DustScanAQ

P10650

Dust Characterisation Study

August, 2022

Buro Blauw b.v

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Document Control Sheet

Project Information

Title	Dust Characterisation Report
Project Ref.	ZBBP10650
Report Ref.	ZBBP10650_RevA_Draft
Report Type	Microscopy
Client	Buro Blauw b.v
Client Contact	[redacted]
Revision	A
Status	Draft
Date of Issue	08 August 2022

Revision History

Issue	Date	Author	Reviewer	Approver	Status
A	08 August 2022	[redacted]	[redacted]	[redacted]	Draft

Distribution

Organisation	Contact	Date of Issue	Copies
Buro Blauw b.v	[redacted]	08 August 2022	1

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Report Prepared By

DustScanAQ
Unit 8 Nimrod
De Havilland Way
Witney
Oxfordshire
OX29 0YG
United Kingdom
Tel: + 44 (0) 1608 810110
E-mail: info@dustscan.co.uk
Web: www.DustScan.co.uk

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1 Introduction

Buro Blauw b.v (herein “BB”) instructed DustScanAQ (DS) to carry out optical light microscopy analysis on eight directional dust samples from their site at P10650.

Directional dust monitoring was carried out at two locations with 1 week sampling intervals between 15 March and 12 April 2022.

It is understood that the site in question contains numerous large greenhouses. The site is surrounded to the east and south by arable fields, to the west and north by industrial areas.

The aim of this investigation was to analyse specific segments of the directional dust samples from the southwest and northwest and to determine the materials and potential sources of the dust.

The specific materials for investigation, as instructed by BB include; stone/rock/concrete/cement dust, fertiliser, grain/flour products and incinerator bottom ash. These materials are all known to be handled by companies working in the locality.

2 Methodology

2.1 Directional dust monitoring

Directional dust was monitored using DustScan sticky pad directional dust samplers. Being cylindrical, the samplers collect dust from 360° around the sampling head and are reported in discrete 15° intervals (i.e. 0 – 15°, 15 – 30° and so on).

Directional dust samples were analysed for dust coverage (Absolute Area Coverage - AAC) and dust soiling (Effective Area Coverage - EAC) which are typically expressed as %AAC and %EAC, both per sampling interval and per day. The potential risk of annoyance through directional dust at each sampling location was assessed in accordance with the 'risk' matrix in Table 2.1.

Table 2.1: Directional dust annoyance 'risk' matrix for use with directional dust samplers

EAC: Dust soiling	AAC: Dust coverage				
	Level 0: <80%/interval	Level 1: 80 to <95%/interval	Level 2: 95 to <99%/interval	Level 3: 99 to 100%/interval	Level 4: 100% over 45°/interval
Level 0: <0.5%/day	Very Low	Very Low	Very Low	Low	Medium
Level 1: 0.5 to <0.7%/day	Low	Low	Low	Medium	High
Level 2: 0.7 to <2.0%/day	Medium	Medium	Medium	High	High
Level 3: 2.0 to <5.0%/day	High	High	High	High	Very High
Level 4: ≥5%/day	Very High	Very High	Very High	Very High	Very High

2.1.1 Monitoring locations

DS100 directional dust monitoring gauges were installed by BB at the two locations shown in blue in Figure 2.1. It is understood that this area was experiencing elevated levels of dust, and it was suspected that this dust may have been derived from industrial sources in the locality, as shown in Figure 2.2.

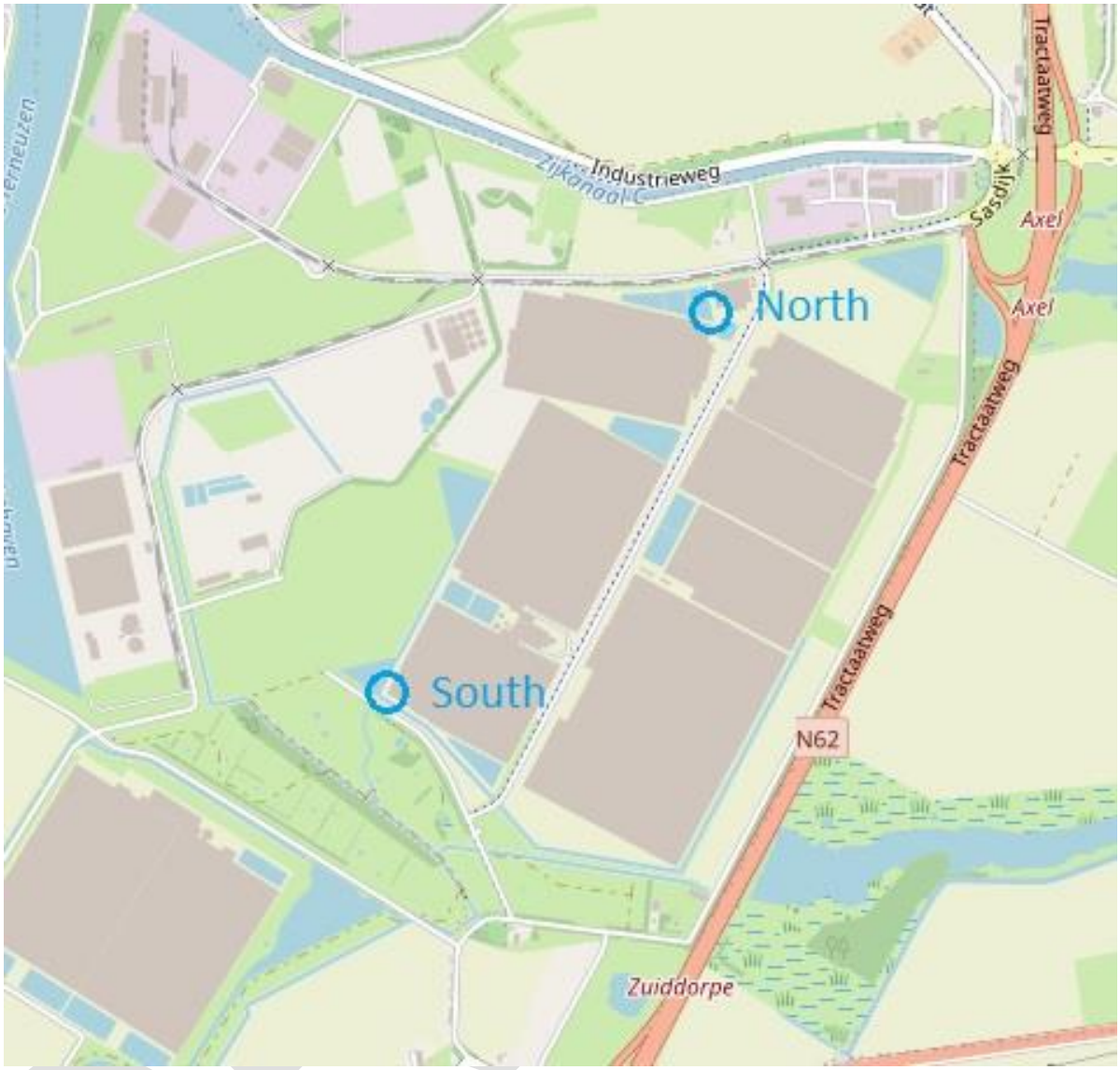

Figure 2.1: Dust monitoring locations

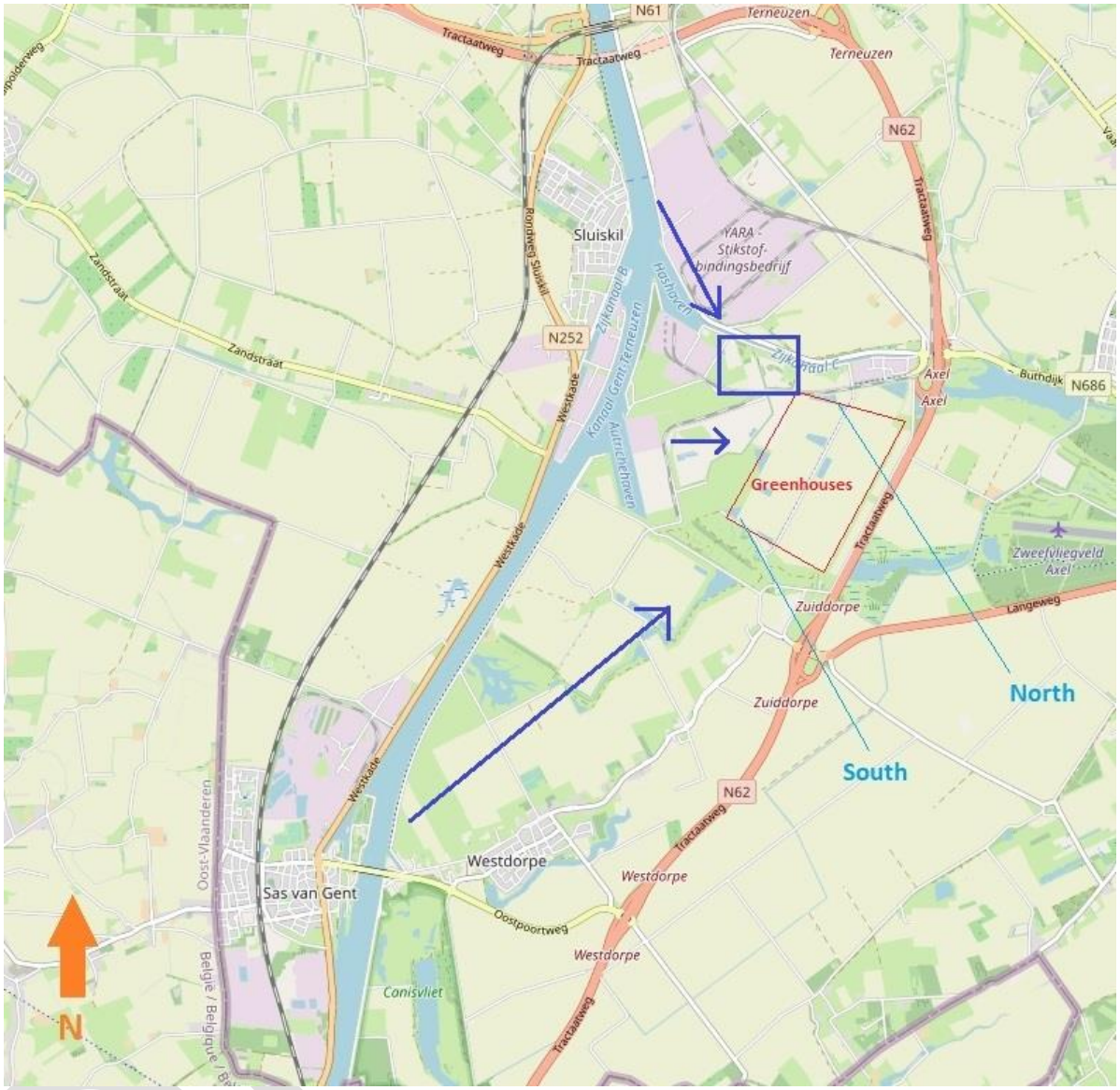

Figure 2.2: Dust monitoring locations with direction of suspected sources of contamination

2.2 Optical light microscopy

Optical light microscopy is an indicative method which enables objects to be examined in detail under different lighting conditions and from which comparative analyses of the samples can be made, based on established morphological and mineralogical techniques. These samples were analysed using a Motic BA310Pol microscope.

The microscope equipment at DS can be used to examine samples in reflected light (RL), plane-polarised light (PPL) and cross-polarised light (XPL).

RL microscopy enables observations that are essentially as seen by the naked eye but magnified, whilst PPL and XPL are used for mineralogical identifications in rock and soil samples. PPL and XPL are conventionally used with 'thin sections', which are specially prepared rock samples of a set thickness, typically 30 µm (micron).

Although the thickness of the materials mounted on the dust slides vary considerably the principles by which minerals are identified under PPL and XPL can be applied, with caution, to dust slides.

When analysing samples using light microscopy, materials are identified using a variety of optical and morphological characteristics. These include:

- Morphological characteristics:
  - The shape of individual grains (circularity, mean diameter, angularity);
  - The texture of grain surfaces (smooth, rough, patterned, etc.);
  - The spatial relationship between grains of similar or different composition (isolated, agglomerated etc.).
- Optical characteristics:
  - The colour of grains under RL ('true' colour);
  - The colour of grains under PPL (transmitted colour);
  - The opacity of grains under PPL;
  - The brightness and colour of interference colours under XPL; and
  - Extinction angles of mineral grains under XPL.

The results of the optical light microscopy analysis are discussed in terms of the relative proportions of materials in the samples. Materials observed can be considered **primary components** (indicated below using ●●●) when they are the most abundant materials present. These materials are observed in virtually every analysed field of view. **Secondary components** (●●) are not as abundant as primary, but they still represent a significant proportion of the sample and are present in most of the fields of view analysed. **Tertiary components** (●) are less abundant than secondary, and only make up a small proportion of the entire sample. They have observed in fewer than half of the fields of view analysed. Materials deemed to be **trace components** (○) of the sample are only detected in very small quantities but are considered worth highlighting due to the nature of the investigation. Where a material was not observed in any field of view in a particular sample, the material has been reported as not detected (ND).

