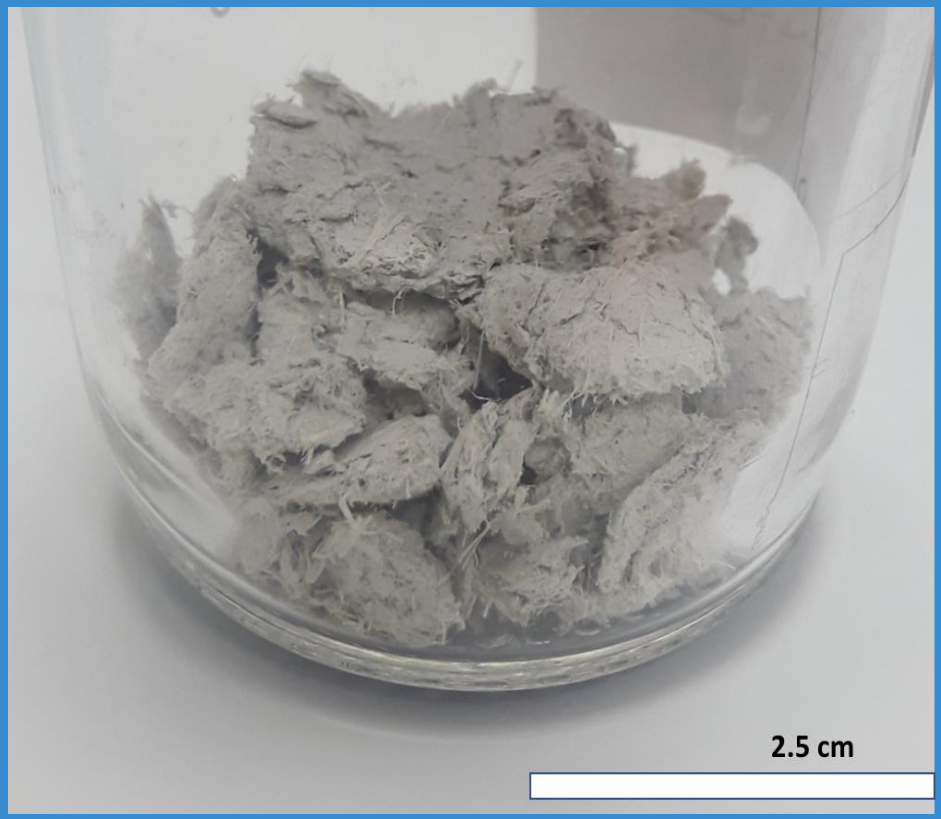
PRIN 2017
Meeting venerdì 9 Ottobre

Unità di Modena e Reggio Emilia

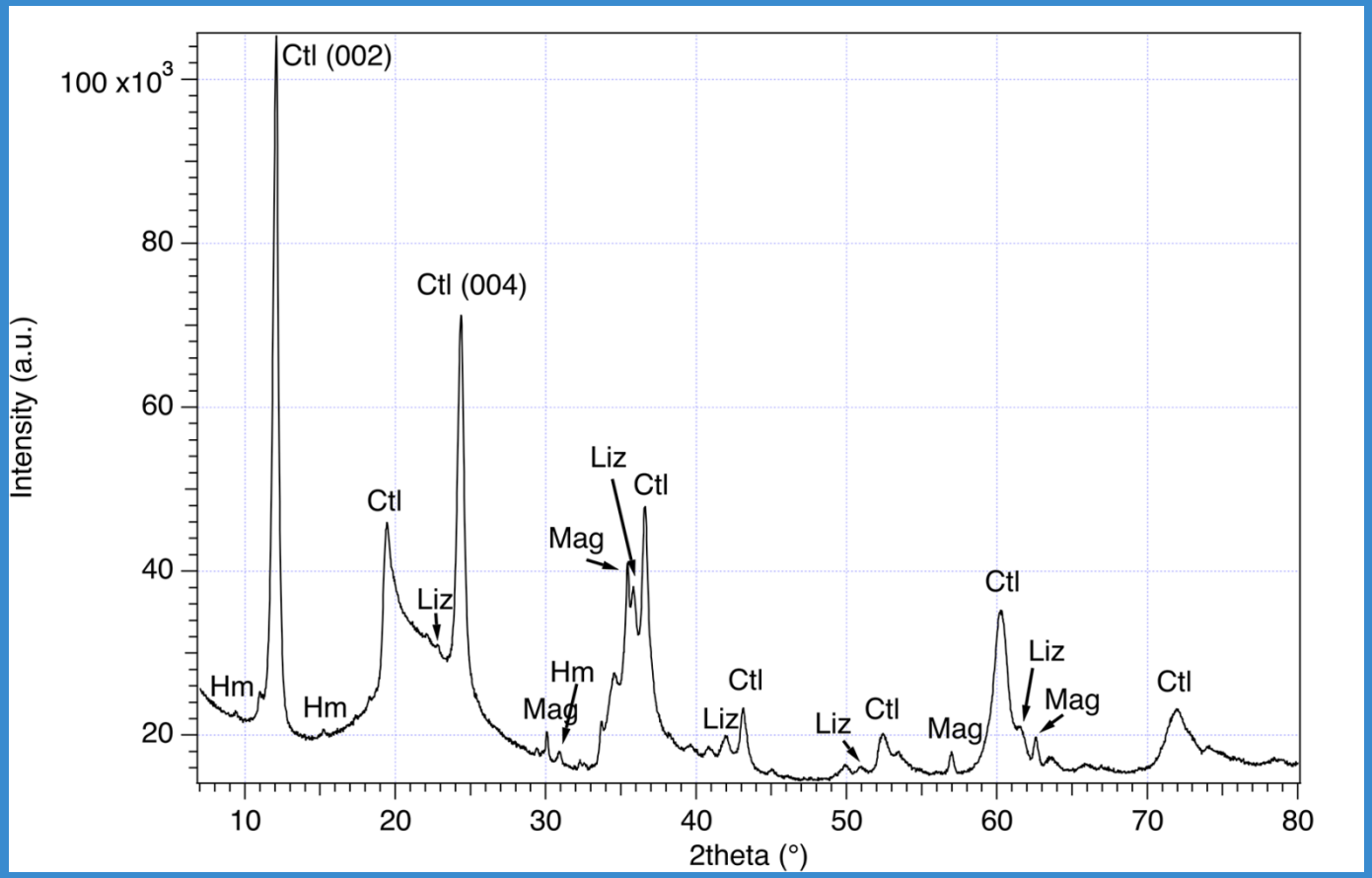
CRISOTILO COMMERCIALE RUSSO

Yasniy, Orenburg. Ural Mountains

CRISOTILO COMMERCIALE RUSSO



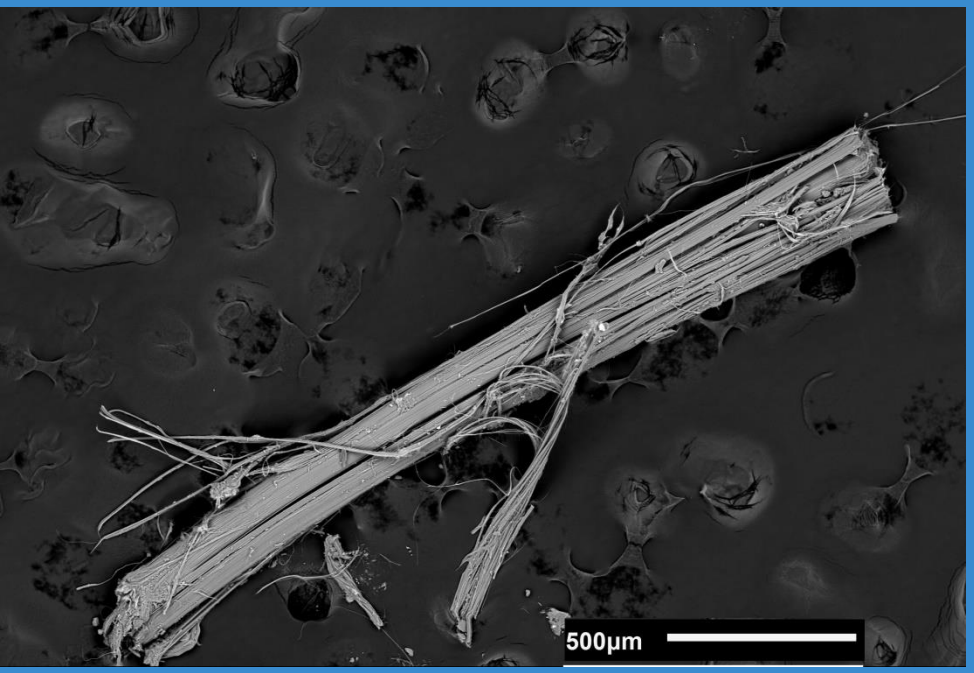
Chrysotile

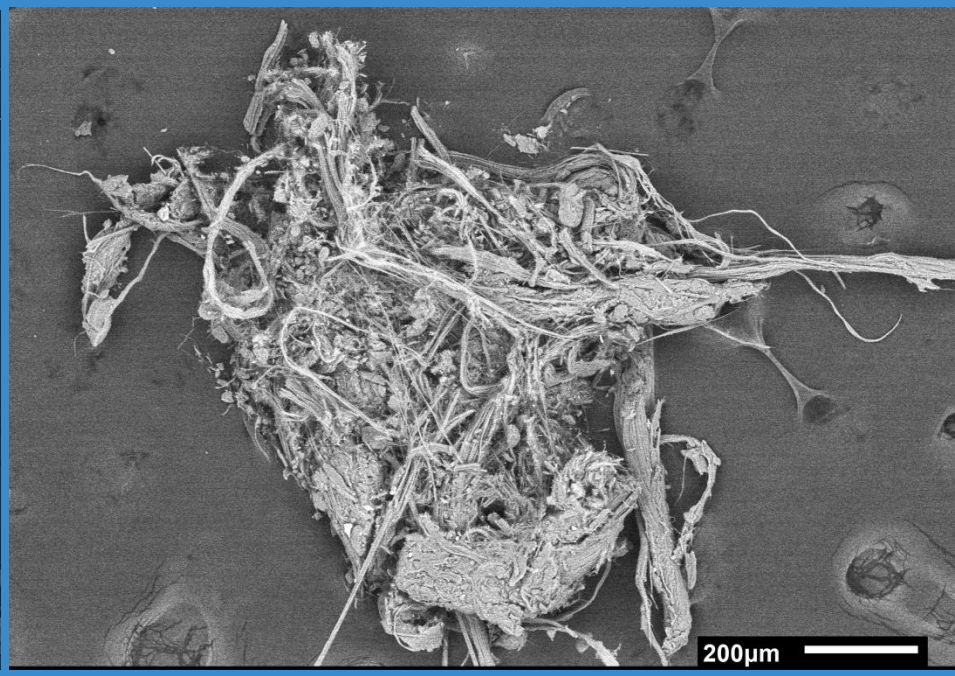

Ctl (002)
100 x10^3
80
Ctl (004)
60
Ctl
Liz
Ctl
Mag
40
Liz
Ctl
Hm
Hm
Hm
Mag
Ctl
Liz
Liz
Ctl
Mag
Ctl
Liz
Mag
Ctl
20
Intensity (a.u.)
10
20
30
40
50
60
70
80
2theta (°)

FPTI model

Parameter	Major adverse effect	Major pathobiological process
Morphometric		
length L	frustrated phagocytosis	Inflammation and oxidative stress
diameter D	frustrated phagocytosis	inflammation and oxidative stress
crystal curvature	reduced surface adhesion of proteins/cells	inflammation and oxidative stress?
crystal habit	airways deposition depth	inflammation and oxidative stress
fiber density	airways deposition depth	inflammation and oxidative stress
hydrophobic character of the surface	Interaction with biopolymers, phagocytosis	inflammation and oxidative stress?
surface area	airways deposition depth, frustrated phagocytosis	(chronic) inflammation and oxidative stress
