

Comparison of summer and winter pollution effects on PM_{2.5} Sr radiogenic isotopic ratios from central Europe

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Atmospheric pollution has adverse health effects on humans. We analysed concentrations and Sr isotopic ratios in fine airborne particulate matter (PM_{2.5}) in three Central European cities with populations exceeding 90,000 people. Aerosol sampling in 12-h intervals was performed during summer and winter in Brno, Olomouc and Hradec Králové. Trace elements (Zn, Cu, Cd, As, and S) and PM_{2.5} concentrations were higher in winter than in summer in all studied sites; the overall mean concentration of PM_{2.5} in the air was 21 µg.m⁻³[1]. The summertime Sr concentrations are similar in all cities: 0.24 ng.m⁻³ in Brno, 0.27 ng.m⁻³ in Olomouc and 0.29 ng.m⁻³ in Hradec Králové. In winter, the Sr concentration in the air dramatically increases in all cities: 1.92 ng.m⁻³ in Brno, 0.73 ng.m⁻³ in Olomouc and 1.61 ng.m⁻³ in Hradec Králové. Martinková et al. [1] suggest that rare winter-time smog episodes cannot explain such a significant increase in seasonal pollution levels; Czech and Polish thermal power plants and household heating play a more important role. In ⁸⁷Sr/⁸⁶Sr isotopic composition, we also observe seasonal differences. In winter, ⁸⁷Sr/⁸⁶Sr of PM_{2.5} vary from 0.7077 to 0.7140 in Brno and Hradec Králové, from 0.7079 to 0.7134 in Olomouc. In summer, we observe wider dispersion in Sr isotopic composition, especially in Brno, where ⁸⁷Sr/⁸⁶Sr vary from 0.7087 to 0.7178. The ⁸⁷Sr/⁸⁶Sr composition of PM_{2.5} in Olomouc (⁸⁷Sr/⁸⁶Sr=0.7094–0.7147) is similar to ⁸⁷Sr/⁸⁶Sr composition of PM_{2.5} in Hradec Králové (⁸⁷Sr/⁸⁶Sr=0.7090–0.7135). We propose that coal combustion has a large effect on the Sr concentration in the air in winter, and therefore, we probably see a Sr isotope signal in the winter patterns from burning coal with a very homogeneous Sr isotope composition. The greater dispersion of the ⁸⁷Sr/⁸⁶Sr isotopic composition of PM_{2.5} observed in cities during the summer may be due to the larger number of pollen grains, but a more significant contribution will be from geogenic components originating from soil weathering.

[1] Martinková E., Erban Kochergina Y.V., Šebek O., Seibert R., Chrástný V., Novák M., Štěpánová M., Čuřík J., Pacharová P., Přechová E., Veselovský F., Volná V., ... (2023): Atmospheric Environment, 310, 119941