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Evaluation of errors in quantitative determination of asbestos in rock

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The quantitative determination of the content of asbestos in rock matrices is a complex operation which is susceptible to important errors. The principal methodologies for the analysis are Scanning Electron Microscopy (SEM) and Phase Contrast Optical Microscopy (PCOM). Despite the PCOM resolution is inferior to that of SEM, PCOM analysis has several advantages, including more representativity of the analyzed sample, more effective recognition of chrysotile and a lower cost. The DIATI LAA internal methodology for the analysis in PCOM is based on a mild grinding of a rock sample, its subdivision in 5-6 grain size classes smaller than 2 mm and a subsequent microscopic analysis of a portion of each class. The PCOM is based on the optical properties of asbestos and of the liquids with note refractive index in which the particles in analysis are immersed.
The error evaluation in the analysis of rock samples, contrary to the analysis of airborne filters, cannot be based on a statistical distribution. In fact for airborne filters a binomial distribution (Poisson), which theoretically defines the variation in the count of fibers resulting from the observation of analysis fields, chosen randomly on the filter, can be applied. The analysis in rock matrices instead cannot lean on any statistical distribution because the most important object of the analysis is the size of the of asbestiform fibers and bundles of fibers observed and the resulting relationship between the weights of the fibrous component compared to the one granular.
The error evaluation generally provided by public and private institutions varies between 50 and 150 percent, but there are not, however, specific studies that discuss the origin of the error or that link it to the asbestos content. Our work aims to provide a reliable estimation of the error in relation to the applied methodologies and to the total content of asbestos, especially for the values close to the legal limits.
The error assessments must be made through the repetition of the same analysis on the same sample to try to estimate the error on the representativeness of the sample and the error related to the sensitivity of the operator, in order to provide a sufficiently reliable uncertainty of the method.
We used about 30 natural rock samples with different asbestos content, performing 3 analysis on each sample to obtain a trend sufficiently representative of the percentage. Furthermore we made on one chosen sample 10 repetition of the analysis to try to define more specifically the error of the methodology.