FROZEN GROUND

The News Bulletin of the International Permafrost Association Number 21, December 1997

International Permafrost Association

The International Permafrost Association, founded in 1983, has as its objectives fostering the dissemination of knowledge concerning permafrost and promoting cooperation among persons and national or international organizations engaged in scientific investigation and engineering work on permafrost. Membership is through adhering national or multi-national organizations or as individuals in countries where no adhering body exists. The IPA is governed by its officers and a Council consisting of representatives from 22 adhering bodies having interests in some aspect of theoretical, basic and applied frozen ground research, including permafrost, seasonal frost, artificial freezing and periglacial phenomena. Working groups organize and coordinate research activities and special projects. The IPA became an Affiliated Organization of the International Union of Geological Sciences in July 1989. The association's primary responsibilities are convening international permafrost conferences and accomplishing special projects such as preparing maps, bibliographies, and glossaries. The first conference was held in West Lafayette, Indiana, USA, in 1963; the second in Yakutsk, Siberia, 1973; the third in Edmonton, Canada, 1978; the fourth in Fairbanks, Alaska, 1983; the fifth in Trondheim, Norway, 1988; the sixth in Beijing, China, 1993. The seventh will be in Yellowknife, Canada, in 1998. Field excursions are an integral part of each conference, and are organized by the host country.

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Cover: Drilling platform at the upper terminus of the Piz Corvatsch cable station, 3303 m a.s.l. in the eastern Swiss Alps. A new terminal is planned for the site. The coring in bedrock reached a depth of 20 m and temperatures are below 0°C throughout the borehole. Permafrost thickness in the area reaches 100 m, with an active layer of about 3 m. The mean annual air temperature is –6.3 °Celsius. The active Murtel-Corvatsch rock glacier is located downslope between 2620 and 2850 m a.s.l. These sites were visited in August 1997 during the M4 field excursion of the Fourth International Conference on Geomorphology—see p. 24. (Photograph by Daniel Vonder Mühll, Laboratory of Hydraulics, Hydrology and Glaciology (VAW), Federal Institute of Technology (ETH), Zurich, Switzerland.)

FROZEN GROUND

THE NEWS BULLETIN OF THE
INTERNATIONAL PERMAFROST ASSOCIATION
NUMBER 21 • DECEMBER 1997

Frozen Ground, the News Bulletin of the International Permafrost Association, is published semi-annually. The IPA is a non-governmental association of national organizations representing 22 countries or groups of countries. The success of the bulletin depends upon the willingness of IPA participants to supply information for publication. Submission deadlines are 1 May and 1 October. Please ensure that working group and member country reports are submitted in good time for publication. News items are also very welcome from any IPA participant or others, as are interesting photographs for the cover (please furnish high quality glossy prints). To submit news items or photos please contact the appropriate individual listed on page 35, or the Secretary General.

Frozen Ground is compiled by Jerry Brown with the assistance of Alan Heginbottom of the Editorial Committee. Production is courtesy of the Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, USA. Copies of *Frozen Ground* are available in Canada from Alan Heginbottom, Geological Survey of Canada, 601 Booth Street, Ottawa K1A 0E8; in Russia from the Consolidated Scientific Council on Earth Cryology, Vavilov Str. 30/6, 117982 Moscow; in the United States from Jerry Brown, P.O. Box 7, Woods Hole, Massachusetts 02543-0007; and elsewhere from Council members.

The IPA Web site may be found at http://www.geodata.soton.ac.uk/ipa.

Editor's Note: The June 1997 issue of *Frozen Ground* was not published. This issue is a combined June/December news bulletin.

Erratum — Frozen Ground No. 20, December 1996: *Cover: Damming of a river by two rock glaciers converging from opposite sides of the valley to form Lake Zhasyl-Kul, located in Kirgizstan about 5 km from its border with Kazakstan, northern Tien Shan Mountains, at 42°52′N, 77°08′E, 3150 meters a.s.l.*

2
EXECUTIVE COMMITTEE REPORT

3
INTERNATIONAL ACTIVITIES
PACE, GEWEX, GCOS, WCRP

8
NEWS FROM MEMBERS

20
WORKING GROUP REPORTS

29
PUBLICATIONS

34
FORTHCOMING MEETINGS

35
MEMBERSHIP

EXECUTIVE COMMITTEE REPORT

The past year has been an extremely active time for the International Permafrost Association. Many activities are highlighted in this report, and details are found elsewhere in the news bulletin. A decision was made early in 1997 to publish only one issue of *Frozen Ground*; consequently there was no June issue. Since much news centered on summer activities, it seemed appropriate to combine information into a single issue which would reach most readers by the end of 1997. A second reason was to save costs, in terms of both time and funds.

The Executive Committee met in April in Pushchino and in late summer in Bologna, Italy, during the Fourth International Conference on Geomorphology (ICG). Thirty-one participants and guests representing 18 IPA Adhering Members attended the open committee session in Bologna. This large representation was in part the result of attendance on the pre-conference field trip in the Alps to observe and discuss mountain permafrost phenomena. The trip, organized by Wilfried Haeberli and Francesco Dramis, included a one-day symposium and was followed by a session in Bologna on periglacial geomorphology. Discussions at the Bologna committee meetings centered on present and future working group activities, changes in the constitution, the status of planning for the Yellowknife conference, and international programs.

The results of the Nomination Committee meeting were formally announced, with the nomination of Hugh French (Canada) for president and Felix Are (Russia) and Wilfried Haeberli (Switzerland) for the two vice president positions. As a result of several discussions in Bologna, the Executive Committee recommends that the constitution be changed in Yellowknife to expand the present four-member Executive Committee to six members and that each member agree to assume specific responsibilities. A decision was reached to provide a limited number of travel stipends for the Yellowknife conference. The IPA and Canadian Organizing Committee will coordinate the review of applications and awards to authors of papers or posters and other delegates from non-North American countries. The final circular describes application procedures for eligible participants.

Working groups were urged to propose new activities as part of their continuing goals or suggest new or reorganized groups. Several new groups or task forces might represent Southern Hemisphere permafrost and periglacial processes, regional mapping programs, environmental security, engineering, and coastal permafrost distribution and processes. The possibility of establishing a permanent data and monitoring organization or service was introduced. As questions of the magnitude of global change and its impact on the cryosphere persist, the role of IPA as a representative of the geoscience and engineering communities should be explored and responses proposed and implemented.

During 1997 international activities focused on conferences and program development and coordination. Starting in April there were a series of major international conferences: Pushchino, Russia, Anchorage and Fairbanks, Alaska, and Syktyvkar, Russia. Several of these were sponsored by IPA, and details are reported in member and/or working group reports. In addition to many proceedings volumes, several new publications appeared. The new Russian journal *Earth Cryosphere* published four issues in 1997. The Russian geocryology map (1:2,500,000) in a series of 16 sheets became available. The IPA Circum-Arctic Map of Permafrost and Ground Ice Conditions (1:10,000,000) was published by the U.S. Geological Survey. Considerable progress was made in identifying and acquiring data sets for the IPA CD Circumpolar Active-layer Permafrost Systems (CAPS).

Several IPA-related monitoring programs and activities were formally identified. The European community is funding a new project on mountain permafrost, Permafrost and Climate in Europe (PACE), which will involve field studies and ground temperature measurements in six European countries, including Svalbard. It will be coordinated in the U.K. The Circumpolar Active Layer Monitoring (CALM) network was expanded to include approximately 70 sites. Other international activities involved participation in World Meteorological Organization (WMO) organized meetings and programs. Both active layer and thermal state of permafrost were formally introduced into the Global Climate Observing Systems programs, and permafrost was introduced into several World Climate Research Program meetings and resulting publications. Coordination continued with the International Arctic Science Committee (IASC) and the Arctic Data Directory (ADD).

We are looking forward to the conference and the IPA council meetings in Yellowknife and to learning of new advances and proposed activities resulting from those meetings and discussions. Approximately 260 papers were submitted for review. For those who will not attend, we will make a special effort to disseminate information about the conference on the Internet and in the December 1998 issue of *Frozen Ground.*

INTERNATIONAL ACTIVITIES

Since the last issue of *Frozen Ground* a number of new projects and activities related to IPA interests have emerged. The following reports on several of these. IPA continues coordination of and involvement in a number of ongoing activities, including: International Tundra Experiment (ITEX), the International Arctic Science Committtee (IASC) and its programs on Land–Ocean Interactions in the Russian Arctic (LOIRA) and Barents Sea Impact Study (BASIS), and the Arctic Data Directory (ADD). Other programs of interest include the Arctic–Alpine Terrestrial Ecosystem Research Initiative (ARTERI) of the European Union, the related Scandinavian/ Northern European Region Transect (SCANTRAN) and the IGBP Eurasian Transect, the EC project Tundra Degradation in the Russian Arctic (TUNDRA), and several Antarctic data and geoscience activities.

PERMAFROST AND CLIMATE IN EUROPE (PACE)

Mountain permafrost in Europe is often only a few degrees Celsius below zero, and is therefore highly sensitive to climate warming. The combination of high ice content and steep slopes leads to significant potential hazard from slope instability arising from mountain permafrost degradation. A new three-year European collaborative research project to monitor mountain permafrost temperatures in a transect from Svalbard (Norway) in the north to the Sierra Nevada of Spain in the south has been selected for funding under the second call of the Fourth Framework Environment and Climate Programme of the European Community. The PACE project, subtitled Climate Change, Mountain Permafrost Degradation, and Geotechnical Hazard, is coordinated by Charles Harris, University of Cardiff. It includes the following collaborators or partners: Johan-Ludvig Sollid (University of Oslo), Per Holmlund (University of Stockholm), Lorenz King (Justus Liebig Universität, Giessen, Germany), Wilfried Haeberli (University of Zurich), Daniel Vonder Mühll (The Federal Technical Institute, Zurich), Francesco Dramis (Third University of Rome), and David Palacios (Universidad Complutense de Madrid).

The objectives of the project are:

- To establish a network of instrumented boreholes for monitoring the geothermal impact of global climate change on mountain permafrost in Europe
- To map and model thermally sensitive mountain permafrost and predict changes in distribution resulting from climate change
- To provide new, process-based methods for assessing environmental and geotechnical hazards associated with mountain permafrost degradation

The major results and products will be:

- A Europe-wide, long-term permafrost temperature monitoring program
- Improved field techniques for mapping permafrost distribution, based on geophysical and geomorphological approaches
- Improved techniques for the numerical modeling of permafrost distribution, based on new microclimatological studies coupled with computer-based digital terrain modeling
- Technical guidelines for the assessment of landslide and other geotechnical hazards associated with permafrost degradation

The project will be accomplished through six interrelated subprojects or work packages:

1. *Permafrost temperature monitoring in a transect from Svalbard to Spain* (Leader: King). This involves drilling new boreholes to depths of 8–80 m, and automatic logging of ground temperature. The European Permafrost Monitoring Network will provide early indications of permafrost warming, define the geophysical properties of the frozen ground, and generate information vital for the thermal and geotechnical modeling aspects of this project. Data will be archived via the University of Southampton node of the IPA Global Geocryological Database, and information relating to active layer thickness and thermal regimes will be contributed to the CALM program. Temperature sensors will be retrievable to facilitate calibration and servicing and to ensure the long-term viability of the monitoring program.

2. *Mapping of permafrost distribution and character based on geophysical techniques* (Leader: Vonder Mühll). An experimental phase targets known permafrost areas to develop refined geophysical field techniques. A key geophysical parameter will be developed for rapid mapping of permafrost and assessment of its temporal variation. Detailed geophysical surveys will then be undertaken in each test site, in order to provide evidence concerning permafrost distribution, depth and character.

3. *Geomorphological mapping and monitoring of temporal changes in mountain permafrost distribution and the processes associated with permafrost degradation* (Leaders: Sollid and Dramis). Field data and remote sensing imagery will extend the geophysics-based surveys (2) in GIS-based mapping of permafrost processes. Field relationships will be established between processes and geotechnical and environmental conditions, and these will be related to (5). Standardized field mapping and GIS processing will ensure a common approach.

4. *Energy balance measurement and permafrost distribution modeling* (Leader: Haeberli). Field measurements taken at microclimatological monitoring stations, together with

other thermal measurements (including BTS), will be combined with digital elevation models to develop improved modeling of permafrost distribution patterns in different mountain regions and for various climatic scenarios.

5. *Thermally controlled geotechnical centrifuge modeling of permafrost degradation processes* (Leader: Davies, University of Dundee). Physical modeling of permafrost degradation processes will include thaw subsidence impact on foundations and slope instability processes resulting from permafrost thaw. Measurement of progressive strain, pore water pressures, temperature changes, and thaw consolidation during modeling will allow determination of thresholds of slope instability and process/intensity relationships, providing new quantitative data.

6: *Guidelines for geotechnical and environmental hazard prediction in the context of global warming* (Leader: Harris). Integration of the previous five activities will be undertaken to develop new methods of geotechnical and environmental hazard prediction. Guidance will be provided on the mapping and assessment of permafrost distribution and character and prediction of the geotechnical impacts of future climate warming, thus facilitating risk assessment and project planning in the mountains of Europe.

The PACE program will disseminate results to the scientific community via the Global Geocryological Database, CALM, scientific meetings, and published research papers. A Web site will be established where program details, progress reports and preliminary results will be posted. The project will offer opportunities for post-graduate and post-doctoral research positions. Interested candidates for these positions, or others wishing details of the project, can obtain information from Charles Harris.

Charles Harris (harris@cardiff.ac.uk)

GEWEX Asian Monsoon Experiment (GAME/Siberia)

The objective of GAME is to understand the role of the Asian monsoon as a major component of the global energy and water cycle, and to understand the feedback processes, i.e. radiation, cloud, precipitation and land surface hydrology, in the diurnal cycle, and intraseasonal, seasonal and annual variability of the Asian monsoon. The GAME/Siberia subprogram is a collaborative effort of Japanese scientists from the University of Shiga Prefecture and the University of Hokkaido, Russian scientists from the Institute of Biology and the Permafrost Institute in Yakutsk, and American scientists from the University of Alaska Fairbanks. The Tiksi site on the Lena Delta in the Republic of Sakha has been selected as one of three regions in which to conduct intensive process studies of the energy and moisture fluxes at the surface and the planetary boundary layer.

The objective of the GAME/Siberia project is to clarify the characteristics and processes of water accumulation and transfer and their relation with the energy cycle, in the atmosphere/land surface interface of cold environments from the seasonal to the annual time scale. A separate objective is to obtain the climate trend and land surface change during the past 50 years and evaluate possible feedback mechanisms. The spatial scale to be studied will be from the local scale to that of continental rivers.

The GAME/Siberia research is being conducted at the Polar Geocosmophysics Observatory, 7 km south of Tiksi. Two nested watersheds (8 km^2 and 70 km^2) have been selected for analysis in this study (approximate latitude 71°N, longitude 129°E). They are both tributaries of the Suonannaf River. The research initiated to date includes monitoring of snowmelt heat balance and snowmelt runoff response, snowmelt water balance on plot and basin scales, installation of a full meteorologic station, monitoring the variation of soil moisture distribution, evaluating the variation of one-dimensional vapor and energy flux, and monitoring the variation of the active layer (thickness, temperature, moisture) on the 1-km^2 CALM grid. Vegetation mapping of both watersheds is being conducted by Roman Desyatkin of the Yakutsk Institute of Biology. Field hydrologic and meteorologic process studies are being led by Yuji Kodama of the Institute of Low Temperature Science, Hokkaido University. Modeling studies of hydrologic and thermal processes are being conducted by Larry Hinzman of the Water and Environmental Research Center, University of Alaska.

The CALM grid and markers were installed in May 1997 to facilitate monitoring of active layer depths and moisture content. The depth of thaw was monitored at grid points periodically throughout the summer by Vadeem Zlobin of the Polar Geocosmophysics Observatory, and surface soil moisture was collected by personnel of the Institute of Low Temperature Science.

Observation and modeling of seasonal variations of local water/heat exchange in taiga and tundra, and regional analyses of the water cycle in the Lena River area, will be the main activities for 1996–1998, followed by an intensive operating program in 1999–2000.

To learn more about GAME, contact Y. Fukushima, Secretary General, at the GAME International Project Office, Nagoya University (yoshi@ihas.nagoya-u.ac.jp). To learn more about GAME/Siberia, contact T. Ohata, the University of Shiga Prefecture (ohata@ses.usp.ac.jp). Hydrologic research conducted by the University of Alaska and vegetation mapping conducted by the Yakutsk Institute of Biol-

ogy were supported by a grant from the National Science Foundation's Hydrology, Arctic System Science, and International programs.

An additional newly emerging international research project in discontinuous permafrost regions is the Yukon Water and Energy Budget Experiment (YuWEX). The goals of the project are: 1) to characterize water/heat cycles for different types of watershed (forest, tundra, soil, seasonal snow), 2) to understand the hydrologic process in summertime: evapotranspiration, change of active layer (relation with surface conditions, topography, heat balance), short-term water balance of a watershed, change of ground water level, soil moisture contents, and 3) to characterize the seasonal variations of the water regime of the Yukon River, including runoff, snowmelt runoff, summer runoff, and winter runoff. This research is sponsored by the Japan Marine Science and Technology Center. The lead investigators in the program include Nobuyoshi Ishikawa from the Institute of Low Temperature Science, Hokkaido University, Japan, and Atsushi Sato from the National Research Institute for Earth Science and Disaster Prevention in Shinjo, Japan.

Larry D. Hinzman (ffldh@aurora.alaska.edu)

PERMAFROST IN THE GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)

The recommendation from the Second World Climate Conference in 1990 called for the urgent establishment of a systematic approach to meet needs for climate system monitoring, climate change detection, and climate modeling and prediction, and to provide information for national economic development. In 1992, the Global Climate Observing System (GCOS) was established by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC of UNESCO), the United Nations Environment Program (UNEP), and the International Council of Scientific Unions (ICSU). This program is intended to make systematic and comprehensive global observations of the key variables available to nations to enable them to:

- Detect and quantify seasonal and interannual climate change at the earliest possible time
- Document natural climate variability and extreme climate events
- Model, understand and predict climate variability and change
- Assess the potential impact on ecosystems and socio-economics
- Develop strategies to diminish potentially harmful effects and amplify beneficial ones
- Provide services and applications to climate-sensitive sectors
- Support sustainable development

An efficient and cost-effective global observing system for climate would provide the essential observational information to enable governments to better understand, interpret, and respond to the challenges posed by decadal-to-centennial global climate change. It would provide critical input to enable climate models and outlooks for seasonal-to-interannual periods to be improved. As a result, key economic sectors affected by climate variability would benefit.

A substantial capability for the required observations from both in situ and satellites already exists, principally in operational programs (e.g., World Weather Watch for operational meteorology, National Aeronautics and Space Administration (NASA)/National Oceanic and Atmospheric Administration (NOAA) Pathfinder program) and research programs, e.g., World Climate Research Program (WCRP), and International Geosphere–Biosphere Project (IGBP). GCOS will take a comprehensive, integrated view of the requirements for all the climate system components, including the global atmosphere, the oceans, the biosphere, the hydrosphere, the cryosphere and the linkages among them. Such an integrated view is required to adequately interpret climate variability, as well as to determine anthropogenic climate change. The GCOS strategy involves three specific management objectives:

- Design an effective operational climate observing system
- Establish, coordinate and manage an initial operational system
- Develop new components to meet future needs

Complementary to observations relating to the atmosphere and the ocean, the initial operational system includes land surface and ecosystems. Terrestrial ecosystems have an important role in determining the trace gas composition of the atmosphere affecting the Earth's heat budget. They also have a strong influence on surface albedo (solar energy, absorption and reflectance) and on the hydrological cycle. Characteristics of the land surface and cryospheric elements are also important for the climate system. Many of these variables are especially important for monitoring the impact of change, and for input into models for applications and national policy-making. A special Terrestrial Observation Panel for Climate (TOPC) has published version 2.0 of a GCOS/GTOS Plan for Terrestrial Climate-related Observations (GCOS-32), and defined the minimum set of required variables for the biosphere, the hydrosphere and the cryosphere.

