

Physicochemical characteristics of land waters in the Bellsund region (Spitsbergen)

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Studies of physicochemical properties of polar environment waters were carried out in individual stages of water hydrological circulation in the north-west part of Wedel Jarlsberg Land on Spitsbergen. The aim of the research was estimation of changeability of physicochemical characteristics of waters during the polar summer in the rivers supplied from the glacier and from the permafrost. In the period of 15 July – 21 August 2005 there were taken up 290 water samples including 15 of precipitation, 9 from patches of melting snow, 39 from the glaciers Scott and Renard, 132 river samples 31 from streams on tundra, 56 from springs and 8 from small lakes. Time changeability was recorded from everyday observations of water levels and physicochemical analyses of the samples taken up from the river sup-

Table 1. Contents of metals in the studied waters

Radical	Value mg dm ⁻³	Limit of detection
Fe	< 0.5	0.01
Mn	< 0.05	0.05
Zn	< 0.01	0.001
Cd	< 0.001	0.001
Pb	< 0.005	0.005
Cu	< 0.001	0.001

plied from the Scottbreen and Wydrzyca Rivers, its tributaries and the springs draining the unglaciated area. In the water samples there were signified: suspension, pH, electrolytic conductivity, BOD, COD, TOC, SiO₂, PO₄, F, Cl, NO₂, SO₄, Ca, Mg, Na, K, NH₄, Li, Sr, Fe, Mn, Zn, Cd, Pb, Cu. The analyses were made based on potentiometric, spectrophotometric, available in the Hydrography Department, Maria Curie-Skłodowska University in Lublin.

Table 2. Typical contents of ions in the precipitation waters

Parameter	Rainfall, wind E	Rainfall, wind WS
pH	5.88	5.27
Conductivity [μ S cm ⁻³]	45.60	10.90
Alkalinity [mval dm ⁻³]	0.05	<0.05
Cl [mg dm ⁻³]	10.50	0.67
SO ₄ [mg dm ⁻³]	1.80	0.38
NO ₃ [mg dm ⁻³]	0.05	0.27
Ca [mg dm ⁻³]	0.96	1.10
Mg [mg dm ⁻³]	0.28	0.14
Na [mg dm ⁻³]	5.40	0.37
K [mg dm ⁻³]	0.19	0.05

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The precipitation waters studied in Calypsobyen were characterized by slightly acidic reaction and low contents of mineral substances of the order from a few to several dozen mg dm^{-3} . Atmospheric precipitation chemistry was largely formed by marine aerosols which resulted in predomination of Na and Cl ions. Their concentration was connected with the direction of air mass influx.

The waters flowing within the Scott and Renard glaciers showed low mineralization and slightly acidic reaction similar to the precipitation waters. The lowest concentration of mineral substances and reaction was observed in the forefield, particularly in the waters loaded with the suspension. Hydrochemical type of waters in the upper part of glacier was a result of Na and Cl ions predomination

