Study of pretreatment methods on removing ice surface contamination for ultra trace elements analysis in Antarctic ice core

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Introduction

Antarctic ice cores are the most important samples for the paleoclimatology. These cores also potentially provide us background information for trace to ultra-trace elements in wet precipitations since these samples have been stayed far from anthropogenic sources either time or space. To investigate ultra-trace elements in the ice cores, it is most important to remove surface contaminations.In this study, we made clean ice samples in a laboratory using ultra-high purity water and contaminated their surfaces intentionally by a solution of known concentrations of trace elements, and examined pretreatment procedures to reduce ice surface contaminations.We tested the pretreatment procedures using an Alaskan Glacier Ice.

Methods

We tested three different procedures using surface contaminated ice pieces. The ice pieces were made of ultra-high purity water.In the first experiment, we used a 10ppb standard solution of six elements Co, Zn, Cs, Ba, Pr and Pb. The ice pieces were dipped in the solution and frozen again.Surface removing procedures were classified to three processes, (1) 60% of the surface ice was removed by ultra-high purity water, (2) 50% of the surface ice was mechanically shaved by a ceramic knife, (3) combination of mechanical shaving and washing by ultra-high purity water. In the second experiment, dipping solution was changed to 100ppb containing Co, Zn, Sn, Sb, Cs, Ba, Pr and Pb. Surface removing procedure was only washing process, namely removing surface ice 10, 20, 30, 50% respectively. In the third experiment, the ice surface was removed 50% by ultra-high purity water. This process was repeated three times. We applied 50% washing procedure to an Alaskan Glacier Ice. The small block of ice was washed and melted the surface by ultra-high purity water to 50% by weight. Sixty-three elements were analyzed by ICP-MS (PQ-ExCell-S, Thermo Elemental, UK) including rare earth elements (REE) and platinum group elements (PGE).

Results and discussion

The first experiment indicated that the surface washing procedure by ultra-high purity water showed better performance than the mechanical shaving. The ice for which the surface was removed 60% showed essentially the same level of blank. The second experiment indicated that 50% surface removal by ultra-high purity water was sufficient to reduce the surface contamination. In the third experiment, we confirmed reproducibility of the method (50% removal). We applied the method to an Alaskan Glacier Ice and measured 63 elements.To remove surface contamination on the ice core samples, it was effective to wash and melt the surface of the core by ultra-high purity water to 50% by weight.