Geomorphological and Glaciological Survey of the Minami-Yamato Nunataks and the Kabuto Nunatak, East Antarctica

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南やまとヌナターク群とかぶと岳の地形・雪氷調査報告

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要旨: 第 14 次日本南極地域観測隊 (1973–1974) のやまと山脈旅行隊は，以前からやまと山脈南西方に望見されていたヌナターク群を調査する支隊を編成した．この支隊は 1973 年 12 月 13 日から 18 日まで行動し，やまと山脈南西約 30 km 付近に 7 個のヌナタークを確認し，露岩上での天文測量 (1 点) および地形，雪氷，地質の調査を行った．これらのヌナタークのうち北北西に孤立する一峰はかぶと岳，他の六峰より成る山群は南やまとヌナターク群，天測点はくらかけ山，最高峰はくわがた山と命名された．天測によるくらかけ山の位置は 72°00′30″S, 35°13′30″E である．ヌナタークの標高は 1,986 m から 2,282 m，氷床表面との比高はいずれも 100 m から 150 m 程度である．またこの地域において，深い溝を持つ氷の丘が南東から北西に連なっていることが確認された．その方向はこの地域の氷床の流動方向にほぼ一致すると思われる．

Abstract: A group of six nunataks and an isolated nunatak in the southwest of the Yamato Mountains were explored for the first time in December 1973 by the 14th Japanese Antarctic Research Expedition (1973–1974). The former has been named as the Minami-Yamato Nunataks, and the latter as the Kabuto Nunatak. The main group of the Minami-Yamato Nunataks lying NNW-SSE is composed of five nunataks about 30 km SW from the south end of the Yamato Mountains, and one nunatak is located about 7 km E of the main group. The astro-fixed position of the Kurakake Nunatak in the main group determined is 72°00′30″S, 35°13′30″E. The Kabuto Nunatak is about 20 km NNW, isolated from the main group. The elevation of the nunataks are 1,968 m to 2,282 m above sea level and the surface elevation of the ice sheet is about 1,850 m to 2,100 m. Between the Yamato Mountains and these nunataks, two trains of ice hills run from NW to SE, which presumably coincides with the general direction of the flow of the ice sheet.

1. Introduction

There are many massifs and nunataks in the inland of East Antarctica, some of

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which are several hundred kilometers away from the coast. In Mizuho Plateau, the Yamato Mountains lie about 300 km SW of Syowa Station. The Mountains had been visited by the inland traverse parties of the 4th Japanese Antarctic Research Expedition (JARE-4, 1960-1961), JARE-5 (1961-1962) and JARE-10 (1969-1970). Those parties had seen several nunataks to the southwest of the Yamato Mountains (YOSHIDA, 1961; YOSHIDA and FUJIWARA, 1963; FUJIWARA, 1964).

The wintering party of JARE-14 (1973-1974) sent a traverse glaciology party to the inland, and when the traverse party approached the Yamato Mountains in December 1973, a three-man branch party was organized for exploring the above-mentioned nunataks (NARUSE, 1975). The branch party was composed of Hitoshi SHIRANE (leader, medical officer), Kazuyuki SHIRAISHI (geologist) and the present author (glaciology, navigation). Table 1 shows the outline of the traverse. The party

Table 1. Itinerary.

Date December 1973	Nunataks surveyed
13	From the Base Camp in Yamato Mountains to the foot of Massif B
14	From Massif B—Station: N0—N8—Kabuto Nunatak—N8
15	N8—N16—Kurakake Nunatak
16	Nunatak II and Kurakake Nunatak
17	Kuwagata Nunatak, Nunataks V, VI—N17—Nunatak VII—N17
18	N17—N23—B12 (re-joined the main party)

first took the course directed to the northernmost nunatak which had been recognized from the Yamato Mountains. When they reached the top of the nunatak, they found several nunataks in the south. Then they took the way to the south and confirmed six nunataks. These nunataks were temporarily designated as Nunatak I, II, ... VII in the field, and official place-names were given by the Antarctic Place-Names Committee of Japan on November 22, 1975. The names are: the Kabuto Nunatak for Nunatak I, the Kurakake Nunatak for Nunatak III, the Kuwagata Nunatak for Nunatak IV and the Minami-Yamato Nunataks for the group of the six nunataks, i.e. Nunataks II, III, IV, V, VI and VII.

