GLACIOLOGICAL STUDIES IN MIZUHO PLATEAU, EAST ANTARCTICA, 1969 – 1975

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Edited by

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GLACIOLOGICAL STUDIES IN MIZUHO PLATEAU, EAST ANTARCTICA, 1969–1975

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Preface

Presented in this volume is the general report of the traverse project of the Glaciological Research Program in Mizuho Plateau, East Antarctica. The report, which covers the period from 1969 to 1975, is composed of five sections dealing with studies of geomorphological analysis of the ice sheet, climatic conditions, snow accumulation, ice sheet flow and geochemical analysis. Each section contains several related papers contributed by individual authors.

The background of the Glaciological Research Program in Mizuho Plateau is traced back to 1957, when the Japanese Antarctic Research Expedition launched out into preliminary surveys in Syowa Station and its vicinities. It was in September 1967 that this Program took a final shape under the supervision of the late Professor Hirobumi ÔURA of the Institute of Low Temperature Science, Hokkaido University, and it was in 1969 that the consistent observation began with an ultimate object aimed at investigating the local mass balance of the Antarctic ice sheet in Mizuho Plateau.

What happened during the period before 1969 are: traverses to the Yamato Mountains in 1960 and further to 75°S in 1961 for glaciological and related studies; temporary closing down of Syowa Station from 1962 to 1965 during which elaborated glaciological study programs were blueprinted and the reopening of the Station was prepared; reopening of the Station in 1966; a reconnaissance traverse to Plateau Station (U.S.A.) in 1967–1968, a round-trip traverse between Syowa Station and the South Pole in 1968–1969. In the meantime the long-term project was taking shape on the basis of the experiences of these traverses so that the past shortcomings, owing to that the observations had mainly been limited to small regions and not systematically related to each other concerning time and location, were eliminated.

The Glaciological Research Program in Mizuho Plateau thus formulated was required to obtain the accurate amount of input and output of snow or ice, together with the dynamics of the ice sheet, by taking advantage of the useful techniques and information accumulated during the past traverses. For this purpose the program was divided into two major projects: the traverse project and the deep core project. The reason why Mizuho Plateau was chosen as the research area for one local system of mass budget was that this plateau was easily accessible from Syowa Station, bounded on the east by Sandercock Nunataks and on the west by the Yamato Mountains.

The observation was made in three periods and started in 1969 under this

chief investigator succeeding Professor Ôura, who passed away unexpectedly on 11 March 1969. During the first period (1969–71), a survey was carried out in 1969–1970 on the side of the Yamato Mountains, which was followed in 1970–1971 by a survey on the side of Sandercock Nunataks and the construction of the inland station, Mizuho Camp. The second period (1971–73) was devoted to a pilot study of deep cores of the ice sheet and glaciological studies at Mizuho Camp. During the third period (1973–75), the sides of the Yamato Mountains and the Sandercock Nunataks were resurveyed in 1973–1974 and 1974–1975, respectively.

The data obtained by the observations in the consecutive years except the results of deep cores have been published in four volumes of JARE Data Reports with an aim to have them shared by researchers who may make effective use of them.

A separate volume will be published about the deep core project for the studies of the structure and the property of the inland ice.

This chief investigator wishes to express his heartiest appreciation to the following leaders of the wintering parties of each year, who have contributed extensively and willingly to the research: Dr. K. KUSUNOKI (1969–70), Dr. T. MATSUDA (1970–71), Dr. T. OGUTI (1971–72), Mr. S. KAWAGUCHI (1972–73), Dr. T. HIRASAWA (1973–74), and Mr. N. MURAKOSHI (1974–75). Many thanks are also due to the members of the research parties for their energetic efforts in conducting observations and surveys in the field. Finally his deep gratitude is expressed to the staff of the National Institute of Polar Research. With the kind cooperation of them, this volume is published as a special issue of the Memoirs of National Institute of Polar Research.

Tamotsu ISHIDA
Chief Investigator
Glaciological Research Program
in Mizuho Plateau

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Hiromu SHIMIZU

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1. Introduction

The Glaciological Research Program in Mizuho Plateau was planned in order to study the mass balance of the ice sheet in Mizuho Plateau, East Antarctica, by the Japanese Antarctic Research Expedition during the period of 1969–1975 (in this volume, the term Mizuho Plateau stands for the region of Mizuho Plateau–West Enderby Land).