Please note that every sample prepared for microscopy can contain a small proportion of materials that cannot be confidently identified using this technique alone or were not detected in sufficient quantities to be considered tertiary components. These materials are listed under ‘Other’ in the sample proportion tables.

The identity of the observed materials and their relative proportions are based on the observations made when viewing the sample, the expert opinion of DS technical scientists and background information on the samples and the environments from which they were collected.

The images presented in this report were taken under RL, PPL and XPL. A scale bar is given to indicate approximate dimensions of objects in the images. The images presented below indicate as to the constitution of the samples provided but might not be fully representative of dust sample and reference samples provided. Please also note that the observations may also consider images that were not included in this report in the interest of brevity.

For more quantitative analysis methods, please contact the DustScanAQ office.

3 Directional dust monitoring results

The directional dust results for each monitoring period are presented in Figure 3.1 to Figure 3.4 using the directional dust annoyance 'risk' matrix described above.

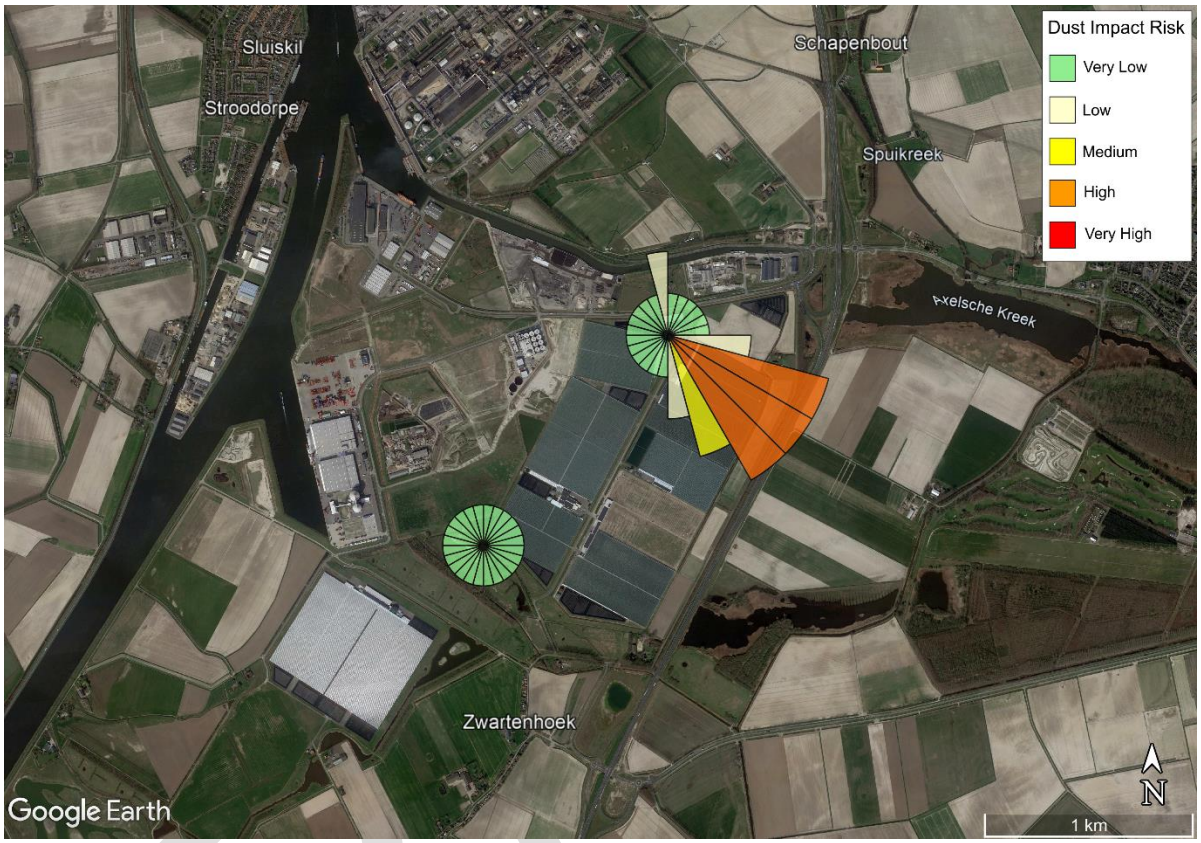

Figure 3.1: Directional dust results, 15 March – 22 March 2022

For the first sampling interval 15 – 22 March 2022, the North side dust monitor recorded High dust impact risk from the southeast. The South side dust monitor recorded Very Low dust impact risks from all directions.

Figure 3.2: Directional dust results, 22 March – 29 March 2022

For the second sampling interval 22 – 29 March 2022 both the North and South monitors recorded Very Low dust impact risks from all directions.

Figure 3.3: Directional dust results, 29 March – 05 April 2022

For the third sampling interval 29 March – 05 April 2022 results were similar to the second sampling interval with dust impact risks recorded as Very Low at both monitoring locations from all directions.

Figure 3.4: Directional dust results, 05 April – 12 April 2022

For the fourth sampling interval 05 – 12 April 2022 the North side dust monitor recorded a Low dust impact risk from the northwest and the South side monitor also recorded Low dust impact risks from the southwest to northwest. All other directions for both monitoring locations recorded Very Low dust impact risks.

3.1 Sample Section

Table 3.1 below shows the samples analysed by optical light microscopy with the specific directions which were investigated. These directions were informed by BB with reference to the directions shown in Figure 2.2.

Table 3.1: Samples selected for microscopy including directions analysed

Monitoring period	Directional samples	Direction analysed
15/03/22 – 22/03/22	North South	NW 285° – 315° SW 210° – 240°
22/03/22 – 29/03/22	North South	NW 285° – 315° SW 210° – 240°
29/03/22 – 05/04/22	North South	NW 285° – 315° SW 210° – 240°
05/04/22 – 12/04/22	North South	NW 285° – 315° SW 210° – 240°

4 Microscopy results

The results of analysis of the directional dust samples are given in Section 4.1 and 4.2.

4.1 Observed materials

Table 4.1 provides a brief description of all materials observed in the directional dust samples. Representative, annotated photomicrographs are also presented below to provide visual identification of all the observed materials (Figure 4.1 – Figure 4.2).

Table 4.1: Description of observed materials

Observed particles	Description	Possible material
Common mineral grains	Typically pale and translucent, but some appear reddish-brown or grey-blue in colour. Normally subangular to subrounded in shape. Under XPL, distinctive bright interference colours.	Common mineral grains such as quartz, calcite and gypsum from a variety of sources including local soils, rocks, construction activity and roads.
Black opaque material	Irregular opaque black particles, most likely from a variety of sources. Occasionally some display the characteristic sinuous appearance of rubber crumb, whilst others appear perfectly spherical (cenospheres).	Rubber (tyre) crumb, cenospheres associated with combustion, and unidentifiable material most likely related to industrial activity.
Fibres	Generally brightly coloured and translucent.	Textiles including clothing fibres.
Organic material	Generally pale brown to orange in colour, and irregular in shape. Some particles display identifiable surface features or morphology, whilst others are more amorphous.	Pollen grains, insect fragments, plant and fungal material.
Grain / flour	Spherical in shape with bright pale blue interference colours and distinctive black crosshair interference pattern.	Starch or flour grains

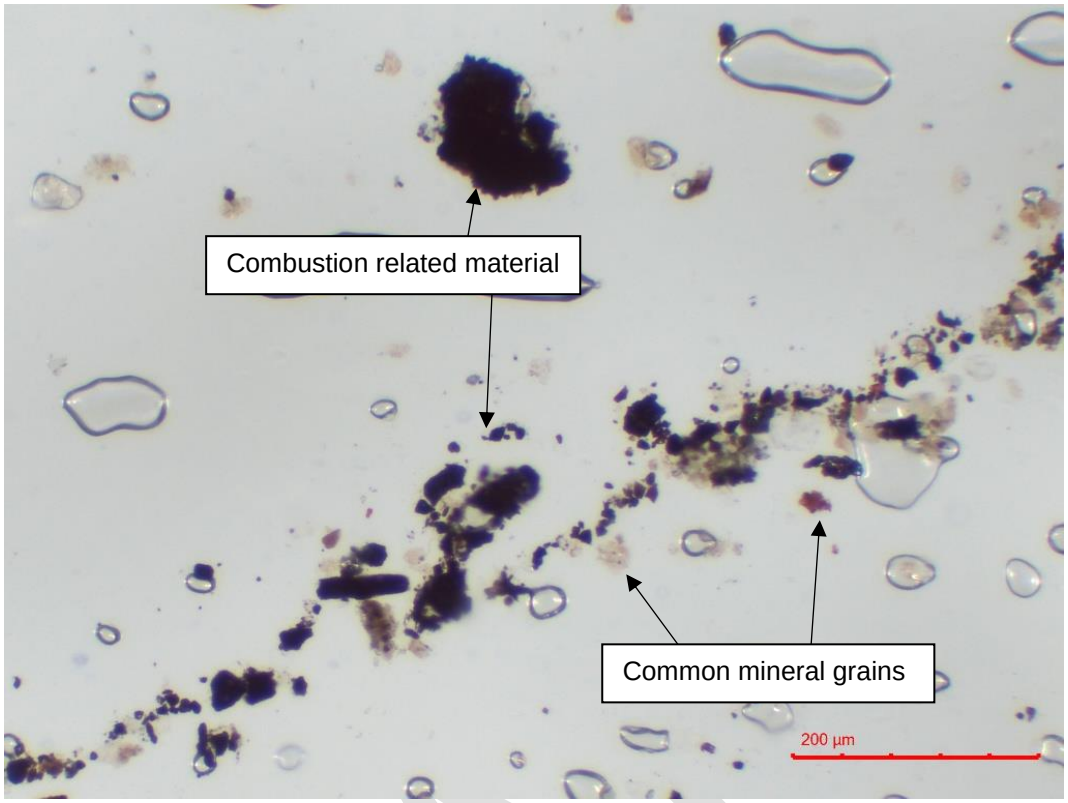

Figure 4.1: Annotated photomicrograph of North 15/03/22 – 22/03/22 RL

Figure 4.2: Annotated photomicrograph of South 15/03/22 – 22/03/22 RL

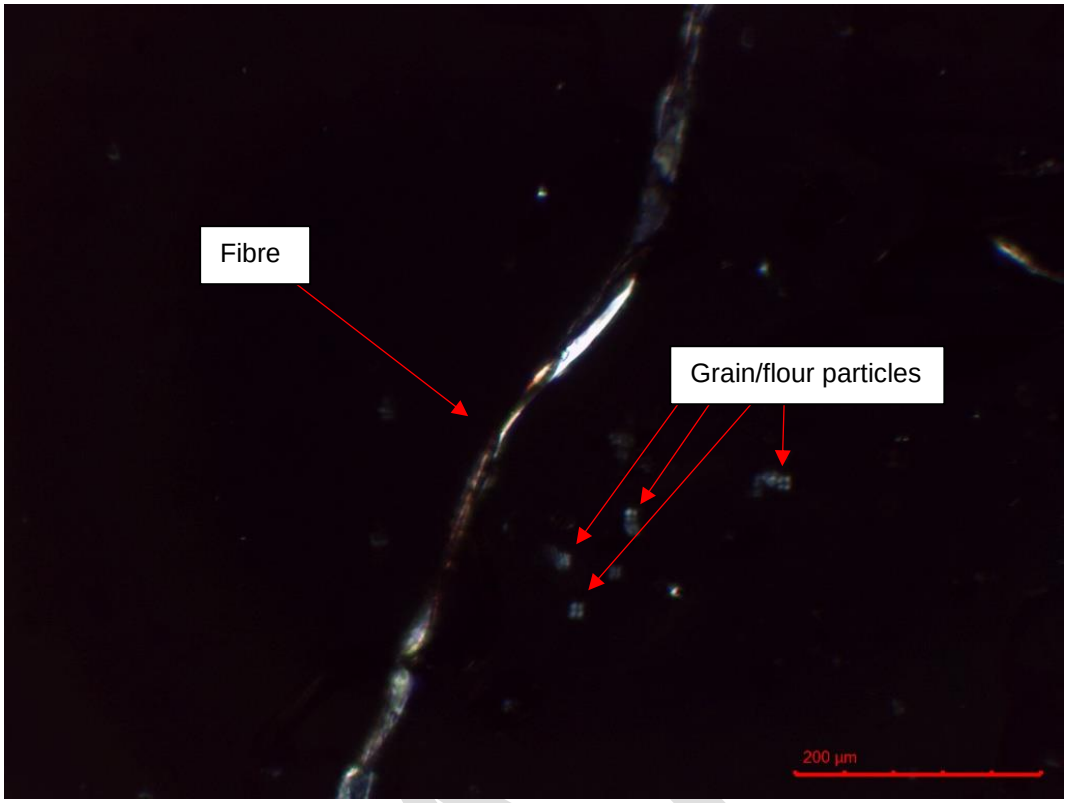

Figure 4.3: Annotated photomicrograph of South 29/03/22 – 05/04/22 XPL

4.2 Relative proportions

The relative proportions of materials observed in the directional dust samples collected between 15 March – 12 April 2022 are presented below in Table 4.2; they are discussed in detail in Section 5.

