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Impurities in ice as measured by laser ablation – extracting the climate signal from high resolution line scans through use of a conceptual model and comparison with meltwater analysis

Content

The application of the technique laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) on ice has so-far revealed high resolution line profiles and, relatively recently, also 2D maps of impurities in glacier ice. With its high resolution and micro destructiveness, this technique promises to be of great use in analysing deep and highly thinned ice. High resolution line profiles obtained from LA-ICP-MS have been shown to agree with CFA signals but only when smoothed substantially. At the same time, the high resolution signal components have shown a strong association of impurities with the crystal matrix. This association with the crystal matrix may be especially obstructive in deep ice with large crystals. Thus, a reliable procedure to isolate the climate signal from high-frequency spatial variation in the impurity distribution, comparable to that given by continuous flow analysis (CFA), has yet to be developed for the highest possible resolution. For each section of ice we require the determination of some ideal resolution, a 'sweet spot', that gives information on both an impurity's high resolution variation and on its climate signal.

Here we will present progress made towards creating a conceptual model that will guide the choice of experimental parameters and subsequent analysis to exploit data acquired from LA-ICP-MS scans to reliably extract the climate signal. We will discuss our current understanding of the link between the high frequency impurity signal and the climate signal and our aim to validate calibrated LA-ICP-MS signals through comparison to CFA. This work will provide a framework for LA-ICP-MS climate-focused analysis of ice, ready for the arrival of ice from the BEOI core.

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Track Classification: The Oldest Ice challenge, and the preservation of climatic signals in the deepest ice