The Microscopic Analysis of World Trade Center Dust

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ABSTRACT

On the morning of September 11, 2001, in New York City, the World Trade Center (WTC) financial complex was reduced to a fine powdery dust by two commercial passenger airplanes flown by terrorists. Since this was a unique, cataclysmic event, an analytical method to study the dust specimens had to be developed. Initial studies revealed that the dust generated by the collapse of the buildings was composed of a myriad of materials. It appeared that all the materials composing the buildings, and all of the buildings' contents were literally pulverized by the collapse of the WTC. The complex nature of this material dictated the necessity to develop a polarized light microscopy (PLM) method to study these WTC dust specimens. Aliquots of WTC dust specimens were taken at random from samples collected at Ground Zero and around the surrounding areas and analyzed as follows: 1) each bulk specimen was thoroughly loosened and mixed gently using an agate mortar and pestle; 2) each bulk sample was equally divided into eight aliquots; 3) each aliquot was divided into eight equal portions; 4) each portion was placed on a microscope slide (MS), covered with a No. 1½, 22mm, round cover-glass, and dispersed evenly in Melt Mount® R.I. 1.539; and 5) each specimen was labeled for identification. Next, a quantitative particle count of each specimen was carried out with a PLM fitted was a Chaulkly, point-count reticle. At least 1,000 particles were counted for all of the microscope slide preparations made from each bulk specimen. The results were recorded on a WTC dust data sheets. This data was used to compute the percent of each material present in the average specimen. The findings of this study are presented in this paper.

INTRODUCTION

On the morning of September 11, 2001, in New York City, the World Trade Center (WTC) financial complex was reduced to a fine powdery dust by two commercial passenger airplanes flown by terrorists. After the initial shock and horror of the event, one of the greatest and largest humanitarian and recovery efforts ever seen in recorded history was initiated. With no thought to their own safety, men and women from around New York and all parts of America dug thru dangerous piles of rubble with their hands and simple tools in an effort to start the recovery of hundreds of potential survivors. Unfortunately, many of these heroic men and women as well as residents of the areas surrounding the WTC, almost immediately started to show signs of respiratory health problems in the form of a dry, relentless cough. Many police colleagues asked for an analysis of the dust specimens they collected from Ground Zero and other surrounding areas. In addition, six month later, specimens were collected from nearby commercial buildings because of the frequent failure of their elevators and air ventilation systems. Since this was a unique, cataclysmic event, an analytical method to study the dust specimens had to be developed. Initially, a few of the specimens were examined with a stereomicroscope in order to obtain an rough idea of the content. Macroscopically, each bulk specimen appeared somewhat like recently erupted volcanic ash. Tiny aliquots of bulk specimens were studied with a polarized light microscope (PLM). These initial PLM studies revealed that each bulk sample was composed of a myriad of materials. It appeared that all the materials composing the buildings and all of the buildings' contents were literally pulverized by the collapse of the Twin Towers. The complex nature of this material dictated the necessity to develop a PLM method to study these WTC dust specimens. Figure 1 depicts the formation of WTC dust during the collapse of the World Trade Center buildings.

Figure 1- The collapse of the World Trade Center and generation of WTC dust.

MATERIALS AND METHODS

Specimens of Ground Zero dust where obtained from first responders: members of the police department sworn laboratory personnel, crime scene unit detectives and personnel from the OCME's office. Additional specimens of WTC dust were obtained from individuals employed to clean and restore historical churches and grave yards located near Ground Zero. Finally, specimens where collected by the authors from several buildings six months after 9/11.
All of the specimen were numbered and placed in appropriate containers.

Initially, a few of the specimens were examined with a stereomicroscope in order to acquire a rough idea of the content. Next, tiny aliquots of a few bulk specimens were studied with the polarized light microscope (PLM) at 100x. These initial PLM studies revealed that each bulk

sample was composed of a myriad of materials. A dust data count sheet was prepared from these initial observations, see Figure 2.