The Program was composed of two major projects: (1) The traverse project, namely, glaciological, meteorological, geographical, geophysical and geochemical studies by means of oversnow traverses by the 10th, 11th, 14th and 15th Japanese Antarctic Research Expedition (JARE-10, -11, -14 and -15); (2) The deep core project, namely a pilot study of deep cores of the inland ice sheet by means of drilling and analyses by JARE-12, -13, -15 and -16. The Program was supervised by the late Dr. Hirobumi ÔURA initially, then by Tamotsu ISHIDA, with Hiromu SHIMIZU in charge of the traverse project and Yoshio SUZUKI in charge of the deep core project.

Measurements and observations were carried out by means of the oversnow traverses in Mizuho Plateau on the following principal subjects:

i) Morphological studies of the ice sheet,
ii) Studies on climatic condition,
iii) Studies on snow accumulation,
iv) Studies on the ice sheet movement,
v) Geophysical surveys,
vi) Geochemical studies of the ice sheet.

Individual studies were proceeded cooperatively with a common ultimate object of investigating the mass balance of the ice sheet in Mizuho Plateau.

The oversnow traverses extended over two periods, the first period from 1969 to 1971, the second from 1973 to 1975. Basic observations and establishments of markers were carried out during the first period by JARE-10 and -11, and complementary and extensive observations, and resurveys of the markers by

JARE-14 and -15 during the second period.

Glaciological and meteorological studies in an inland area were carried out at Mizuho Camp by JARE-12 and -13, in addition to their regular project of deep core drilling during the interval between the first and second traverse periods.

Next section gives a brief outline of glaciological studies carried out by JARE-10 to -15 under the Program so that a better understanding can be afforded of the reports compiled in this volume.

2. Glaciological Studies Carried out by JARE-10 to -15, 1969–1975

2.1. Routes of the oversnow traverses

Oversnow traverses were carried out by each JARE for the field studies of the Program, as well as for the logistic supply to Mizuho Camp. The routes of the traverses are summarized in Fig. 1 and Table 1.

2.2. Mizuho Camp (70°41'53"S, 44°19'54"E; 2230 m above sea level)

Mizuho Camp was established in July 1970 by JARE-11 on the inland ice sheet in Mizuho Plateau, at a position approximately 270 km southeast of Syowa Station. Its aim was to serve as an advanced base for inland traverses, and also as an inland station for glaciological and meteorological studies. When established, it was provided only with a minimum facility: an iron hut of 8.5 m long, 3.2 m wide and 2 m high which was equipped with an automatic weather recorder and had a snow pit of 4 m deep.

JARE-12, -13 and -15 expanded the Camp widely, as shown in Figs. 2 and 3, the construction being mostly undersnow. JARE-12 and -13 stayed at Mizuho Camp during most of the period of their wintering over 1971–1973. Deep cores were drilled at Mizuho Camp by JARE-12, -13, -15, and the summer party to the Camp of JARE-16. JARE-12 and -13 carried out intensive studies on glaciological and meteorological subjects in addition to deep core drilling.

Today, Mizuho Camp is accessible by an oversnow vehicle in 4–5 days from Syowa Station without difficulty with the aid of kilometer-posts scrupulously set up along Route S-H-Z, and also by a light airplane in 80 minutes from S16 with the aid of an instrument landing system. After the Program, Mizuho Camp has been fully used for inland researches on the subjects of glaciology, meteorology, geophysics, geochemistry and medical science.

2.3. Glaciological studies by JARE-10 (1969–1970)

JARE-10 carried out the following glaciological studies:

2.3.1. Coastal region

Measurements and observations were made on the following subjects:

i) Snow accumulation at Syowa Station throughout the year (in cooperation with Meteorology Section),