Table 4.2: Possible materials observed in the directional dust samples from the site between 15/03/22 – 12/04/22

Sample ID	Common mineral grains (stone/ concrete/ cement)	Black opaque material		Organic material	Grain / flour	Fibres	IBA	Fertiliser	Other
		Rubber (tyre) crumb	Combustion related						
124028 North	●●	○	●●●	●	ND	○	ND	ND	○
124029 South	●●●	ND	●	○	ND	ND	ND	ND	○
124030 North	●●●	●	●●	●	ND	●	ND	ND	○
124031 South	●●●	●	●●	●	ND	●	ND	ND	○
124032 North	●●	○	●●●	○	○	○	ND	ND	○
124033 South	●●●	●	●●	○	○	●	ND	ND	○
124034 North	●●●	●	●●	●●	ND	○	ND	ND	○
124035 South	●●●	ND	●●●	●●	ND	○	ND	ND	○

Key: Primary (●●●); Secondary (●●); Tertiary (●); Trace (○); ND (Not Detected)

5 Discussion

All eight of the samples provided were analysed by optical light microscopy; see additional microscopy images in Appendix A.

As evidenced by the dust monitoring results in Section 3, some of the directional dust samples analysed by optical light microscopy contained very little material; this typically makes confident identification of materials more difficult. It is important to note that the materials and proportions in the analysed segments would likely be very different from other directional segments.

As seen in Table 4.2, the primary component for the eight samples analysed is either common mineral grains or black opaque material. The common mineral grains are likely a combination of minerals such as quartz, calcite and gypsum, from a variety of sources. These minerals are commonly associated with construction materials but are likely also coming from local soils, rocks and roads. It is also possible that some proportion of this material may be derived from the industrial sources identified in the locality. The black opaque particles observed had predominantly two contrasting characteristics, one with an angular edges and the other displaying a distinctive sinuous appearance. The angular particles resemble typical combustion related materials and the sinuous particles resemble rubber (tyre) crumb likely derived from wear to tyres on the nearby roads. In general, a higher abundance of the black opaque particles is found in the North samples and a higher abundance of the common mineral grains is found in the South samples, however, this does not always apply. It is also worth noting that of the black opaque particles, the angular particles are more abundant than the sinuous ones.

Organic material was present in all the samples in varying relative proportions from secondary components to trace amounts. The organic material observed is thought to be primarily composed of pollen grains and plant matter. Organic material of this nature is another common component of dust in outdoor environments and can typically be regarded as a ‘background’ material.

Fibres were also found in most of the samples as either a tertiary or trace component. This is another typical component of dust and can come from a variety of textile sources including clothing.

The North and South samples from 29 March – 05 April 2022 contained trace amounts of what is likely starch grains. These particles are very distinctive due their crosshair interference pattern, and are most likely related to grain or flour handling and processing activities in the locality. Incinerator bottom ash (IBA) and fertiliser were not detected (ND) in any of the samples analysed.

6 Summary

Eight directional dust segments were analysed using optical light microscopy to investigate the materials present from southwest and northwest directions.

The findings of this report conclude that all of the samples contain primarily common mineral grains associated with construction materials and the local soils and rocks, as well as black opaque material likely derived from combustion processes. Starch particles were found in both of the samples from the third sampling interval but only in trace amounts. Incinerator bottom ash and fertiliser were not observed in any of the samples.

