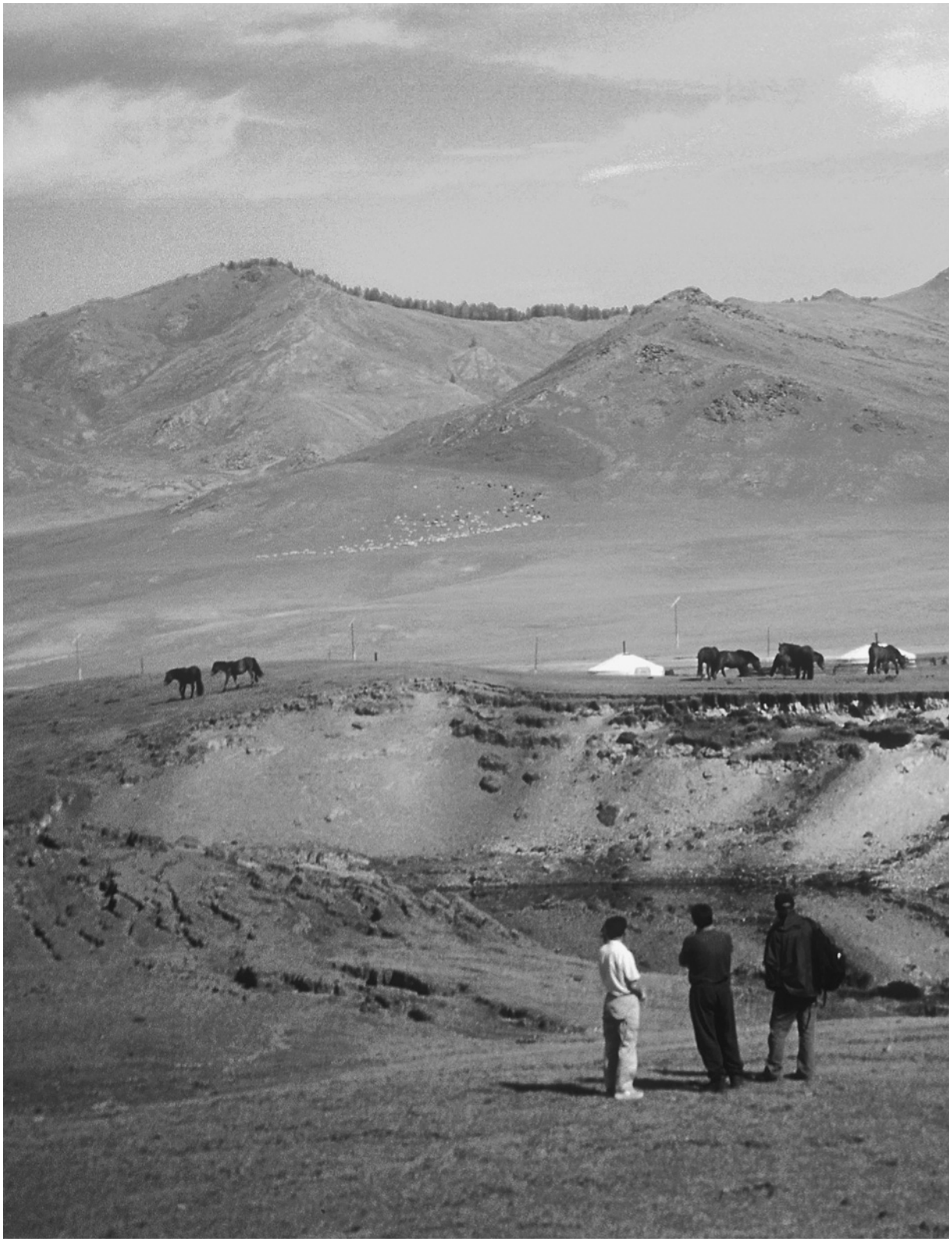
FROZEN GROUND

The News Bulletin of the International Permafrost Association

Number 25, December 2001



International Permafrost Association

The International Permafrost Association, founded in 1983, has as its objectives fostering the dissemination of knowledge concerning permafrost and promoting cooperation among persons and national or international organizations engaged in scientific investigation and engineering work on permafrost. Membership is through adhering national or multinational 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 23 Adhering Bodies having interests in some aspect of theoretical, basic and applied frozen ground research, including permafrost, seasonal frost, artificial freezing and periglacial phenomena. Committees, Working Groups, and Task Forces organize and coordinate research activities and special projects.

The IPA became an Affiliated Organization of the International Union of Geological Sciences in July 1989. The Association's primary responsibilities are convening International Permafrost Conferences and accomplishing special projects such as preparing maps, bibliographies, and glossaries. The first Conference was held in West Lafayette, Indiana, USA, 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; and the seventh in Yellowknife, Canada, 1998. The eighth will be in Zurich, Switzerland in 2003. Field excursions are an integral part of each Conference, and are organized by the host country.

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Permafrost Engineering
Cryosols
Coastal and Offshore Permafrost
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Rock Glacier Dynamics and Permafrost Creep
Mapping and Distribution Modelling of Mountain Permafrost
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Frozen Ground, the News Bulletin of the International Permafrost Association, is currently published annually.

The IPA is a non-governmental association of national organizations representing 23 countries or groups of countries. The success of the bulletin depends upon the willingness of IPA participants to supply information for publication. News items from any IPA participant or others are very welcome, as are interesting photographs. To submit news items or photos please contact:

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This issue of *Frozen Ground* was compiled by Hanne H. Christiansen and Jerry Brown.

The IPA Secretariat will move from 1 February 2002 to the following address:

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Cover: *Thermokarst site in the broad Chuluut river valley of the Khangei Mountains, Central Mongolia, located at 48°04' N and 100°24' E and at 1860 m asl. The site is described in more detail by Prof. N. Sharkuu from the Institute of Geography of the Mongolian Academy of Sciences, who has carried out borehole temperature measurements and thermokarst monitoring since the late sixties. The valley surface is undergoing very active thermokarsting, thermal erosion, thaw settlement and headwall erosion in the upper 5-10 meters of the ice-rich sediments. The thawing of this ice-rich permafrost may be contributing to river and groundwater discharges. The grassland around the numerous thermokarst pits and lakes is used by nomads and their life stock. Typical ger tents are shown behind the thermokarst lake. The Central Mongolian mountains are very dry, with warm summers and low precipitation. Therefore, the forest is restricted to north-facing slopes. The photograph also shows some participants on the six-days-field trip led by Prof. Sharkuu following the International Symposium on Land Permafrost in Mongolia. Both the symposium and this particular site are addressed in more detail in this issue. Photograph by Bernd Etzelmüller, Department of Physical Geography, University of Oslo, Norway, 11 September, 2001.*

Executive Committee Report

The past year has been one of the most active in the history of the International Permafrost Association. Committees, working groups and task forces organized and participated in workshops, symposia, conferences and field trips. Several international cooperative projects, monitoring programmes and climate assessment activities continued. The Executive Committee and the newly formed International Conference Advisory Committee met in Rome. Highlights of the year 2001 activities are summarized below. Details are presented in the following pages.

