CHARACTERIZATION OF NATURAL MATERIALS CONTAINING N.O.A. (*NATURALLY OCCURRING ASBESTOS*): THE PROBLEM OF QUANTIFICATION

DOTT. GEOL. MARTINA VITALITI

RESEARCH GRANT HOLDER AT POLITECNICO DI TORINO, DEPARTMENT OF ENVIRONMENT, LAND AND INFRASTRUCTURE ENGINEERING (DIATI)

ING. OLIVIERO BAIETTO

PHD CANDIDATE AT POLITECNICO DI TORINO, DEPARTMENT OF ENVIRONMENT, LAND AND INFRASTRUCTURE ENGINEERING (DIATI)

5TH INTERNATIONAL CONFERENCE ON SUSTAINABLE SOLID WASTE MANAGEMENT

ATHENS, 21–24 JUNE 2017

The fibrous habit of these minerals links the asbestos exposure to adverse human health effects.

The presence of Naturally Occurring Asbestos is one of the biggest dangers to deal with during excavations and tunnelling.

Asbestos, which is an accessory or occasional mineral of secondary origin, can be found into ophiolites rocks (serpentinite-metabasite..) also called
green stones.
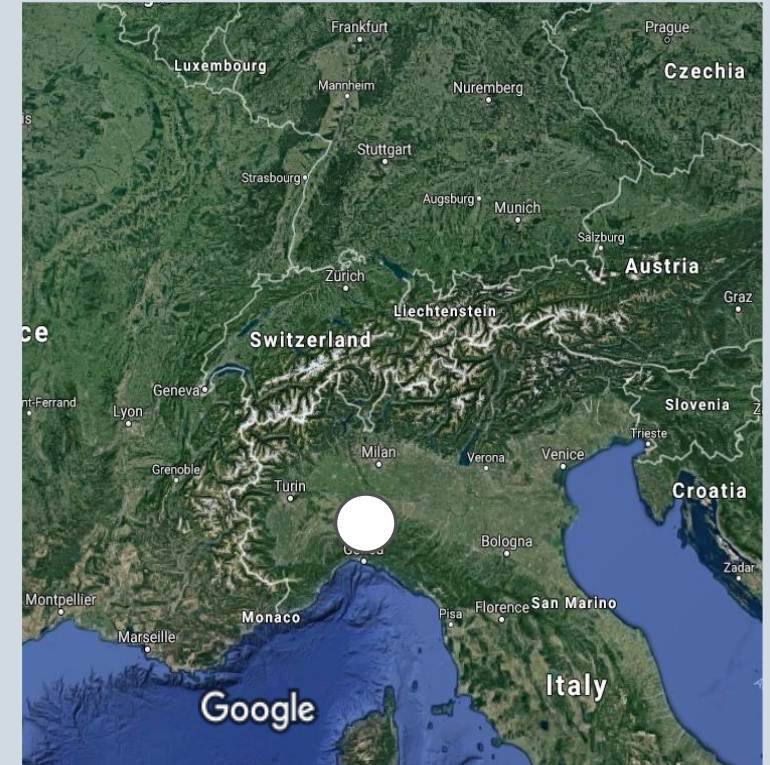
TECHNOLOGY	USE	DETECTION LIMITS	RESOLUTION
DRX	• Asbestos weight determination	Concentration >1%	
IR	• Asbestos weight determination	Concentration >1%	
SEM	• Asbestos weight determination • Determination of airborne fiber number concentration	Concentration > 0,1% (quantitative) < 0,01% Concentration > 0,1% (semi-quantitative)	5 nm
PCOM	• Asbestos QUALITATIVE determination • Determination of airborne fiber number concentration (not used)	Concentration < 1% Fiber diameter > 0,75 µm	0,2 µm

ITALIAN LAWS IN FORCE: DM 6/9/94

The threshold beyond which the material is considered as hazardous waste is a concentration of asbestos fibres of 1000 mg/kg . (152/2006)

Mild grinding of a rock sample

Classification of the sample (100 gr) into
5 grain size classes (< 2 mm) by wet sieving

Preparation of the set of slides (1 set = 4 slides)
using oils with note refractive index

Sieve column

PCOM

The observation and measuring (length, diameter) of the asbestos fibers on a fixed number of fields is based on optical properties as pleoclorism and interference color.

