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Natural Occurrence of Fibrous Antigorite in New Caledonia: a Comparative Assessment of Potential Toxicity

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An increased incidence of mesothelioma, a malignancy associated with asbestos exposure, was highlighted in some areas of New Caledonia, where ultrabasic units extend for more than a third of the land and economy largely relies on nickel mining activity. Ultramafic rocks exploitation includes, beside nickel, the natural occurrence of chrysotile and tremolite asbestos and asbestiform fibrous minerals, such as fibrous antigorite. In New Caledonia, fibrous antigorite is considered an asbestos by the law, despite limited toxicity assessment is available so far. This work delivers preliminary information on the in vitro toxicity of fibrous antigorite and comparatively discusses results with respect to chrysotile asbestos. Three fibrous antigorite samples, differing by the alteration level and containing about 50% of fibrous particles mostly in respirable size, were compared with chrysotile in terms of physico-chemical properties, cell-free reactivity tests, and cellular toxicity induced in human epithelial cells (A549) and in murine macrophages (MH-S). Samples with alteration grade 2 (low weathering) and 4 (high weathering) exhibited the same reactivity in terms of hydroxyl radicals release of UICC chrysotile, but did not catalyze carbon-centered radical generation and contained smaller amount of bioavailable iron. Weathered antigorite samples were cytotoxic in a dose-dependent manner and induced oxidative stress and a pro-inflammatory intracellular messenger (NO). A similar effect was obtained with chrysotile at 4-times lower dose. Conversely, the non-weathered antigorite (alteration grade 1) showed a very weak surface reactivity and did not trigger any cellular effect. Asbestos toxicity depends on fibrous habit, surface reactivity, and biopersistence. Our tests revealed that fibrous antigorite has a lower reactivity than chrysotile. However, fibrous antigorite showed a leaching kinetics in simulated body fluids slower than chrysotile, suggesting that antigorite biopersistence could be higher than chrysotile. Further research is needed to confirm antigorite higher biopersistence and lower reactivity of unaltered samples, with respect to weathered ones.