The First European Conference on Permafrost was convened in Rome in March with over 120 attendees from Europe, Russia, North and South America, Japan, China and South Africa. Major emphasis of the conference was on initial results of the Permafrost and Climate Change in Europe (PACE) programme and mountain permafrost. The task forces on Permafrost Creep and Mapping and modelling organised several sessions. Special issues of *Permafrost and Periglacial Processes* and the *Norwegian Journal of Geography* published a series of conference papers. The working groups on the Southern Hemisphere and the Coastal and Offshore Permafrost organized special sessions.

The six members of the Executive Committee met in open session during the Rome conference and reviewed activities, budgets, plans for the 8th International Conference on Permafrost (ICOP) in 2003, and appointed the nominating committee for the next election. The International Conference Advisory Committee held its first meeting with members of the organizing committee of the 8th ICOP. The first circular was distributed and over 400 abstracts were received.

Several members of Arctic Coastal Dynamics (ACD) Steering Group attended the Arctic Summit Week in April in Iqaluit, Canada. Plans for the ACD were presented there to the International Arctic Science Committee (IASC). The IASC approved funding for a second workshop that was held in Potsdam in November.

The Third International Conference on Cryopedology was held in Copenhagen in August and was co-organized by the Cryosol Working Group. Major themes of the conference were devoted to soil carbon stocks and fluxes and feedback mechanisms important in regional and global climate change. The new circumarctic soils map and soil database were displayed and demonstrated. During the Conference, Iceland indicated its intention to join IPA.

The first major international meeting of permafrost specialists took place in Mongolia in September 2001. Approximately 50 attendees from Mongolia and Argentina, China, Japan, Kazakhstan, North America, Norway, and Russia took part in the formal symposium and two days of local field trips. A small group visited permafrost regions of northcentral Mongolia. The Asian participants agreed to develop a revised permafrost map of Central Asia.

The Working Group on Periglacial Processes and Environments organized several sessions and a post conference field trip in association with the Fifth International Conference on Geomorphology held in Japan in August and September. The Southern Hemisphere Working Group met during the IGC conference. Members of the Working Group on Permafrost Engineering met at several national and international conferences in Pushchino and Moscow, Russia, and Canada. Members of several working groups are participating in the preparation of the infrastructure report for the first Arctic Climate Impact Assessment (ACIA).

The Standing Committee on Data, Information and Communications began coordination for production of the second CD ROM on Circumpolar Active-layer Permafrost System (CAPS). Initial results and site documentation of the Circumpolar Active Layer Monitoring (CALM) programme involving its 15 participating countries were prepared for publication in an issue of *Polar Geography*. The cochairs of the Working Group on Global Change and Climate completed work on the Arctic and Antarctic chapter of the Third Asessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC).

Calendar year 2002 will focus on the preparations for the 8th International Conference on Permafrost, including the review of manuscripts and camera copy of accepted papers, preparing for the IPA Executive Committee and Council meetings, and continuing activities of working parties. Preparation of the CAPS CD will be continue.

The IPA Secretariat will move to its new location at the University Course on Svalbard, UNIS, starting in February 2002, but will still be run by Hanne H. Christiansen. The Executive Committee extends its appreciation to the Institute of Geography, University of Copenhagen, Denmark for hosting the Secretariat since 1999.

The Executive Committee notes, with deep regret, the passing of Arturo Corte, former Argentinean member of the Council and pioneer in periglacial research.

1st European Permafrost Conference

The First European Permafrost Conference took place on 26-28 March 2001 at the Consiglio Nazionale delle Ricerche in Rome and was attended by over 120 scientists and engineers from Europe, Russia, North and South America, Japan, China and South Africa. The conference was held under the auspices of the International Permafrost Association and received financial support from the European Union, the Consiglio Nazionale delle Richerche and the 3rd University of Rome. Themes reflected the wide diversity of permafrost research in Europe, and the international importance of this research. Major elements in the conference sessions were the potential impacts of global climate change on permafrost regions of the world, and the importance of permafrost monitoring in detecting climate change within the Global Climate Observing System (GCOS). Charles Harris (Cardiff) chaired the conference organising committee and the local organising committee chair was Francesco Dramis (Rome).

Selected papers were presented orally in all conference sessions, but a large number of poster presentations were also included. Time was made available for short oral presentations introducing the posters, and this format proved highly effective. Conference Session 1, concerned with permafrost monitoring, was introduced by Margo Burgess (Canada) who discussed the Global Terrestrial Monitoring Network for Permafrost (GTN-P). Daniel Vonder Mühll (Switzerland) and Ketil Isaksen (Norway) presented results from the European PACE permafrost borehole network. The final two papers were by Jerry Brown who discussed progress in the CALM programme, and Tingjun Zhang (USA) who reviewed plans for the Global Geocryological Database (GGD). Fifteen poster presentations were included in Session 1.

The second session was entitled Permafrost, Active-layer and Climate. Permafrost and active-layer dynamics in Siberia were discussed in papers by Peter Kuhry (Finland), V. Y. Ostroumov (Russia), Hanno Mayer (Germany), and S.P. Gorshkov, (Russia). Hanne H. Christiansen (Denmark) described active-layer monitoring in Greenland, David Gilichinsky (Russia) discussed cryobiological research in permafrost, E.M. Pfeiffer (Germany) described measurements of methane flux in Siberia, and M. Bolter (Germany) reported on long-term CO_2 flux in arctic tundra. Jef Vandenberge (Netherlands) reviewed Pleistocene permafrost evolution in Europe; L. Eissmann (Germany) described Pleistocene permafrost structures in central Europe, and finally Charles Harris (UK) reported on laboratory modelling of ice-wedge casting mechanisms. This session was accompanied by some thirty poster presentations.

Session 3 was organised by the Task Force on Rock Glacier Dynamics and Permafrost Creep. Review papers were presented by Wilfried Haeberli (Switzerland: rock glacier dynamics), Vonder Mühll (Switzerland: thermal conditions), Matsuoka (Japan: rock glacier composition), Kääb (Switzerland: rock glacier dynamics), Springman (Switzerland: rheology and geotechnical considerations), and Haeberli (overview and summary). In addition, a total of 35 poster presentations were made.

The Task Force on Permafrost Mapping and Distribution Modelling of Mountain Permafrost, coordinated by Bernd Etzelmüller (Norway) and Martin Hoelzle (Switzerland), was responsible for Session 4. Numerical modelling of permafrost distribution was discussed in papers presented by Martin Hoelzle, Stephan Gruber (Switzerland), S.P Malevsky-Malevich (Russia), Catherine Mittaz (Switzerland), L.M. Tanaro (Spain), J.H. Christensen (Denmark), and Tingjun Zhang (USA). Other reports included cryospheric modelling in Siberia (E.D. Ershov, Russia), the influence of snow on ground freezing (A.S. Kashtanov, Russia), numerical modelling of permafrost in Europe during the last Pleistocene cold stage (G. Delisle, Germany), and the climate impact on glacial thermal regimes (Per Holmlund, Sweden). An additional 14 poster presentations reported on details of modelling and mapping of permafrost distribution.

Session 5 was concerned with Hazards, Geotechnics and Geophysics in Permafrost Regions. Permafrost-related hazards were discussed in papers on the PACE mountain permafrost assessment procedures (Charles Harris, UK), potential impact of permafrost degradation on urban infrastructure (N. Karstkarel, Russia), permafrost hazards arising from climate change (O. Anisimov, Russia), pile foundations in permafrost (V. Torgashov, Russia), soil cryogenic processes affecting the stability of buildings (V. Karlov, Russia) and finally, the use of freezing indices in designing and maintaining buried water pipes in mountain permafrost (Felix Keller, Switzerland).

