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Influence of marine aerosols and aerotechnogenic load on chemical composition of rainwaters on small islands (ludas) of the White Sea

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In June 2001 intensive monitoring plots were established on the island part of Kandalaksha Bay of the White Sea (the island Tonnaya Luda; 67^{o}06'60"N; 32^{o}24'12"E) with the installation of stationary rainwater collectors. The purpose was studying the chemical composition of rain waters in the zone of cumulative influence of marine aerosols and aerotechnogenic load. Water sampling was carried out monthly during the vegetative season of 2001 and 2002. pH of rain water was determined by potentiometric method without preliminary filtration. The samples were passed through the paper filter with the pore diameter of 1-2.5 microns, the analysis of filtrate carried out by methods of atomic emission spectrometry (K, Na) and atomic absorption spectrometry (Ca, Mg, Zn, Mn, Cu, Ni, Al, Fe), total P and P of phosphates, Si and NH_4^+ - by photocolorimetry, total carbon - by bichromate method, NO_3^-, SO_4^{2-}, Cl^- – by ion exchange chromatography method.

Balance method was chosen as a research basis to determine the interrelation of rain water organic matter and dynamics of its redistribution under the influence of natural and technogenic factors. The difference between the cations sum (including NH_4^+ and H^+) and mineral acids anions sum (SO_4^{2-}, Cl^-, NO_3^-) was identified as organic acids anions concentration (μeq l^{-1}).

The level of Na, Cl^-, K, Ca, Mg, SO_4^{2-}, Sr in rainwaters on the island and the remote areas is indicative of the possible influence of marine aerosols on the island part of the White Sea. The increase of Al, Cu, Ni, Cd, Co concentrations in rainwaters up to one order against the background values points to the cumulative influence of the emissions of industrial enterprises located in the region.

The relative stability of pH values of rain waters during all seasons indicates to the buffer action of weak organic acids anions. The correlation analysis of ionic structure in normal concentrations has allowed us to estimate the distribution of the cationic part from the interrelation with the anionic part on the basis of statistically significant positive correlation coefficients (n=15). So, H^+ and Ca^{2+} ions are related mainly with organic acids anions (r=0.67 and 0.47 respectively), NH_4^+, K^+, Mg^{2+} - with SO_4^{2-} (r=0.78, 0.73 and 0.58 respectively). It is impossible to exclude the interrelation of organic acids anions and Mg^{2+} (r=0.38).

The calculations of input parameters for physical and chemical modeling have been carried out to estimate the elements distribution through relations metals form with organic acids' anions. The findings show the domination of the simple salts of low-molecular organic acids (acetates, formates) in rainwaters and the presence of metals with a variable valency in reduced state (Fe^{2+}, Ni^{2+}) that can be caused by the existence of reducers as part of the organic matter of waters.