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# TEXTURES AND FABRICS OF 700-M DEEP ICE CORE OBTAINED AT MIZUHO STATION, EAST ANTARCTICA

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***Abstract:*** Crystal grain-areas and shape factors of a 700-m deep ice core obtained at Mizuho Station (70° 41.9′S, 44° 19.9′E), Antarctica, in 1983–1984 were measured from photographs of thin sections taken in crossed polarized light within a month after the core recovery. Also, *c*-axis orientations were examined with the sections at selected depths *in situ*. Comparison of the data with those of the Camp Century, Dye III and Byrd Station cores indicated the ice of the late Wisconsin might be existing at depth below about 520 m at Mizuho Station.

## 1. Introduction

The past climate as well as the ice flow conditions influence the depth profiles of crystal grain textures and fabrics in deep ice cores. For example, a sudden decrease in crystal size and a marked enhancement of ice fabric pattern (*c*-axis orientations) were found over a very short depth interval at 1149 and 1200 m in the Camp Century core and the Byrd Station core, respectively (HERRON and LANGWAY, 1982). These pronounced changes were considered to take place at the boundary between the last Wisconsin ice layer and the Holocene ice on the top of it.

In 1983–1984, glaciological parties of the 24th and 25th Japanese Antarctic Research Expedition (JARE) carried out ice-coring down to a depth 700 m at Mizuho Station, East Antarctica, as part of the Glaciological Research Program in East Queen Maud Land. The obtained core was subjected to the grain texture and fabric analyses. In the present paper, the results of the observations are presented, and compared with those of other deep cores obtained at Byrd Station, Camp Century and Dye III.

## 2. Methods and Results

### *2.1. Crystal grain area and its shape factor*

For texture analysis, horizontal thin sections were prepared at 20 depths between 70 and 700 m within a month of the recovery of the core. The cross-sectional area and the shape factor of the grains were obtained on the photographs of the thin sections taken in crossed polarized light using a semi-automatical particle analyzer, for which 200 to 300 crystal grains were measured. Where, the shape factor is a dimensionless parameter and expresses the complexity of crystal grains. It is defined by the ratio of the circumference ($L_c$) of a circle which has the same area of a grain to its actual periphery length ($L$). Figures 1a and 1b show the vertical profiles of arithmetic mean values of these quantities. It can be found from Fig. 1 that they are almost equal against depth. However, thin sections seldom intersect crystal grains at their maximum diameter. Therefore, the average grain size obtained from thin-section analysis would

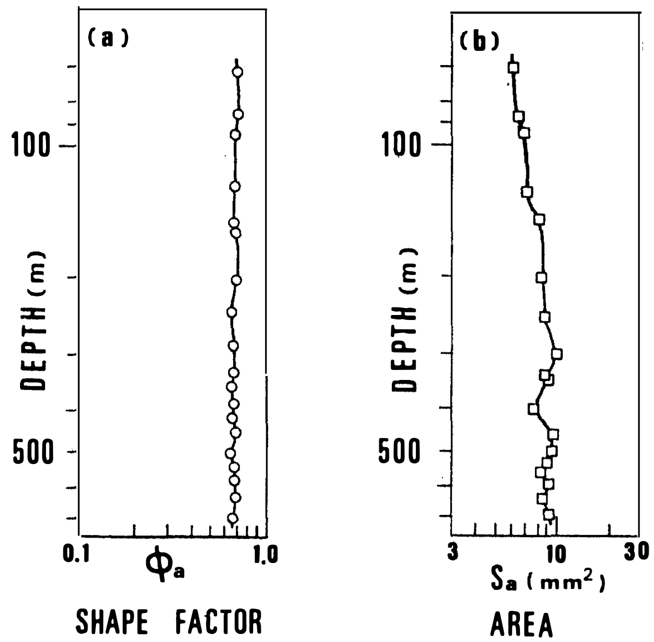


*Fig. 1. Arithmetic mean values of shape factor ($\phi_a$), and area ($S_a$) versus depth in the Mizuho Station core.*

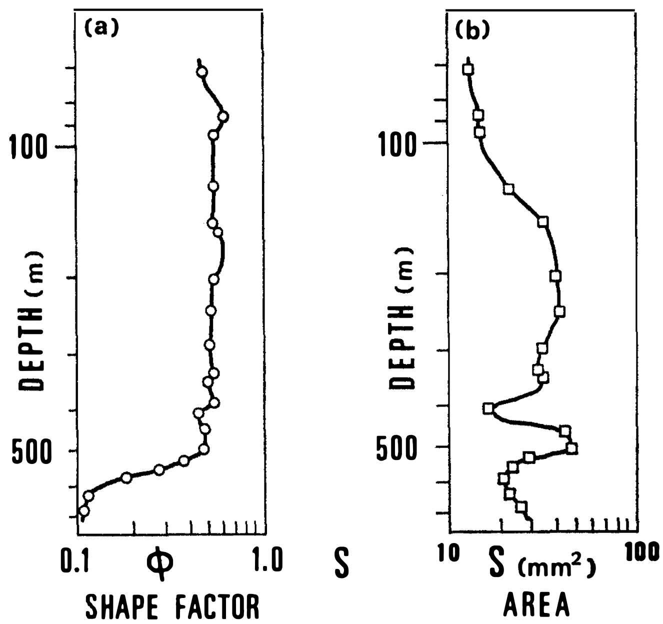


*Fig. 2. Shape factor ($\phi$), and area ($S$) versus depth in the Mizuho Station core. These values were obtained by taking 75% large value in the distribution of shape factor and area of crystal grains.*

