Report on Examination, Analysis and Comparison of Soil recovered from Productions in the Sheku Bayoh Public Inquiry

Professor Lorna Dawson

1 December 2022

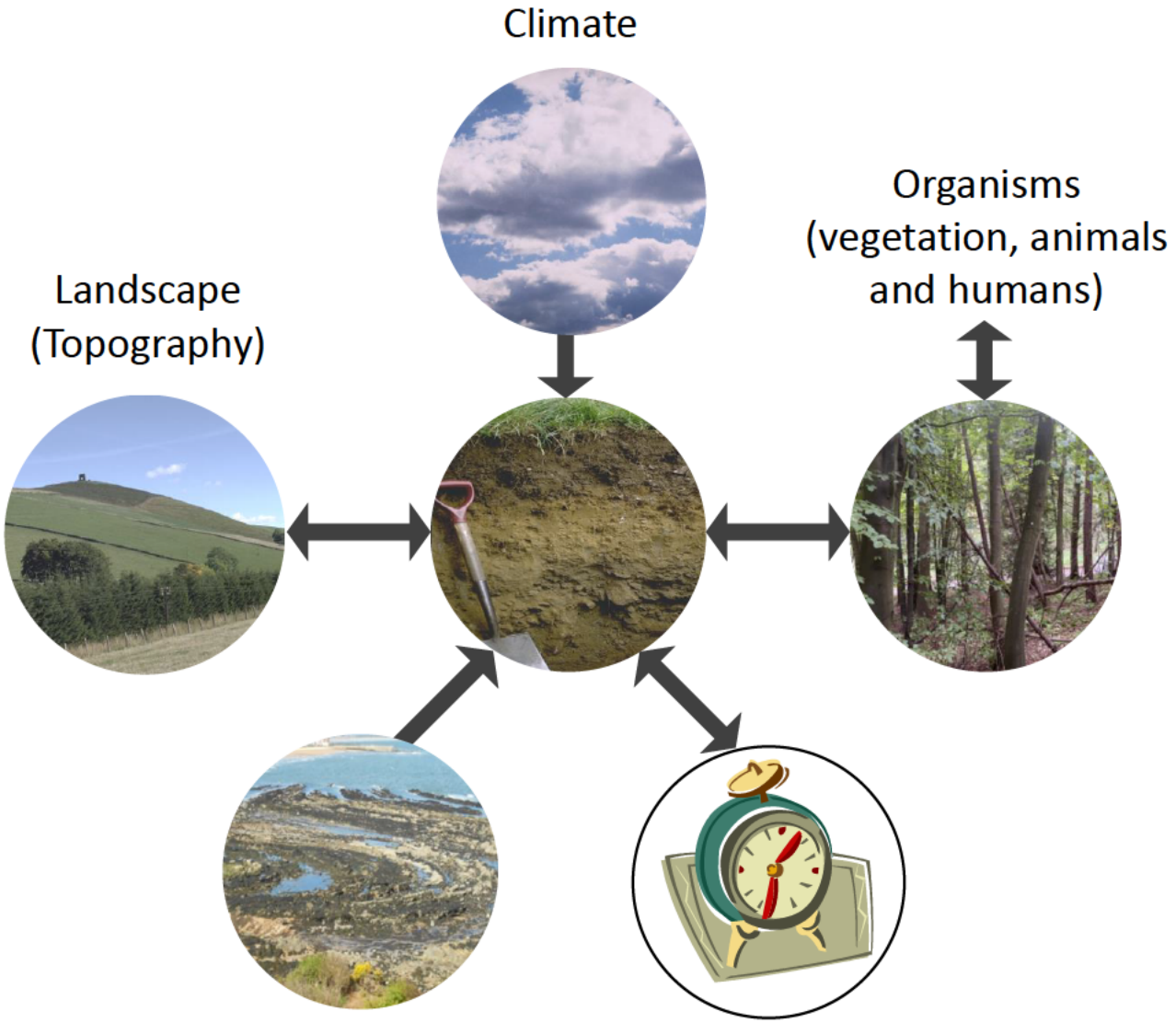
[redacted]
2022/LAD19

BioSS

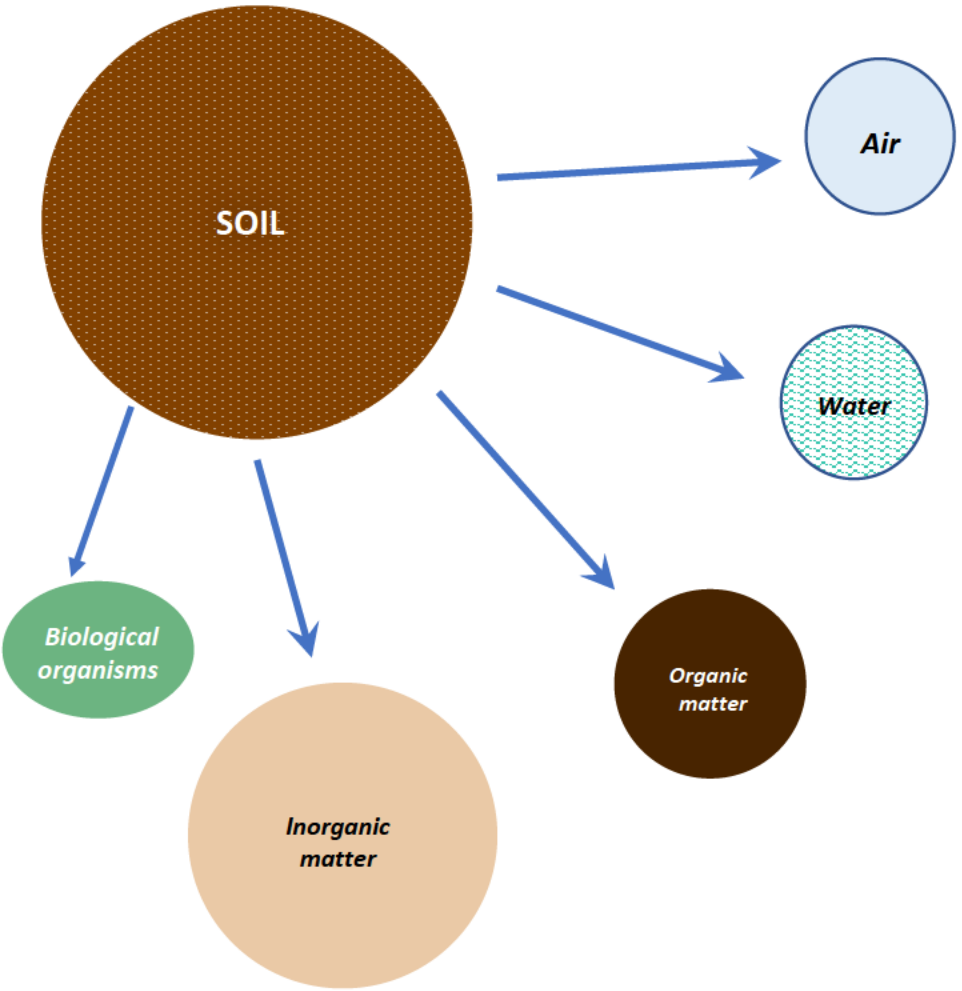
RGU ABERDEEN

The James Hutton Institute

Soil forming factors



Soil Composition



Soil is composed of:

Inorganic matter - geological parent material and human induced inorganic particles (minerals and elements, such as metals).

Organic matter - plant and animal derived components at various levels of decay and human-induced organic compounds such as hydrocarbons (carbon, oxygen, nitrogen and hydrogen).

Biological organisms - the living organisms, plants/plant fragments.

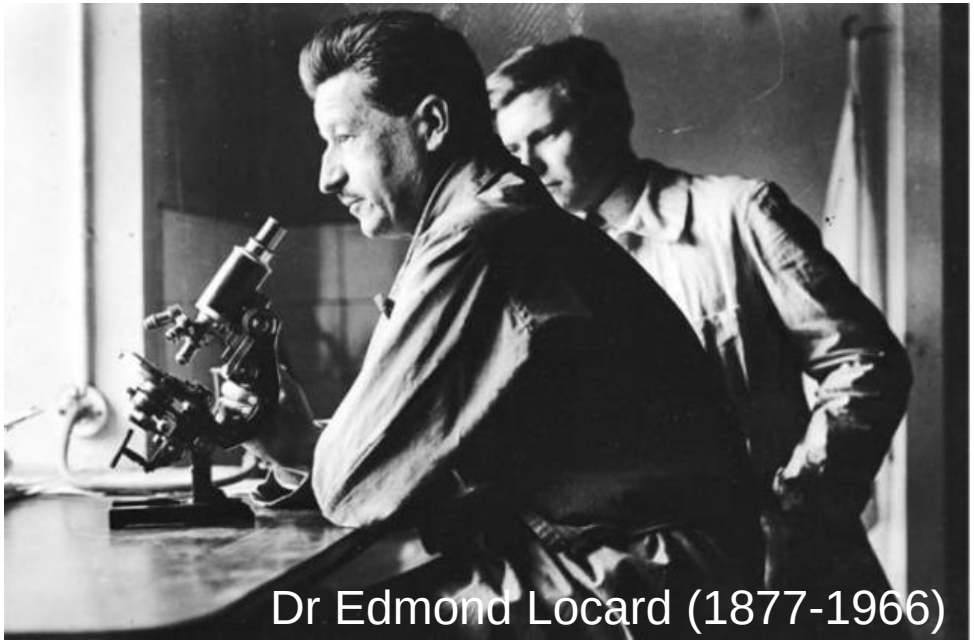
Air and water

Dawson and Hillier, 2010, Measurement of soil characteristics for forensic applications. *Surface and Interface Analysis*. 42, 363-377.

Dawson LA, Macdonald L, Ritz K (2018) Plant wax compounds and soil microbial DNA profiles to ascertain urban land use type. *Geological Society of London, Special Publications* 65, 1–25.