DustScanAQ
July 2022

Appendix A: Selected photomicrographs

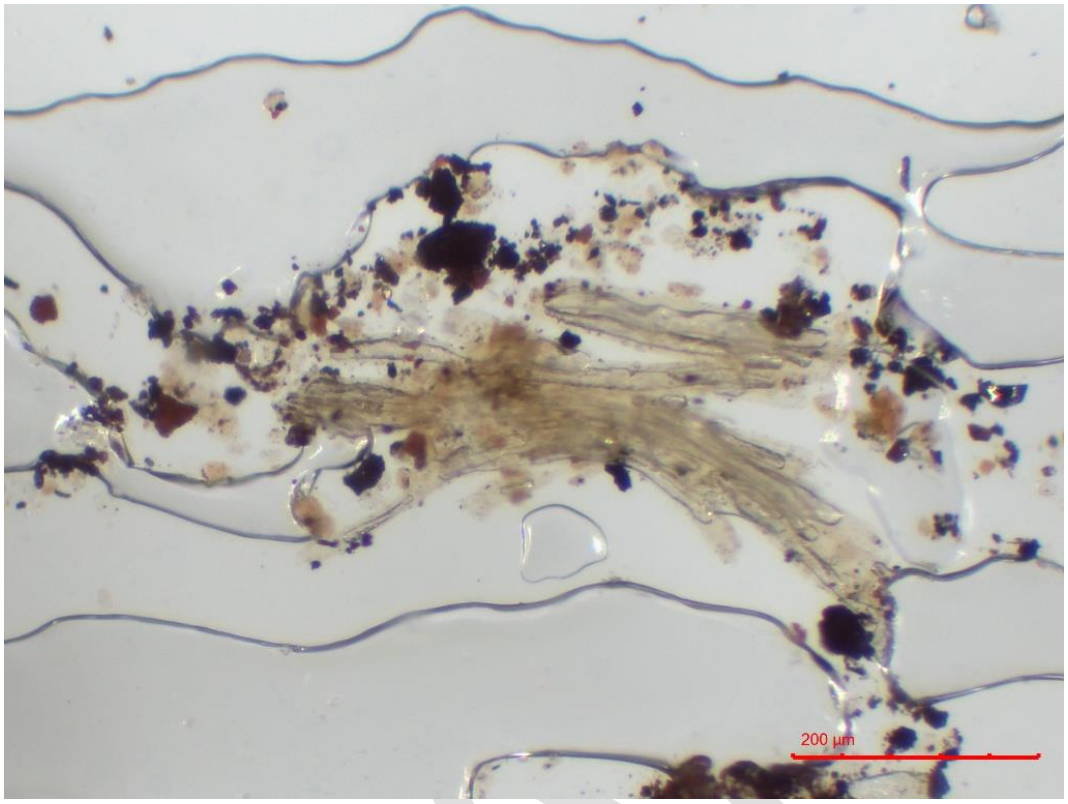

Figure A.1: 124028 North, 15/03/22 – 22/03/22 RL

Figure A.2: 124028 North, 15/03/22 – 22/03/22 RL

Figure A.3: 124028 North, 15/03/22 – 22/03/22 PPL

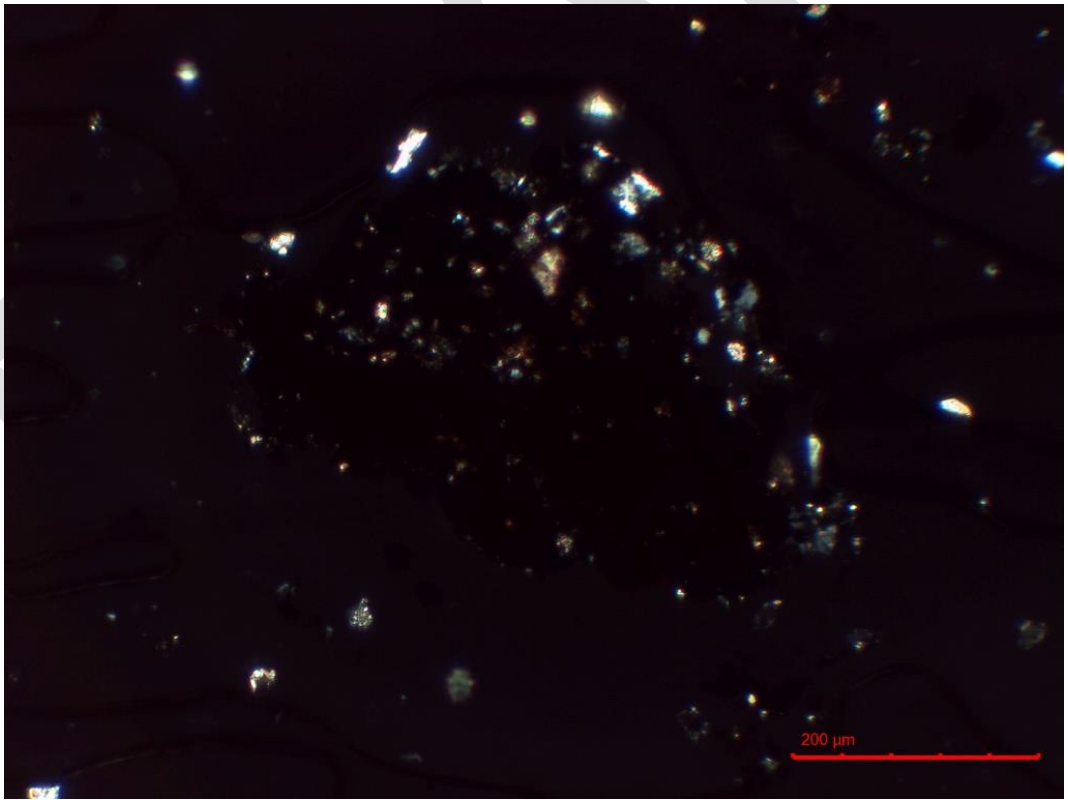

Figure A.4: 124028 North, 15/03/22 – 22/03/22 XPL

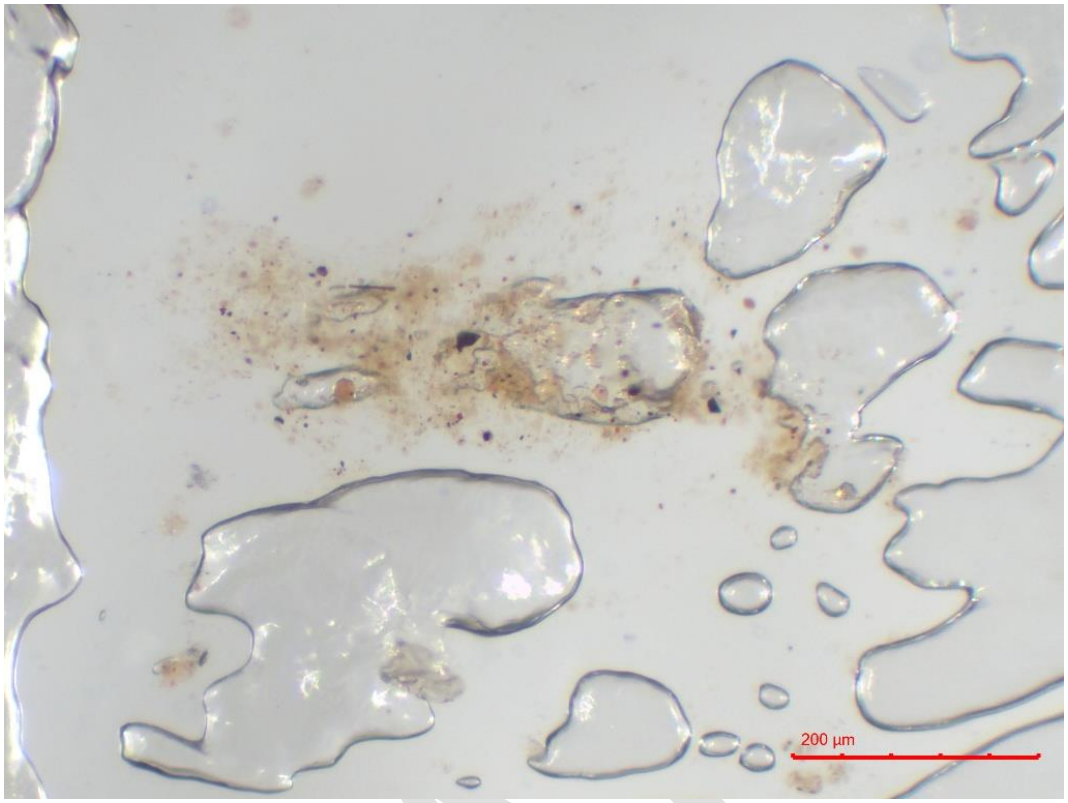

Figure A.5: 124029 South, 15/03/22 – 22/03/22 RL

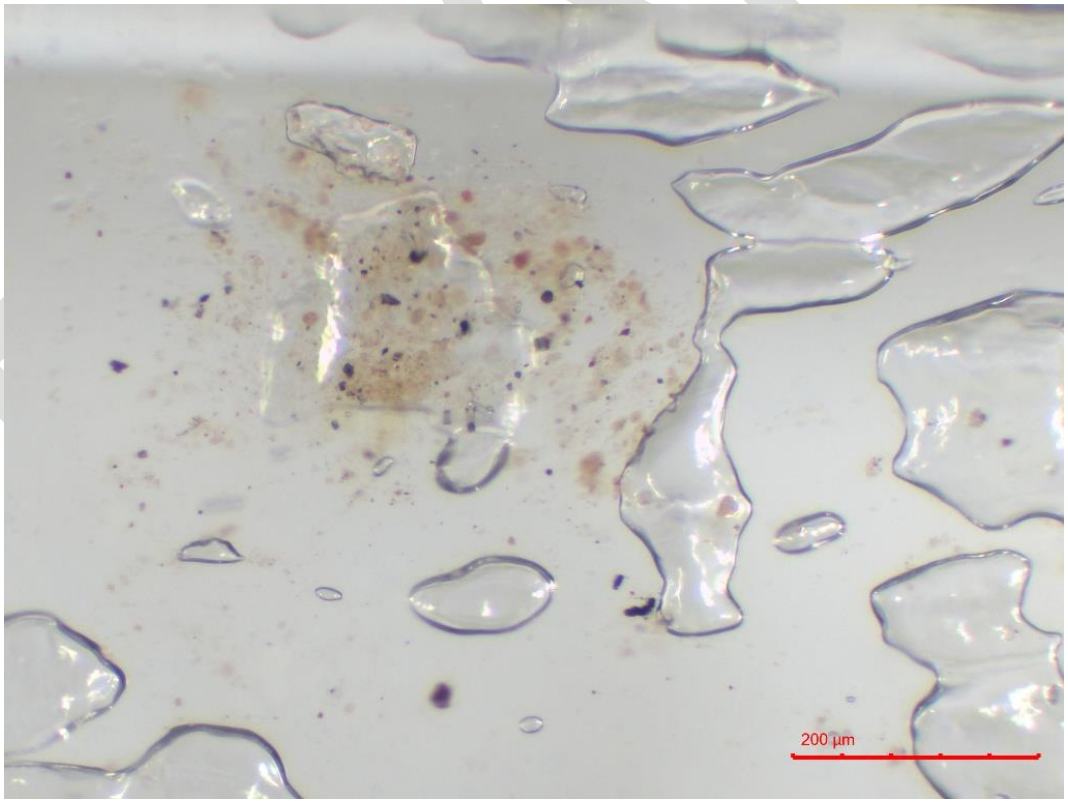

Figure A.6: 124029 South, 15/03/22 – 22/03/22 RL

Figure A.7: 124029 South, 15/03/22 – 22/03/22 PPL

