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EPA assurances contradicted by UCD scientists

By Edie Lau and Chris Bowman --
Bee Staff Writers
Published 5:30 a.m. PST Tuesday,
Feb. 12, 2002

An independent analysis of air around Ground Zero shows the collapse of the World Trade Center towers spewed enormous amounts of potentially lethal, extremely tiny particles unrecognized by the U.S. Environmental Protection Agency's air monitoring.

The ominous findings by scientists at the University of California, Davis, contradict repeated assurances by EPA Administrator Christie Whitman that the air around the wreckage largely was safe to breathe.

"They had an unprecedented situation, and they applied the usual approaches," said Thomas Cahill, a physicist and international authority on air pollution who led the study.

He released early results Monday that showed lung-penetrating pollutants in startling concentrations, about 500 times more than what's in the air on the smoggiest days in the Sacramento Valley.

The Sept. 11 collapse of the 110-story skyscrapers crushed concrete, glass, computers, electrical wiring, carpeting, furniture and everything else in the building, then burned and



UC Davis professor emeritus Thomas Cahill used the drum sampler at right to detect particles in the air in New York after the World Trade Center attacks.

Sacramento Bee/ Lezlie Sterling

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broiled the compressed, pulverized mass for weeks. In the super-heated rubble the material disintegrated into extremely small particles, which were released into the air for weeks.

"It's like having a large power plant at ground level with no stack," Cahill said.

UC Davis released its findings amid mounting questions of why firefighters, cleanup workers and some residents are plagued by chronic coughing and other respiratory problems if the air truly has been safe.

Cahill's study has not been published nor peer-reviewed. The EPA, while aware of the work, has not seen the data.

The EPA came under heavy criticism Monday during a U.S. Senate subcommittee hearing for telling New Yorkers the pollution posed no problem, according to news reports.

EPA regional administrator Jane Kenny said the agency "used the most extensive data ever" in assessing air quality in the neighborhood around the World Trade Center site.

In New York, at least 2,500 of the 10,000 members of the Fire Department have respiratory problems, said Tom Manley, health and safety officer for the Uniformed Firefighters Association, their labor union. He said about 700 are out on medical leave.

In following standard monitoring protocols, EPA officials passed over what many health experts consider the deadliest air pollutants: invisible "very fine" and "ultra-fine" particles that can slip past the body's defenses, lodge deep in the lungs and possibly pass into the bloodstream to invade and weaken the heart.

Some research has linked exposure of fine particles to chronic respiratory disease and premature deaths from heart attacks, asthma, emphysema and other illnesses.

So small are the particles that it would take 1 billion to fill the period at the end of this sentence.

A weeks-long inundation of fine particles would be especially threatening to people with lung and heart conditions, said Kent Pinkerton of UC Davis, an expert on the health effects of particulate pollution.

"They are going to be the ones most at risk," Pinkerton said. "But for most people who are healthy, they probably would be able to handle it."

The EPA is considering updating its pollution standard to account for the finest particles, Raymond Werner, the agency's regional chief of air monitoring programs, said in an interview Monday. The EPA collected fine particles around the World Trade Center site for future reference.

But the science of collecting, measuring and assessing the health effects of such tiny particles is young, and Werner said the agency lacks data.

"The health community hasn't established evidence that there's a direct health effect," he said.

If not conclusive, the evidence is worrisome, said Robert Nolan, a specialist on particulate pollution at the City University of New York in Brooklyn.

patient, the Placer County Sheriff's Department said Tuesday.

Yuba County supervisors place two more health officials on leave
MARYSVILLE -- Two more Yuba County Health and Human Services Department officials -- health services director Beverly Craig and programs manager Carolyn Williams -- have been placed on administrative leave, authorities said Tuesday.

Huge display of heart: Tiny infant survives groundbreaking surgery
Her chest is the size of an adult's palm, her once-defective heart no larger than a grape.

What price health?
Health care inflation is on the rise again, and unlike the last cycle of skyrocketing employee health insurance premiums a decade ago, this time around there's nothing on the horizon that promises to get costs back under control.

