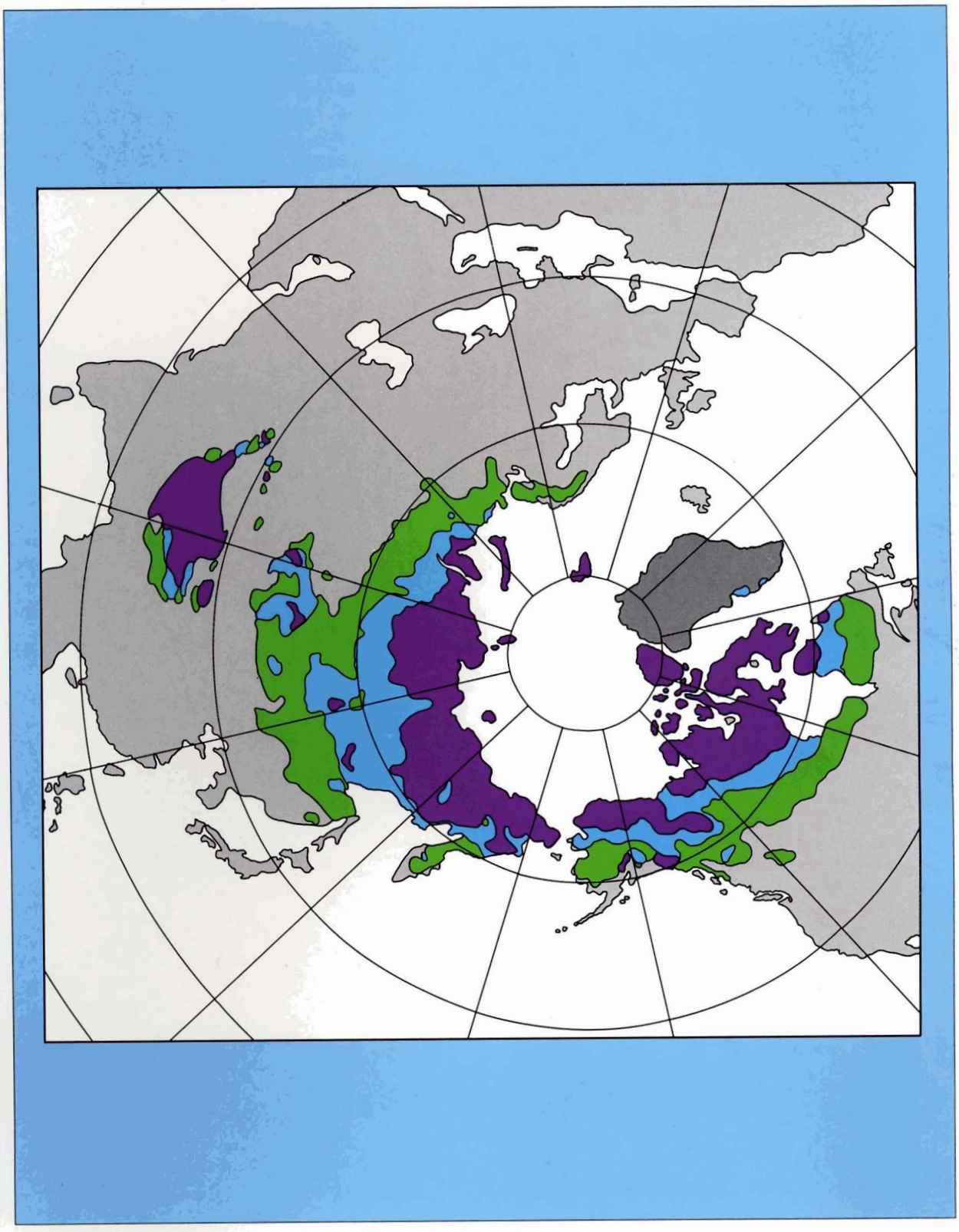
FROZEN GROUND

The News Bulletin of the International Permafrost Association

Number 17, June 1995



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 investigations 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 20 adhering bodies having interests in some aspects 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 responsibility is the convening of the international permafrost conferences, and special projects such as preparation of 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 is planned for Canada, in 1998. Field excursions are an integral part of each conference, and are organized by the host country.

Cover: Contemporary distribution of permafrost in the Northern Hemisphere, derived from the "surface frost index" and long-term climate data from several thousand weather stations. The frost index, computed from mean monthly temperature and precipitation normals, is based on the ratio of freezing to thawing degree-days and is normalized to assume values from zero to unity. Computed values were reclassified into three categories corresponding to the sporadic (green), widespread discontinuous (blue), and continuous (purple) permafrost zones.

A derivation of the frost index and its correspondence with zonal boundaries is given in *A Computational Method for Prediction and Regionalization of Permafrost*, by F.E. Nelson and S.I. Outcalt, *Arctic and Alpine Research*, 19(3): 279–288, 1987. Further discussion in the context of climatic change is contained in *Permafrost Zonation in Russia Under Anthropogenic Climate Change*, by F.E. Nelson and O.A. Anisimov, *Permafrost and Periglacial Processes*, 4(3): 137–148. Climate data were obtained from *The IIASA Database for Mean Monthly Values of Temperature, Precipitation and Cloudiness on a Global Terrestrial Grid*, by R. Leemans and W.P. Cramer, International Institute for Applied Systems Analysis, Luxenburg, Austria, Research Report RR-91-18.

This modeling approach provides a basis for assessing changes in permafrost distribution under various scenarios of anthropogenic climatic change. The map was contributed by Oleg A. Anisimov, State Hydrological Institute, St. Petersburg, Russia and Frederick E. Nelson and Nikolai I. Shiklomanov, State University of New York at Albany, USA.

FROZEN GROUND

THE NEWS BULLETIN OF THE
INTERNATIONAL PERMAFROST ASSOCIATION
NUMBER 17 • JUNE 1995

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 20 countries or groups of countries. The success of the bulletin depends upon the willingness of IPA participants to supply information for publication. Copy date for issue No. 18 is 15 October 1995. 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 8"×10" glossy prints). To submit news items or photos please contact the appropriate individual listed on page 23, or the Secretary General.

Issue No.17 of *Frozen Ground* was 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 Nikolai Grave, National Permafrost Committee, USSR Academy of Sciences, Fersman Street 11, 117312 Moscow; in the United States from Jerry Brown, P.O. Box 9200, Arlington, Virginia 22219-0200; and elsewhere from Council members.

Executive Committee Report

This issue of *Frozen Ground* will be available to participants in the XIV International Congress of the International Union for Quaternary Research (INQUA) being held in Berlin in August 1995. In the following, we would like to introduce the International Permafrost Association to some of these new readers, and provide an update of activities to our regular readership of over 2200. A brief summary of the IPA organization, an affiliated member of the IUGS, is given on the inside of the front cover, and the addresses of members and working groups are provided on pages 23 and 24.

The IPA has several ongoing projects that are close to completion. A multilanguage glossary (eight languages to date) of permafrost and ground ice terms has been prepared in draft form; it is undergoing review and should be available for distribution in early 1996. A Chinese–English–Russian glossary was published in 1994. A new map of the permafrost conditions of the Northern Hemisphere (1:10,000,000) will be available by fall 1995 in paper copy with a digital version to follow. A companion permafrost map for National Atlas of Canada was prepared and published this year.

The influence of climate on permafrost—past, present and future—is of concern to virtually all IPA and working group activities. An annotated bibliography on permafrost and climatic change was published in 1994. An earlier issue of *Frozen Ground* (No. 15) presented a draft assessment report to the Intergovernmental Panel on Climate Change (IPCC) on the impacts of climate or global change on permafrost terrains. Revisions to the report are under review by IPCC and should be published in the Cryosphere and Mountain chapters of the IPCC Assessment. The cover plate illustrates a modeling approach used to predict permafrost distribution as a function of climate. The working groups on both global change and mountain permafrost are conducting surveys on monitoring and detection programs. Our Russian colleagues devoted much of the annual meeting of the Scientific Council on Earth Cryology in Pushchino in April 1995 to the problems of permafrost and global change (a detailed report follows). In cooperation with the UNESCO CLIMEX project, a hemispheric paleoenvironment map of permafrost is being compiled.

The most wide-reaching and active project is the Global Geocryological Database (GGD) project under the leadership of the Data and Information Working Group. A November 1994 workshop in Oslo developed the rationale for the database and recommended priorities for data recovery, with special emphasis on data relevant to global change and those at risk of being lost. A follow-up workshop is taking place just prior to the INQUA Congress in Potsdam; it will focus on specific regional data opportunities. In support of these recommendations several major sets of Russian data have been compiled and accessioned into the GGD: soil temperature from 25 meteorological stations, borehole data for units shown on the IPA permafrost map, and a bibliography of over 350 published Russian permafrost maps. Other countries and individuals are beginning to identify and recover priority data, and everyone's participation is requested.

Several working groups have planned workshops and field excursions prior to 1998 and the Seventh International Conference on Permafrost to be held in Canada. A workshop to explore current understanding of frozen ground processes and the ability to predict change is planned for December 1995. A field trip to the Canadian High Arctic to examine geomorphic processes and soils as a function of climate variability and change is under consideration. A major international conference on cryopedology is planned for summer 1997 (see inside back cover and working group reports for details).

Although the IPA does not have its own journal, a special arrangement for subscriptions has been made with the international journal *Permafrost and Periglacial Processes.* In addition, individual countries have specialized journals for frozen ground, the newest in Russia being *Russian Geocryological Research* and in China the well-established *Journal of Glaciology and Geocryology.* Bibliographies on frozen ground and special reports are prepared and distributed through the World Data Center-A for Glaciology, Boulder, Colorado.

Finally, IPA will be actively involved in the INQUA Congress. A special session on late Cenozoic ground ice has been organized. A poster presentation and display will illustrate IPA activities. The 20-member IPA Council will meet and consider membership for additional countries having major permafrost programs as well as for individuals from countries with no formal adhering body. Future projects, implementation and liaison with other international organizations will be discussed. For more information about IPA, please contact members, working groups or the Executive Committee.

Special Report

H.M. French, IPA Vice President

25th Annual Meeting
Russian Scientific Council on Earth Cryology
Pushchino, 24-28 April 1995

Since 1971 the Russian scientific permafrost community has met annually in Moscow under the auspices of the Scientific Council of Earth Cryology of the Soviet, non-Russian, Academy of Sciences. These meetings were initiated by the late Academician P.I. Melnikov. It was fitting, therefore, that the 25th Annual Meeting began with tributes to the life and achievements of Academician Melnikov. The meeting began with 2 minutes of silence in memory of Dr. Melnikov followed by an in-depth summary of his scientific career delivered by R.M. Kamensky, Director of the newly named Melnikov Permafrost Institute in Yakutsk. Details of his early life and childhood and his work in the Soviet Union in the 1920s and 1930s can now be added to the more well-known details of his activities since 1950.

This year's meetings were organized by David Gilichinsky of the Institute of Soil Science and Photosynthesis of the Russian Academy of Sciences, located in Pushchino. Pushchino is an academic community located 120 km south of Moscow. It was built approximately 30 years ago. The theme of the meeting was Evolutionary Geocryological Processes in the Arctic Regions and Problems of Global Changes of the Environment and Climate in Permafrost Areas. Over 100 Russians participated. For the first time, non-Russian participants were invited. They included H.M. French, C. Tarnocai, P. Kurfurst and S. Dallimore from Canada, J. Bockheim of the USA, and M. Fukuda of Japan. It is planned to hold next year's meeting in Pushchino also.

The meetings were highly successful and rewarding for several reasons. The presence of excellent simultaneous translation into English (or Russian) enabled foreign participants to benefit from more than 100 scientific communications presented by predominantly Russian permafrost scientists and engineers. If a non-Russian wishes to establish contact with Russian permafrost scientists in their particular field of interest, this is certainly the meeting to attend.

The program and the abstracts volume were prepared in both Russian and English.* Since these can be obtained by writing to David Gilichinsky, Institute of Soil Science and Photosynthesis, Russian Academy of Sciences, Pushchino, Moscow Region, Russia, the following does not attempt to be comprehensive but merely highlights the flavor of the meetings.

