PA45) Summarize Water-soluble Ions of $PM_{2.5}$ in Northeastern Asia

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1. Abstract

Atmospheric fine aerosol particles play an important role in controlling a number of atmospheric processes, such as the deposition of different compounds, the optical properties etc. (Molnár et al., 1999). In this report, water-soluble species of PM2.5 obtained from simultaneous measurements at four Asia sites (Beijng (39.56°N, 116.17°E), China; Gwangju (35.10°N, 126.53°E), South Korea; Kyoto (35.01°N, 135.44°E), Japan; and Ulan-Bator (47.55°N, 106.52°E), Mongolia) during the periods of 14-22 August, 30 October-06 November 2000, 14-21 January 2001, 23 July-02 August and 05-16 November 2002, within the framework of an APN (The Asia-Pacific Network for Global Change Research) project are reported. Ion components in 23 July-02 August 2002 were not obtained because of the technical problem of equipments.

2. Methods

$PM_{2.5}$ were collected on a Teflon filter (Gelman, P5PJ047) via an aluminum cyclone $PM_{2.5}$ inlet (URG-2000-30EN, URG Co.). The flow rate was maintained at 16.7 l/min by a rotameter, which was calibrated in laboratory with a critical orifice. The critical orifice flow rate was calibrated with a Wet Test Meter (Tokyo Shinagawa, SINAGAWA). For both samplings, anionic (Cl^-, NO_3^-, SO_4^{2-}) and cationic (Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}) ion concentrations of $PM_{2.5}$ were analyzed by Ion Chromatography (IC). The anion column was an IONPAC AS4A-SC column (Dionex Co.) The eluent was 1.8mM Na_2CO_3/1.7mM $NaHCO_3$, with a flow rate of 2ml/min. Meanwhile, in order to decrease the base conductivity, a suppressor was set onto IC under these IC analyzer conditions, the retention time for Cl^-, NO_3^-, SO_4^{2-} are 2, 4.1, and 8.4 min, respectively. The cationic ions were detected by an IONPAC CS12 column (Dionex Co.) with 20mM MSA eluent and a flow rate of 2ml/min. Both columns used a conductivity detector. The retention times for Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+} are 4.1, 4.8, 6.1, 7.9, and 10.0 min, respectively. The samples were kept frozen at -10°C before analyzing by IC (He et al., 2003).

3. Results and discussion

The average $PM_{2.5}$ mass concentrations in Beijing are higher than other sites for all samplings (fig. 1). The $PM_{2.5}$ mass ranged from 9.84 to 366.88, from 1.82 to 59.22, from 4.31 to 126.40, from 16.93 to 28.04μg/m3 in Beijing, Kyoto, Gwangju and Ulan-Bator, respectively. SO_4^{2-}, NH_4^+ and NO_3^- are three major ion components of $PM_{2.5}$ for all sampling, except one, which shows that SO_4^{2-}, NO_3^- and Na^+ are the first three major components in Kyoto in 05-14 November 2002. The averaged nss-SO_4^{2-}, nss-K^+, and nss-Ca^{2+} calculated from formula reported by Kennish (1994) are given in fig. 2. It can be seen that Beijing have the highest concentrations of nss-SO_4^{2-} for all samplings. Figs. 3a-d give the ratio of eight major water soluble ions of $PM_{2.5}$ in 08/2000, 11/2000, 01/2001 and 11/2002, respectively. Although $PM_{2.5}$ mass are lower in Japan, the ratio of SO_4^{2-} are higher than Beijing and Gwangju in 08/2000, 11/2000 and 11/2002. The relationships between ion concentration and meteorological elements and air mass history are also investigated in the study.

4. Acknowledgement

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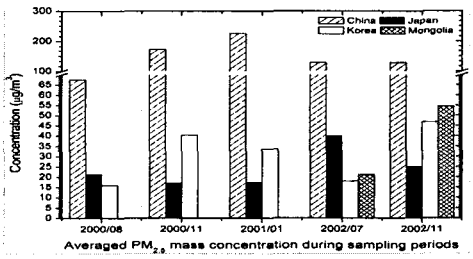

Fig. 1. Averaged $PM_{2.5}$ mass concentration.

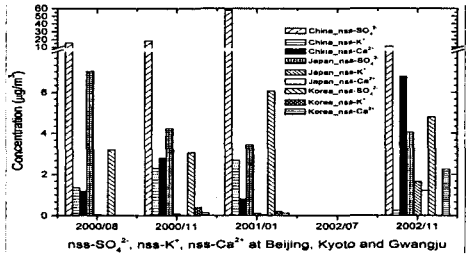

Fig. 2. nss-SO_4^{2-}, nss-K^+ and nss-Ca^{2+} concentration.

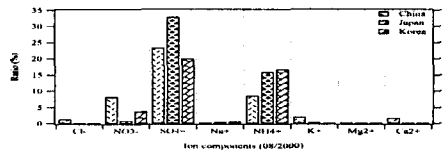

Fig. 3a. Ratio of ion components (08/2000).

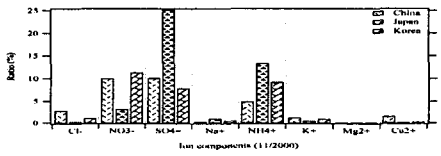

Fig. 3b. Ratio of ion components (11/2000).

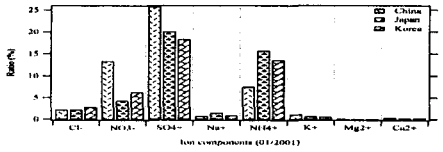

Fig. 3c. Ratio of ion components (01/2001).

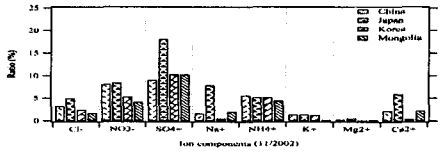

Fig. 3d. Ratio of ion components (11/2002).

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