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Enrichment and environmental risk assessment of military-related heavy metals on inner-city shooting range soils in the Berlin Metropolitan Area

Kolja Thestorf[1], Annika Krüger[1,] Mohsen Makki[1]

[1]*Humboldt-Universität zu Berlin, Unter den Linden 6, 10099 Berlin*

Corresponding author: Kolja Thestorf (thestoko@hu-berlin.de)

Abstract (max. 400 words)

Shooting range soils, both for recreational and military purposes, count as hotspots for antimony (Sb), lead (Pb), and copper (Cu) deposition, causing also elevated heavy metal contents in the adjacent areas. These military-related elements may pose increased risks for the environment (soil fauna, plant, groundwater) and human health when inhaled or ingested.

In the Berlin Metropolitan Area (BMA), shooting ranges are severely affected by heavy metal and metalloid (HM) contamination. Thus, investigations on two partly restored former shooting range sites and their surroundings have been carried out in order to show the impact of military-related actions and (sub-)recent restoration efforts on the soils of the abandoned shooting ranges. Pseudo-total HM contents of these areas have been assessed to determine the pollution indices (PI) of top- and subsoil horizons as well as the contamination factors (C_f) of the underlying C horizons.

The soils on the investigated sites display a heterogeneous pattern of natural and anthropogenic soils with anthroturbations up to a depth of 150 cm. Therefore, even some subsoil (B) and C horizons on the former shooting lanes and fields display a significant enrichment of antimony, lead, and copper. Maximum HM values in the topsoils exceed precautionary values by 267 times (Sb), 526 times (Pb), and 35 times (Cu), respectively. Compared to the regional background values (RGB) for sandy topsoils of 0.3 mg kg^{-1} Sb, 15.0 mg kg^{-1} Pb, and 2.0 mg kg^{-1} Cu, these values relate to PI values in the range of 0.17-1782 (Sb), 0.16-1402 (Pb), and 0.32-354 (Cu).

Based on these findings, plant-available soluble HM contents have been determined by EDTA and NH_4NO_3 for assessing mobile HM fractions and show the potential of soil-to-plant and soil-groundwater transfer of these elements.