Natural and urban soils

Locard's exchange principle

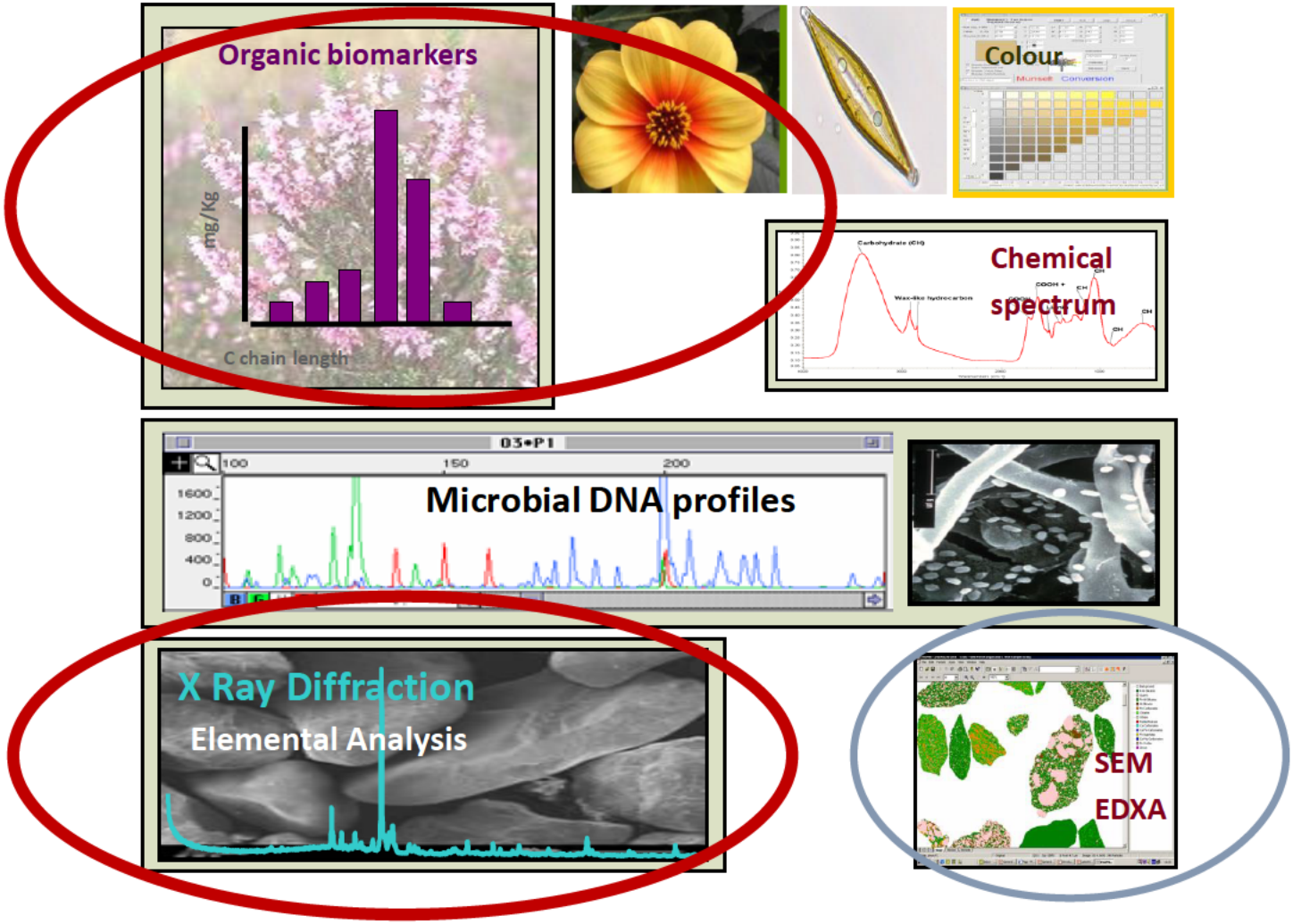

Dr Edmond Locard (1877-1966)

Dr Edmond Locard, a pioneer in forensic science, formulated the basic principle of forensic science:

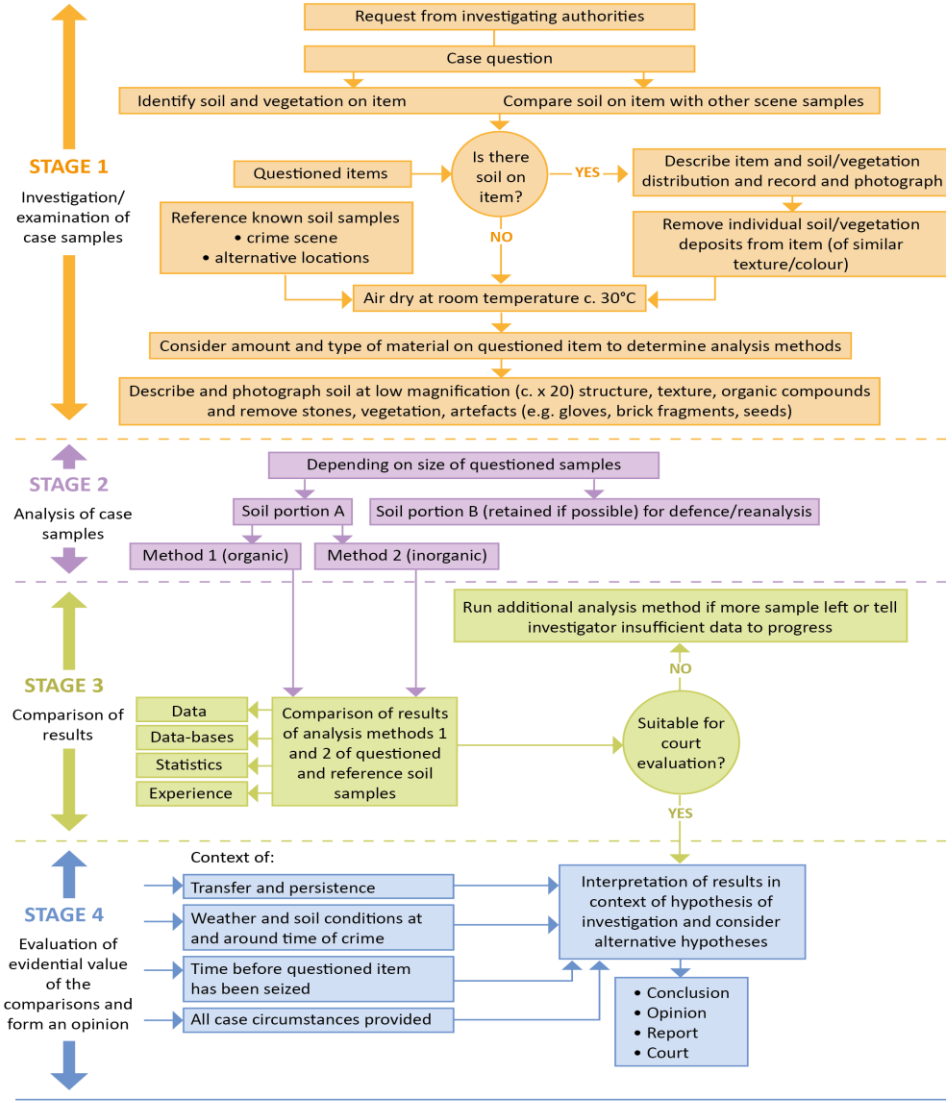
"Every contact leaves a trace."

"With contact between two items, there will be an exchange."

Methods of analysis in forensic soil science

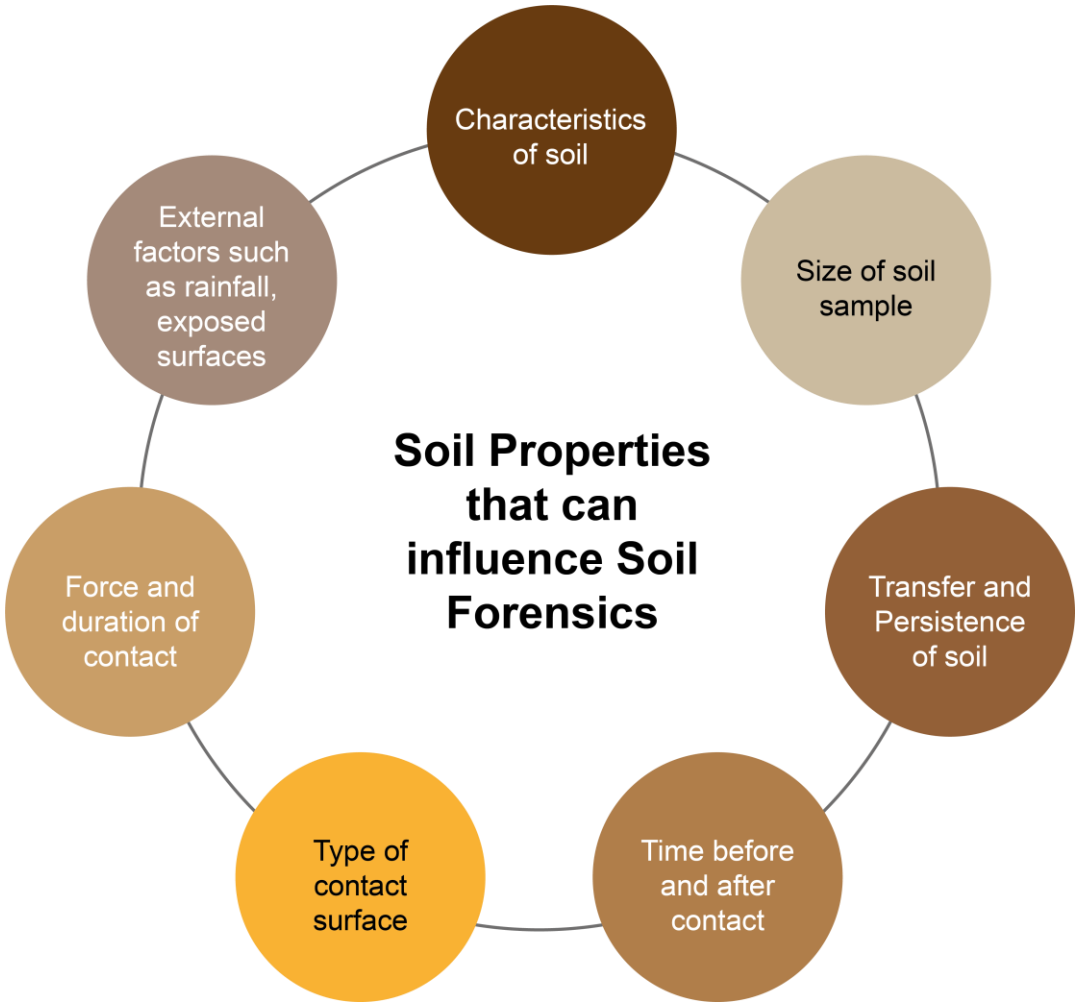


Process of examination and analysis in forensic soil science



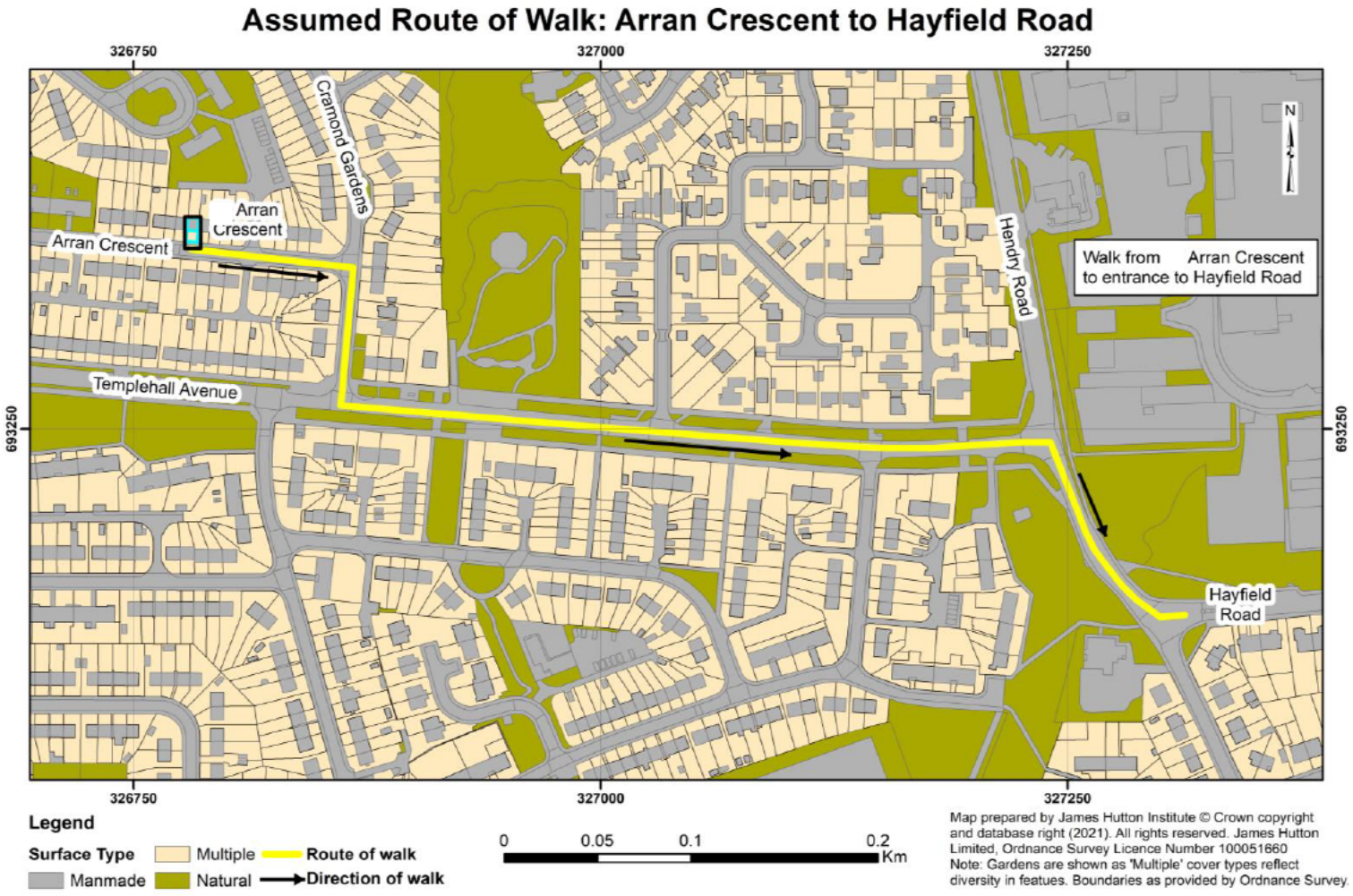
Approach to examination and analysis of forensic soil, adapted from ENFSI (2019) Best Practice Manual for the Forensic Comparison of Soil Traces (enfsi.eu)

