Bulletin of Glacier Research 8 (1990) *103–106*

Outline of the Japanese Arctic Glaciological Expedition in 1989 (JAGE 1989)

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(Recieved January 14, 1990 ; Revised manuscript recieved March 7, 1990)

Abstract

Prime Objective of the Japanese Arctic Glaciological Expedition (JAGE) in 1987–1992 is to drill shallow ice cores for the studies of the climatic and environmental changes during the last few hundred years in various parts of the Arctic cryosphere. As the 1989 activities of the JAGE, 101 and 205 m deep ice core drillings and the in-situ core analyses were carried out at Site-J (67.5°N, 43.5°W and 2,000 m a.s.l.) in southern Greenland ice sheet from May to June 1989.

1. Introduction

Japanese Arctic Glaciological Expedition (JAGE) was planned as a six-years program consisting of every other year field work from 1987 to 1992, by the Arctic Research Committee (chairman ; Professor S. Kobayashi of Niigata University) of the Japanese Society of Snow and Ice.

As a 1989 field work of the JAGE, ice core drillings were carried out in the southern part of Greenland ice sheet from May to June 1989 under the leadership of Okitsugu Watanabe of the National Institute of Polar Research. Two shallow cores to 101 and 205 m depths were obtained and in-situ core analyses were carried out.

This report is to discribe objectives of the JAGE and outlines of the field work in 1989.

2. Objective of the JAGE 1987–1992

Prime objective of the Japanese Arctic Glaciological Expedition (JAGE) is to study the climatic and environmental change for the last few hundred years in the various parts of Arctic cryosphere. This study includes to get clues for understanding variations of Arctic climate system and to assess physical, chemical and biological environmental processes in the climatic change.

Cryosphere in the Arctic is composed of various types of ice masses, in contrast to a relatively simple huge ice mass of the Antarctica. The ice masses in the Arctic such as Greenland, Axel Heiberg, Baffin, Ellesmere and Svalbard have regional varieties in the present atmosphere-ocean-ice system and past fluctuations since Pleistocene.

Therefore, we planned to get firn-ice cores which covers past $10^2 \sim 10^3$ years at various places in the Arctic.

The 1987 main field work of the JAGE was shallow drilling of ice cores carried out at the top of Jostedalsbreen in Norway with a cooperation of Norwegian Water Resources and Energy Administration and at the top of Asgardfonna in northern Svalbard with a cooperation of the Norsk Polarinstitutt from May to June. Firn-ice cores were obtained from the surface to the bedrock (Watanabe and Fujii, 1988). The field work to be described in this paper is the second field work carried out in Greenland.

3. Research program in 1989

3.1 Objective

The prime objectives of this program was as follows.

a) To obtain shallow ice core from southern Greenland ice sheet.
b) To analyse ice core to obtain data for studies on environmental and climatic changes during

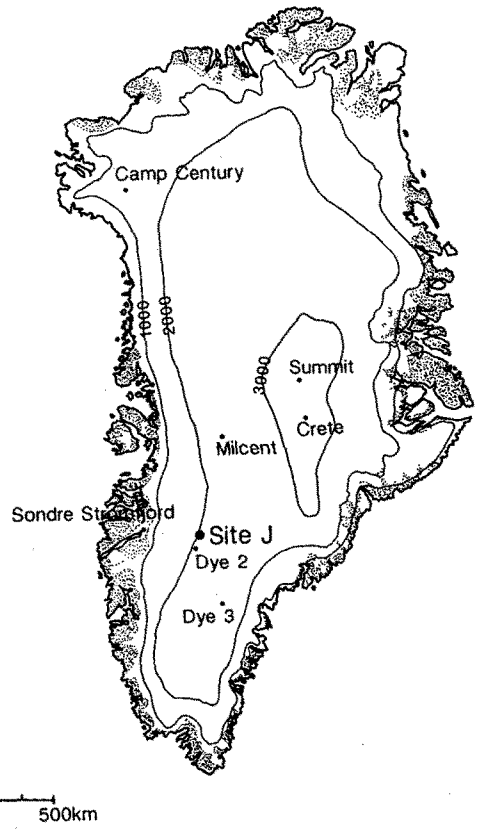

Figure 1. Location of Site-J ; research site of the JAGE 1989 in southern Greenland.

last few hundred years.

c) To understand chemical and physical processes in surface snow layer during snow melt season by analysing pit samples.

