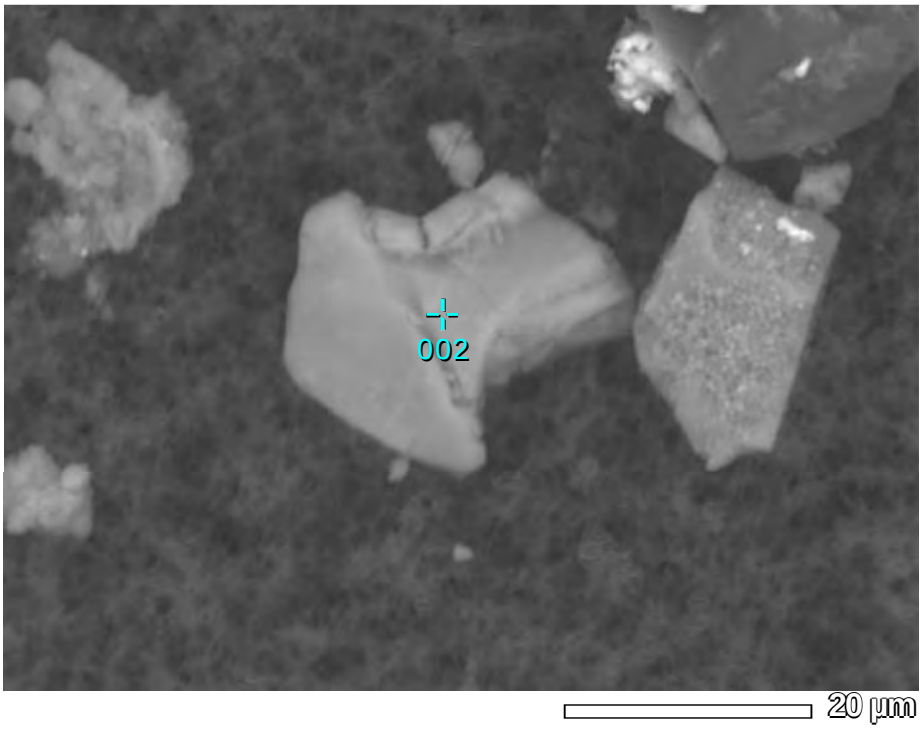
PM4. Stockton North Petri *(Exposed: 08/04/15, Collected: 08/04/15*, UQMP # 13401. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



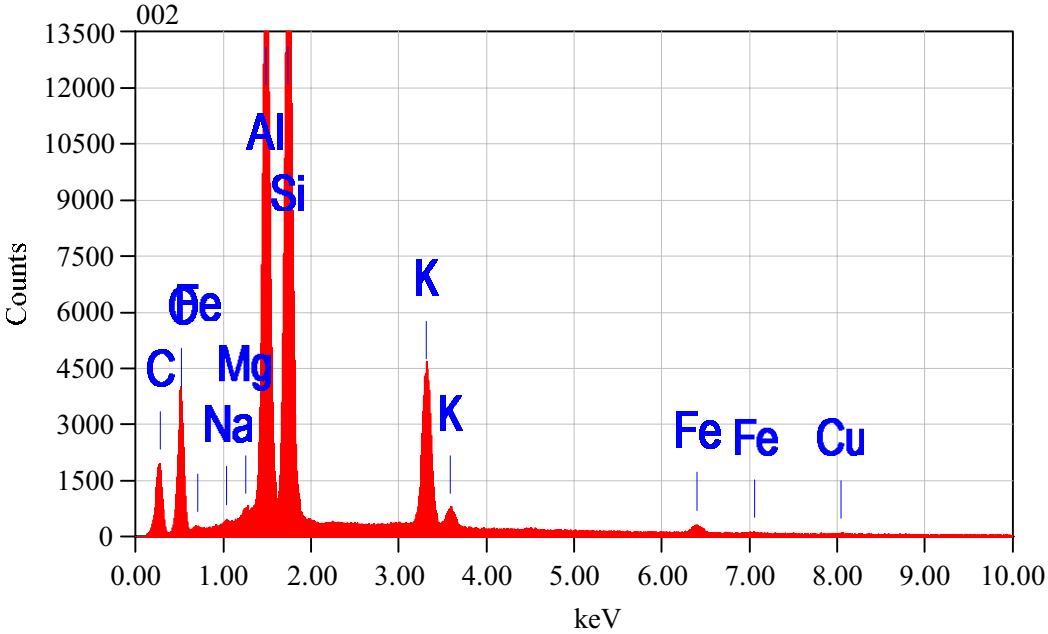
EDS4. Stockton North Petri *(Exposed: 08/04/15, Collected: 08/04/15*, UQMP # 13401 The SEM/EDS spectrum of the overall area is rich in carbon with only traces of the balance of the elements. A high degree of carbon tape is exposed due to the sparseness of the deposit. Fourty percent of the deposit was found to consist of organic material with the majority of the deposit assigned to mineral dust. The organic materials observed include coal, soot and plant debris.

6. APPENDIX D

6.1 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A MINERAL DUST PARTICLE

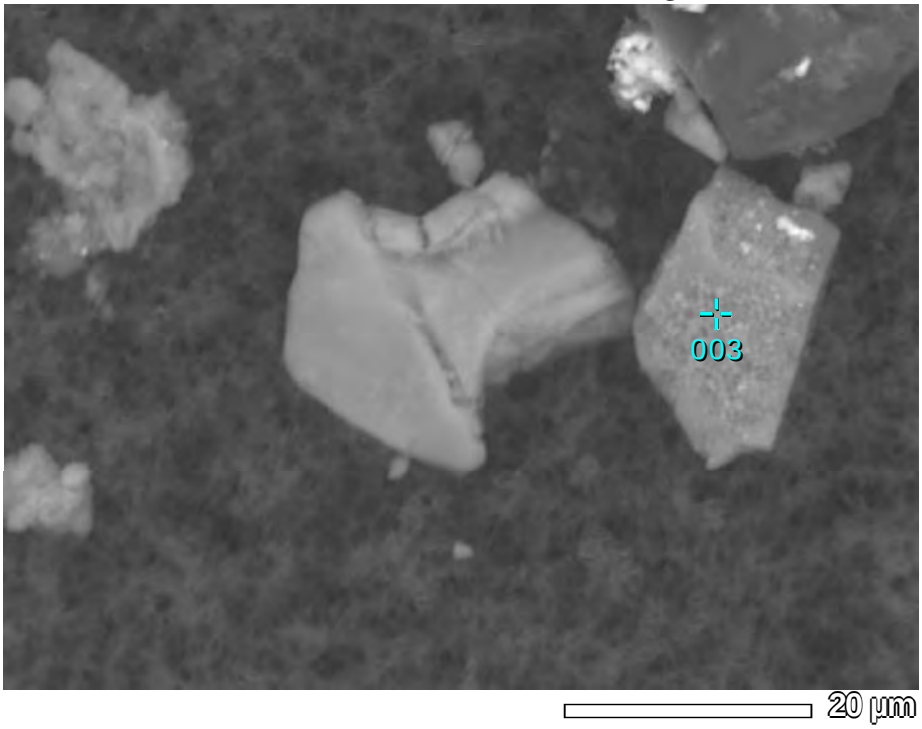


PM1. Waratah Dust Gauge *(Exposed: 06/03/15 Collected:07/04/15)*, UQMP # 13398. An SEM/BSE image of a particulate annotated with 002 is selected for SEM/EDS analysis.

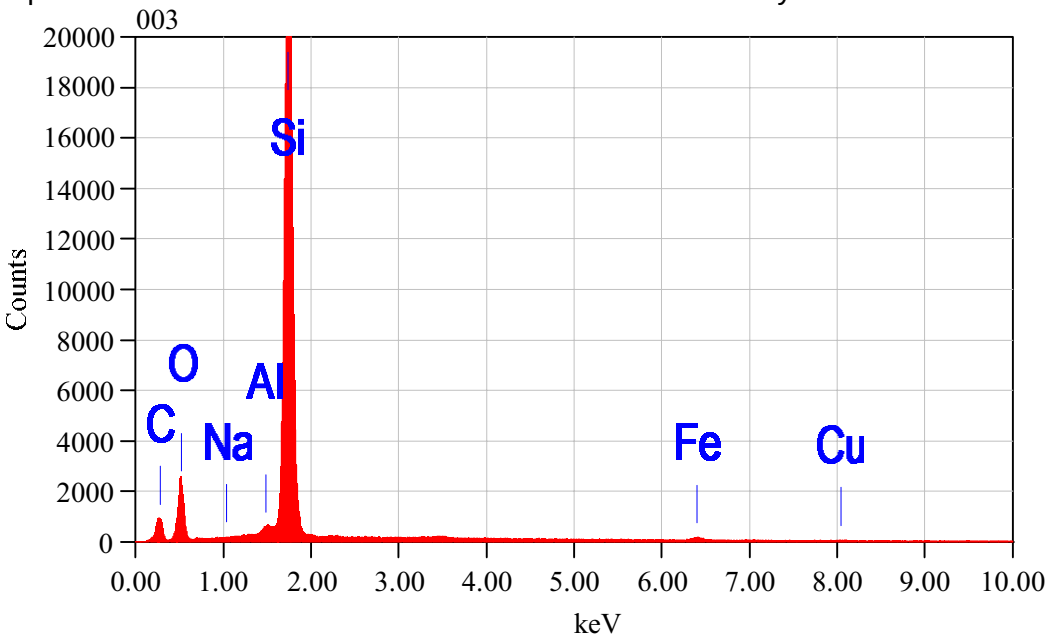


EDS1. Waratah Dust Gauge *(Exposed: 06/03/15 Collected:07/04/15)*, UQMP # 13398. The SEM/EDS spectrum of the particle annotated with 002 displays elevated levels of aluminium, silicon, and potassium with traces of sodium, magnesium, iron and copper. Copper is most likely a contaminant from the presences of copper sludge the balance of the spectrum is typical of an aluminosilicate rich mineral dust, possibly feldspar.

6.2 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A QUARTZ PARTICLE

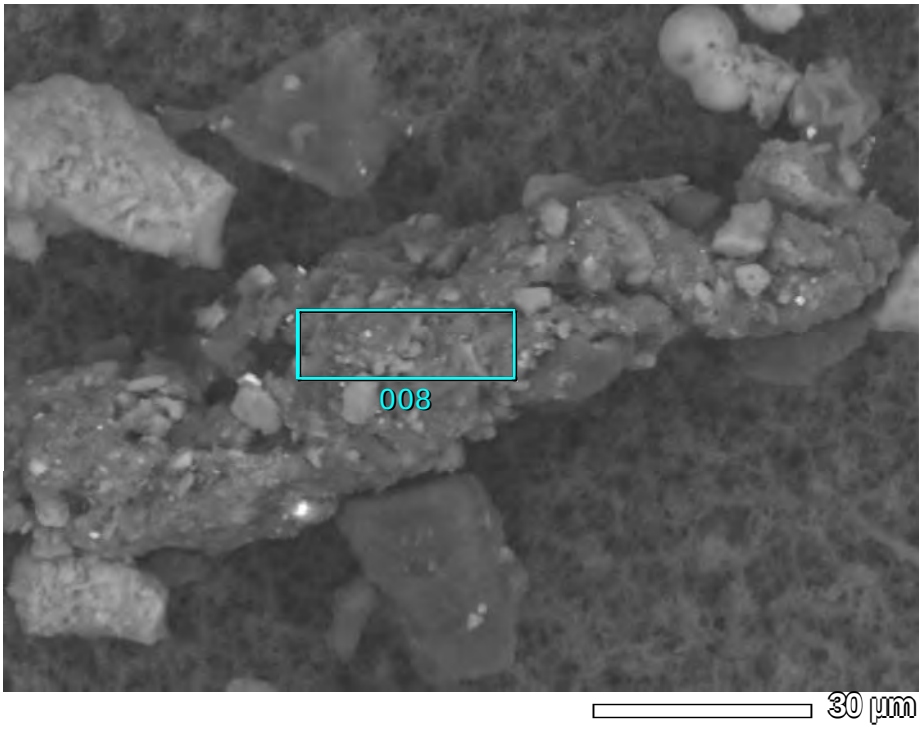


PM2. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398. An SEM/BSE image of a particulate marked with 003 is selected for SEM/EDS analysis.

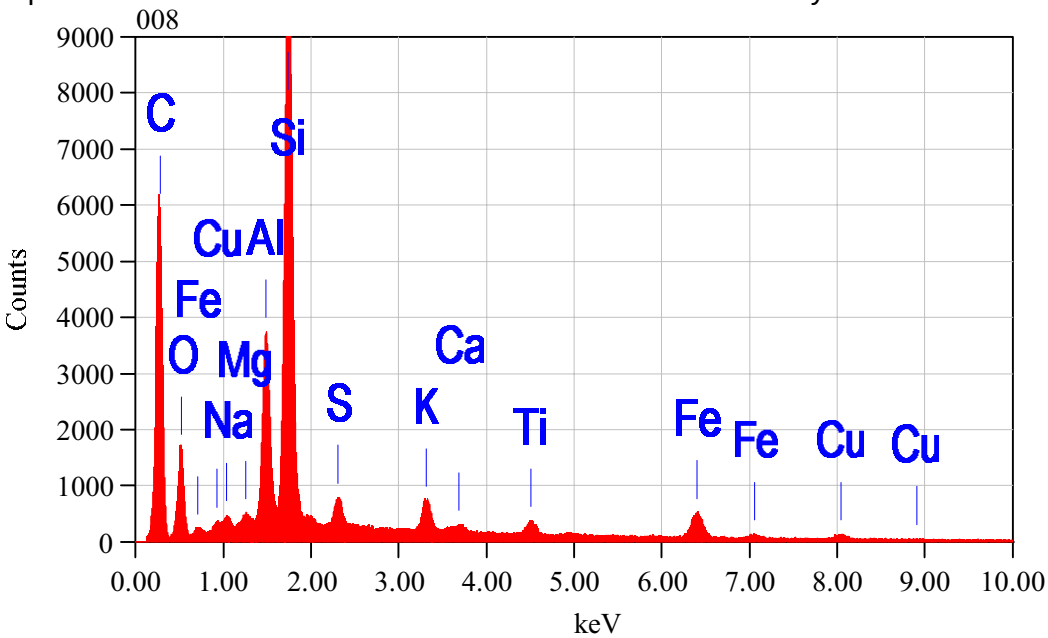


EDS2. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398. The SEM/EDS spectrum of the particle marked with 003 displays a major peak of silicon with traces of the balance of the elements. The elemental profile is characteristic of quartz.

6.3 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A RUBBER DUST PARTICLE

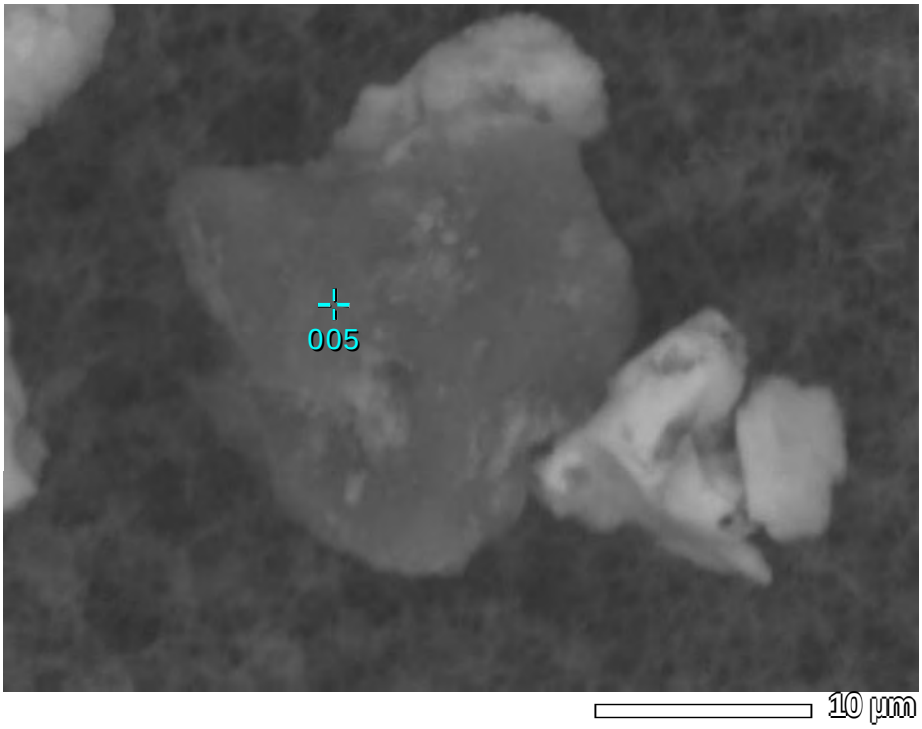


PM3. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398. An SEM/BSE image of a particulate annotated with 008 is selected for SEM/EDS analysis.

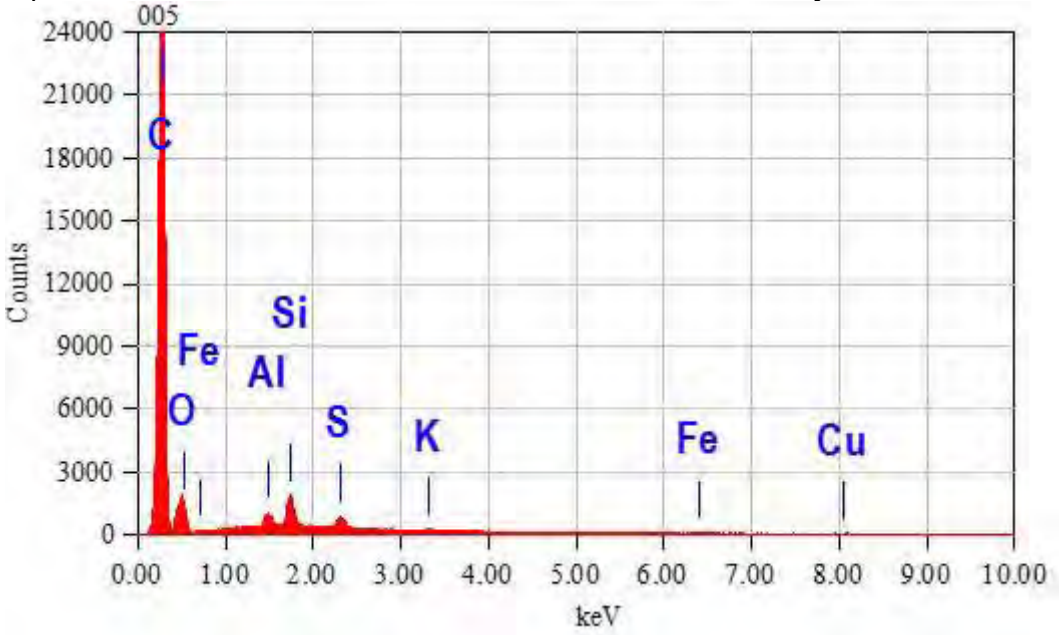


EDS3. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398. The SEM/EDS spectrum of the particle annotated with 008 shows elevated levels of carbon, aluminium and silicon with trace amounts of the balance of the elements. The particle morphology and SEM/EDS spectrum is characteristic of rubber dust. A trace amount of copper sludge is also present in the spectrum.

6.4 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A COAL PARTICLE

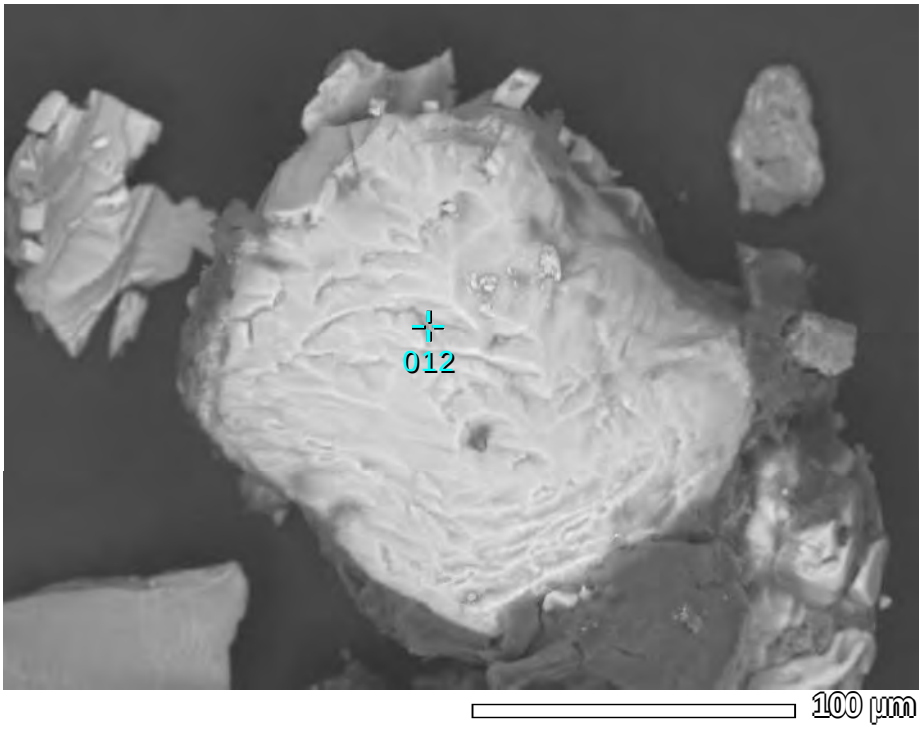


PM4. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398. An SEM/BSE image of a particulate annotated with 005 is selected for SEM/EDS analysis.

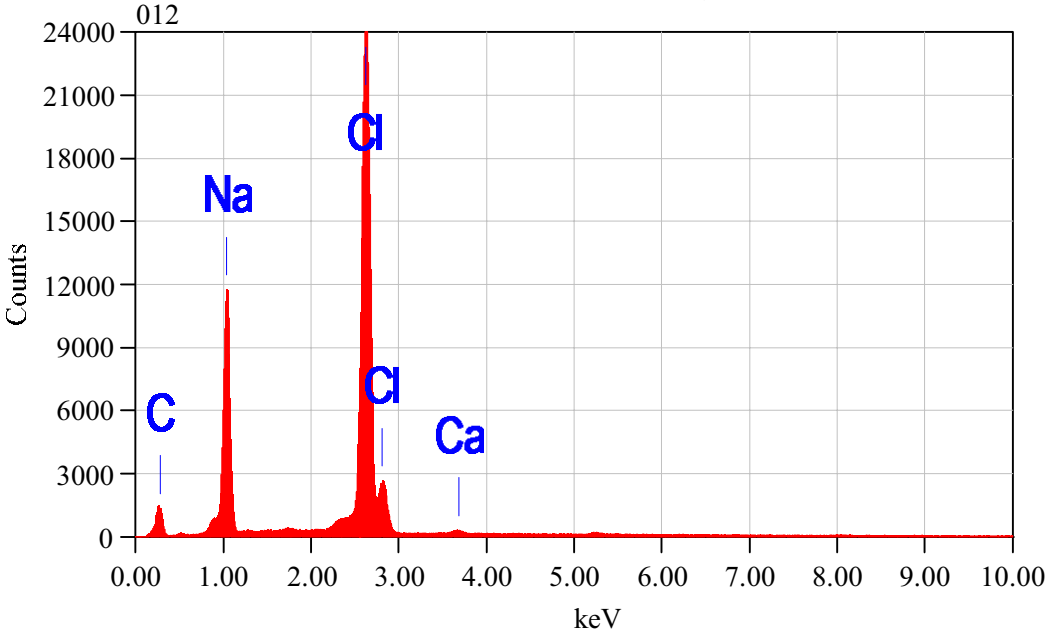


EDS4. Waratah Dust Gauge *(Exposed: 06/03/15, Collected:07/04/15)*, UQMP # 13398**.** The SEM/EDS spectrum of the particle annotated with 005 shows elevated levels of carbon with trace amounts of aluminium, silicon, sulfur, potassium, copper and iron. A trace amount of copper sludge is present The SEM/EDS spectrum displays a profile charachteristic for low ash coal.

6.5 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A HALITE PARTICLE



PM5. Warabrook Petri *(Exposed: 08/04/15, Collected: 08/04/15*, UQMP # 13399**.** An SEM/BSE image of a particulate annotated with 012, selected for SEM/EDS analysis.



EDS5. Warabrook Petri *(Exposed: 08/04/15, Collected: 08/04/15*, UQMP # 13399**.** The SEM/EDS spectrum of the particle annotated as 012 displays two major elements of sodium and chlorine. The particle is a common salt, sodium chloride or halite.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.09

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 25th June 2015

Sample Description:

	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Stockton South	07/04/15	05/05/15	UQMP # 13469
2	Newcastle East	11/05/15	13/05/15	UQMP # 13470
3	Stockton North	11/05/15	13/05/15	UQMP # 13471
4	Stockton South, Punt Road	11/05/15	13/05/15	UQMP # 13472
5	Fern Bay, Taylor Road	11/05/15	13/05/15	UQMP # 13473

#Method Ref: Internal AMCP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples was supplied as a washing from a dust fallout gauge deposit and loose deposits from petri dishes. The dust gauge deposit was filtered onto a membrane filter and the loose deposits were examined directly by stereomicroscopy to check for particle distribution and general appearance. The sample from the dust fallout gauge deposit Stockton South was very sparse and overall analysis was not possible.

2. RESULTS

Appendix A attached presents the table of results of the combined microscopy observations.
Appendix B presents colour picture micrographs of the stereomicroscopy images.
Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. All of the deposits were very sparse and some of the spectra displayed erroneous levels of carbon, this has been noted during the discussion of each spectrum.
Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of Applied Materials Characterisation and Performance

Jim Haig

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13469	UQMP # 13470	UQMP # 13471
	SAMPLE ID	*Stockton South*	*Newcastle East*	*Stockton North*
	PARTICLE TYPE			
BLACK	COAL		10	20
	SOOT	tr	tr	tr
	BLACK RUBBER DUST	tr	tr	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**65**	**85**	**75**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	20		
	PLANT DEBRIS (General)	10	5	5
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	5		tr
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS		The deposit was very sparsley populated with particulates with less than 50 particles observed.		

3.2 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13472	UQMP # 13473	
	SAMPLE ID	*Stockton South, Punt Road*	*Fern Bay, Taylor Road*	
	PARTICLE TYPE			
BLACK	COAL	5	20	
	SOOT	3	tr	
	BLACK RUBBER DUST		5	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**87**	**75**	
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS		tr	
	PLANT DEBRIS (General)	5	tr	
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr		
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

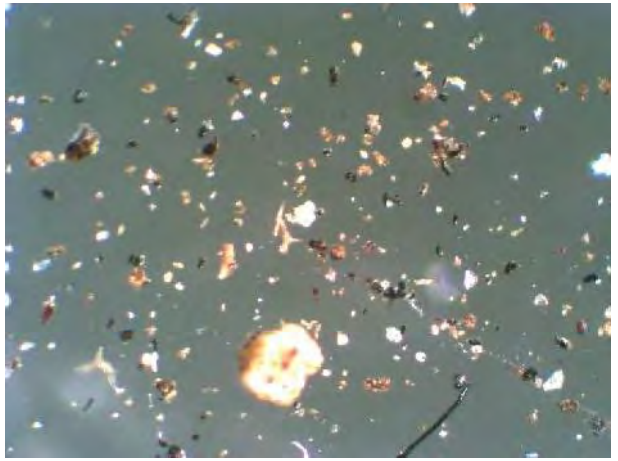
3.3 PARTICLE IDENTITY LEGEND

Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black.
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

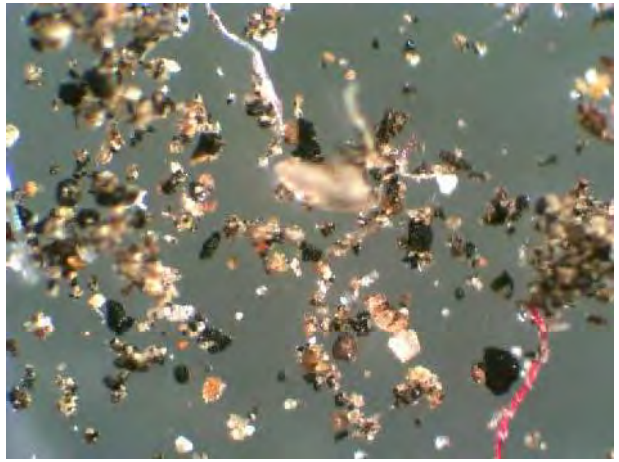
4. APPENDIX B

4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS

StMPM1. Stockton South, UQMP # 13469



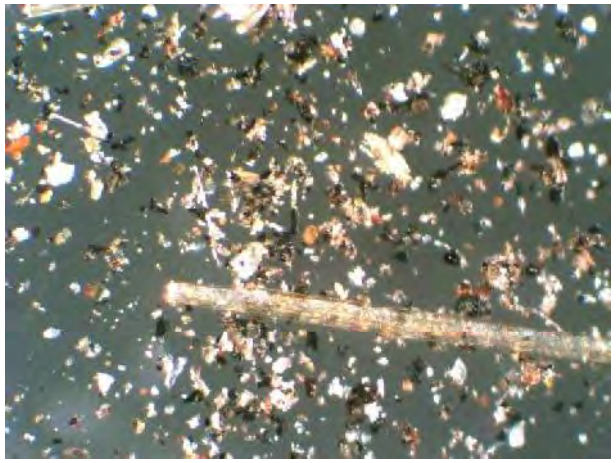
StMPM2. NewCastle East, UQMP # 13470



StMPM3. Stockton North, UQMP # 13471.

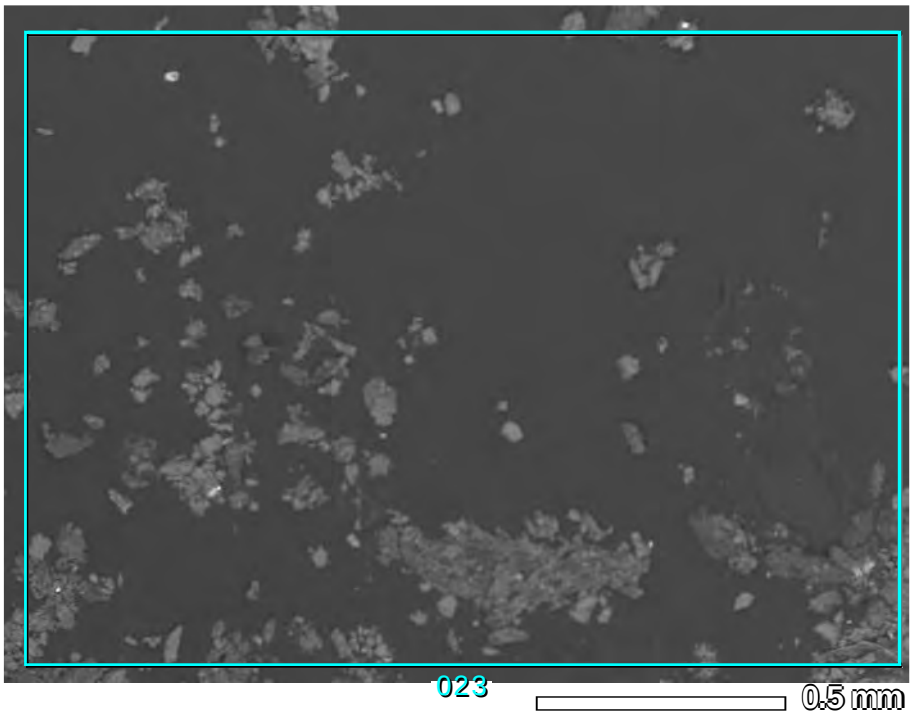
StMPM4. Stockton South, Punt Road, UQMP # 13472.

4.2 STEREOMICROSCOPY PICTURE MICROGRAPHS

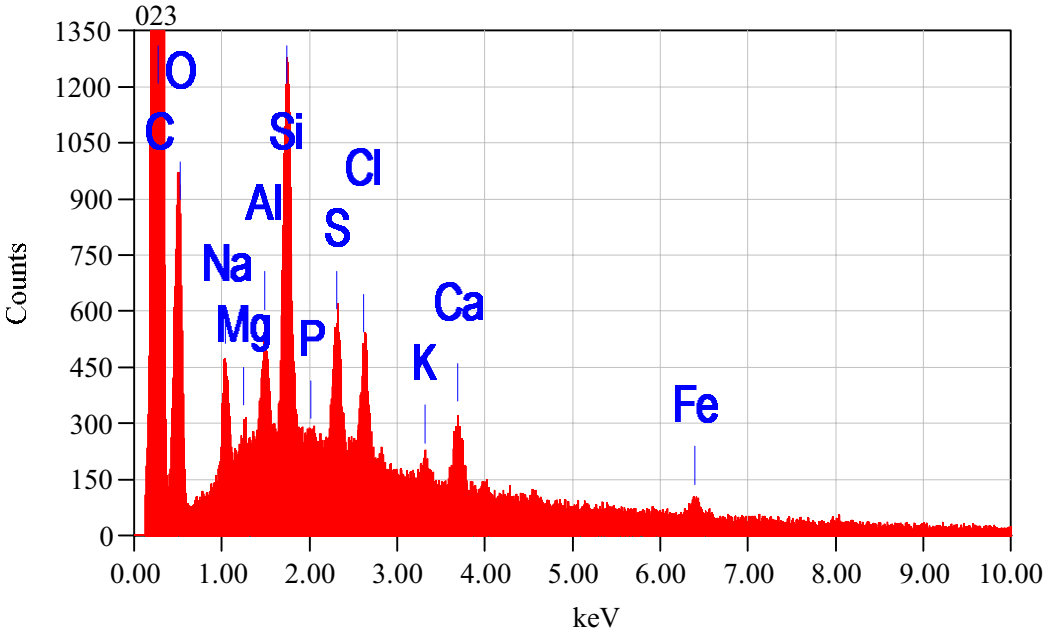


StMPM5. Fern Bay, Taylor Road, UQMP # 13473.

5. APPENDIX C
5.1 SEM/BSE IMAGES AND EDS SPECTRUM OF AN OVERALL AREA

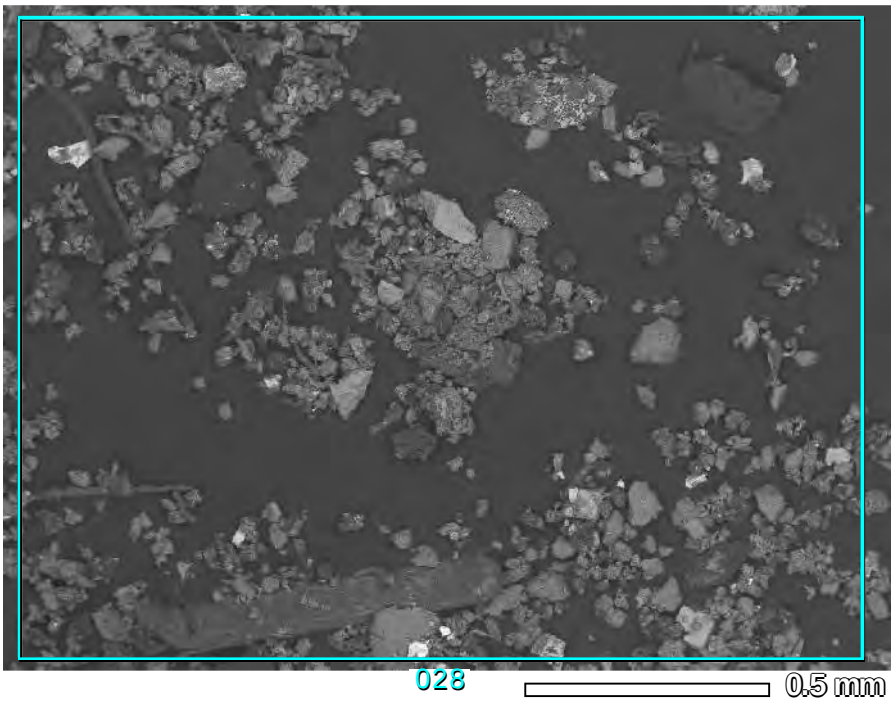


PM1. NewCastle East, UQMP # 13470. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

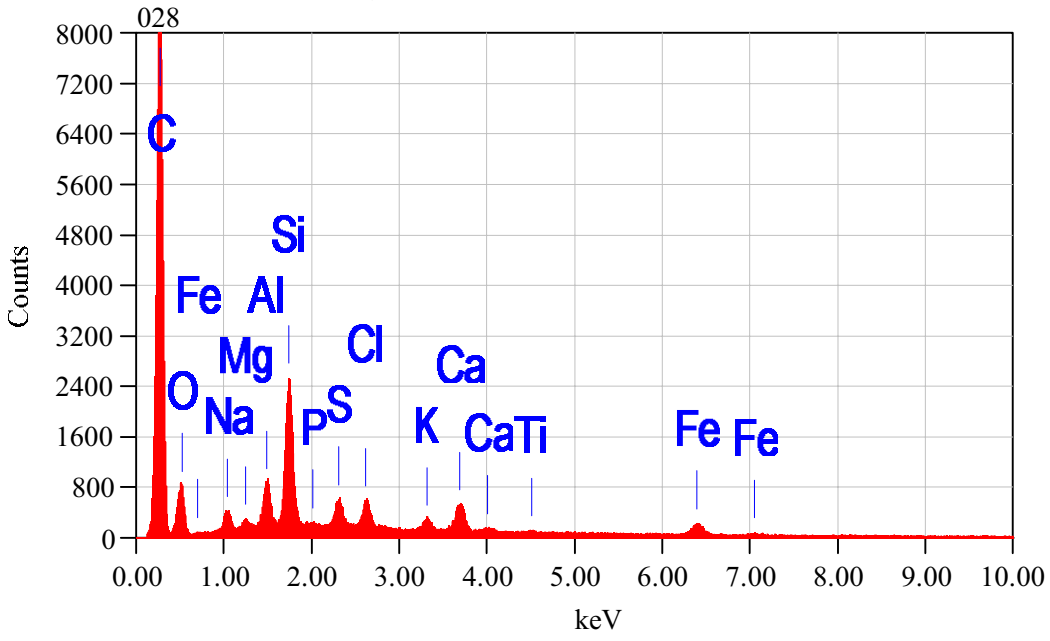


EDS1. New Castle East, UQMP # 13470. The SEM/EDS spectrum of the overall area is rich in carbon, silicon, aluminium, sodium, sulfur and chloride with traces of the balance of the elements. The carbon peak is erroneous and represents the degree of exposed carbon tape whilst the actual carbon containing particles were observed as minor and included coal, soot, rubber dust and plant debris. The bulk of the deposit was observed as mineral dust paticulates.

5.2 SEM/BSE IMAGES AND EDS SPECTRUM OF AN OVERALL AREA

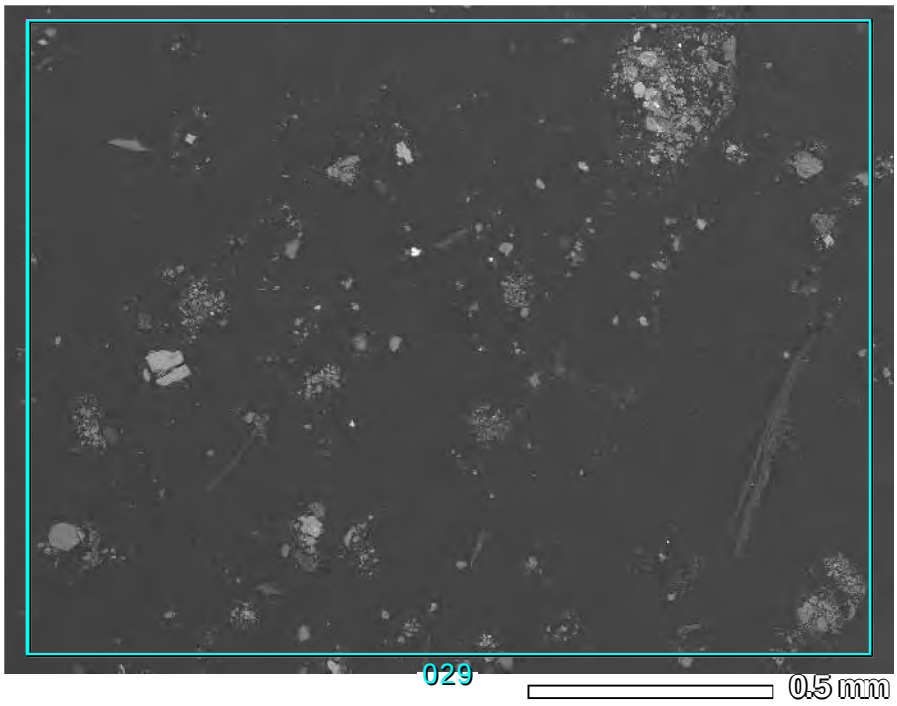


PM2. Stockton North, UQMP # 13471. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

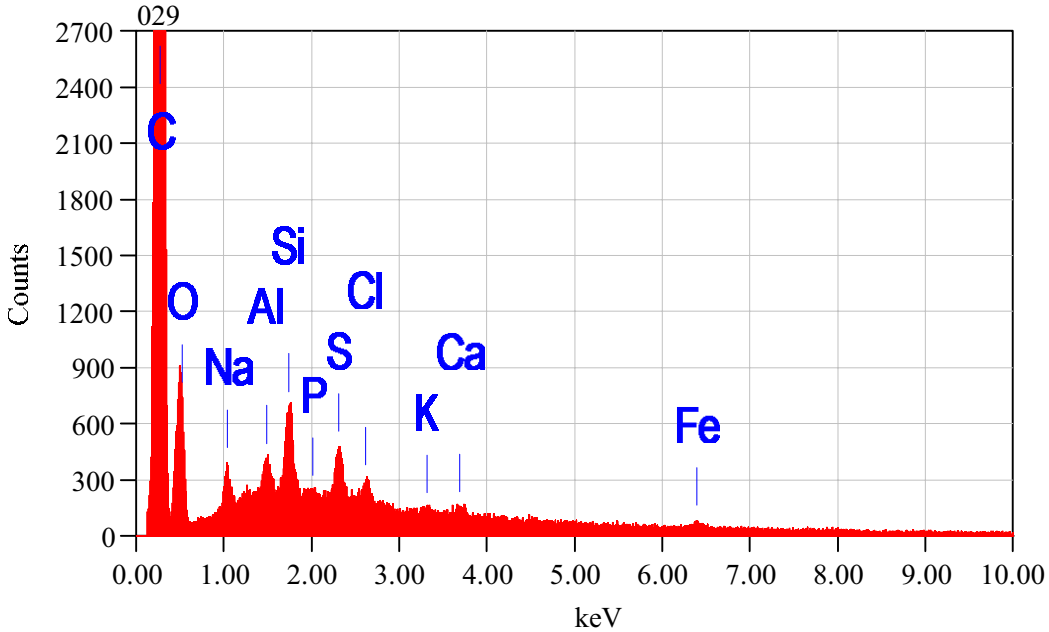


EDS2. Stockton North, UQMP # 13471. The SEM/EDS spectrum of the overall area is rich in carbon, silicon and aluminium with traces of the balance of the elements. The carbon peak includes some of the exposed carbon tape whilst the actual carbon containing particles were observed as minor and included coal, soot and plant debris and traces of fibres. The major particle type was observed as mineral dust.

5.3 SEM/BSE IMAGES AND EDS SPECTRUM OF AN OVERALL AREA

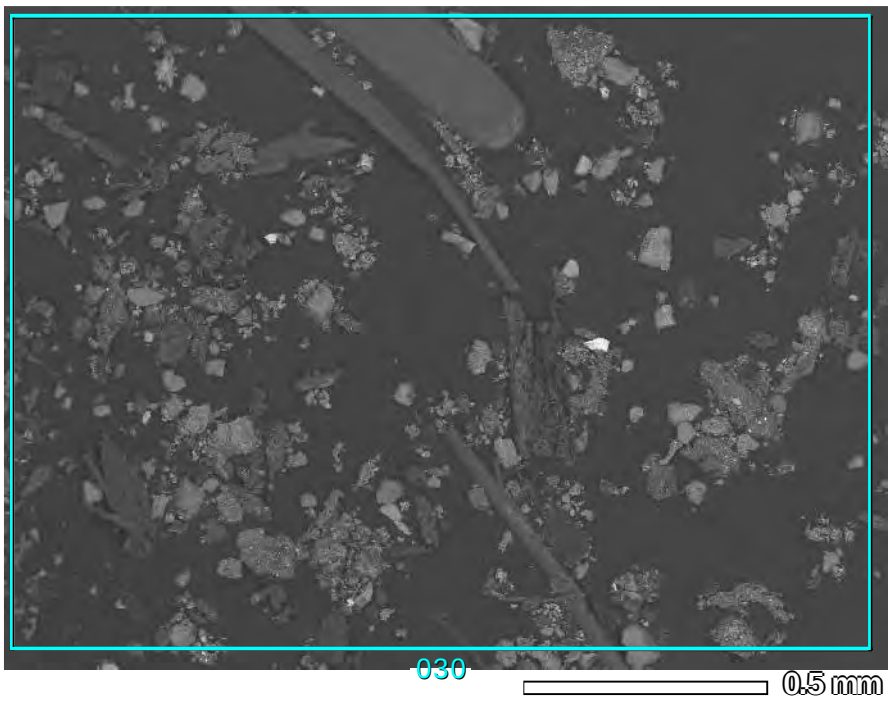


PM3. Stockton South, Punt Road, UQMP # 13472. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

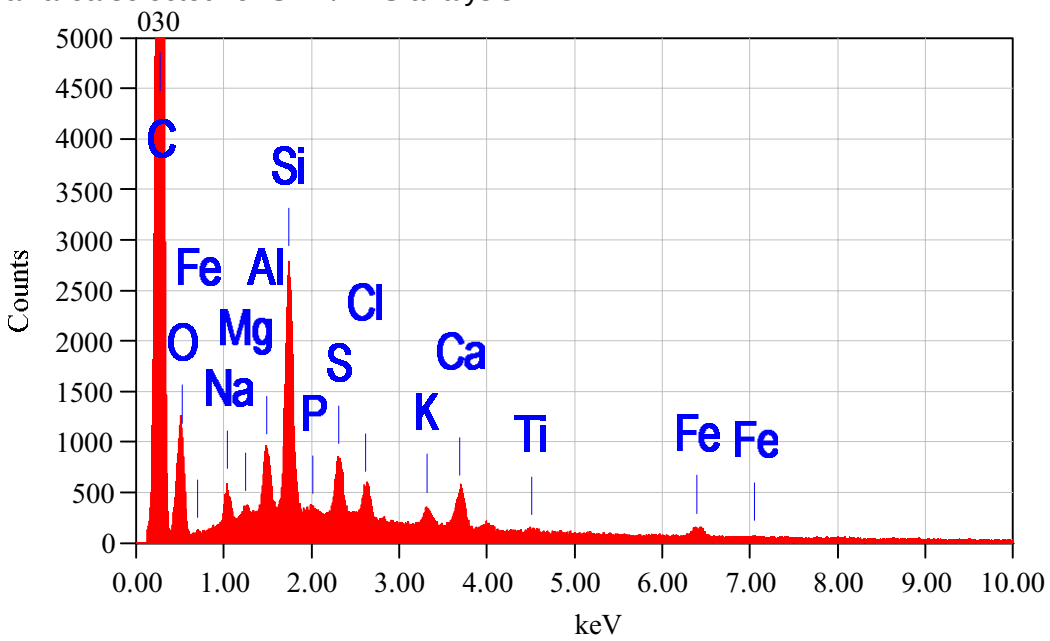


EDS3. Stockton South, Punt Road, UQMP # 13472. The SEM/EDS spectrum of the overall area is rich in carbon with minor amounts of sodium, aluminium, silicon and sulfur and traces of the balance of the elements. The carbon peak is erroneous and includes some of the exposed carbon tape whilst the carbon containing particles were observed as minor and included coal, soot, plant debris and traces of fibres. The major particle type of the deposit was observed as mineral dust.

5.4 SEM/BSE IMAGES AND EDS SPECTRUM OF AN OVERALL AREA



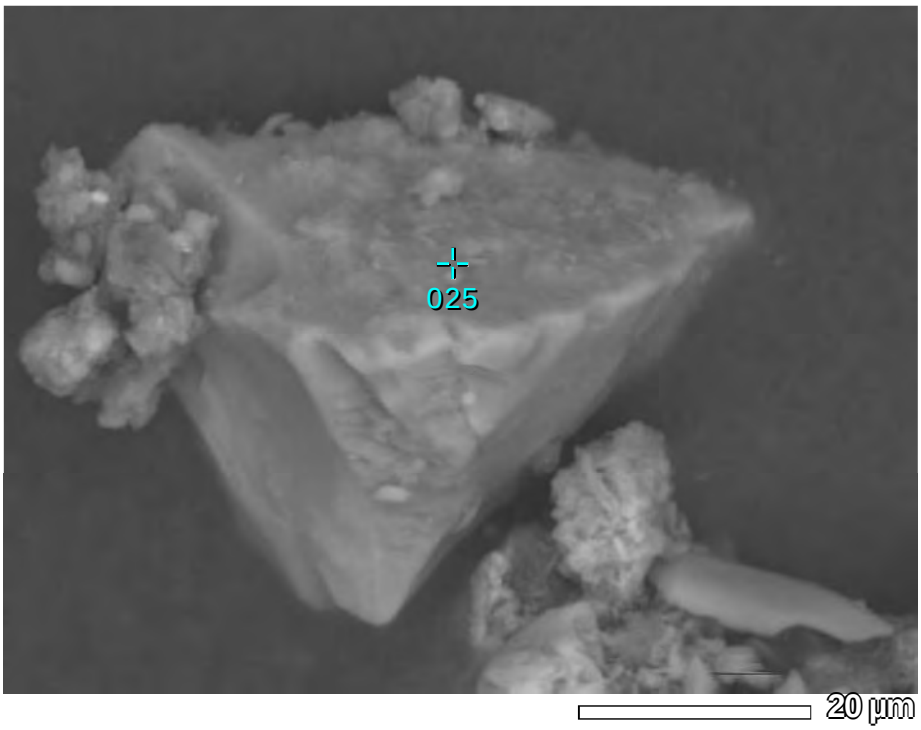
PM4. Fern Bay, Taylor Road, UQMP # 13473. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



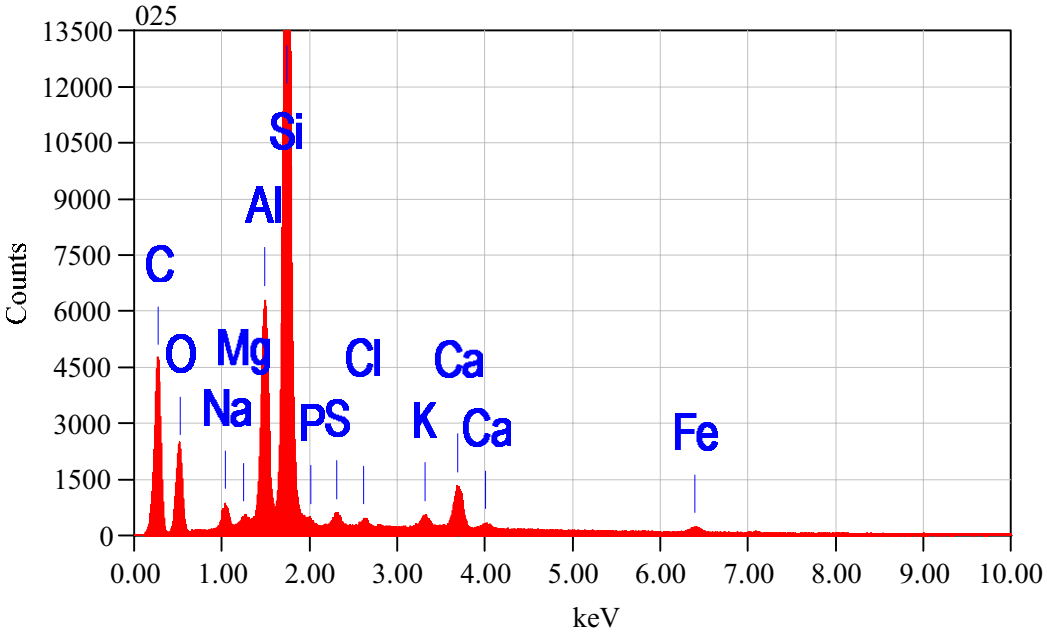
EDS4. Fern Bay, Taylor Road, UQMP # 13473. The SEM/EDS spectrum of the overall area is rich in carbon, aluminium and silicon with trace amounts of the balance of the elements. The elevated carbon peak incorporates carbon from the exposed carbon tape whilst the observed organic particulates were minor and included coal, soot, rubber dust and insect and plant debris. Stereomicroscopy observations noted a previlance of mineral dust particles.

6. APPENDIX D

6.1 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A MINERAL DUST PARTICLE

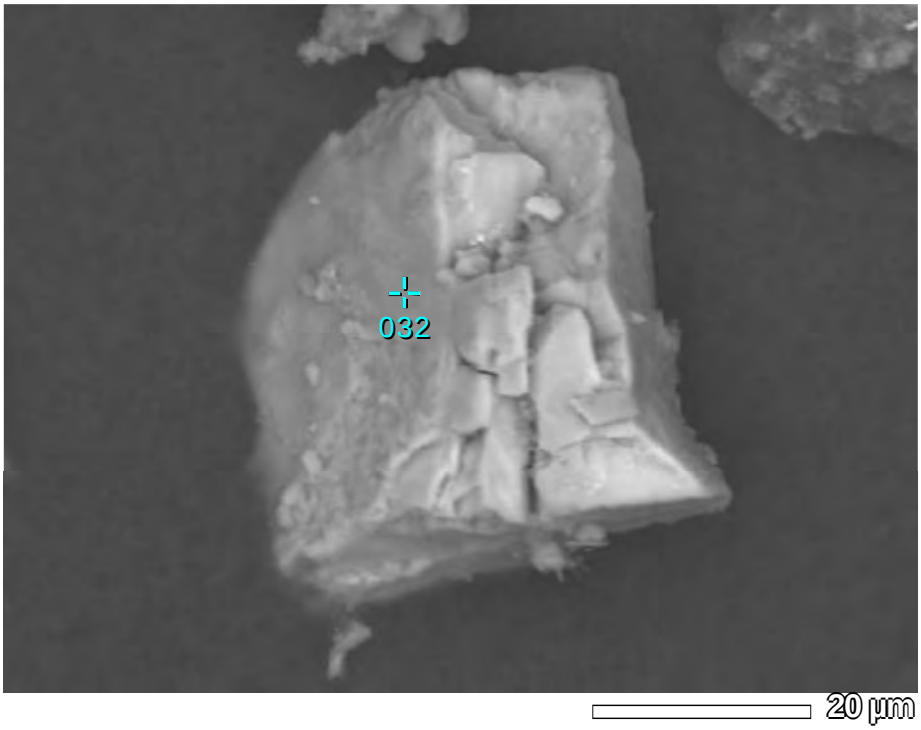


PM1. Newcastle East UQMP # 13470. An SEM/BSE image of a euhedral particulate annotated with 025 is selected for SEM/EDS analysis.

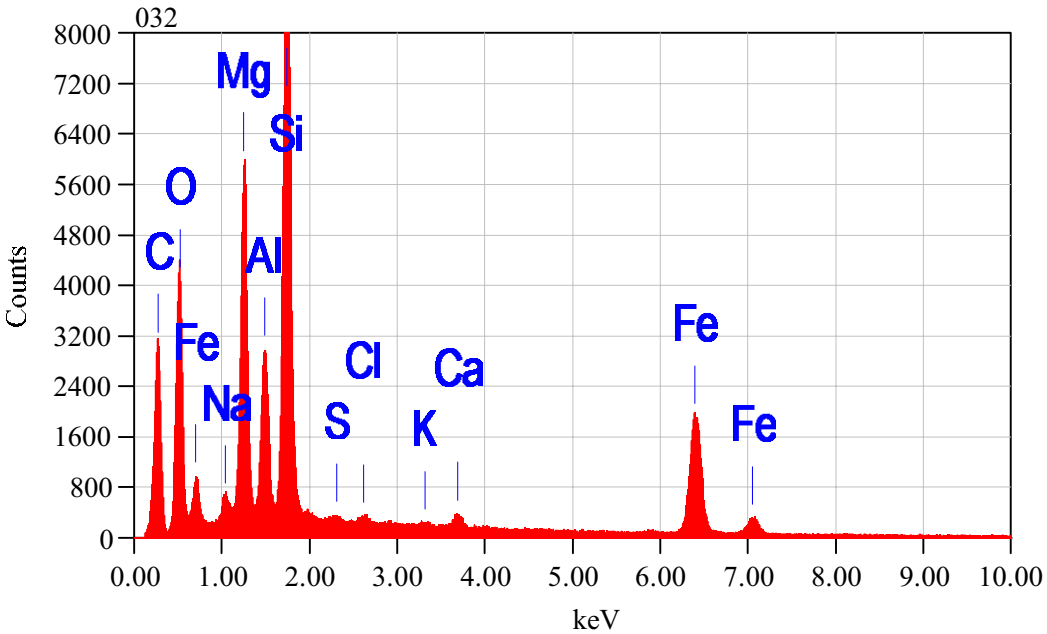


EDS1. Newcastle East UQMP # 13470. The SEM/EDS spectrum of the particle annotated with 025 displays predominant peaks of aluminium and silicon and minor amounts of carbon with traces of the balance of the elements. The particle is an aluminosilicate rich mineral dust.

6.2 SEM/BSE IMAGE AND SEM SPECTUM OF A MINERAL DUST PARTICLE

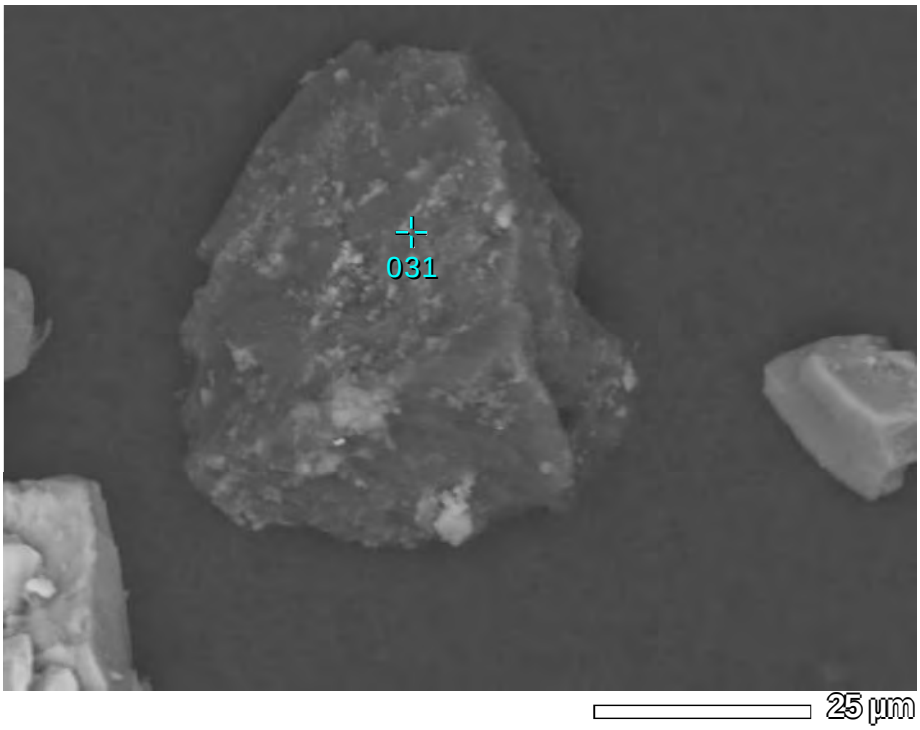


PM2. Fern Bay, Taylor Road, UQMP # 13473. An SEM/BSE image of a particulate marked with 032 is selected for SEM/EDS analysis.

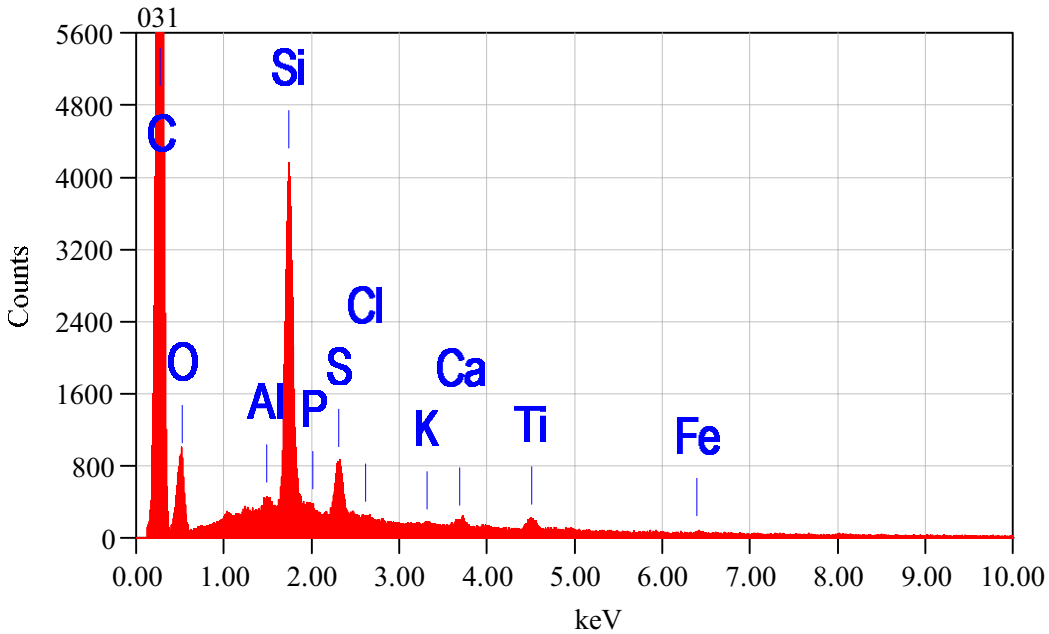


EDS2. Fern Bay, Taylor Road, UQMP # 13473. The SEM/EDS spectrum of the particle marked with 032 shows elevated levels of aluminium, silicon, magnesium and iron. The particle is possibly from the amphibole group of rock forming silicates.

