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# SEM EDS silicates recognition in histological samples of human neoplasia

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## Abstract

Biological samples from 4 patients affected by carcinoma were investigated by SEM-EDS from a mineralogical point of view in order to ascertain presence of solid particles that could have caused their disease.

Many dusty particles, in particular the silicatic ones, were foud; in particular there were recognized minerals as talc, biotite, amphiboles, pyroxene, olivine, wollastonite, feldspars, zircon, apatite, barite, and xenotime. Rare acicular fibre, likely amosite and chrysotile were observed only in the histological specimen of the patient that underwent surgery for colorectal cancer. These silicates, that are the causes of various and widespread pulmonary cancer, like the mesothelioma, seems to be strictly related also to colon carcinoma.

*Keywords: SEM-EDS analyses; Asbestos; Human neoplasia.*

## 1. Introduction

In the last decades occupational exposure to mineral dusts has been extensively studied. Fibrosis and pneumoconiosis have been documented in workers involved in the mining and processing of Al-Ca-Mg-Zr silicates. These silicates in some case defined clay-like

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components because they contain silicon, oxygen, and one or more metals are widely used as abrasive, inert or fireproof materials, excipients for medicines and also for cosmetics.

Particle size, fibrogenicity, concentration, and mineral composition had the greatest effect on toxicity. Larger particle size and longer and wider fibres cause more adverse effects (Elmore, 2003)

In fact the breathing and ingestion of asbestos fibres, can determine different diseases, all characterized by a long interval of time between the start of exposure and the appearance of the disease. The risk to health is directly related to the amount and type of inhaled fibres and their chemical stability. Mesothelioma is a cancer caused by asbestos, the most widespread one.

For years there was an increase in bowel cancer. Although one of the main causes is linked to poor dietary habits would not underestimate the possibility of a relation between the presence of asbestos and colon cancer. A probability that in our country is just supported by the medical literature on the subject, but abroad is instead the subject of research. Indeed bodies of asbestos have been found in tumours of colorectal cancer in people exposed to asbestos.

The effects are related to the type and duration of exposure (Bunderson-Schelvan et al., 2011), as well as already highlighted in order to mesothelioma, and by the studies of Kanarek et al. (1980), Andersen et al.(1993) and then Kjaerheim et al. (2005) shows that the most frequent is that of the stomach, as well as is caused by asbestos colon cancer (Germani et al., 1999; Kjaerheim et al., 2005) and esophagus (Kang et al., 1997).

On gastrointestinal cancer and their nature of asbestos related diseases, had earlier already pronounced Selikoff (1974), which found authoritative and definitive reply in the conclusions of the IARC (International Agency for Research on Cancer) in 2010.

## 2. Studies cases

Biological samples from 4 patients affected by carcinoma were investigated from a mineralogical point of view in order to ascertain presence of solid particles that could have caused their disease. These patients during their life have had frequent contact with dusty environments with probable presence of asbestos minerals, heavy metals particles and other potentially dangerous substances.

Four histological samples were prepared from the suspected carcinoma masses removed from kidney (2 patients) and from colon (2 patients).

The paraffin embedded histological samples were fixed on an aluminium stub using an adhesive conductive tape (aluminium or copper tape), for sale as a SEM supplies product (Fig. 1). The possibility of further research on the same samples suggested to avoid the usual carbon sputter procedure before SEM observations; then, to prevent the electrical charge of the specimen surface during SEM investigation, the electron microscope was set in variable pressure configuration.

Morphology and chemical composition of the samples were obtained by a SEM (LEO-Zeiss, EVO50XVP) coupled with an X-max (80 $mm^2$) Silicon drift Oxford detector equipped with a Super Atmosphere Thin Window©. Investigations were performed using the following operating conditions: 15 kV accelerating potential, 500 pA probe current, gas chamber pressure 10 Pa (Acquafredda & Fiore, 2005).

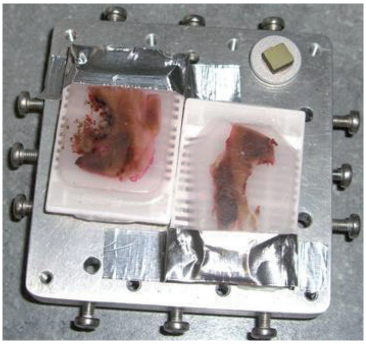

Fig. 1. SEM specimen holder with two paraffin embedded specimen.

SEM investigations revealed the presence of various particles, from 200 nm up to 30 $\mu$m in size, containing metals, metal alloys, and minerals (sulfates, phosphates and silicates). In particular there were recognized very little particle of metals (Al, Zn, Ti, Ni) and metal alloys (Cu-Zn, Cu-Fe-Sn, Ni-Cu-Zn, Fe-Cu) that were always associated with silicates, the most commons being feldspars and Mg-Fe silicates.

Quantitative chemical analyses of the silicates have been performed on the basis of cationic proportions. Difference with respect to theoretical were ascribed to the presence of nanoparticles forming the analysed grain (as it was the case of complex silicate phases containing Al, Mg, Na, K, Ca, Fe, Ti, and S) or to the intense mineral alteration during its permanence in the human body.

The chemical composition of these particles can be related to minerals as talc, biotite, amphiboles (amosite, richterite(?)), pyroxene, olivine, wollastonite, feldspars (albitic and andesinic plagioclase), zircon, chrysotile, apatite, barite, and xenotime (sometimes with appreciable Eu quantities).

