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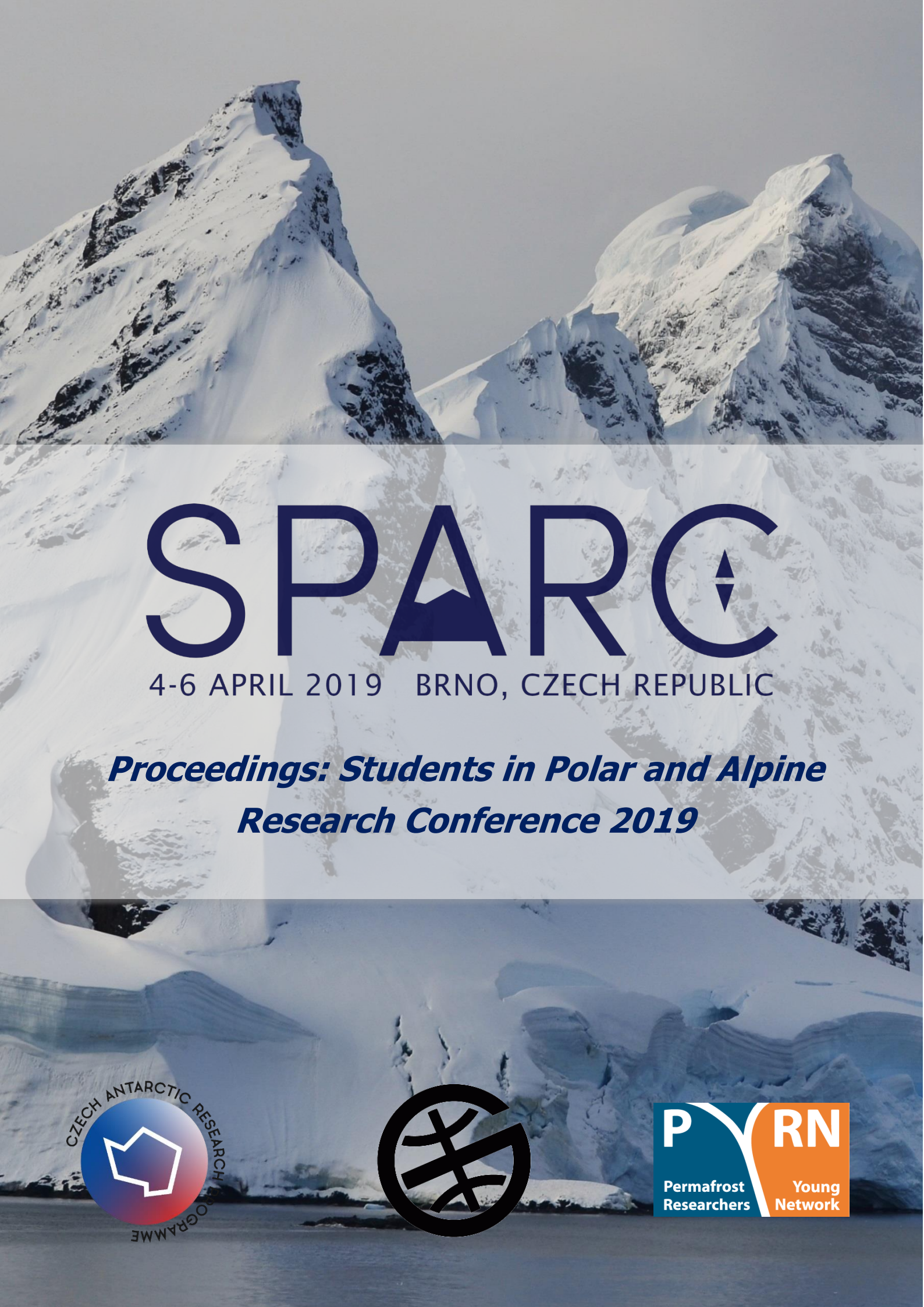

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Contents:

The trace metals in the lake bottom sediments of the Lena delta, Samoylov Island

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In the industrial period, the Arctic ecosystems increasingly attract attention of researchers due to their high sensitivity and vulnerability to anthropogenic impact (Presley, 1997). The contaminants can be atmospherically transported thousands of kilometers from mid- and low-latitude sources to the Arctic troposphere: acidifying gases (SOx), heavy metals, and persistent organic pollutants (POP). The evaluation of anthropogenic impacts on the Arctic ecosystems requires knowledge on the background levels of trace elements, particularly heavy metals. Furthermore, the study of geochemical features of lake systems helps to reconstruct the developing of ecosystems to find their changes and adaptations to anthropogenic influence.