6.3 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A HIGH ASH COAL PARTICLE.

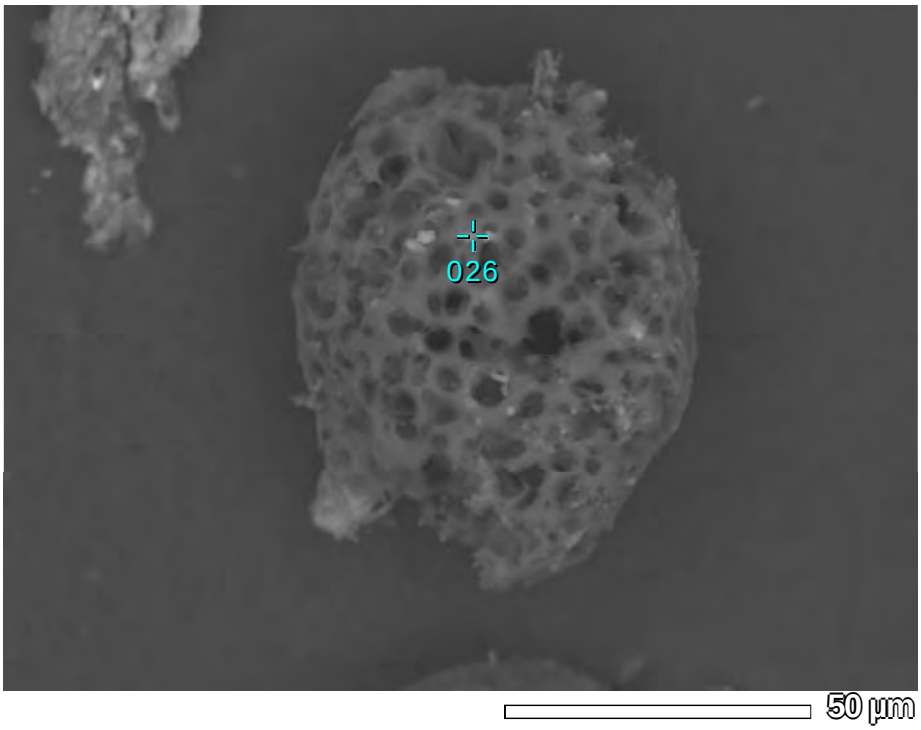


PM3. Fern Bay, Taylor Road, UQMP # 13473. An SEM/BSE image of a particulate annotated with 031 is selected for SEM/EDS analysis.

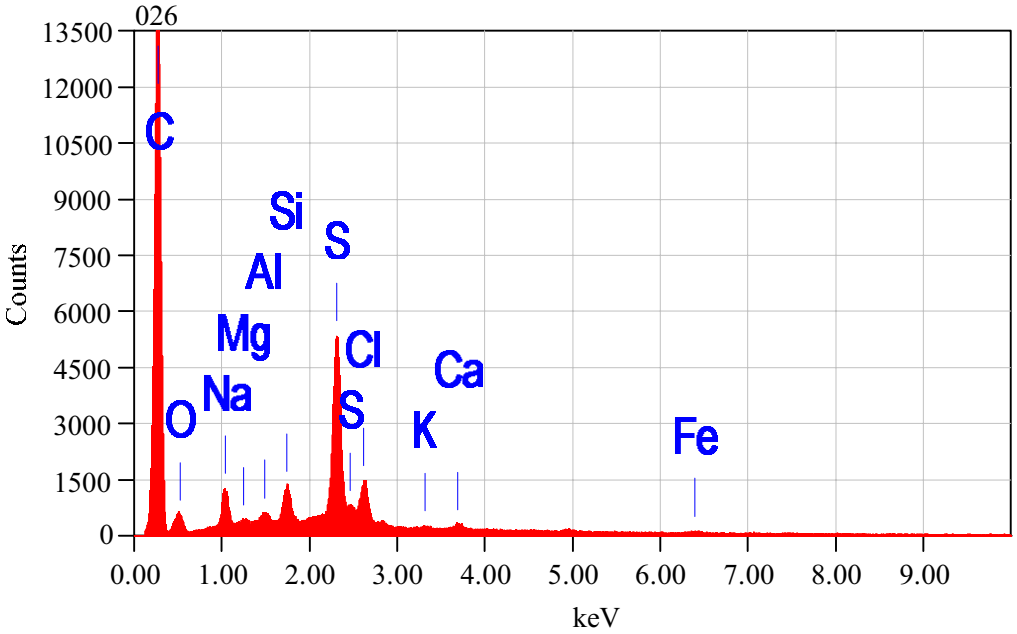


EDS3. Fern Bay, Taylor Road, UQMP # 13473. The SEM/EDS spectrum of the particle annotated with 031 shows elevated levels of carbon and silicon with trace amounts of the balance of the elements. The spectrum is suggestive of a high ash coal particle.

6.4 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A SOOT PARTICLE.



PM4. Newcastle East, UQMP # 13470. An SEM/BSE image of a particulate annotated with 026 is selected for SEM/EDS analysis.



EDS4. Newcastle East, UQMP # 13470. The SEM/EDS spectrum of the particle annotated with 026 shows elevated levels of carbon and sulfur the balance of the elements are trace level. The lacey particle morphology and SEM/EDS spectrum are characteristic for soot.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.10

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 14th September, 2015

Sample Description:

	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Stockton North Dust Gauge	05/05/15	02/06/16	UQMP # 13496
2	Hamilton Brush	02/06/15	02/06/15	UQMP # 13497
3	Stockton South Brush	02/06/15	02/06/15	UQMP # 13498

#Method Ref: Internal UQMP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples were supplied as washings from a dust fallout gauge deposit. The samples were filtered onto a membrane filter and examined by stereomicroscopy to check for particle distribution and general appearance.

2. RESULTS

Appendix A attached presents the table of results of the combined microscopy observations.

Appendix B presents colour picture micrographs of the stereomicroscopy images.

Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. Trace amounts of copper sludge was noted in the dust fallout gauge deposit.

Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of UQ Materials Performance

Fiona Jones

_____

Fiona Jones

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

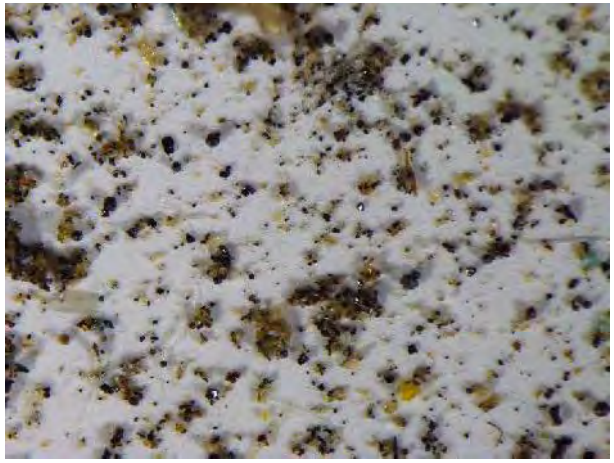
PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13496	UQMP # 13497	UQMP # 13498
	SAMPLE ID **PARTICLE TYPE**	*Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15)*	*Hamilton Brush (Exposed: 02/06/15, Collected: 02/06/15)*	*Stockton South Brush (Exposed: 02/06/15, Collected: 02/06/15)*
BLACK	COAL	20	10	20
	SOOT	10		
	BLACK RUBBER DUST	2	10	10
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**63**	**70**	**65**
	MINERAL DUST (type = Halite)			5
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE	tr		
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	tr	tr
	PLANT DEBRIS (General)	5	10	tr
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)		tr	
	STARCH			
	PAINT	tr	tr	tr
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS			Large red brown flakes noted.	

3.2 PARTICLE IDENTITY LEGEND

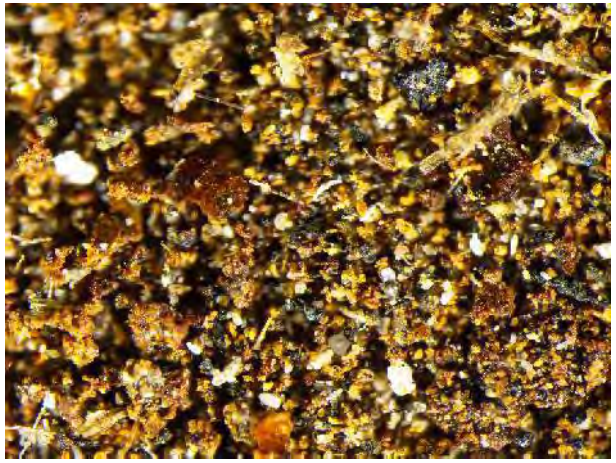
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

4. APPENDIX B

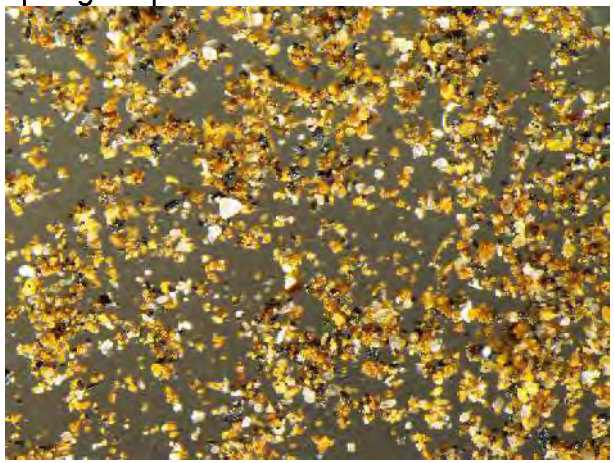
4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS



StMPM1. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496. Minor numbers of black particulates were observed, sharp angular particles are consitent with coal.



StMPM2. Hamilton Brush (Exposed: 02/06/15, Collected: 02/06/15), UQMP # 13497. Minor amounts of black, col and red/brown rust particulates were examined.

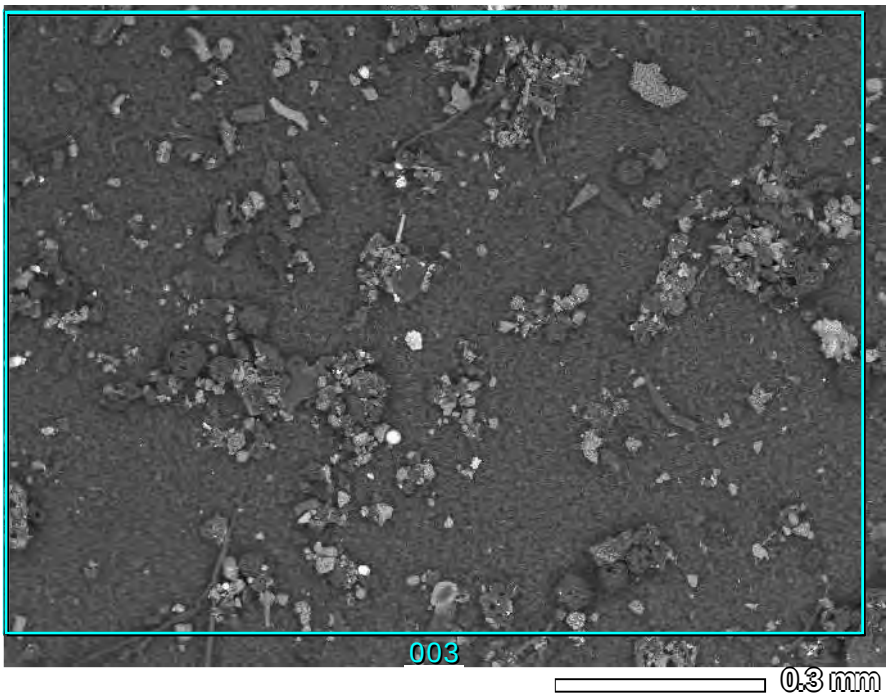


StMPM3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498.

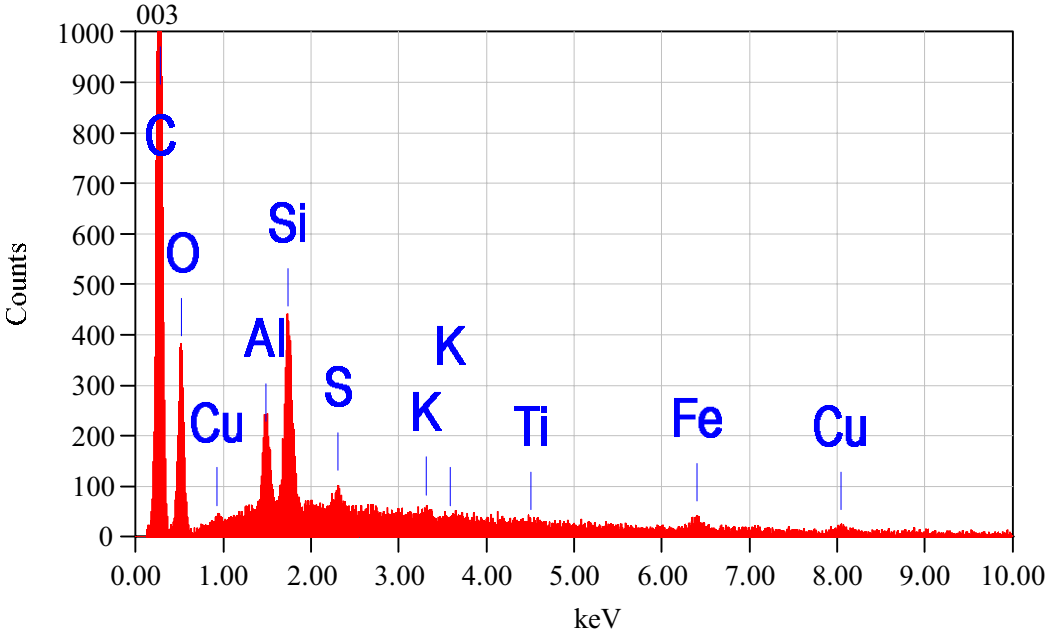
.

5. APPENDIX C

5.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

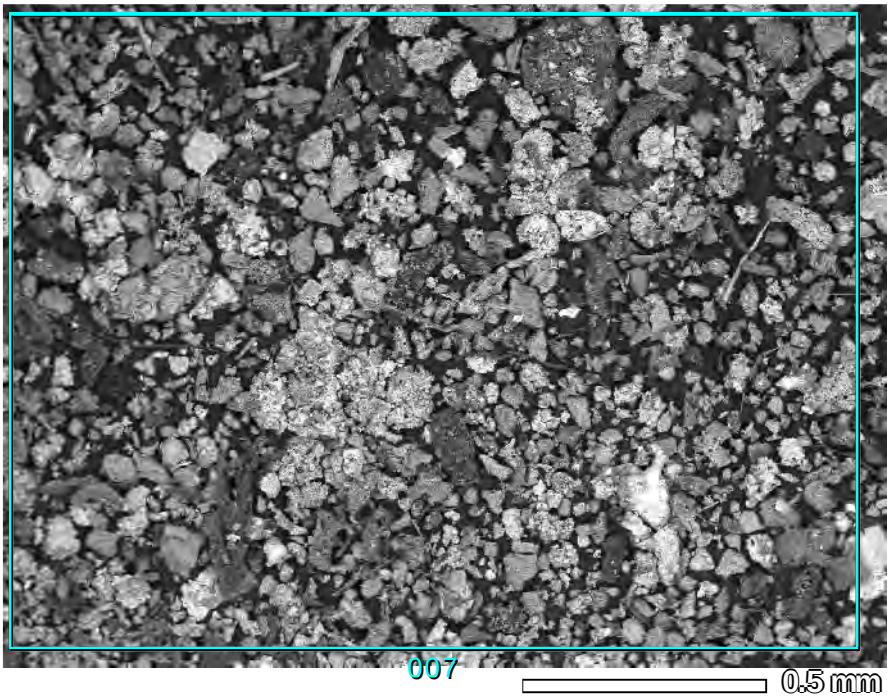


PM1. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

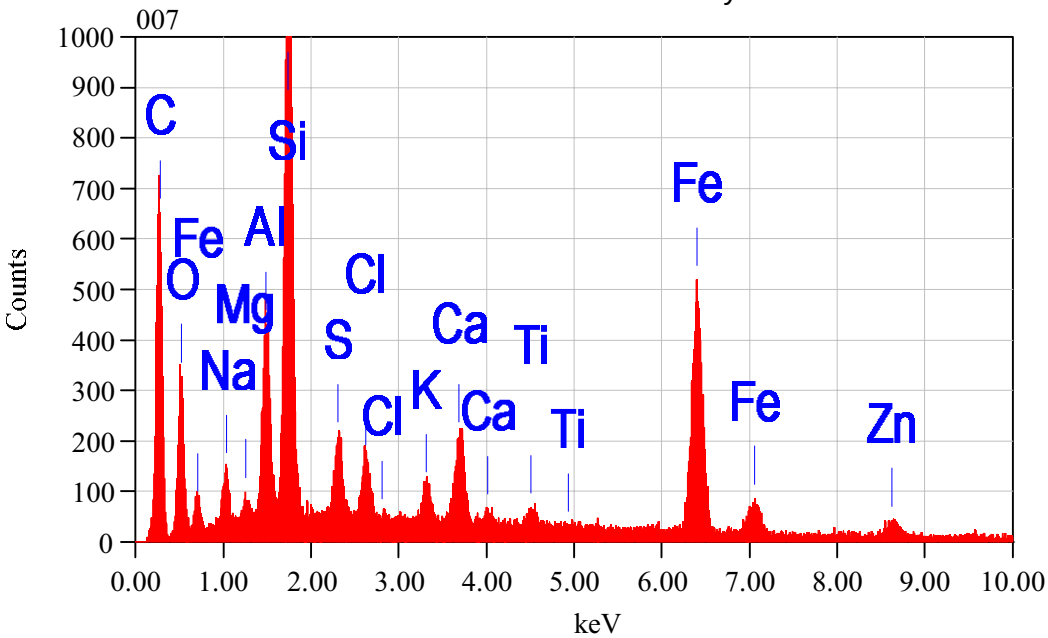


EDS1. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496. The SEM/EDS spectrum of the overall area is rich in carbon with minor amounts of aluminium and silicon. The deposit sparsley populates the membrane filter and the elevated carbon represents the degree of exposed filter. Observations found a minor amount of carbon contributing particles including coal, soot, rubber dust, plant debris and traces of paint and insect debris, with the balance of the deposit being aluminosilicate rich mineral dust. Traces of copper sludge were also noted.

5.2 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

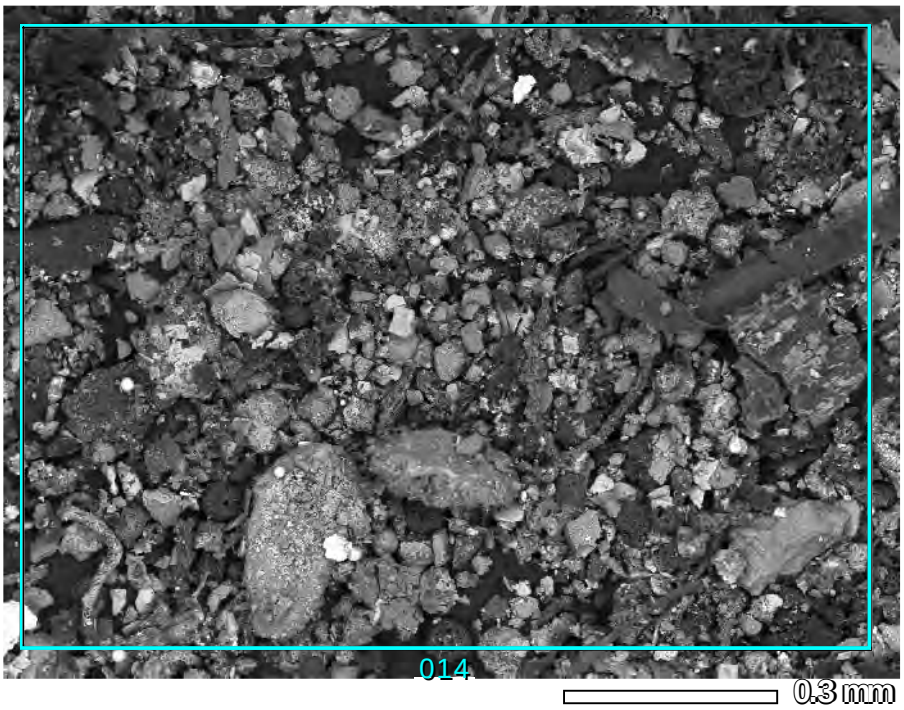


PM2. Hamilton Brush (Exposed: 02/06/15, Collected: 02/06/15), UQMP # 13497. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

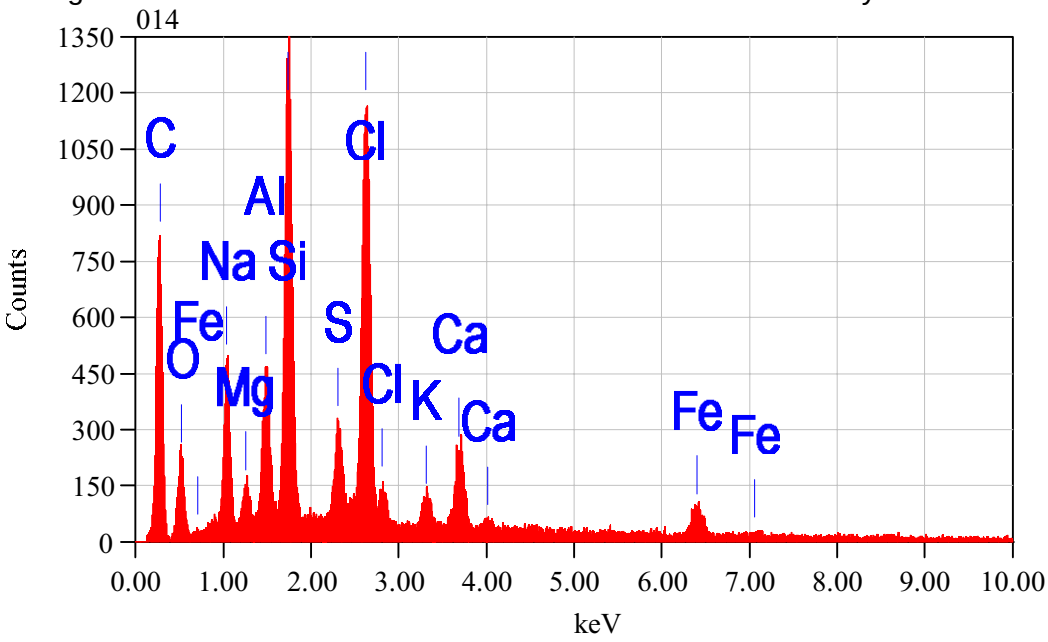


EDS2. Hamilton Brush (Exposed: 02/06/15, Collected: 02/06/15), UQMP # 13497. The SEM/EDS spectrum of the overall area is rich in carbon, silicon, aluminium and iron with minor amounts of sodium, potassium and calcium with trace amounts of magnesium, titanium and zinc. The elevated carbon peak is representative of the organic materials examined which included coal, rubber dust, fibres, paint and insect and plant debris. A prominent iron peak is consistent with the microscopy observations or a red/brown rusty material an iron oxide. Mineral dust was the major particle type present.

5.3 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



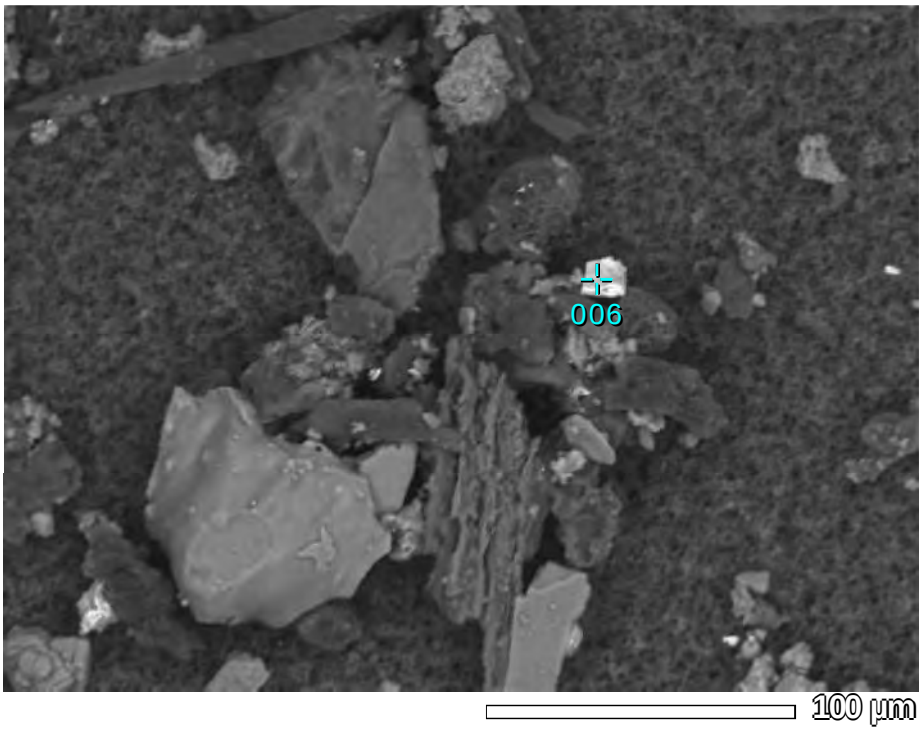
PM3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



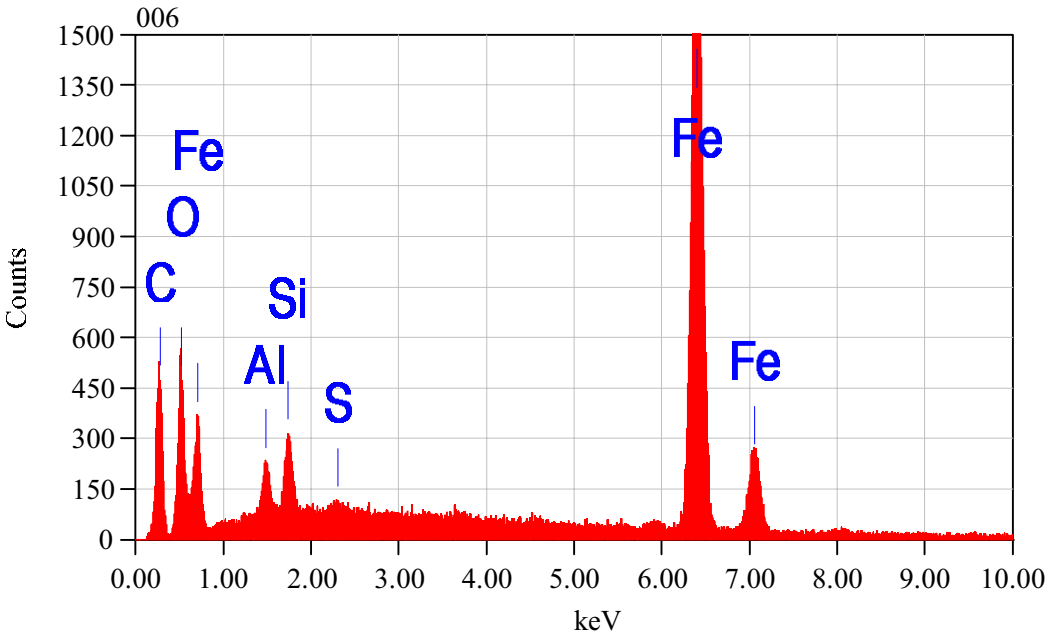
EDS3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. Carbon, sodium, aluminium and chloride are the dominant elements of the SEM/EDS spectrum. A minor amount of organic particulates were observed by microscopy and included coal, rubber dust, paint and insect and plant debris. The balance of the deposit was composed of mineral dust which consisted mostly of aluminosilicate rich mineral dust and halite (sodium chloride).

6. APPENDIX D

6.1 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF AN IRON OXIDE PARTICLE

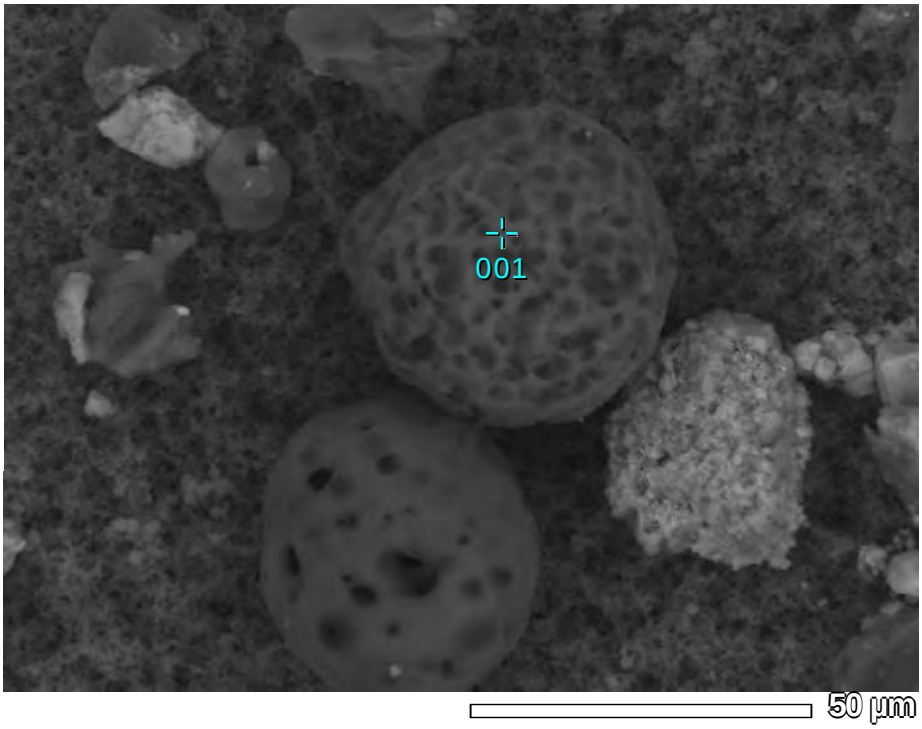


PM1. # 13496. An SEM/BSE image of a particulate annotated with 006 is selected for SEM/EDS analysis.

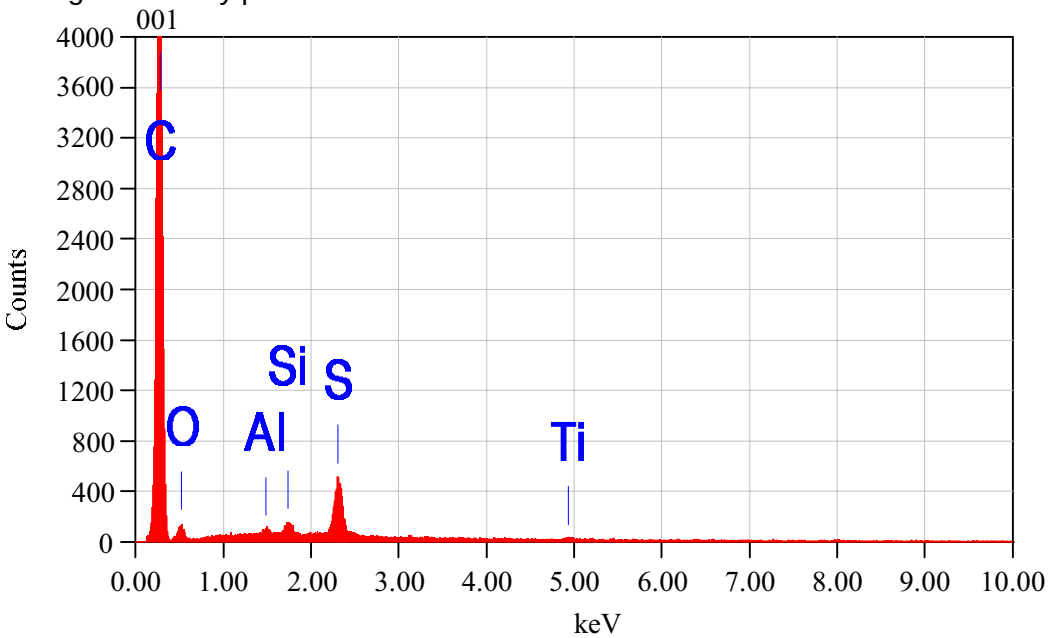


EDS1. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496**.** The SEM/EDS spectrum of the particle annotated with 006 displays elevated levels of iron with minor amounts of carbon, aluminium, silicon and traces of sulfur. The spectrum is representative of an iron oxide particle overlaying mineral dust and organic material. The accelerating voltage is sufficient to detect some of the elements in the particles below.

6.2 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF SOOT

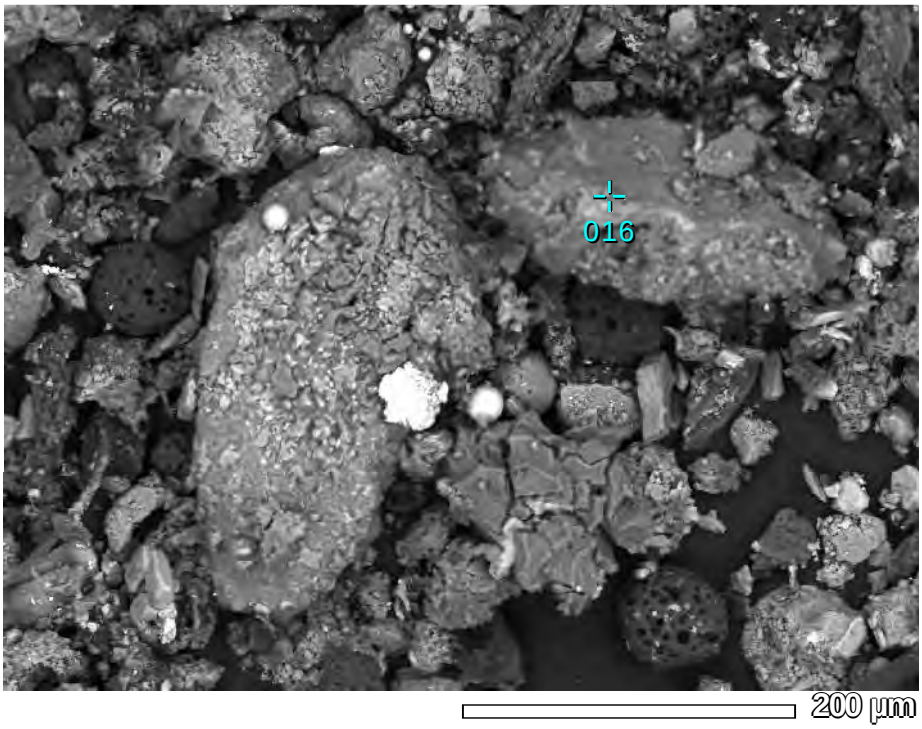


PM2. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496**.** An SEM/BSE image of a lacey particulate marked with 001 which is selected for SEM/EDS analysis.

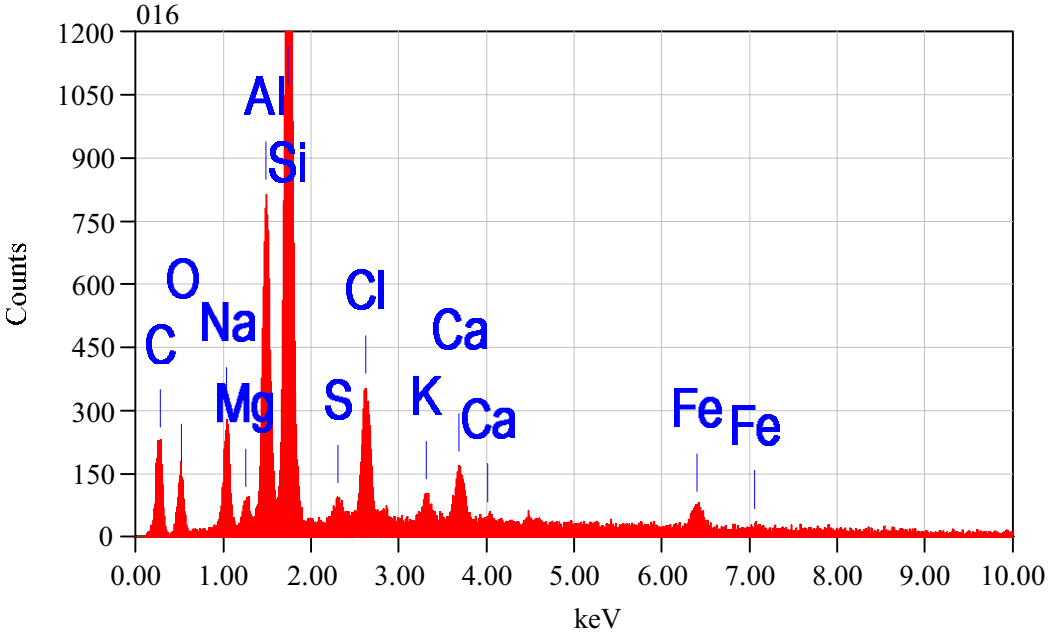


EDS2. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496**.** The SEM/EDS spectrum of the particle marked with 001 diplays an elemental profile typical of soot.

6.3 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A MINERAL DUST PARTICLE

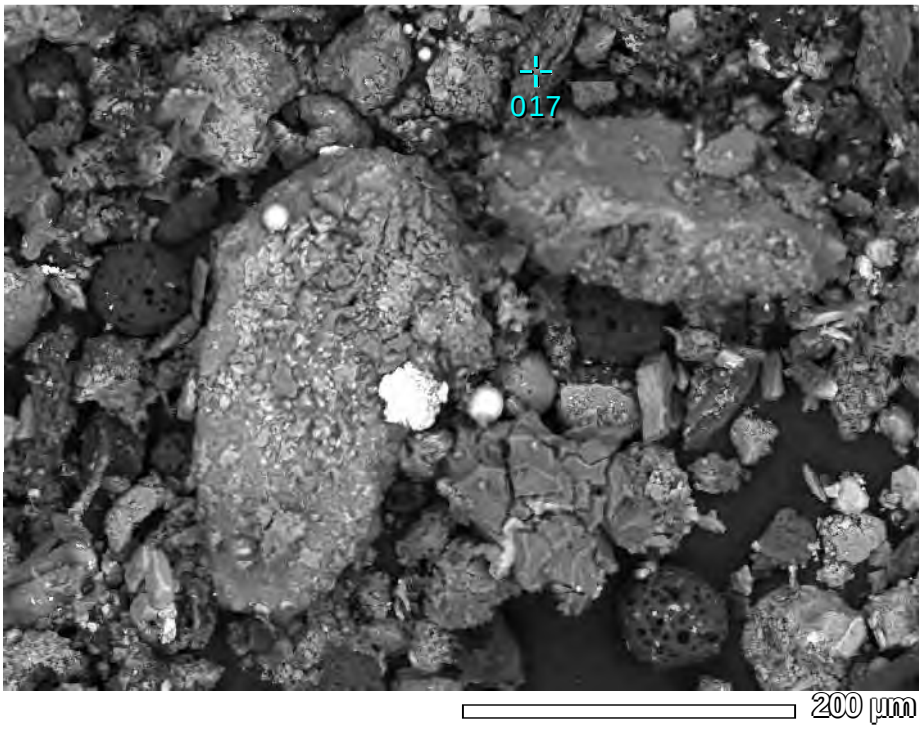


PM3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. An SEM/BSE image of a particulate annotated with 016 is selected for SEM/EDS analysis.

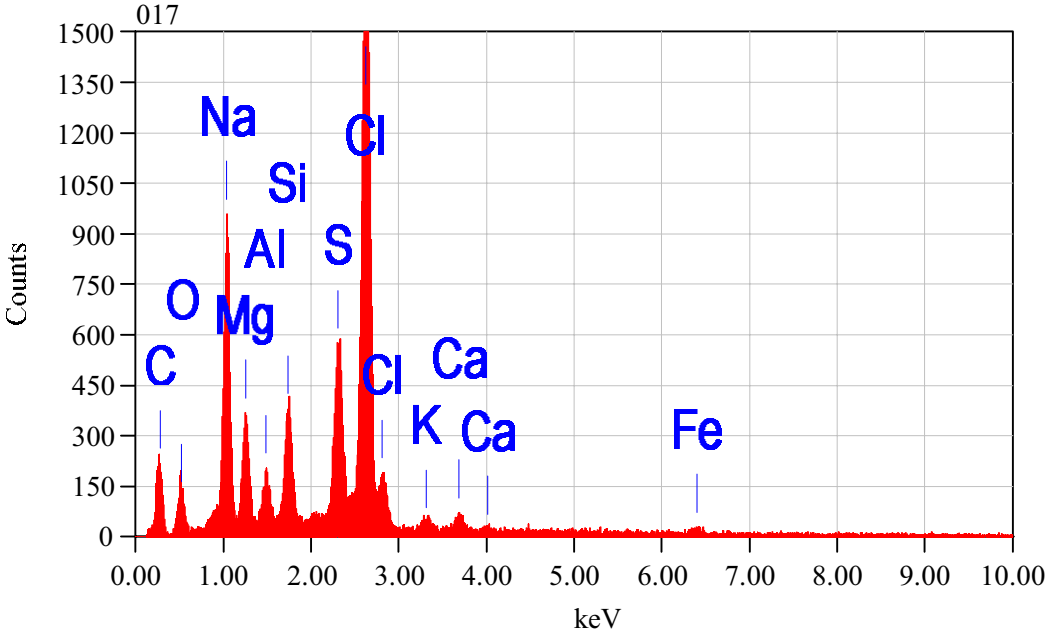


EDS3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. The SEM/EDS spectrum of the particle annotated with 016 shows elevated levels of aluminium and silicon with minor amounts of sodium and chloride with traces of the remaining elements. The spectrum is characteristic of an aluminosilicate rich mineral dust.

6.4 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A HALITE PARTICLE



PM4. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. An SEM/BSE image of a particulate annotated with 017 is selected for SEM/EDS analysis.



EDS4. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. Sodium and chloride are the predominant elements of the spectrum, this is typical of a halite particle which is rich in sodium chloride.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.09

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 25th June 2015

Sample Description:

	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Stockton South	07/04/15	05/05/15	UQMP # 13469
2	Newcastle East	11/05/15	13/05/15	UQMP # 13470
3	Stockton North	11/05/15	13/05/15	UQMP # 13471
4	Stockton South, Punt Road	11/05/15	13/05/15	UQMP # 13472
5	Fern Bay, Taylor Road	11/05/15	13/05/15	UQMP # 13473

#Method Ref: Internal AMCP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples was supplied as a washing from a dust fallout gauge deposit and loose deposits from petri dishes. The dust gauge deposit was filtered onto a membrane filter and the loose deposits were examined directly by stereomicroscopy to check for particle distribution and general appearance. The sample from the dust fallout gauge deposit Stockton South was very sparse and overall analysis was not possible.

2. RESULTS

Appendix A attached presents the table of results of the combined microscopy observations.
Appendix B presents colour picture micrographs of the stereomicroscopy images.
Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. All of the deposits were very sparse and some of the spectra displayed erroneous levels of carbon, this has been noted during the discussion of each spectrum.
Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of Applied Materials Characterisation and Performance

Jim Haig

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13469	UQMP # 13470	UQMP # 13471
	SAMPLE ID	*Stockton South*	*Newcastle East*	*Stockton North*
	PARTICLE TYPE			
BLACK	COAL		10	20
	SOOT	tr	tr	tr
	BLACK RUBBER DUST	tr	tr	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**65**	**85**	**75**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	20		
	PLANT DEBRIS (General)	10	5	5
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	5		tr
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS		The deposit was very sparsley populated with particulates with less than 50 particles observed.		

3.2 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13472	UQMP # 13473	
	SAMPLE ID	*Stockton South, Punt Road*	*Fern Bay, Taylor Road*	
	PARTICLE TYPE			
BLACK	COAL	5	20	
	SOOT	3	tr	
	BLACK RUBBER DUST		5	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**87**	**75**	
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS		tr	
	PLANT DEBRIS (General)	5	tr	
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr		
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

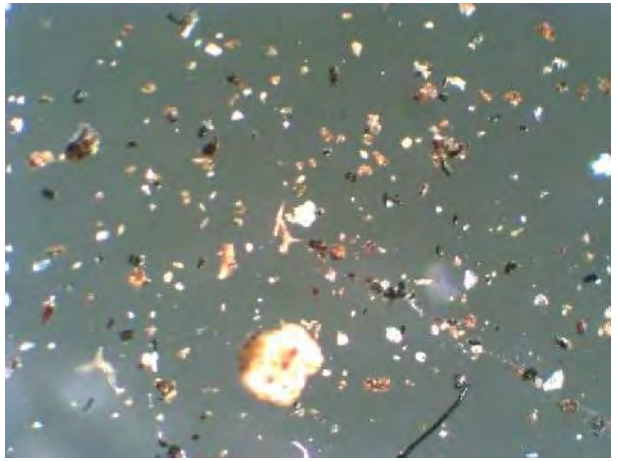
3.3 PARTICLE IDENTITY LEGEND

Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black.
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

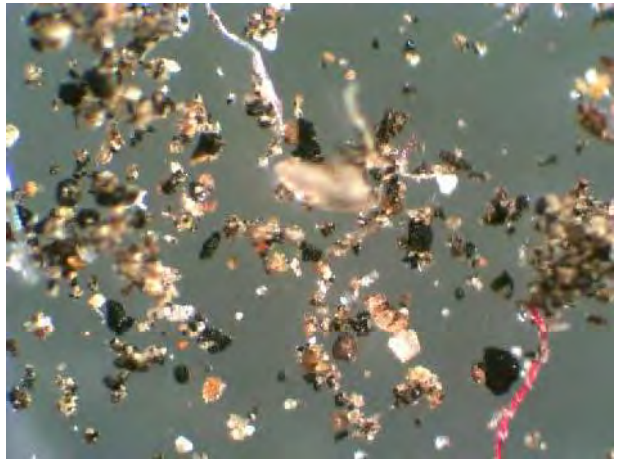
4. APPENDIX B

4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS

StMPM1. Stockton South, UQMP # 13469



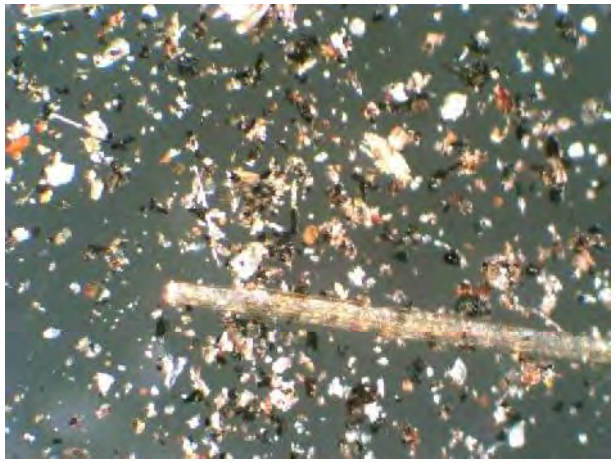
StMPM2. NewCastle East, UQMP # 13470



StMPM3. Stockton North, UQMP # 13471.

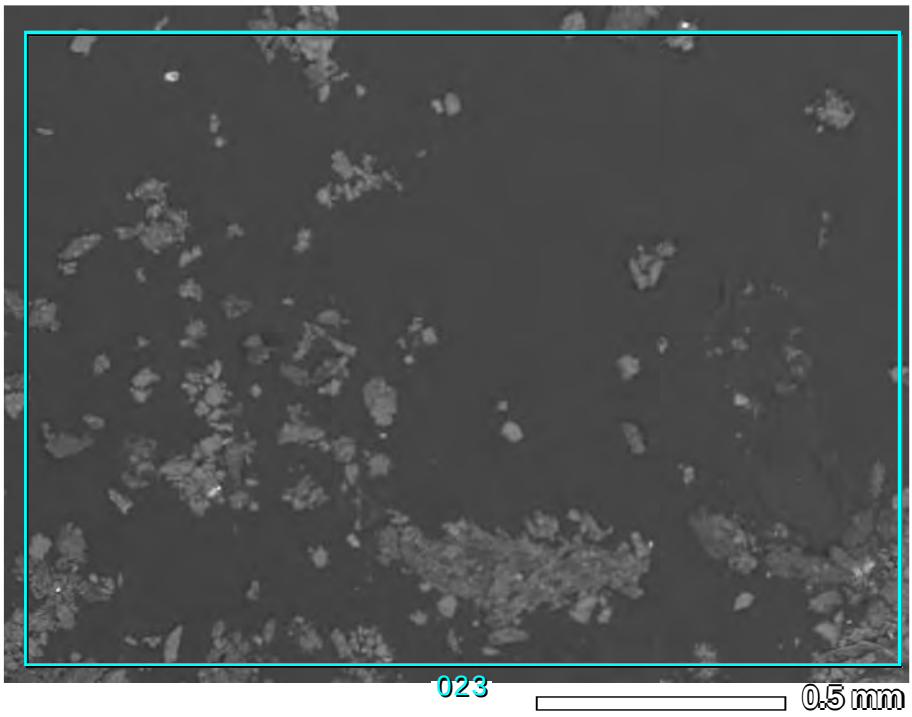
StMPM4. Stockton South, Punt Road, UQMP # 13472.

4.2 STEREOMICROSCOPY PICTURE MICROGRAPHS

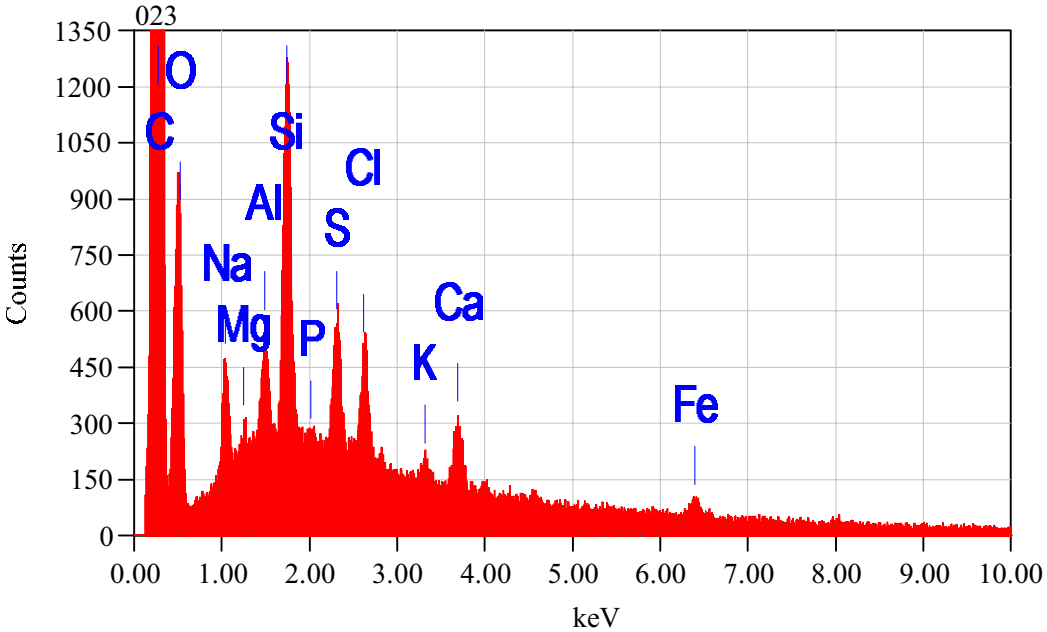


StMPM5. Fern Bay, Taylor Road, UQMP # 13473.

5. APPENDIX C
5.1 SEM/BSE IMAGES AND EDS SPECTRUM OF AN OVERALL AREA

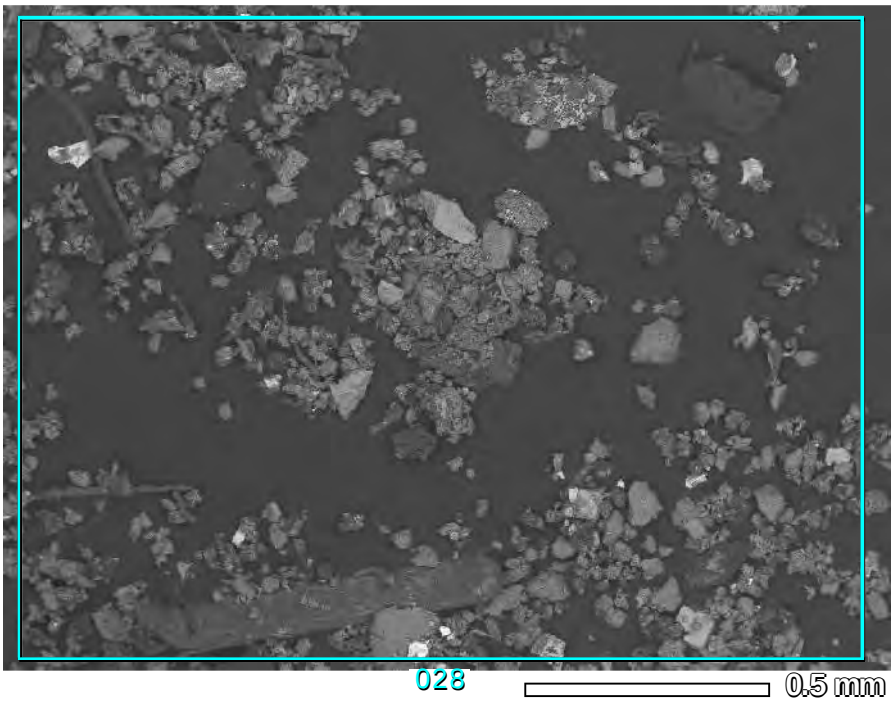


PM1. NewCastle East, UQMP # 13470. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

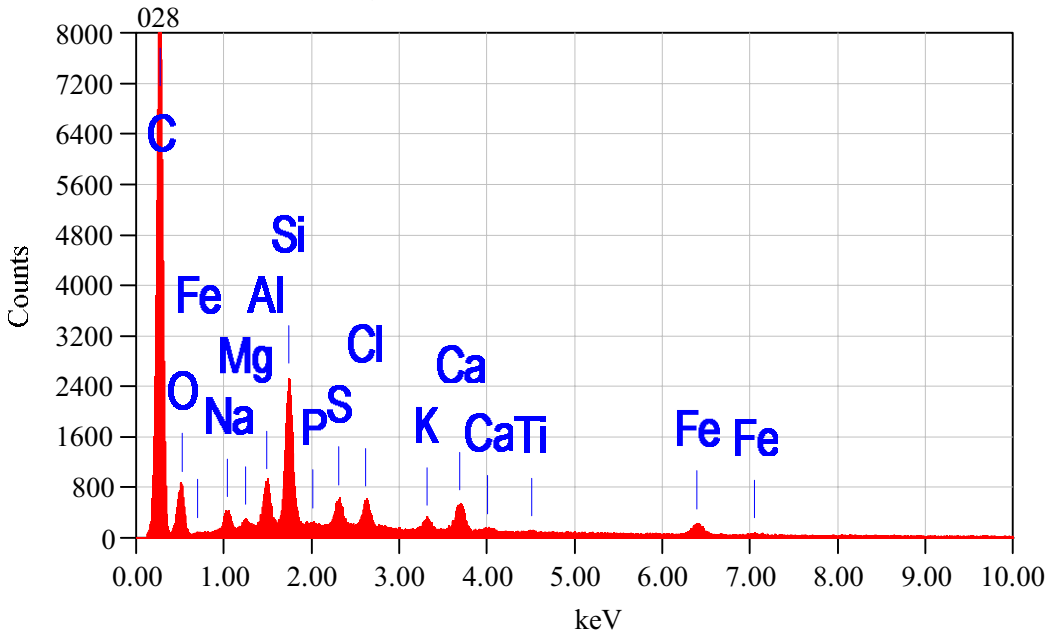


EDS1. New Castle East, UQMP # 13470. The SEM/EDS spectrum of the overall area is rich in carbon, silicon, aluminium, sodium, sulfur and chloride with traces of the balance of the elements. The carbon peak is erroneous and represents the degree of exposed carbon tape whilst the actual carbon containing particles were observed as minor and included coal, soot, rubber dust and plant debris. The bulk of the deposit was observed as mineral dust paticulates.

5.2 SEM/BSE IMAGES AND EDS SPECTRUM OF AN OVERALL AREA

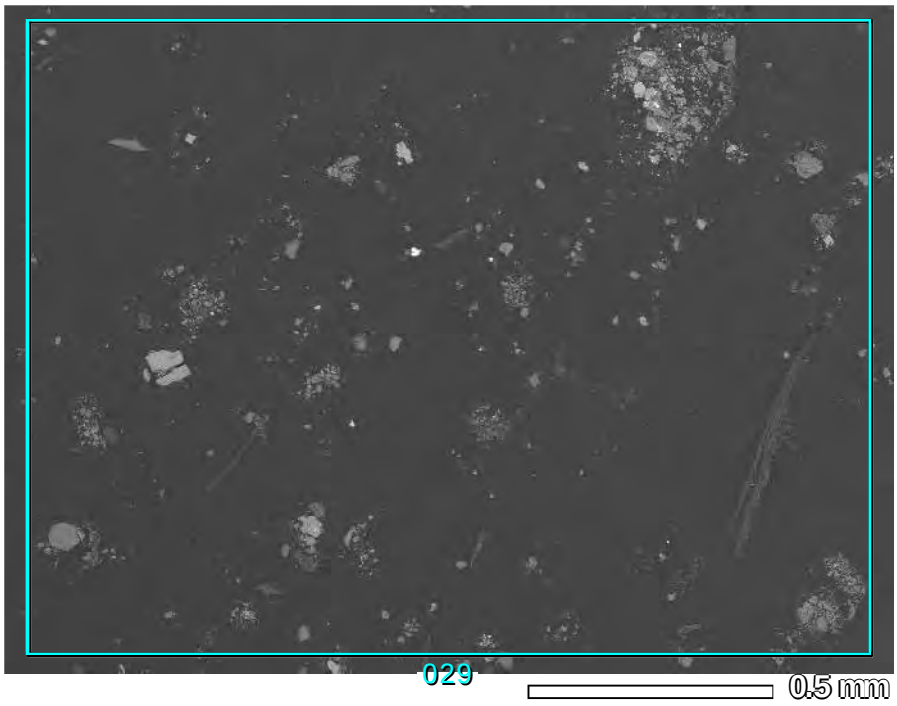


PM2. Stockton North, UQMP # 13471. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

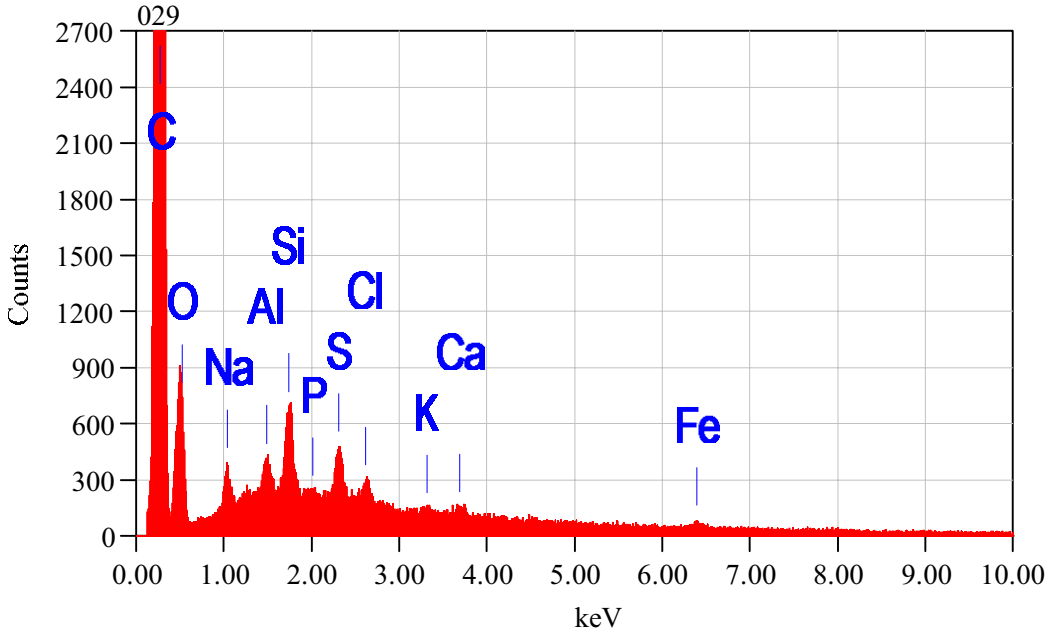


EDS2. Stockton North, UQMP # 13471. The SEM/EDS spectrum of the overall area is rich in carbon, silicon and aluminium with traces of the balance of the elements. The carbon peak includes some of the exposed carbon tape whilst the actual carbon containing particles were observed as minor and included coal, soot and plant debris and traces of fibres. The major particle type was observed as mineral dust.

