Metallic and organic pollutant (lead and PCB) historical trends as recorded by Rhone river sediments

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Introduction: In fall 2005, fish contamination by dioxin-like PCBs above the threshold for fish consumption was observed in the Rhône River, in the vicinity of Lyon (France). In this collaborative study, we seek to explain the historical sediment distributions of lead and PCBs in sediment cores along a 125 km catchment area upstream and downstream of Lyon in order to evaluate the status of the Rhone river environmental quality according to physical, geochemical and sedimentary analyses carried out on sediment deposited continuously at three sites on the Rhone. The aim is (i) to obtain some insight into sediment processes based on chemical composition, (ii) to document the recent contamination history of lead and PCBs in Rhone sediment to make some inferences on the major sources of toxic contaminants and the influence of watershed management on the concentration of contaminants. Sediment samples were also studied for comparative purposes between fluvial and remote system (Lake Paladru) inputs.

Methods: Short cores (from 52 to 112 cm in length and 60mm diameter) were collected with a UWITEC gravity coring system during May to July 2008 from presumed long-term depositional areas (by-pass reaches and reservoirs) protected from erosion. One half of each core was sub-sampled at 1 cm intervals and analyzed for PCBs (18 congeners) by high resolution capillary gas chromatography, age-dating radionuclides by gamma spectrometry and total lead by atomic adsorption spectrometry. Detailed grain-size distributions were generated from granulometric analysis with a Mastersizer 2000 laser granulometer and the Gradistat software program. This granulometric data were analyzed with a Passega diagram to characterize the nature of the sediment and deposition processes.

Results: Many interesting observations can be drawn regarding the transport and the sediment storage of contaminants in this important fluvial system. An upstream to downstream gradient is seen for Pb and PCBs (fig. 1), indicating a multiple contamination in the Rhone, and reflecting a regional contribution associated both with the presence of industrial complexes, including those treating PCBs, and with the city of Lyon. This gradient is the result of the combination of numerous and intermittent point and diffuse sources in the Rhone river basin. The floods caused a distinct increase in PCBs concentration due to washing out from land and riverbeds and subsequent transfer of large amounts of PCBs by rivers to the Rhone River.

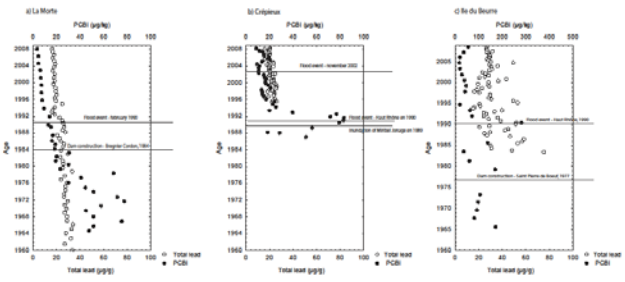

Figure 1: Total lead and PCBi historical trends

Discussion: This study demonstrates the occurrence of a tight connection between the sedimentary dynamic past and present and the levels of contamination in the sediment record.

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