Part 2 of this session included papers on Site Investigation. Four presentations discussed geophysical applications. Reports by D.M. Shesternyov (Russia) described the use of microwave radiometry, Christian Hauck (Switzerland) discussed electromagnetic methods, Daniel Vonder Mühll (Switzerland) reported on new radiometric thermal measurements, and O.F. Nielsen (Denmark) described the use of ground penetrating radar in detecting permafrost. A.E. Sundström (Norway) presented results on thermal modelling of a tailing deposit in Svalbard, and Daniel Vonder Mühll described new boreholes drilled in the Murtèl-Corvatsch rock glacier in Switzerland. The influence of permafrost on slope instability formed the final part of Session 5, with papers by Charles Harris and Michael Davies (both UK) on centrifuge modelling of slope process, the former discussing soil slopes and the latter rock slopes. The final contribution by Y.V. Mudrov (Russia) reported on natural per-

mafrost slopes in the Russian arctic. Twenty poster presentations were included in Session 5.

Session 6, on Antarctica, was convened by Mauro Guglielmin (Italy) and included a total of nine oral presentations. David Gilichinsky (Russia) discussed the age of Antarctic permafrost; Hugh French (Canada) described frost mounds in Northern Victoria Land; G. Viera (Portugal) discussed geomorphological dynamics in the South Shetlands; Toni Lewkowicz (Canada) reported on the thermal regime of tors in Ellesmere Island, Canada and Victoria Land, East Antarctica; and Kevin Hall (Canada) described thermal monitoring in relation to rock weathering. These were followed by a series of papers concerned with Antarctic permafrost monitoring by M.R. Balks (New Zealand), T. Sone (Japan), Miguel Ramos (Spain), and Mauro Guglielmin (Italy). Five poster presentations accompanied the Antarctica Session.

The final session of the Conference, Session 7, was on Coastal and Marine Permafrost. The German-Russian collaborative programme on the Laptev Sea coordinated by Hans Hubberten (Germany) made a major contribution, with papers presented by G. Delisle (Germany), N. Kaul (Germany) and V. Rachold describing subsea permafrost, temperature measurements, and coastal erosion, respectively. In addition, A.V. Brouchkov (Russia) described frozen saline soils, V.Y. Ostroumov discussed drainage of super-permafrost waters; Felix Are (Russia) reported on arctic shore faces; Michelle Allard (Canada) described permafrost in emergent marine sediments; and I.A. Komarov discussed the role of salt transport in sub-aquatic permafrost. Accompanying Session 7 were three poster presentations.

Copies of the conference abstract volume are available from Charles Harris (Cardiff University, Earth Sciences). A special volume of the journal *Permafrost and Periglacial Processes* was published for the conference (Volume 12, no. 1, 2001) and contains twelve papers reporting preliminary results of the EU PACE programme. Contact Charles Harris for information on reprints etc. A special volume of the *Norwegian Journal of Geography*, edited by Bernd Etzelmüller and Martin Hoelzle contains papers from Session 4.

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Participants in the Post-Conference field excursion standing on a sliding plane in the village of Montelparo.
Photo by Hanne H. Christiansen, 30 March, 2001.

Post-Conference field excursion

A two-day Post-Conference field excursion illustrated a geomorphological transect through the Appennines in Italy. The excursion took place from 28 - 30 March, and was led by F. Dramis, who has lived and worked in the area over the past many years. Several other guides, who presented individual sites, assisted Prof. Dramis. The excursion was joined by more than 25 participants from different countries, who enjoyed the presentation of the geomorphology of the central Italian mountains in combination with the excellent Italian cuisine.

We travelled by bus from Rome when the conference closed, and visited on the first day an active tectonic site in the area of the town Colfiorito, where an earthquake in 1999 heavily damaged the town and killed several people. Travertine deposits in the Camerino area were demonstrated along river exposures, and their formation as controlled partially by ground temperature variations was explained. The day ended with some visits to the stratified slope waste deposits of Middle to Upper Pleistocene age, which is widespread in this part of Italy. Finally, we reached the town of Ancona on the east coast of Italy.

On the second day we visited the huge Ancona landslide (1982), which was triggered by deep-seated gravitational slope deformation. We saw the characteristic landslide morphology with trenches, scarps, steps and reverse slopes together with evidence of destruction of buildings. Our journey continued through the typical badlands of the Adriatic side of central Italy, and we visited another landslide in the village of Montelparo. Here one part of the town is being moved as a whole away from the other part by large-scale translational sliding. Before reaching Rome again, we were introduced to the area around Mt. Ascensione, where badlands, slope deposits and pediments were discussed.

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Executive Committee Meeting 2001

All six members of the Executive Committee met in the Hotel Laurentia, Rome, Italy, March 25, 2001, immediately prior to the 1st European Permafrost Conference. An informal meeting in the morning was followed by an open meeting of the Excecutive Committee in the afternoon. Dr H. H. Christiansen, the IPA Secretariat, was present throughout. On occasions during the afternoon session, there were in excess of

20 observers. The agenda included review of the IPA budget for 2001, the review and allocation of $3,000 to IPA activities (i.e. Working Parties), and a review of the production schedule and projected costs of the next issue of Frozen Ground (2001). The IPA Secretariat was congratulated upon the quality and efficient production of the past issues of Frozen Ground. It was noted that the current annual revenue of the IPA is derived solely from contributions paid by Adhering Members. Revenues totaled about $14,000 (US) in 2001. The majority of funds are allocated to the production of Frozen Ground ($4,000); the support of the IPA Secretariat ($4,000), and the travel and other expenses associated with the EC meeting in Rome ($3,000). It was noted that several Adhering Bodies were delinquent in their payment of dues. Discussion also centered around the possibility of increasing the annual contributions so as to permit additional initiatives. Funding is also allocated to a travel grant reserve being built-up to assist with the 8th ICOP in Zurich, Switzerland in 2003.

Status reports of the organization of the 8th ICOP by W. Haeberli (Swiss Organizing Committee Member, speaking on behalf of the Chair of the Swiss Organizing Committee for the 8th ICOP, Sarah Springman) and the activities of the IPA International Conference Advisory Committee by K. Flaate (Chair) were presented. Discussion included the procedures to be adopted for the submission and review of abstracts and papers, registration fees, and Chinese and Russian participation.

In accordance with the IPA constitution, a Nominations Committee was appointed consisting of JL. Sollid (Norway, Chair), F. Are (Russia), and R. Tart (USA). It was asked to submit recommendations for the next IPA Executive Committee by June 2002, in order that they be circulated to all Adhering Members and then voted upon at the Council meeting in Zurich in 2003. There was an extensive discussion about the nature of the next election, and the desirability or not of having multiple candidates for the six positions.

There was discussion as to the possible venue for the proposed 9th ICOP in 2008. Both China and the USA have expressed interest. The President requested that formal invitations should be submitted in writing and these would be considered, and voted upon, at the 2003 Council meeting.