Body Talk
Q: It's cold outside, and I'm looking for ways to stay in shape indoors. A gym is financially out of the question right now, and videos are boring. Any suggestions?

Other Views: Manage health costs with drug-

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The pollutants his team examined were collected beginning Oct. 2 from a rooftop at 201 Varick St., about one mile north of Ground Zero.

From the first few days, the scientists found high concentrations of "very fine" and "ultra-fine" particles lasting two to three hours.

The Ground Zero readings surprised Nolan at the City University of New York in Brooklyn.

"These numbers of fine particles are higher than I ever expected -- they're off the chart," Nolan said.

The conventional analysis used by the EPA captured the same range of particle sizes but averaged them in a way that smooths out the extraordinary peaks of the smallest particles.

EPA spokeswoman Nina Habib Spencer said the agency was obligated to follow its established monitoring methods.

"We are an agency of numbers and an agency of standards, and we adhere to those standards," she said Monday in an interview. "Just remember, those standards weren't built in a day. ... We based what we said to the public on our data, and the standards we have available to us."

The EPA collected samples, mostly in December, in three smaller size categories, down to 0.3 microns, according to Werner. Results of that sampling are not yet available.

The UC Davis team's assessment was for even finer particles still. Their system collected and sorted particles smaller than 2.5 microns, in six categories down to 0.09 microns.

Even at those vanishingly small dimensions, size matters: The smaller the speck, the harder it is for the body to flush out.

Further, a mass of very small particles poses a greater risk than an equal mass of larger particles because each particle surface potentially can react with body chemistry to damage cells.

The EPA readings may have met the criteria for safe air, Cahill said, but the standard is inadequate under the circumstances.

"The aerosols from the World Trade Center are so anomalous that the criteria are irrelevant," he said.

Bruce Case, former director of the EPA's Center for Environmental Epidemiology, agreed.

"This was a unique event in many ways, and one of those ways was the types of human exposures produced," said Case, an asbestos disease specialist now at McGill University in Montreal.

"We don't yet know what those were, and I think it is possible that the data that has so far been reported, since it used traditional methods, was not necessarily the most relevant data."

Beyond particulates, much of the EPA's investigation has focused on the release of cancer-causing pollutants such as lead and chromium, and asbestos fibers, contained in the fireproof

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"There are a lot of reasons to believe that people who inhale very fine particles have a higher risk of lung cancer," he said.

Nolan lives within four miles of Ground Zero. "I have been coughing for four months," he said.

In a way, the UC Davis findings are just scientific confirmation of what New Yorkers believe through common sense, said Michael Barasch, a New York lawyer who has filed health claims against the city on behalf of nearly 1,000 firefighters, plus some police and sanitation workers.

For months, he detected the scent of danger in the air. "It was that acrid smell. It was clearly electrical things burning," said Barasch, whose office is two blocks from Ground Zero. "Every single person you would speak to knew it was not safe."

The UC Davis analysis is continuing, but Cahill said he felt obligated to share results quickly to help New Yorkers take precautions to protect their health.

Cahill's team sent a custom-designed air sampler to New York in October at the request of Robert Leifer, a scientist with the U.S. Department of Energy's Environmental Measurements Laboratory. The project was not funded by the government; the UC Davis researchers donated their time.

Cahill, 65, is a professor emeritus of physics and atmospheric sciences. He has used his background in nuclear physics to pioneer methods and tools for analyzing aerosols -- tiny particles suspended in the air -- and has led more than 40 studies on pollution around the world, including several in national parks and in the basins of Lake Tahoe and Mono Lake.

The Ground Zero monitoring showed the fallout had subsided by late December, when Cahill's team stopped sampling. He said rain probably has cleared the air outside, but he is concerned about New Yorkers returning to contaminated buildings.

"These-size particles ... travel like a gas. They penetrate windows, doors, everywhere," he said. "You don't feel it, and you can't see it."

