

OUTLINE OF STUDIES OF THE GLACIOLOGICAL RESEARCH  
PROGRAM IN MIZUHO PLATEAU, EAST ANTARCTICA,  
1969–1975

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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),

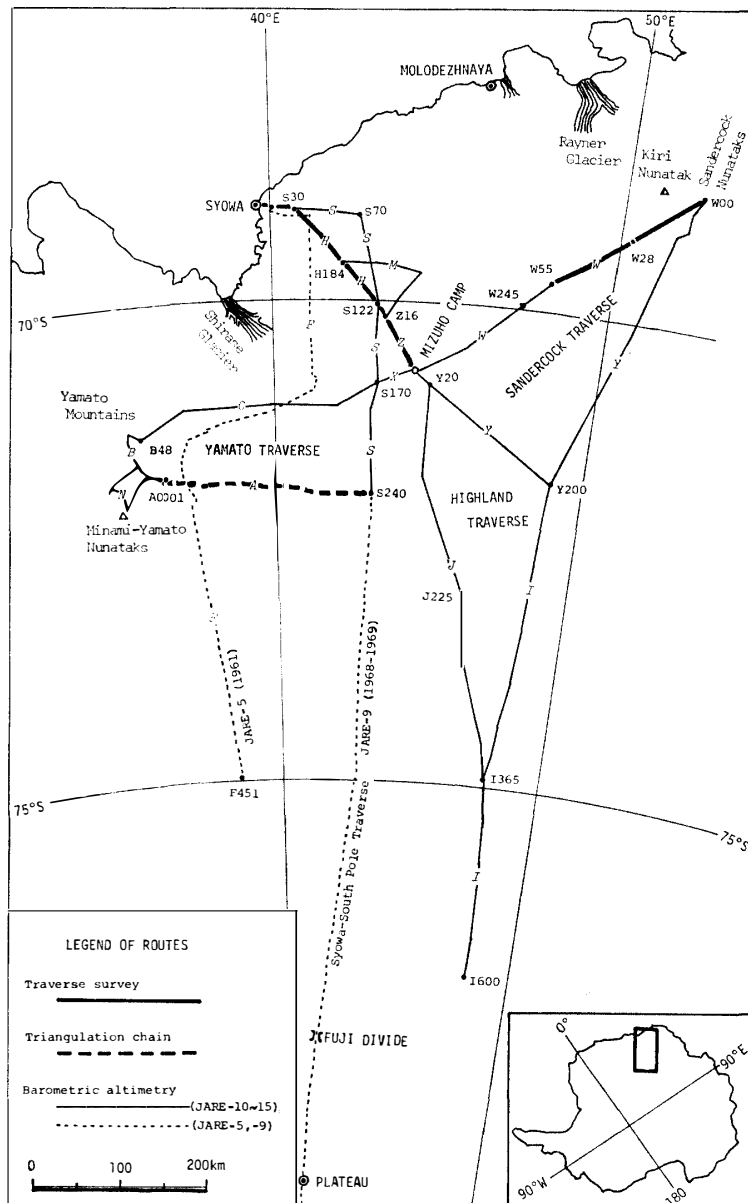


Fig. 1. Routes of the oversnow traverses carried out by JARE, in 1961-1975.

- 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.

