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**Pb-Zn-Cd-Hg multi isotopic  
characterization of 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<sup>2</sup>. Upstream, the Loire river flows following a south to north direction from the Massif Central down 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. Over time, its basin has been exposed to numerous sources of anthropogenic metal pollutions, such as metal mining, food industry, agriculture and domestic inputs. The Loire River basin is thus an excellent study site to develop new isotope systematics for tracking anthropogenic sources of metal pollutions.

We have chosen to analyze the isotope composition of cadmium (Cd), zinc (Zn), mercury (Hg) and lead (Pb). These heavy metals have been chosen for their toxicity, even at low levels, to humans. The main goal of this study is to characterize 1) the sources and behavior of these heavy metals in the aquatic environment, and 2) their spatial distribution using a multi-isotope approach. Sources responsible for the release of Pb-Zn-Cd-Hg in the Loire basin were sampled and analysed for their concentrations and corresponding isotope compositions. We also analyzed river waters and suspended solids samples, known to play an important role in the transport of heavy metals through river systems. Biota samples (mussels, oysters), as natural accumulators of metal pollutants, were also analyzed.

All trace elements were analysed in the BRGM laboratories using a Q-ICPMS. Pb-Zn-Cd isotope compositions were measured using a Neptune MC-ICPMS at the BRGM. Hg isotope compositions were measured at the U. of Illinois using a Nu Plasma MC-ICPMS. To analyse Zn and Cd, we carried out a two-steps analytical development: 1) a chromatographic separation, followed by 2) analysis on the MC-ICPMS.

The results showed that, on their own, each of these isotope systematics reveals important information about the geogenic or anthropogenic origin of these metals. Considered together, they are however providing a more integrated understanding of the overall budgets of these pollutants at the scale of the Loire River Basin.