

Thursday, 4 September 2025

Geological Occurrence and Characterization of Mineral Fibers in New Zealand Soils

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Millennium Hotel Queenstown
Corner Frankton Road & Stanley Street, Queenstown

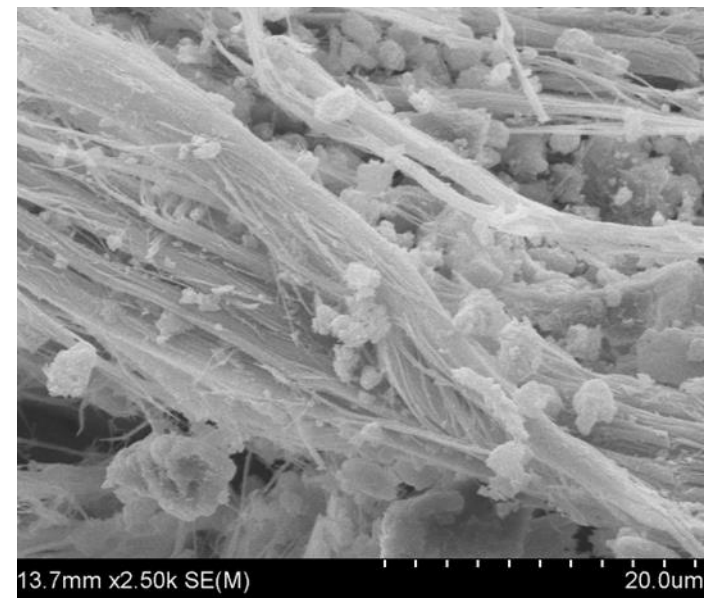


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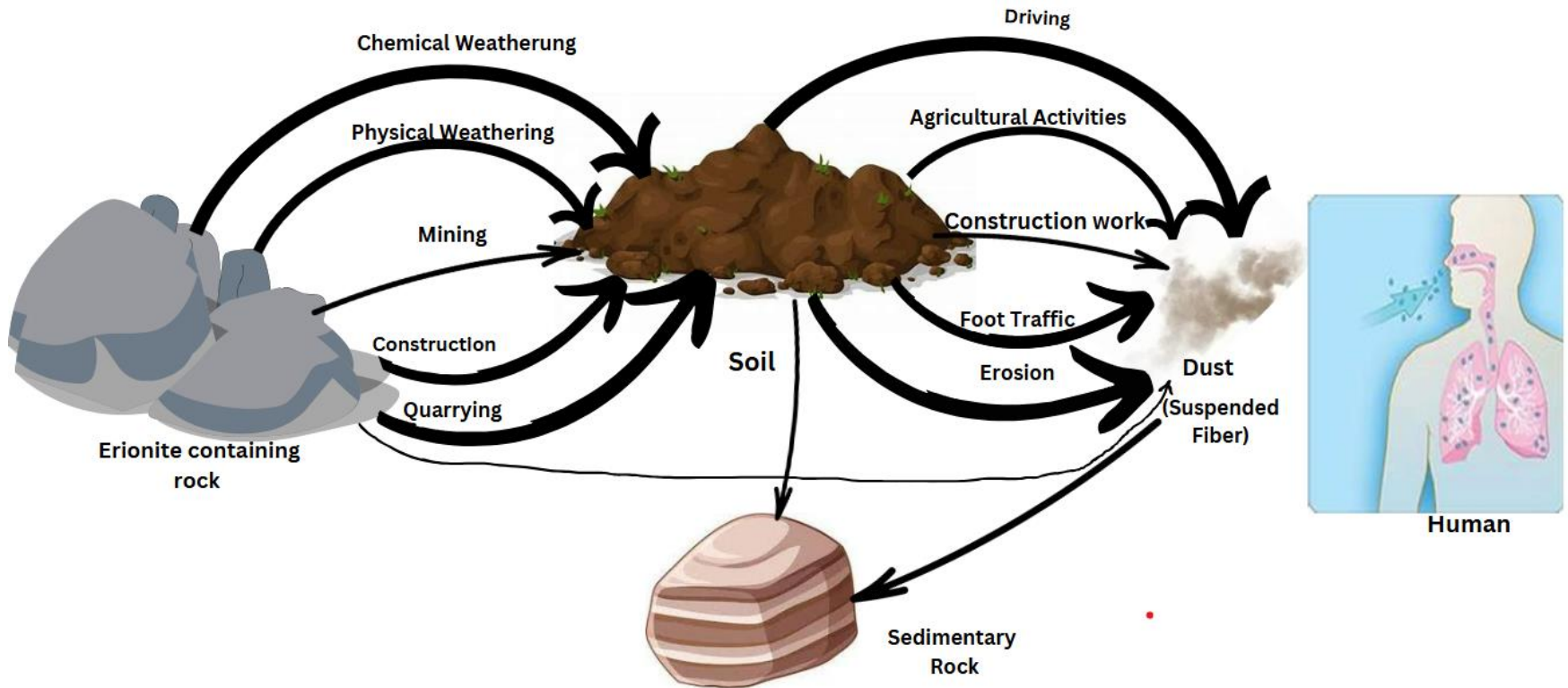