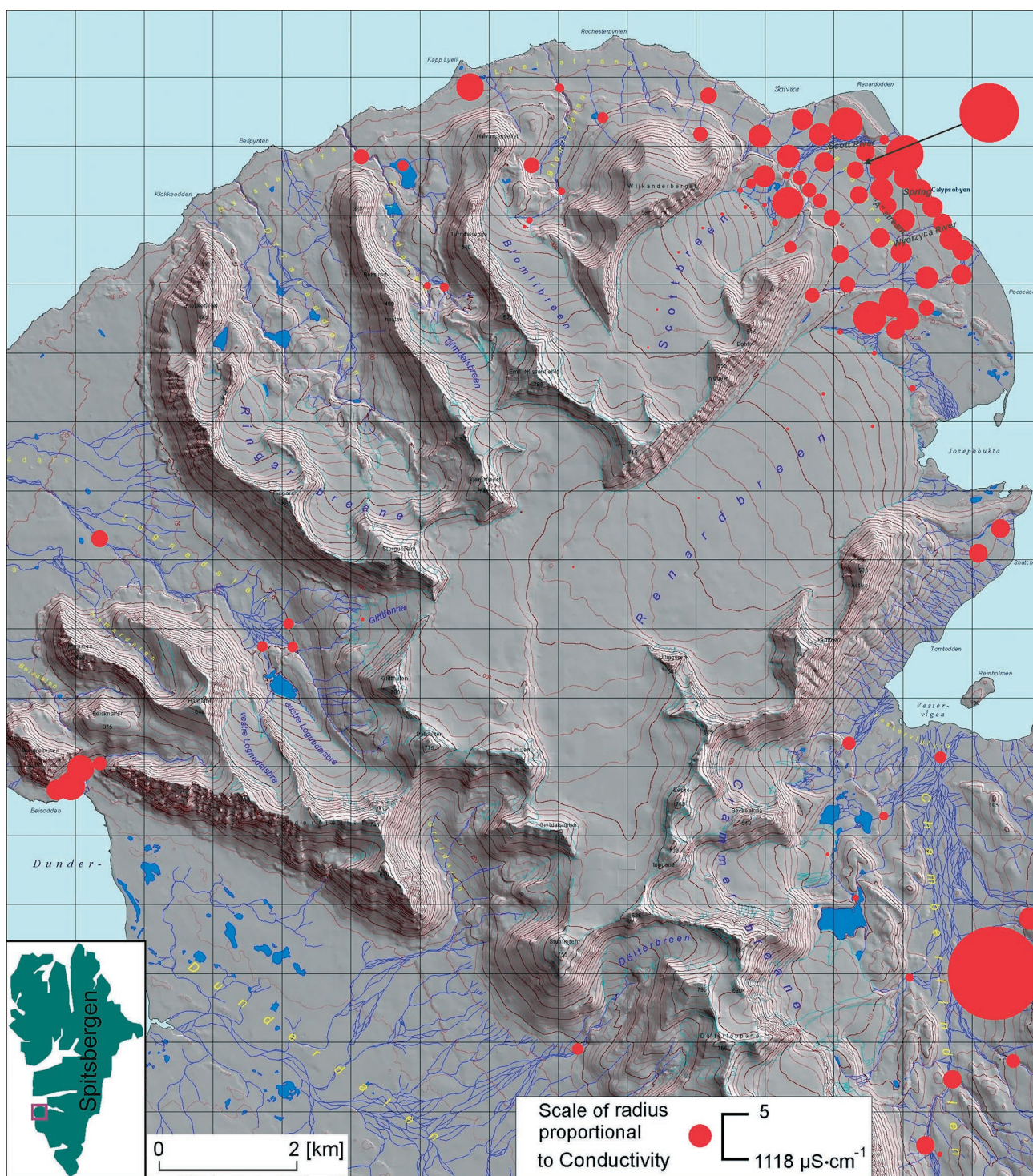


Fig. 1. Electric conductivity of waters in the Bellsund region. The shadow relief map made on the basis of digital terrain model from the aerial photos of 1990 (Zagórski 2002)