Day one (April 25th) began with a plenary meeting on the theme Permafrost and Global Change. Papers were presented by A.V. Pavlov (VSEGINGEO), E.D. Ershov et al. (Moscow State University), V.T. Balobayev (Melnikov Permafrost Institute, Yakutsk), S.E. Grechishchev (VSEGINGEO) and L.N. Khrustalev (Moscow State University) before lunch, followed by V.N. Kudeyarov et al. (Institute of Soil Science and Photosynthesis, Pushchino), S.M. Fotiev et al. (Research Institute for Construction), F. Are (St. Petersburg), E.M. Rivkina et al. (Institute of Soil Science and Photosynthesis, Pushchino), S. Dallimore (Geological Survey of Canada), and V.S. Yakushev (VNIIGAZ). I list the affiliations of the contributors to this first session deliberately since it illustrates the range of institutes and organizations within Russia involved in permafrost investigations. The presentation by Dallimore described intrapermafrost gas hydrates from the Mackenzie Delta and provided an excellent information exchange with Russian colleagues with whom GSC personnel are currently working closely. The Russian topics included several dealing with long term predictions of geocryological change following warming while others considered the engineering implications, coastal erosion, methane distribution and gas hydrates. On the same day, in the evening, a special IPA-sponsored session on Permafrost in the Southern Hemisphere saw two interesting presentations by J. Bockheim on Antarctic permafrost distribution and A.P. Gorbunov on permafrost in the Central Andes.

Day two (April 26th) began with another plenary session chaired by IPA Vice-President N.N. Romanovskii. Topics covered included permafrost history (E.D. Ershov et al., N.A. Shpolyankaya, and G.E. Rosenbaum), permafrost mapping (E.S. Melnikov et al.), and climate–permafrost relations (C. Tarnocai, V.R. Alekseev). Tarnocai's paper described the effect of the 1994 warm summer on permafrost soils in the Mackenzie Valley of Canada. After lunch, the plenary session continued, with a strong theme being coastal erosion and thermokarst (papers by M.N. Grigorev and S. Dallimore). The evening saw a roundtable discussion in which V.N. Konishchev and N.N. Romanovskii outlined their progress in

* Russian Academy of Sciences, Scientific Council on Earth Cryology, Annual Meeting, 24-28 April 1995. Program and Abstracts. Evolutionary Geocryological Processes in the Arctic Regions and Problems of Global Changes of the Environment and Climate in Permafrost Areas. Pushchino, Russia. ISBN 5-20-14268-0 (19 pp + 158 pp).

developing a Russian version of the IPA- sponsored multilingual glossary of permafrost and ground ice terms, and D.A. Gilichinsky reported upon the results of the IPA Cryosol Working Group meeting, held earlier that week in Pushchino. There was lively discussion amongst Russian colleagues, both at the roundtable discussion and also earlier, during the afternoon.

Day three (April 27th) saw an increasing specialization of the conference, with "special sessions" rather than "plenary sessions." The topics of these special sessions, each consisting of four to six presentations at least, were: Monitoring of the Cryolithozone (4 papers), Gas Hydrates and Radiative Gases in the Cryolithozone (8 papers), Cryolithozone Evolution (9 papers), Geophysics (14 papers), and Engineering Geocryology (15 papers).

Day four (April 28th) presentations included special sessions on physico-chemistry of permafrost and ground ice, and general geocryology. In addition, the IPA Working Group on Foundations held a meeting on the morning of April 28th.

My overwhelming impression is a reinforcement of earlier impressions concerning the depth of permafrost knowledge and expertise existing within Russia. This is slowly becoming more available to non-Russian-speaking permafrost scientists. A second impression is the desire by Russian scientists to become more involved in the international permafrost community on an individual level and through the IPA. At this meeting, the Russian organizers arranged several special IPA paper sessions, and two working groups, those of Cryosols and Foundations, held meetings. The achievements of the Cryosols WG are particularly commendable since there is increasing unanimity on permafrost soil classifications amongst Russian, US, Canadian, Chinese and Danish workers. In addition, e-mail and fax are making communications increasingly easier. My advice to others who wish to obtain a rapid update on the status of Russian permafrost science and engineering is that they should attend next year's Pushchino meeting. It will probably be in late April again; details will appear in the December 1995 issue of *Frozen Ground*. If this meeting is as successful as 1995's, then attendees will be grateful. The organizers of this year's meeting, especially Dr. Gilichinsky, are to be congratulated.

Participants in the Scientific Council on Earth Cryology, Pushchino, April 1995.

Reports of Working Groups

We remind interested individuals who wish to become corresponding members of working groups to contact the appropriate Chair or Secretary (see p. 24 for addresses).

Data and Information

R.G. Barry, Chair (USA)
J.A. Heginbottom, Secretary (Canada)

The Data and Information Working Group has continued its efforts to establish the Global Geocryological Database (GGD) as a major contribution of the International Permafrost Association. The previous issue of *Frozen Ground* (No. 16, December 1994) included a lengthy report on activities up to November 1994. A brochure on the GGD and a database inventory sheet were distributed along with that issue. A full report on the 1994 GGD workshop in Oslo, Norway (November), will be published in the Glaciological Data Report series (GD 28) by the World Data Center-A for Glaciology (Snow and Ice), University of Colorado, Boulder, Colorado, USA.

Individual investigators have submitted database inventory sheets. To date, data forms have been received from Canada, Italy, New Zealand, Romania, Russia, Spain, Switzerland and the USA. The main center of activity has been in Russia, where efforts to establish a National Geocryological Database (NGD) at the Federal Center for Geoecological Systems, Moscow, are well advanced. Results of the data inventory will be reported on and reviewed at the next meeting of the working group, to be held at the Alfred Wegener Institute in Potsdam, and at the IPA Council meeting during the INQUA Congress in Berlin in August 1995. Information on IPA activities will be exhibited at the Congress on a poster and display prepared by Elisabeth Schmitt, Chair, IPA Editorial Committee.

As a follow-up to the Oslo workshop, the Russian work to date includes: 1) A list of organizations, institutions and key individuals who have been involved in permafrost data collection over the past two to three decades; 2) A bibliography of 370 published maps of permafrost in the Former Soviet Union; 3) Borehole logs used in compiling the Russian sector of the IPA Circumarctic Permafrost map; and 4) Soil temperature data from 25 preselected stations from among the several thousand meteorological stations in the permafrost and deep seasonal frost regions of the FSU. These data, collected to the depth of 3 meters, in many instances extend back to 1915 or earlier. Although these data are available in printed data reports, access is limited and they are not in digital form. The strategy of the IPA-initiated pilot effort is to extract and transcribe selected soil temperature attributes and compile them into a readily accessible computerized database. In addition to the meteorological stations, data from agricultural stations contain both soil temperature and moisture data, from natural and cleared sites. Once the data for these initial 25 stations are transcribed and entered into the computer database, a standard printout and graphic display will be available for review. The review of the data will be undertaken at the Potsdam data workshop and a decision made on the future direction for this valuable data capture program. Funding for added acquisition costs and expanded computer capabilities is being explored. These initial data activities demonstrate the ability of the Russian NGD to produce data sets of interest globally and for specific projects.

The IPA Circum-Arctic Map of Permafrost and Ground Ice Conditions (scale 1:10,000,000) is in final review and is scheduled for publication in fall 1995. A digitized version of the map will be prepared.

Details of the Potsdam data workshop and the status of the map will be included in the next issue of *Frozen Ground*. Readers are reminded to complete the data questionnaire and return it to Boulder or to their national representative.

Members: H.J. Åkerman (Sweden), M.J. Clark (United Kingdom), Chen Xianzhang (China) and E.S. Melnikov (Russia). Ex-Officio: F.E. Nelson, R.O. van Everdingen and N.N. Romanovskii.

Corresponding members: J. Branson (UK), C. Hanson (USA), M. Leibman (Russia), O. Gregersen (Norway) and M. Thorley (SCAR-COMNAP).

Terminology

R.O. van Everdingen, Chair (Canada)
Qiu Guoqing, Secretary (China)

The Terminology Working Group was organized after the 5th International Permafrost Conference (Trondheim, 1988), to develop a set of internationally accepted permafrost terms for use in both engineering and science, with equivalents in various languages, and to disseminate and encourage the use of such terminology.

A preliminary edition of the IPA Multilanguage Glossary of Permafrost and Related Ground-Ice Terms was produced in December 1994. The glossary currently contains terms in eight languages (555 English, 419 French, 380 German, 394 Italian, 513 Norwegian, 563 Russian plus transliteration, 485 Spanish, and 512 Swedish). A few terms have been added

during the past year. The Russian terminology requires additional revision, and a small meeting for this purpose is planned for Calgary, Canada, in November 1995. Preparations for the addition of Icelandic terms to the glossary were started by H. G. Pitursson, Akureyri, Iceland, early in 1995. K. Pękala, Lublin, Poland, has recently provided a listing of Polish equivalents for most of the terms. A poster illustrating sample pages from the glossary was presented at the 15th Polar Libraries Colloquy held in Cambridge, UK, in July 1994.

Copies of the 318-page glossary have been distributed for review and comment to IPA council members, chairs of standing committees and working groups, and other experts. Comments have been received from R.G. Barry, A.E. Corte, D. Trombotto, K. Hall, V.N. Konishchev, N.N. Romanovskii, A. Pissart, M. Seppälä, Y. Shur, Qiu Guoqing and Zhou Youwu (mostly dealing with Russian terms). Remaining copies of the glossary are still available from the working group chair for $20.00 U.S., including postage. Copies of the glossary are also available on two MF2HD diskettes, in WordPerfect v. 5.1 (for IBM DOS), formatted for HPIII laser printer, for $15.00 U.S., including postage.

Work is continuing on definitions and comments for the Russian/English Glossary of Geocryology Terms which is being developed by Nikolai Romanovskii and co-workers. Modest financial support for this work has been provided by IPA. A Geocryological Glossary containing about 600 terms in Chinese, Russian and English, edited by Qiu Guoqing, Liu Jinren and Liu Hongxu, was published by the Lanzhou Institute of Glaciology and Geocryology in mid-1994. The 275-page book is available from LIGG, 730 000 Lanzhou, China, for $15.00 U.S., including postage.

Members: H.J. Åkerman (Sweden), A.E. Corte (Argentina), F. Dramis (Italy), O.J. Ferrians, Jr., J. Karte (Germany), J.-P. Lautridou (France), O. Gregersen (Norway) and V.N. Konishchev (Russia). Ex Officio: N.N. Romanovskii.

Corresponding members: R.G. Barry, Y. Shur, and T.S. Vinson (USA), E. Buk and D. Trombotto (Argentina), K. Hall, S.A. Harris, B. Ladanyi and C. Tarnocai (Canada), L. King (Germany), K. Pękala (Poland), H.G. Pitursson (Iceland), M. Seppälä (Finland), and Zhou Youwu (China).

Global Change and Permafrost

F.E. Nelson, Chair (USA)
A.E. Taylor, Secretary (Canada)

Following the December 1994 working group meeting in San Francisco, several tasks were undertaken: 1) preparation and distribution of a questionnaire on climate change and permafrost impact monitoring; 2) development and distribution of an active layer measurement protocol; and 3) review and revision of the IPCC assessment report.

The purpose of the questionnaire is to document the state-of-art in monitoring permafrost and frozen ground in the field, to share information on recent advances, and to identify priorities for future research. The form was distributed by conventional mail and electronically to a large number of North Americans and to the IPA Council and working group representatives. The following information was requested:

- Project title and investigator names
- Project goals
- Relation to other programs
- Specific site locations
- Parameters measured and techniques used
- Availability of climatic data
- Relation to models including GCMs
- Publications

Results to date have been encouraging, with over 20 returns from North America and additional information provided internationally to supplement the Mountain Permafrost questionnaire (see following report). The results of these questionnaires will be summarized, coordinated with the growing numbers of GGD data sets, and reported at the December 1995 permafrost meetings described elsewhere. The form can be obtained by contacting the working group (see p. 24 for addresses).

Some members of this working group met with some members of the Periglacial Processes and Environments WG in Ottawa during the 6th International Tundra Experiment (ITEX) Workshop (7-11 April 1995). Our purpose was to agree upon a standard method of measuring active layer thickness at the experimental and control sites associated with ITEX. A protocol was prepared and it was accepted by the ITEX participants as part of the ITEX Manual. Ideally the methods will be used by other projects elsewhere. Briefly stated, the protocol allows for randomized measurements within a grid, point measurements, and soil temperature measurements. Copies of the protocol and associated data forms are available from the Danish Polar Center, Copenhagen (fax: 45 32 88 0101; e-mail: nsn@pops.dpc.min.dk). As a result of these collective discussions, we propose that the IPA formulate an active layer monitoring program that can be employed by individuals and national programs in permafrost areas of both hemispheres. This proposed program is tentatively termed the Circumpolar Active Layer Monitoring (CALM) Program. A. Popov (Russia) has made a similar recommendation at the Pushchino meeting (see p. 3) and the working group

plans to develop a coordinated approach to the monitoring needs.