Hugh M. French (hfrench@science.uottawa.ca)

Third International Cryopedology Conference

The Third International Conference on Cryopedology entitled Dynamics and Challenges of Cryosols was held at the Institute of Geography, University of Copenhagen, August 20-24, 2001. The conference was organised by the Cryosols Working Group of the International Union of Soil Sciences (IUSS) and the International Permafrost Association in cooperation with the Institute of Geography at the Geocenter Copenhagen.

The focus of the scientific programme was to emphasize the importance of different natural sciences in order to understand the complex climate-landscape interactions in arctic areas, feedback mechanisms important for changes in regional and global climate, and other aspects of global change. Soil processes in many cases play a key role within integrated terrestrial arctic systems. The conference addressed key problems concerning soils, soil ecology, active layer-permafrost processes of polar regions and responses of arctic terrestrial landscapes to global change. Approximately 45 oral presentations and 35 posters were given in the following topical sessions.

- Northern Circumpolar Soil Database.
- Active layer dynamics and Cryosols.
- Soil Ecology of Cryosols
- Carbon storage and carbon cycling in Cryosols.
- Cryogenic processes, hydrogeochemical cycling and pedogenesis in Cryosols.
- Responses of Cryosols to anthropogenic impact.
- Environmental change - Palaeoenvironments and Cryosols.

Selected papers will be published in a special issue of the *Danish Journal of Geography*.

An afternoon session was hosted at the Danish Polar Center. Several Danish arctic research institutions and their programmes and facilities in Greenland were presented to the conference participants, together with presentations of the international organizations and their activities hosted in Copenhagen, such as the IPA International Secretariat. Short seminars on terrestrial Arctic Systems and Global Change were organised during the last day of the conference. These seminars focused on the main challenges, theories and methodologies for: (1) understanding carbon fluxes in Arctic Systems; (2) the main challenges for the polar soil scientific community to support the establishment of and the access to soil data of high quality; (3) and on monitoring of permafrost and Cryosols as part of a monitoring programme for the polar terrestrial systems.

A joint meeting of the IPA and IUSS Cryosols Working Groups prepared the following conference resolution: The Third International Conference on Cryopedology was held in Copenhagen, Denmark on August 20–24, 2001. As a result of the four seminars held on the last day of this conference, the following resolutions and recommendations were made.

1. In order to better understand carbon fluxes in arctic soils, soil scientists should be involved in (a) providing data for detailed site selection and descriptions for plot and regional scale flux measurements to ensure that flux data is collected on representative soils, and (b) spatially displaying the carbon fluxes on a circumpolar map, and ensuring that soil data is available through a central database;
2. Develop a homepage for Cryopedology to ensure that activities and expertise are made known to other disciplines, and continue to organise international conferences on Cryopedology;
3. Provide information on soil organic matter content, soil organic matter quality (chemical fractions), and soil water content for scientists involved with carbon flux measurements;
4. Develop methodologies for scaling up carbon flux data collected from plots;
5. Develop interpretative maps such as active layer thickness, soil texture, levels of pollution and soil behaviour under various usages;
6. Develop a circumpolar carbon stock map for permafrost-dominated soils;
7. Carry out monitoring for special purposes (e.g., coastal erosion, pollution, soil carbon) to supplement and compliment other ongoing circumpolar monitoring projects (e.g. CALM and ITEX);
8. Employ an ecosystem approach for future monitoring. Soils should be part of this monitoring and proper soil and site descriptions and analytical data should be given; and
9. Employ the soil protocol developed for ITEX and CALM for soil descriptions.

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Participants in the Cryosols conference at the Danish Polar Center 22 August, 2001. Photo: Hanne H. Christiansen.

International Symposium on Mountain and Arid Land Permafrost and Field Excursions in Mongolia

Introduction

The first major international meeting of permafrost specialists took place in Mongolia occurred during the period 2-12 September 2001. Approximately 50 permafrost specialists from Mongolia and eight other countries (Argentina, Canada, China, Japan, Kazakhstan, Norway, Russia and United States) took part in three days of formal sessions and two days of local field trips. A small group participated in a six-day, post-symposium excursion to the mountainous regions of north central and central Mongolia to examine regional permafrost distribution and characteristics.

The symposium and field trips were organised by the Institute of Geography of the Mongolian Academy of Sciences (MAS) and the International Permafrost Association (IPA). In addition to local sponsors, the International Arctic Research Center (IARC) at the University of Alaska, Fairbanks, Alaska, through its cooperative agreement with the U.S. National Science Foundation, provided financial support for a number of foreign participants. The concept of the meeting was first discussed in 1998 at the 7th International Conference on Permafrost in Yellowknife, Canada, (French 1998) with N. Sharkhuu of the MAS Institute of Geography. Although the permafrost regions of Mongolia were known from the Russian, Polish and Mongolian literature (Sharkhuu 1993: Gravis et al), few foreign geocryologists had actual first hand knowledge, including those from neighboring China and Kazakhstan. The IPA facilitated the organization of the meetings in order to assist in its current activities as represented by participating members of several of its committees and working parties: Executive Committee: Jerry Brown; Standing Committee on Data, Information and Communication: Tingjun Zhang; Task Force on Mapping and Modelling of Mountain Permafrost: Bernd Etzelmuller, Sergei Marchenko, Dario Trombotto and Stuart Harris; Working Group on Permafrost and Climate Change: Fritz E. Nelson and Nikolai Shiklamonov.

Symposium

The formal paper and informal poster sessions were based on 35 abstracts submitted prior to the meetings and published in a 95-page extended abstract volume. N. Batnasan, science secretary of the Institute of Geography, Mongolian Academy of Sciences, and a hydrologist assisted N. Sharkhuu to organise the programme and publication. Major topics presented and discussed included:

1 Mountain permafrost distribution, mapping and modelling in Argentina, Canada, China, Kazakhstan, Mongolia, the Nordic and European countries, and Russia.
2 Monitoring of active layer and boreholes as part of the Global Terrestrial Network-Permafrost (GTN-P) and the Circumpolar Active Layer Monitoring (CALM) programme.
3 Observations of hydrologic responses from climate, glaciers and ground ice, and effects on lake levels and river discharges.
4 Proposed pipeline construction across Mongolia.
5 Continuing plans for the Global Geocryological Database (GGD) and preparation of its second CD-

Symposium participants at the, Mongolian Academy of Sciences, Ulaanbatar, Mongolia. Photo: Bernd Etzelmüller

