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The geochemistry of Seine River Basin particulate matter: distribution of an integrated metal pollution index

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Abstract

Spatial analysis (1994–2001) and temporal trends (1980–2000) for particulate-associated metals at key stations in the Seine River Basin have been determined using a new metal pollution index (MPI). The MPI is based on the concentrations of Cd, Cu, Hg, Pb and Zn, normalized to calculated background levels estimated for each particulate matter samples for four fractions (clays and other aluminosilicates, carbonates, organic matter, and quartz). Background levels ascribed to each fraction were determined from a specific set of samples collected from relatively pristine areas in the upper Seine basin and validated on prehistoric samples. The unitless MPI is designed to vary between 0 for pristine samples to 100 for the ones extremely impacted by human activities and to assess the trends of general metal contamination and its mapping. Throughout the Seine basin, MPI currently range from 1 to 40, but values exceeding 100 have been found in periurban streams and the Eure tributary. Based on the MPI spatial distribution, the Seine River Basin displays a wide range of anthropogenic impacts linked to variations in population density, stream order, wastewater discharges and industrial activities. Correlations between the MPI and other trace elements indicate that anthropogenic impacts also strongly affect the concentrations of Ag, Sb, and P, marginally affect the concentrations of Ba, Ni, and Cr, and appear to have little effect on the concentrations of Li, Be, V, Co, and the major elements. Temporal MPI trends can also be reconstituted from past regulatory surveys. In the early 1980s, MPI were 2–5 times higher than nowadays at most locations, particularly downstream of Greater Paris where it reached levels as high as 250 (now 40), a value characteristic of present Paris urban sewage. The exceptional contamination of the Seine basin is gradually improving over the last 20 years but remains very high.

Keywords: Heavy metals; Contamination; Seine basin; Flood plain deposits; Metal pollution index

1. Introduction

The major goals of many water quality surveys are to establish spatial and/or temporal trends. Spatial surveys are useful for determining the occurrence and distribution of a variety of chemical constituents, for identifying potential anthropogenic sources, and for assessing the effects of various socioeconomic factors (e.g. changes in population density, in land use or in seasonal changes…). Temporal surveys are useful for delin-

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