Geophysical Research Abstracts
Vol. 20, EGU2018-18998, 2018
EGU General Assembly 2018
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Using metal isotopes (Zn, Pb & Cu) to track anthropic pollutants on a watershed scale

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With the aim to identify and quantify the processes that govern the evolution of the Critical Zone, it is crucial to understand and document the impacts caused by human activities on the surficial environment. Zinc (Zn), copper (Cu) and lead (Pb) are widespread present in hydrological systems within the Critical Zone and they are important anthropic pollutants in continental aquatic settings. The goal of this study is to use the Cu-Zn-Pb multi-isotopic signature to track the pollutions in surface water, and to understand the complex processes causing the metals mobilization and transport in environment. As case study, we chose a small and poorly urbanized watershed situated in the Loire river basin (France). The river's spring is located in a pristine area, while it is only impacted some kilometers further by liquid effluents coming from a Waste Water Treatment Plant and more further down by diffuse pollution from the road traffic. A sampling of the liquid effluents as well as dissolved load and sediments from upstream to downstream was realized. For dissolved load, a "grab" sampling and an integrated sampling using passive samplers DGT were carried. The labile fraction of sediments was also investigated. Isotopic ratios were measured using a MC-ICPMS at the BRGM, after a protocol of purification. The Pb, Cu and Zn isotopic analyses of sediments and dissolved load showed the contribution of anthropogenic pollution in these natural samples. The Cu and Zn isotopic compositions of the labile sediment fraction allowed to highlight the physico-chemical processes which take place from upstream to downstream in the river (precipitation, dissolution, etc.).