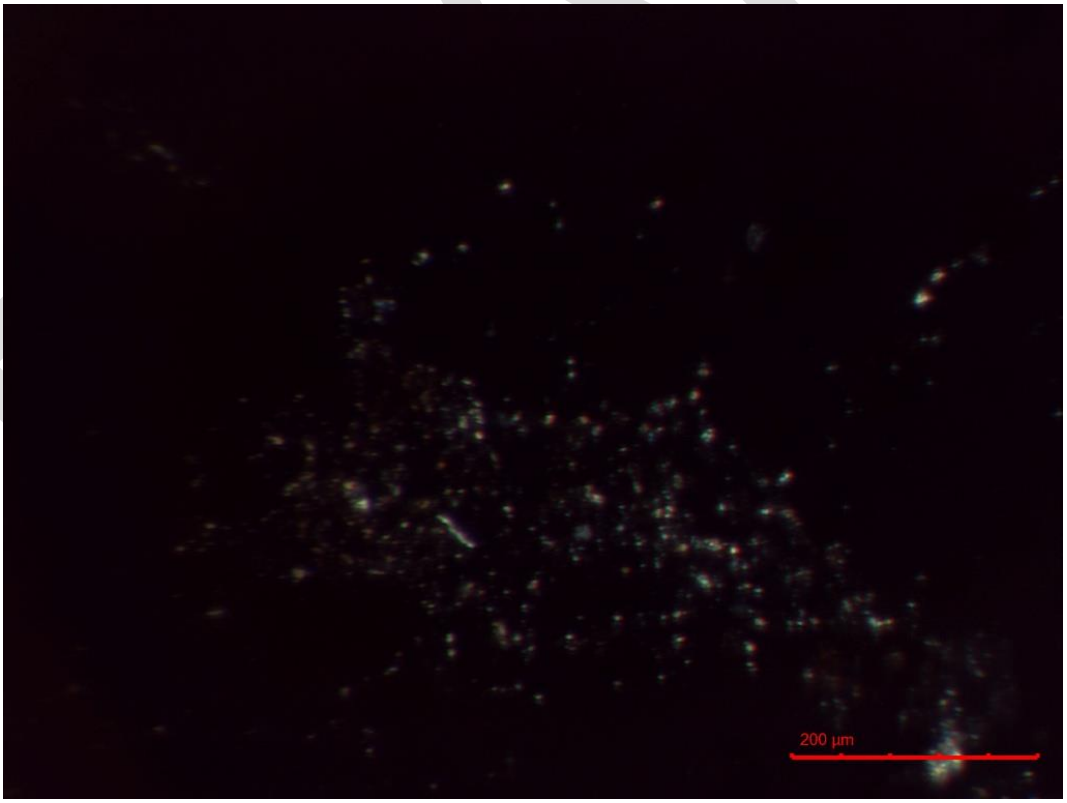

Figure A.8: 124029 South, 15/03/22 – 22/03/22 XPL

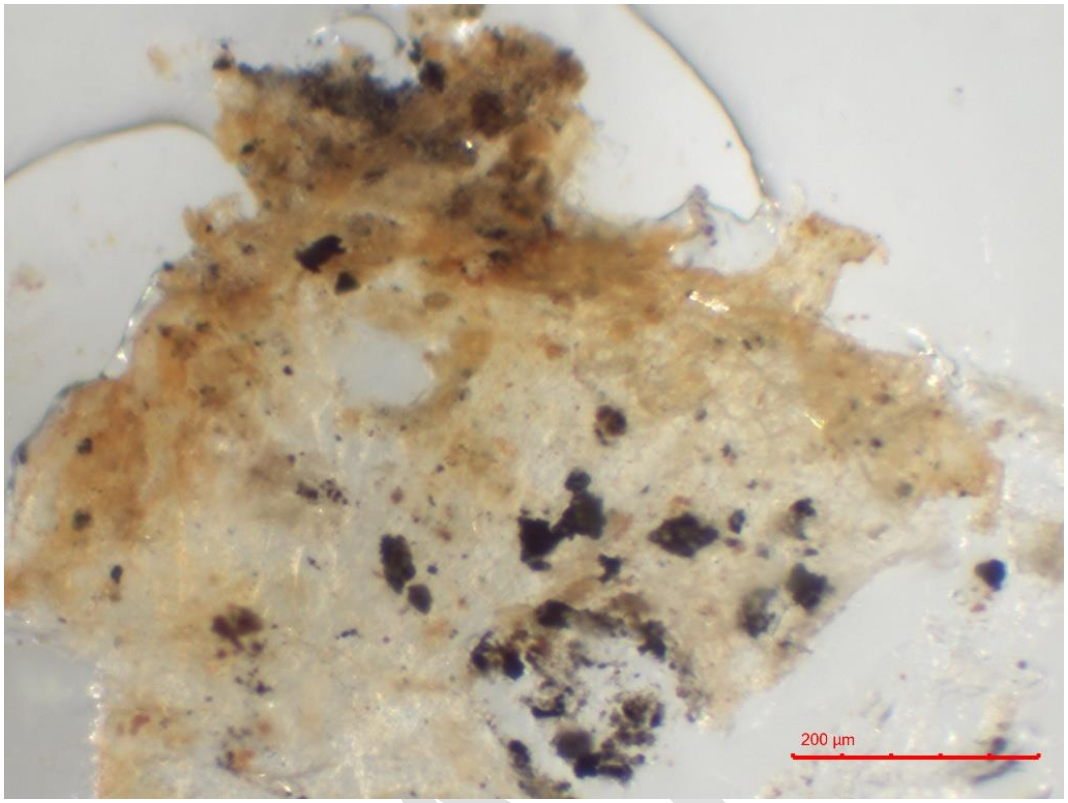

Figure A.9: 124030 North, 22/03/22 – 29/03/22 RL

Figure A.10: 124030 North, 22/03/22 – 29/03/22 RL

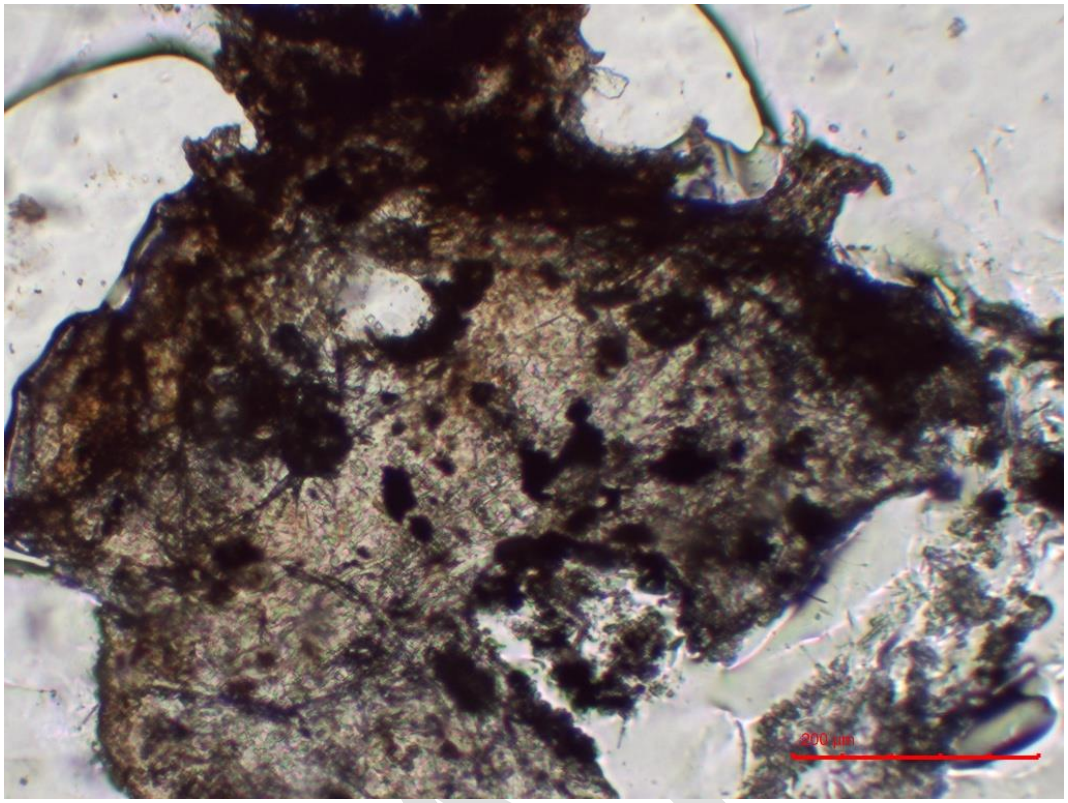

Figure A.11: 124030 North, 22/03/22 – 29/03/22 PPL

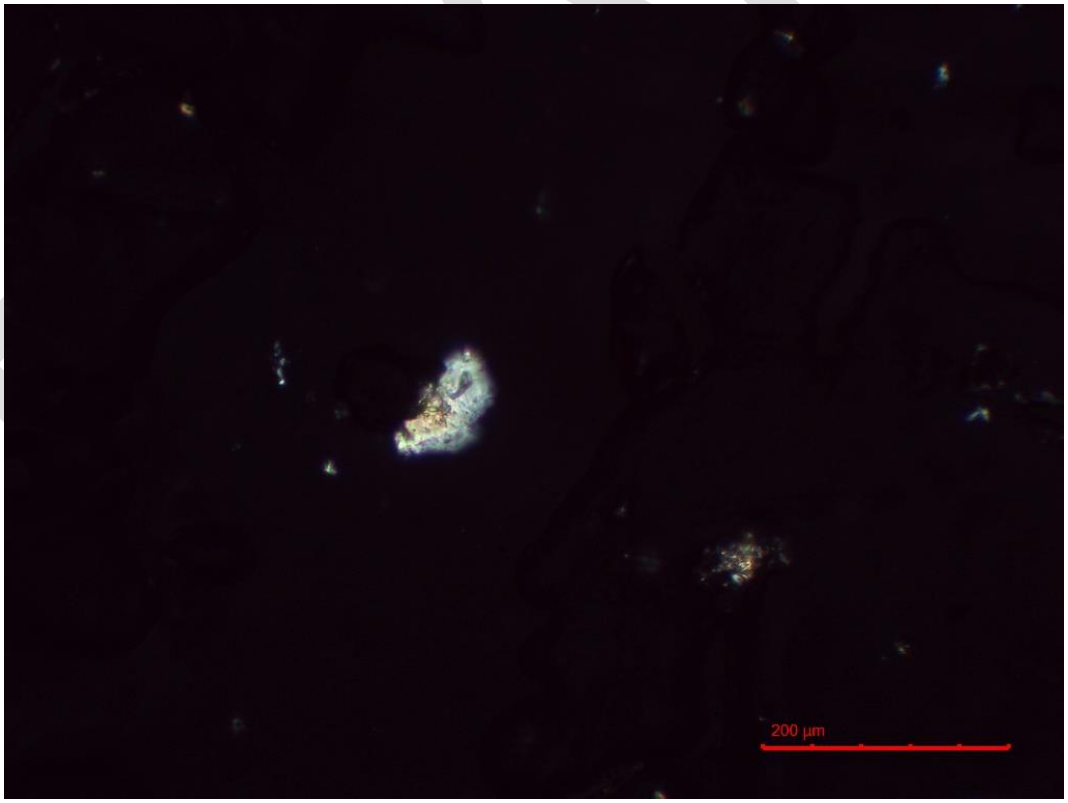

Figure A.12: 124030 North, 22/03/22 – 29/03/22 XPL

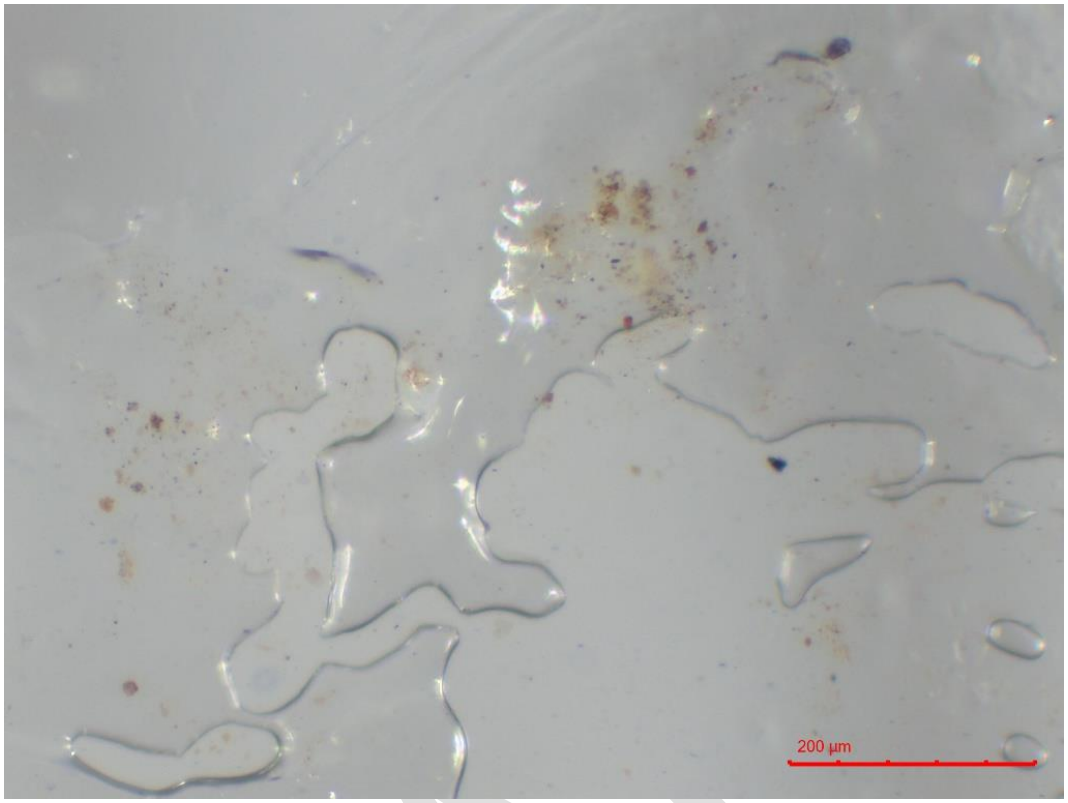

Figure A.13: 124031 South, 22/03/22 – 29/03/22 RL

Figure A.14: 124031 South, 22/03/22 – 29/03/22 RL