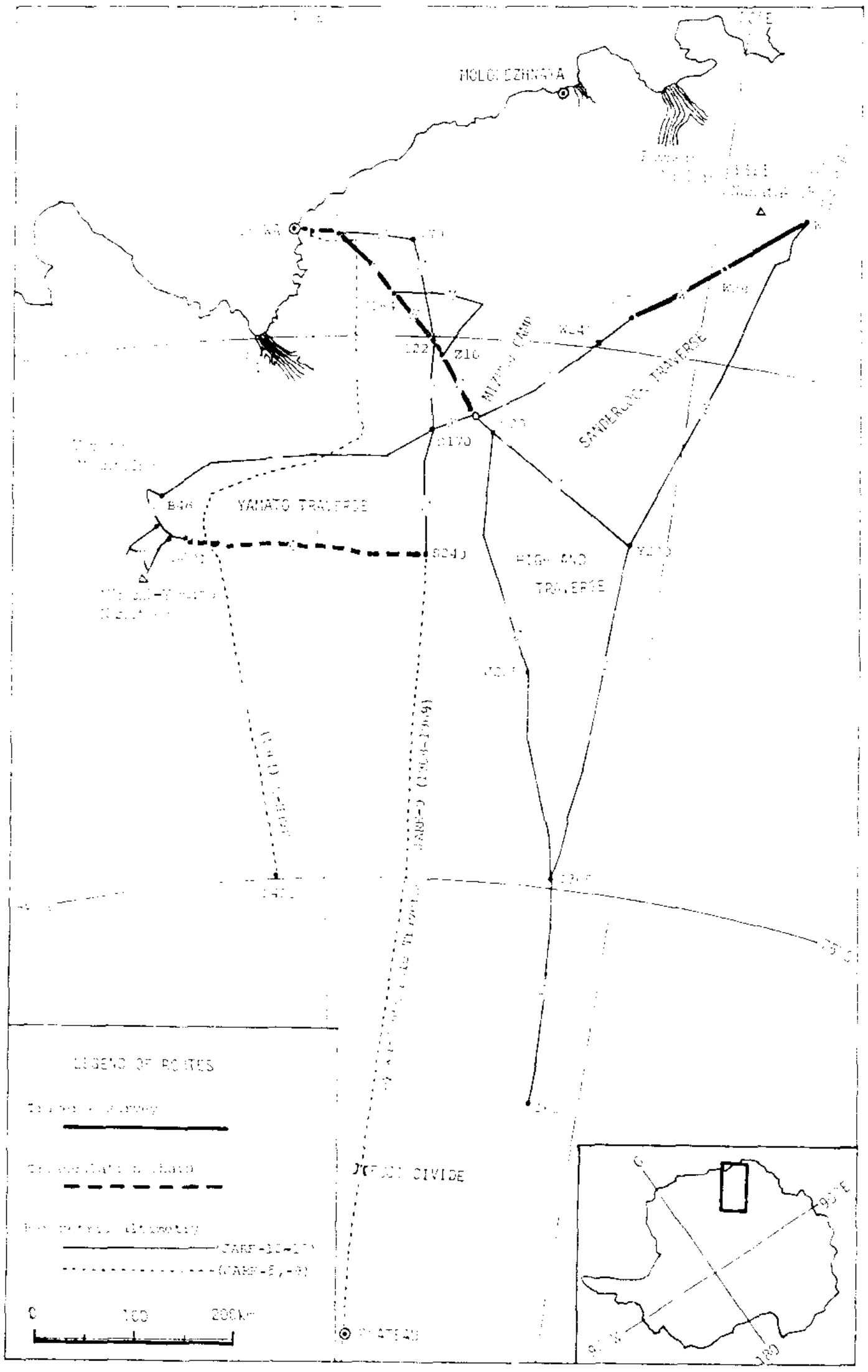


Fig. 1. Routes of the oversnow traverses carried out by JARE, in 1961–1975.

ii) Thickness of fast ice in the vicinity of Syowa Station throughout the year (in cooperation with Meteorology Section),

iii) Drifting snow at S16 in August 1969,

iv) Movement of the coastal ice sheet between Mukai Rocks and S16 during the period of August 1969–September 1970 (in cooperation with JARE-11),

v) Glaciological observation of the Shirase Glacier and Skallen Glacier in October 1969; Movement of the Skallen Glacier during the periods of February–October 1969–February 1970 (in cooperation with JARE-11).

Table 1. Routes of the oversnow traverses by JARE in Mizuho Plateau, 1961-1975.