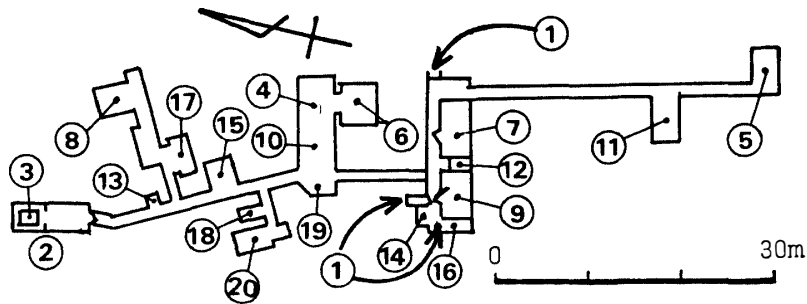
Route	Set up by (year)	Station		Coverage by JARE	Remarks	
		from—to	Approximate interval			
S	JARE-8 (1967)	S0(MR*) —S663(PS*)	2 km	8~15	Syowa-South Pole traverse by JARE-9 (1968–1969)	
A	JARE-10 (1969–1970)	A001(YM*)—A164(S240)	irregular	10, 14	Triangulation chain (JARE-14)	Yamato Traverse
B		B0(A003) —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			
W	JARE-11 (1970–1971)	W00(SN*) —W55	irregular	11, 15	Traverse survey (JARE-11)	Sandercock Traverse
		W200(W55)—W377(MC*)	5 km			
X		X0(MC*) —X20(S169)	2 km	11, 12, 14		
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,             | 7. Laboratory and radio  | 13, 14. Fuel storage, |
| 2. Iron hut,             | communication,           | 15, 16. Food storage, |
| 3. 20-m snow pit,        | 8. Geomagnetic station,  | 17, 18. Storage,      |
| 4, 5. Deep core drilling | 9. Living quarters,      | 19. Bath,             |
| site-1, -2,              | 10, 11. 12kVA generator, | 20. Lavatory.         |
| 6. Glaciological         | 12. 1kVA generator,      |                       |
| laboratory,              |                          |                       |

Fig. 2. Mizuho Camp (1975).

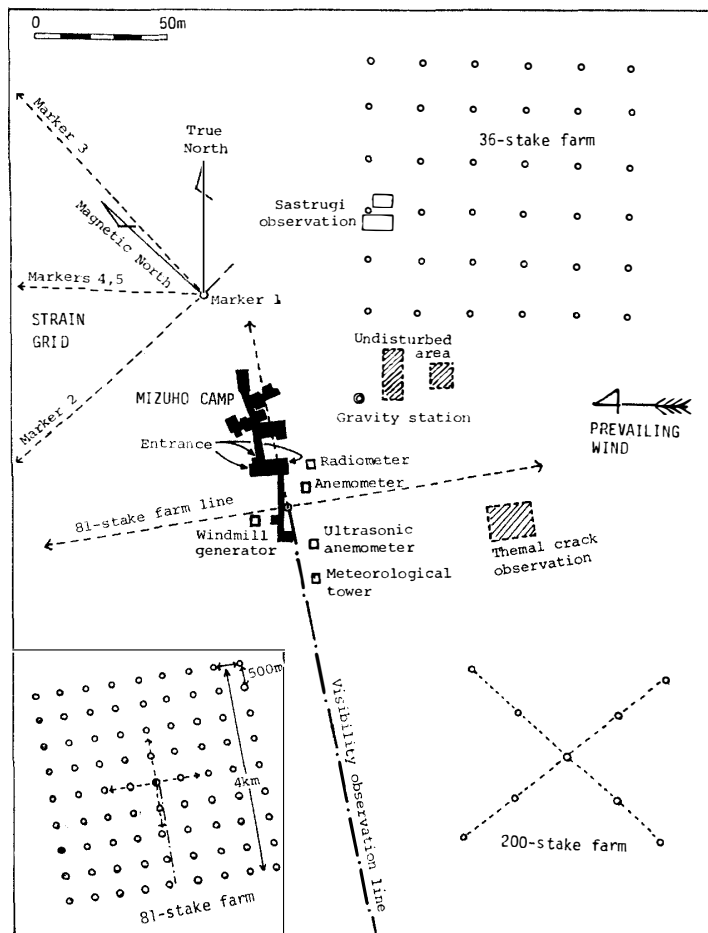


Fig. 3. Observational area of Mizuho Camp (1975).

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,
Shimpei 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,

vii) Weather observation.

### 2.7. *Glaciological studies by JARE-14 (1973–1974)*

JARE-14 carried out the following glaciological studies:

#### 2.7.1. Traverse survey

A traverse survey was carried out by JARE-14, along the route Syowa Station—S30—H200—S122—Mizuho Camp, during the period of 10 September–14 October 1973. As the result of this work, the geodetic position and elevation of each station on the route were accurately estimated, and they were used as the basis of the barometric altimetry of the inland ice sheet surface.

