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# DISTRIBUTION OF SURFACE CONDITIONS OF ICE SHEET IN ENDERBY LAND AND EAST QUEEN MAUD LAND, EAST ANTARCTICA

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***Abstract:*** Data on surface features collected by the Japanese Antarctic Research Expedition (JARE) along traverse routes were compiled to understand their aerial distribution in Enderby Land and East Queen Maud Land. This area can be divided into three regions on the basis of the regional characteristics of surface features. The results will be useful for deducing the aerial distribution of surface features from satellite images.

## 1. Introduction

There exist many types of surface features, such as sastrugi, snow dunes and pitted patterns on the Antarctic ice sheet. Smooth and glazed surfaces should also be considered as kinds of surface features. Surface features represent stages of the deposition-erosion process and may be an index of surface mass balance of the ice sheet (WATANABE, 1978). For the study of the mass and heat balance of the Antarctic ice sheet, it is important to clarify glazed surface distribution characteristics. Especially, a glazed surface which is composed of multilayered ice crust is thought to be a long-term (more than a few years) accumulation-free surface (WATANABE, 1978), and mass loss exceeding $5\ g\cdot cm^{-2}$ per year occurs at the glazed surface of Mizuho Station due to sublimation (FUJII and KUSUNOKI, 1982).

The Japanese Antarctic Research Expeditions (JARE) have carried out observations of surface features along the traverse routes. Here we compiled data collected in the period between 1968 and 1988, and obtained the distribution of surface features along traverse routes in Enderby Land and East Queen Maud Land.

## 2. Sources of Data

Sources of data are listed in Table 1. Some unpublished data were provided by traverse party observers in the form of field notes and personal communications. The observation periods extend over various seasons from 1968 to 1988.

*Table 1. Sources of data.*

| Expedition | Route | Season of observation | Source of data |
|---|---|---|---|
| JARE-9 | S | Sep. 1968–Feb. 1969 | FUJIWARA and ENDO (1971) |
| JARE-11 | Y, W | Nov.–Dec. 1970 | WATANABE (1978) |
| JARE-15 | I, J | Oct.–Dec. 1974 | WATANABE (1978) |
| JARE-22 | Y, V | Jan.–Feb. 1981 | SATOW (unpublished) |
| | U | Nov. 1981 | SATOW (unpublished) |
| JARE-24 | RY, KR, YM | Oct. 1983–Jan. 1984 | NARITA (unpublished) |
| JARE-25 | IY, ID | Oct.–Dec. 1984 | FUJII *et al.* (1987) |
| | ES | Nov. 1984 | FUJII (unpublished) |
| | S, H, Z | Jan. 1985 | FUJII (unpublished) |
| JARE-26 | IM | Sep.–Oct. 1985 | AGETA (unpublished) |
| | ID, DF | Nov.–Dec. 1985 | AGETA (unpublished) |
| | IR, KR, RY, L | Jan.–Feb. 1986 | AGETA (unpublished) |
| JARE-27 | SS | Oct.–Nov. 1986 | NISHIO (unpublished) |
| JARE-29 | IM, E | Oct.–Dec. 1988 | WATANABE and FURUKAWA (unpublished) |

## 3. Classification of Snow Surface Features

The traverse parties did not have common definitions or terminology for the surface features. Therefore, surface features are morphologically classified into four categories for the present compilation as described below on the basis of the average scale and conditions of the surface features.

Rough snow surface: composed of sastrugi and/or dunes greater than 30 cm in average height.

Smooth snow surface: composed of a smooth surface, erosional pits, and/or very small-scale sastrugi and dunes (less than 30 cm in average height).

Glazed surface: composed of flat and multilayered ice crust. Usually polygonal cracks are visible on the surface.

Bare ice surface: composed of ice around mountains and coastal region.

FUJII (1981) showed daily, seasonal changes of surface condition on the basis of observations through the year at Mizuho Station (70°42′S, 44°20′E, 2230 m a. s. l.). However, such observations were not carried out in other areas. In this compilation, we don't consider the difference of seasons which observations were carried out.

## 4. Characteristics of the Distribution of Snow Surface Features along Traverse Routes

The distribution of surface features along the traverse routes is shown in Fig. 1. From this figure, this area can be divided into three regions on the basis of the degree of alternation of types of surface features as described below.

(1) Region I (elevation lower than about 2000 m)

This region is characterized by smooth surface. Below the firn line, superimposed ice or bare ice is exposed during the summer season. But near Asuka Station, rough surface also exists.