Because of the limited time for survey, only a preliminary survey was made on astronomical observation, geomorphology, glaciology and geology of this region. This paper deals with the first three disciplines; geological report was given by SHIRAISHI (1975).

2. Location and Elevation of the Nunataks

The location and elevation of these seven nunataks are shown in Table 2. The location of the Kurakake Nunatak was determined by astronomical observation,

Table 2. Location and elevation of the nunataks.

Designation of nunatak	Latitude	Longitude	Elevation
Kabuto Nunatak	71°49.4′ S	34°50.3′ E	1986 m
Nunatak II	71 58.9	35 10.3	2197
Kurakake Nunatak	72°00′30″	35°13′30″	2218
Kuwagata Nunatak	72 04.0	35 14.7	2282
Nunatak V	72 04.0	35 17.3	2273
Nunatak VI	72 03.5	35 17.6	—
Nunatak VII	71 58.2	35 22.6	2136

and others were by azimuth observation at the Kurakake Nunatak and compass survey at the summits of the nunataks. The elevation was determined by barometric altimetry using two Paulin MT–5 altimeters. The single altimeter method was employed, and the readings of elevation differences were corrected with air temperature. The elevation of the station on Route-N was calculated by accumulating the elevation differences successively onto the elevation of B12 at 1,990.5 m, which is the average of two elevation values obtained by JARE–10 (SHIMIZU *et al.*, 1972). On the other stations, the routes of altimetry formed the closed circuits including, at least, one station on Route-N. In such a case, the error of closure was distributed according to the time intervals of measurements, and the elevation of each station was calculated with reference to the station on Route-N. The elevations in Table 2 are the averages of the values measured with two altimeters.

A topographical map of this area is shown in Fig. 1. The locations and elevations of the stations along Route-N were reported by NARUSE and YOKOYAMA (1975). The nunataks lie approximately between 71°49′S and 72°04′S in latitude and 34°40′E and 35°18′E in longitude. The elevations of the nunataks are 1,986 m to 2,282 m above sea level and the surface elevation of the ice sheet is about 1,850 m to 2,100 m, showing relative height of the nunataks being 100 m to 150 m.

3. Topography of the Nunataks

Figure 2 is a geomorphological sketch map of the nunataks. The main part of the Minami-Yamato Nunataks is situated at about 30 km from the southern part of the Yamato Mountains. The nunataks in the main group are in a row trending NNW–SSE. Nunatak VII is isolated from the main part with a distance of about 7 km from Nunatak II, and the Kabuto Nunatak is about 20 km from Nunatak II. It is very difficult to determine the exact boundary of exposed land area because most of the nunataks have snowdrifts, wind scoops around themselves and snow-covers on their surfaces. The topography of each nunatak is as follows (see Figs. 3, 4, 5 and 6).

