Contaminated geoenvironments: examples from mining and smelting sites

V. Ettler[1], M. Mihaljevič[1], Z. Johan[2], B. Kříbek[3], O. Šebek[4]

1 Institute of Geochemistry, Mineralogy and Mineral Resources, Faculty of Science, Charles University in Prague, Albertov 6, 128 43 Prague 2, Czech Republic, e-mail: ettler@natur.cuni.cz, mihal@natur.cuni.cz
2 BRGM, av. Claude Guillemin, 45060 Orléans, France, e-mail: zdenek.johan@free.fr
3 Czech Geological Survey, Geologická 6, 152 00 Prague 5, Czech Republic, e-mail: bohdan.kribek@geology.cz
4 Laboratories of the Geological Institutes, Faculty of Science, Charles University in Prague, Albertov 6, 128 43 Prague 2, Czech Republic, e-mail: sebek@natur.cuni.cz

Non-ferrous metal mining and smelting activities represent one of most important local pollution sources. The present contribution will underline the usefulness of a multi-approach investigation (mineralogy, geochemistry, isotopes) to understand the cycling of metals and metalloids in the environments highly polluted by mining and metallurgy. The examples from three mining/smelting districts will be presented: (a) Příbram district, Czech Republic (Ettler et al., 2001; Ettler et al., 2005; Ettler et al., 2008; Mihaljevič et al., 2008); (b) Tsumeb, Namibia (Ettler et al., 2009); (c) Copperbelt Province, Zambia (Mihaljevič et al., 2011).

Smelting industry produces a large variety of mineral waste materials (slags, mattes, fly ash). Slags are generated in high volumes and are generally deposited on the dumps in the vicinity of smelters, where they undergo weathering processes. The issues related to contaminant-hosting phases, natural alteration, laboratory leaching and long-term stability prediction will be addressed (Ettler et al., 2001; Ettler et al., 2009).

The knowledge of the mineralogy and reactivity of smelter fly ashes (emissions) is extremely important to predict their fate in the environmental, in particular in soil systems (Ettler et al., 2008). Extremely high levels of metals/metalloids have been reported for smelter-affected soils having significant (agro)environmental and ecotoxicological implications (Ettler et al., 2005; Mihaljevič et al., 2011).

The application of Pb isotopes for tracing the sources of pollution in smelter-affected environmental systems will also be demonstrated. Some recent examples of Pb isotopic fingerprinting in smelter-polluted soils and geochemical archives such as peat bogs and tree rings (Ettler et al., 2005, Mihaljevič et al., 2008; Mihaljevič et al., 2011) will be presented.

References:

Ettler, V., Legendre O., Bodénan F., Touray J. C. (2001): Primary phases and natural weathering of old lead-zinc pyrometallurgical slag from Příbram, Czech Republic. – Can. Mineral., 39, pp. 873-888.

Ettler V., Vaněk A., Mihaljevič M., Bezdička P. (2005): Contrasting lead speciation in forest and tilled soils heavily polluted by lead metallurgy. – Chemosphere, 58, 1449-1459.

Ettler V., Šebek O., Grygar, T., Klementová M., Bezdička P., Slavíková H. (2008): Controls on metal leaching from secondary Pb smelter air-pollution-control residues. – Environ. Sci. Technol., 42, pp. 7878-7884.

Ettler V., Johan Z., Kříbek B., Šebek O., Mihaljevič M. (2009): Mineralogy and environmental stability of slags from the Tsumeb smelter, Namibia. – Appl. Geochem., 24, 1-1.

Mihaljevič M., Zuna M., Ettler V., Chastný V., Šebek O., Strnad L., Kyncl T. (2008): A comparison of tree rings ad peat deposit geochemical archives in the vicinity of a lead smelter. – Water Air Soil Pollut., 188, 311-321.

Mihaljevič M., Ettler V., Šebek O., Sracek O., Kříbek B., Kyncl T., Majer V., Veselovský F. (2011): Lead isotopic and metallic pollution record in tree rings from the Copperbelt mining-smelting area, Zambia. – Water Air Soil Pollut., 216, 657-668.