3.2 Research site

The research site was located at 67.5°N, 43.5°W and 2,000 m a.s.l. about 200 km east from Sondrestromfjord in southern Greenland and was named as "Site-J" (Figure 1).

The site was selected because of following reasons.

(1) High representativeness of the climate system in southern Greenland

(2) Relatively small amount of accumulation rate and glacier flow

(3) Adequate snow melt in summer for the study of summer ablation change

(4) Easy access from Sondrestromfjord by commercial aircraft

Figure 2 shows a plan view of Site-J. Drilling and living trenches were excavated by using a chain saw and they are covered with polyethylene seats (Figure 3). Their areas were 6.3×3.8 m and 10.2×3.8 m respectively. Core processing cave was dug at 4 m depth from the surface with an area of 5.3×1.1 m to keep room temperature lower than −10°C.

3.3 Subjects of research carried out

a) Shallow ice coring.

Two shallow ice cores were obtained to 101.53 and 205.15 m depths with an electro-mechanical drill (Figure 4).

b) Auxiliary 6 m firn coring.

c) In-situ ice core analyses.

Following core analyses were carried out in-situ in the core processing cave (Figure 5), with all cores stated in a) and b).

stratigraphy
electrical conductivity for solid (ECM) and liquid samples
pH
density
thin section photographing of ice cores for entire depths

d) Laboratory ice core analyses

Selected segments of the ice core and the melt water samples were transported to Japan for following laboratory analyses.

$\delta^{18}O$ and δD
microparticle concentration
chemical composition (major ions)
radio-active isotope analysis
tritium content
^{210}Pb
organic compounds
gas composition (CO_2 and CH_4)
total gas content
mechanical property of ice

e) Pit work.

An 1.6 m deep pit wall was examined on 23 May before surface snow melt occured. Successive pit works were carried out on 8 and 22 June after snow melt started.

In-sites analyses were carried out in the same subjects as stated in c).

f) Borehole temperature distribution.

g) Sampling of new snow.

h) Accumulation and ablation rate measurement.