Route	Set up by (year)	Station from—to		Approximate interval	Coverage by JARE	Remarks	
S	JARE-8 (1967)	S0(MR*)	—S663(PS*)	2 km	8～15	Syowa-South Pole traverse by JARE-9 (1968-1969)	
A	JARE-10 (1969 -1970)	A001(YM*)	—A164(S240)	irregular	10,14	Triangulation chain (JARE-14)	Yamato Traverse
B		B0(A003)	—B48(YM*)	irregular			
C		C0(B48)	—C150(S170)	2 km			
F	JARE-5 (1961)	F2(MR*)	—F451	irregular	5		
H	JARE-12 (1971)	H0(S30)	—H306(S122)	0.3 or 0.5 km	12～15	Traverse survey (JARE-14)	
I	JARE-15 (1974)	I0(Y200)	—I600	5 km	15		Highland Traverse
J		J0(I365)	—J482(Y20)	5 km			
M	JARE-14 (1973)	M0(Z16)	—M80(H184)	2 km	14	Ice mounds and morain fields	
N		N0(B18)	—N23(B12)	2 or 4 km		Minami-Yamato Nunataks and Kabuto Nunatak (Yamato Traverse II)	
W	JARE-11 (1970 -1971)	W00(SN*)	—W55	irregular	11,15	Traverse survey (JARE-11)	
		W200(W55)	—W377(MC*)	5 km			
X		X0(MC*)	—X20(S169)	2 km	11,12,14		Sandercock Traverse
Y		Y0(MC*)	—Y573(SN*)	5 km	11,15		
Z		Z0(S122)	—Z105(MC*)	0.5 or 1 km	11～15	Traverse survey (JARE-14)	

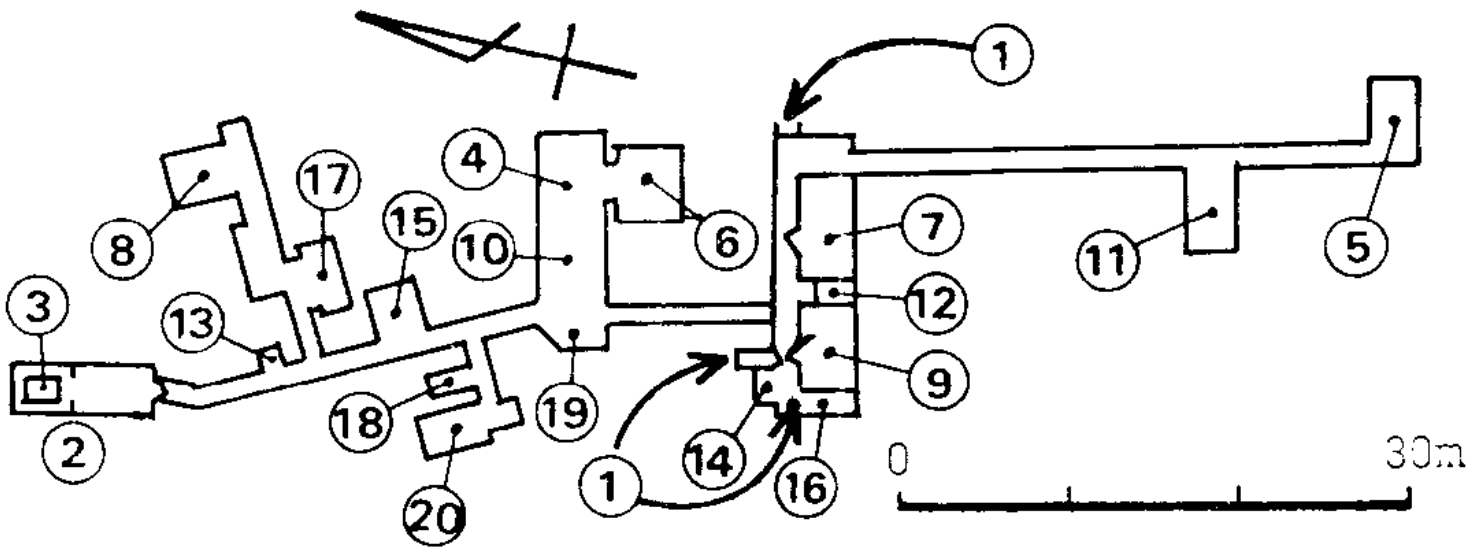
* MC: Mizuho Camp, MR: Mukai Rocks, PS: Plateau Station, SN: Sandercock Nunataks, YM: Yamato Mountains

2.3.2. Inland traverse

JARE-10 conducted an inland traverse, Yamato Traverse I, by a 10-man team with 4 oversnow vehicles during the period of 1 November 1969–29 January 1970. The traverse party was organized with the following personnel:

Hisao ANDO — Leader; Geology and seismic sounding (ice thickness).

