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대기중의 중금속, 납의 시간적 및 지형적 분포
변이 특성 - 원주시의 도심 및 비도심 지역에서의
관측

Temporal and Geographical Variabilities in
Distribution Characteristics of Heavy Metal,
Lead in Urban and Nonurban Atmospheres of
Won Ju City

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Abstract The distribution characteristics of atmospheric lead in Won Ju City, Kang Won Do measured during February 1991 - August 1995 are discussed . The data consistently indicate the development of concentration gradients across the four sampling sites on the order: grassland (Haeng Goo Dong: HG), residential (Myung Ryoong Dong: MR), commercial (Hak Sung Dong: HS), and industrial (Woo San Dong: WS) sites. In addition to this finding, we have noticed a strong seasonality in measured lead concentrations, regardless of selected study sites: maximal concentrations of a given study site commonly occurred during winter, whilst minimal concentrations were typically observed during summer. The seasonal mean and SD values of atmospheric Pb concentrations, derived from monthly measurements, from each monitoring site fell in the range of 0.027 ± 0.027 (Summer, N=10, HG) to $0.458 \pm 0.455 \text{ mg m}^{-3}$ (Spring, N=11, WS). We suspect that observed seasonalities in atmospheric Pb are regulated by the variabilities in soil dust input.

I. Introduction

The input of a broad spectrum of atmospheric constituents to the earth's environment is already large enough to alter earth's composition and to cause adverse effects on human health. The impact of such input processes, although diluted, is recognized even in the soils and aquifers of remotely located sites (e.g., Kim, K.-H. in prep.). Due to the significant role of atmosphere in transferring pollutants across various reservoirs of the earth's environment, studies of the distribution and behavior of atmospheric pollutants offer unique insights into their environmental cycling and fate.

As a part of a project to monitor the air-quality of local provinces (managed by the Korean Dept. of Environment), heavy metal concentrations of airborne particulates had been measured on a monthly basis from the four sampling sites established in Won Ju City, Kang Won Do (situated in the mid-east of the Korean Peninsula) beginning the year 1991. Selection of the sampling sites were made to facilitate investigations not only of their background levels but also of their geographical gradients at varying source strengths. Although actual measurements were made on a number of species including Pb, Cd, Cr, Cu, Mn, Fe, and Ni, here we report the results of our preliminary analysis made on atmospheric lead concentrations. Results on the other analytes will be reported in the subsequent future publications.

II. Study Sites and Study Periods

To consider geographical variabilities of each measured specie at varying source strengths, the sampling sites were established at the four locations of Won Ju City including: Haeng Goo Dong (referred hereafter as HG), Myung Ryoong Dong (MR), Hak Sung Dong (HS), and Woo San Dong (WS). These sites are representative of grassland, residential, commercial, and industrial areas, respectively. The data collected for the duration of 55 months (periods covering February 1991 to August 1995) are presented and discussed below.

III. Results and Discussion

Seasonal means for each sampling sites were derived after sorting out the data into Spring (March-May), Summer (June-August), Fall (September-November), and Winter (December-February). Results shown in Figure 1 show clear seasonalities in that: 1) the lowest values are found in the summer, 2) the values measured during the fall season is slightly higher than the summer but much lower than winter or spring, and 3) the highest values of Pb concentrations mostly occur during the winter with an exception of the WS sampling site. Despite some patterns merging over time, the data from the four localities show a development of distinctive gradient across HG, MR, HS, and WS. Although values obtained from residential (MR) and commercial (HS) areas are quite comparable, the differences between the grassland area (HG) and industrial area (WS) are considerably large.

As seen by the results of these preliminary work, atmospheric Pb levels measured in Won Ju City are much lower than the maximum allowance level guided by the Korean Department of Environment (1.5 mg m^{-3} as a mean for the three month duration). Observations of generally reduced concentrations of atmospheric Pb (approximately in the range of 0.1-0.2 from most study sites except for WS) indicate that there are no intense sources in the study area that might contribute to the build-up of atmospheric Pb level in the area. The significant temporal variabilities, observed consistently from all monitoring sites, suggest that the trend is real. The relatively high concentrations measured during the spring/winter seasons are likely to be associated with increasing input of high dust during that time of the year (e.g., Yellow sand phenomenon). It was demonstrated previously that most of Pb tend to adsorb on to fine size particles which can be transported over long-distance (Buat-Menrad 1983).

References

Buat-Menrad, P. (1983) Particle geochemistry in the atmosphere and oceans. In Air-Surface Exchange of Gases and Particles (Liss, P. S. and Slinn, W. G. N. eds.), D. Reider Pub.

Figure 1. Seasonal and geographical variabilities of atmospheric Pb in Won Ju City, Kang Won Do during 1991-1995: atmospheric Pb concentrations are expressed in terms of $\mu\text{g m}^{-3}$.