This investigation is focused on the study of trace metals in the bottom sediments of the Arctic lakes (The Lena River delta, Siberia). Because of the location and landscape diversity of this region, geochemical data can be useful for paleolimnological and environmental researches. The distribution of trace metals in soils was analyzed by Antcibor et al. (2014). However, existing data on the presence of these substances in bottom sediment of lakes (Chetverova et.al., 2013) remain poorly studied. Delta of Lena River is located in the northern part of eastern Siberia. This area can be subdivided into three terraces and various floodplain levels of different ages. The investigations of the lakes carried out on Samoylov Island in the southern-central Lena River delta. This site is representative for the youngest delta areas including a Holocene estuarine terrace and various floodplain levels. Samoylov Island is relatively young, with an age of between 4 and 2 ka BP (Schwamborn et al., 2002), which is also the estimated maximum age of the lakes on the island. Two lakes with different origin were investigated: thermokarst lake Molo and ox-bow lake Banya (Chetverova et.al., 2013). They are characterized by different flood regimes. Lake Banya is affected by seasonal river floods, whereas lake Molo is now isolated from river water.

Bottom sediments are accumulative natural archives that can be used as integrating indicator of the condition of aquatic ecosystems. In contrast to hydrological parameters, the geochemical features of bottom sediments demonstrate a long-term situation of water environment. This investigation is focused on content of heavy metals in stratified bottom sediments of the lakes on Samoylov Island (depth of sediment core is 35 cm for Molo and 18 cm for Banya). For chemical analysis we used ICP-AES (laboratory of Research Park at St. Petersburg University). We analyzed total content of heavy metals (As, Co, Cr, Cu, Fe, Mn, Mo, V, Pb) in that these elements are most often associated with anthropogenic activity. We also estimated the content of dispersed organic matter (digestion at 550 °C) in the same samples for further palaeoreconstruction of river flood regimes of these lakes and physical and chemical parameters of sedimentation.

Most of the trace metals (Cr, Cu, Fe, Mn, Ni, V, Zn) are distributed quite homogeneously in depth

Table 1 Range (min–max) and median values (parentheses) of the trace metals in mg kg^{-1} determined in the bottom sediments and soils (1T Rim1 and 1T-Ce1) of Samoylov Island. * represents the data by (Antcibor et al., 2014)

Trace metal (LOD ppm)	Lake Molo	Lake Banya	1T-Rim1 (n =6)	1T-Ce1 (n =4)
As (0.1)	<DL	<DL	2.09–10.0 (2.95)	3.18–3.82 (3.35)
Cu (0.1)	11.2–35.2 (21.52)	11.0 – 33.6 (24.39)	2.74–7.91 (4.51)	9.70–12.0 (11.0)
Fe (8.0)	7280 –36200 (20820)	8920 – 74567 (28461,50)	17 800–41 200 (18900)	17 000–21 000 (18800)
Mn (3.3)	93–524 (277)	100–284 (212.2)	224–1206 (334)	143–481 (187)
Ni (2)	10,8–27.4 (21,8)	13.7–28.6 (19.3)	11.2–23.3 (21.7)	17.1–24.1 (18.5)
Zn (3)	35–113.4 (60,3)	29,6 – 66,8 (48,4)	43.1–60.6 (59.3)	34.9–59.2 (49.0)
Co (0.2)	<DL – 15.16 (5.6)	<DL – 11.5 (4.9)	40.0–146 (48.8)	28.5–79.5 (43.5)
V (2)	22.6 – 66.6 (46.2)	20.2 – 66.8 (42.13)	-	-
Cd (0.1)	<DL	<DL	0.03–0.07 (0.047)	0.027 0.058 (0.035)

of bottom sediments in two lakes. The content of Co varies from concentration that is below the limit of detection (LOD) to 15.6 ppm. The average concentrations of heavy metals of two lakes are quite similar. The content of dispersed organic matter varies from 5% to 25% in lake Molo and from 3% to 10% in lake Banya. The correlation between contents of organic matter and concentrations of trace metals was not detected.

We compared the content of heavy metals in the bottom sediments of lakes and the soils from two sites on Samoylov Island with the same flood regime. The results are presented in Table 1. The average contents of the elements are relatively similar with the exception of As, Cu and Co. The average concentration of Cu in bottom sediment is higher but the content of Co in the sediments 10 times lower than in soils. The content of As and in the bottom sediments of two lakes were below the detection limit (LOD <0.1 ppm) unlike arsenic average concentration in the soils (3.35 ppm). According to Antcibor et al. (2014), the concentrations of all the investigated metals were similar to those reported for other pristine northern regions. The studied area is pristine and can serve as a reference region for determining human influences on permafrost affected landscapes or comparing similar pristine areas in the Arctic region. The results of our investigation can be useful for environmental and palaeolimnological researches of other lakes of different river terraces of the Lena delta. It can serve as geochemical background for other Arctic lakes of the northern Siberia. We are planning to complement the data by study of chemical fractionation of heavy metals to estimate their mobility and bioavailability in the different lakes of the Lena delta.

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