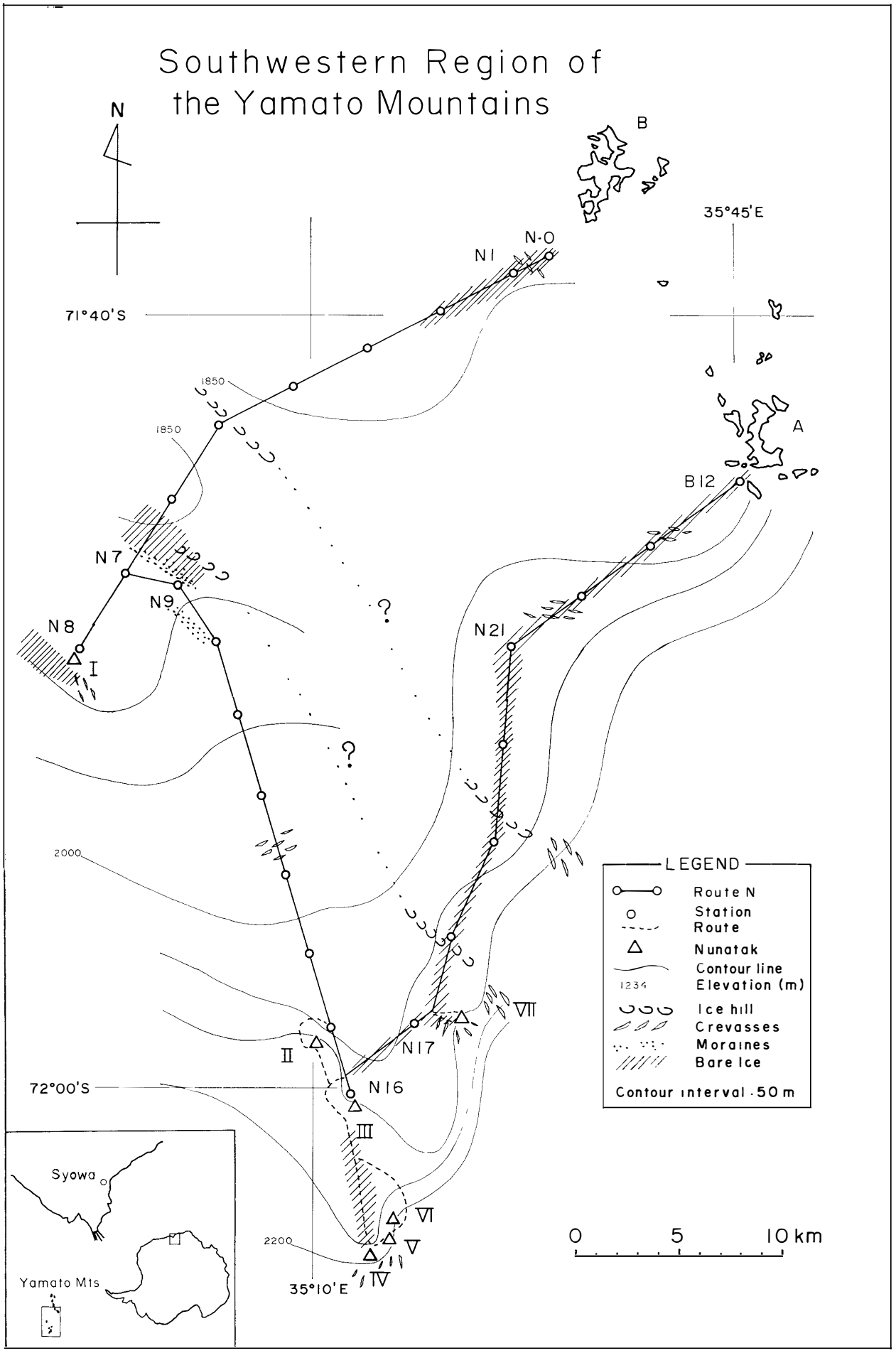

Fig. 1. Topographical map of the southwestern region of the Yamato Mountains.

