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Characterization of Aerosols in the Snows on Styx Glacier, Antarctica

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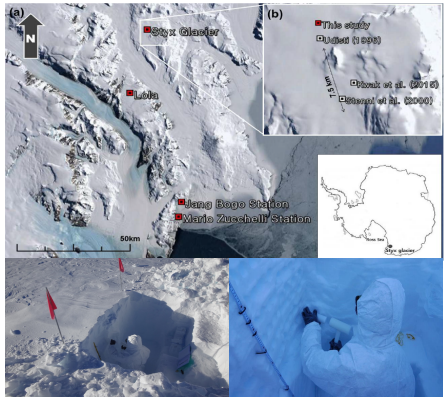
ABSTRACT

Atmospheric aerosols are conservatively archived in polar ice sheets, which can be used to reconstruct past climate conditions in their source regions as well as long-range atmospheric transport patterns. We investigated recent snow chemistry and mineral dust records in the snow pit recovered from Northern Victoria Land in Antarctica. We estimated the age of the snow pit to cover approximately 4 years from 2011 to 2014/2015 based on seasonal variations in $\delta^{18}O$, δD, and major ion values. Here we present the data record for various chemical components such as trace elements from the snow samples using inductively coupled plasma-sector filed mass spectrometry (ICP-SFMS) equipped with Apex sample introduction systems. We observed high crustal enrichment factors (EFs) for the elements As, Bi, Cd, Cu, Mo, Rb, Sb, Tl, and Zn at the depth of 70 ~ 80 cm that are a summer season in 2013. We focus on analysis of chemical compositions of individual particles in the samples to understand the origins of elements using quantitative energy-dispersive electron probe X-ray microanalysis, called low-*Z* particle EPMA. The complementary information obtained from both ICP-SFMS and low-*Z* particle EPMA is expected to provide the source of aerosols.

Site and Sampling



(a) The location of Styx glacier 85 km north of Jang Bogo Station and Mario Zucchelli Station.
(a) The snow pit sampling site for previous studies and this study within the Styx glacier area.

Sampling: a 1.6 m snow pit at Styx Glacier plateau (73°51.10′S, 163°41.22′E) in Victoria Land, Antarctica, during 2014/2015 austral summer season.

- We obtained 32 snow samples using an PTFE tube and hammer.
- Ultraclean procedures and great precaution were taken during all the sampling steps to prevent the possibility of snow contamination.
- Snow samples were collected in pre-cleaned 1L LDPE bottles.
- All sample bottles were double sealed and transported back to KOPRI clean laboratory, which were stored at –20 ℃ until analysis.

* The map was modified from a Google Earth image.

low-Z particle EPMA

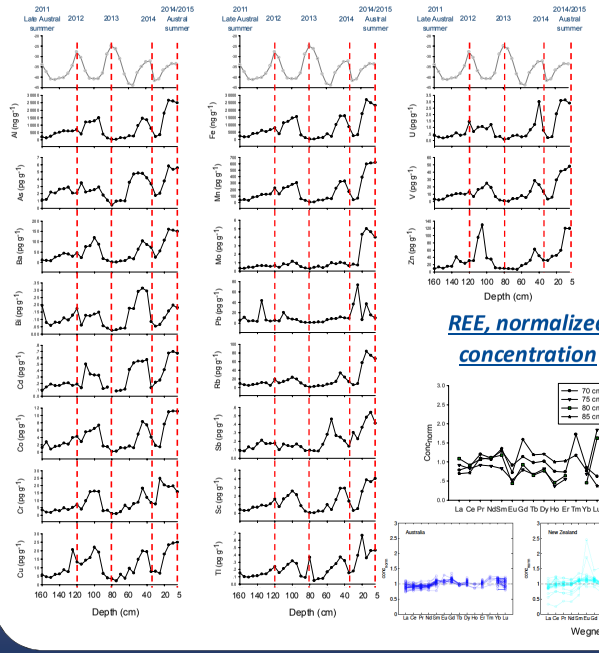
Single particles were analyzed by low-*Z* particle EPMA (SEM/EDX), equipped with an ultra-thin window EDX detector to analyze low-*Z* elements, such as C, N, and O.
Single particles were classified into several types based on chemical composition and morphology. From the analysis of aerosol particle type s, their potential sources and aging can also be understood.

*** SEM/EDX**
(Scanning Electron Microscopy / Energy Dispersive X-ray Spectrometry)
- Individual Particle Analysis
- **shape and size : secondary electron images**
- **chemical compositions : X-ray spectrum**

On an average 100 ~150 particles were analyzed for each sample using low-*Z* particle EPMA.
→ using INCA software, with a 10kV accelerating voltage and 0.5nA beam current
Combined X-ray spectra, atomic concentration, and morphology.
→ obtain the information on particles types.
→ quantitative analysis is possible.
Classified by soil-derived, secondary nitrates/sulfates, mixture groups

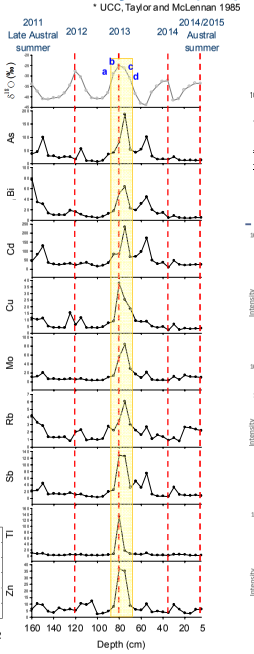
Results and discussion

Trace elements concentration (pg g^{-1} , ng g^{-1})



REE, normalized concentration

Enrichment factors (EFs)



Typical secondary electron images & spectra