Masaru YOSHIDA — Geology, geomagnetism and gravity.



1. Entrance,
2. Iron hut,
3. 20-m snow pit,
4, 5. Deep core drilling site-1, -2,
6. Glaciological laboratory,
7. Laboratory and radio communication,
8. Geomagnetic station,
9. Living quarters,
10, 11. 12kVA generator,
12. 1kVA generator,
13, 14. Fuel storage,
15, 16. Food storage,
17, 18. Storage,
19. Bath,
20. Lavatory.

Fig. 2. Mizuho Camp (1975).

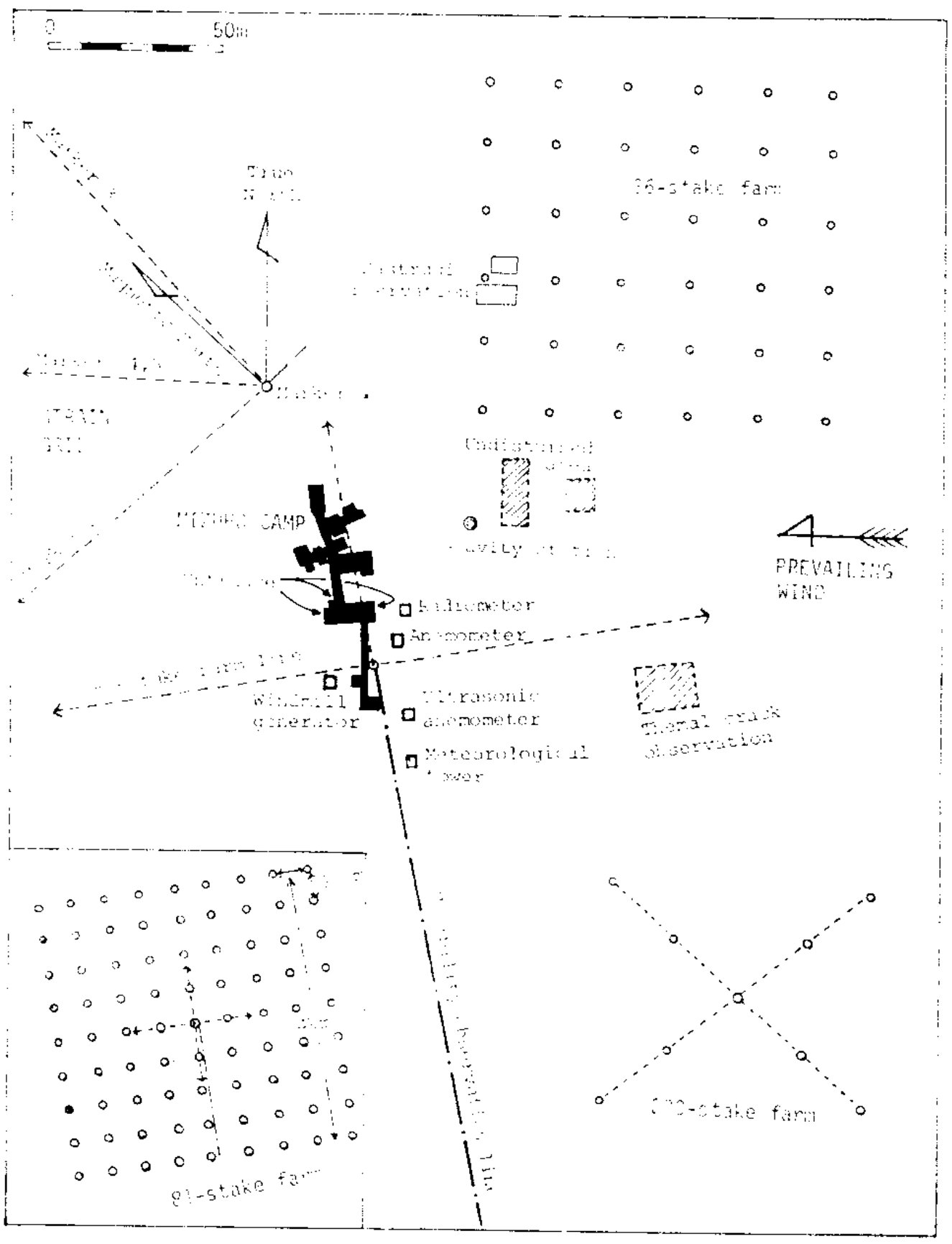


Fig. 3. Observational area of Mizuho Camp (1975).

