

EGU21-9587, updated on 29 Nov 2022

<https://doi.org/10.5194/egusphere-egu21-9587>

EGU General Assembly 2021

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## Trace elements and Pb isotope composition of annual tree rings and pine needles growing in highly industrialized region in southern Poland

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Trees can provide annual records of ecosystem changes connected with human activity over several decades. These changes can be recorded in the pattern of variation of tree-rings widths and in the variation in the elemental composition of wood. Analysis of trace metal pollution is based on the assumption that element concentrations in tree foliage and tree rings represent element availability in the environment.

We determined the chemical composition of pine needles and annual tree rings to monitor environmental contamination in an urban forest environment in the most industrialized part of southern Poland.

The concentrations of trace elements (Cr, Co, Ni, Cu, Zn, Pb) and the Pb isotope composition were measured in needles from *Pinus sylvestris* L. growing in nine urban forests near five factories. Trace elemental concentration and Pb isotope ratio were determined by ICP-MS and MC-ICP-MS, respectively. The needles were characterized based on the concentrations of Cr, ranging from 0.05 to 0.7 mg/kg, Co, from 0.005 to 0.075 mg/kg, Ni, from 0.12 to 0.66 mg/kg, Cu, from 0.49 to 1.0 mg/kg, Zn, from 3.9 to 14 mg/kg, and Pb, from 0.06 to 0.53 mg/kg. The <sup>208</sup>Pb/<sup>206</sup>Pb ratio ranged from 2.08 to 2.11 and the <sup>206</sup>Pb/<sup>207</sup>Pb ratio between 1.15 and 1.17. The heterogeneity of Pb isotope ratio indicates that there are different sources affecting the Pb isotopic composition of pine needles (Sensuła et al., 2021).

In one of the investigated site, a radial trace-element profiles were determined by Laser Ablation Inductively Coupled Plasma-Mass Spectrometry (Laser ablation: New Wave Research UP-193 FX Fast Excimer, ICP-MS: Thermo Scientific X-Series2 with CCT -Collision Cell Technology) at Royal Museum for Central Africa (Belgium). LA-ICP-MS provides a repeatable, minimally destructive, sensitive method for determining many elements in wood tissue, with relatively high spatial resolution. Temporal variations of element concentration (median) in annual tree-rings of pines were compared with time series of wet deposition of pollutant and air pollutant concentration in the investigated area. The similar trends of magnitudes changes can be observed between analysed elements concentration (Na, Mg, Fe, Ni, Zn) and total wet deposition of these elements in

the environment during vegetation period or these elements concentration in the rain (Sensuła et al. 2017).

Different space-time patterns of element accumulation in pine needles and annual tree rings were observed. The variation in isotopic composition reflects a mix between different anthropogenic sources.

#### References:

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