Numerous studies have shown that aerosols are of importance for atmospheric chemistry and climate of the Arctic [Pacyna, 1991; Barrie, 1996; Leck et al., 1996; Shevchenko et al., 2003]. At the coasts of Arctic seas and in their catchment areas delivery of chemical elements and compounds are registered in natural archives, for example in lichens. Lichens absorb substances, including trace elements, through dry and wet deposition, and have been widely used as biomonitor [Cordi and Cicchella, 2001; Garth, 2001; Walker et al., 2003; Shevchenko et al., 2010]. In the Northern Eurasia terrestrial lichens have a widespread environmental occurrence and thus offer a possibility of testing both short- and long-range atmospheric transport of matter (including pollutants).

MATERIALS AND METHODS

We studied multi-element composition of terrestrial (mostly of genera Cladonia and Cetraria) lichens collected in 2004–2010 in Kola Peninsula, Karelia, Arkhangelsk Region, Komi Republic and NW Siberia, mostly in the frame of International Polar Year activity (Fig. 1–3). In total, 145 samples were analyzed. The unwashed lichen samples were air dried and homogenised to a fine powder in an agate crusher. Samples were treated in a four-step chemical digestion procedure (full dissolution via acid attack) for major and trace element analysis. Element concentrations were determined by inductively coupled plasma-mass spectrometry (ICP-MS). Parts of dry samples were analyzed by instrumental neutron activation analysis (INAA). An enrichment factor (EF) was calculated for each element (X) relative to the composition of earth’s crust: \( EF = (X/Al) \text{ in lichen} / (X/Al) \text{ in the earth’s crust} \) [Rudnick and Gao, 2003]. Al was used as a crustal indicator.

RESULTS AND DISCUSSION

In most samples the contents of Ti, V, Cr, Mn, Fe, Co, rare earth elements (REEs), Th, U are at the background level and their EFs are below 10 (Fig. 4, 5). Such low EF values indicated that, relative to average values for crystal rocks, there was no significant of these enrichment elements in the lichen. For some elements (Se, Cd, Zn, Sb, As, Ni, Cu) consistently higher EF values were obtained. These higher values were interpreted in terms of sources of both anthropogenic and natural origin other than crustal rock and (or) soil. These elements could be derived by long-range atmospheric transport. Highest concentrations of Cu, Ni, Pb in lichens and EF by these elements were registered in the proximity of Monchegorsk and Nickel Cu-Ni smelters (Kola Peninsula).

CONCLUSIONS

In general, elemental composition of lichens in the Northern Eurasia reflects complex influence of atmospheric deposition of aerosols from both natural and anthropogenic sources.

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