Why does it matter

- There are over 400 mineral species ; however, certain mineral fibres—such as **erionite and asbestos amphiboles**—are classified as Group 1 carcinogens by the International Agency for Research on Cancer (IARC).
- The hazard is determined by the particle size
- Airborne fibre: **L) $\geq 5 \mu\text{m}$, w $\leq 3 \mu\text{m}$** , and an **L/w value $\geq 3:1$** (WHO, 1986)
- Inhalation (and then respiration) of airborne erionite fibers has been linked to malignant mesothelioma (A rare and aggressive form of cancer)

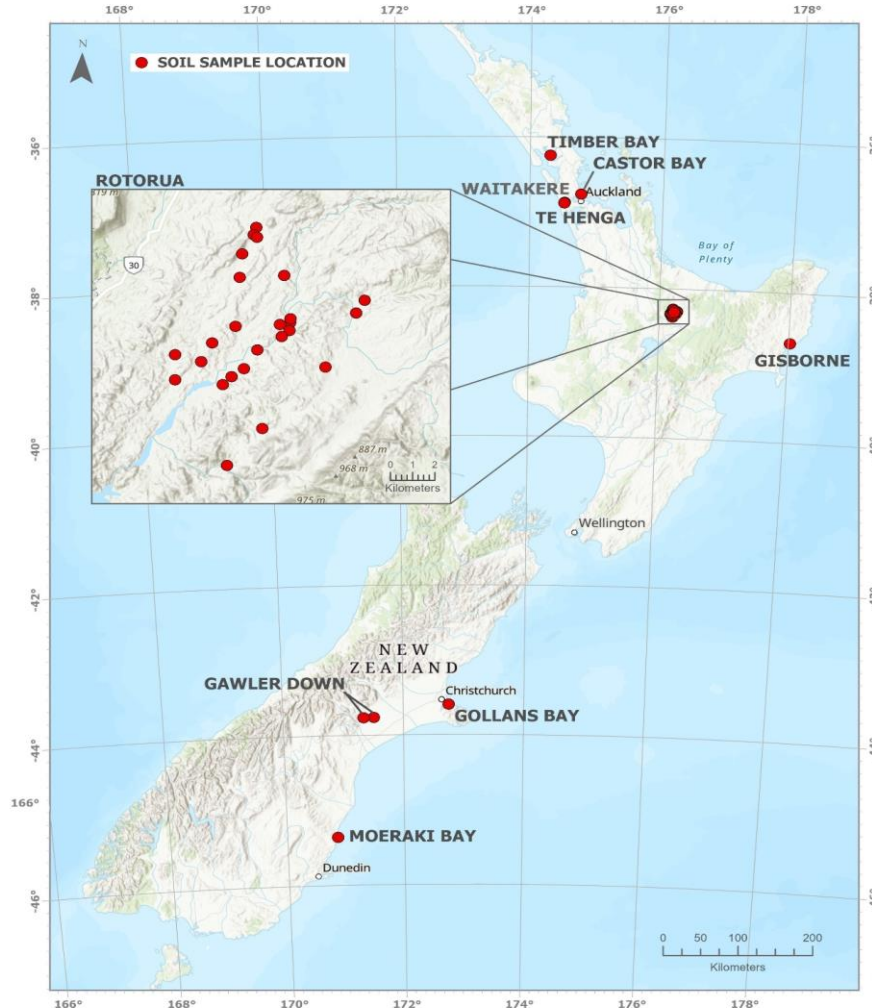


Schematic showing the potential transfer pathways of fibers between rock, soil, and air.



Study on fibrous mineral on soils of New Zealand

Soil samples were collected from the locations where zeolite has been reported in rock.