He recommended throwing away carpeting and fabrics that cannot be thoroughly washed, and cleaning everything else with water -- not by vacuuming, which blows particles around. He suggested that people handling the cleanup wear soaking wet masks in lieu of respirators.

Fine particles almost always are byproducts of human activities, produced through combustion, typically power plants, or gasoline and diesel engines.

In trying to understand the presence of a high volume of extremely fine particles at the World Trade Center site, Cahill combed through reports and photographs of the towers' collapse. He believes the answer is in the way the second tower came down.

Whereas the first tower fell laterally, the second tower dropped vertically, like a rock. "You have 180,000 tons of mass moving at 120 miles per hour," Cahill said.

By his assessment, the superheated core of the building, buried under a giant pile of rubble with little to no oxygen, created a pressure cooker that broiled the concrete, glass, computers and everything else into infinitesimally small particles that were exuded in a gassy, lingering haze.

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purchase, the cheaper each
item is. That same fiscal
wit is propelling new
legislation in California
that could change how the
state purchases prescription
drugs.

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an encampment near the
American River Parkway
by firefighters who initially
thought they were
responding to a grass fire.

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Californians will begin to
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advertisements aimed at
desperate parents who may
be thinking about
abandoning their
newborns, state officials
announced Monday.

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coating on some of the north tower's steel frame.

The UC Davis sampling found no asbestos fibers small enough to be inhaled. Nor did it turn up worrisome levels of toxic metals.

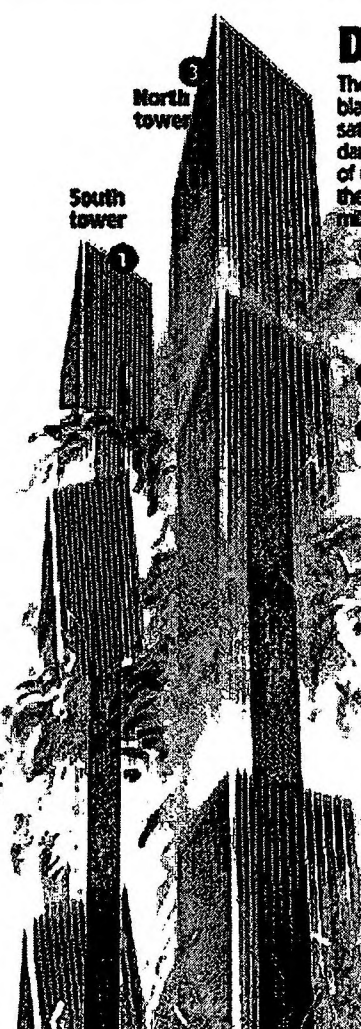
Case said the emphasis on asbestos turned out to be misplaced. "What happened to the glass and concrete?" he asked. "There is no question that it was inhaled. How much? By whom? With what immediate and long-term effects?"

Case predicted that the health fallout from the World Trade Center attack will continue indefinitely. "Regrettably," he said, "what we have here is a human experiment on a grand scale."

About the Writer

The Bee's Edie Lau can be reached at (916) 321-1098 or elau@sacbee.com.

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Danger at Ground Zero

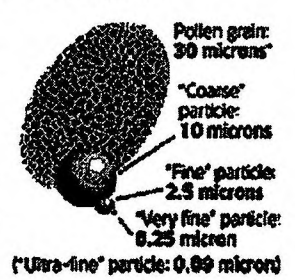
The Sept. 11 destruction of the World Trade Center not only blackened New York's sky and powdered the city gray, it also saturated its air with an extraordinarily high concentration of dangerous "very fine" and "ultra-fine" particles, according to University of California, Davis, scientists. On Monday, UCD released results of their air sampling, conducted in October from a rooftop about a mile northeast of Ground Zero.

Collapse dusts lower Manhattan

- 1 The 110-story south tower tipped south, crumbled and fell with such force that it pulverized tons of concrete and glass into a fine powder.
- 2 The particles were dispersed in huge clouds, mostly by wind from the subsequent collapse of the twin north tower.
- 3 The north tower plummeted straight down at about 120 mph, pancaking into a 70-foot-deep hole.

