Fate of smelter particulates in soils

VOJTECH ETTLER[1*], ALICE JAROSIKOVA[1], MARTIN MIHALJEVIC[1], BOHDAN KRIBEK[2], FRANTISEK VESELOVSKY[2], VIT PENIZEK[3], ALES VANEK[3], ONDRA SRACEK[4], TOMAS MATOUSEK[5]

[1] Charles University, 128 43 Prague 2, Czech Republic (*correspondence: ettler@natur.cuni.cz)
[2] Czech Geological Survey, 152 00 Prague 5, Czech Republic
[3] Czech University of Life Sciences Prague, 165 21 Prague 6, Czech Republic
[4] Palacky University, Faculty of Science, 771 46 Olomouc, Czech Republic
[5] Institute of Analytical Chemistry of the CAS, 602 00 Brno, Czech Republic

Soils represent an important sink for smelter-derived metal(loid)s emitted into the environment. Soil in the vicinity of non-ferrous metal smelter often exhibit extremely high metal(loid) concentrations [1]. Using a combination of mineralogical techniques (XRD, SEM, EPMA, HRTEM) we have studied heavy mineral fractions from smelter-polluted soils and found a large variety of metal(loid)-bearing particulates originating from the smelter emissions (rounded droplets of sulphides, oxides and slag-like glass) and windblown angular particles from mine tailings or granulated slag disposal sites [2]. Compared to other soil systems, lower frequency of weathering features and lower metal(loid) availability have been observed especially in semi-arid soils. To determine reactivity of smelter dusts in soil systems we have conducted laboratory pot experiments and long-term *in situ* experiments in contrasting soils from both temperate and semi-arid areas. The mineralogical transformations of incubated flue dust materials were linked to the analyses of soils and soil pore waters including determination of arsenic speciation. Highly soluble phases from flue dusts (e.g., chalcantite, arsenolite) lead to high releases of metal(loids) into the soil systems within first hundreds hours of incubation [3]. Long-term exposures under field conditions confirmed high mass losses exceeding 40% of the flue dust materials incubated in soils. However, arsenolite being a dominant phase in As-rich smelter flue dust is, despite its high solubility, not completely dissolved after 3 years of incubation and Ca-Cu-Pb arsenates seem to efficiently control As mobility in soils. This indicates that the mineralogical composition of smelter particulates strongly affects the rate of contaminant leaching after their deposition in soils.

[1] Ettler (2016) *Appl. Geochem.* **64**, 56-74. [2] Ettler *et al.* (2016) *Sci. Total Environ.* **563-564**, 329-339. [3] Ettler et al., (2016) *J. Soils Sedim.* **16**, 115-124.