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IsoCarb: A new analytical tool for measuring $\delta^{13}\text{CO}_2$ in ice cores

Content

New ice core drilling projects such as the on-going EU Beyond EPICA-Oldest Ice project provide a thrilling opportunity to extend the temporal coverage of existing records back to 1.5 Myr. However, it is expected that the very deep and old ice has experienced extreme thinning with almost 15 kyr being compressed into barely 1 m of ice. Analysing climate proxies on the very deep ice cores, especially at the sub-millennial scale, requires improving analytical precision and accuracy as well as reducing air (and therefore ice) sample size to ensure optimal temporal resolution.

In the framework of the Labex OSUG IsoCarb project, we are currently developing a new multi-parameter optical spectroscopy instrument measuring both CO_2 concentration and its isotopic signature ($\delta^{13}\text{CO}_2$) in ice cores with an analytical precision below 1 ppm and 0.04‰ respectively. Based on the direct mid-infrared absorption technique, it relies on the injection of a tunable ICL DFB diode laser operating at 4.35 microns into a 20 cm dual optical cell. The spectrometer is coupled to a dry air extraction system, based on a ball mill crusher where dead volumes and CO_2 degassing will be minimized. Hence, our approach will allow fast (few minutes) and high precision $\delta^{13}\text{CO}_2$ measurements while reducing the size of ice sample (aiming for 20 g per measurement, compared to 400-500 g needed with current available techniques). Measurements made with our new instrument provide unique constraints on past carbon cycle changes from glacial-interglacial to multi-centennial timescales. Details on the undergoing development and preliminary results will be presented.

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