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Comparison between wet and dry extractions for isotope analysis of Methane and Nitrous Oxide from ice cores

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Methane and nitrous oxide are two important greenhouse gases. In order to predict their future concentrations, their present budgets and past variations need to be understood.

Recent data have revealed surprising variations in the stable isotope signatures of CH4 over the past millennium which underlines the need of D measurements of methane from air trapped in ice core.
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We present a new dry extraction method for ice core air coupled to an isotope ratio mass spectrometry (IRMS) technique developed for CH4 and N2O 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. Before the Hayesep D trap, N2O is cryogenically separated in a U-shape glass. Subsequently, the N2O is flushed in a helium carrier gas to the IRMS system to measure 15N and 18O. Simultaneoulsy, the extracted air from the Hayesep D trap is flushed in a He carrier gas to another IRMS system where methane is extracted on a second Hayesep D trap, cryo-focused, and sent to the IRMS for 13C or D measurements .

Our extraction method allows high precision measurements of D (=2 per mil) and 13C (=0.2 per mil) of methane and is still under testing for the N2O isotopes.

In parallel, a standard wet extraction method was set up for comparison with the dry extraction aiming to determine if any contamination appears during the grating process.

Results of an intercalibration between our extraction system and other systems measuring as well methane isotopes from air trapped in ice core will also be presented.