5.3 SEM/BSE IMAGES AND EDS SPECTRUM OF AN OVERALL AREA

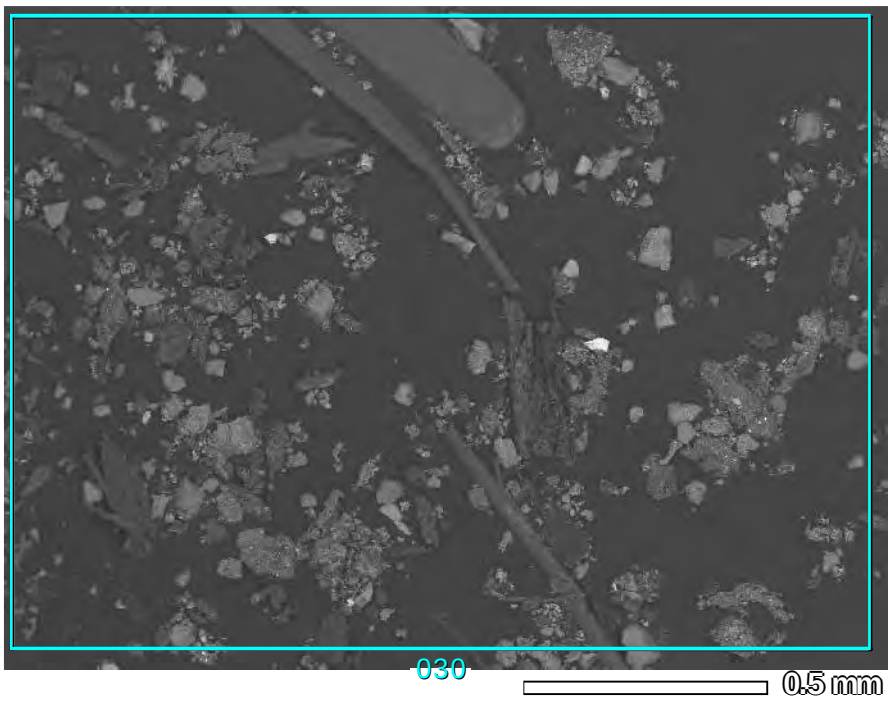


PM3. Stockton South, Punt Road, UQMP # 13472. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

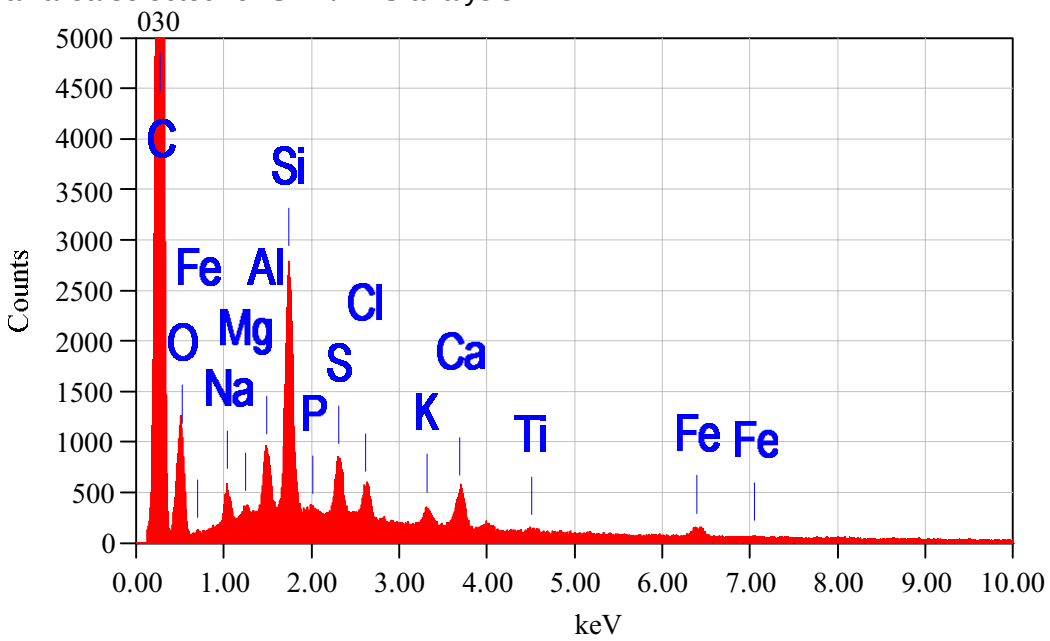


EDS3. Stockton South, Punt Road, UQMP # 13472. The SEM/EDS spectrum of the overall area is rich in carbon with minor amounts of sodium, aluminium, silicon and sulfur and traces of the balance of the elements. The carbon peak is erroneous and includes some of the exposed carbon tape whilst the carbon containing particles were observed as minor and included coal, soot, plant debris and traces of fibres. The major particle type of the deposit was observed as mineral dust.

5.4 SEM/BSE IMAGES AND EDS SPECTRUM OF AN OVERALL AREA



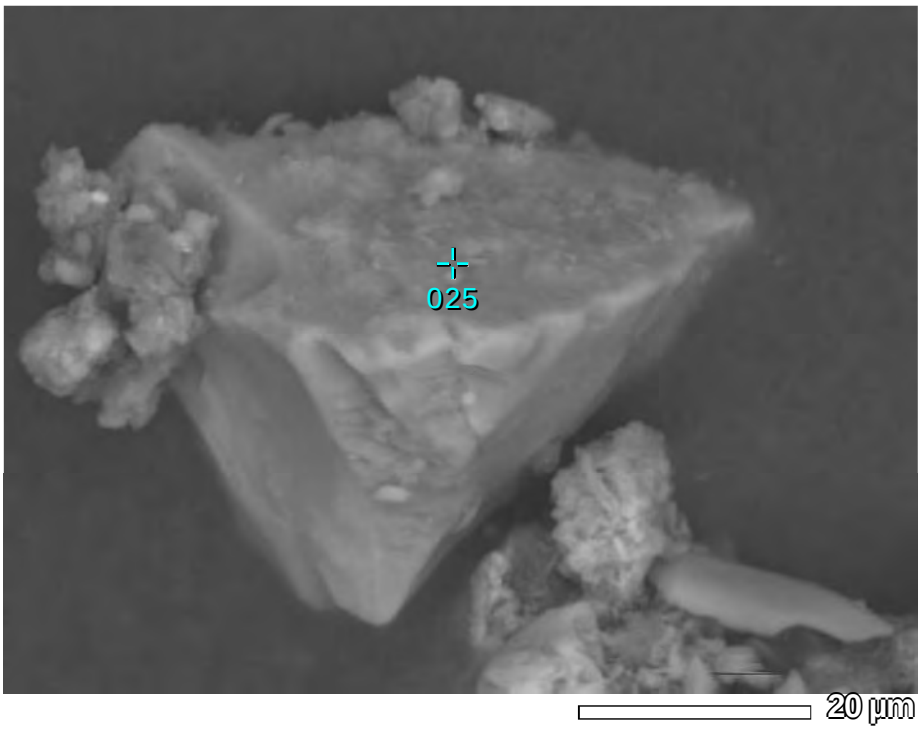
PM4. Fern Bay, Taylor Road, UQMP # 13473. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



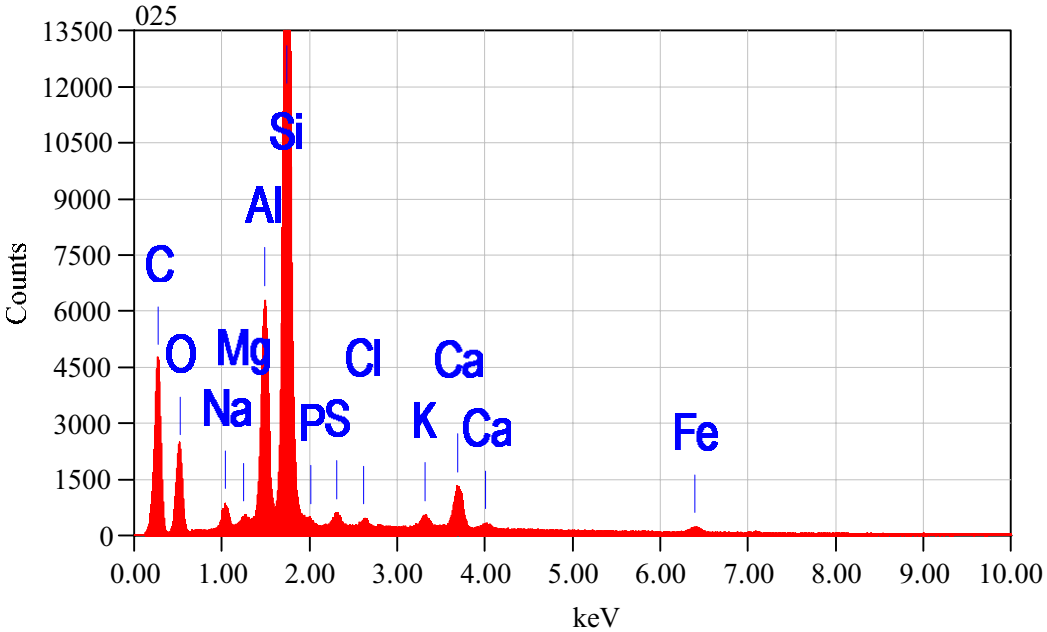
EDS4. Fern Bay, Taylor Road, UQMP # 13473. The SEM/EDS spectrum of the overall area is rich in carbon, aluminium and silicon with trace amounts of the balance of the elements. The elevated carbon peak incorporates carbon from the exposed carbon tape whilst the observed organic particulates were minor and included coal, soot, rubber dust and insect and plant debris. Stereomicroscopy observations noted a previlance of mineral dust particles.

6. APPENDIX D

6.1 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A MINERAL DUST PARTICLE

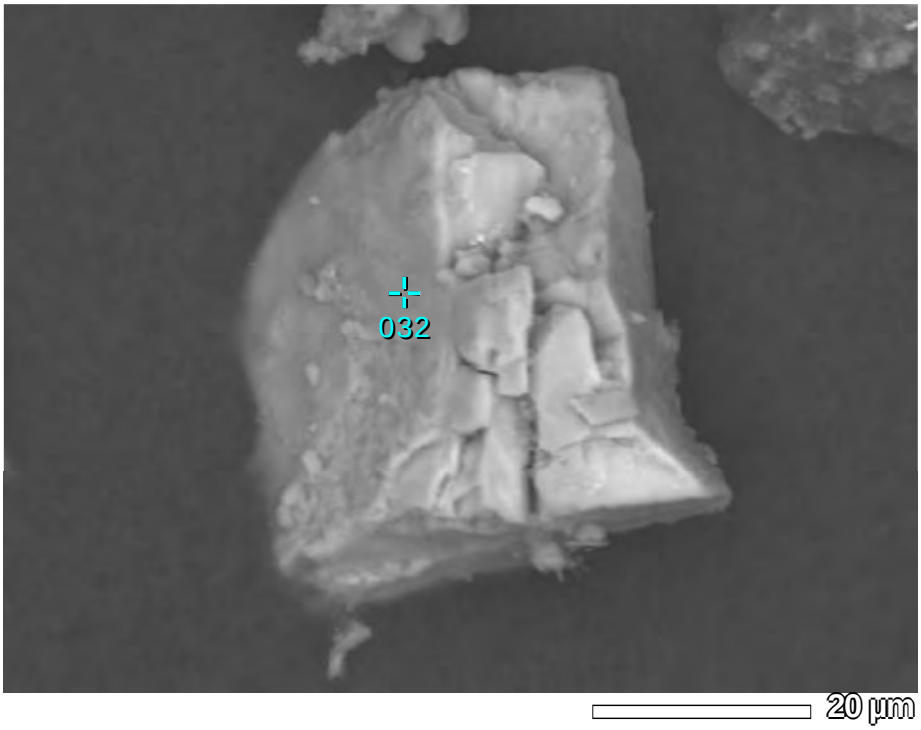


PM1. Newcastle East UQMP # 13470. An SEM/BSE image of a euhedral particulate annotated with 025 is selected for SEM/EDS analysis.

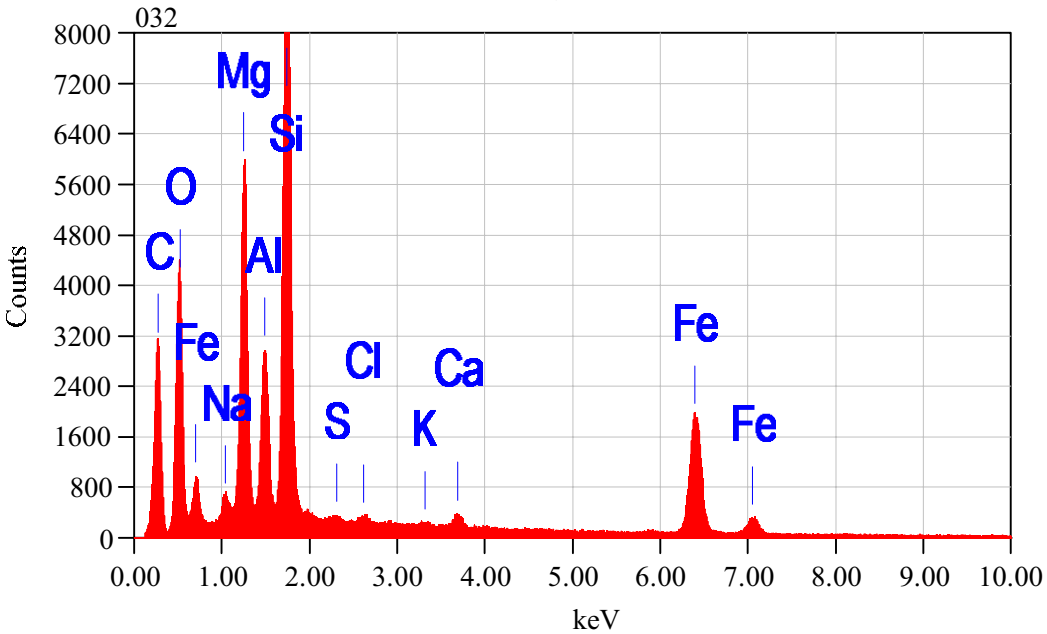


EDS1. Newcastle East UQMP # 13470. The SEM/EDS spectrum of the particle annotated with 025 displays predominant peaks of aluminium and silicon and minor amounts of carbon with traces of the balance of the elements. The particle is an aluminosilicate rich mineral dust.

6.2 SEM/BSE IMAGE AND SEM SPECTUM OF A MINERAL DUST PARTICLE

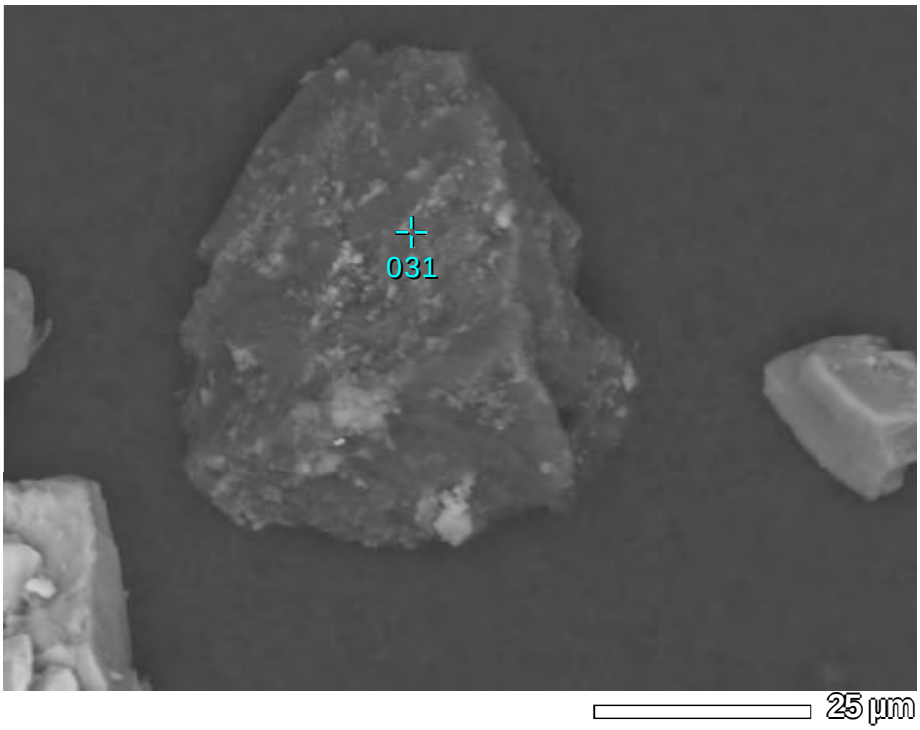


PM2. Fern Bay, Taylor Road, UQMP # 13473. An SEM/BSE image of a particulate marked with 032 is selected for SEM/EDS analysis.

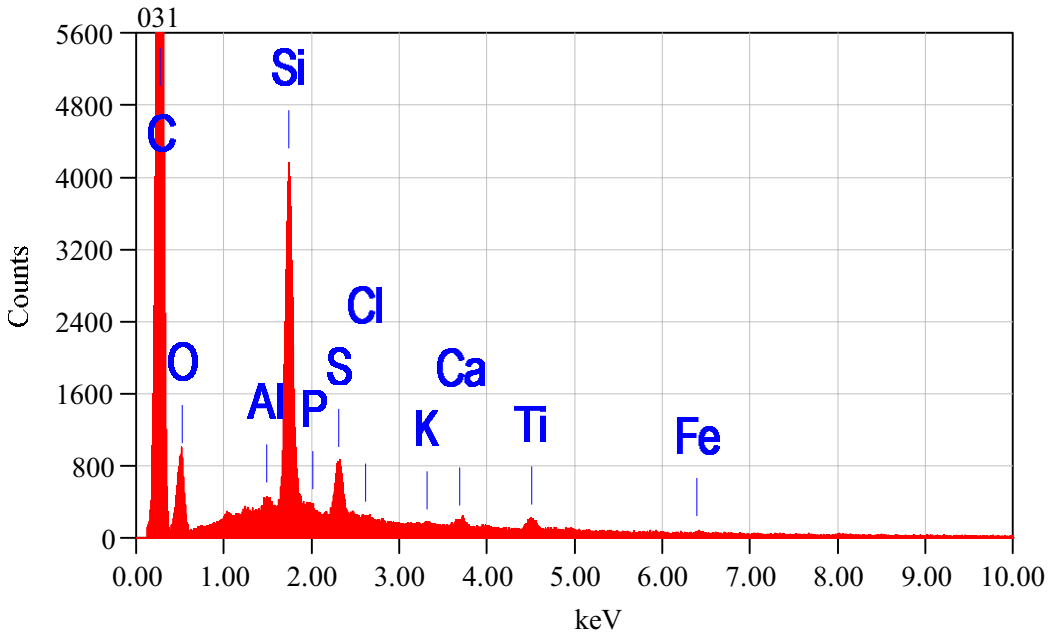


EDS2. Fern Bay, Taylor Road, UQMP # 13473. The SEM/EDS spectrum of the particle marked with 032 shows elevated levels of aluminium, silicon, magnesium and iron. The particle is possibly from the amphibole group of rock forming silicates.

6.3 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A HIGH ASH COAL PARTICLE.

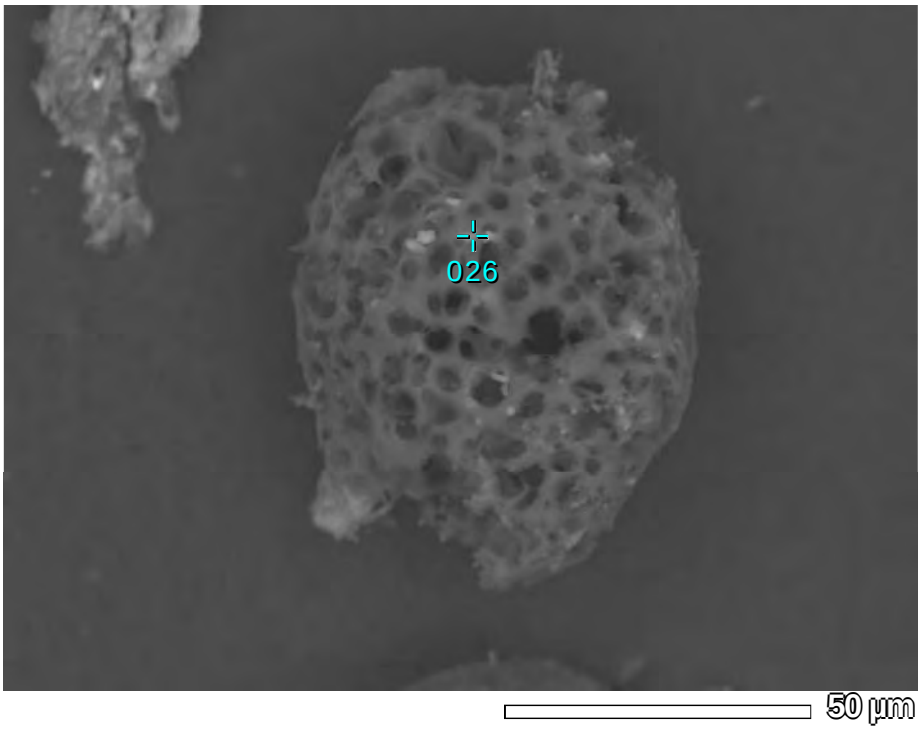


PM3. Fern Bay, Taylor Road, UQMP # 13473. An SEM/BSE image of a particulate annotated with 031 is selected for SEM/EDS analysis.

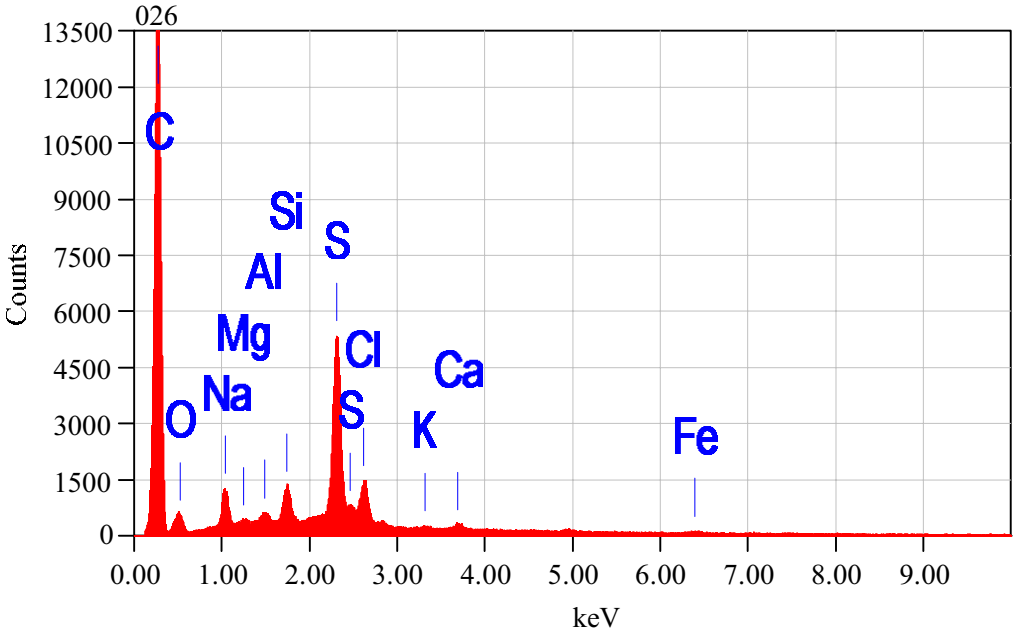


EDS3. Fern Bay, Taylor Road, UQMP # 13473. The SEM/EDS spectrum of the particle annotated with 031 shows elevated levels of carbon and silicon with trace amounts of the balance of the elements. The spectrum is suggestive of a high ash coal particle.

6.4 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A SOOT PARTICLE.



PM4. Newcastle East, UQMP # 13470. An SEM/BSE image of a particulate annotated with 026 is selected for SEM/EDS analysis.



EDS4. Newcastle East, UQMP # 13470. The SEM/EDS spectrum of the particle annotated with 026 shows elevated levels of carbon and sulfur the balance of the elements are trace level. The lacey particle morphology and SEM/EDS spectrum are characteristic for soot.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.10

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 14th September, 2015

Sample Description:

	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Stockton North Dust Gauge	05/05/15	02/06/16	UQMP # 13496
2	Hamilton Brush	02/06/15	02/06/15	UQMP # 13497
3	Stockton South Brush	02/06/15	02/06/15	UQMP # 13498

#Method Ref: Internal UQMP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples were supplied as washings from a dust fallout gauge deposit. The samples were filtered onto a membrane filter and examined by stereomicroscopy to check for particle distribution and general appearance.

2. RESULTS

Appendix A attached presents the table of results of the combined microscopy observations.

Appendix B presents colour picture micrographs of the stereomicroscopy images.

Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. Trace amounts of copper sludge was noted in the dust fallout gauge deposit.

Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of UQ Materials Performance

Fiona Jones

_____

Fiona Jones

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

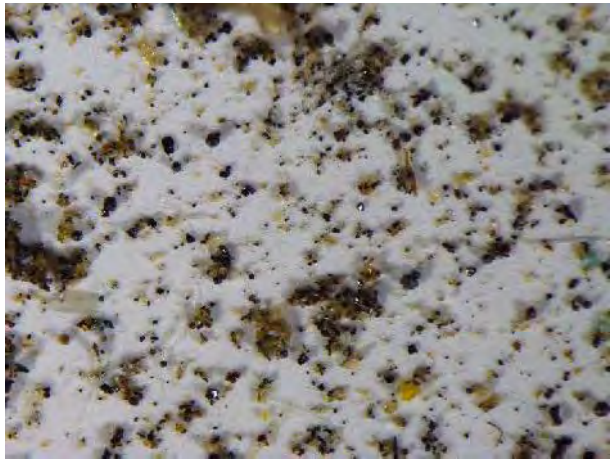
PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13496	UQMP # 13497	UQMP # 13498
	SAMPLE ID **PARTICLE TYPE**	*Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15)*	*Hamilton Brush (Exposed: 02/06/15, Collected: 02/06/15)*	*Stockton South Brush (Exposed: 02/06/15, Collected: 02/06/15)*
BLACK	COAL	20	10	20
	SOOT	10		
	BLACK RUBBER DUST	2	10	10
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**63**	**70**	**65**
	MINERAL DUST (type = Halite)			5
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE	tr		
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	tr	tr
	PLANT DEBRIS (General)	5	10	tr
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)		tr	
	STARCH			
	PAINT	tr	tr	tr
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS			Large red brown flakes noted.	

3.2 PARTICLE IDENTITY LEGEND

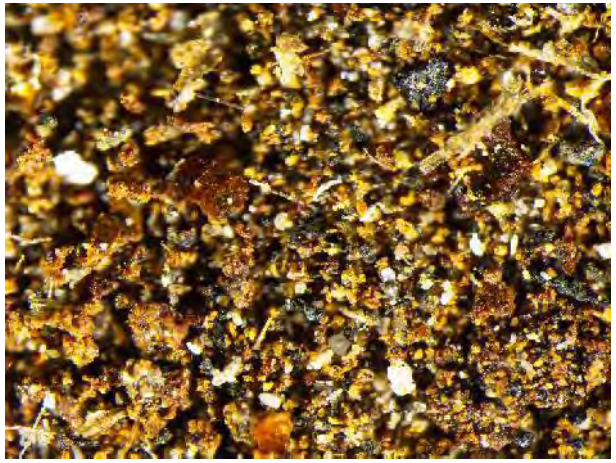
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

4. APPENDIX B

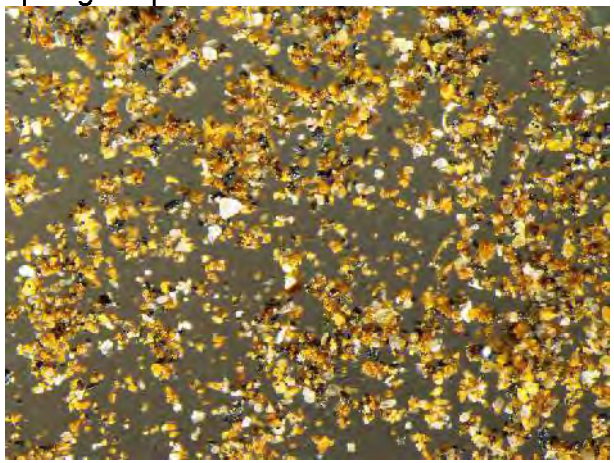
4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS



StMPM1. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496. Minor numbers of black particulates were observed, sharp angular particles are consitent with coal.



StMPM2. Hamilton Brush (Exposed: 02/06/15, Collected: 02/06/15), UQMP # 13497. Minor amounts of black, col and red/brown rust particulates were examined.

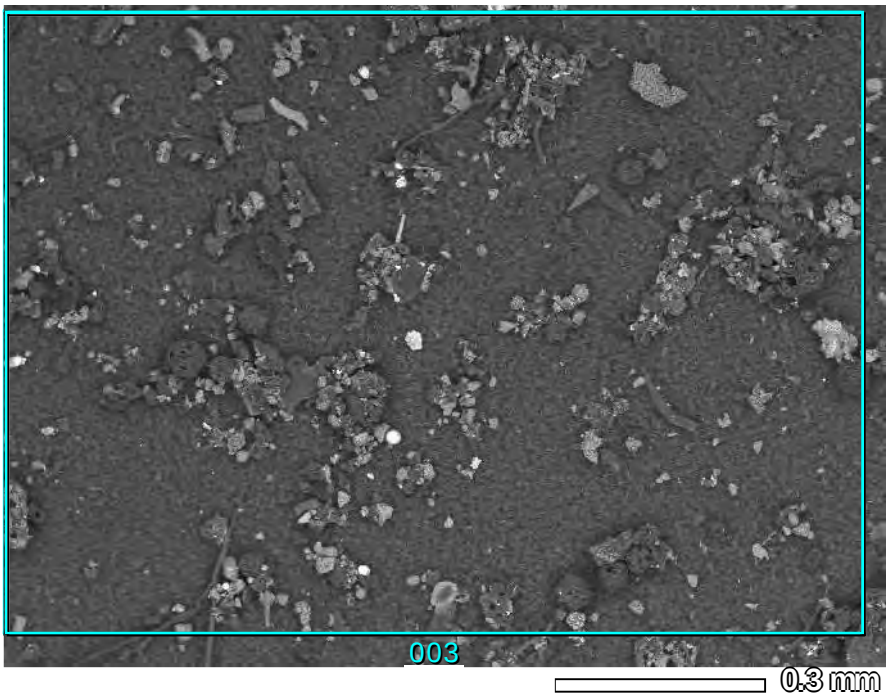


StMPM3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498.

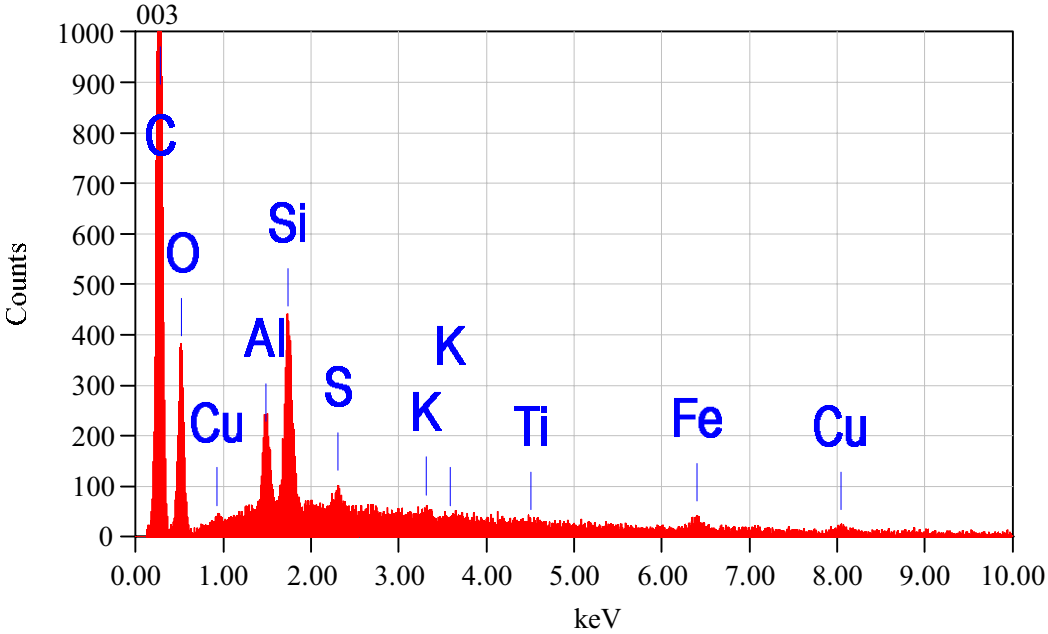
.

5. APPENDIX C

5.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

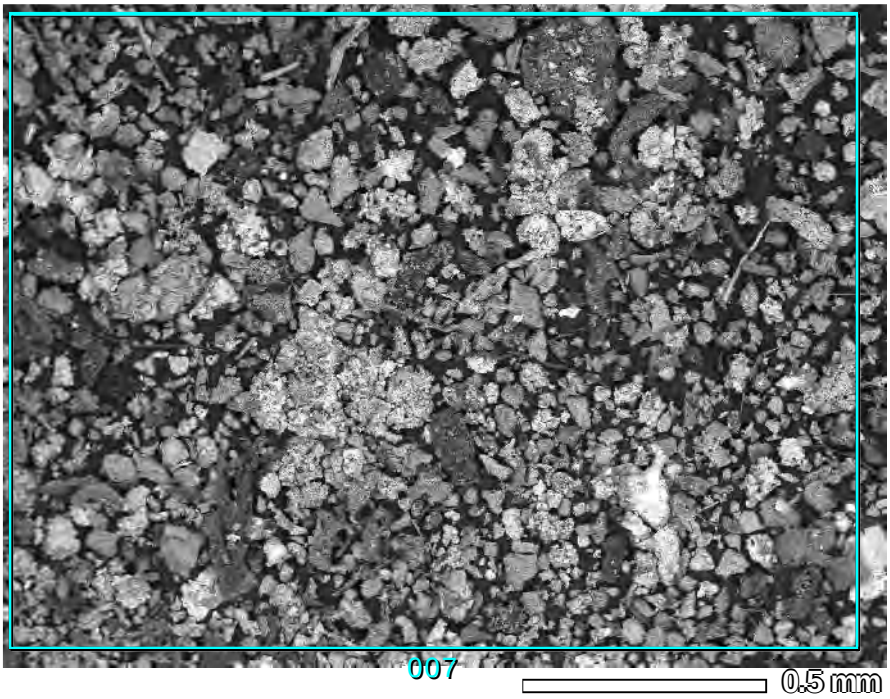


PM1. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

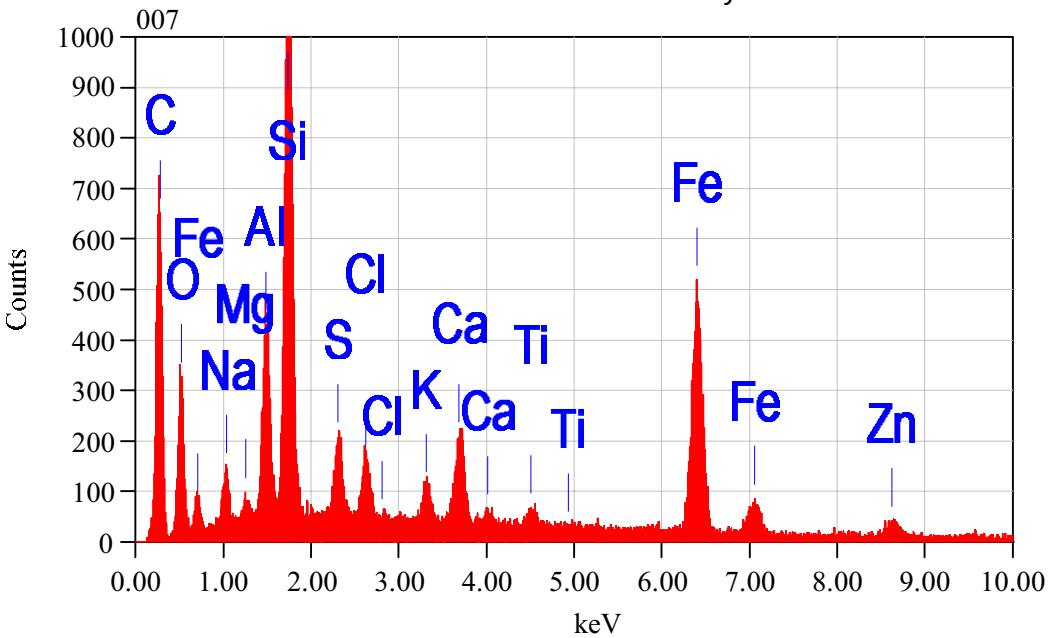


EDS1. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496. The SEM/EDS spectrum of the overall area is rich in carbon with minor amounts of aluminium and silicon. The deposit sparsley populates the membrane filter and the elevated carbon represents the degree of exposed filter. Observations found a minor amount of carbon contributing particles including coal, soot, rubber dust, plant debris and traces of paint and insect debris, with the balance of the deposit being aluminosilicate rich mineral dust. Traces of copper sludge were also noted.

5.2 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

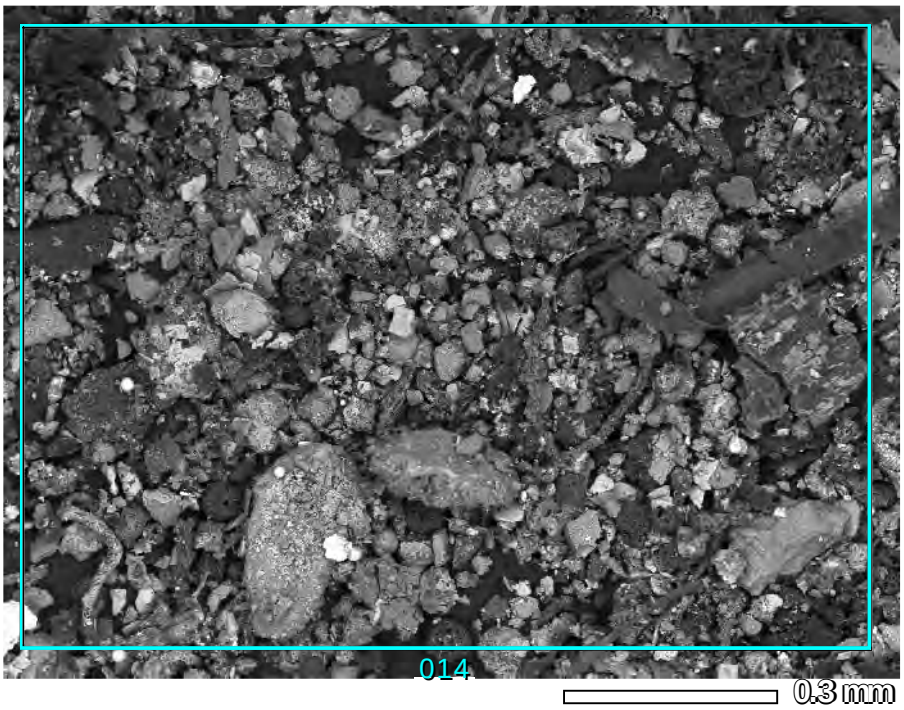


PM2. Hamilton Brush (Exposed: 02/06/15, Collected: 02/06/15), UQMP # 13497. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

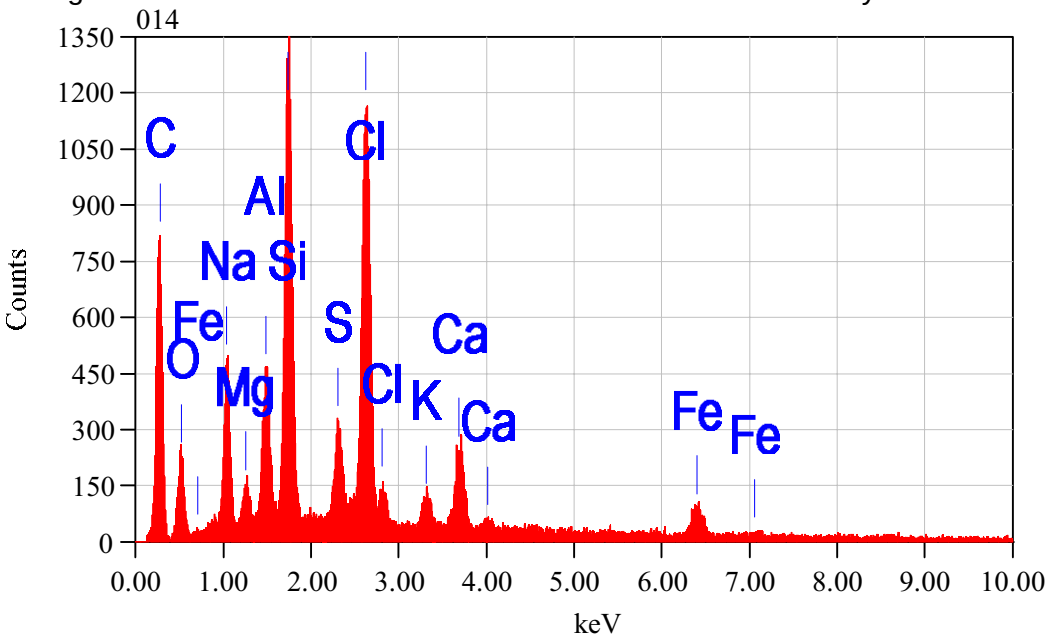


EDS2. Hamilton Brush (Exposed: 02/06/15, Collected: 02/06/15), UQMP # 13497. The SEM/EDS spectrum of the overall area is rich in carbon, silicon, aluminium and iron with minor amounts of sodium, potassium and calcium with trace amounts of magnesium, titanium and zinc. The elevated carbon peak is representative of the organic materials examined which included coal, rubber dust, fibres, paint and insect and plant debris. A prominent iron peak is consistent with the microscopy observations or a red/brown rusty material an iron oxide. Mineral dust was the major particle type present.

5.3 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



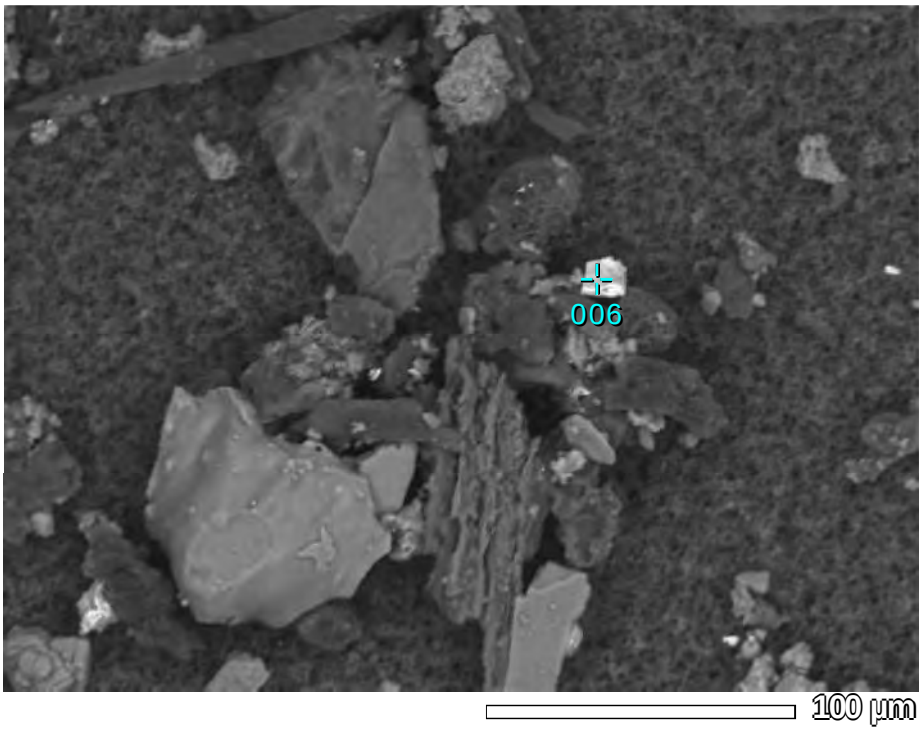
PM3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



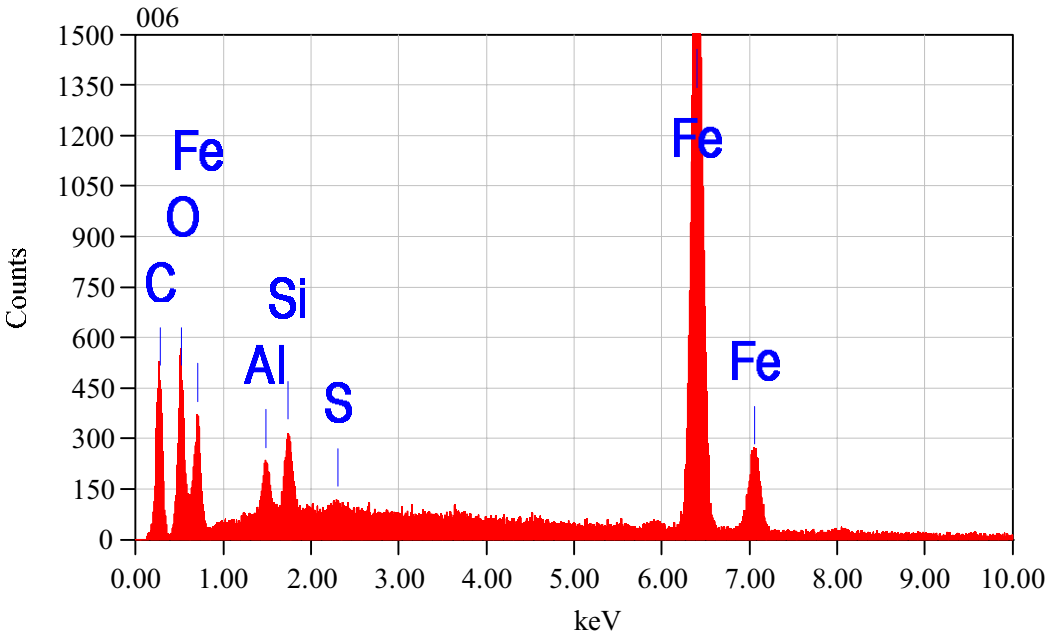
EDS3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. Carbon, sodium, aluminium and chloride are the dominant elements of the SEM/EDS spectrum. A minor amount of organic particulates were observed by microscopy and included coal, rubber dust, paint and insect and plant debris. The balance of the deposit was composed of mineral dust which consisted mostly of aluminosilicate rich mineral dust and halite (sodium chloride).

6. APPENDIX D

6.1 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF AN IRON OXIDE PARTICLE

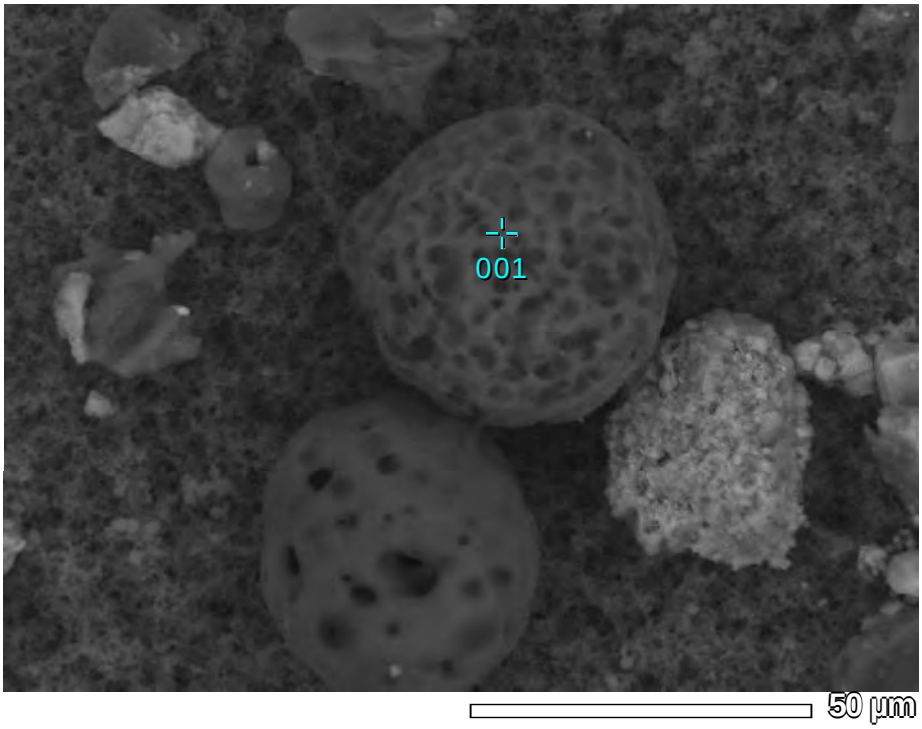


PM1. # 13496. An SEM/BSE image of a particulate annotated with 006 is selected for SEM/EDS analysis.

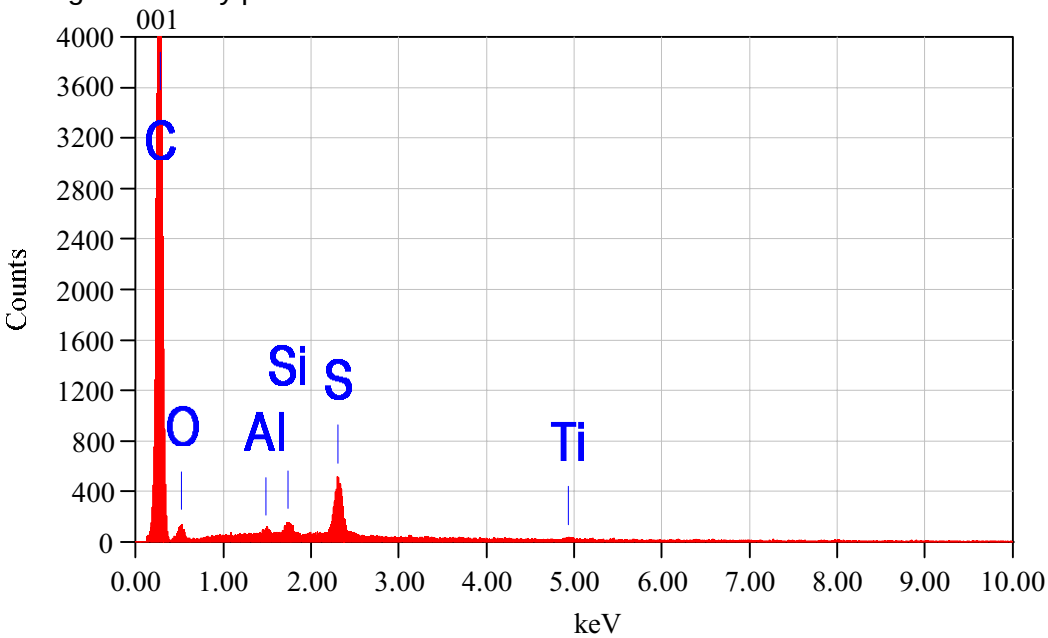


EDS1. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496**.** The SEM/EDS spectrum of the particle annotated with 006 displays elevated levels of iron with minor amounts of carbon, aluminium, silicon and traces of sulfur. The spectrum is representative of an iron oxide particle overlaying mineral dust and organic material. The accelerating voltage is sufficient to detect some of the elements in the particles below.

6.2 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF SOOT

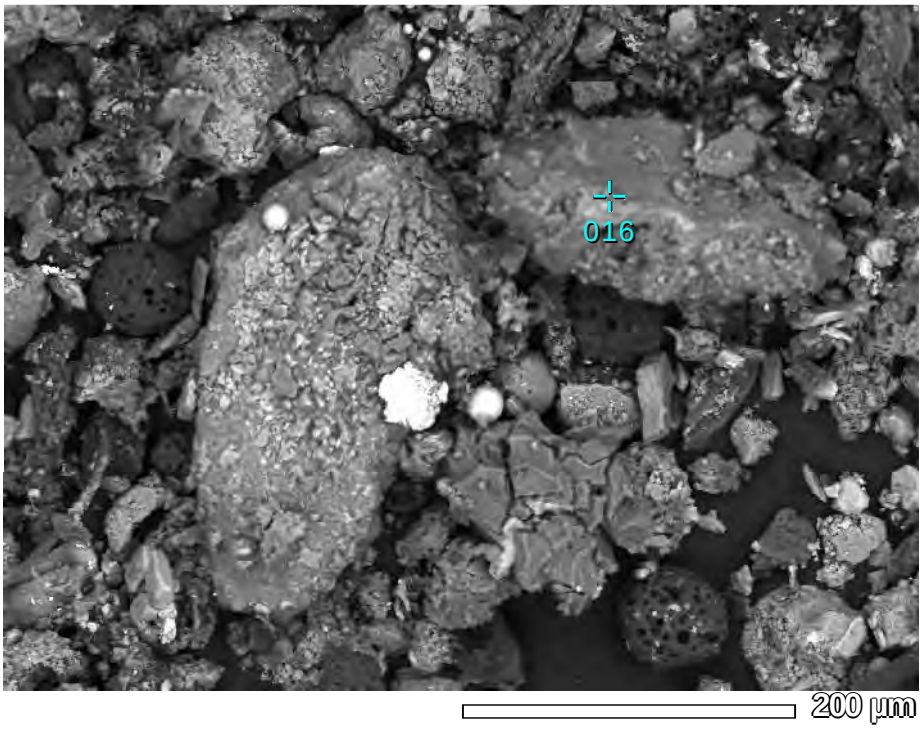


PM2. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496**.** An SEM/BSE image of a lacey particulate marked with 001 which is selected for SEM/EDS analysis.

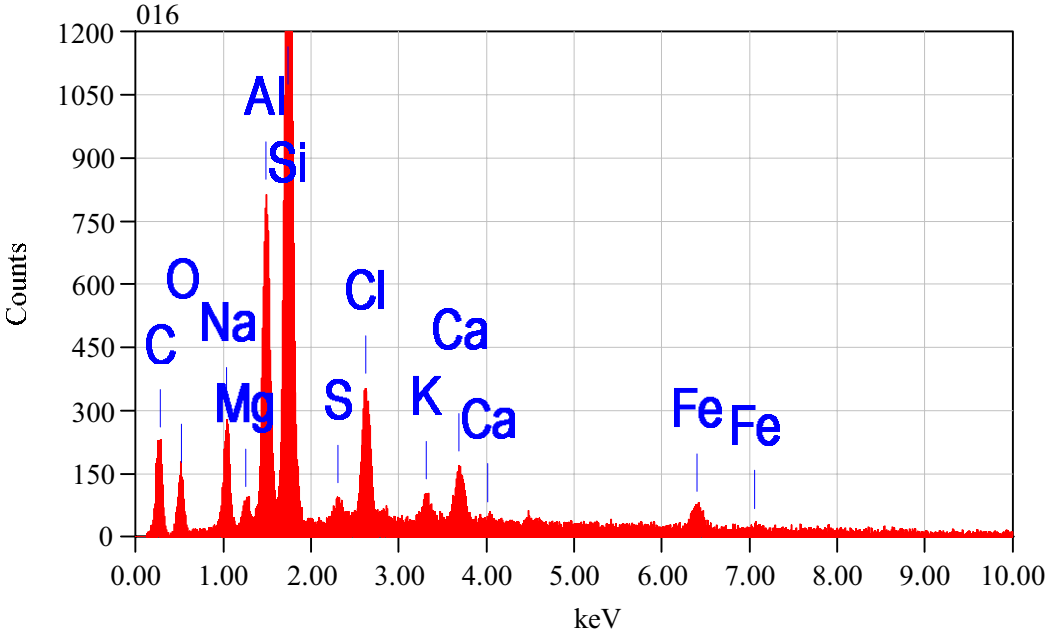


EDS2. Stockton North Dust Gauge (Exposed: 05/05/15, Collected: 02/06/15), UQMP # 13496**.** The SEM/EDS spectrum of the particle marked with 001 diplays an elemental profile typical of soot.

6.3 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A MINERAL DUST PARTICLE

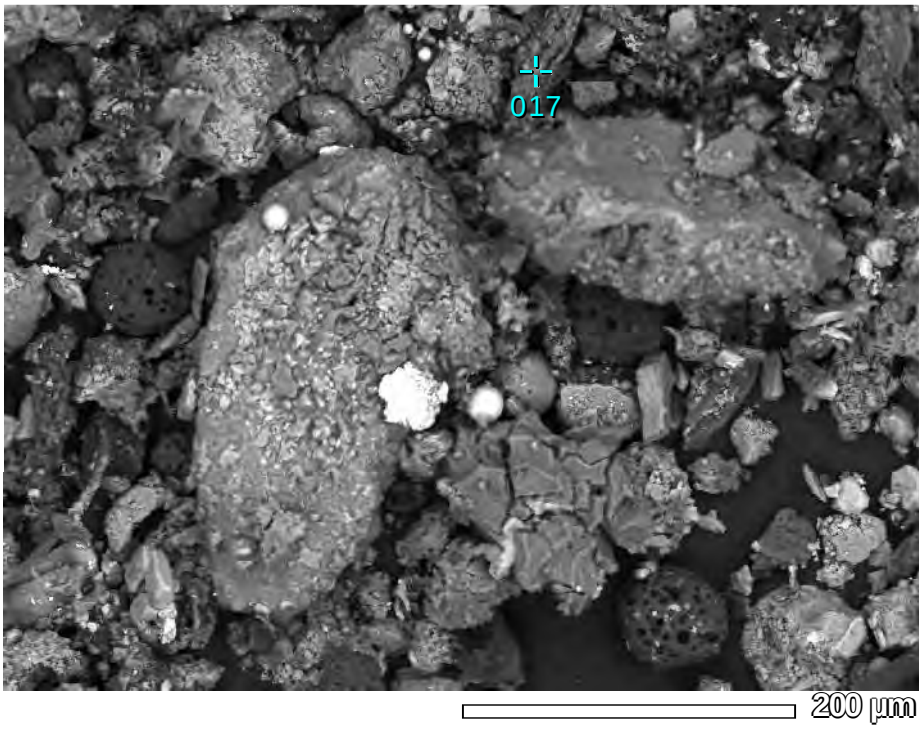


PM3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. An SEM/BSE image of a particulate annotated with 016 is selected for SEM/EDS analysis.

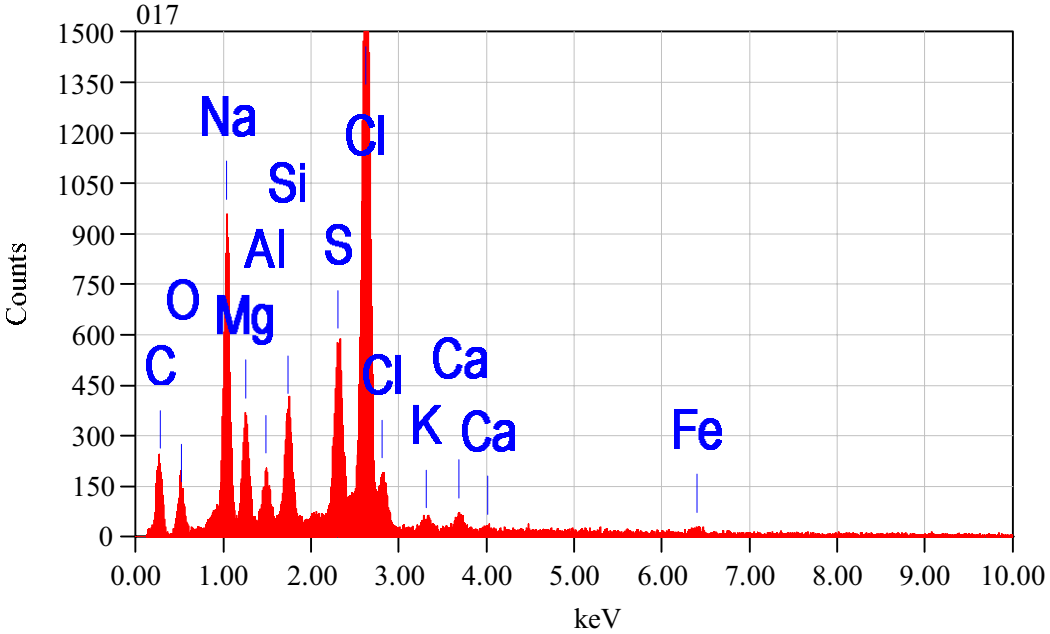


EDS3. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. The SEM/EDS spectrum of the particle annotated with 016 shows elevated levels of aluminium and silicon with minor amounts of sodium and chloride with traces of the remaining elements. The spectrum is characteristic of an aluminosilicate rich mineral dust.

