Preliminary results of an ice core obtained from Northwestern Greenland Ice Sheet (SIGMA-D).

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1. INTRODUCTION
To elucidate the snow/ice albedo feedback effect caused by snow grain growth and light-absorbing snow/ice impurities, including glacial microbes, for the recent abrupt snow/ice melting in the Arctic, the Snow Impurity and Glacial Microbe effects on abrupt warming in the Arctic (SIGMA) Project was launched in 2011 (Aoki et al., 2014). In this project, we conducted ice core drilling and snow observations in the northwestern Greenland Ice Sheet (GrIS) in 2004 to reconstruct temporal variations of snow albedo and climate changes in GrIS. We also established an auto weather station at the drilling site.

2. FIELD OBSERVATIONS AND CHEMICAL ANALYSES
We flew seven personnel and equipment (3000 kg) from Qaanaaq, which was mail settlement in northwestern Greenland area, to drilling site (SIGMA-D site; N77°38', W5º07', 2100m a.s.l.) by three flight of Twin Otter airplane on 5 May. We conducted 222m ice coring with an electro-mechanical drill developed by Geotech Co. Ltd. Ice cores were measured stratigraphy, density and analyzed by near infrared photometry in whole depth. The ice cores from surface to 112m depth were cut vertically, and half portion (40%) was used for preparation of liquid samples for chemical analysis in 5cm interval and the other portion was packed in insulation boxes. The ice cores from 112m to 175m were cut vertically, and half portion was removed and discarded to reduce volume of ice core samples. After three weeks for observation and one week for waiting owing to bad weather, we flew back 7 personnel and equipment (2500 kg) to Qaanaaq by two flight of Twin Otter, and two personnel and ice core samples (1000kg) from Qaanaaq to Resolute by one flight of Twin Otter on 3 June. In Resolute, the ice core samples were kept in cold rooms of Polar Continental Shelf Program Resolute Facility, and transported to National Institute of Polar Research by commercial flight in frozen. We also conducted a bore hall logging, snow pit observations for snow collection and near infrared photometric observation, measured surface flow velocity and surface elevation around the drilling site by GPS system. We established an auto weather station near drilling site. The measurement parameters were air temperature, relative humidity, air pressure, wind speed and direction, snow height change, down and upward solar radiation, down and upward longwave radiation, snow temperature, and tilt angle of AWS main pole. The ten-minute average data are stored on a data logger, and are transported to us via Argos satellite. These data are prepared to open on the Arctic Data archive System (ADS) in National Institute of Polar Research.

Liquid samples were transported to Institute of Low Temperature Science, Hokkaido University after research expedition, and were kept frozen until chemical analyses were done. Chemical species were determined with an ion chromatography (Thermoscientific, ICS-2100), and stable isotope ratios of water were measured with a cavity ring-down spectroscopy (Picarro, L-2130i). We analyzed the samples from surface to 11.2m.

3. RESULTS
Figure 1 shows a profile of density of the ice cores. The pore close-off depth, where density of ice core reached to 830 kg m⁻³, was approximately 60m, which was comparable to that (68m) in Camp Century 70km south from SIGMA-D (Gow, 1971). Figure 2 shows the profile of δD in ice cores from surface to 11.2m, which corresponds to 4.5m water eq. The profile of δD showed obvious seasonal variations. We calculated annual thickness which was determined by the distance of δD negative peaks. The depth of 11.2m corresponded to AD 1995, and average accumulation rate from 1996 to 2013 was 0.21 m water eq. yr⁻¹, which was also comparable to those reported in previous studies (Bales et al., 2009)
References

![Figure 1. Density profile of ice cores obtained from SIGMA-D](image1)

![Figure 2. Profile of δD from surface to 4.5m water eq. depth at SIGMA-D](image2)