Tiny threats

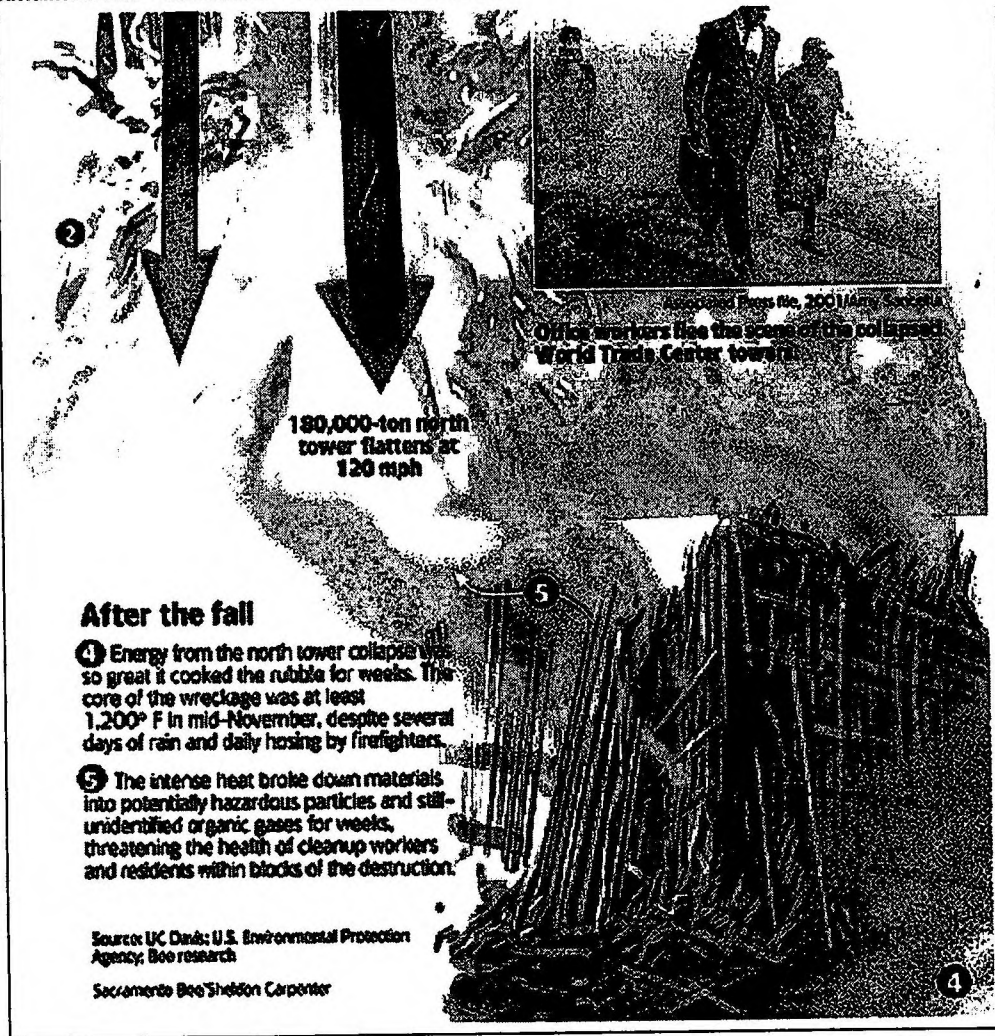
The air around Ground Zero is laden with unusually high concentrations of respirable particles of concrete, glass and other materials. Particles smaller than 2.5 microns are potentially dangerous.



"Very fine" particles can pass through the airways and lungs, enter the bloodstream and invade the heart. Several studies have linked particulate pollution to deaths of people with heart and lung conditions.

- * The point of a pin is approximately 50 microns

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Trade Center Air Held Unprecedented Amounts of Very Fine Particles, Silicon, Sulfates, Metals, Say UC Davis Scientists

February 11, 2002

In the most thorough analysis yet of the dust and smoke blown through lower Manhattan after the collapse of the World Trade Center, researchers at the University of California, Davis, today described unprecedented clouds of very fine particles that should be considered in evaluating rescue workers' and residents' health problems.