Lastly, members of the working group reviewed and contributed additional information to the permafrost sections of the Cryosphere chapter of the draft assessment report prepared by the Intergovernmental Panel on Climate Change Working Group II (see *Frozen Ground* No. 15, p. 16-26, for the original IPA submission). The IPCC report is undergoing official governmental review and is scheduled for publication in 1996. Recommendations in the Cryosphere chapter again include the need for long-term field monitoring and data archiving, points consistent with the IPA working groups' recommendations.

Members of the working group plan to meet in Hanover during the December 1995 IPA meetings.

Members: O.A. Anisimov (Russia), J. Boike (Germany), M.K. Gavrilova (Russia), M. Fukuda (Japan), T.E. Osterkamp (USA). Ex-Officio: Cheng Guodong (China), R.G. Barry (USA) and W. Haeberli (Switzerland).

Mountain Permafrost

W. Haeberli, Chair (Switzerland)
F. Dramis, Secretary (Italy)

The questionnaire on mapping, modeling and monitoring of mountain permafrost was completed for Argentina, Austria, China, France, Germany, Italy, Japan, Kazakhstan, Norway, Russia, Switzerland and the USA. China, Germany, Italy, Norway and Switzerland are using models for numerically simulating permafrost distribution patterns in mountain areas. Boreholes in mountain permafrost are being monitored in the Andes of Mendoza, in the European Alps (Valtellina and Engadin), in the Jotunheimen area of Norway, in several mountain areas of Russia, in the Chinese Tian Shan, and in the Daisetsu Mountains of Japan. All participants showed interest in continuing with joint efforts related to an international monitoring programme and an international comparison of mapping/modeling techniques. Representatives from Germany, Italy, Norway, Spain, Sweden, Switzerland and the UK are presently undertaking strong efforts to organize the necessary funds for establishing a network for monitoring mountain permafrost in Europe (see UK report).

In order to compile an inventory of the existing mountain permafrost data sets with the corresponding background information (metadata), working group members have been asked to prepare a short paper explaining the available information and to present this material at the December 1995 IPA meeting (see following report). This meeting is planned to be the main meeting of the working group during the present five-year period between the Beijing (1993) and Canadian (1998) conferences. In close cooperation with the Data and Information Working Group of IPA, the form for a data interchange format was evaluated. The general goal is to feed the first mountain permafrost data sets into the Global Geocryological Database (GGD) before the conference in 1998.

With respect to mapping and modeling, efforts for better international exchange of information and software are coordinated by combining mapping and modeling techniques. Such a combination allows for comparison of modeling results with field evidences in a number of test regions in different climatic and topographic settings. The December 1995 meeting will have as its purpose the establishment of the necessary contacts for testing and comparing numerical simulations of permafrost distribution patterns in mountain areas in connection with digital terrain models and geographical information systems. Contributions on recent research on permafrost creep and rock glaciers are also expected to be presented at the San Francisco AGU Fall 1995 meeting.

Special recommendations for monitoring were provided by the chair to the Terrestrial Observation Panel (TOP) related to the Global Climate Observing System (GCOS) of the WMO, ICSU and UNEP. These include methods for both active layer thickness and permafrost thermal measurements.

Members: S.A. Harris (Canada), N. Caine (USA), A.P. Gorbunov (Kazakhstan), M.M. Koreisha (Russia), D. Trombotto (Argentina), and J.L. Sollid (Norway). Ex-Officio: Cheng Guodong (China).

Corresponding Members: A. Corte (Argentina), G.K. Lieb (Austria), M. Evin (France), D. Barsch, L. King (Germany), N.N. Romanovskii (Russia) and R. Giardino (USA).

Periglacial Processes and Environments

A.G. Lewkowicz, Chair (Canada)
C. Harris, Secretary (United Kingdom)

The WG is currently active in three areas. In December 1995, a meeting co-sponsored by this WG, the Mountain Permafrost WG, and the Global Change and Permafrost WG will be held at CRREL in Hanover, NH. The objectives are to review the current understanding of frozen ground and the state-of-the-art in monitoring physical, chemical, and biological changes in frozen ground in the field and laboratory, to share information on recent advances in measurement and analysis methods, to compare modeling results with field and laboratory data, and to identify priorities

for future research. The workshop was originally discussed during the VI International Conference on Permafrost while members of the several working groups were in Lhasa.

Workshop themes are:

- Unfrozen water and frost heave
- Soil displacement processes: slopes and patterned ground
- Hydrologic processes, including snow melt
- Soil biogeochemistry and gas exchange
- Monitoring the evolution of mountain permafrost

The workshop will consist of a combination of keynote speakers to present state-of-the-art talks on selected topics followed by regular presentations in the same domains. Details of the workshop are available from Bernard Hallet (see inside back cover and Forthcoming Meetings).

The second activity is the High Arctic Field Meeting, planned for 8-17 July 1996 and co-sponsored by the International Geographical Union Commission on Frost Action Environments. The theme of the meeting is the influence of climate variability and change on geomorphic processes in high arctic environments. Weather permitting, participants will have the opportunity to visit sites on Ellesmere, Axel Heiberg and Cornwallis islands in the Canadian High Arctic. A one-day symposium will take place at Eureka (80N). The trip will start and end in Ottawa. Cost will be in the order of $5000 Can. per person and numbers will be limited to 9 or 18 participants. The itinerary will allow participants to observe geomorphic features developed in the lowlands of the Fosheim Peninsula, including active-layer detachment slides, ice-wedge polygons, retrogressive thaw slumps, various forms of nonsorted patterned ground, and anthropogenic terrain disturbance. In the Sawtooth Mountains of Ellesmere Island, large-scale debris flows, stone-banked lobes and cold-based glaciers will be examined. A visit will also be made to the Expedition Fiord area of Axel Heiberg Island to view ice-cored moraines. On Cornwallis Island, patterned ground features developed on carbonate bedrock will be the focus, together with permafrost slope hydrology.

For more information on the field meeting please contact Antoni Lewkowicz, Department of Geography, University of Ottawa, Canada (Phone: 613 562 5704; Fax: 613 562 5145; E-mail: alewkowi@acadvm1.uottawa.ca). A deposit will be required by 1 October 1995.

A final activity involves the preparation of a handbook or manual on methods to measure periglacial processes. This activity is still in the early planning stages; however, the need for such standardized measurements is increasing as more intersite comparisons of rates of change are made. A proposal will be presented to the IPA Council on how to best accomplish this task in conjunction with other working groups, individuals and organizations with common interests. We would hope to have a working draft for the 1998 permafrost conference.

Members: H.J. Åkerman (Sweden), Cui Zhijiu (China), B. Hallet (USA), A. Pissart (Belgium), V. Solomatin (Russia), J. Vandenberghe (The Netherlands). Ex-Officio: J.-P. Lautridou, liaison, Commission on Frost Action, IGU (France).

Cryosols

D.A. Gilichinsky, Chair (Russia)
C.L. Ping, Secretary (USA)

A joint session of the Soil Cryology section of the Scientific Council on Earth Cryology, Russian Academy of Sciences, and the IPA Cryosols Working Group was held 24 April 1995 in Pushchino (see p. 3). The working group was represented by D. Gilichinsky, C. Tarnocai (Canada), and J. Bockheim (USA). The sessión, which was organized by D. Gilichinsky, featured eight papers that dealt with the cryogenic soil-ground complex (O.V. Makeev), active layer dynamics (Siegert et al.), ecology and pedogenesis of cryosols (Fedorov-Davydov et al., Fominykh, Shklyaruk, Gubin and Gulyaeva), and mapping and classification of cryosols (Maksimovich, Sokolov et al.). The session included a demonstration of the IPA/GGD-supported database and computer program containing long-term soil temperatures from stations in the permafrost and seasonally frozen zones of Russia. The session concluded with a half-day field trip led by S. Gubin in which participants viewed a Gray Forest Soil on deep loess of Riss-Illinoian age in the Pushchino area.

A meeting was held to discuss the definition of the Cryosolic Order to be included in the World Reference Base for Soil Resources, the soil classification developed by the International Society of Soil Science. Those attending this meeting agreed that cryosols are mineral soils that have permafrost and cryoturbation within 2 metres of the soil surface. This definition is presently under review.

The Second International Conference on Cryopedology was rescheduled for 5-8 August 1997 in Syktyvkar, Komi Republic, with a two-day post-conference trip to Vorkuta to examine relict soils, treeline dynamics and agriculture in the Arctic tundra. The organizing committee consists of: G.V. Dobrovolsky, Chairman (Russia); S.V. Gubin, Secretary-Organizer (Russia); G.A. Simonov, Secretary (Russia); V.O. Targulian, Deputy Chairman (Russia); C. Tarnocai, Deputy Chairman (Canada); D.A.S. Smith (Canada); B. Jakobsen (Denmark); G. Broll (Germany); and J. Brown, J. Kimble and C.L. Ping (USA) (see first announcement on inside back cover).

The IPA Cryosols Working Group will be assisting the Terminology Working Group in completing the interna-

Participants in the cryosol meeting in Pushchino, April 1995.

tional glossary of terms for permafrost and ground ice by providing additional terms for cryosols.

The Cryosols Working Group is developing a circumpolar soil map of the Arctic region. Although the scale, projection, and areas to be included have yet to be determined, source maps have been obtained for the Russian, Alaskan and Canadian sectors for digitizing. The map will contain a legend cross-referencing several soil classification systems, including the FAO, Russian, United States and Canadian systems and soil taxonomy. The WG activities are coordinated with the International Committee on Permafrost-Affected Soils (ICOMPAS) and with the International Society of Soil Science.

Members: J. Bockheim (USA), G. Broll (Germany), Wang Haoqing (China), B. Jakobsen (Denmark), G. Mazhitova (Russia), C. Tarnocai (Canada). Ex-Officio: J. Brown (USA).

Foundations

J.W. Rooney, Chair (USA)
K. Flaate, Secretary (Norway)

Pavel Kurfurst met with several Russian members and members of the working group during the Scientific Council on Earth Cryology meetings in Pushchino. The state-of-the-art practices on foundations and the monograph on permafrost and oil–gas development have not progressed since the last report and meetings in Edmonton in 1994. Funding and time constraints are the principal problems. The working group plans to submit a new approach to the IPA Council in Berlin.

Members: R.M. Kamensky (Russia), L. Khrustalev (Russia), P.J. Kurfurst (Canada), R.G. Tart, Jr. (USA), Zhu Yuanlin (China). Ex-Officio: A. Phukan (USA).

Corresponding members: D.C. Sego, D. Hayley, B. Ladanyi, K. Jones (Canada), Mait Mets (Estonia), K. Senneset, O. Gregersen (Norway), S.E. Grechishchev, E.S. Melnikov (Russia), and C.W. Lovell and B. Shen (USA).

Seasonal Freezing and Thawing of Permafrost Areas

A. Phukan, Chair (USA)
B. Ladanyi, Secretary (Canada)

Additional information is presented from the meeting of the 7th International Symposium on Ground Freezing (ISGF) held in Nancy, France, 24-28 October 1994. Branko Ladanyi is the IPA liaison and member of the ISGF International Organizing Committee, chaired by Prof. H.L. Jessberger. Approximately 100 participants attended the Nancy conference with 66 papers published in the proceedings by Balkema, Rotterdam. There were 10 paper sessions and a poster session covering heat and mass transfer, mechanical properties, environmental soil freezing, engineering design and case histories.

In addition, the following meetings were held during the Symposium: International Organizing Committee, Working Group on Testing Methods for Frozen Soils (chaired by Ladanyi), Working Group on Mechanical and Thermal Design of Frozen Soil Structures (chaired by J.T. Thimus),

and the ISSMFE Technical Committee 8 (chaired by E. Slunga).

The working group maintains liaison with the Technical Committee on Frost of the International Society of Soil Mechanics and Foundation Engineers (ISSMFE). The following is an update of the TC 8 activities as reported by Eero Slunga.

The President of the ISSMFE, Professor Jamiolkowski, established a Technical Committee on Frost (TC 8) to discuss questions concerning seasonal frost. TC 8 has today 21 members from Belgium, Canada, Denmark, Finland, France, Japan, Norway, Poland, Russia, Sweden, Switzerland, UK and USA. The ongoing period (1994–97) is already the third one in the history of the committee.

During the first working period (1985–89), TC 8 prepared recommendations for Definitions, Terminology and Symbols Pertaining to Seasonal Frost, and for Reference Frost-Susceptibility Criteria (International Symposium, Saariskelkä, Finland, 13–15 March 1989: *Frost in Geotechnical Engineering*, vol. 1). The frost-susceptibility criteria concerned the prediction of frost heaving.

