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Monitoring environmental risk in fibrous minerals in New Caledonia: a comparison between different analytical methods.

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The New Caledonia is covered by ultrabasic units for more than a third of its surface, and it is one of the largest world producers of nickel ore. Mining activity, focused on extraction from lateritic ore deposits formed by the alteration of ultramafic rocks, must deal with the natural occurrence of asbestos and fibrous minerals. Almost all outcrops of geological units in open mines contain serpentine and amphibole, also as asbestos varieties (Lahondère, 2007). Owing to humid tropical to sub-tropical conditions, weathering processes and supergene mineralization are one of the main responsible for fibrogenesis of asbestos minerals.
The presence of fibrous minerals in mining and storage sites requires attention due to public health problems and for the safety of the operators. In this context, the evaluation of risk and health hazard to prevent the effects due to exposition is closely linked to the formation, alteration and release of fibers into the environment.
It has been demonstrated that different fibrous minerals have different toxicity (Fubini & Otero-Arean, 1999; Fubini & Fenoglio, 2007). An analytical strategy to discriminate and characterize, with certainty, the different varieties of the asbestiform phases is required to the establishment of an environmental monitoring system.
We have therefore analyzed by different methods a set of about fifty asbestos sampled for mapping environmental risk in fibrous minerals in New Caledonia. The samples contain serpentines (chrysotile, antigorite) and amphibole (tremolite), all fibrous and have been sorted by their different degree of alteration.
Data obtained with the more traditional mineralogical and petrological analytical techniques - such as optical microscopy, X-ray diffraction, secondary electron microscopy (SEM-EDS), and transmission electron microscopy – have been completed by the employment of more specialized tools as phase contrast microscopy (PCM), Raman spectroscopy, and thermal analysis (DTA). Moreover analytical performances of a Raman portable equipment, to be used in field observation, were assessed against other laboratory methods. Portable Raman was tested first in laboratory to check its reliability, and then on fieldtrip, directly on the mining front under normal environmental conditions (sun, strong wind, high temperature, etc.).
Thus, for each analytical method, ability for fibers identification was tested. This project is part of the French-Italian program "Amiantes et Bonnes Pratiques", financed by the CNRT "Nickel and its environment" of New Caledonia.

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Lahondère, D. (2007): L'amiante environnemental en Nouvelle Calédonie: Expertise géologique des zones amiantifères. Evaluation des actions engagées. BRGM/RP-55894-FR, 55 p.