National Institute of Polar Research

AERC NEWSLETTER

Arctic Environment Research Center

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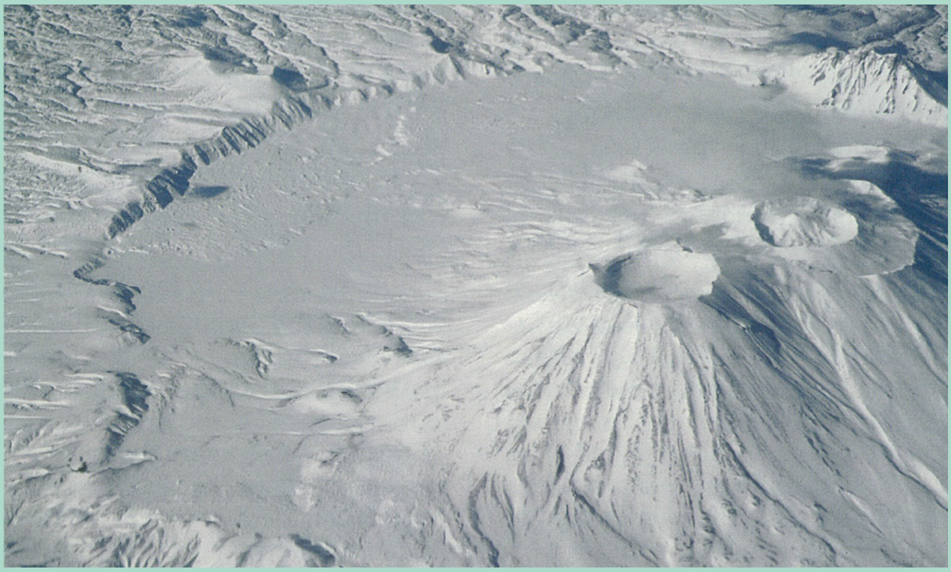

Kamchatka

Oobloyah Bay, Ellesmere Island

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Fiscal 2003 Research Plans

◆ Study of Climatic and Environmental Changes in the Arctic

by Yoshiyuki FUJII

1) Research on the mechanism of environmental change in the Arctic region: Research on the mechanism of environmental change in the Arctic is being conducted by groups planning research on the atmosphere, ocean, glaciology and terrestrial ecology. The coordination group aims comprehensive study of the mechanism of environmental change in the Arctic, treating also the boundaries between disciplines. Carbon dioxide, which contributes to climatic warming, spans several of these research areas. The atmosphere group is studying its transport and transformation processes. The glaciology group is studying its past variations. The terrestrial ecology group is studying the role of plants in carbon dioxide variations. The oceanography group is studying exchanges between ocean and atmosphere. The coordination group is pursuing integrated research on the carbon circulation in the Arctic. Research topics include the relation between climate and sea ice area; the study of records of environmental index substances in ice cores; and evidence in Arctic data of large-scale atmospheric fluctuations including the North Atlantic Oscillation.

2) Holding of workshops: Workshops are being held to report on progress on each research topic, exchange research results, coordinate research and promote progress in continuing research. The discussions emphasize the nature of climatic and environmental changes in the Arctic and research to clarify the mechanism of changes.

3) External evaluation committee: An external evaluation committee is planned during the Workshop at which evaluations of progress through the 4th year of the program and advice on how to proceed in the future are given.

4) Coordination committee meetings: The coordination committee meets twice per year to check the progress of each of the research groups and make sure that the research is conducted in a way that will produce results during the planned time frame.

5) Dissemination of information: Newsletters No. 5 will be issued during the summer. And the program's home page has been updated to provide information on activities and research results to date.

◆ Dynamic Coupling of the Middle Atmosphere and Thermosphere in the Arctic

by Takehiko ASO

The middle and lower atmosphere are coupled together to the thermosphere via precipitation of aurora particles, joule heating, electric field and upward propagating wave disturbances from the lower atmosphere. Observations from various radars including EISCAT, and airglow and aurora observations, are combined to clarify this coupling, focussing on overall atmospheric wave motions over the whole atmosphere from the thermosphere to the lower atmosphere. In particular, research in the following 4 categories is being pursued.

1) Radar observations in the Arctic: Research, associated with the EISCAT radar is being conducted on polar magnetosphere dynamics, in particular on coupling between plasma and neutral atmosphere. These include studies on atmospheric waves coming from below ionospheric dynamics with the Super DARN radar, PSME with SSR (SOUSY radar) and analysis of atmospheric wave motions using those observations.

2) Meteor radar observations: Together with continuous observations, cooperative global and local observations with ESR (EISCAT Svalbard Radar) and SSR are carried out during periods of geomagnetic disturbances. This permits investigation of the effect of the electric field on the drift of meteor trail and on the neutral velocity field itself during geomagnetic disturbances. In addition, an important part of the plan during the current fiscal year is clarification of the latitudinal variation of the principal modes of atmospheric tides at high latitude. Further, meteor radar is being newly installed at Tromsø to complement the EISCAT radar and MF radar and to realize intercomparison in the aurora zone.

3) Optical observations of airglow and aurora: Research on excitation and emission processes in the atmosphere, by simultaneous EISCAT heating and radar observations and ALIS optical observation, is being continued. The relation between particle precipitation and ion line is further investigated by simultaneous aurora spectrograph and ESR observations.