Based on their findings, the UC Davis researchers also recommended specific cleaning methods for contaminated apartments, offices, schools and other indoor spaces.

"No one has ever reported a situation like the one we see in the World Trade Center samples," said UC Davis researcher Thomas Cahill, Ph.D., an international authority on the constituents and transport of airborne particles. "The air from Ground Zero was laden with extremely high amounts of very small particles, probably associated with high temperatures in the underground debris pile. Normally, in New York City and in most of the world, situations like this just don't exist."

Cahill, a UC Davis professor emeritus of physics and atmospheric sciences and a research professor in applied science, heads the UC Davis DELTA Group (for Detection and Evaluation of Long-range Transport of Aerosols), a collaborative association of aerosol scientists at several universities and national laboratories. The DELTA Group has made detailed studies of aerosols from the 1991 Gulf War oil fires, volcanic eruptions, global dust storms, and most recently Asia.

The Manhattan air samples were collected at the request of a U.S. Department of Energy scientist from Oct. 2 through mid-December, by a DELTA Group air monitor placed on a rooftop at 201 Varick St., one mile north-northeast of the trade center complex.

The samples were collected continuously in eight separate size modes from coarse (12 micrometers diameter) to ultra-fine (0.09 micrometers diameter). Regional meteorology showed that the site at Varick Street could have received material from the World Trade Center site about half the time.

The samples were periodically shipped back to Davis, where the DELTA Group analyzed the samples for size, shape and composition. They used a suite of seven techniques including synchrotron-induced X-ray fluorescence (at DOE's Advanced Light Source at Lawrence Berkeley Laboratory), scanning transmission ion microscopy and proton elastic scattering analysis (at DOE's Lawrence Livermore National Laboratory), and soft beta mass measurements and scanning electron microscopy (at UC Davis).

"The UC Davis DELTA Group's ability to measure and analyze particle size, composition and time continuously, day and night, is unequalled," Cahill said.

All analyses were done on a volunteer basis and will be available as public documents. We report today on the data from Oct. 2 through Oct. 31, 2001.

Airborne particles and human health

In general, there are myriad ways that materials released into the air can affect human health. What the particles are made of matters; so do size, shape and quantity.

The DELTA team analyzed the samples for the unique chemical and physical signatures of dozens of substances, including elements from concrete and glass, such as silicon; from burning fuel oil, such as sulfur, vanadium and nickel; and from burning computers and electrical systems, such as lead. They also looked for organic, or carbon-based, compounds from burning wood, plastic and carpets. And they tested for glass shards and asbestos.

Some of these materials are known to cause health problems in some people when they are inhaled in sufficient amounts. Sulfur, for example, can irritate lung tissues. Lead can damage the central nervous system. Some carbon-based compounds can cause cancer. So can the mineral asbestos.

http://www-pubcomm.ucdavis.edu/default.lasso?-database=news_db.fmp_&-layout 2/11/2002

Just as the composition of inhaled particles can affect health, so can size.

The team analyzed the particles by size in eight ranges from coarse (12 micrometers to 5 micrometers in diameter) to very fine (0.24 micrometers to 0.09 micrometers in diameter). Most of the ultrafine mode (particles less than 0.1 micrometers) was not collected.

Coarse particles are typically filtered by the nose or coughed out of the throat and upper lungs. They can irritate the mucous membranes, causing coughs and nosebleeds. In some individuals, they can cause allergic reactions such as dry eyes; nose, throat and skin irritation; coughing, sneezing and respiratory distress. They can also cause breathing problems or aggravate pre-existing breathing problems, such as asthma.

However, very fine particles can travel deep into human lungs. Such small particles may have no immediate apparent health effects in moderate concentrations, but they typically are removed from the lungs through the bloodstream and heart, increasing the possibility of health impacts.

