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Geological occurrence, mineralogical character and preliminary risk assessment of carcinogenic erionite in New Zealand

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Erionite is a naturally-occurring zeolite mineral that has emerged as a well-known health hazard over the last few decades. Human exposure to erionite fibers has been unequivocally linked to malignant mesothelioma, a disease also associated with inhalation of airborne asbestos. Indeed, erionite is now classified by the International Agency for Research on Cancer (IARC) as a Group 1 carcinogen (i.e., carcinogenic to humans), but it appears to be more toxic than asbestos. Since volcanoclastic rocks containing erionite are widely present in New Zealand, there is a concern over potential health issues following inhalation of dust particles in particular areas. Indeed, New Zealand is one of a number of high-income countries with elevated incidence of malignant mesothelioma (2.6 per 100,000), and this has traditionally been thought to be a result of occupational exposure to airborne asbestos fibers. However, recent cases of malignant mesothelioma have emerged without a known link to asbestos exposure, and in 2015, the New Zealand Government acknowledged that erionite was a more potent carcinogen than asbestos. Despite this, there are no established occupational exposure limits for erionite in New Zealand or globally. We are currently using a multi-methodological approach, based upon field investigation, morphological characterization, scanning electron microscopy (SEM)/energy-dispersive spectroscopy (EDS), Transmission Electron Microscopy (TEM), and X-ray powder diffraction (XRPD) to analyse erionite from sites around New Zealand. Preliminary results are reported here, including erionite from Miocene tuff in Auckland. The erionite appears to be erionite-K. From the dimensional analysis, 45.6% of minerals satisfied the requirements for a respirable airborne fibre (length, $L \geq 5 \mu\text{m}$, a diameter, $w \leq 3 \mu\text{m}$, and L/w value $\geq 3:1$). The presence of this mineral is of concern for risk to human health, especially considering the land development in the Auckland region and the quarries and mining-related activities that are operating in the zeolite host rocks elsewhere in New Zealand. Thus, there is a need for a detailed risk assessment in parts of the country indicative of potential hazard. Further assessments of erionite species, quantification of the potentially respirable airborne fibers, and targeted epidemiological surveillance are planned.