Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.5735

USING REDOX-STAT BIOREACTORS TO ELUCIDATE MECHANISMS OF Sb MOBILIZATION IN CONTAMINATED SHOOTING RANGE SOILS

LARA CARDOSO COSTA[1], ROLF KEISER[2], MORITZ F. LEHMANN[3], CHRISTINE ALEWELL[3] AND MARKUS LENZ[1]

[1]Institute for Ecopreneurship, School of Life Sciences, University of Applied Sciences and Arts Northwestern Switzerland (FHNW)

[2]ARMASUISSE Competence Center Soil

[3]University of Basel

Presenting Author: lara.dacosta@fhnw.ch

Switzerland has around 4000 shooting ranges polluted sites. Overall, an estimated 25 tons of ammunition - associated Sb and 200 tons of Pb are shot every year. Whereas Pb contamination can be managed by lime or phosphate addition, Sb leaching from soils into ground and surface waters represents an environmental problem. However, mechanisms leading to Sb leaching are not fully understood.

In contrast to trivalent Sb (antimonite), pentavalent Sb (antimonate) has a moderate affinity to sorb to soil Fe and Mn hydr(oxides). During water logging, soils can become anoxic, favoring reductive dissolution of Fe and Mn phases, mobilizing sorbed antimonate. However, moderately reducing conditions are also conducive to the microbial reduction of antimonate to antimonite, aiding the adsorption-driven sequestration of Sb. The interplay and balance between multiple reductive reactions thus ultimately controls Sb mobility [1]. Since several redox reactions can occur simultaneously it is difficult to assess their individual contribution to Sb fate.

Continuous-stirred-tank bioreactors were operated as “redox-stats” to elucidate individually the contribution of reductive processes in shooting range soils. [2] More specifically, the redox potential was set to $\geq$ 450 mV which made Fe and Sb reduction not thermodynamically favoured and thus allowed us to quantify the impact of Mn reduction on Sb mobilization. Sb speciation was accessed by LC – ICP – MS, whereas total dissolved metal (Sb, Pb, Mn, Fe) concentrations were measured by ICP-MS. Dissolved organic matter (DOM) was determined by TOC analysis. Ultimately, Sb and Pb mobilization were correlated to dissolved Mn, Fe and DOM. A sequential extraction of soil was performed at the beginning and upon termination of the experiment to assess metal bioavailability. Preliminary results underscore clear links between Sb and Mn hydr(oxide) reductive dissolution, while suggesting a minor/subordinated role of Fe.

[1] K. Hockmann, M. Lenz, S. Tandy, M. Nachtegaal, M. Janousch, and R. Schulin, “Release of antimony from contaminated soil induced by redox changes,” *J. Hazard. Mater.*, 2014, doi: 10.1016/j.jhazmat.2014.04.065.

[2] L. Rajpert, A. Schäffer, and M. Lenz, “Redox-stat bioreactors for elucidating mobilisation mechanisms of trace elements: an example of As-contaminated mining soils,” *Appl. Microbiol. Biotechnol.*, 2018, doi: 10.1007/s00253-018-9165-4.