4) Comprehensive data analysis and numerical modeling: Based mainly on the observational and analysis results obtained in this research, and also combining them with global observational data, the results are being compared with GCM numerical modeling in view of atmospheric coupling in terms of wave motions.

◆ Variations of Atmospheric Constituents and Their Climatic Impact in the Arctic

by Takashi YAMANOUCHI

The purposes of this research are to clarify the variability of greenhouse gases, aerosols, ozone and clouds in the Arctic troposphere and stratosphere and the source, sink, transport and transformation processes that cause that variability; and to evaluate the effect on climate via radiation, comparing with the Antarctic. The observations are centered on the base at Ny-Ålesund, in the Svalbard archipelago, at the entrance to and exit from the Arctic Ocean and typical of the marine Arctic. These substances in the atmosphere are being continuously observed to clarify their variability; and, at the same time, use balloons and aircraft to obtain vertical distributions so as to obtain observations of 3-dimensional distributions over a wide area. Through analysis of these observations together with satellite and meteorological objective analysis data, and evaluation using models, we hope to clarify the transport and transformation processes that cause the observed variability, and the effect on climate. The principal activities during the 2003-2004 fiscal year are the following.

(1) Regarding greenhouse gases, observations on the ground at Ny-Ålesund have been continued, leading to an accumulation of highly accurate observational results, so as to fulfill our monitoring obligations. These are being analyzed, together with observations of air-sea exchange of carbon dioxide to clarify the material cycle, including transport mechanisms, sources and sinks.

(2) Regarding aerosols and clouds, we are continuing in-situ observations on the ground at Ny-Ålesund and remote sensing observations, and at the same time are preparing instruments to start strengthened observations of the interactions between aerosols and clouds. In particular, we are considering doing observations with tethered balloons using sensors that measure aerosols and cloud particles to verify the vertical distributions.

(3) We are proceeding with advanced analysis of joint Japan - Germany simultaneous aircraft and ground observations of Arctic tropospheric aerosols and their radiation effect carried out in the springs of the 2000 and 2001 fiscal years (ASTAR 2000), and aircraft observations taken on a path crossing the Arctic Ocean in the spring of 2002 (AAMP 02). We are also proceeding with analysis of the circulation field by comparing vertical cross-sections above the Arctic Ocean obtained from dropsonde observations with meteorological objective analysis data, and investigating the relation between variability of the distributions of greenhouse gases and other substances with transport processes. We are also verifying satellite observations using aerosol observation results and, at the same time, incorporating the results into an Arctic climate model (HIRHAM) to evaluate the radiative forcing and the effect on climate.

(4) In the plan for the 2004 fiscal year, Japanese and German group are to install more aircraft instruments involving modification of the aircraft and increase the sophistication of the observational methods used in their coodinated aircraft and ground observations (ASTAR 04). Next time we will use 2 aircraft, with the aim of observing not only tropospheric aerosols but also the interactions between aerosols and clouds.

◆ Research on Global and Local Environmental Variabilities Using Ice Cores Drilled Around the Arctic

by Kumiko GOTO-AZUMA

The polar regions play important roles in the global climate system as cold sources, together with the tropical region which acts as a heat source. In the process of heat transport which takes place between the cold sources in the polar regions and the low latitude heat source, the polar regions act as convergence regions in the atmospheric and oceanic general circulations, and materials from a variety of sources gather there and are deposited on glaciers and ice sheets, where they are preserved. The substances contained in ice cores form time series; the composition ratios and amounts of the substances are indices of climatic and environmental variability on a global scale. In addition, expansion and contraction of the polar icecaps has greatly affected their roles as cold sources. There are great differences from one region to another in climatic and environmental variability. To clarify the mechanisms of climatic and environmental variability in the Arctic region it is necessary to clarify the climatic and environmental variations that occurred in the past in a number of locations around the Arctic. In the present research program, efforts are being made to reproduce past climatic and environmental variations throughout the Arctic by drilling ice cores at many points and analyzing them; and, at the same time, to clarify the present status of the Arctic cryosphere, mainly through observations. As one link in this research program, the following research is being conducted during the current fiscal year.

1. As one link in the ICAPP (International Circum-Arctic Paleoclimate Program) being conducted under the auspices of IASC, last year an ice core was drilled at King Col on Mount Logan, Canada to reproduce the past climate and environment in the Pacific sector of the Arctic. This core is being analyzed during the current fiscal year. Meanwhile, to obtain information on

glacier flow and amount of snow accumulation, measurements with a strain net and snow stakes installed last year will be repeated, and a borehole survey will be conducted.
2. Under the ICAPP project, it is planned to drill ice cores in Alaska, where until now there have been practically no ice core records of past climatic and environmental variations. During the current fiscal year, as preparation for that drilling, observations of snow melt conditions, snow accumulation observations, ice radar observations, etc. will be carried out on the McCall Glacier. Meteorological instruments will also be installed.
3. In continuation of work done last year, we are participating in North GRIP (North GReenland Ice core Project) where we are drilling an ice core near the pressure-melting point close to the bedrock. In addition, also in continuation of work done last year, we are analyzing a deep ice core from the North GRIP site. By comparing the results obtained with results from analysis of the deep ice core drilled at Dome Fuji, Antarctica, we are able to compare glacial cycles in both polar regions and study the mechanism of large-scale climatic variability.