There are no established safe limits for inhaled very fine particles. The closest reference is the U.S. EPA "PM2.5" standard, which limits the allowable mass of airborne particles in the size range 2.5 micrometers to 0.09 micrometers. That standard is based on health studies of typical air samples, in which very fine particles are a small fraction of the total mass.

In contrast, in the World Trade Center samples analyzed at UC Davis, the very fine particles are a large fraction of the total mass.

In a news conference today, the DELTA researchers described key findings in these categories: very fine particles, coarse particles, metals, asbestos and glass.

Very fine particles

There were numerous events when bursts of wind lasting six to eight hours carried unprecedented amounts of very fine particles to the sampling site.

In the largest spike, the DELTA Group analysis found 58 micrograms per cubic meter of very fine particles in one 45-minute period – "an extremely high peak," Cahill said.

Cahill said the very fine particles contained high levels of sulfur and sulfur-based compounds, which in early analyses appear to have been dominated by sulfuric acid. The very fine particles also contain high levels of very fine silicon, potentially from the thousands of tons of glass in the debris.

Cahill noted that even those large amounts were likely to be smaller than those present at Ground Zero and some other parts of Lower Manhattan, since weather data show that typically only part of the dust clouds traveled directly over the sampling site.

"Even on the worst air days in Beijing, downwind from coal-fired power plants, or in the Kuwaiti oil fires, we did not see these levels of very fine particulates," Cahill said. The amounts of very fine particles, particularly very fine silicon, decreased sharply during the month of October.

Coarse particles

Similar to the high concentrations of very fine particles, virtually all the air samples from the trade center site carried high concentrations of coarse particles – those about 12 micrometers to 5 micrometers in diameter.

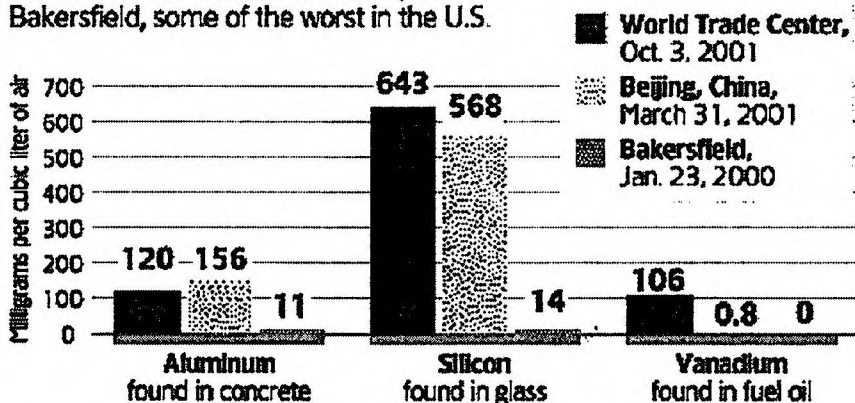
"These particles simply should not be there," Cahill said. "It had rained, sometimes heavily, on six days in the prior three weeks. That rain should have settled these coarse particles." The finding suggests that coarse particles were being continually generated from the hot debris pile. This observation is at least qualitatively supported, for while they are still being analyzed, the coarse particles appear to be coated with combustion products, including soot, Cahill said.

Metals

Many different metals were found in the samples of very fine particles, and some were found at the highest levels ever recorded in air in the United States.

Comparative particulate concentrations

The levels of very fine and ultra-fine particles near the World Trade Center site as compared with peak days of air pollution for Beijing, considered the worst in the world, and Bakersfield, some of the worst in the U.S.



Worrisome findings

- The collapse of the twin towers spewed lung-piercing particles.
- Vapors from the super-hot wreckage emitted still more of the potentially dangerous particles weeks after the collapse.
- Some of the particles were insoluble elements of concrete and glass – silicon, calcium, aluminum – that can stay lodged in the lungs for decades.

Good news

- Relatively few cancer-causing asbestos fibers from the buildings' fireproofing material were detected.
- Glass from thousands of windows and computer screens disintegrated into smooth particles instead of more dangerous shards.
- Lead levels were low. The metal can damage the central nervous system, particularly in children.