$$Ca_{tot} = \frac{M_{c1} c_1 + M_{c2}\ c_2 + \cdots + M_{c4}\ c_4}{M_{tot}}$$

PCOM is used in the US (ASTM D7521 − 16)
The methodology is based on point-count.
"This test method has an analytical sensitivity of 0.25 %
by weight with optional procedures to allow for an
analytical sensitivity of 0.1 % by weight."
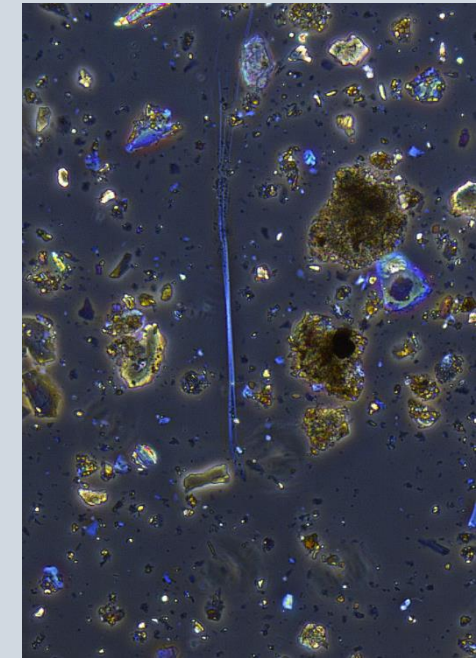
200 μm

Chrysotile
> 0,075 mm; 10x.

PCOM

The measurements are expressed
by two values:
mean (μ) and
standard deviation (σ).

Operator 1: 433,1 ± 109,19
Operator 2: 413,1 ± 71

|	Operator 1	Operator 2
	Ca_{tot} (mg/kg)	Ca_{tot} (mg/kg)
Sample 1	546	393
Sample 2	575	406
Sample 3	449	514
Sample 4	423	515
Sample 5	398	370
Sample 6	567	485
Sample 7	228	370
Sample 8	326	380
Sample 9	405	294
Sample 10	414	404
Mean (μ)	433	413
Standard deviation (σ)	109	71

PCOM
Uncertainty of methodology

Dispersion of an amount of a powder sample
with a granulometry between 10 and 100 μm
in a known volume of a solution

Filtration of a part of the suspension
on a polycarbonate filter

Observation, at 1000-2000X,
of a number of microscopic
fields adapted
to the limit of detection,
in order to analyse 1-4 mm^2
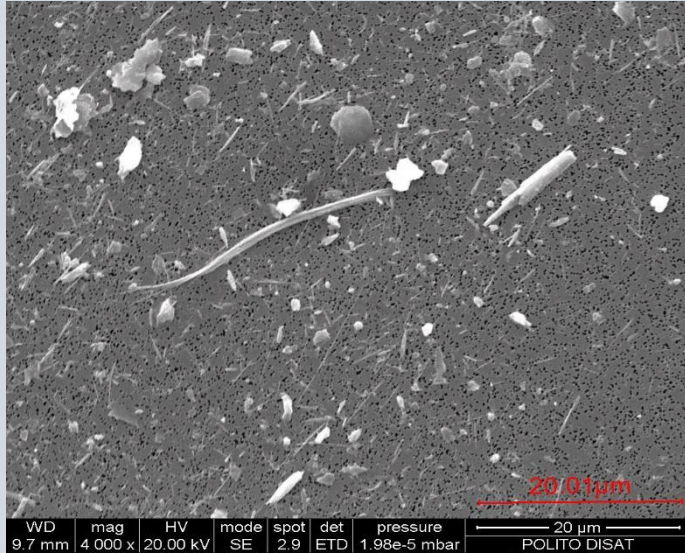
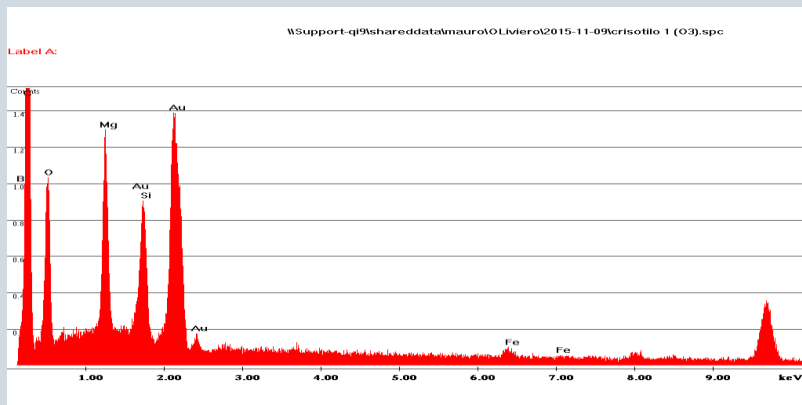Scanned image by
SEM (mag = 4000 X)