6.4 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A HALITE PARTICLE



PM4. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. An SEM/BSE image of a particulate annotated with 017 is selected for SEM/EDS analysis.



EDS4. Stockton South Brush (Exposed 02/06/15, Collected: 02/06/15), UQMP # 13498. Sodium and chloride are the predominant elements of the spectrum, this is typical of a halite particle which is rich in sodium chloride.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE AND LOOSE DUST DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.11

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 16th September 2015

Sample Description:

	Dust Sample #	Date Exposed	Date Collected	UQMP #
1	Stockton North Dust Gauge	02/06/15	03/07/15	UQMP # 13555
2	Stockton South DDG Site Petri	03/07/15	07/07/15	UQMP # 13556
3	Stockton North DDG Site Petri	03/07/15	07/07/15	UQMP # 13557
4	Carrington DDG Site Petri	03/07/15	07/07/15	UQMP # 13558
5	Tighes Hill DDG Site Petri	03/07/15	07/07/15	UQMP # 13559
6	Hamilton DDG Site Petri	03/07/15	07/07/15	UQMP # 13560

#Method Ref: Internal UQMP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples were supplied as washings from a dust fallout gauge deposit and loose dust deposits. The samples were filtered or washed onto a membrane filter and examined by stereomicroscopy to check for particle distribution and general appearance.

2. RESULTS

All the deposits examined displayed particles of soot, coal and rubber dust at levels not usually observed in ambient dusts. Mineral dust was the major particle type of all the deposits which is typical of ambient dusts. Carrington, Tighes Hill and Hammilton dust deposition gauge site petri samples were very sparsley populated with particulates and overall areas were not produced as they were not representative. Overall Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy (SEM/EDS) spectra are of little value when particulates are not of sufficient depth to cover the supporting nitrocellulose membrane.

Appendix A attached presents the table of results of the combined microscopy observations.

Appendix B presents colour picture micrographs of the stereomicroscopy images.

Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter.

Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of UQ Materials Performance

Fiona Jones

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13555	UQMP # 13556	UQMP # 13557
	SAMPLE ID / **PARTICLE TYPE**	*Stockton North Dust Gauge (Exposed: 02/06/15, Collected 03/07/15)*	*Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15)*	*Stockton North DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15)*
BLACK	COAL	20	10	20
	SOOT	10	20	5
	BLACK RUBBER DUST	5	tr	tr
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**60**	**65**	**75**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI	tr		
	INSECT DEBRIS	5	tr	tr
	PLANT DEBRIS (General)		5	tr
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr	tr	
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

3.2 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13558	UQMP # 13559	UQMP # 13560
	SAMPLE ID / **PARTICLE TYPE**	*Carrington DDG Site Petri (Exposed: 03/07/15, Collected: 07/07/15)*	*Tighes Hill DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15)*	*Hamilton DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15)*
BLACK	COAL	10	20	20
	SOOT	5	tr	tr
	BLACK RUBBER DUST	5	5	5
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**75**	**75**	**75**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	tr	tr
	PLANT DEBRIS (General)	5	tr	
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr	tr	tr
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

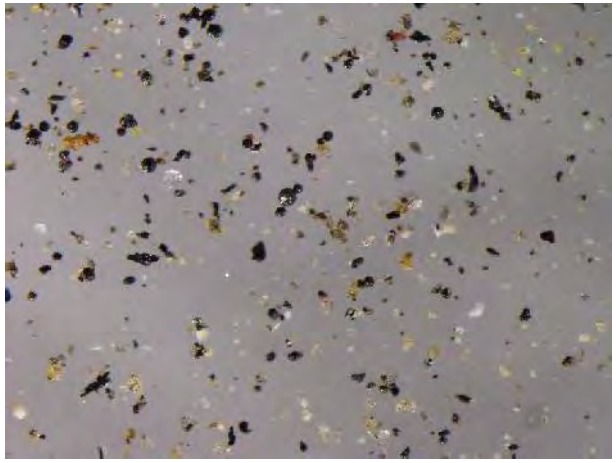
3.3 PARTICLE IDENTITY LEGEND

Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

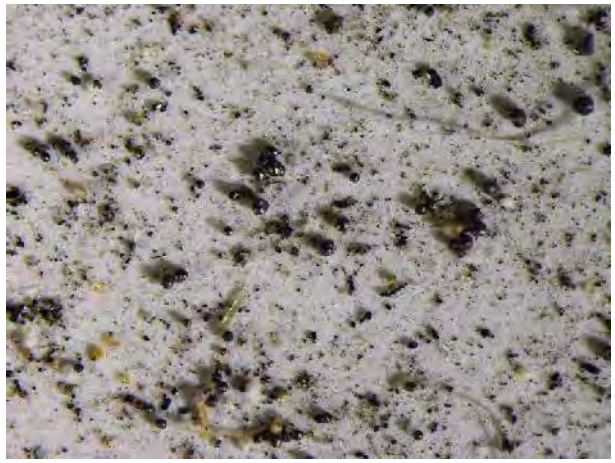
4. APPENDIX B

4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS

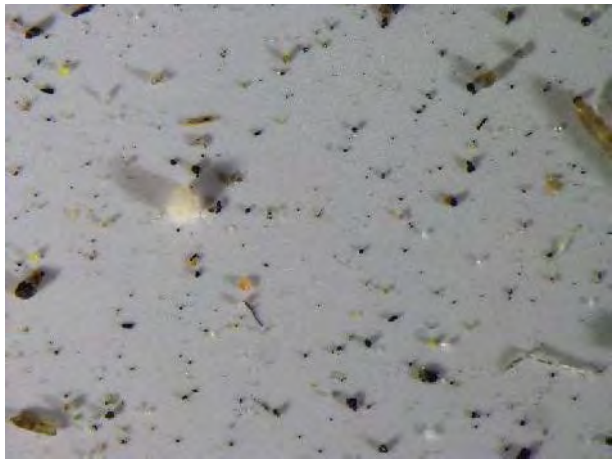
StMPM1. Stockton North Dust Gauge (Exposed: 02/06/15, Collected 03/07/15), UQMP # 13555



StMPM2. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556

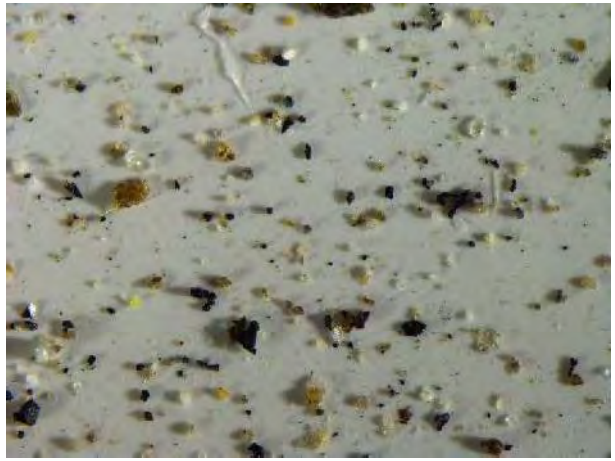


StMPM3. Stockton North DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15), UQMP # 13557.

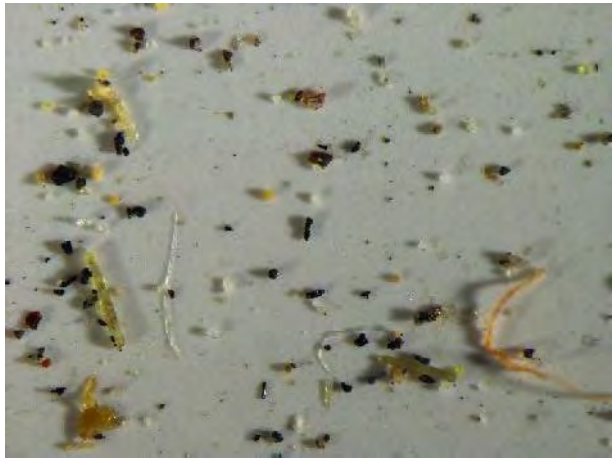


StMPM4. Carrington DDG Site Petri (Exposed: 03/07/15, Collected: 07/07/15), UQMP # 13558.

4.2 STEREOMICROSCOPY PICTURE MICROGRAPHS

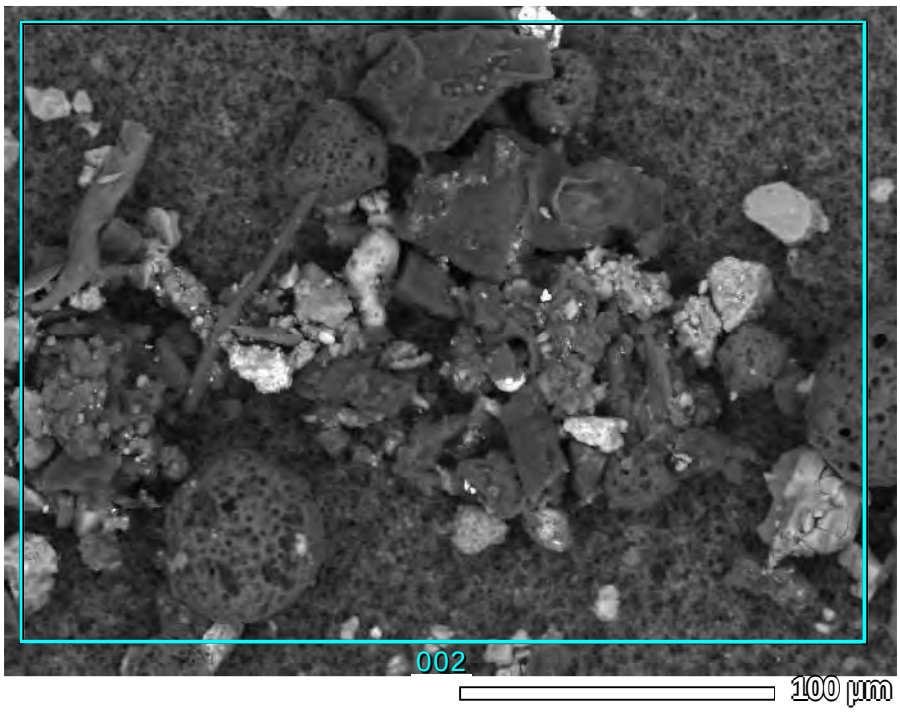


StMPM5. Tighes Hill DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15), UQMP # 13559.

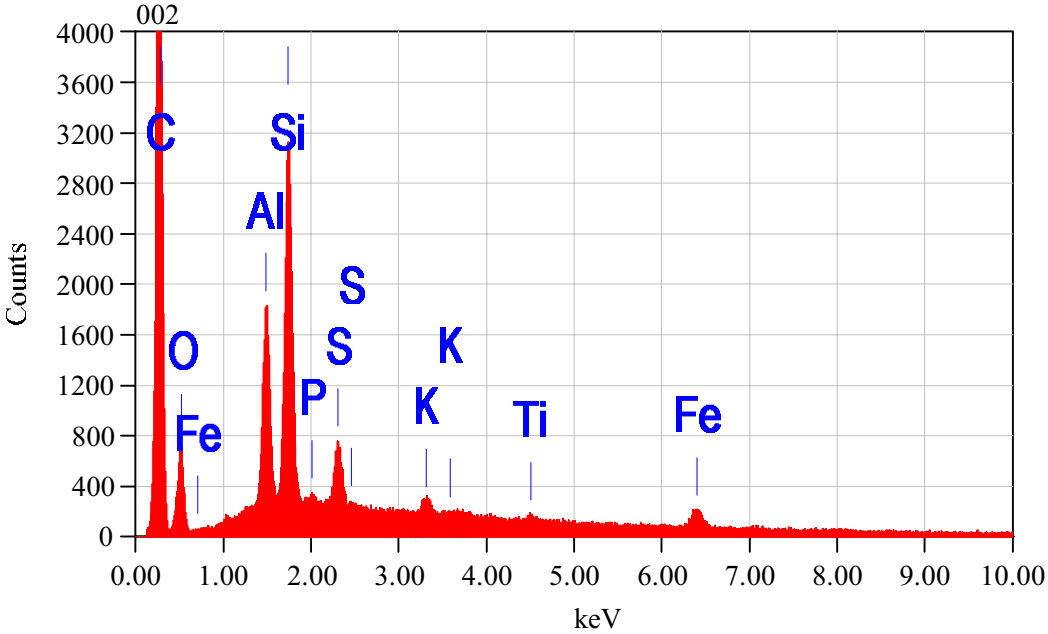


StMPM6. Hamilton DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15), UQMP # 13560

5. APPENDIX C
5.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

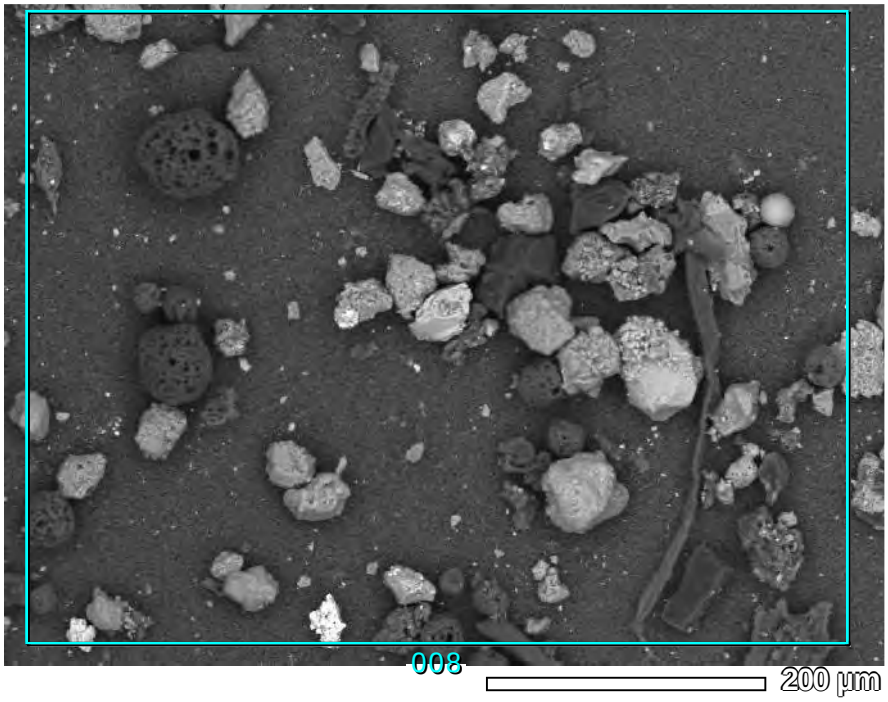


PM1. Stockton North Dust Gauge (Exposed: 02/06/15, Collected 03/07/15), UQMP # 13555. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

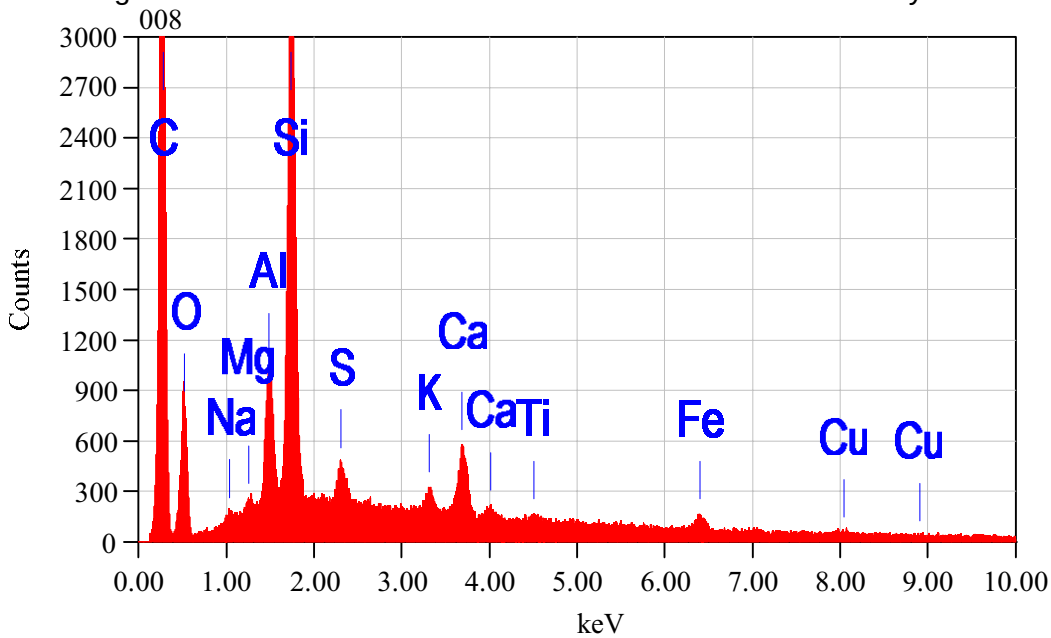


EDS1. Stockton North Dust Gauge (Exposed: 02/06/15, Collected 03/07/15), UQMP # 13555. The SEM/EDS spectrum of the overall area is rich in carbon, silicon and aluminium with minor amounts of sulfur and traces of potassium, titanium and iron. The elevated carbon is mostly due to the degree of exposed filter paper, microscopy observations found a minor organic component including coal, soot, rubber dust, plant debris and traces of insect debris and fibres. Aluminosilicate based mineral dust was the major particulate of the deposit.

5.2 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

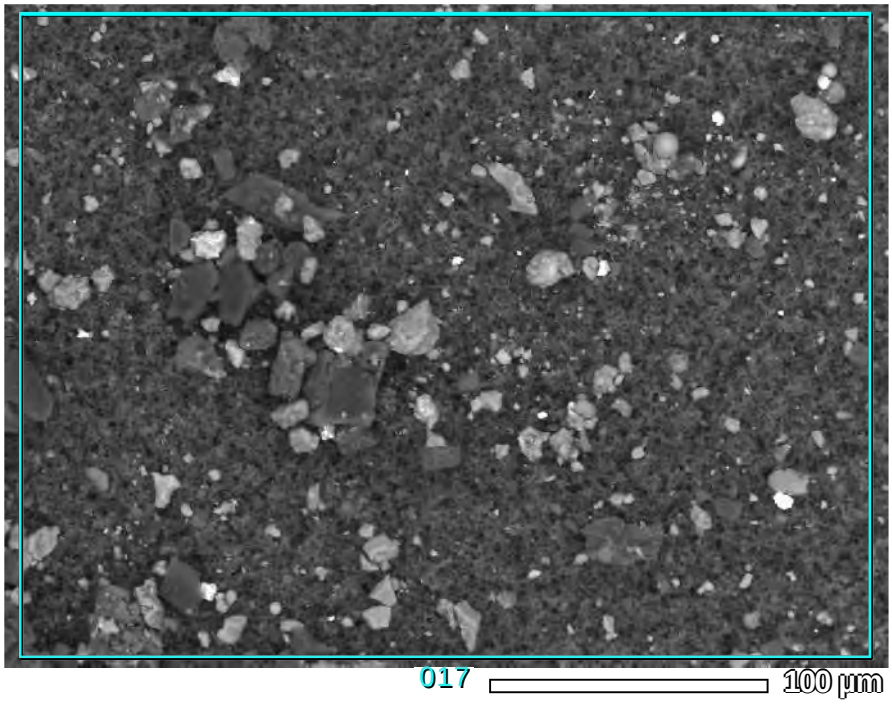


PM2. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

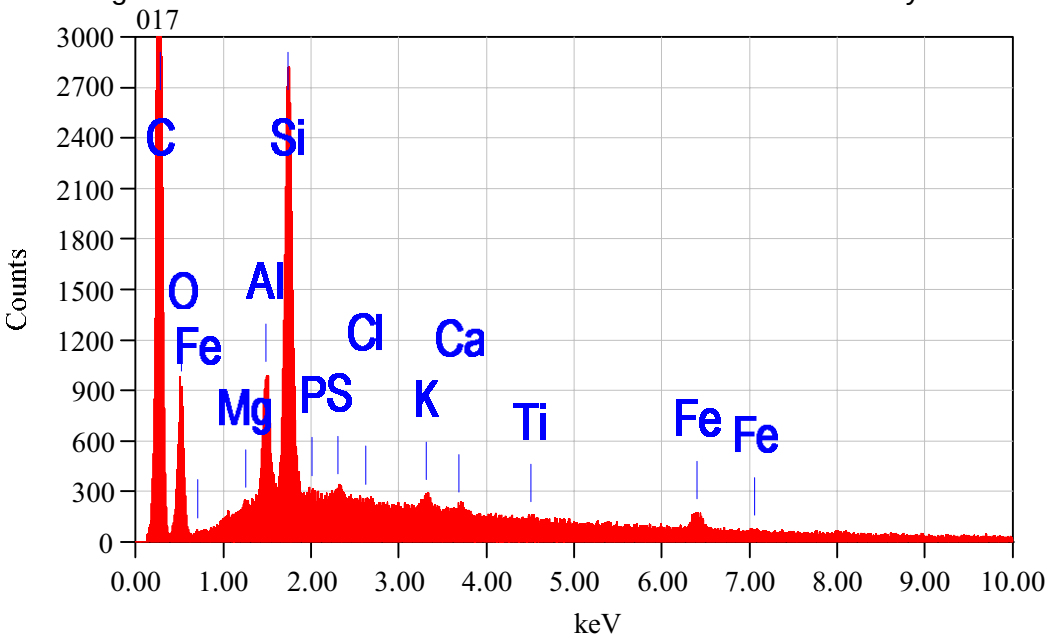


EDS2. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556. The SEM/EDS spectrum of the overall area is rich in carbon, aluminium and silicon with minor amounts of sulfur and calcium and traces of the remaining elements. Carbon contributing particles were observed as minor and included coal, soot, rubber dust, insect and plant debris and fibres. Major particles were mineral dust consisting mostly of aluminium and silicon such as feldspar and quartz.

5.3 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

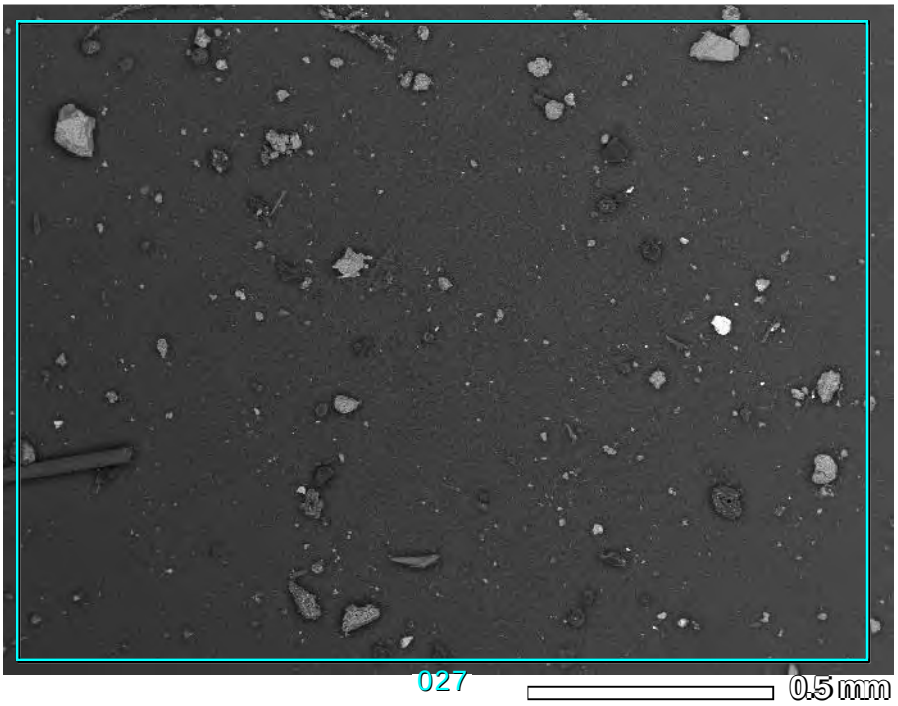


PM3. Stockton North DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15), UQMP # 13557. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

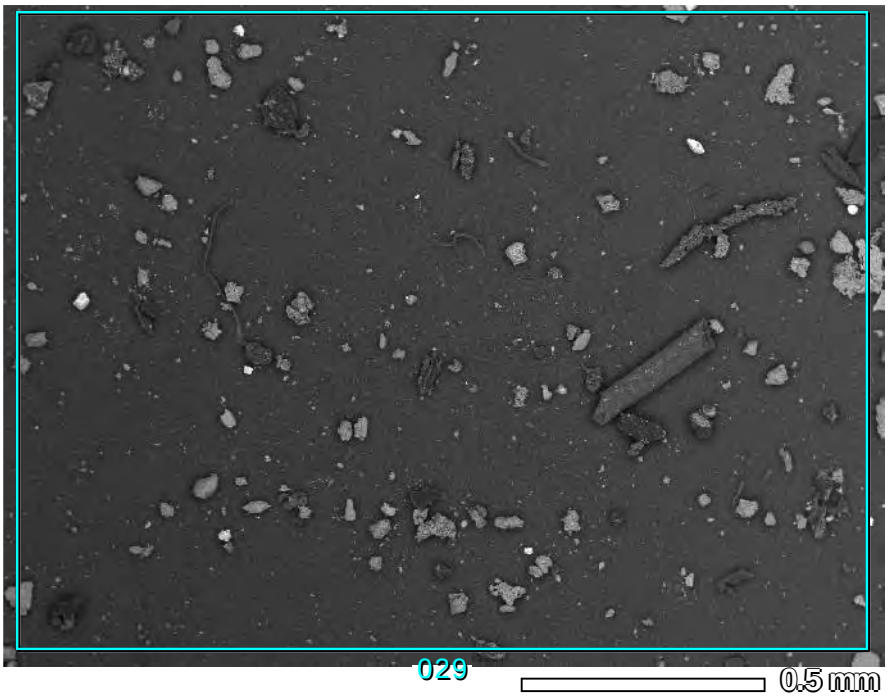


EDS3. Stockton North DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15), UQMP # 13557. The SEM/EDS spectrum of the overall area is predominantly carbon, aluminium and silicon with traces of the balance of the elements. The elevated carbon includes mostly the exposed filter however, a minor number of coal and soot particulates and traces of insect and plant debris were observed Mineral dust was noted as the major particle type present.

5.4 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

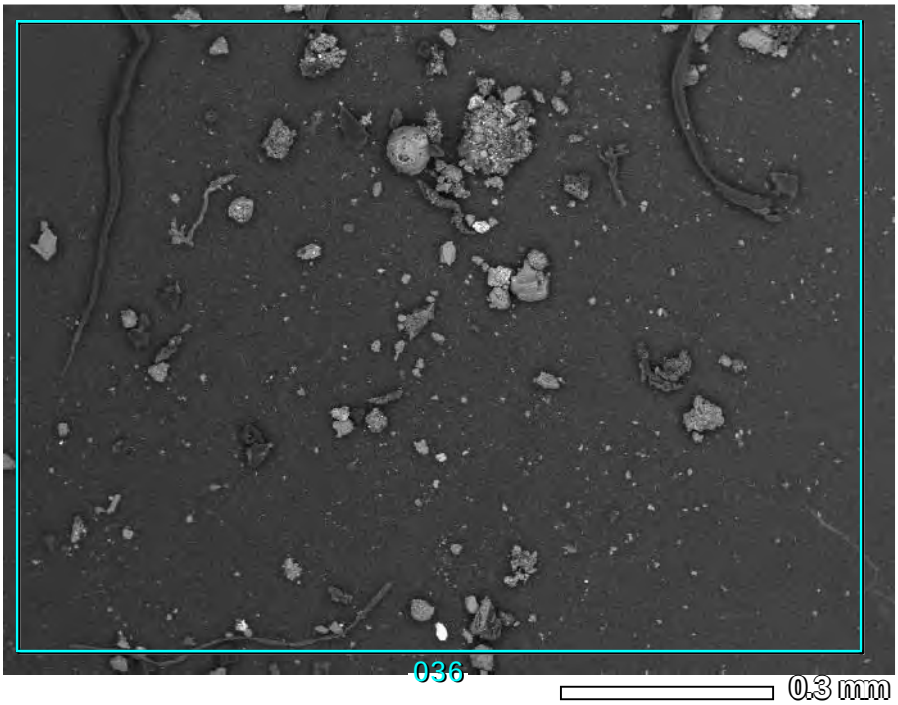


PM4. Carrington DDG Site Petri (Exposed: 03/07/15, Collected: 07/07/15), UQMP # 13558. An SEM/BSE image of a sparsley populated overall area.



PM5. Tighes Hill DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15), UQMP # 13559. An SEM/BSE image of a sparley populated overall area.

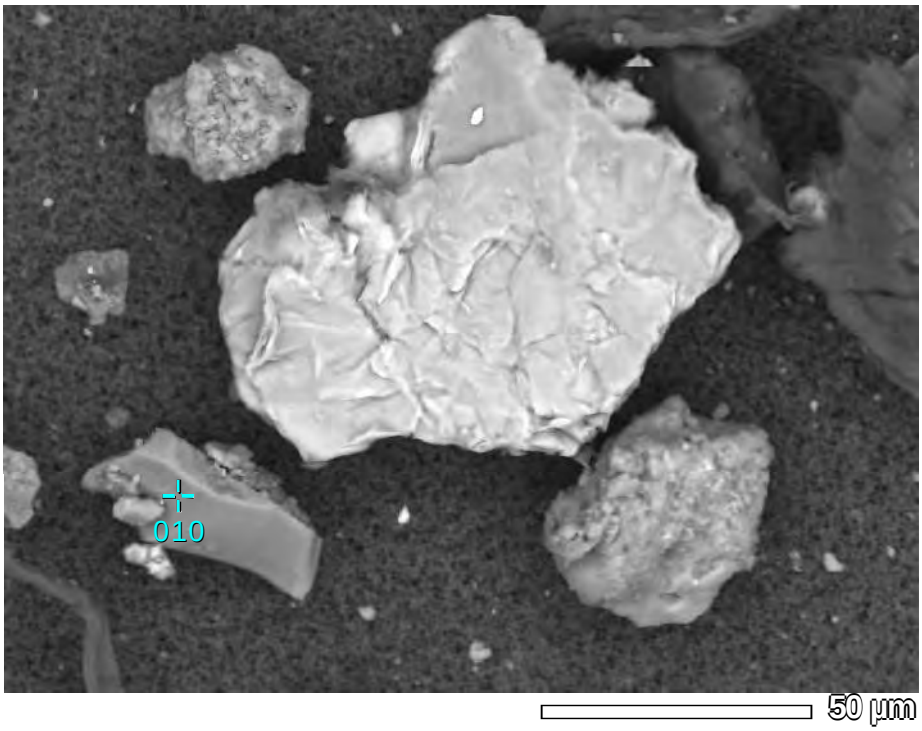
5.5 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



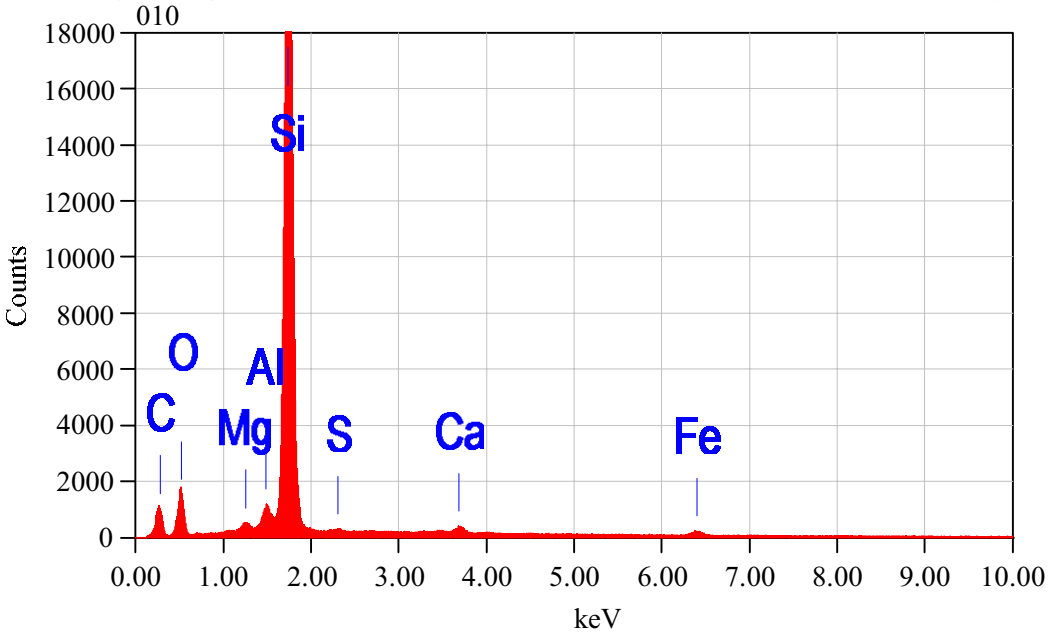
PM6. Hamilton DDG Site Petri (Exposed: 03/07/15, Collected 07/07/15), UQMP # 13560. An SEM/BSE image of a sparsley populated overall area.

6. APPENDIX D

6.1 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A COMMON PARTICLE TYPE

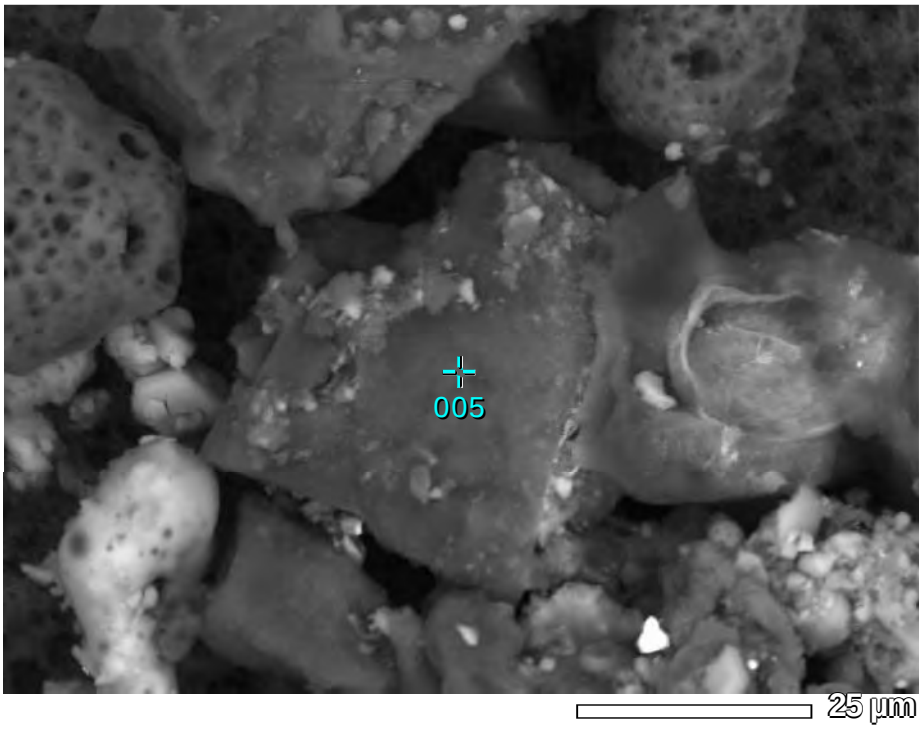


PM1. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556. An SEM/BSE image of a particulate annotated with 010 is selected for SEM/EDS analysis.

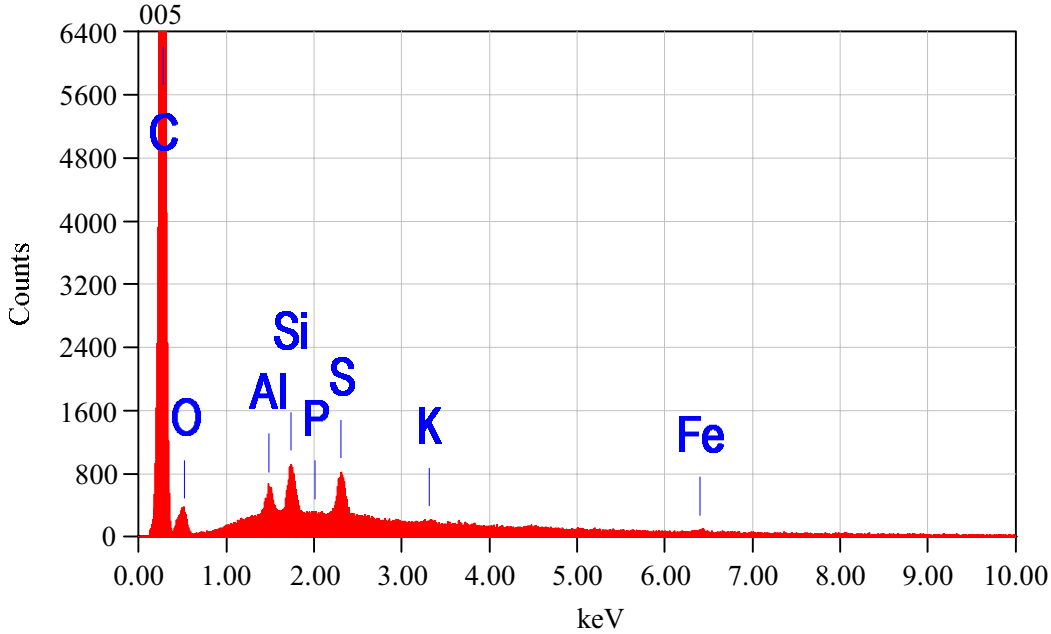


EDS1. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556. The SEM/EDS spectrum of the particle annotated with 010 displays elevated levels of silicon and traces of the balance of the elements. The particle is characteristic of quartz.

6.2 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A LOW ASH COAL PARTICLE

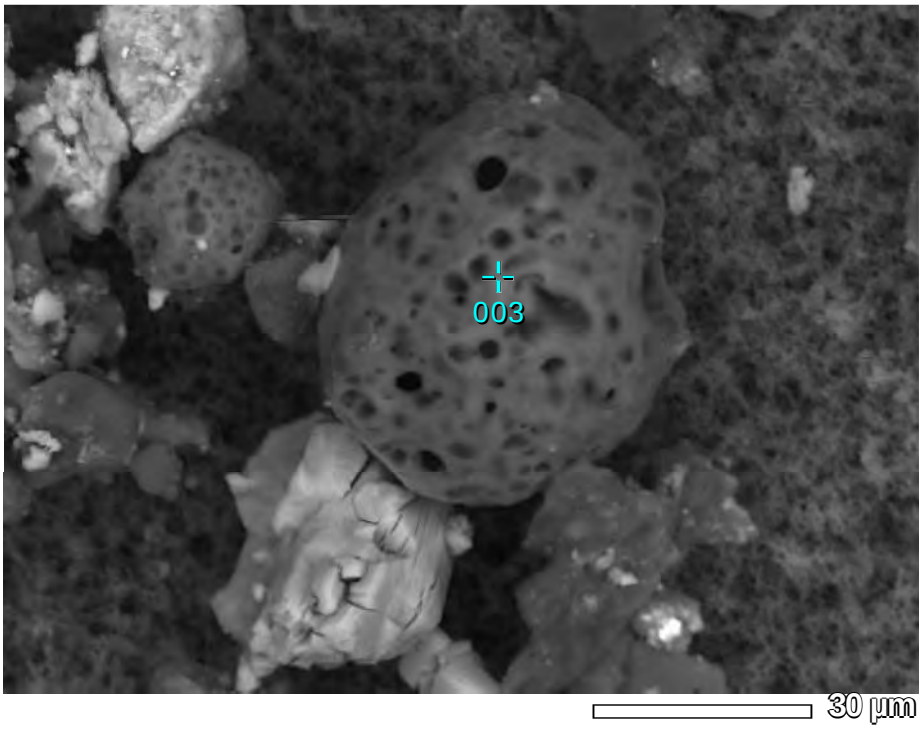


PM2. Stockton North Dust Gauge (Exposed: 02/06/15, Collected 03/07/15), UQMP # 13555. An SEM/BSE image of a particulate marked with 005 is selected for SEM/EDS analysis.

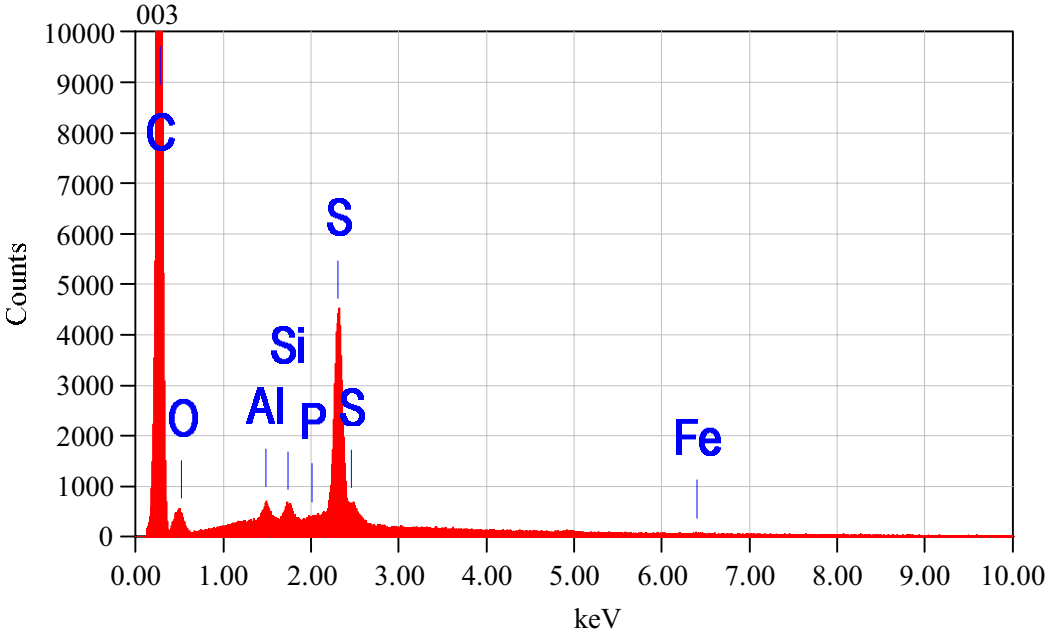


EDS2. Stockton North Dust Gauge (Exposed: 02/06/15, Collected 03/07/15), UQMP # 13555. The SEM/EDS spectrum of the particle marked with 005 shows elevated levels of carbon with traces of aluminium, silicon, phosphorous, sulfur, potassium and iron. The elemental profile and sharp angular particle morphology is characteristic of a low ash coal.

6.3 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A SOOT PARTICLE

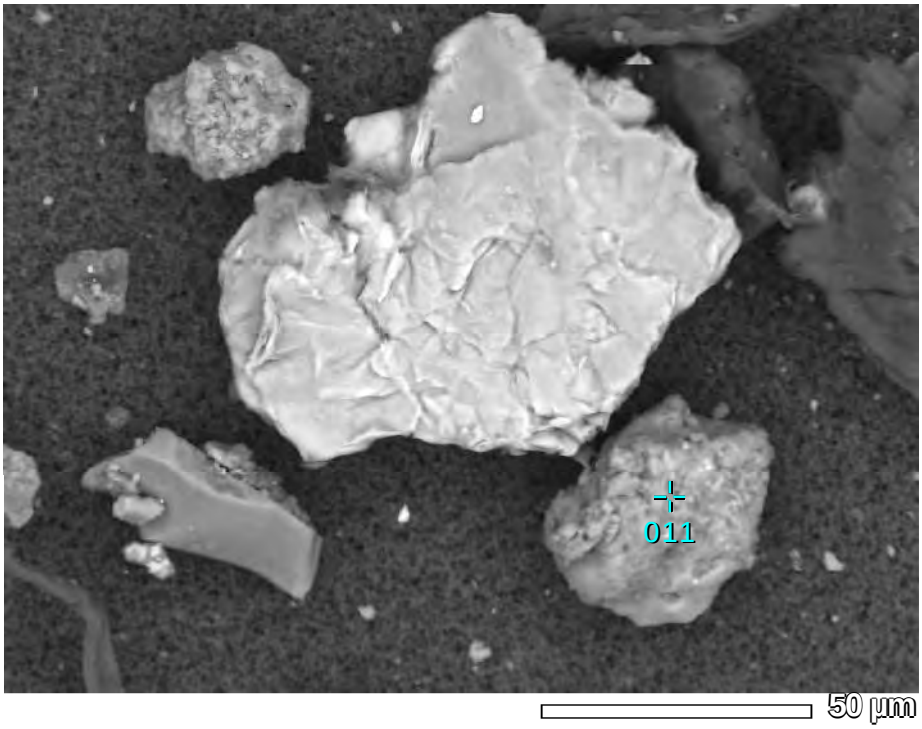


PM3. Stockton North Dust Gauge (Exposed: 02/06/15, Collected 03/07/15), UQMP # 13555. An SEM/BSE image of a particulate annotated with 003 is selected for SEM/EDS analysis.

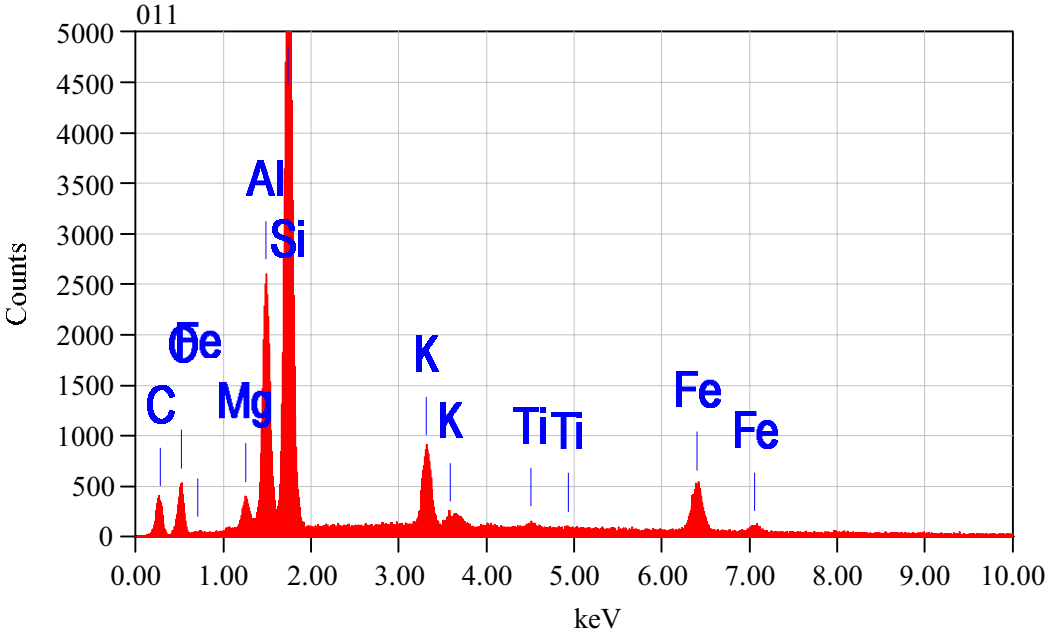


EDS3. Stockton North Dust Gauge (Exposed: 02/06/15, Collected 03/07/15), UQMP # 13555. The SEM/EDS spectrum of the particle annotated with 003 shows elevated levels of carbon and sulfur with trace amounts of aluminium, silicon, phosphorous and iron. The spectra and lacey spheroidal shape are typical of soot, the product of incomplete hydrocarbon combustion.

6.4 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A MINERAL DUST PARTICLE

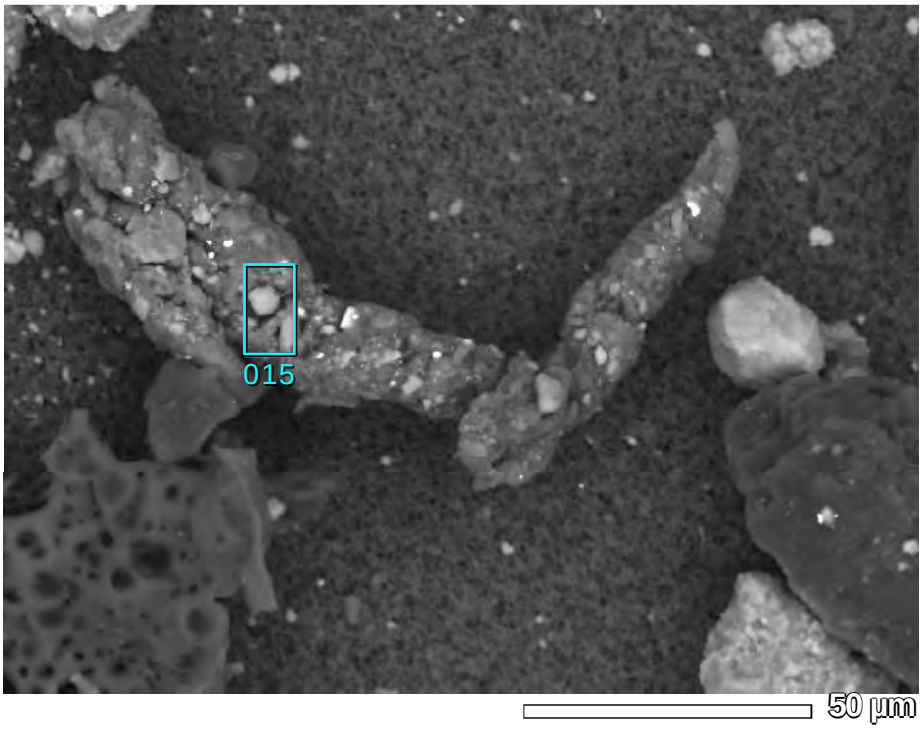


PM4. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556. An SEM/BSE image of a particulate annotated with 011 is selected for SEM/EDS analysis.

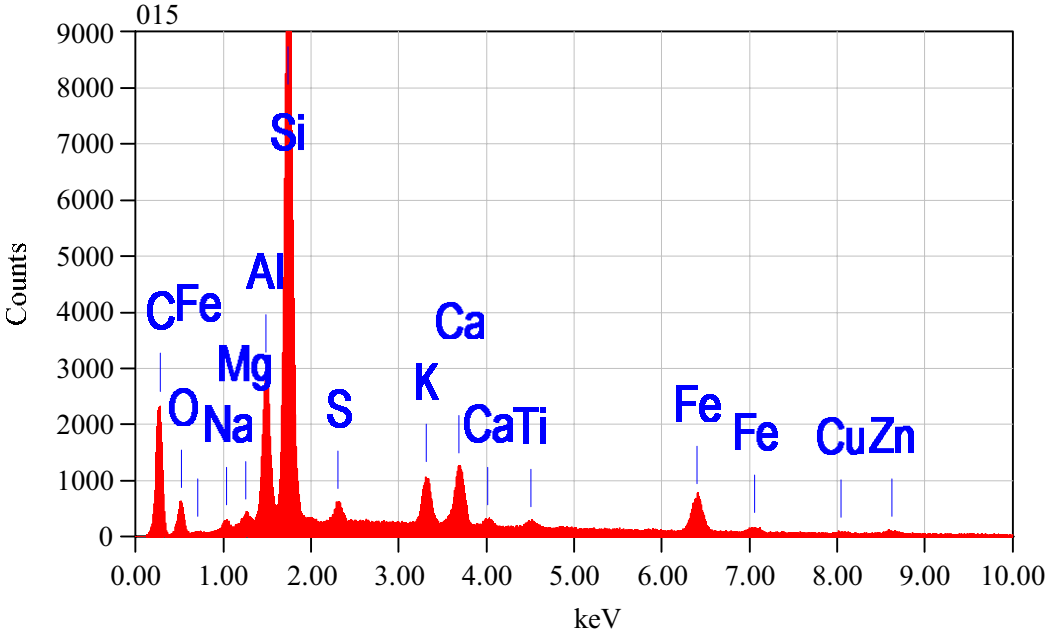


EDS4. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556. The SEM/EDS spectrum of the particle annotated with 011 shows elevated levels of aluminium and silicon with minor amounts of potassium and iron with traces of titanium and magnesium. The spectrum is typical of an aluminosilicate rich mineral dust most likely feldspar.

6.5 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A RUBBER DUST



PM5. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556. An SEM/BSE image of a particulate annotated with 015 is selected for SEM/EDS analysis.



EDS5. Stockton South DDG Site Petri (Exposed 03/07/15, Collected 07/07/15), UQMP # 13556. The SEM/EDS spectrum of the particle annotated with 015 displays a spectrum typical of rubber dust.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.12

Prepared for: Hayley Worthington, ALS ENVIONMENTAL

Prepared By: Fiona Jones

Date: 26th October 2015

Sample Description:

	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Newcastle East Dust Gauge	03/07/15	03/08/15	UQMP # 13632
2	Mayfield West DDG Site Petri	03/08/15	06/08/15	UQMP # 13633
3	Stockton North DDG Site Petri	03/08/15	06/08/15	UQMP # 13634
4	Carrington DDG Site Petri	03/08/15	06/08/15	UQMP # 13635
5	Newcastle East DDG Site Petri	03/08/15	06/08/15	UQMP # 13636

#Method Ref: Internal UQMP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples were supplied as washings from a dust fallout gauge deposit and loose dust deposits in petri dishes. The dust gauge sample was filtered onto a membrane filter and loose dust deposits were examined directly by stereomicroscopy to check for particle distribution and general appearance. All samples were mounted onto a carbon stub for examination by Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy (SEM/EDS).

2. RESULTS

Appendix A attached presents the table of results of the combined microscopy observations.

Appendix B presents colour picture micrographs of the stereomicroscopy images.

Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. Trace amounts of copper sludge was noted in the dust gauge deposit. Overall SEM/EDS results are not included when the deposit is very sparsley populated with particulates as the carbon peak is exaggerated and the elements of the spectra provide limited or erroneous diagnostic information.

Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of UQ Materials Performance

Fiona Jones

1. APPENDIX A

1.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13632	UQMP # 13633	UQMP # 13634
	SAMPLE ID / **PARTICLE TYPE**	*Newcastle East Dust Gauge (Exposed: 03/07/15, Collected: 03/08/15)*	*Mayfield West DDG Site Petri (Exposed: 03/08/15, Collected: 06/08/15)*	*Stockton North DDG Site Petri (Exposed: 03/08/15, Collected: 06/08/15)*
BLACK	COAL	15		10
	SOOT	2		5
	BLACK RUBBER DUST	tr	10	tr
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**73**	**70**	**75**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	20	tr
	PLANT DEBRIS (General)	10	tr	10
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)			
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS			The deposit consisted of very few particulates.	The deposit consisted of very few particulates.

1.2 TABLE OF COMBINED MICROSCOPY RESULTS

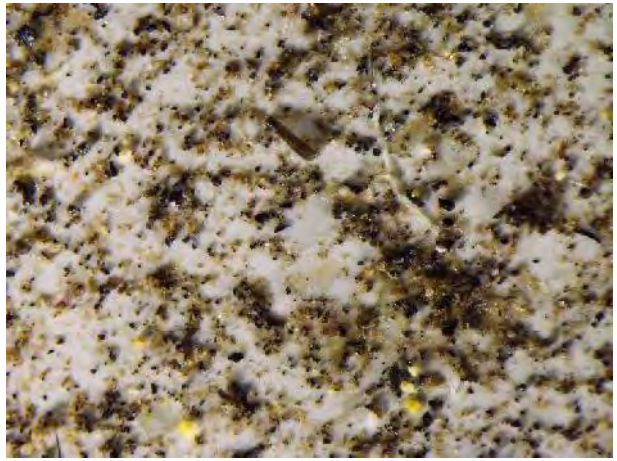
PARTICLE IDENTITY		PERCENTAGE (Projected area basis)	
	SAMPLE #	UQMP # 13635	UQMP # 13636
	SAMPLE ID **PARTICLE TYPE**	*Carrington DDG Site Petri (Exposed: 03/08/15, Collected 06/08/15)*	*Newcastle East DDG Site Petri (Exposed: 03/08/15, Collected 06/08/15)*
BLACK	COAL	5	5
	SOOT	5	tr
	BLACK RUBBER DUST	5	20
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**75**	**65**
	MINERAL DUST (type = Fly Ash)		
	MINERAL DUST (type = Cement Dust)		
	MINERAL DUST (type =glassy)		
	GLASS FRAGMENTS		
	COPPER SLUDGE		
	P/S SLIME & FUNGI		
	INSECT DEBRIS	tr	tr
	PLANT DEBRIS (General)	10	10
	PLANT DEBRIS (type = plant char)		
	PLANT DEBRIS (type =)		
GENERAL ORGANIC TYPES	WOOD DUST		
	FIBRES (type = Miscellaneous)		
	STARCH		
	PAINT		
	PLASTIC FRAGMENTS		
	RED RUBBER DUST		
COMMENTS		The deposit consisted of very few particulates.	

1.3 PARTICLE IDENTITY LEGEND

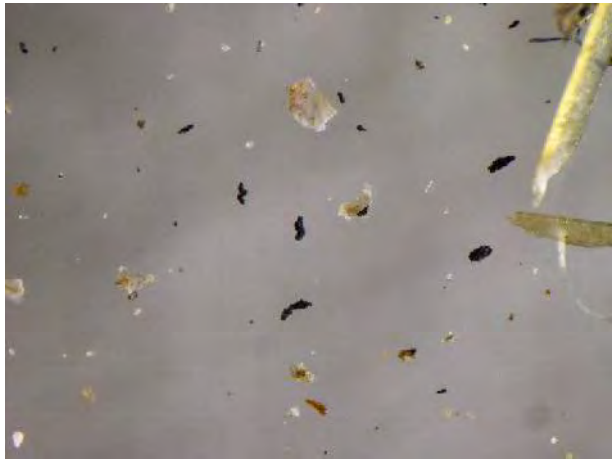
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

1. APPENDIX B

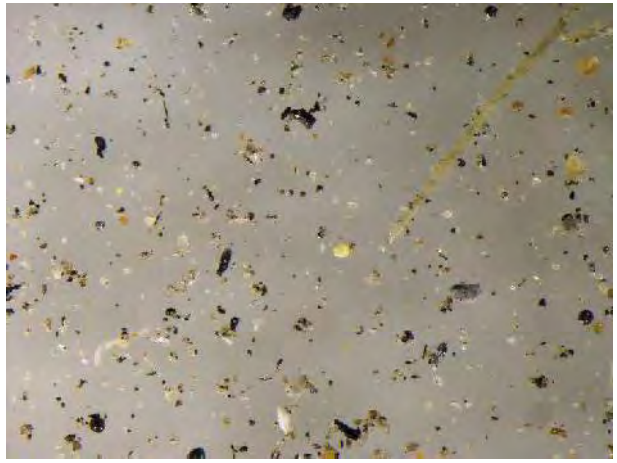
1.1 STEREOMICROSCOPY PICTURE MICROGRAPHS



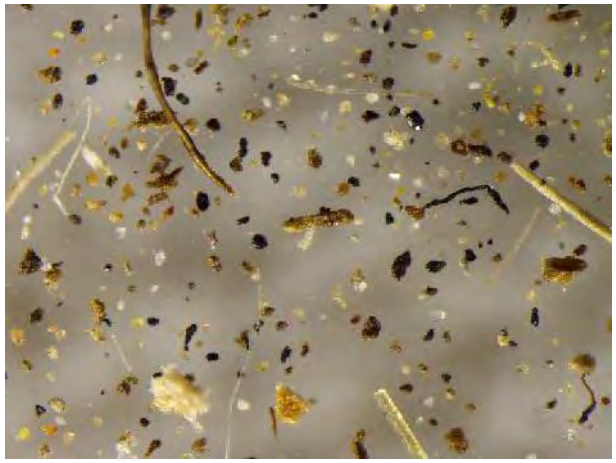
StMPM1. Newcastle East Dust Gauge (Exposed: 03/07/15, Collected: 06/08/15), UQMP # 13632



StMPM2. Mayfield West DDG Site Petri (Exposed: 03/08/15, Collected: 06/08/15), UQMP # 13633

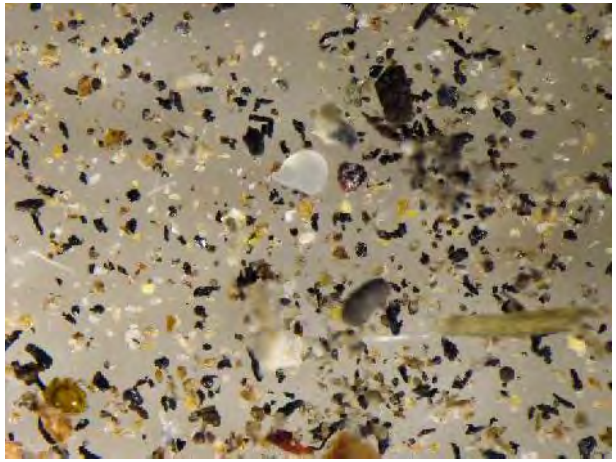


StMPM3. Stockton North DDG Site Petri (Exposed: 03/08/15, Collected: 06/08/15), UQMP # 13634.



StMPM4. Carrington DDG Site Petri (Exposed: 03/08/15, Collected 06/08/15), UQMP # 13635.

