New insights on the biomineralisation process developing on inhaled asbestos fibres

F. BARDELLI[1*], G, VERONESI[2], S. CAPELLA[3], D. BELLIS[4], L. CHARLET[5], A. CEDOLA[1], E. BELLUSO[3]

[1]CNR-Nanotec, 00185 Rome, Italy, (*fabrizio.bardelli@gmail.com & alessia.cedola@cnr.it)
[2]CNRS/CEA/University Grenoble Alpes, 38054, France (giulia.veronesi@cea.fr)
[3]Department of Earth Sciences, University of Torino, 10125, Italy (silvana.capella@unito.it & elena.belluso@unito.it
[4]Department of Pathological Anatomy, Martini Hospital, 10141, Turin, Italy (donata.bellis@aslto1.it)
[5]ISTerre, University Grenoble Alpes, 38400, France (charlet38@gmail.com)

Once penetrated into the lungs, asbestos induces an in vivo biomineralisation process that leads to the formation of a ferruginous coating embedding the fibres, which is believed to be responsible for the high toxicological outcome of asbestos. Lung tissue of two former workers of an asbestos plant located in the Piedmont region (NW Italy), who have been subjected to prolonged exposure to crocidolite asbestos, was investigated using synchrotron radiation nano-probe tools [1]. Direct observation of the distribution of K and of elements heavier than Fe (Zn, Cu, As, and Ba) in the asbestos bodies (*AB*) was observed for the first time. In particular, Fe was found to be more concentrated in the inner area, and P, K, and Ca were shown to be co-localized. The distribution of Si suggested the incipient dissolution of the inner fibre, and that of Zn, Cu, As, and Ba, indicated that the *AB* are efficient scavengers for these species, in agreement with the uptake ability of ferrihydrite, which is the mineral core of ferritin and hemosiderin. Elemental quantification confirmed that the coating is highly enriched in Fe (~20% w/w), while the other species are present in trace amounts (0.02 – 0.3% w/w). XANES spectroscopy indicated that Fe is in the 3+ oxidation state, and confirmed that it is present in the form of ferrihydrite, a poorly crystalline Fe oxide. Comparison between *AB* studied upon removing the biological tissue by chemical digestion with NaClO, and those embedded in histological sections, allowed understanding to what extent the digestion procedure altered their chemical composition. In particular, the comparison of the distributions of P, K, and Ca indicated that they are present as soluble species that are removed during the digestion of the tissue. Iron enrichment in the inner part of the *AB* may be attributed to the gradual conversion of Fe-overloaded ferritin in the inner part of the *AB* into hemosiderin with higher Fe content, and to subsequent precipitation of its ferrihydrite core, or to the release of exogenous Fe from the asbestos fibre itself.

[1] F. Bardelli *et al.* (2017) *Sci. Rep.* **7**, 44862.