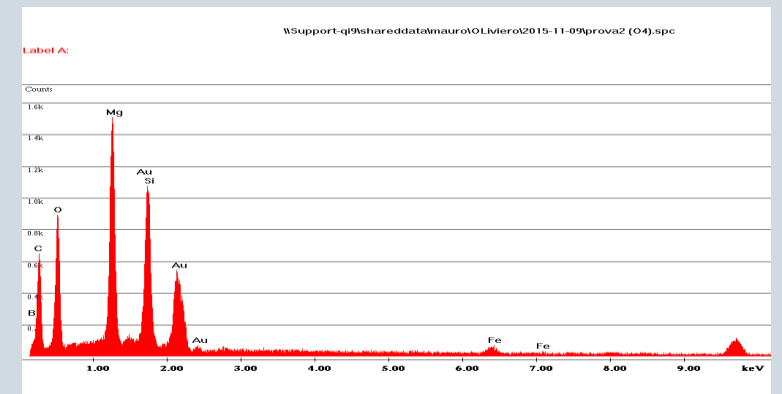Scanned image by SEM
(mag = 16000 X)

SEM

Identification of the asbestos fibers by X-ray dispersion energy spectroscopy (EDS), and measurement of their dimensions.

Determination of the asbestos content obtained by the relationship between the weights of the fibrous component compared to the granular one.
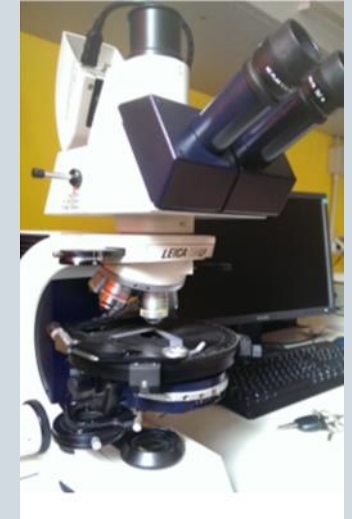