Sample preparation and characterisation

Soil samples were

- Dried at 60 °C
- Sieved
- Samples were prepared using Donut
- All samples were analyzed using Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM)



A novel approach for quantifying elongated airborne mineral particles (EMPs) using an automated scanning electron microscope (SEM)

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Novel Dry Spiking Technique for Erionite Detection

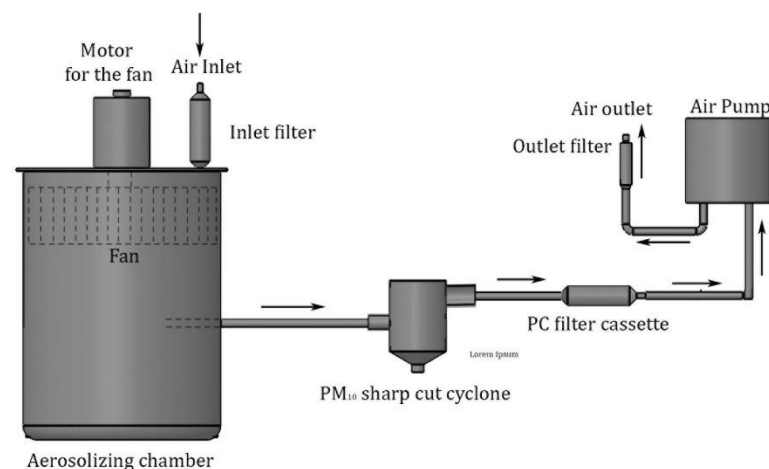
Erionite is aerosolized in a special chamber.

Particles are sampled onto filters at 2 LPM for one minute.

A cyclone removes particles larger than 10 μm .

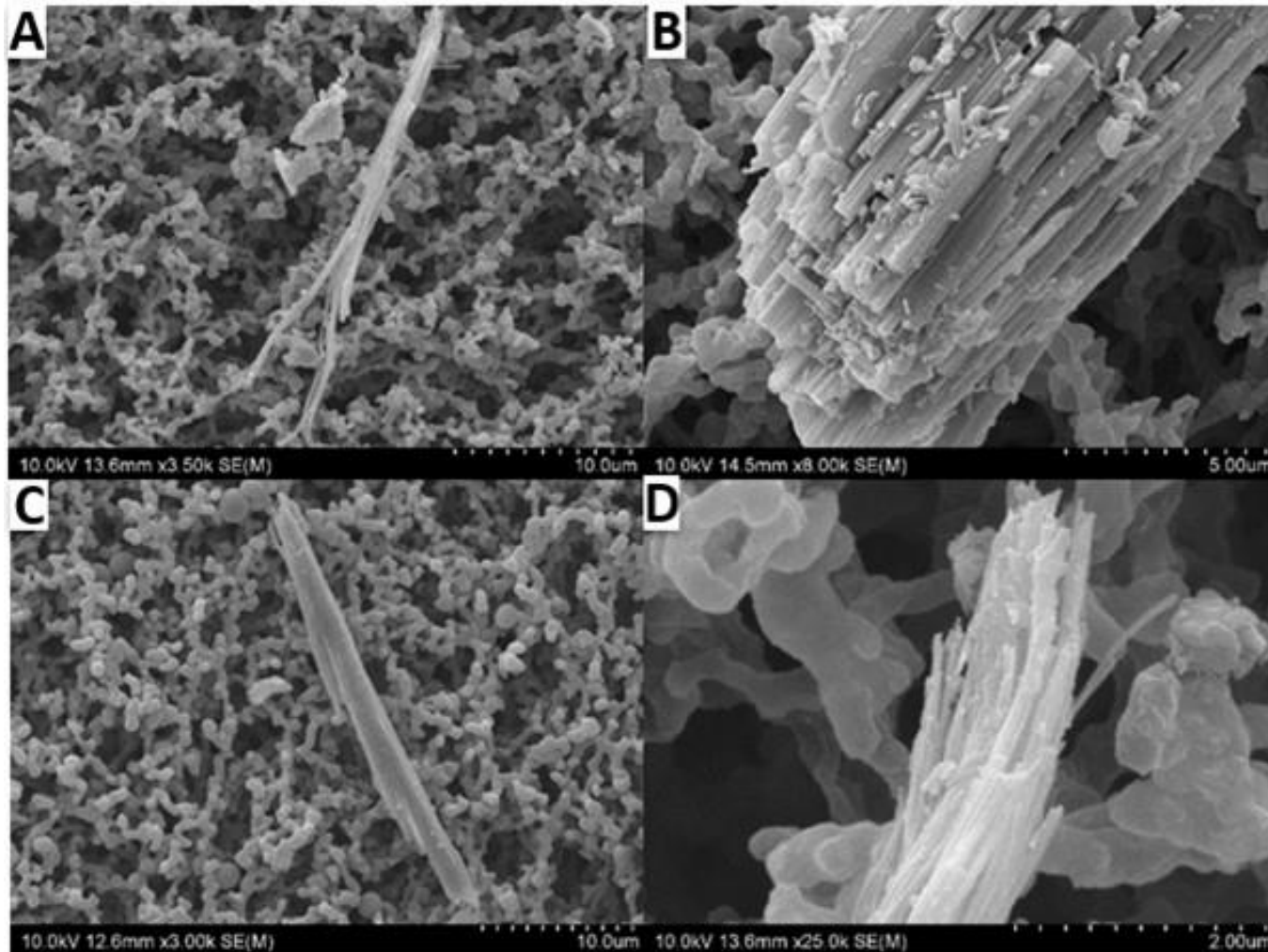
The system is cleaned between runs to prevent contamination.

