# Interplay between As, Sb, Cr and N in argillaceous suspensions under redox oscillating conditions

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Redox conditions ($E_H$), pH, mineralogy and microbial activity affect the mobility and toxicity of arsenic (As), antimony (Sb), chromium (Cr) and nitrogen (N) in soils and sediments. However, biogeochemical cycling of individual redox sensitive elements may also depend on the presence of other compounds. Here, we examine the interplay between toxic compounds ($HAsO_4^{2-}$, $Sb(OH)_6^-$, and $CrO_4^{2-}$) and nutrients ($NO_3^-$ and $O_2$) in an argillaceous suspension of the Tégulines clay. The suspension was exposed to redox oscillations in the presence of (a) the indigenous microbial community, (b) an amended soil microbial inoculum, (c) labile organic carbon (ethanol), and (d) microbial inhibitors.

The results show that in the clay suspensions aqueous contaminant concentrations did not oscillate during the oxic/anoxic cycles in contrast to similar experiments conducted in Fe and Mn-rich soils [1]. All compounds were reduced under anoxic conditions but were not re-oxidized under oxic conditions. We hypothesize that the mineralogy and microbiota of the Tégulines clay do not stimulate microbial processes controlling contaminant re-oxidation and mobility coupled to Fe and Mn cycling. Instead, direct microbial processes, such as reductive respiration and reductive detoxification, play a major role in the immobilization of Sb and Cr; whereas, reduced As remains in the solution of the argillaceous suspension.

We show that depending on microbial activity and diversity the interplay between coexisting contaminants and nutrients may differ. Contaminants inhibit each other's reduction when acting as terminal electron acceptors in microbial respiration implying successive reduction in the order: $O_2 > CrO_4^{2-} > NO_3^- > HAsO_4^{2-} > Sb(OH)_6^-$. Alternatively, aerobic ($O_2$) or anaerobic ($NO_3^-$) reductive respiration can be concurrent with multiple reductive detoxifications: $O_2 > NO_3^- | CrO_4^{2-} / HAsO_4^{2-} / Sb(OH)_6^-$.

[1] Couture, R.-M *et al.* (2015) *ES&T* **49**, 3015–3023.