◆ Research on Arctic Ocean Dynamics and Ecosystem Variability

by Mitsuo FUKUCHI

The oceanic area covered by the Canadian Arctic Shelf Exchange Study (CASES), an international cooperative project, extends from the Cape Bathurst Polynya, which forms in Amundsen Bay in the southeastern Beaufort Sea, to the continental shelf offshore of the Mackenzie Delta and the basin to the north of it. The purpose of our research is to clarify the structure and functions of the ecosystems in this region and the circulation of biogeochemical substances. At the same time, we are attempting to clarify the relationship of secular changes in these factors to long-term changes in the sea ice environment. These observational results will become important knowledge for evaluating long term global scale environmental changes.

During the current fiscal year, it is planned to conduct a full scale observational cruise under the CASES project on an international cooperative basis under the leadership of Laval University of Canada. This cruise will be divided into 9 legs during which full scale observations will be taken for a full year, from September 2003 through the end of August 2004. Eight moorings that were put in place last year will be recovered and new instruments moored to replace them; up to a maximum of 20 moorings are to be put in place during the current fiscal year. The stations that are taken by the ship will be centered on the locations of these 20 moorings, and some oceanographic observations will also be taken at other locations. From fall through winter, when sea ice is forming, sea ice information obtained from satellite images will be used for reference, and the oceanographical observation program will be designed to match the observed sea ice distribution. During the large scale observations this year about 10 researchers from Japan will participate, and some graduate students will also participate as cooperative researchers. This will be continued throughout the year, using a research icebreaker. It is hoped that very important information will be obtained on the polar ecosystem, particularly on the production and consumption of phytoplankton and zooplankton from winter through spring.

In addition, we also plan to participate in other international research, to the extent possible, in the Greenland Sea, the Barents Sea, the ocean around Svalbard, and the Chukchi Sea. We also plan to participate in international meetings relevant to the planning and execution of this international cooperative research. Further, we will gather information about the Antarctic Ocean which is indispensable to to understand the movements in the Arctic Ocean and changes in its ecosystem, and to evaluate the relation to global scale environmental changes.

◆ Research on Environmental Change in the Arctic Tundra

by Hiroshi KANDA

In the 2003-2004 fiscal year, as in the previous year, we research the carbon cycle at many points on moraines in different stages of vegetation succession formed by glacial retreat near Ny-Ålesund, Svalbard. We also construct a compartment model based on measurements in regions having different amounts of pure primary productivity in the ecosystem. In addition, to evaluate the effect on formation of colonies of *Pythium* spp. which are known as soil-borne plant parasite on *Sanionia uncinata*, we continue outdoor experiments using chambers.

Meanwhile, we also conduct researches in the Canadian Arctic for the purpose of comparison with fluctuations in the ecosystem at glacier foreland in Svalbard. During the current fiscal year we conduct a second year of surveys around Oobloyah Bay on Ellesmere Island. In addition to last year's geomorphological survey, we conduct concentrated observations of the eco-physiological characteristics of vegetation as follows:
1. We analyze aerial photographs and determined what kinds of flora and fauna are present in the survey area.
2. To detect the changes taking place in vegetation during the primary succession process in a glacial

retreat area, we establish research sites and survey the biological diversity of mosses, lichens and microorganisms, in relation to the glacial topography, the growth environment and the soil environment. In particular, we research surveys of the water relation and production of *Hylocomium splendens* for comparison with Svalbard.
3. We survey the microbiological biomass, soil respiration characteristics and the eco-physiological characteristics of vegetation on the moraines with different ages. In particular, we survey colonies of mosses, lichens, saxifrages (*Saxifraga*), *Dryas*, willows (*Salix*) and *Luzula* on the moraines.
4. As one of the analyses of plant reproduction, we conduct sampling to study the flowering characteristics of *Dryas octopetala* and phenology analysis of *Polygonum viviparum* and *Casiope tetragona*.

Japanese Arctic Research Directory in 2002

Edited by the Japan National Committee for Polar Research, Science Council of Japan
Published by the National Institute of Polar Research (October 2002)

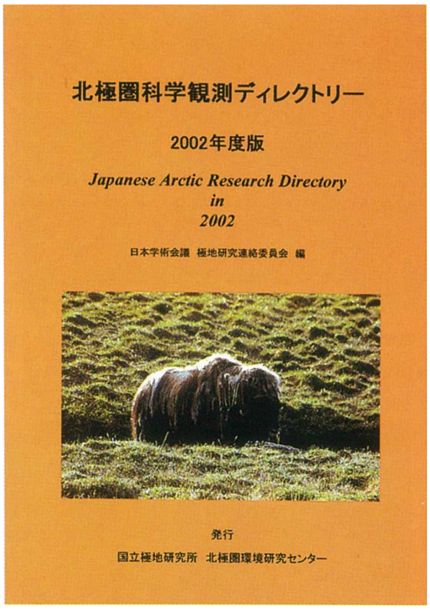
As one of the efforts to understand global scale environmental changes, many universities and research institutions in Japan are undertaking surveys and scientific observational programs in the Arctic. This publication summarizes scientific field works in the Arctic based on a questionnaire survey. This year's publication is the 3rd volume in the series. Starting this year some changes are being made in the questionnaire survey method and in the way the information received is published. For convenience, information is now being made available on the Web. A summary of the information available can be browsed at http://www-arctic.nipr.ac.jp .