The second period (1990–93) ended at the Second International Symposium on Frost in Geotechnical Engineering, which was held in Anchorage, 28 June–1 July 1993 as a joint symposium with the IPA Working Group on Seasonal Freezing and Thawing. During this period the committee produced recommendations for determining the elastic stiffness modulus of a thawing subgrade (*Proceedings of the 2nd International Symposium on Frost in Geotechnical Engineering*, Arvind Phukan, Ed.).

The terms of reference for the third period (1994-97) given by the ISSMFE are:

1. To promote cooperation and exchange of information on frost in geotechnical engineering
2. To establish liaison with the International Permafrost Association and the International Symposium on Ground Freezing (ISGF)
3. To continue the unfinished work of the past committee
4. To arrange the 3rd International Symposium on Frost in Geotechnical Engineering in four to five years' time

Concerning item 3 the following have been adopted:

3.1. Field and laboratory methods for the determination of deformation parameters of thawing soils (convener: S. Saarelainen, Finland)

3.2. The procedure of a reference frost heave test including sampling (convener: J.-M. Konrad, Canada)

3.3. Estimation of frost heave and thaw weakening by statistical methods and physical models (convener: K. Jujala, Finland)

3.4. Related effects of frost action, e.g. freezing index and other climatic quantities, frost action in mineral lining materials, etc. (convener: M. Dysli, Switzerland).

The work will take place in four working groups chaired by the abovementioned conveners. The results of the committee work will be published in connection with the next symposium, to be held in Luleå, Sweden, 14-17 April 1997, as a joint symposium with the International Symposium on Ground Freezing.

Members: M. Fukuda (Japan), H.L. Jessberger (Germany), S. Knutsson (Sweden), G.Z. Perlstein (Russia), K. Senneset (Norway), E. Slunga (Finland). Ex-Officio: J.W. Rooney (USA).

News from Members

As usual, invited reports dealing with special topics are welcome (see Canadian report). *Frozen Ground* No. 16 presented additional recent reports from members.

Canada: Permafrost and National Defence in Northern Canada

Engineers with the Canadian Department of National Defence (DND) have had an interest in permafrost and the special problems it presents ever since their experience with it during World War II. During the war, American army engineers and civilian contractors built the Alaska Highway and CANOL road and pipeline system across northwestern Canada, to ensure a secure supply of fuel and other materiel for Alaska. Canadian military officers were attached to the construction effort, and many got their first exposure to the problems of thaw settlement in disturbed, ice-rich, fine-grained soils at that time (S. Thompson, personal communication, 1973). T. Lloyd provides a description of the problems encountered at the first site of Camp CANOL, across the Mackenzie River, just downstream of Norman Wells (Oil in the Mackenzie. *Geographical Review*, 34(2): 275–307, 1944) . The camp signals area, which was enclosed by a fence and so remained undisturbed, soon developed into an island several feet higher than the surrounding sea of mud (T. Lloyd, personal communication, 1972).

After the end of the war, the Cold War and Canadian commitments to NATO resulted in the construction of a number of facilities and installations for the defence and security of North America. Most were constructed and operated jointly with the United States. In recent years, many have been decommissioned, as a result of obsolescence and the lessening of international tension. Given Canada's northern location, and the Cold War preoccupation with Asia, many of these facilities were built in the permafrost region. The problems faced by the military engineers responsible for their construction were the same as those that face all engineering projects in permafrost areas. These included questions of location (controlled by the purpose of the specific facility), site selection, foundation conditions, sources of construction materials, water supply and waste disposal. In the early years, however, they were exacerbated by a poorly developed supply and transportation system. Each of the major facilities had to include an airstrip in addition to the living quarters and operational structures.

These defence installations in the north comprised four main components: 1) Joint Arctic Weather Stations, built in the 1950s; 2) Distant Early Warning (DEW) Line radar stations, also built in the 1950s; 3) Short Range Radar Stations, built in the 1980s; and 4) the current Forward Operating Locations program, of upgrading selected arctic airstrips for potential military use.

When the Arctic Weather Stations and the DEW Line sites were being designed and built, it was thought urgent to get them completed quickly. Thus the approach to their design and construction planning was one of "overdesign and overbuild" as a way of coping with the possible foundation problems presented by permafrost. Thus more piles than may have been necessary were placed under the buildings and thick pads of gravel were laid down for the airstrips and roadways.

In the 1980s, when the Short Range Radar Sites were being built, however, there was less pressure for a quick completion and much more was known about design and construction in permafrost terrain. Like the original DEW Line construction, much of the work on site selection and investigation, design and construction was done by civilian contractors. More attention was therefore paid to optimizing pile design, for example, and research on pile design for specific permafrost conditions was undertaken (K.W. Biggar and D.C. Sego, Field pile load tests in saline permafrost. I. Test procedures and results. II. Analysis of results. *Canadian Geotechnical Journal*, 30(1): 34-59, 1993).

The current program of airstrip upgrading began in the late 1980s. A major concern is the possible effects of global warming on permafrost stability and on the performance of the airstrips and associated buildings and, in particular, the possible effects of differential thaw settlement of runways on the safety of jet aircraft. Jets land and take off at relatively high speeds and differential settlements of as little as 5–10 cm over a horizontal distance of 60 m are considered excessive by aircraft manufacturers. Thus research into the extent of permafrost and of ground ice and their seasonal variation in the soils beneath runways has been undertaken, principally at Inuvik and Rankin Inlet, NWT (A.S. Judge, C.M. Tucker, J.A. Pilon and B.J. Moorman, Remote sensing of permafrost by ground-penetrating radar at two airports in Arctic Canada. *Arctic*, 44(1): 40–48, 1991). At Rankin Inlet, because of the high costs associated with mobilization and construction at this relatively inaccessible location, the runway and building foundations have been deliberately overdesigned, so as to accommodate a potential warming of the permafrost by 1–2°C over the next few decades.

Prepared by J.A. Heginbottom
with the assistance of C.M. Tucker, June 1995

CHINA

The Chinese National Workshop on Cryosphere and Global Change was held on 5-7 May 1995 at the Lanzhou Institute of Glaciology and Geocryology, Chinese Academy of Sciences. About 50 Chinese glaciologists and geocryologists attended. Abstracts have been published in Chinese and the proceedings will be published at the end of this year.

In order to systematically investigate the response of permafrost to the construction and operation of highways in cold regions, an in-situ experiment and observation site is being constructed on the Qing-Kang No. 214 highway by the Transportation Bureau of Qinghai Province in cooperation with the State Key Laboratory of Frozen Soil Engineering, Chinese Academy of Sciences. More information will appear in future news bulletins.

Submitted by Zhu Yuanlin

GERMANY

A joint Russian–German expedition was carried out from July to September 1994 on the Taimyr Peninsula, Siberia. Hydrological, cryopedological and paleogeographical permafrost studies were undertaken by scientists of the Potsdam Research Department of the Alfred Wegener Institute for Polar and Marine Research (AWI), the Institute of Polar Ecology, Kiel (IPÖ) and the Institute of Soil Sciences, Hamburg University (HH) together with Russian counterparts. The investigations are part of an ongoing German–Russian project on the Late Quaternary environmental history of Central Siberia.

Hydrological studies were carried out in the Levinson–Lessing Lake catchment (Byrranga Mountains) by the AWI group in cooperation with scientists from the AARI (Arctic and Antarctic Research Institute), St. Petersburg. The objective is to trace seasonal water and solute transport in the active layer under a variety of geomorphological settings within the lake watershed underlain by continuous permafrost. The study focuses specifically on the determination of 1) flowpaths of water in the phreatic and vadose zone of the active layer and 2) sources and sinks of active layer water (precipitation, evaporation, frozen ground, lateral flow). During summer 1994, instruments were installed in the active layer to depths of maximum thaw. In-situ bulk electrical conductivity and volumetric moisture content of the active layer were measured using time domain reflectometry (TDR). Wells and piezometers were installed to determine water table elevations in the phreatic zone and to calculate hydraulic conductivities. The chemical and isotopical composition of water from the vadose and phreatic layer, precipitation, lake and stream water will be used to infer residence times, mixing rates, flowpaths and sources of water. Further field work is planned to start in May 1995 and continue until October to obtain data for one complete cycle of the active layer (thawing, maximum thaw depth, refreezing).

2. Paleogeographical studies of permafrost were carried out in the Labaz Lake area (Taimyr lowland) by scientists from the AWI, IPÖ, HH and the Department of Geocryology, Moscow State University. The main task of the field work was to study lithological and cryogenic structures of the perennially frozen sediments of the Labaz Lake drainage area using outcrops and core drilling. Samples of organic material were taken for C14-dating in various stratigraphic horizons. In peat and sediment profiles, samples were taken for palynological, lithological, stable isotopes (oxygen-18, deuterium) and tritium analysis of ground ice. The study was complemented by soil and microbiological investigations of recent tundra soils. These results will be used for reconstruction of the vegetation history, climatic conditions and character of sedimentary and cryogenic processes in the East of the Taimyr Lowland during the Late Quaternary period. In both areas measurement of the active layer depth related to the ITEX program was started (see *Frozen Ground* No. 16, p. 7, for data from the Taimyr sites).

At the AWI in Potsdam, Christine Siegert has started a research project on Frozen Geochemical Barrier (FGB): Its Dynamics and Influence on Substance Flux in Permafrost Landscapes. The project is in cooperation with Vladimir E. Ostroumov, Institute of Soil Sciences and Photosynthesis, and Bjarne Holm Jakobsen, Institute of Geography, University of Copenhagen. Integrated field work at different study sites and laboratory experiments is planned.

Geochemical processes in polar and subpolar regions are strongly influenced by the near-surface permafrost table. The boundary between the seasonally thawing soil and the perennially frozen ground is an important geochemical barrier. The thermodynamic conditions at the FGB determine phase transformations of water and the presence of ice. Extremely high gradients of chemical potentials are characteristic for this boundary. As a result, the intensity of chemical substance transformation and mass transfer increases. Specific geochemical processes developing at the FGB have a great influence on soil formation and other landscape forming processes in polar and subpolar terrestrial ecosystems. The character of geochemical processes at the FGB is determined by the interaction of climatic, biotic, geomorphological, geological and geocryological factors, which have varied over geological time.

The German working group on polar geography held its meeting in Jena (12-13 May). New results of the Geoscientific Spitzbergen Expeditions 1990/92 were presented. On 14 May the Quaternary geomorphology and chronology was discussed in the field on a full-day excursion to Bad Kösen and Weimar (led by R. Mäusbacher, Jena). The next working group meeting will be in Heidelberg on 10-11 November 1995.

Submitted by Lorenz King

Poland

Studies of permafrost and periglacial phenomena in 1994 were carried out during expeditions to Spitzbergen and King George Island (Antarctica) as well as the Kola Peninsula. These were continuations of programs started in previous years.

On Spitzbergen studies were carried out on Weddell Jarlsberg Land in the regions of Hornsund and Bellsund Fiords. They included problems of tundra freezing and thawing as well as the temperature of active layer and near-surface permafrost. The annual research programme was carried out by teams from Wroclaw University, Nicolai Copernici University in Torun, and the Institute of Geophysics of the Polish Academy of Sciences in Warsaw, and were coordinated by A. Jahn.

During the summer, polar expeditions headed by K. Pękala, Department of Geomorphology, Institute of Earth Sciences, M. Curie-Sklodowska University, Lublin, undertook a monitoring program of contemporary morphogenetic processes and thermal conditions. The effect of meteorological conditions, relief, aspect of slopes, vegetation and soil moisture on permafrost active layer dynamics was studied in different tundra ecosystems in the region of the southern border of Bellsund. Contemporary frost processes, Arctic soil development, and permafrost water chemistry were also the subjects of investigation.

Some examinations of slope processes in the discontinuous permafrost zone were made by M. Harasimiuk (Department of Geology, Institute of Earth Sciences, M. Curie-Sklodowska University) on Kola Peninsula.

The investigations on King George Island, with the Polish H. Arctowski Station as a base, were undertaken by the team of A. Kostrzewski (Adam Mickiewicz University, Poznañ) and concerned monitoring of contemporary periglacial processes and tundra ecosystems.

The results of investigations carried out by the Polish polar center are presented every year at polar symposia of the Polar Club of the Polish Geographical Society as well as at the polar sessions organized by the Institute of Earth Sciences, M. Curie-Sklodowska University. The proceedings are published after each session and symposium. In 1994 two volumes were published: the 21st Polar Symposium in Warsaw, *60 Years of Polish Research of Spitzbergen* (54 contributions, 371 pages, Warsaw), as well as Polar Session *Arctic Natural Environment Problems* (25 contributions, 202 pages, M. Curie-Sklodowska University, Lublin).