Chemical		
Total iron content	Production of ROS	DNA damage and inflammation
ferrous iron	Production of ROS	DNA damage and inflammation
Surface ferrous iron/iron nuclearity	Production of ROS	DNA damage and inflammation
content of metals other than iron	Production of ROS	DNA damage and inflammation
Biodurability		
Fiber dissolution rate	frustrated phagocytosis …	Inflammation …
velocity of iron release	production of ROS	inflammation
velocity of silica dissolution	production of ROS?	oxidative stress and inflammation?
velocity of release of metals	ROS production	DNA damage, inflammation, …
Surface activity		
ξ potential	production of ROS and hemolysis	Inflammation …
fibers' aggregation	frustrated phagocytosis	inflammation
Cation exchange in zeolites	interference with ER cross-talk?	apoptosis, necrosis?

Morphometric parameter





		Percentiles						
	Min	5th	25th	50th	75th	95th	Max	σ
L (µm)	1.36	3.90	15.1	27.2	45.3	81.9	188	28.2
W (µm)	0.05	0.10	0.37	0.59	0.80	1.65	2.79	0.46

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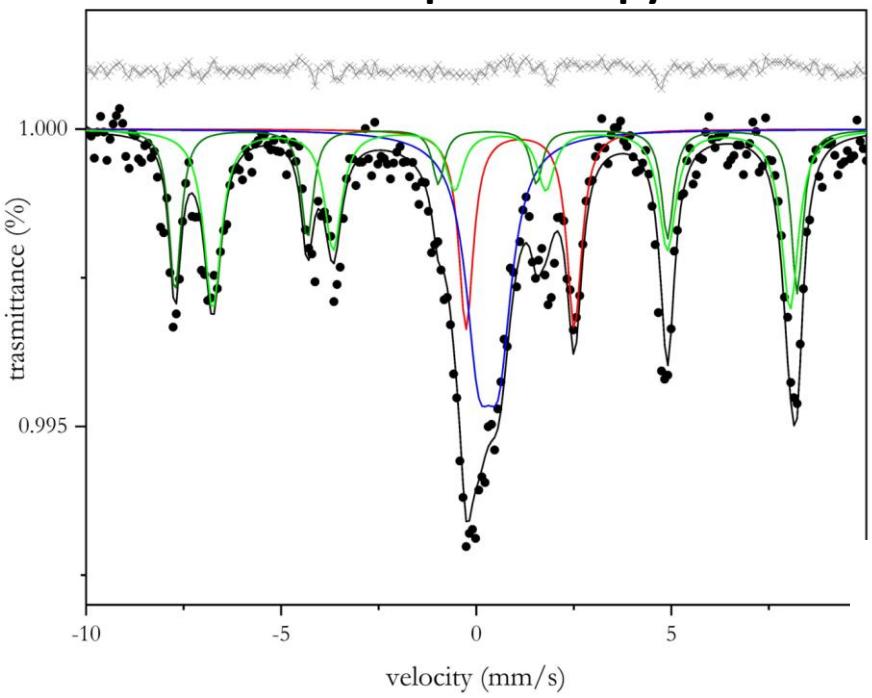
Chemical parameter

