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Source apportionment of carbonaceous aerosols in a megacity of northwest China: insights from radiocarbon measurement

Haiyan Ni (1,2), Rujin Huang (2), and Ulrike Dusek (1)

(1) Centre for Isotope Research (CIO), Energy and Sustainability Research Institute Groningen (ESRIG), University of Groningen, Groningen, the Netherlands (h.ni@rug.nl), (2) Key Laboratory of Aerosol Chemistry & Physics (KLACP), Institute of Earth Environment, Chinese Academy of Sciences, Xi'an, China

Fine particulate matter ($PM_{2.5}$) samples were collected from 5 July 2008 to 27 June 2009 at Xi'an, a very polluted megacity in Northwest China. The 24 h averaged $PM_{2.5}$concentrations (ranged from 32 μg m^{-3} to 339 μg m^{-3}) were 1-14 times higher than the WHO guideline for 24 h $PM_{2.5}$(25 μg m^{-3}).

In this work, we unambiguously quantify fossil (e.g., vehicle emissions, coal burning etc.) and non-fossil (e.g., biomass burning, cooking, biogenic emissions etc.) contributions to organic carbon (OC) and elemental carbon (EC) of $PM_{2.5}$using radiocarbon (^{14}C) measurement. In addition, we measured $PM_{2.5}$ major components and source markers, including OC and EC, ions, trace elements, polycyclic aromatic hydrocarbons (PAHs), oxygenated PAHs (o-PAHs), anhydrous sugars and hopanes.

The preliminary results of radiocarbon measurements in OC and EC show that the annual mean contributions from fossil-fuel combustion to EC was 76 $\pm$ 8% (6 $\pm$ 2 μg m^{-3}). The remaining 24 $\pm$ 8% (2 $\pm$ 1 μg m^{-3}) was attributed to biomass burning, with higher contribution in the cold period ($\sim$33%) compared to the warm period ($\sim$21%), due to enhanced emissions from local biomass burning activities in winter. In contrast with EC, OC was dominated by non-fossil sources, with an annual average of 54 $\pm$ 8 % (13 $\pm$ 10 μg m^{-3}). Clear seasonal variations were seen in OC concentrations both from fossil fuel (OC_{ff}), and from non-fossil sources (OC_{nf}), with maxima in the cold period and minima in the warm period, because of enhanced fossil and non-fossil activities in winter, mainly biomass burning and domestic coal burning.

Further source apportionment of OC, including primary/secondary fossil OC, primary/secondary non-fossil OC, will be conducted by combining ^{14}C results with positive matrix factorization (PMF) analysis of organic matter (OM).