Submitted by K. Pękala

Russia

A summary of the highly successful meeting of the Scientific Council on Earth Cryology is reported elsewhere (p. 3-4). N.A. Grave has also provided a very useful summary of the monitoring session held during the council meetings. Copies are available by direct mail or E-mail from the Secretary General's office. In addition to many national and international activities, Russian geocryologists and cryopedologists are actively involved in the development of the Global Geocryological Database. The results of some of those activities are provided in the reports of the Data and Information and Cryosols Working Groups (p. 5 and 8). These include a compilation of over 370 published permafrost maps, a list of Russian organizations and institutions with potential permafrost data holdings, results of a pilot project to extract soil temperature data from existing meteorological station records, and borehole data from units within the IPA permafrost maps. The initial steps to prepare an international soils legend and map of regions underlain by permafrost have been taken.

Numerous bilateral and multilateral initiatives are underway, including the joint program with Japan and a program started with Sweden in 1994 on Tundra Ecology–94. A guidebook entitled *Diversity of Natural Ecosystems in the Russian Arctic* was prepared by Russian specialists and published (Reprocentralen Lunds Universitet) with general soils and permafrost conditions described for some 20 sites visited by the TE-94 field parties. Under the International Tundra Experiment (ITEX) program, active layer measurements are being obtained at several sites (see Global Change and Permafrost Working Group report; p. 6). Active layer data are being collected (by German colleagues) at several sites on the Taimyr Peninsula as well as in West Siberia and Chukotka using the ITEX-IPA protocol.

Plans for the Second International Conference on Cryopedology have been announced (see inside back cover). Finally, the Russian participants in the IPA Council meeting in Berlin will introduce a proposal to establish an International School for Permafrost. Results of those discussions will be announced in the next issue of *Frozen Ground*.

Southern Africa

The Council of the Southern African Permafrost Group (SAPG) has changed again, with Stefan Grab (University of Natal, Pietermaritzburg) now taking over as president from Margaret Marker (University of Cape Town). Wilson Rooy (University of Pretoria) and Ian Meiklejohn (University of Pretoria) remain as secretary/treasurer and IPA representative respectively.

Some members attended and presented papers at a special Periglacial Session of the SASQUA (Southern African Society for Quaternary Research) Biennial Conference, held in Cape Town from 30 April to 6 May 1995. Papers presented included:

Interpretation of relict periglacial landforms in the High Drakensberg: Pleistocene or Holocene? (S. Grab)

Evidence for perennial snowbeds and Quaternary glaciation in the eastern Cape Drakensberg (C. Lewis)

Cenozoic sequences from Lesotho (M. Marker)

Valley asymmetry in the High Drakensberg: What are the palaeoclimatic implications? (I. Meiklejohn)

Debris deposits at Bannermans Pass, KwaZulu/Natal Drakensberg: Some palaeoclimatic implications (P. Sumner, I. Meiklejohn and S. Currie)

The debates at the SASQUA conference again highlighted the considerable differences in opinion regarding the interpretation of Quaternary periglacial/glacial landforms in southern Africa. The stimulating and sometimes heated discussion is seen as healthy for the discipline, particularly as there are so few periglacial researchers in southern Africa. This bodes well for a more rigorous scientific approach and an improvement in the periglacial/glacial research component of southern African Quaternary studies. In future, SAPG sessions and field meetings will be closely associated with the Southern African Association of Geomorphologists and SASQUA biennial meetings, which are held during alternate years, so that we will all be able to meet on an annual basis.

Given the small academic community in southern Africa, it is indeed gratifying to note how many researchers are currently involved in periglacial research. Stefan Grab, Paul Sumner and Ian Meiklejohn are continuing investigations in the KwaZulu/Natal regions of the Drakensberg and adjacent areas of Lesotho, where research is focused on debris deposits, slope deposits and patterned ground. Colin Lewis is working on similar periglacial features in the Eastern-Cape Drakensberg as well as evidence for Quaternary glaciation, while Jan Boelhouwers and Wilson Rooy continue their work on periglacial features and other slope deposits in the Western Cape Mountains. It can be seen that much of the research conducted concerns the Quaternary, primarily as a result of the debate highlighted above and due to the marginal nature of contemporary periglacial activity.

Submitted by Ian Meiklejohn

United Kingdom

European members of the International Permafrost Association have recently submitted a three-year research proposal to the European Union under its Fourth Framework Environment and Climate Program. The project is entitled High Mountain Slope Instability Associated with Permafrost Degradation Due to Climate Change: Monitoring, Modeling and Hazard Assessment. As the title implies, we propose to monitor mountain permafrost temperatures and slope instability associated with permafrost degradation, and undertake numerical and physical modelling in order to provide a new process-based approach to mountain slope hazard assessment in the context of climate change.

Objectives of the program are: 1) to establish a framework for monitoring the impact of global climate change in the high mountains of Europe, particularly in relation to the stability of mountain permafrost, and 2) to provide a new process-based method for mountain landslide hazard assessment in the context of changing climate and permafrost degradation.

Coordinator of the proposal is Charles Harris (Cardiff, UK) and partners include Dietrich Barsch (Heidelberg, Germany), Lorenz King (Geissen, Germany), Wilfried Haeberli (ETH Zurich, Switzerland), Francesco Dramis (Rome, Italy), Jonas Åkerman (Lund, Sweden), Johan Ludvig Sollid (Oslo, Norway) and David Palacios (Madrid, Spain). Field sites will be located in the Pyrenees, the Alps and the mountains of Scandinavia, including Spitsbergen.

Future plans and results of the program, including involvement of the Global Geocryological Database node at the GeoData Institute, University of Southampton, will be presented in future issues of *Frozen Ground*.

Submitted by Charles Harris

United States

Several U.S. membership and professional organizations continue their activities related to both seasonally and perennially frozen ground. These include the American Geophysical Union (AGU), American Society of Civil Engineers (ASCE), Association of American Geographers (AAG), and several boards and committees of the National Research Council. Permafrost research projects and monitoring are also active under several governmental programs. Brief reports follow.

The AGU continues to provide support for the IPA Secretariat and to promote permafrost interests both nationally and internationally. The Snow, Ice and Permafrost Committee meets regularly at the annual Fall meetings. As was the case in 1994, a special session on frozen ground is planned for the 1995 meeting in San Francisco. The topics are related to:

> Continuing advances in understanding physical, chemical, and biological processes occurring in areas of permafrost and seasonal frost, combined with increasing interest in the role of permafrost in diverse practical problems ranging from Arctic contamination to global change, provide the impetus for this general session on frozen ground processes.

It is anticipated that some participants in the IPA Frozen Ground Workshop to be held at CRREL on 9-11 December (see inside back cover) will continue on to the San Francisco meetings and present additional reports.

The ASCE's Technical Council on Cold Regions Engineering (TCCRE) continues to be active in all aspects of cold regions research and engineering. In addition to the work of the Frozen Ground Committee, the Design and Construction Committee is developing monographs on Roadways and Airfields, Arctic Foundations, and Cold Climate Utilities. TCCRE co-sponsored the 7th International Conference on Cold Regions Engineering in March 1994 with the Canadian Society for Civil Engineering in Edmonton, Alberta. An informative 869-page proceedings (with 20 permafrost and frozen ground papers) is available from Dan Smith, University of Alberta (403 492 4138). The Eighth International Conference is being held in Fairbanks, Alaska, on 12-17 August 1996, with a focus on infrastructure and including a mini-symposium on the Trans-Alaska Oil Pipeline. TCCRE is also sponsoring the International Symposium on Cold Regions Development (ISCORD 1997) in Anchorage on 16-19 June 1997. ISCORD promotes the exchange of information and experience related to the development of cold regions of the world. ASCE's quarterly *Journal of Cold Regions Engineering* has a new editor, Professor John Dempsey, Clarkson University. The journal continues to seek quality papers on all aspects of cold regions engineering and research. For information on TCCRE contact Jon E. Zufelt, CRREL (fax: 603 646 4477).

The AAG, under the leadership of Jesse Walker, Louisiana State University, has taken another step closer to forming a Cryosphere Specialty Group. The group's interests would include snow, ice (glacier, lake, sea), permafrost, periglacial processes, and cryosols, among other topics and disciplines in all cold regions of the Earth. It would organize special sessions at the annual meetings and other activities. In order to form such a group 100 interested AAG members are required and a petition is being circulated among members within and outside the U.S. to demonstrate support for its formation.

The NRC Transportation Research Board's Committee A2L04 on Frost Action met on 22 January 1995 in Washington, DC. Among the technical topics discussed were presentations on centrifuge modeling for frost effects, recent results from the Minnesota road test sections (MN/Roads), the Strategic Highway Research Program (SHRP) monitoring program, the CRREL Frost Effects Research Facility (FERF), and open grade embankments in Alaska. The committee reviewed its research needs statements; more information can be obtained from the committee's new chairperson, Billy Connors of the Alaska Department of Transportation and Public Facilities, 2301 Peger Road, Fairbanks, Alaska 99709-5316.

Several research, monitoring and planning activities related to permafrost are underway in the U.S. The National Science Foundation funds permafrost and periglacial research in both the Antarctic and Arctic. The Arctic System Science (ARCSS) program has a number of projects in Alaska at which ground temperatures and active layer thickness are monitored. The ITEX-IPA protocol for active layer measurements is being conducted on six 1000-meter grid sites in 1995. The U.S. Geological Survey (Clow, Lachenbruch) and CRREL (Lunardini) continue to monitor permafrost temperatures at sites in northern and central Alaska. The University of Alaska in Fairbanks has several groups at the Geophysical Institute (Osterkamp) and the Water Research Center (Kane and Hinzman) that continue their long-term measurements of permafrost and the active layer, respectively.

The National Science Foundation sponsored a small international workshop at the Byrd Polar Research Center in Columbus, Ohio, in January 1995 to define research priorities for the Russian Arctic land–shelf systems. Both subsea and onshore permafrost were identified as major topics of interest in understanding past, present and future processes. The 40 participants included invitees from Russia, Latvia, Norway, Germany, and Canada. More information will be provided as the research opportunities are identified.

Submitted by Jerry Brown

Other News

New Zealand

For the past 30 years, several soil scientists from New Zealand have been studying soils in Antarctica to determine their properties and their significance in respect to weathering processes, glacial history and landscape evolution.

The soils are Cold Desert soils, formed in the coldest and driest environment on Earth. Notwithstanding the severe climate, where mean annual temperatures for much of the continent range from –15°C to –50°C, significant variation in soil properties has existed, largely as a function of available moisture. A distinctive feature of the soils is their very great age. Some land surfaces are now considered to date from the middle Miocene or earlier. The extreme aridity and great age of these soils provide a unique background for the study of cryopedology and geocryology.

Recent research by our New Zealand group in the McMurdo Dry Valley region has focused largely on the properties of permafrost and the impacts of humans on the Antarctic environment. Extensive disturbances in the vicinity of major bases have significantly influenced the soils, the biology and the permafrost. Such disturbances are now forbidden under the Environment Protocol to the Antarctic Treaty.

To predict human impact on permafrost in Antarctica, our research has concentrated on determining the properties of permafrost in the McMurdo coastal environment over a wide range of sites, comparing the permafrost at undisturbed sites with that at sites disturbed 35 years ago, investigating the properties of permafrost in differing soil climatic zones, and measuring the summer water content and other physical and chemical properties of the active layer. The movement of contaminants from point sources and the rates and extent of tracer movements in the soil and permafrost at experimental sites are also being studied, providing useful information on soil moisture movement.

An experiment to determine the rate of de-watering of ice-cemented permafrost, using a neutron probe in aluminum access tubes, is currently in progress. Various site climate and soil climate parameters are also being measured. Other experiments have measured the rate at which ground disturbance from typical field work activity occurs. Assessment of sites disturbed up to 30 years ago in field investigations is providing a measure of natural regenerative processes.

Our investigations to date have shown that permafrost and active layer properties vary greatly from place to place. They also confirm the very fragile nature of the Antarctic landscape and the very long time scales over which processes in Antarctica operate. This understanding will help to minimize the impacts of humans within the Antarctic environment and to predict the impacts of global climate change on exposed land surfaces of Antarctica.

Submitted by Iain B. Campbell

Mongolia

The following is the first technical report received from Mongolia. Additional information may be obtained from the author at the Institute of Geography and Geocryology, Mongolian Academy of Sciences, Ulanbator, Mongolia, 210620.