There is considerable confidence that many components of the cryosphere react sensitively to changes in atmospheric

temperature because of their thermal proximity to melting conditions. The varying extent of glaciers has often been used as an indicator of past global temperatures and significantly influences sea level. In fact, obvious thinning, mass loss and retreat of mountain glaciers has taken place during the 20th century. The areal extent of Northern Hemisphere continental snow cover has decreased since 1987, even though there is much variability from year to year and no definitive long-term trends can as yet be identified. Climate projections into the coming century indicate that there could be pronounced reductions in seasonal snow, permafrost and glacier extent, with a corresponding shift in landscape processes. Such a reduction would have significant impacts on related ecosystems, associated people and their livelihoods. The thickness of the active layer of permafrost could increase, and extensive areas of discontinous permafrost could disappear in both continental and mountain areas. More water would be released from regions with extensive glaciers. Both engineering and agricultural practices would need to adjust to changes in snow, ice and permafrost distribution.

Implementation of the cryosphere part within the GCOS/GTOS plan should involve:

- Continuation of existing monitoring programs for snow, sea ice, glaciers and the permafrost active layer
- Further development of monitoring programs for ice sheets, permafrost thermal state, temperatures in cold firn areas and lake/river ice
- Coordination of an integrated cryosphere monitoring program, possibly under the guidance of the International Commission on Snow and Ice (ICSI/IAHS) and the IPA

Priorities with respect to initial implementation of monitoring cryosphere variables are being attributed according to climate relevance and feasibility, i.e. already existing techniques and structures. The following cryosphere variables have been selected for the terrestrial environment (sea ice is part of the ocean component of GCOS):

- Cold firn areas (borehole temperature)
- Glaciers and ice caps (mass balance, geometry)
- Ice sheet geometry and surface balance
- Lake and river freeze-up and break-up (timing)
- Permafrost (active layer, thermal state)
- Snow cover area and snow water equivalent

Efforts of the IPA with respect to long-term monitoring presently concentrate on the rescue of borehole and soil temperature data, on circumpolar active layer monitoring (CALM), and on mountain permafrost monitoring (see page 3 for details of the PACE project). Other international programs have identified permafrost as an important object for observation. For example the IUGS Commission on Geological Sciences for Environmental Planning has developed a checklist of geo-indicators for rapid change that include frozen ground dynamics. Priority attribution for initial implementation is based on the importance of the feedbacks involved with changes in active layer depth (CH_4 emission, soil moisture, growth conditions), practical applications (stability of foundations for roads, pipelines, buildings, etc.), and the existence of monitoring networks (CALM, PACE). Further information on GCOS and all documents are available through the GCOS Web page at: http://www.wmo.ch/web/gcos/pub/topv2_1.html.

Wilfried Haeberli (haeberli@geo.unizh.ch)
Hal Kibby (hkibby@www.wmo.ch)

The Cryosphere in the World Climate Research Programme (WCRP)

The WCRP is jointly sponsored by the World Meteorological Organization(WMO), the International Council on Scientific Unions (ICSU) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO. Its goal is to develop fundamental understanding of the climate system and its processes by studies of the atmosphere, oceans, land surface, sea and land ice and their coupling.

Until recently, the main organized activity of the WCRP in polar regions has been the Arctic Climate System Study (ACSYS), which focuses on arctic sea ice and ocean interaction. Plans are being discussed for a global cryosphere–climate component.

Although permafrost underlies a large proportion of the Earth's surface and constitutes an important source of greenhouse gases and detrimental influences over human activities, it has remained less prominent in international research programs than other cryospheric components (snow cover, glaciers, ice sheets, sea ice). Members of several IPA working groups have been active in bringing attention to these important roles of permafrost.

A meeting of experts on The Cryosphere and Climate organized by H. Grassl, Director of the World Climate Research Program (WCRP), was held in Cambridge, U.K., 3–5 February 1997. R.G. Barry, National Snow and Ice Data Center, University of Colorado, and F.E. Nelson, University of Delaware, were among the 22 participants from nine countries who met to review polar research related to the WCRP, to advise on optimal observational and modeling strategies for studying the role of the cryosphere in the global climate system, and to prepare a statement for the WMO Joint Scientific Committee. R. G. Barry was nominated chairman of the meeting. One of the meeting's fore-

most goals was to ascertain and outline cryospheric data and modeling strategies necessary to improve the accuracy and resolution of existing and next-generation climate models, as well as to assist in validation efforts. Following presentations on current and planned polar climate research, two working groups chaired by B. Goodison, Atmospheric Environment Sciences, Canada, and P. Lemke, University of Kiel, met to address the meeting objectives and formulate recommendations. One group focused on cryospheric components of the climate system (including permafrost) and the other on bipolar similarities and contrasts.

Two reports relating to permafrost were prepared: Permafrost and Global Climate-Change Research, by F.E. Nelson, and Cryosphere/Climate Interactions, by B. Goodison and F.E. Nelson. Both may be found in *Proceedings, Meeting of Experts on Cryosphere and Climate, Cambridge, U.K.* (V. Savtchenko, Ed.), Geneva, Switzerland: World Climate Research Program, World Meteorological Organization, in press.

An ACSYS-sponsored conference on the theme Polar Processes and Global Climate was held on Orcas Island, Washington, U.S.A., 3–7 November 1997. Alan Taylor, Secretary of the Global Change and Permafrost Working Group, attended the meeting. Some 150 specialists from the United States, Canada, Europe, Russia and Asia represented diverse backgrounds in oceanography and meteorology, field techniques and climate modeling. The program, consisting of key oral presentations and contributed posters, was well balanced between the Arctic and Antarctica. Despite budgetary constraints, a significant increase in observational programs and techniques (icebreaker transects, buoys, satellites) has led to much new data. However, there was an underlying concern for continuance of key long-term measurement programs and the preservation of major data sets.

There was a general recognition of the pivotal role of the Arctic Ocean in global climate, but also of dramatic changes in the ocean on time scales of years and an increased recognition of natural variability, natural oscillations and new feedback processes identified in the climate system. An excellent presentation summarized the freshwater discharge data from north-flowing rivers available for much of the 20th century. This led one rapporteur to note that there is not universal acceptance of this circumpolar terrestrial input as a key driving force in Arctic Ocean dynamics. Another rapporteur identified the need for more "gridable" data to be readily available to those needing to test climate models and processes. This is applicable to IPA observational and data activities such as CALM and GGD and access of data to the world community through WDC-A for Glaciology, the Internet and CDs.

The continuing challenge for the permafrost community is to demonstrate the proportional impact of this data on the global climate system through improved understanding and predictions of physical processes. The proceedings of the meeting, consisting of extended abstracts with figures, should be available by the end of 1997.

Roger Barry (rbarry@kryos.colorado.edu)
with contributions by
F. E. Nelson (fnelson@cnsvax.albany.edu)
Alan E. Taylor (ataylor@kcorp.com)

News from Members

Previously reported news can be found on the IPA Web site: http://www.geodata.soton.ac.uk/ipa

Argentina

Between 1996 and 1997 research focused on the following study areas:

Laguna del Diamante, Cordillera Principal (34°S), Mendoza. At this site different periglacial geomorphological, sedimentological and paleoclimatic studies are carried out. In 1996, and with the support of the geocryology research team and the cooperation of other researchers at the Argentinean Institute of Ice, Snow and Environmental Research (IANIGLA), a report was prepared on the possible harm to the environment and the dangers that could result from construction of a gas pipeline from Argentina to Chile.

Lagunita del Plata, Cordillera Frontal (33°S), Mendoza. Periglacial long-term studies which had been interrupted in 1987 were resumed with geodetic measurements and geocryological investigations. Data on solifluction at a height of 4000–4500 m a.s.l. were updated. Geoelectrical measurings and geodetic calculations were made. Field work at this study site provided support for the General Irrigation Department of the Province of Mendoza and nearby communities. This work was carried out with the cooperation of E. Buk, José Hernández and José Corvalán.

Expedition to the Mesón San Juan, Cordillera Principal (33°33′S), Mendoza. The aim of the expedition was to drill into the upper ice of the glacier of the Mesón San Juan (6035 m a.s.l.) in order to analyze the glacial stratigraphy. It was organized by the Laboratory for Glacial Stratigraphy and Geochemistry of Water and Snow (Alberto Aristarain, Conicet and National Antarctic Institute) and carried out with the logistical help of the Argentine Army. The success of the expedition was limited by the considerable retreat of the glacier and the presence of *penitentes* up to 5 m high on its surface. At the same time periglacial studies had as their initial objective the distinction of different altitudinal levels of the cryogenic environment, the distinction of cryogenic geoforms, and the detection of "quasi-continuous" permafrost. Geophysical radar soundings were made on a cryoplanation surface close to a glacier at 4335 m a.s.l., in order to indirectly determine the occurrence of permafrost. These studies were made with the help of J. Travassos, geophysicist from the CNP National Observatory of Rio de Janeiro, Brazil.

Valley of La Esperanza, Southern Andes (42°32′S), Chubut. Research was conducted on paleoclimate in the Southern Andes with R. Villalba from the Laboratory of Dendrochronology (IANIGLA). Trees (*Fitzroya cupressoides*) older than 2000 years were discovered. An important geomorphological inventory (GPS mapping) of the study area was accomplished.

In addition, the following activities were carried out:

A postgraduate course in geocryology was prepared. Formal preparations for a postgraduate course on present and fossil permafrost were completed at the University of Tucumán. The course will be presented by Dario Trombotto and A.-L. Ahuma, da Lillo Fundation, San Miguel de Tucumán.

Dr. Trombotto was invited by K. Shimokawa, Sapporo University, to take part in an academic exchange concerning present periglacial investigations in the mountains of Hokkaido, Japan, and the Andes of Mendoza. Japanese researchers presented their studies on palsas and the degradation of permafrost due to climatic changes. An expedition will be conducted to the Daisetsuzan Mountains, Hokkaido, by Prof. Shimokawa, N. Takahashi and K. Sato (Hokkai-Gakuen University), and Hai Yin (Urümqi University, China).

A revised proposal was resubmitted to the Inter-American Institute (IAI) for its global change program entitled Development of the Southern Hemisphere Sector of a Mountain-Climate Permafrost Network. The proposal focused on the establishment of the Southern Hemisphere sector of a north–south transect from northern Canada to southern Argentina to provide data on permafrost distribution and environments along the eastern Cordillera of the Americas. These measurements involved drilling of access holes into the unconsolidated frozen overburden and bedrock and placement of ground temperature cables at key sites, accompanied by automated microclimatic stations. Because of the interannual variability of climate, long-term installations are essential. Unfortunately, the proposal was declined by IAI; but since it has similar objectives and approaches to the European-funded PACE program, other sources of support will continue to be explored. This program could become associated with a new IPA working group on the Southern Hemisphere and be coordinated with similar studies in Antarctica.

Arturo Corte (cricyt@planet.losandes.com.ar)
Dario Trombotto (aristar@cpsarg.com)

Canada

Since the last report from Canada, the main activity of the Canadian permafrost community has been the planning and organization of the 7th International Conference on Permafrost. The National Organizing Committee held several meetings, and the Local Arrangements Committee based in Yellowknife is actively preparing for the conference. The final circular was mailed in October (see the inside back cover for the

conference program and a map of field trip routes). Approximately 450 abstracts were received in spring 1997. At the time of writing approximately 260 papers are in the review process. A group of associate editors are processing the manuscripts, and authors will receive review comments in December.

At the Canadian Geotechnical Society's 49th annual conference, held in St. John's, Newfoundland, in September 1996, the Cold Regions Division organized a session on Ice, Permafrost and Seasonally Frozen Ground. The 1996 Roger J.E. Brown Award went to Elizabeth Hivon, of EBA Engineering Associates, and David Sego, University of Alberta, for a paper on the mechanical properties of saline permafrost.

The 50th (Jubilee) Canadian Geotechnical Conference was held in Ottawa in October 1997. The 1997 Roger J.E. Brown Award was presented to Jack Clark, in recognition of his role in the development of permafrost engineering in northern Canada in the 1970s and 1980s. Dr. Clark was formerly president and CEO of the Center for Cold Oceans Research and Engineering in St. John's, and still has an emeritus appointment there. He is also a former member of the Canadian National Committee for the IPA. At the business meeting of the Cold Regions Division, a new division chair was elected — Alan Hanna, of AGRA Earth & Environmental Limited, Calgary, Alberta. He replaces Elizabeth Hivon on 1 January 1998. The business meeting also considered the problem of competing conferences, and noted that there are at present too many conferences with similar themes in cold regions or northern engineering. Smaller meetings have increasing difficulty competing with larger, aggressively promoted conferences. The 51st Canadian Geotechnical Conference will be held in Edmonton, Alberta, in fall 1998. For more information, contact Don Lewycky (Tel: 403 496 6773; Fax: 403 944 6753; e-mail: dlewycky@gov.edmonton. ab.ca).

J.Alan Heginbottom, Secretary, CNC-IPA
(heginbottom@gsc.emr.ca)

CHINA

An active layer monitoring site was established in the Yituli River basin, northeast China, in 1997 based on the ITEX/CALM protocol. Two boreholes for monitoring ground temperatures were drilled at this site to depths of 13 and 40 m .

The Lanzhou Institute of Glaciology and Geocryology (LIGG) is undertaking a program for research and monitoring of the cryosphere of the Qinghai–Tibet Plateau. This includes a model of the response of plateau permafrost to climate change and is supported by a GIS and an engineering–geological database of permafrost along the Qinghai–Tibet highway. The present processes of the active layer in permafrost areas of the plateau are being investigated.

In 1997 LIGG, in cooperation with the Japanese GAME National Subcommittee for GAME/Tibet (GNSGT), set up seven observational sites for investigating the variation of ground temperature and moisture in the active layer along the Qinghai–Tibet highway. A test site for observing methane flux has been established in the permafrost region in the Huashi Valley of Qinghai Province.

A major national research progam on the interaction among atmosphere, vegetation and permafrost on the Qinghai–Tibet Plateau will be started next year.

Two books, *An Assessment of Climate Change Impact on Snow Cover, Glacier and Permafrost in China* and *Seasonally Freezing Saline Soils and Their Improvement: Utilization in the Hexi Corridor, Gansu, China,* were published. Three additional books, *Frozen Ground in China, Mechanism of Frost Heave and Moisture Potential in Soil* and *Fracture Mechanics of Frozen Soil,* will be published in 1998.

Cheng Guodong (cdcheng@ns.lzb.ac.cn)
Zhu Yuanlin (zhuyl@ns.lzb.ac.cn)

DENMARK/GREENLAND

The permanent research station in the High Arctic Zackenberg area in northeast Greenland was officially opened in August 1997. Temperature measurements, using TinyTalk miniature dataloggers, in a transect through a nivation hollow with a perennial snowpatch showed that during the 1995–96 season the BTS (bottom of the snow) temperature was about –10°C. The mean annual air temperature was –9.8°C. The BTS temperature was found to be less than 2–3°C higher than the annual terrain surface temperature outside the snowpatch. As reported previously, two CALM grids were established at Zackenberg in summer 1996, with maximum average active layer thicknesses of 60 and 61 cm, and measurements continued in 1997. Studies of the soil water chemistry, physical and geochemical processes controlling pore water chemistry in the active layer and monitoring of the content of unfrozen water in the layer were started during the 1996 summer in Zackenberg. These studies are part of the long-term monitoring program of physical parameters under the GeoBasis program. Further information on the GeoBasis program and the research projects carried out at Zackenberg is given in Zackenberg Ecological Research Operations, 2nd Annual Report 1996, 80 p., Danish Polar Center, e-mail: dpc@dpc.dk, or on the Web: http://www. dpc.dk/Sites/Zackenberg/FirstChoise.

A soil map of Greenland, scale 1:7,500,000, has been compiled by B. H. Jakobsen, Institute of Geography, University of Copenhagen. It was presented at the Cryopedology Conference in Russia in August 1997.

A project on water and chemical fluxes in frozen soil has been initiated by B. Elberling, Institute of Geography, University of Copenhagen. The project aims to provide a better understanding of the chemical processes and transport mechanisms within mining waste in arctic areas. This will provide guidelines for the management of mining waste to minimize the chemical fluxes of trace metals to the terrestrial and aquatic environment. A field study was initiated at the active sulfide mine in Nanisivik, Baffin Island, in northern Canada and will be followed up by detailed laboratory experiments with partly frozen waste material. This project is funded by the Ministry of Energy and the Environment (MIKA), Institute of Geography, University of Copenhagen and the National Environmental Research Institute, Denmark.

Rock glacier studies were carried out on Disko Island, West Greenland, by O. Humlum, Institute of Geography, University of Copenhagen during the summer of 1997. Flow rates and active layer temperatures were measured. Since 1983, Dr. Humlum has studied the characteristics of rock glaciers in different parts of the island, probably one of the areas of the world with the highest density of rock glaciers.

During the summer of 1997 another CALM grid was established close to Qeqertarsuaq (69°15′N, 53°30′W) on Disko Island by H. H. Christiansen, Institute of Geography, University of Copenhagen. The average active layer thickness was 57 cm. The mean annual air temperature is –4°C. Three TinyTalk miniature dataloggers have been installed in a profile from the terrain surface down to the top of the permafrost to log the active layer temperatures at 0.5, 30 and 74 cm.

Hanne Hvidtfeldt Christiansen (hhc@geogr.ku.dk)

GERMANY

During the summers of 1995 and 1996 soil scientists from the Institute of Landscape Ecology in Muenster (G. Broll, G. Mueller) carried out fieldwork on permafrost-affected soils in the Auyuittuq National Park on Baffin Island, N.W.T., Canada. This DFG-sponsored project is accomplished in cooperation with Canadian soil scientists from Agriculture and Agri-Food Canada Research Branch and Parks Canada. Besides investigations on soil genesis, the study focused on soil ecological interactions. Soil temperatures were measured at different depths. The results of the study will be presented at Yellowknife and at the International Soil Science Society Congress.

In connection with the IGCP 297 (Geocryology of the Americas), correlations of periglacial phenomena among Mexico, South America and Southern Africa were studied by K. Heine, Regensburg. The distinction of permafrost and non-permafrost related periglacial forms and processes and the reconstruction of paleo-temperatures by dating past permafrost-induced phenomena are a main point of this study. Current results show that in central Mexico temperatures rose by about 1.5–2.0°C at 4000 m altitude during the last 150 years. In Ecuador and Bolivia the last glacial maximum (LGM) temperatures at about 4000 m a.s.l. were at least 4.8°C lower than today.