Kunio OMOTO	Geography, barometric altimetry and radio-echo sounding (ice thickness),
Renji NARUSE	Glaciology and triangulation chain (ice flow),
Yutaka AGETA	Glaciology and meteorology,
Masamoto KIKKAWA	Medical doctor,
Shinpei ISHIWATA	Mechanics,
Yuji MAEDA	Mechanics,
Minoru YAGI	Logistics.
Yukio KIMURA	Journalist and logistics.

The traverse route was Syowa Station—S70—S240—(triangulation chain)—A001 (a southern nunatak of the Yamato Mountains)—B48 (in the northern region of the Yamato Mountains)—S170—S70—Syowa Station.

Observations and measurements were made on the following subjects:

i) Altimetry of the ice sheet surface (by a barometric method).

ii) Ice thickness (by seismic sounding and radio-echo sounding),

iii) Snow accumulation (by the stake method; stakes were set along newly explored routes),

iv) Installation of a triangulation chain between A001 (the Yamato Mountains) and A164 (S240), about 250 km in total length along Route A, and of isolated strain grids on the ice sheet surface (for precise measurements of movements and deformations of the ice sheet surface),

v) Stratigraphic study of the snow cover (pit study and core study), and observations of the surface features (sastrugi and dune),

vi) 10 m snow temperature,

vii) Weather observation,

viii) Measurement of sea-salt particles,

ix) Geographical, geological and glaciological surveys of the Yamato Mountains,

x) Geophysical surveys (geomagnetism and gravity),

xi) New findings: Meteorites were collected in the vicinity of the Yamato Mountains; moraine fields were found in a region around (69°38′S, 43°20′E).

2.4. Glaciological studies by JARE-11 (1970–1971)

JARE-11 carried out the following glaciological studies:

2.4.1. Coastal region

Glaciological observations were made on the following subjects:

i) Snow accumulation at Syowa Station throughout the year (in cooperation with Meteorology Section),

ii) Glaciological observations on the firn in West Ongul Island.

iii) Thin section observation of glacier ice sampled from glaciers in the

vicinity of Syowa Station,

iv) Experiment of uni-axial compression of polar snow,

v) Movement of the coastal ice sheet along the Sôya Coast between Mukai Rocks and Langhovde during the period of September 1970–January 1971,

vi) Glaciological observations on the Heitô Glacier, in September of 1970; Movement of the Heitô Glacier, during the periods of February–September 1970–March 1971 (in cooperation with JARE-10 and -12),

vii) Glaciological observations of the glaciers on the Sôya Coast between the Honnør Glacier and Rundvågshetta in September 1970.

2.4.2. Mizuho Camp

JARE-11 established Mizuho Camp in July 1970, as described in Section 2.2. Observations on glaciological, meteorological and geophysical subjects were carried out there for ten days right after the establishment of the Camp, and the operation of a long-term automatic weather recorder was started at the same time.

2.4.3. Inland traverse

JARE-11 conducted an inland traverse, Sandercock Traverse I, by a 8-man team with 4 oversnow vehicles during the period of 3 November 1970–22 January 1971. The traverse party was organized with the following personnel:

Hiromu SHIMIZU	Leader; Glaciology, barometric altimetry, radio-echo sounding (ice thickness), traverse survey line (ice flow) and chemical sampling,
Okitsugu WATANABE	Glaciology, geology and seismic sounding (ice thickness),
Aiichiro YOSHIMURA	Geodetic survey, geomagnetism and gravity,
Yasuo FUKUSHIMA	Medical doctor and meteorology,
Shingo KANEKO	Mechanics,
Hiromi KAMADA	Logistics and mechanic assistant,
Yasuo ISHIMOTO	Logistics and navigation,
Hajime ITO	Logistics and glaciology.

The traverse route was Syowa Station—S70—S122—Mizuho Camp—Y200—Sandercock Nunataks—(traverse survey line)—W55—Mizuho Camp—S169—S70—Syowa Station.

