THE CONCENTRATIONS OF LEAD IN URBAN AND NONURBAN ATMOSPHERES OF WON JU CITY, KOREA

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Abstract. The geographical and temporal distribution patterns of atmospheric lead (Pb) were investigated using the data acquired from four sampling locations in Won Ju City, Kang Won Do, Korea (February 1991 to August 1995). The monthly atmospheric Pb concentrations of four study sites were found in the range of 0.005–0.250 (site #1: grassland, N=47), 0.013–0.405 (site #2: residential, N=53), 0.004–0.420 (site #3: commercial, N=50), and 0.004–1.881 μg m⁻³ (site #4: industrial, N=52). From all four sampling stations, maximum concentrations of Pb commonly occurred during winter, whilst minimum concentrations were typically observed during summer. Although seasonal differences in meteorological conditions are important to explain such temporal distribution trends, the increase in Pb levels during the spring season, especially during the month of April appears to reflect the influence of soil dust evasion from China. While Pb distributions were strongly affected by seasonality, examination of inter-annual variation trends revealed that the Pb levels had been gradually decreasing over the study periods and that such phenomenon was ubiquitous throughout all the study sites. The annual decrease rates of Pb, computed from the regression analysis, spanned from –0.014 (grassland) to –0.055 μg m⁻³ yr⁻¹ (industrial). The existence of strong geographical variabilities was also confirmed by the development of a concentration gradient across the four sampling sites on the order: industrial (0.326±0.307, N=52) >> commercial (0.157±0.104, N=50) > residential (0.149±0.102, N=53) > grassland (0.088±0.060, N=47). A series of statistical analysis on the data sets in concert with computation of Pb/Fe elemental ratios indicate that the industrial sources may not directly be influencing the Pb levels of the other studied sites. Albeit changes in its long-term distribution trends, the data collected from this study confirm that atmospheric Pb may be classified as a group of constituents whose distribution is rather predictable spatiotemporally due both to: (1) strong repetitiveness of seasonal distribution trends and (2) relative spatial homogeneities that are associated with its unique physicochemical properties.

Key words: atmosphere, Korea, lead, Pb/Fe ratio, urban/nonurban

1. 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. Many toxic metals are emitted to the earth’s atmosphere as a result of both natural and anthropogenic processes. In general, the intensities of both sources are expected to be comparable to each other for most metals of environmental interests. However, enhanced role of anthropogenic emissions has already been confirmed for several metals including Pb, Cd, V, Hg, and Zn (Nriagu, 1992). The on-going human perturbations, while altering the biogeochemical cycles

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of those metals, are posing potential threats to the earth's biota in both terrestrial and aquatic ecosystems.

The impact of such perturbations is already widespread throughout the world, but their intensities are more pronounced in the Northern Hemisphere (NH) due to denser industrial activities (Slemr and Langer, 1992). As a consequence, the database of environmental pollutants is relatively well established from not only urban but also nonurban atmospheres of the NH including western Europe and North America. Yet efforts to compile the distribution behavior of such harmful substances are extremely scarce in other parts of the NH including the far east Asia. In light of the rapidity with which industrialization proceeds in those regions of the world, extension of databases to accurately reflect their relative importance is thought to be of urgent task.

As part of an overall project to monitor the air-quality of local provinces in Korea (managed by the Korean Ministry of Environment (MOE), heavy metal