Naturally Occurring Asbestos in New Zealand – a fictional risk or significant hazard?

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May 2026

Introduction

- Where can Naturally Occurring Asbestos (NOA) be found in New Zealand?
- What geological processes lead to their formation.
- What types of asbestos and asbestos-like fibres are present?
- Tier 2 risk considerations.

NOA in New Zealand

- Primarily within serpentinite and in altered or metamorphosed ultramafic rocks.
- Occurs in the Richmond Ranges (Nelson) at Dun Mountain and Red Hills and D'Urville Island (Dun Mountain - Maitai terrane within dunite, peridotite and harzburgite rocks).
- Minor occurrences in Kaharangi National Park (Tasman), the West Coast and Bluff (Green Hills).
- Serpentinite also present in isolated places in Piopio (Waitomo) and Northland with potential for asbestos.

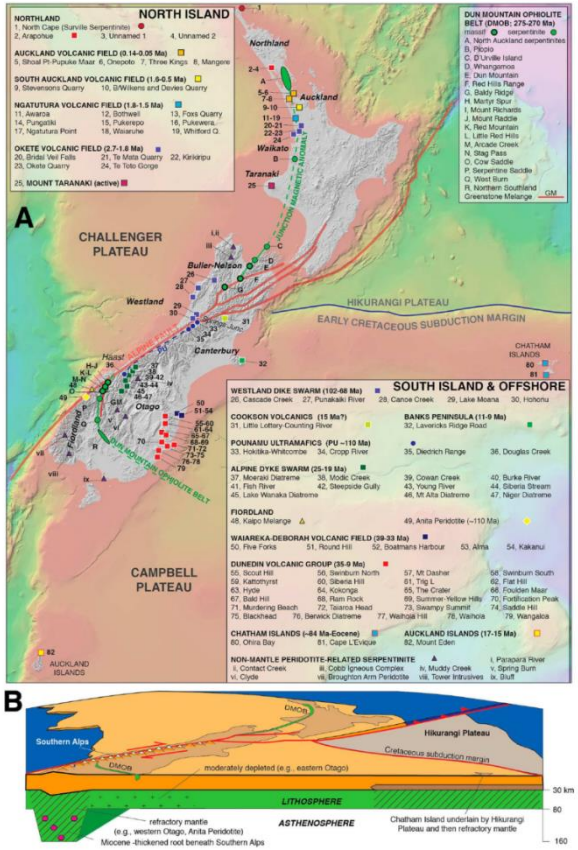


Figure 1. A. Location diagram of mantle peridotite and serpentinite in New Zealand. Base diagram is a satellite gravity map from NIWA. Q, quarry; Mt., Mount; Pt, Point. **B.** Cartoon of the Zealandia continental lithosphere today. Diagram is modified from Scott et al. (2019a).

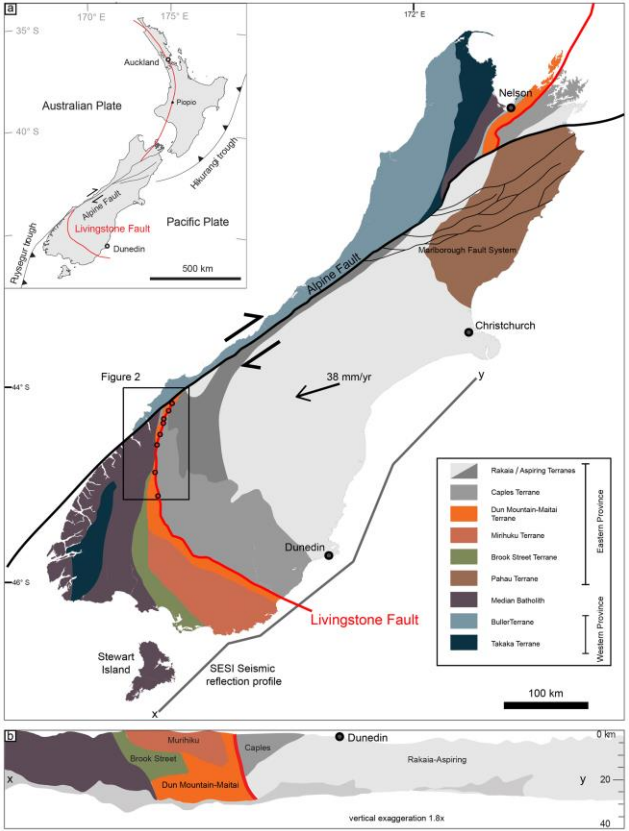
An updated catalogue of New Zealand's mantle peridotite and serpentinite, James M. Scott, New Zealand Journal of Geology and Geophysics, 2020

In Summary – NOA in New Zealand

- Located in relatively small, isolated areas that are low-populated.
- Disturbance limited to civil works like dam building and road maintenance and mining.
- Don’t appear to be linked geologically with other Elongate Mineral Particles (EMPs)
  – e.g. erionite, mordenite.

