Multi-isotope tracers of human impact on anthropophile elements in river systems

JIU BIN CHEN[12], JEROME GAILLARDET[2], VINCENT BUSIGNY[2], JULIEN BOUCHEZ[2], PASCALE LOUVAT[2] AND YI NA WANG[1]

[1]Institute of Geochemistry, CAS, Guiyang 550002, China.
[2]Institut de Physique du Globe de Paris (IPGP), 75252 Paris, France.

River transport accounts for up to 90% of the flux of material delivered to the oceans mainly in suspended particulate phase highlights the importance of river-suspended sediments when studying the global biogeochemical cycles of elements. However, little is known about “anthropophile” elements and their isotopes in rivers strongly impacted by human activities.

Anthropophile elements Zinc, Iron and Copper are essential for terrestrial and oceanic organisms. Supply changes in continental rivers may affect their global bio-geochemical cycles and even the related metamorphic activities of aquatic organisms. It is thus essential to precisely determine the sources of these metals in river systems and the variations of fluxes of these metals input by human activities and to the ocean in modern environment. Multi isotopes may provide more precise picture of anthropogenic impact on geochemistry and the fluxes of these elements in rivers.

We report multiple isotopic compositions in both dissolved and suspended loads of the anthropogenically impacted Seine River (France). The concentrations and isotope compositions of these metals, together with major and trace element concentrations, were measured for a wide sample sets including a geographic transect, a temporal series and an anthropogenic sample series. Our data show that the concentrations of these metals in SPM clearly increase downstream, and are strongly controlled by hydrodynamic condition, while their isotope compositions show a decrease. Calculation of enrichment factor relative to natural background points to an important anthropogenic input of these metals. This input could be traced by combining multiple isotopic data with the geochemistry of other major and trace elements. Taken as a whole, though Zn, Fe and Cu concentrations correlate very well, Cu displays different isotopic trends compared to those of Zn and Fe. Our study demonstrated the importance of multi-isotopes in studying the anthropogenic contribution and characterizing the geochemical behaviors of heavy metals in river systems.