

Antimony fate and transport in shooting range soils

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Antimony (Sb) is a metalloid often added as a hardening agent to the lead (Pb)-alloyed core of bullets. The firing of bullets and fragmentation in soil represents a major pathway of Sb/Pb release to soil pore waters. While Pb has primarily been the focus of shooting range studies, there is a growing concern that Sb accumulation may pose a serious contamination risk to local soils and waters since Sb is toxic and Sb(III) is also a suspected carcinogen. The present study details the geochemical analyses of newly constructed shooting range test berms that were fired into in a controlled firing event. In addition, Sb speciation was characterized in an older (15+ years) shooting range berm to establish a timeline of oxidation. We found aqueous concentrations of Sb were generally greater than Pb indicating Sb is more mobile despite being present ~2 orders of magnitude less in bullets than Pb. Both Sb(III) and Sb(V) species were initially present in soil solution depending on the type of matrix, but Sb(III) was not observed after 9 months. The primary species present in the weathering crust of deposited bullets fragments was determined to be Sb(V) in octahedral coordination with 5 O and 3 Fe atoms. The results from this study suggest Sb is an emerging inorganic contaminant at shooting ranges and also highlight a natural association of Sb with Fe in soils.