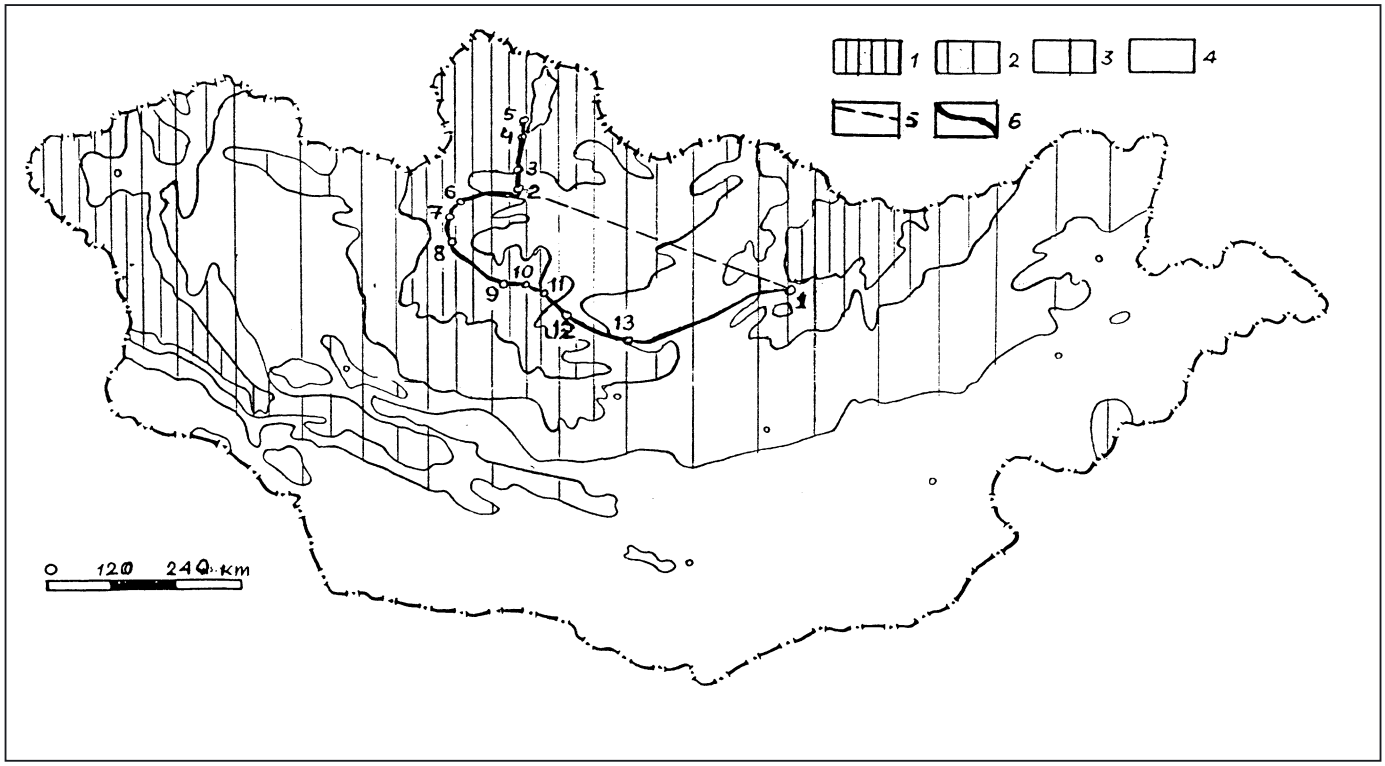
ROM for presentation at the 8th International Conference on Permafrost.

A series of roundtable discussions resulted in five recommendations that were approved in the closing session:

1. Improved knowledge of the occurrence and changes of permafrost in mountains due to natural and human-induced changes require standard mapping and classification across national boundaries. Further, an international team of experts is required to prepare a uniform map of Central Asia permafrost (China, Kazakhstan, Mongolia, and Russia).
2. Modelling of permafrost distribution in representative areas of mountain regions is required at different scales.
3. Construction, land use, local and Pan Arctic water balance prospects should take into account long-term changes in active layer and permafrost under natural and disturbed conditions.
4. International long-term observational networks of soil moisture, thaw and ground temperature, and periglacial features in the mountains should be established and maintained as part of the WMO/FAO GTN-P programme; for example in the Altai Mountains.
5. Mapping, modelling, and monitoring strategies in mountain regions should be designed for testing and verification of climate change scenarios.

The first recommendation supports the need to further refine the IPA permafrost and ground ice map of the Northern Hemisphere (Brown et al, 1997). The priority is to develop a common permafrost classification for the Asian mountains and plateaus so that a regional permafrost map including southern Russia, Mongolia, China and Kazakhstan and adjacent countries can be prepared. Representatives of each of the four countries agreed to develop this activity and to prepare a paper or report in time for the 8thICOP. Kazakhstan and Mongolia are concluding a three-year cooperative project on their common permafrost problems.

The other recommendations represent next steps for the IPA and to improve modelling, mapping, monitoring techniques and management of data, and to apply them to questions of human-induced and natural changes. The modelling approach requires availability of digital elevation data from which energy balance calculations in conjunction with other parameters are used to estimate the occurrence or absence of permafrost on slopes of differing aspects and elevations (Hoelzle et al., 2001; Etzelmüller, et al, 2001). Several areas in Mongolia and Kazakhstan have adequate borehole data for use in calibrating or validating the models at differing resolutions. At present there are some 20 CALM monitoring sites in the high elevations of Kazakhstan, Mongolia and China that are observing active layer thickness and temperature.



Distribution of permafrost and seasonally frozen ground in Mongolia and route of 6-day field trip. Symbol and lines: 1. Continuous and discontinuous permafrost zones (50-100%); 2. Isolated permafrost zone (1-50%); 3. Sporadic permafrost areas (0-1%); 4. Seasonal frost zone; 5. Route of air travel; 6. Route by ground vehicles. Numbers on map: 1.Ulaanbaatar; 2. Muren; 3. Burenkhan; 4. Khatgal (Lake Hövsgöl); 5. Ardag; 6. Sharga; 7.Tes; 8. Tosontsengel; 9. Terkh; 10. Tariat; 11. Chuluut; 12. Tsetserleg; 13. Kharkhorum.

Permafrost distribution and climate

Based on results of the joint Russian-Mongolia expeditions of the late 1960s and more recent maps and publications by Sharkhuu (1998) and others, it is known that permafrost conditions underlie almost two thirds of Mongolia (976,500 km^2), predominantly in the Khentei, Hövsgöl, Khangai, and Altai mountains and surrounding areas. The territory is characterized by mountain and arid-land permafrost as an extension of the southern fringe of the Siberia permafrost zones. Most of this region forms the Selenge River basin, which drains into Lake Baikal to the north. Annual precipitation averages about 200 mm. The extent of permafrost ranges from areas where a majority of the land surface is underlain by permafrost (>50%; continuous and discontinuous) to areas only sparsely occupied by permafrost (<50%; isolated and sporadic). The lower limit of continuous permafrost (>85%) on south facing slopes ranges from 1400 to 2000 m asl. in the Hövsgöl and Khentei mountains, and between 2200 and 3200 m asl. in the Altai and Khangai mountains. The lowest limit of sporadic permafrost is found at 600 to 700 m asl.

In the continuous and discontinuous permafrost areas, taliks (permafrost free areas) are found only on steep south-facing slopes, under large river channels and deep lake bottoms, and along tectonic fractures with hydrothermal activity. In isolated permafrost areas, frozen ground is found only on north-facing slopes and in fine-grained and moist deposits. Average thickness and temperature of continuous permafrost is 50-100 m and -1 to -2°C in valleys and depressions, and 100-250 m and -1 to -3°C in mountains, respectively. Permafrost in Mongolia is characterized mainly by low and moderate ice contents in unconsolidated sediments. Ice-rich permafrost is characteristic of lacustrine and alluvial sediments in valleys and depressions.

