GISP2 と NGIRP から見た過去 2000 年のグリーンランドの気温変動

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Consistent Greenland temperature variability over the past 2000 years from NGRIP and GISP2

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For the past decades, Greenland temperature has been rising rapidly, inducing melting of ice sheet. Therefore, it is critical to understand how it has been changing (precise records) and why it has changed (causes). To understand the multi-decadal trend of Greenland temperature change, observational records are too short such that another method to infer the past temperature is necessary. Therefore, we have been developing a method to reconstruct the past Greenland temperature from argon and nitrogen isotopes occluded air in ice cores (Kobashi et al., 2008;Kobashi et al., 2010;Kobashi et al., 2011). As our previous reconstructed temperatures were from GISP2 ice core (Kobashi et al., 2010;Kobashi et al., 2011), the new data from NGRIP can provide more robust estimates of Greenland temperature by comparing two records over the past two thousand years. We developed a new gas extraction line from ice core at National Institute of Polar Research similar to the one at Scripps Institution of Oceanography. We used DELTA V isotope ratio mass spectrometer (Thermo Scientific) for isotopic analyses. We found that the machine have very good accuracy but with large linearity corrections for argon isotopes. After the corrections, it is found that determinations of nitrogen and argon isotope ratios from ice cores can be done as accurate as for the GISP2 data.

The NGRIP data for argon and nitrogen are highly correlated (r = 0.98) as expected over the past 2000 years. Theoretically, differences in variations of nitronge and argon isotopes represent temperature gradients between the top and bottom of the firn layer. Isotopic data of GISP2 and NGRIP show similar variation. Preliminary calculation of surface temperature indicates that GISP2 and NGRIP temperatures are significantly correlated over the past 2000 years (r = 0.47, p = 0.02, after slight adjustments on age within its uncertainty). The NGRIP temperature shows clear negative responses to solar variability, which is a persistent character of GISP2 temperature over the past 4000 years (Kobashi et al., 2013;Kobashi et al., in press), indicating that the phenomenon occurred in a large area of Greenland.

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