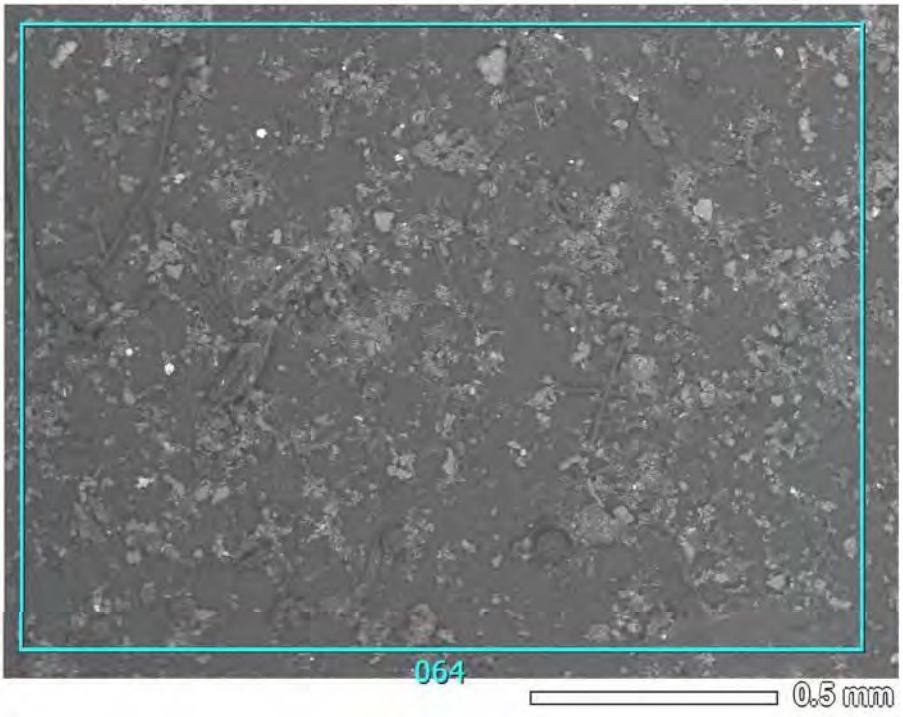
1.2 STEREOMICROSCOPY PICTURE MICROGRAPHS



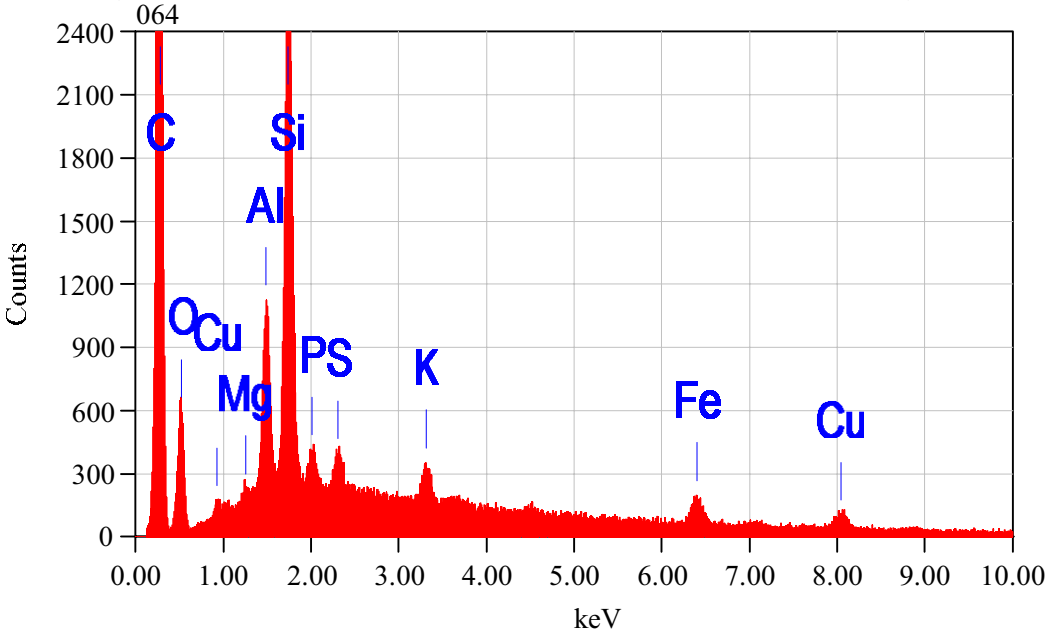
StMPM5. Newcastle East DDG Site Petri *(Exposed: 03/08/15, Collected 06/08/15)*, UQMP # 13636.

1. APPENDIX C

1.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

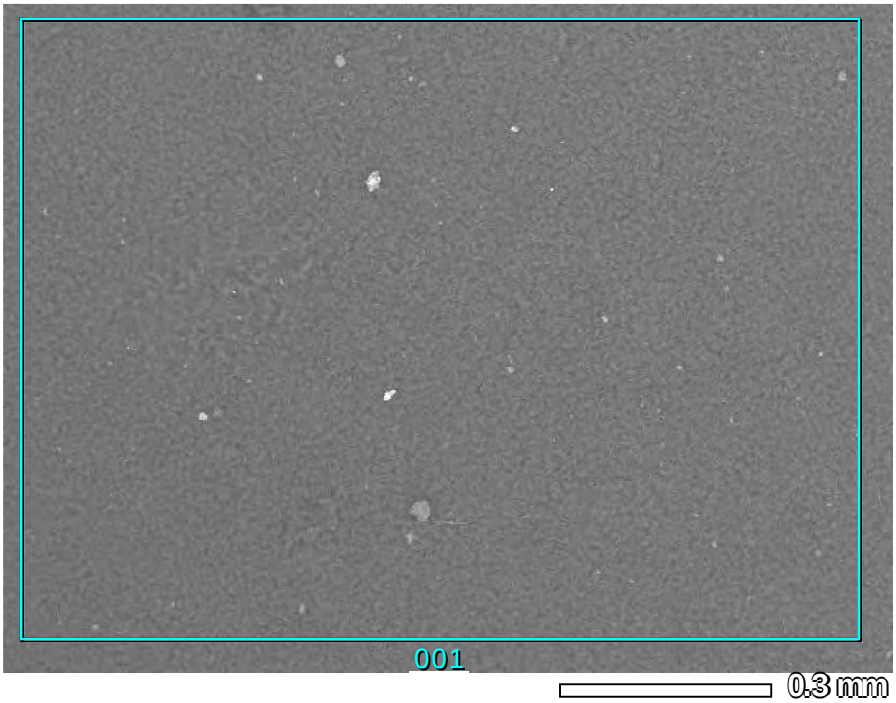


PM1. Newcastle East Dust Gauge (Exposed: 03/07/15, Collected: 03/08/15), UQMP # 13632. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



EDS1. Newcastle East Dust Gauge (Exposed: 03/07/15, Collected: 03/08/15), UQMP # 13632. The SEM/EDS spectrum of the overall area is rich in carbon and silicon with minor amounts of aluminium and traces of the remaining elements. Aluminium and silicon based mineral dust was the predominant particulate type with a minor organic component of coal, plant debris and soot with traces of rubber dust and insect debris.

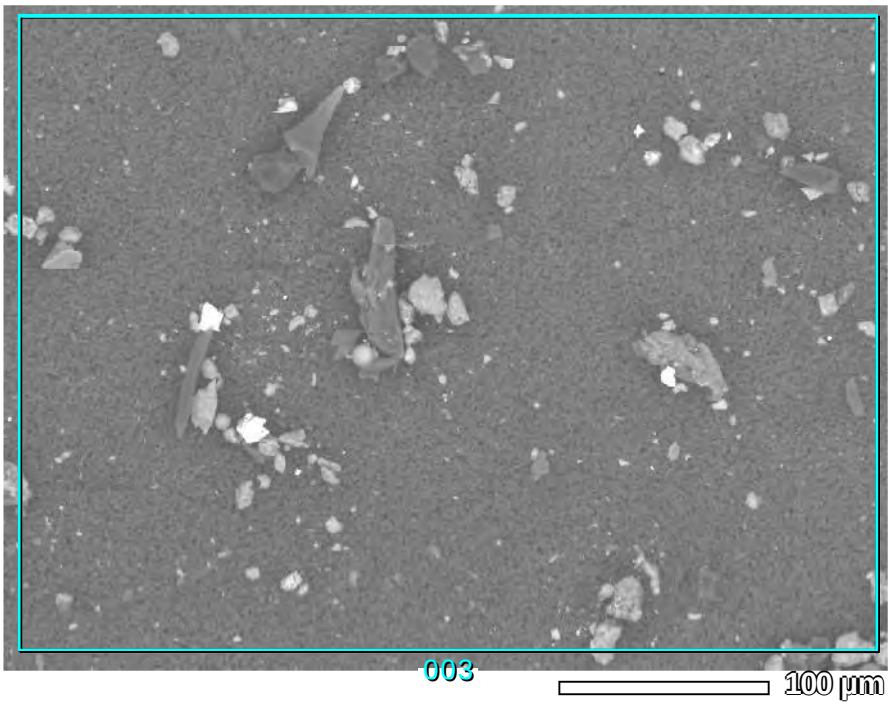
1.2 SEM/BSE IMAGES AND SEM/EDS SPECTRUM OF AN OVERALL AREA OF THE DEPOSIT



PM2. Mayfield West DDG Site Petri (Exposed: 03/08/15, Collected: 06/08/15), UQMP # 13633. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis. The EDS spectrum was not included as too few partcicles were available for analysis.

The Spectrum was intentionaly excluded.

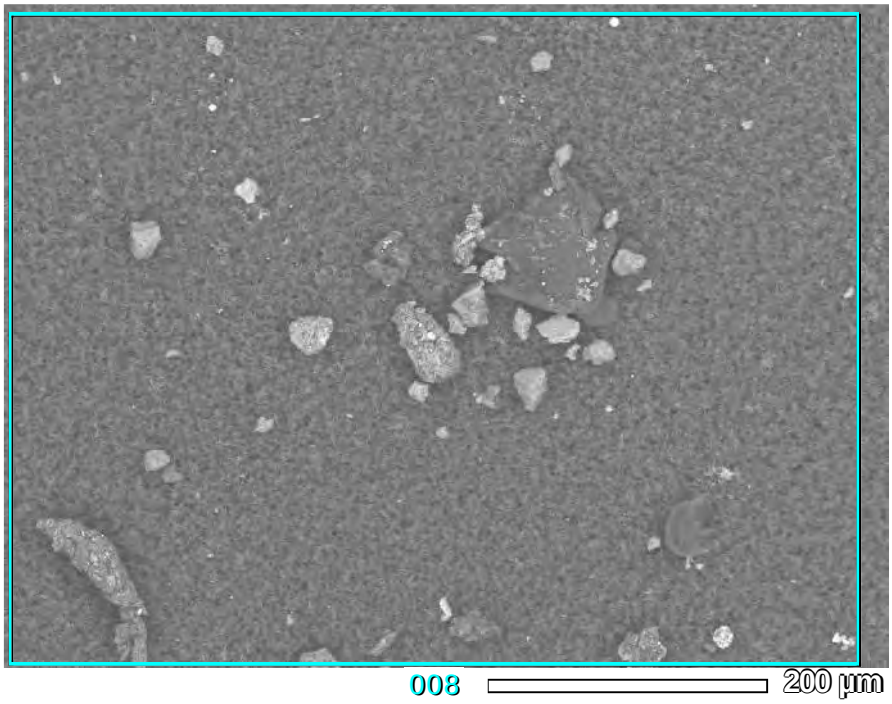
1.3 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



PM3. Stockton North DDG Site Petri (Exposed: 03/08/15, Collected: 06/08/15), UQMP # 13634. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis. The EDS spectrum was not included as too few partcicles were available for analysis.

The Spectrum was intentionaly excluded.

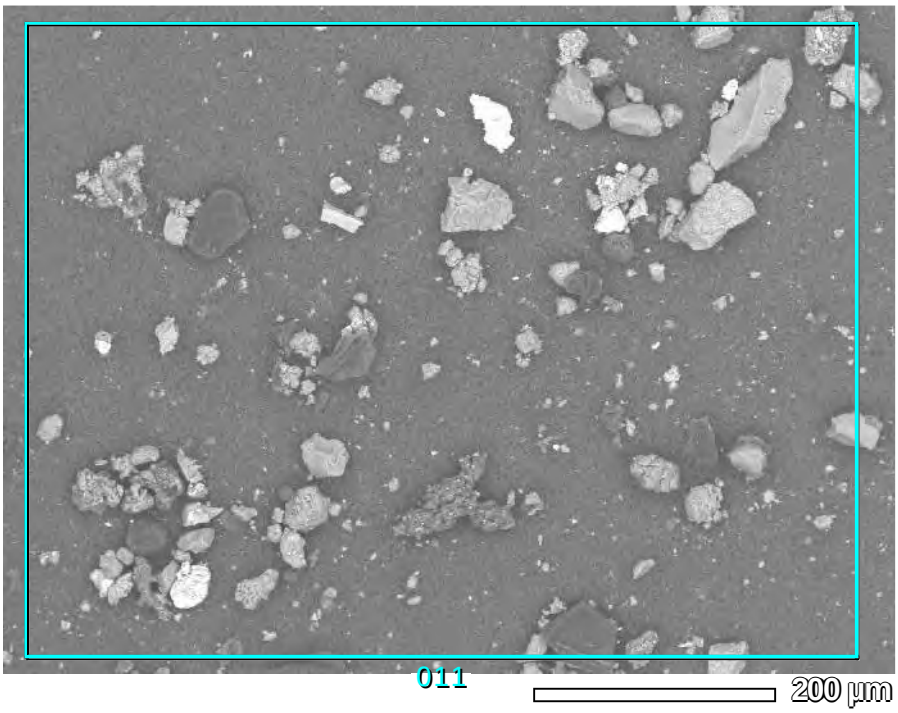
1.4 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



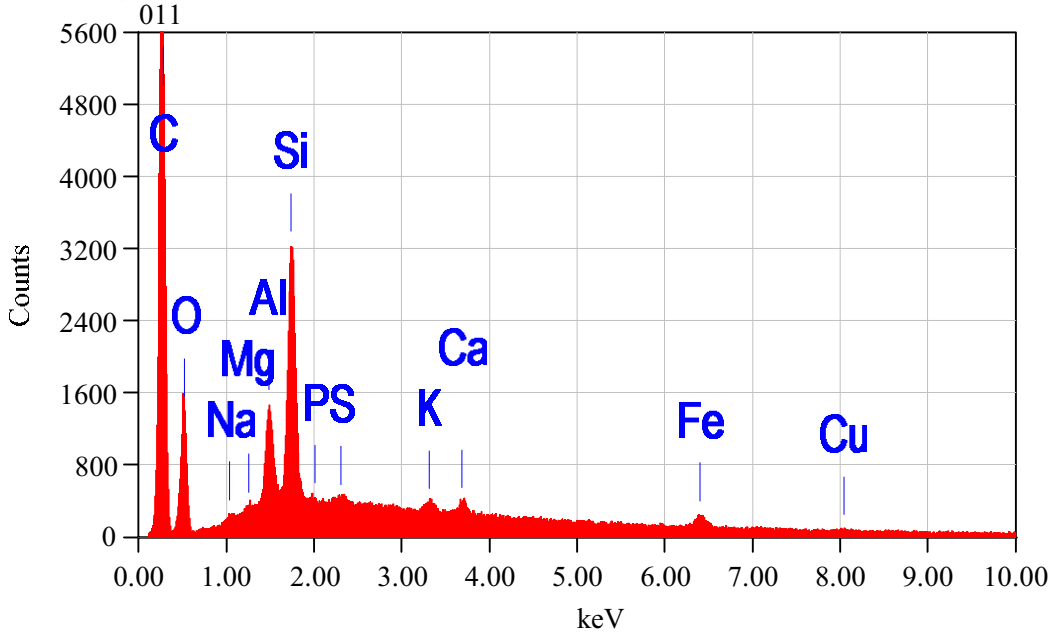
PM4. Carrington DDG Site Petri (Exposed: 03/08/15, Collected 06/08/15), UQMP # 13635. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis. The EDS spectrum was not included as too few partcicles were available for analysis.

The Spectrum was intentionaly excluded.

1.5 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



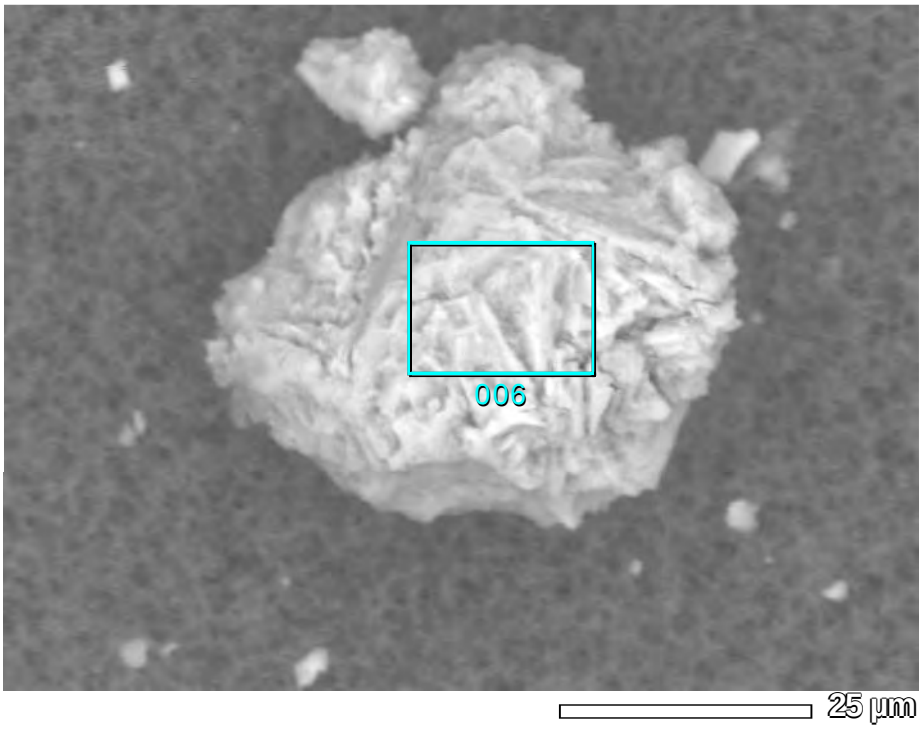
PM5. Newcastle East DDG Site Petri (Exposed: 03/08/15, Collected 06/08/15), UQMP # 13636. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



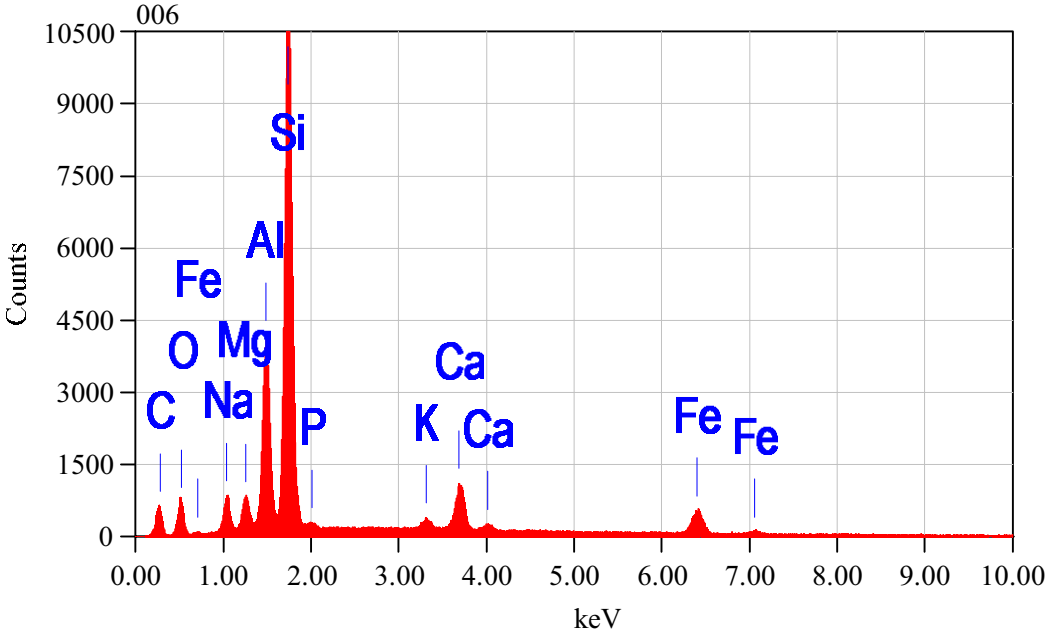
EDS5. Newcastle East DDG Site Petri (Exposed: 03/08/15, Collected 06/08/15), UQMP # 13636. The SEM/EDS spectrum of the overall area displays a predominance of carbon and silicon with minor amounts of magnesium and traces of the balance of the elements. The elevated carbon includes contributions from the areas of exposed filter whilst the organic particulates were minor. The organic components included minor amounts of coal, rubber dust, plant debris and traces of soot and insect debris. Microscopy observations found that the major particle type present was aluminium and silicon based mineral dust.

2. APPENDIX D

2.1 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A MINERAL DUST PARTICLE

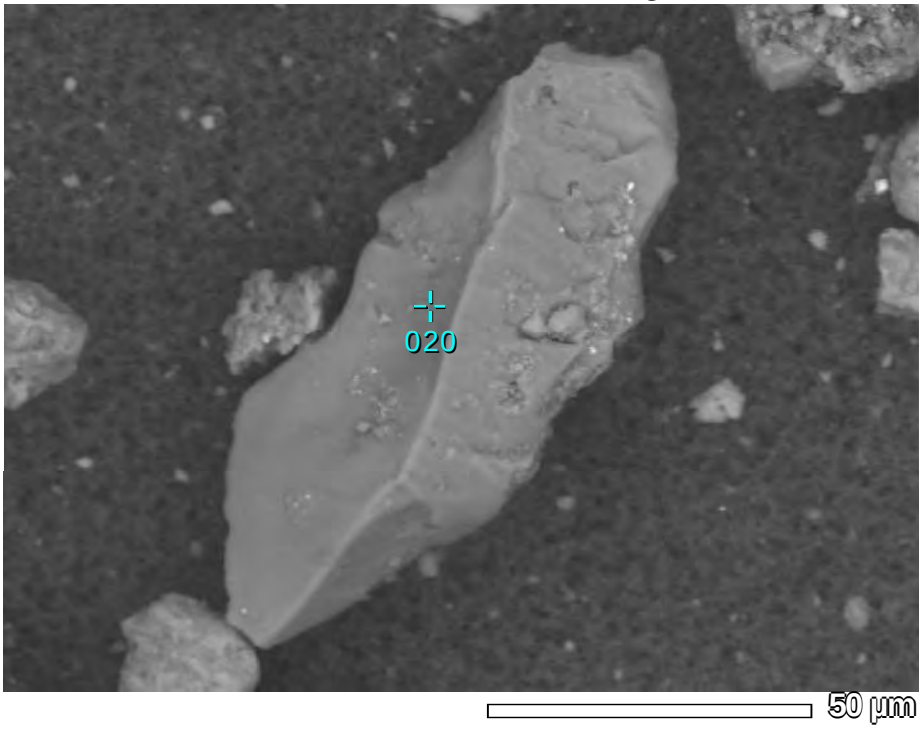


PM1. Stockton North DDG Site Petri (Exposed: 03/08/15, Collected: 06/08/15), UQMP # 13634. An SEM/BSE image of a particulate annotated with 006 is selected for SEM/EDS analysis.

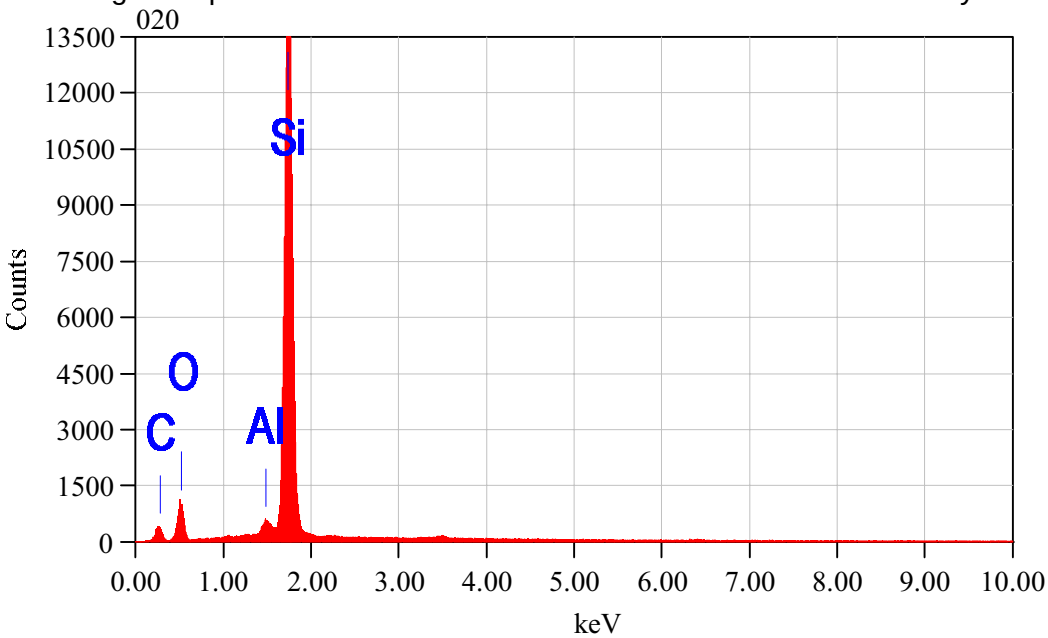


EDS1. Stockton North DDG Site Petri (Exposed: 03/08/15, Collected: 06/08/15), UQMP # 13634. The SEM/EDS spectrum of the particle annotate with 006 consists primarily of aluminium and silicon with minor amounts calcium and traces of the balance of the elements. The elemental profile is characteristic for an aluminosilicate based mineral dust possibly a feldspar.

2.2 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A QUARTZ PARTICLE

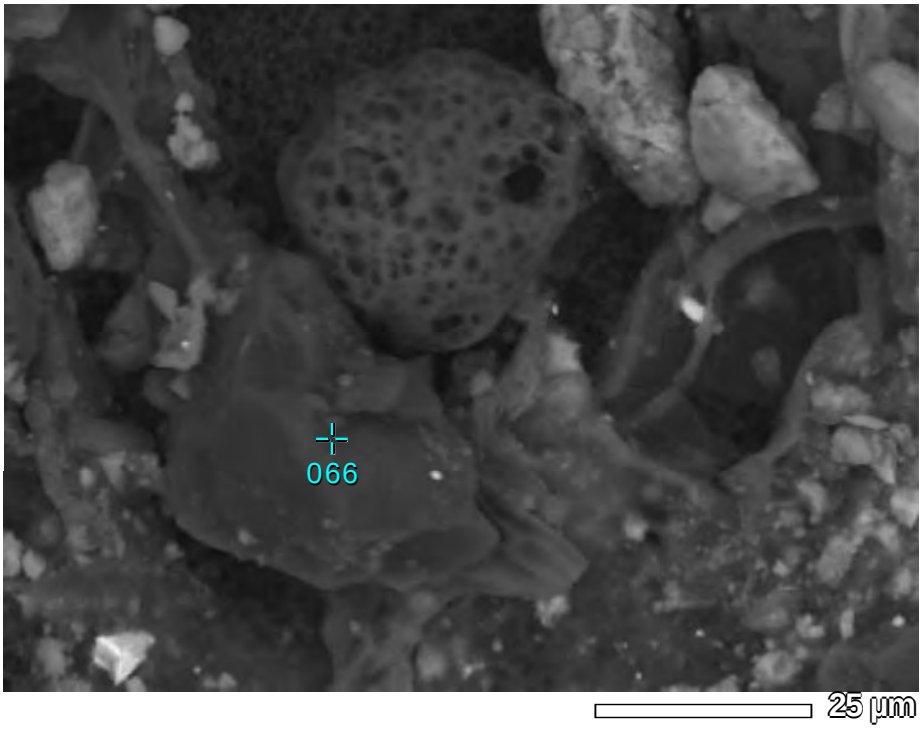


PM2. Newcastle East DDG Site Petri (Exposed: 03/08/15, Collected 06/08/15), UQMP # 13636. An SEM/BSE image of a particulate marked with 020 is selected for SEM/EDS analysis.

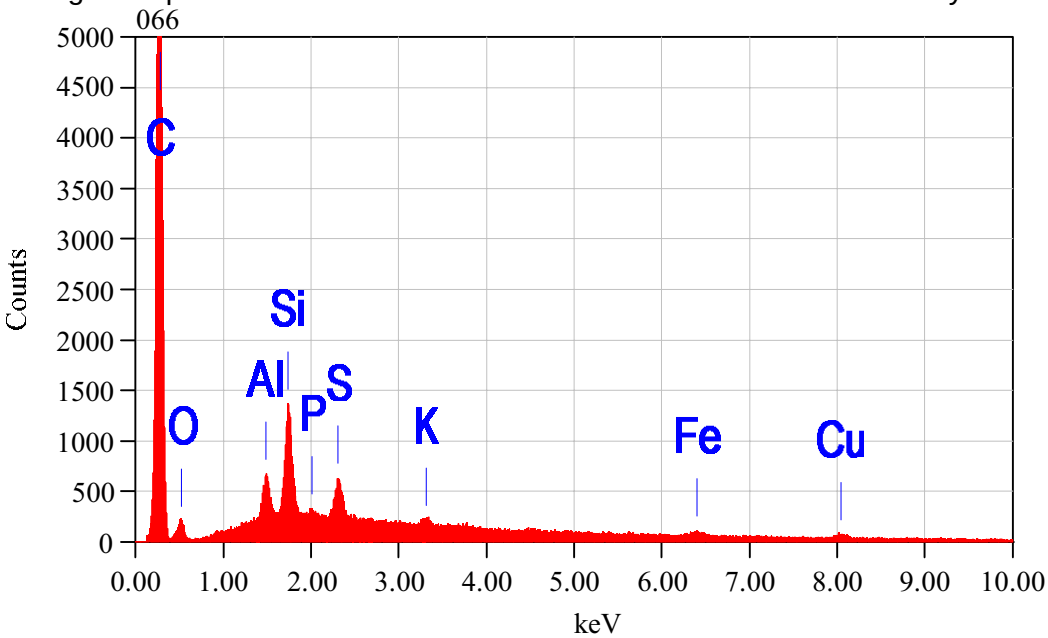


EDS2. Newcastle East DDG Site Petri (Exposed: 03/08/15, Collected 06/08/15), UQMP # 13636. The SEM/EDS spectrum of the particle marked with 020 consist predominantly of silicon which is typical of quartz. Quartz is a common mineral dust and was observed in all deposits.

2.3 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A COAL PARTICLE

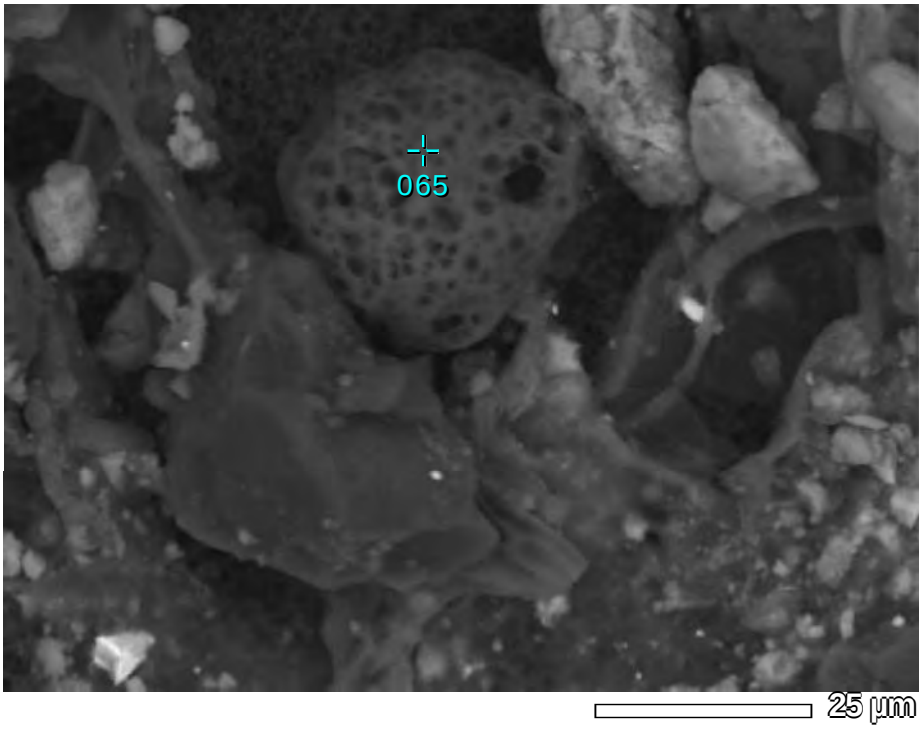


PM3. Newcastle East Dust Gauge (Exposed: 03/07/15, Collected: 03/08/15), UQMP # 13632. An SEM/BSE image of a particulate annotated with 066 is selected for SEM/EDS analysis.

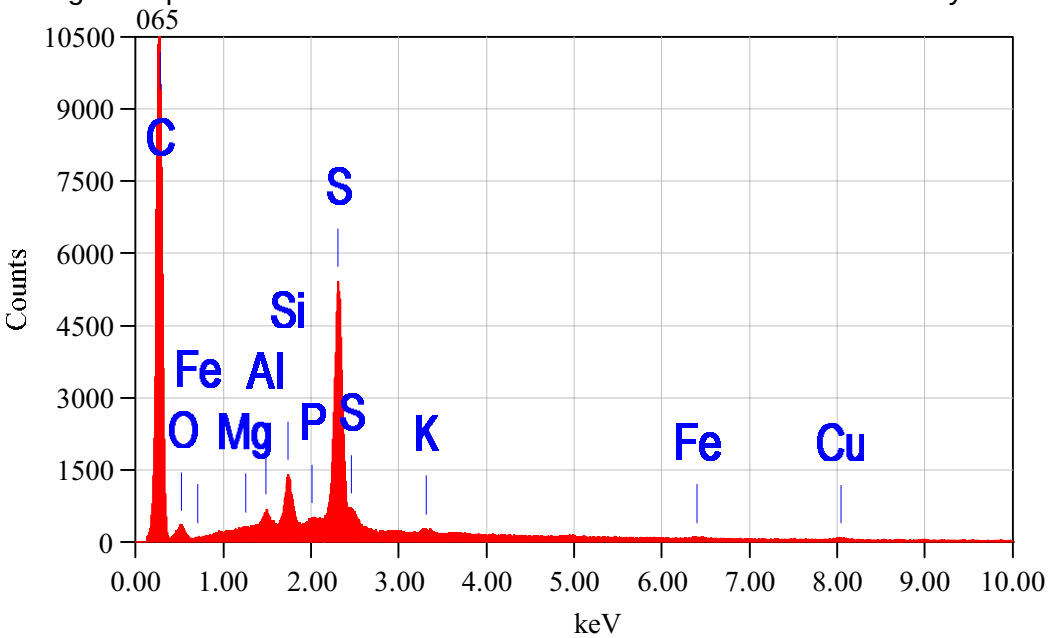


EDS3. Newcastle East Dust Gauge (Exposed: 03/07/15, Collected: 03/08/15), UQMP # 13632. The SEM/EDS spectrum of the particle annotated with 066 shows an elevated peak of carbon and minor amounts of aluminium, silicon and sulfur. The particle morphology and elemental profile is typical of coal.

2.4 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A SOOT PARTICLE



PM4. Newcastle East Dust Gauge (Exposed: 03/07/15, Collected: 03/08/15), UQMP # 13632. An SEM/BSE image of a particulate annotated with 065 is selected for SEM/EDS analysis.



EDS4. Newcastle East Dust Gauge (Exposed: 03/07/15, Collected: 03/08/15), UQMP # 13632. The SEM/EDS spectrum of the lacey particle annotated with 065 displays two major peaks of carbon and sulfur and traces of the remaining elements. The elemental profile, spheroidal shape and lacey structure are common for soot particles. Soot is a by-product of uncombusted hydrocarbon fuels.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.14

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 23rd October 2015

Sample Description:

	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Wickham Dust Gauge	03/08/15	03/09/15	UQMP # 13746
2	Stockton South Petri	17/08/15	03/09/15	UQMP # 13747
3	Stockton North Petri	17/08/15	20/08/15	UQMP # 13748
4	Carrington Petri	28/08/15	31/08/15	UQMP # 13749
5	Honeysuckle Petri	28/08/15	31/08/15	UQMP # 13750
6	Stockton South Petri	17/08/15	20/08/15	UQMP # 13751
7	Wickahm Brush 1		03/09/15	UQMP # 13752
8	Wickahm Brush 2		03/09/15	UQMP # 13753
9	Lott St Carrington Brush		08/09/15	UQMP # 13754
10	Bull St Mayfield Brush		08/09/15	UQMP # 13755
11	Elcho St Hamilton Brush		08/09/15	UQMP # 13756
12	Kings Rd Tighes Hill Brush		08/09/15	UQMP #13757
13	Neville St Mayfield Brush		08/09/15	UQMP #13758
14	Hargrave St Carrington Brush		08/09/15	UQMP # 13759
15	Bourke St Mayfield Brush		08/09/15	UQMP # 13760
16	Stevenson Pl Newcastle East Brush		09/09/15	UQMP # 13761
17	Gregson St Mayfield West Brush		09/09/15	UQMP # 13762

#Method Ref: Internal AMCP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples were supplied as washings from a dust fallout gauge deposit and loose deposit in petri dishes. The samples were filtered or washed onto a membrane filter and examined by stereomicroscopy to check for particle distribution and general appearance.

2. RESULTS

Appendix A attached presents the table of results of the combined microscopy observations.

Appendix B presents colour picture micrographs of the stereomicroscopy images.

Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. Trace amounts of copper sludge was noted in all deposits.

Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of UQ Materials Performance

Fiona Jones

3. APPENDIX A

3.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13746	UQMP # 13747	UQMP # 13748
	SAMPLE ID / **PARTICLE TYPE**	*Wickham Dust Gauge (Exposed: 03/08/15, Collected 03/09/15)*	*Stockton South Petri (Exposed: 17/08/15, Collected: 03/09/15)*	*Stockton North Petri (Exposed: 17/08/15, Collected: 20/08/15)*
BLACK	COAL	20	10	15
	SOOT	tr	tr	tr
	BLACK RUBBER DUST	5	5	5
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**50**	**55**	**75**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =Alumina)			5
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	5	tr	tr
	PLANT DEBRIS (General)	20	30	tr
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr		tr
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

3.2 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13749	UQMP # 13750	UQMP # 13751
	SAMPLE ID / **PARTICLE TYPE**	*Carrington Petri (Exposed: 28/08/15, Collected: 31/08/15)*	*Honeysuckle Petri (Exposed: 28/08/15, Collected: 31/08/15)*	*Stockton South Petri (Exposed: 17/08/15, Collected 20/08/15)*
BLACK	COAL	10	5	25
	SOOT	tr	tr	15
	BLACK RUBBER DUST	20	20	5
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**40**	**45**	**55**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =alumina)			tr
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	tr	tr
	PLANT DEBRIS (General)	30	30	tr
	PLANT DEBRIS (type = plant char)			tr
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)	tr	tr	
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

3.3 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13752	UQMP # 13753	UQMP # 13754
	SAMPLE ID / **PARTICLE TYPE**	*Wickahm Brush 1 (Collected: 03/09/15)*	*Wickahm Brush 2 (Collected: 03/09/15)*	*Lott St Carrington Brush (Collected 08/09/15)*
BLACK	COAL	15	10	5
	SOOT	5	5	5
	BLACK RUBBER DUST	10	5	5
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**70**	**65**	**50**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =alumina)			35
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	10	tr
	PLANT DEBRIS (General)	tr	5	tr
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)			
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

3.4 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13755	UQMP # 13756	UQMP #13757
	SAMPLE ID	*Bull St Mayfield Brush*	*Elcho St Hamilton Brush*	*Kings Rd Tighes Hill Brush*
	PARTICLE TYPE	*(Collected: 08/09/15)*	*(Collected 08/09/15)*	*(Collected: 08/09/15)*
BLACK	COAL	5	5	15
	SOOT	5	tr	tr
	BLACK RUBBER DUST	5	tr	tr
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**60**	**95**	***85**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type = alumina)	25		
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr	tr	tr
	PLANT DEBRIS (General)	tr	tr	tr
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)			
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				*Trace amounts of lead rich mineral dust was observed.

3.5 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP #13758	UQMP # 13759	UQMP # 13760
	SAMPLE ID	*Neville St Mayfield Brush*	*Hargrave St Carrington Brush*	*Bourke St Mayfield Brush*
	PARTICLE TYPE	*(Collected: 08/09/15)*	*(Collected: 08/09/15)*	*(Collected: 08/09/15)*
BLACK	COAL	15	15	5
	SOOT	tr	tr	5
	BLACK RUBBER DUST			
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**75**	**75**	***90**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type = alumina)	10	10	
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	tr		
	PLANT DEBRIS (General)	tr		
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)			
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				Mineral dust included high levels of zinc possibly 1/3 of the mineral dust total.

3.6 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)	
	SAMPLE #	UQMP # 13761	UQMP # 13762
	SAMPLE ID	*Stevenson Pl Newcastle East Brush (Collected: 09/09/15)*	*Gregson St Mayfield West Brush (Collected: 09/09/15)*
	PARTICLE TYPE		
BLACK	COAL	15	10
	SOOT	5	5
	BLACK RUBBER DUST	10	
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**45**	**85**
	MINERAL DUST (type = Fly Ash)	10	
	MINERAL DUST (type = Cement Dust)		
	MINERAL DUST (type =glassy)		
	GLASS FRAGMENTS		
	COPPER SLUDGE		
	P/S SLIME & FUNGI		
	INSECT DEBRIS	5	
	PLANT DEBRIS (General)	10	tr
	PLANT DEBRIS (type = plant char)	tr	
	PLANT DEBRIS (type =)		
GENERAL ORGANIC TYPES	WOOD DUST		
	FIBRES (type = Miscellaneous)		
	STARCH		
	PAINT		
	PLASTIC FRAGMENTS		
	RED RUBBER DUST		
COMMENTS			

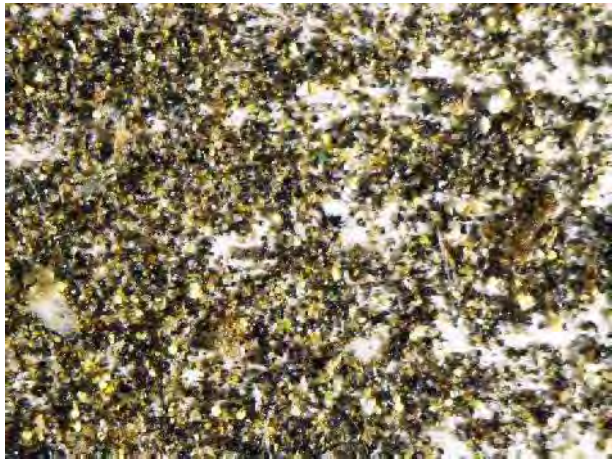
3.7 PARTICLE IDENTITY LEGEND

Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

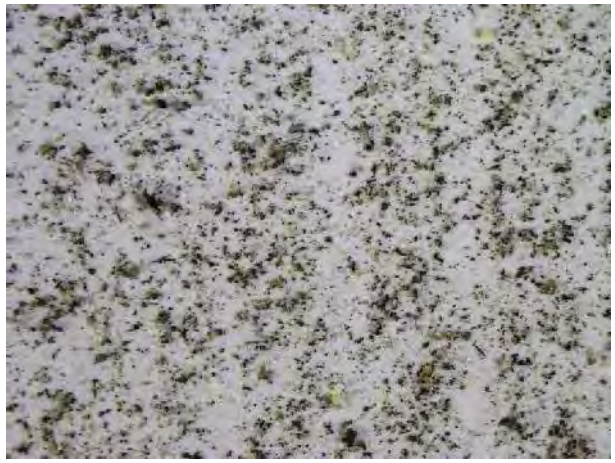
4. APPENDIX B

4.1 STEREOMICROSCOPY PICTURE MICROGRAPHS

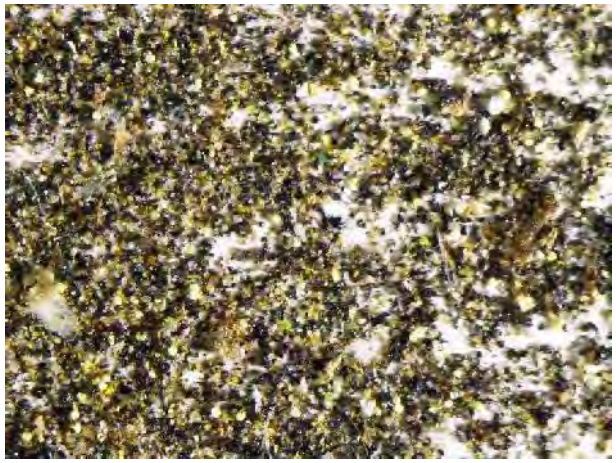
StMPM1. Wickham Dust Gauge (Exposed: 03/08/15, Collected 03/09/15), UQMP # 13746



StMPM2. Stockton South Petri (Exposed: 17/08/15, Collected: 03/09/15), UQMP # 13747

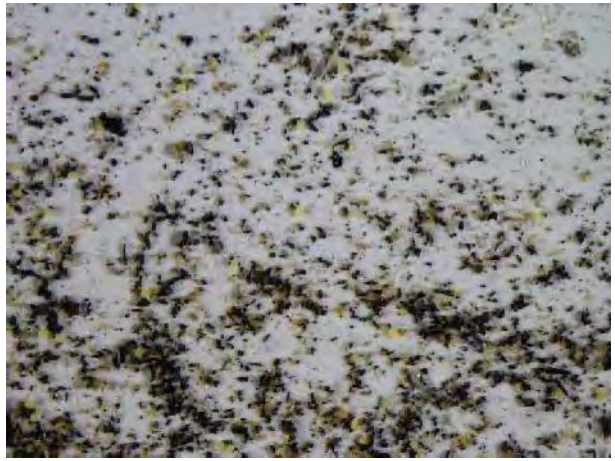


StMPM3. Stockton North Petri (Exposed: 17/08/15, Collected: 20/08/15), UQMP # 13748.

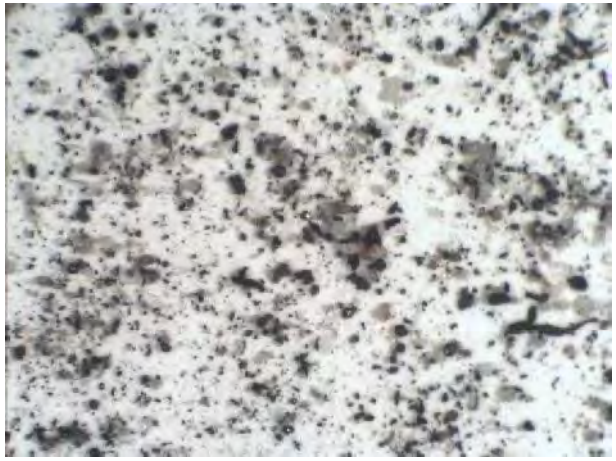


StMPM4. Carrington Petri (Exposed: 28/08/15, Collected: 31/08/15), UQMP # 13749.

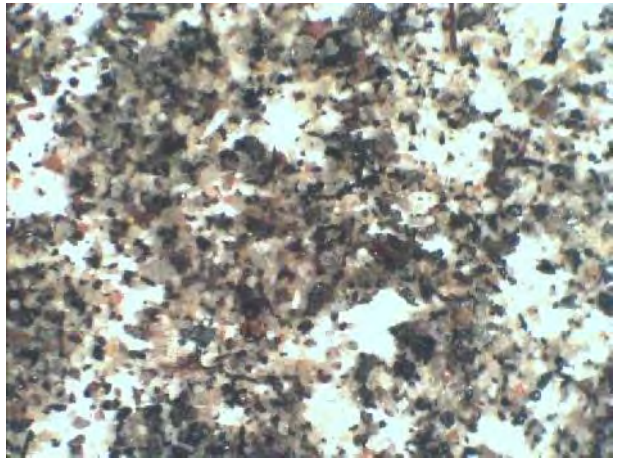
4.2 STEREOMICROSCOPY PICTURE MICROGRAPHS



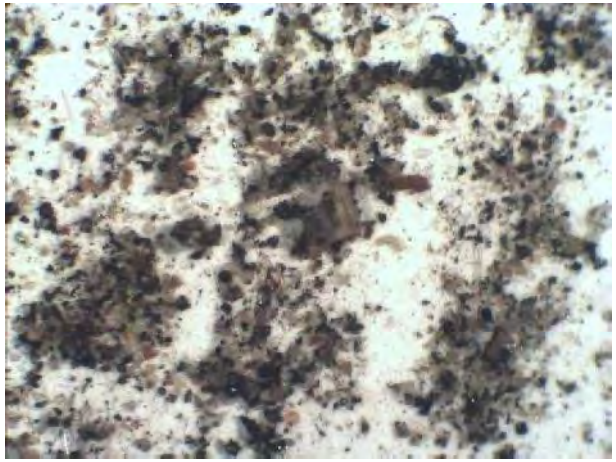
StMPM5. Honeysuckle Petri (Exposed: 28/08/15, Collected: 31/08/15), UQMP # 13750.



StMPM6. Stockton South Petri (Exposed: 17/08/15, Collected 20/08/15), UQMP # 13751

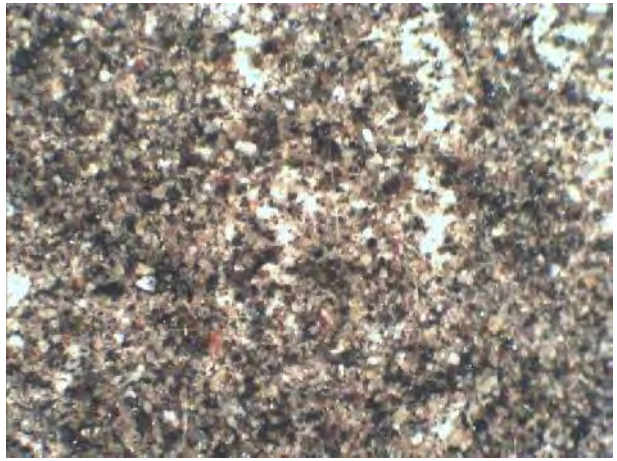


StMPM7. Wickahm Brush 1 (Collected: 03/09/15), UQMP # 13752.

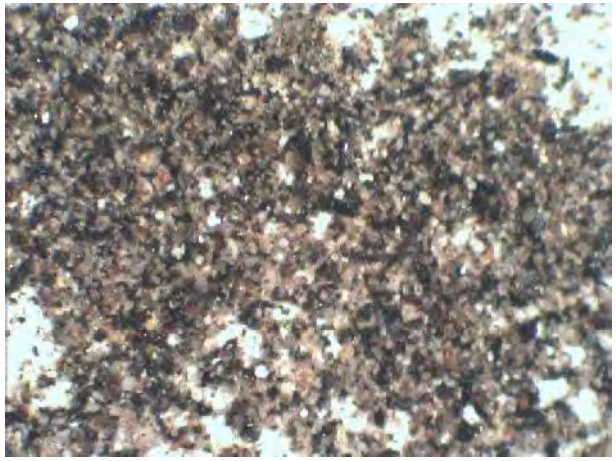


StMPM8. Wickahm Brush 2 (Collected: 03/09/15), UQMP # 13753.

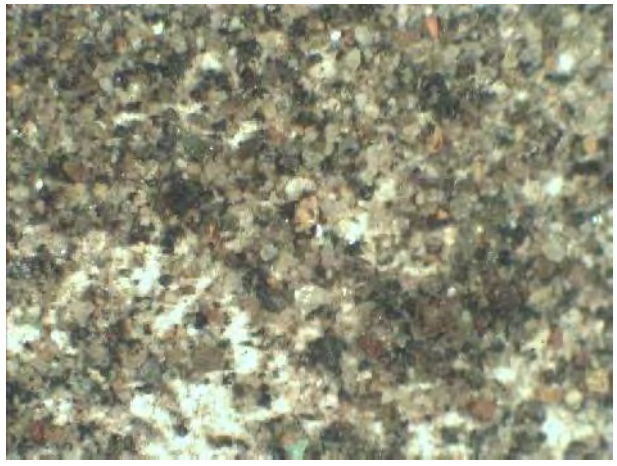
4.3 STEREOMICROSCOPY PICTURE MICROGRAPHS



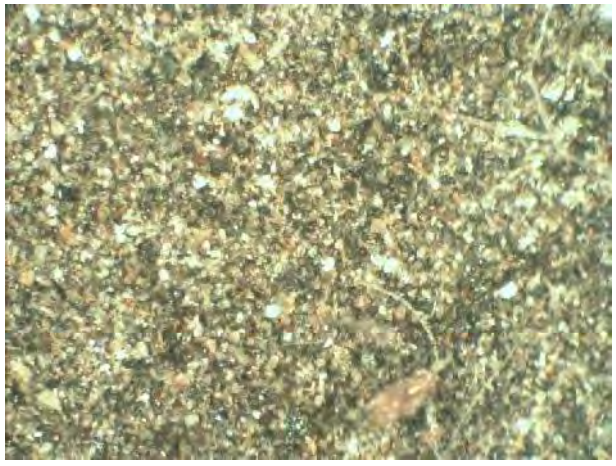
StMPM9. Lott St Carrington Brush (Collected 08/09/15), UQMP # 13754.



StMPM10. Bull St Mayfield Brush (Collected: 08/09/15), UQMP # 13755.

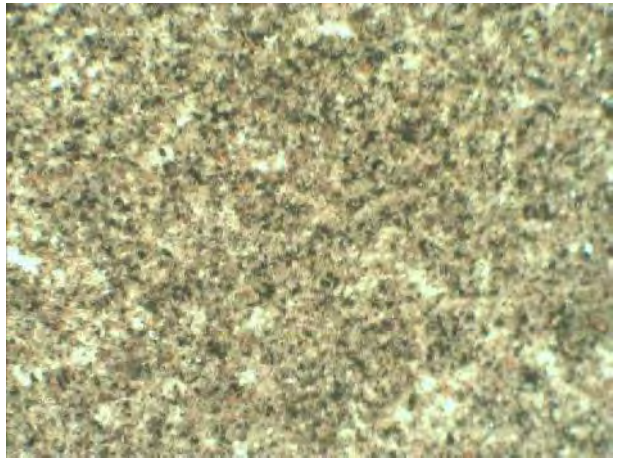


StMPM11. Elcho St Hamilton Brush (Collected 08/09/15), UQMP # 13756.

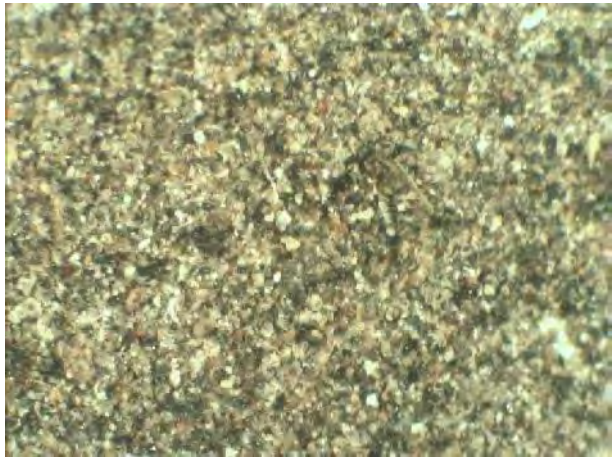


StMPM12. Kings Rd Tighes Hill Brush (Collected: 08/09/15), UQMP #13757.

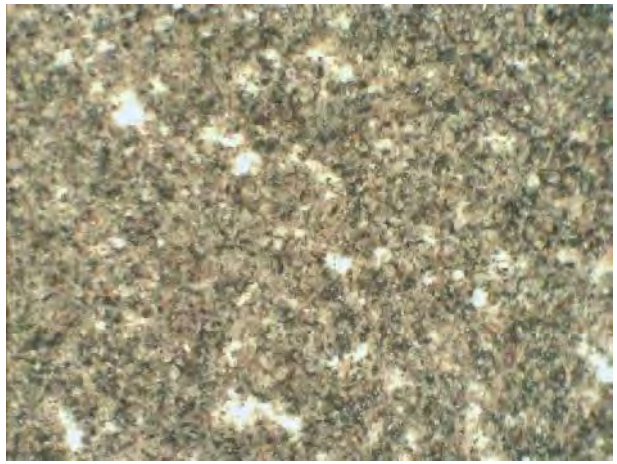
4.4 STEREOMICROSCOPY PICTURE MICROGRAPHS



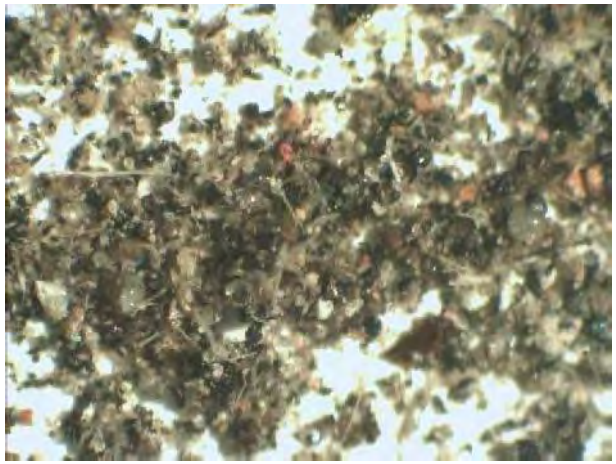
StMPM13. Neville St Mayfield Brush, UQMP #13758



StMPM14. Hargrave St Carrington Brush (Collected: 08/09/15), UQMP # 13759

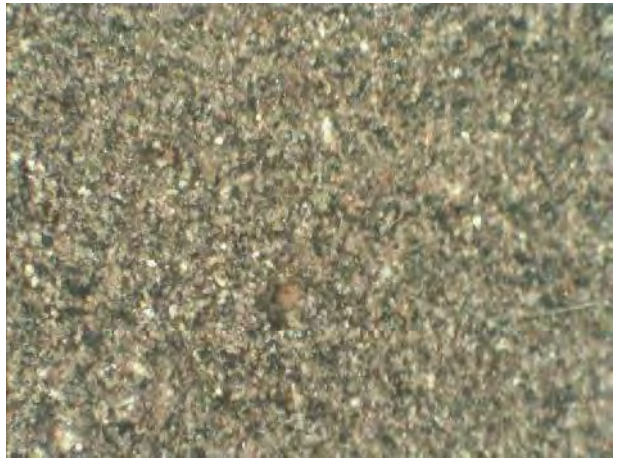


StMPM15. Bourke St Mayfield Brush, UQMP # 13760.



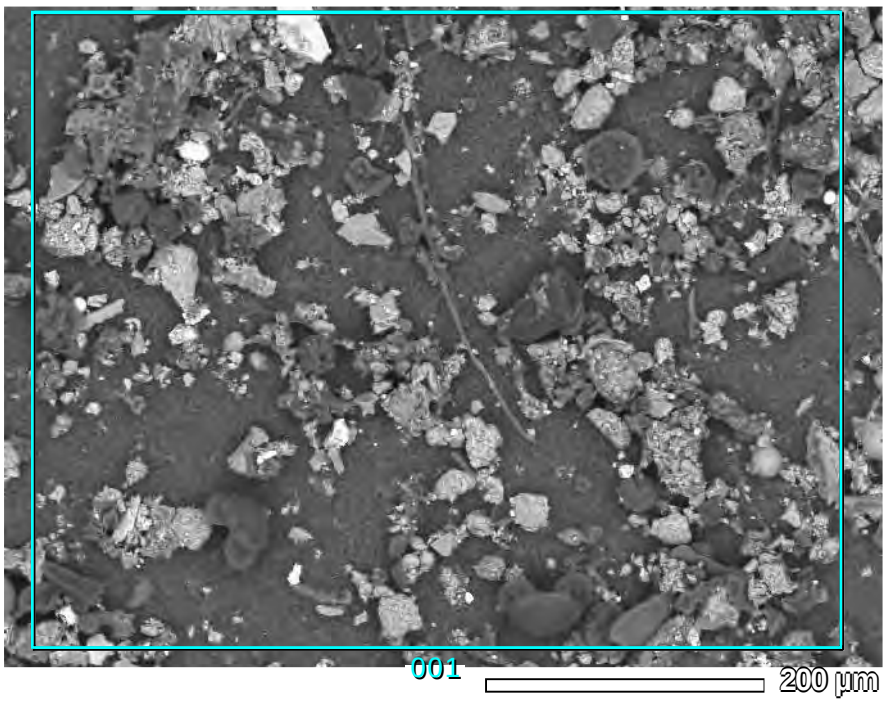
StMPM16. Stevenson Pl Newcastle East Brush (Collected: 09/09/15), UQMP # 13761.

