Proc. NIPR Symp. Polar Meteorol. Glaciol., **11**, 253, 1997

HIGH RESOLUTION DENSITY PROFILE OF ICE CORES MEASURED BY A NEW X-RAY METHOD (ABSTRACT)

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The density of ice cores is one of the fundamental quantities in ice core studies. In order to clarify the densification and close-off processes at a drilling site, a depth profile of the densities has been measured by the conventional volumetric method. However, the method requires laborious work and time consuming procedures. In addition, the method itself has a drawback in depth resolution, because it also requires a large volume of sample. Since density variations with much shorter wavelengths than the resolution of the method have been suggested by optical observations of ice cores, it has been desired to develop a new method with higher depth resolution. In the present study, we aim to apply the X-ray absorption method for this purpose. From the view point of the X-ray absorption method, an ice core is a material composed of pure ice and pores, and small amounts of impurities included in ice can be neglected. Accordingly, transparent X-ray intensities depend only on the densities of the ice cores. The ice core samples were prepared with a microtome knife so that a long bar sample has two parallel flat surfaces. The profile of transmitted X-ray intensities directly measured was converted to that of densities, using a calibration curve for transmitted intensities against various thicknesses of pure bulk ice. The depth resolution of the present method is 1mm in these preliminary measurements. Taking account of statistical errors in X-ray intensity measurement and fluctuations of the sample thickness along the sample axis, the error included in each data point of the density profile is about 1%. In order to obtain high sensitivity to density variations, the X-ray generator was operated at low voltage below 30 kV. A two dimensional detector of X-rays, the Imaging Plate, was also used for observing layer structures of the ice cores. The intensity measurement takes only about 5 min for a sample with a length of 500 mm. Such a very quick measurement can be achieved by a strong X-ray generator, Rigaku RU-300, installed in a cold room. The method was applied to Dome Fuji shallow cores. As a preliminary result, we found seasonal variations of density and very thin layers with very high densities.

(Received January 16, 1997; Revised manuscript accepted March 18, 1997)