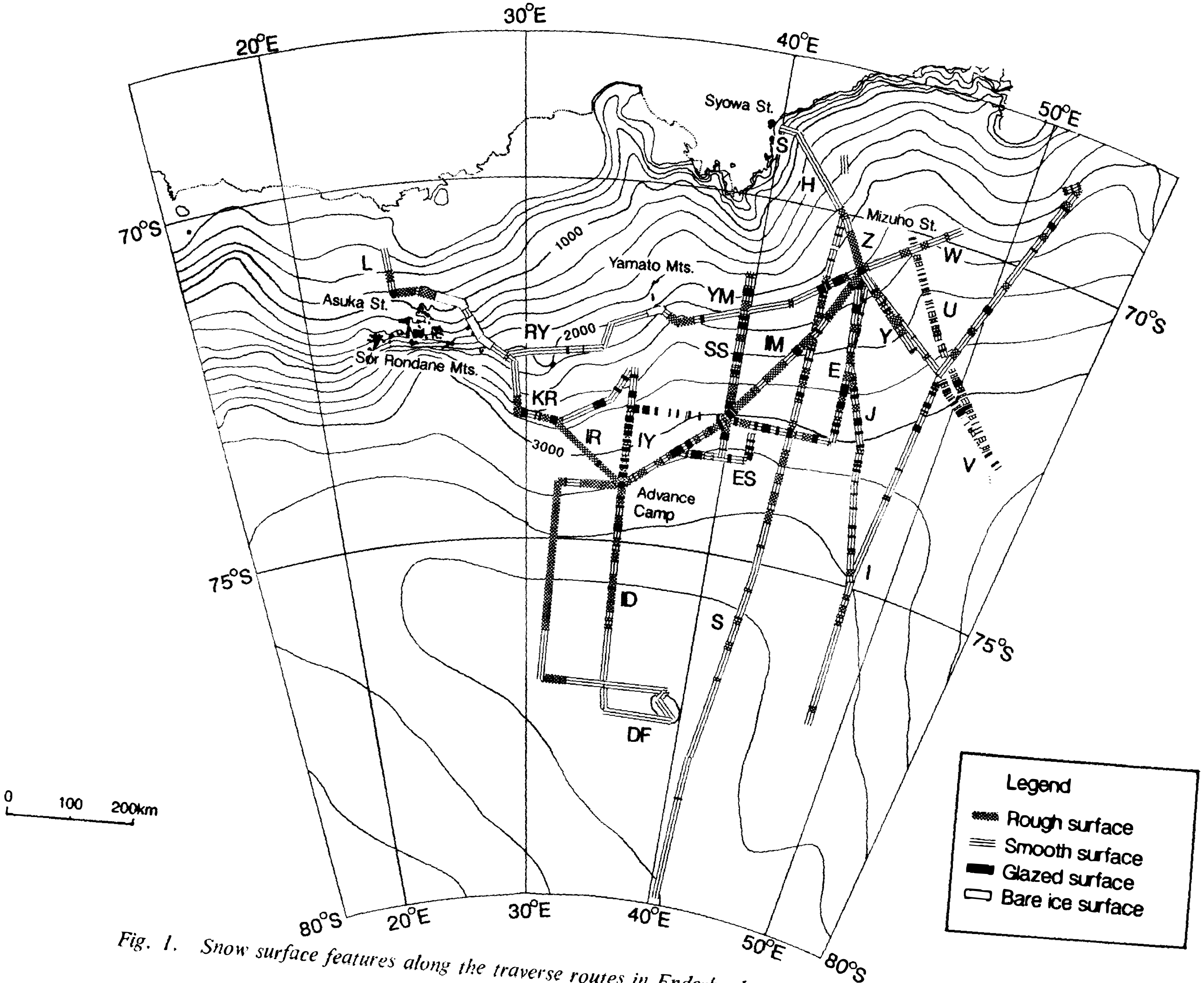


*Fig. 1. Snow surface features along the traverse routes in Enderby Land and East Queen Maud Land.*

(2) Region II (elevation about 2000 m to 3200–3700 m)

This region is characterized by glazed surface and sastrugi. Along the routes in this region, rough, smooth and glazed surface are alternately observed at intervals from several to tens of kilometers. Upper limits of this region are different between traverse routes. For example, along Route-ID, the upper limit elevation is about 3700 m, along Route-S it is about 3400 m and along Route-I it is 3200 m. Regions where sastrugi exist extend to higher elevation than those where glazed surface exists.

(3) Region III (elevation higher than 3200–3700 m)

In this region, smooth surface predominates. Surface feature scales become small. Along the ice divide and around the highest part of the observed area, glazed surface is hardly observed. In such an area, the surface slope is relatively small, less than $1.5\times10^{-3}$ (AGETA *et al.*, 1989).

## 5. Discussion

Here we discuss factors controlling the distribution of snow surface features described above.

The distribution of surface features is related to the erosion and deposition process due to katabatic wind. Because the velocity of katabatic wind is small in the interior region where the surface slope is gentle, the erosion and deposition process is inactive in such an area. The area where surface features are alternately distributed seems to correspond to the strong katabatic wind regime simulated by PARISH and BROMWICH (1987). These indicate a close relationship between the surface feature distribution pattern and ice sheet topography.

For occurrence of the alternation of surface features along the traverse route in a region from about 2000 m to 3200–3700 m, we think that the existence of undulation with the wavelength of the order of several to tens of kilometers on the ice sheet (*e.g.*, BUDD and CARTER, 1971; MCINTYRE, 1986) is important. FUJII *et al.* (1987) indicated that the glazed surface develops on a relatively steep slope where the katabatic wind accelerates and snow deposition does not occur.

FUJII *et al.* (1987) also compared the ground observation of surface conditions along the route with NOAA-7 AVHRR data and indicated that the variations of ice sheet surface radiance in CH. 2 and 4 are well related to the glazed surface distribution. Further study of the aerial distribution of surface features with NOAA AVHRR data is now in progress.

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