In 1992-93, in order to develop a new method to decrease the depth and duration of seasonal freezing in the area of the Baganuur coal deposit, N. Sharkhuu carried out temperature observations on freezing processes using insulation covers over gravels and sands. Sawdust 15 and 35 cm thick was used. The depth of seasonal freezing for gravel and sand was 4.1 m (moisture content 5%, mean annual temperature –2°C). The sawdust had a moisture content of 55% and a density of 0.17 g/cm^3. The temperature observations give the following results: decrease of the date from the beginning of freezing and from the ending of thawing and reduction of the depth of seasonal freezing of ground for the sawdust covers with thickness of 35 cm to 2.6 m, with changes from 43 to 52 days. The results obtained show that this method is suitable for development of coal deposit earthworks under the conditions in Mongolia.

N. Sharkhuu obtained ground temperature regimes for the period 1991–93 in more than 20 boreholes in the Nalaikh coal deposit to depths of 20–100 m. As a result of the observations the author has elucidated ground temperature regimes for the seasonal thawing layers and permafrost and established the thickness and annual temperature of continuous permafrost in this deposit. In this area the permafrost is up to 45 m thick with an annual temperature from 0° to –1°C. The depth of the active layer ranges from 2.2 to 4.8 m. All characteristics obtained are shown on the author's permafrost map of the Nalaikh deposit area at a scale of 1:5000. According to temperature data measured in borehole N23 over the period 1945–93, the rate of decrease of permafrost thickness from below (from subpermafrost exploitation of the deposit) was on the average 0.4 m/yr or a decrease from 50 m to 20 m for 48 years.

In 1993, geocryological field research was carried out on the Bajankhongor territory, an area of 116,000 km^2 that embraces the Kangai Mountains on the south. As a result of previous geocryological generalization and new research by N. Sharkhuu, D. Tumurbaatar and R. Lomborenchen, maps

have been compiled of permafrost and seasonally freezing and thawing soils, and also a map of the distribution of cryogenic processes and phenomena on a scale of 1:500,000. According to these maps, mean annual ground temperature ranges from –8°C to –10°C, permafrost thickness in the Kangai Mountains reaches to some hundred meters, and the depth of seasonal freezing and thawing is from 1 to 5 m. There is widespread occurrence of cryogenic processes and features, including frost mounds, surface icings, thermokarst and stone polygons.

Submitted by N. Sharkhuu

Kazakhstan

In 1994 the Laboratory of Geocryology operated within the International Centre of Geoecology of Mountain Countries in Arid Regions (ICGM) in Almaty, Kazakhstan. It carried out studies on monitoring of alpine permafrost, including observations of changes of temperature and thickness of permafrost, depth and thermal regime of the active layer, and dynamics of cryogenic processes, and on features influenced by global climatic changes and human activity in the mountains.

Investigations on distribution and composition of perennially and seasonally frozen ground have been carried out in Pamirs-Alai, Tien-Shan and Djungar Alatau. The general principles of the distribution of permafrost versus altitude in the mountains were determined.

Original methods of mapping of permafrost and seasonally frozen ground have resulted in a number of maps of different scales, showing characteristics of permafrost and the active layer, and local prognosis of engineering conditions.

The Laboratory of Snow Cover and Avalanches of ICGM has organized monitoring of snow cover and avalanche activity in some typical river basins of Zailiisky Alatau. Changes with altitude, exposure and different slopes are taken into account. Research data on snow cover and avalanche hazard estimation in the Tien-Shan are generalized, and maps of snow cover characteristics (dates of snow cover formation and disappearance, water content, etc.) are drawn for the entire Tien-Shan area.

The Laboratory of Glaciology has continued to observe glaciological elements on the glacier station Tuyuksu in the Zailiisky Alatau. Components of mass/energy balance on Tuyuksu Glacier are determined for three typical years. Prognosis for ice mass variations of the Djungar Alatau glacial system are elaborated.

Additional information is available from the author at the Institute of Geography, Pushkin St. 99, Almaty 480 100, Kazakhstan (fax: 7 3272 53 6973).

Submitted by A.P. Gorbunov

Romania

The Retezat and Fagaras Mountains are situated in the Southern Carpathians (Transylvanian Alps), where many peaks are higher than 2500 m. Moldoveanu (Fagaras) is 2544 m, the maximum altitude for the Romanian Carpathians; Peleaga (Retezat) is 2509 m with 10% of the surface area above 2000 m.

Glacial cirques and valleys are fundamental geomorphic elements in the landscape of the highest area of the southern Carpathians, having originated from Pleistocene glaciers which reached altitudes of around 1100–1200 m.a.s.l. during their maximum extension. The interaction of paraglacial processes and periglacial phenomena produced a variety of periglacial forms: rock glaciers, talus cones and scree slopes, block fields, rock streams, cryoplanation terraces, and solifluction forms.

The climatic conditions specific for the high zone of the Southern Carpathians are cold; mean temperatures are below 0°C above 2000 m (–0.5°C at Taracu, 2180 m, –2.6°C at Omu, 2505 m), with an absolute minimum of –38°C. The number of days with frost is 200–254, and the number of freezing–thawing cycles is more than 125, with frost being possible during the whole year. The mean annual precipitation is 1178 mm at Taracu and 1278 mm at Omu. The thickness of the snow layer can be between 50 and 370 cm and is a function of wind; the upper limit of the forest is between 1750 and 1800 m.

Monitoring and predicting the activity of the permafrost in the Southern Carpathians relies on measurements of summer temperatures of springs situated at the bases of rock glaciers as well as the BTS method. Annual temperature measurements began in 1986, in July and August, using mercury and digital thermometers. The BTS method has been applied since 1992.

Submitted by P. Urdea

IGCP Proposal 385

At its February meeting in Paris, the IGCP Scientific Board recommended resubmission next year of the proposal dealing with kurums and the palsa complex. Accordingly, the project will be delayed in the anticipation of better success with the resubmission. Suggestions or comments would be appreciated. We need closer cooperation with INQUA, remote sensing organizations (radarsat) and IGCP Project 341. Contact S. A. Harris, Department of Geography, University of Calgary, Calgary, Alberta, Canada, T2N 1N4. Fax: 403 282 6561; <harriss@acs.ucalgary.ca>

Submitted by S.A. Harris

PUBLICATIONS

An Introduction to Frozen Ground Engineering (Professor O.B. Andersland and B. Ladanyi). This comprehensive resource integrates the basic theory and design methods for frozen ground support systems used for construction of deep shafts, tunnels, deep excavations, and subsurface containment barriers in unfrozen ground world-wide. The extensive review of seasonally and perennially frozen ground provides information essential for infrastructure design and construction, making this volume a major sourcebook for engineers and geologists. Contact: Steve Hawe, Chapman & Hall, One Penn Plaza, 41st Floor, New York, NY 10119. Phone: 212 564 1060; Fax: 212 564 1505 ($84.95 U.S./ $115.00 C).

The Geothermal Regime of the Frozen Zone of the Lithosphere in Northern Asia (V.T. Balobayev). This monograph provides a detailed treatise on the thermophysical controls of temperature regime at the surface, in the upper lithosphere, and at depth in frozen rock strata. Throughout, the mathematical expressions of the physical relationships are fully presented, together with observational material. In the foreword, the author traces the 20th century worldwide development of geophysics and study of ground temperature regimes. Nineteenth century observations on ground temperature in Siberia by A. Middendorf are noted, as well as technical advances in measurements at the Yakutsk Permafrost Institute in the 1960s to 1980s under P.I. Melnikov's leadership. The author himself published extensively during this period.

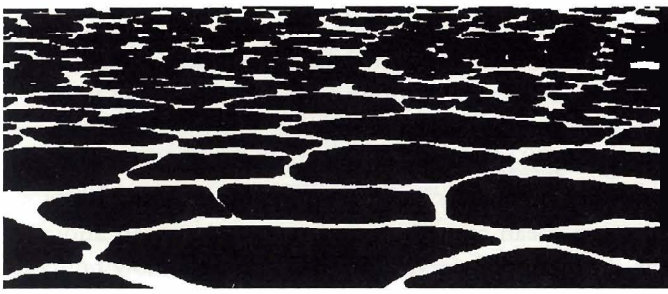
Chapter 1 treats the surface energy budget and atmospheric influences, illustrated by a range of climatic maps and diagrams for northeastern Siberia, before proceeding to describe ground temperature conditions. Chapter 2 discusses the principles of ground heat flow and the role of soil properties, snow cover, and vegetation. Mean ground temperature conditions along the Lena River and elsewhere are described and data tables are included for a selection of localities. Chapter 3 follows a similar treatment for deep ground temperatures in frozen and unfrozen material. Ground heat flux is characterized for the structural zones of northern Asia and western Siberia, including the influence of surface and structural inhomogeneities, and the thickness distribution is mapped. The final chapter examines the non-stationary cryolithozone in the past, present and future. Temperature profiles and cross-sections are shown and methods for reconstructing past conditions are detailed. Pleistocene and Holocene geothermal parameters are calculated and there is a brief discussion on possible future conditions associated with anthropogenic influences. There is a 16-page bibliography of Russian and Western literature. The book contains much information on permafrost conditions and the geothermal regime in northern Asia that would be of great interest to western scientists. Nauka Press, Novosibirsk, 1991, 193 p., ISBN-5-02-029996-0.

R.G. Barry, University of Colorado
Boulder, Colorado

Principles of the Cryogenesis of the Lithosphere (N.N. Romanovskiy). This text is developed from courses in geology and geocryology taught at Moscow State University. It is aimed at advanced students in those fields, as well as hydrogeologists, exploration geologists, geographers, mining and petroleum engineers, and construction workers. The author previously published monographs on patterned ground formation and groundwater in the permafrost zone. Following an outline of historical development of studies of ground freezing and thawing and the associated surface phenomena, or cryogenesis, there are chapters on the climate and geomorphic factors determining the zonal and altitudinal characteristics of permanently and seasonally frozen ground, and periglacial phenomena. Chapter 4 deals with the formation and composition of syngenetic and epigenetic frozen ground, thermokarst complexes, including taber soils and alas depressions, and sediments formed by cryoturbation and ice wedge growth. Chapter 5 addresses the processes of permafrost development and characteristics of permafrost thickness in relation to ground heat flow and thermal regime, drawing particularly on V.T. Balobayev's work. The influence of structural and hydrogeological conditions, glacial history, and Arctic marine transgressions and regressions is also treated, and the relationship of these factors to gas hydrate occurrence is examined. The final three chapters describe the characteristics of cryogenic processes and permafrost in the Eurasian platform area, in mountain areas, and offshore in the Arctic shelf seas, respectively. Here, specific regional information is presented and illustrated.

The book is illustrated by some 89 figures. Most of the diagrams are schematic, in keeping with the textbook character of the work. Surprisingly, it contains only seven tables of numerical information. There is a brief index and a list of 132 references, all but 13 of them to Russian sources. Focusing as it does primarily on northern and eastern Russia, the book provides an up-to-date and useful overview of Russian geocryological research. An English translation would be useful to western readers in the field. Moscow University Press, 1993, 336 p., ISBN-5-211-02379-X.

R.G. Barry, University of Colorado
Boulder, Colorado



PERMAFROST AND PERIGLACIAL PROCESSES

John Wiley and Sons, Ltd., publishers of *Permafrost and Periglacial Processes,* has agreed in principle to offer reduced individual subscription rates of approximately $50.00 (U.S.) to those individuals who can demonstrate a professional interest in permafrost and other forms of frozen ground. Recipients of *Frozen Ground* and participants in the international permafrost and related periglacial conferences can qualify for this reduced subscription rate. Those interested in obtaining more information should contact: Subscriptions Department, John Wiley and Sons Ltd., Baffins Lane, Chichester, West Sussex, PO19 IUD, England.

