

INTERSPECIES COMPARISON OF ELEMENTAL CONTENT IN MOSS FROM IVANOVO REGION DETERMINED BY NAA AND AAS

Rumyantsev I.V.¹, Dunaev A.M.¹, Frontasyeva M.V.², Ostrovnaya T.M.²

¹ – Ivanovo State University of Chemistry and Technology, Ivanovo, Russia

² – Joint Institute of Nuclear Research, Dubna, Russia

Methodological aspects of biomonitoring are still of interest. One of the main directions in this field is looking for most appropriate species. Biomonitoring is widely used to assess air quality. Mosses are the most favourable organisms for this purpose. At this case searching species of moss with highest accumulation ability is the serious problem.

Among various techniques for environment contamination control the biomonitoring methods found recognition because they are simple, cheap and fast processing. Mosses as biomonitors of air pollution have an advantage expressed in developed surface, high cation exchange capacity and absence of covering tissues. However different moss species exhibit different ability to metal accumulation. According to the most monitoring manual it is recommended to collect species *Hylocomium splendens* and *Pleurozium schreberi*.

Coefficients of metal accumulation for three moss species: *Hylocomium splendens*, *Pleurozium schreberi* и *Polytrichum commune* were calculated based on the results obtained by atomic absorption spectroscopy (AAS) in Ivanovo and neutron activation analysis (NAA) in Dubna. Ivanovo region situated in the interflaves of the Volga and Klyaz'ma rivers has an area of 22 000 km². 45 squares were separated within the region with average area of 400 km² (Fig.1) Samples of moss were taken from each square. A total of 25 moss samples were collected according to UNECE ICP Vegetation monitoring manual. Sampling grid on average was about 20 km. The determination uncertainties were about 30% and 10% for AAS (Pb, Cd, Cr, Co, Cu, Zn, Ni, Mn, Fe) and NAA (Na, K, Mg, Ca, Al, In, V, Mn, Cu, Cl, Br, I, Si), respectively.

To investigate some toxic elements, for example HM, using a combination of AAS and NAA is of interest. However NAA can't measure the concentrations of Pb and Cd, which are most dangerous HM. It is a reason for choosing Cu, Ni, Fe, Mn, Zn as elements for comparison.

AAS showed the presence of all elements under study except cobalt. The concentrations of Cu and Mn determined by NAA are on average 2 and 3 times, respectively, higher than the AAS data. It is explained by incomplete dissolution of Cu and Mn compounds while sample preparation for AAS using wet digestion and 1M HNO₃ extraction. The interspecies comparison was made. It was revealed that *Pleurozium schreberi* has the highest ability for accumulation of elements, especially for In, Cu, Br, and I. It was found that the average ratio between concentrations in *Pleurozium schreberi* to *Polytrichum commune* was 1.32. The same results were

obtained for *Pleurozium schreberi*/*Hylocomium splendens* ratio. Among three moss species under study *Pleurozium schreberi* was found as most suitable for biomonitoring purposes.

