Abstract ID : **317**

Towards a semi-continuous dry extraction technique for CO_2 and δ^{13}C-CO_2 analysis using laser spectrometry

Content

We face two major challenges in the ice core gas community: resolving centennial-scale changes in high-accumulation ice cores and extracting orbital-scale variability in highly thinned deep ice cores. Ice core measurements of the concentration and isotopic composition of CO_2 are historically costly, labour-intensive, and have a low throughput. A step change, similar to the advances made by continuous flow analysis of CH_4, is needed.

We have focused on developing a new type of dry extraction technique capable of analysing ~3x3 cm ice sticks – akin to continuous flow analysis cross section. In vacuum, a grating surface supports the vertical ice stick and is translated back and forth using a bellows. Experiments with various grating surfaces, including microtome blades, and their impact on extraction efficiency will be discussed. The liberated air is first dried and then condensed in dip tubes (volume ~ 8 mL) using a closed-cycle cryogenic system.

The trapped air is analysed for the concentration and carbon isotopic composition of CO_2 by tuneable infrared laser direct absorption spectroscopy with a custom-built instrument package from Aerodyne Research. The instrument utilises a quantum cascade laser ranging between 2299.6 – 2299.9 cm^{-1} with an optical cell of ~160 mL operating at pressures ranging between 1 and 5 torr – roughly equivalent to a sample size of 0.2 and 1 mL (STP). Sample and reference gas are introduced statically into the cell through critical orifice valves with very fast response times (<8 ms) such that pressure can be controlled to within ~0.001 torr. The instrument uses a fully automated referencing scheme that can interweave multiple references within a series of sample aliquots.

Preliminary tests with dry atmospheric reference gases at glacial levels in SilcoNert-coated dip tubes suggest the instrument is capable of high-precision measurements on at least 4 mL of air for CO_2 and δ^{13}C-CO_2 (1-sigma s.d. of 0.2 ppm and 0.03 per mil, respectively).

Primary authors: BAUSKA, Thomas (British Antarctic Survey); KING, Amy (British Antarctic Survey)

Co-authors: NEHRBASS-AHLES, Christoph (University of Cambridge); EMANUELSSON, Daniel (British Antarctic Survey); WEHR, Rick (Aerodyne Research, Inc.); NELSON, David (Aerodyne Research Inc.)

Presenters: BAUSKA, Thomas (British Antarctic Survey); KING, Amy (British Antarctic Survey)

Track Classification: Progress in proxy development

Contribution Type: Poster

Submitted by **BAUSKA, Thomas** on **Monday, 9 May 2022**