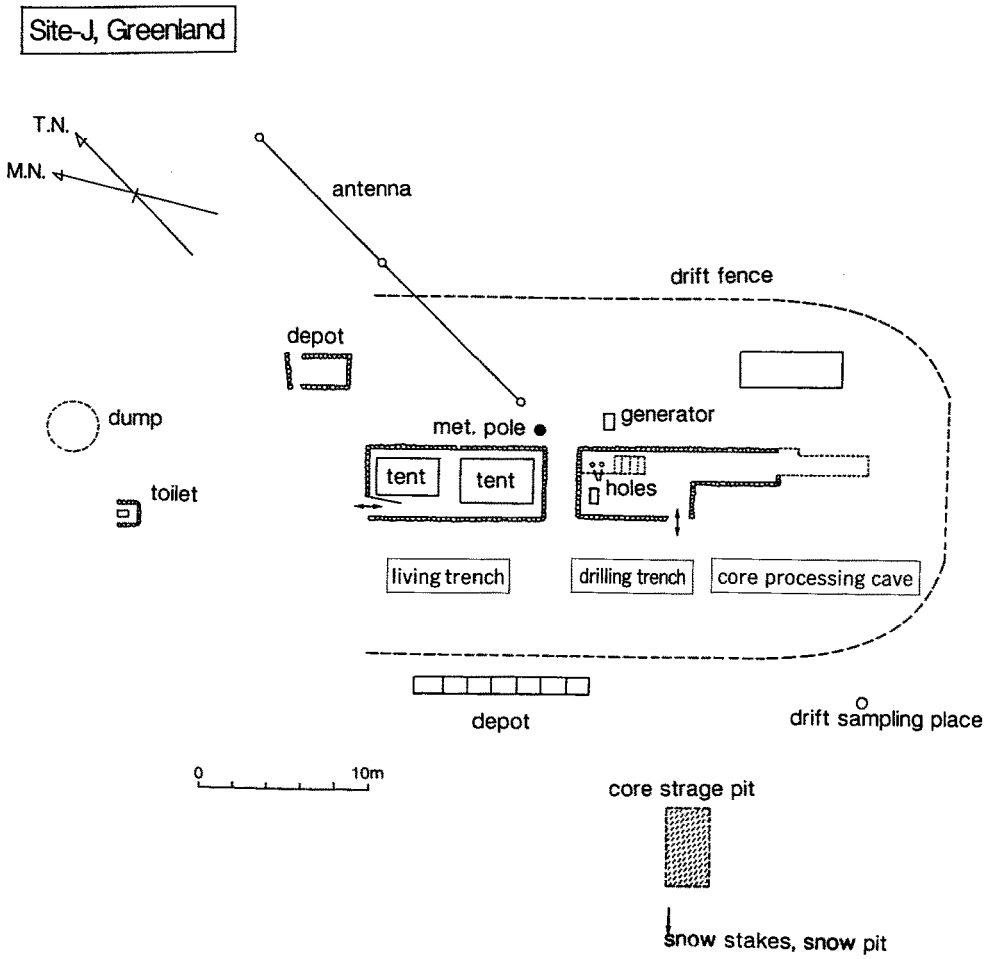

Figure 2. A plan view of Site-J.

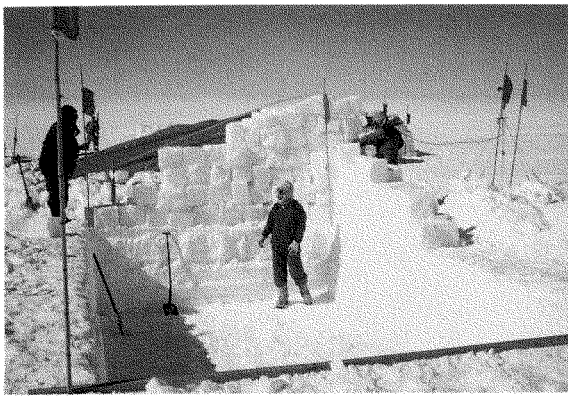

Figure 3. Construction of a drilling trench.

Figure 4. Shallow ice core drilling with an electro-mechanical drilling system.

Figure 5. Stratigraphic observation of ice core in core proc essing cave.

i) General meteorological observation.

3.4 Participants

Chief investigator

Okitsugu Watanabe : Professor, National Institute of Polar Research Field party

Field members

Yoshiyuki Fujii (leader) : National Institute of Polar Research

Hideki Narita : Institute of Low Temperature Science, Hokkaido University

Fumihiko Nishio : National Institute of Polar Research

Hitoshi Shoji : Toyama University

Kokichi Kamiyama : Geophysical Research Station, Kyoto University

Takao Kameda : Institute of Low Temperature Science, Hokkaido University

Yoichi Tanaka : Geo Systems Co. Ltd., Tokyo

Moriatsu Miyahara : Geo Tecs Co. Ltd., Nagoya

3.5 Further studies and publications

Preliminary scientific results were presented at the 12 th NIPR Symposium on Polar Meteorology and Glaciology held in July 1989 and at the general assembly of the Japanese Society of Snow and Ice held in October 1989. Laboratory ice core analyses are carried on for the items listed in 3.3 (d). The results will be presented at concerned symposium and journals.

Acknowledgments

We would like to express our sincere gratitutede to Professor W. Dansgaard of University of Copenhagen and Professor C. C. Langway, Jr. of State University of New York at Baffalo for their valuable suggestions to our expedition. Our particular thanks are due to Dr. N. Gundestrup of University of Copenhagen for his hearty assistance and advices to our activities, particularly his daily radio communication with us.

We are indebted to Mr. G. E. Andersen, the Secretary of the Commission for Scientific Research in Greenland for granting research permission to us.

This research was carried out as a Mombusho (Ministry of Education, Culture and Science) International Scientific Research Program.

Reference

Watanabe, O. and Fujii, Y. (1988) : Outline of the Japanese Arctic Glaciological Expedition 1987. Bulltin of Glacier Research, **6**, 47−50.