Permafrost-related research by M. Böse, Berlin, focuses on fossil features (mainly sand wedges and ice wedge casts) that indicate permafrost conditions during the Weichselian. A recently investigated site southeast of Berlin contains syngenetic ice wedge casts up to 6.5 m long, in fluvioglacial sands above the palaeobiological site of the Rixdorfer Horizon. These ice wedges document permafrost prior to the LGM. Further studies in Poland may give additional information about the periglacial conditions after deglaciation.

The same group continued field work in the Finnish Subarctic in cooperation with the Geological Survey of Finland. Topics were the occurrence of podzolization and brunification processes in seasonally frozen soils, their dependence on different glacial till deposits and cryoturbation, the classification of permafrost-affected organic soils, and the influence of overgrazing by reindeer on soil ecological processes. Results were presented at the Cryopedology Conference in Syktyvkar, Russia, in August 1997.

R. Baumhauer and Ch. Kneisel (Trier) and W. Haeberli (Zurich) are currently studying the relationship among surface ice, ground ice and permafrost in recently deglaciated terrain in the St. Moritz area of Switzerland and the Paarte/Kebnekaise area of Sweden. Surface temperature logging and geophysical soundings as well as geomorphological studies are applied in order to investigate these interactions and the origin and the characteristics of the different ice types. BTS measurements and DC resistivity soundings indicate the existence of permafrost/ground ice in the recently deglaciated glacier forefields.

Mountain permafrost research in Germany is focused on discontinuous permafrost in the Swiss Alps and monitoring is mainly done at the Universities of Giessen, Jena and Heidelberg. Long-term observations include borehole temperature measurements, photogrammetry and geodetical surveys of permafrost creep at selected rock glaciers, as well as systematic inventorying of geophysical data (refraction seismics, DC resistivity soundings, BTS mapping). An important rock glacier site located at Macun (Oberengadin, Swiss Alps) has been studied mainly by Barsch and Hell. The rock glaciers are measured at intervals of between 2 and 5 years; the recent surveys were in 1989, 1992, 1994 and 1997. It is planned to include these data in the IPA CD. Other rock glacier monitoring sites are located at Albana

and Val Sassa, and regular surveys at longer intervals are planned there.

L. King (Giessen) and his group continued their studies on permafrost distribution and permafrost-related processes in the Zermatt area, Swiss Alps. In connection with the new European PACE project, numerical modeling of permafrost distribution, geophysical permafrost mapping, and monitoring of the active layer and of ground and bedrock temperatures at construction sites in the permafrost area continue.

At the University of Munich, the working group Stoetter/Belitz continued studies on alpine permafrost in the Vinschgau and the Oetztal Alps. The latest results show that discontinuous permafrost has decreased about 40% in area during the last 150 years. Erosion and hazard studies continued in connection with climatic change monitoring.

The periglacial group of the Alfred Wegener Institute in Potsdam, Germany (Christine Siegert, Julia Boike), was involved in a number of permafrost activities in 1997. A project in Central Yakutia was initiated in cooperation with the Permafrost Institute, Yakutsk. The main aim is to acquire high resolution data to reconstruct the Holocene climate through thermokarst lake sediments using stable isotope compositions of the aquatic fauna and autochthonous plant remains. Within the project Late Quaternary Environmental History of Central Siberia a final expedition took place in the vicinity of Norilsk. In cooperation with the Geocryology Department, University of Moscow, and the Arctic and Antarctic Research Institute, St. Petersburg, deep sediments from Lama Lake were recovered and geocryological studies were carried out in the lake catchment. At Ny-Ålesund, Spitsbergen, a long-term project on thermal and hydrologic dynamics of the active layer was started in cooperation with the Soil Physics Group, University of Hohenheim and the Norsk Polar Institut, Tromsö and Oslo. The first sites were instrumented in August and data are continuously recorded. During a two-week pilot expedition to Zackenberg, East Greenland, basic data for a project on geochemical processes and weathering were collected in cooperation with the University of Copenhagen and the Danish Polar Center.

Matthias Kuhle (Göttingen) continued his studies on periglacial keyforms and indicators of permafrost and their relationships with the Ice Age glacier surfaces in Asia. In the mountains bordering the Tibetan Plateau (the Himalaya in the south, the Quilian Shan in the north, and the Kunlun), periglacial keyforms and indicators of permafrost have been found between 4400 and 5400 m a.s.l. in the form of patterned ground, polygonal frost cracks and pingos. These periglacial macroforms show arctic dimensions. The keyforms occur in corresponding topographic positions on valley floors, on saddles at valley heads, and on valley shoulders, where the Ice Age deglaciation came to an end early. In striking contrast are the central Tibetan areas where permafrost is present, but neither patterned ground, frost cracks, pingos, nor slopes covered with thick frost debris occur as periglacial keyforms. The author considers these observations to be an indication of an extended Ice Age inland glacier cover which, as a result of its thickness, lasted far into the Late Glacial.

The present German–Russian collaboration in the Laptev Sea has identified new direct and indirect evidence of ice-bonded offshore permafrost extending from the current shoreline to the edge of the continental slope. Nikolai Romanovskii (Moscow State University) and Felix Are (St. Petersburg) have been collaborating with Hans Hubberten (AWI, Potsdam) and Heidi Kassens (GEOMAR, Kiel). Utilizing recent geophysical observations and existing Russian data and publications, the extent of ice-bonded offshore relict permafrost has been further evaluated. Paleo-environmental scenarios of permafrost formation and evolution during the last glacial cycle (past 110,000 years) have been developed. Mathematical modeling of offshore permafrost evolution is underway. A map forecasting offshore permafrost and subsea talik distribution of the Laptev Sea shelf was prepared and exhibits continuous relic permafrost distribution to the 60 m water depth, and discontinuous permafrost to the edge of the shelf. The proposed German program, Laptev Sea System 2000, includes investigations of offshore ice-bonded permafrost, paleo-environmental evidence, modeling of gas hydrates, and thermo-erosion studies. Results are very important for planning the location and operations of the Nansen Drilling Program.

German engineers successfully constructed several tunnels employing artificial freezing techniques: Farlach Tunnel in Mannheim and subway tunnels in Düsseldorf. They also applied artificial freezing techniques in restoration work at the leaning tower of Pisa. Results of various projects were discussed at the International Ground Freezing Symposium in Lulea, Sweden.

The German National Permafrost Committee (DNP/IPA) met in Jena on 31 October and 1 November 1997. New results from permafrost studies in the Arctic, Antarctic and high mountain areas were presented by the following scientists: K. Hinz and G. Delisle, BGR Hannover (seismic evidence of subsea permafrost and numerical simulation of permafrost development in the Laptev Sea, respectively); E.-M. Pfeiffer, Hamburg (cryosols, Taimyr Peninsula); Ch. Siegert and H.W. Hubberten, AGI Potsdam (results of permafrost studies of the AWI in Taimyr and Yakutia); B. Hagedorn, AGI Potsdam (processes in cryosols, Taimyr);

H. Gossmann, Freiburg (Dynamic Processes in Antarctic Geosystems—DYPAG); L. King, Giessen (Permafrost and Climate in Europe—PACE); Ch. Kneisel, Trier (ground ice in glacier orefields, St. Moritz). Nine papers have been submitted for the Seventh International Conference on Permafrost.

Lorenz King (lorenz.king@geo.uni-giessen.de)

ITALY

During 1997 the following activities were carried out within the Italian IPA Adhering Body.

Research was conducted on mountain permafrost in the Italian Alps with particular reference to permafrost degradation and related slope instability phenomena.

A three-year research program on permafrost and buried ice in Victoria Land, Antarctica, funded by the ENEA-PRNA Project, is in progress. It includes geophysical soundings, thermal logging and monitoring of boreholes, and chemical and isotope analysis of ground ice.

A research project on permafrost distribution and thermal characteristics in the Svalbard Islands has been initiated with the financial support of the National Research Council. The first field investigations (including deep drilling) will start in the spring of 1998.

The Italian IPA group contributed to the one-day workshop associated with the M4 field trip, Mountain Permafrost Monitoring and Mapping (Zurich–Bologna, 22–28 August 1997), in cooperation with the IPA Mountain Permafrost Working Group and the IGU Commission on Climatic Change and Periglacial Environments. For more information and a site map, see *Supplementi di Geografia Fisica e Dinamica Quaternaria*, suppl. III, t.2, p. 181–203, 1997.

A contribution was also made to the preparation of the PACE EU Project, and a book on mountain permafrost was published (see p. 33).

Francesco Dramis (dramis@uniroma3.it)

KAZAKSTAN

In 1997, the International Center of Geoecology of Mountains in Arid Regions (ICGM) continued observations on monitoring the thermal regime of seasonally and perennially frozen ground at the special polygon for thermometry in the basin of the Bolshaya Almatinka River (Zailiysky Alatau Range, Northern Tien Shan). The polygon includes over 30 observation sites with different conditions of absolute elevation, ground and vegetation. Observations of the dynamics of representative rock glaciers as well as glacio-hydrophysical observations on the Tuyuksu Glacier were continued. Winter observations of the frost heaving of seasonal mounds (thufurs) showed that the vertical movement of their surfaces reaches 10 cm, i.e. about one-third of the height of these features in summer.

An inventory of rock glaciers of the Dzungar Alatau Range has been undertaken. In the territory studied (about two-thirds of the range), 489 rock glaciers occupying a total area of 40.25 km^2 have been recorded. Of this total, 426 features covering 33.37 km^2 are considered active. On the basis of this inventory, a Map of Rock Glaciers of Dzungar Alatau has been compiled at 1:500,000.

In July and August, the Laboratory of Geocryology investigated permafrost in the morainic dam of the lake associated with mud–debris flow in the Northern Tien Shan, near Almaty. The permafrost thickness at 3600 m a.s.l. is about 100 m and active layer thickness is 1.5–3.5 m, depending on the slope orientation.

In August, the Laboratory of Mountain Geoecology organized an international expedition to the Inylchek Glacier (Central Tien Shan) supported by the G. Ebert Foundation (Germany) with scientists from Germany, Austria and Uzbekistan. This expedition confirmed the surge of the northern Inylchek Glacier, which up to the present time was not considered to be a surging glacier. During one month, starting 6 July, the glacier moved down-valley for 4.5 km and reached the position it occupied in 1932. At the same time, the expedition of the Laboratory of Glaciology determined that the mass balance of the Tuyuksu Glacier this summer was close to its extreme negative value.

In October, Kazakstan joined the CALM program. Temperature recorders were installed to a depth of 4.5 m (thickness of the active layer) in a borehole in the mountains of the Northern Tien Shan (43°N, 77°E, 3330 m a.s.l.).

In late 1996, a book by A.P. Gorbunov, E.V. Seversky and S.N. Titkov, *The Geocryology of the Tien Shan and Pamir*, was published (in Russian). It contains information about permafrost and seasonal freezing processes of the Northern and Inner Tien Shan, as well as results of investigations and mapping of different periglacial features of the Tien Shan, Pamir-Alai and Dzungar Alatau. The ICGM has completed preparations for publishing of four volumes of the *Catalog of Glaciers of the Northern Tien Shan*. A Map of Thickness, Water Content and Duration of Snow Cover in the Mountains of Southeastern Kazakstan at 1:1,000,000 has been compiled. In China, with the participation of the ICGM, the book *Snow and Avalanches in the Tien Shan* (in Chinese) has been published.

A.P. Gorbunov and I.V. Seversky (ingeo@asdc.kz)

MONGOLIA

Geocryologists at the Institute of Geography of the Mongolian Academy of Sciences are working on the generalization of the permafrost research materials obtained over the past years. In 1996, a publication on the geocryological character-

istics of the economic zones was prepared, and a monograph on permafrost conditions in Mongolia was initiated.

As a result of many years of observations of the surface temperature regime on the protected Bogd Khan Mountain near Ulaanbaatar, N. Sharkhuu analyzed regional regularities in the quantitative alteration of permafrost conditions depending on latitudinal belts, slope exposure, winter air temperature inversion, and snow and vegetation covers. Results are reflected in a report and permafrost map (1:125,000) compiled in 1996 for the national atlas of this protected mountain.

On the basis of generalizations of field and experimental observations of frost heaving at many sites, Dr. Sharkhuu and A. Anand in 1996 compiled a map (1:100,000) of frost heaving distribution in the Selenge River basin. The mapping approach provides the basis for compiling similar maps of the discontinuous permafrost region at small and medium scales. The methods and results of compiling the maps were presented at the International Conference on Geotechnic-96 in Ulaanbaatar.

N. Sharkhuu

NETHERLANDS

The Utrecht University (Koster) and Vrije Universiteit Amsterdam (Vandenberghe/Kasse) will take part in the EC-funded project TUNDRA (Tundra Degradation in the Russian Arctic) within the framework of the Environment and Climate program. The project is coordinated by Peter Kuhry (Arctic Center, Rovaniemi, Finland) and has as a general objective to obtain net fluxes for carbon and fresh water from an arctic catchment under base-case and global change scenarios. The Dutch contribution will concern climate change and the hydrological cycle. Its specific aim is to develop a GIS-based hydrological model of the Usa catchment which will provide seasonal to annual water and sediment budgets under natural conditions (based on the variability of the last 2000 years) and global change scenarios. Validation will take place at four selected field sites through comparson of model output with long-term records from hydrographic stations in the Usa basin.

Jef Vandenberghe (vanj@geo.vu.nl)

NORWAY

Since 1989 several high-mountain areas in southern Norway have been investigated by the University of Oslo to map permafrost distribution using BTS, DC resistivity sounding, and sledge hammer seismic technique. A map of permafrost in southern Norway was recently presented based on this type of investigation. A new grid-based temperature map of mean annual air temperature by the Department of Norwegian Meteorological Institute (DNMI) and GIS analysis opens the possibility of mapping the southern limits of discontinuous permafrost over vast areas. Sporadic permafrost in connection with palsas and snow patches is excluded. The approach is well suited for interpretations on a regional scale to study past and future climate through change in permafrost distribution. A special study of frozen ground processes is being performed at Finse.

Rock glaciers on Svalbard have been studied for several years. In the vicinity of Ny Ålesund, a velocity measurement program was launched in 1985. In collaboration with ETH-Zurich (W. Haeberli), rock glaciers in this area were investigated by geophysical methods, including refraction seismic, geoelectric and gravimetric surveys. In the Longyearbyen area rock glaciers are examined, in collaboration with UNIS, with a view to morphology, velocity and internal structure. Permafrost problems associated with the runway at Svalbard airport have been studied since 1994, including changes in the surface elevation. The runway was constructed in 1976 without adequate attention being paid to the effect of the permafrost.

A program to study rock glaciers on Prins Karls Forland in western Svalbard was established in 1995. On the northwestern part of the island, rock glaciers build a 10-kilometer-long continuous transition between the rockwall and the strandflat area. Results of the flow pattern, internal structure and morphology of some of these rock glaciers are analyzed based on geodetic surveys, DC resistivity soundings, and high-resolution digital modeling. These results will be used in a numerical model to estimate build-up time of the rock glaciers. This might contribute to better understanding of the paleoclimate in the area and the size of the Weichselian ice sheet.

Johan Ludvig Sollid (j.l.sollid@geografi.uio.no)

POLAND

Research on permafrost and contemporaneous periglacial processes, carried out in 1996–97, was a continuation of a complex program of research in the region of the H. Arctowski Polish Antarctic Station, King George Island, West Antarctica, on the west coast of Spitsbergen in the vicinity of Hornsund Fjord and the Polish Station founded there in 1956, and other university polar stations which are active during the summer months. In the Hornsund region (south Spitsbergen), research was undertaken by teams from the Silesian University in Sosnowiec, the Adam Mickiewicz University of Poznan, and the University of Wroclaw. The Maria Curie–Sklodowska University in Lublin was engaged in research in the Recherche Fjord region (central Spitsbergen), whereas the Mikolaj Kopernik University of Torun owns a station on the Kaffoyra plain on the northwest coast.

The studies carried out are complex in character:

- Thermics and dynamics of the active layer of different tundra ecosystems
- Physico-chemical processes in the active layer
- Thermic and hydrological regime
- Development of relief influenced by contemporaneous periglacial processes on slopes, in marginal areas of glaciers, on coastal plains and in coastal areas

Since 1993, geophysical research on fossil permafrost in the alpine zone of the Tatra Mountains has been undertaken by teams of scientists from the Silesian University in Sosnowiec, the Institute of Geography of the Polish Academy of Sciences, and the Academy of Mining and Metallurgy in Krakow. The Maria Curie–Sklodowska University has cooperated with the Institute of Marine Biology of the Russian Academy of Sciences in research on periglacial phenomena in the Khibiny Mountains on the Kola Peninsula.

Research programs are coordinated by the Permafrost Committee of the Committee on Polar Research of the Polish Academy of Sciences, the National Adhering Body for IPA. The results of research and studies carried out by these Polish teams are presented during Polar symposia, organized annually by the Committee on Polar Research of the Polish Academy of Sciences and the Polar Club of the Polish Geographical Society, as well as during topical conferences. These results were published in conference proceedings in *Biuletyn Peryglacjalny* (1996, vol. 35, p. 153–195) and *Polish Polar Research* (1996, vol. 17, 1–4; 1997, vol.18, no. 1).

Conference publications include:

- *23rd Polar Symposium*, Sosnowiec, *1996*
- *24th Polar Symposium—40 Years of the Polish Polar Station in Hornsund, Spitsbergen*, Warsaw 1997
- *Problems of the Contemporaneous and Pleistocene Periglacial Zone*, Spitsbergen Geographical Expeditions, Maria Curie–Sklodowska University Press, Lublin, 1996
- *Dynamics of the Polar Environment. Spitsbergen Geographical Expeditions*, Maria Curie–Sklodowska University Press, Lublin, 1997

Kazimierz Pekala (pekala@golem.umcs.lublin.pl)

RUSSIA

Several major geocryological and cryopedological conference were held in Russia this year. The results of the Cryopedology '97: Second International Conference held in Syktyvkar in the Komi Republic are reported in the Cryosol Working Group report (page 26).

The annual permafrost conference in Pushchino was held 21–25 April 1997 under the title International Conference on the Problems of Earth Cryosphere (Basic and Applied Studies). A total of 162 abstracts were submitted by researchers from various regions of Russia, North America, Asia and Europe. Registered participants totaled 140 Russian and 30 foreign. The conference included plenary and sectional sessions, symposia, a roundtable discussion, and the annual meeting of the Consolidated Scientific Council on Earth Cryology of the Russian Academy of Sciences (CSCEC RAS). An abstract volume in Russian and English was available and copies can be obtained from the council.

The plenary session dealt with the main directions of modern geocryology. Topics introduced were elaborated upon in the sections, symposia and roundtable:

Section 1: Periglacial processes on the shelf and land of the arctic sea coasts; Chair N.N. Romanovskii (23 presentations).

Section 2: Reliability of geotechnical systems in the cryolithozone; Chair L.N. Khrustalev (24 presentations).

Symposium: Microbiology of permafrost: Life at negative temperatures; Chairs D.A. Gilichinsky and J.M. Tiedje (13 presentations).

Symposium: Cryogenic processes and phenomena, conditions of their formation, palaeogeographic information; Chair V.I. Solomatin (12 presentations).

Symposium: Physical–chemical mechanics of frozen ground; Chairs S.E. Grechishchev, E.D. Ershov, and Yu.K. Zaretsky (17 presentations).

Roundtable: Geoinformation systems, digital maps and databases in geocryology; Chairs M.A. Minkin and E.S. Melnikov (11 presentations).

