Pollen analysis of ice cores drilled in the Pamir-Arai Mountains, central Asia

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Ice cores drilled from mountain glaciers usually contains abundant pollen grains supplied from vegetation around the glaciers. Pollen grains have been used in ice core studies as markers of annual layer boundary since they are supplied on the glacier in a certain season of a year. Furthermore, they have been used as a proxy of vegetation in the surrounding area since their composition reflects relative abundance of each species in the source area. An ice core from the surface to the bottom was drilled on a glacier in Pamir Arai Mountains in central Asia in 2016. In this study, pollen grains in a part of the ice core and snow pit were analyzed. Annual layers of the ice core, which were determined based on a seasonality of stable isotope, were compared with the variations of pollen grains concentration, and the seasonality of pollen supplies was examined.
Ice cores were recovered at two sites (sites 1 and 2 at 5300 m and 5208 m, respectively) on the glacier. Oxygen stable isotope in the 7 m deep ice cores at both sites showed significant fluctuations. We assumed that they are periodic seasonal signals and determined the annual layers. As a result, the ice cores of Sites 1 and 2 includes layers for 8 years and 9 years, respectively. Microscopic analysis revealed that 6 types of pollen grains, which were identified as Cupressaceae, Artemisia, Chenopodiaceae, Pinaceae, Betulaceae, and Ephedra, were contained in the ice cores. Mean concentration of the pollen grains was highest for Cupressaceae at both sites (2.20, 2.62 grains/ml (74, 67%)), was second highest for Artemisia (0.65, 1.06 grains/ml (22, 27%)). The depth profile of the pollen grain concentrations showed several spikes in the ice cores. The depth of peaks differed between species. The peaks of Artemisia and Chenopodiaceae appeared at the same depth while the peaks of Cupressaceae appeared just below the depth of their peaks. The peak depths of Artemisia and Chenopodiaceae roughly agreed with the depth of the maximum value of the isotope ratio, indicating that these pollens were supplied in the summer or autumn. On the other hand, Cupressaceae found in the layer below is likely to be supplied in spring or summer. There are exceptional annual layers, in which the peaks of all species were not present, and the flux of pollen grains did not agree between two sites. These inconsistencies were likely due to the influence of the melting of the glacier surface. Results shows that the ice cores contain sufficient pollen grains for analysis and pollen profiles can be used to annual layer counting.

Keywords: Mountain glaciers, Ice core, Pollen, Pamir Arai Mountains, Central Asia