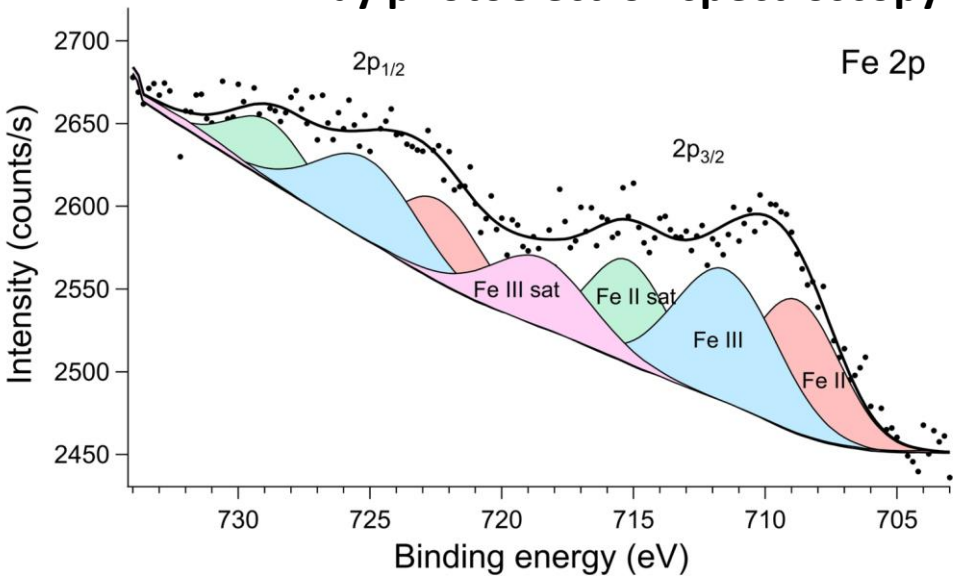
Mössbauer spectroscopy



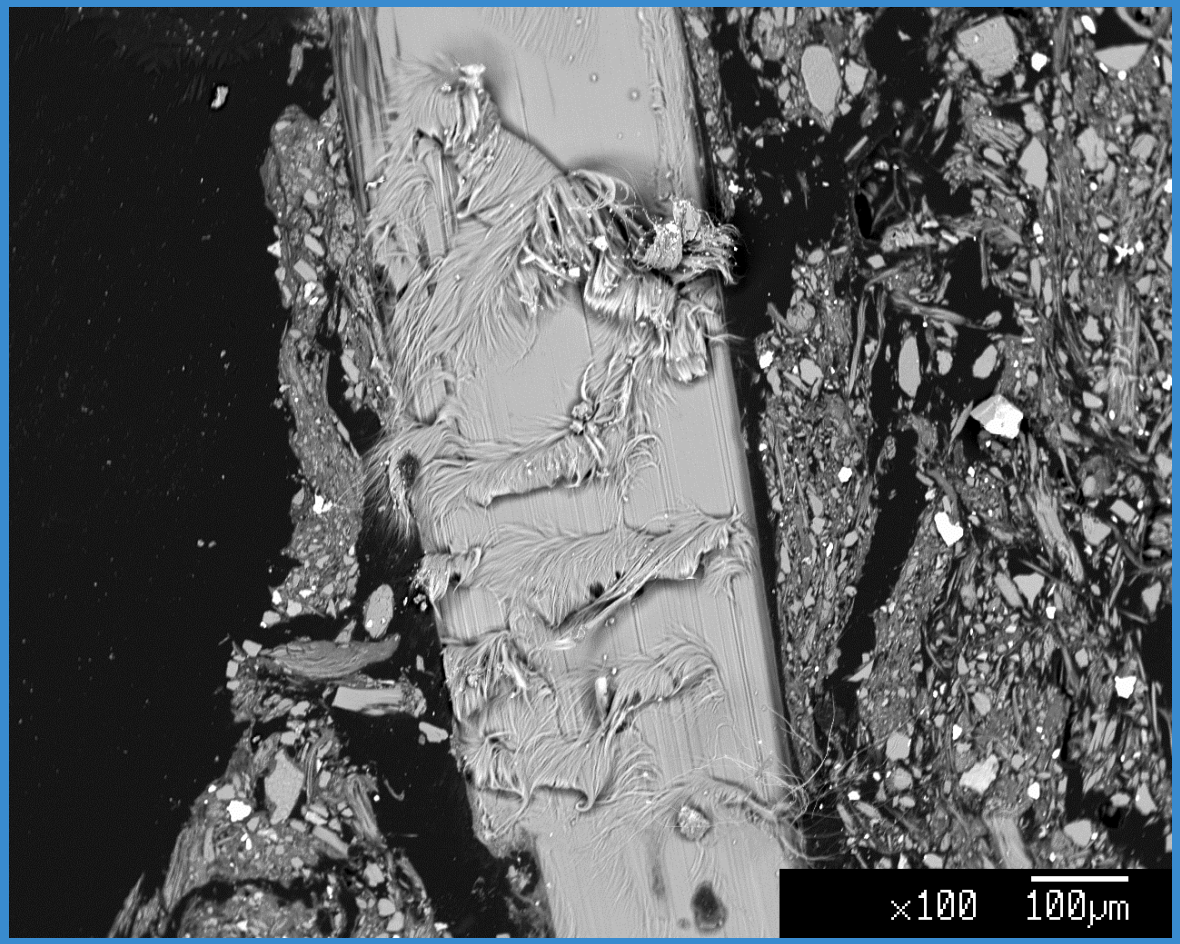
(%)	Assignment
17	Fe^{2+} octahedral
28	Fe^{3+} octahedral

Fe^{2+}/Fe^{3+} ratio at the close to surface layers of the chrysotile fiber sis 0.86

X-ray photoelectron spectroscopy



Chemical parameter

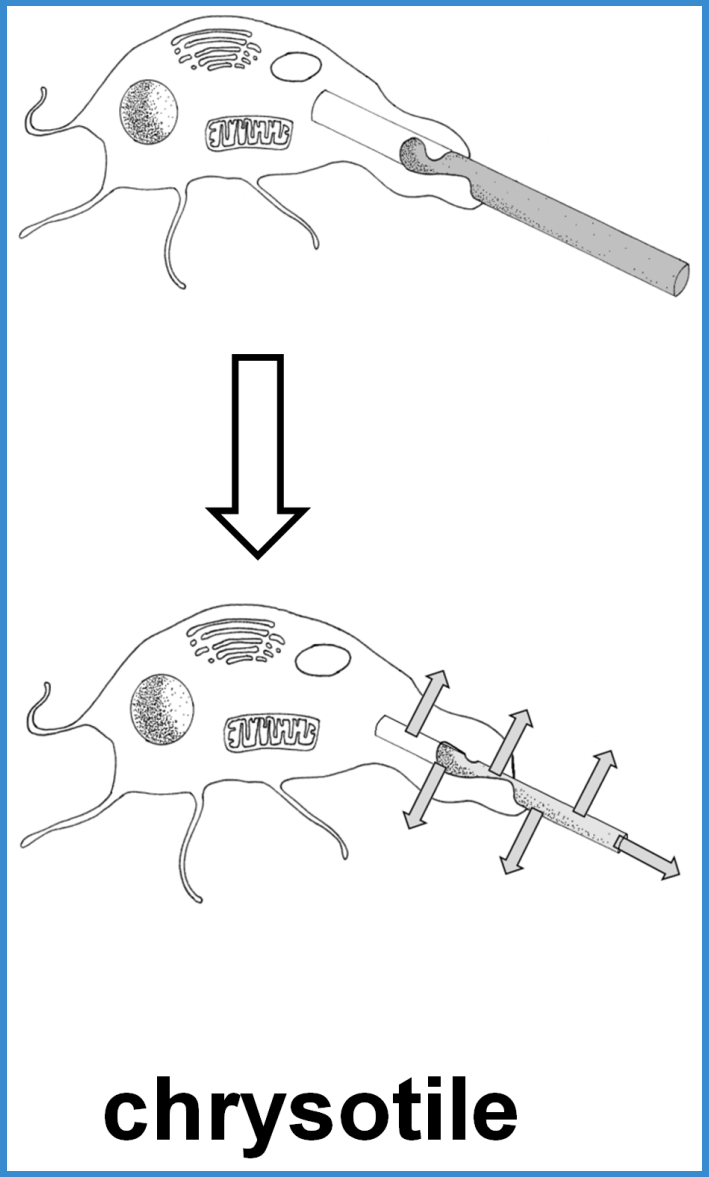


Wt%	Yasniy	UICC	Balangero	Valmalenco
SiO_2	42.4	42.5	40.6	42.5
TiO_2	0.03	0.01	0.01	0.06
Al_2O_3	0.62	0.2	2.4	0.2
Cr_2O_3	0.14	0.05	0.2	0.08
MnO	0.06	0.05	0.06	0.06
MgO	41.2	41.9	39.8	41.6
CaO	0.05	0.01	0.02	0.09
Na_2O	0.02	0.01	0.01	0.02
K_2O	0.01	0.004	0.003	0.05
NiO	0.15	0.06	0.05	0.20
FeO	0.7	1.40	2.50	1.40
Fe_2O_3	1.27	0.20	0.4	0.00
Tot	86.5	86.4	86.1	86.3

