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A dry extraction method for isotope analysis of atmospheric methane and nitrous oxide from ice cores

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Methane is an important greenhouse gas. In order to predict its future concentration, its present budget and past variations need to be understood. Recent data have revealed surprising variations in the stable isotope signatures of CH_4 over the past millennium.

We present a dry extraction method for ice core air coupled to an isotope ratio mass spectrometry (IRMS) technique developed for CH_4 isotope analysis on atmospheric air samples. Ice samples are grated in a stainless steel pot provided with a perforated cylinder (cheese grater) by shaking at -30˚C. Subsequently, the air released from the air bubbles in the ice is adsorbed on Hayesep D in a glass bottle at liquid nitrogen temperature. Finally, the extracted air is flushed with a He carrier gas to the IRMS system. Here, the methane is extracted on a second Hayesep trap, cryo-focused, and sent to the IRMS for isotope ratio measurement.

Our extraction method allows the measurements of δD of methane with an uncertainty of 3-5‰ for ice samples of 400g. Smaller samples can also be analyzed, but with lower precision. The complete process lasts about 3 hours per ice sample and the analytical part has been automated.

The system is presently being extended to allow simultaneous measurement of N_2O isotope ratios on the same ice core sample. For this, the N_2O fraction is cryogenically separated in the extraction step and transferred to our N_2O isotope system.