MINERALOGICAL ANALYSIS AND GEOCHEMICAL CHARACTERIZATION OF EXOGENIC AND ENDOGENIC PARTICLES IN EXPLANTED LUNG AND HILAR LYMPH NODE TISSUE

GREG MEEKER[1]*, GEOFFREY S. PLUMLEE[1], M. BALDWIN[2], D. PREZANT[3]

[1]*U.S. Geological Survey, Denver, CO 80225, USA*
[2]*Columbia University College of Physicians and Surgeons, USA*
[3]*New York City Fire Department , New York City, USA*
gmeeker@usgs.gov

Scanning electron microscopy and x-ray microanalysis were used to image and analyze particles in the explanted lung and hilar lymph node tissue of a New York City firefighter who was exposed to World Trade Center (WTC) dust. The patient was diagnosed with idiopathic pulmonary fibrosis in 2006, and underwent a successful lung transplant in July 2008. Results presented here are part of a larger study in collaboration with the Columbia University College of Physicians and Surgeons and New York City Fire Department to identify particulate matter and other anomalies in lung tissue that might be attributable to exposures at the WTC site.

Lung and hilar lymph node tissue samples were prepared by fixing in formalin and mounting in paraffin. Electron microscopy samples were prepared by thick sectioning using a tissue slicer. Slices of tissue were mounted on conductive carbon tape for analysis. Samples were imaged and analyzed in variable pressure mode in standard and field emission electron microscopes. Particles were counted and probable mineralogy was determined by stoichiometry.

Results showed clear differences in relative phase abundance between lung and lymph node. Both tissue types had a variety of minerals and other phases, such as feldspars, clays, silica-rich particles, iron and iron-titanium oxides, glasses, and various unidentified phases. However, within the node, silica-rich phases, predominately quartz, were much more abundant than other phases. These results suggest different physiological processes were at work in the two tissue types, and potentially include different mixtures of physical clearance, particle dissolution and precipitation of new particles. Particles identified in the lung tissue are inhaled exogenic or altered exogenic particles. Particles in the hilar lymph nodes represent inhaled particles that have been transported from the lung parenchyma via pulmonary lymphatics, and deposited in the hilar lymph nodes. Other particles, including calcite crystals and a layered aluminosilicate phase, identified near and at the margin of the node appear to be forming in place. Further studies including chemical speciation and reaction path modeling should provide insights into geochemical-physiological processes within the lung and how the body deals with exposures such as those encountered at the WTC disaster site.

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