4.5 STEREOMICROSCOPY PICTURE MICROGRAPHS

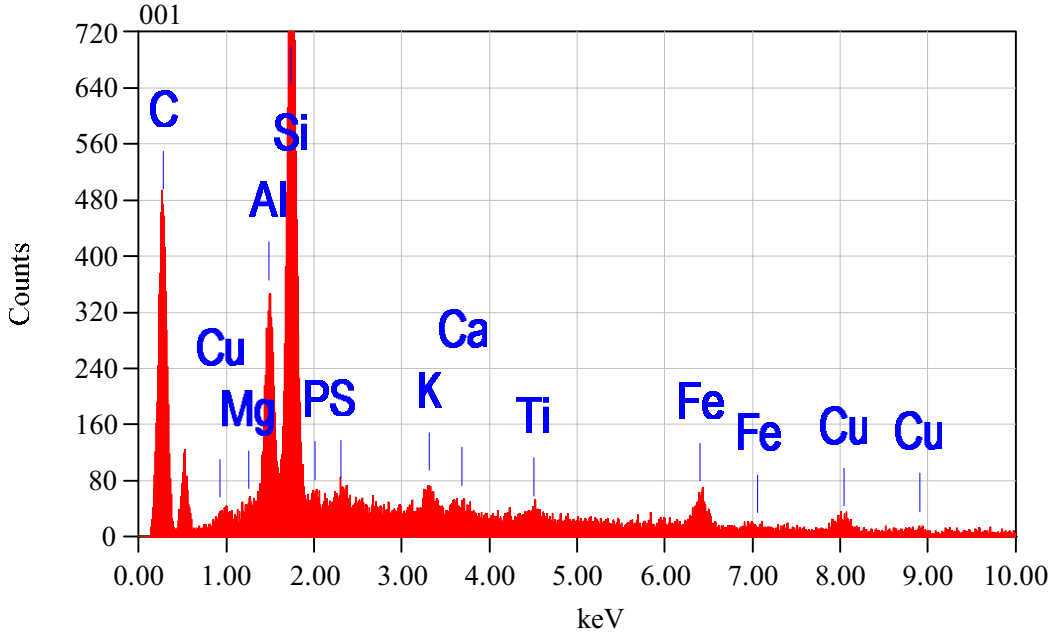


StMPM17. Gregson St Mayfield West Brush (Collected: 09/09/15), UQMP # 13762.

5. APPENDIX C
5.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

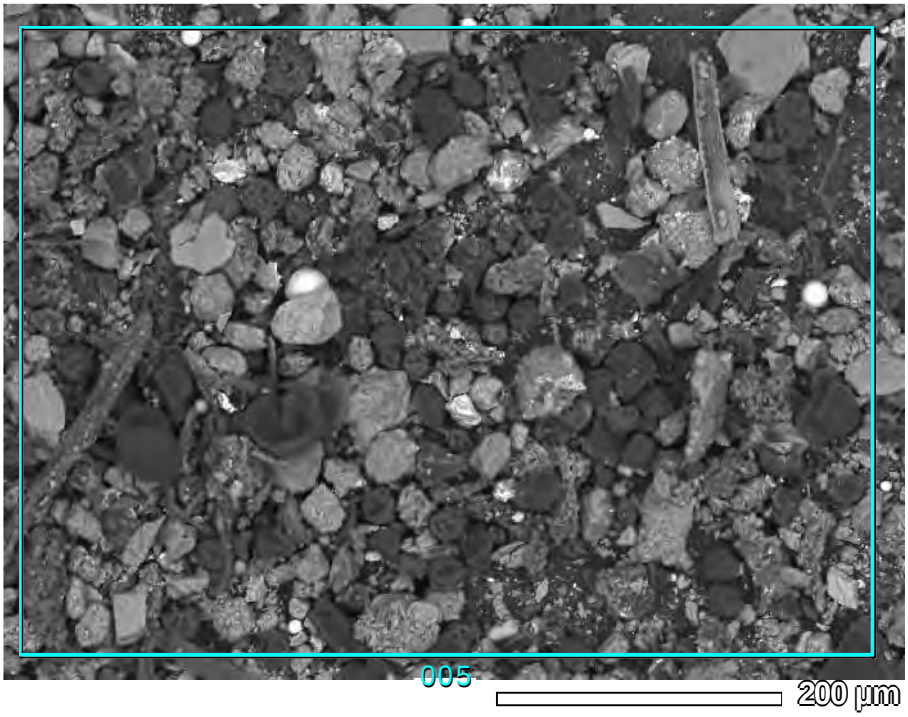


PM1. Wickham Dust Gauge (Exposed: 03/08/15, Collected 03/09/15), UQMP # 13746. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

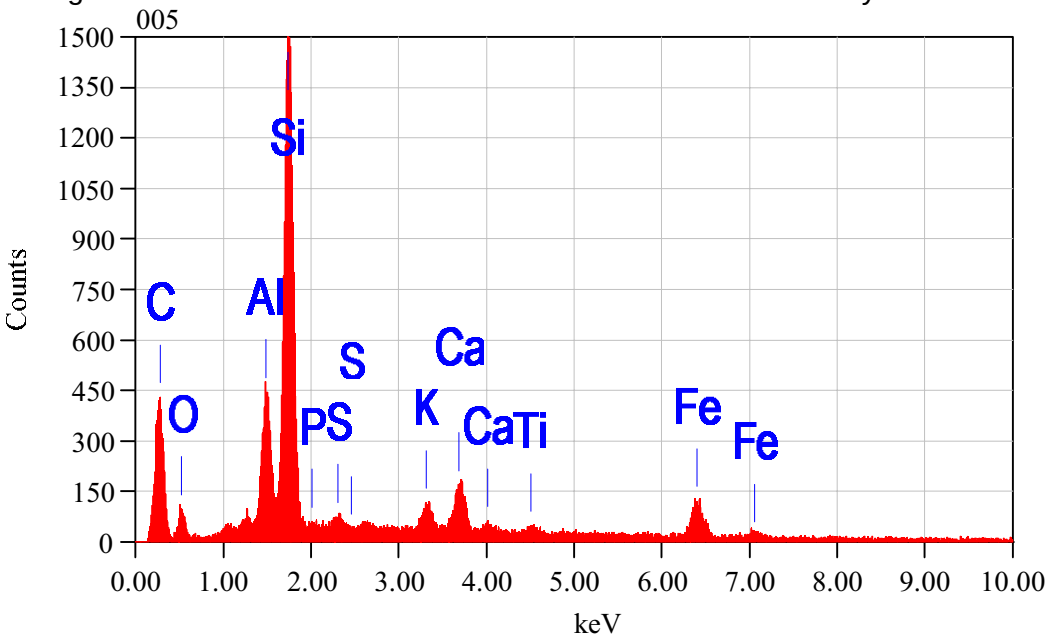


EDS1. Wickham Dust Gauge (Exposed: 03/08/15, Collected 03/09/15), UQMP # 13746. The SEM/EDS spectrum of the overall area is rich in carbon, aluminium and silicon with trace amounts of the balance of the elements. A trace amount of copper sludge is present note the phosphorous, sulfur and copper peaks. The elevated carbon is partly from the degree of exposed filter paper. The observed organic component was major and included plant and insect debris, coal, rubber dust and traces of soot and fibres, the balance of the deposits was aluminosilicate based mineral dust.

5.2 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

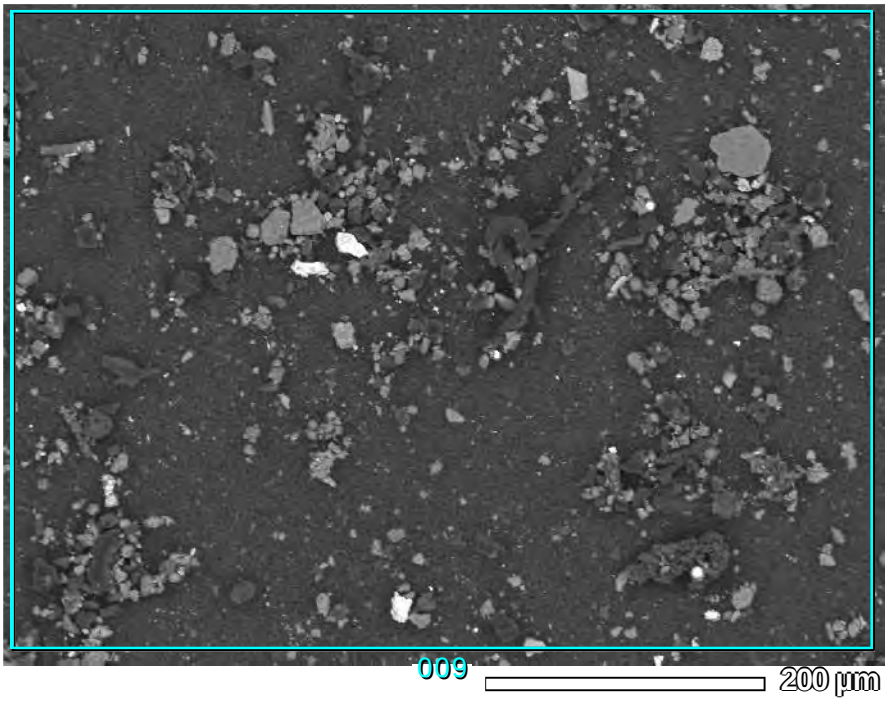


PM2. Stockton South Petri (Exposed: 17/08/15, Collected: 03/09/15), UQMP # 13747. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

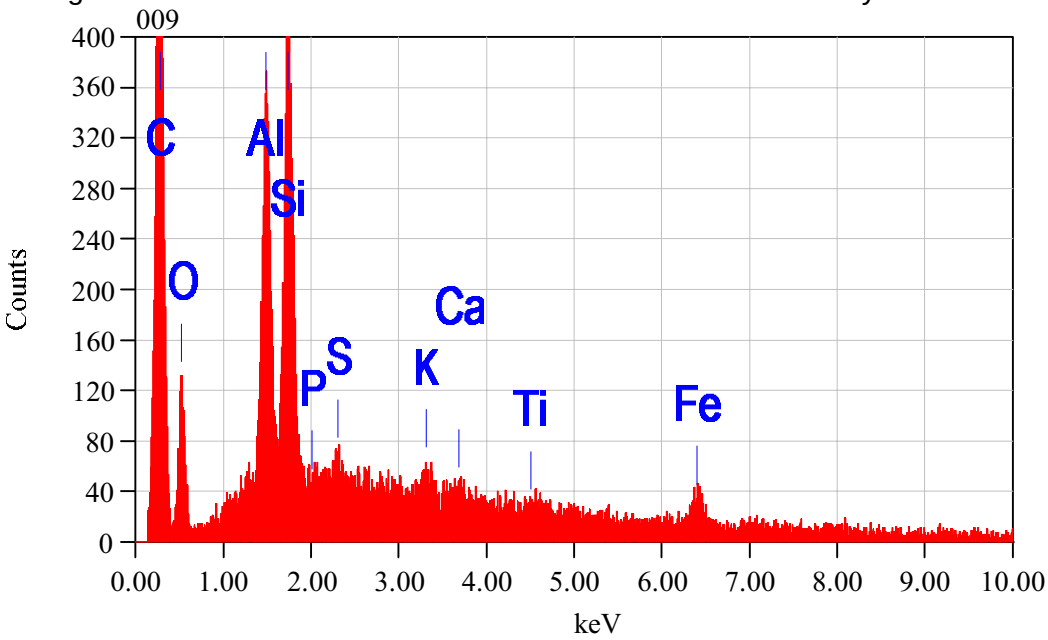


EDS2. Stockton South Petri (Exposed: 17/08/15, Collected: 03/09/15), UQMP # 13747. The SEM/EDS spectrum of the overall area is rich in silicon with minor amounts of aluminium and carbon with traces of the remaining elements. Aluminosilicate based mineral dust was the major particle type present with a minor organic of plant debris mostly pollen, coal, rubber dust, insect debris and traces of fibres and soot.

5.3 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

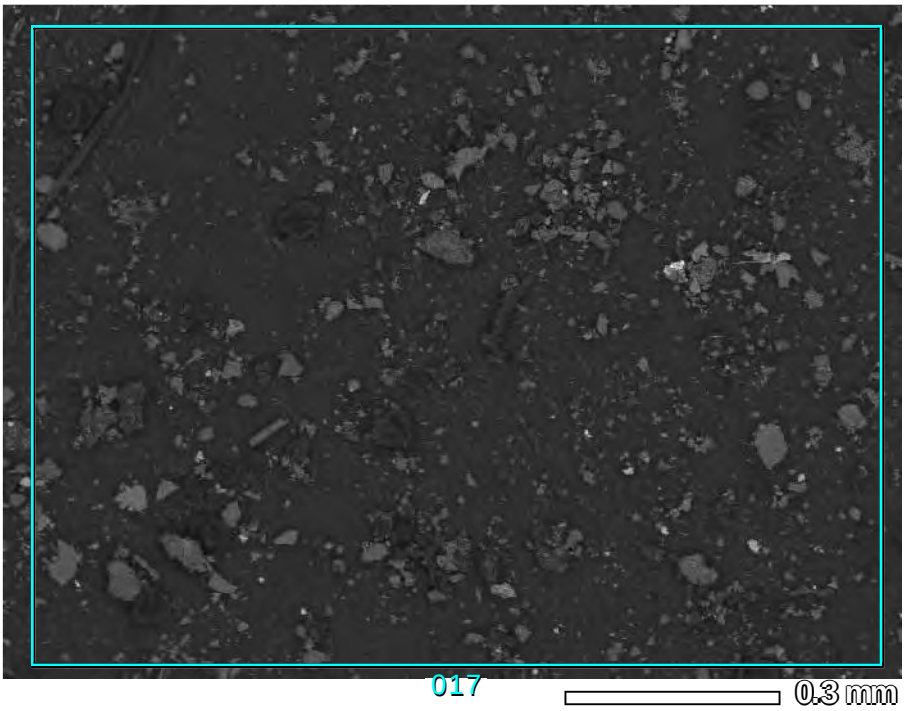


PM3. Stockton North Petri (Exposed: 17/08/15, Collected: 20/08/15), UQMP # 13748. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

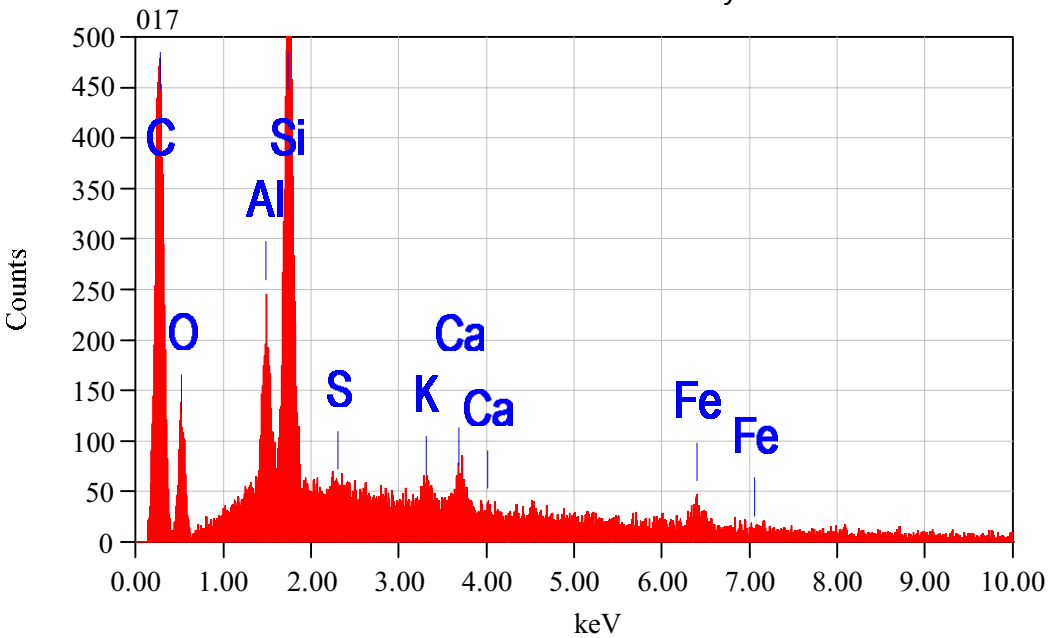


EDS3. Stockton North Petri (Exposed: 17/08/15, Collected: 20/08/15), UQMP # 13748. The deposit was partialy populated with particulates and as a result the elevated carbon includes counts from the exposed filter. Mineral dust was the predominant particle type present with a minor organic component of coal, rubber dust and traces of fibres, soot and insect and plant debris.

5.4 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

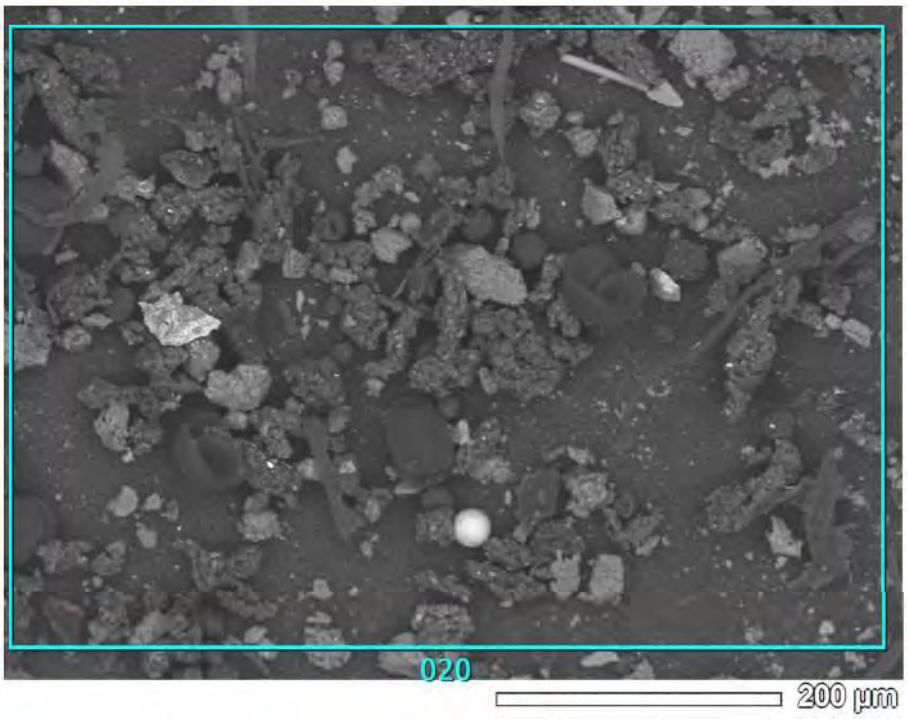


PM4. Carrington Petri (Exposed: 28/08/15, Collected: 31/08/15), UQMP # 13749. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

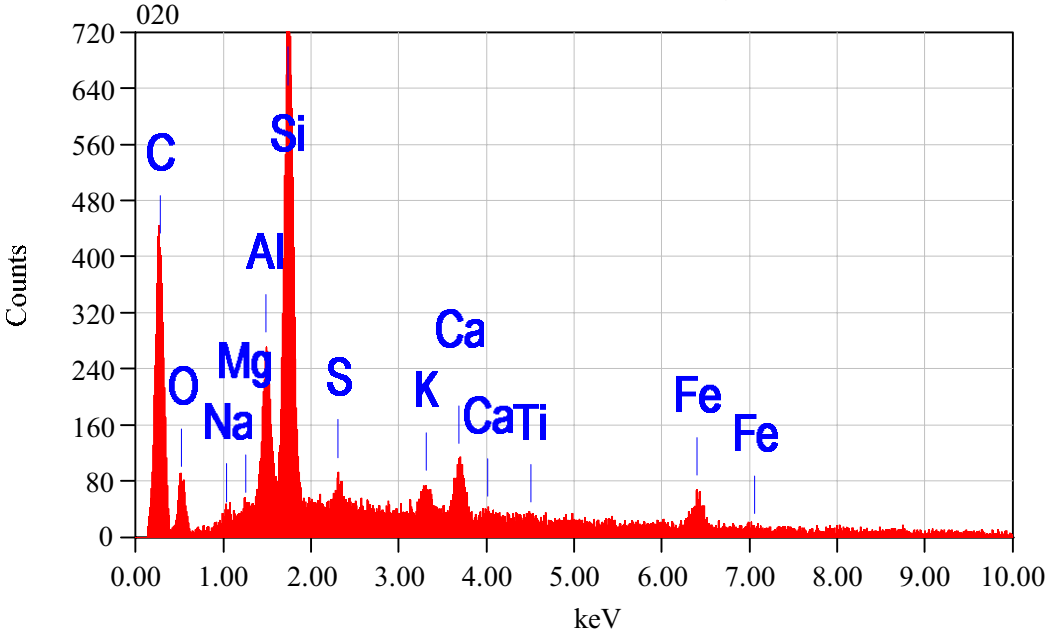


EDS4. Carrington Petri (Exposed: 28/08/15, Collected: 31/08/15), UQMP # 13749. The deposit was partialy populated with particulates and as a result the elevated carbon includes counts from the exposed filter. Mineral dust was the predominant particle type present with a minor organic component of coal, rubber dust and traces of soot, insect and plant debris.

5.5 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

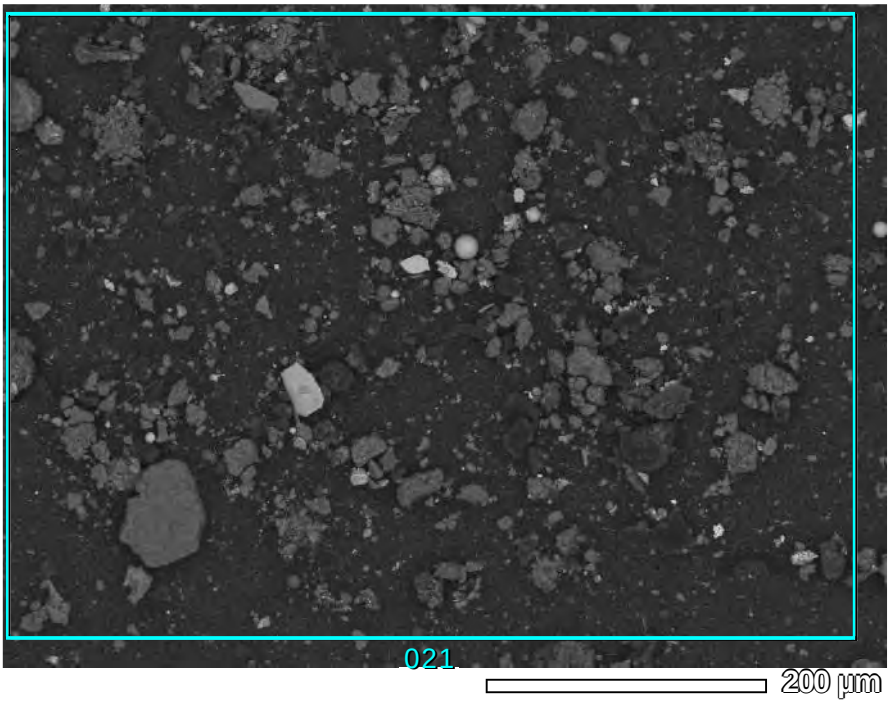


PM5. Honeysuckle Petri (Exposed: 28/08/15, Collected: 31/08/15), UQMP # 13750. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

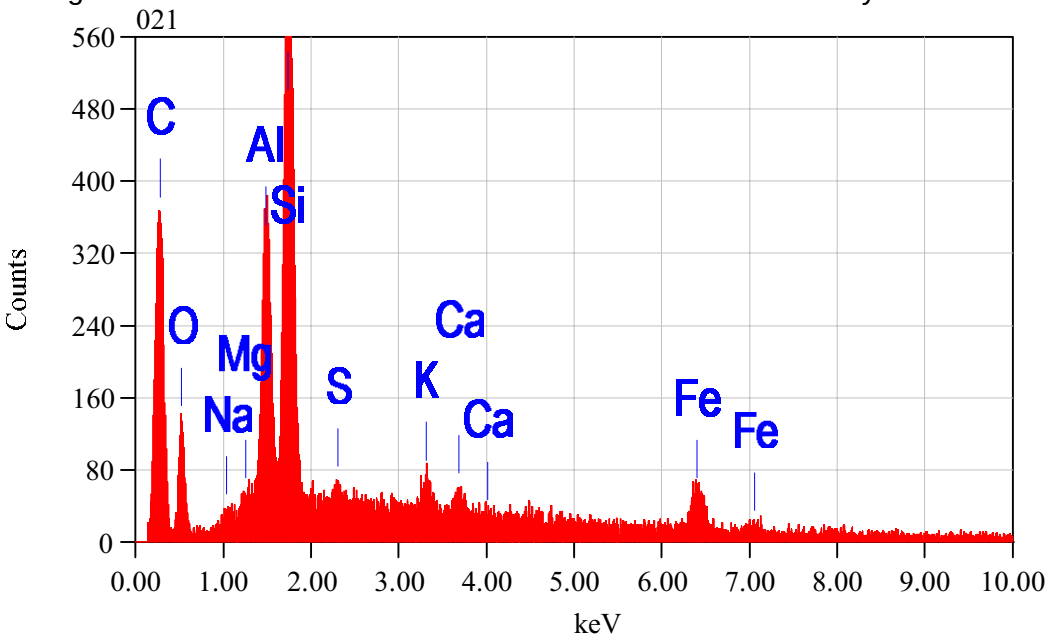


EDS5. Honeysuckle Petri (Exposed: 28/08/15, Collected: 31/08/15), UQMP # 13750. The deposit was partialy populated with particulates and as a result the elevated carbon includes counts from the exposed filter. Organic particle types were the predominant particle types with a minor contribution from mineral dust Coal, rubber dust and plant debris (mostly pollen) and traces of soot and insect debris. Less than half of the sample consisted of mineral dust - mostly aluminosilicate based.

5.6 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

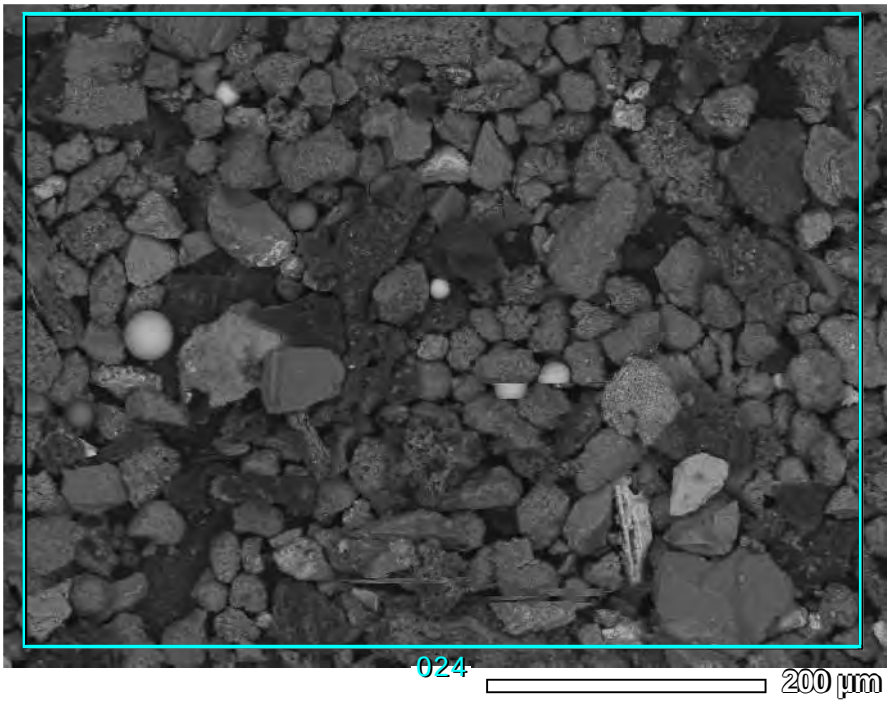


PM6. Stockton South Petri (Exposed: 17/08/15, Collected 20/08/15), UQMP # 13751. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

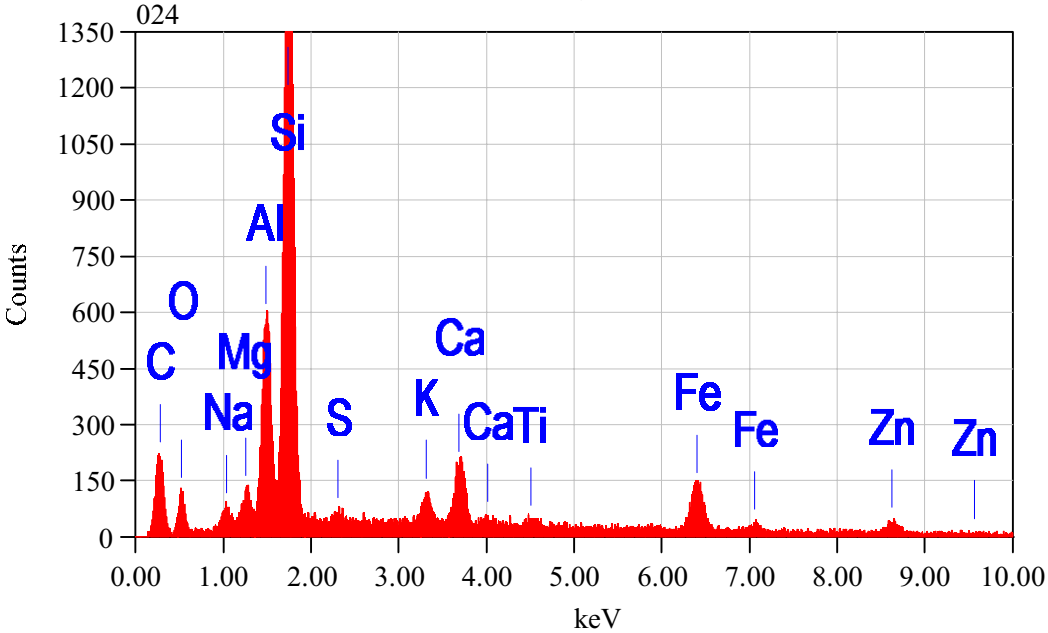


EDS6. Stockton South Petri (Exposed: 17/08/15, Collected 20/08/15), UQMP # 13751. The deposit was partialy populated with particulates and as a result the elevated carbon includes counts from the exposed filter. Mineral dust was the predominant particle type present with a minor organic component of coal, soot, rubber dust and traces of soot and insect and plant debris.

5.7 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

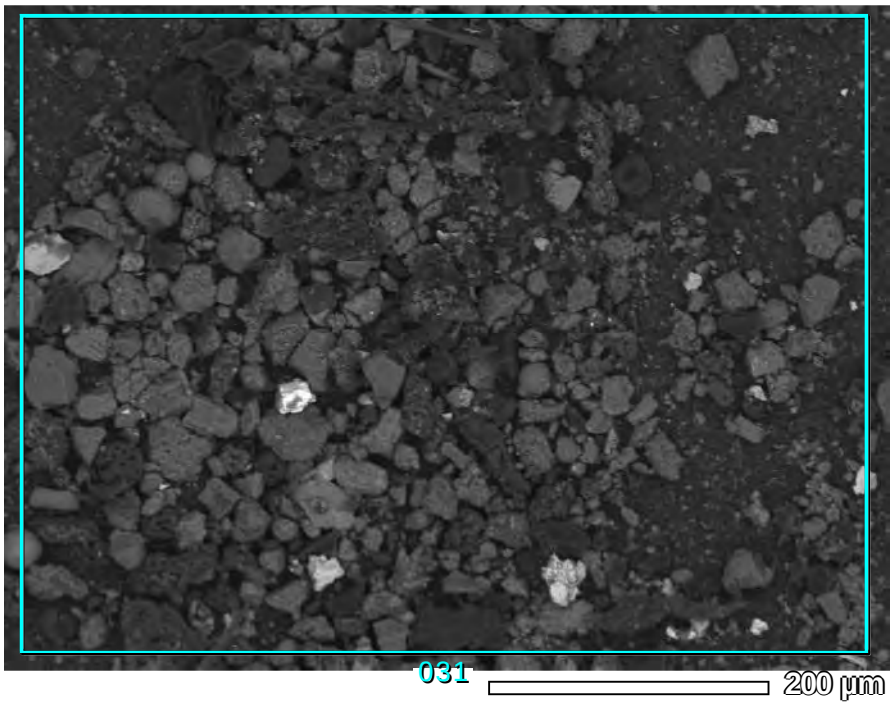


PM7. Wickahm Brush 1 (Collected: 03/09/15), UQMP # 13752**.** An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

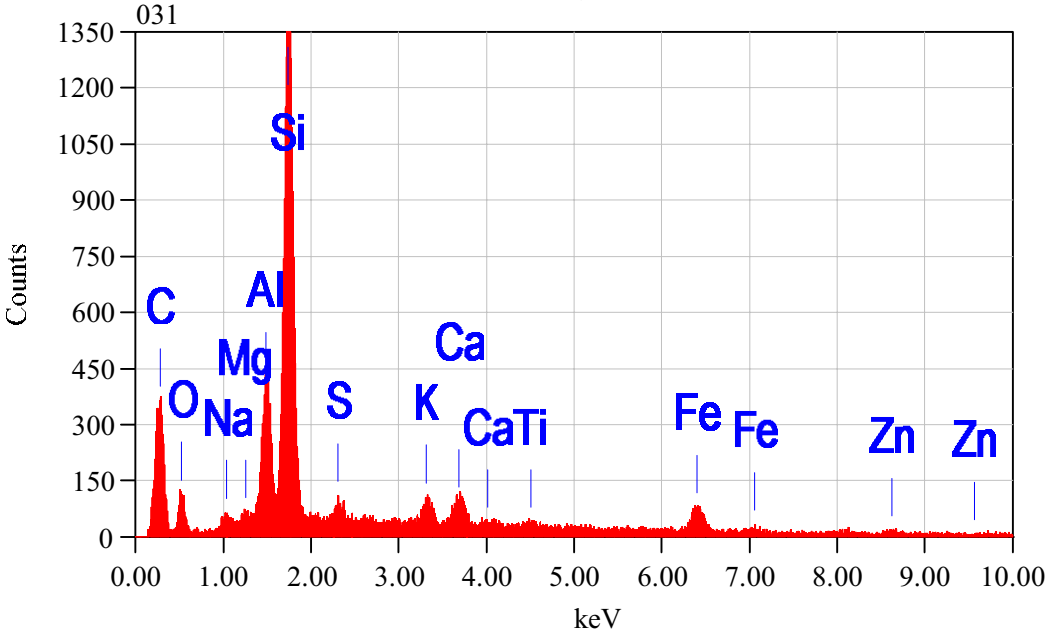


EDS7. Wickahm Brush 1 (Collected: 03/09/15), UQMP # 13752**.** The SEM/EDS spectrum is rich in silicon with minor amounts of aluminium, calcium and iron and traces of the balance of the elements. Aluminosilicate rich mineral dust was the most predominant particle type with an organic component consisting of coal, soot, rubber dust and traces of plant and insect debris.

5.8 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

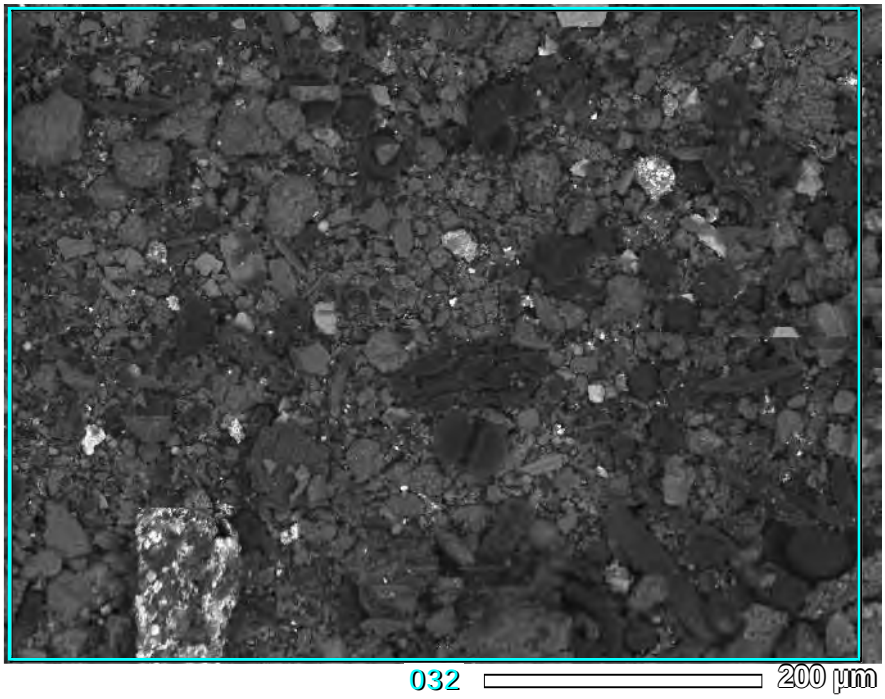


PM8. Wickahm Brush 2 (Collected: 03/09/15), UQMP # 13753. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

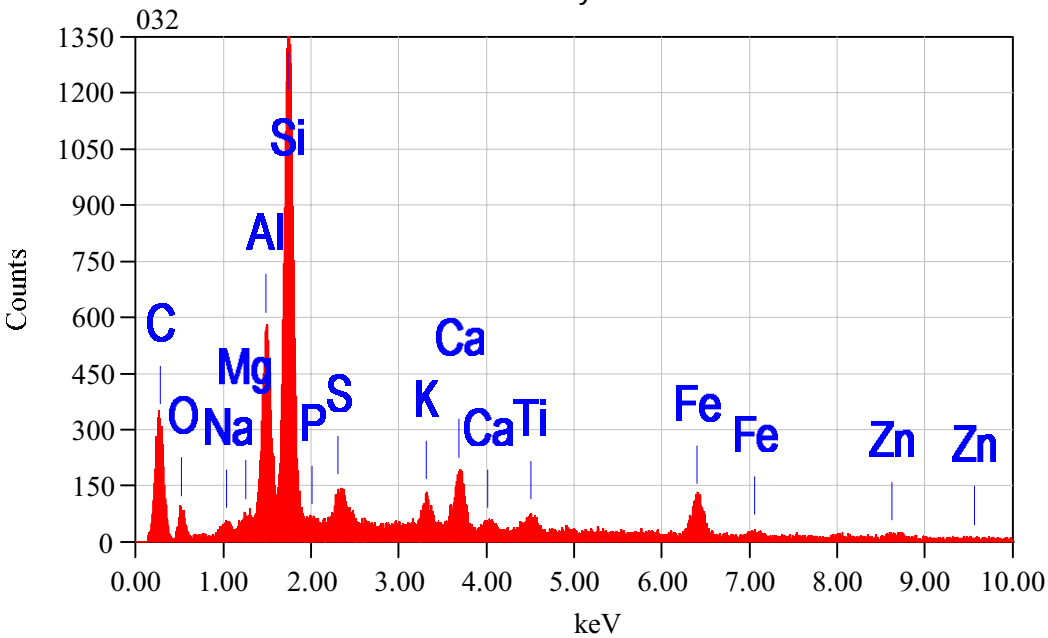


EDS8. Wickahm Brush 2 (Collected: 03/09/15), UQMP # 13753. The SEM/EDS spectrum of the overall area is rich in silcon with minor amounts of aluminium and carbon and traces of the balance of the elements. Mineral dust is the major particle type mostly aluminosilicate rich. Organic material is present in minor amounts and includes coal, soot, rubber dust and insect and plant debris.

5.9 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

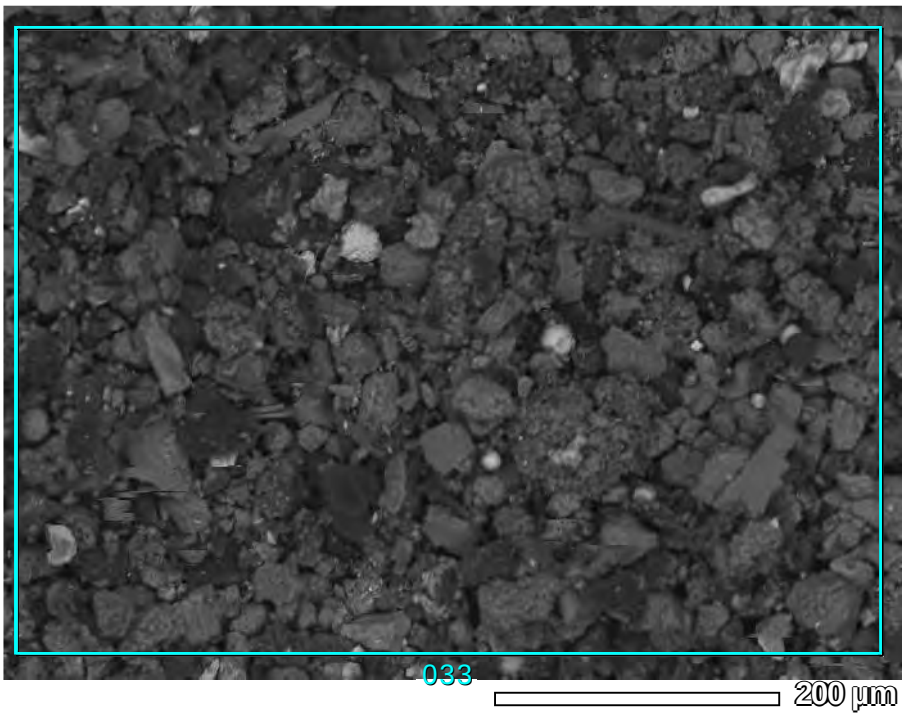


PM9. Lott St Carrington Brush (Collected 08/09/15), UQMP # 13754. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

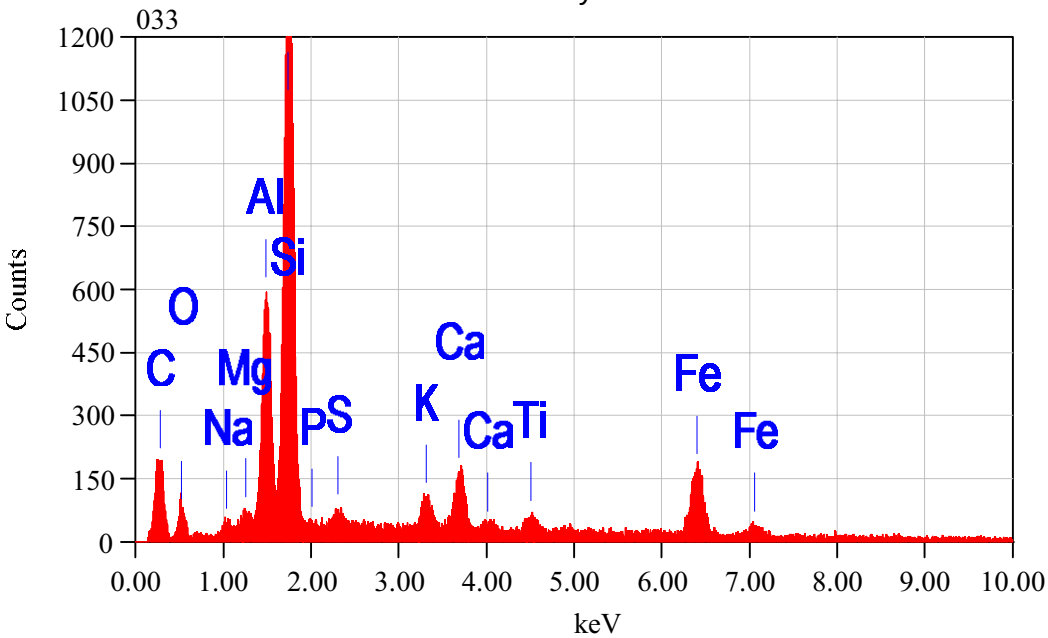


EDS9. Lott St Carrington Brush (Collected 08/09/15), UQMP # 13754. The SEM/EDS spectrum of the overall area is rich in silcon with minor amounts of aluminium and carbon and traces of the balance of the elements. Mineral dust is the major particle type mostly aluminosilicate rich and alumina. Organic material is present in minor amounts and includes coal, soot, rubber dust and traces of fibres and insect and plant debris.

5.10 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

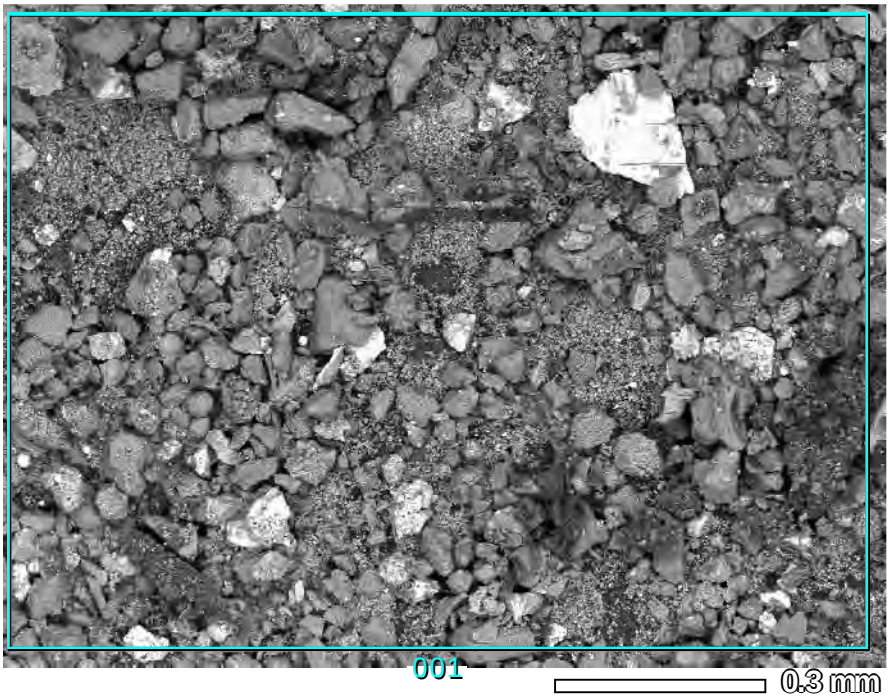


PM10. Bull St Mayfield Brush (Collected: 08/09/15), UQMP # 13755. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

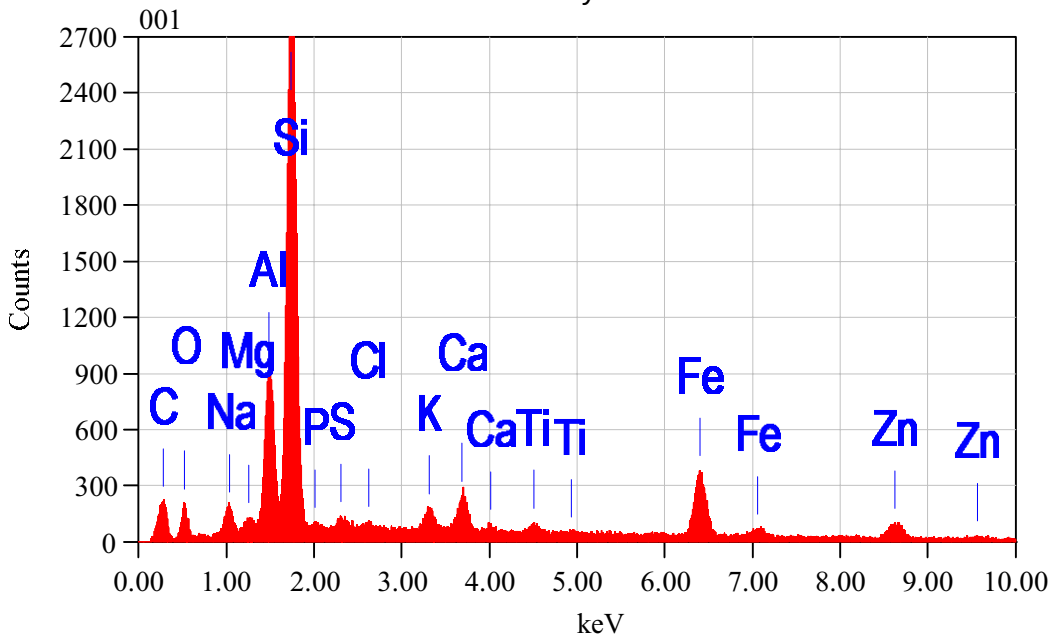


EDS10. Bull St Mayfield Brush (Collected: 08/09/15), UQMP # 13755. The SEM/EDS spectrum of the overall area is rich in silcon with minor amounts of aluminium and carbon, iron, calcium and traces of the balance of the elements. Mineral dust is the major particle type mostly aluminosilicate rich and alumina. Organic material is present in minor amounts and includes coal, soot, rubber dust and traces of insect and plant debris.

5.11 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

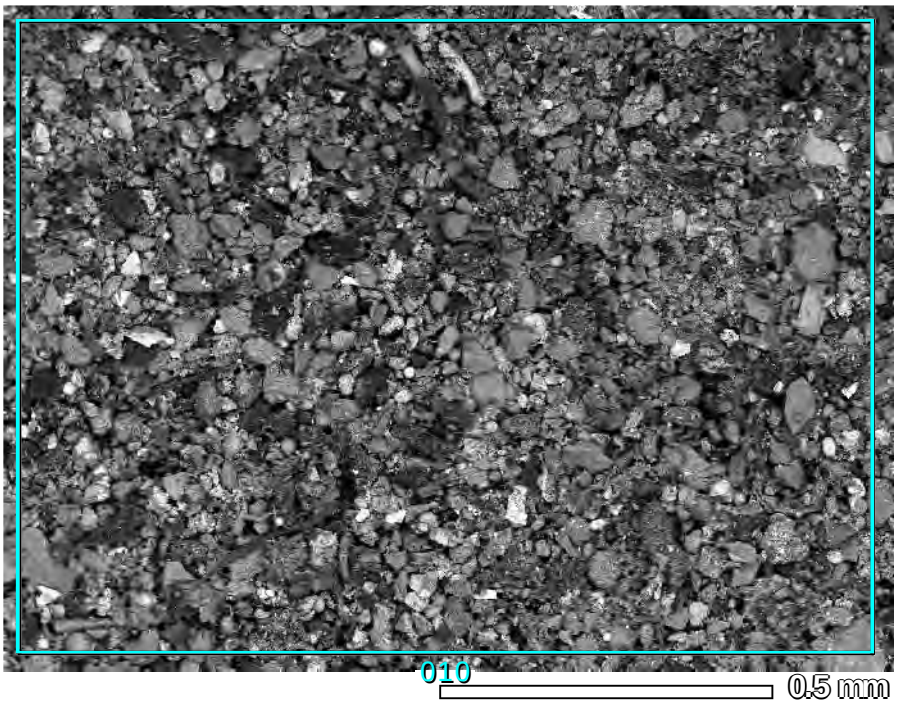


PM11. Elcho St Hamilton Brush (Collected 08/09/15), UQMP # 13756. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

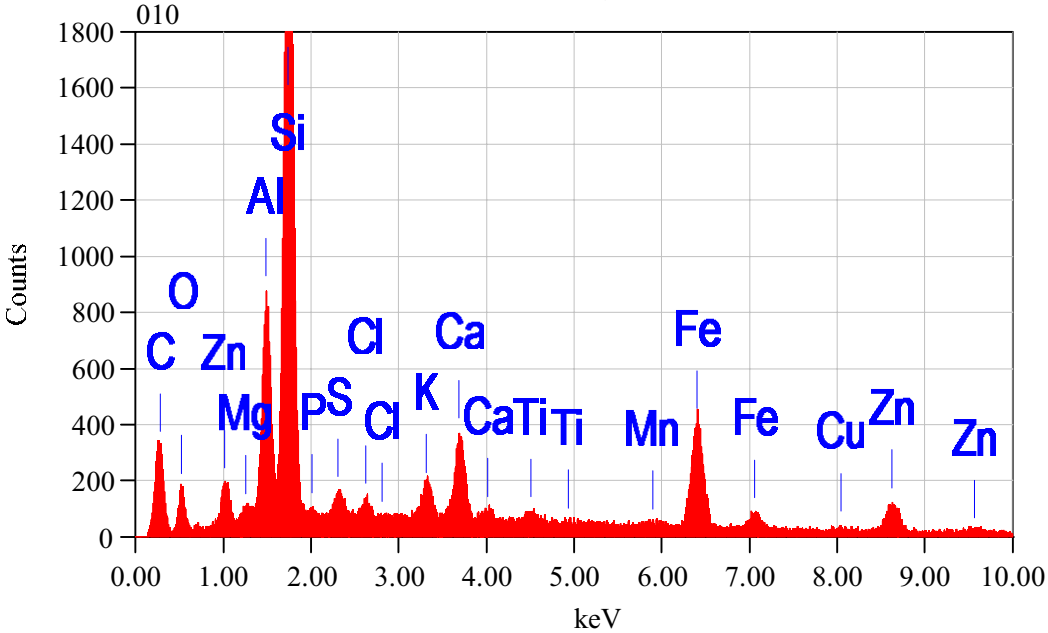


EDS11. Elcho St Hamilton Brush (Collected 08/09/15), UQMP # 13756. The SEM/EDS spectrum of the overall area is rich in silcon with minor amounts of aluminium and carbon and traces of the balance of the elements. Mineral dust is the predominant particle type mostly aluminosilicate rich. Organic material is present in minor amounts and includes coal and traces of soot, rubber dust and insect and plant debris.

5.12 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

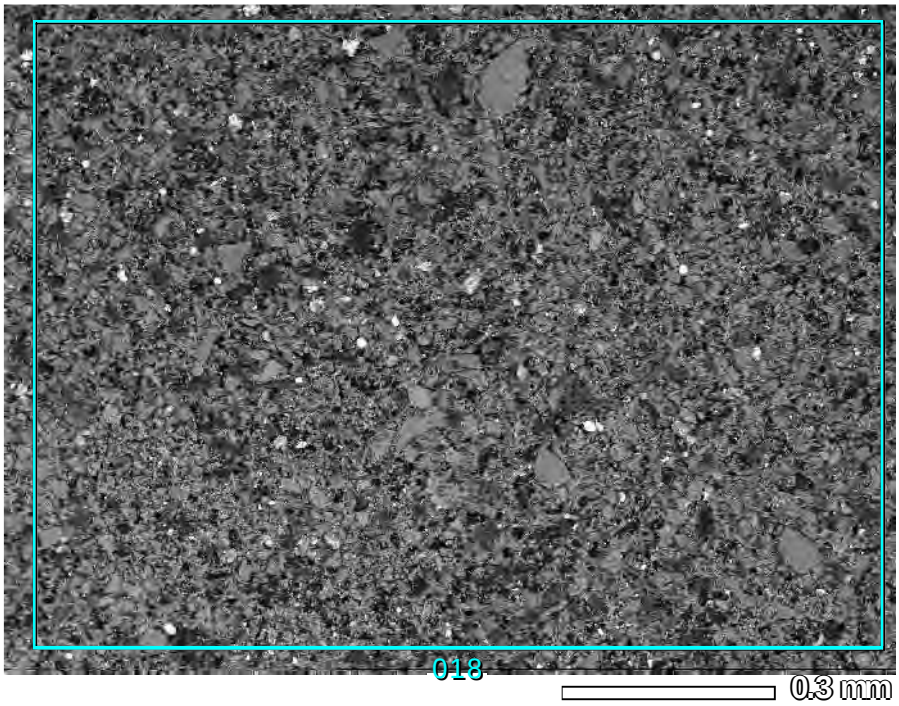


PM12. Kings Rd Tighes Hill Brush (Collected: 08/09/15), UQMP #13757. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

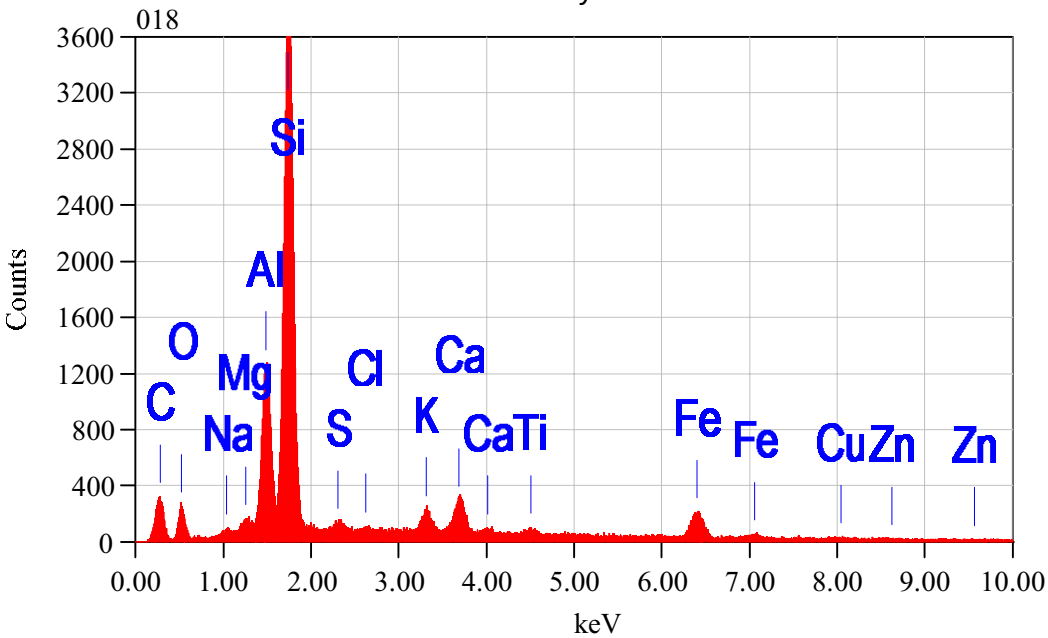


EDS12. Kings Rd Tighes Hill Brush (Collected: 08/09/15), UQMP #13757. The SEM/EDS spectrum of the overall area is rich in silcon with minor amounts of aluminium, calcium, iron and carbon and traces of the balance of the elements. Mineral dust is the major particle type mostly aluminosilicate rich. Organic material is present in minor amounts and includes coal and traces of rubber dust, soot and traces of insect and plant debris.

5.13 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

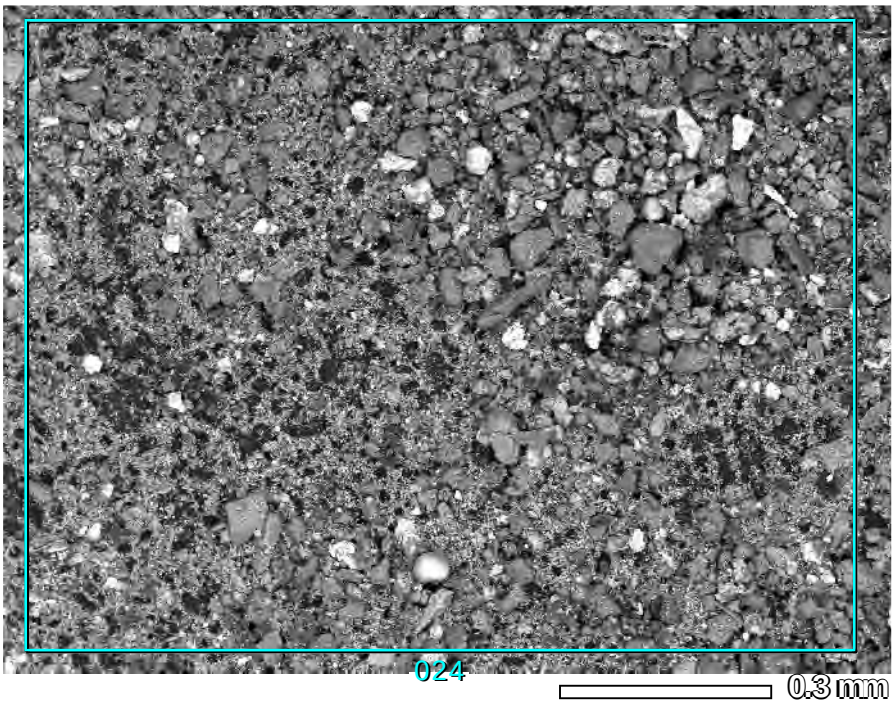


PM13. Neville St Mayfield Brush (Collected 08/09/15), UQMP #13758. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

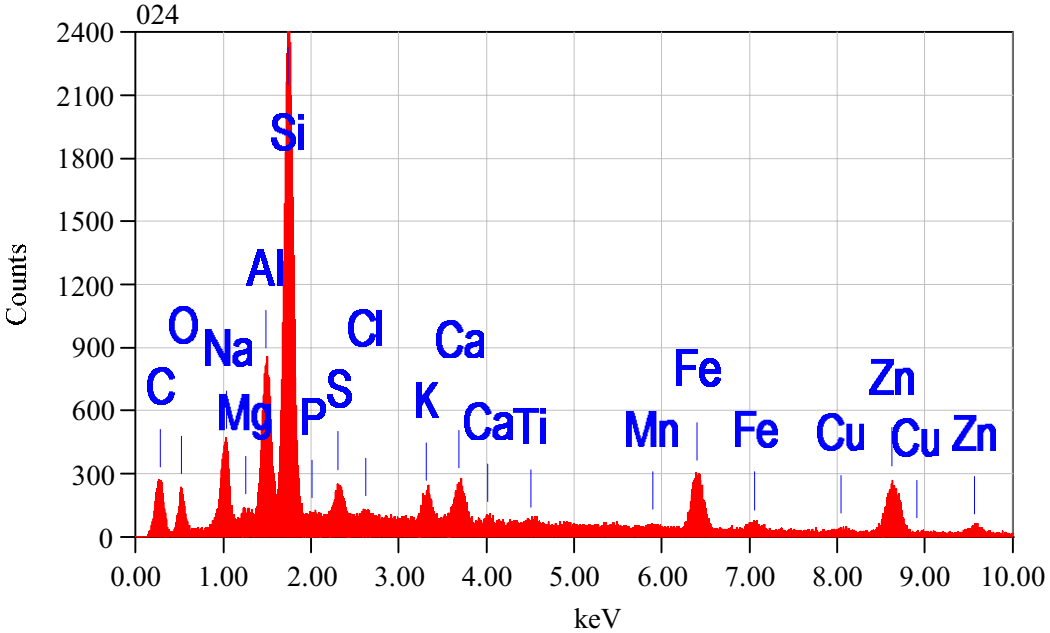


EDS13. Neville St Mayfield Brush (Collected 08/09/15), UQMP #13758. The SEM/EDS spectrum of the overall area is rich in silcon with minor amounts of aluminium and traces of the balance of the elements. Mineral dust is the predominant particle type mostly aluminosilicate rich and alumina. Organic material is present in minor amounts and includes coal and soot.

