Composition of trace elements in Elbrus ice core

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Anthropogenic activity as well as different natural processes bring trace elements to the atmosphere to change its geochemical composition. After being released into the atmosphere, the trace elements can be transported over large distances and deposited on the surface of glaciers. Glaciologically, the Caucasus region is studied comprehensively, however the geochemical composition of glaciers is still poorly investigated. The knowledge of the chemical composition allows us to determine the main source of precipitation and specifies the geochemical environment of glacier formation.

Our data were obtained from the ice core drilled at the Elbrus Western Plateau in 2017 and from the snow pits cut in the Garabashi glacier. Twenty-four trace elements were analyzed in the study. As absolute concentrations do not show the geochemical pattern adequately, the special index, i.e. enrichment factor (EF), was introduced.

According to the calculated degree of enrichment, three groups of trace elements were distinguished. The first group (EF≤10) includes Li, La, Ca, Ti, Pr, V, Cr, Mn, Ni, Sr, Fe, which content corresponds to the clarke. Elements of the second group (EF = 10-100) Cu, Mo, Ag, Cs are characterized by moderate enrichment. The elements of the third group (Cd and Zn) show abnormally high enrichment (EF ≥ 100).

The main hypotheses of the trace element's sources were considered: weathering from local sources (rock outcrops) and subsequent aeolian transfer, dust (long-distant transfer), volcanic aerosols and anthropogenic aerosols (emissions). At this stage, the influence of all input factors is not excluded. The maximum enrichment correlates with the human activity (industry).

To reveal the contribution of local sources due to weathering and aeolian transfer, the average EF of ice core was normalized to the trace elements concentration in samples of potential sources in the Elbrus region. A significant difference was found between the EF of the trace elements studied in the Elbrus core and EF in the samples. Regarding these ratios, it was concluded that trace elements have rather non-local origin.