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Methane concentration in the Dome Fuji ice core measured by a continuous flow analysis system: method and initial results from the LGM to Holocene

Content

A Continuous Flow Analysis (CFA) system has been developed at National Institute Polar Research (NIPR) for major elements, water isotopes, dust, black carbon, and CH4 in polar ice cores. We present the technique for the CH4 measurements and the results of the Dome Fuji (DF) ice core from the LGM to Holocene. We use the melt rate of about 3 cm/min, giving about 1.5 ccSTP/min of air (in the case of high-elevation core with relatively low air content). The gas is separated from the water by a “debubbler unit” and a “degasser tube” and dried by a Nafion tube, following the established method by other laboratories. We use Picarro G2301 operated at low cavity pressure (40 Torr). We draw a calibration line every measurement day using three standard gases from ~300 to 900 ppb, mixed with degassed pure water (at similar flow rates as ice-core samples), extracted, and measured in the similar manner as the ice-core samples. We elevate the raw CH4 data by ~8 % according to the calibration, but they are still lower than those discretely measured with our wet extraction-GC system by about 4 %, possibly due to temperature and bubble size and/or pressure just after the melt head, which is difficult to reproduce. We also found high importance of degassing (both CH4 and bubbling gas) of pure water, thus we employ Helium bubbling (including overnight before each measurement day) and three degassing modules. We remove contaminated CH4 signal from the raw data at most boundaries of ice sticks by slight intrusion of room air (typically 10 – 30 ppb), for about 220 seconds (roughly the time to change 80 % for a total stepwise shift). With the DF data with abrupt transitions over the last termination and 8.2-kyr event, we will discuss the rapid CH4 events in the low-accumulation core (for future applications for the penultimate glacial and older periods), and the possibility of high-resolution gas-age synchronization for chronological/glaciological applications.

Primary authors: KAWAMURA, Kenji (National Institute of Polar Research); Ms YONEKURA, Ayaka (The Graduate University for Advanced Studies, SOKENDAI); OYABU, Ikumi (National Institute of Polar Research); KITAMURA, Kyotaro (National Institute of Polar Research); DALLMAYR, Remi (Alfred Wegener Institut); RHODES, Rachael (University of Cambridge); Mr OGATA, Jun (National Institute of Polar Research); HIRABAYASHI, Motohiro (National Institute of Polar Research); Mrs FUKUDA, Kaori (National Institute of Polar Research); GOTO-AZUMA, Kumiko (National Institute of Polar Research); MOTOYAMA, Hideaki (National Institute of Polar Research)

Presenter: KAWAMURA, Kenji (National Institute of Polar Research)

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