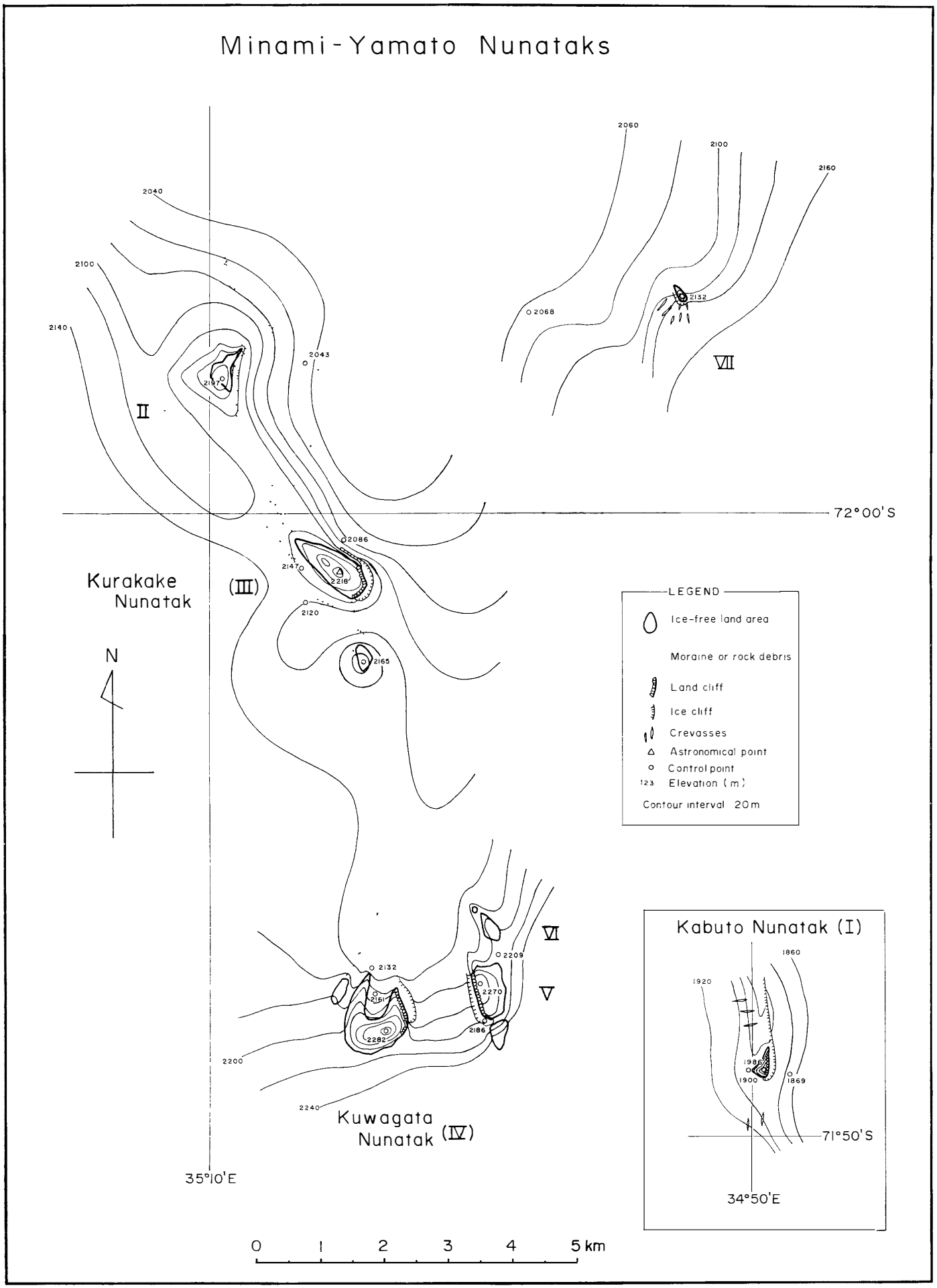

Fig. 2. Sketch map of the Minami-Yamato Nunataks and the Kabuto Nunatak.