Figure 2 - WTC dust data count sheet.

Next, each bulk specimen was thoroughly loosened and mixed gently using an agate mortar and pestle. Random samples of each WTC dust specimen where then obtained utilizing a micro sampling apparatus. Each sample was treated as follows: 1) each bulk sample was equally divided into eight aliquots; 3) one aliquot was divided into eight equal portions; 4) each portion was placed on a microscope slide (MS), covered with a No. 1½, 22mm, round cover glass, and dispersed evenly in Melt Mount® 1.539; and 5) each specimen was labeled for identification.

Finally, a quantitative particle count of each specimen was carried out with a PLM fitted with a Chaulkly, point-count reticle. At least 1,000 particles were counted for the microscope slide preparations made from each bulk specimen. The results were recorded on the WTC dust data sheets, see Figure 2. This data was used to compute the percent of each material present in the average specimen.

RESULTS

Since this was a unique, cataclysmic event, an analytical method to study the dust specimens had to be developed. To begin with a few of the specimens were examined with a stereomicroscope. Macroscopically, each bulk specimen appeared somewhat like recently erupted volcanic ash. These initial PLM studies revealed that each bulk sample was composed of a myriad of materials. It appeared that all the materials composing the buildings, and all of the buildings' contents, were literally pulverized by the collapse of the World Trade Center, some of these materials are depicted in Figures 3(A) thru 3(C).

The PLM method developed and employed in this study proved to be quite useful both in the identification (qualitative analysis) of the WTC dust's components as well as in the quantitative analysis of dust's components. After the data (Figure 2) for each specimen was collected the numbers were totaled and Table 1 was prepared.

