

# Multi isotope characterization (Pb-Zn-Cd-Hg) of the suspended sediments from the Loire River Basin, France

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**Introduction:** The impact of human activities such as industries, agriculture and domestic inputs, becomes more and more significant on the chemical composition (major ions and pollutants including metals) of the dissolved load of rivers in addition with natural inputs [1, 2]. Furthermore, this influence can also be evidenced in the suspended solid matter known to play a major role in the transport of heavy metals through river systems. Human factors act as an additional key process. Therefore the mass-balance for the budget of catchments and river basins includes anthropogenic disturbances.



**Fig. 1:** Sketch of the ISOP Research Project illustrating the various sources for metals in a river basin.

**Loire River Basin:** 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 originating in the Massif Central, and continues up to the city of Orléans, 650 km down from the source. In the upper basin, the bedrock is old plutonic rock overlaid by much younger volcanic rocks. The Loire River then follows a general east to west direction down to the Atlantic Ocean. The intermediate basin includes three major tributaries flowing into the Loire River from the left bank: the Cher, the Indre and the Vienne rivers; the main stream flows westward and its valley stretches toward the Atlantic Ocean. Here, the Loire River drains the sedimentary series of the Paris Basin, mainly carbonate deposits. The lower Loire basin drains the pre-Mesozoic basement of the Armorican Massif and its overlying Mesozoic to

Cenozoic sedimentary deposits. The Loire River is one of the main European riverine inputs to the Atlantic ocean.

**Methods:** the aim of this work is to document the sediment sources at the Loire catchment scale in complement of previous studies on isotope tracing in sediments [3, 4]. Isotopic compositions are measured after sample preparation (acid digestion and specific matrix purification) in river suspended sediments for Pb-Zn-Cd using a Neptune MC-ICP-MS at the BRGM and using a Nu Plasma MC-ICP-MS at the University of Illinois for Hg isotopes.

In addition, we also determined Sr isotopic ratios in these samples by TIMS, because  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios are a good tracer of the origin of sediments.

**Results:** Here we are reporting concentrations and isotope data for heavy metals Zn-Cd-Pb-Hg in suspended sediments from the Loire River Basin. In addition, we are also reporting concentration and isotope data for these metals for the different industrial and agricultural sources within the Loire Basin.

The main objective of this study is to characterize the sources and the behavior of these heavy metals in the aquatic environment, and their spatial distribution using a multi-isotope approach.

Each of these isotope systematics on their own reveals important information about their geogenic or anthropogenic origin but, considered together, provide a more integrated understanding of the budgets of these pollutants within the Loire River Basin.

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**References:** [1] Meybeck et al. (2004) *Sci. Total Environ.* **328**:219-236; [2] Millot et al. (2004) *Chem. Geol.* **203**:75-90; [3] Négrel and Grosbois (1999) *Chem. Geol.* **156**:213-249; [4] Négrel and Petelet-Giraud (2012) *App. Geochem.* **27**:2019-2030.