Factors that influence the use of soil in forensic science



Adapted from: Stella, T.W.L. et al. (2020). Forensic Pedology: From Soil Trace Evidence to Courtroom.
In: Rakshit, A., Ghosh, S., Chakraborty, S., Philip, V., Datta, A. (eds) Soil Analysis: Recent Trends and Applications. Springer

Assumed route walked by Mr Sheku Bayoh



Assumed route (c. 0.69km). Edges of the assumed route which was likely walked by Mr Sheku Bayoh in 2015 contained c. 60% natural cover for potential exposure to natural surfaces (trees, grass, or bare soil).

Imagery date 7 September 2015

Sheku Bayoh Inquiry, 2022

Imagery date 13 September 2021

Inquiry request

To recover and carry out trace evidence analysis and comparison of traces from a police vest worn by PC Nicole Short, with traces from two pairs of boots; one pair worn by Mr Sheku Bayoh and another pair worn by PC Craig Walker in the early morning of 3 May 2015.

Vest worn by PC Nicole Short

PC Short's vest from 2015. Photograph taken after incident.

PC Short's vest from 2022. Photograph taken at Cellmark Forensic Services.

Recovery of samples from vest worn by PC Nicole Short

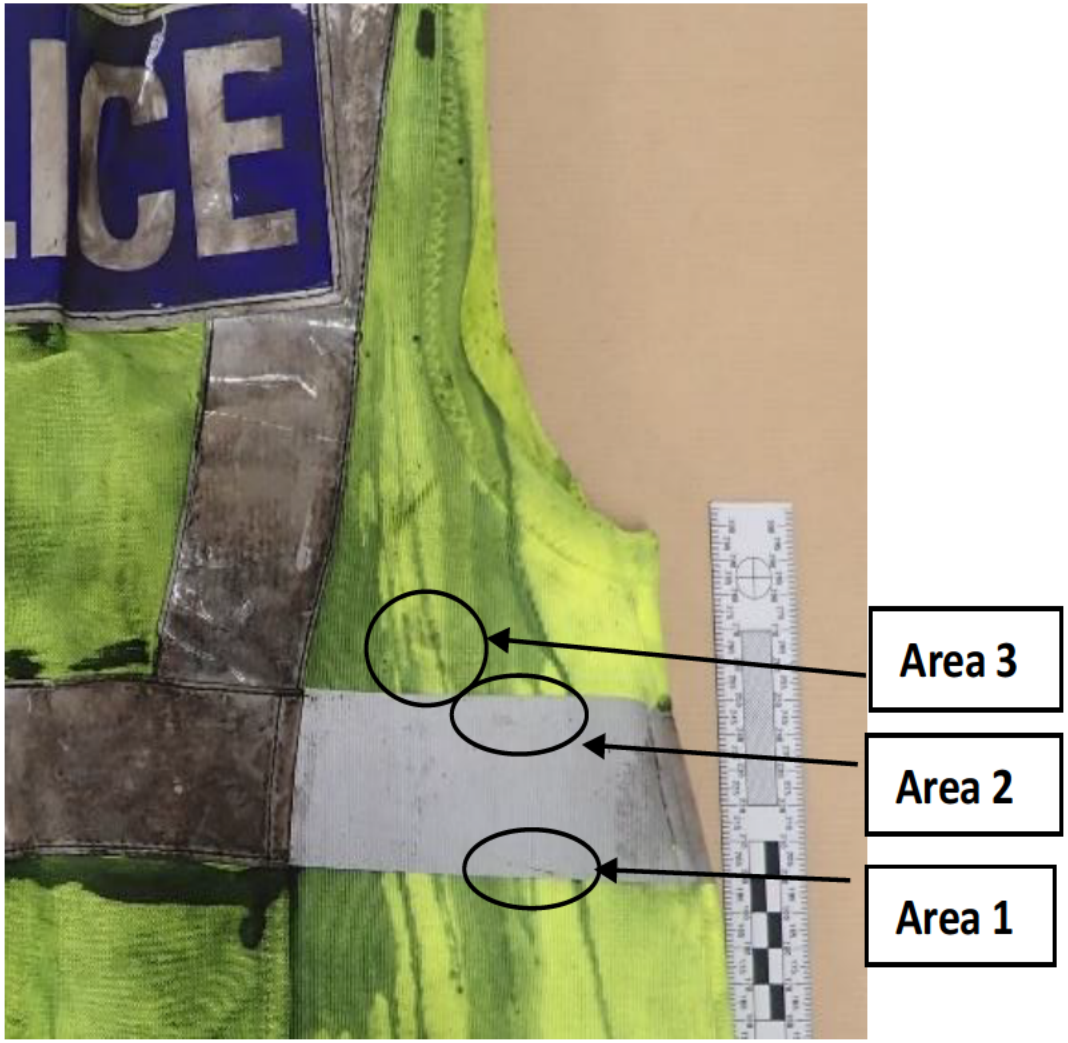
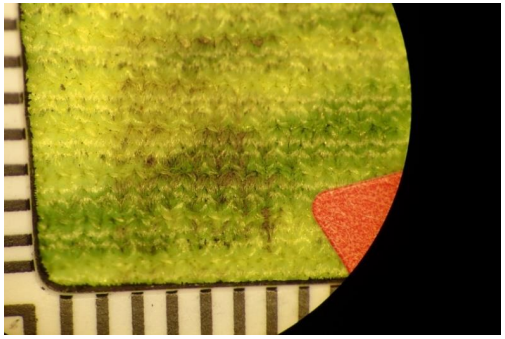


Image of vest worn by PC Nicole Short taken in 2022 by Hannah Hogg and Martyn Hathaway, Cellmark Forensic Services, August 2022

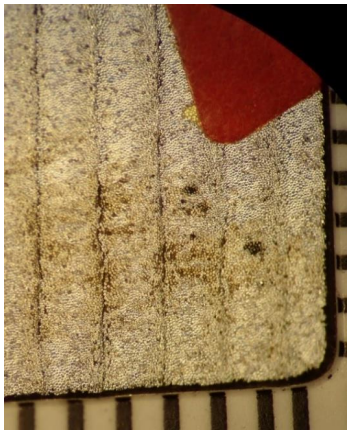
Recovery of samples from vest worn by PC Nicole Short

Scale bar units represent 1mm

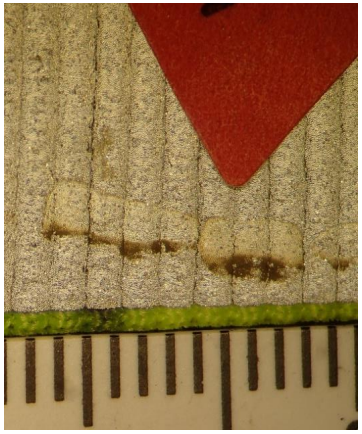
Samples recovered from vest worn by PC Nicole Short



Soil from yellow fabric-Area 3



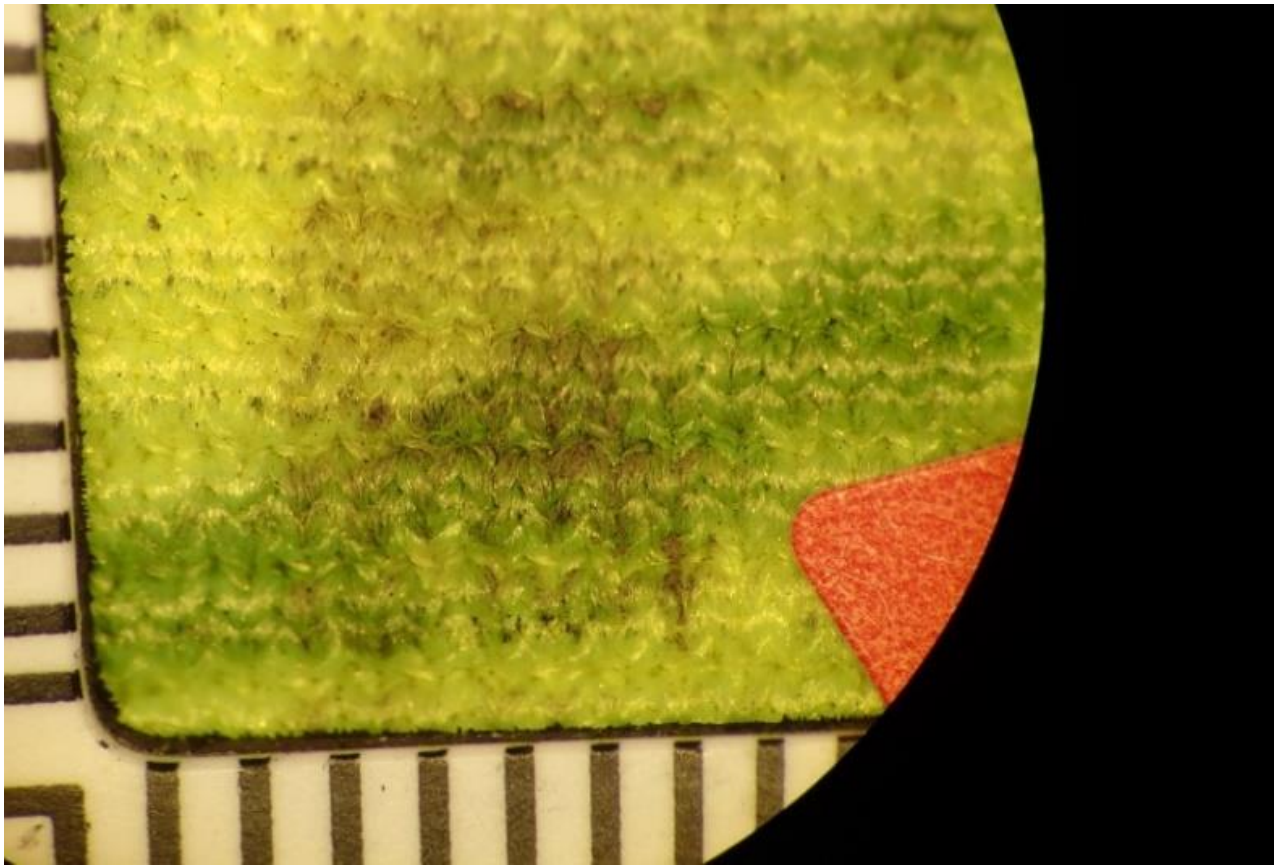
Soil from silver strip near edge of yellow fabric-Area 2



