Chemical and isotopic compositions of atmospheric particulate-bound mercury at urban and rural sites in South Korea

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Particulate matter (PM), and especially, aerodynamic diameter ≤ 2.5 µm; $PM_{2.5}$, is of particular interest as it has negative impacts on human health. Deciphering its origins and contributing sources is therefore vital for establishing effective reduction policies. We collected weekly $PM_{2.5}$ samples from an urban (Seoul) and a rural (Baengnyeong Island) sites in South Korea from January 2014 to July 2016 and analyzed the isotopic compositions of $PM_{2.5}$, including $\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$- SO_4^{2-}, $\delta^{15}N$-NO_3^-, $\delta^{18}O$-NO_3^-, and $\delta^{15}N$-NH_4^+, as well as particle-bound mercury (PBM). The mean concentrations of PBM were 36 ± 34 pg m^{-3} at the Seoul and 12 ± 11 pg m^{-3} on Baengnyeong. Obvious seasonal PBM variations were observed at both sites, as concentrations were higher in winter than in summer. At Baengnyeong, PBM concentrations showed good positive correlations with OC, EC, and Pb concentrations, as well as the isotopic compositions of $\delta^{13}C$, $\delta^{34}S$-SO_4^{2-}, and $\delta^{15}N$-NO_3^-, whereas $\delta^{15}N$-NH_4^+ showed negative correlations with PBM. The stable isotopic compositions are expected to be more enriched with $\delta^{13}C$, ^{34}S-SO_4^{2-}, and $\delta^{15}N$-NO_3^- and depleted of $\delta^{15}N$-NH_4^+ when $PM_{2.5}$ arises from coal combustion rather than from vehicle and biogenic emissions. Thus, the positive correlations of $\delta^{13}C$, $\delta^{34}S$-SO_4^{2-}, and $\delta^{15}N$-NO_3^- with PBM and the negative correlations of ^{15}N-NH_4^+ with PBM imply that the major PBM source during winter in Baengnyeong is coal combustion.