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Assessment of Pb and Zn sources in the Orne watershed (Moselle basin, France) using isotopes and geochemical tracers

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In continental waters, Zn and Pb are common tracers of human activities and human land use. In the Orne watershed, a tributary of the Moselle River, France, those metals were used to follow the spatio-temporal evolution of water quality. This small river course is highly impacted by past industrial activities (ex: mining and steel-making activities) and urbanization. This study is part of a research project aiming at qualify and quantify the resuspension-settling phenomenon and identify the global impact on water column composition. Suspended particulate matter (SPM) is brought to riverine water by weathering of soils, sewer network discharge, urban surface run-off and sediment re-suspension influenced by discharge variations. In the riverine basin, SPM integrates both natural and anthropogenic sources. SPM plays a major role in the transport and fate of these micro-pollutants. The purpose of this work is to (1) identify the different sources of SPM (2) study the behavior of SPM during flood events. In order to reach this aim, Zn and Pb concentrations and isotopes in the SPM have been assessed as fingerprint tools. SPM flow is predominant during flood events, then our sampling focused on flooding events with a relatively high frequency of SPM collection.

Our results indicate that Zn and Pb concentrations range from 177 to 1814 mg/kg and from 30 to 532 mg/kg respectively. The $\delta^{66}Zn$ and $^{206}Pb/^{204}Pb$ isotope ratios range from -0.77 to 0.26 ‰ and 18.11 to 18.65 respectively. On one hand, we could evidence a clear decrease of $^{206}Pb/^{204}Pb$ with water flow increase, resulting of dilution phenomenon. On the other hand Zn concentrations and isotopic signature displayed relatively more complex trends with the variations of river discharge. Zn data were put against supplementary data (water global parameters, anions concentrations, $\delta^{18}O$...) to unravel the different sources of Zn in SPM. Both Zn and Pb isotope signatures values mainly reflect different SPM sources, that include natural and anthropogenic contributions. The latter is not unique and indicates different kinds of human activities.