Volume 6, Issue No. 1 (January–March 1995)

Permafrost in China: Past and Present, Qiu Guoqing and Cheng Guodong

Active Patterned Ground and Cryoturbation on Muckish Mountain, Co. Donegal, Ireland, P. Wilson and D. Sellier

Permafrost Distribution in the Southern Circumpolar Region and Its Relation to the Environment: A Review and Recommendations for Further Research, J.G. Bockheim

Systématique du Remplissage en Eau des Fentes de Gel: Les Résultats d'une Étude Oxygène-18 et Deutérium, B. Lauriol, C. Duchesne and I.D. Clark

Suprapermafrost Groundwater Seepage in Gravelly Terrain, Resolute, N.W.T., Canada, Ming-ko Woo and Zhaojun Xia

Mountain Permafrost and Slope Instability in the Italian Alps. The Val Pola Landslide, F. Dramis, M. Govi, M. Guglielmin and G. Mortara

Volume 6, Issue No. 2 (April–June 1995): *Proceedings of the Grèzes Litées Symposium and Excursion, France, 4-9 September 1994. Processus et Dépôts Périglaciaires de Versant*

Hommage à Yves Guillien, le "Pape des Grèzes," J.-P. Lautridou

Grèzes, Grèzes Litées: Historique des Définitions, J.-C. Ozouf, J.-P. Coutard, and J.-P. Lautridou

Quelques Coupes Caractéristiques dans les Dépôts de Versant d'Aquitaine Septentrionales: Facies et Interprétation Dynamique, J.-C. Ozouf, J.-P. Texier, P. Bertran and J.-P. Coutard

Processus Génétiques à l'Origine des Formations de Pente à Graviers de Craie en Champagne, M. Laurain, H. Guérin, A. Marre and J. Richard

Enseignements de l'Étude Morphosedimentaire de la Grézière de Tilly-Sur-Meuse, D. Harmand, A. Weisrock and M. Deshaies

The Lorraine "Grèzes Litées" Deposits, M. Deshaies, S. Ghanimi, D. Harmand and A. Weisrock

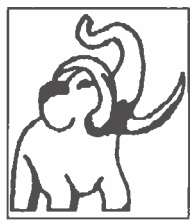
Models for the Genetic and Environmental Interpretation of Stratified Slope Deposits, H. van Steijn, P. Bertran, B. Francou, B. Hétu and J.-P. Texier

Le Litage des Éboulis Stratifiés Cryonivaux en Gaspésie (Québec, Canada): Rôle de la Sédimentation Nivéo-Eolienne et des Transits Supranivaux, B. Hétu

Le Rôle des Coulées de Pierre Sèches dan la Genèse d'un Certain Type d'Éboulis Stratifiés, B. Hétu, H. van Steijn and P. Bertran

Quelques Considérations Concernant Certaines Formations de Pente dans les Carpates Méridionales, P. Urdea

RUSSIAN GEOCRYOLOGICAL RESEARCH



Volume 1, 1995

On the Mechanism of Heat Transfer at the Surface of Thawing Ground, *G.Z. Perlshtein and V.M. Mikhailov*

Consolidated Frozen Soil as A Load-Bearing Foundation, *N.B. Kutvitskaya and A.A. Anishin*

Probabilistic Design of Permafrost Zone Foundations and Its Practical Applications, *L.N. Khroustalev*

Regularities in Thermal Regime of Lakes in Permafrost Areas, *A.V. Pavlov*

Modeling Temperature Fields During Inhomogeneous Rock Freezing and Thawing, *L.S. Garagulya, V.Ye. Romanovsky and N.V. Seregina*

The Geochemical Paradox of Ice Complex Sediments in North Siberia, *V.N. Konishchev and I.R. Plakht*

Investigation of Needle Ice in the USSR, *A.P. Gorbunov, E.D. Ermolin and E.V. Seversky*

Role of Plant Cover in Permafrost Zone, *N.G. Moskalenko*

Maps from China

Map of Qomolangma (8848 m) ($16 U.S.)
Map of K2 (Mt. Qogori 8611 m) ($16 U.S.)
Map of Mt. Xixiabangma (8012 m) ($16 U.S.)
Map of Kongur Tagh (7719 m) and Muzta Ata (7546 m) ($16 U.S.). These maps are on a scale of 1:100,000 with a contour interval of 40 m, and have a sheet coverage of 52 cm × 74 cm.
Map of Snow, Ice and Frozen Ground in China (Shi Yafeng, Chief Editor; Mi Desheng, Editor; Xi Yaokun, Responsible Editor). The map is on a scale of 1:4,000,000. It has a sheet coverage of 110 cm × 158 cm ($8 U.S.).
Sketch Map of Landsat Image of the Karakorum Mountains. The map is on a scale of 1:500,000. It has a sheet coverage of 74 cm × 206 cm ($5 U.S.).

Contact Mi Desheng, Lanzhou Institute of Glaciology and Geocryology, Chinese Academy of Sciences, Lanzhou, Gansu 730000, P.R. China. Fax: 86 931 888 5241.

Canada Permafrost

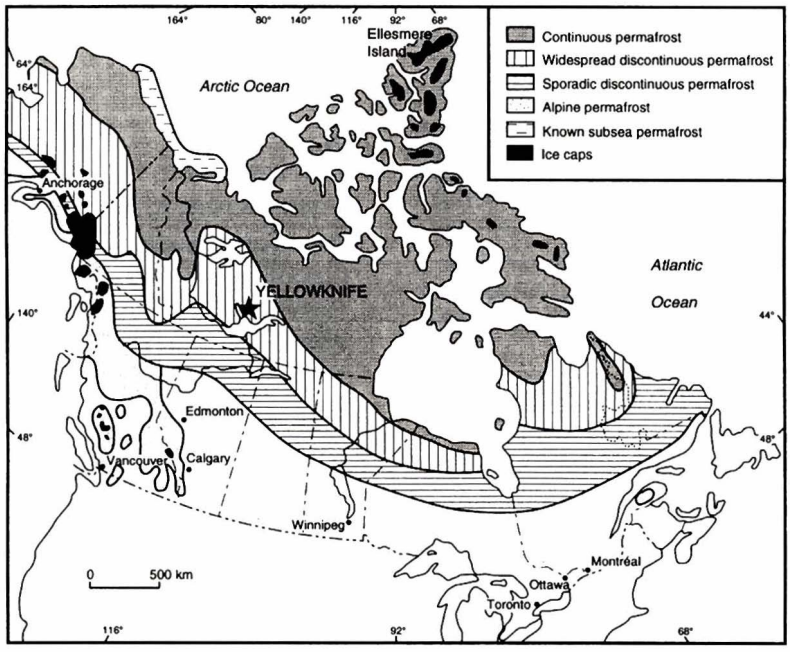
The map, which is a sheet of the *National Atlas of Canada*, 5th Edition, was jointly produced by the Geological Survey of Canada and Geomatics Canada, both of which are Sectors of Natural Resources of Canada.

The main map shows together the extent of permafrost and the abundance of ground ice, with mapping units being based on physiographic regions. The map also has point data giving permafrost temperatures and thicknesses for specific sites. A smaller insert map of Canada specifically focuses on mean annual ground temperatures. In addition, the sheet contains graphs showing both shallow temperature profiles (to 25-m depth) and deep temperature profiles (to several hundred meters depth), and has an extensive explanatory text.

The map can be obtained from the Canada Map Office in Ottawa at a cost of approximately $15 (Canadian). Contact the Canada Map Office, citing reference number MCR 4177. Tel: 1 800 465 6277. Fax: 1 800 661 6277.

Glaciological Data Report GD-28

Workshop on Permafrost Data Rescue and Access, 3–5 November 1994, Oslo, Norway, by Roger G. Barry, J. Alan Heginbottom and Jerry Brown, 134 p., June 1995. Available from World Data Center for Glaciology, CIRES, Campus Box 449, University of Colorado, 80309-0449, USA.



Generalized map of Canadian permafrost distribution and locations of 1996 and 1998 meetings (see inside back cover).

Forthcoming Meetings

1995

XIV International Union for Quaternary Research (INQUA) and IPA Council Meeting
3–10 August 1995, Berlin, Germany
Contact: Congress Partner GMBH, Emmastr. 220, 28213 Bremen, Germany
Tel: 49 421 21 9073; Fax: 49 421 21 6419

Global Change and Geography
14–18 August 1995, Moscow, Russia
Contact: Secretariat, IGU '95, Staromonetry 29, Moscow 109017, Russia
Fax: 7 095 230 2090
E-mail: geography@glas.apc.org

International Symposium on Glacial Erosion and Sedimentation
20–25 August 1995, Reykjavik, Iceland
Contact: Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, United Kingdom
Tel: 44 223 355974; Fax: 44 223 336543

19th International Congress of International Institute of Refrigeration (IIR) and Institut International Froid (IIF)
20–26 August 1995, The Hague, The Netherlands
Contact: PR Group 19th Congress IIR/IIF 1995, c/o Den Daas/CM, P.O. Box 747, 3700 AS Zeist, The Netherlands

International Conference on Past, Present, and Future Climate
22–25 August 1995, Helsinki, Finland
Contact: SILMU, Academy of Finland, P.O. Box 57, FIN-00551, Helsinki, Finland
Tel: 358 0 7748 8338; Fax: 358 0 7748 8299
E-mail: silmu@aka.fi

Disturbance and Recovery of Arctic Terrestrial Ecosystems
24–30 September 1995, Rovaniemi, Finland
Contact: Secretariat, Arctic Centre, P.O. Box 122, FIN 96101, Rovaniemi, Finland
Tel: 358 60 324 771; Fax: 358 60 324 760
E-mail: iascgcpo@levi.urova.fi

48th Canadian Geotechnical Conference: Trends in Geotechnique
25–27 September 1995, Vancouver, British Columbia, Canada
Contact: Bryan Watts, Klohn-Crippen Consultants Ltd., 10200 Shelbridge Way, Richmond, British Columbia V6X 2W7, Canada
Tel: 1 604 279 4325; Fax: 1 604 279 4300.

ISOPE '95–Ocean Mining Symposium
21–22 November 1995, Tsukuba, Japan
Contact:Prof. Jin S. Chung, Co-Chairman, ISOPE, PO Box 1107, Golden, Colorado 80402-1107, USA
Tel: 1 303 273 3673; Fax: 1 303 420 3760

International Conference for Arctic Research Planning
5–9 December 1995, Hanover, New Hampshire, USA
Contact: Oran R. Young, 6193 Murdough Center, Dartmouth College, Hanover, New Hampshire 03755, USA
Fax: 1 603 646 1279
E-mail: oran.r.young@dartmouth.edu

Workshop on Frozen Ground: Our Current Understanding of Processes and Ability to Detect Change
9–11 December 1995, Hanover, New Hampshire, USA
and
Frozen Ground Processes and American Geophysical Union Fall Meeting
13–15 December 1995, San Francisco, California, USA
Contact: Bernard Hallet, Quaternary Research Center, Box 351360, University of Washington, Seattle, Washington 98195-1360, USA
Tel: 1 206 685 2409; Fax: 1 206 543 3836
E-mail: hallet@u.washington.edu

1996

75th Annual Meeting, Transportation Research Board Committee on Frost Action
6–11 January 1996, Washington, D.C., USA
Contact: G.P. Jayaprakash, TRB, National Research Council, 2101 Constitution Avenue NW, Washington, D.C. 20418, USA
Tel: 1 202 334 2952

ISOPE '96–Offshore and Polar Engineering Conference
26–31 May 1996, Los Angeles, California, USA
Contact: Jin S. Chung, Chairman, ISOPE-96, Box 1107, Golden, Colorado 80402-1107, USA
Tel: 1 303 273 3673; Fax: 1 303 420 3760

High Arctic Field Meeting, Ellesmere, Axel Heiberg, and Cornwallis Islands
8–17 July 1996, Ottawa, Ontario, Canada
Contact: Antoni G. Lewkowicz, Department of Geography, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5
Tel: 613 562 5704; Fax: 1 613 562 5145
E-mail: alewkowi@acadvm1.uottawa.ca

International Symposium on Representation of Cryosphere in Climate and Hydrological Models
12–15 August 1996, Victoria, British Columbia, Canada
Contact: Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, United Kingdom
Tel: 44 223 355974; Fax 44 223 336543

8th International Cold Regions Engineering Conference
12–17 August 1996, Fairbanks, Alaska, USA
Contact: Larry Bennett, School of Engineering, University of Alaska, Fairbanks, Alaska 99775, USA
Tel: 1 907 474 6121; Fax: 1 907 474 6087

30th International Geological Congress and IPA Executive Committee Meeting
4–14 August 1996, Beijing, China
Contact: Professor Zhao Xun, 30th International Geological Congress, P.O. Box 823, Beijing 100037, China
Tel: 86 10 8327772; Fax: 86 10 8328928
E-mail: zhaox@bepc2.ihep.ac.cn

International Conference on Oil , Gas and Ecology of the Earth Cryosphere
September 1996, Nizhnevartovsk, Tumen
Contact: Vladimir Melnikov
Tel: 34 52 24 3649; Fax: 34 52 22 3380
E-mail: root@ikz.tyumen.su

1997

8th International Symposium on Ground Freezing and 3rd International Symposium on Frost in Geotechnical Engineering
14–17 April 1997, Luleå, Sweden

ISCORD 1997 International Symposium on Cold Regions Development
16–19 June 1997, Anchorage, Alaska, USA
Contact: Ted Vinson, Department of Civil Engineering, Oregon State University, Corvallis, Oregon 97331-2302, USA
Tel: 1 503 753 0725; Fax: 1 503 753 3052
E-mail: vinsont@ccmail.orst.edu

