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Magnetic biomonitoring of industrial air pollution in SW Finland

Hanna Salo and Joni Mäkinen
Department of Geography and Geology, University of Turku, Finland (hansalo@utu.fi)

Moss bags made of Sphagnum papillosum were exposed along 8 km transects near Harjavalta Industrial Park in SW Finland. Previous studies have identified Cu-Ni smelter's pipe as the main source of air pollution. Our research hypothesis is that nowadays the local pollution load of airborne particulate matter from Industrial Park is mainly caused by other emission sources than the smelter's pipe. To identify possible magnetic fingerprints, industrial samples (fiberglass filters from the smokestacks of Cu-Ni smelter and Ni-dryer, final Cu-slag, granulated Ni-slag, Cu-concentrates, Ni-concentrates) were investigated.

Mass-specific susceptibility and heavy metal levels were significantly higher near Industrial Park and showed a decreasing trend with increasing distance from the source. The magnetic mineralogy of moss bags, smelter's filter and Cu-slag was dominated by a low-coercivity magnetite while high-coercivity minerals were observed in dryer's filter, Ni-slag and majority of concentrates including all Ni-concentrates. Angular and sharp-edged particles prevailed in moss bags and industrial samples, except for smelter's filter and granulated Ni-slag in which spherical particles dominated.

Seven air pollution impact zones were distinguished around Industrial Park on the basis of magnetic susceptibility and previous studies. Overall, industrial area's influence is observable up to 4 km and even further distances in SE and NW along prevailing wind directions and Kokemäenjoki River valley. The heaviest anthropogenic air pollution load is deposited at 0.5–1 km distances. Particle morphology and magnetic data of the moss bags indicate that the particulate matter in the hot spot area, which spatial emphasis is in S-SW-W-NW in the upwind from the smelter, originate mainly from the dust emissions from other sources rather than the smelter's pipe. The industrial activities in and nearby hot spot area include handling and moving of concentrates and slags as well as heavy traffic. This study shows that air pollution from various dust-providing sources outweighs the fly-ash load from the Cu-Ni smelter's pipe especially at short distances. Furthermore, active magnetic monitoring by moss bags is spatially detailed sampling method for the identification of air pollutants and emission sources.