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The trick of Asbestos and Iron revealed by Synchrotron radiation X-ray Fluorescence Microscopy

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Asbestos exposure has been associated to the development of pulmonary diseases and cancer but still the mechanisms responsible for fibers toxicity and carcinogenic activity are not understood. Many studies have indicated that asbestos toxicity is a consequence of peculiar physico-chemical characteristics of the material, amongst them the presence of transition metals in the fibres and their ability to absorb iron on the surface. It has been demonstrated that asbestos causes an alteration of the iron homeostasis in the tissue, particularly during the formation of the so-called "asbestos body", when an abundant aggregation of iron containing proteins around the fibres occurs. In order to shed light on iron mobilization and its role in lung reaction to asbestos presence, we performed X-ray imaging combined with X-ray Fluorescence and absorption microspectroscopy studies on archive lung tissues from patients professionally exposed to asbestos. The experiments were performed at the X-ray microscopy and imaging beamlines at three different synchrotron facilities (Elettra, ESRF and Australian Synchrotron). Simultaneous mapping the morphology and the distribution of different chemical elements using softer X-rays allowed localization of the asbestos fibers and the provided important information about elemental presence in the surrounding tissue. The analyses revealed an abundant amount of magnesium in the asbestos bodies that suggests that this element is involved in the physiological processes of the tissue response. By tracing iron, many coated and uncoated fibres were recognized and the analyses have revealed a peculiar distribution of this element in the tissue, related to different stages of interaction with the fibers. In addition, preliminary data from XANES analyses under XRF set-up suggest anomalous iron mineral forms in asbestos containing tissues.

References.

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