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Published in:
Geophysical Research Abstracts

Publication date:
2014

Document Version
Early version, also known as pre-print

Citation for published version (APA):
Lunga, D. D., Muller, W., Rasmussen, S. O., & Svensson, A. (2014). Ultra high resolution cation analysis of NGRIP deep ice via cryo-cell UV-laser-ablation ICPMS. Geophysical Research Abstracts, 16, [EGU-11660].

Geophysical Research Abstracts
Vol. 16, EGU2014-11660, 2014
EGU General Assembly 2014

Ultra high resolution cation analysis of NGRIP deep ice via cryo-cell UV-laser-ablation ICPMS

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During glacial periods, Earth experienced abrupt climate change events that led to rapid natural warming/ cooling over a few years only (Steffensen et al., 2008).

In order to investigate these rapid climate events especially in old thinned ice, highest spatial/time resolution analysis of climate proxies is required. A recently developed methodology at Royal Holloway University of London (Müller et al., 2011), which permits in situ chemical analysis of frozen ice with spatial (and thus time) resolution up to 0.1 mm (100 ?m) using cryo-cell UV-laser ablation inductively-coupled-plasma mass spectrometry (UV-LA-ICPMS), has been optimized and utilized for analysis of (major) elements indicative of dust and/or sea salt (e.g. Fe, Al, Ca, Mg, Na), while maintaining detection limits in the low(est) ppb-range.

NGRIP samples of Greenland Stadial GS22 ($\sim$86 ka, depth of $\sim$2690 m), representing a minor δ^{18}O shift (of about $\pm$ 4%¸) within the stadial phase of D-O event 22, have been selected and analysed. With a single storm-event resolution capability, seasonal, annual and multiannual periodicity of elements have been identified and will be presented with particular focus on the phasing of the climate proxies. Corresponding results include also an optimized UV-LA-ICPMS methodology, particularly with reference to depth-profiling, assessing contamination of the sample surface and standardization. Finally, the location and distribution of soluble and insoluble micro-inclusions in deep ice have also been assessed concerning the partitioning of elements between grain boundaries and grain interiors. Results show that impurities tend to be concentrated along boundaries in clear (winter) ice, whereas in cloudy bands ('dirtier' ice) they distribute equally between boundaries and interiors.

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