International Society of Soil Science Congress–Cryosols
8–17 July 1998, Montpelier, France
Contact: David Gilichinsky, Institute of Soil Science and Photosynthesis, Russian Academy of Sciences, 124292 Pushchino, Moscow Region, Russia
Tel: 7 095 923 3558 (Moscow) Tel: 7 095 923 1887 (Pushchino)
E-mail: gilichin@issp.serpukhov.su

Second International Conference on Cryopedology
5–8 August 1997, Syktyvkar, Russia
Contact: Prof. I.V. Zaboeva, Institute of Biology, Komi Center, Russian Academy of Sciences, 167610 Syktyvkar, Komi Republic, Russia
Tel: 7 821 22 25213; Fax: 7 821 22 25231
E-mail: gilichin@issp.serpukhov.su

IV International Geomorphology Conference and IPA Executive Committee Meeting
28 August–3 September 1997, Bologna, Italy
Includes pre- and post-conference permafrost excursions
Contact: M. Panizza, Universita Degli Studi di Moden, 59-41100 Modena, Italy
Tel: 059 23 0394; Fax: 059 21 8326

1998

Seventh International Conference on Permafrost and IPA Council Meeting
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
E-mail: heginbottom@gsc.emr.ca
Conference e-mail: permafrost.conference@gsc.emr.ca

International Arctic Science Committee Meetings

Plans for several IASC meetings in 1995 are well advanced. The NATO Advanced Research Workshop on Disturbance and Recovery of Terrestrial Ecosystems in September at Rovaniemi, Finland, will include several reports on permafrost terrain. A number of IPA representatives plan to participate in the International Conference for Arctic Research Planning in December in Hanover, New Hampshire. Additional details about these and related IASC activities can be obtained from the IASC Secretariat, P.O. Box 5072, Majorstua, 0301 Oslo, Norway. E-mail: iasc@npolar.no

Oil, Gas and Ecology of the Earth Cryosphere

This conference will be held in September 1996 in the Mizhnevartovsk, Tyumen region. Organizers are the Mizhnevartovsk Regional Committee for Natural Resources and Environmental Protection and the Institute for Earth Cryosphere, Russia, Northern Branch. Contact Vladimir Melnikov, Tel: 34 52 24 3649. Tel/Fax: 34 52 22 3380. E-mail: root@ikz.tyumen.su

International Permafrost Association

June 1995

Council

Executive Committee

President
Prof. Cheng Guodong, Director
Lanzhou Institute of Glaciology and Geocryology
Chinese Academy of Sciences
Lanzhou, 730 000
China
Tel: 86 931 882 6725
Fax: 86 931 888 5241
Telex: 72008 IGGAS CN
E-mail:ggcheng@bepc2.ihep.ac.cn

Vice President
Dr. Hugh M. French
Dean of Science
University of Ottawa
P.O. Box 450 Stn A
Ottawa, Ontario K1N 6N5
Canada
Tel: 1 613 562 5985
Fax: 1 613 562 5193
E-mail:
hfrench@science.uottawa.ca

Vice President
Prof. Nikolai N. Romanovskii
Geocryology Department
Faculty of Geology
Moscow State University
119899 Moscow
Russia
Tel: 7 095 939 1937 (office)
Tel: 7 095 133 2668 (home)
Fax: 7 095 932 8889
E-mail: nromanovsky@glas.apc.org

Secretary General
Dr. Jerry Brown
P.O. Box 9200
Arlington, Virginia 22219-0200
USA
Tel/Fax: 1 703 525 3136
E-mail: jerrybrown@igc.apc.org

Members/National Contacts

Argentina
Dr. Arturo E. Corte
Geocriología, CRICYT
Casilla de Correo 330
5500 Mendoza
Argentina
Tel: 54 61 241029
Fax: 54 61 380370
E-mail: ntcricyt@criba.edu.ar

Belgium
Dr. Albert Pissart
Université de Liège
Géomorphologie et Géologie du Quaternaire
7, Place du 20 Août
4000 Liège
Belgium
Tel: 32 41 66 5257
Fax: 32 41 66 5722

Canada
Mr. Don Hayley
EBA Engineering Consultants Ltd.
14535 118th Avenue
Edmonton, Alberta T5L 2M7
Canada
Tel: 1 403 451 2121
Fax: 1 403 454 5688
E-mail: hayley@eba.ca

China
Professor Zhu Yuanlin
Lanzhou Institute of Glaciology and Geocryology
Chinese Academy of Sciences
Lanzhou, 730 000
China
Tel: 86 26725 237
Fax: 86 931 888 5241
Telex: 72008 IGGAS CN
E-mail:ggcheng@bepc2.ihep.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 0 1911
Fax: 358 0 191 8670

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: 49 641 702 8203
Fax: 49 641 702 8211
E-mail: lorenz.king@geo.uni.giessen.de

Italy
Dr. Francesco Dramis
Dipartimento di Scienze Geologiche
Via Osteinse 169
00154 Rome
Italy
Tel: 39 657 37 2876
Fax: 39 657 37 2827

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

Netherlands
Professor Eduard A. Koster
Geographical Institute
University of Utrecht
P.O. Box 80.115
3508TC Utrecht
Netherlands
Tel: 31 30 532044
Fax: 31 30 540604

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

Poland
Dr. Kazimierz Pękala
Department of Geomorphology
Maria-Curie Sklodowska Univ
Akademicka 19
20-033 Lublin
Poland
Tel: 48 81 37 5915
Fax: 48 81 37 5102
E-mail:
geomor@biotop.umcs.lublin.pl

Russia
Dr. Nikolai Grave, Secretary
National Permafrost Committee
Russian Academy of Sciences
Fersman Street 11
117312 Moscow
Russia
Tel: 7 095 292 6511
Fax: 7 095 938 2097

Southern Africa
Mr. Ian Meiklejohn
Department of Geography
University of Pretoria
0002 Pretoria
South Africa
Tel: 27 12 420 2881
Fax: 27 12 420 3248
E-mail: kim@scinet2.up.ac.za

Spain
Dr. David E. Palacios
Comite Español del IPA
Departamento A.G.R. y Geografia Fisica
Universidad Complutense
28040 Madrid
Spain
Tel: 34 1 394 5955
Fax: 34 1 394 5963

Sweden
Dr. H. Jonas Åkerman
Department of Physical Geography
University of Lund
Soelvegatan 13
S-23362 Lund
Sweden
Tel: 46 46 108693
Fax: 46 46 104417
E-mail: jonas.Åkerman@natgeo.lu.se

Switzerland
Dr. Wilfried Haeberli
VAW/Glaciology
Gloriastrasse 37/39
ETH-Zentrum
CH-8092, Zurich
Switzerland
Tel: 41 1 632 4093
Fax: 41 1 632 1192
E-mail: haeberli@vaw.ethz.ch

United Kingdom
Dr. Charles Harris
Department of Geology
University of Wales
PO Box 914
Cardiff, CF1 3YE
United Kingdom
Tel: 44 1222 874830
Fax: 44 1222 874326
E-mail: sglch@cardiff.ac.uk

United States of America
Dr. C.W. Lovell
School of Civil Engineering
Purdue University
West Lafayette, Indiana 47907
USA
Tel: 1 317 494 5034
Fax: 1 317 496 1364
E-mail: lovellc@ecn.purdue.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
E-mail: 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
E-mail: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
E-mail: heginbottom@gsc.emr.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
E-mail: ervan@acs.ucalgary.ca

Secretary: Dr. Vyacheslav Konishchev
Geography Faculty
Moscow State University
119899 Moscow
Russia
Tel: 7 095 939 3673

Global Change and Permafrost
Chair: Dr. Frederick E. Nelson
Department of Geography and Planning
State University of New York at Albany
Albany, New York 12222
USA
Tel: 1 518 442 4469, 4770
Fax: 1 518 442 4867
E-mail: fnelson@cnsvax.albany.edu

Secretary: Mr. Alan E. Taylor
Terrain Sciences Division
Geological Survey of Canada
601 Booth St.
Ottawa, Ontario K1A 0E8
Canada
Tel: 1 613 996 9324
Fax: 1 613 992 2468
E-mail: ataylor@gsc.emr.ca

Mountain Permafrost
Chair: Dr. Wilfried Haeberli
VAW/Glaciology
Gloriastrasse 37/39
ETH Zentrum
CH 8092 Zurich
Switzerland
Tel: 41 1 632 4093
Fax: 41 1 632 1192
E-mail: haeberli@vaw.ethz.ch

Secretary: Dr. Francesco Dramis
Dipartimento di Scienze della Terra
Università di Camerino
Via Betti 1/A
62032 Camerino
Italy
Tel: 39 737 40827
Fax: 39 737 40839

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
E-mail: 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
E-mail: sglch@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: 7 095 923 3558 (Moscow)
Tel: 7 095 923 1887 (Pushchino)
E-mail: 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
E-mail: pfclp@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

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 22073 444

Seasonal Freezing and Thawing of Permafrost Areas
Chair: Dr. Arvind Phukan
School of Engineering
University of Alaska Anchorage
3211 Providence Drive
Anchorage, Alaska 99508
USA
Tel: 1 907 786 1970
Fax: 1 907 786 1079

Secretary: Dr. Branko Ladanyi
Dept de Genie Civil
Ecole Polytechnique
CP 6079 Succ A
Montreal, P.Q. H3C 3A7
Canada
Tel: 1 514 340 4804
Fax: 1 514 340 5841

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; E-mail: vaikmae@gaia.gi.ee

IPA Meetings

9–11 December 1995
Frozen Ground Workshop
Workshop on Frozen Ground: Our Current Understanding of Processes and Ability to Detect Change
Hanover, New Hampshire

Followed by
AGU Frozen Ground Session, Fall Meeting
San Francisco, California, USA
13–15 December 1995

Approximate cost: $75–100 U.S. per day
Contact: Bernard Hallet, Quaternary Research Center,
Box 351360, University of Washington,
Seattle, Washington 98195-1360
Tel: 1 206 685 2409 • Fax: 1 206 543 3836
E-mail: hallet@u.washington.edu

8–17 July 1996
High Arctic Field Meeting
Ellesmere, Axel Heiberg, and Cornwallis Islands

IPA Working Group on Periglacial Processes and Environments
and
IGU Commission on Frost Action Environments

Approximate cost: $5000 C
Deposit required by 1 October 1995
Contact Dr. Antoni G. Lewkowicz, Department of Geography
University of Ottawa, Ottawa, Ontario, Canada K1N 6N5
Tel: 613 562 5704 • Fax: 613 562 5145
E-mail: alewkowi@acadvm1.uottawa.ca
See page 8 for more details.

5–8 August 1997
II International Conference on Cryogenic Soils
Ecology, Genesis and Classification

Programme

Ecological aspects of cryogenic soils:
Ecological functions of cryogenic soils • Productivity • Biochemical cycles • Gas exchange
Global climate change and cryogenic soils • Effect of anthropogenic factors on cryogenic soils
Contamination and remediation of cryogenic soils

Genesis and geography of cryogenic soils:
Soil-forming processes in cryogenic soils • Evolution and age of cryogenic soils • Cryogenic soils geography
Soil mapping and geographic information systems of polar and boreal regions • Methods of cryogenic soils study, including soil micromorphology, characterization of humus materials, etc. • Classification and databases of cryogenic soils and soil regimes and patterns

Round table discussion: International environmental monitoring activities in permafrost regions.

Field excursions

1. One-day mid-conference excursion to Syktyvkar area—soils of European Russia boreal forests, natural forests and ancient alluvial sands

2. Two-day post-conference field trip to southern part of tundra zone near Vorkuta—treeline fluctuations, relict Podzolic features, productive agriculture in tundra zone.

Registration fees about $250 or $300 U.S. including Vorkuta trip.

Notice of intent should be sent no later than April 1996 (name, address, phone, fax, E-mail, title of presentation, participation in excursion to Vorkuta).

Contact: Prof. I.V. Zaboeva, Institute of Biology,
Komi Center, Russian Academy of Sciences, 167610
Syktyvkar, Komi Republic, Russia
Tel: +7 821 22 25213, Fax: +7 821 22 25231
E-mail: gilichin@issp.serpukhov.su

23–27 June 1998
VII International Conference on Permafrost
Yellowknife, Northwest Territories, Canada
Sponsors: IPA • National Research Council of Canada • Geological Survey of Canada
Canadian Geotechnical Society • Science Institute of the Northwest Territories

Contact J.A. Heginbottom, Geological Survey of Canada, 601 Booth St.
Ottawa, Ontario, Canada K1A 0E8
Tel: 613 992 7813 • Fax: 613 992 2468 • E-mail: heginbottom@gsc.emr.ca
Conference e-mail: permafrost.conference@gsc.emr.ca