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Distribution of lead in single atmospheric particles

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Abstract. Three independent single particle mass spectrometers measured Pb in individual aerosol particles. These data provide unprecedented sensitivity and statistical significance for the measurement of Pb in single particles. This paper explores the reasons for the frequency of Pb in fine particles now that most gasoline is unleaded. Trace amounts of Pb were found in 5 to 25% of 250 to 3000 nm diameter particles sampled by both aircraft and surface instruments in the eastern and western United States. Over 5% of particles at a mountain site in Switzerland contained Pb. Particles smaller than 100 nm with high Pb content were also observed by an instrument that was only operated in urban areas. Lead was found on all types of particles, including Pb present on biomass burning particles from remote fires. Less common particles with high Pb contents contributed a majority of the total amount of Pb. Single particles with high Pb content often also contained alkali metals, Zn, Cu, Sn, As, and Sb. The association of Pb with Zn and other metals is also found in IMPROVE network filter data from surface sites. Sources of airborne Pb in the United States are reviewed for consistency with these data. The frequent appearance of trace Pb is consistent with widespread emissions of fine Pb particles from combustion sources followed by coagulation with larger particles during long-range transport. Industrial sources that directly emit Pb-rich particles also contribute to the observations. Clean regions of the western United States show some transport of Pb from Asia but most Pb over the United States comes from North American sources. Resuspension of Pb from soil contaminated by the years of leaded gasoline was not directly apparent.

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