$$\left(Mg_{2.870}Fe^{2+}{}_{0.027}Fe^{3+}{}_{0.045}Al_{0.034}Cr_{0.005}Ni_{0.006}\right)_{2.986}(OH)_4Si_{1.982}O_5$$

Chemical parameter

mg/kg	Russian chrysotile	Elements in human lungs	Threshold values
V	186	0.50	100
Cr	5461	0.50	100
Mn	2305	3.00	n.a.
Co	233	0.01	20.0
Ni	5521	1.00	50.0
Cu	61.6	5.00	100
As	6.51	0.10	5.00
Pb	615	0.50	60.0
Be	3.51	0.03	n.a.



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Biodurability parameter

	SSA (m^2g^{-1})	k (s^{-1})	R ($mol \cdot m^{-2}s^{-1}$)	t (days)	t (years)
Yasnyj chrysotile	18.4	2.3×10^{-10}	5.1×10^{-10}	129	0.4
Balangero chrysotile	42.0	1.8×10^{-10}	1.7×10^{-10}	124	0.3
UICC chrysotile	43.0	2.5×10^{-10}	2.3×10^{-10}	94.0	0.3
Valmalenco chrysotile	68.0	2.1×10^{-10}	1.2×10^{-10}	177	0.5
UICC amosite	9.5	6.1×10^{-14}	2.7×10^{-13}	27010	74
UICC anthophyllite asbestos	4.4	1.2×10^{-13}	1.0×10^{-13}	83950	245
Val d'Ala tremolite asbestos	9.2	5.4×10^{-14}	4.5×10^{-13}	17885	49.0
UICC crocidolite	16.1	1.3×10^{-13}	3.2×10^{-13}	24090	66.0

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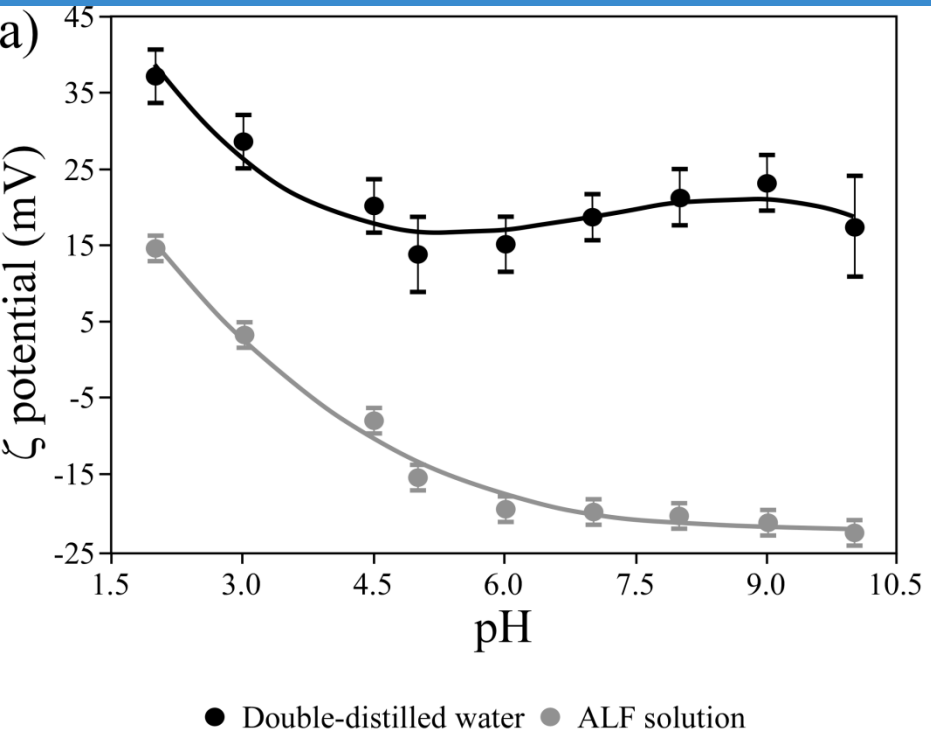
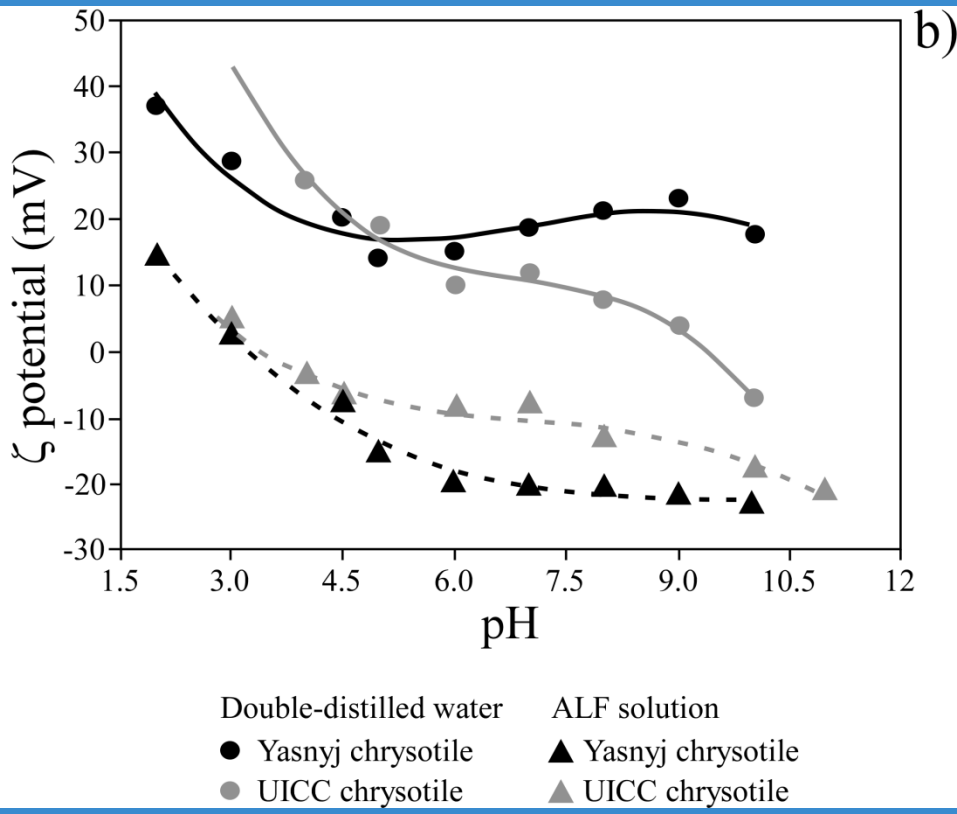
Surface activity