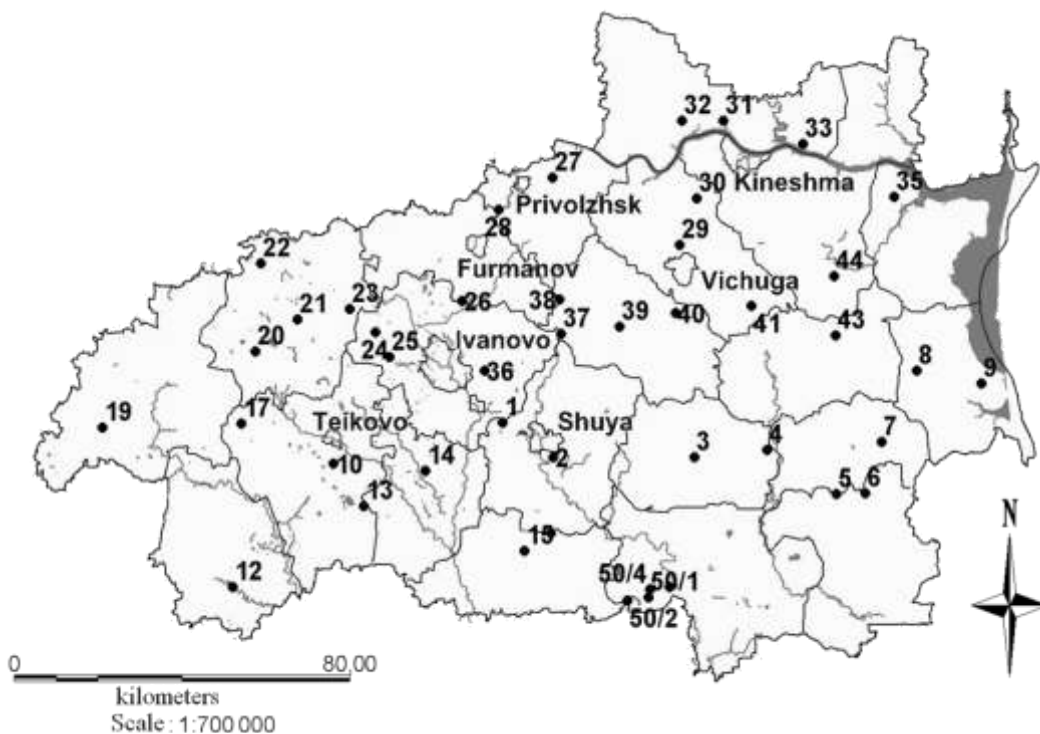


Fig.1. Sampling map.

This work is concerned with the comparison of these species of moss as well as *Polytrichum commune* by their accumulation ability. The species *Polytrichum Commune* was chosen, because of its wide occurrence at the territory of Ivanovo region, which was the object under study.

The results of the investigation are in Table №1.

Table.1. Elements content in moss species

Element	Na	Mg	Al	Cl	K	Ca	V	Cr	Mn	Fe
PS/PC	0.96	1.06	0.95	1.26	0.86	1.09	0.96	0.97	0.93	1.18
PS/HS	1.06	1.11	1.41	1.17	0.96	1.06	1.22	0.86	1.07	1.20
Element	Co	Cu	Zn	As	Se	Br	Rb	Sr	Cd	Mo
PS/PC	0.97	1.80	0.82	0.88	0.84	0.85	0.78	0.96	1.15	0.65
PS/HS	1.07	3.09	1.2	1.04	0.85	0.88	1.04	1.09	1.31	0.65
Element	I	Ba	Cs	Ta	W	Hg	Th	U	Zr	Sc
PS/PC	2.03	1.07	0.95	0.91	1.16	1.81	1.17	1.06	0.72	1.16
PS/HS	1.04	1.38	1.03	1.28	1.01	1.53	1.23	1.11	1.91	1.20
PS- <i>Pleurozium schreberi</i> ; PC- <i>Polytrichum commune</i> ; HS- <i>Hylocomium splendens</i> .										

It was revealed that *Pleurozium schreberi* has the highest ability for accumulation of elements, especially for In, Cu, Br, and I. It was found that the average ratio between concentrations in *Pleurozium schreberi* to *Polytrichum commune* was 1.32. The same results were obtained for *Pleurozium schreberi*/*Hylocomium splendens* ratio. Among three moss species under study *Pleurozium schreberi* showed itself as most suitable for biomonitoring purposes.

High values for *Pleurozium schreberi*/*Hylocomium splendens* ratio was fixed for Al, V, Hg, Se, Br, Zr, Ba, Cu, Cd, Fe.

The comparison between element content in moss determined by NAA and AAS was made for Cu, Zn, Ni, Mn, Fe.

It was established that maximum of Zn content in moss samples situated near Rodnyky city may be explained by the activity of asphalt plant. However NAA also gives to additional areas with increased Zn concentration – near Kineshma and Ilinskoe towns (Fig.2).

