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Reconstruction of Metal Enrichment in Continental Hydrosystems Through Mineralogical and Geochemical Analysis of Bank Sediments: The Case of the Upper Rhine

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Human activities have directly or indirectly released metals into rivers, with intensities increasing since the 19th century. These discharges have resulted in metal concentrations in various compartments of continental hydrosystems that, for some metals (Pb, Cu, etc.), can reach critical values for human health and ecosystems. Regulatory measures have been implemented in the last decades to reduce and limit the impact of these discharges on the environment. Beyond environmental monitoring, which is generally limited in space and time, it is often difficult to assess the impact and response time of these measures on metal concentrations in hydrosystems. Within the framework of Cassandra Euzen's PhD (Euzen, 2023; Euzen et al., 2024, 2025), we proposed using fluvial sediment deposits to reconstruct the evolution of metal concentrations in the sediments of the Rhine over the past decades. These concentrations can be considered as a first proxy for the metal concentrations in the Rhine hydrosystem. Several sedimentary sequences were sampled in overbank sediments of the Upper Rhine between Basel and Strasbourg and dated using the still underdeveloped combination of ^{137}Cs-^{210}Pb chronometric approaches, luminescence methods, old maps and hydrological data (Euzen et al. 2024). The mineralogical and geochemical analysis of these deposits allows for evaluating the evolution of metal concentrations in these sediments over the past 100 years. Our results highlight the utility of these approaches in reconstructing the temporal evolution of river metals as well as assessing their application limits, at least partly related to the grain-size variability of the sediments. Nevertheless, these approaches provide new information on the evolution of Pb, Cu, Zn, and Sn concentrations in the Upper Rhine over the past decades and allow for discussing their origin (Euzen et al. 2025).

References : Euzen, C. (2023) Reconstruction spatio-temporelle des dépôts métalliques le long d'un hydrosystème fluvial fortement anthropisé. [PhD Thesis Strasbourg University, France]. https://theses.fr/s270912 - Euzen, C., et al. (2024). Quaternary Geochronology, 83, 101561. https://doi.org/10.1016/j.quageo.2024.10156. - Euzen, C. et al. (2025) Science of Total Environment 967 - 178678