

MINERALS IN THE HUMAN BODY

**Determination of the concentration of asbestos minerals in highly contaminated mine tailings:
An example from abandoned mine waste of Crètaz and Èmarese (Valle d'Aosta, Italy)†**

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ABSTRACT

For the first time, this work reports concentration maps of asbestos minerals in contaminated mine tailings drawn using the results of Rietveld quantitative phase analysis (QPA). The investigated sites are located in the Valle d'Aosta region (Italy): Crètaz, the most important Italian magnetite mine, active until 1979 and Emarèse, one the most important chrysotile asbestos mines in Italy, active until 1968. The results of the study permit to draw the spatial distribution of the asbestos (chrysotile and tremolite in this specific case) concentration, useful to plan reclamation of the sites, with priority given to the areas with the highest asbestos concentration. Because of the complexity of the mineral assemblage, which includes, among the others, antigorite, chlorite, talc, and tremolite, the concentration of chrysotile was cross-checked using different experimental techniques such as X-ray powder diffraction (XRPD), Fourier transform infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), polarized light optical microscopy (PCOM), and differential thermal analysis (DTA). The accuracy of the results was validated by analyzing standard samples with known concentrations of chrysotile and tremolite. The comparison allowed to point out the advantages and disadvantages of each experimental method.

At Crètaz, chrysotile ranges from 4.4 to 22.8 wt% and tremolite from 1.0 to 10.3 wt%, whereas at Emarèse the concentration of chrysotile varies from 3.3 to 39.5 wt% and tremolite from 5.9 to 12.4 wt%. Antigorite and chlorite are the major accompanying phases with variable amounts of other accessory minerals including magnetite, carbonates, talc, olivine, pyroxene, talc, and brucite. The results of our study are of key importance for the local environmental policies as the knowledge of the spatial distribution of the asbestos concentration allows to plan a detailed reclamation agenda of the contaminated sites. The spots with the highest surface contamination of both chrysotile and tremolite were identified and classified as priority areas in the reclamation plan.

Keywords: Chrysotile, tremolite, serpentine, mine tailings, quantitative determination