Geophysical Research Abstracts
Vol. 21, EGU2019-9076, 2019
EGU General Assembly 2019

deepSLice: A novel multi-species and high-resolution method for trace gas analytics in extremely thinned ice

Bernhard Bereiter (1,2), Lars Mächler (1), Béla Tuzson (2), Philipp Scheidegger (2), Jochen Schmitt (1), Lukas Emmenegger (2), and Hubertus Fischer (1)

(1) Climate and Environmental Physics and Oeschger Centre for Climate Change Research, University of Bern, Sidlerstrasse 5, 3012 Bern, Switzerland., (2) Swiss Federal Laboratories for Materials Science and Technology, Empa, Überlandstrasse 129, 8600 Dübendorf, Switzerland.

The quest of “Oldest Ice” is to find a location in Antarctica where 1.5 million year old stratified ice could have survived the natural ice throughput in the ice sheet. Potential locations are either places where old ice has survived despite the continuous compression and flow towards the coast in the ice sheet (deep ice near the bedrock), or places where old ice comes back to the surface (e.g. blue ice areas). In particular in the first case of prolonged compression, the oldest ice must be extremely thinned, such that a 10,000 year long glacial/interglacial transition 1.5 million years ago will be found in only 1 meter of a corresponding ice core. With the aim of a century-scale temporal resolution in greenhouse gas records from an “Oldest Ice” ice core, the vertical extent of an ice sample will be constrained to a few centimeters containing only a few milliliters of air (STP). With current analytical methods it is not possible to analyze all greenhouse parameters with only so little sample. Within the ERC Advanced Grant “deepSlice” we aim to change this.

Our approach is to develop a novel method in which we continuously release air from a stick of ice using dry sublimation, and then analyze the collected air from a 1-2 centimeter long section for CO_2, CH_4 and N_2O concentrations, as well as the stable carbon isotope ratio of CO_2. For the extraction, the ice stick is placed in a vacuum vessel and the top surface is illuminated by a high-power mid-IR laser, while the pressure in the vessel is kept low by efficient freezing of the sublimated water and parallel cryo-trapping of the released air. The gas analytical technique is based on non-destructive direct absorption mid-IR laser spectroscopy using two quantum cascade lasers (QCL). This configuration allows for simultaneous analytics of all the target species, and in addition the re-use of the precious air for subsequent analysis. We will present the challenges and advances of this ambitious development, with a special focus on the high-precision levels reached in all parameters with the custom-made dual QCL spectrometer.