



Analysis of Aerosols from the World Trade Center Collapse Site, New York, October 2 to October 30, 2001

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The collapse of the World Trade Center (WTC) buildings #2 (South Tower), #1 (North Tower), and #7 created an enormous collapse pile which emitted intense plumes of acrid smoke and dust until roughly mid-December, when the last spontaneous surface fire occurred. We collected particles by size (8 modes, ≈ 12 to 0.09 micrometers diameter) and time (typical resolution of 1 to 3 h) from October 2 until late December at the EML 201 Varick Street site roughly 1.8 km NNE of the collapse site and 50 m above ground level. Here we show some of the 70,000 mass and elemental data from the time period October 2 through October 30. Identification of a WTC collapse pile source for aerosols seen at the receptor site were based upon the simultaneous presence of finely powdered concrete, gypsum, and glass with intense very fine combustion mode mass episodes concurrent with winds from the southwest

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quadrant. The results, derived from seven independent beam-based analytical techniques, showed that while PM_{10} and $PM_{2.5}$ 24 h values rarely, if ever, violated federal air quality standards, WTC-derived plumes swept over lower Manhattan Island, resulting in intense aerosol impacts of duration a few hours at any one site. The WTC plume resembled in many ways those seen from municipal waste incinerators and high temperatures processes in coal-fired power plants. The size fractions above 1 micrometer contained finely powdered concrete, gypsum, and glass, with sootlike coatings and anthropogenic metals, but little asbestos. Composition in the very fine size range ($0.26 > D_p > 0.09 \mu m$) was dominated by sulfuric acid and organic matter, including polycyclic aromatic hydrocarbons (PAHs) and their derivatives, and glasslike silicon-containing aerosols. Many metals were seen in this mode, most, but not all, at low concentrations. The concentrations of very fine silicon, sulfur, and many metals, as well as coarse anthropogenic metals, decreased markedly during October, probably in association with the cooling of the collapse piles. Values of very fine elements seen in May, 2002 at the WTC site were only a few percent of October values.

INTRODUCTION

The collapse of the World Trade Center (WTC) buildings #2 (South Tower), #1 (North Tower), and #7 on September 11, 2001 is an unprecedented event in numerous ways. Yet the prompt and massive emissions of smoke and dust in the first days after the collapse were in accord with common understanding of such phenomena. However, the continuing emission of these plumes, especially after the heavy rains of September 14 and the increasingly effective efforts of fire suppression in mid- and