Glaciological observations were made on ice mounds in the region around ( $69^{\circ}40'S$ ,  $44^{\circ}12'E$ ), and a morain field in the region around ( $69^{\circ}38'S$ ,  $43^{\circ}20'E$ ), during an exploration of Route M on the way back from Mizuho Camp to Syowa Station.

#### 2.7.2. Inland traverse

JARE-14 conducted an inland traverse, Yamato Traverse II, by a 10-man team with 4 oversnow vehicles, during the period of 10 November 1973–2 February 1974. The traverse party was organized with the following personnel:

Renji NARUSE	Leader; Glaciology and triangulation chain (ice flow),
Shun'ichi KOBAYASHI	Meteorology and glaciology,
Yoshiaki ABE	Geodetic survey, geomagnetism and gravity,
Kotaro YOKOYAMA	Glaciology and radio-echo sounding (ice thickness),
Masayuki KAWASHIMA	Geomagnetism,
Kazuyuki SHIRAIISHI	Logistics and geology,
Hajime SHIRANE	Medical doctor,
Shigeo SHIGA	Mechanics,
Yoshinori MURAYAMA	Mechanics,
Masaru AYUKAWA	Logistics.

The traverse route was Syowa Station—S30—H200—Mizuho Camp—S169—C0 (the Yamato Mountains)—N16 (Minami-Yamato Nunataks)—A001—(triangulation chain)—S240—S169—Mizuho Camp—H200—S30—Syowa Station.

Observations and measurements were made on the following subjects:

- i) Barometric altimetry and maximum slope of the ice sheet surface,
- ii) Ice thickness (by radio-echo sounding),
- iii) Snow accumulation (by the stake method),
- iv) Resurvey of the triangulation chain established in 1969, and strain grids established in 1969 and 1970,
- v) 10 m snow temperature,

- vi) Ice shock,
- vii) Weather observation,
- viii) Meteorological study (on sea salt particles, and katabatic wind by means of radio-sonde),
- ix) Geodetic and geological survey of the Yamato Mountains,
- x) Geophysical survey (geomagnetism and gravity),
- xi) New findings: Kabuto Nunatak ( $71^{\circ}49'S$ ,  $34^{\circ}50'E$ ), Minami-Yamato Nunataks (around  $72^{\circ}S$ ,  $35^{\circ}15'E$ ) and Motoi Nunatak ( $71^{\circ}47'S$ ,  $36^{\circ}10'E$ ) were newly found, and meteorites were collected in the vicinity of the Yamato Mountains.

## 2.8. *Glaciological studies by JARE-15 (1974–1975)*

JARE-15 carried out the following glaciological studies.

### 2.8.1. Mizuho Camp

JARE-15 expanded Mizuho Camp further, and conducted deep core drilling and glaciological researches there during the periods of 19 January–2 February; 13 March–4 September 1974; 18 November 1974–5 February 1975.

The Mizuho Camp team of JARE-15 was organized with 3 to 4 men out of the following personnel:

Okitsugu WATANABE	Leader; Glaciology,
Masayuki INOUE	Glaciology,
Kazuhide SATOW	Glaciology,
Isao FUJII	Medical doctor,
Takashi IKARASHI	Mechanics,
Kei TERAJ	Logistics.

Deep cores of 146 m in total length were obtained by JARE-15 by the use of a thermo-drill in cooperation with Takatoshi TAKIZAWA and Takeshi KUROKAWA, the summer party of JARE-16, during the period of 14 January–5 February 1975.

They made observations and measurements on the following subjects:

- i) Snow accumulation by means of stake farms, throughout the year,
- ii) Drifting snow, during the period of June–August 1974,
- iii) Observation of surface relief of the snow cover, in March and July 1974, and January 1975,
- iv) Vertical profile of snow temperature from the surface down to a depth of 10 m during the period of December 1974–January 1975.