Thicknesses of the seasonally thawed active layers are 1-3 m in fine-grained soils and 4-6 m in coarse materials or at sites with mean annual ground temperature close to 0°C. There are widespread cryogenic processes and phenomena in the permafrost regions. Trends of air temperatures for the period 1940 to 1990 indicate that mean summer temperatures in the Selenge River Basin have increased by only 0.5°C, whereas winter temperatures have increased by 4.0 °C. During the same period, mean annual air temperatures have increased by 1.8 °C in western Mongolia, 1.4 °C in Central Mongolia and 0.3 °C in southern and eastern Mongolia. Mean summer, winter and annual precipitation has not changed significantly. According to data of the Baruun Kharaa weather station, located about 120 km northwest of Ulaanbaatar, the trend of mean annual air temperatures for the periods of 1940-1999 and 1996-1999 are 0.042 °C and 0.152 °C per year. The mean annual and summer air temperatures during the last five years were at a maximum in 1998; and greater than the trend observed during the last 60 years.

During the last five years, maximum depth of seasonal thawing of ground for all boreholes was observed in 1998 and minimum depth mostly in 1999. Mean annual ground temperatures in the Selenge Basin have increased at rates of 0.01 to 0.02 ºC per year and permafrost degradation is occurring in 75% of the areas where permafrost exists. Therefore, if the present warming rates continue permafrost with thicknesses of 15-20 m will disappear by the middle of the 21st century (Sharkhuu, 1998). This would represent a reduction of permafrost occurrence from 25-35% to 20% of the Selenge Basin. However, permafrost is aggrading under dense forests where moss is present. Essentially all remaining areas without permafrost in Mongolia are subjected to deep seasonal freezing. Climate modelling suggests 24-28% of present-day permafrost may disappear by 2040 (see the Symposium extended abstracts for more details on permafrost distribution, monitoring, and climate scenarios).

Field excursions

Both the two-day local and six-day extended field trips offered the participants opportunities to visit sites of known permafrost occurrence and to view some of the natural scenery and nomadic cultures of Mongolia. The Khentei Mountains surrounding Ulaanbaatar were the focus of the two-day excursions; and the Hövsgöl and Khangai Mountain regions of north central and central Mongolia, respectively, were the regions visited during the extended excursion. Both trips were well organised and led by N. Sharkhuu who has mapped and monitored permafrost conditions over the past 35 years (Sharkhuu 1993). Sharkhuu illustrated the locations visited with a series of cross sections, borehole profiles, maps and related data. These will be incorporated into a guidebook that will be available for general distribution.

During the two-day excursion the group of foreign participants visited permafrost sites in several protected areas and national parks in the Khentei Mountains where elevations range from 1600 to 2800 m asl. It was illustrated how the presence of talus block fields or rockfalls on steep mountain slopes (kurums) promote permafrost formation as cold winter air penetrates the porous slopes. Other sites included visits to: a coal mining district in which permafrost degradation had caused damage to buildings in this discontinuous permafrost area; an above-ground, cold storage facility constructed of ice in the 1940s and which is still functioning; location of a new oil refining facility

Participants in six-day field excursion in central Mongolia. Photo: Bernd Etzelmüller.

on permafrost; and a small ice-cored mound (pingo) in a partially drained lake.

The six-day excursion began with a flight from Ulaanbaatar to Muren, the administrative center of the Hövsgöl region (aimag). During the ensuing days the party of eleven and two drivers (see group photograph) covered approximately 1500 km by Russian jeep and a Japanese mini van across a wide range of mountain trails and unpaved roads; only the last 300 km on the way back to Ulaanbaatar was on paved road. Overnight stops included two tourist camps consisting of small houses (gers) used by the pastoral nomadic population. Herding of sheep, goats, cattle and yaks were observed everywhere on the treeless grassland steppes. Occasional encounters with small herd of grazing camels offered excellent photo opportunities. Forest covered slopes, predominantly of larch, covered most north-facing slopes to the treeline.

The first two days in the Hövsgöl Mountain Range included visits in the Burenkhaan and Ardag mountains to observe borehole and mapping sites at which the relation of slope, aspect, elevation and vegetative cover were illustrated as controlling the extent and thickness of permafrost. Boreholes located between 1600 and 2300 m asl have been monitored over the past 40 years, including the period of phosphorite exploration in the 1980s. Both areas with their rich phosphorite deposits and unique natural environments have been subsequently protected from future development. The town of Khatgal (Hatgal) located at the southern end of Lake Hövsgöl is underlain by moderately ice-rich permafrost. Many buildings suffered structural damage as permafrost thawed and settlement occurred. This was also the case at the nearby Russian-Mongolian phosphorite geological base camp at Ardag Mountain on the lower west side of Lake Hövsgöl.

The 262-m deep Lake Hövsgöl is the deepest lake in central Asia south of Russia, and is the center of the 8381km^2 Khubsugul National Park. The Park and Lake Hövsgöl are bordered on the north by the Russia Federation. The recently established site of the World Bank's Global Environmental Facility (GEF) and international Long Term Ecological Research (LTER) is located on the east side of the lake (Goulden et al. 2000; Gosz et al., 2000). This LTER project offers an excellent opportunity to develop the mountain mapping and modelling approaches, to monitor changes in the active layer and permafrost, and assess how future changes in permafrost may affect the biodiversity and biogeochemistry of this area

On Day 3 boreholes and others sites were visited to explain permafrost characteristics in lacustrine deposits, seasonal ice-mound formation, pingos, and thermokarst features in the Sharga and Tes river valleys surrounding the mountains. The Mungot pingo in the Tes valley was drilled in 1968 and water was encountered under pressure at 32 m. The initial flow resulted in a 70 cm high artesian fountain whose flow was carefully monitored for 120 hours (Sharkhuu, pers. comm.).

Days 4 and 5 were devoted to crossing uplands and broad valleys of the Khangai Mountains. The Khangai Range extends about 800 kilometers from the western part of Mongolia to the southeast with elevations ranging upwards from 3000 to 4000 m asl. Valley floors are usually above 2000m asl. In the broad Terkh River valley stops were made to observe borehole and active layer monitoring sites. Temperature measurements in many of these boreholes were first measured in the late 1960s and provide evidence for the recent regional warming of the permafrost. Active solifluction lobes are observed on many of the valley slopes vegetated by both steppe and larch forests. A recently instrumented site was visited.

The thermokarst and thermal erosion processes of the Chuluut river valley were the main object of the Day 5 (Sharhkuu, 1998). The Chuluut River cuts a spectacular deep canyon across lava flows that blocked the river in the vicinity of several small volcanoes and formed a large lake. Refreezing of the lacustrine-alluvial deposits resulted in formation of high-ice content permafrost. Horizontal ground ice lenses up to 80 cm thick are observed in riverbanks and thermal erosion cuts. The valley surface consists of gently undulating mound-like features with small-incised drainages. The highest mound visited rises 15 meters above this surface, and although it has the features of a pingo, drill logs reveal it is composed of segregation ice; not injection ice. The western downstream portion of this valley surface is undergoing very active thaw or thermokarst and thermal erosion as headward erosion and thaw settlement erode the upper 5-10 meters of ice-rich sediments (see cover photo). Springs are seen emerging in thaw ponds. Rate of thermal erosion, thaw settlement, and ground temperatures are being monitored by Sharkhuu.