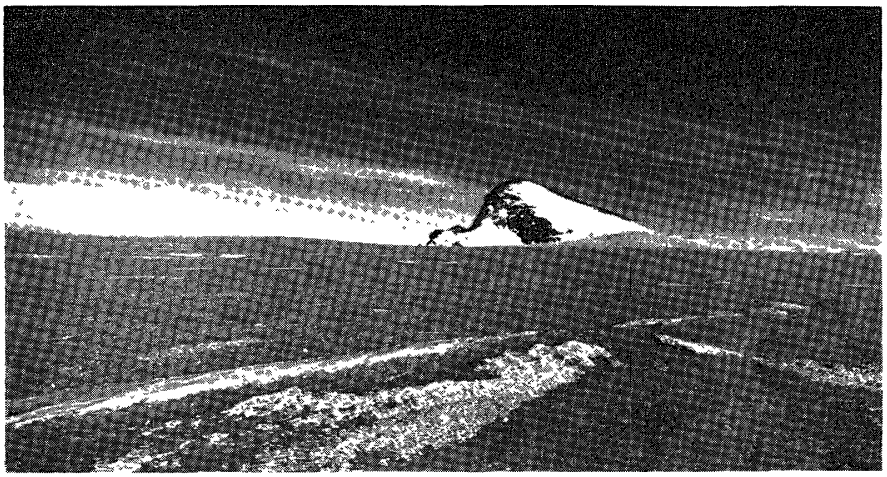

Fig. 3. West side of the Kabuto Nunatak.

Fig. 4. Nunatak II (right) and the Kurakake Nunatak viewed from north.

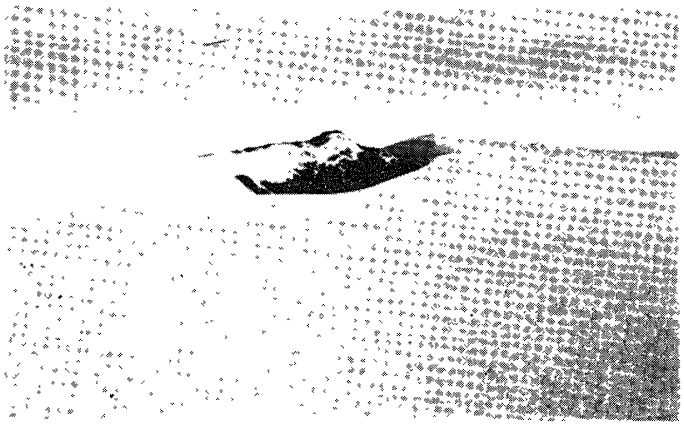

Fig. 6. Nunatak VII viewed from west.

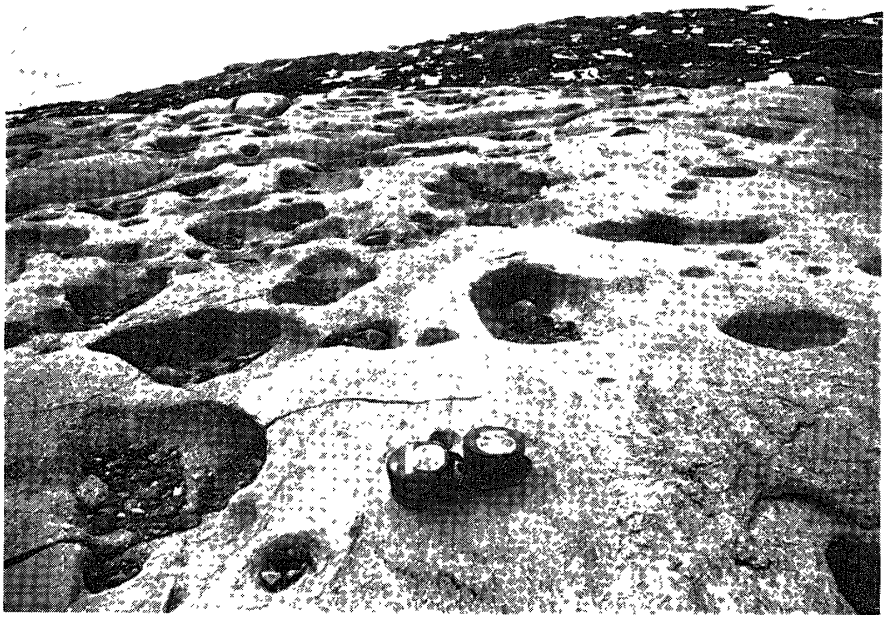

Fig. 7. Pot holes on Nunatak V; Paulin MT–5 altimeter in the foreground.