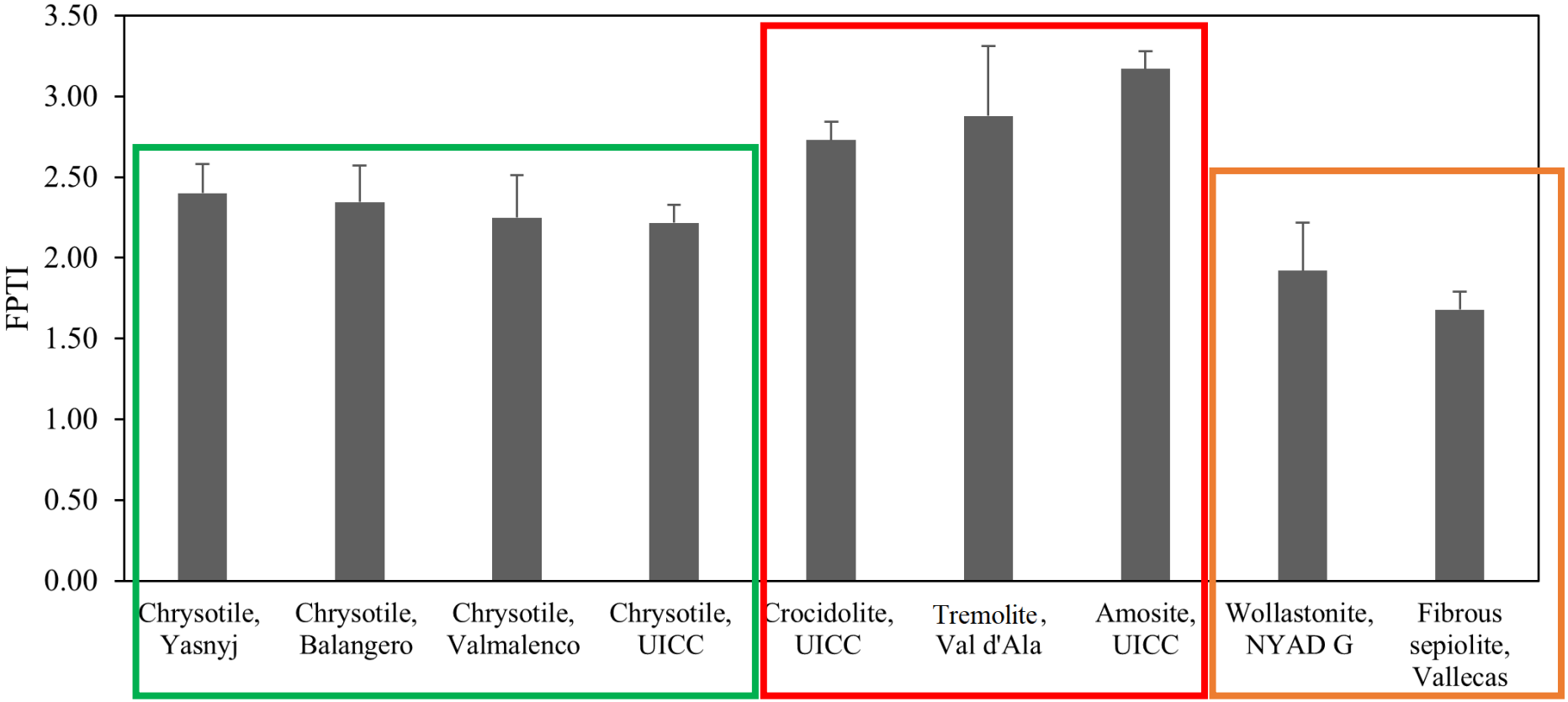


FPTI index

Morphometric		
(1,1)	> 5μm and < 10μm	0.1
	> 10μm and < 20μm	0.2
	> 20μm	0.4
(1,2)	> 1μm and < 3μm	0.1
	> 0.25μm and < 1μm	0.2
	> 0.25μm	0.4
(1,3)	Flat surface (perfect crystal)	0.05
	Altered surface	0.1
	Cylindrical surface	0.2
(1,4)	Curled	0.1
	Mixed Curled/acicular	0.2
	Acicular	0.4
(1,5)	$< 2.75\ g/cm^3$	0.05
	> 2.75 and $< 3.5\ g/cm^3$	0.1
	$> 3.5\ g/cm^3$	0.2
(1,6)	Hydrophobic	0.05
	Amphiphilic	0.1
	Hydrophilic	0.2
(1,7)	$> 25\ m^2/g$	0.05
	< 25 and $> 5\ m^2/g$	0.1
	$< 5\ m^2/g$	0.2
Chemical		
(1,8)	Fe_2O_3 + FeOwt% < 1	0.05
	1 < Fe_2O_3 + FeOwt% < 10	0.1
	Fe_2O_3 + FeOwt% > 10	0.2
(1,9)	0 < FeOwt% < 0.25	0.05
	0.25 < FeOwt% < 1	0.1
	FeOwt% > 1	0.2
(1,10)	Fe^{2+} nuclearity > 2	0.02
	Fe^{2+} nuclearity = 2	0.03
	Fe^{2+} nuclearity = 1	0.07
(1,11)[a]	$\sum_l \frac{C_l}{L_l} < 1$	0.1
	$1 < \sum_l \frac{C_l}{L_l} < 5$	0.2
	$\sum_l \frac{C_l}{L_l} > 5$	0.4

Biodurability related		
(1,12)[a]	< 1 y	0.05
	> 1 and < 40 y	0.1
	> 40 y	0.2
(1,13)[a]	< 0.1	0.03
	> 0.1 and < 1	0.07
	> 1	0.13
(1,14)[a]	< 0.5	0.02
	> 0.5 and < 1	0.03
	> 1	0.07
(1,15)[a]	< 1	0.03
	> 1 and < 10	0.07
	> 10	0.13
Surface activity		
(1,16)	Negative at pH = 4.5 (intracellular)	0.1
	Negative at both pH = 4.5 and 7 (intracellular and extracellular)	0.2
(1,17)	$\varsigma > \|20\|$	0.03
	$\|10\| < \varsigma < \|20\|$	0.07
	$\|0\| < \varsigma < \|10\|$	0.13
(1,18)	Cation exchange (zeolite)	0.07
	No cation exchange (no zeolite)	0

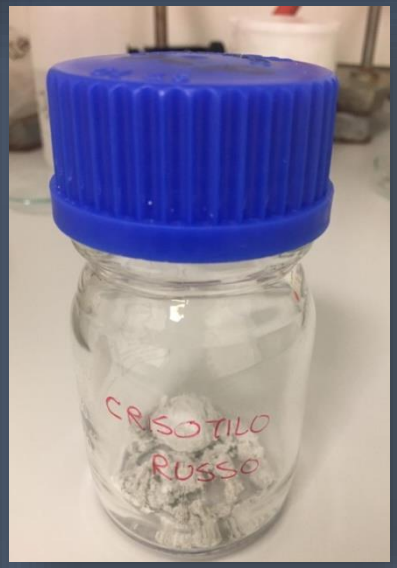
FPTI index


FPTI
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Chrysotile, Yasnyj
Chrysotile, Balangero
Chrysotile, Valmalenco
Chrysotile, UICC
Crocidolite, UICC
Tremolite, Val d'Ala
Amosite, UICC
Wollastonite, NYAD G
Fibrous sepiolite, Vallecas

Dipartimento di Scienze Chimiche e Geologiche
Università degli Studi di Modena e Reggio Emilia
dott.ssa Valentina Scognamiglio

Criomacinazione e caratterizzazione morfologica di frazioni granulometriche ottenute dal crisotilo russo

Progetto PRIN «FIBRES A MULTIDISCIPLINARY MINERALOGICAL, CRYSTAL-CHEMICAL AND BIOLOGICAL PROJECT TO AMEND THE PARADIGM OF TOXICITY AND CANCEROGENICITY OF MINERAL FIBRES»



