Accumulation of major and trace elements in pine needles (*Pinus nigra*) in the Viennese Conurbation

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Background & Methodology

Anthropological activities during the last decades led to heavy metal pollution in the environment, causing problems due to their toxicity. (Heavy) metals are accumulated in crops or plants. Pine needles are considered as good bio-monitors for air pollutants. In Vienna (capital of Austria) many pine tree of the species Pinus nigra grow at various places. Needles of such pine trees were collected at different places in the city (see Figure 1), characterised by high, medium and low traffic volume in spring and summer 2015 (once per week from May to August). Fresh needles from that year as well as one-year-old needles were sampled. Thus, changes in space and time could be investigated in addition to the differences in needle age.

After sampling, the needles were washed and dried prior to acidic microwave assisted digestion. The quantitative determination of 22 elements was carried out using inductively coupled plasma – sector field mass spectrometry. The elements chosen were Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, K, Li, Mn, Mo, Ni, Pb, Se, Sr, U, V, and Zn. Prior to measurement, all solutions were diluted 1:20 with ultrapure water. The validity of the applied analytical procedure was checked by analysing the NIST standard reference material SRM 1575a - Trace Elements in Pine Needles.
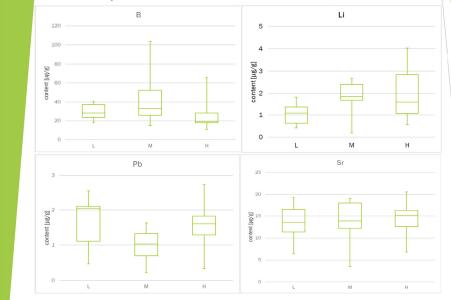
Results & Discussion

Analysis of the data obtained for the fresh needles compared to the one-year-old ones revealed, that the contents of Ag, B, Ba, Co, Cr, Fe, K, Li, Ni, Pb, Se, Sr, U, and V differ significantly (see table below). Except for Ni, higher amounts were found in the older needles.

Table 1: mean elemental contents in mg/kg (elements with statistically significant differences between fresh shoots and one-year-old needles are written in red)

Element	fresh shoots	1a	p-value
Ag	0.0022	0.013	0.014
As	0.053	0.102	0.098
B	18.3	30.4	0.005
Ba	1.35	4.94	0.000
Cd	0.033	0.036	0.635
Co	0.058	0.082	0.033
Cr	0.102	0.727	0.001
Cu	6.04	4.83	0.081
Fe	35.9	214	0.001
Li	0.129	1.364	0.002
Mn	27.7	38.5	0.181
Mo	0.407	0.275	0.193
Ni	0.743	0.406	0.005
Pb	0.162	0.912	0.003
Se	0.026	0.079	0.010
Sr	6.23	19.3	0.006
U	0.0018	0.0121	0.004
V	0.027	0.268	0.002
Zn	32.3	28.8	0.436

Results & Discussion

Regarding the sampling site and thus the traffic volume, only the Li content is statistically significant higher in needles from trees at the place with high and that with low traffic. Comparing medium and low traffic volume, statistically significant higher contents are found in the samples from the former site for Li, Mo and Zn.

The metal contents determined change with time, but no statistically significant general trend could be observed based on Neumann trend test.