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Chemical Characterization of the Particulate $PM_{2.5}$ in the Human Respiratory System from People who Lived in Mexico City. Study by Scanning Electron Microscopy and EDS-X ray

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Particulate matter (PM) in urban areas is made up of dust deposited on the soil as well as by particles released by anthropogenic activities [1, 2]. Particles with a diameter less than 10 µm are classified as PM10. Particles with diameters between PM_{10} and $PM_{2.5}$ are defined as the coarse fraction [3]. Those with less than 10 micrometers in diameter adhere to the mucous membrane and are eliminated in the lower part of the respiratory tract, for this reason, they are known as inhalable. Of these, particles less than 2.5 micrometers in diameter penetrate easily into the lungs, so they are called breathable. The smallest particles correspond to the "ultrafine" particles, which are less than 0.1 micrometer, and therefore have greater capacity for alveolar entry and can even reach the bloodstream [4]. Particle deposition in the various regions of the human respiratory system depends strongly on particle size and shape by the complex action of aerosol deposition mechanisms, with the greatest fractional deposition occurring in the deep lung between 5 nm and 100 nm. The objective of this work is to carry out a detailed characterization of individual metallic atmospheric particles in respiratory tissue from deceased people in Mexico City, which provide information on their source and formation reactivity, transport, and removal. This analysis is carried out using the technique of Scanning Electron Microscopy and X ray microanalysis (EDS), which is commonly used for the study of single particles, because this technique provides useful information on the morphology, elemental composition, and provides insight into the particle origin, which may be from anthropogenic or natural processes. Two samples from different individuals were analyzed, both from the peribronchial nodule and from the pulmonary lobe. The crushed and dried samples were mounted in graphite sample holder cylinders and graphite coated and studied by SEM and EDS. The results of both kinds of tissues present the following metallic chemical elements in order from most to least frequent: Fe, Al, Mn, Cr, Ni (Figures 1a, b), and Mo, Ce and Ba (Figures 1c-d) particles were scarcely detected. The comparison of the relative frequency of the metallic elements detected shows that the lower frequency and presence of particles with larger sizes (less than 14 micrometers) occurs in the tissue of bronchial nodules, while the highest frequency of particles with lowest sizes occurs in the lobes. Most of these particles presented an irregular shape, which suggests an anthropomorphic origin. It is concluded in this work that the probable cause for this distribution of smaller metallic particles in the pulmonary lobe is the finer particles penetrate more easily into the alveolar deposition.

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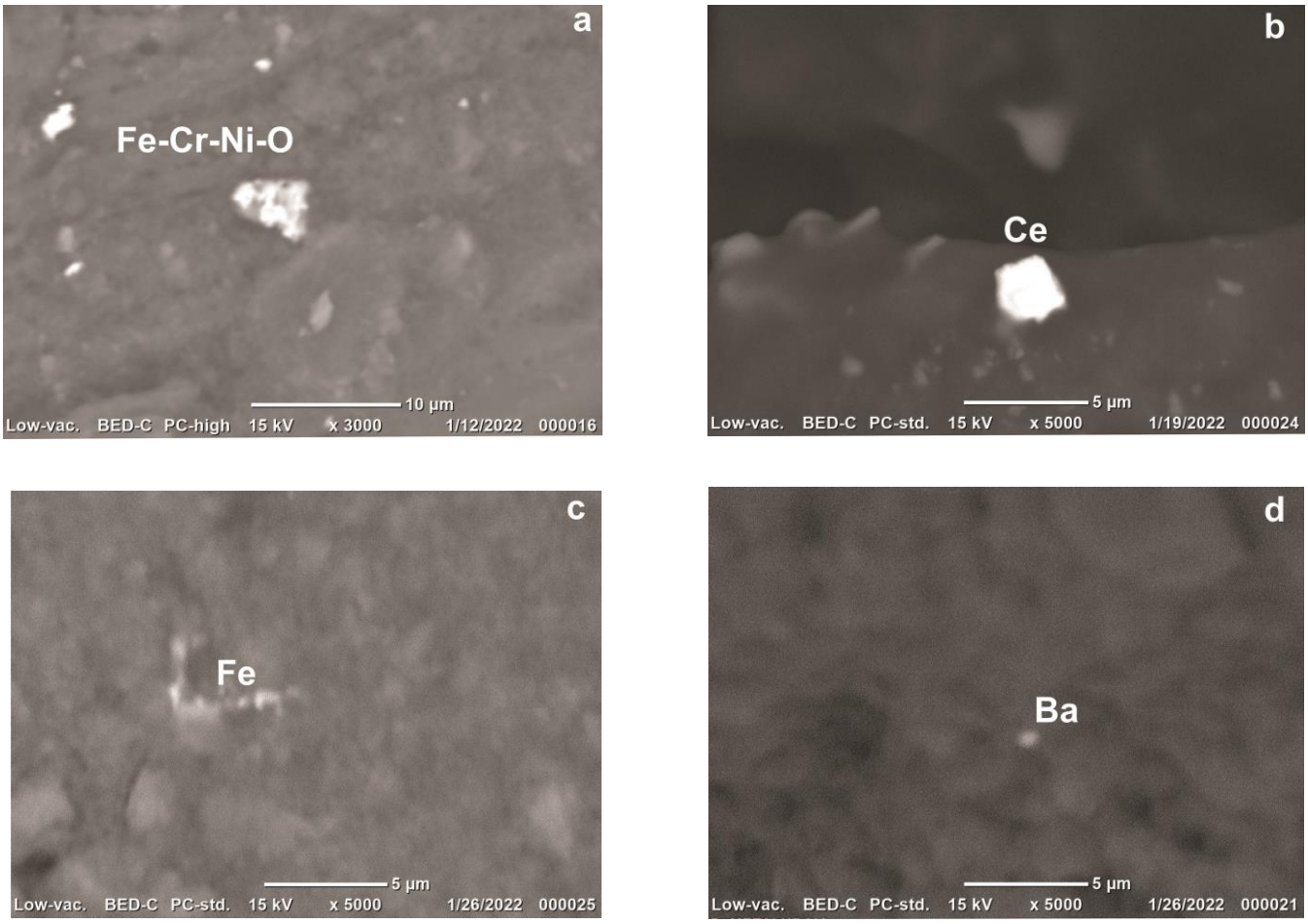

Figures 1. a-d. SEM images of detected particles in long tissue. (a-b) from peribronquial nodule, and (c-d) from pulmonary Lobe.

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