Evidence for the presence of secondary phosphorus in continental fine aerosol

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The role of the atmosphere in the biogeochemical cycle of phosphorus is generally associated with the emission of soil dust, sea-salt particles, bioaerosols and industrial aerosols Mahowald *et al* (2008). Quite independently, a reduced gaseous phosphorus compound (phosphine, PH_3) was measured over various sources such as marshes and sewage plants Dévai *et al* (1988) and also in the global troposphere. Given that phosphine is a reactive gas that rapidly yields low-volatility phosphoric acid in the atmosphere Frank and Rippen (1987), secondary aerosol formation can be an important sink that has never been considered in the global phosphorus cycle.

In our study we present mass size-distribution measurements of phosphorus in aerosol samples collected at three locations in Hungary. The elemental compositions of the samples were determined by proton induced X-ray emission (PIXE). The evaluation of the X-ray spectra was performed with the PIXEKLM program code. The bimodal size distribution of phosphorus indicated two distinct formation mechanisms in the fine and coarse modes.

As expected, the mass concentration of phosphorus was dominated by the coarse particles (aerodynamic diameter >1 μm) Vicars *et al* (2010), the contribution of fine mode phosphorus was in the range of 10–27 % (median 19 %) of the total. The contribution of biomass burning to the fine mode phosphorus was inferred from measured K concentrations and P/K ratios reported for biomass smoke (Echalar, 1995).

It was found that biomass burning just partly accounted for fine mode phosphorus, the major part of which likely formed as secondary aerosol component from the photooxidation product of gaseous phosphine.

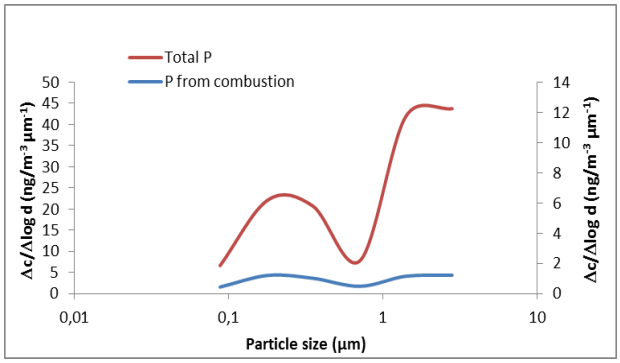

Figure 1. Measured size distribution of phosphorus in rural aerosol collected on 21st of July in 2003.

Secondary aerosol phosphorus can be even more important in providing this essential nutrient for remote ecosystems since it is associated with fine aerosol particles which have longer residence time and thus are more prone to long-range atmospheric transport than coarse primary particles.

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