Seasonally Resolved Age Scale for Greenland SE-Dome II Ice Core Based on Oxygen Isotope Record

*SAAYA HAMAMOTO[1], Ryu Uemura[1], Sumito Matoba[2], Kaoru Kawakami[2], Mahiro Sasage[2], Mai Matsumoto[2], Kei Yoshimura[3], Atsushi Okazaki[4], Yoshinori Iizuka[2]

1. Nagoya University, 2. Institite of Low Temperature Science, Hokkaido University, 3. Institute of Industrial Science, The University of Tokyo, 4. Hirosaki University

Highly accurate age estimation is essential for interpreting past aerosol concentration variations and other data preserved in ice cores with seasonal time resolution. Here, we report the results of a precise age estimation of the SE-Dome II ice core (length 250.51 m) drilled in 2021 in southeast Greenland using $\delta^{18}O$.

We analyzed the oxygen isotope ratio of water ($\delta^{18}O$) with a cavity ring-down spectrometer (L2130-i, Picarro) at 5 cm resolution. Two methods were used to create the age scale: (i) pattern matching of $\delta^{18}O$ with precipitation isotope models based on meteorological reanalysis data (1881-2019) and (ii) an automated annual layer counting algorithm (pre-1881). For 1881-1978, we used a precipitation isotope model based on 20th-century reanalysis data.

As in previous studies (Furukawa et al., 2017), the correlation between the ice core data and the model in (i) was high (r = 0.73), and the pattern matching of $\delta^{18}O$ was able to estimate the age with an accuracy of a few months. High correlations were also obtained for the interval of 20th-century reanalysis data. For the automated annual layer counting (1799-1881), the error was ±1 year. The age scale was also consistent with the reference layers of volcanic eruptions, melting, and Tritium peak.

To confirm the usefulness of the age scale, we applied the age scale to available H_2O_2 concentration data from the SE2 ice core. The results showed that the seasonality of H_2O_2 concentration can be reconstructed within a few months of age uncertainty. These results suggest that the obtained age scale can be used to reconstruct various atmospheric environmental data over the past 140 years at the level of seasonal variations.

References :
Furukawa et al. (2017) Journal of Geophysical Research: Atmospheres, https://doi.org/10.1002/2017JD026716

Keywords: Ice core, oxygen stable isotope