Soil from silver strip-Area 1

Scale bar units represent 1mm

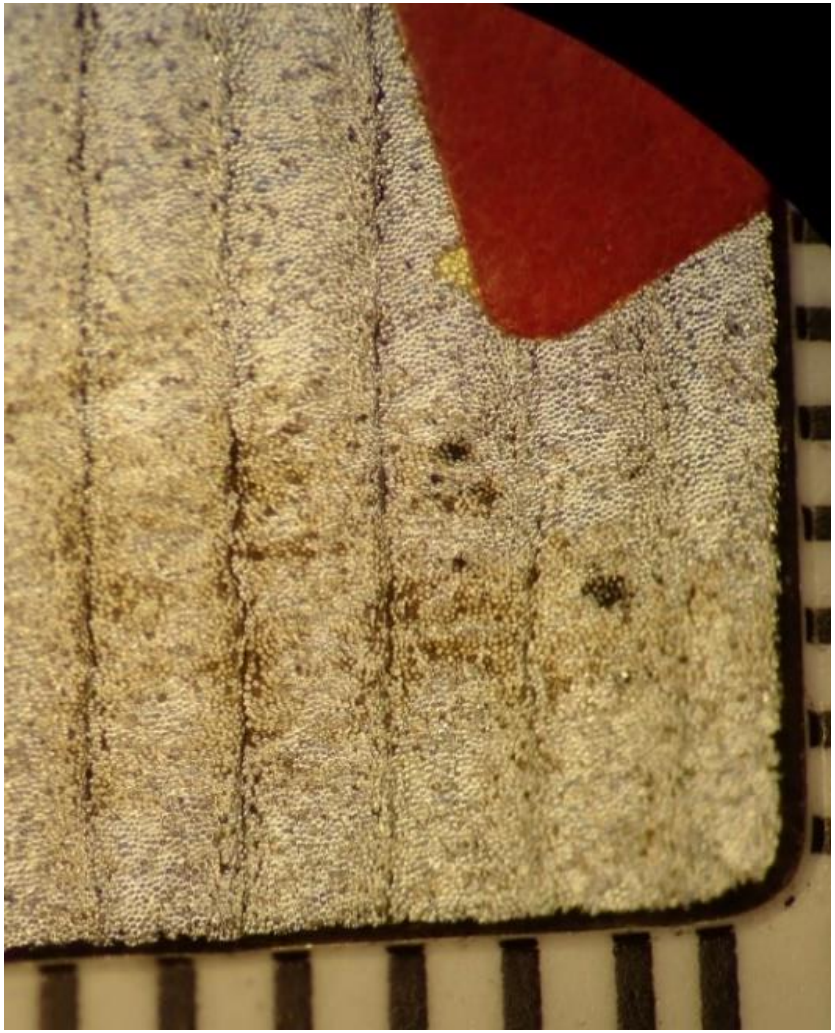
Soil on yellow fabric, PC Nicole Short's vest



Soil on yellow fabric-Area 3

Scale bar units represent 1mm

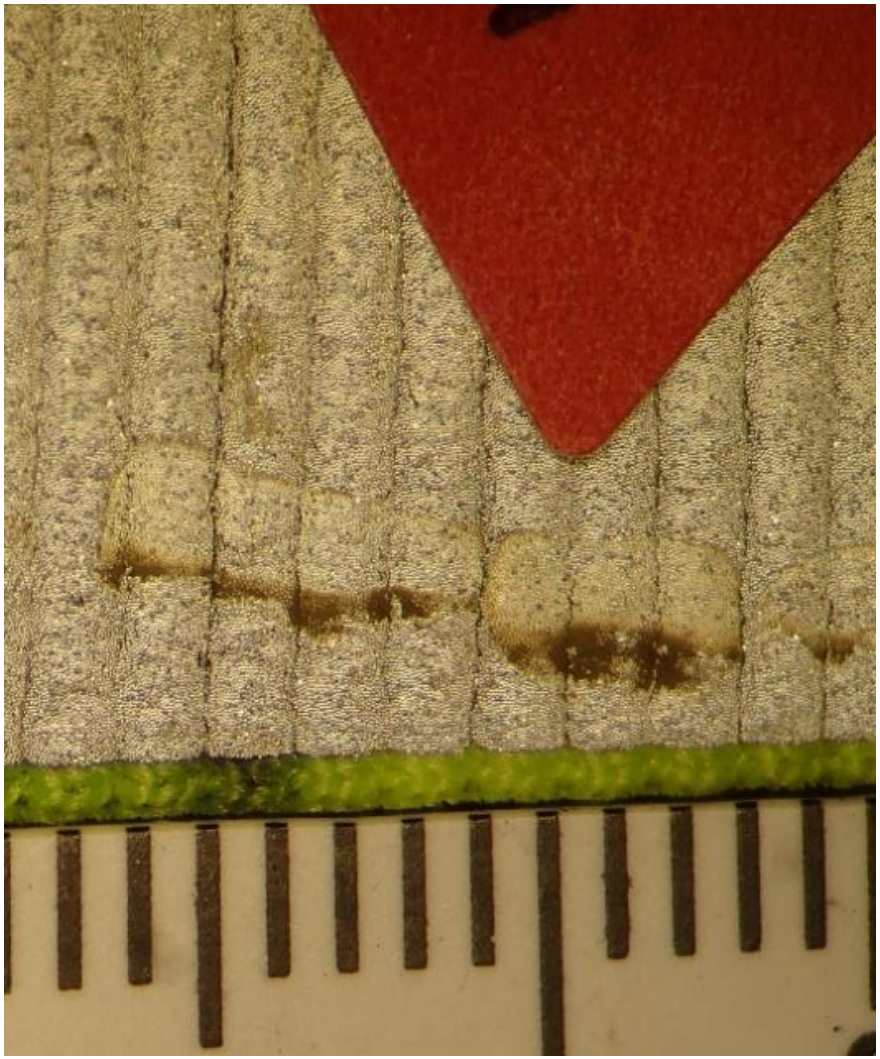
Soil on silver strip near edge of yellow fabric
PC Nicole Short's vest



Soil on silver strip near edge of yellow fabric-Area 2

Scale bar units represent 1mm

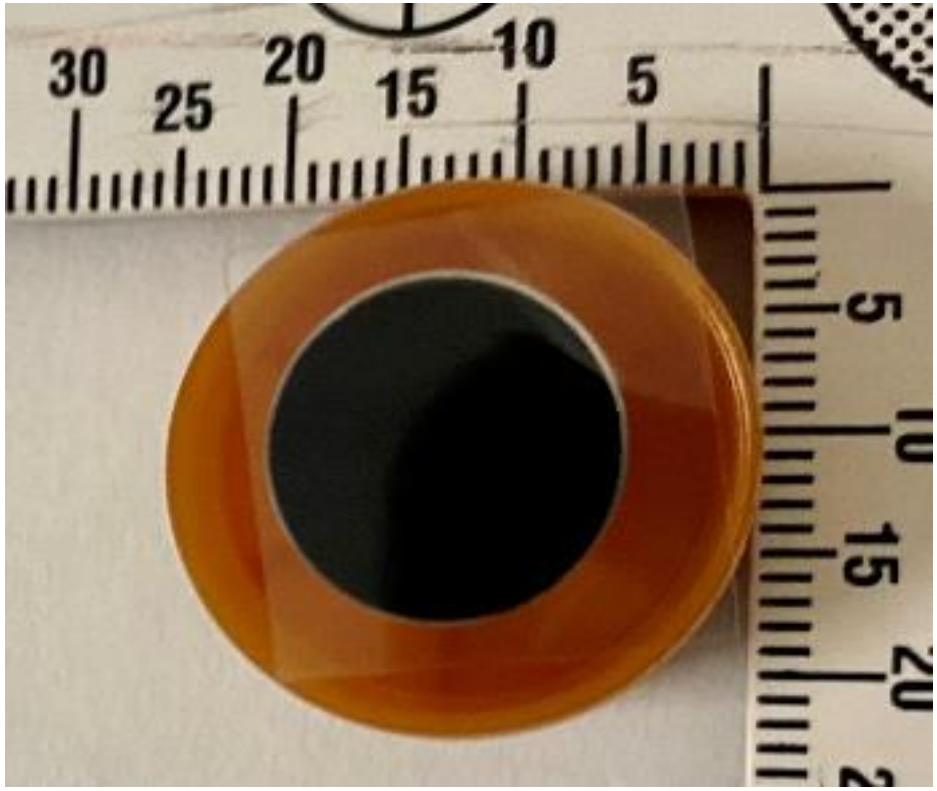
Soil on silver strip
PC Nicole Short's vest



Soil on silver strip-Area 1

Scale bar units represent 1mm

Blank SEM stub



Scale bar units represent 1mm

Pair of boots worn by Mr Sheku Bayoh

Production GAY016 (Inner aspect of right boot, Mr Bayoh)

Production GAY017 (Inner aspect of left boot, Mr Bayoh)

Soil on right boot worn by Mr Sheku Bayoh

Soil on toe at welt, right boot Mr Bayoh

Soil on heel of sole, right boot Mr Bayoh

Soil on left boot worn by Mr Sheku Bayoh

Welt inner aspect mid section, left boot Mr Bayoh

Sole towards inner aspect of toe area, left boot Mr Bayoh

Pair of boots worn by PC Craig Walker

Production AM001 (Inner aspect of left boot PC Walker)

Production AM002 (Inner aspect of right boot PC Walker)

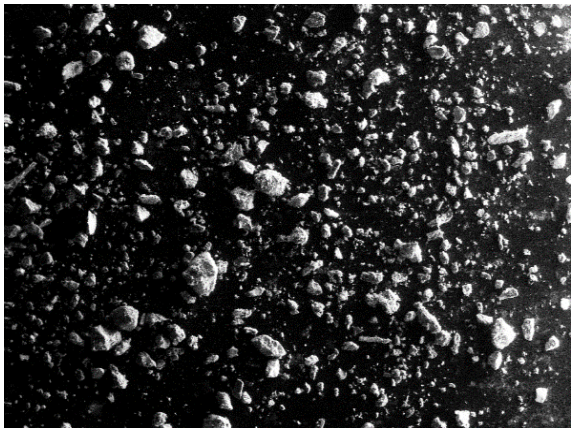
Soil on boots worn by PC Craig Walker

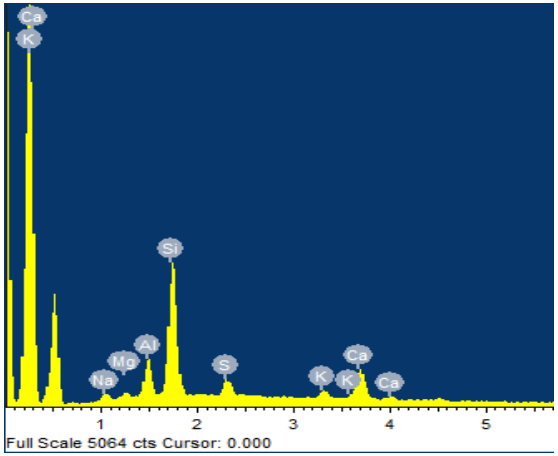
Sole on toe area from PC Walker left boot

