Multi-isotopic monitoring of industrial metal emissions (Cu-Zn-Pb) within the Loire River Basin, France

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The Loire River in Central France is approximately 1010 km long and drains an area of 117 800 km^2. Upstream, the Loire river flows south to north from the Massif Central to the city of Orléans, 650 km from its source. The Loire River is one of the main European riverine inputs to the Atlantic Ocean.

We have chosen to analyze the isotope composition of copper (Cu), zinc (Zn) and lead (Pb), because many compagnies and industries such as nuclear power plants, food processing industries release directly in the Loire liquid effluents that are very rich in Cu, Zn and Pb (several hundreds of tons per year). Industrial sources responsible for the release of Cu-Zn-Pb within the Loire basin were sampled and analysed for their concentrations and corresponding isotope compositions. We also analyzed river waters (upstream to downstream) and suspended solids samples.

Cu-Zn-Pb isotope compositions were measured using a Neptune MC-ICPMS at the BRGM. In order to analyse Cu and Zn, we carried out a two-steps analytical development: 1) a chromatographic separation, followed by 2) analysis on the MC-ICPMS.

The first results for Zn and Pb isotopes in dissolved load show a very homogeneous Pb and Zn signature from upstream to downstream (0.2 variations in $^{206}Pb/^{204}Pb$ ratio and 0.15‰ in $\delta^{66}Zn/^{64}Zn$ value). Moreover, the Pb isotopic signature is close to geogenic domain. For Zn, the characterization of the geogenic signature is in progress. These results suggest the absence of substantial anthropic pollution in the Loire river waters. On the contrary, preliminary measurements on suspended matter suggest a more substantive anthropic contribution. Noteworthy, suspended matter is known to play a significant role in the riverine transport of heavy metals. As a consequence, precise studies of the interaction between the suspended and dissolved load will be necessary to assess the importance of the anthropic input within the Loire river.