Figure A.15: 124031 South, 22/03/22 – 29/03/22 PPL

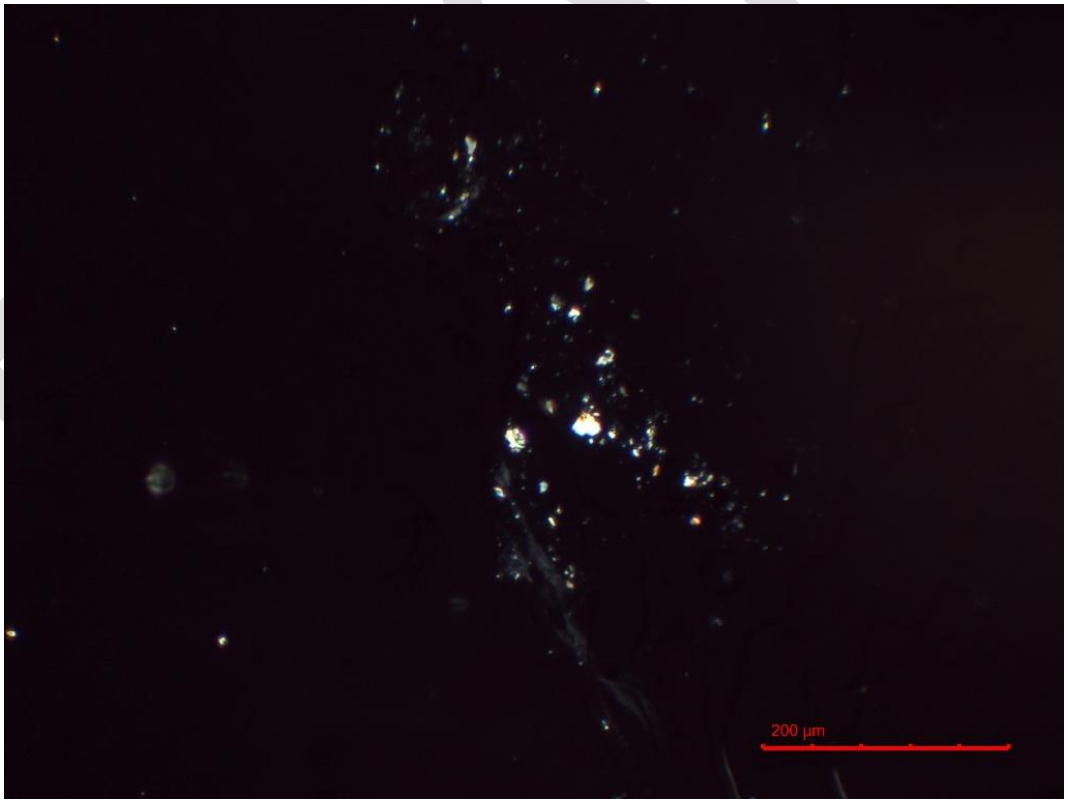

Figure A.16: 124031 South, 22/03/22 – 29/03/22 XPL

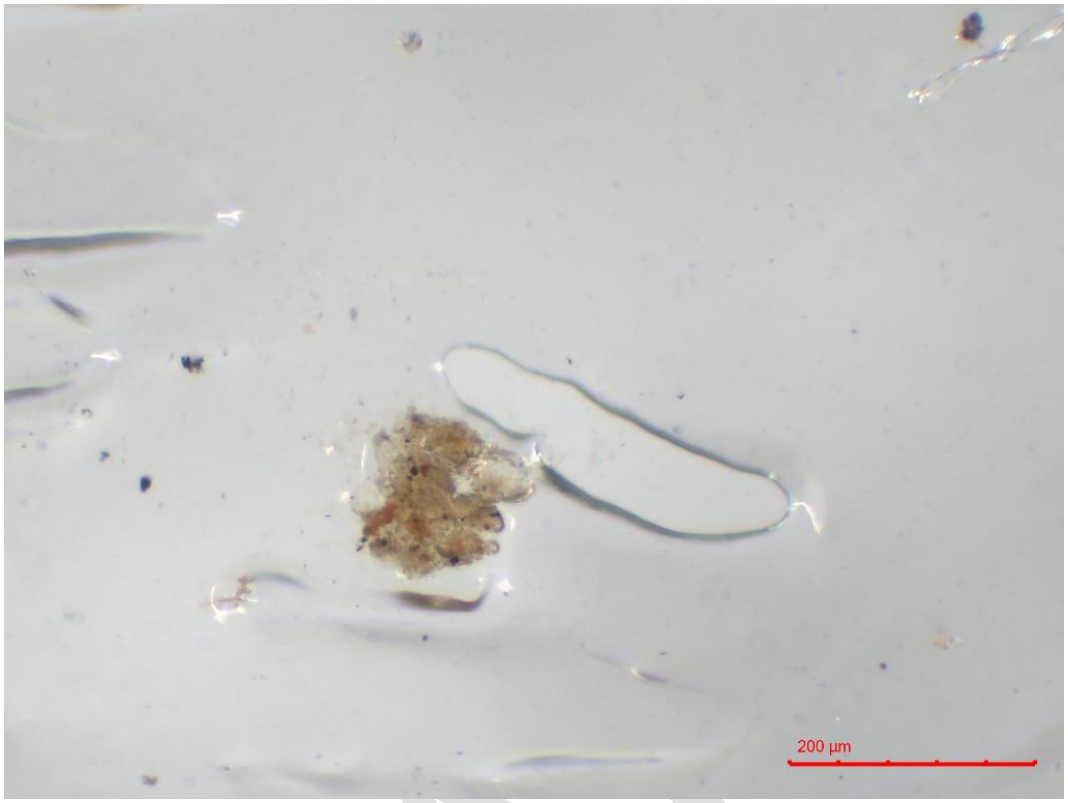

Figure A.17: 124032 North, 29/03/22 – 05/04/22 RL

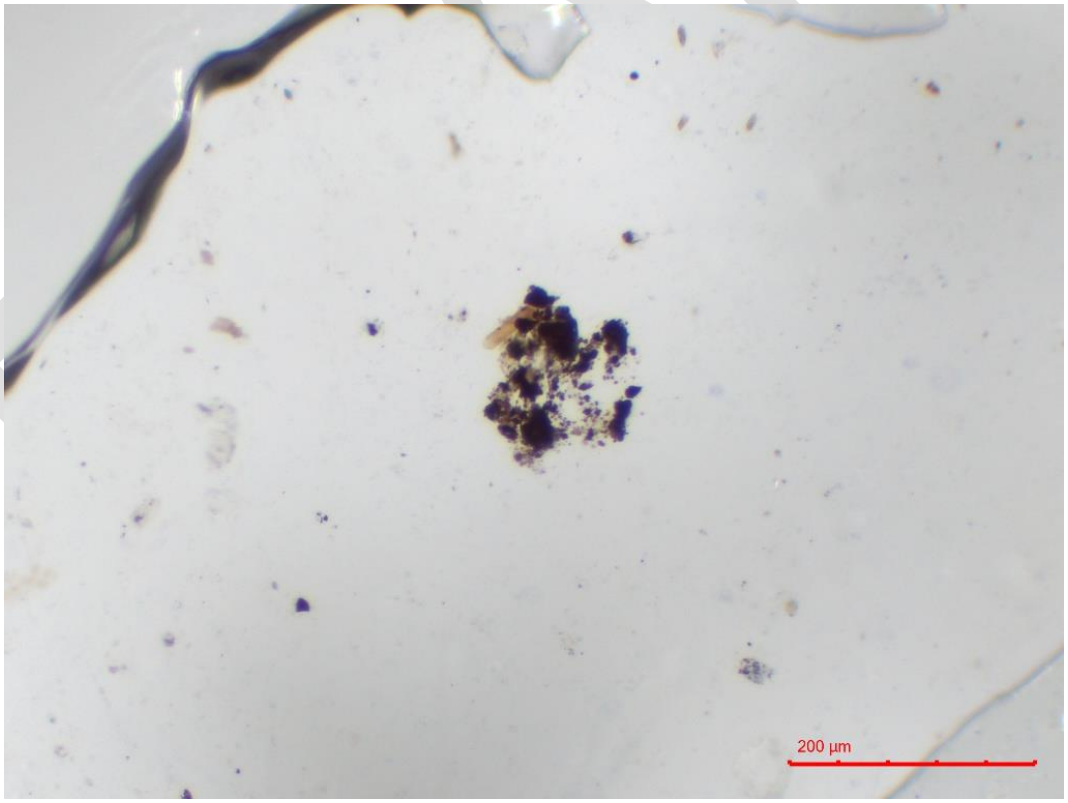

Figure A.18: 124032 North, 29/03/22 – 05/04/22 RL

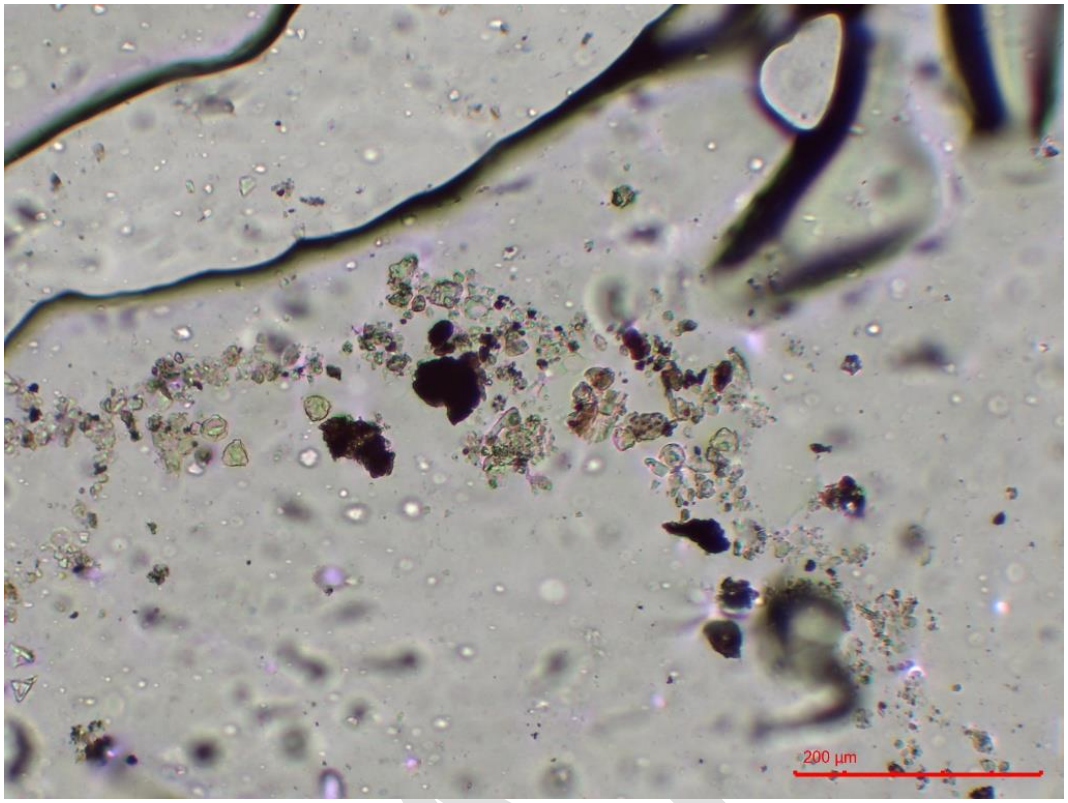

Figure A.19: 124032 North, 29/03/22 – 05/04/22 PPL

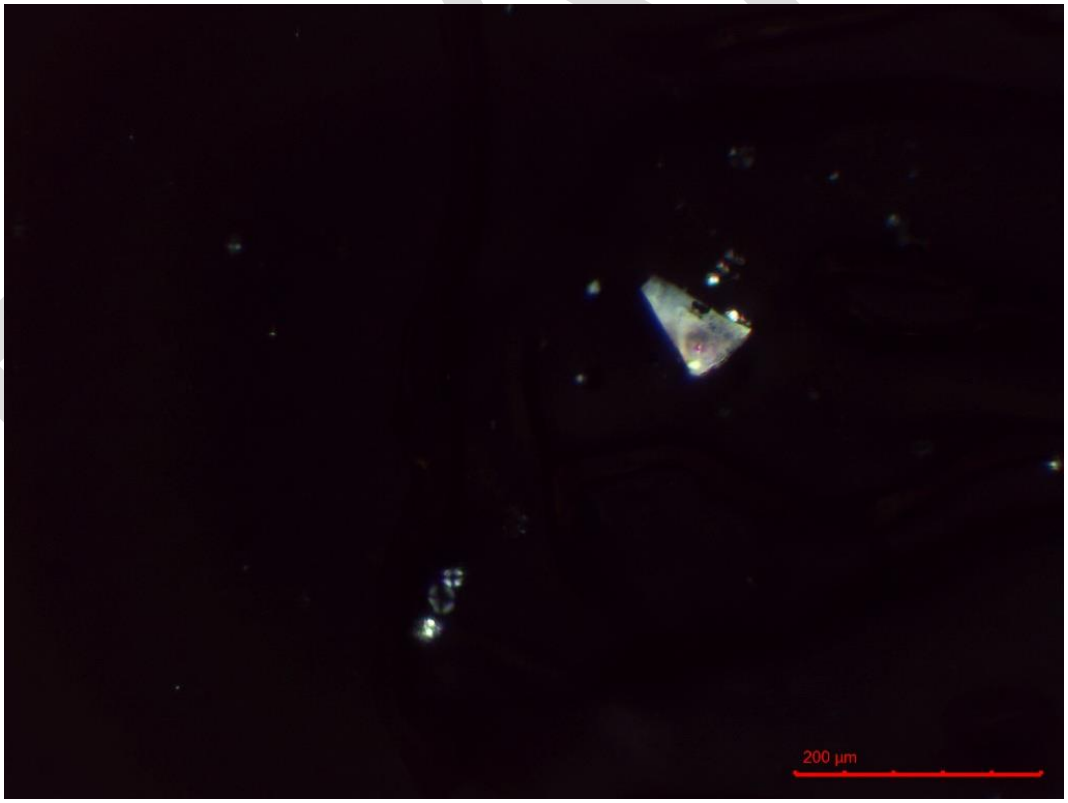

Figure A.20: 124032 North, 29/03/22 – 05/04/22 XPL

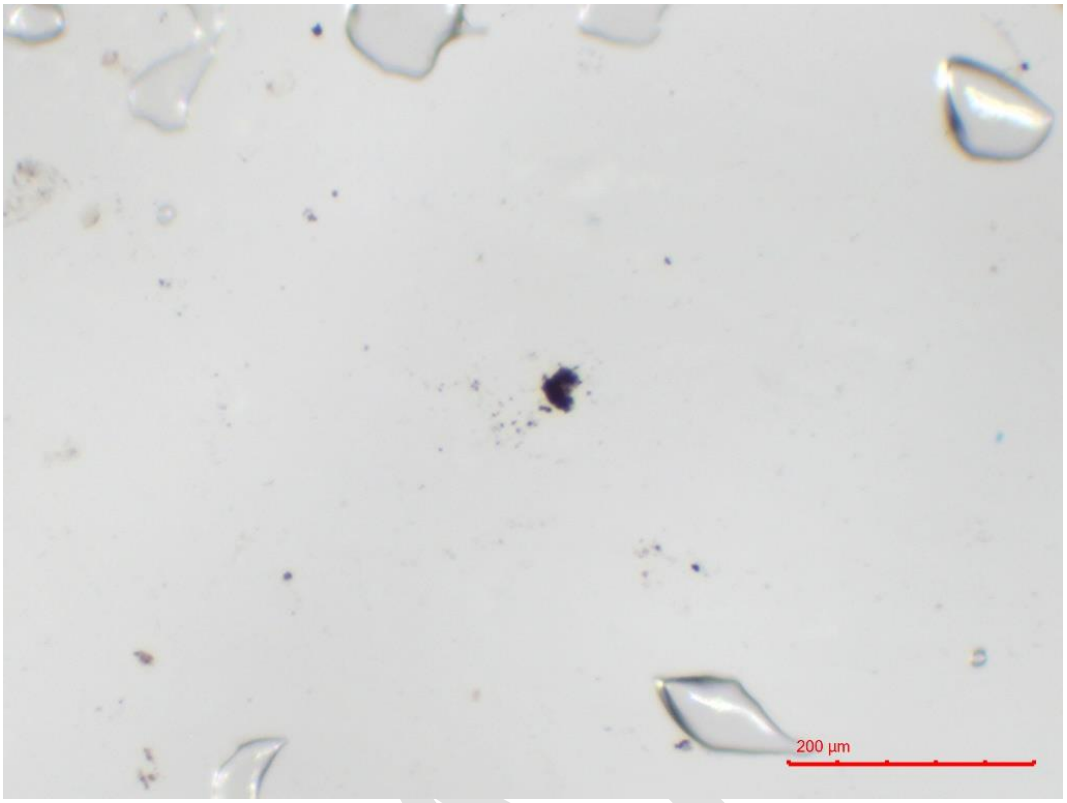