Starting this year, in addition to observations in natural science fields we also provide information on a field survey in a humanities field. Information is provided on a total of 41 projects. Comparing the information that was provided during the last 3 years, there is some fluctuation in the number of observational projects in each field. It is possible to discern a trend in the observational projects being carried out in the Arctic.

We thank the people who provided this information for their cooperation, and at the same time express the hope that the information provided in this booklet will contribute to the research activities of readers and to Japan's Arctic research.

by Sakae Kudoh

Arctic observations in which NIPR participated directly (excerpted from the Japanese Arctic Research Directory in 2002)



Oceanography
- Observation of sinking particles in the Mackenzie Shelf

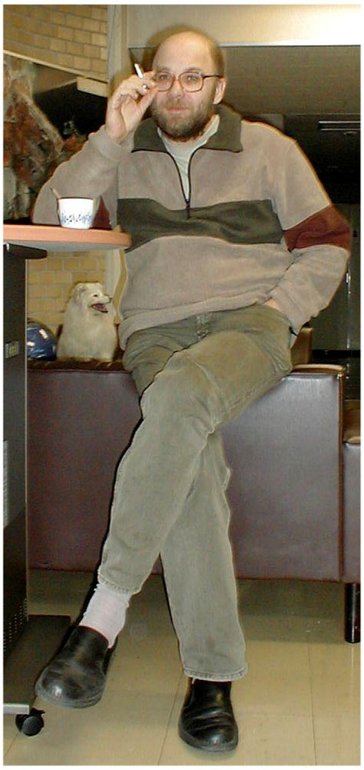
Bio-Science
- Study of ecosystem at the deglaciated area in Ellesmere Island,Canadian Arctic
- Successional process on vegetation occurred in the deglacial area, Spitzbergen, Svalbard
- Biodiversity of snow mold fungi

Glaciology
- North Greenland Ice Core project
- Ice core drilling on Mt. Logan, Yukon, Canada

Atmospheric Science
- Observation of greenhouse gasses in the Arctic
- Arctic Airborne Measurement Program

Upper Atmosphere Physics
- Conjugate auroral observation in Iceland
- Observations of large-scale waves in the polar middle atmosphere and lower thermosphere by the EISCAT radar and collaborative radar and optical platforms
- ALIS (Auroral Large Imaging System) aurora/airglow conjunction observation with EISCAT radar and/or satellites
- Observation of atmospheric dynamics in the polar mesosphere and lower thermosphere by the NSMR - NIPR - Nippon/Norway Svalbard Meteor Radar
- Auroral spectrograph

Visiting Professor (March - June, 2003)



Serguei M. ARKHIPOV

Institute of Geography, Russian Academy of Sciences, Moscow (IGRAS)

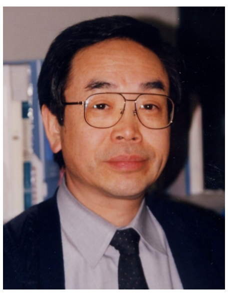
I belong to the Institute of Geography of the Russian Academy of Sciences (Moscow, Russia). Now I am a Senior Research Scientist (since 1994) of the Department of Glaciology of the Institute, where I started to work being just an undergratuate student (in 1978). My education has been a glaciological one, as well: in 1980, I graduated from the Lomonosov Moscow State University, Department (Faculty) of Geography, Chair of Cryolithology and Glaciology. In 1986, in IGRAS, I defended my PhD thesis under the title «Isotope-Chemical Composition and Ice Structure of Polar Glaciers as an Indicator of Ice Facies Conditions (Results of Spitsbergen and Severnaya Zemlya Studies)». Actually, this title describes the main field of my scientific interests and research: deep drilling of glaciers and ice core investigation; hydrothermal state, structure and isotopic-chemical parameters of snow, ice, and firn; multiparameter studies of the active layer, deep and bottom sections of glaciers; development of glaciological and climatogical data banks, glaciological object classification.

I have participated in more than 20 Russian and intenational expeditions and field projects, mainly concerned with drilling of glaciers (Svalbard, Severnaya Zemlya, Franz Josef Land, Antarctic, Caucasus, Tien Shan, Altai and other regions), including Japanese-Russian expeditions to Svalbard (1995, Vestfonna) and Altai (Sofiysky glacier, 2000/01). However, my first regional interest is the Eurasian Arctic.

In 1975-1988, deep core drilling of glaciers of the Eurasian Arctic was intensively developed, primarily by scientists of the Institute of Geography of the Russian Academy of Sciences and the Arctic and Antarctic Research Institute (AARI), with robust participation of the Institute of Geology of the Estonian Academy of Sciences and Lomonosov Moscow State University. Since 1987, the Japanese Arctic Glaciological Expedition has done successful work on Svalbard. Since 1997, international projects have been carried out on Frantz Josef Land, Svalbard, and Severnaya Zemlya.

As well as in Antarctic and Greenland, a preference to drill holes on glaciers already studied, and even directly at sites of a previous drilling, is now evident in these placees. The reason is clear – fast progress in techniques of ice core analysis makes it possible to enhance the quality and quantity of information obtained, especially of palaeogeographic information. At the same time, interest was aroused in earlier data which are necessary for estimation of the representativeness of data from deep levels of glaciers in the Eurasian Arctic, and of natural condition change tendencies for the last decades. Thereupon, the data bank «Deep Drilling of Glaciers in Eurasian Arctic» has been created in IGRAS with robust support by NIPR, and now we are going to extend this work and discuss further plans for joint glaciological expeditions to the Russian Arctic and Altai.

