Alkali metal content of individual particles in Mexico City during the MILAGRO campaign in 2006

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As the population of the world grows, urban areas expand rapidly and the number of very large metropolitan areas increases. The MILAGRO (Megacity Initiative: Local and Global Research Observations) field measurement campaign was conducted in Mexico City in March 2006. Aims of the campaign were to characterize the air quality in this densely populated area and the influence of the city on regional and global climate. The Mexico City Metropolitan Area (MCMA) is the second largest megacity in the world, with a population of more than 18 million people and it covers an area of 1,500 km². MCMA has severe air pollution problems, which are influenced by several factors including the basin-like topography of the city, high altitude, meteorology, urban expansion, and demographic and industrial growth. The emissions of pollutants in MCMA routinely exceed the standards recommended by the World Health Organization. As a result air pollution has serious health consequences and large economic costs to society.

Traffic is known to be a major polluter in the MCMA, while the contributions from other sources including combustion of solid fuels are less well characterized. In the present study an aerosol mass spectrometer (AMS) was deployed to quantify the alkali metal content of the single particles. The AMS is based on orthogonal acceleration time-of-flight mass spectrometry combined with surface ionization (Svane et al. 2004; 2005) and it provides quantitative measurements of the alkali content of individual particles in the size range 20-1000 nm. Measured ratios of Na and K contents make it possible to distinguish particles emitted from biomass and waste burning from other sources.

The AMS was used together with a scanning mobility particle sizer (SMPS) to provide size information of the aerosol. The aerosol entered into the SMPS system, which was set to scan from 8 to 320 nm under 6 min periods. The monodisperse aerosol flow from the DMA unit of the SMPS was split and let into a CPC and the AMS. The aerodynamic lens system of the AMS produces a narrow particle beam that is directed towards a restively heated (1500 K) platinum surface in the vacuum system. Particles that impact on the hot surface decompose and the alkali content of the particles is efficiently ionised at the hot surface by surface ionisation (Svane et al 2004). Alkali metals have unusually low ionisation potentials and the ionisation probability may approach 100%. The ions are accelerated into a time-of-flight unit and ions with different mass to charge ratio (m/z) reaches the ion detector separated in time. Ions are detected with a multi channel plate (MCP) and the outgoing pulses from the MCP are amplified and counted by a computer-controlled Fastflight-2 Digital Signal Avarager. 1000 consecutive scans were added to a mass spectrum with a 13.5 ms long data collection period, and mass spectra were continuously stored to computer for further analysis.

The concentrations of alkali-containing particles were measured during the MILAGRO field campaign in Mexico City from March 7 to March 31, 2006. The measurements were performed on a roof-top site at the Instituto de Petroleo near the center of Mexico City. The concentrations of sodium- and potassium-rich particles were generally observed to be low compared to the total particle number concentrations of sub-micrometer particles. Measured Na:K ratios in individual particles indicated that biomass and waste burning, as well as sodium-rich mineral particles, make significant contributions to the aerosol in the MCMA. Typical AMS results will be presented and related to meteorological conditions in the Mexico City area and to other gas and particle measurements carried out during the field campaign.

References