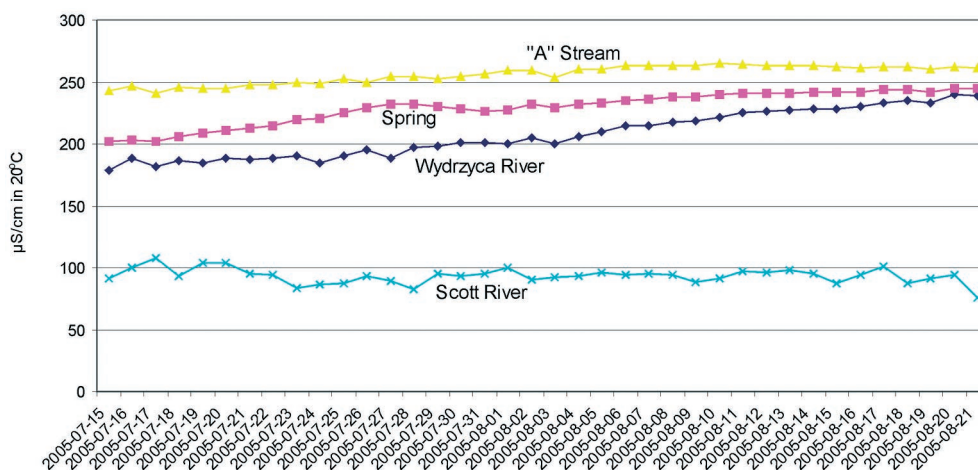


Fig. 2. Changeability of conductivity in the period of research

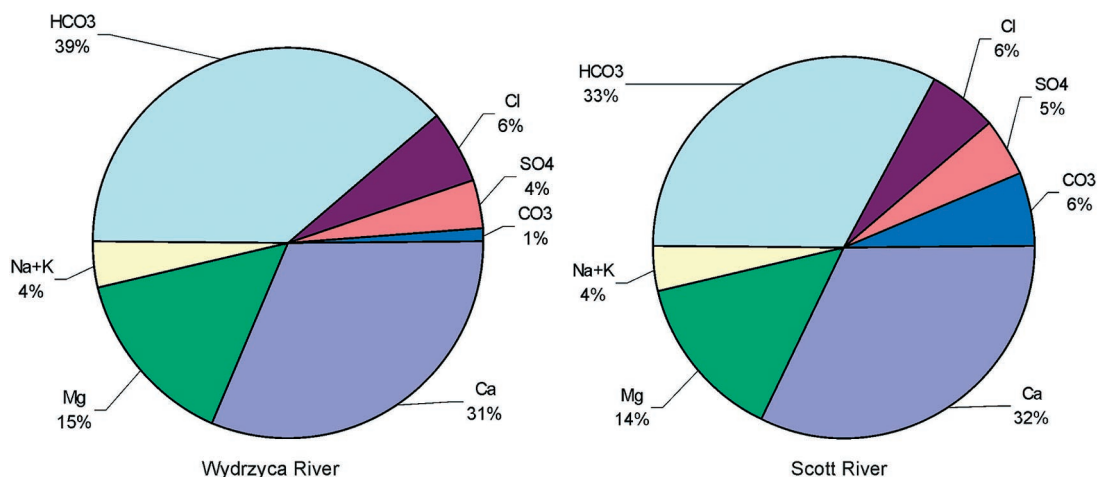


Fig. 3. Contribution of percentage share of ions in the waters of the Wydrzyca River end Scott River

but on its edge it was determined by HCO_3^- , Ca, Mg ions.

Further increase of mineralization of waters flowing down from the glaciers was observed in their forefield. Mineralization of waters reaching the level $\sim 50 \text{ mg/l}$ and the reaction became weakly alkaline. The waters of the Scott River in the estuary profile had mineralization reaching 100 mg dm^{-3} and concentration of the suspended material of the order several hundred mg dm^{-3} .

In the unglaciated areas the surface and underground waters were characterized by low concentration of suspension (mostly below $<10 \text{ mg dm}^{-3}$). However, they exhibition much higher mineralization, $\sim 200 \text{ mg dm}^{-3}$ and their reaction was weakly alkaline. The surface waters under investigation were related to existence of patches of melting snow which caused decrease of dissolved substances level. In the river waters of glaciated and unglaciated basins HCO_3^- , Ca and Mg ions were predominant.

Twenty-four hour cycle studies of physicochemical features of waters of the unglaciated Wydrzyca River showed their significant stability.

Relatively large dynamics of changes was recorded for the Scott River taking away the waters from the glacier.

As follows from the studies of waters in individual stages of hydrological circulation, they exhibited low contents of substances of biogenous character. The low levels were also found for organic carbon, silica and synthetic indices: biochemical and chemical demands of waters from oxygen. Concentrations of heavy metals were found to be low from a few to several dozen $\mu\text{g dm}^{-3}$ and their concentration scheme is as follows: $\text{Fe} > \text{Mn} > \text{Zn} > \text{Pb} > \text{Cu} > \text{Cd}$.

The collected material indicates significant hydrological differentiation of waters in individual stages of hydrological circulation as well as time and spatial changeability resulting from the extent of basin glaciation and geochemical conditions.

Acknowledgment

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