This is already my second visit to Japan and NIPR. I feel very thankful to Director Watanabe and Professor Fujii for the invitation. NIPR provides everything necessary for fruitful scientific work, particularly a very extensive library, what is especially attractive for Russian scientists. I also have a possibility to feel and enjoy the Japanese way of life again, which, as it seems to me, is very convenient for Russians, too.



Visiting Professor 2003
Takeo HONDOH
(Glaciology)

Visiting associated Professor 2003
Yasunobu MIYOSHI
(Upper atmosphere)

Research Reports

Glaciological observations on Mount Logan, Canada (report of expedition participation)

Sumito Matoba, National Institute of Polar Research
(from January 2003 at the National Institute for Environmental Studies)

From late April to early June, 2002, as one link in the international Ice core Circum-Arctic Paleoclimate Program (ICAPP)glaciological observations, principally the drilling of a shallow ice core, were conducted on Mount Logan (5,959m) in the Yukon Territory, Canada. The purposes of these observations are to clarify the secular variation of environmental pollution in the Circum-Arctic region in recent years, to clarify the climatic change on a scale of several decades in the North Pacific region and to clarify the dynamical characteristics of an alpine glacier in a cold climate. The observations were carried out by a group of 6 people led by Assistant Professor Kumiko Goto-Azuma of the National Institute of Polar Research.

These observations were carried out at King Col on the middle slopes of Mount Logan, at 60°35'20"N, 140°36'15"W, 4,135m elevation. Since the drilling point was at high elevation, landing suddenly at the drilling point by aircraft or helicopter would risk altitude illness, so it was necessary to gain elevation gradually while acclimatizing.

On April 28 we landed in a Single Otter aircraft at 2,800m on the Quintino-Sella Glacier. We transported the scientific equipment to the observation point by aircraft, then returned to the 2,800m point to acclimatize. We climbed up and down the glacier several times to acclimatize on May 1 and 3, then on the 5th put on skis and pulled sleds with our personal gear to King Trench at 3,200m. There was little snow that year so we encountered 2 crevasses en route and had to walk or jump across them. We judged that there would be avalanche danger on the route beyond King Trench, so on May 8 we moved to the observation point by helicopter. There were no serious cases of altitude illness, but there were cases of people who felt lazy and did not move for half a day, or had trouble breathing and woke up during the night.

The drilling point was decided upon by using ice radar to measure the ice thickness. The ice thickness at the drilling point that was selected was measured to be 197 to 209m. Subsequently, we completed preparations for drilling and ice core analysis, and from the 13th started drilling with a shallow mechanical drill. On the whole the drilling proceeded normally, but at about 150m depth the drill refused to advance into the ice for 3 days, and the mast that supported the drill broke at a welded section at the base. We dealt with each of the problems as they occurred, made the necessary repairs and continued drilling. When the drilling was finished the drill was thoroughly damaged from one end to the other. The drilling was stopped after 18 days at 220.52m without reaching the bedrock because the cable ran out. The ice core that was obtained was of very good quality with few cracks to a depth of 200m; beyond that depth there were many cracks. In an analysis trench at the observation point, the 50cm core sections were matched and their lengths measured and logged, and stratigraphic observations were carried out. Two layers believed to be volcanic ash were discovered in the core. Half of each 50cm core section from the top 30m was melted to form a water sample; the rest, together with the whole 50cm sections from deeper than 30m, was transported back to Japan in the frozen state. Plans are to conduct physical and chemical measurements on each of the core sections, followed by specialized analyses for the purposes of the present research.

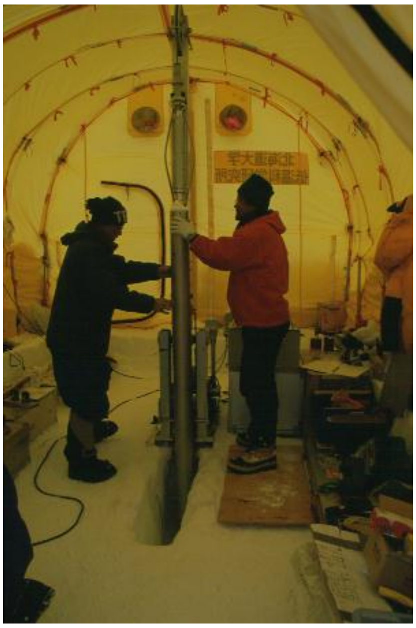


Photo 2: Drilling in progress

Photo 1: Climbing up the glacier

Photo 3: The observation camp

Glacial Topography in the Vicinity of Oobloyah Bay, Ellesmere Island

Hirohiko Hasegawa, Meiji University

This Ellesmere Island survey was carried out by 2 of us, Shin'ichi Sawaguchi of Niigata University of International and Information Studies, who does research on the topography of glaciers and the land around glaciers to form the basis for research on ecological system variability, and myself. From Sawaguchi, who also participated in a similar survey the previous year (2001), I heard that the area that we would be surveying is a unique area within Ellesmere Island and is particularly well suited to clarifying the history of development of glacial topography. However, for me this was my first experience of Arctic Canada, and, in addition, the amount of time allowed for the survey was short, so it was with some trepidation that I arrived. The area surveyed is the area downstream from glacier termini on the southern slope of the Krieger Mountains, which tower above the inner end of Oobloyah Bay (Figure 1). To the east and west of the Krieger Mountains, outlet glaciers from the inland icecap flow southward; a glaciated penetrating valley, to be referred to here as Oobloyah Valley, extends east and west, joining the termini of the two glaciers. There are 6 alpine glaciers on the southern slope of the Krieger Mountains; our survey emphasized the 2nd glacier from the west (to be referred to here as the No. 2 Glacier, area 6 square kilometers), where we located our Base Camp.

