

Identifying the anthropogenic sources in river sediments with Zn and Pb isotope signatures: a case study in northeast France

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The Orne River is a tributary of Moselle River in the northeastern part of France, which has been strongly modified by steel-making facilities and associated urbanization. As a heritage of the past steel activities, the river displays several dams that were built for blast furnace cooling purpose. Those dams enhance the deposition of highly contaminated material in the riverbed and despite a river dredging in late 1980's, several spots of steel-making waste are still present in the vicinity of the dams. Those sediment deposits, as deep as 1.3 m in some places, contain high content of Fe, Zn and Pb. In order to follow the eventual re-suspension of those sediments in the water column, a multi-marker study was performed, including the determination of Zn and Pb isotopic fingerprints.

This study aims to (i) determine the Zn and Pb isotopic signatures of two dam front river sediment cores and suspended particles (SPM) along the river; (ii) establish the Zn and Pb isotope signatures of local anthropogenic and natural sources; (iii) assess the anthropogenic input sources with the isotope signatures as indicators.

The $\delta^{66}\text{Zn}_{\text{IRMM-3702}}$ values of the river sediments and SPM were shown to range from -0.12 to 1.36 ‰ and -0.12 to -0.05 ‰, respectively, while the $^{206}\text{Pb}/^{204}\text{Pb}$ ratio ranges between 18.326 and 18.690 for river sediments and from 18.370 to 18.609 for SPM. Within both cores, the isotope signatures suggest different source origins, including tailings, slag and atmospheric deposition. In the bottom 50 cm of the down stream core, the distinctive isotope signatures highlight one more source coming from past activities. Comparing the SPM signatures to the surface sediments show the potential of using isotopic tools to follow sediment re-suspension in the river.