Soil on heel from PC Walker right boot

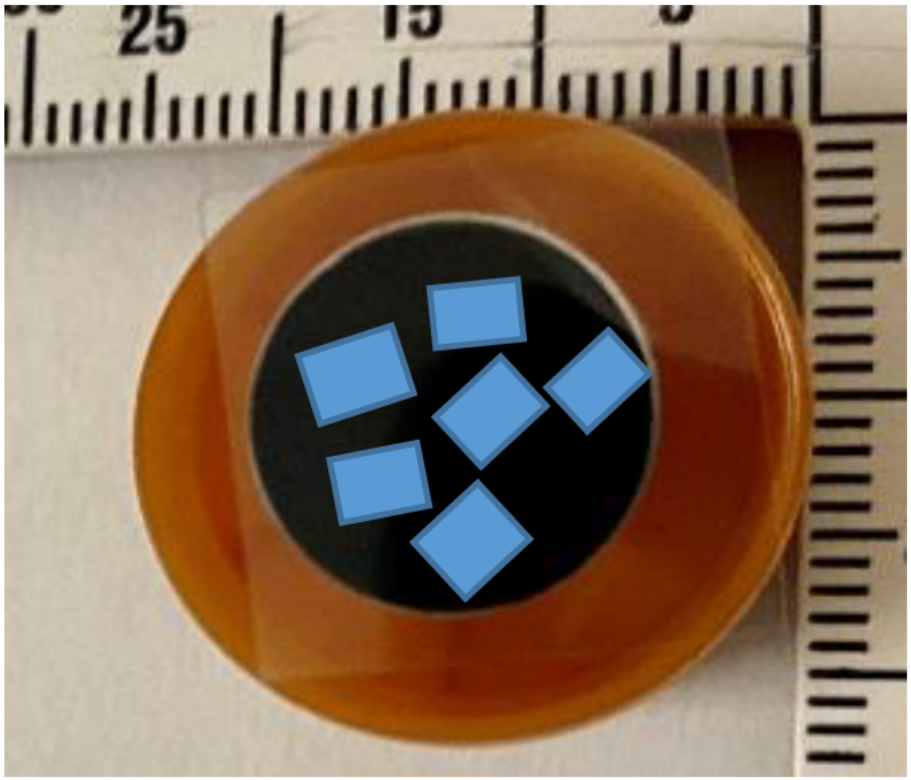
Sample analysis using Scanning Electron Microscopy

The Zeiss EVO LS10 Variable Pressure Scanning Electron Microscope





Scanning Electron Microscopy (SEM) analysis

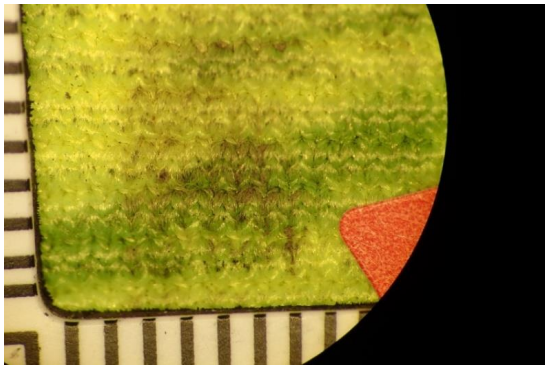


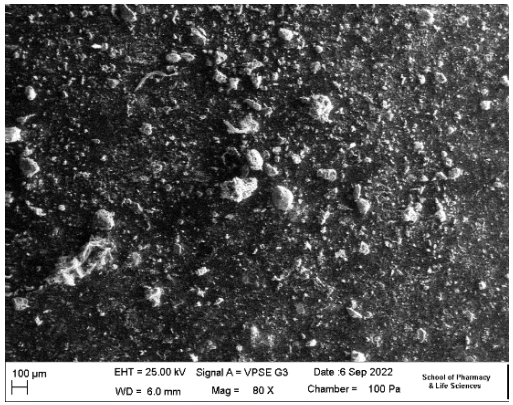
SEM stub showing six random areas for analysis

Scale bar units represent 1mm

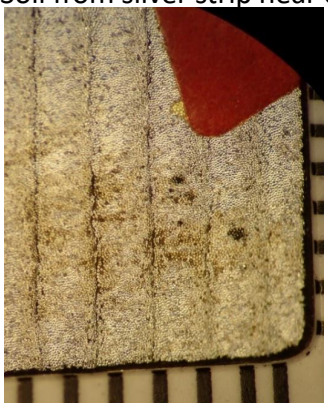
SEM images of soil from vest worn by PC Nicole Short

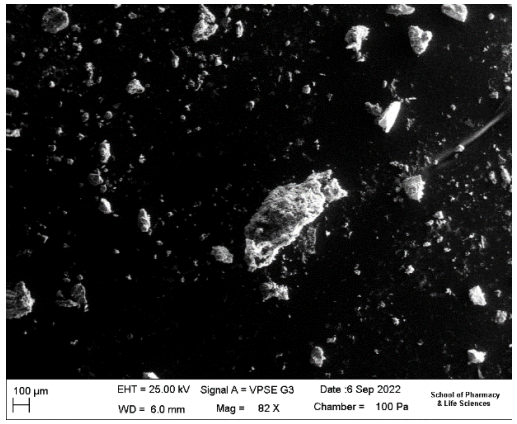
Soil from yellow fabric-Area 3



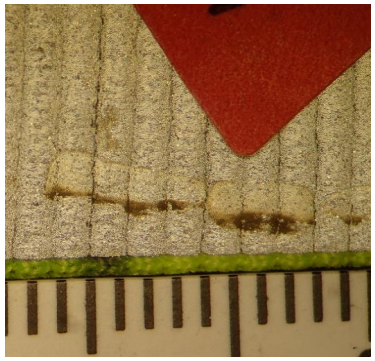


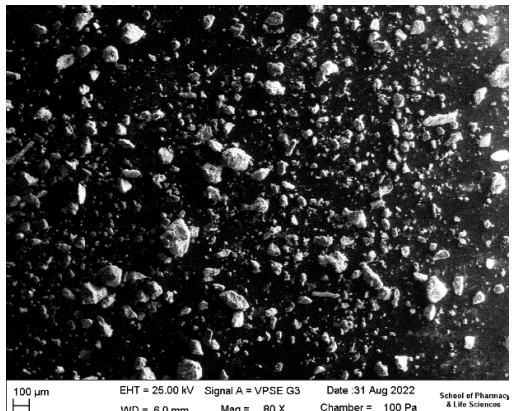
Soil from silver strip near edge of yellow fabric-Area 2



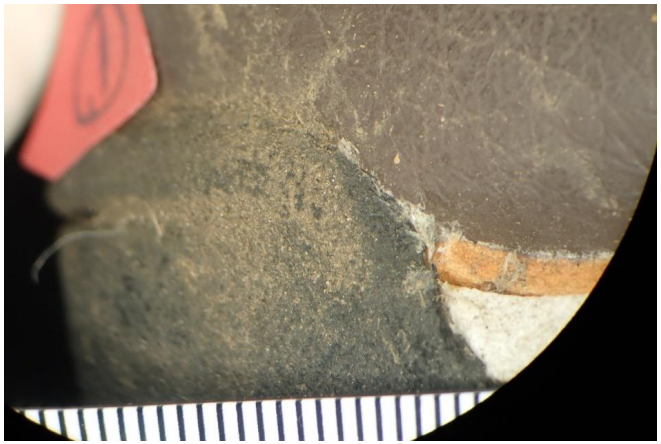


Soil from silver strip-Area 1

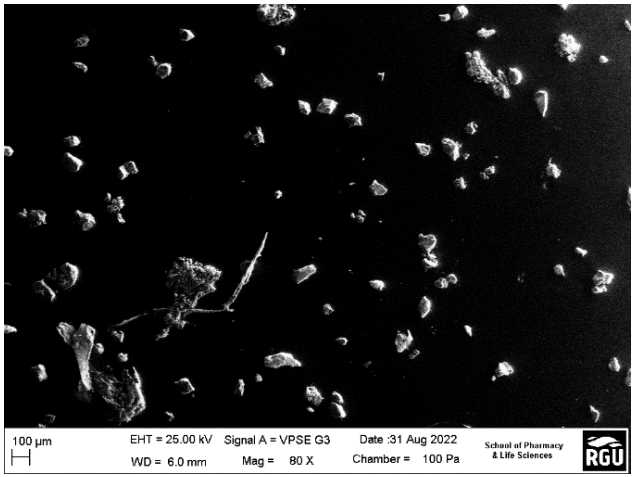




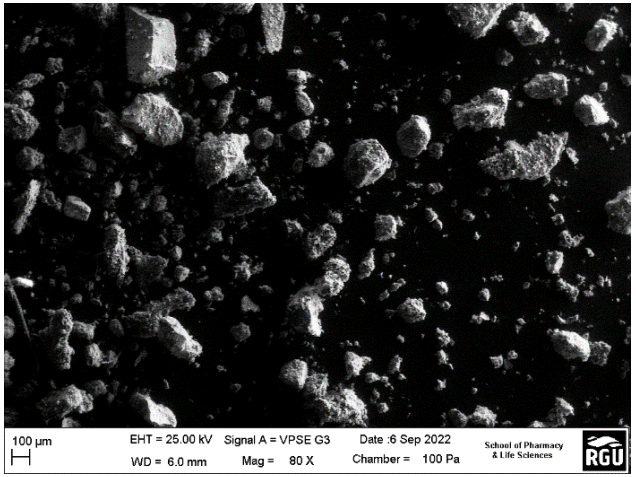
SEM images of soil from right boot worn by Mr Sheku Bayoh



