



The metallic contamination of the Loire River Basin (France): Spatial and temporal evolution with a multi-scale approach

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Since the early 19th century, important agricultural, mining and industrial development has been active in Western Europe. The Loire River Basin (117,800 km², total population of 8.4 Mp) presents a long history of human pressures, reflecting temporal evolution of technological and urban activities (Grosbois et al, 2012). Hence, sediments of the Loire River and its tributaries have recorded partially and/or totally organic, nutrients and trace element contamination. Nowadays, can we determine history of metallic emissions in sediment records and what is the part of these past inputs relative to the actual contamination? Can we point out historical sources of contamination? To answer these questions, two approaches were used in this study. Firstly, in four coring sites in the Loire River Basin, a temporal re-enacting of metallic contamination trapped in sediments was carried out. Based on age-model and inter-element correlations in each core, trace element signals were deconvoluted and compared to actual and specific chemical signatures of anthropogenic inputs (300 bed sediment samples collected downstream of former and current industrial sites like mines, smelters, planting/coating plants, glassware and car industries, metal recycling plants and waste water treatment plants). The second approach was at a larger basin scale, comparing location of these former and actual contamination sources with explanatory factors such as geology, evolution of population density, of industrial activities and of land use. This was done in the main stream of the Loire River and its major tributaries and locally at a smaller scale (0-500 km²). All these approaches emphasized three temporal periods of metallic contamination: (i) the first period begins with the 20th century until 1950, it corresponds to the first increase of major contaminants like Ag, As, Cd, Cr, Hg, Pb, Sb, Sn and Zn; some trace elements like Hg and Sn seem to be present in the Loire sediments much earlier as they were already enriched before 1900.; (ii) the second one (1950-1980s) represents the highest level of contamination for the cited contaminants above; (iii) the last period is characterized by a large decrease of pollution from 1980s to nowadays when environmental policies and contaminant emission control started. At a spatial scale, small and medium-scale sub-basins, presenting numerous important mining sites and associated industrial plants, are specifically associated to local sources. In contrast, industrial and urban poles are related to polymetallic concentrated bed sediments.