A first impression by Western observers suggests that this thermokarst landscape may be an early stage

in the formation of alas valleys as observed in some areas of Yakutia (S. Harris, pers. comm.). This undulating thermokarst topography may represent past episodes of thermokarst development and stabilisation. The cause of the present 'cycle' of accelerated thermokarst development was not immediately obvious; it could be triggered by either human disturbance or may be a natural process responding to contemporary climate (see Sharhkuu, 1998). These processes and related ground-ice features warrant further investigation as the thawing of this ice-rich permafrost may in fact be contributing to river and groundwater discharges.

The final day of the excursion was devoted to the 460-km drive to Ulaanbaatar across the mountain steppe zone and a visit enroute to the 13th century capital of Chenggis Khan at Kkarkorum and site of the present-day Buddhist monastery at Erdene Zuu.

Conclusions

The symposium and field excursions will leave a long-lasting impression on the international visitors and the Mongolian participants. The formal and personal contacts will provide opportunities for new scientific and geotechnical projects and institutional exchanges, increased IPA activities in Asian and other mountain regions, and a better understanding of how the permafrost conditions of this vast area of Mongolia is responding to the observed climate changes. For further information on the availability of the abstract volume and guidebook contact the Institute of Geography, MAS at (aisav@mongol.net) and (geodgv @ magicnet.mn).

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Report of Working Parties

The IPA Council at the 1998 7th ICOP in Yellowknife approved the formation or continuation of one Standing Committee, six Working Groups (WG) and three Task Forces (TF); collectively referred to as Working Parties (WP). Task Forces are intended to be short-term activities resulting in assessments or recommendations on specific subjects. Additional details on the guidelines for Working Parties and international liaison are found in Frozen Ground Number 22.

The following reports cover activities over the past 12 months. A number of WP meetings took place in 2001 in conjunction with the conferences, symposia and workshops in Rome, Moscow and Pushchino, Copenhagen, Tokyo and Mongolia. These meetings provided the venues for formal and informal WP discussions on present activities and plans leading up to the 8th International Conference on Permafrost in Zurich. Brief status reports of several international programmes are presented and include the Global Terrestrial Network for Permafrost (GTN-P), CALM, PACE and Climate and Cryosphere (CLIC).

Reports are reviewed and edited by Jerry Brown, Member, IPA Executive Committee.

Standing Committee

Data, Information, and Communications

The objectives of the SCDIC are to initiate and implement IPA strategies for data, archiving, information product development, and communication within and beyond the permafrost community. In addition to the cochairs Roger Barry (USA) and Mike Clark (UK), members include Julia Branson (UK), Margo Burgess (Canada), Daniel Vonder Muehll (Switzerland), Hanne H. Christiansen (Denmark), representatives from China, Russia and several Working Groups, and Jerry Brown (USA) as liaison for the Executive Committee and GTN-P.

During the past year SCDIC members have communicated via email although a number of them were able to meet in Rome during the 1st European Permafrost Conference to discuss progress on the GTN-P and preparations of the CAPS CD for the 8th International Conference in 2003. The IPA web site was revised by Julia Branson and the staff of GeoData Center, University of Southampton. Full text of the Frozen Ground 21-24 and current reports of IPA Members and Working Parties are readily accessible on the web.

To continue the IPA strategy for data and information management as part of the Global Geocryological Database, the SCDIC working with the National Snow and Ice Data Center (NSIDC), University of Colorado, and the International Arctic Research Center (IARC), Unversity of Alaska, will revise and update the 1998 CAPS CD-ROM and expand the GGD. Tingjun Zhang and Mark Parsons are leading the work at NSIDC. Provisional plans include development of a new search engine with an interactive data access through the CD-ROM, an internet web site and FTP. Current status, plans and requirements for the GGD-CAPS II activities were presented at the IPA meetings in Russia, Rome, Copenhagen, and Mongolia (see other reports of these meetings). Since the 1998 conference, new and continuing IPA projects have developed large amounts of information for inclusion in GDD. These include, but are not limited to: (1) the Global Terrestrial Network for Permafrost (GTN-P) including CALM, PACE and the borehole network, (2) the Arctic Coastal Dynamics (ACD) project; (3) the Cryosol database and maps; and (4) the results from the task forces on permafrost creep and mountain permafrost modelling and mapping.

Other candidate data sets and products include: selected Chinese permafrost maps and borehole data; time series of Russian soil temperatures from climate stations; data from Russian INTAS projects on ground ice and TUNDRA; the Japanese GEWEX Asian Monsoon Experiment (GAME)-Tibet and GAME-Siberia projects; the Canadian climate cryopshere programmes; the United States Arctic System Science (ARCSS) projects; revisions to the English-Russian permafrost glossary; an updated bibliography on frozen ground; experimental data from the Caen's ice-segregation bedrock experiment; and a metadata catalog of frozen ground models. Identification of additional data and information for CAPS II by all countries, organizations, individuals, and IPA working parties are requested. A small January 2002 meeting is planned in Boulder to review the inventory of metadata and data sets, plan revisions in existing files, and solicit new data.

While on sabbatical visit in Russia, Cochair Barry attended both the annual Earth Cryology and Council meetings in Pushchino and the 2nd Russian Conference on Cryology at Moscow State University. He presented reports in Russian on (1) the role of snow and ice in the climate system, (2) the Global Geocryological Database (GGD), and (3) the distribution of perennially and seasonally frozen ground in the northern hemisphere. Abstracts of these and related reports by Barry and Zhang are available in proceedings of the meetings reported upon in this issue of Frozen Ground. The proceedings of the November 1998 NATO-sponsored workshop on Permafrost Response on Economic Development, Environmental Security and Natural Resource was published by Kluwer and contains the reports on the IPA monitoring networks.

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Working Groups

Global Change and Permafrost

The objectives are to facilitate analysis of changes in permafrost and its distribution induced by climate change, and to promote knowledge about the impact of these changes on natural systems and human activities. F.E. Nelson (USA) and Oleg Anisimov (Russia) co-chair the Working Group. A subgroup coordinates the CALM network.

Results from the Third Assessment Review (TAR) of the Intergovernmental Panel on Climate Change (IPCC) were published in mid-2001, after extensive scientific and governmental review. Chapter 16 'Polar Regions (Arctic and Antarctic)' of the volume 'Impacts, Adaptation, and Vulnerability,' prepared by Working Group II, contains a review of the current status of permafrost research as it relates to climatic change, as well as its relation to international monitoring and assessment efforts (Ansimov et al., 2001). The regional focus of the chapter facilitated integration of permafrost research into other sections treating related topics, including climate drivers, hydrology, biota, and impacts on human communities. Permafrost is also discussed in chapters treating other regions, and a short section on observed active layer and recent permafrost thermal trends, written by M. Burgess (Canada) and S. Smith (Canada), appeared in Chapter 2 of the Working Group I Assessment Report 'The Scientific Basis.' This section includes a reference to the GTN-P Programme.

At its final meeting in February 2001, the IPCC TAR compiled and approved the Final Report and the Summary for Policymakers (WGII). Due largely to insistence by representatives of the Russian and Canadian governments, the IPCC Summary for Policymakers (WGII) contains a statement to the effect that ongoing changes of climate in the permafrost regions may result in substantial release of greenhouse gases and that the degradation of permafrost may have adverse impacts on northern infrastructure.

