Abstract ID : **162**

Laser Ablation sampling for water isotopic analysis on ice cores

Content

The Beyond EPICA project for retrieving the Oldest Ice Core (1.5 Myr) in Antarctica aims at obtaining high resolution climate records and water isotopes will be one of the most important parameters investigated. Given the extremely thin nature of the annual ice core layers, as we get deep down to the core, analysis of such an ice core requires new adopted techniques on water isotopes with high accuracy and precision. Laser ablation (LA) is an established powerful technique used in various fields and it can also be applied in ice sampling serving a dual purpose: a.direct solid-gas transition and b. the smallest amount of sample possible is used for analysis and that makes LA a micro-distructive process. A new instrument which couples LA sampling with the established Cavity Ring Down Spectroscopy (CRDS) for water isotopic analysis is developed. This novel design will allow both fast gas phase sample collection directly from the ice sample and high quality water isotopic measurements. Particular focus was given in the LA system which consists of a High Energy femtosecond IR LASER and the optical elements that focus the LASER beam into the ice surface. The focusing lens system is placed inside a freezer, up above a motorized stage that accomodates the ice sample. An enclosure supplied with dry air flow was built around the optics and tested by the means of humidity experiments. Subsequent series of experiments with varying laser ablation parameters: pulse energy, repetition rate, ablation time, together with the ablated crater characterization allow the evaluation of LA efficiency in ice and thus the optimization of the parameters controlling the ablation mechanism. Understanding the LA mechanism will provide the knowledge to further develop the sampling procedure and efficiently control and guide the vaporized ice into a CRDS instrument for detection.

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