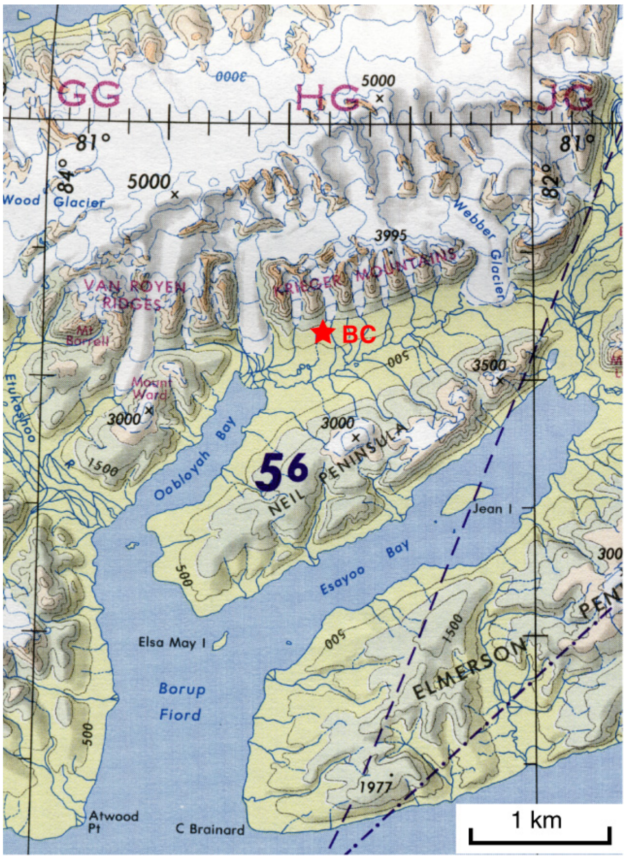


Fig. 1: The survey area. The star shows the location of our Base Camp.

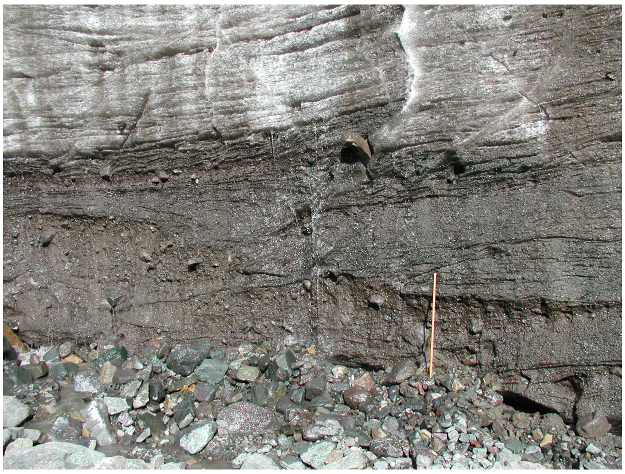


Photo 2: Debris-rich basal ice along the bottom of the right bank of the No. 2 Glacier.

The first thing that I felt upon entering this area was that, although the Oobloyah Valley might have been affected by the glaciers during the Last Glacial period. the evidence of that action was unclear. The walls of the glaciated valley are gradual in slope; practically the entire area is covered by a weathered debris layer formed by periglacial action after the ice melted. This valley must certainly have been a dry valley during the Last Glacial period. This initial intuitive feeling hardened into a firm belief as the survey progressed.

At the terminus of the No. 2 Glacier we were able to observe typical debris-rich basal ice, just like one sees in textbooks (Photo 1= cover picture, bottom, Photo 2). Within the basal ice clear shear structures and folded structures are developed. If we had the time I would liked to have continued observing these for several days, but unfortunately we did not. After observing them for a mere 2 hours, we moved on to survey the groups of moraines distributed in front of the glaciers.

Ice-cored moraines from the Little Ice Age are distributed around the present glacier termini. Surrounding them, in turn, were a number of terminal moraines and lateral moraines in the bottom of the valley along the right bank (looking downstream) of the main river that runs through the Oobloyah Valley (we called it the "Kanda Gawa" after a river that runs through Tokyo) (Photo 3). These groups of moraines are classified into the oldest group, the old group and the young group. Whereas the oldest moraines have been considerably subdued as a result of periglacial action, and their forms are unclear, the old and young moraines have clear ridges and steep