5.14 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

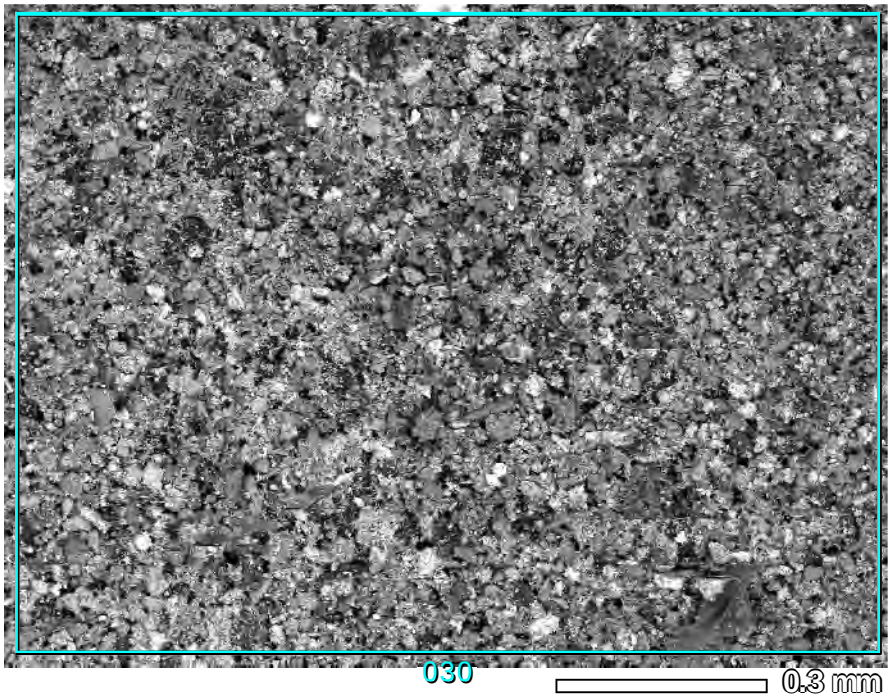


PM14. Hargrave St Carrington Brush (Collected: 08/09/15), UQMP # 13759. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

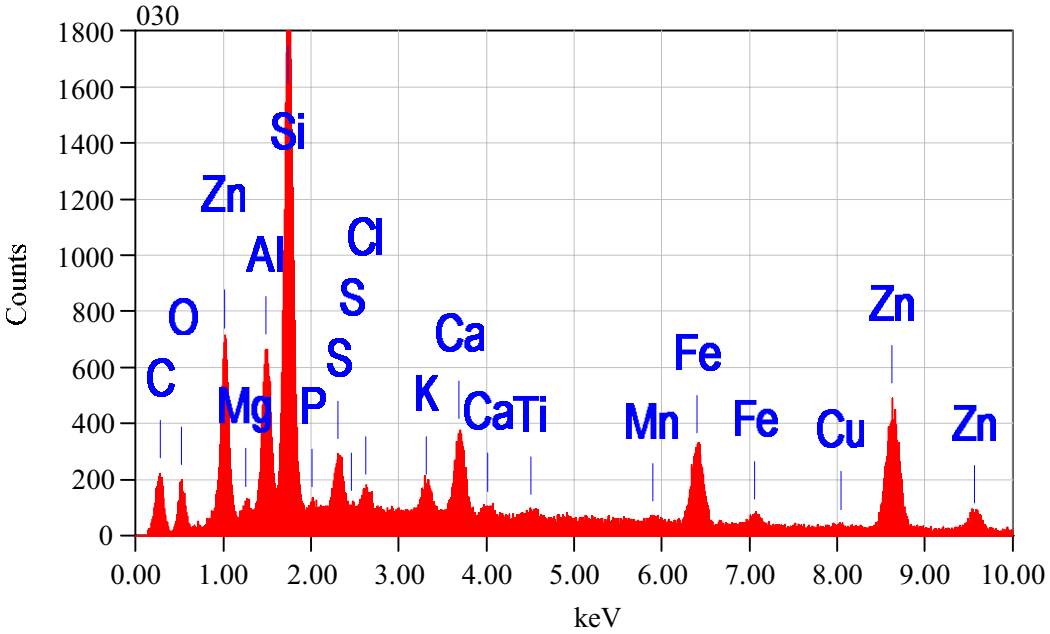


EDS14. Hargrave St Carrington Brush (Collected: 08/09/15), UQMP # 13759. The SEM/EDS spectrum of the overall area is rich in silcon with minor amounts of aluminium and traces of the balance of the elements. Mineral dust is the predominant particle type mostly aluminosilicate rich, zinc and alumina. Organic material is present in minor amounts and includes coal and soot.

5.15 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

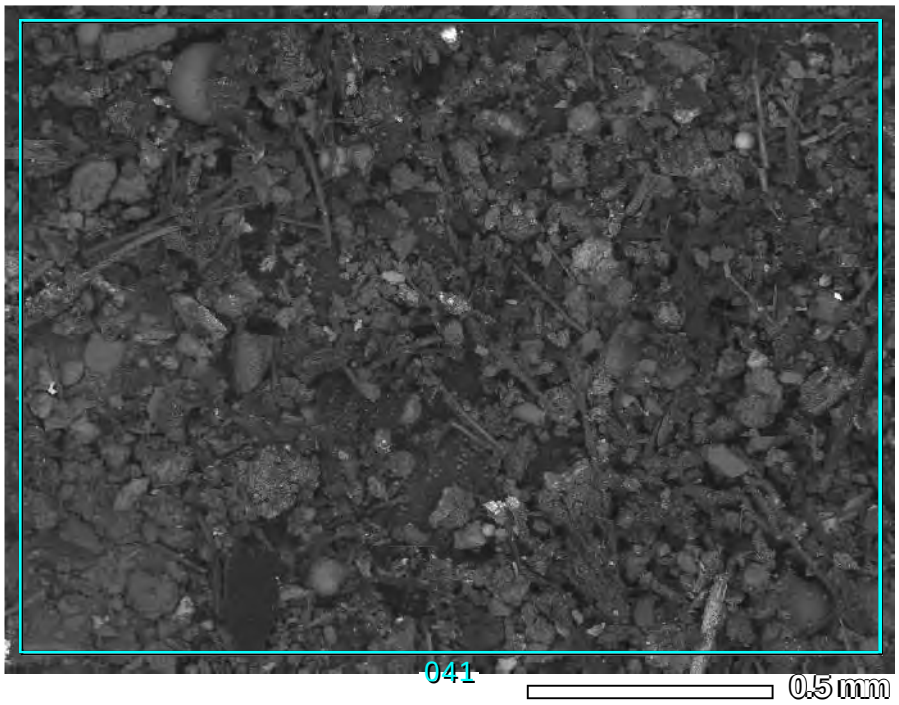


PM15. Bourke St Mayfield Brush (Collected: 08/09/15), UQMP # 13760. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

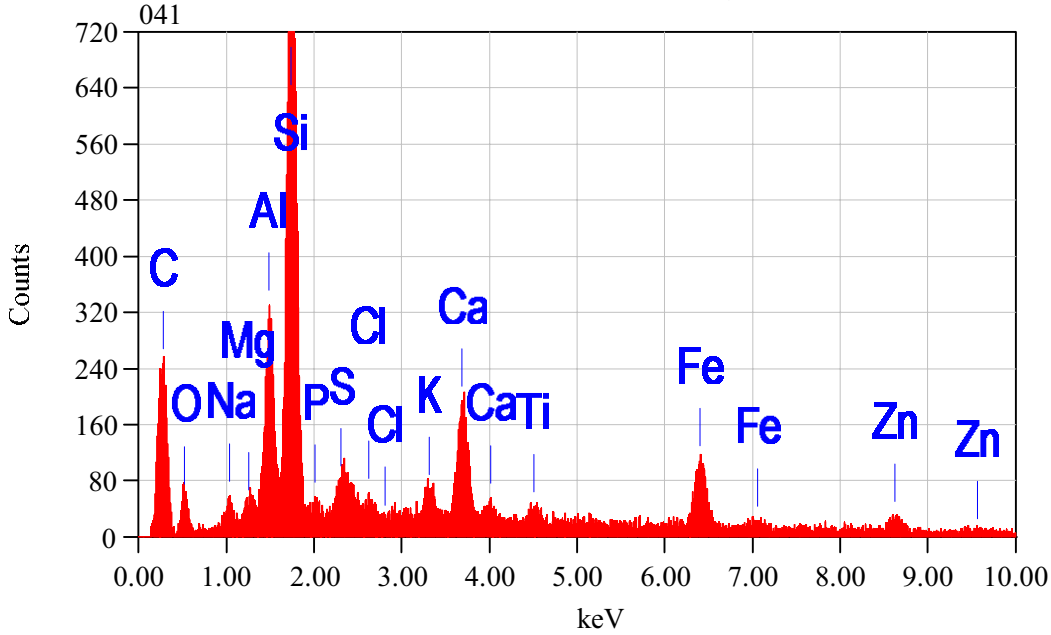


EDS15. Bourke St Mayfield Brush (Collected: 08/09/15), UQMP # 13760. The SEM/EDS spectrum of the overall area is rich in silcon and zinc with minor amounts of aluminium and traces of the balance of the elements. Mineral dust is the predominant particle type mostly aluminosilicate rich, zinc and alumina. Organic material is present in minor amounts and includes coal and soot.

5.16 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

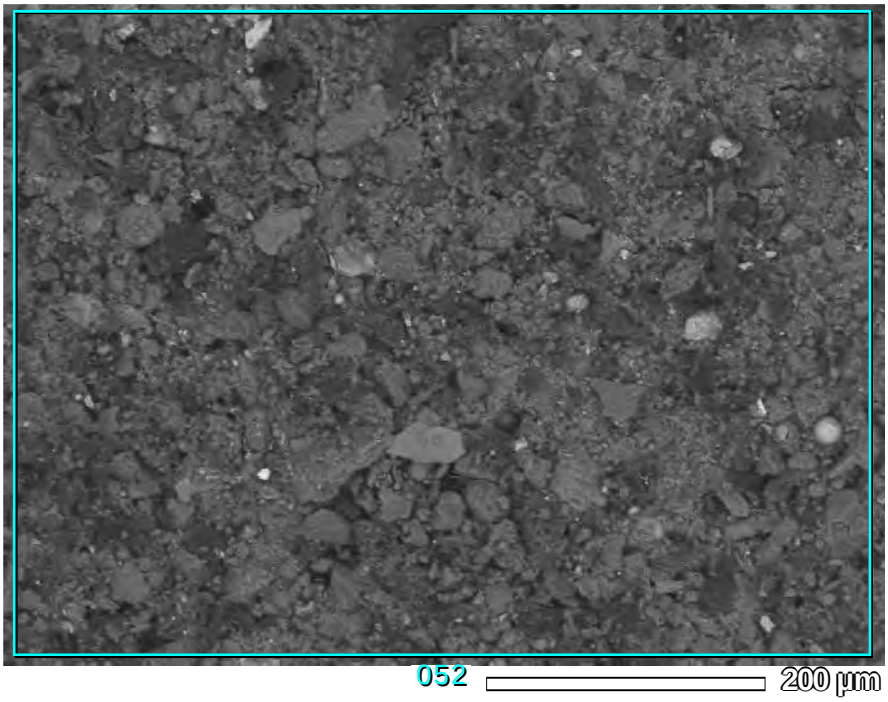


PM16. Stevenson Pl Newcastle East Brush (Collected: 09/09/15), UQMP # 13761. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

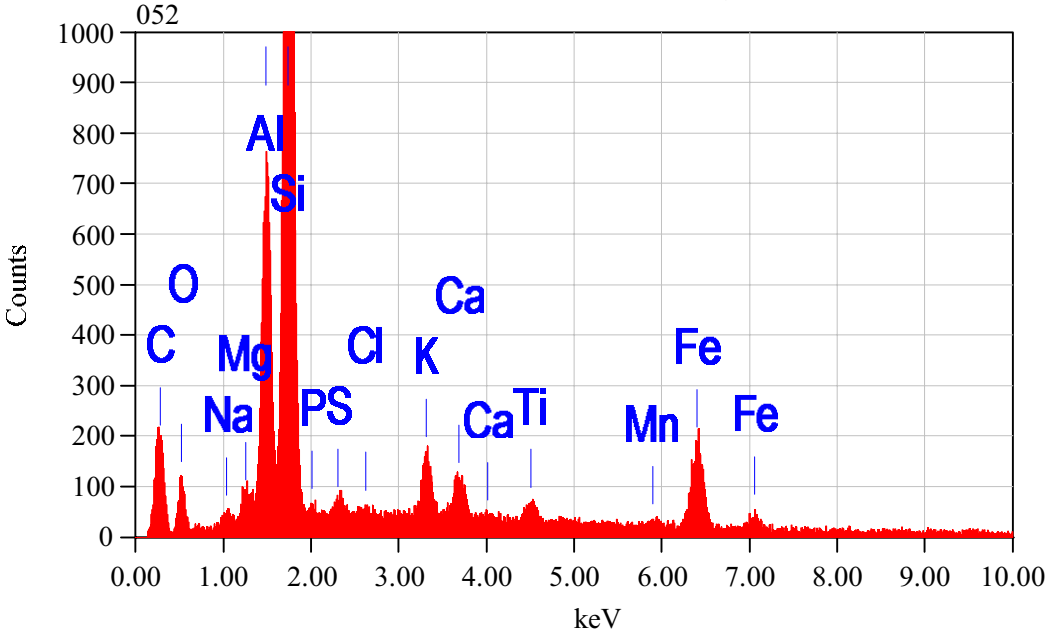


EDS16. Stevenson Pl Newcastle East Brush (Collected: 09/09/15), UQMP # 13761. The SEM/EDS spectrum of the overall area is rich in silcon with minor amounts of aluminium, calcium and iron and traces of the balance of the elements. Mineral dust is the predominant particle type mostly aluminosilicate rich. Organic material is present in minor amounts and includes coal, soot, rubber dust, insect and plant debris.

5.17 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



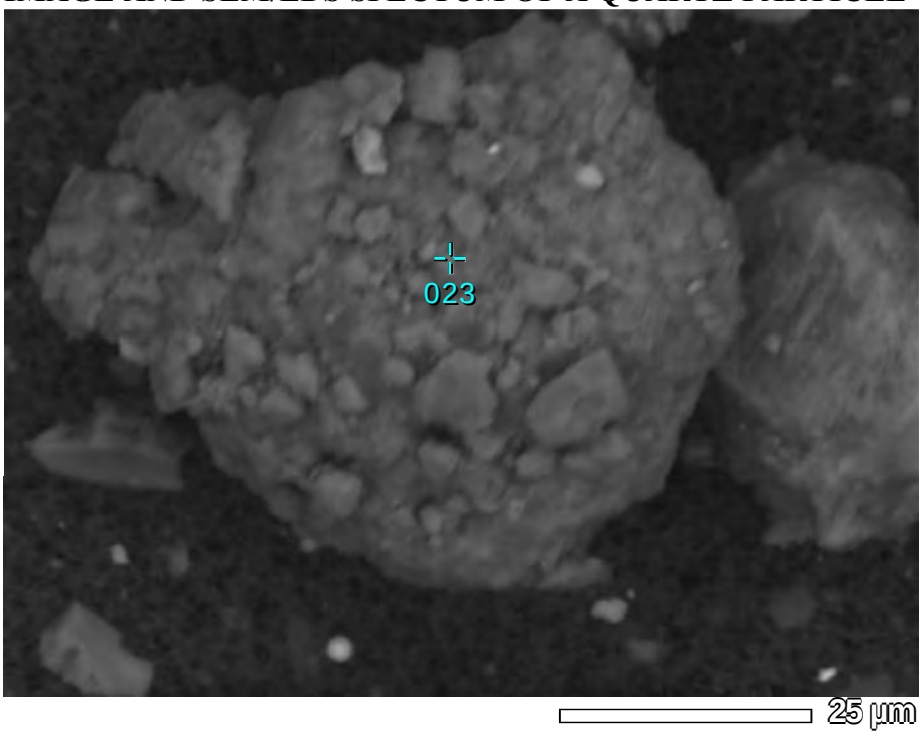
PM17. Gregson St Mayfield West Brush (Collected: 09/09/15), UQMP # 13762. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



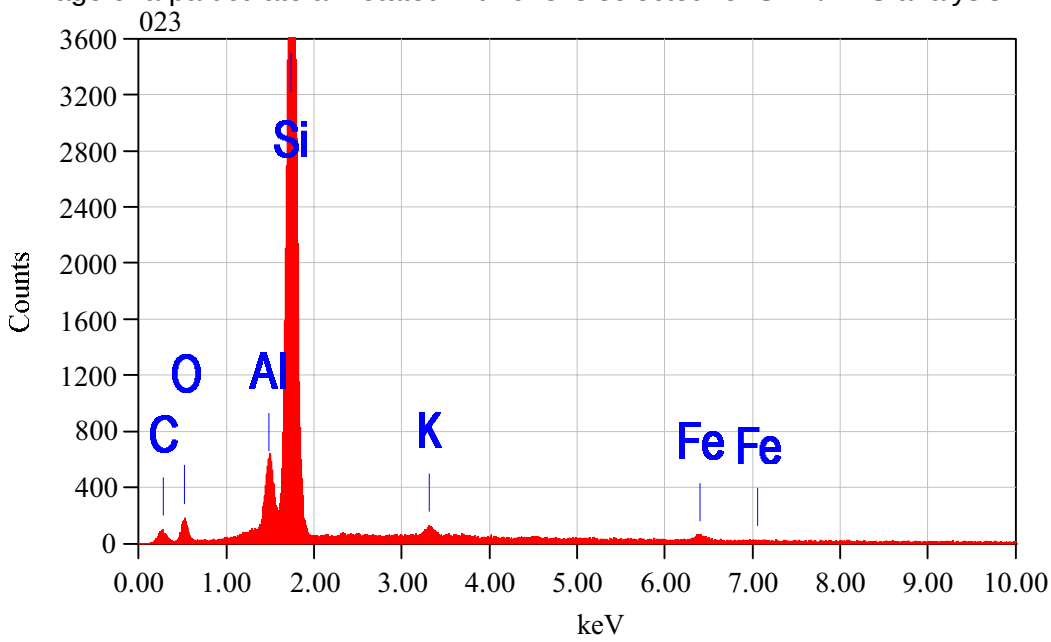
EDS17. Gregson St Mayfield West Brush (Collected: 09/09/15), UQMP # 13762. The SEM/EDS spectrum of the overall area is rich in aluminium and silicon with minor amounts of iron, carbon and potassium. Aluminosilicate rich mineral dust was the predominant particle type of the deposit with a minor organic component of coal, soot and traces of plant debris.

6. APPENDIX D SEM/BSE IMAGES AND SEM/EDS SPECTRA OF PARTICLE TYPES FOUND IN THE DEPOSITS.

6.1 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A QUARTZ PARTICLE

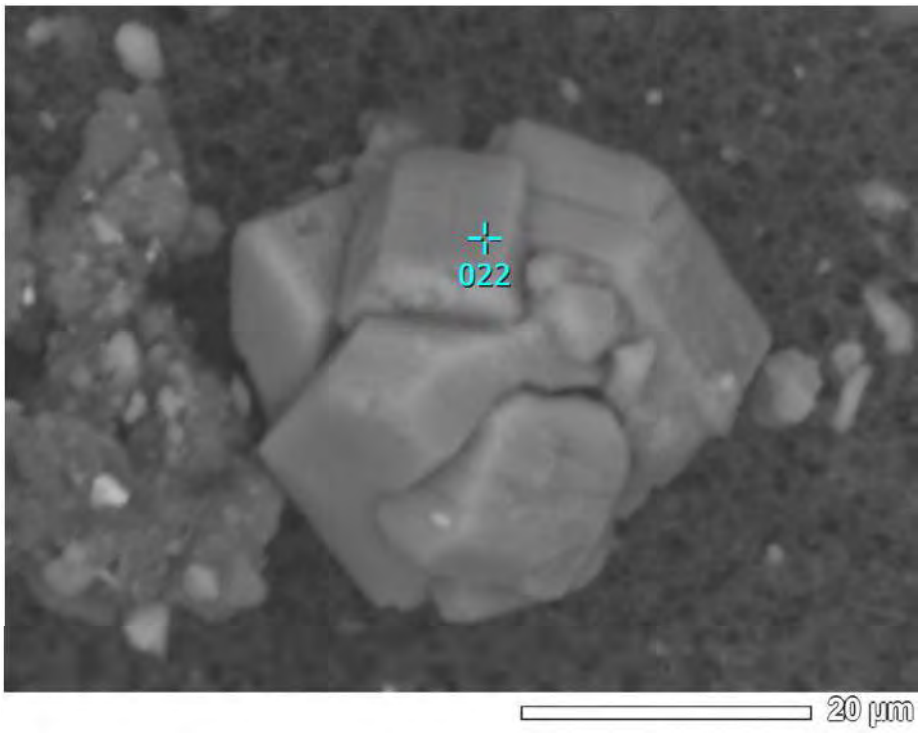


PM1. Stockton South Petri (Exposed: 17/08/15, Collected 20/08/15), UQMP # 13751. An SEM/BSE image of a particulate annotated with 023 is selected for SEM/EDS analysis.

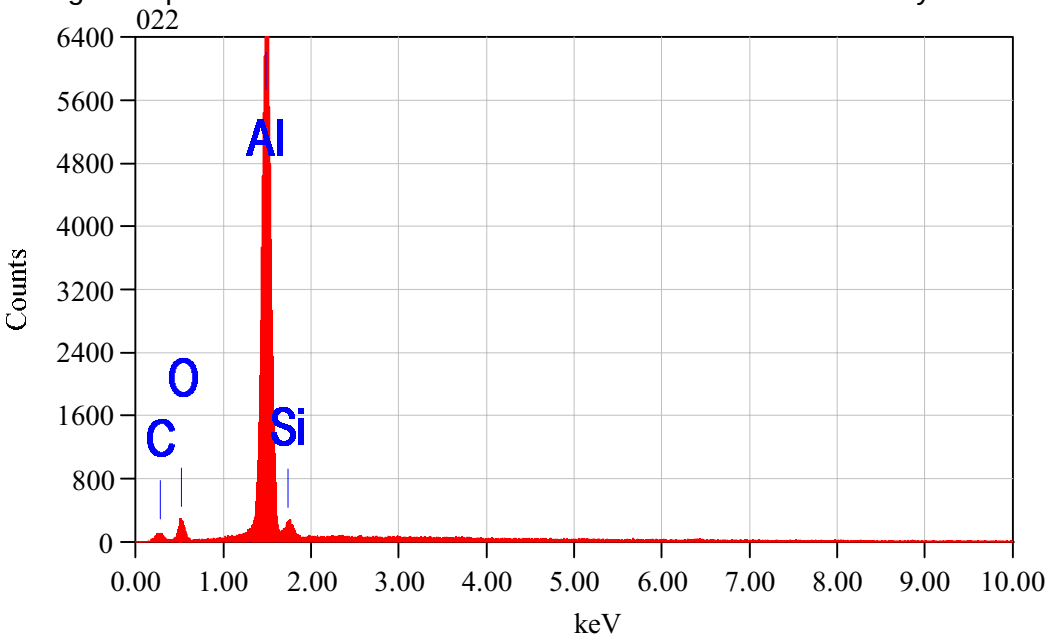


EDS1. Stockton South Petri (Exposed: 17/08/15, Collected 20/08/15), UQMP # 13751. The SEM/EDS spectrum of the particle annotated with 023 displays elevated levels of silicon with only traces of the balance of the elements. The elemental profile and particle morphology is typical of quartz a common mineral dust.

6.2 SEM/BSE IMAGE AND EDS SPECTUM OF AN ALUMINA PARTICLE

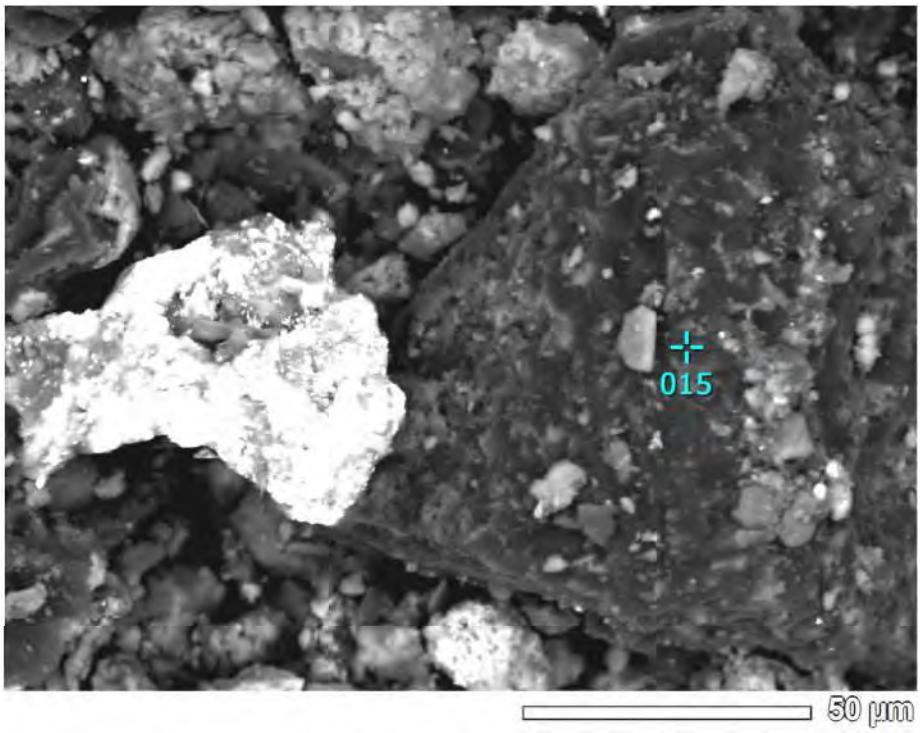


PM2. Stockton South Petri (Exposed: 17/08/15, Collected 20/08/15), UQMP # 13751. An SEM/BSE image of a particulate marked with 022 is selected for SEM/EDS analysis.

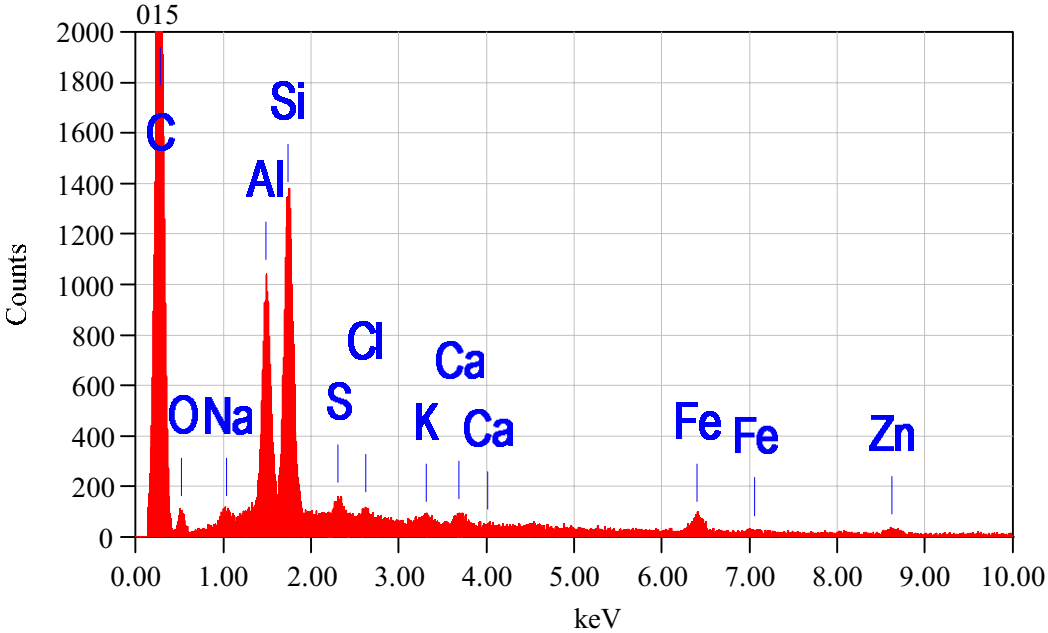


EDS2. Stockton South Petri (Exposed: 17/08/15, Collected 20/08/15), UQMP # 13751. The SEM/EDS spectrum of the particle marked with 022 displays a predominance of aluminium and a characteristic crystal habit of alumina.

6.3 SEM/BSE IMAGE AND EDS SPECTUM OF A COAL PARTICLE

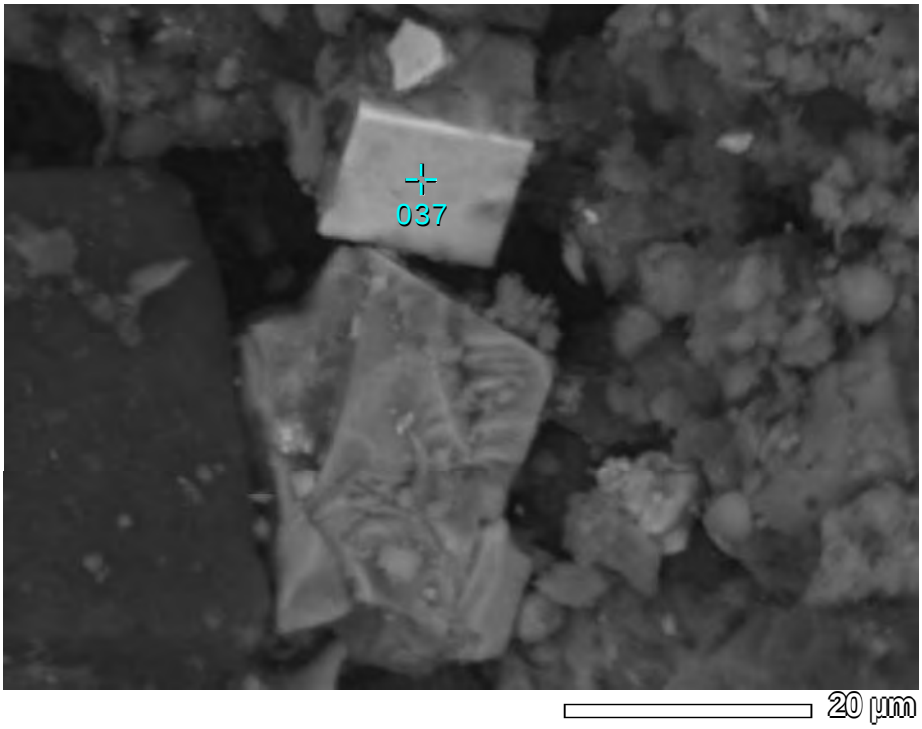


PM3. Kings Rd Tighes Hill Brush (Collected: 08/09/15), UQMP #13757. An SEM/BSE image of a particulate annotated with 015 is selected for SEM/EDS analysis.

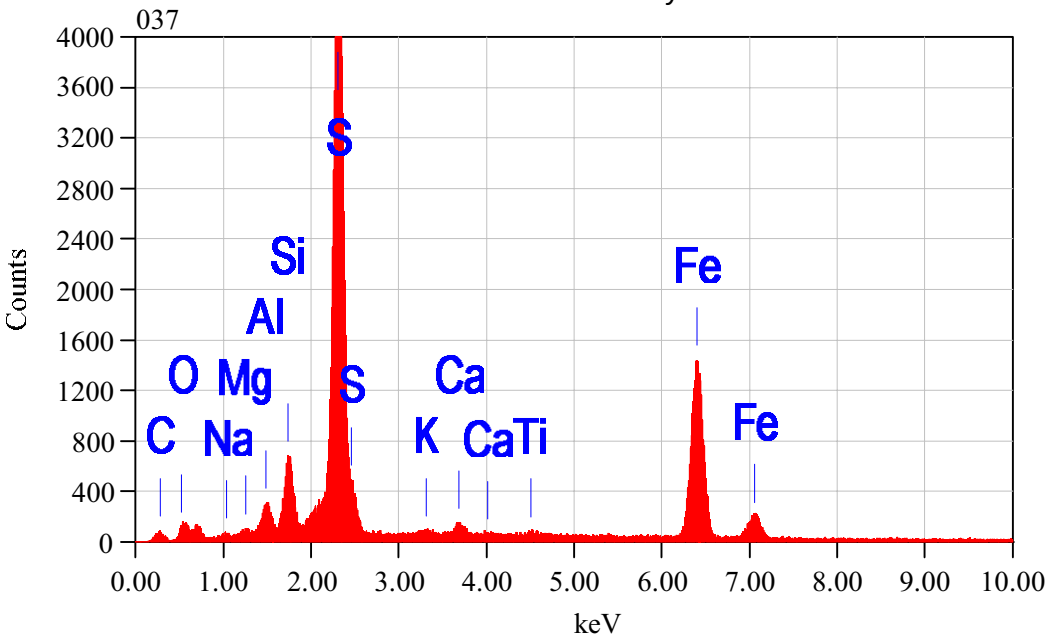


EDS3. Kings Rd Tighes Hill Brush (Collected: 08/09/15), UQMP #13757. The SEM/EDS spectrum of the particle annotated with 015 shows elevated levels of carbon, aluminium and silicon with trace amounts of the remaining elements. The SEM/EDS elemental profile and particle morphology is characteristic for high ash coal.

6.4 SEM/BSE IMAGE AND EDS SPECTUM OF AN IRON DISULFIDE PARTICLE

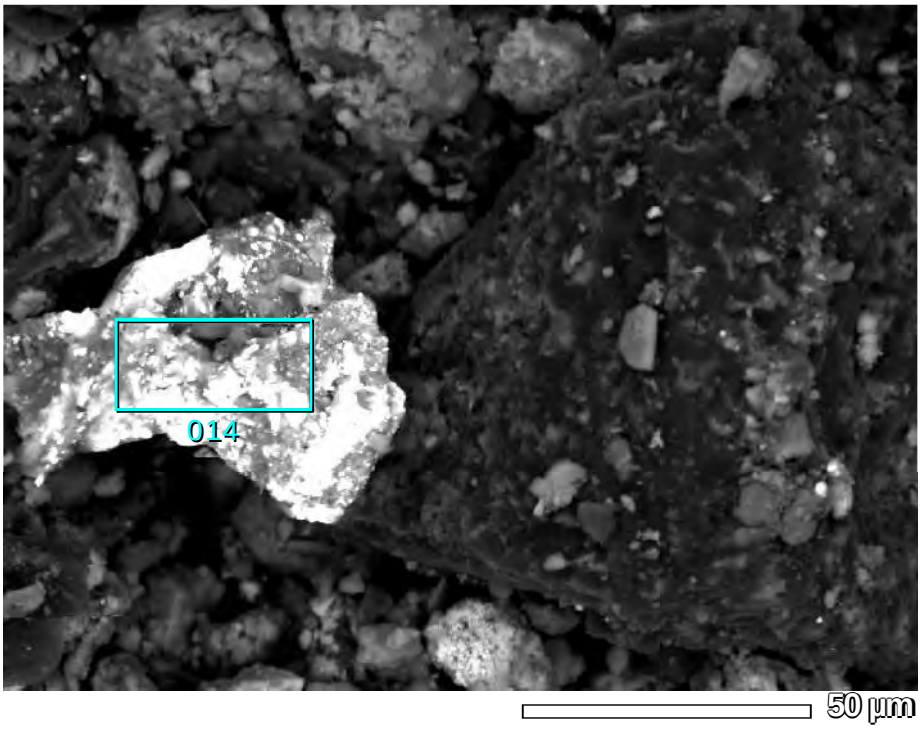


PM4. Bull St Mayfield Brush (Collected: 08/09/15), UQMP # 13755. An SEM/BSE image of a particulate annotated with 037 is selected for SEM/EDS analysis.

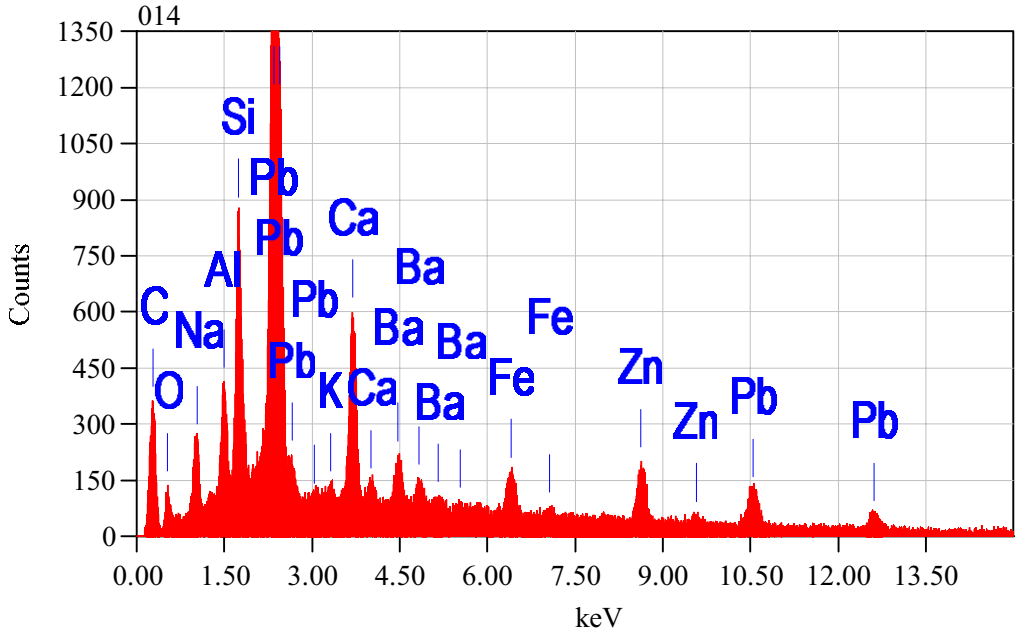


EDS4. Bull St Mayfield Brush (Collected: 08/09/15), UQMP # 13755. The SEM/EDS spectrum of the particle annotated with 037 displays elevated peaks of iron and sulfur and is suggestive of iron disulfide

6.5 SCANNING ELECTRON MICROSCOPE BSE IMAGE AND SPECTUM OF A LEAD RICH PARTICLE



PM5. Kings Rd Tighes Hill Brush (Collected: 08/09/15), UQMP #13757. An SEM/BSE image of a particulate annotated with 014 is selected for SEM/EDS analysis.



EDS5. Kings Rd Tighes Hill Brush (Collected: 08/09/15), UQMP #13757. The SEM/EDS spectrum of the particle annotated with 014 consists of elevated levels of silicon and lead with minor amounts of calcium and traces of the balance of the elements. The particle is a lead rich mineral dust.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

UQMP
UQ Materials Performance
Materials engineering consultancy, expert opinion, evaluation and research

Phone +61 7 3365 6123
Email uqmp@uq.edu.au
Web www.uqmp.com

Lvl 5 Advanced Engineering Bldg 49
Staff House Road
The University of Queensland
St Lucia Qld 4072 Australia

A registered business of UniQuest Pty Limited (ABN 19 010 529 898)

MICROSCOPY REPORT

Subject: **EXAMINATION OF DUST FALLOUT GAUGE DEPOSIT BY OPTICAL AND ELECTRON MICROSCOPY**

UQMP Project No. C02204.15

Prepared for: Hayley Worthington, ALS ENVIRONMENTAL

Prepared By: Fiona Jones

Date: 26th October 2015

Sample Description:

	Dust Gauge Sample #	Date Exposed	Date Collected	UQMP #
1	Hamilton Dust Gauge	03/09/15	02/10/15	UQMP # 13764
2	Mayfield East Petri	09/09/15	11/09/15	UQMP # 13765
3	Waratah Petri	09/09/15	11/09/15	UQMP # 13766
4	Carrington Petri	02/10/15	06/10/15	UQMP # 13767
5	Newcastle Petri	02/10/15	06/10/15	UQMP # 13768
6	Broadmeadow Petri	02/10/15	06/10/15	UQMP # 13769
7	Warabrook Petri	02/10/15	06/10/15	UQMP # 13770

#Method Ref: Internal UQMP method.

AS 3580.10.1 - 2003 Methods for sampling and analysis of particulate matter - Deposited matter - Gravimetric method

1. INTRODUCTION

The samples were supplied as washings from a dust fallout gauge deposit or loose deposits collected in a petri dish. The samples were filtered or washed onto a membrane filter and examined by stereomicroscopy to check for particle distribution and general appearance.

2. RESULTS

Appendix A attached presents the table of results of the combined microscopy observations.

Appendix B presents colour picture micrographs of the stereomicroscopy images.

Appendix C displays the Illustrative SEM photomicrographs and spectra taken of an overall area of the insoluble matter. Trace amounts of copper sludge was noted in all deposits.

Appendix D attached presents illustrative SEM photomicrographs and spectra taken of representative particles that were common among many of the deposits. The SEM photomicrographs were taken with Back Scattered Electron (BSE) imaging in which average atomic number is roughly proportional to brightness. For example, coal particles appear darker than siliceous mineral dust and biological particles somewhat darker again.

Signed for and on behalf of UQ Materials Performance

Fiona Jones

1. APPENDIX A

1.1 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13764	UQMP # 13765	UQMP # 13766
	SAMPLE ID / **PARTICLE TYPE**	*Hamilton Dust Gauge (Exposed: 03/09/15, Collected: 02/10/15)*	*Mayfield East Petri (Exposed: 09/09/15, Collected 11/09/15)*	*Waratah Petri (Exposed: 09/09/15, Collected: 11/09/15)*
BLACK	COAL	20	5	
	SOOT	5		5
	BLACK RUBBER DUST		20	20
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**50**	**45**	**45**
	MINERAL DUST (type = Fly Ash)			
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	10	10	10
	PLANT DEBRIS (General)	15	15	15
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)		5	5
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

1.2 TABLE OF COMBINED MICROSCOPY RESULTS

PARTICLE IDENTITY		PERCENTAGE (Projected area basis)		
	SAMPLE #	UQMP # 13767	UQMP # 13768	UQMP # 13769
	SAMPLE ID / **PARTICLE TYPE**	*Carrington Petri (Exposed 02/10/15, Collected 06/10/15)*	*Newcastle Petri (Exposed 02/10/15, Collected 06/10/15)*	*Broadmeadow Petri (Exposed: 02/10/15, Collected 06/10/15)*
BLACK	COAL	10	5	10
	SOOT	15	5	5
	BLACK RUBBER DUST	10	15	10
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**55**	**40**	**40**
	MINERAL DUST (type = Fly Ash)		10	5
	MINERAL DUST (type = Cement Dust)			
	MINERAL DUST (type =glassy)			
	GLASS FRAGMENTS			
	COPPER SLUDGE			
	P/S SLIME & FUNGI			
	INSECT DEBRIS	5	10	20
	PLANT DEBRIS (General)	5	15	10
	PLANT DEBRIS (type = plant char)			
	PLANT DEBRIS (type =)			
GENERAL ORGANIC TYPES	WOOD DUST			
	FIBRES (type = Miscellaneous)			
	STARCH			
	PAINT			
	PLASTIC FRAGMENTS			
	RED RUBBER DUST			
COMMENTS				

1.3 TABLE OF COMBINED MICROSCOPY RESULTS

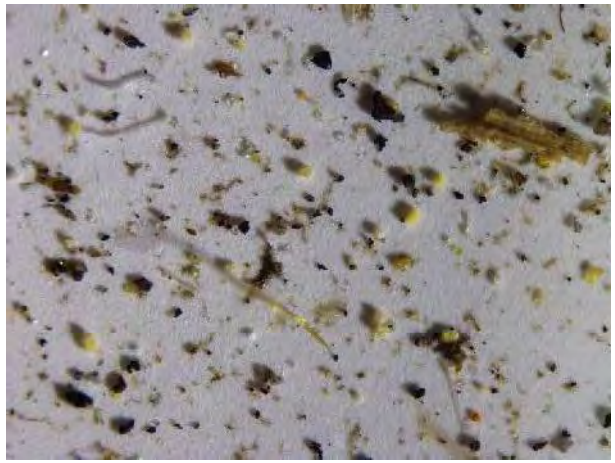
PARTICLE IDENTITY		PERCENTAGE (Projected area basis)
	SAMPLE #	UQMP # 13770
	SAMPLE ID	*Warabrook Petri (Exposed: 02/10/15, Collected 06/10/15)*
	PARTICLE TYPE	
BLACK	COAL	5
	SOOT	5
	BLACK RUBBER DUST	10
INORGANICS & MINERALS	MINERAL DUST (Soil or Rock Dust.)	**50**
	MINERAL DUST (type = Fly Ash)	10
	MINERAL DUST (type = Cement Dust)	
	MINERAL DUST (type =glassy)	
	GLASS FRAGMENTS	
	COPPER SLUDGE	
	P/S SLIME & FUNGI	
	INSECT DEBRIS	10
	PLANT DEBRIS (General)	10
	PLANT DEBRIS (type = plant char)	
	PLANT DEBRIS (type =)	
GENERAL ORGANIC TYPES	WOOD DUST	
	FIBRES (type = Miscellaneous)	
	STARCH	
	PAINT	
	PLASTIC FRAGMENTS	
	RED RUBBER DUST	
COMMENTS		

1.4 PARTICLE IDENTITY LEGEND

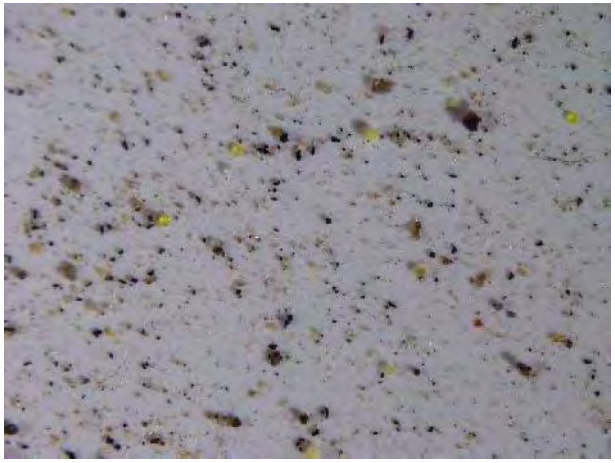
Insect parts/debris	Includes arachnids. Present as crushed body fragments, trichomes, wing scales, etc.
P/s slime	Polysaccharide slime. This extra-cellular bio-polymeric material may have different sources which might include microbiological growth, vertebrate excreta, decomposing biological matter, etc. Sometimes seen in these samples as a stringy gel binding other particles together. Sometimes fungal hyphae associated with the gel.
Copper sludge	Some well developed turquoise crystal growths can be found, but usually as subhedral to euhedral grains. Sometimes as blue highlights on a greenish cakey material. This is probably copper salts precipitated from the copper sulfate algaecide solution as the hydroxide, with or without sulfate and or phosphorous inclusion.
Mineral matter	Usually equant siliceous appearance and typically colourless to brown, transparent to translucent, euhedral, rounded grains. The clays very fine particles. Other constituents of siliceous appearance, sand etc.
Plant Debris/ char	Usually as trichomes, fragmented tissue, reproductive products and structures. Sometimes charred particles from incinerator, grass or bush fires.
Fly ash particles	Appears as spheroidal particles - colourless, milky or black
Coal dust	Black, equant, sharp angled grains. Some glossy; some edges dark brown translucent.
Soot	Black glossy spherical to botryoidal aggregates, typically hollow or lacey. Usual source is incompletely burnt organic liquids, eg. fuel oils.

2. APPENDIX B

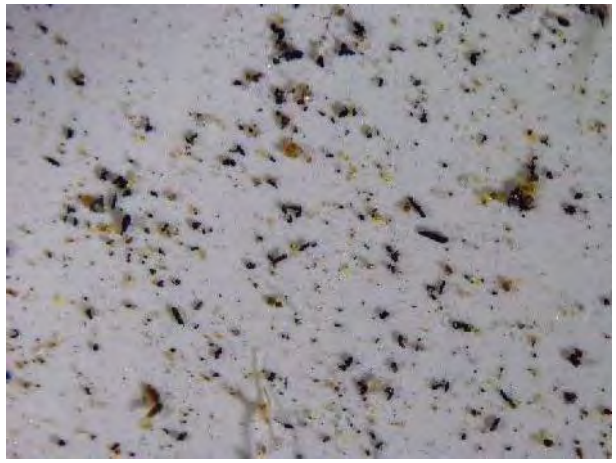
2.1 STEREOMICROSCOPY PICTURE MICROGRAPHS



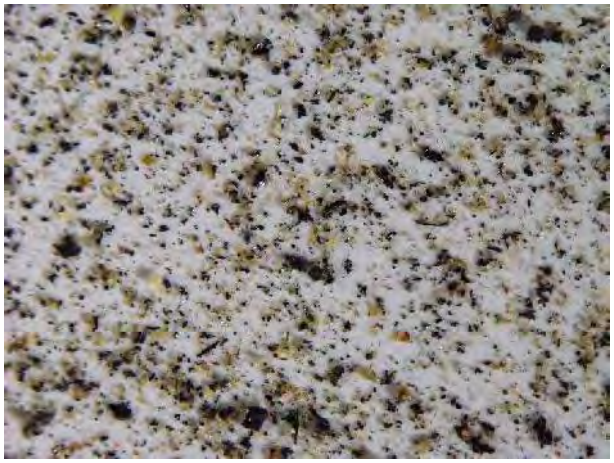
StMPM1. Hamilton Dust Gauge (Exposed: 03/09/15, Collected: 02/10/15), UQMP # 13764



StMPM2. Mayfield East Petri (Exposed: 09/09/15, Collected 11/09/15), UQMP # 13765

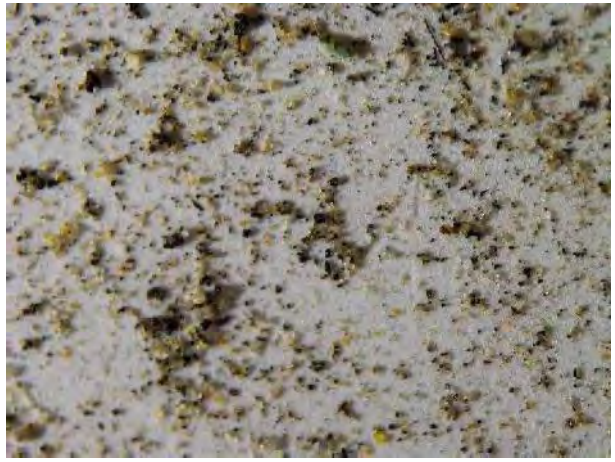


StMPM3. Waratah Petri (Exposed: 09/09/15, Collected: 11/09/15), UQMP # 13766.

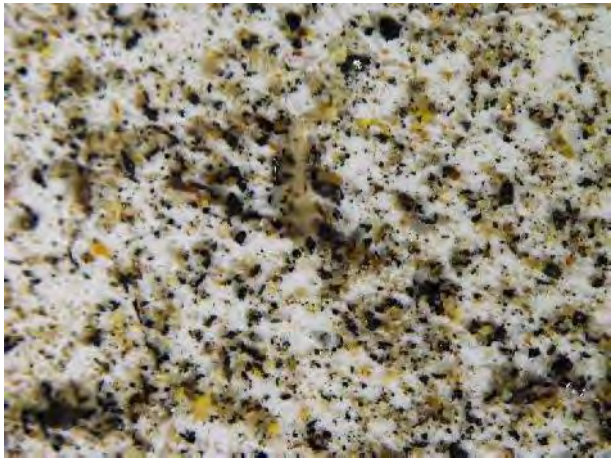


StMPM4. Carrington Petri (Exposed 02/10/15, Collected 06/10/15), UQMP # 13767.

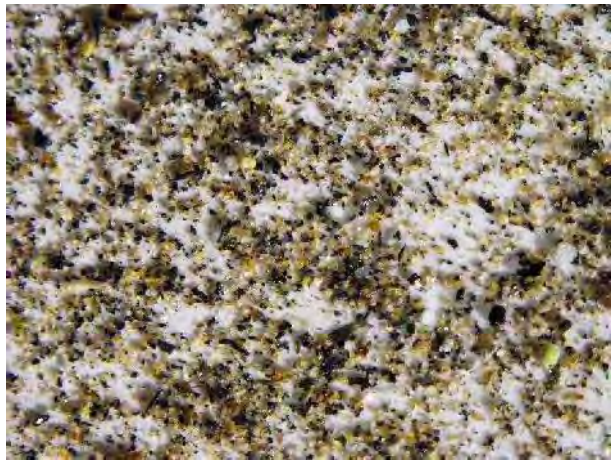
2.2 STEREOMICROSCOPY PICTURE MICROGRAPHS



StMPM5. Newcastle Petri (Exposed 02/10/15, Collected 06/10/15), UQMP # 13768.



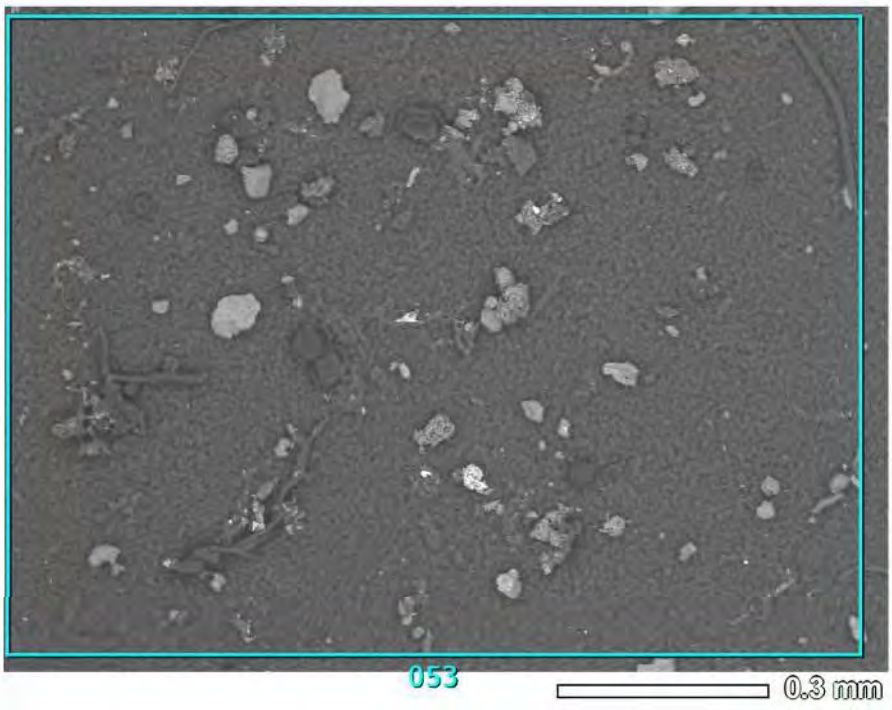
StMPM6. Broadmeadow Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13769



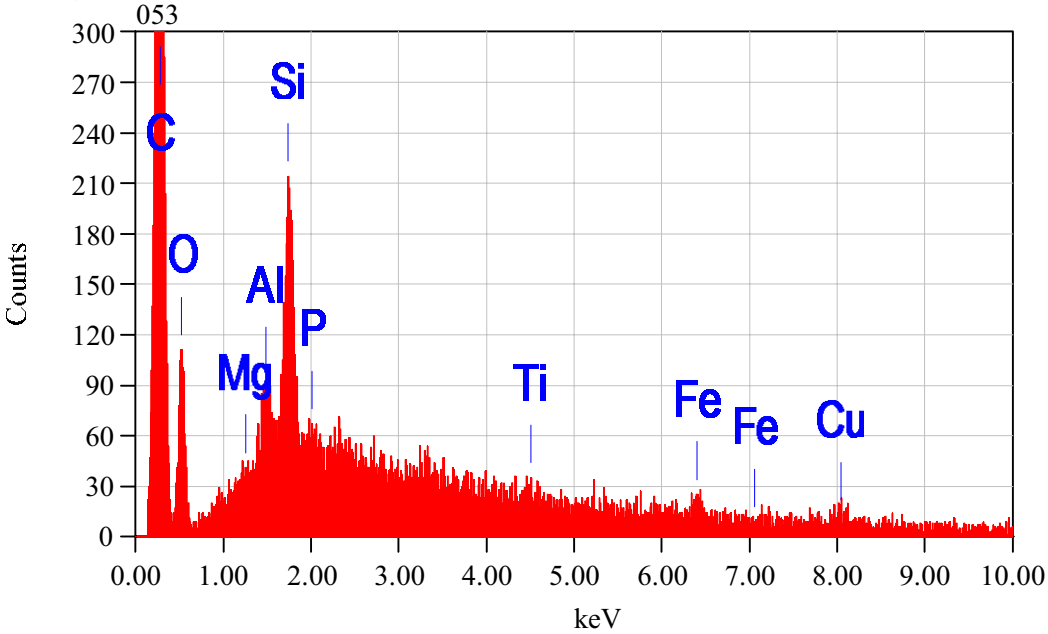
StMPM7. Warabrook Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13770.

1. APPENDIX C

1.1 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

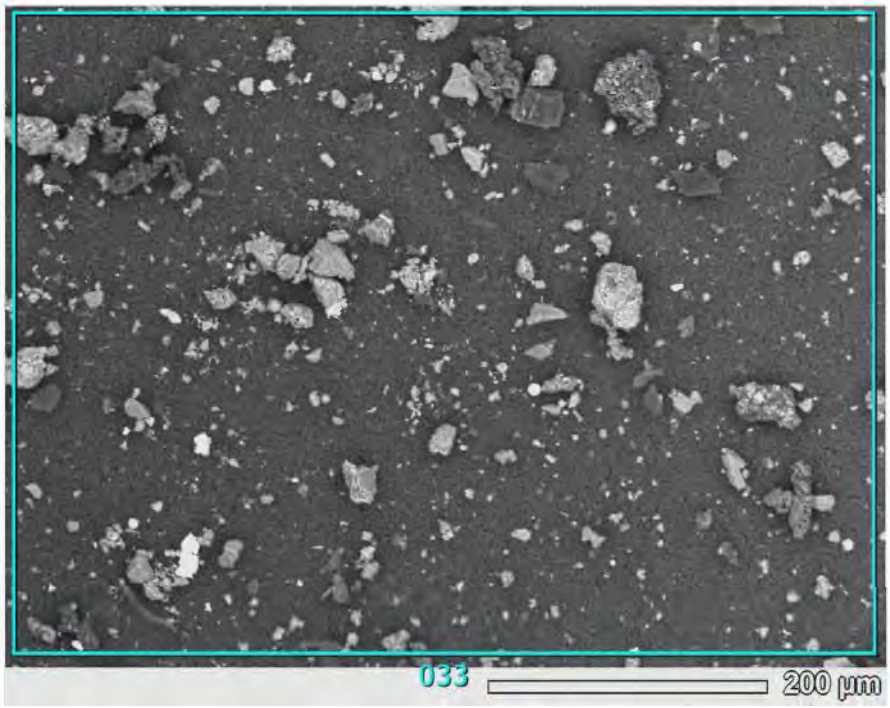


PM1. Hamilton Dust Gauge (Exposed: 03/09/15, Collected: 02/10/15), UQMP # 13764. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

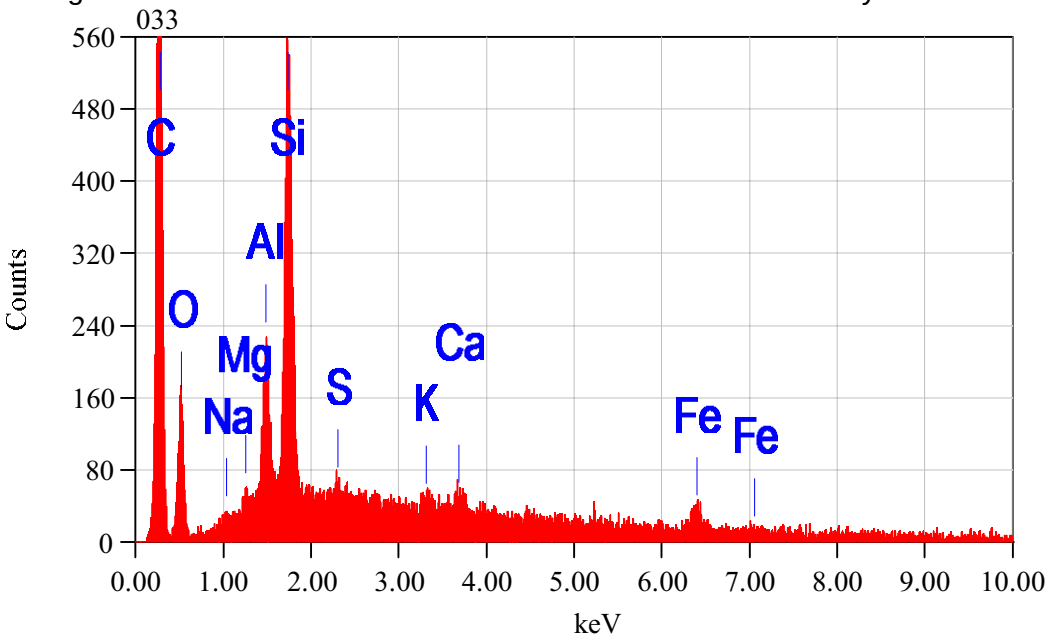


EDS1. Hamilton Dust Gauge (Exposed: 03/09/15, Collected: 02/10/15), UQMP # 13764. The SEM/EDS spectrum of the overall area is rich in carbon and silicon with minor amounts aluminium and traces of the remaining elements. The deposit was sparsley populated with particulates and as a result the elevated carbon includes carbon from the exposed filter. The microscopy observations found a deposit consisting of equal amounts of mineral dust and organic material. The organic particulates include coal, soot, insect and plant debris whilst the mineral dust was predominantly aluminium and silicon based derived from soil or rocks.