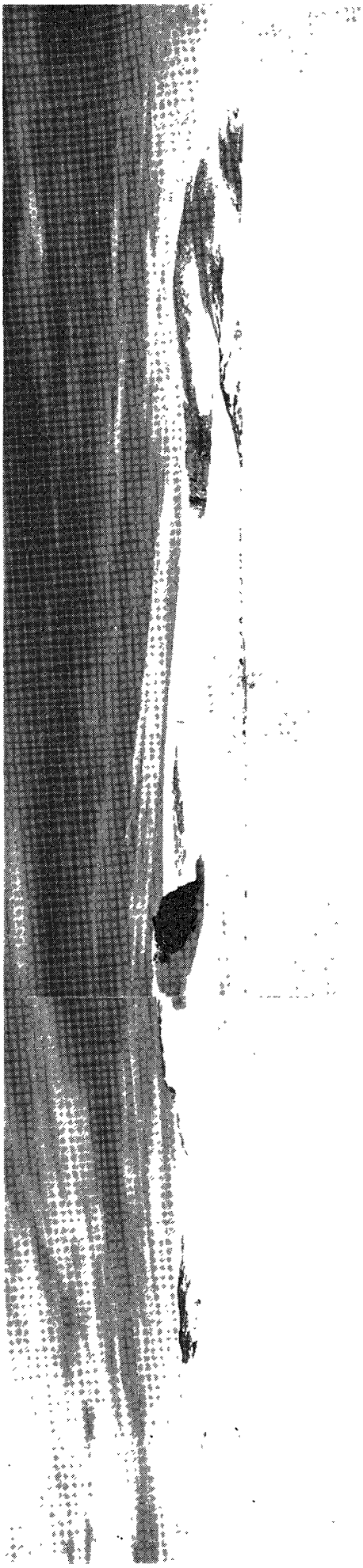

Fig. 5. The Kuwagata Nunatak, Nunatak V and Nunatak VI (right to left) viewed from northwest.

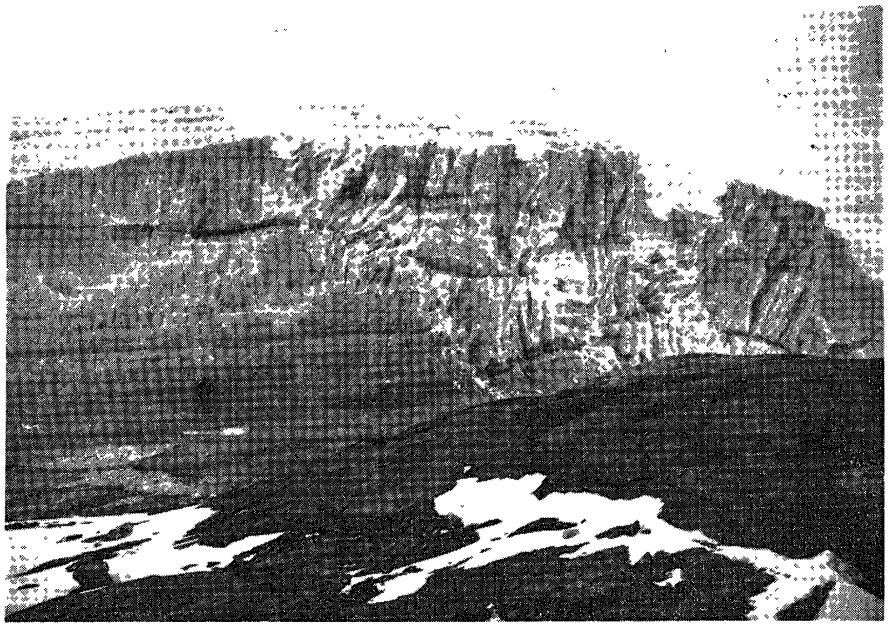

Fig. 8. Ice cliff in the south of Nunatak VII.

