

Lead, copper and zinc in atmospheric and fluvial particulates from the Caracas Valley, Venezuela

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Abstract

The atmospheric particulates from the Caracas Valley in Venezuela and the fluvial particulates transported by the Tuy River into the Caribbean sea have been evaluated for Pb, Cu and Zn with the purpose of determining the contamination levels in the study area. The atmospheric particulate samples were collected in the city of Caracas using a low volume sampler whereas the fluvial particulate were collected at the mouth of the Tuy River. The particulate samples were analysed by flame or graphite furnace atomic absorption spectrometry depending upon the concentration levels of the heavy metal under study.

The results obtained for the fluvial particulates enabled estimates to be made of the total anthropogenic flux of Cu (383 ton year⁻¹), Pb (528 ton year⁻¹) and Zn (865 ton year⁻¹). These results yield annual per capita inputs for Cu (96 g), Pb (132 g) and Zn (216 g) which greatly exceed those from global anthropogenic emissions. The weighted average concentration of Pb (1.13 %) found in the atmospheric particulates was much higher than those for Cu (140 mg kg⁻¹) and Zn (200 mg kg⁻¹) and reflects the high motor car traffic in the Caracas Valley. The anthropogenic/natural ratios estimated in this study were as follows: 2.6 for Pb; 1.5 for Cu and 1.5 for Zn. This indicates that anthropogenic inputs for Cu, Pb, and Zn in the study area exceed those from natural sources, cars being the major source for Pb and industrial activities the major sources for Cu and Zn.

Introduction

The quantity and distribution of heavy metals in air, water, sediments, soils and biological materials have notably increased in the last decades due to human activities (Förstner and Wittmann, 1983; Salomons and Förstner, 1984; Warren, 1981). This anthropogenic input of heavy metals to the environment may surpass the natural fluxes and produce significant change in global biogeochemical cycles.

The urban development, growing industrialisation and the discharge of gaseous, liquid and solid wastes into the environment without treatment, have been the main reasons for the degree of contamination that exists in the developing countries (Ajmal *et al.*, 1987; Kouadio and Trefry, 1987; De Lacerda *et al.*, 1987; Romieu *et al.*, 1991).

Venezuela has also experienced a high demographic expansion, especially in the north where a high degree of pollution has been reported for Lake Maracaibo (Parra, 1979), Lake Valencia

(Lewis and Weibezhan, 1983; Mogollón *et al.*, 1988), Tuy River (Humphreys, 1975; Mogollón *et al.*, 1987, 1990; Ramirez, 1991; Ramirez *et al.*, 1988; Taboada and Garcia, 1978), Coastal areas (Gamboa and Bonilla, 1983; Mogollón, 1989) and Caracas City (Ishizaki and Sanhueza, 1979; Sanhueza *et al.*, 1979; Lara *et al.*, 1984)

Caracas, the capital and largest Venezuelan city, is located in the northwestern part of the Tuy River basin and it is the major source of pollutants into the Tuy River. This study is mainly concerned with the atmospheric particulates in the Caracas Valley and the fluvial particulates transported by the Tuy River into the Caribbean sea. The objectives of this study are: (1) to evaluate the concentrations of Pb, Cu and Zn in the atmospheric particulates; (2) to estimate the annual anthropogenic fluxes of Pb, Cu and Zn out of the basin; (3) to compare the anthropogenic to the natural sources and in addition, to compare the influence of cars to other identified anthropogenic sources.