Soil on toe at welt, right boot Mr Bayoh

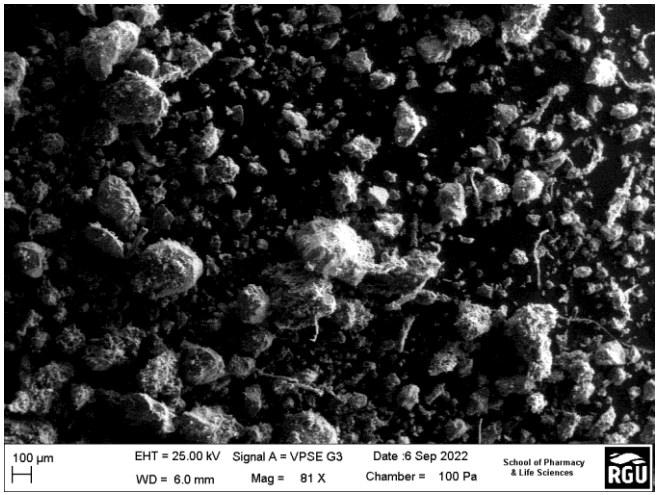


Soil on heel of sole, right boot Mr Bayoh

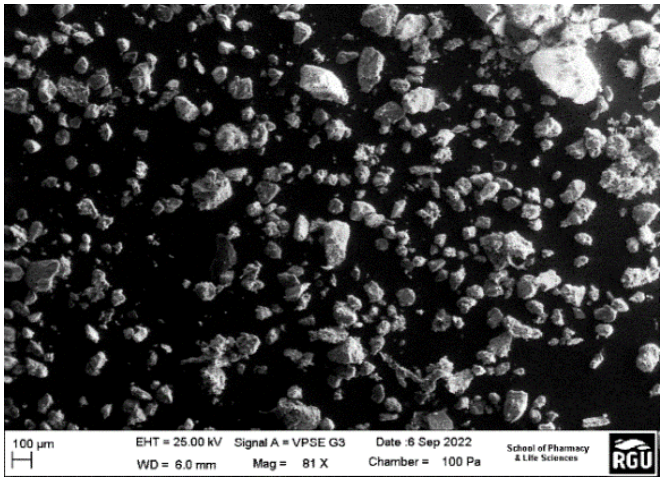


SEM images of soil from left boot worn by Mr Sheku Bayoh

Welt inner aspect mid section, left boot Mr Bayoh

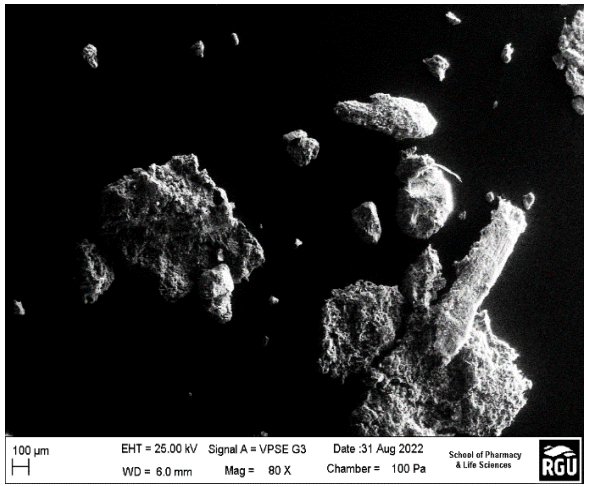


Sole towards inner aspect of toe area, left boot Mr Bayoh

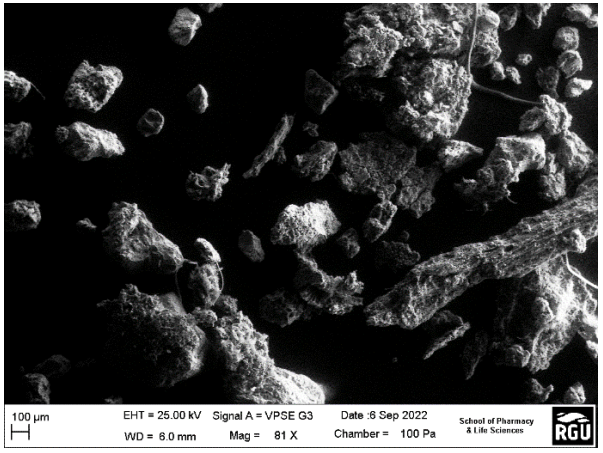


SEM images of soil from boots worn by PC Craig Walker

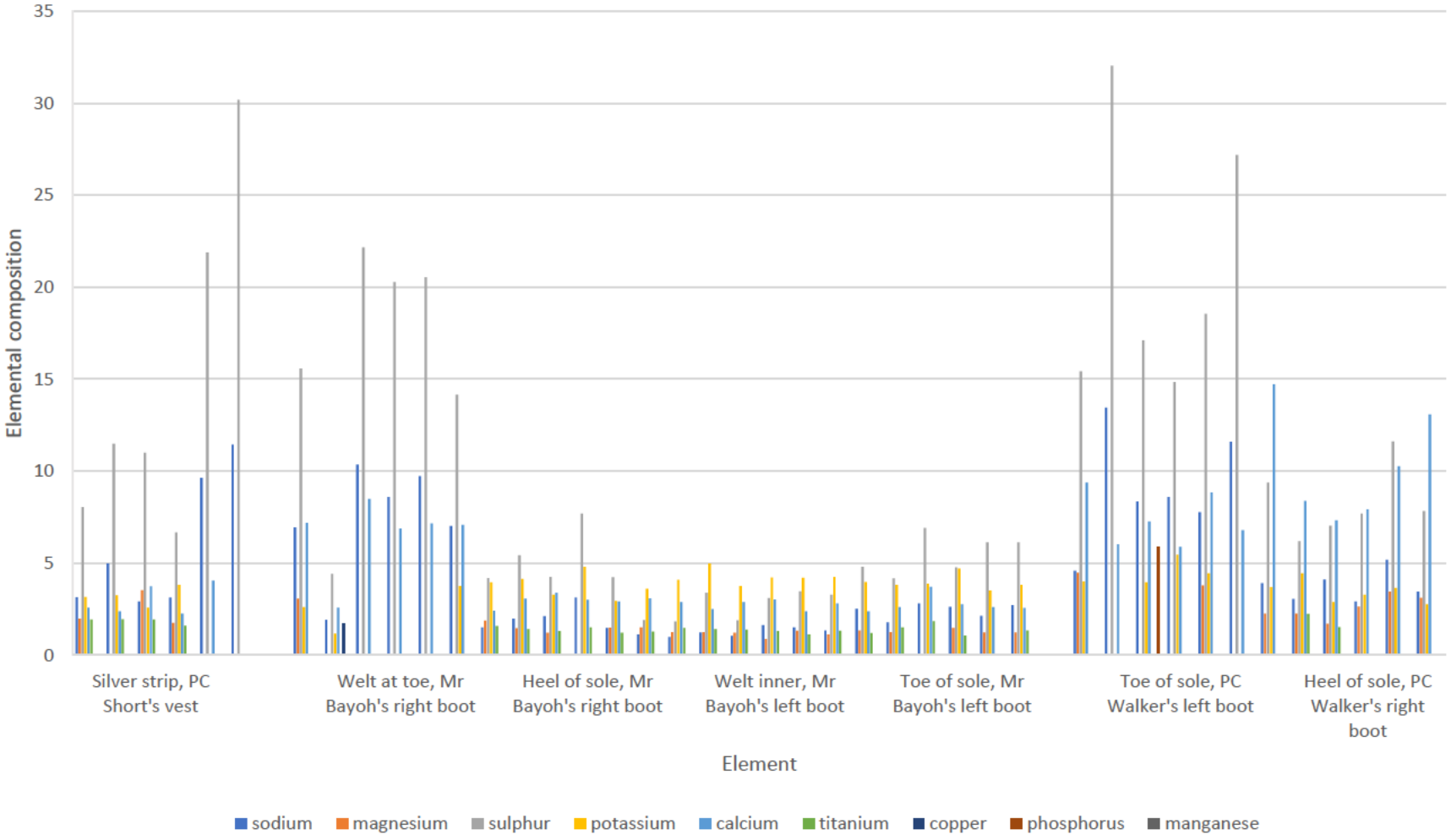
Sole at toe area from PC Walker left boot



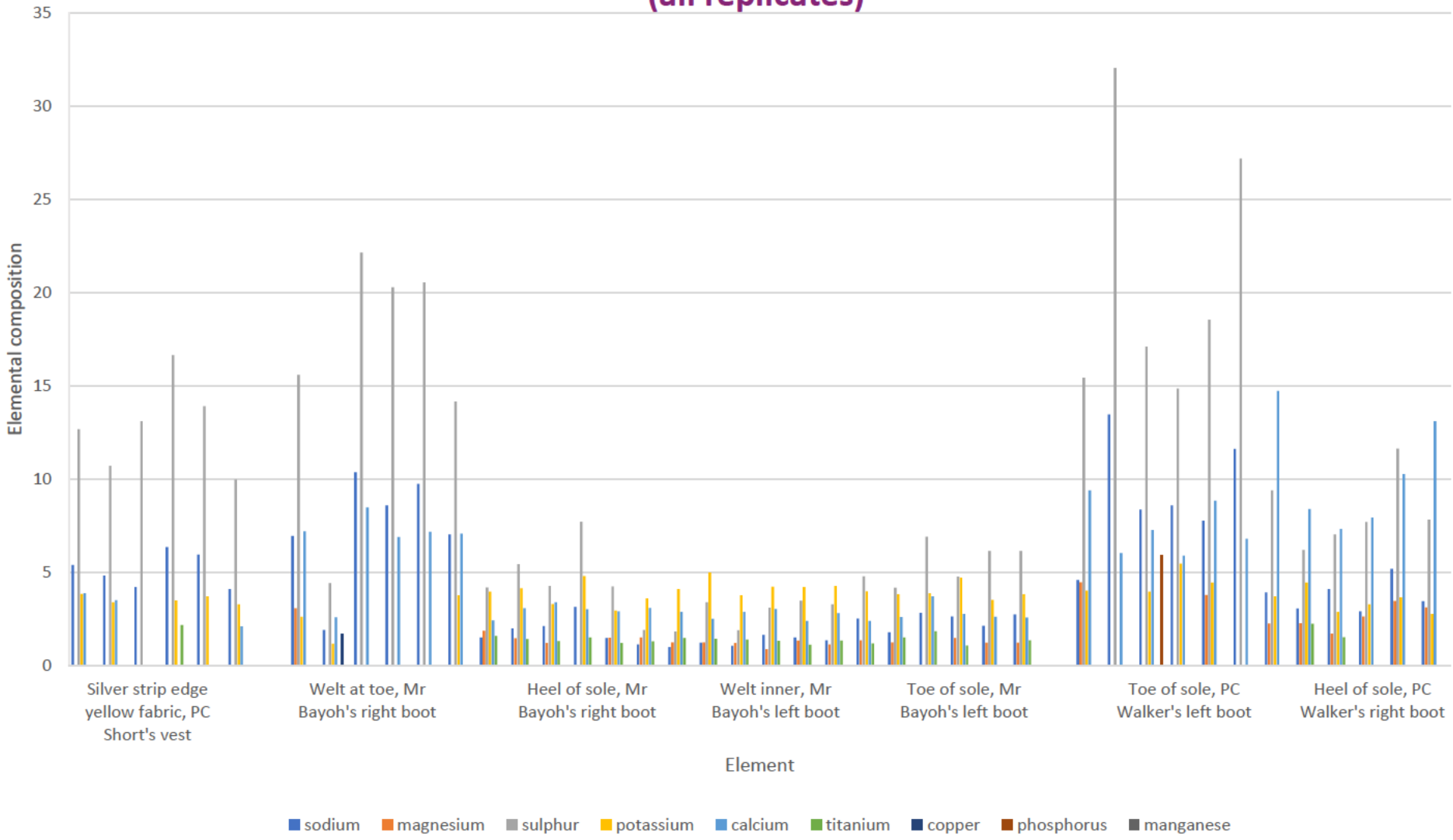
Soil on heel from PC Walker right boot



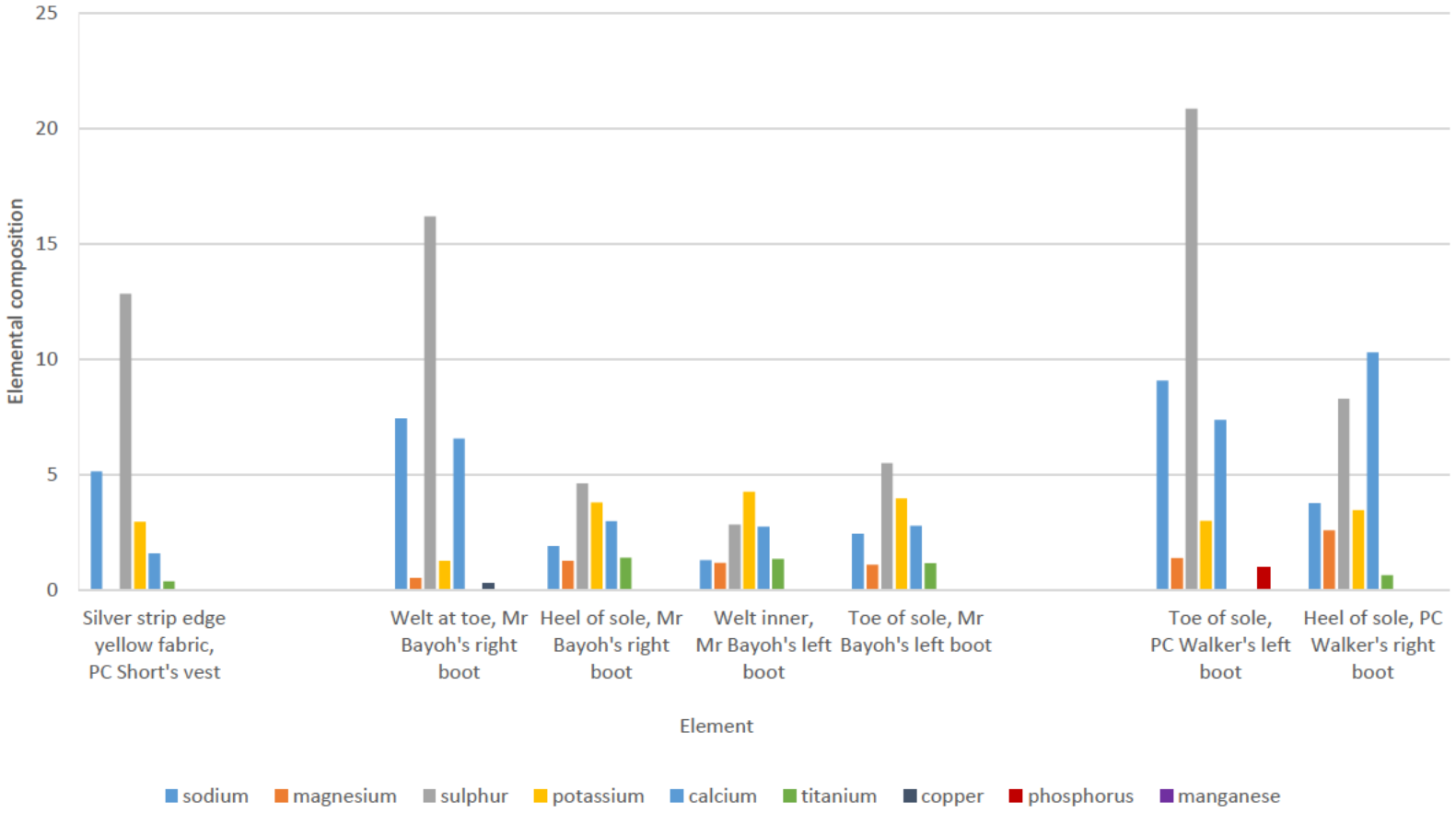
Trace elemental composition, Silver strip
Area 1
PC Nicole Short's vest compared with all footwear samples (all replicates)