be less than the actual value in general, and in order to obtain precise values from thin-section analysis, we must consider the problem as described above. KRUMBEIN (1935) found that the observed average size was some 24% smaller than the actual. The result was applied to our present analysis. That is, for representative values of cross-sectional area and the shape factor of crystal grain of core at a depth, the average value over the interval of difference between the arithmetic value and the maximum value of the distribution was obtained. The representative value is called "75% large value" of distribution in this paper. Figures 2a and 2b give the vertical profile of 75% large value of the grain area and the shape factor to the 700 m depth. As seen from the figures, shape factors were almost constant to about 520 m in depth, but below 520 m they decrease suddenly. On the other hand, the grain areas increase gradually to about 160 m in depth, and between 160 and 520 m they are almost equal if the value at 400 m can be eliminated. Below 520 m in depth they decrease suddenly in the same manner as the shape factor.

*2.2. Fabrics*

Crystal *c*-axis orientations were measured on horizontal thin sections by using a Rigsby-type universal stage (RIGSBY, 1951). Those at depths of 100.1, 201.9, 401.9 and 600 m are shown in Figs. 3a–3d, respectively. As is obvious from the figures, they are distributed at random at shallow depths up to about 200 m. However, their concentration increased gradually with increasing depth, and the fabric pattern became a great circular girdle at the 600 m depth.

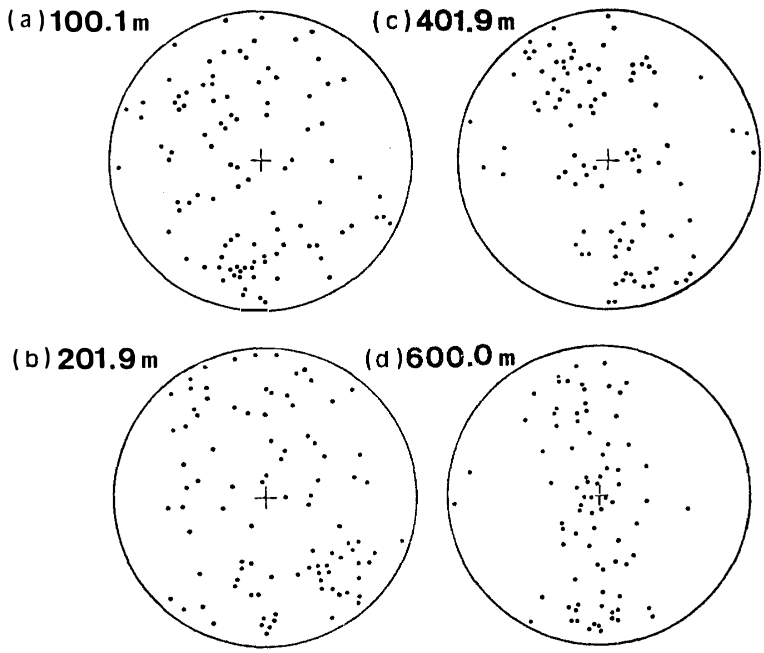


*Fig. 3. Fabric pattern of the cores from Mizuho Station. Dots represent c-axis orientations plotted on the Schmidt net.*

## 3. Concluding Remarks

HERRON and LANGWAY (1982) and HERRON *et al.* (1985) carried out the measurements of crystal size and $c$-axis orientation with the deep ice cores from Byrd Station, Antarctica, and Camp Century and Dye III, Greenland. According to these results, at the crystal size increased gradually with increasing depth at shallow depths, and remained fairly constant in the intermediate-layer. On the other hand, $c$-axis preferred orientation was gradually becoming a concentrated pattern from the random distribution at shallow depths with increasing depth. At deeper depths (at 1149 m in the Camp Century core, Greenland, and 1200 m in the Byrd Station core, Antarctica), crystal sizes decreased suddenly and fabrics were markedly enhanced over a very short depth interval (HERRON and LANGWAY, 1982). At 1787 m of the Dye III core, Greenland, the similar profile was recognized also (HERRON *et al.*, 1985).

Profiles of crystal grain area and its shape factor of the Mizuho Station core shown in Fig. 2 have a very similar tendency to the results of the above-mentioned deep cores. The pronounced change at the 520 m depth in the Mizuho Station core may possibly imply a climatic analogy to the Camp Century core, the Byrd Station core, etc., although we can not find the remarkable enhancement against the depth in fabric patterns of the Mizuho Station core. However, for the details of the climatic implication, we shall wait for future studies such as stable oxygen isotopic composition analysis.

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