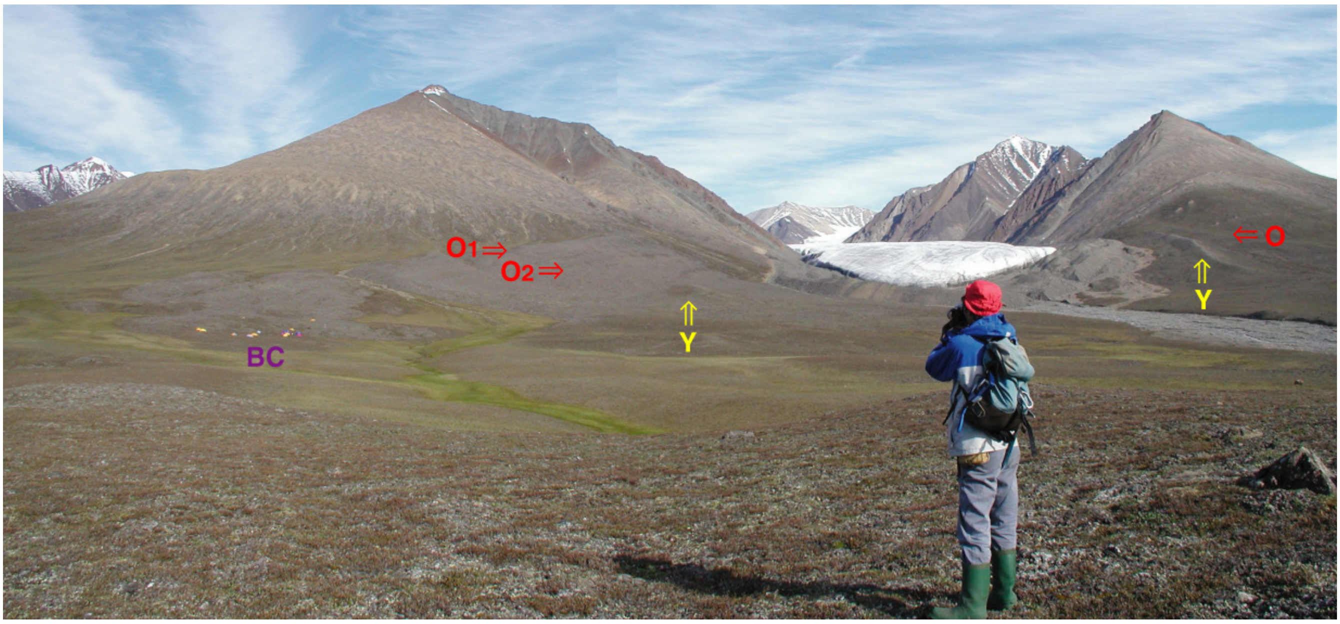


Photo 3: The No. 2 Glacier and groups of moraines.
The moraines distributed so as to form an outline of the glacier are ice-core moraines from the Little Ice Age. Photographed from above the old period 2 terminal moraine.
O: Old period lateral moraines   O1: old period 1; O2: old period 2
Y: New period lateral moraines.   BC: Base Camp.

lateral slopes. The young moraines consist of a series of ridges immediately outside of and parallel to the Little Ice Age moraines; the old moraine groups consist of a number of prominent lateral and terminal moraine groups. We decided to use 2 relative dating methods to more clearly distinguish the periods of formation of these moraines. One method was lichenometry, using the diameter of *Rhizocarpon geographicum* s.l., the other was to use the thickness of the weathering rind of sand stone gravels (Photo 4). As a result, we were able to subclassify the old period into old period 1 and old period 2; and we were also able to subclassify the Little Ice Age moraines into 2 groups.

From analysis of aerial photographs, we were able to confirm the presence of lateral moraines on the left bank of Oobloyah Bay that correlate to the oldest period and the old period. Since it was during the Last Glacial period that Oobloyah Bay was acted on by glaciers (King, 1981; England, 1990), we believe that the oldest and intermediate periods correspond to the last Ice Age or a previous period. However, as of the present time we have not obtained any data that indicate the absolute age of the period of glacial advance. Since we obtained samples for dating from a number of points in the sediments left by outflowing glacial melt water, we expect that as the results from dating them become available it will become possible to determine a relative age scale. In the future, it will become necessary to gather more samples for relative dating of moraines of overflow glaciers, to compare with periods of advance of alpine glaciers.

Until now, in Arctic Canada, attention has been focused on the history of advance and retreat of icecaps and relatively large overflow glaciers. The alpine glaciers on the south slope of the Krieger Mountains are small in scale and simple in form; even during the Last Glacial period they did not merge with other glaciers. Consequently, in this area there is a possibility to discuss in detail the history of change in the glacial environment from the last Ice Age to the present. In the future, I am thinking of computing the topographical snow-line height in each period of glacial advance.

England, J. (1990): The late Quaternary history of Greely Fiord and its tributaries, west-central Ellesmere Island. *Can. J. Earth Sci.*, 27, 255-270.
King, L. (1981): Studies in glacial history of the area between Oobloyah Bay and Esayoo Bay, northern Ellesmere Island, N. W. T., Canada. In *Results of the Heidelberg Ellesmere Island Exedition*. Heidelberger geographische Arbeiten, 69, 233-267.

Photo 4: A weathering rind seen in floater above the oldest period terminal moraine.

