EGU22-7167
https://doi.org/10.5194/egusphere-egu22-7167
EGU General Assembly 2022

Mineralogy of particles deposited on biomass and in soils from various smelter-polluted sites

Marek Tuhý[1], Vojtěch Ettler[1], Juraj Majzlan[2], and Stefan Kiefer[2]
[1]Institute of Geochemistry, Mineralogy and Mineral Resources, Faculty of Science, Charles University, Prague, Czechia (marek.tuhy@natur.cuni.cz)
[2]Institute of Geosciences, Friedrich-Schiller University, Jena, Germany

For this investigation, biomass and soil samples from several smelter areas in sub-Saharan Africa were used. Grass samples and topsoils were collected in the Tsumeb area in northern Namibia (Cu-smelter, former mine), Selebi-Phikwe in Botswana (Ni-Cu mine and smelter), Luanshya in the Zambian Copperbelt (Cu mine and smelter), and Kabwe in central Zambia (Pb-Zn mine and smelter). Metal(loid)s concentration in soils and grass were generally in the order of hundreds to thousands mg/kg.

The surfaces of all the grass biomass samples contained a variety of geogenic (quartz, carbonates, clay minerals, feldspars) and anthropogenic (usually metal-bearing) particles directly attached to the biomass tissues. These smelter-derived particles are predominantly slag fragments enriched in various contaminants, droplets of metals/sulfides, and, in the case of the biomass from Kabwe, newly formed aggregates of submicrometric anglesite ($PbSO_4$) crystals. Heavy mineral fractions were obtained from all biomass samples to better understand the solid-phase speciation of contaminants. In Tsumeb, the key metal-hosting minerals/phases on biomass were Cu-Fe sulfides, arsenolite (As_2O_3) and metal-bearing slag glass. In Selebi Phikwe pyrrhotite ($Fe_{1-x}S$), pyrite (FeS_2), pentlandite [$(Fe,Ni)_9S_8$] and chalcopyrite ($CuFeS_2$) were predominant. Samples from Kabwe were composed of galena (PbS), pyrite (FeS_2), sphalerite (ZnS), chalcopyrite ($CuFeS_2$) and anglesite ($PbSO_4$) and in Luanshya, the particulates were mainly formed by phases from the Cu-Fe-S ternary system. The mineralogy of particulates collected in the grass samples was similar to that in the corresponding topsoil samples. The knowledge of solid-phase speciation is of key importance for determining the fate of contamination in such environments.

This study was supported by the Czech Science Foundation (GAČR project no. 1-23794J) and a grant from the Endowment Fund of the Faculty of Science, Charles University, attributed to M. Tuhý. The Charles University team was partially supported by the institutional funding from the Center for Geosphere Dynamics (UNCE/SCI/006).