Campione grezzo

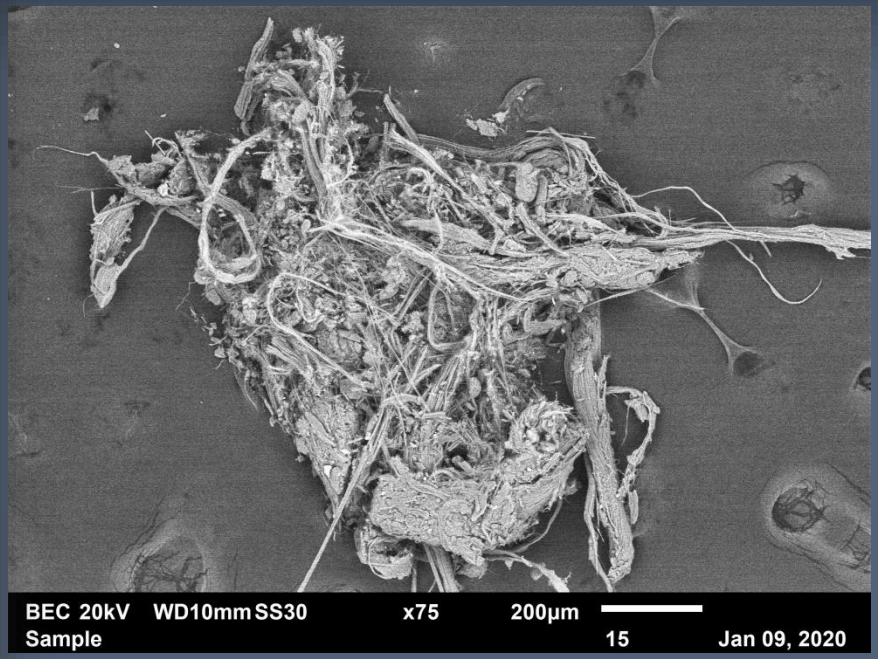
Macinazione criogenica mediante l’utilizzo di un crio mulino MM 400 Retsch

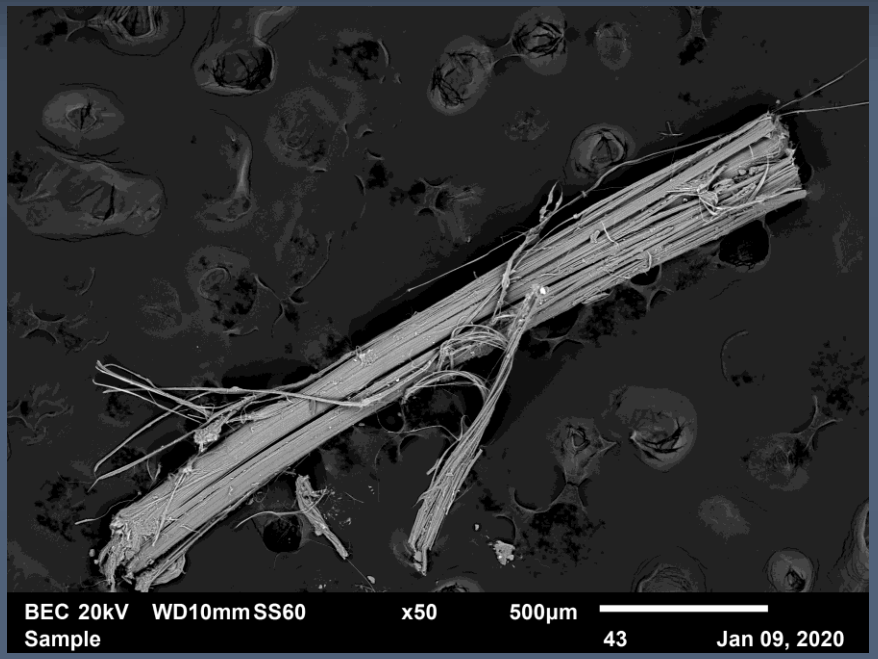
Frazioni ottenute a 10, 20, 30 minuti, con frequenza massima di 30Hz