Dun Mountain Ultramafics

- Asbestos veins randomly occur through Dun Mountain – Maitai Terrane/Ophiolite Belt Ultramafics.



The internal structure and composition of a plate-boundary-scale serpentinite shear zone: the Livingstone Fault, New Zealand, Matthew S. Tarling, Solid Earth, 2019.

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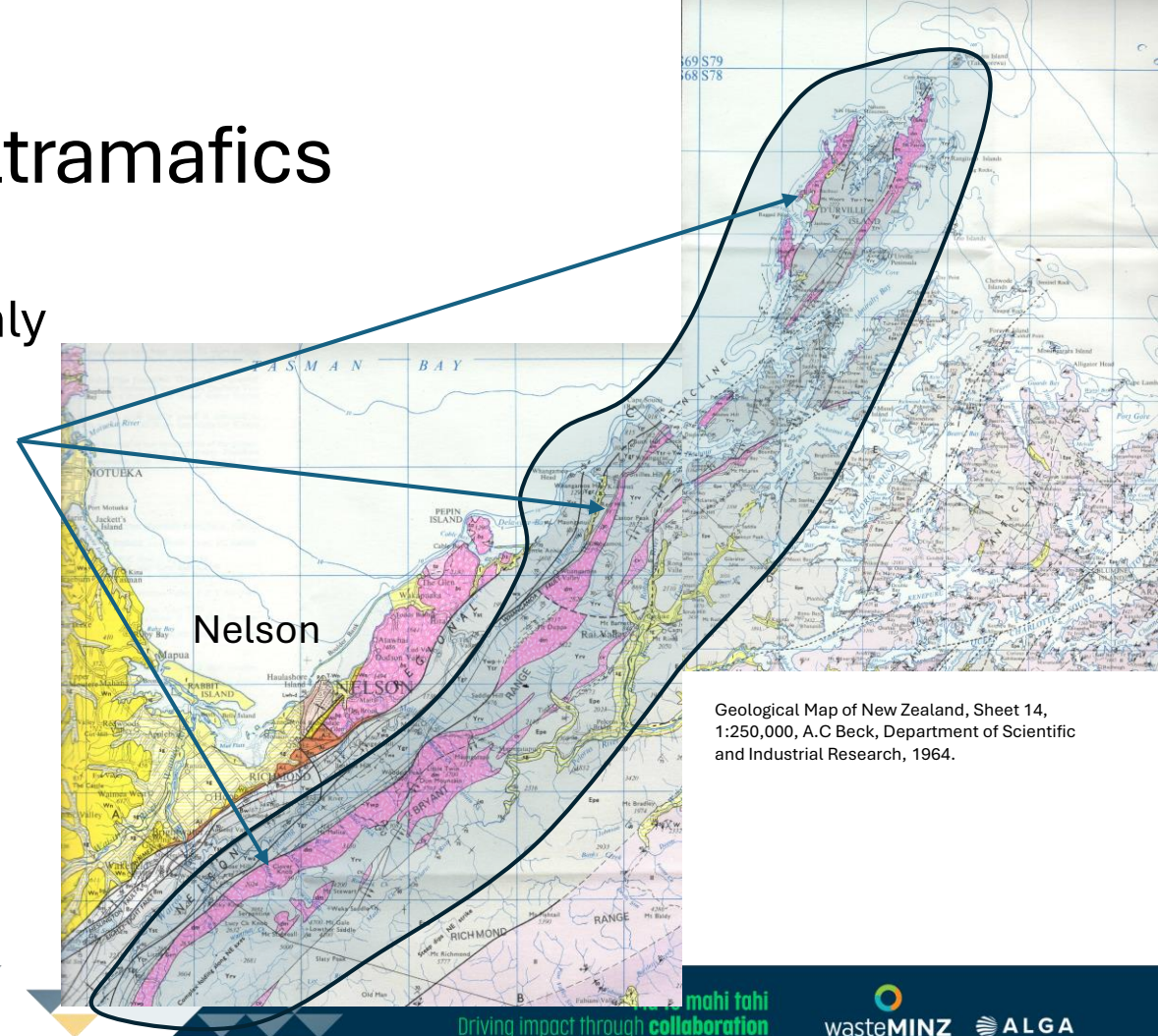

Geological Map of New Zealand, Sheet 14, 1:250,000, A.C Beck, Department of Scientific and Industrial Research, 1964.

