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Trace metals reactivity during resuspension of river sediment: a source of contamination spread

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In the tropics, illegal gold mining amplifies the dismantling of laterite profiles that may contain trace metals (TM) such as Cr, As, V, or Pb and generates a massive transfer of eroded particles to downstream rivers. The fate of trace metals strongly depends on processes only visible during episodic resuspension of river sediment by flooding. These events drastically modify physicochemical conditions (redox, pH) leading to the release or trapping of trace elements thanks to the new adsorption/desorption or precipitation/dissolution equilibrium.

This study aims at quantifying the extent of TM remobilisation during resuspension and to identify the main processes involved. Resuspension experiments of 5 grams of sediment in 1 liter of river water for 48 hours were carried out for 30 sediments collected along 450 km of the Maroni and the Mana River (French Guiana). Metal mobility is characterised by two types of incubations: incubations filtered right after mixing of the sediment, which favours the precipitation of mineral phases and unfiltered incubation favouring adsorption/desorption interactions.

Most trace metals show consistent behaviour along the 30 stations with some metals (e.g., Al, Cu, and Ni) presenting only limited variations probably induced by the release of pore water while other metals show important reactivity such as Mn, V, Cr, As and Fe. Manganese and V show a rapid desorption during the first 5 minutes, followed by slow adsorption to the surface of suspended particles that last about 48 hours. The remobilisation of these redox sensitive elements is even higher for sediments from gold-mining creeks showing that it is very important to focus on these contaminated systems.

Hence, locally, the sediments from the Tapanahomy sub-catchment, which drains the east of the neighbouring Suriname, present significant As contamination at 58 µg/g. This is accompanied by a 10-fold increase of dissolved As concentration in the Maroni after the confluence with Tapanahomy. During resuspension, As is affected by slow desorption from the surface of suspended particles over 48 hours, increasing the As concentration up to 0,9 µg/L. This remobilisation may indicate critical As releases in both Tapanahomy and Maroni Rivers and the transfer of illegal-mining related pollution.