Layering, densification and bubble close-off of firn at a new site near Dome Fuji, East Antarctica

*Ryo Inoue[1], Shuji Fujita[2,1], Kenji Kawamura[2,1,3], Fumio Nakazawa[2,1], Ikumi Oyabu[2]

1. The Graduate University for Advanced Studies, SOKENDAI, 2. National Institute of Polar Research, 3. JAMSTEC

Ice cores provide proxies for chronology and past climatic changes from their ice and gas compositions, and the understanding of firn layering, densification and gas fractionation processes is crucial for better interpretation of the ice-core records. It has been hypothesized that metamorphism and geometric layer structure of firn determines the processes on gas trapping at deep firn, such as the depth range where bubbles are formed, close-off depth and the fractionation of gas components. Fujita et al. (2009; 2016) has reported in detail the layer structure of firn around Dome Fuji, East Antarctica. However, little is understood on the relationships between the geometric layer structure, bubble formation, and gas fractionation. For example, degree of growth of geometric anisotropy differ from one location to another (Fujita et al., 2016), but it is not known as to how such site-dependent difference influences gas trapping process. Another example is poor understanding of the effect of insolation on ice crystal fabric formation and/or water isotope composition. Therefore, it is important to clarify spatial variability of geometric properties of firn and gas trapping process to compare site-dependent variability of ice core signals, especially because a deep drilling of an oldest ice core is planned near Dome Fuji in the near future.

A new shallow ice core was drilled to ~152 m in December 2017 at a site about 54 km south of Dome Fuji station (named NDF, 77°47’ 18S, 39°3’ 15E, 3763 m a.s.l.). Up to now, we have measured multiple physical properties on this ice core; density and geometric anisotropy using a dielectric permittivity tensor measurement, near-infrared reflectance of firn (a proxy for specific surface area) using an optical method, and qualitative measure of permeability using an air-suction system. We also plan to analyze gas component of bubbles at high resolution to quantify gas fractionations in layer-by-layer scale. In the JpGU presentation, we will report the results of the physical properties on the NDF shallow core and compare them with those from the Dome Fuji and Dome Fuji South cores (Fujita et al., 2009; 2016).

Fig. Shallow core sites around Dome Fuji. Numbers after site names indicate the drilling season.

Keywords: firn, layering, densification, ice core