POLAND AS A SOURCE REGION OF HEAVY METAL DEPOSITION IN NORWAY AS ASSESSED BY ANALYSIS OF PEAT CORES

E. Steinnes[1], I. Twardowska[2]

[1)] ***Norwegian University of Science and Technology in Trondheim (NTNU), Department of Chemistry, Trondheim, Norway***

[2)] ***Polish Academy of Sciences, Institute of Environmental Engineering, Zabrze, Poland***

eiliv.steinnes@ntnu.no

Keywords: Long-range atmospheric transport, metals, peat cores, Poland, Norway

Introduction

The southernmost part of Norway has received substantial deposition of several heavy metals originating from pollution sources in other European countries (Amundsen et al., 1992; Berg et al., 1994; Steinnes et al, 2011). Studies of aerosols combined with air trajectory analyses showed that source regions to the southwest, south, and southeast of the exposed region were mainly responsible for the supply of airborne metals. Peat cores from ombrotrophic bogs are widely used to study temporal trends of airborne metal deposition (Shotyk et al., 2000; Steinnes et al., 2005). In this work selected data from comparative analysis of peat bogs from northwest Poland and south Norway are presented and discussed.

Methods

Peat cores down to 40 cm depth were collected in ten ombrotrophic bogs, five in NW Poland and five in Norway, all of which at considerable distance from local industries. Two of the Norwegian bogs were located in areas substantially affected by long-range atmospheric transport of pollutants, and the others in relatively clean regions. All samples were air-dried and decomposed with 14M HNO_3 and subsequently analyzed for 36 elements using ICP-MS. The peat cores were dated using the ^{14}C-method.

Results

Some typical results from this study are shown in Fig.1, demonstrating temporal trends and geographical differences in atmospheric deposition for two elements characteristic of long-range transported aerosols: arsenic, and lead. Whereas these elements are mainly derived from different categories of pollution sources, they show remarkably similar geographical and temporal trends. The strong influence from long-range transport of pollution aerosols in southern Norway is confirmed. However, this study also shows that northwest Poland is only moderately affected by the extensive industrial activity in the southern and southwestern parts of the country.

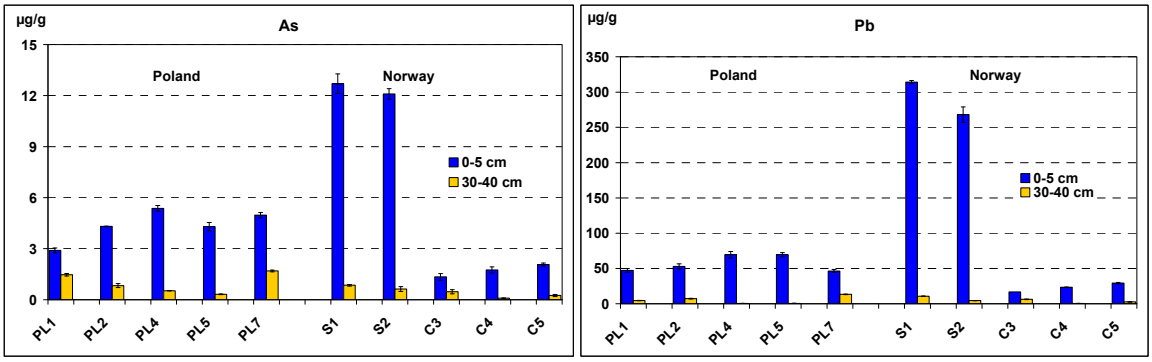

Figure 1. Mean concentrations of airborne As and Pb in the surface layer (0-5 cm) of peat cores from ombrotrophic bogs, representing recent deposition, and in the 30-40 cm layer, representing the pre-industrial period. Bogs PL1 - PL7 are located in NW Poland, S1 and S2 in southernmost Norway, and C3-C5 in central Norway

Conclusion

From these data it appears that the deposition of Pb and As in southernmost Norway over time has been distinctly greater than the corresponding levels in NW Poland. According to EMEP (2015) Poland is currently the country providing the greatest contribution to transboundary transport of Pb into Norway. This seems somewhat surprising considering the fact that the main polluting industries in Poland are in the southern part of the country, and polluted air from that region is likely to pass across northwest Poland before reaching southern Norway. However, differences in surface topography and precipitation patterns may be part of the explanation.

Acknowledgement

The IMPACT project received funding from the Polish-Norwegian Research Program operated by the National Centre for Research & Development under the Norwegian Financial Mechanism 2009-2014 in the frame of Project contract No Pol-Nor/199338/45/2013.

References

Amundsen, C.E.; Hanssen, J.E.; Semb, A; Steinnes, E. (1992). Long-range transport of trace elements to southern Norway. *Atmos. Environ. 26A, 1309-1324.*

Berg, T.; Røyset, O.; Steinnes, E. (1994). Trace elements in atmospheric precipitation at Norwegian background stations (1989-1990) measured by ICP-MS. *Atmos. Environ. 28, 3519-3536.*

EMEP (2015). Pollution assessment of EMEP countries..
<http://www.msceast.org/index.php/pollution-assessment/emep-countries-menu>

Shotyk, W.; Blaser,P., Grünig, A.; Cheburkin, A.K. (2000). A new approach for quantifying cumulative, anthropogenic, atmospheric lead deposition using peat cores from bogs: Pb in eight Swiss peat bog profiles. *Sci. Total Environ. 249, 281-295.*

Steinnes, E.; Hvatum, O.Ø.; Bølviken, B.; Varskog, P. (2005). Atmospheric supply of trace elements studied by peat samples from ombrotrophic bogs. *J. Environ. Qual. 34, 192-197.*

Steinnes, E.; Berg, T.; Uggerud, H.T. (2011). Three decades of atmospheric metal deposition in Norway as evident from analysis of moss samples. *Sci. Total Environ. 412-413, 351-358.*