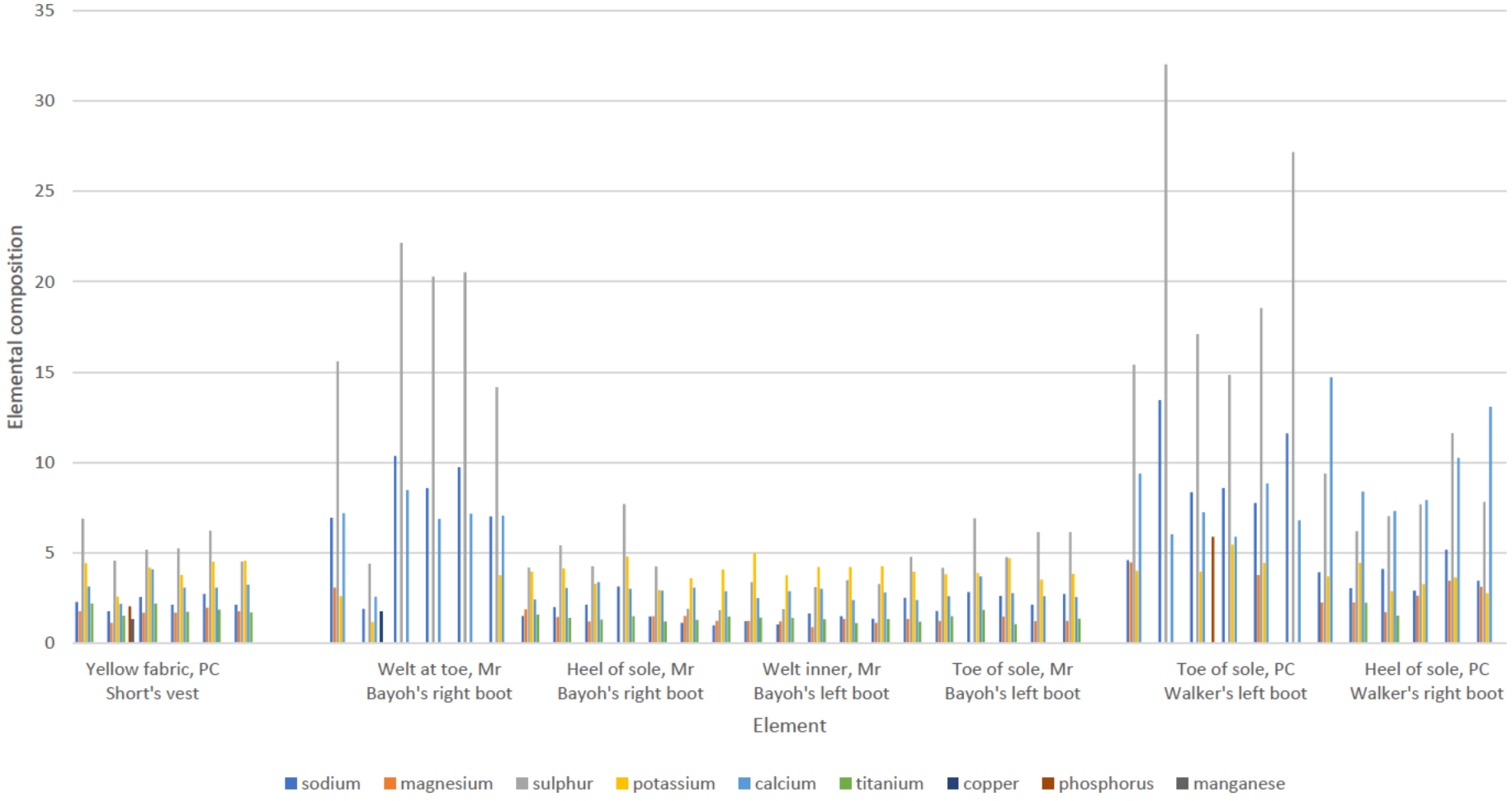
Trace elemental composition, Silver strip edge of yellow fabric, Area 2
PC Nicole Short's vest compared with all footwear samples (all replicates)



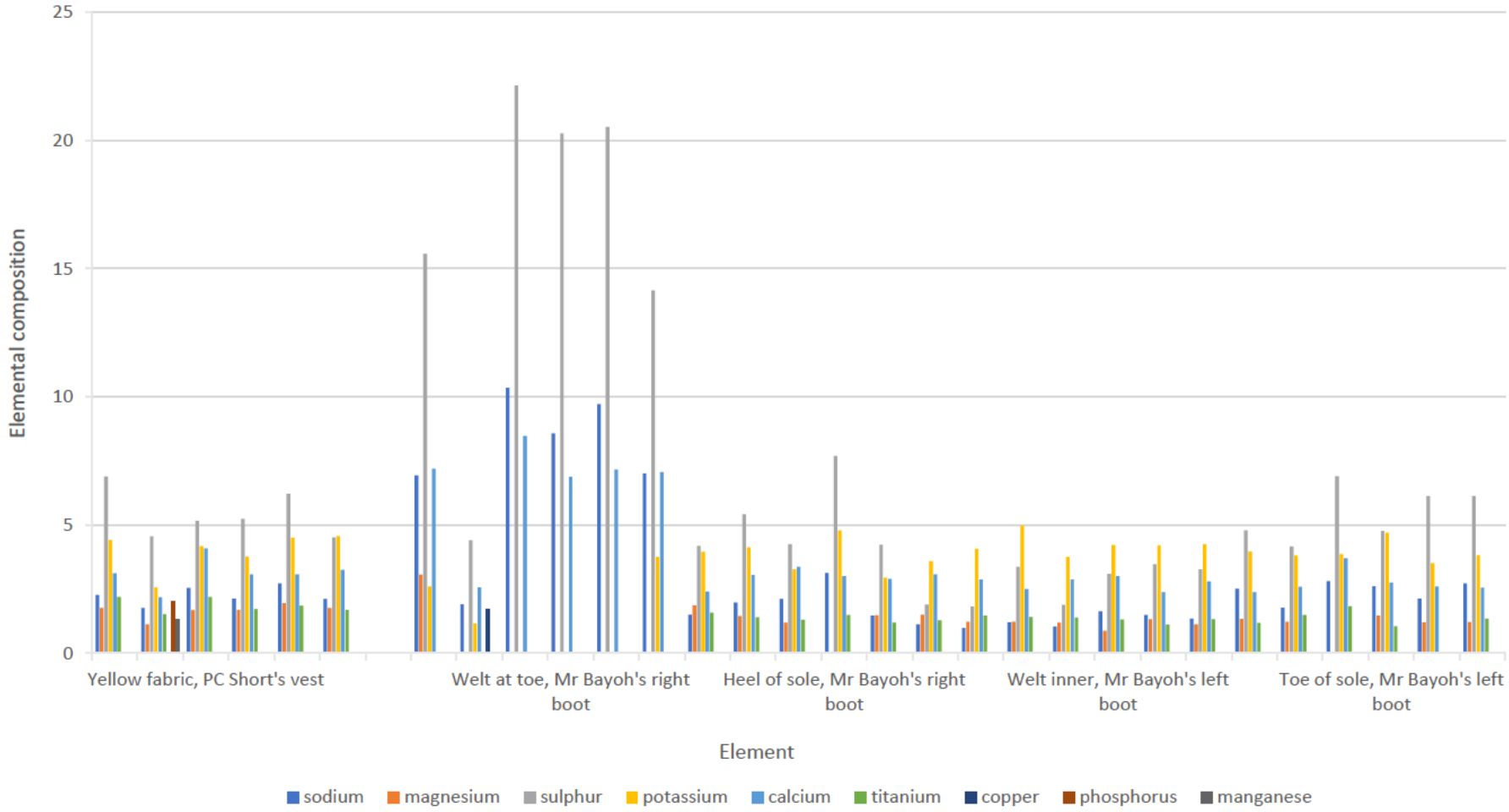
Trace elemental composition, Silver strip edge of yellow fabric Area 2 PC Nicole Short's vest compared with all footwear samples (mean)



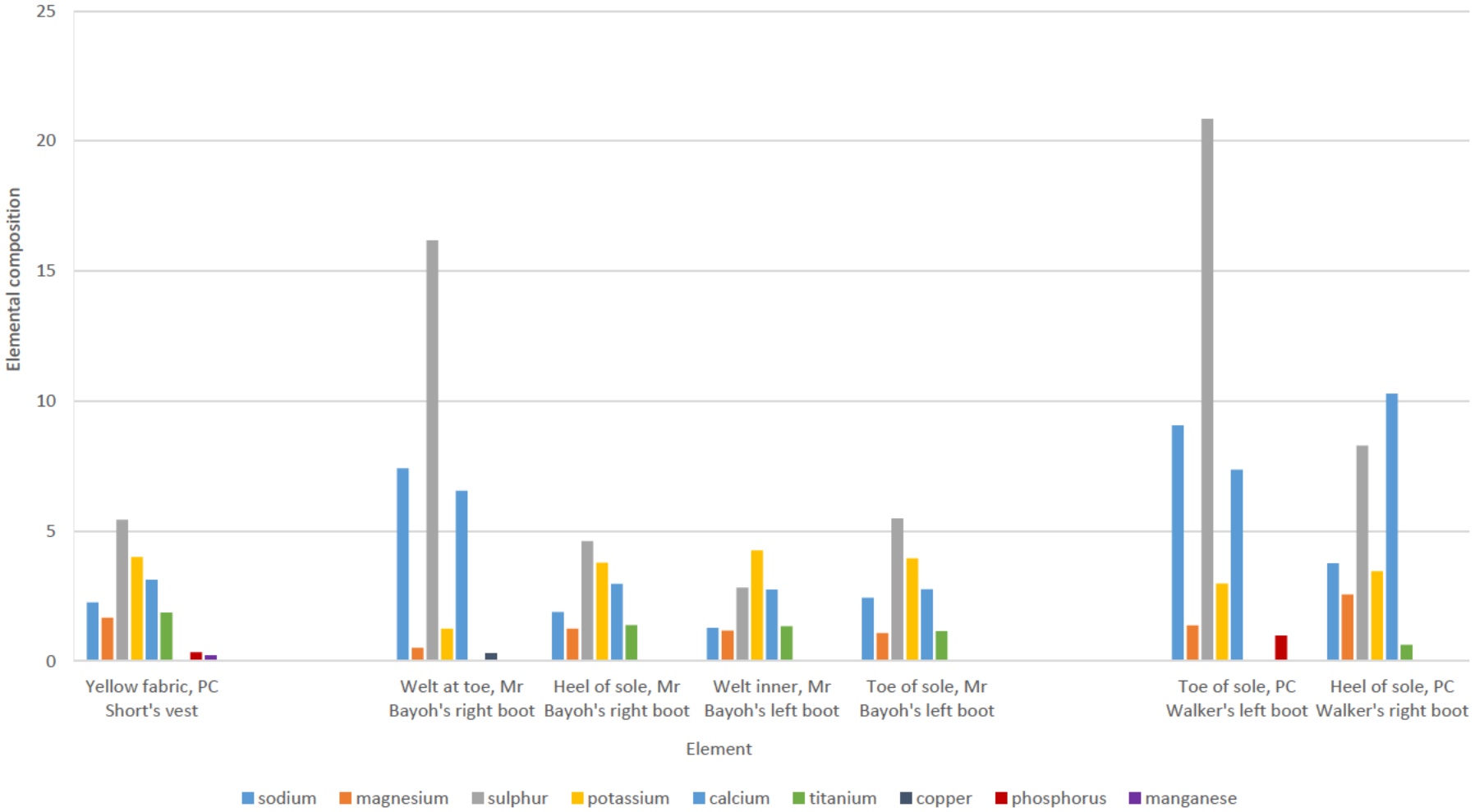
Trace elemental composition, Yellow fabric
Area 3
PC Nicole Short's vest compared with all footwear (all replicates)