The annual meeting of the Consolidated Scientific Council on Earth Cryology, Russian Academy of Sciences, was held on the last day. The topics discussed were Russian participation in the 7th International Conference on Permafrost, policies and plans for the journal *Earth Cryosphere*, and plans for next year's conference to be held in late April and devoted to the 90th anniversary of P.I. Melnikov's birth. Priority would be given to the following topics: permafrost as one of the cryospheric components, the application of remote sensing in permafrost investigation, ground water, gas hydrates, offshore permafrost, engineering in a permafrost environment, and geophysical methods in permafrost investigations.

It should be noted that the National Geocryological Foundation (NGF) was established in Russia two years ago for the purpose of collecting and disseminating permafrost data. Information on several Russian institutions' data collections is stored in the NGF. Specific regional databases are devised under its aegis. Metadata concerning digital and paper databases on Yakutia, Transbaikal, the Norilsk region, West Siberia, and European North Russia are available. Raw data can be obtained by negotiation with the data owners. Contact the NGF Director, M.A. Minkin.

Participants in April 1997 conference, Pushchino, Russia

The new quarterly Russian journal *Earth Cryosphere* began publication in 1997 under the auspices of the Russian Academy of Sciences. Its goal is to publish scientific contributions on all aspects of the Earth's cryosphere and to help formulate a unified concept of it. Papers are published in Russian with title and abstracts in English. A decision to translate papers into English will depend on the number of potential non-Russian subscribers. Papers, short communications and reviews in the following fields will be considered for publication:

- New data on the lithosphere, hydrosphere and atmosphere as parts of the Earth cryosphere at global, regional and local scales, including possible changes under natural and anthropogenic conditions.
- New data on the structure, composition, formation and evolution of natural and artificial cryogenic features, from single crystals of ice to snow and ice covers and the entire cryolithozone.
- Distribution of cryogenic (periglacial) processes, their development, and possibilities of their prediction and control.
- Cryogenesis and its role in the evolution of other Earth cryosphere components.
- Role of cryosphere and cryogenesis in supporting the biosphere and its utilization at various scales.
- Modeling of the cryosphere, its components and links, cryogenic (periglacial) processes and phenomena, and the interrelations of the cryosphere with other Earth envelopes.
- Development of methods, techniques, and technological means and instrumentation to study components of the cryosphere and their interactions.
- Development of provisions for collection, processing, storage, dissemination and use of cryological information.

Four issues of the journal are planned for 1997. Issue number 1 is available and the other three will contain reports presented at the April 1997 conference in Pushchino (see page 31 for the contents of the four issues and subscription information). Several issues in 1998 are planned to include papers for the Yellowknife conference. Complimentary copies of the first issue are available. Future issues will be priced at US$20.00 each.

The Geocryological Map of the U.S.S.R. (1:2,500,000) with explanatory note (edited by E.D. Ershov) in 16 sheets was published in December 1996 and is available for purchase. The map, displayed in Pushchino, summarizes the results of a 25-year research effort by the Geocryology Department, Faculty of Geology, Moscow State University. Geological formations, Quaternary deposits, genetic complexes, type of freezing, cryogenic structure, macro-inclusions of ice and ice content form one map layer. Other layers are permafrost extent and ground temperature, thickness and structure, altitudinal and latitudinal zonations, cryopegs, relic permafrost, periglacial features and taliks. Supplementary 1:25,000,000 inset maps show geological regions, types of rocks with syngenetic or epigenetic freezing, and hydrogeocryological structures (see page 33 for ordering information).

The following monographs were published recently in Russian:

Gavrilova, M.K., Fedorov, A.N., Bosikov, N.P. and others. 1996. Impact of climate changes on development of permafrost environments of Central Yakutia. Yakutsk, Permafrost Institute, 180 p.

Gorbunov, A.P., Seversky, E.V., Titkov, S.N. 1996. Geocryological conditions of Tien-Shan and Pamir. Yakutsk, Permafrost Institute, 184 p.

Kazansky, O.A. Cryostructural method of palaeopermafrost reconstructions. Yakutsk, Permafrost Institute, 98 p.

Konyakhin, M.A., Mikhalev, D.I., Solomatin, V.I. 1996. Oxygen-isotope composition of ground ice: Textbook. Moscow, Moscow University Press, 156 p.

Engineering–geological monitoring of Yamal gas fields, volume 2: Geocryological conditions of Bovanenkovo gas field development. 1996. Novosibirsk, SB Nauka.

Principles of geocryology. 1996. Moscow, Moscow University Press.

Pozdnyakov, I.V. 1996. Permafrost of northern Amur valley. Yakutsk, Permafrost Institute.

Salnikov, P.I., 1996. Stability of foundations for construction on permafrost in southern Transbaikal. Yakutsk, Permafrost Institute.

Melnikov, E.S., ed. 1997. Results of basic research of Earth cryosphere in Arctic and Subarctic. Proc. of the International Conference in Pushchino. Novosibirsk, SB Nauka.

E. S. Melnikov (emelnikov@glas.apc.org)
with contributions from
M.O. Leibman (mleibman@glas.apc.org)
I.D. Streletskaya and M.A. Minkin

Southern Africa

The Southern African Permafrost Group (SAPG) is involved in three major projects; mountain geomorphology, mountain environments, and soil frost research on Marion Island. Apart from the research carried out on Marion Island, the major emphasis is on relict features and palaeoenvironmental reconstruction. A particularly pleasing aspect is that the community appears to be growing at a student level. There are at least five Masters and Ph.D. students doing periglacial research under the leadership of the SAPG members.

In 1996 a five-year research project was started on Marion Island to study present-day soil frost processes, their controls and their physical manifestations in this maritime sub-Antarctic environment. The project has now been expanded to include a survey of the Holocene periglacial record of the island. Two additional studies that will commence in 1998 will focus on mechanical weathering and ice-mass balance. The first is a study into the mechanisms and environmental controls of mechanical weathering processes to evaluate the potential use of mechanical weathering products as palaeoenvironmental indicators. The second is a study in collaboration with H. Oerlemans (Utrecht, Netherlands) on the modeling of past mass balance changes of the Marion plateau glacier. With the focus on Holocene environmental changes on Marion Island the project is generously supported by the South African Committee on Antarctic Research.

At the INQUA Congress in 1999 in Durban, South Africa, the Southern African Permafrost Group will organize a workshop and post-conference excursion under the auspices of the IPA Working Group on Periglacial Processes and Environments and the IGU Commission on Climate Change and Periglacial Environments. The one-day workshop will take place during the conference and run under the theme Periglacial Research and Environmental Change. It will consist of a series of paper sessions. A morning session of invited papers on the theme of Periglacial Research in the Southern Hemisphere: A State of the Art is being considered.

Immediately following the congress a four-day excursion will observe evidence in the field and debate the Quaternary (peri-) glacial record of the Lesotho Highlands. This area is one of the few places in the world where the question of a Quaternary glaciation has not yet been resolved.

The provisional program is:

Day 1: Travel from Durban to the Drakensberg escarpment, followed by four-wheel-drive transport up to 2900 m a.s.l. Accommodation will be in a rustic mountain chalet at the edge of the main escarpment offering spectacular views. The afternoon will be used for an introduction to the area.

Day 2: Quaternary glaciation of the Lesotho Highlands: site visits, with data presentations and discussion, to the hollows and their sedimentary sequences proposed as evidence for Quaternary nivation and cirque glaciation.

Day 3: Quaternary record of periglacial landforms: site visits, with data presentations and discussion to the block streams and other periglacial slope deposits and their paleoclimate significance.

Day 4: Slope deposits along the main escarpment and synthesis and site visit to slope deposits below the escarpment. Final discussion and synthesis and return to Durban.

Numbers will be limited to about 25 people. Costs for the post-conference excursion are estimated to be in the order of US$350.

Jan Boelhouwers and Kevin Hall are in the process of developing a proposal on the formation of an IPA Southern Hemisphere Working Group. The intention is to bring together researchers from the Southern Hemisphere, including Antarctica, involved in permafrost and periglacial issues, as well as research data on these topics. Initial projects will

involve the creation of a Southern Hemisphere bibliography and a synthesis of permafrost maps. It is intended that the group be formalized in Yellowknife. For more information or suggestions, contact Jan Boelhouwers or Kevin Hall:

Jan Boelhouwers, Department of Earth Sciences, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa. e-mail: janboel@artso.uwc.ac.za, fax: +27 21 9592438.

Kevin Hall, Geography Program, University of Northern British Columbia, 333 University Way, Prince George, B.C., Canada V2N 4Z9. e-mail: hall@unbc.ca, fax: +1 250 9605795.

Ian Meiklejohn (kim@scientia.up.ac.za)

SPAIN

The Spanish group of the IPA hosted a conference on present cold frozen processes from 17–20 July 1997, in Andorra. Forty-five Spanish and Portuguese specialists in permafrost and ice-related natural processes participated. The 23 papers that were submitted will be published in a special volume. The papers addressed a variety of aspects, including snow distribution in Spanish mountain ranges; the formation of protalus ramparts in the Gredos, Cantabrian and Pyrenees mountain ranges; periglacial processes associated with the active layer in the Pyrenees and Sierra Nevada; research conducted by Spanish scientists on current permafrost-related processes in the Antarctic and northern Sweden; present activity associated with periglacial processes in Portuguese mountain ranges; and data collection linked to geomorphologic processes related to permafrost. The conference closed with a synthesis of the status of current studies on periglacialism and permafrost in the Iberian Peninsula and the projection of future lines of research. The next meeting of the Spanish group of the IPA will be held in Albarracin (Teruel, Spain) in July 1999.

Gonçalo Vieira from the Centro de Estudos Geograficos, Universidade de Lisboa, Portugal, has sent the following report on periglacial geomorphological research in Portugal.

The study of present-day geocryological processes is quite recent and is still emerging. The first reference to periglacial processes was by Andre Guilcher (1949) on the head deposits of the Cabo da Roca. It was not until the 1970s with Suzanne Daveau that research started to develop, expanding in the 1980s, especially after the meeting on the Iberian Quaternary held in Lisbon in 1985. The majority of the studies focus on Quaternary deposits. Present-day processes are still poorly evaluated due to the present climatic conditions (Mediterranean type) and the low altitude of the mountains on the mainland, with a maximum of 1993 m a.s.l. in the Serra da Estrela. However, Pleistocene periglacial deposits are widespread from the mountains to near sea level in north and central Portugal. These are mainly stratified slope deposits (i.e. *grèze litée* type), screes and head deposits. Antonio de Brum Ferreira (1985) supports a decrease of about 10°C in the mean annual temperature in the last glacial maximum. The lower limit for the periglacial belt in the Serra da Estrela is near 1750 m a.s.l. No permafrost occurs in the Portuguese mountains.

Recent research on periglacial phenomena is centered mostly in mountain areas and is being conducted by researchers from the Centro de Estudos Geograficos (University of Lisbon) in the Serra do Geres (Antonio de Brum Ferreira, Maria Luisa Rodrigues, Jose Luis Zêzere and Gonçalo Vieira), Serra da Estrela (Gonçalo Vieira and Antonio de Brum Ferreira) and Maciço Calcario Estremenho (Maria Luisa Rodrigues); by the Instituto de Estudos Geograficos (University of Coimbra) in the Serras do Caramulo and Freita (Antonio Rochette Cordeiro) and Serras de Condeixa-Sicó-Alvaiázere (Lucio Cunha); and by the Instituto de Geografia (University of Oporto) in the Serra do Marao (Antonio de Sousa Pedrosa). In the Serras da Estrela and Geres the occurrence of a late-Pleistocene glaciation allows the study of the relations between periglacial and glacial deposits and forms.

David Palacios (davidp@eucmax.sim.ucm.es)

SWITZERLAND

The former Glacier Commission of the Swiss Academy of Sciences (SAS) has been restructured. The scope of the new Glaciological Commission includes all naturally existing ice, in particular glaciers, snow and permafrost. According to this extension, several new members joined the commission. There is a delegate for glaciers (Martin Hoelzle) and one for permafrost (Daniel Vonder Mühll), who act as national correspondents for the World Glacier Monitoring Service (WGMS) and the IPA, respectively. A Swiss permafrost monitoring network is being established. It will be maintained by the Glaciological Commission like the already existing glacier monitoring network. Besides SAS and the universities, the Swiss Alpine Club supports the development of the concept for the permafrost network.

The annual meeting of the Swiss Geomorphological Society took place in July at the Academia Engadinaisa in Samedan (Upper Engadin) with about 60 participants. Several of the 15 talks and 14 posters were related to the topic permafrost. On the one-day excursion, several themes such as geology, glacier stages, and permafrost investigations were presented. A guided walking trail devoted to the topic of climate change has been developed.

In August 1997, 50 participants in the M4 field trip of the International Geomorphology Conference started in Zurich, spent three days in the Swiss Alps, then continued

to Italy (more details are given on page 24).

A booklet with 20 extended abstracts from the meeting of the Coordinating Group on Permafrost, held in April 1996, has been published. It includes an article about the permafrost map of Switzerland by Felix Keller. It shows that approximately 5% of the Swiss area is underlain by permafrost. Interested colleagues can order the booklet from vondermuehll@vaw.baum.ethz.ch.

Daniel Vonder Mühll (vondermuehll@vaw.baum.ethz.ch)
http://www.vaw.ethz.ch

United Kingdom

The U.K. Adhering National Body organized a two-day workshop at the University of Cardiff, 16–17 December 1997, in association with the IPA Periglacial Processes and Environments Working Group and the Cryostratigraphy Working Group of the Quaternary Research Association. The workshop theme on the first day is periglacial processes, landforms and cryostratigraphy, and on the second day, monitoring and modeling periglacial processes. The second day includes a visit to the Cardiff Geotechnical Centrifuge Center in the School of Engineering, where participants can see the new cryogenic testing facility used in scaled physical modeling. Participants from the following countries are attending the conference: Canada, Denmark, France, Italy, Japan, Norway, Poland, Russia, South Africa, Spain, Sweden, Switzerland, U.K. and U.S.A. A detailed report of the meeting will be included in the next issue of *Frozen Ground.*

The Permafrost and Climate in Europe (PACE) project is being coordinated at the University of Cardiff (see page 3 for details).

The 8th Annual International Tundra Experiment (ITEX) Workshop was held at the Royal Holloway Institute for Environmental Research, Surrey, U.K., in April 1997. Forty-four delegates from 14 countries participated. Phil Wookey, ITEX Chair, organized the workshop; for additional information contact: philip_andrew.wookey@natgeog.uu.se

O.W. Heal, University of Edinburgh, co-authored the report of a workshop held in Trondheim, Norway, 16–18 June 1996, to develop a plan for an IGBP high latitude transect in the Scandinavian/Northern European Region (SCANTRAN). The workshop, organized under the auspices of the Research Council of Norway Environment and Development, was co-sponsored by the Norwegian National IGBP Committee and ARTERI-Arctic-Alpine Terrestrial Ecosystems Research Initiative of the European Union. For details contact: b.heal@ed.sac.ac.uk

Charles Harris (harrisc@cardiff.ac.uk)

United States

Three frozen-ground-related international meetings were held in Alaska in 1997.

The International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils was held 10–12 June 1997 at the University of Alaska in Fairbanks. In attendance were 105 people representing 11 countries (Canada, China, Finland, Germany, Japan, Norway, Russia, Sweden, Switzerland, United Kingdom, U.S.A.).

Peter J. Williams delivered the opening keynote address, entitled The Seasonally Frozen Layer: Geotechnical Significance and Needed Research. The first day included 19 oral and 12 poster presentations on the fate of carbon and phosphorus; soil stability; soil water, gas and solute movement; and northern ecosystems.

The second day commenced with a keynote address by F. Stuart Chapin III on Influence of Frozen Soils on Ecosystem Processes and Their Sensitivity to Climatic Change. There were 21 oral and 13 poster presentations on this day, with topics ranging from nitrate dynamics to watershed hydrology, fauna adaptation, solutions at low temperatures, soil structure, and bioremediation.

The final day concluded with 16 oral and 12 poster presentations on remote sensing; modeling soil frost; compaction; and heat, water and solute movement. On 13 June, 45 participants toured research and engineering facilities in the Fairbanks area, including visits to the Geophysical Institute Synthetic Aperture Radar Facility, Permafrost Tunnel, and Bonanza Creek Long-Term Ecological Research Site. See page 33 for information on ordering the proceedings.

In August 1997 the Water and Environmental Research Center, University of Alaska Fairbanks hosted the Eleventh International Symposium and Workshop on Northern Research Basins. In 1975 the national committees of the International Hydrologic Program (IHP) for Canada, Denmark, Finland, Norway, Sweden, U.S.A. and U.S.S.R. established a working group on northern research basins (in 1992 Iceland joined the group). The objective of this group is to encourage research and information dissemination on the hydrology of basins in northern latitudes that are affected by snow, ice and frozen ground.

Each meeting has one or more designated themes. Most of these in the past have been process-oriented. The main theme of the 1997 meeting was An Evaluation of Spatial Variability of Hydrologic Processes in the Circumpolar Arctic. The objective was to examine available process-oriented, spatially distributed data sets (water and energy fluxes), and make a comparison amongst them to see if a generalized understanding could be developed. Development of a clear understanding of global scale climatic dynamics is not

possible until we complete regionalized comparisons of process interactions and variability.

Forty-four participants from 12 nations (Canada, Denmark, England, Finland, Germany, Greenland, Iceland, Japan, Norway, Russia, Sweden, and the United States) joined in the traveling workshop. The workshop began in Prudhoe Bay with field excursions into the oilfields and continued on to research sites across the North Slope. Two days were spent at the University of Alaska field camp at Toolik Lake. The final day was spent in a symposium on the campus of the UAF. Thirty-nine papers were presented, 17 of which were printed in Volume 1 of the proceedings; a second volume was also published. Twelve of these papers will also be submitted for possible publication in the journal *Nordic Hydrology*. Copies of the two-volume proceedings are available from Douglas L. Kane, Water and Environmental Research Center, University of Alaska Fairbanks, Fairbanks, Alaska 99775-5860 (or email ffdlk@aurora.alaska.edu).

The Fifth International Symposium on Cold Regions Development sponsored by the American Society of Civil Engineers (ASCE) and the International Association of Cold Regions Development Studies was convened 4–10 May 1997 in Anchorage. See page 33 for information on ordering the proceedings.

The ASCE Technical Council on Cold Regions Engineering (TCCRE) published a new monograph in its cold regions engineering series. Edited by Daniel Smith, *Cold Regions Utilities* is a guide to the basic principles of cold regions environmental engineering. Its focus is on geotechnical and thermal considerations that influence the design of utility systems. Highlighted are problems related to water supply, wastewater, solid waste, and the energy components of infrastructure to cold regions. A major thrust of the publication is its emphasis on thermal design considerations of piped water and sewerage systems in frozen ground. TCCRE is sponsoring the Ninth International Conference on Cold Regions Engineering in Duluth, Minnesota, on 27–30 September 1998. The theme of the conference is Cold Regions Impacts on Civil Works. Topics encompass issues related to transportation, foundations, geosynthetics, navigation, and utilities in seasonally frozen ground. For more information on ASCE activities and publications visit its Web site: http://www.asce.org or call 800 548 2723/ 703 295 6300.

