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Trajectories of legacy and emerging metal contaminants in French river sediments

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Trace metals and metalloids (TMMs) are substances disseminated in the critical zone (CZ) as a result of *i.* mechanical erosion processes or chemical alteration of bedrocks and uncontaminated soils, and *ii.* releases from multiple sources related to anthropogenic activities during several millennia. In rivers, legacy and emerging TMMs, including Rare Earth Elements (REEs), are predominantly or partially adsorbed on suspended particulate matter. Therefore, riverine transport of natural and anthropogenic TMMs depends on hydraulic conditions, and storage occurs in depositional zones (e.g. reservoirs, floodplains, ponds). As rivers are the receptacle for many substances released into the CZ, analysing temporal trends of TMMs in dated sediment cores can reflect the trajectory of contaminant pressure in watersheds, as sediments are considered as testimonies of past and current anthropogenic activities, and may provide information about the potential future impacts of emerging pollutants.

This study aims at establishing regional geochemical backgrounds (RGB) and the trajectories of legacy and emerging TMMs in dated sediment cores at the outlets of the main French river watersheds (Rhône, Loire, Eure-Seine, Lot-Garonne). These investigations are supported by temporal TMM and REE trends in watersheds characterized by contrasting geological features. Preliminary results showed that mean REE concentrations are approximatively twice higher in sediment deposits collected in the Loire River than in the Seine and Rhone Rivers for which mean REE contents are relatively similar. Moreover, European Shale (EUS)-normalized concentrations of REEs highlighted positive anomalies of light- and medium-REEs as Cerium (Ce), Samarium (Sm), and Europium (Eu). These anomalies determined in the Rhône and Loire Rivers, and in the Eure-Seine continuum have not been systematically measured in the most recent deposits as expected. As REE anomalies are not exclusively due to anthropogenic signals, but may also derive from lithology (calcareous versus crystalline rocks) and biogeochemical processes, it appears essential to discriminate the contributions of anthropogenic signals and RGB to total concentrations. Based on these results, we discuss the potential of increasingly used Technology-Critical Elements (TCEs), recorded in sediment archives, as markers of the beginning of the 4^{th} industrial revolution.