Inorganic and organic chemical characteristics of suspended particulate matter in Ulan Bator

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Ulan Bator, capital of Mongolia, is one of the large cities subjected to the serious atmospheric pollution. In winter, density of suspended particulate matter (SPM) exceeds 250 μg/m^3, and the air pollution in Ulan Bator is seven times higher than the WHO environmental criterion.

We collected 53 SPM samples at a centeral part of Ulan Bator from Jan. 2014 to Apr. 2015 by a high volume air sampler. All samples were used for inorganic mateiral analysis by ICP-MS (Agilent 7700x). Aliphatic and polycyclic aromatic hydrocarbons were also analyzed for selected 13 samples by FID-GC (Shimazdu GC-2014).

SPM density fluctuates seasonally from about 50 μg/m^3 in summer to about 250 μg/m^3 in winter. Summer SPM samples show high concentrations of elements enriched in soils such as Al, Ti and Fe, whereas winter SPMs do those from coal combustion such as C and As. High carbon contents up to about 40 wt.% suggest high concentration of organic materials in winter SPMs. By the statistical positive matrix factorization (PMF) method, contribution of coal combution, derived mainly from the ger area surrounding city area, is estimated to be 60 wt.% in winter, whereas contribution from soil amounts 70~80 wt.% in other seasons.

Winter SPMs show high aliphatic hydrocarbon concetrations up to 1,100 ppm (C_{24-38}) with a peak abundance at C_{29} and a clear odd-number carbon preference index (CPI), suggesting higher plant origin. Various PAHs were also detected in the winter SPMs, such as pyrene, chrysene, benzo(b)fluoranthene benzo(a)pyrene, and ndeno(1, 2, 3-cd)pyrene. The latter four compunds are referred to as carcinogens. The high concentrations of As and carcinogenic PAHs must be harmful for human health. More detailed and continuous geochemical observations about SPMs are needed.