FROSTFIRE is a new project in Alaska investigating the role of wildfire. It is funded by the Department of Energy and the National Science Foundation. This project is an experimental and regional approach to improve our understanding of boreal feedbacks to climate. The objective of this research is to develop a predictive understanding of the major classes of feedbacks from boreal fire to climate as a basis for improved understanding of the changing role of the boreal forest in the Earth system. The hypotheses to be tested include:

1. The direct effects of regional warming in Alaska will be to increase fire severity by increasing the flammability and consumption of biomass, especially of the organic soil layer.

2. The greatest carbon loss due to fire results from post-fire decomposition rather than combustion during the fire.

3. Increased fire severity has a threshold effect on the loss of permafrost that depends on local microclimate (e.g. slope and aspect).

4. Fire causes threshold changes in energy exchange with the atmosphere.

The lead investigators on the project include F. Stuart Chapin, Department of Integrative Biology, University of California, Berkeley, California (fschapin@garnet.berkeley. edu) and David V. Sandberg, USDA Forest Service, Pacific Northwest Research Station.

Jerry Brown (jerrybrown@igc.apc.org)
with contributions by
Breton Sharratt (bsharratt@mail.mrsars.usda.gov)
Larry Hinzman (ffldh@aurora.alaska.edu)
Jon E. Zufelt (jzufelt@crrel.usace.army.mil)

REPORTS OF WORKING GROUPS

Results of working groups will be reviewed by the IPA Council at the Yellowknife conference. At that time, decisions on continuing working groups and forming new ones will be made. Detailed reports follow for a number of working groups. We remind interested individuals who wish to become corresponding members of working groups to contact the appropriate chair or secretary. Addresses for chairs and secretaries may be found on page 36.

DATA AND INFORMATION

Preparations for the release of a CD of permafrost-related data at the conference in Yellowknife have been the focus of working group members during 1997. To be called CAPS—Circumpolar Active-layer Permafrost System—the CD will be the first-ever compilation of permafrost and related data with a truly global perspective. It will also be the culmination of five years of work to identify and organize selected sets of basic permafrost data and make them available to the international science and engineering communities. These efforts are conducted within the framework of the IPA's Global Geocryological Database (GGD). Selected data and information from the GGD activities will be contributed to the CAPS CD.

The CD is targeted primarily at the scientific and engineering research communities; educators, particularly at the university level; and policy makers within governments and international agencies such as the Intergovernmental Panel on Climate Change (IPCC). The data on the CD are expected to assist climate modelers in understanding the importance of permafrost and its place within the global thermal regime. Coupled with the IPA's Circum-Arctic Map of Permafrost and Ground Ice Conditions, the CD will provide researchers basic information on permafrost conditions at global, hemispheric and regional scales. It will also provide valuable sets of time series data from specific localities. Along with the data, the CD will include full text search capabilities and simple GIS (geographic information systems) that will allow geographical searching of the data, to facilitate use by individual researchers.

In order to increase awareness of the IPA and data activities, Claire Hanson of WDC-A presented a CAPS poster at the 27th Arctic Workshop in Ottawa in February1997. She represented the IPA at the International Arctic Data Directory (ADD) meeting in Sioux Falls, South Dakota, in October 1997, and reported on the CAPS and IPA actvities. The IPA Web site was updated several times this year by Julia Branson, GeoData Institute, University of Southampton, U.K.

In May 1997, M.J. Clark and R.G. Barry met at ETH, Zurich, to discuss the preparation of a joint paper on the GGD development. The paper covers the period from the initiation of the data activities at the 5th International Conference on Permafrost in Trondheim in 1988 though to current activities and to future plans for the management and dissemination of permafrost data. This paper and several other data and information papers have been submitted for the Yellowknife conference. The working group has recommended to the Executive Committee that a long-term, continuing commitment be made to the permafrost data and information activities and that the IPA Council consider the establishment of a permanent organization dealing with data recovery and dissemination. This activity could be embodied in a standing committee or a more substantial organization committed to both monitoring and data management. A review of the designation of regional GGD nodes will be undertaken at the meeting of the working group in Yellowknife.

The U.S.-based GGD activities have been supported by the IPA Working Group, the U.S. National Science Foundation grants to R.G. Barry and C. Hanson (with subcontract to N.N. Romanovskii) and to R.G. Barry and F. Nelson (with subcontract to D.A. Gilichinsky). Preparation of the CAPS CD is being supported by NSIDC-NASA Snow and Ice Distributed Active Archive Center (DAAC).

Roger G. Barry (rbarry@kryos.colorado.edu)

TERMINOLOGY

The glossary now has a total of 393 terms in 12 languages (Chinese, English, French, German, Icelandic, Italian, Norwegian, Polish, Romanian, Russian, Spanish, Swedish). For most of the languages a number of synonyms are also included (e.g. the total number of terms in the English list is 594). The glossary is set up in 15 sections. The first section contains terms in English as the prime language; each English term is followed by its equivalents in the other 11 languages. After the first "complete" section there are 11 separate sections listing terms in each of the other languages alphabetically; each term is followed by a number that refers back to the "complete" section, and to a following section which contains definitions. Photographs and diagrams are being considered to illustrate selected terms. The final two sections contain the references and the illustrations.

Methods have been devised to include terms in Chinese, using MS Word 6.0 and Unionway Asian ProPack 97. A listing of Chinese entries has been prepared and is being reviewed. Some minor "file-merging" problems with Russian terms in WordPerfect 5.1 and 6.1 were resolved. Defi-

nitions for some of the terms added in late 1995 are still under discussion.

A complete digital copy of the 12-language glossary will be prepared for the IPA CD. Plans for publication of a paper copy are still pending. However, a limited number of copies will be available in Yellowknife for cost of reproduction. Six copies remain of the December 1994 draft IPA glossary. If you are interested in receiving a copy of the 1994 draft or the new 1998 version, see contact below.

We received information from the working group secretary, Vyacheslav Konishchev, that he has received permission at Moscow State University to prepare and publish a 3000-term Russian–English glossary, possibly in time for the Yellowknife conference.

With the anticipated publication of the glossary in 1998 the Terminology Working Group will have completed its 10-year mandate, which started in 1988.

Robert O. van Everdingen (ervan@acs.ucalgary.ca)

Global Change and Permafrost

The working group concentrated during 1997 on several interrelated topics:

1. International activities, particularly gaining increased recognition for permafrost as a critical component of cryospheric and global-change studies, and its integration with other international research programs.

2. Expansion of the Circumpolar Active Layer Monitoring (CALM) network and derivative databases.

3. Increasing the use of explicitly spatial techniques and spatially distributed databases in global-change/permafrost research.

Several of our international efforts are reported under WCRP and GCOS activities (pages 5 and 6).

CALM. Major attention was devoted to further development of the Circumpolar Active Layer Monitoring network, which is now formally designated CALM and is closely affiliated with IPA, several IPA working groups, and the International Tundra Experiment (ITEX). During 1997 the CALM network was expanded in the Northern Hemisphere, and additional coordination activities with other international programs were developed. Poster displays and abstracts were presented at several international meetings, including the 27th Arctic Workshop in Ottawa in March 1997 and in Pushchino and Syktyvkar, Russia. A number of the Yellowknife papers are reporting results from the CALM sites, and other papers deal with active layer observations. Based on the collective results we hope to develop a consensus of recent changes and stability of the active layer and determine what additional sites should be added to the network.

Changes to the existing ITEX protocol were discussed at the Ottawa meeting, and revisions have been drafted and will be discussed and finalized in Yellowknife. These revisions will include detailed instructions on data reduction with the objective of ensuring similar collection and analyses of data over time. The existing protocol for observing active layer thickness is given in the ITEX Manual and on the IPA and ITEX web sites: http://www.dpc.dk/Sites/Secretariats/ITEX Manual/html.

As reported in *Frozen Ground* No. 20, the CALM network consists of sites where the maximum active layer thickness is measured by physical probing on grids ranging in size from 100 to 1000 meters, by probing at a single point or along transects, or from permanently installed frost tubes, soil temperature cables or boreholes. These active layer measurements are important indicators of landscape variability and provide documentation of annual and decadal fluctuations in soil thaw. They can serve as a basis for intersite comparison of ecosystem structure and function and provide data to validate site, regional and GCM models.

The majority of the sites are in tundra regions consisting of fine grained sediments. Bouldery and rocky sites in mountains are being added to the network, primarily as measurements in boreholes rather than physical probing. With funding of the three-year PACE project (page 3), monitoring of active layer temperature in the European mountains and on Svalbard will commence in 1998, and these sites will form an important part of the CALM network. As reported elsewhere, the GCOS program may adopt the CALM and PACE networks as part of its global network. We anticipate that sites in the Southern Hemisphere will begin to be added in 1998.

The accompanying map and table show sites, responsible individuals and available summarized data going back to 1991. There are now 69 sites reporting in the CALM network. ITEX programs are located at or near 13 of these sites. There are three types of active layer observations (many sites utilize more than one method):

1. Probing of grids ranging in size from 10 to 1000 m (up to 121 points) at 45 sites.

2. Probing at a single point or on transects and/or frost tubes at 20 sites.

3. Temperature measurements and interpolated depths, including shallow boreholes at 50 sites.

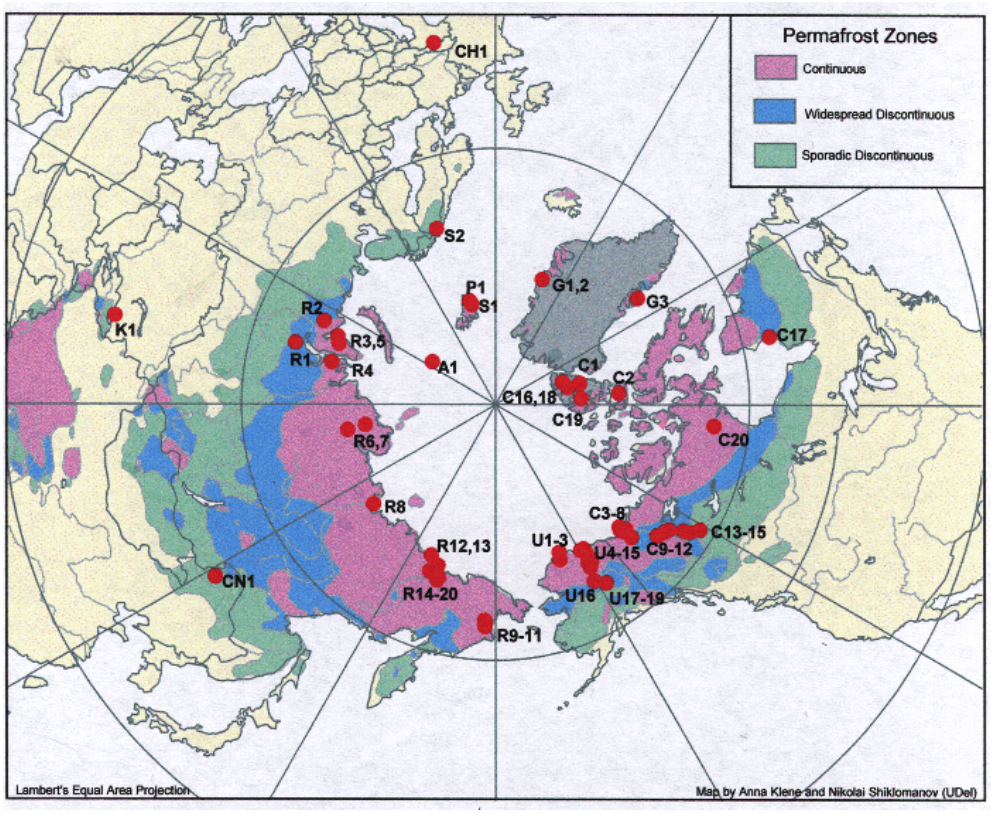
Eleven countries are involved in CALM, although only ten are shown in the table (page 22). Since two German sites on the Taimyr Peninsula are currently inactive. China added a site in the northeast that includes two boreholes. Several other well-instrumented sites exist on the Tibet Plateau, and presumably they will begin reporting also. Japan is also involved in joint programs at several sites in Russia

CIRCUMPOLAR ACTIVE LAYER MONITORING (CALM) NETWORK—NOVEMBER 1997

Map	Site	Location		Method	Late summer thaw						
					1991	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*
Austria/Russia											
A1†	Franz Josef Land [7]	81°04′N	56°18′E	50	—	—	—	—	—	21	*
Canada											
C1†	Alexandria Fiord [1]	79°54′N	75°54′W	100	—	—	—	—	43	*	
C2†	Truelove Lowland, Devon Island [2]	75°33′N	84°40′W	60	—	—	—	30	31	*	*
C3	North Head [3]	69°43′N	134°27′W	TT	61	62	63	64	62	60	
C4	Taglu [3]	69°22′N	134°57′W	TT/T	—	111	119	118	>124	112	
C5	Lousy Point [3]	69°13′N	134°17′W	TT/T	81	85	80	86	85	75	
C6	Parsons Lake [4]	68°58′N	133°33′W	T/P	80	85	84	91	91	84	*
C7	Reindeer Depot [3]	68°41′N	134°08′W	TT	—	127	129	132	136	134	
C8	Rengleng River [3]	67°48′N	134°05′W	TT	—	102	106	111	111	108	
C9	Mountain River [3]	65°40′N	128°50′W	TT	—	58	59	62	62	58	
C10	Pump Station [4]	65°17′N	126°53′W	T/P	66	64	58	60	60	61	77
C11	Norman Wells [3]	65°12′N	126°28′W	TT	—	64	63	61	61	59	
C12	Great Bear River [4]	64°55′N	125°35′W	T/P	72	72	72	69	69	63	69
C13	Ochre River [3]	63°28′N	123°02′W	TT/T	—	—	58	60	58	63	
C14	Willowlake River [3]	62°42′N	123°04′W	TT/T	—	—	79	83	84	90	
C15	Fort Simpson [3]	61°53′N	121°36′W	TT/T	—	—	95	106	123	128	
C16	Lake Hazen, Baffin Island [4]	81°49′N	71°23′W	T	—	—	—	—	—	—	
C17	Sheldrake River [23]	56°38′N	76°06′W	T	145	126	150	159	150		
C18†	Tanquary Fiord, Ellesmere Island [24]	81°24′N	76°42′W	100/TT	—	—	—	—	—	—	56
C19	Eureka, Ellesmere Island [24]	80°01′N	85°45′W	1000/TT	—	—	—	—	—	—	52
C20†	Baker Lake [25]	64°10′N	95°30′W	T	—	—	—	—	—	—	1.2
China											
CN1	Yitulihe, Northeast China [28]	50°56′N	121°20′E	T	—	—	—	—	—	—	
Denmark/Greenland											
G1†	Zackenberg, ZEROCALM 1 [5]	74°28′N	20°30′W	100/T	—	—	—	—	—	60	62
G2	Zackenberg, ZEROCALM 1 [5]	74°28′N	20°30′W	150/T	—	—	—	—	—	61	57
G3†	Disko Island [5]	69°15′N	53°30′W	100/T	—	—	—	—	—	—	57
Kazakstan											
K1	Northern Tien Shan, Cosmostation [26]	43°05′N	76°52′E	T	—	—	—	—	—	—	
Poland/Svalbard											
P1	Calypsos Tranda, Svalbard [6]	77°34′N	14°30′E	P	127	140	112	130	125	123	*
Russia											
R1	Nadym, West Siberia [9]	65°20′N	72°55′E	1000/T	—	—	—	—	—	—	73
R2	Ayach-Yakha, Vorkuta [8]	67°35′N	64°11′E	100/T	—	—	—	—	—	70	63
R3	Marre Sale, Yamal Peninsula [9]	69°43′N	66°45′E	1000/T	—	—	—	—	131	107	91
R4	Parisento, Gydan Peninsula [9]	70°07′N	75°35′E	1000	—	82	91	*	94	*	*
R5	Vaskiny Dachy, Yamal Peninsula [10]	70°17′N	68°54′E	1000/T	—	—	84	85	94	88	81
R6	Labaz Lake, Taimyr [11]	72°23′N	99°30′E	100/T	—	—	—	42	50	*	*
R7	Levinson Lessing Lake, Taimyr [12]	74°32′N	98°36′E	100/T	—	—	—	36	42	34	*
R8	Tiski (Game), Lena Delta[13]	71°35′N	128°47′E	1000/T	—	—	—	—	—	—	40
R9†	Cape Rogozhny, Chukotka [16]	64°47′N	176°58′E	100/T	—	—	—	43	43	49	50
R10	Upper Kargoplgyno River, Chukotka [16]	64°05′N	177°04′E	100	—	59	51	56	*	*	*
R11†	Mt. Dionisy, Chukotka [17]	64°34′N	177°12′E	100/T	—	—	—	—	—	50	47
R12	Kuropatochya River, Kolyma [14]	70°55′N	156°38′E	1000/T	—	—	—	—	—	(37,27)	35
R13	Cape Chukochii, Kolyma [14]	70°05′N	159°59′E	1000/T	—	—	—	—	—	—	36
R14	Chukochya River, Kolyma [14]	69°10′N	158°04′E	1000/T	—	—	—	—	—	(43)	36
R15	Konkovaya River, Kolyma [14]	69°05′N	158°06′E	1000/T	—	—	—	—	—	(39)	49
R16	Segodnya pingo, Kolyma [14]	69°05′N	158°54′E	100	—	—	—	—	—	38	*
R17	Khalarchinskaya tundra, Kolyma [14]	68°49′N	161°02′E	1000/T	—	—	—	—	—	(85,44,72)	55
R18	Mt Rodinka, Kolyma [15]	68°45′N	161°32′E	1000/T	—	—	—	—	—	—	69
R19	Panteleekha River, Kolyma [15]	68°25′N	161°13′E	100	—	—	—	—	—	45	*
R20	Malchilovskaya Channel, Kolyma [14]	68°25°N	161°13′E	100	—	—	—	—	—	54	*
( )100-m grids expanded and/or consolidated into 1000 m in 1997											
Sweden/Svalbard											
S1	Kapp Linne, Svalbard [18]	78°03′N	13°37′E	100/T	89	92	113	99	97	102	
S2†	Abisko area, Sweden [18]	68°20′N	18°50′E	100/T	69	66	65	66	61	68	
Switzerland											
CH1	Murtel-Corvatsch [27]	46°26′N	9°50′E	T	3.4	3.5	3.5	3.5	3.2	3.3	3.5

Map	Site	Location		Method	Late summer thaw						
					1991	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*
United States/Alaska											
U1	Barrow [19]	71°19′N	156°36′W	1000/T	—	22	30	35	35	36	37
U2†	Barrow, CRREL Plots [19]	71°19′N	156°35′W	10/T	23	23	29	34	34	35	37
U3†	Atkasuk [19]	70°27′N	157°24′W	1000/T	—	—	—	—	44	47	45
U4	West Dock [20]	70°22′N	148°33′W	100/T	—	—	—	—	—	30	31
U5	West Dock [19]	70°22′N	148°34′W	1000	—	—	48	55	51	55	52
U6	Deadhorse [20	70°10′N	148°28′W	100/T	—	—	—	—	—	64	65
U7	Betty Pingo [19]	70°17′N	148°52′W	1000/T	—	—	52	54	55	55	55
U8	Franklin Bluff [20]	69°41′N	148°43′W	100/T	—	—	—	—	—	63	66
U9	Happy Valley [20]	69°10′N	148°50′W	100/T	—	—	—	—	—	36	40
U10	Happy Valley [19]	69°06′N	148°30′W	1000/T	—	—	44	45	43	43	48
U11	Imnavait Creek [19]	68°30′N	149°30′W	1000/T	—	56	60	60	49	46	50
U12†	Toolik [19]	68°37′N	149°36′W	1000/T	—	—	—	—	45	47	49
U13	Toolik LTER Transect [21]	68°37′N	149°36′W	P/T	28	40	46	36	43	33	
U14	Galbraith Lake [20]	68°29′N	149°30′W	100/T	—	—	—	—	—	51	59
U15	Chandalar Shelf [20]	68°04′N	149°35′W	30/T	—	—	—	—	—	35	*
U16	Old Man [20]	66°27′N	150°37′W	100/T	—	—	—	—	—	33	37
U17	Wickersham Dome Transect [22]	65°16′N	148°03′W	TT/P	41	46	45	47	48	36	40
U18	Bonanza Creek LTER Transect [22]	64°45′N	148°00′W	TT/P/T	49	50	—	55	58	45	63
U19	Pearl Creek [22]	64°54′N	147°48′W	TT/P	63	71	66	66	72	53	61

Data compiled by Jerry Brown (jerrybrown@igc.apc.org).
† Denotes area of active ITEX project, but not necessarily the same site.
* Indicates no data collected for given year following the initial year of measurements.
Missing 1997 or prior data will be added in subsequent revisions and posted on WWW.
Methods: Numbers refer to size of grid in meters; P – single point probe or multiple points for transects; TT – thaw tube; T – interpolated depth based on temperature profile generally obtained by data logger and/or borehole logging and reported to closest 0.1 m.