There were observed the presence of many rounded shaped particles having compositions comparable with amphiboles. Rare acicular fibre, likely amosite and chrysotile (Fig. 2), with length from 6 to 32 $\mu$m, were observed only in the histological specimen of the patient that underwent surgery for colorectal cancer (Fig. 3).

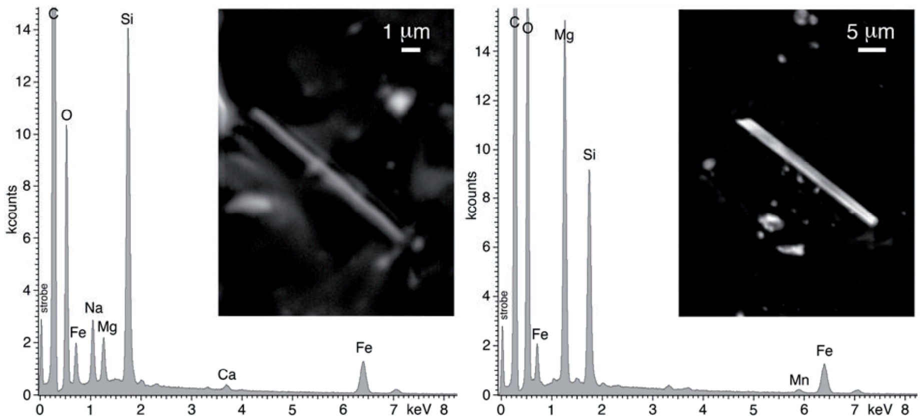


Fig. 2. Energy dispersive spectra and the relative back scattered electron. SEM image of an amosite (left) and a chrysotile (right) fibre.

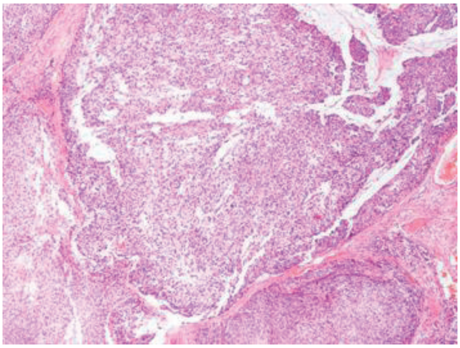

Fig. 3. Neoplastic infiltration of pericolic lymph node (colorectal cancer).

These observations and the very rare occurrence of finer asbestos' fibres with respect to other silicates (i.e., pyroxenes, amphiboles, feldspars, and zircon) might be related to their different degree of alteration.

## 3. Conclusions

SEM-EDS investigations, directly on paraffin embedded histological samples prepared for histological optical microscope observation, allow to recognize in the diseased tissue the presence of dusty particles, in particular the silicatic ones. These silicates, that are the causes of various and widespread pulmonary cancer, like the mesothelioma, seems to be strictly related also to colon carcinoma.

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## References

Acquafredda P., Fiore S. (2005). La microscopia elettronica a scansione. In: "Analisi di materiali argillosi per diffrazione di raggi X e microscopia elettronica a scansione. Teoria ed applicazioni" - Argille e Minerali delle Argille vol. V, 143-188; editore digilabs; stampato da Global Print srl, Gorgonzola (MI) ISBN 88-7522-006-9.

Andersen A., Glattre E., Johansen B.V. (1993). Incidence of cancer among lighthouse keepers exposed to asbestos in drinking water. American Journal of Epidemiology 138, 682–687.

Bunderson-Schelvan M., Pfau J.C., Crouch R., Holian A. (2011). Non pulmonary outcomes of asbestos exposure. Journal of toxicology and environmental health. Part B 14, 122-152.

Elmore A.R. (2003). Final report on the safety assessment of aluminum silicate, calcium silicate, magnesium aluminum silicate, magnesium silicate, magnesium trisilicate, sodium magnesium silicate, zirconium silicate, attapulgite, bentonite, Fuller's earth, hectorite, kaolin, lithium magnesium silicate, lithium magnesium sodium silicate, montmorillonite, pyrophyllite, and zeolite. International Journal of Toxicology 22 Suppl 1, 37-102.

Germani D., Belli S., Bruno C., Grignoli M., Nesti M., Pirastu R., Comba F. (1999). Cohort mortality study of women compensated for asbestosis in Italy. American Journal of Industrial Medicine 36, 129–134.

Kanarek M.S., Conforti P.M., Jackson L.A., Cooper R.C., Murchio J.C. (1980). Asbestos in drinking water and cancer incidence in the San Francisco Bay area. American Journal of Epidemiology 112, 54–72.

Kang S.K., Burnett C.A., Freund E., Walker J., Lalich N., Sestito J. (1997). Gastrointestinal cancer mortality of workers in occupations with high asbestos exposures. American Journal of Industrial Medicine 31, 713–718.

Kjaerheim K., Ulvestad B., Martinsen J.I., Andersen A. (2005). Cancer of the gastrointestinal tract and exposure to asbestos in drinking water among lighthouse keepers (Norway). Cancer Causes & Control 16, 593–598.

Selikoff I.J. (1974). Epidemiology of gastrointestinal cancer. Environmental Health Perspectives Vol. 9, pp. 299-305.