Attenuation of lead and antimony in shooting range soils by iron amendments using simulated rainwater and soil columns

A. J. BARKER[1*], T. A. DOUGLAS[2] AND T. P. TRAINOR[1]

[1]Department of Chemistry and Biochemistry, University of Alaska Fairbanks, Fairbanks, AK, 99775, USA (*correspondence: ajbarker@alaska.edu)

[2]U.S. Army Cold Regions Research and Engineering Laboratory, Ft. Wainwright, AK, 99703, USA

Lead (Pb) and antimony (Sb) contamination pose a major environmental threat to training land sustainability for areas used by the U.S. Department of Defense (DoD). This is a result of firing excercises that use soil berms as backstops. Fragments of bullets are susceptible to weathering processes in soil environments, leading to the release of metal(loid) species into solution. Pb and Sb are contaminants of interest because they primarily constitute small arms rounds [1]. Pb and Sb are both toxic, and Sb is also a suspected carcinogen [2]. Understanding Pb and Sb speciation and mobility is essential for identifying the potential toxicity of a range soil and for remediating a given site.

As a result, stabilization of metal contaminants is of interest, particularly, what types of substrates have potential to promote the retention of Pb and Sb from migrating off-site. Treating soils with both cationic (Pb) and oxyanionic (Sb) components can be difficult due to enhanced mobility of Sb at circumneutral/high pHs and enhanced mobility of Pb at low pHs [3] [4]. Traditional treatments, such as phosphate or carbonate would not be approprite, however, iron (Fe) has been shown to be a potentially effective sorbent [5].

In this study, we added Fe(II) chloride and nanoscale zero-valent iron (NZVI), in a dispersion, to four types of shooting range berm soils in laboratory soil columns in order to study the effects Fe has on metal attentuation. The columns were flushed with simulated rainwater and monitored using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and synchrotron-based X-ray Absorption Spectroscopy (XAS). We found significant attentuation of Sb by Fe in certain systems, whereas Pb became more mobilized.

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