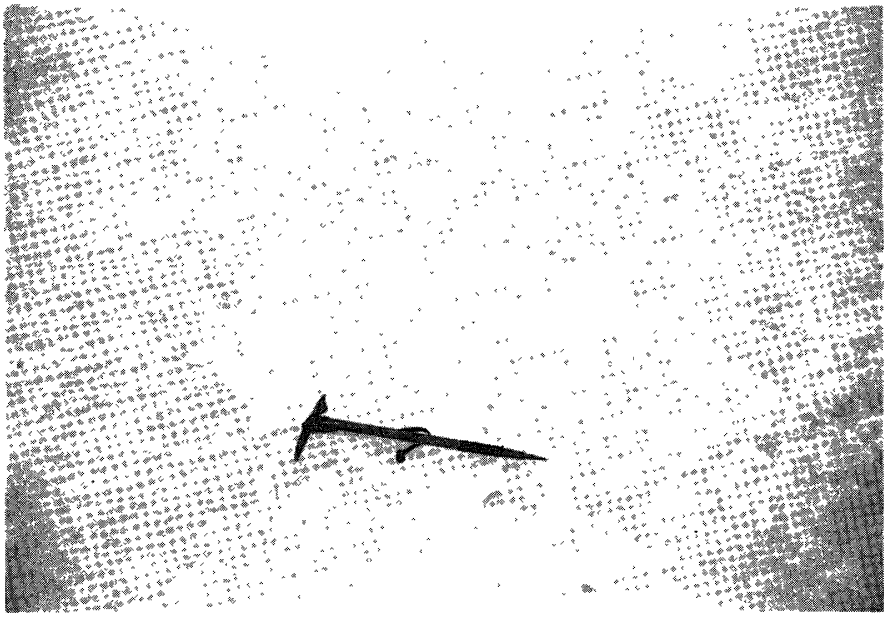

Fig. 9. Cracked ice near N17. The cracks intersects the ice surface with small angles.

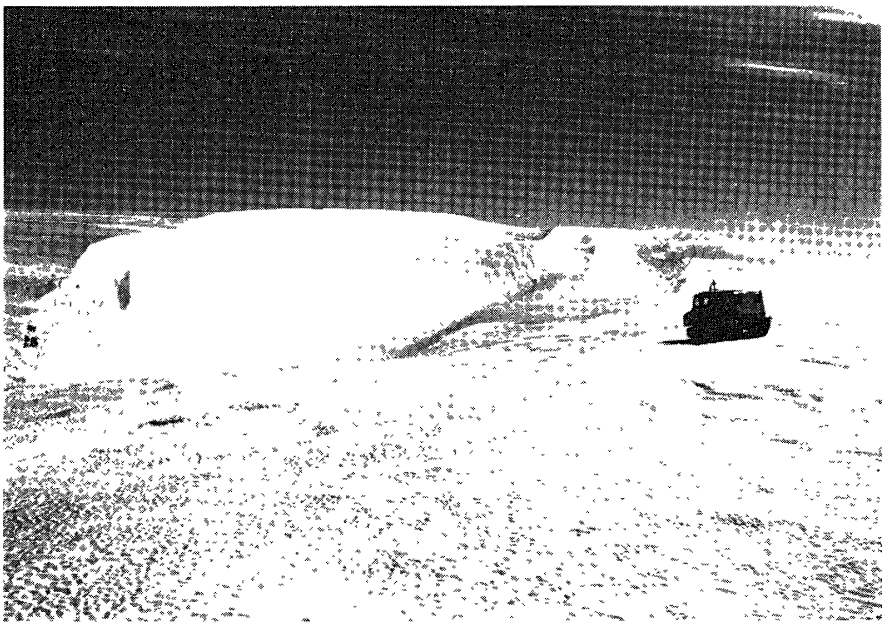

Fig. 10. An ice hill near N5 and an oversnow vehicle KC–20.

Kabuto Nunatak: Its northeast face is a steep cliff, while the opposite side is a rather gentle slope partly covered with snow. It has a 'tail' extending NW.

Nunatak II: It is a conical nunatak with gentle slopes covered with snow or rock debris. Polygonal structures in rock debris develops near the summit and its northern foot.

Kurakake Nunatak: It has two peaks, and a steep cliff on the NE side. The slopes are covered with rock debris for the most part, except a small exposed rock area in the south.