Individuals responsible for current data collection are: [1] Greg Henry; [2] Larry Bliss, Warren Gold; [3] Mark Nixon, Al Taylor; [4] Charles Tarnocai, Sheila Kroetsch, David Kroetsch; [5] Hanne Hvidtfeldt Christiansen, GeoBasis/ZERO staff; [6] Jania Repelewska-Pekala; [7] Michael Gottfried, Georg Grabherr, Karl Reiter; [8] Galena Mazhitova; [9] Nataly Moskalenko, V. Dubrovin, Evgeny Melnikov; [10] Marina Leibman; [11] Martin Sommerkorn; [12] Julia Boike; [13] Sergei Ryabchuk, Larry Hinzman; [14] David Gilichinsky, D.G. Fyodorov-Davydov, Victor Sorokovikov, Vladimir Ostroumov; [15] Sergei Zimov, Sergei Davydov; [16] Anatoly Kotov; [17] Volodya Razzhivin; [18] Jonas Åkerman; [19] Jerry Brown, Ken Hinkel, Larry Hinzman, Anna Klene, Jerry Mueller, Fritz Nelson, Kolia Shiklomanov; [20] Tom Osterkamp, Vlad Romanovsky; [21] George Kling, Gus Shaver, Jim Laundre; [22] Les Viereck; [23] Michel Allard, Janusz Frydecki; [24] Antoni Lewkowicz, Barry Troke; [25] Josef Svoboda, Margo Burgess, Orin Durey; [26] Igor Seversky, Aldar Gorbunov; [27] Wilfried Haeberli, Martin Hoelzle, Daniel Vonder Mühll; [28] Liu Futao.

and on the plateau. Four new 1000-meter gridded sites were added in Russia: Tiksi on the Lena Delta as part of GAME (see page 4), Nadym in West Siberia, and two sites in the Kolyma region (several Kolyma 100-meter grids were expanded to 1000 m). One new site was added in Greenland on Disko Island. In Canada, five new sites were added, two with grids and frost tubes and the others with temperature measurements. Both Switzerland and Kazakstan are reporting instrumented boreholes.

This year we started to indicate sites where no data were collected (*), generally as a result of insufficient logistic funding. To offset some of these logistic limitations, to provide additional instrumentation, and to assist in data management and analysis, U.S. investigators (Hinkel and Nelson) submitted a proposal to the U.S. National Science Foundation to support CALM over a five-year period. As part of the proposal, an updated CALM table and map and the existing ITEX active layer protocol were placed on the IPA Web site. The standard metadata and detailed field data are being archived at the WDC-A for Glaciology in Boulder, Colorado. Summarized data will appear on the IPA CAPS CD, and revisions to the table will appear periodically on the IPA Web site.

Spatial Integration. Permafrost scientists have traditionally conducted field observations at point locations. With the advent of "global change science" (Houghton, J.T. et al. Climate Change 1995: The Science of Climate Change. Cambridge: Cambridge University Press) and development of computer technology capable of handling very large volumes of spatially distributed data, many scientific priorities have become focused on integration of data and examination of geographic patterns. Several ongoing permafrost activities will improve our ability to deal with problems of spatial integration. Although not a direct product of the working group, the IPA permafrost map of the Northern Hemisphere (see page 33 for ordering information) is the first circumarctic representation of permafrost and ground ice conditions to use a standard method of compilation. A digital version of the map will soon be available on CD, as will temperature and/or lithologic information for approximately 500 boreholes from Russia, Canada and Alaska (see page 20).

A specialized information system for permafrost and related data has been developed at the State Hydrological Institute under the direction of O. Anisimov. The computer package makes use of the extensive geocryological data being archived at NSIDC and elsewhere. It can analyze and display temperature time series at point locations, has routines for simulating the ground thermal regime, and uses general circulation model output to calculate permafrost distribution under various climate-change scenarios. The package, which has a module for bibliographic research, is fully "bilingual" (Russian and English) and can produce documents in either language. The package has been instrumental in several recent publications focusing on the distribution of permafrost under several climate-change scenarios, e.g.:

Anisimov, O.A. and Nelson, F.E. (1997) Permafrost zonation and climate change: Results from transient general circulation models. *Climatic Change*, 35: 241–258.

Anisimov, O.A., Shiklomanov, N.I. and Nelson, F.E. (1997) Effects of global warming on permafrost and active-layer thickness: Results from transient general circulation models. *Global and Planetary Change* (in press).

Several members of the working group are preparing a review paper detailing the necessity for permafrost scientists to adopt a rigorous approach to mapping and spatial analysis that will complement and extend other lines of cryospheric research.

Frederick E. Nelson (fnelson@cnsvax.albany.edu)
Jerry Brown (jerrybrown@igc.org)

Mountain Permafrost

Efforts continue to cooperate internationally with respect to mapping, modeling and monitoring mountain permafrost. The delivery of actual data from ongoing mountain permafrost monitoring programs into the Global Geocryological Database is now underway, and an overview paper is being prepared for the Yellowknife conference.

The International Commission on Snow and Ice (ICSI) expressed the wish to collaborate with IPA in the field of rock glacier research, a topic which has received remarkably growing interest during the past decade. The main challenge today consists in modeling the involved processes and materials. Such modeling primarily requires quantitative input about ground thermal conditions, ice formation processes and the rheology of ice/rock mixtures. A short-term ICSI/IPA working group could prepare an assessment of the presently available understanding and data base from field measurements, laboratory experiments and existing flow models. Recommendations could be formulated concerning important research perspectives and priorities. The President of ICSI is E. Morris (U.K.) and the Secretary is A. Fountain (U.S.)

The pre-conference field trip M4 (22–28 August 1997), organized in cooperation with the IGU Commission on Climate Change and Periglacial Environments and leading from Zurich to the International Geomorphology Congress at Bologna (28 August–3 September 1997), emphasized slope stability problems related to mountain permafrost. Research on displacements of slope materials under perigla-

cial conditions has a long tradition. Rock falls, debris flows, solifluction and permafrost creep have, indeed, been observed and studied for decades. Renewed attention and remarkable progress can now be observed, however, for three main reasons:

1. Advanced technologies, including core drilling, borehole measurement, geophysical sounding, continuous data-logging under harsh field conditions, detailed laboratory experiments and sophisticated numerical modeling, help build up a much more precise process understanding than was hitherto possible.

2. Full treatment of all involved scales in time and space, including impacts on and effects from thick, ice-bearing permafrost layers, allow research into processes and phenomena of rock destruction and slope stability not investigated before that relate to important environmental and hazard aspects in cold-climate mountain topography.

3. Observed glacier shrinkage and permafrost warming/degradation at secular to decadal time scales leads to the widespread recognition that periglacial mountain belts are subject to major changes due to their pronounced sensitivity with respect to effects from atmospheric warming.

Slope stability aspects involve time and depth scales ranging from daily cycles to millennia and from centimeters to hundreds of meters. At daily and centimeter scales, surficial frost weathering by volume expansion and frost creep from pipkrake formation predominate. At the decimeter to meter scale, rock destruction, frost creep and gelifluction through ice segregation and subsequent thawing within seasonally frozen ground and permafrost active layers take place. At the scales of tens to hundreds of meters and decades to millennia, permafrost creep (rock glacier flow) and destabilization of large rock masses result.

The excursion, in which 50 participants from 17 countries took part, illustrated characteristic examples of such aspects and documented the intensive research activity carried out by international and interdisciplinary research groups in the European Alps. A number of Swiss and Italian mountain permafrost sites were visited according to the following itinerary:

22 August (Zurich to St. Moritz, Switzerland): Permafrost in a scree slope at Flüelapass (Haeberli).

23 August
- Projects on Pontresina-Schafberg (Vonder Mühll).
- Photogrammetric analyses (Andreas Kääb).
- Avalanche defense structures in permafrost terrain (Phillips).
- Muragl rock glacier (Vonder Mühll).

24 August
- Murtel-Corvatsch rock glacier (Vonder Mühll).
- Miniature dataloggers for mapping and monitoring (Hoelzle, Wegmann, Krummenacher).
- Energy balance and numerical modeling of discon-

Participants in M4 field trip, Piz Corvatsch Cable Station (see cover).

tinuous mountain permafrost (Hoelzle, Mittaz, Haeberli).

Weathering and rockwall instability (Matsuoka)

Rock glacier Suvretta (Vonder Mühll)

Water pipes in high mountain permafrost areas (Keller)

25 August (Bormio, Italy)

Periglacial phenomena, permafrost distribution, and glacial evolution in Foscagno area, Livigno (Guglielmin)

Vegetation patterns in Foscagno Valley and La Foppa cirque (Cannone)

26 August: Periglacial morphology in Val Pisella (Smiraglia and Guglielmin)

27 August (Bormio): Workshop on Mountain Permafrost and Monitoring and Mapping

28 August: Travel to Bologna, stopping to observe Val Pola landslide (Dramis) and visit local winery.

Approximately 20 talks were presented during the one-day workshop. The topics are fundamentally important elements of scientific research in order to detect sensitive areas and situations in complex topography, to allow improved understanding of the multiple interactions and feedback mechanisms related to freezing and thawing of ground materials on slopes, and to establish the database for estimating impacts from potential future climate change scenarios on living conditions in cold mountainous areas. Charles Harris presented the plans for the EC PACE program, whose activities will strengthen research in mountain permafrost activities (see page 3). A booklet containing summaries of the presentations was available; a formal publication is in final preparation.

Wilfried Haeberli (haeberli@geo.unizh.ch)
Francesco Dramis (dramis@uniroma3.it)

Periglacial Processes and Environments

During the past year the working group organized the High Arctic Field Meeting and Symposium, which was held on Ellesmere Island, Canada, 8–17 July 1996. The excursion, led by A. Lewkowicz, had 10 participants from seven countries. This was the first organized field trip concerning geocryology in the Canadian Arctic for more than 20 years. The meeting was co-sponsored by the IGU Commission on Climate Change and Periglacial Processes (CCPP).

Members of several IPA working groups met informally in Ottawa during the 27th Arctic Workshop in February 1997, and in Bologna in August with the CCPP. The status of the handbook on recommended methods for measuring periglacial processes was reviewed. Preliminary lists of topics and lead contributors have been drawn up. We will propose in Yellowknife that the working group be renewed and that preparation of the handbook be its main task. The membership would be enlarged to include the lead authors (about 20). It is proposed that a first draft of the handbook be produced by the year 2000, followed by a meeting of the working group to review and revise the draft. Liaison with the IGU Commission would continue, as would publication of the joint newsletter and organization of meetings and symposia over the years 1998–2003.

The next meeting sponsored by the working group is at Cardiff, U.K., 16–17 December 1997. It has been organized by C. Harris (see page 18 for details). The working group is co-sponsoring the joint meeting of the two IGU Commissions Geomorphology and Environmental Change (GERTEC) and CCPP in Krakow and Lodz, Poland, 20–28 September 1998. The theme of the meeting is Holocene landform evolution in mountains and periglacial transformation of lowland areas of the temperate zone. There will be field visits to the Tatra Mountains and the lowlands of Poland. This will be the first meeting co-sponsored by IPA and the two IGU commissions.

A. Lewkowicz (alewkowi@acadvml.uottawa.ca)
Charles Harris (harrisc@cardiff.ac.uk)

Cryosols

The Cryosol Working Group met in conjunction with the ISSS Cryosol Working Group dealing with permafrost-affected soils at Cryopedology '97: Second International Conference, 5–8 August 1997, in Syktyvkar, Republic of Komi, Russia. The conference was opened by G.V. Dobrovolskii, President of the Russian Soil Society. A post-conference excursion to Vorkuta took place on 9–10 August.

The conference followed five years after the first one, which was held in Pushchino, Russia, in 1992. The Institute of Biology, Komi Science Center, Ural Division, Russian Academy of Sciences in Syktyvkar was the lead institute for organizing the meeting. Other groups within the Russian Academy of Sciences were the Institute of Soil Science and Photosynthesis (Pushchino), the Institute of Geography (Moscow), the Scientific Council on Earth Cryology, the Scientific Council on Soil Science, and the Society of Soil Science. The V.V. Dokuchaev Soil Science Institute (Moscow) of the Russian Academy of Agricultural Sciences was also part of the organizer group. Other groups were the International Society of Soil Science (ISSS), the International Permafrost Association, and the Head of the Republic of Komi. Financial support was provided by the Head of the Republic of Komi, the Russian Fund for Basic Research, ISSS, USDA–

NRCS, and the IPA. An abstract volume in English and Russian and a field guidebook were published as part of the conference. I.V. Zaboeva was responsible for organizing the conference, and she was ably assisted by an editorial group including E.M. Lapteva, G.G. Mazhitova, A.V. Kononenko and G.A. Simonov.

About 60 soil scientists from 14 countries participated (Canada, China, Denmark, Finland, France, Germany, Hungary, New Zealand, Romania, Russia, South Africa, Sweden, The Netherlands, and the United States). There were three days of oral and poster sessions with a one-day, mid-week tour near Syktyvkar. Papers covered topics related to cryosols (chemistry, physics, biology, mineralogy, etc.), agriculture in areas with permafrost, remediation of environmental problems (oil spills for example), and the general use and management of these soils. Selected papers which cover the major ideas discussed will be submitted to *Pochvovedenie* (*Eurasian Soil Science*) for a special cryosol issue that ideally will be available in time for the Yellowknife conference. Additional papers will be submitted to the new Russian journal *Earth Cryosphere*.

The local field trip observed soils both in the native state (taiga) and areas cleared for agriculture. Soils in this area do not have permafrost, but had relic cryogenic features.

The field excursion to Vorkuta looked at long-term research on natural tundra and areas converted to agricultural use over 40 years ago. This area is at 67°N latitude, and observing agricultural development and discussing problems arising under these conditons were extremely informative. The latest draft of the cryosol order of the FAO/ISSS World Reference Base for Soil Resources (WRB) proposal was field tested and discussed. This was the first time for a large group of soil scientists to actually test the proposal in the field and it was a useful test of the proposal.

Participants were informed of the geoecological monitoring network in the Vorkuta area that was started in 1957 and includes 15 field stations and 1200 sites. Of these, 9 stations and 540 monitored sites are still operating. Several periods of cooling and warming and resulting formation and degradation of permafrost are well documented in the area. The Tundra Hydrogeological Station in the Pechora lowlands 30 km southwest of Vorkuta, directed by N.B. Kakunov, maintains an extensive network of geocryological, geoecological, and hydrogeological sites typical of the southern tundra subzone. The station data and observations are of considerable importance to the IPA GGD and other global change programs.

The conference participants agreed upon a series of resolutions. The Cryosol Working Group decided that the Third International Conference on Cryogenic Soils would be held 27–31 August 2001 in Denmark, hosted by the Danish Polar Center. A post-conference field excursion (1–5 September) will take place in northern Scandinavia. Topics include: soil genesis, cryogenic processes and patterned ground, soil ecology–soil biota interactions, carbon storage (CO_2/CH_4 cycles), soil mapping and classification, soils as an

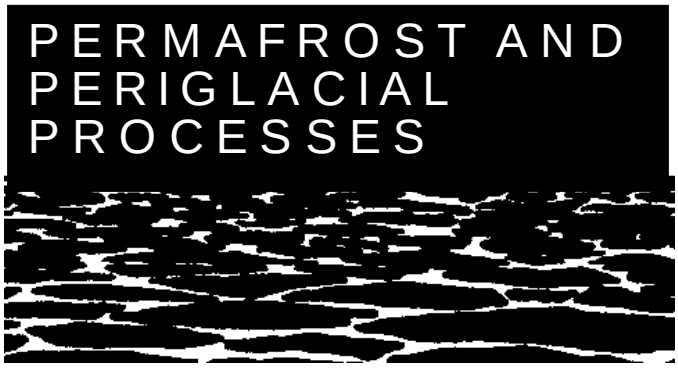
Participants in August 1997 conference, Syktyvkar.

archive of past climates or environments, cryosols' effect on energy balance and hydrologic cycle, and cryosols' response to anthropogenic impact and global change (see *Forthcoming Meetings*, p. 34).

Preparation of the soils map of permafrost-affected soil (1:7,500,000) is progressing. A soils map of Greenland was prepared by B. H. Jakobsen as a contribution to the mapping program. Long-term soil temperature data are being compiled by David Gilichinsky with selected stations as input to the CD. Plans for reports and papers for the Yellowknife conference and the ISSS conference in Montpelier were reviewed. A special issue of *Permafrost and Periglacial Processes* is planned. The future direction of the IPA and ISSS working groups is under consideration, and these plans will be further discussed and presented at Yellowknife. Included in these plans for the following five years is the preparation of a monograph on cryosols to be edited by Charles Tarnocai and David Gilichinsky. This monograph will include papers from the members of these working groups as well as from other scientists on topics such as cryogenic processes as a driving force for the development of cryosols, soil properties resulting from cryogenic processes, biological activities in these soils, classification and distribution of cryosols, and the effect of climate warming on these soils.

