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Indirect 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. Quite independently, a reduced gaseous phosphorus compound (phosphine, PH_3) was measured over various sources such as marshes and sewage plants [1] and also in the global troposphere. Given that phosphine is a reactive gas that rapidly yields low-volatility phosphoric acid in the atmosphere [2], 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 two locations in Hungary. 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), 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 [3]. It was found that biomass burning accounted for only a small fraction of fine mode phosphorus, the rest of which likely formed as secondary aerosol component from gaseous phosphine. 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.

[1] Dévai *et al.* (1988) *Nature* 333, 343–345. [2] Frank & Rippen (1987) *Lebensmitteltechnik* 7-8, 409-411.[3] Echalar *et al.* (1995) *Geophysical Research Letters* 22, 3039–3042.