



## **Naturally occurring asbestos in soils and stream sediments: an example from Valmalenco (central Alps, northern Italy)**

Alessandro Cavallo

University of Milan-Bicocca, Department of Earth and Environmental Sciences, Milano, Italy (alessandro.cavallo@unimib.it)

A huge ultramafic body (mainly serpentinites) is well exposed over an area of 130 km<sup>2</sup> in the Valmalenco area (central Alps, northern Italy), at the Penninic to Austroalpine boundary zone. The presence of chrysotile asbestos veins gave rise to widespread mining activity, particularly between the end of the XIX century and 1975, when the extraction stopped completely. At present time the extractive sector is still important, with an active talc mine and several serpentinite open-cast quarries (dimension and decorative stone). For these geological reasons, the Valmalenco district is an excellent “naturally occurring asbestos” (NOA) example. The presence of asbestos in serpentinite quarries (rock-masses, stones and in the air) was extensively investigated during the last 15 years, but its “environmental” distribution (e.g. in soils) is still little known. To evaluate environmental asbestos contamination, extensive sampling of soils, stream sediments and airborne particulate was carried out, considering specific criteria and procedures for the NOA environment (careful sample preparation, serpentine polymorphs, non-asbestiform mineralogical varieties). “Massive” samples were preliminary characterized by XRPD and OM, and the quantitative analysis was carried out by SEM-EDS, whereas air samples were studied by SEM-EDS and TEM. Little amounts of chrysotile (generally < 400 ppm, range 150 – 2500 ppm) were detected in stream sediments and soils, as well as traces of asbestiform tremolite (< 300 ppm, range <100 – 280 ppm). The highest concentrations of chrysotile were detected close to the abandoned mines, with peaks in debris and reclaimed mining landfills. If the presence of chrysotile was obvious, asbestiform tremolite was a disturbing and widespread surprise: it is not reported in literature, and is probably linked to talc lodes and veins, occurring both in serpentinites and dolomitic marbles. The analysis of air samples showed a complex environment, with significant analytical difficulties, especially due to abundant pseudo-fibrous antigorite fragments (falling into the WHO fiber definition criteria). The chrysotile concentrations at quarry property borders and at nearest villages were always below the Italian environmental exposure limit (2 ff/l), and traces of asbestiform tremolite were reported only in 3 cases out of 130 determinations. TEM-SAED investigations highlighted in some cases traces of chrysotile “micro-fibrils” (length < 5 μm, not countable per WHO criteria). The over ten-year experience in cooperation with INAIL (Italian worker’s compensation authority) allowed significant improvements in quarrying and processing laboratories, as well as the release of specific protocols for the NOA environment, but the presence of asbestiform tremolite requires in-depth studies (geological surveys, analytical determinations) on its presence and distribution.