NOA in New Zealand

- Chrysotile (serpentine) asbestos appearance.
  - Cross fibre (fibres span the full vein width)
    Fibres readily become airborne.
  - Slip fibre (fibres align parallel with rock surface)
    More tightly bound.
- Frequently occurs with tremolite (amphibole) asbestos and talc deposits.
  Less frequently as actinolite and anthophyllite.
- Non-asbestiform chrysotile, antigorite, lizardite have also been documented.

NOA – ‘Serpentine Factor’

- Natural conditions often cause stunted vegetation in the vicinity of serpentinite and asbestos veins (Serpentine Factor).

NOA ‘Serpentinite Factor’

- Natural causes of stunted/sparce vegetation:
  - Toxic effects of Ni, Cr, Co, Mg.
  - Mg can inhibit Ca uptake.
  - Low levels of plant-essential macronutrients.
  - Typically sandy, shallow soils susceptible to erosion.
  - Subjected to burn off to aid in early mineral exploration.


All times are Pacific/Aud

NOA in New Zealand

Fibrous Serpentinite

Serpentinite – soapy/greasy feel

NOA in New Zealand

Chrysotile veins within host rock

Serpentinite

NOA and Tier 2 Human Health Risk

- Tier 2 criteria needs evidence.
  Do we have sufficient information on:
  - Respirable airborne asbestos fibres?
    (<3 µm in diameter, >5 µm in length, aspect ration of ≥3:1)
  - NOA v anthropogenic sources – when is it no longer NOA?
  - Respirable fibres in soil?
  - Fibre types (other than Chrysotile)?
  - Duration/nature of exposure?
  - Natural processes at play?
    - Soil moisture/humidity.
    - Soil type (sand, gravel v silt, clay).
    - Vegetation cover.

NOA and Tier 2 Human Health Risk

- Tier 2 risk assessment – Ultramafics:
  - Limitations of BRANZ semi-quant soil analytical method.
  - Worst case conditions (soil moisture, humidity, open gravelly soils etc).
  - Alternative analysis to confirm – i.e. Transmission Electron Microscopy (TEM) :
    - Fibre type in air, rocks, and soils.
    - Personal exposure asbestos air monitoring:
      - Accurate representation of breathing zone.
      - Identifies/counts respirable fibres.
      - Lower detection limit (Approx 0.004 fibres/mL).
  - Fluidised Bed Asbestos Segregator – quantifies respirable fibre from soil sample with definitive fibre type.
  - Duration of exposure.

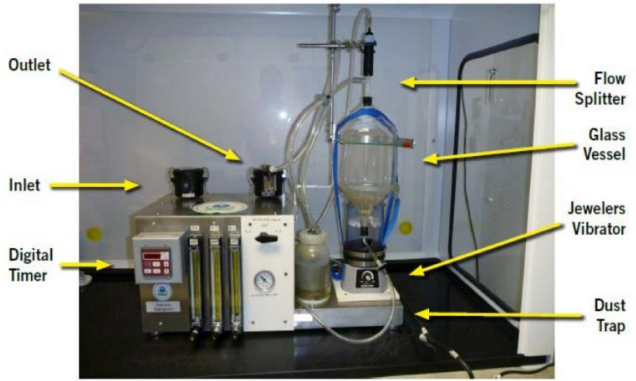

Figure 1 – Image of a fully assembled fluidized bed asbestos segregator.

Other Test Method – 42: Sampling, Sample Preparation and Operation of the Fluidized Bed Asbestos Segregator, Draft, USEPA, 2018.