Designed by Mote in NZ



The apparatus used for particle aerosolization and air sampling.

SEM Image of erionite in soil from GD



Scanning electron microscopy (SEM) images of Auckland, New Zealand. (A) fibers splitting into fibrils; (B) hexagonal bundle of erionite fibrils; (C) single fiber; and (D) erionite bundles.

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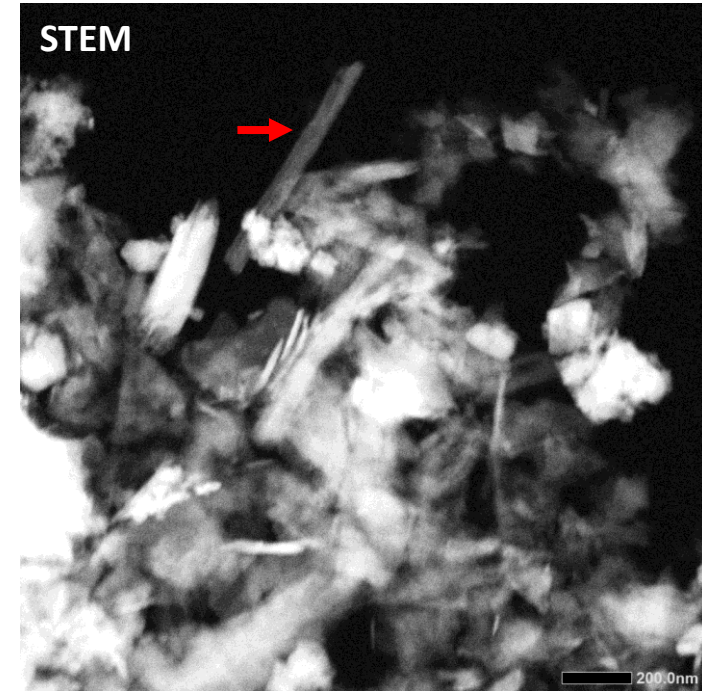
TEM

3D ED
data collection

erionite

200 nm

STEM



Element	(keV)	Mass%	Counts	Sigma	Atom%
C K* (Excluded)					
O K (Ref.)	0.525	50.50	3216.88	1.45	65.20
Mg K !	1.253	1.33	84.95	0.32	1.13
Al K !	1.486	7.88	497.18	0.79	6.03
Si K !	1.739	33.85	2156.36	1.63	24.90
K K		ND			ND
Ca K*!	3.690	2.45	129.20	0.49	1.26
Fe K !	6.398	3.98	154.72	0.71	1.47
Cu K* (Excluded)					
Total		100.00			100.00

Mineral fibers in soils of New Zealand



Sample No	Sample ID	Location	Mineral identified	Mineral Group
1	CB	Caster Bay	Albite	Carbonate
2	MW5	Moeraki Bay	Phillipsite	Zeolite
3	TH5	Te- Henga Quarry	Phyllosilicate	silicate
4	GD4	Gawler Downs	Annite	Plagioclase feldspar
5	GD8	Gawler Downs	Erionite	Zeolite
6	SOI	Rotorua	Mordenite	Zeolite
7	GB4	Gollan's Bay	Albite	Plagioclase feldspar
8	OLRD4	Riber Head	Gibbsite	Hydroxide
9	TB	Timber Bay	Actinolite	Asbestos

Implications



- Erionite and asbestos like fibrous minerals poses serious health risks, including links to malignant mesothelioma—its presence in soil also demands greater attention.
- Pathways of erionite mobilisation from rock → soil → air are underexplored and require focused study.
- Human activities (mining, construction, agriculture) can accelerate erionite release into the atmosphere.
- **It's very important to conduct regular air quality monitoring, especially during mining, quarrying, or other construction activities.**

Conclusions

- Erionite and other fibrous minerals in soil remain an overlooked hazard in environmental health research.
- Hazardous mineral fibers are present in New Zealand soils.
- Future research should focus on bridging the critical gaps between erionite and other mineral fiber occurrence, environmental pathways, and human exposure risk.
- It is **critical** to conduct **regular air-quality monitoring** during mining, quarrying, and construction to prevent fibre and dust exposures and **safeguard workers' health—avoiding irreversible, potentially fatal respiratory diseases.**

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Questions?

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