Multi-isotopic approach to study Rare Earth Element contamination in river during flood events

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Recent human activities are disrupting the biogeochemical cycle of REE and enrichments of various anthropogenic REE (AREE) are detectable in contaminated river waters. There is a pressing need for an adequate quantification of the temporal anthropogenic impacts on rivers. Filling these knowledge gaps is a pre-requisite for the design and implementation of sustainable water resources management strategies.

Here, we focus at the identification and quantification of the contributions of geogenic and anthropogenic sources of REE using $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, $^{206}Pb/^{207}Pb$ isotopic ratios during flood events. The use of these three separate isotopic systems together with REE concentrations is new in the field of anthropogenic source identification in river systems. Our water sampling protocols have been carried out in the mesoscale Alzette River basin in Luxembourg and cover a wide range of contrasted hydrological states. Through this innovative approach, we aim at identifying micropollutant dynamics and impacts in polluted water bodies in an industrialized river basin. Additionally, we combine this quantification with knowledge on fundamental hydrological functions of catchments, i.e. water collection, storage, mixing and release. This knowledge is generated through dynamic storage calculations on the one hand and the analysis of temporal series of $\delta^{18}O$ and δD isotopic ratios on the other hand.

Our results indicate that the radiogenic Sr-Nd-Pb isotope complex is a powerful tool for the reduction of the estimation uncertainty in the micropollutant source identification under any given hydrological condition – characterized by prevailing hydrological states (i.e. dynamic storage). Linking micropollutant source information to catchment storage dynamics delivers fundamental information on anthropogenic impacts in polluted river systems subject to changing conditions and allow determining the short term resilience to pollution of water bodies at river basin scale.