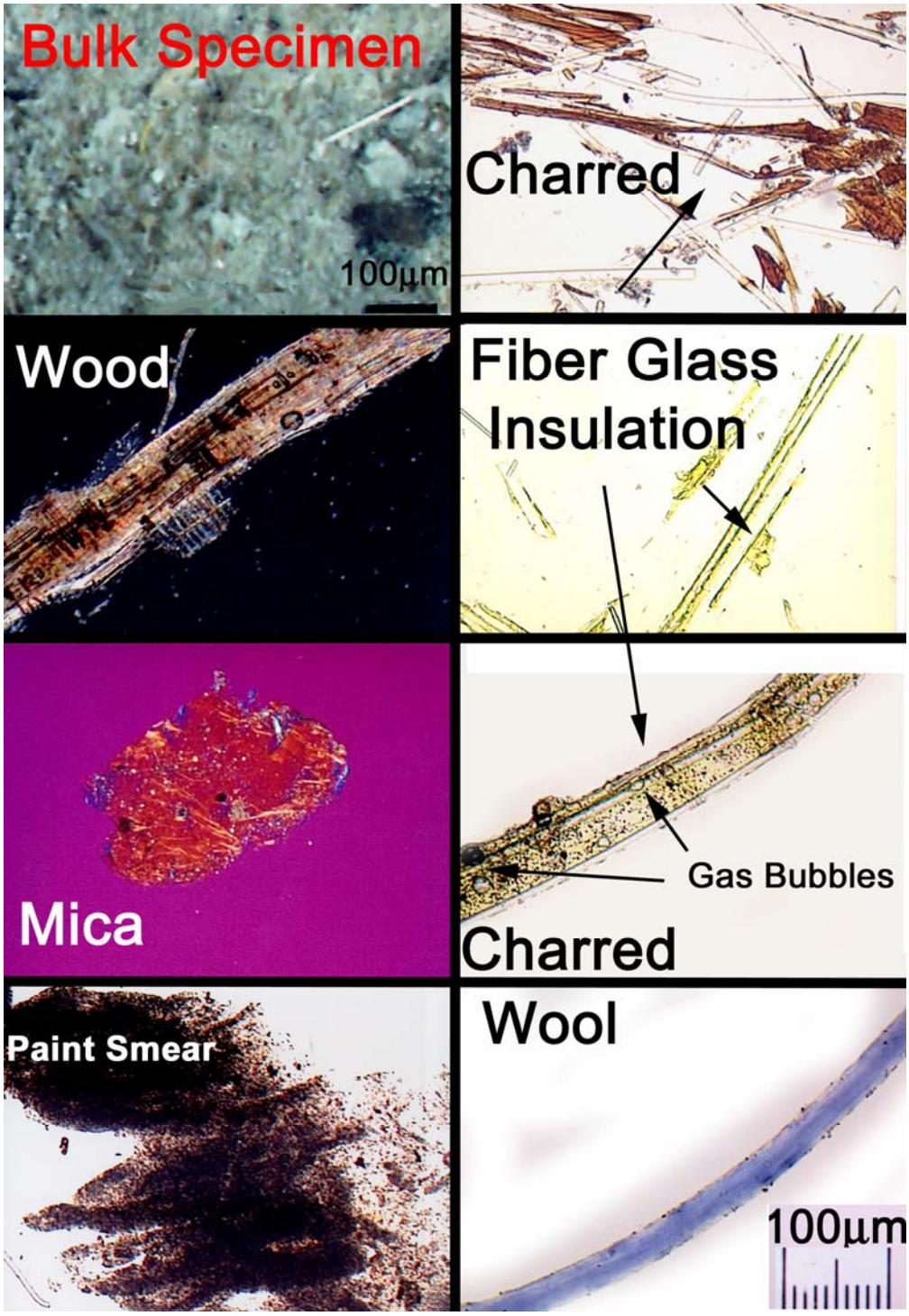