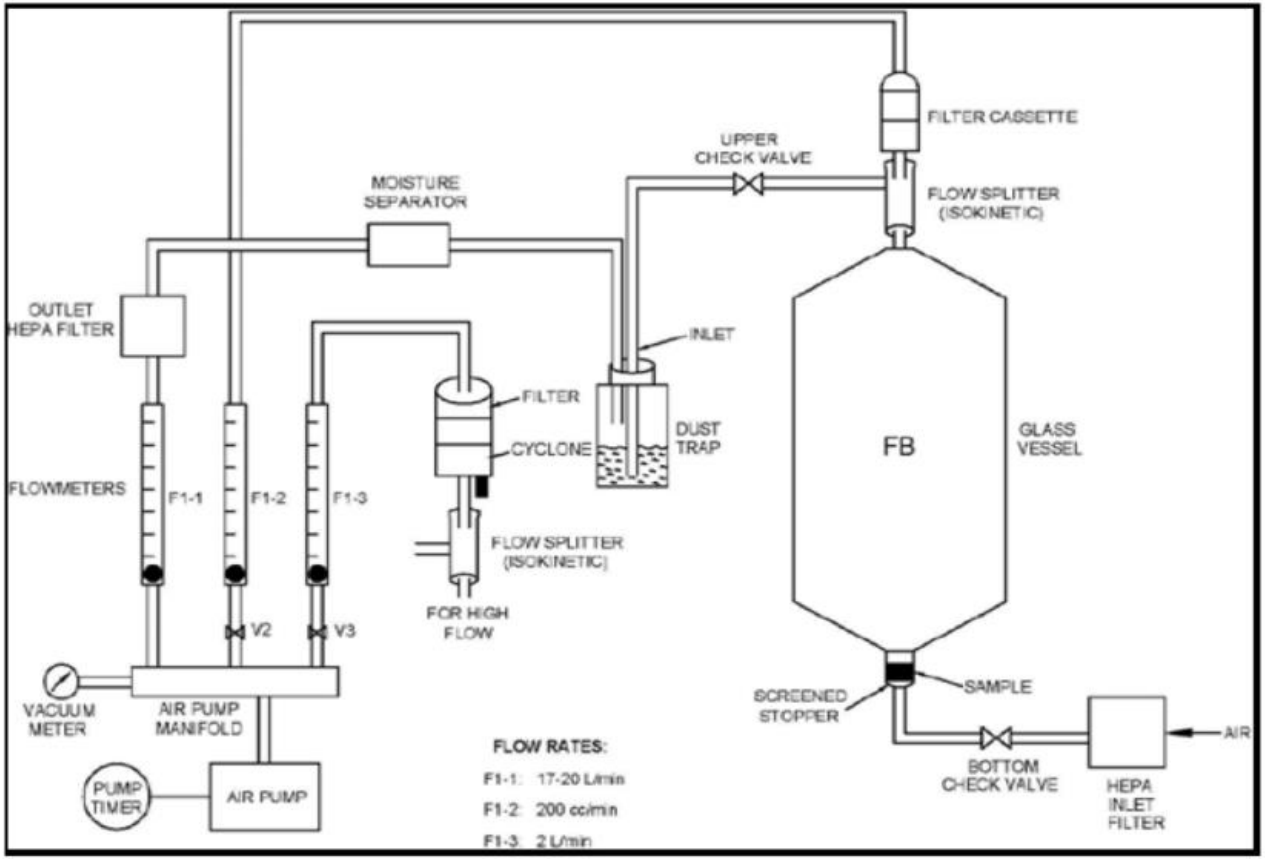

Figure 2 – Schematic of Fluidized Bed Asbestos Segregator.

Other Test Method – 42: Sampling, Sample Preparation and Operation of the Fluidized Bed Asbestos Segregator, Draft, USEPA, 2018.

NOA in New Zealand

- Prevalence of asbestos and other EMPs is relatively low and isolated.
- Weathered asbestos veins present in random locations throughout Ultramafics.
- Respirable tremolite often associated with chrysotile in soils/weathered rock – likely to increase health risk.
- Mining, quarrying, dam building and use in road materials pose a higher risk – no longer NOA.
- Unlikely to influence national mesothelioma rates compared with the built environment but need to be characterised.
- Standard analytical methods may not be sufficient for sites that have higher concentrations of asbestos.

References

- An updated catalogue of New Zealand's mantle peridotite and serpentinite, James M. Scott, New Zealand Journal of Geology and Geophysics, 2020.
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- New Zealand Guidelines for Assessing and Managing Asbestos in Soil, BRANZ, 2017 (Updated 2024).
- Other Test Method – 42: Sampling, Sample Preparation and Operation of the Fluidized Bed Asbestos Segregator, Draft, USEPA, 2018.
- Plant-available elements in soils and their influence on the vegetation over ultramafic ("serpentine") rocks in New Zealand, Brett H. Robinson et al., Journal of The Royal Society of New Zealand, Volume 26, No.4, 1996.
- The internal structure and composition of a plate-boundary-scale serpentinite shear zone: the Livingstone Fault, New Zealand, Matthew S. Tarling, Solid Earth, 2019.

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- Acknowledgements:
  - Simon Hunt, Technical Director, EHS Support
  - Andrew Rumsby, Principal, EHS Support