David Gilichinsky (gilichin@issp.serpukhov.su)
with contributions by
John Kimble (kimble@nssc1000.nssc.nrcs.usda.go)
I.A. Zaboeva (root@biology.komitex.ru)

PUBLICATIONS



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Volume 8, Issue No. 1 (January–March 1997)

Thawing of the Active Layer on the Coastal Plain of the Alaskan Arctic, V.E. Romanovsky and T.E. Osterkamp

Freezing of the Active Layer on the Coastal Plain of the Alaskan Arctic, T.E. Osterkamp and V.E. Romanovsky

Effects of Climate on the Active Layer and Permafrost on the North Slope of Alaska, USA, T. Zhang, T.E. Osterkamp and K. Stamnes

Rock Temperatures and Implications for Cold Region Weathering. 1: New Data from Viking Valley, Alexander Island, Antarctica, K. Hall

Critical Degree of Saturation as a Threshold Moisture Level in Frost Weathering of Limestones, A. Prick

Distribution of Mountain Permafrost, Fontanesses Basin, Valaisian Alps, Switzerland, J.-M. Gardaz

Cyclic Development and Thermokarstic Degradation of Palsas in the Mid-Alpine Zone at Leirpullan, Dovrefjell, Southern Norway, J.A. Matthews, S-O. Dahl, M.S. Berrisford and A. Nesje

Monitoring of Mountain Permafrost in the Central Andes, Cordon Del Plata, Mendoza, Argentina, D. Trombotto, E. Buk, and J. Hernandez

Volume 8, Issue No. 2 (April–June 1997)

Special issue associated with the Fourth International Association of Geomorphologists Conference, Bologna, Italy, 28 August–3 September 1997

Application des Méthodes Électromagnétiques à la Délimitation du Pergélisol Salin dans la Péninsule de Yamal, Secteur Nord-Ouest de la Sibérie, S. Krylov, N. Bobrov and M. Séguin

Weathering of Quartzite on a Cryoplanation Terrace in Northern Yukon, Canada, B.M. Lauriol, A.E. Lalonde and V. Dewez

Monitoring of Periglacial Slope Processes in the Swiss Alps: The First Two Years of Frost Shattering, Heave and Creep, N. Matsuoka, K. Hirakawa, T. Watanabe and K. Moriwaki

Electrical Resistivity Measurements on the Rock Glaciers of Grizzly Creek, St. Elias Mountains, Yukon, M. Evin, D. Fabre and P.G. Johnson

Formation of High-Mountain Talus Slopes Related to Debris-Flow Activity in the High Tatra Mountains, A. Kotarba

A Neural Network Method to Determine the Presence or Absence of Permafrost Near Mayo, Yukon Territory, Canada, D.W. Leverington and C.R. Duguay

Ground Icing Formation: Experimental and Statistical Analyses of the Overflow Process, X. Hu and W.H. Pollard

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Essai de Cartographie du Pergélisol Discontinu à l'Aide d'un SIG: Détroit de Manitounuk, Québec Nordique, Canada, E. Ménard, M. Allard and Y. Michaud

Some Observations Regarding Protalus Ramparts, K. Hall and I. Meiklejohn

Pleistocene Gelifluction and Rock Deformation on Slopes in Southern Wyoming, B. Mears, Jr.

Volume 8, Issue No. 3 (July–September 1997)

Hydrology of a Small Drainage Basin with Polar Oasis Environment, Fosheim Peninsula, Ellesmere Island, Canada, M. Woo and K.L. Young

The Hydrologic Analysis and Modelling of River Icing Growth, North Fork Pass, Yukon Territory, Canada, X. Hu and W.H. Pollard

Cold-Climate Aeolian Sand-Sheet Formation in North-Western Europe (c. 14–12.4 ka): A Response to Permafrost Degradation and Increased Aridity, C. Kasse

Permafrost Distribution and Temperatures in Europe During the Younger Dryas, R.F.B. Isarin

Radiocarbon Dating and Oxygen-Isotope Variations in Late Pleistocene Syngenetic Ice Wedges, Northern Siberia, Y.K. Vasil'chuk and A.C. Vasil'chuk

Volume 8, Issue No. 4 (October–December 1977)

Time Domain Reflectometry as a Field Method for Measuring Water Content and Soil Water Electrical Conductivity at a Continuous Permafrost Site, J. Boike and K. Roth

A Multivariate Analysis of Clast Displacement on Stone Banked Sheets, Cordillera Real, Bolivia, B. Francou and P. Bertran

Active Layer Thermal Regime at Three Rock Glaciers in Greenland, O. Humlum

Analyzing the Creep of Mountain Permafrost Using High Precision Aerial Photogrammetry: 25 Years of Monitoring Gruben Rock Glacier, Swiss Alps, A. Kääb,W. Haeberli and G. Hilmer-Gudmundsson

Permafrost Changes in the Northern Tien Shan During the Holocene, S.S. Marchenko and A.P. Gorbunov

Short Communications

Thermal Regime for a Thufur and Its Adjoining Depression, Mashai Valley, Lesotho, S. Grab

Evidence for Cell Collapse in Sorted Circle Development, J. Kling

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JOURNAL OF GLACIOLOGY AND GEOCRYOLOGY

SELECTED FROZEN GROUND TITLES

Volume 18, Special Issue (1996)

Response Processes of Permafrost

Ground Temperature, Permafrost Distribution and Climate Warming in Northeastern China, Zhou Youwu, Wang Yingxue, Gao Xingwang and Yue Hansen

The Classification of High-Asia Periglacial Process Types and Their Altitudinal Spectrums, Guo Dongxing and Cheng Guodong

Response of Permafrost to Climate Change in the Qinghai–Xizang Plateau, Wang Shaoling, Zhao Xiufeng, Guo Dongxing and Huang Yizhi

Permafrost Zonation of Ground Temperature and Stability of Engineering Constructions in the Western Region, China, Tong Changjiang and Wu Qingbai

A Preliminary Analysis on the Regularity of Permafrost Degradation, Its Advantages and Disadvantages in the Greater and Lesser Xing'an Mountains, Wang Chunhe, Zhang Baolin and Liu Futao

The Relationship Between Permafrost Evolution and the Formation of Gold Placers in Northern Part of the Greater and Lesser Hinggan Mountains Since Late Pleistocene Epoch, Zhang Baolin, Wang Chunhe, Chunyu Shuju, Song Changchun, Wang Ruishan and Liu Futao

Numerical Simulation of the Future Change of Thermal Regime in the High Temperature Permafrost of Qinghai-Xizang Plateau Under Climate Warming, Li Shuxun and Cheng Guodong

The Analysis and Approximate Calculation of Permafrost Evolution, Li Shuxun and Cheng Guodong

A Statistical Forecasting Model of the Variations in Active Layer Influenced by Snow Cover: Exemplified by a Study in Northeastern China, Gao Xingwang, Zhou Youwu and Wang Yinxue

Water Chemical Characteristics and the Evaluation of Water Aplplication in the Permafrost Regions of Northeast China, Wang Chunhe, Zhang Wenfen, Zhang Baolin and Liu Futao

Effect of Gold Mining on Permafrost and Environment, Wang Chunhe, Zhang Baolin, Li Fenghua, Liu Futao,Wang Ruishan and Song Changchun

Remote Sensing Technology and Data Bank

Microwave Remote Sensing on Freezing/Thawing Dynamic of Terrai Soil in Tibetan Plateau of the High-Asia, Cao Meisheng

Interchange of Information on Cryosphere Science Data Set, Chen Xianzhang, Yang Zhihuai and Lu Anxin

Volume 18, No. 4 (December 1996)

Study on Prevention of Frost Heaving of Reinforced Soils, Chen Lun, Guo Ruiping and Li Guangxin

Monitoring the Change of Structures in Frozen Soil in Uniaxial Creep Process by CT, Wu Ziwang, Ma Wei, Pu Yibin and Chang Xiaoxiao

The Creep Photoviscoelastic Simulation Experiments of Frozen Soil with a Round Hole, Wang Tingdong, Wu Jianjun, Zhao Xishu, Wu Ziwang and Liu Yongzhi

Experimental Study on Heat–Moisture Transfer in Lanzhou Loess During Freezing–Thawing Processes, Li Shuxun, Cheng Guodong, Liu Jimin and Lin Jingfang

CH_4 and CO_2 Emission from Permafrost Surface in Wudaoliang in the Tibetan Plateau, Lin Qing, Jin Huijun, Cheng Guodong and Li Ning

Volume 19, No. 1 (March 1997)

Frozen Ground and Environment in the Zoige Plateau and Its Surrounding Mountains, Wang Shaoling

The Relation Between Permafrost Degradation and Kobresia Meadow Change on the Southern Piedmont of the Tangula Range, Yuan Jiuyi, Yan Shuiyu, Zhao Xiufeng et al.

Monitoring the Change of Structures in Frozen Soil in Triaxial Creep Process by CT, Ma Wei, Wu Ziwang, Pu Yipin et al.

The Photoviscoelastic Study on the Stress of an Underground Tunnel with Circular Section, Wu Jianjun, He Lihong, Wang Tingdong et al.

The Quasi-Static Temperature Field and Heat Engineering Parameters of Buried Petroleum Pipelines in Seasonally Frozen Ground Regions, Li Nansheng, Li Hongsheng and Ding Dewen

Groundwater Consuming in Original Soil During Freezing Period, Zhao Donghui

Fractal Properties of Size-Frequency Distribution of Fragments of Artificial Frozen Soil, Ke Changsong

Study on the Influence of Cl/SO_4 on the Engineering Behaviors of Sulphate Salty Soil, Yang Liying and Li Bin

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Volume 1, No. 1 (January–March 1997)

Problems of Earth Cryology

The Earth Cryosphere as an Object of Cryology, V.P. Melnikov

Cryosphere in the Earth History, V.N. Konishchev

Environmental Restructuring at the Pleistocene/Holocene Boundary in the East Siberian Arctic and Its Role in Mammalian Extinction and Establishment of Modern Ecosystems (Communication 1), A.V. Sher

Regionalization of the Territory of the Permafrost Zone by the Extent to Which Ecological Conditions are Affected by Technological Geocryological Processes, L.S. Garagulya, G.I. Gordeeva and L.N. Khrustalev

Snow Cover Changes and Their Role in Climate, A.N. Krenke, L.M. Kitaev, D.V. Turkov, T.G. Kadomtseva and E.M. Aizina

Geocryological Monitoring and Prediction

*Permafrost-Climatic Monitoring of Russia: Methodology, Results of Observation and Forecas*t, A.V. Pavlov

Prediction of Permafrost Thawing and Distribution and Changes of Frost Soil Cracking for the Territory of Russia Under Climate Warming, S.E. Grechishchev

About the Tendency in Evolution of the Seasonally Frozen Ground Zone of West Siberia for the Nearest Decades, N.A. Scorbilin

Ice and Frozen Soil Properties

Peculiarities of Frozen Saline Grounds and Their Electric and Elastic Properties, O.P. Chervinskya, Y.D. Zykov and A.D. Frolov

Ice Properties Under High Concentration of Structure Defects, A.V. Shavlov

Atmospheric Processes

The Mechanism of the Atmospheric Vortexes, V.P. Melnikov and J.J. Smulsky

Vol. 1, No. 2 (April–June 1997)

Problems of Earth Cryology

Environmental Restructuring at the Pleistocene/Holocene Boundary in the East Siberian Arctic and Its Role in Mammalian Extinction and Establishment of Modern Ecosystems, A.V. Sher (Communication 2)

Use of the Reliability Theory for Decision of Engineering Geological Problems, L.N. Khroustalev

Snow Cover Changes and Their Role in Climate, A.N. Krenke, L.M. Kitaev, D.V. Turkov, T.G. Kadomtseva and E.M. Aizina (Communication 2)

Cryogenic Phenomena and Paleo-Geographical Reconstructions

*The Cryolithogenic Method for Estimating Paleotemperature Conditions During Formation of Ice Complex and Subaerial Periglacial Sediment*s, V.N.T. Konishchev

Hydrochemical Method for Estimation of Palaeotemperature of Rocks on the Arctic Coast, S.M. Fotiev

Cryogenic Processes on Shelf and on Land of the Arctic Coasts

The Evolution of the Arctic Shelf During Late Cenozoic and Cryogenic-Glaciogenic Processes, I.D. Danilov

Reconstruction of Paleogeographic Conditions on Laptev Sea Shelf for Late Pleistocene–Holocene Glacial–Eustatic Cycle, N.N. Romanovskii, A.V. Gavrilov, A.L. Kholodov, H.-W. Hubberten and H. Kassens

Cryolithological Peculiarities of the Active Layer on Slopes in Relation to Cryogenic Landslides, M.O. Leibman

The Role of Fluvial Processes in the Evolution of the Icy Complex Soils, G.F. Gravis

Microbiology of the Cryosphere

Life in Cryosphere: A Current View, E.A. Vorobyova, D.A. Gilichinsky and V.S. Soina

Yeasts in Late Pliocene–Early Pleistocene Siberian Permafrost, V.V. Dmitriev, D.A. Gilichinsky, R.N. Faizutdinova, N.V. Ostroumova, V.I. Golubev and V.I. Duda

Blue–Green and Green Algae from Arctic Permafrost, T.A. Visnivetskaya, L.G. Erokhina, D.A. Gilichinsky and E.A. Vorobyova

Volume 1, No. 3 (July–September 1997)

Cryogenic Processes on the Russian Arctic Shelf

Dynamics of Cryolithosphere in the Area of Continent–Shelf Interaction During Last 25,000 Years (the East Siberian Sea as an Example), I.D. Danilov, I.A. Komarov and A. Yu. Vlasenko

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Physico-Chemical Mechanics of Frozen Soils

Simplest Physical Models of Cryogenic Phenomena, J.B. Gorelik, V.S. Kolunin and A.K. Reshetnikov

Freezing Kinetics, Thermal Strains and Heaving of Frozen Soils, S.E. Grechishchev

Ice Melting in Non-Cohesive Frozen Soils, Caused by Local Pressure, S.B. Ukhov, A.N. Vlasov, L.D. Lisin, V.P. Merzljakov and V.L. Savatorova

Peculiarities of Water Vapor Migration on the Frozen Ground/ Snow Interface, V.N. Golubev, Yu.G. Seliverstov and S.A. Sokratov

The Theory of HMR-Relaxation in Unfrozen Water Films, G.V. Anikin and S.N. Plotnikov

Frozen Soil Properties

Seismic-Geological Classifications of Soils in Cryolithozone, O.K. Voronkov, G.A. Motorin, G.V. Mikhailovsky and S.P. Kunzevich

Study of Relationship Between Dynamic Load and Strength Properties of Soft Frozen Ground, V.N. Kutergin, R.G. Kalbergenov and V.I. Aksenov

The Features of Saline Frozen Soil Deformation, Y.D. Zykov, O.P. Chervinskaya and A.D. Frolov

Features of the Structure of Elastic Oscillation Field in Non-Lithified Frozen Ground, A.G. Skvortsov

Regional Problems of Earth Cryology

Assessment Techniques in the Analysis of the Cryolithosphere Structure and Dynamics, A.A. Konowalov

Isotopic Composition of Ground Ice at the Labaz Lake Region (Taimyr), A.B. Chizhov, A.Yu. Dereviagin, E.F. Simonov, H.-W. Hubberten and Ch. Siegert

Recent Gas Hydrate Research at the Geological Survey of Canada, P.J. Kurfurst

Volume 1, No.4 (October–December 1997)

Problems of Earth Cryology

Generalized Analytic Solution of Modeling the Process of Freezing–Thawing by Perturbation Methods, J.A. Komarov

Regional Problems of Earth Cryology

Age and Distribution of the "Mammoth" Fauna of the Polar Regions of Asia, L.D. Sulerzhitsky and F.A. Romanenko

A Relict of Late Quaternary Permafrost on a Former Nunatak at Plateau Mountain, S.W. Alberta, S.A. Harris

Cryogenic Weathering of Limestones Evaluated by Laboratory Techniques and Applied to a Mountain Permafrost Area, A. Prick

Ecological Problems of Earth Cryology

Reliability of Landscape Indication of Engineering–Geocryological Conditions on Transition from Large- to Medium-Scale Regional Investigations in Western Siberia, D.S. Drozdov

Technique and Results of Large-Scale Ecologo-Geological Environmental Research of Ore Fields in Cryolithozone, A.A. Vasiljev and D.S. Drosdov

Reliability of Basements and Structures in Cryolithozone

The Inclusion of Climatic Change in the Design of the Basements of Structures on Permafrost Soils, G.P. Pustovoit

Stabilization of the Pile Basements of a Local Structure on the Frozen Ground, Ja.B. Gorelik, V.N. Feclistov and A.N. Nesterov

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Improving Reliability of Air Convection Type Refrigeration Units, G.P. Kuzmin

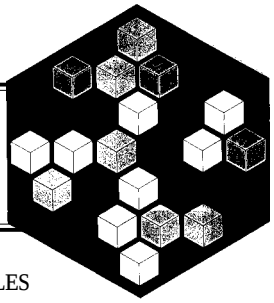
Deformation of Earth-Filled Dams and Low-Pressure Spillways in the Permafrost Area, R.V. Zhang

Deformation of Roadbed Base in Ice-Rich Permafrost Areas and Methods of Their Improvement, V.G. Kondratiev

Geoinformation Systems

Geoinformation Approach to Investigation of Carbon Fluxes in Tundra Landscapes, D.G. Zamolodchikov, D.V. Karelin and A.I. Ivacyenko

Electronic Landscape-Based Map for Ecological Circum-Polar Maps of Russian Arctic, E.S. Melnikov, L.A. Konchenko and L.S. Molchanova



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Volume 25, No. 1 (January 1997)

Moisture Migration During Freeze and Thaw of Unsaturated Soils: Modeling and Large-Scale Experiments, S.A. Shoop and S.R. Bigl

Book Review
Ground Freezing in Practice, T.H.W. Baker

Volume 25, No. 2 (March 1997)
Simulation and Analysis of Frost Heaving in Subsoils and Granular Fills of Roads, F. Padilla, J.-P. Villeneuve and J. Stein
Soil Freezing—The Concept of Soil Water Potential. State of the Art, M. Hohmann (geb. Porebska)
Movement of Liquid Contaminants in Partially Saturated Frozen Granular Soils, D.C. Wiggert, O.B. Andersland and S.H. Davies

OTHER PUBLICATIONS

The Geocryological Map of the USSR (1:2,500,000)
The price of the 16-sheet set with the explanatory notes in English is US$480. Contact: Vladimir Zaitsev, Nina Trush, or Tamara Nistratova, Department of Geocryology, Faculty of Geology, Moscow State University, Vorobievy Gory, Moscow, 119899, Russia. Tel: 095 939 49 65, 939 49 19, e-mail: geocryol@artifact.geol.msu.ru

Circum-Arctic Map of Permafrost and Ground Ice Conditions (1:10,000,000).
Compiled and edited by J. Brown, O.J. Ferrians, Jr., J.A. Heginbottom, and E.S. Melnikov. Circum-Pacific Map Series CP45. Available after 1 January 1998 from the U.S. Geological Survey, Information Services, Box 25286, Denver, Colorado 80225, USA. Price: US$4.00 plus postage.

Cold Regions Engineering
Proceedings of International Symposium, 11–14 September 1996, Harbin, China, University of Harbin Industry Technology Press. Contact: R.M. Kamesky, Permafrost Institute, Russian Academy of Sciences, Yakutsk 677018, Russia.

ISCORD '97
Proceedings of Fifth International Symposium on Cold Regions Development (H.K. Zubek, C.R. Woolard, D.M. White and T.S. Vinson, Ed.). Published with the assistance of USA Cold Regions Research and Engineering Laboratory, Hanover, N.H. Available at US$30/copy plus postage from Ted Vinson. Fax: 1 503 737 3052, e-mail: vinsont@ccmail.orst.edu.

