PAHs in $PM_{2.5}$ at high altitude in southern China: Meteorology, Emissions and Transport

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$PM_{2.5}$ samples were collected for polycyclic aromatic hydrocarbons (PAHs) analysis from March 18 to May 20 in 2012 at Mount Lushan (1165m), where is located in southern China. The sampling site was located between the boundary layer and troposphere, an ideal site for learning the influences of long-range transport on PAHs distributions. The volume concentrations of the measured PAHs were 6.98 ng/m^3 ranged from 1.47-25.17 ng/m^3 during the sampling time. The PAHs level at Mount Lushan was at a medium level comparing to other sites around the world. PAHs mass in $PM_{2.5}$ were 160.24 ug/g ranging from 63.86 to 427.97 ug/g. The predominant compounds were BbF (benzo[b]fluoranthene), Pyr (pyrene) and BP (benzo[g,h,i]perylene). In terms of aromatic-ring PAHs distributions, 6-ring and 4-ring were predominant, accounting for 27.9% and 24.2% of the total. It is due to that high molecular weight (HMW) PAHs have lower volatility and easier to attach in the particles comparing to low molecular weight (LMW) PAHs.
Meteorological conditions including temperature and humidity could affect the PAHs distributions. Temperature had a negative correlation with PAHs concentrations, i.e. when the temperature was higher, the PAHs concentrations become lower. This is due to the volatility of PAHs. Humidity had no significant relationship with PAHs concentrations. When the wind is strong, PAHs concentrations were lower. Strong wind would accelerate air motion, therefore PAHs were not easy to attach to particulates. Foggy and rainy weather occured during the sampling campaign. Selected samples before and after the special weather were analyzed. The concentrations of LMW PAHs were much higher than the HMW PAHs before fog or rain. For the PAHs concentrations, they are lower obviously after fog and rain. This suggested that foggy and rainy day lower pollutant levels and played a role in cleaning air.
The backward trajectories simulated by HYSPLIT (the Hybrid Single Particle Lagrangian Intergrated Trajectory) model were mainly originated from five directions. The air mass from northwest, northeast, southwest, southeast and east accounted for 27.9%, 9.3%, 13.9%, 7.0% and 7.0%, respectively. Figure 1 suggested that Mount Lushan was mainly influenced by air mass from northwest during the sampling. The total concentration of PAHs were highest (11.31 ng/m^3, 6.65-17.60 ng/m^3) under the influence of northwestern air mass. The PAHs levels were similar when air mass from northeast (5.08 ng/m^3) and southwest (5.03 ng/m^3). When sample were originated from the sea in the east, the PAHs concentrations were at lowest level (3.97 ng/m^3).In addition, when Mount Lushan was mainly affected by northwestern air mass, most of the PAHs species were much higher except for AnT (anthracene) and Flu (fluorene). The concentration of AnT was similar (low level) in every sample during the sampling time and Flu concentration was the highest when affected by air mass from northeast. Thus, the air mass from northwest carried large amounts of pollutants to Mount Lushan and the long-range transport influenced the PAHs distributions.
Another important factor that affected PAHs distributions was the emissions. Ratio analysis AnT/(AnT+PhA), FluA/(FluA+Pyr), BaA/(BaA+Chr) and InP/(InP+BP) and PCA (principal components analysis) were used to identify the emission sources of PAHs in $PM_{2.5}$. It is suggested that the main emission sources were mainly from pyrolysis of petroleum fuel (vehicle exhaust) and biomass (coal) combustion. Many factories and highways existing in the north and southwest of Mount Lushan can well explain the main source of the PAHs. The PAHs distributions were mainly influenced by long-range

transport and emission sources. Temperature, wind, fog and rain could also affect PAHs distributions in $PM_{2.5}$.

We gratefully acknowledge the National Natural Science Foundation of China (21177073) and Mount Lushan Meteorological Station.

Keywords: PAHs distributions, Transport, Meteorology, Mount Lushan