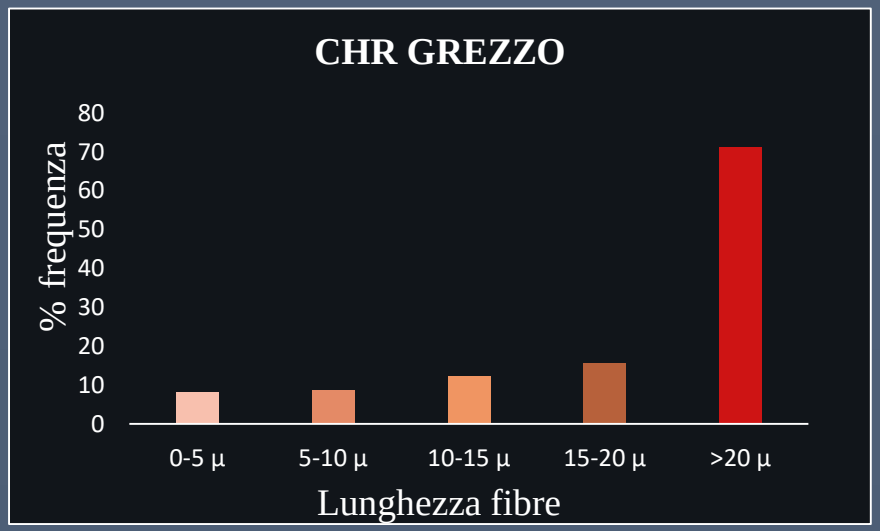
Stubs per osservazione SEM

SEM JEOL JSM-6010PLUS/LA

CHR GREZZO

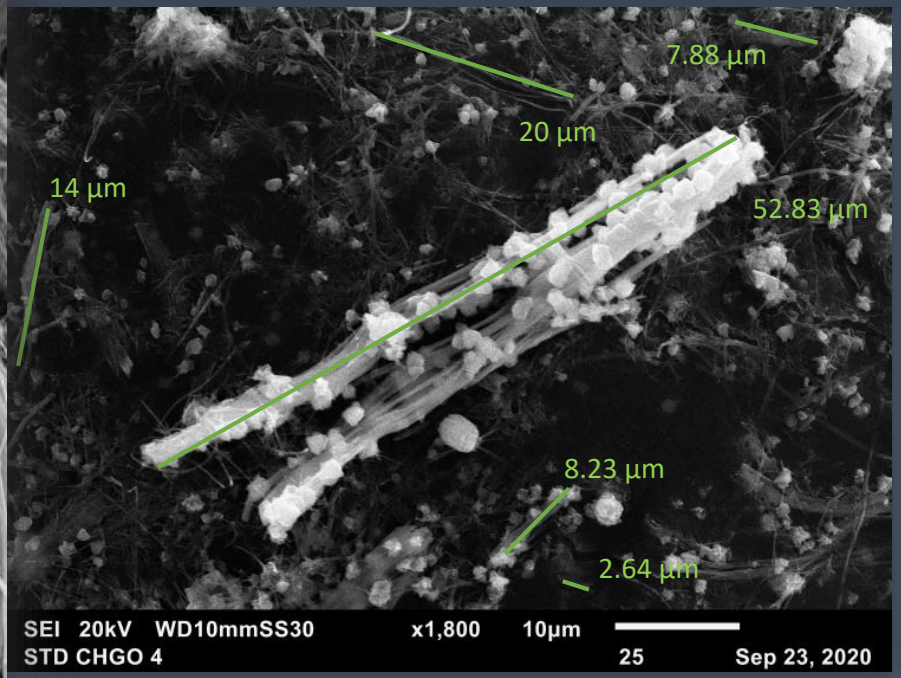


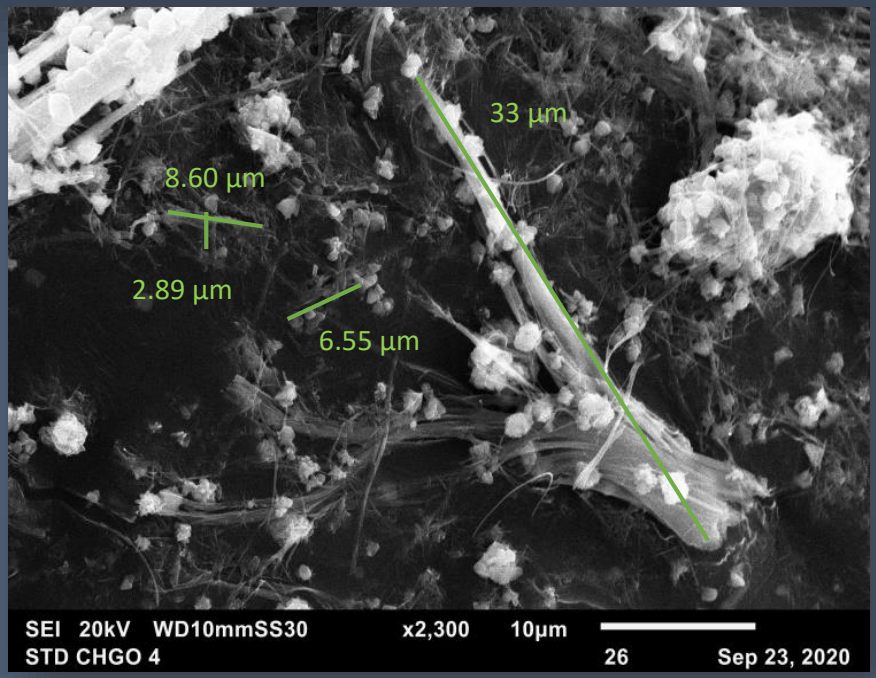


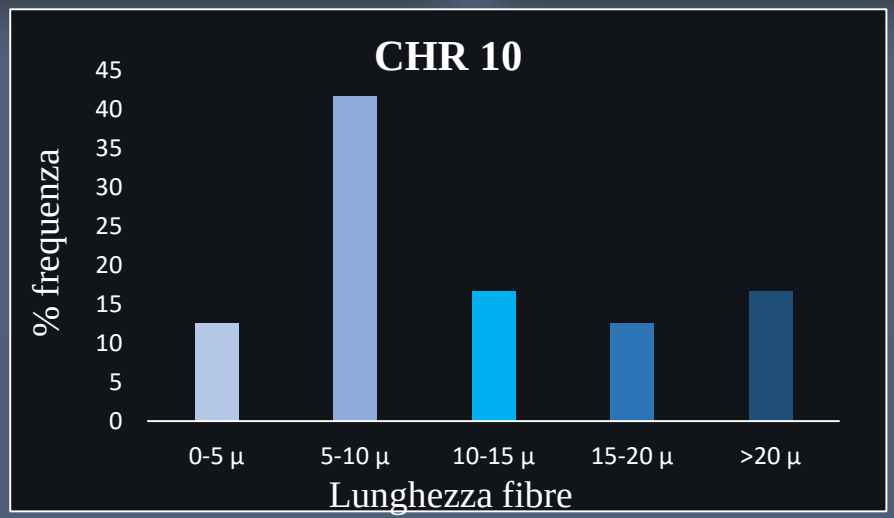


SEM JEOL JSM-6010PLUS/LA

CHR 10

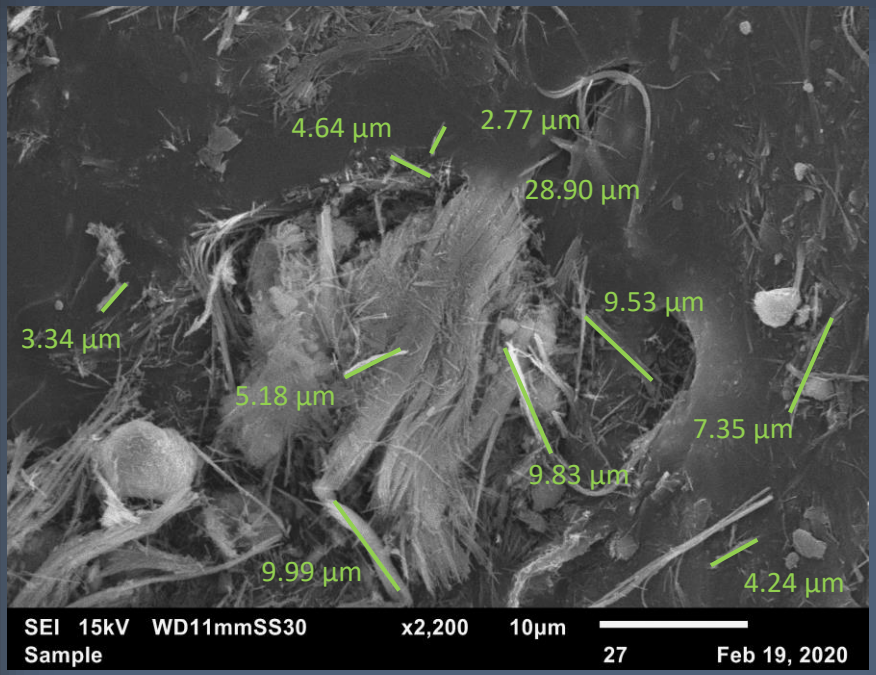


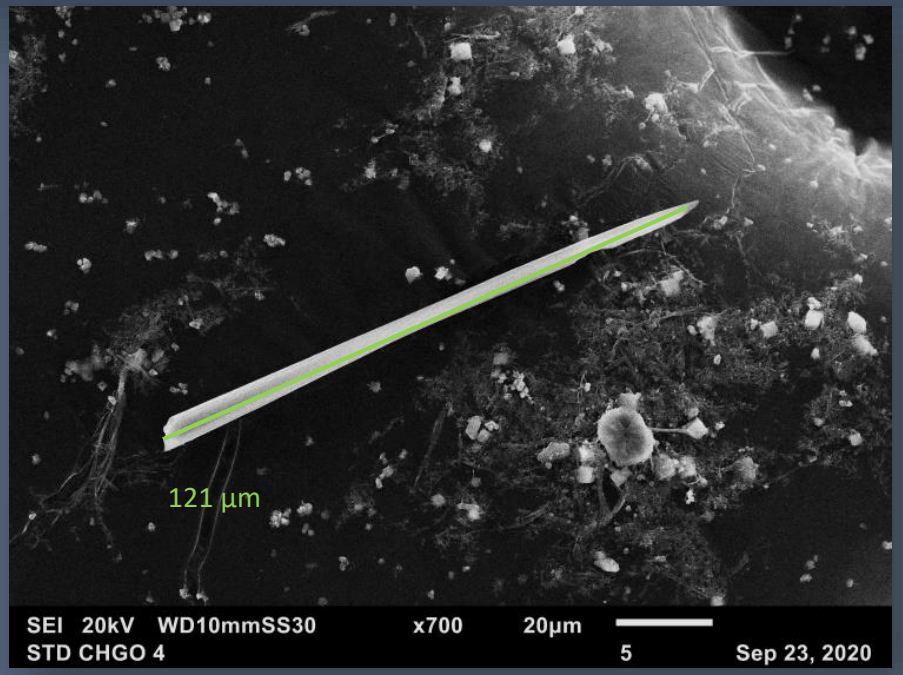


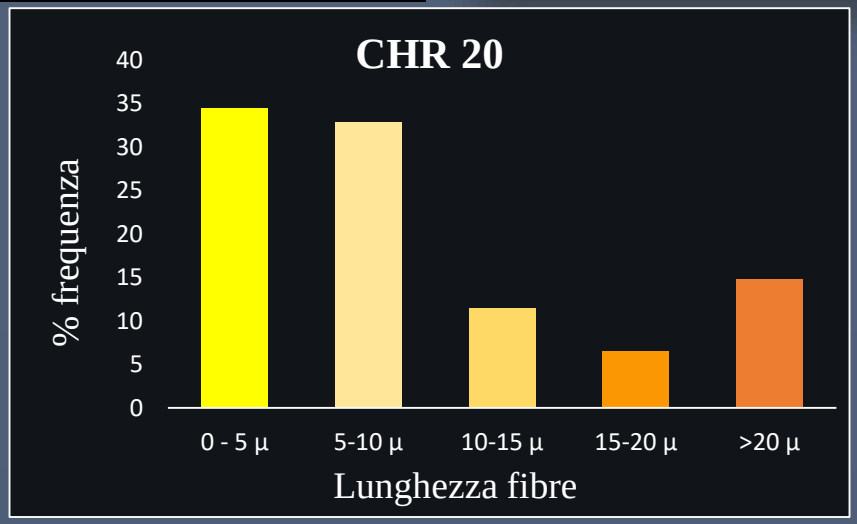


SEM JEOL JSM-6010PLUS/LA

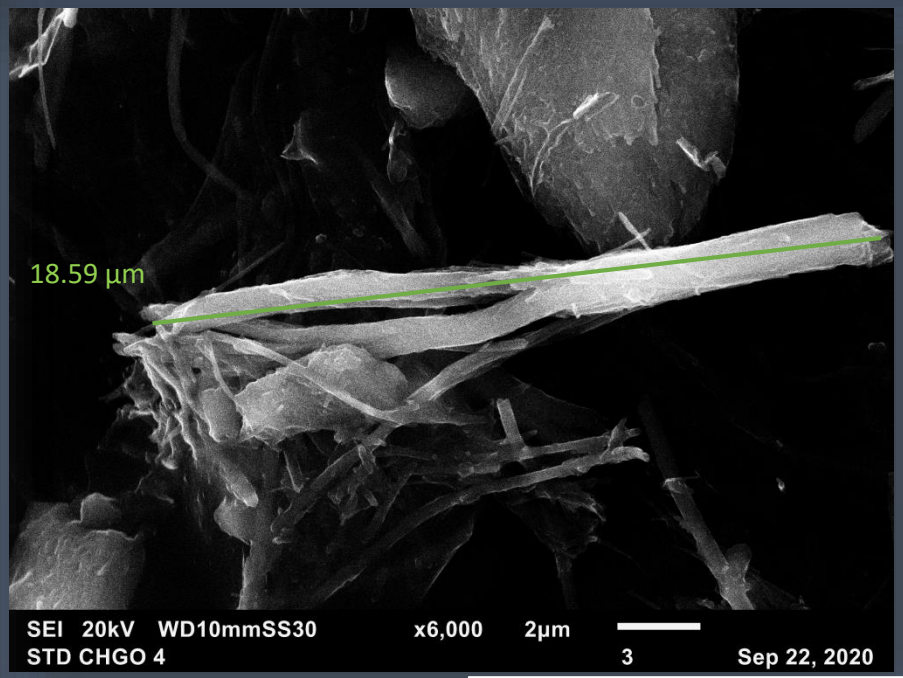
CHR 20

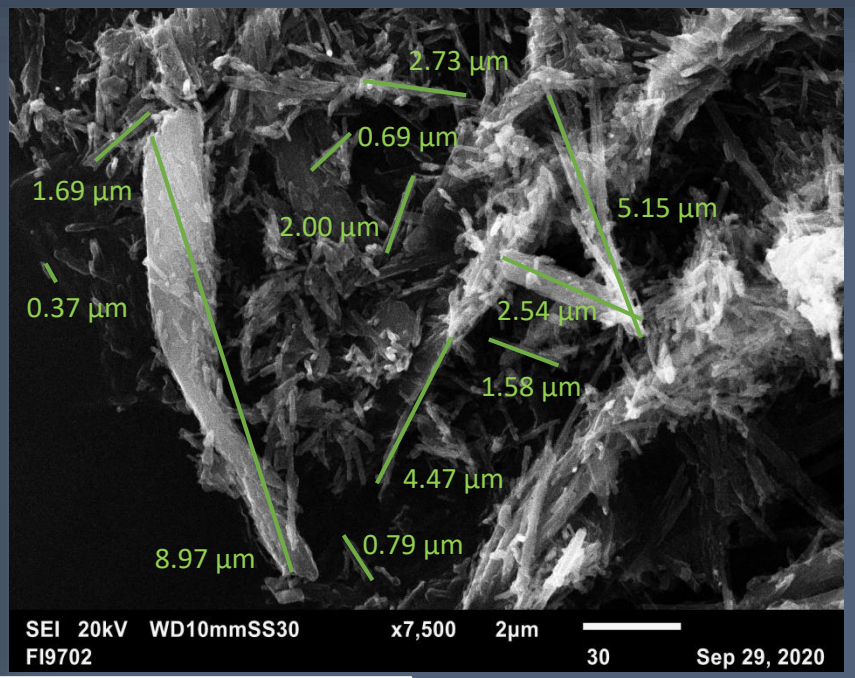


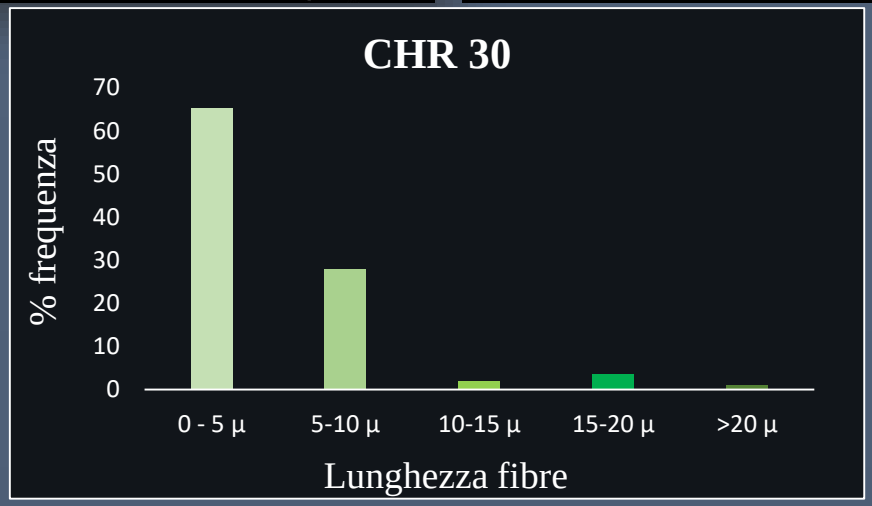




SEM JEOL JSM-6010PLUS/LA
CHR 30







Unità di Modena e Reggio Emilia
Attività di ricerca 2020

SUBMITTED

- Characterization and assessment of the potential toxicity/pathogenicity of Russian commercial chrysotile.

- WebFPTI: A tool to predict the toxicity/pathogenicity of mineral fibres including asbestos

- Crystal structure determination of a lifelong biopersistent asbestos fibre using single-crystal synchrotron X-ray micro-diffraction

Unità di Modena e Reggio Emilia
Attività di ricerca 2020

Work in progress

- ***In vitro*** **toxicity of fibrous glaucophane**
- **Occurrence and characterization of fibrous tremolite from the Mid Atlantic Ridge**
- **The crystal structure of the carcinogenic fibrous erionite from Tuzköy (Cappadocia, Turkey)**
- **Time-lapse video microscopy. THP-1 cells**