

Sources and dynamics of trace metals in an urban river under geogenic and anthropogenic influences: the Jalle River (Bordeaux Metropole, France)

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The aquatic ecosystems of industrialized countries are confronted to different degrees by anthropogenic pressures that generate metal pollution, particularly in urban areas. This study is based on hydrogeochemical monitoring of trace metals (TMs), including Rare Earth Elements (REEs), Al and Fe in dissolved and particulate phases (n=35) over a 2 year period at the outlet of the Jalle River (330 km²), that drains Bordeaux Metropole (France), discharging directly into the Gironde Estuary. This monitoring was supplemented by intermittent sampling on 4 sites to characterize the upstream catchment as well as effluents from a wastewater treatment plant (WWTP) and runoff from the outlet of the stormwater collector draining the Northern part of Bordeaux Highway (NBH). The objectives of this study were to analyze the spatio-temporal variability of concentrations, to identify controlling factors and to evaluate the contribution of different sources to the fluxes exported by the Jalle River. We demonstrated that the upstream watershed strongly influences the geochemical composition of the Jalle waters for many TMs (e.g. Al-Fe-REEs) and that it contributes the bulk of dissolved TM inputs (e.g. >95% for Al and REEs except Gd [71%]) excepting Cu_d-Zn_d-Mo_d-Ag_d-Sn_d. The effluents from the WWTP affect the quality of the Jalle waters by significantly increasing Gd_d-Cu_d-Mo_d-Ag_d-Sn_d concentrations and by contributing between 25% (Gd) and 50% (Sn) to exported fluxes. The runoff from the NBH (excluding major storm events) influences the Jalle River only more intermittently with regard to Sb_d-Cu_d-Zn_d concentrations and is thought to represent respectively 16, 24 and 34% of input into the Jalle River. Anthropogenic loads does not seem to affect the particulate TM concentrations of the Jalle River, contrary to observations made during a major storm event analyzed with high temporal resolution. Such a difference could be explained by the sampling strategy put in place for this monitoring operation which i) would not take account of non-treated, bypass WWTP water discharge during major storm episodes, where the particulate TM removal are low and ii) would underestimate particulate emissions during storms which are mostly transmitted during the first flush of the event.