Trace elemental composition, Yellow fabric
Area 3
PC Nicole Short's vest compared with Mr Sheku Bayoh's boots (all replicates)



Trace elemental composition, Yellow fabric, Area 3, PC Nicole Short's vest compared with all footwear samples (means)

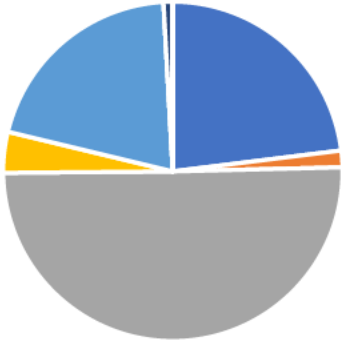


Mean trace elemental compositions, Yellow fabric of PC Short's vest, Area 3, compared with Mr Sheku Bayoh's right boot samples

Yellow fabric, PC Short's vest

sodium magnesium sulphur potassium calcium
titanium copper phosphorus manganese

Welt at toe, Mr Bayoh's right boot

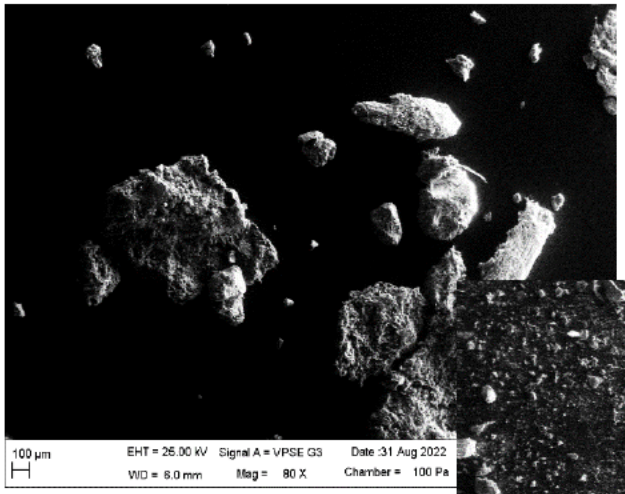


sodium magnesium sulphur
potassium calcium titanium
copper phosphorus manganese

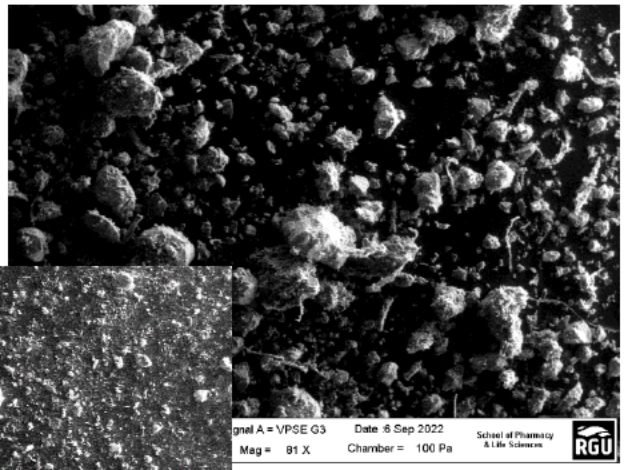
Heel of sole, Mr Bayoh's right boot

sodium magnesium sulphur
potassium calcium titanium
copper phosphorus manganese

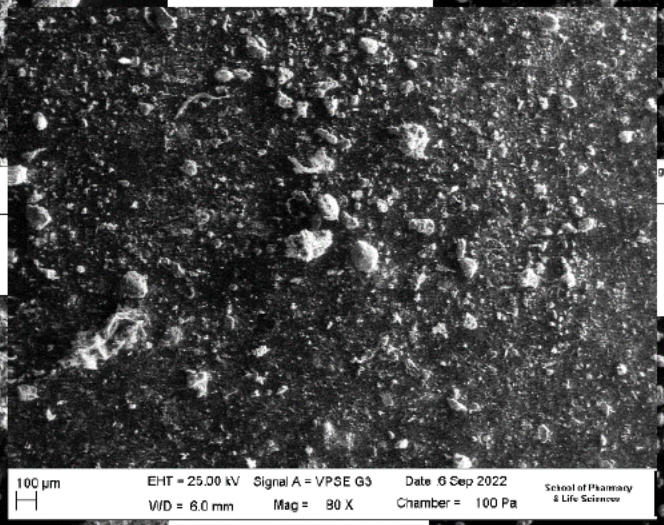
SEM images of soil from boots worn by PC Craig Walker and soil from boots worn by Mr Sheku Bayoh compared with soil from the yellow fabric of vest worn by PC Short



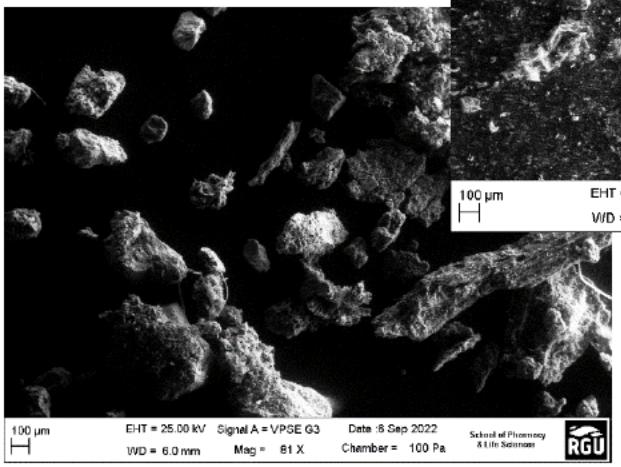
Left boot, PC Walker



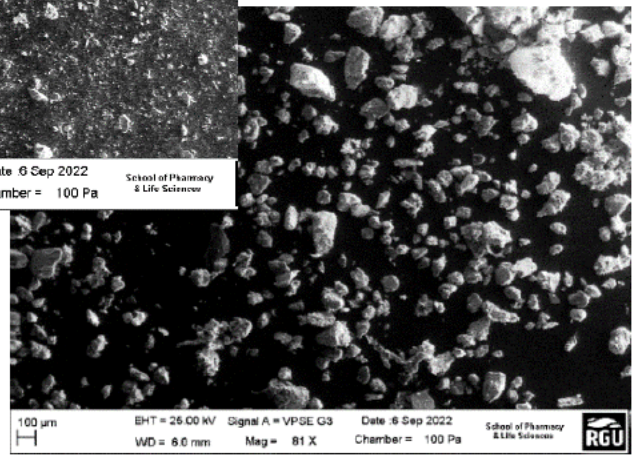
Left boot, Mr Bayoh



Vest, PC Short yellow fabric- Area 3



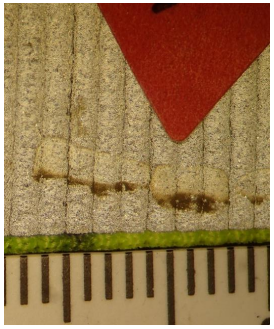
Right boot, PC Walker



Left boot, Mr Bayoh

Opinion 1

Soil from silver strip (Area 1) on vest worn by PC Nicole Short



The characteristics of some of the soil from Area 1, from the silver strip of the vest, worn by PC Nicole Short, is *consistent* with having originated from soil from the toe at the welt of the right boot and from soil from the heel of the sole of the right boot of Mr Sheku Bayoh.

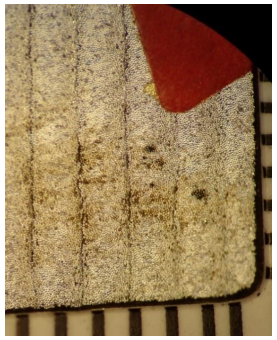
Opinion 2

Soil from silver strip (Area 1) on vest worn by PC Nicole Short

The characteristics of the soil from Area 1, from the silver strip of the vest, worn by PC Nicole Short, is *not consistent* with having originated from soil from the boots of PC Craig Walker.

Opinion 3

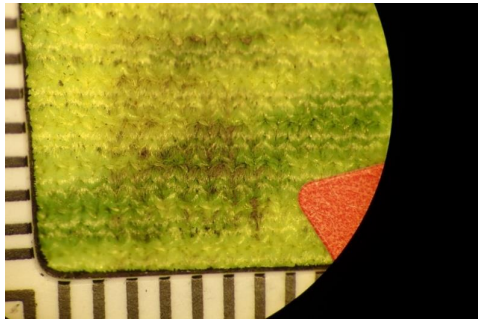
Soil from silver strip near edge of yellow fabric (Area 2) on vest worn by PC Nicole Short



The characteristics of the soil from Area 2, from the silver strip near the edge of yellow fabric, of the vest worn by PC Nicole Short, is *not consistent* with having originated from the boots of Mr Sheku Bayoh or from the boots of PC Craig Walker.

Opinion 4

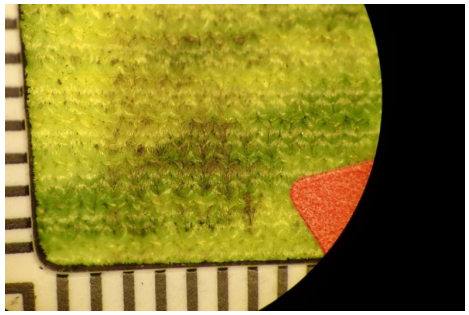
Soil from yellow fabric (Area 3) of vest worn by PC Nicole Short and soil from Mr Sheku Bayoh's boots



The characteristics of the soil from Area 3, from the yellow fabric, of the vest worn by PC Nicole Short, is *consistent* with having originated from soil from the toe of the sole of the left boot, and soil from the heel of the sole of the right boot worn by Mr Sheku Bayoh.

Opinion 5

Soil from yellow fabric (Area 3) on vest worn by PC Nicole Short and soil from PC Craig Walker's boots



The characteristics of the soil from Area 3, from the yellow fabric, of the vest worn by PC Nicole Short, is *not consistent* with having originated from soil from the boots of PC Craig Walker.

Source material referred to in creating this presentation

- Report by Prof Lorna DAWSON. ' Report on Examination, Analysis and Comparison of Soil recovered from Productions in the Sheku Bayoh Inquiry'. 1 November 2022
- Maps by Prof David MILLER, James Hutton Institute
- References within the report and presentation
- Statistical analysis and report by Dr Nicholas SCHURCH. 'Soil Elemental Composition Statistical Similarity Assessment'. 31 October 2022

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