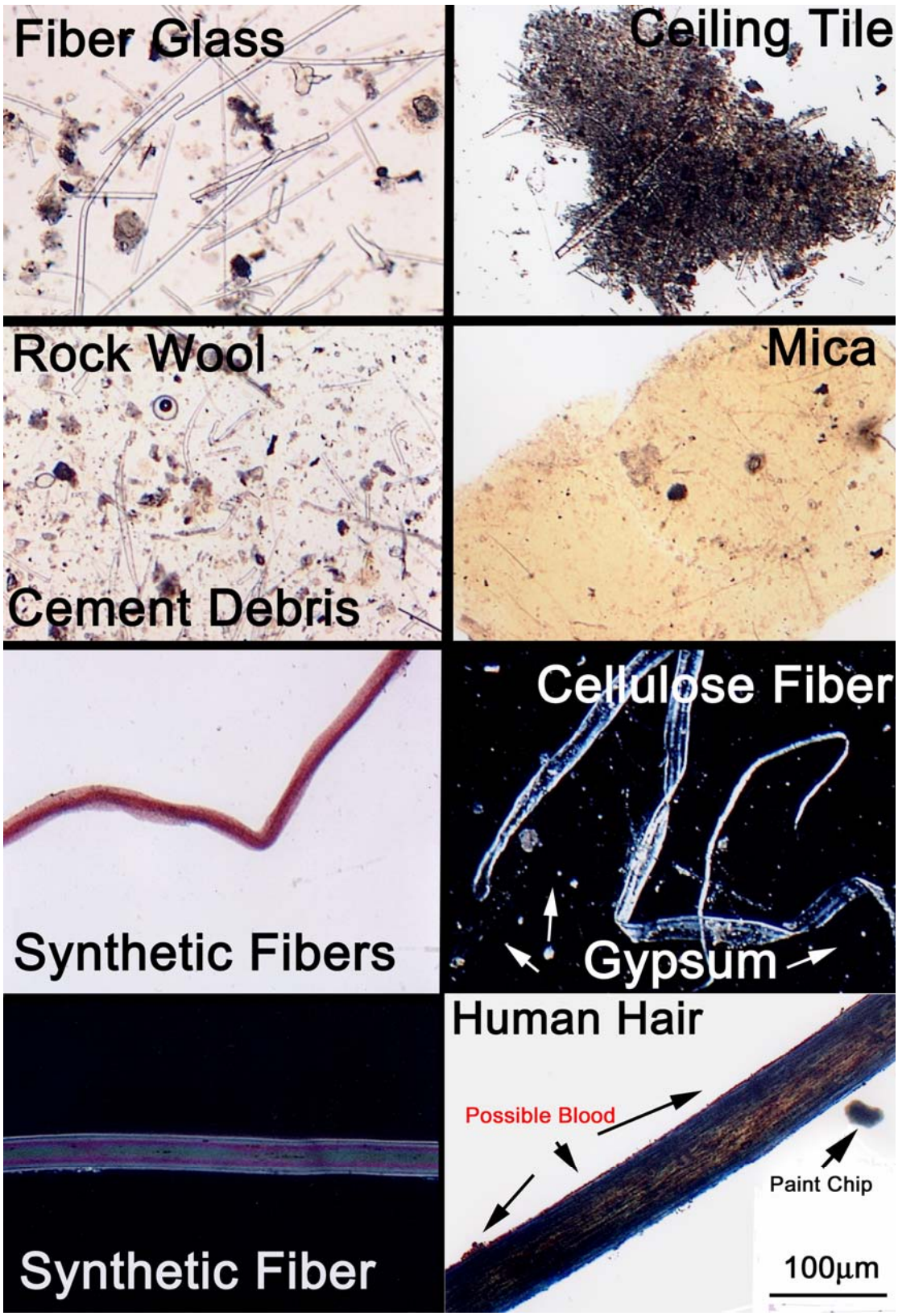