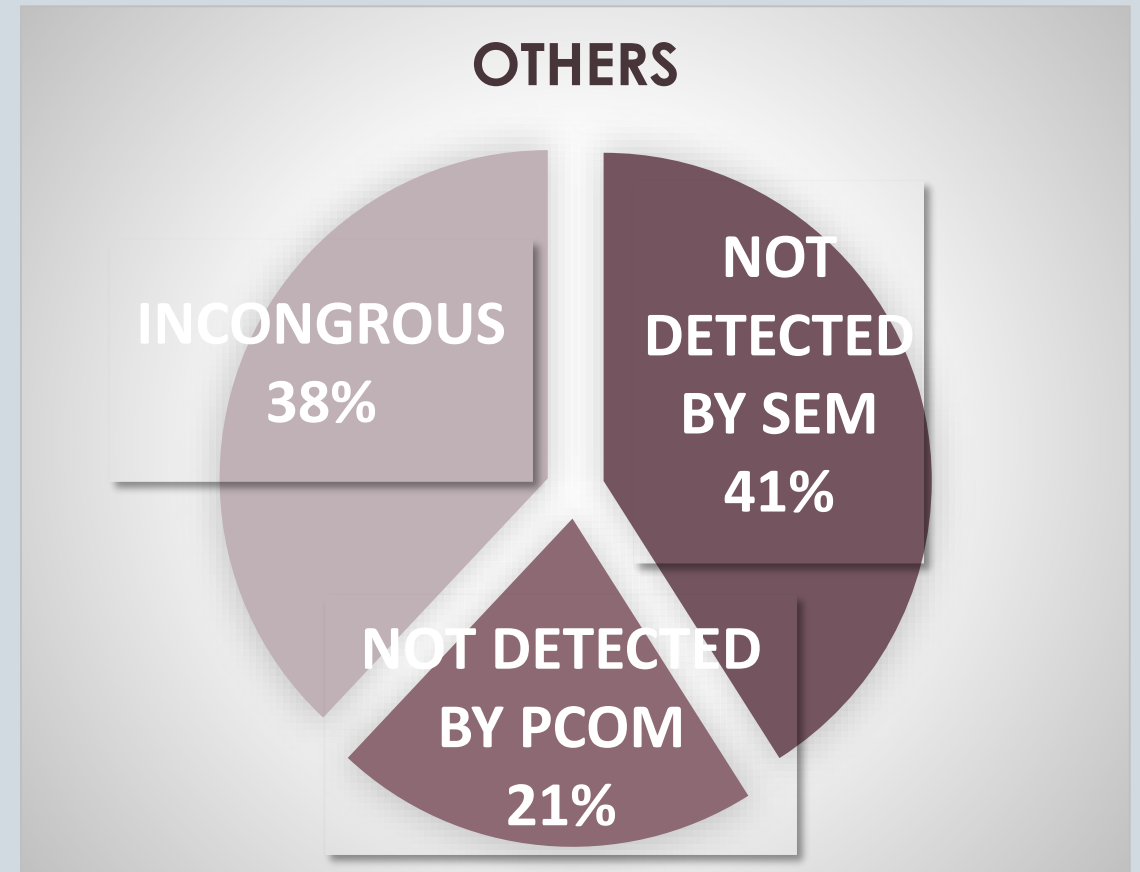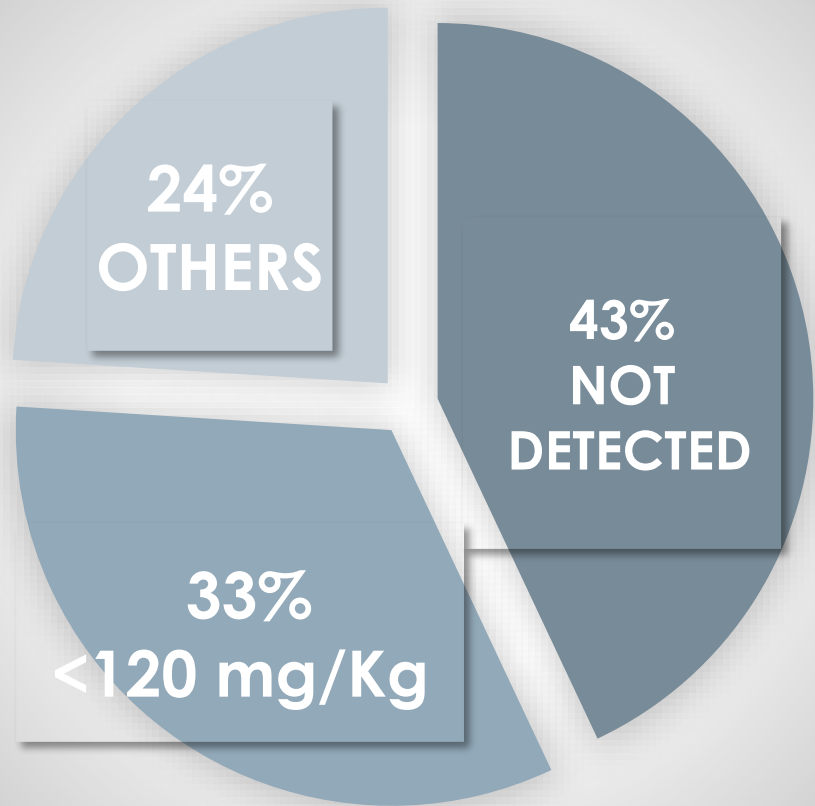X-ray dispersion energy spectroscopy (EDS)

SEM

Scanning Electron
Microscope

- Amount of analysed sample portion: 0,008 mg SEM; 150 mg PCOM

- Grinding

- Distinguishing between chrysotile and antigorite

Phase Contrast
Optical Microscope

SEM vs PCOM

24% OTHERS

43% NOT DETECTED

33% <120 mg/Kg

OTHERS

INCONGROUS 38%

NOT DETECTED BY SEM 41%

NOT DETECTED BY PCOM 21%

SEM vs PCOM

ASBESTOS NOT DETECTED BY PCOM:

ASBESTOS NOT DETECTED BY SEM:

SEM HIGHER THAN PCOM:

PCOM HIGHER THAN SEM:

Thin fibers / Antigorite

Representativeness of the sample

Out of scale objects / Antigorite

Representativeness

DISCUSSION

PCOM ADVANTAGES

Representativeness

Reproducibility

Cost

Time

Sustainability

CONCLUSIONS

Thank you for your attention