Characteristics of the Ny-Ålesund Terrestrial Ecosystem as Seen from Vegetation

Satoru Kojima, Tokyo Women's Christian University

The history of the terrestrial ecosystem around Rabben base at Ny-Ålesund is young. This area was covered by glaciers until recently; the glaciers that exist in the area today are still receding. Most of the land emerged from under ice cover only within the last few hundred years. After the glaciers receded, a variety of plants advanced onto the newly bare land and formed ecosystems. However, these ecosystems are still in an early stage of succession and are immature. Important constituents include blue-green algae, algae, lichens and mosses. There are relatively few vascular plants, and on the whole the vegetation cover is low. Further, whereas plant communities are normally differentiated to correspond to the local landform characteristics, at the present time there is little differentiation. So a major characteristic of the ecosystem in this area is that it is "young".

The immaturity of the ecosystem is also evident from the soil characteristics. The soil in this area is as yet practically undifferentiated into layers, perhaps in part because such development is slow in the cold climate. With little differentiation into layers, and immature soils (Regosol or Entisol) extend over a wide area. Leaching has not progressed much in these immature soils so in general the pH is high. The soil pH is an indicator of the amount of base in the soil. Around Ny-Ålesund sedimentary rocks having character similar to limestone occur over a wide area so the parent material of the soil is rich in lime and, reflecting that, the soil pH is naturally high. Analysis showed the pH to be in the range 5.3 to 7.9. Comparing this to the normal pH of 4 to 5 of soil in a forest, and 3 to 4 of peat in a peat bog, it is clearly a high pH, reflecting a

An ecosystem in an early stage of succession formed on a field of gravel following glacial retreat.

highly basic soil composition. This then becomes an important factor regulating the growth of vegetation in the area. For example, vascular plants which occur widely in this area include *Saxifraga oppositifolia*, *Salix polaris* and *Polygonum viviparum;* these are basically plants which grow in high pH soil.

From the point of view of soil conditions, another important conditions is moisture. The soils in this area vary greatly in their moisture content, from very dry soils to hygric (very wet) soils. Since in general the soil has high pH, the moisture condition essentially determines the growth characteristics, and plant communities differentiate in response to that. For example, *Draba nivalis* grows in dry soil, whereas communities consisting of *Luzula confusa* and *Cerastium regelii* are formed in hygric soil. In soils of average moisture content, communities of *Saxifraga oppositifolia*, *Salix polaris*, *Polygonum*

Salix polaris

Polygonum viviparum

Kongsfjord, which extends eastward from the Ny-Ålesund base.

viviparum, Cerastium arcticum, Luzula arctica, Oxyria dygina and *Carex misandra* form. Thus, although the ecosystem is still in the initial stage of succession, some differentiation of plant communities has occurred in response to differences in soil moisture content. However, at present communities of such species as *Cassiope tetragona*, which are very common in the Arctic, as well as of *Eriophorum scheuchzeri, Carex stans* and *Saxifraga hirculus*, are practically not found at all in this area. This also indicates that the ecosystem is still in an immature stage.

If the succession continues on its present course, what kind of ecosystem will eventually develop in this area? In general, in the Arctic the climate is extremely cold, so successions proceed very slowly and there is a question as to whether climax is ever actually reached. Also, a characteristic of succession in the Arctic is that so-called pioneer plants which appear in the early stage of succession often remain until the climax period; not much change is seen from the pioneer species to the climax species. So there is room for argument as to exactly what constitutes the climax in the Arctic.

Even so, assuming that the succession does continue on its present course, it is conceivable that the vegetation cover by vascular plants will increase. Perhaps at the same time the amount of organic matter in the soil will increase. When organic matter is deposited, organic acids are formed in the process of its decomposition, accelerating the acidification of the soil. Leaching of bases from the soil also proceeds. Perhaps as a result the soil pH will decrease. In addition, in hygric soil perhaps peat will be deposited. The species composition of plant communities will perhaps change in response to this change in the chemical composition of the soil. Plants that can be expected to increase and form communities include *Dryas octopetala* and *Cerastium arcticum* in dry soil; *Cassiope tetragona* and *Salix polaris* in soil of average moisture content; *Eriophorum scheuchzeri, Carex stans* and *Saxifraga hirculus* in hygric soil; so that plant communities will become differentiated in response to local conditions.

There is concern about climatic warming on a global scale. Needless to say, the warming that is predicted will show up most prominently in the Arctic, and it is the Arctic terrestrial ecosystem that will suffer the greatest impact. How will the Arctic ecosystem respond when warming proceeds rapidly? Clarifying this is of vital importance. Warming will accelerate the production of matter by plants, while at the same time it will accelerate microorganism activity to promote greater decomposition of organic matter in the soil. What will the net effect be on the carbon budget of the ecosystem? How will it affect the movement of bases in the soil? Will not warming upset the equilibrium among plant communities and trigger changeover of species and change in species composition? What will the effect on the breeding ecology be? How will this affect animal communities? Clarification of these riddles is an unavoidable topic not only for purely academic interest, but also to understand global environmental problems. From this point of view, also, Arctic research will continue to become more important in the future.

Dryas octopetala

Silene acaulis

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EDITOR'S NOTE

The Arctic Environment Research Center of the National Institute of Polar Research, Japan, has been distributing a newsletter (2 domestic editions in Japanese per year) to provide Japanese Scientists with news of Japanese projects under way, news of important research abroad and news of domestic and international conferences. This volume, AERC NEWSLETTER, Vol. 8, incorporates our Arctic research plan in 2003, and numbers 16 and 17 of the domestic bulletin, which includes news of potential interest and/or novelty to international readers. Contributions are welcome and should be addressed to:

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