Figure A.21: 124033 South, 29/03/22 – 05/04/22 RL

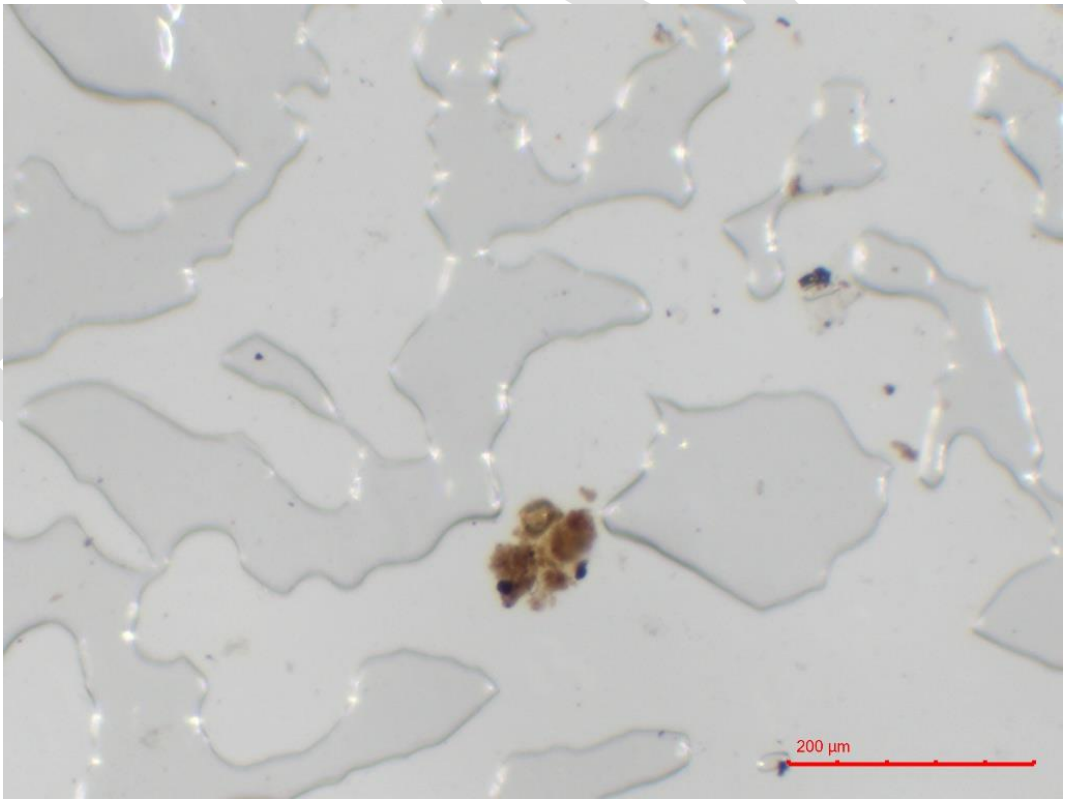

Figure A.22: 124033 South, 29/03/22 – 05/04/22 RL

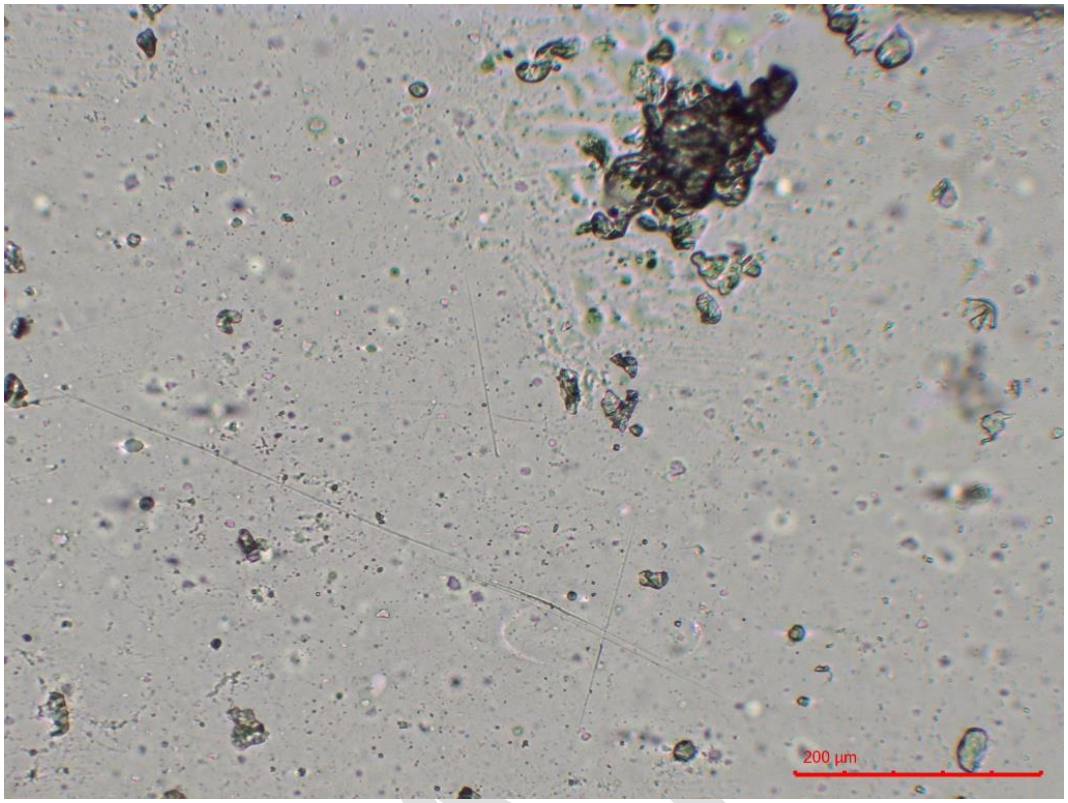

Figure A.23: 124033 South, 29/03/22 – 05/04/22 PPL

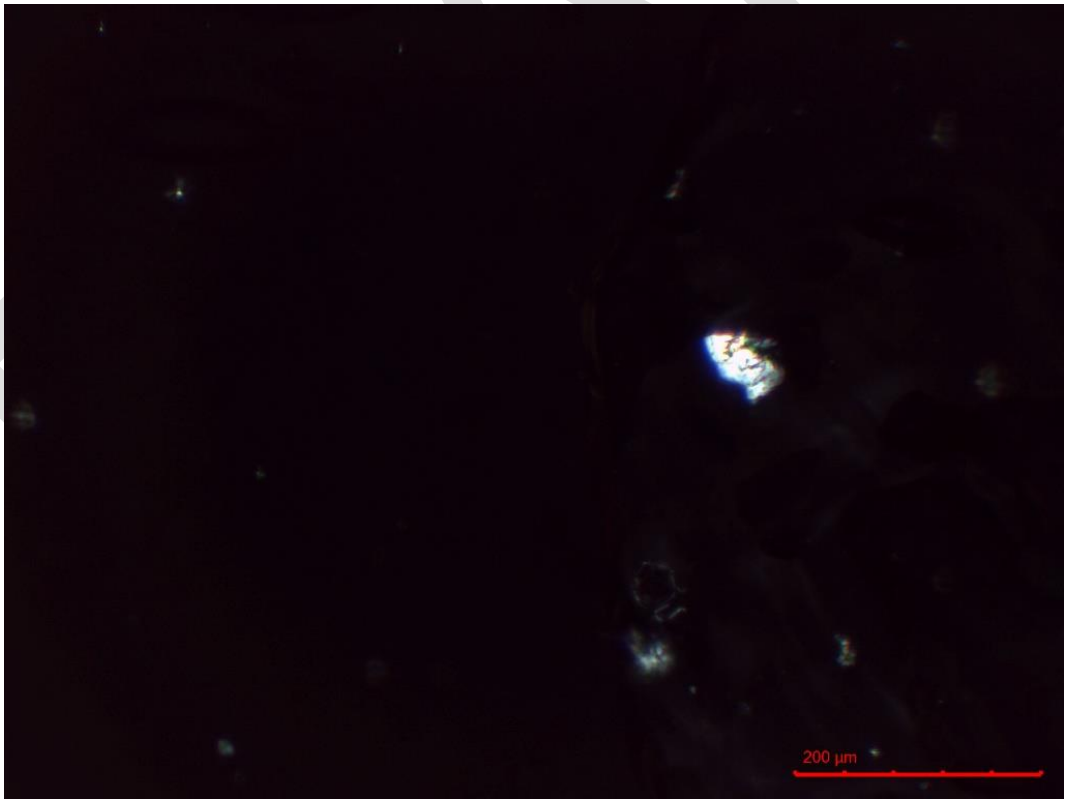

Figure A.24: 124033 South, 29/03/22 – 05/04/22 XPL

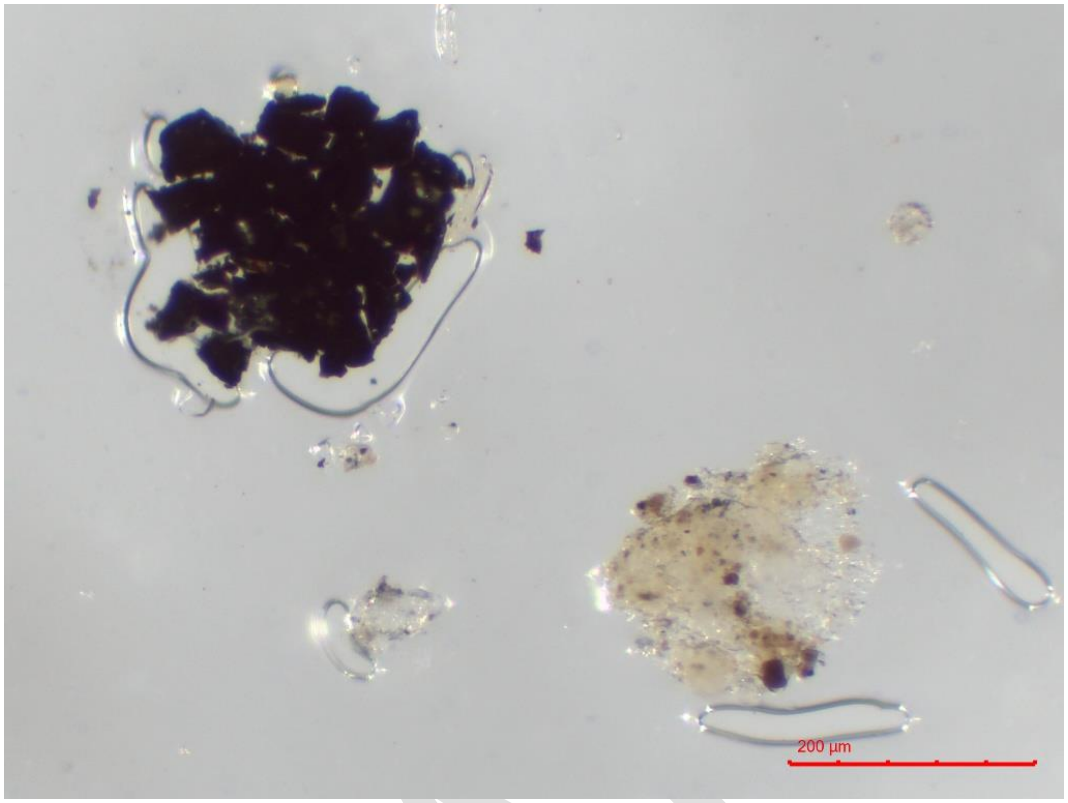

Figure A.25: 124034 North, 05/04/22 – 12/04/22 RL

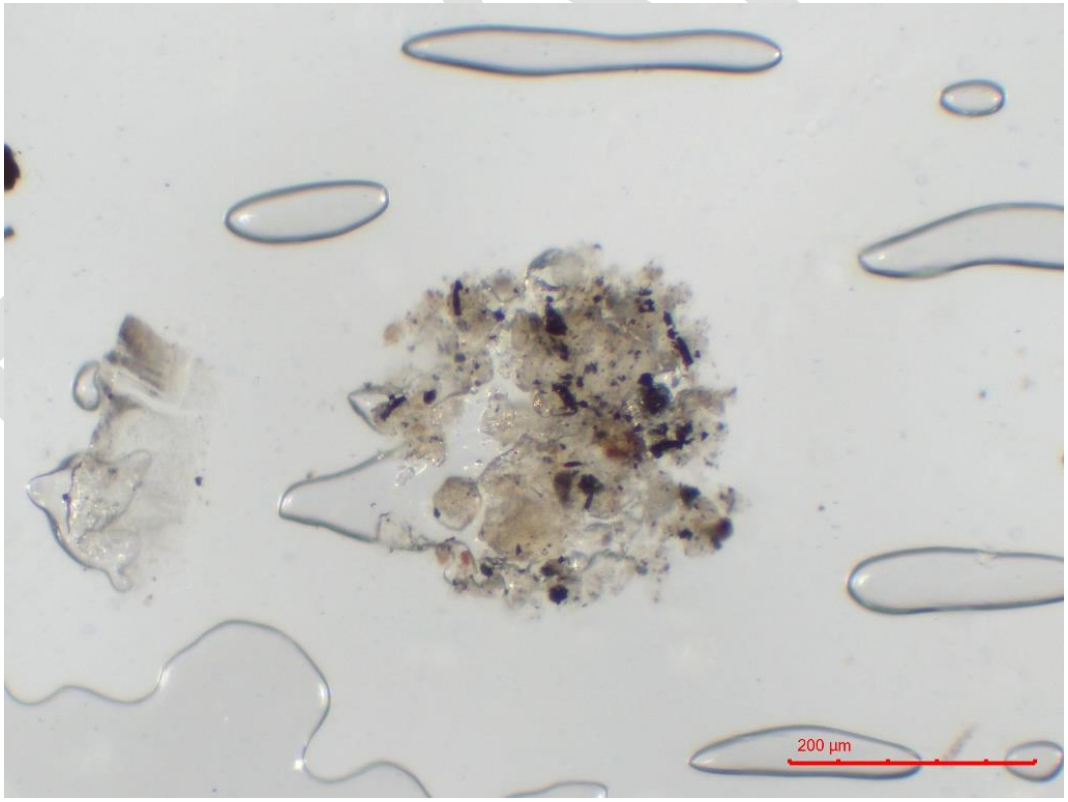

Figure A.26: 124034 North, 05/04/22 – 12/04/22 RL

Figure A.27: 124034 North, 05/04/22 – 12/04/22 RL

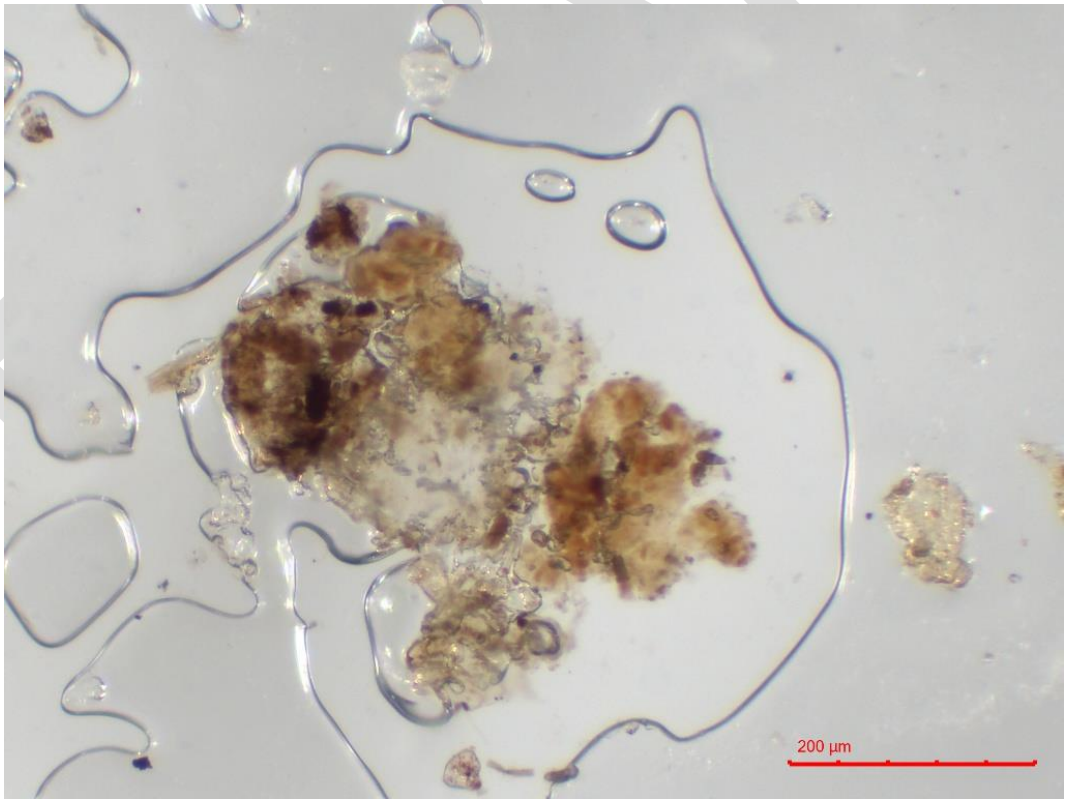

