

Variations in chemical composition of surface ice and meltwater on Svalbard glaciers

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Snow and ice on glaciers usually contain small amounts of various soluble substances. These chemical substances were supplied through the atmosphere, rain, and snow. Chemical substances in glacier surface ice and melting water are important to understand atmospheric circulation, material cycle and the ecology of glacial microbes. We analyzed the major soluble ions of surface ice, melt water, and fresh snow for three glaciers (Austre Broggerbreen, Midtre Lovénbreen, and Pedersenbreen) in the northwestern part of Svalbard in the melting season of 2013.

The concentrations of all of the solutes were low generally, but the compositions varied among the samples. Based on the significant correlation on the concentration of each samples, the solutes could be classified into 3 groups: Group A (Cl^- , SO_4^{2-} , Na^+), B (Mg^{2+} , Ca^{2+}), and C (NO_3^- , NH_4^+ , K^+). They are likely to be derived from different sources. Group A solutes are probably sea salt origin, and Group B solutes are terrestrial dust origin, and Group C are anthropogenic or other unknown origin.

The altitudinal distribution of the concentration on Austre Broggerbreen showed that Group A (sea salt) solutes varied significantly although Group B (dust) solutes did not. Group A solutes were particularly higher in the higher area of the glacier. This variation can not be explained by distance from sea. It is probably due to supply from snow area remaining upper part of the glacier.

The chemical composition of the melting water was generally similar to those of the ice at the same site. However, some of the solutes (K^+ and SO_4^{2-}) were more abundant in meltwater than glacier ice at specific locations. This is probably due to supply from upper part of the glacier.

Keywords: Svalbard, glacier, chemical composition, sea salt