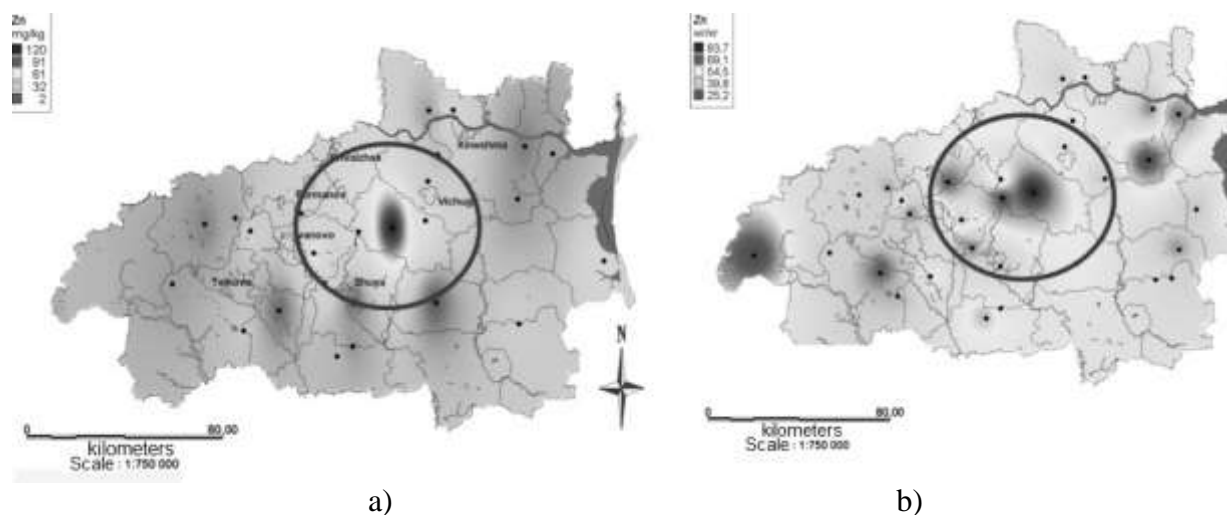


Fig.2. The comparison between Zn content in moss determined by AAS (a) and NAA (b).

The activity of Rodniky's asphalt plant is possible source of iron too. It was determined both by NAA and AAS. AAS also shows the increased iron content in Savino and Furmanov districts

The Ni concentration in the vicinity of Furmanov, Ivanovo and Shuya districts was higher than at other (Fig.3). The data both NAA and AAS agreed well.

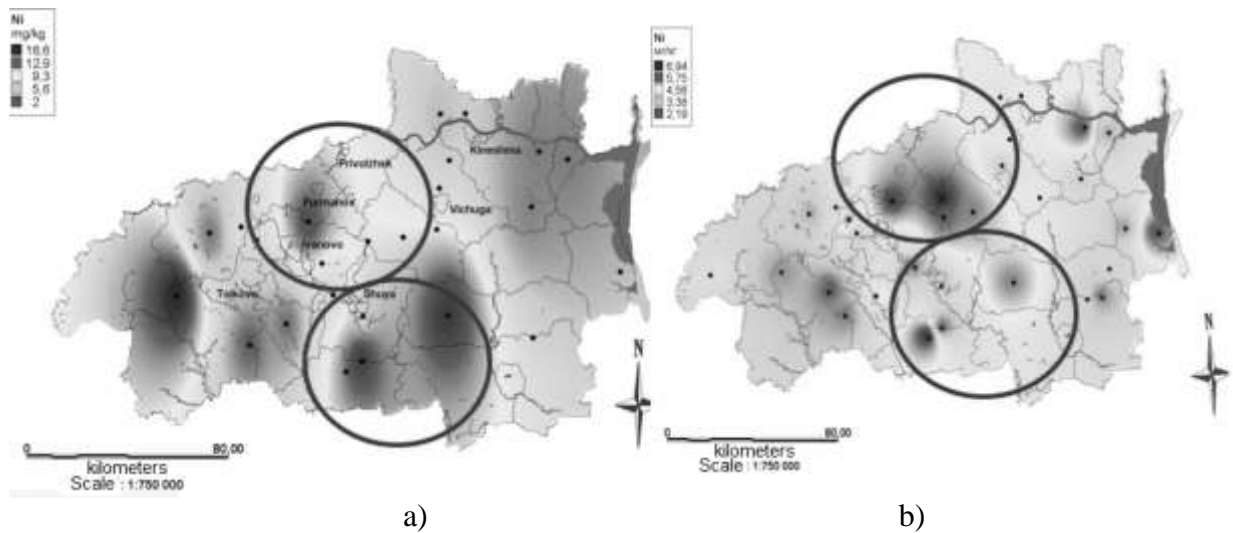


Fig.3.The comparison between Ni content in moss determined by AAS (a) and NAA (b).

Mn content in Ivanovo region soil is usually high. Under wind transfer Mn can migrate into moss, especially it is typical for northern-east part of the region.

There are some difficulties with Cu determination by NAA. This is a reason of observed discrepancy of Cu content in Ivanovo region mosses measured by NAA and AAS.

In conclusion it may postulate: 1) *Pleurozium schreberi* is optimal moss species from observed ones, specially for Al, Cu, Cd, I, Ba, Hg; 2) *Polytrichum commune* is more appropriate for Mo, Na, K, Rb, Cs determination; 3) AAS data successfully supplemented data of NAA for majority of observed elements.

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