Figure 3 (A) - The top left shows a photomicrograph of a bulk specimen, the remaining photomicrographs are of a few particulates.


Fiber Glass
Ceiling Tile
Rock Wool
Cement Debris
Mica
Synthetic Fibers
Cellulose Fiber
Gypsum
Synthetic Fiber
Human Hair
Possible Blood
Paint Chip
100µm
Figure 3(B).

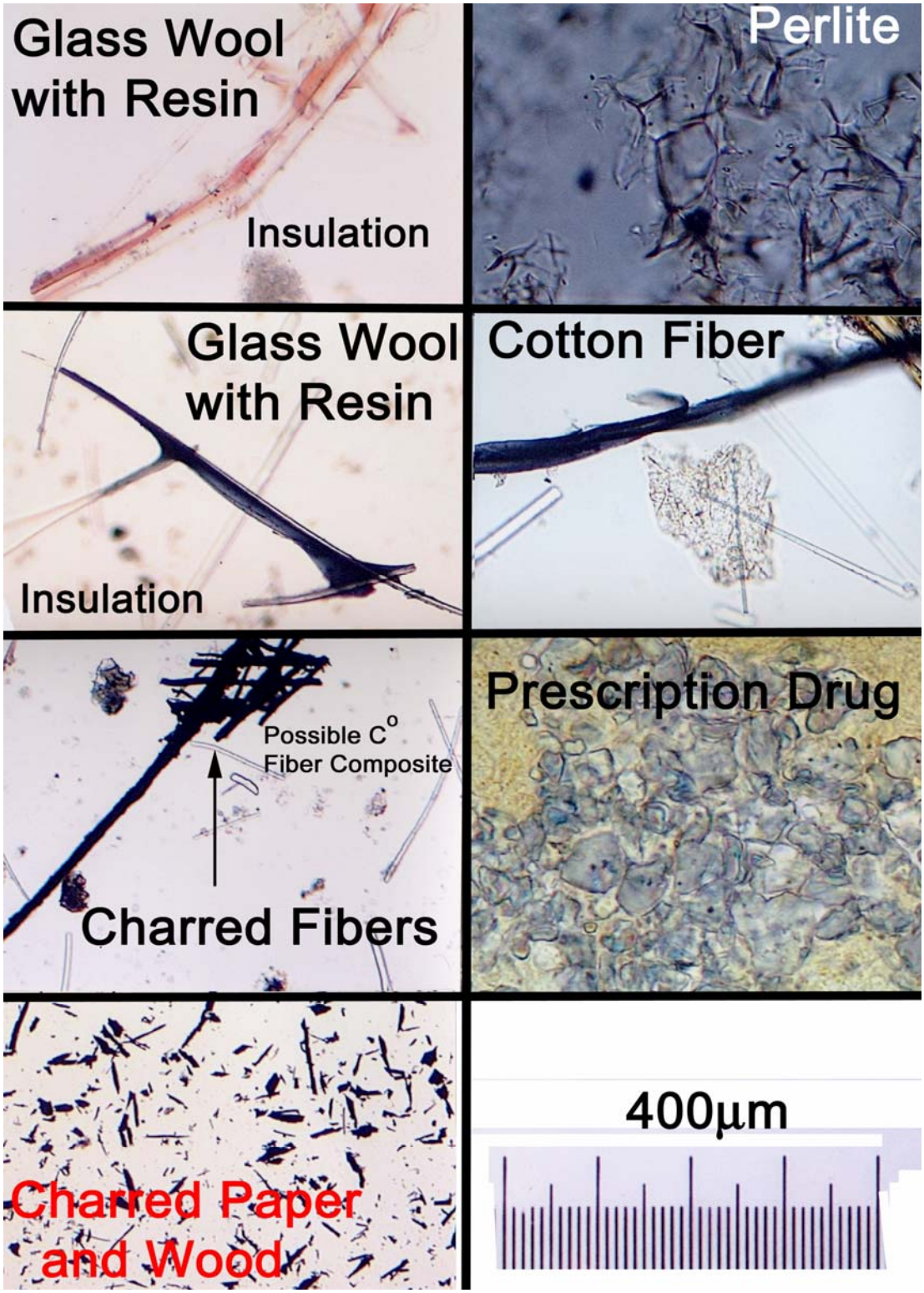

Glass Wool
with Resin
Insulation
Perlite
Glass Wool
with Resin
Insulation
Cotton Fiber
Possible C°
Fiber Composite
Charred Fibers
Prescription Drug
Charred Paper
and Wood
400µm
Figure 3(C).

Table 1 - Tabulation of WTC dust data.

Materials	Count	Percent of Total
Fiber Glass/Rock Wool	1615	45.1
Asbestos	5	Trace*
Synthetic Fibers	72	2.0
Human Remains	47	1.3
Natural Fibers	49	1.4
Paper Fibers	74	2.1
Ceiling Tiles	73	2.0
Mica Flakes	76	2.1
Plaster/Concrete Calcite, Dolomite, Gypsum	1138	31.8
Paint Smears & Chips	18	Trace
Metal Flakes	19	Trace
Wood Fragments	20	Trace
Foam Fragments	6	Trace
Charred Wood & Debris	257	7.1
Plastic Fragments	5	Trace
Perlite	8	Trace
Drug Fragments	12	Trace
Glass Fragment	50	1.4
Unknowns	40	1.1
Totals	**3584**	**100%**

*Less than 1%.

Table 1 clearly shows that the WTC specimens contained a large percentage of both caustic and abrasive materials. Over 45% of the fibrous material turned out to be tiny, sharp lengths of fiber glass which can easily penetrate the soft tissue of one's respiratory system. Over 30% of its content is composed of limestone base minerals as well as the many components of concrete. Such materials can easily form strongly basic and very corrosive solutions when hydrated with water. In addition, airborne, irritating and dangerous particulates such as metal flakes, glass fragments, and mineral dust were also present in hazardous quantities. These types of materials can easily cause abrasions to skin and mucous membranes as well as to eye, lung and other soft

tissue. Asbestos, plastic fragments, organic and inorganic particulates, unknown chemicals as well as some unknown substances were also observed at alarming levels.

CONCLUSION

In the final analysis, one can only speculate whether or not the dust generated by the collapse of the World Trade Center will have both current and/or long term effects on the health and lives of the people of New York City and those who came to help them.