Trace element analysis on spider webs – identification of sources of particulate matter

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Particulate matter (PM) in the urban atmosphere is regarded as a main environmental and health problem in cities [1]. Urban populations are exposed to enhanced levels of PM emitted from natural and various anthropogenic sources [2]. Since composition and toxicology might vary depending on the source, more information on the sources is needed.

A potential complement to classical sampling of PM is the collection of spider webs that adsorb air contaminants. Spider webs are widespread in urban areas and their sampling is inexpensive [3, 4]. Wheel webs were sampled repeatedly from 22 locations in the city of Jena, Central Germany from 2016 to 2018. Contents of 29 elements, mainly metals, in the samples were determined by ICP-OES and ICP-MS after aqua regia digestion.

Enrichment factors (EFs), comparing element contents to contents in continental crust [5], show a pronounced anthropogenic influence for Cr, Cu, Ni, Pb, Sb, Sn and Zn ($EF > 10$) and a minor anthropogenic influence for Ba, Ca, Fe, K, Li, Mn and Sc ($5 < EF < 10$). A cluster analysis leads to four distinct sub-clusters of elements that are expected to be due to different sources. Results of a factor analysis confirm this assumption: Besides an influence of geogenic dust particles, identified by e.g. Al, Ca, Li and Mg, different patterns can be found that identify road traffic (high loadings of Cu, Sb, Sn) as well as tram/rail transport (high loadings of Cr, Fe, Ni).

The spider web biomonitoring presented is a useful tool to assess element patterns and corresponding sources of PM at a variety of locations and times. PM in the exemplary city of Jena (continental climate, no big industries, valley bottom) is influenced mainly by traffic and the suspension of geogenic dust.

[1] Landrigan *et al.* (2018) *Lancet* **391**, 462-512. [2] Furusjö *et al.* (2007) *Sci. Total Environ.* **387**, 206-219. [3] Rybak *et al.* (2015) *Ecol. Chem. Eng. S* **22**, 389-400. [4] Xiao-li *et al.* (2006) *B. Environ. Contam. Tox.* **76**, 271-277. [5] Zhu *et al.* (2015) *Rapid Commun. Mass Sp.* **29**, 1403-1410.