Figure A.28: 124034 North, 05/04/22 – 12/04/22 RL

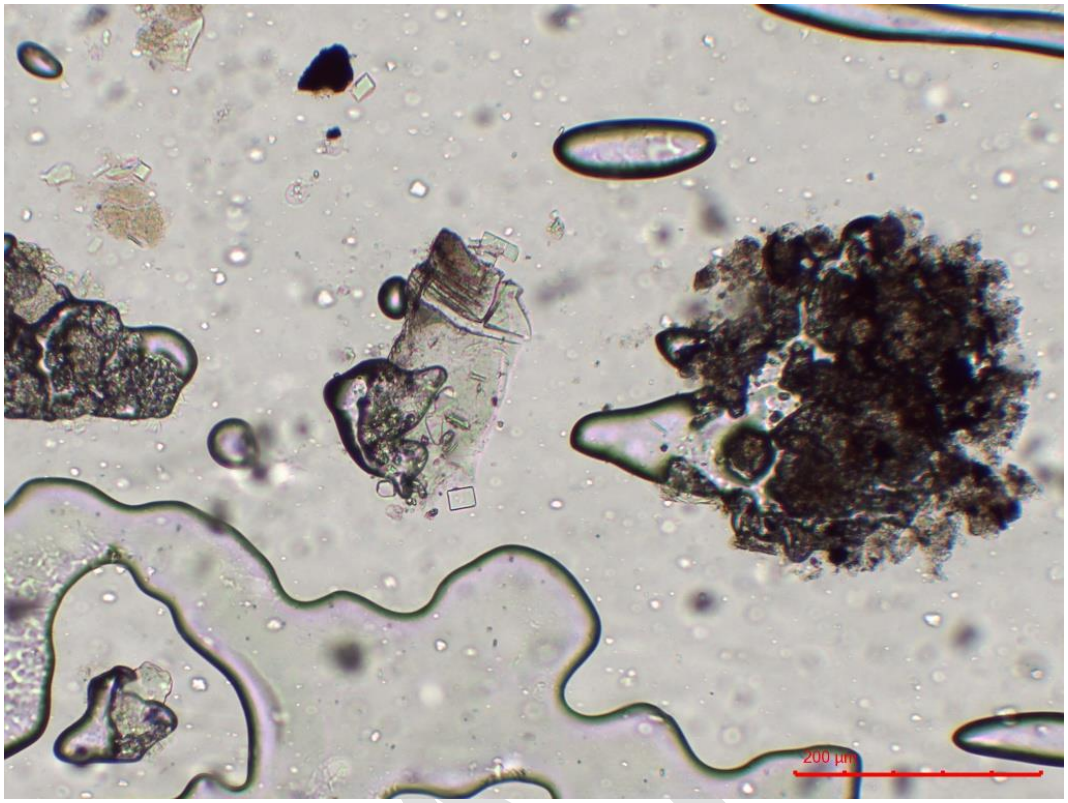

Figure A.29: 124034 North, 05/04/22 – 12/04/22 PPL

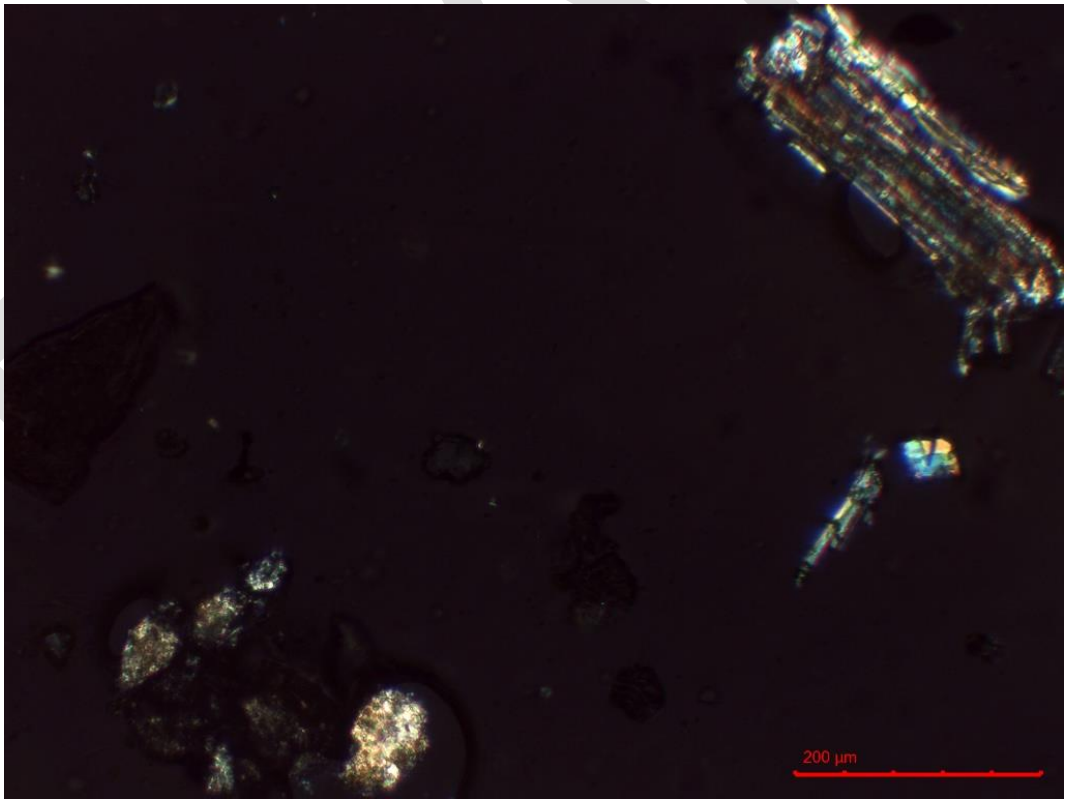

Figure A.30: 124034 North, 05/04/22 – 12/04/22 XPL

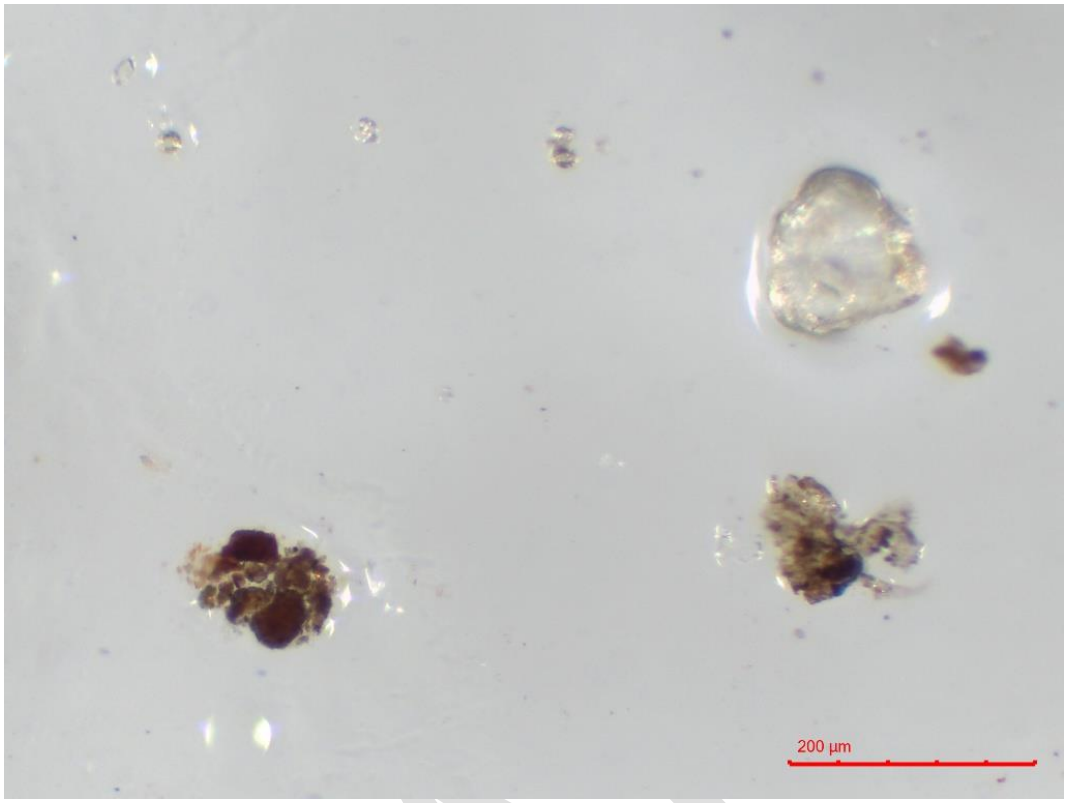

Figure A.31: 124035 South, 05/04/22 – 12/04/22 RL

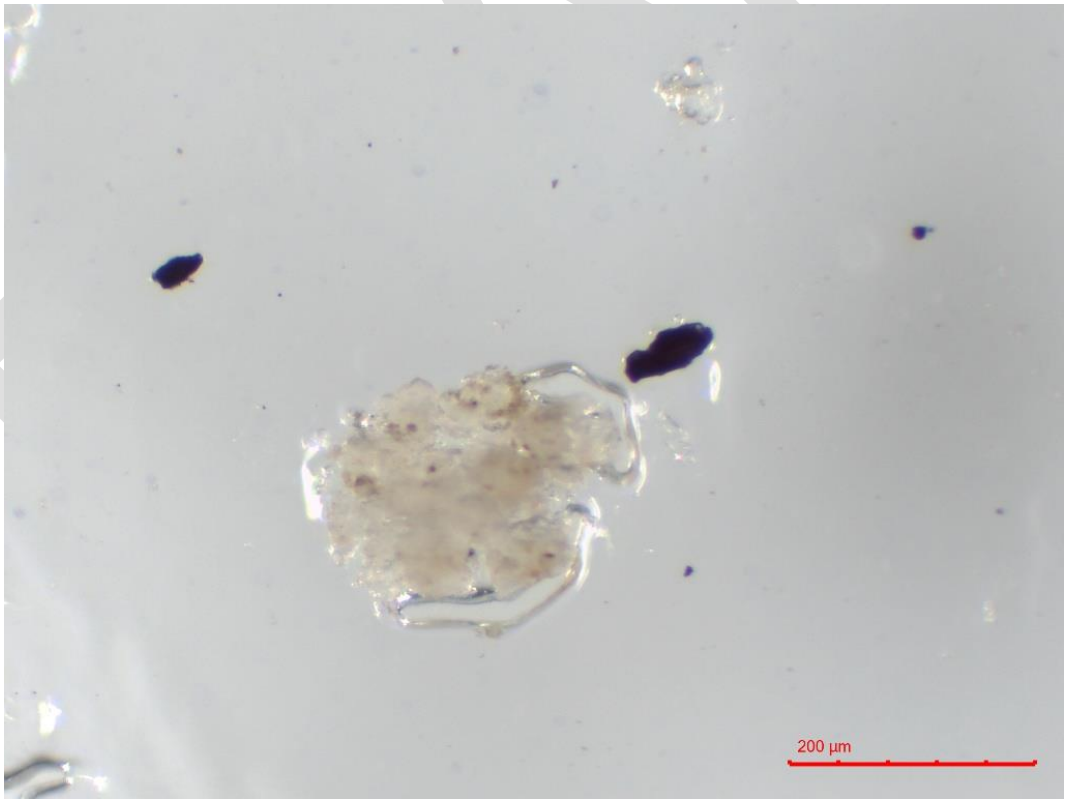

Figure A.32: 124035 South, 05/04/22 – 12/04/22 RL

Figure A.33: 124035 South, 05/04/22 – 12/04/22 PPL

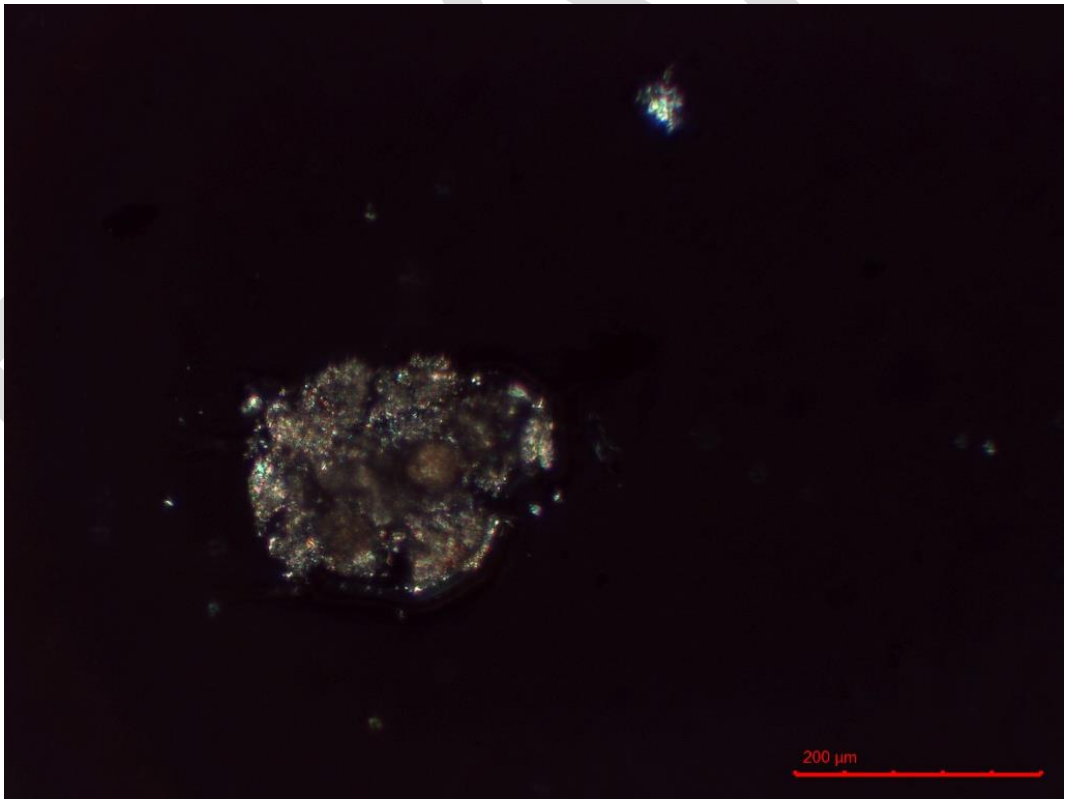

Figure A.34: 124035 South, 05/04/22 – 12/04/22 XPL