International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, Alaska, June 10–12, 1997
Proceedings (I.K. Iskandar et al., Ed.). USA CRREL Special Report 97-10, 573 p. Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. Tel: 703 487 4650; e-mail: orders@ntis.fedworld. gov

Eva Interglaciation Forest Bed, Unglaciated East–Central Alaska: Global Warming 125,000 Years Ago
Troy L. Péwé, Glenn W. Berger, John A. Westgate, Peter M. Brown and Steven W. Leavitt, 1997. Available at US $36.00 from Geological Society of America, Publication Sales, P.O. Box 9140, Boulder, Colorado 80301. Tel: 1 800 472 1988, Fax: 1 303 447 1133, e-mail: pubs@geosociety.org, http://www.geosociety.org

The Seasonally Freezing Halic Soils and Their Improvement—Utilization in the Hexi Corridor, Gansu, China
Qui Guoqing, Zhao Lin, Wang Shujuan, Zhang Xilin, Sheng Wenkun, Yue Hansen and Jin Huijun, Lanzhou University Press, 1996. Contact: Lanzhou Institute of Glaciology and Geocryology, Lanzhou 730 000, China.

Mountain Permafrost: Definitions, Morphology and Methods to Detect Its Distribution (with three examples in Upper Valtellina, Italy)
Mauro Guglielmin with contributions by Adalberto Notarpietro [Il Permafrost Alpino. Concetti, morfologia e metodi di individuazione (con tre indagini esemplicative in alta Valtellina). Quaderni di Geodinamica Alpina e Quaternaria, 5, 117 p.] The book is in Italian with figure captions in both Italian and English. It is available without charge from the author at: cannone. guglielmin@galactica.it

Changes in Periglacial Environment
Bulletin of the Geological Society of Finland, vol. 69, no. 2, 1997. Proceedings of an October 1996 symposium organized by the Finnish National Committee for Quaternary Research (INQUA Committee).

FORTHCOMING MEETINGS

1998

LOIRA: Land–Ocean Interactions in the Russian Arctic
15–18 January 1998, Moscow, Russia
Contact: Dr. Vyacheslav V. Gordeev, P.P. Shirshov Institute of Oceanography, Nakhimovsky prosp. 36, Moscow 117851, Russia
Tel: 7 095 124 59 58; Fax: 7 095 124 59 83; gordeev@geo.sio.rssi.ru

SCANTRAN Meeting
19–22 March 1998, Finland
Contact: Minna Turunen, Arctic Centre, University of Lapland, P.O. Box 122, FIN-96101, Rovaniemi, Finland
Tel: 358 16 324774; Fax: 358 16 324777; mturunen@levi.urova.fi
http://www.urova.fi/~arktinen/scantran.htm

Past Global Changes and Their Significance for the Future
20–23 April 1998, University of London, United Kingdom
Contact: IGBP PAGES, International Project Office, Bärenplatz 2, CH 3011 Bern, Switzerland
Tel: 41 31 312 3133; Fax: 41 31 312 3168; pages@ubeclu.unibe.ch

ISOPE-98: 8th International Offshore and Polar Engineering Conference
24–29 May 1998, Montreal, Canada
Contact: Jin S. Chung, ISOPE, P.O. Box 1107, Golden, Colorado 80402-1107, USA
Tel: 1 303 273 3673; Fax: 1 303 420 3760

POLARTECH 98
8–14 June 1998, Nuuk, Greenland
Contact: P.O. Box 1003, DK-3900 Nuuk, Greenland
Tel: 299 2 10 45; Fax: 299 2 45 01; hoyer@greennet.gl

5th International Symposium on Mining in the Arctic
14–17 June, Yellowknife, N.W.T., Canada
Contact: Symposium Secretariat, Canadian Institute of Mining, Metallurgy and Petroleum, Xerox Tower, 1210-3400 de Maisonneuve Boulevard West, Montreal, Quebec, Canada H3Z 3B8
Tel: 1 514 939 2710; Fax: 1 514 939 2714

7th International Conference on Permafrost
23–27 June 1998, Yellowknife, N.W.T., Canada
Contact: J.A. Heginbottom, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8, Canada
Tel: 1 613 992 7813; Fax: 1 613 992 2468; permafrost.conference@gsc.nrcan.gc.ca

Symposium on Glaciers and the Glaciated Landscape
17–20 August 1998, Kiruna, Sweden
Contact: C.S.L. Ommanney, IGS, Lensfield Road,Cambridge CB2 1ER, United Kingdom
Tel: 44 1223 355974; Fax: 44 1223 336543; 100751.1667@compuserve.com

16th World Soil Congress
20–26 August 1998, Montpellier, France
Contact: Agropolis-Avenue, Agropolis-34394, Montpellier, Cedex 5, France
Tel: 33 6704 7538; Fax: 33 6704 7549

6th International Symposium on Antarctic Glaciology (ISAG-6)
5–9 September 1998, Lanzhou, China
Contact: Secretary General of ISAG-6, Lanzhou Institute of Glaciology and Geocryology, CAS, Lanzhou 730000, China
Fax: 86 931 8885241; icecore@ns.lzb.ac.cn

17th Polar Library Colloquy: Electronic Information and Publications
20–25 September 1998, Reykjavik, Iceland
Contact: Eirikur Einarsson, Marine Research Institute, P.O. Box 1390, 121 Reykjavik, Iceland
Tel: 354 552 0240; Fax: 354 562 3790; eirikur@hafro.is
http://www.hafro.is/hafto/Joint/conf.html

IGU–IPA Periglacial Joint Meeting: Holocene Landform Evolution
20–28 September 1998, Krakow, Poland
Contact: Zofia Raczkowska, Institute of Geography, sw. Jana 22, 31-018, Krakow, Poland
Tel/Fax: 48 12 22 40 85

Ninth International Conference on Cold Regions Engineering
27–30 September 1998, Duluth, Minnesota, USA
Contact: American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, Virginia 20191-4000, USA
Tel: 1 800 548 2723 or 703 295 6300; Fax: 703 295 6333
http://www.asce.org

International Conference on Snow Hydrology: The Integration of Physical, Chemical and Biological Systems
6–9 October 1998, Brownsville, Vermont, USA
Contact: J. Hardy, USACRREL, 72 Lyme Road, Hanover, New Hampshire 03755-1290, USA
Fax: 1 603 646 4397; jhardy@crrel.usace.army.mil

1999

ISOPE-99: 9th International Offshore and Polar Engineering Conference, Call for Papers
30 May–4 June 1999
Contact: Contact: Jin S. Chung, ISOPE, P.O. Box 1107, Golden, Colorado 80402-1107, USA
Tel: 1 303 273 3673; Fax: 1 303 420 3760

International Union for Quaternary Research XV International Congress
3–11 August 1999, Durban, South Africa
Contact: Secretary General, INQUA, P.O. Box 61, Cape Town, 8000 South Africa
Fax: 27 21246716; mavery@sasuseum.ac.za

Nordic Field Symposium: Limits and Changes in Permafrost and Periglacial Environments
20–24 August 1999, Kevo Subarctic Research Station, Finland
Contact: Matti Seppala, Geography, P.O. Box 9, 00014 Helsinki University, Finland
Tel: 358 9 1918674; Fax: 358 9 1918670; matti.seppala@helsinki.fi

2000

31st International Geological Congress
6–17 August 2000, Rio de Janeiro, Brazil
Contact: 31st IGC, Secretariat Bureau, Av. Pasteur, 404-ANEXO 31 IGC, Urca, Rio de Janeiro, RJ, CEP 22.290-240 Brazil
Tel: 55 21 295 5847; Fax: 55 21 295 8094; 31igc@cristal.cprm.gov.br

2001

III International Conference on Cryogenic Soils
27–31 August 2001, Copenhagen, Denmark
Contact: Dr. Bjarne Holm Jakobsen, Institute of Geography, University of Copenhagen, Øster Voldgade 10, 1350 Copenhagen K Denmark
Tel: 45 3532 2500; Fax: 45 3532 2501; bhj@geogr.ku.dk

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7, Place du 20 Août
4000 Liège
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Fax: 32 41 66 5722
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Canada
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EBA Engineering Consultants Ltd.
14535 118th Avenue
Edmonton, Alberta T5L 2M7
Canada
Tel: 1 403 451 2121
Fax: 1 403 454 5688
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China
Professor Zhu Yuanlin
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Lanzhou, 730 000
China
Tel: 86 931 884 1490
Fax: 86 931 888 5241
Telex: 72008 IGGAS CN
zhuyl@ns.lzb.ac.cn

Denmark
Mr. Sven Bertelsen
Danish Society for Arctic Technology
NN&R A/S
Sortemosevej 2
DK-3450 Allerød
Denmark
Tel: 45 48 14 0066
Fax: 45 48 14 0033

Finland
Dr. Matti Seppälä
Physical Geography Laboratory
University of Helsinki
P.O. Box 9
FIN-00014 Helsinki
Finland
Tel: 358 9 191 8674
Fax: 358 9 191 8670
matti.seppala@helsinki.fi

France
Dr. Jaime Aguirre-Puente
Centre de Géomorphologie
CNRS (URA 1694)
24, rue des Tilleuls
F-14000 Caen
France
Tel: 33 31 45 5708
Fax: 33 31 45 5757

Germany
Dr. Lorenz King
Geographisches Institut
Justus Liebig-Universitat
35394 Giessen
Germany
Tel: 49 641 99 36205
Fax: 49 641 99 36219
lorenz.king@geo.uni-giessen.de

Italy
Dr. Francesco Dramis
Dipartimento di Scienze Geologiche
Terza Universita
Via Osteinse 169
00154 Rome
Italy
Tel: 39 657 37 2877
Fax: 39 657 54 88 8201
dramis@uniroma3.it

Japan
Dr. Masami Fukuda
Institute of Low Temperature Science
Hokkaido University
N19 W8 Sapporo 060
Japan
Fax: 81 11 706 7142
masami.fukuda@lt.hines.hokudai.ac.jp

Kazakstan
Dr. Aldar P. Gorbunov
Institute of Geography
Kazakstan Academy of Sciences
Pushkin St. 99
Almaty 480 100
Kazakstan
Tel: 7 3272 321363
Fax: 7 3272 618102
ingeo@kazmail.asdc.kz

Mongolia
Dr. D. Tumurbaatar
Institute of Geography and Geocryology
Mongolian Academy of Sciences
Ulanbator 210620
Mongolia
Tel: 976 1 322739
Fax: 976 1 326172

Netherlands
Dr. Jef Vandenberghe
Faculty of Earth Sciences
Vrije Universiteit
De Boelelaan 1085
NL-1081 HV Amsterdam
The Netherlands
Tel: 31 20 444 7368
Fax: 31 20 646 2457
vanj@geo.vu.nl

Norway
Dr. Kaare Flaate
Norwegian Directorate of Public Roads
P.O. Box 8142 DEP
N-0033 Oslo
Norway
Tel: 47 22 073 900
Fax: 47 22 073 444
kaare.flaate@vegdir.vegvesen.telemax.no

Poland
Dr. Kazimierz Pekala
Department of Geomorphology
Maria-Curie Sklodowska Univ
Akademicka 19
20-033 Lublin
Poland
Tel: 48 81 37 5915
Fax: 48 81 37 5102
pekala@golem.umcs.lublin.pl

Russia
Dr. Vladimir P. Melnikov
Consolidated Scientific Council on Earth Cryology
Box 1230 Earth Cryosphere Institute
Russian Academy of Sciences
625000 Tyumen
Russia
Tel: 7 345 225 1153
Fax: 7 345 222 3380
root@ikz.tyumen.su

Southern Africa
Dr. Ian Meiklejohn
Department of Geography
University of Pretoria
0002 Pretoria
South Africa
Tel: 27 12 420 4049
Fax: 27 12 420 3248
kim@scientia.up.ac.za

Spain
Dr. David E. Palacios
Facultad de Geografia Fiscia
Universidad Complutense
28040 Madrid
Spain
Tel: 34 1 394 5955
Fax: 34 1 394 5963
davidp@eucmax.sim.ucm.es

Sweden
Dr. H. Jonas Åkerman
Ministry of Agriculture
SCAFE-Land Husbandry Branch
P.O. Box 502 91
Lusaka, Zambia
Tel/Fax: 7 2601 292397
jonas.akerman@natgeo.lu.se
agrisys@zamnet.zm

Switzerland
Dr. Daniel Vonder Mühll
VAW/Glaciology
ETH Federal Institute of Technology
Gloriastrasse 37/39
CH-8092 Zurich
Switzerland
Tel: 41 1 632 41 13
Fax: 41 1 632 11 92
vdmuehll@vaw.baum.ethz.ch

United Kingdom
Dr. Charles Harris
Department of Geology
University of Wales
PO Box 914
Cardiff, CF1 3YE
United Kingdom
Tel: 44 1222 87 4830
Fax: 44 1222 87 4326
harrisc@cardiff.ac.uk

United States of America
Dr. Bernard Hallet
Quaternary Research Center
University of Washington
Box 351360
Seattle, Washington 98195-1360
USA
Tel: 1 206 685 2409
Fax: 1 206 543 3836
hallet@u.washington.edu

Standing Committees

Finance Committee
Chair
Mr. O.J. Ferrians, Jr.
US Geological Survey
4200 University Drive
Anchorage, Alaska 99508
USA
Tel: 1 907 786 7427
Fax: 1 907 786 7401

Advisory Committee on Working Groups
Chair
Dr. C.W. Lovell
School of Civil Engineering
Purdue University
West Lafayette, Indiana 47907
USA
Tel: 1 317 494 5034
Fax: 1 317 494 1364
lovellc@ecn.purdue.edu

Editorial Committee
Chair
Dr. Elisabeth Schmitt
Geographisches Institut
Justus Liebig Universitat
35394 Giessen
Germany
Fax: 49 641 702 8211

Working Groups

Data and Information
Chair: Dr. Roger Barry
World Data Center A: Glaciology
Campus Box 449
University of Colorado
Boulder, Colorado 80309-0449
USA
Tel: 1 303 492 5171
Fax: 1 303 492 2468
rbarry@kryos.colorado.edu

Secretary: Mr. J.A. Heginbottom
Geological Survey of Canada
601 Booth Street
Ottawa, Ontario K1A 0E8
Canada
Tel: 1 613 992 7813
Fax: 1 613 992 2468
heginbottom@gsc.nrcan.gc.ca

Terminology
Chair: Dr. Robert O. van Everdingen
2712 Chalice Road NW
Calgary, Alberta T2L 1C8
Canada
Tel: 1 403 289 6823
Fax: 1 403 282 4609
ervan@acs.ucalgary.ca

Secretary: Dr. Vyacheslav Konishchev
Geography Faculty
Moscow State University
119899 Moscow
Russia
Tel: 7 095 939 3673
av@korzoun.msk.ru

Global Change and Permafrost
Chair: Dr. Frederick E. Nelson
Department of Geography
University of Delaware
Newark, Delaware 19716-2541
USA
Tel: 1 302 831 2294
Fax: 1 302 831 6654
fnelson@cnsvax.albany.edu

Secretary: Mr. Alan E. Taylor
2312 Mills Road
Sidney, British Columbia V8L 2C4
Canada
Tel: 1 604 656 0690
altaylor@kcorp.com

Mountain Permafrost
Chair: Dr. Wilfried Haeberli
Department of Geography
University of Zurich
Winterthurerstrasse 190
CH-8057 Zurich
Switzerland
Tel: 41 1 635 51 20
Fax: 41 1 635 68 48
haeberli@geo.unizh.ch

Secretary: Dr. Francesco Dramis
Dipartimento di Scienze Geologiche
Terza Universita
Via Osteinse 169
00154 Rome
Italy
Tel: 39 657 37 2877
Fax: 39 657 54 88 8201
dramis@uniroma3.it

Periglacial Processes and Environments
Chair: Dr. Antoni G. Lewkowicz
Department of Geography
University of Ottawa
P.O. Box 450 Stn A
Ottawa, Ontario K1N 6N5
Canada
Tel: 1 613 562 5704
Fax: 1 613 562 5145
alewkowi@acadvm1.uottawa.ca

Secretary: Dr. Charles Harris
Department of Geology
University of Wales
P.O. Box 914
Cardiff CF1 3YE
United Kingdom
Tel: 44 1222 874830
Fax: 44 1222 874326
harrisc@cardiff.ac.uk

Cryosols
Chair: Dr. David A. Gilichinsky
Institute of Soil Science and Photosynthesis
Russian Academy of Sciences
124292 Pushchino
Moscow Region
Russia
Tel: 7 096 7 732604
Fax: 7 096 7 790532
gilichin@issp.serpukhov.su

Secretary: Dr. Chien Lu Ping
Palmer Research Center
University of Alaska
533 E Fireweed
Palmer, Alaska 99645
USA
Tel: 1 907 746 9462
Fax: 1 907 746 2677
pfclp@uaa.alaska.edu

Foundations
Chair: Mr. James W. Rooney
R&M Consultants
9101 Vanguard Drive
Anchorage, Alaska 99507
USA
Tel: 1 907 522 1707
Fax: 1 907 522 3403
jrooney@rmconsult.com

Secretary: Dr. Kaare Flaate
Norwegian Directorate of Public Roads
P.O. Box 8142 DEP
N 0033 Oslo
Norway
Tel: 47 22 073 900
Fax: 47 22 073 444
kaare.flaate@vegdir.vegvesen.telemax.no

Seasonal Freezing and Thawing of Permafrost Areas
Chair: Dr. Arvind Phukan
Phukan Consulting Engineers and Associates, Inc.
2702 Gambell St.
Anchorage, Alaska 99503
USA
Tel: 1 907 272 7111
Fax: 1 907 277 3177
arvind1960@wow.com

Secretary: Dr. Branko Ladanyi
Dépt de Génie Civil
École Polytechnique
CP 6079 Succ A
Montréal, P.Q. H3C 3A7
Canada
Tel: 1 514 340 4804
Fax: 1 514 340 5841
branko.ladanyi@mail.polymtl.ca

Individuals
(from countries for which no adhering bodies exist)

Rein Vaikmäe
Institute of Geology
Estonian Academy of Sciences
7 Estonia Ave.
EE-0105, Tallinn
Estonia
Fax: 7 0142 44 41 89
vaikmae@gaia.gi.ee

Petru E. Urdea
Universitatea Timisoara
Catedra De Geografie
Str. Pestalozzi Nr 16
1900 Timisoara
Romania
Fax: 40 056 190 377
40 506 190 333

YELLOWKNIFE CONFERENCE: PROGRAM AND MAP OF FIELD TRIPS

Web site: http://www.nrcan.gc.ca/gsa/permaf_e (or /permaf_f)

Date and time	*Monday 22 June*	*Tuesday 23 June*	*Wednesday 24 June*	*Thursday 25 June*	*Friday 26 June*	*Saturday 27 June*
08:30–10:10	Registration BHP Diamond Project Field Excursion	Registration Opening Ceremony (09:00–10:10)	3 oral sessions	3 oral sessions	Plenary#2	BHP Diamond Project and Pipeline/Cryosols Field Excursions
10:10–10:30		break	break	break	break	
10:30–12:10	Pre-conference field excursions arrive in Yellowknife	Plenary#1	3 oral sessions	Poster session #2	3 oral sessions	
12:10–13:30		lunch	lunch	lunch	lunch	
13:30–15:10		Poster session#1	Local Yellowknife field excursion	3 oral sessions	2 oral sessions; Council mtg #2	*Sunday 28 June*
15:10–15:30		break		break	break	Post-conference field excursions leave Yellowknife
15:30–17:10		3 oral sessions		3 oral sessions	Closing ceremony	
17:30–19:00		Council mtg #1	Working group mtgs	Working group mtgs	Council mtg #2 (cont'd)	
19:30–22:00	Ice-breaker Reception	Public lecture	BBQ	Banquet