Kuwagata Nunatak: It has a cirque-like topography facing to N, a steep cliff on the NE side and a gental slope around the summit. This is the highest nunatak in the main group (2,282 m).

Nunatak V: A steep cliff exists on the SW side facing to the Kuwagata Nunatak. The SE side of this nunatak merges smoothly in the ice sheet. On the Kuwagata Nunatak and Nunatak V, there are many pot holes, varying in diameter from several cm to several tens of centimeters (see Fig. 7).

Nunatak VI: A low cliff forms the NE side of this nunatak.

Nunatak VII: This is the smallest nunatak in the main group, protruding out of a steep slope of the ice sheet (ref. to Sec. 4). On the north side, the rock and the ice sheet join smoothly through snow drifts, but on the south side the ice sheet thrusts up on the nunatak and exhibits an almost vertical cliff, where crevasses, internal moraines and clay bands are seen (see Fig. 8).

Glacial striae were seen at the top of the exposed rock near the Kurakake Nunatak, NE end and the summit of the Kuwagata Nunatak, and the summits of Nunataks V, VI and VII. Their directions are shown in Table 3.

Table 3. Direction of glacial striae.

Position	Direction (true)
Exposed rock on the south of the Kurakake Nunatak	N55°W
Northwest end of the Kuwagata Nunatak	N40°W
Summit of the Kuwagata Nunatak	N30°W
Summit of Nunatak V	N30°W
Summit of Nunatak VI	N45°W
Summit of Nunatak VII	N45°W

4. Surface Phenomena of the Ice Sheet

From the directions of glacial striae on the nunataks and the surface slope of the ice sheet, the direction of ice flow in this region is deduced to be approximately NW.

The surface topography of the ice sheet is shown in Figs. 1 and 2. Between Massif A of the Yamato Mountains and the Minami-Yamato Nunataks, the ice surface abruptly falls, say 100 m to 200 m lowering northwestward within a distance of 2 km to 5 km. This may be called an ice step. This was formerly noted by YOSHIDA and FUJIWARA (1963) as 'the difference of ice levels in a form of rather gentle ice cliff', and by FUJIWARA (1964) as 'rather steep slopes'. On the slope of the ice step several distinguished crevassed areas were seen.

Some crevassed areas with the maximum width of 0.5 m existed on Route-N.

Cracks of ice intersecting its surface with a small angle were seen around N17 (see Fig. 9). The cracks of the same type were seen around D0, between Massifs E and G of the Yamato Mountains.

Bare ice of the region explored are found mostly in the lee of massifs, nunataks or the above-mentioned ice step.

In Figs. 1 and 2, several moraine fields are shown. Their dimensions were approximately several tens of meters to several kilometers in length and several meters to several hundreds of meters in width. In the sparse parts of the two moraine fields near N7 and south of N9, several parallel clay bands which run along the longitudinal direction of the moraine fields were seen in the ice. Internal moraines and clay bands in the ice cliff south of Nunatak VII may indicate shear bands or thrust-fault planes in the ice.

Between the Yamato Mountains and these nunataks, many ice hills were seen in rows. Figure 10 shows the structure of one of these hills. The direction of the ice hills is close to that of the prevailing wind which was inferred from the surface relief. Some meteorological factors may have contributed to maintain or make up the present smooth shape of the ice hills. Route-N crossed the trains of ice hills at four places, and the trains may be grouped into two, namely, N5–N19 and N9–N18 (see Fig. 1). The direction of these ice hill trains seems to coincide with that of ice flow. These trains apparently started from the crevassed areas on the slope of ice step. It is possible that the ice hills were built up in the crevassed areas and were transported by the flow of the ice sheet. YOSHIDA and FUJIWARA (1963) had reported the existence of a large 'crevasse zone' with gigantic scoops of drifted snow near an isolated nunatak west of the Yamato Mountains. The ice hills observed by the author in 1973 are supposed to be identical with the past 'gigantic scoops' described in that report.

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