Source: UC Davis

Sacramento Bee/Sheldon Carpenter

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However, there are few established safety guidelines for airborne metals. One metal for which there is a guideline, lead, was present at low levels in fine and very fine particles.

Some of the metals for which there are no guidelines that were present in very fine particles in relatively high concentrations were iron, titanium (some associated with powdered concrete), vanadium and nickel (often associated with fuel-oil combustion), copper and zinc. Mercury was seen occasionally in fine particles but at low concentrations. Many of those metals are widely used in building construction, wiring and plumbing. Some are common in computers.

The metal content of the coarse particles is still being analyzed.

Asbestos and glass

Although some asbestos was used in the buildings for fireproofing and in floor tiles, and the DELTA group checked for it carefully using the electron microscope, they found very few asbestos fibers, even in the very fine particles.

Some particles that appeared to be glass were seen, but they were not in the form of long shards, which can mimic asbestos fibers.

Clean-up recommendations

All evidence indicates that ambient air in New York City now is little influenced by the World Trade Center collapse, especially since the fires are out and the debris pile has cooled.

However, the presence of large amounts of very fine particles as late as October means that indoor clean up should be done carefully, Cahill said. Very fine particles will have penetrated crevices and fabrics in a way normal dust doesn't. And they are easily re-suspended, which re-exposes the room's occupants to them.

Cahill strongly supports the recommendations made by the New York Department of Health regarding washing with water, and said:

- Don't use vacuum cleaners or brooms because they re-suspend particles. Do use wet rags, mops and wet-vacuum-type cleaners.
- Wipe all surfaces, including window blinds, picture tops and door frames, with wet rags.
- Drapes and curtains should be washed or dry-cleaned. Furniture fabrics should be steam-cleaned. Carpets should be wet-cleaned.
- Use high efficiency electrostatic or HEPA air filters in furnaces and air conditioners.
- Keep humidity reasonably high indoors, to keep very fine particles from floating around.

UC Davis DELTA Group

The UC Davis DELTA Group is one of the world's leading research groups in analyzing the size, composition and movement of airborne particles. DELTA Group scientists analyzing the trade center samples included Cahill; engineering professor James Shackelford, Ph.D., who led the scanning electron microscopy; chemistry professor Peter Kelly, Ph.D. who led the mass spectroscopy; assistant research engineer Steve Cliff, Ph.D., who is project manager for the synchrotron program, and laboratory and field manager Michael Jimenez-Cruz, toxicologist.

Key collaborators from other institutions were Kevin Perry, Ph.D., a former Cahill postdoctoral collaborator and now an assistant professor of meteorology at the University of Utah, Salt Lake City; Graham Bench, Ph.D., a project investigator at the Center for Accelerator Mass Spectroscopy, U.S. Department of Energy's Lawrence Livermore National Laboratory, and his team of scientists; and Jodye Selco, Ph.D., a visiting professor at UC Davis and a professor of chemistry at the University of Redlands, Redlands, California.

The DELTA Group's many previous research projects include studies of the smoke from the Kuwaiti oil fires and two international ACE studies (for Aerosol Characterization Experiment), which are designed to shed light on the roles of aerosols in global weather, water pollution and human disease. The most recent, ACE-Asia, operated under National Science Foundation funding with 21 aerosol-sampling sites from Asia to

western North America from March through August 2001.

DELTA Group currently is continuing analyses of the 2001 ACE samples, as well as studies of Alaskan air quality, the nature of diesel-vehicle exhaust, the impacts of air pollution on human health in California's great Central Valley, and the environmental health of the Lake Tahoe Basin.

For more information, visit the DELTA Web site at: <http://delta.ucdavis.edu>.

The University of California, Davis, is one of the world's leading institutions in the environmental sciences. More than 250 faculty members support an unmatched array of environmental programs in human and animal health, agriculture, biological sciences, engineering, physical sciences, law, social sciences, literature and the arts.

Media contact(s):

Sylvia Wright , (530) 752-7704 , swright@ucdavis.edu

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