### 2.8.2. Inland traverses

JARE-15 conducted two inland traverses, Highland Traverse and Sandercock Traverse II, during the austral summer of 1974–1975.

#### 2.8.2.1. Highland Traverse

Highland Traverse was conducted by a 6-man team with 2 oversnow vehicles

during the period of 1 October–29 November 1974. The traverse party was organized with the following personnel:

Okitsugu WATANABE	Leader; Glaciology,
Masayuki INOUE	Glaciology,
Kazuhide SATOW	Glaciology,
Isao FUJII	Medical doctor,
Yasuhisa YONEZAWA	Mechanics,
Shigekazu INAMURA	Radio communication.

The traverse route was Syowa Station—S30—H200—Mizuho Camp—Y200—I600—I365—J225—Y20—Mizuho Camp.

Observations and measurements were made on the following subjects:

- i) Barometric altimetry and maximum slope of the ice sheet surface,
- ii) Snow accumulation by means of the stake method,
- iii) Observation of surface feature of the snow cover,
- iv) Stratigraphic study of the snow cover (pit study and core study),
- v) 10 m snow temperature,
- vi) Resurvey of the strain grid,
- vii) Sampling of snow for  $\delta^{18}\text{O}$  analysis,
- viii) Weather observation.

(ice thickness was not measured because of instrumental troubles of the radio-echo sounder.)

#### 2.8.2.2. Sandercock Traverse II

Sandercock Traverse II was conducted by a 4-man team with 2 oversnow vehicles during the periods of 14 December 1974–7 January 1975. The traverse party was organized with the following personnel:

Okitsugu WATANABE	Leader; Glaciology and seismic sounding (ice thickness),
Masayuki INOUE	Glaciology,
Yasuhisa YONEZAWA	Mechanics,
Masafumi IGARASHI	Radio communication.

Measurements and observations were made on the following subjects:

- i) Snow accumulation by means of the stake method,
- ii) Stratigraphic study of the snow cover (pit study and core study),
- iii) Measurement of ice thickness (by seismic sounding),
- iv) 10 m snow temperature,
- v) Weather observation.

The heights of the snow stakes set up along Route W, and those of the markers of a strain grid established at W55 were about 2 m above the snow surface at the end of 1970. However, in the region north-east of W245, all the stakes and markers were found buried in deep snow that accumulated during the

last four years. On 24 December 1974, an oversnow vehicle of the traverse party was trapped by a hidden crevasse in the vicinity of W28. They succeeded in extricating the vehicle from the crevasse by themselves with no harm 23 hours later, but they could not proceed further than W28 toward Sandercock Nunataks because of the danger of hidden crevasses and the missing markers of the traverse survey line established in 1970. Resurvey of the traverse survey line between Sandercock Nunataks and W55 was abandoned.

### 3. Reports of the Studies

Reports of the studies described above have been printed in the following publications:

#### JARE Data Reports:

- No. 17 (Glaciology) Part 1, 1969–1971 (November 1972)
- No. 27 (Glaciology) Part 2, 1969–1973 (March 1975)
- No. 28 (Glaciology) Part 3, 1973–1974 (September 1975)
- No. 36 (Glaciology) Part 4, 1974–1975 (March 1977)

#### Kyokuchi Hyôshô no Butsuri-teki Kagaku-teki Kenkyû

(Physical and Chemical Studies on Ices from Glaciers and Ice Sheets) (1974)

#### Nankyoku Shiryo (Antarctic Record):

- Nos. 39, 40, 41 and 42 (1971)
- Nos. 43, 44 and 45 (1972)
- No. 47 (1973)
- Nos. 48, 49 and 50 (1974)
- Nos. 53 and 54 (1975)
- Nos. 55 and 56 (1976)

#### Seppyô (Journal of the Japanese Society of Snow and Ice)

Vol. 33, No. 4 (1971)

#### Teion Kagaku (Low Temperature Science)

Ser. A 28, (1970)

#### Tenki

Vol. 22, No. 1 (1975)

*(Received June 9, 1977)*