Characterization of lung dust

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Mineral dust is the cause for many diseases of the respiratory tract like silicosis, asbestosis, and formation of pleura plaques or tumors. Between 1978 and 2003 the main cause for occupational cancer diseases in Germany was asbestos, which was found responsible for 71.9 % of all cases or a total of 18487 affected individuals [1].

While most research has focused on distinct mineral particles like asbestos or different forms of silica, there are comparatively few mineralogical studies about the overall human lung dust burden.

In a first attempt to characterize the particle content in a human lung, we analysed particles from a tissue sample of a 74 year old former asbestos-exposed mechanic, diagnosed with a pleural mesothelioma. The tissue material was collected during an autopsy and analyzed after removing all organic compounds by low-temperature ashing. For particle identification, we combined the results of an automated scanning electron microscope (SEM) particle analysis with that from manual transmission electron microscope (TEM) analysis, both with an energy dispersive X-ray spectrometer (EDS).

For this sample we analysed 97 individual particles by TEM and 4860 by SEM, of which 3253 could be evaluated in terms of mineralogy. We found 1312 silicate-particles, which include the asbestos minerals, clay minerals and quartz, as well as 1799 Oxide-particles, 45 phosphate-particles, 4 sulfate or sulfide-particles and also 93 other mixed particles. We further could identify many particles as distinct mineral species like e.g. amosite, chrysotile, crocidolite, rutile, mullite, biotite, and talc. With the SEM data we observed that the mean particle diameters differed among the most common particle groups. Whereas most of the particles had an average diameter of 0.3-1.2 μm, the 250 measured feldspar particles were dominated by particles with an average diameter of 1.2-2.4 μm. Generally the SEM results were in accordance with the TEM results and could be used for additional evaluation due to the large number of measured particles.

[1]Butz, M., 2005. Beruflich verursachte Krebserkrankungen: eine Darstellung der im Zeitraum 1978 bis 2003 anerkannten Berufskrankheiten; HVBG, Sankt Augustin.