The subjects observed and measured by JARE-11 were mostly the same as those by JARE-10, except for the following:

i) Installation of a traverse survey line between W00 (a south peak of Sandercock Nunataks) and W55, about 200 km in total length, instead of installing a triangulation chain in the case of JARE-10, (entry iv in Section 2.3.2.),

ii) Maximum slope of the ice sheet surface,

iii) Sampling of the surface snow of the inland ice sheet for a study of

chemical constituents,

iv) Measurement of sea-salt particles (entry viii in Section 2.3.2.) was not made,

v) New finding: Kiri Nunatak was found at the location of (68.5°S, 50.2°E).

2.5. Glaciological studies by JARE-12 (1971–1972)

JARE-12 carried out the following glaciological studies.

2.5.1. Coastal region

Glaciological observations and measurements were made on the following subjects:

i) Snow accumulation at Syowa Station throughout the year (in cooperation with Meteorology Section),

ii) Drifting snow at Syowa Station in August 1971,

iii) Observation of sea ice in the vicinity of Syowa Station in autumn of 1971,

iv) Stratigraphic study of the surface snow cover of the coastal ice sheet in the summer of 1971–1972,

v) Movement of the Heitô Glacier during the period of March 1971–February 1972 (in cooperation with JARE-13).

2.5.2. Mizuho Camp

JARE-12 explored Route H, a short-cut connecting S30 directly to S122, which minimized the travel by oversnow vehicle from Syowa Station to Mizuho Camp. They widely expanded and developed scientific facilities and living quarters of the Camp.

They conducted deep core drilling and analyses, together with other glaciological studies at Mizuho Camp by a 4-man team during the period of 9 October 1971–19 January 1972. The Mizuho Camp team was organized with the following personnel:

Tsuneyoshi KIMURA	Leader; Deep core drilling,
Tomomi YAMADA	Glaciology,
Masayoshi NAKAWO	Logistics and glaciology,
Yoshimasa SHIMAZAKI	Mechanics.

Deep cores of 41 m and 75 m in total length were obtained by JARE-12 by a mechanical drill and a thermo-drill respectively.

They also made observations and measurements on the following subjects:

i) Snow accumulation at Mizuho Camp by means of stake farms and along Route S-H-Z by means of single-stakes and stake farm throughout the year (in cooperation with logistic support parties to Mizuho Camp from Syowa Station),

ii) Drifting snow in November and December 1971,

iii) Observation of surface relief of the snow cover during the period of 10 November 1971–3 January 1972,

iv) Stratigraphic observation of the snow cover,
v) Topographic survey of the ice sheet surface in Mizuho Camp area,
vi) Glaciological analyses of the drilled deep cores,
vii) Vertical profile of the snow temperature from the surface down to a depth of 10 m during their stay,
viii) Net radiation at the snow surface, during their stay,
ix) Weather observation during their stay.

2.6. *Glaciological studies by JARE-13 (1972–1973)*

JARE-13 carried out the following glaciological studies:

2.6.1. Coastal region

Glaciological observations and measurements were made on the following subjects:

i) Snow accumulation at Syowa Station throughout the year (in cooperation with Meteorology Section),
ii) Glaciological observations on the Heitô Glacier in February 1973 (in cooperation with JARE-14).

2.6.2. Mizuho Camp

JARE-13 expanded and developed Mizuho Camp further, and conducted deep core drilling and analyses, together with other glaciological studies there, continuously during the period of 27 April 1972–23 January 1973.

The Mizuho Camp team was organized with 4 to 5 men, including NARITA, Leader, out of the following personnel:

Hideki NARITA	Leader; Glaciology and deep core drilling,
Fumio OKUHIRA	Logistics and glaciology,
Hiroshi SASAKI	Meteorology,
Asao MASUKAWA	Mechanics,
Kazunori UMEDA	Mechanics,
Susumu HAYASHIDA	Logistics.

Deep cores of 147.5 m in total length were obtained by JARE-13, by the use of a thermo-drill.

They also made observations and measurements on the following subjects:

i) Snow accumulation at Mizuho Camp, by means of stake farms and along Route S-H-Z by means of single-stakes and stake farm throughout the year,
ii) Drifting snow in May, June and July 1972,
iii) Formation of the new snow surface by deposition-erosion process of snow throughout the year,
iv) Glaciological analyses of the drilled deep cores,
v) Stratigraphic study on a 20 m deep pit,
vi) Study on climatic conditions,