1.2 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

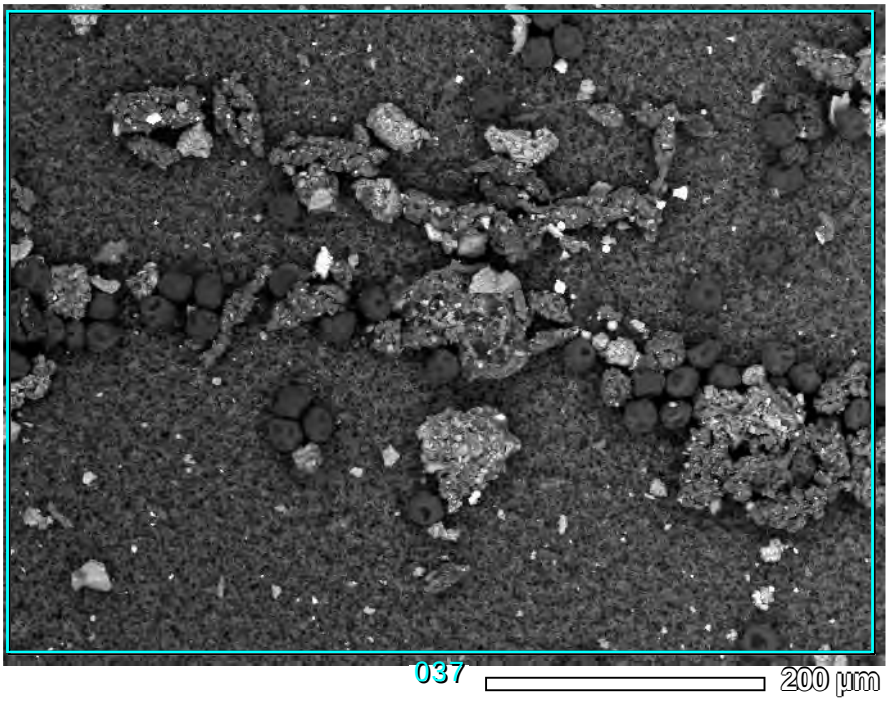


PM2. Mayfield East Petri (Exposed: 09/09/15, Collected 11/09/15), UQMP # 13765. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

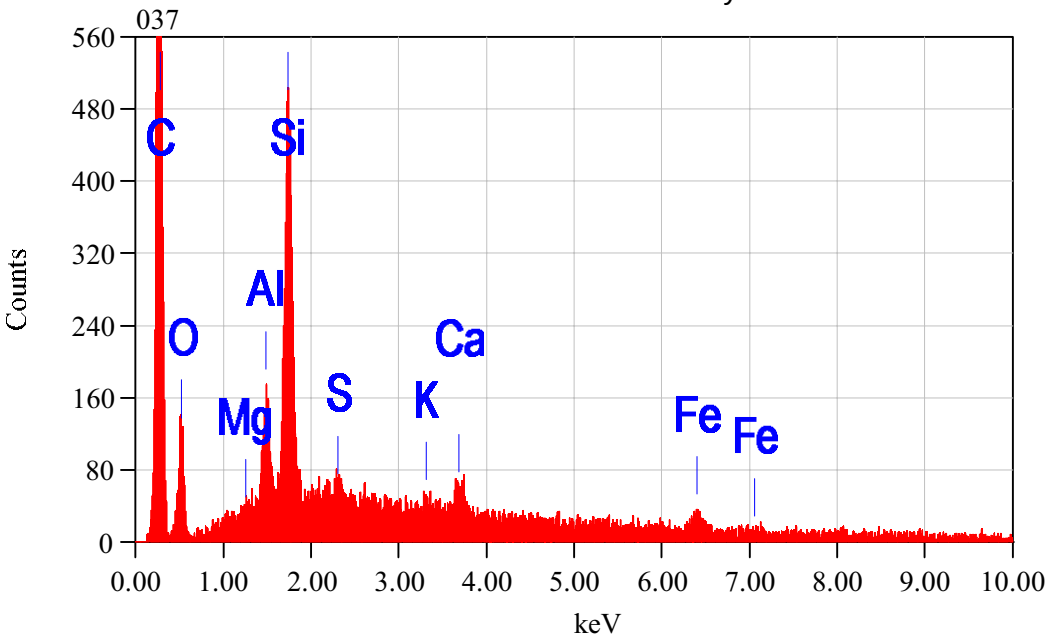


EDS2. Mayfield East Petri (Exposed: 09/09/15, Collected 11/09/15), UQMP # 13765. The SEM/EDS spectrum of the overall area is rich in carbon, silicon and aluminium with traces of the balance of the elements. The deposit was sparsley populated with particulates and as a result the elevated carbon includes carbon from the exposed filter. Microscopy observation found that over half the deposit consisted of organic particulates including coal, rubber dust, fibres and plant and insect debris. Less than half the deposit was composed of aluminium and silicon rich mineral dust particles.

1.3 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

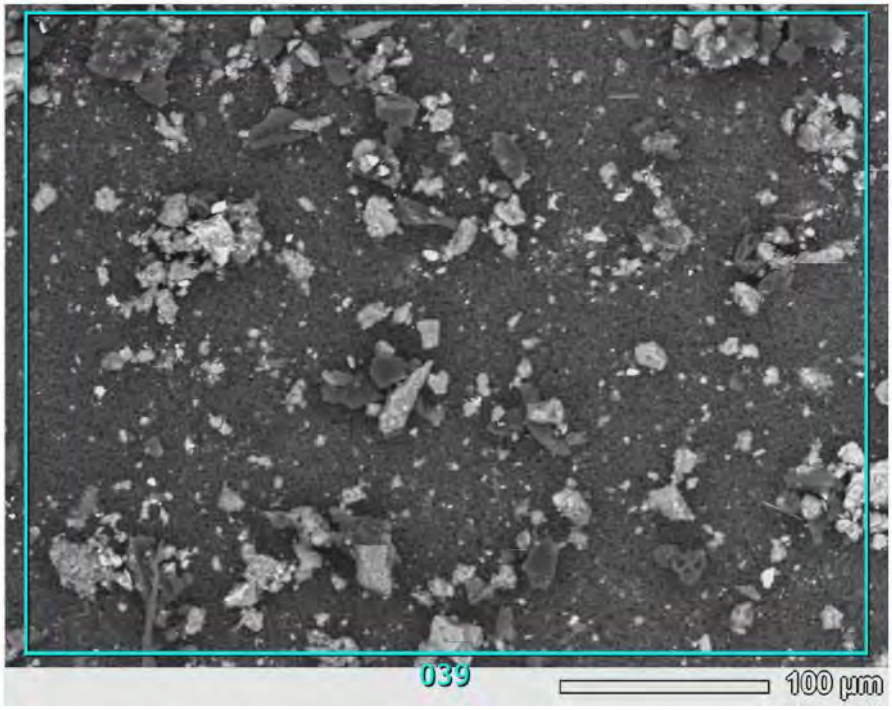


PM3. Waratah Petri (Exposed: 09/09/15, Collected: 11/09/15), UQMP # 13766. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

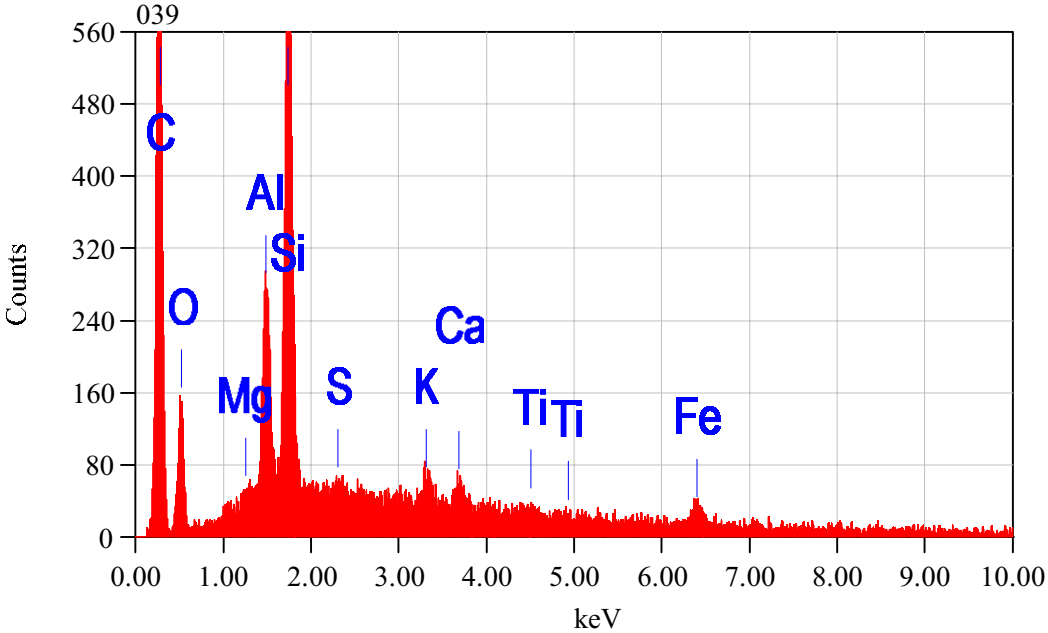


EDS3. Waratah Petri (Exposed: 09/09/15, Collected: 11/09/15), UQMP # 13766. The SEM/EDS spectrum of the overall area is rich in carbon and silicon with minor amounts of aluminium and traces of magnesium, sulfur, potassium, calcium and iron. The deposit was sparsley populated with particulates and as a result the elevated carbon includes carbon from the exposed filter. Organic material constituted around half of the deposit and included soot, rubber dust, fibres and insect and plant debris (mostly pollen) with the balance consisting of aluminium and silicon rich mineral dust.

1.4 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

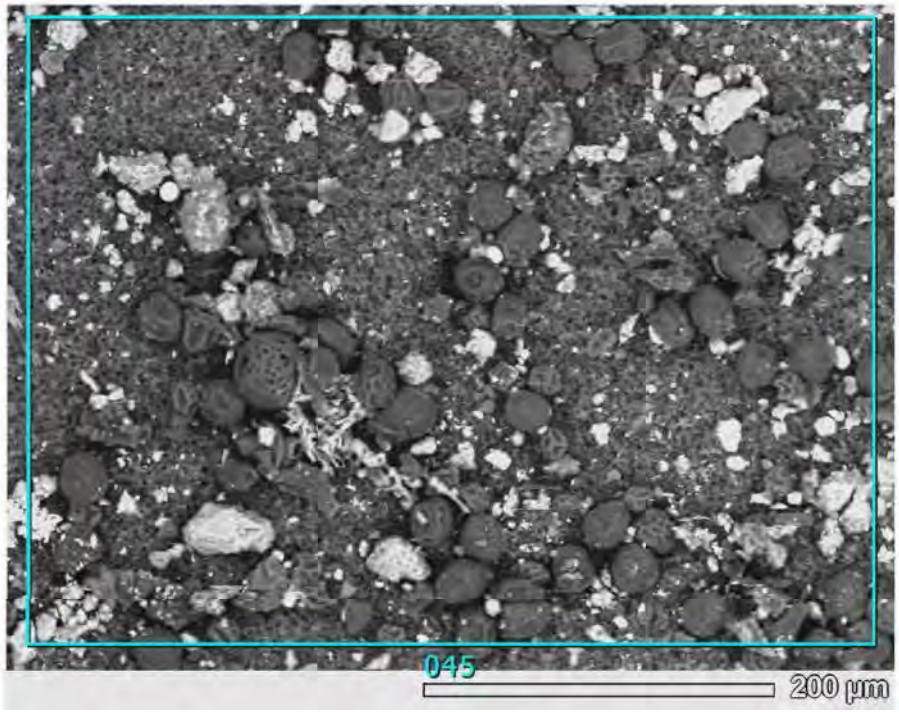


PM4. Carrington Petri (Exposed 02/10/15, Collected 06/10/15), UQMP # 13767. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

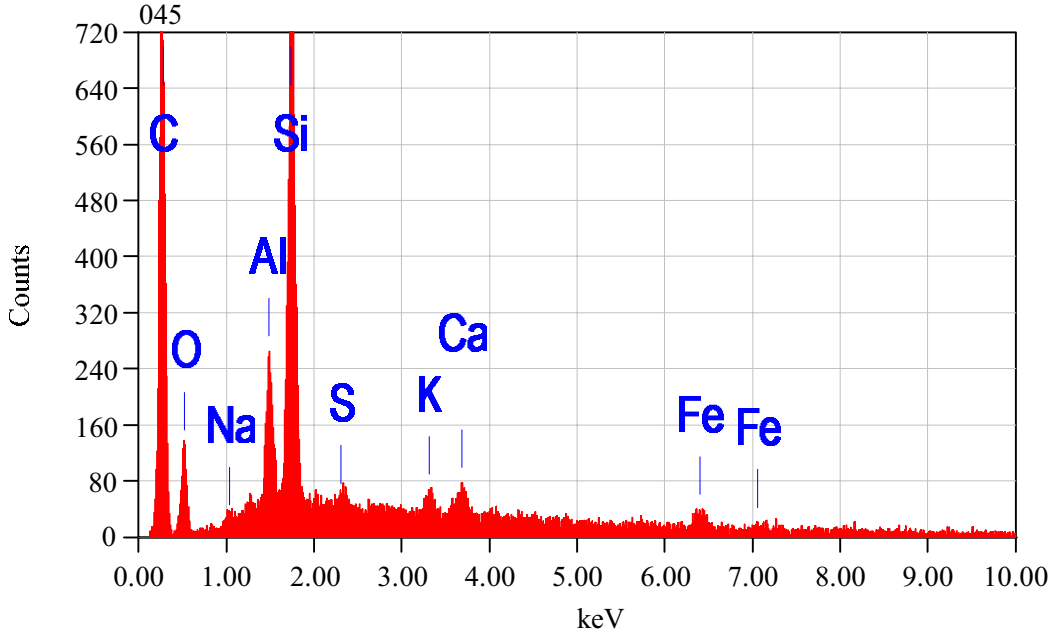


EDS4. Carrington Petri (Exposed 02/10/15, Collected 06/10/15), UQMP # 13767. The SEM/EDS spectrum of the overall area displays a predominance of carbon, aluminium and silicon with trace amounts of the remaining elements. The deposit was sparsley populated with particulates and as a result the elevated carbon includes carbon from the exposed filter. The organic component of the deposit was considered major and includes coal, soot, rubber dust and insect and plant debris. Mineral dust totalled just over half of the deposit and was mostly aluminosilicate rich.

1.5 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

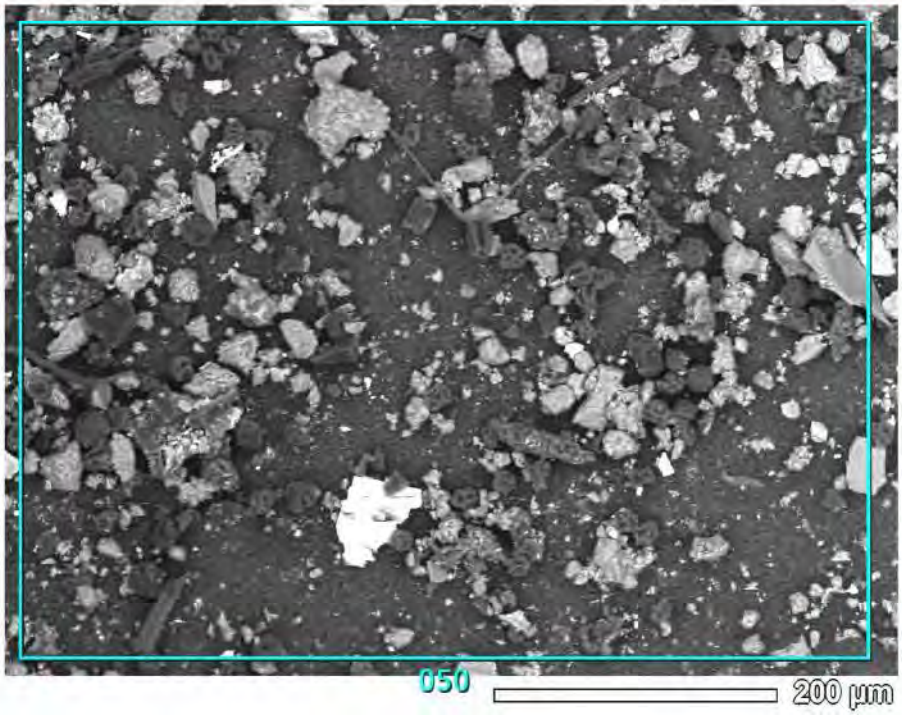


PM5. Newcastle Petri (Exposed 02/10/15, Collected 06/10/15), UQMP # 13768. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

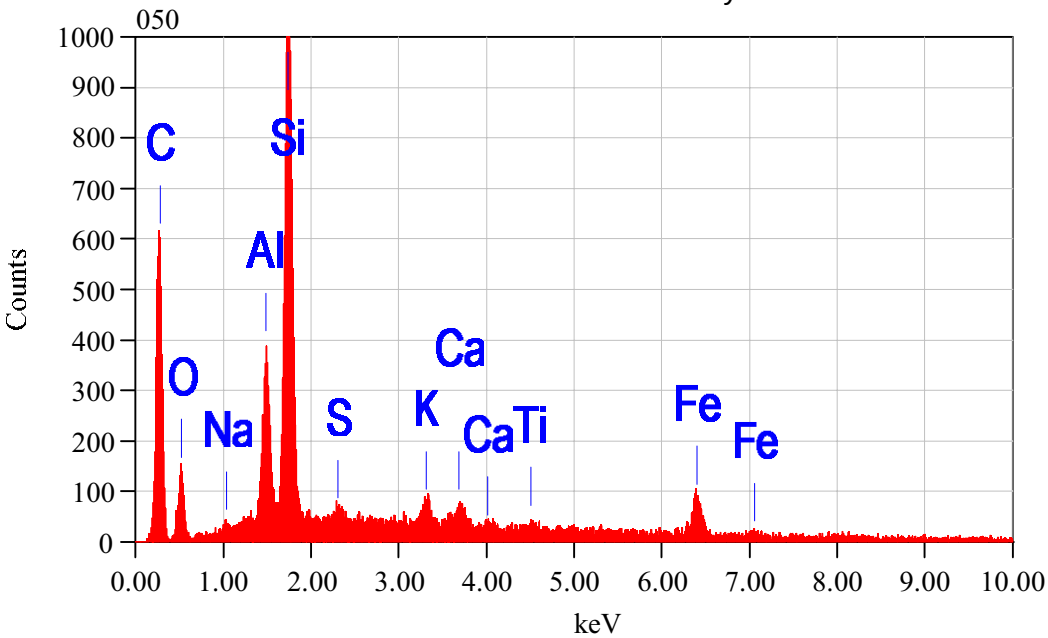


EDS5. Newcastle Petri (Exposed 02/10/15, Collected 06/10/15), UQMP # 13768. The SEM/EDS spectrum of the overall area is rich in carbon, silicon and aluminium and traces of sodium, sulfur, potassium, calcium and iron. The deposit was sparsley populated with particulates and as a result the elevated carbon includes carbon from the exposed filter. Coal, soot, rubber dust and insect and plant debris particles are the organic contributors composing half the deposit. Aluminium and silicon mineral dust constitutes the balance of the deposit.

1.6 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM

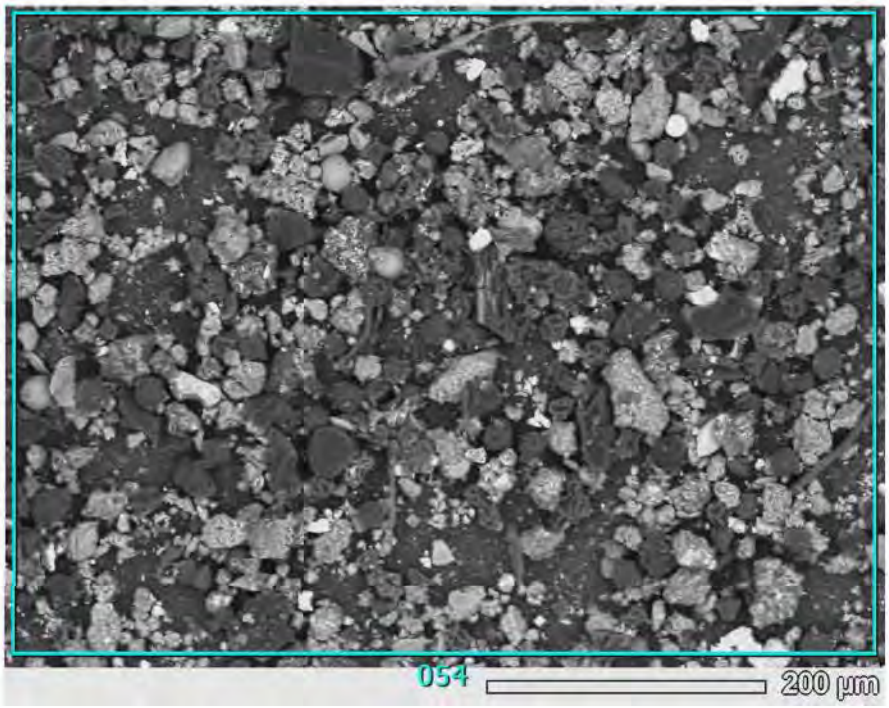


PM6. Broadmeadow Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13769. An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.

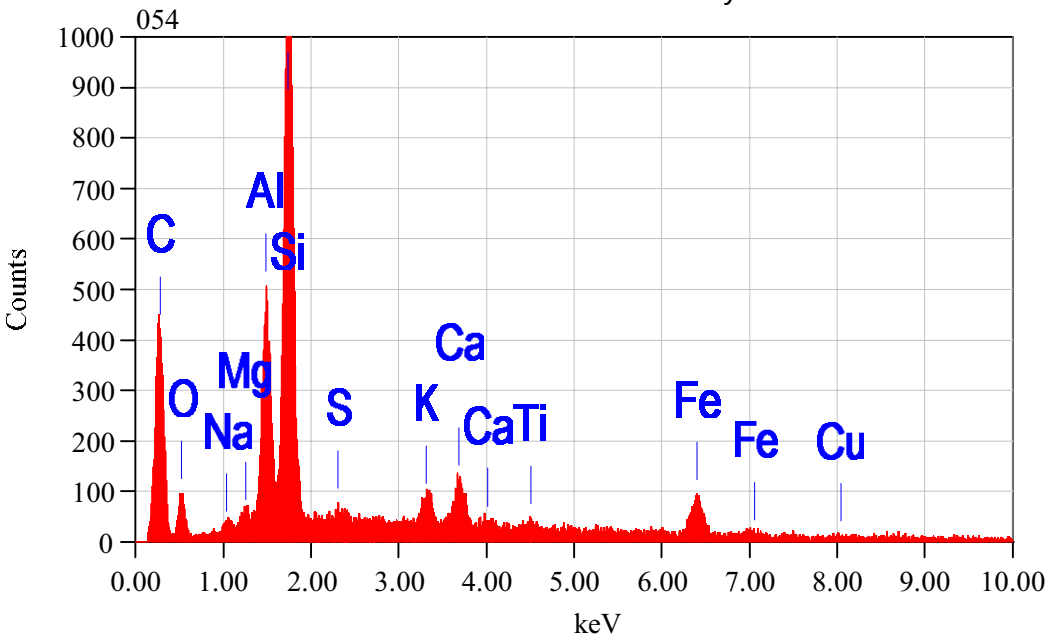


EDS6. Broadmeadow Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13769. The SEM/EDS spectrum of the overall area consists of major peaks of carbon, silicon and aluminium and traces of the balance of the elements. The deposit was sparsley populated with particulates and as a result the elevated carbon includes carbon from the exposed filter. Aluminosilicate based mineral dust composed less than half the deposit with the majority of the particles being organic and included coal, soot, rubber dust and insect and plant debris.

1.7 SCANNING ELECTRON MICROSCOPY BSE IMAGES AND EDS SPECTRUM



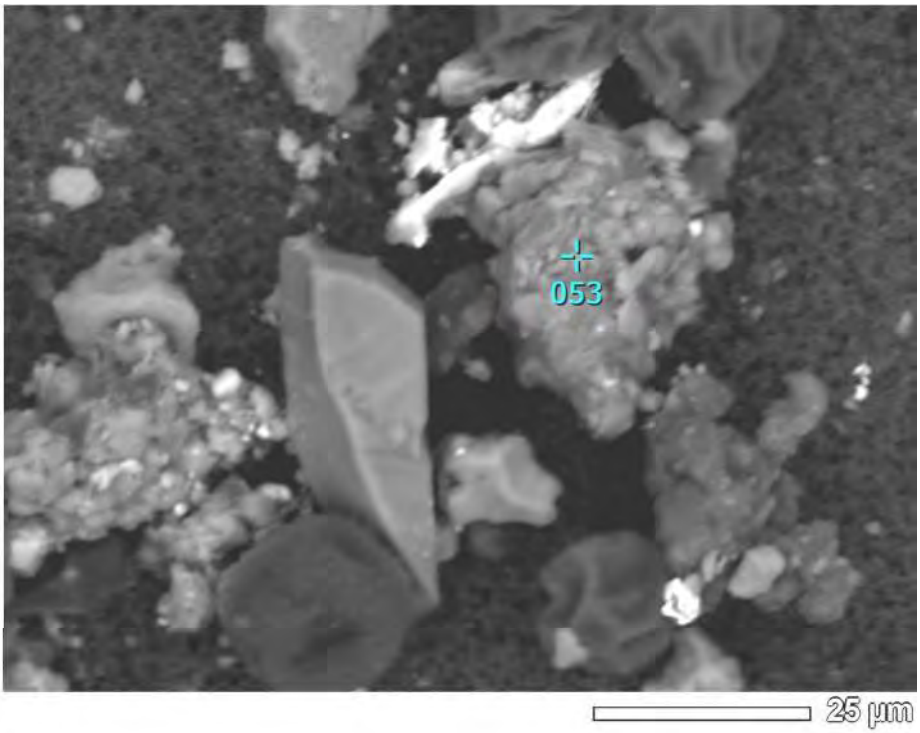
PM7. Warabrook Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13770**.** An SEM/BSE image of a characteristic overall area selected for SEM/EDS analysis.



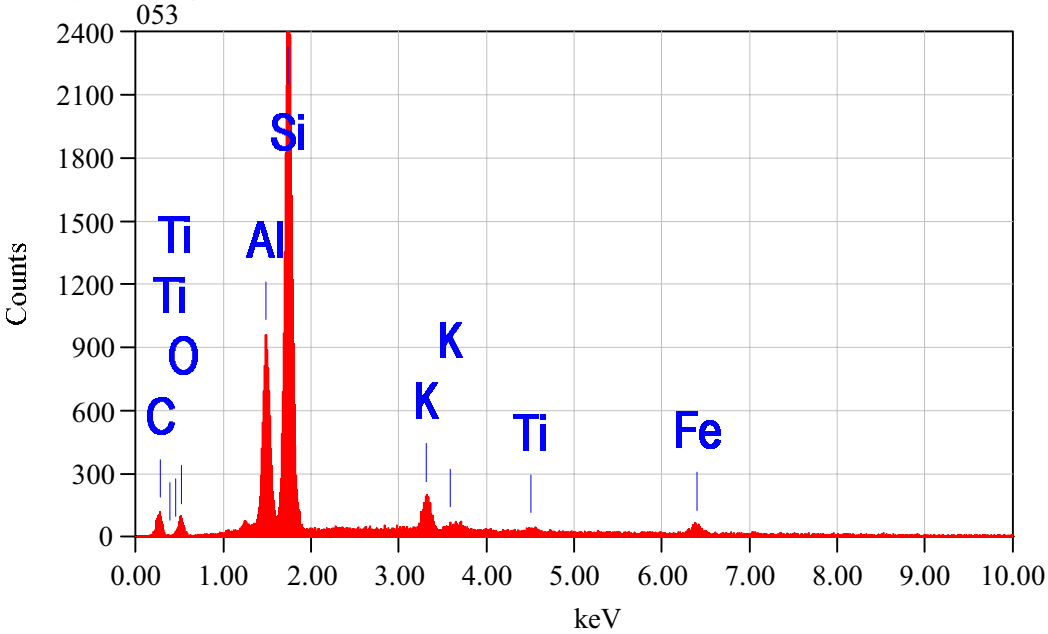
EDS7. Warabrook Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13770**.** The SEM/EDS spectrum of the overall area is rich in carbon, silicon and aluminium with trace amounts of the balance of the elements. The SEM/EDS spectrum compares well with the microscopy observations of a deposit consisting mostly of aluminosilicate rich mineral dust and minor amounts of organic matter including

2. APPENDIX D

2.1 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A MINERAL DUST

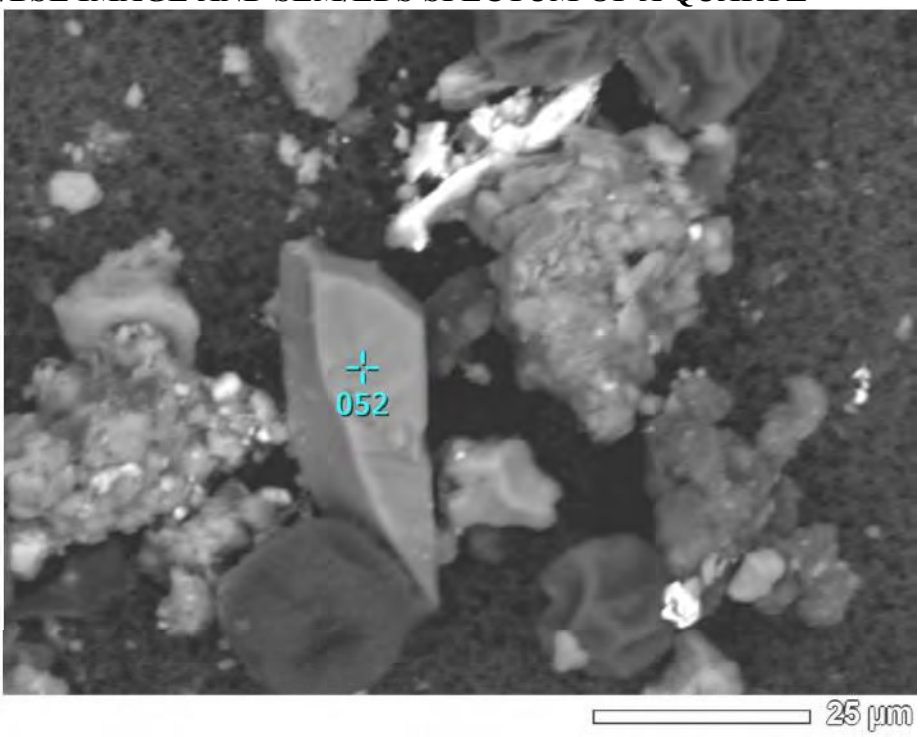


PM1. Broadmeadow Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13769. The SEM/BSE image of the particulate annotated with 053 is selected for SEM/EDS analysis.

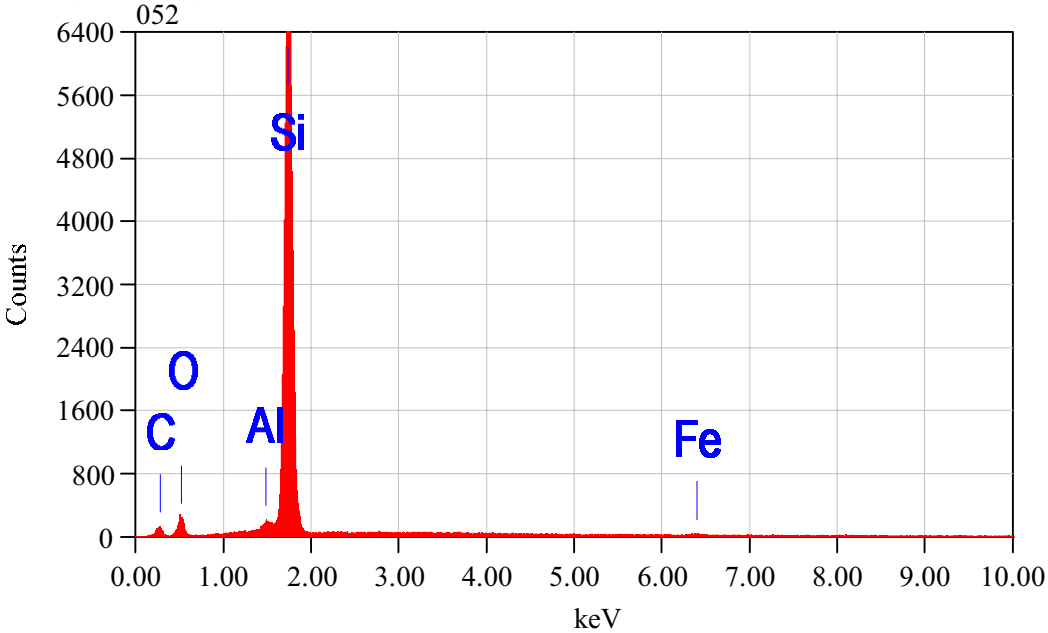


EDS1. Broadmeadow Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13769. The SEM/EDS spectrum of the particle annotated with 053 displays elevated levels aluminium and silicon with trace amounts of the remaining elements. The elemental profile and agglomeration of the particle are characteristic for an aluminosilicate rich mineral dust possibly feldspar.

2.2 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A QUARTZ

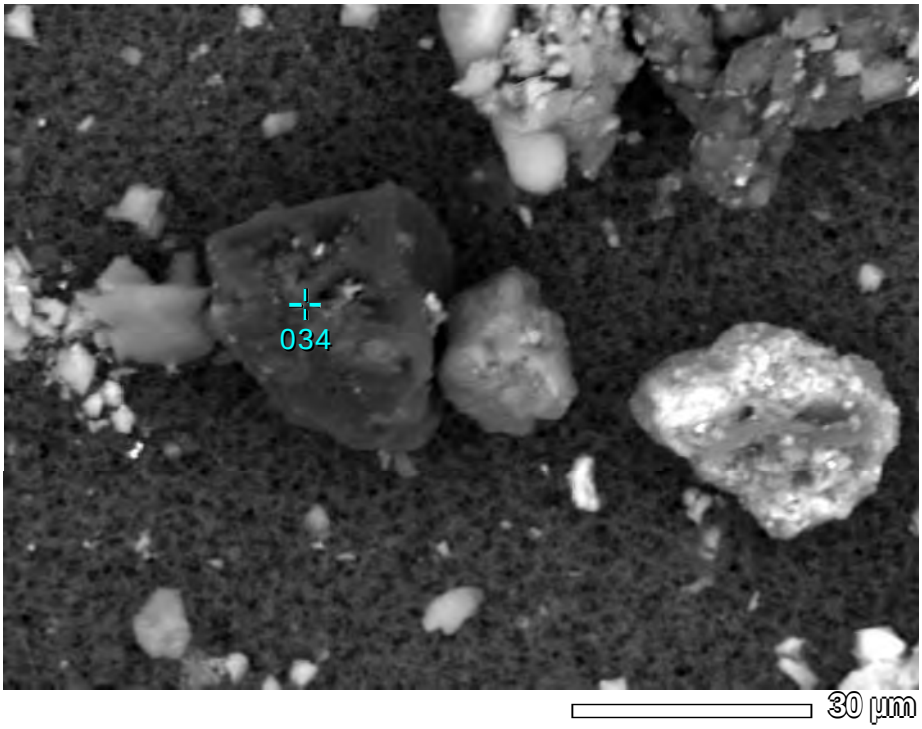


PM2. Broadmeadow Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13769. The SEM/BSE image of the particulate annotated with 052 is selected for SEM/EDS analysis.

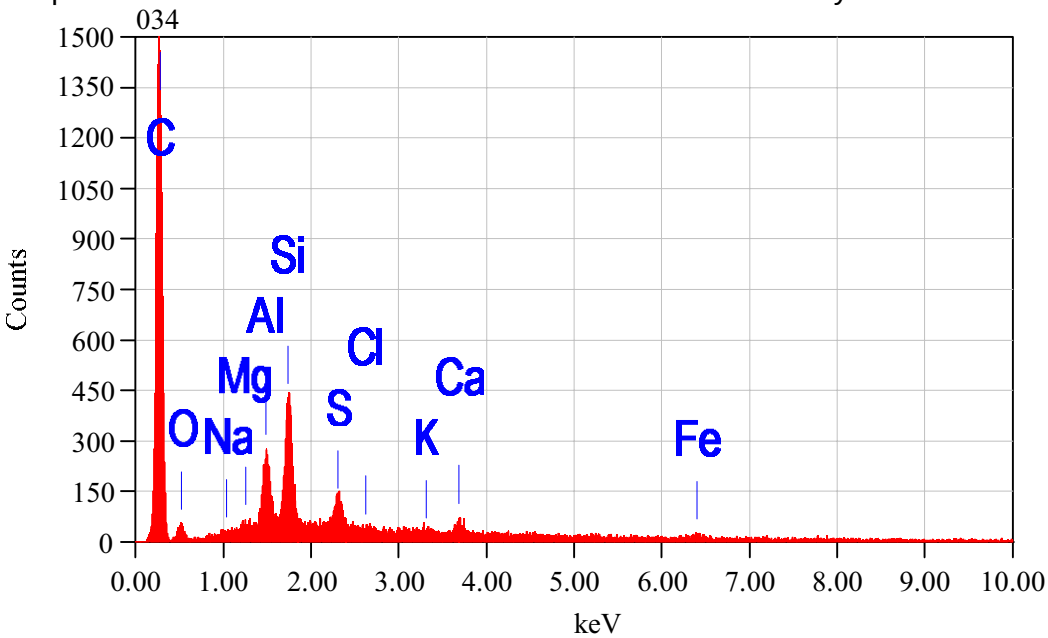


EDS2. Broadmeadow Petri (Exposed: 02/10/15, Collected 06/10/15), UQMP # 13769. The SEM/EDS spectrum of the particle marked with 052 shows elevated levels of silicon with trace amounts of carbon, aluminium and iron. The elemental profile and the sharp well defined particle edges are typical of quartz.

2.3 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A COAL PARTICLE

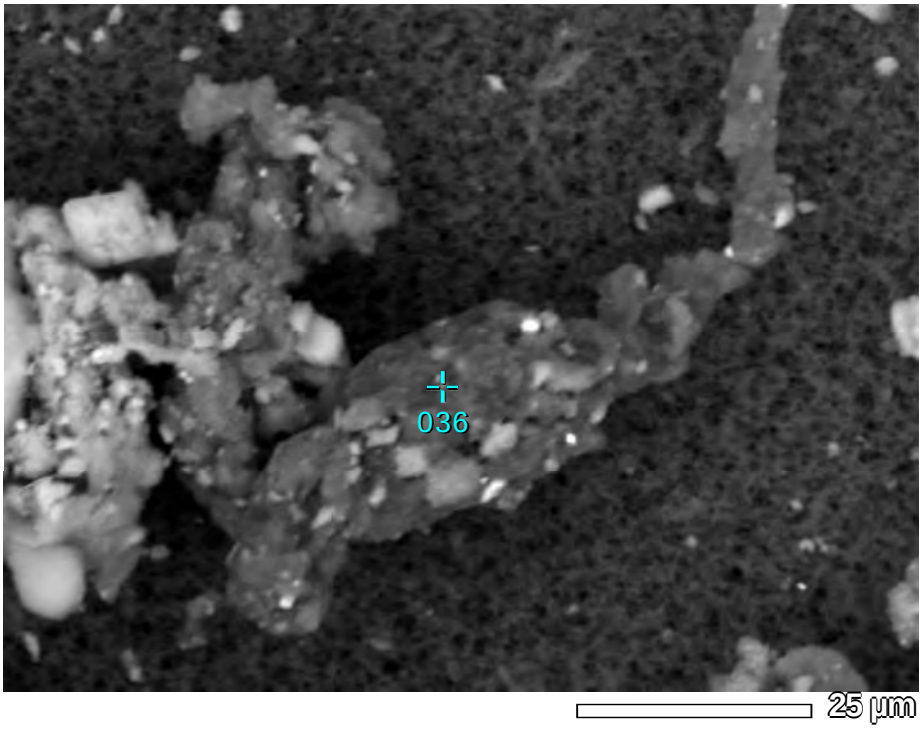


PM3. Mayfield East Petri (Exposed: 09/09/15, Collected 11/09/15), UQMP # 13765. The SEM/BSE image of the particulate annotated with 034 is selected for SEM/EDS analysis.

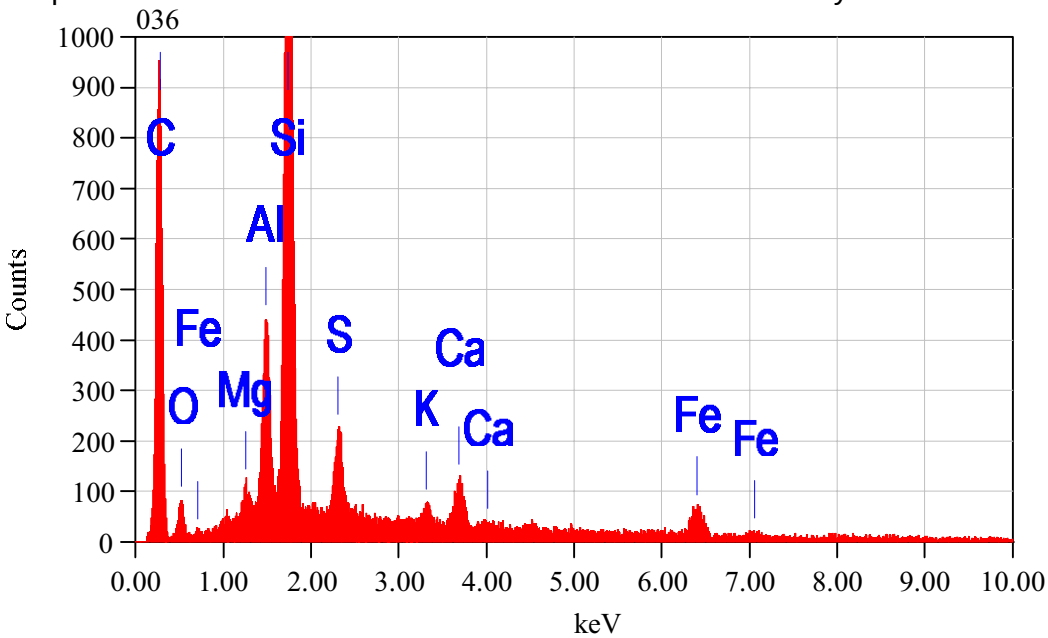


EDS3. Mayfield East Petri (Exposed: 09/09/15, Collected 11/09/15), UQMP # 13765. The SEM/EDS spectrum of the particle annotated with 034 shows elevated levels of carbon, aluminium and silicon with trace amounts of sodium, magnesium, sulfur, chlorine, potassium, calcium and iron.. The spectrum and particle morphology is characteristic for coal.

2.4 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A RUBBER DUST PARTICLE

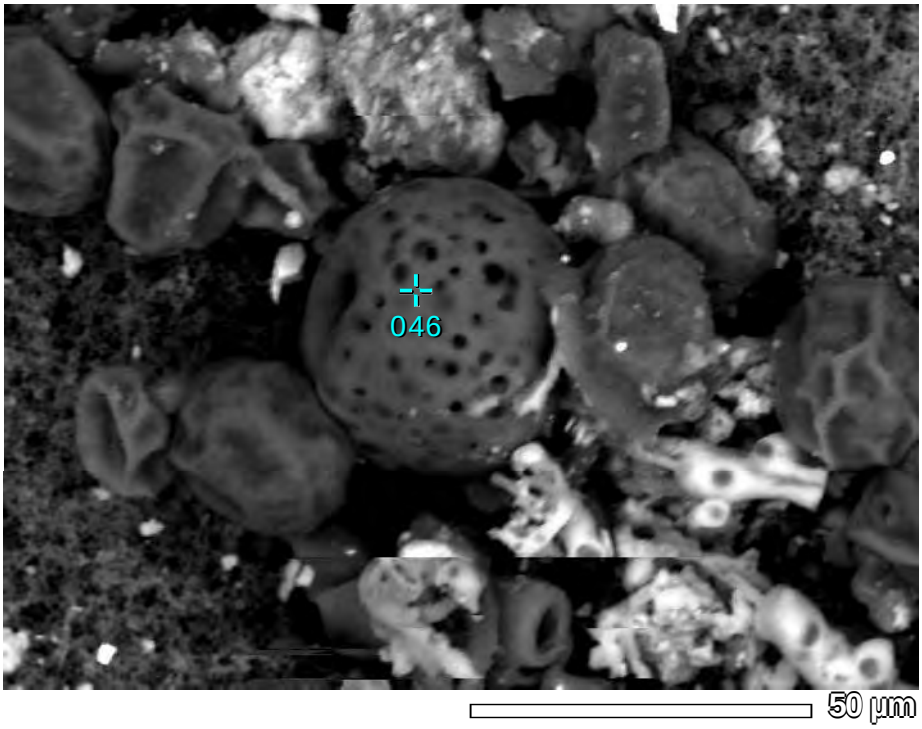


PM4. Mayfield East Petri (Exposed: 09/09/15, Collected 11/09/15), UQMP # 13765. The SEM/BSE image of the particulate annotated with 036 is selected for SEM/EDS analysis.

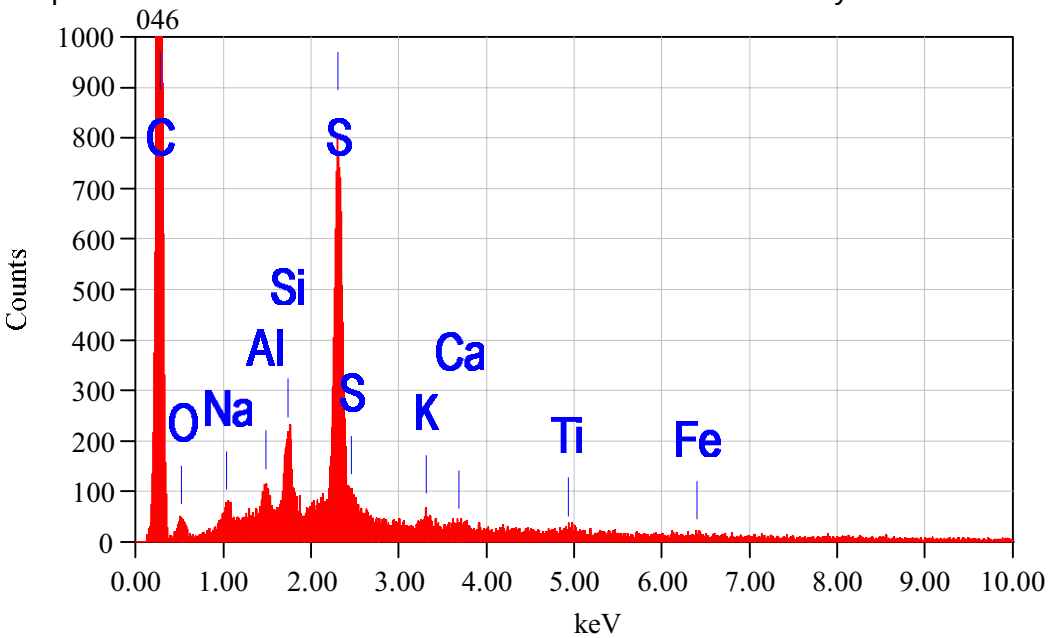


EDS4. Mayfield East Petri (Exposed: 09/09/15, Collected 11/09/15), UQMP # 13765. The SEM/EDS spectrum of the particle annotated with 036 shows elevated levels of carbon, aluminum and silicon, minor amounts of sulfur and trace amounts of the remaining elements. The SEM/EDS spectrum and elongated agglomerated particle is typical of rubber dust.

2.5 SEM/BSE IMAGE AND SEM/EDS SPECTUM OF A SOOT PARTICLE



PM5. Newcastle Petri (Exposed 02/10/15, Collected 06/10/15), UQMP # 13768. The SEM/BSE image of the particulate annotated with 046 is selected for SEM/EDS analysis.



EDS5. Newcastle Petri (Exposed 02/10/15, Collected 06/10/15), UQMP # 13768. The SEM/EDS spectrum of the particle annotated with 046 shows elevated levels of carbon and sulfur with minor amounts aluminium and traces of the balance of the elements. The elemental profile and a spheroidal, lacey particle shape is typical of a soot.

TERMS OF REPORT

UQ Materials Performance is a registered business of UniQuest Pty Limited. The employees and University of Queensland staff and consultants operating with UniQuest will make all reasonable efforts to ensure an accurate understanding of client requirements. The information in reports is based on that understanding, and UniQuest strives to be accurate in its advice and to engage suitably qualified consultants with requisite skills of the highest order.

While all reasonable care will be taken in the preparation of reports, all information, assumptions, and recommendations therein are published, given, made, or expressed on the basis that:

(a) Any liability of any nature which would otherwise exist or arise in any circumstances by reference to any part or any omission from this report is excluded to the maximum extent permitted by law;

(b) Any liability which is unable to be excluded is limited to the minimum sum permitted by law;

(c) These provisions bind any person who refers to, or relies upon, all or any part of a report; and

(d) These provisions apply in favour of UniQuest and its directors, employees, servants, agents and consultants.

The client shall indemnify UniQuest and its directors, employees, servants, agents, consultants, successors in title and assigns against any claim made against any or all of them by third parties arising out of the disclosure of reports, whether directly or indirectly, to a third party.

A laboratory certificate, statement, or report may not be published except in full, unless permission for publication of an approved abstract has been obtained, in writing from the Managing Director of UniQuest.

Samples will be destroyed within 30 days unless collected by the client, or alternative arrangements have been agreed to by UniQuest.

Appendix G

Detailed Summary of Stereomicroscopy Results

This page has been left blank intentionally.

Appendix G Detailed Summary of Stereomicroscopy Results

Table 20 Detailed Stereomicroscopy Results for Brush Samples: Visual Composition Identification Analysis

Sample ID	Analysis ID	Date Collected	Sampling Site	Percentage of Sample																	
				Black			Inorganics and Minerals								Unclassified			General Organic Types		
				Coal	Soot	Black Rubber Dust	Soil or Rock Dust		Cement dust	Fly Ash	Salt	Calcium sulphate	Halite	Alumina	Copper Sludge	P/S Slime and Fungi	Insect Debris - General	Plant Debris (General)	Wood	Fibres (miscellaneous)	Paint
B1	13146	12/12/2014	Islington (DDG site)	5	tr	tr	95			tr	tr			tr			tr	tr		tr	
B2	13147	12/12/2014	Stockton South (DDG site)	5	10		50				tr						5			30	tr
B3	13287	6/03/2015	Stockton South (DDG site)	5	2	tr	68											20		5	
B4	13288	6/03/2015	Roxburgh Street, South Stockton	10	10		65										5			10	
B5	13289	6/03/2015	Mayfield East (DDG site)	tr	tr	tr	95						5	tr						tr	tr
B6	13290	6/03/2015	Ferndale St, Tighes Hill	5	tr	tr	80						5				tr	5	tr	5	tr
B7	13291	6/03/2015	Forbes St, Carrington	5			90						5	tr						tr	tr
B8	13292	6/03/2015	Wickham (DDG site)	20	2	tr	73						tr	tr				5	tr		
B9	13293	6/03/2015	Phillips St, Hamilton North	tr	tr		80		tr				10				tr	5	5	tr	
B10	13294	6/03/2015	Tighes Hill (DDG site)	tr	tr	tr	90						tr	tr					10	tr	
B11	13295	6/03/2015	Islington (DDG site)	10	5		55										10	20			
B12	13497	2/06/2015	Hamilton (DDG site)	10		10	70										tr	10		tr	tr
B13	13498	2/06/2015	Stockton South (DDG site)	20		10	65						5				tr	tr			tr
B14	13752	3/09/2015	Wickham (1) (DDG site)	15	5	10	70										tr	tr			
B15	13753	3/09/2015	Wickham (2) (DDG site)	10	5	5	65										10	5			
B16	13754	8/09/2015	Lott St, Carrington	5	5	5	50							35			tr	tr			
B17	13755	8/09/2015	Bull St, Mayfield	5	5	5	60							25			tr	tr			
B18	13756	8/09/2015	Elcho St, Hamilton	5	tr	tr	95										tr	tr			
B19	13757	8/09/2015	Kings Rd, Tighes Hill	15	tr	tr	85										tr	tr			
B20	13758	8/09/2015	Neville St, Mayfield	15	tr		75							10			tr	tr			
B21	13759	8/09/2015	Hargrave St, Carrington	15	tr		75							10							
B22	13760	8/09/2015	Bourke St, Mayfield	5	5		90														
B23	13761	9/09/2015	Stevenson Pl, Newcastle East	15	5	10	45			10							5	10			
B24	13762	9/09/2015	Gregson St, Mayfield West	10	5		85										tr				

Table 21 Detailed Stereomicroscopy Results for Dust Gauge Samples: Visual Composition Identification Analysis

Sample ID	Analysis ID	Date Exposed	Date Collected	Sampling Site	Percentage of Sample																	
					Black			Inorganics and Minerals									Unclassified			General Organic Types		
					Coal	Soot	Black Rubber Dust	Soil or Rock Dust		Cement dust	Fly Ash	Salt	Calcium sulphate	Halite	Alumina	Copper Sludge	P/S Slime and Fungi	Insect Debris - General	Plant Debris (General)	Wood	Fibres (miscellaneous)	Paint
D1	13079	17/10/2014	14/11/2014	Carrington	10	5	5	75									tr	tr	5			
D2	13143	12/12/2014	9/01/2015	Islington	5	tr	tr	95								tr		tr	tr		tr	
D3	13173	12/12/2014	9/01/2015	Mayfield East	10c	2c		18c								30c	30c	tr	10c			
D4	13239	9/01/2015	6/02/2015	Mayfield West	5	tr	tr	95								tr		tr	tr			
D5	13286	6/02/2015	6/03/2015	Tighes Hill		tr		50c								20c	30c				tr	
D6	13398	6/03/2015	7/04/2015	Waratah	5	5	5	75										tr	10			
D7	13469	7/04/1945	5/05/2015	Stockton South		tr	tr	65										20	10		5	
D8	13496	5/05/2015	2/06/2015	Stockton North	20	10	2	63								tr		tr	5			tr
D9	13555	2/06/2015	3/07/2015	Stockton North	20	10	5	60									tr	5			tr	
D10	13632	3/07/2015	3/08/2015	Newcastle East	15	2	tr	73										tr	10			
D11	13746	3/08/2015	3/09/2015	Wickham	20	tr	5	50										5	20		tr	
D12	13764	3/09/2015	2/10/2015	Hamilton	20	5		50										10	15			

Table 22 Detailed Stereomicroscopy Results for Petri Dish Samples: Visual Composition Identification Analysis

Sample ID	Analysis	Date Exposed	Date Collected	Sampling site	Percentage of Sample																	
					Black			Inorganics and Minerals									Unclassified			General Organic Types		
					Coal	Soot	Black Rubber Dust	Soil or Rock Dust		Cement dust	Fly Ash	Salt	Calcium sulphate	Halite	Alumina	Copper Sludge	P/S Slime and Fungi	Insect Debris - General	Plant Debris (General)	Wood	Fibres (miscellaneous)	Paint
P1	13080	14/11/2014	15/11/2014	Tighes Hill (DDG site)	5	tr	tr	90										tr	5			tr
P2	13144	17/12/2014	18/12/2015	Carrington (DDG site)	tr	tr		90				5	5			tr		tr	tr			
P3	13145	17/12/2014	18/12/2014	Mayfield East (DDG site)	tr	tr		95				5	tr		tr	tr		tr	tr			
P4	13296	18/02/2015	20/02/2015	Mayfield West (DDG site)	5	tr		75											20			
P5	13297	18/02/2015	20/02/2015	Ferndale St, Tighes Hill	10	5	tr	65										tr	20			tr
P6	13298	18/02/2015	20/02/2015	Waratah (DDG site)	10	tr	tr	60						20				tr	10		tr	
P7	13299	18/02/2015	20/02/2015	Islington (DDG site)	5	tr	tr	90						5				tr	tr	tr		
P8	13300	5/03/2015	6/03/2015	Kerr St, Mayfield	tr	tr		70						20				tr	10	tr	tr	
P9	13301	5/03/2015	6/03/2015	Selwyn St, Tighes Hill	10	tr	10	50						20				tr	10			
P10	13399	8/04/2015	8/04/2015	Warabrook Blvde, Warabrook	10		tr	50										30	10			
P11	13400	8/04/2015	8/04/2015	Stockton South (DDG site)	15	5		65										5	10			
P12	13401	8/04/2015	8/04/2015	Stockton North (DDG site)	10	10		60										tr	20		tr	
P13	13470	11/05/2015	13/05/2015	Newcastle East (DDG site)	10	tr	tr	85											5			
P14	13471	11/05/2015	13/05/2015	Stockton North (DDG site)	20	tr		75											5		tr	
P15	13472	11/05/2015	13/05/2015	Punt Rd, Stockton	5	3		87											5		tr	
P16	13473	11/05/2015	13/05/2015	Taylor Rd, Fern Bay	20	tr	5	75										tr	tr			
P17	13556	3/07/2015	7/07/2015	Stockton South (DDG site)	10	20	tr	65										tr	5		tr	
P18	13557	3/07/2015	7/07/2015	Stockton North (DDG site)	20	5	tr	75										tr	tr			
P19	13558	3/07/2015	7/07/2015	Carrington (DDG site)	10	5	5	75										tr	5		tr	
P20	13559	3/07/2015	7/07/2015	Tighes Hill (DDG site)	20	tr	5	75										tr	tr		tr	
P21	13560	3/07/2015	7/07/2015	Hamilton (DDG site)	20	tr	5	75										tr			tr	
P22	13633	3/08/2015	6/08/2015	Mayfield West (DDG Site)			10	70										20	tr			
P23	13634	3/08/2015	6/08/2015	Stockton North (DDG site)	10	5		75										tr	10			
P24	13635	3/08/2015	6/08/2015	Carrington (DDG site)	5	5	5	75										tr	10			
P25	13636	3/08/2015	6/08/2015	Newcastle East (DDG site)	5	tr	20	65										tr	10			
P26	13747	17/08/2015	3/09/2015	Stockton South (DDG site)	10	tr	5	55										tr	30			
P27	13748	17/08/2015	20/08/2015	Stockton North (DDG site)	15	tr	5	75							5			tr	tr		tr	
P28	13749	28/08/2015	31/08/2015	Bourke St, Carrington	10	tr	20	40										tr	30		tr	
P29	13750	28/08/2015	31/08/2015	Wright Ln, Honeysuckle	5	tr	20	45										tr	30		tr	
P30	13751	17/08/2015	20/08/2015	Stockton South (DDG site)	25	15	5	55							tr			tr	tr			
P31	13765	9/09/2015	11/09/2015	Mayfield East (DDG site)	5		20	45										10	15		5	
P32	13766	9/09/2015	11/09/2015	Waratah (DDG site)		5	20	45										10	15		5	
P33	13767	2/10/2015	6/10/2015	Carrington (DDG site)	10	15	10	55										5	5			
P34	13768	2/10/2015	6/10/2015	Newcastle (DDG site)	5	5	15	40			10							10	15			
P35	13769	2/10/2015	6/10/2015	Broadmeadow (train station)	10	5	10	40			5							20	10			
P36	13770	2/10/2015	6/10/2015	Eucalyptus Cct, Warabrook	5	5	10	50			10							10	10			

AECOM Australia Pty Ltd
ABN 20 093 846 925

This is the end of the document