HEAVY METALS IMPACT ON PLANTS AT MINING AND RECOVERY DUMPS OF POLYMETALLIC WASTE ORE MATERIAL IN THE SURROUNDINGS OF THE NEOVOLCANITES OF THE ŠTIAVNICKÉ VRCHY MTS. AREA

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The most expressive manifestations of exploitation activities in mining regions are rests of mining dumps, which represent dumping grounds of disintegrated rocks, fine-milled ores and chemical matters used during the dressing activities. Until now these dumping grounds were perceived only as *"memorials to the industry"* or as anthropogenic relief-creating elements. Surroundings of Banská Štiavnica is a very good model area in this respect. All this region was affected by mining activity even during Antiquity (maybe even during Primeval Age).

Vegetation at dumps of various age was investigated. The oldest dumps from 14th to 16th centuries, worked as meadows, are covered by grass, which consists of species resistant against heavy metals: *Alnus glutinosa*, *Acetosella vulgaris*, *Luzula campestris*, *Arrhenatherum elatius*, *Avenella flexuosa*, *Leucanthemum vulgare*, *Dianthus carthusianorum*. Roveň dump from 18th and 19th centuries is predominantly planted by trees *Pinus nigra*, *Pinus sylvestris* and more rarely by *Picea abies*. On the youngest dumps (Wolf and Michal**)** *Betula pendula*, *Alnus glutinosa*, *Salix caprea* and some other plants subsist.

The following evolutionary vegetation stages were recorded on dumps and soils influenced by heavy metal pollution: on dump areas with fine-grained substrate: *Tussilago farfara*, *Agrostis tenuis* and *Artemisia vulgaris*, *Daucus carota* and *Tanacetum vulgare*, while on places where more humus is available, we can find the next species: *Avenella flexuosa, Nardus stricta*, and mainly species from the surroundings: *Arrhenatherum elatius*, *Veronica chamaedrys*, *Phleum pratense* and *Festuca rubra*. The Fe, Mn, Cu, Zn, Pb, Cd, As and Hg contents in their dry tissues are presented in Table 1.

Percolating acid waters intensively damage and destroy the whole biotope, contaminate underground waters by Zn, Cu, Cd, Fe, Bi, Mn. The result of biological-chemical processes is the biological transformation of the original sulphides as well as of the alumosilicates. The comparison of heavy metal concentrations in *Acetosella vulgaris* from the old dumps and in *Tussilago farfara* from the youngest dumps show that the plants are contaminated by heavy metals and that the contents in *Acetosella vulgaris* are much higher than in *Tussilago farfara*. Both species are resistant to heavy metal pollution and are able adapt themselves to the strongly contaminated soils. According to BANÁSOVÁ *et al.* (1998) the plants can resist the toxic effect of heavy metals by two ways: 1) they prevent heavy metal incorporation to the tissues ("*exclusion mechanism*"), *e.g. Aldus glutinosa* or 2) they convert the metal within their cells to a less toxic form ("*tolerance mechanism*").

Reference

BANÁSOVÁ, V., DANÁKOVÁ, A. & KRIŽÁNI, I. (1998): Bulletin Slovenskej botanickej spoločnosti, 20: 166–171.

Table 1: Average contents (mg · kg^{-1}) of selected heavy metals in dry tissues of *Tussilago farfara (Tf)* and *Acetosella vulgaris (Av)*

	Tussilago farfara				*Acetosella vulgaris*	
Element	dump Roveň	dump Lintich	dump of the Michal adit	dump of the Nová shaft	dump Roveň	dumps Wolf
Fe	169.00	344.00	644.00	280.00	173.00	634.00
Mn	32.50	125.00	57.00	75.00	325.00	1 230.00
Cu	13.00	15.00	11.00	20.00	5.00	22.00
Zn	48.50	190.00	261.00	98.00	353.00	323.00
Pb	13.50	24.00	37.00	21.00	6.00	47.70
Cd	1.00	tr.	6.00	3.00	tr.	1.30
As	0.41	0.44	0.43	0.45	0.49	0.45
Hg	0.02	0.04	0.04	0.03	0.05	0.06