In July 2001, Anisimov presented an overview of climate change impacts in high-latitude regions of the northern hemisphere at the plenary session of the well-publicized IGBP Open Science Meeting in Amsterdam. One of the key points adopted in Amsterdam was that permafrost and arctic tundra play an important role in the atmospheric carbon balance, and that efforts should be made to predict releases of greenhouse gases in the Arctic.

As a regional analysis of the IPCC process the Arctic Climate Impact Assessment (ACIA) covers several topics of interest to the IPA. Chapter 5 on the Cryosphere and Hydrologic Variability contains a section on onshore and offshore permafrost. Contributing and consulting authors are Vladimir Romanovsky (USA) for terrestrial permafrost and Steven Solomon (Canada) for offshore permafrost. Permafrost topics included in Chapter 5 are:

- overview of permafrost: terrestrial and undersea.
- factors affecting permafrost extent, thickness.
- current status of permafrost modelling.
- recent variations of permafrost.
- projected changes: active layer thickness; extent of continuous and discontinuous permafrost; uncertainties in projected changes.

Additional information on Chapter 15 on Infrastructure, including Business/Industry is reported in the Engineering WG report.

At the 7th International Conference on Permafrost, the Global Change Working Group announced the goal of increasing the visibility and significance of permafrost terrain in the context of natural hazards research. Some progress toward this goal was made this year through publication of a short report in the journal *Nature* delimiting areas of the circum-Arctic region with varying degrees of climate-related hazard potential (Nelson et al., 2001b). This paper was given widespread attention by the news media, and also generated considerable interest from government policy analysts. A second paper, reviewing the relationships between climate change, permafrost, and impacts on human infrastructure, has been accepted by the journal *Natural Hazards*, an outlet for specialist research (Nelson et al., 2001a).

During the past year, work continued within several IPA activities related to Global Terrestrial Network for Permafrost (GTN-P) (see Frozen Ground 24, 12-14). The development of the GTN-P and its web site continued at the Geological Survey of Canada (http://sts.gsc.nrcan.gc.ca/gtnp). The GTN-P programme combines a component of active layer observations (the Circumpolar Active Layer Monitoring CALM programme) with a new component of permafrost thermal monitoring. Activities for the borehole component included updating the inventory of locations, and compilation of borehole metadata and its accessibility on the web site. A GTN-P status report was submitted to the IPA Executive Committee at the 1st European Permafrost Conference in Rome, in March 2001 and is available on the GTN-P web site.

The CALM programme, centered at the University of Cincinnati (USA), is designed to observe the response of the active layer and near-surface permafrost to climate change. The network currently incorporates more than 100 sites involving 15 investigating countries in both hemispheres. Both existing PACE sites in Europe and sites in the Antarctic are being added to the circumpolar network. Over 60 sites collect data using a grid sample design, thus allowing for spatial analysis and integration with remotely sensed data. Other sites use thermistor cables to interpolate active layer thickness. Seasonal soil thaw demon-

strated a consistent response to air temperature forcing on an interannual basis in a variety of locations worldwide. During the period 1995-2000, some sites in Alaska, Northwest Canada, the Nordic region and Russia experienced maximum thaw depth in 1998 and a minimum in 2000; these values were consistent with the warmest and coolest summers. All sites demonstrate significant interannual variation. These results serve to emphasize the need for standardized, regional collection of long-term measurements in an effort to discriminate spatial and temporal patterns. A complete issue of *Polar Geography* is devoted to documenting the present CALM network and reporting initial results from the 1990s.

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Periglacial Processes and Environments

The objectives are to evaluate different methodologies and techniques for monitoring periglacial processes, and to publish a manual of techniques. Ole Humlum (The University Courses on Svalbard, UNIS, Norway) and Norikazu Matsuoka (University of Tsukuba, Japan) are the WG cochairs.

This approach was agreed to in 1993 at the 6th International Conference in Beijing, in order to facilitate measurements of various periglacial processes. The original proposal received additional support at the IPA Council meetings in Berlin (1995) and Bologna (1997). In Yellowknife (1998) it was decided that the main objective of the WG should be production of the handbook, and that this should be available at the permafrost conference in 2003. In order to facilitate comments from interested persons and institutions, a first draft compilation of the manual can now be found at the homepage of The University Courses on Svalbard (www.unis.no).

During the 5th International Conference on Geomorphology held at Chuo University, Tokyo, Japan, 23-28 August 2001, the WG co-sponsored a general session (Glacial and Periglacial Geomorphology), a symposium (Glaciation and Periglaciation of Asian High Mountains) and a post-conference field excursion (Alpine Geomorphology in Central Japan). The general session included a plenary lecture on fossil frost mounds and European palaeoclimate by Albert Pissart and 30 other presentations. A special issue of *Geomorphology* is planned for papers from the session. The symposium included 27 presentations highlighting Quaternary glaciation as well as past and present permafrost conditions in a wide range of Asian mountains. The papers are to be published in a supplemental issue of *Zeitschrift für Geomorphologie*. The six-day field excursion visited several high mountains in central Japan with 23 participants from 10 countries (Canada, Finland, Germany, Israel, Japan, Norway, Portugal, Switzerland, UK and USA). The topics included monitoring techniques for periglacial processes, rock glacier recognition, and distribution of mountain permafrost. The 73-page field guide is available from N. Matsuoka.

Liaison continued with the IGU Commission on Climate Change and Periglacial Processes chaired by Jef Vandenberghe. The IGU newsletter is available via e-mail. The Commission is in its second, four-years term. This, however, will be the last one in a series of commissions that have undertaken activities on periglacial research in IGU since 1949. Julian Murton is the Secretary for the Commission.

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Permafrost Engineering

The objectives are to collect information on the practices and procedures of permafrost engineering in various regions of the world, and to facilitate communications with permafrost scientists. Branko Ladanyi (Canada) and Lev Khrustalev (Russia) serve as the cochairs of this WG.

Arne Instanes (Norway) is responsible for the engineering component of the Arctic Climate Impact Assessment (ACIA) project organized under the auspices of the Arctic Council. The overall ACIA objectives are to evaluate and synthesize knowledge on climate variability, climate change, and increased ultraviolet radiation and their consequences (see http://www.acia.uaf.edu/). The main section concerning permafrost engineering is contained in Chapter 15: Infrastructure, including Business/Industry. Instanes as the lead author of the chapter is assisted by the following contributing and corresponding authors:

- Lawson Brigham (USA): marine environment/Arctic marine transport
- Douglas Goering (USA): heat and mass transfer/infrastructure North-American Arctic.

- Lev N. Khrustalev (Russia): infrastructure Russian Arctic.
- Branko Ladanyi (Canada): infrastructure North-American Arctic.
- Vladimar Romanovsky (USA)- permafrost (also contributing to Chap. 5 on the cryosphere).
- Orson Smith (USA) - marine structures.

Consulting Authors: Ole Humlum (Denmark): permafrost Greenland, and Jan Otto Larsen (Norway): avalanches.

The preliminary contents includes:

1. Physical environment (in collaboration with Chapter 5). Description of the present situation based on analysis of historical meteorological data including seasonal frost; permafrost; coastal zone; and offshore.
2. Environmental loads:
   - Description of environmental loads that arctic infrastructure are subjected to during its lifetime.
   - Probability of occurrence of extreme events based on historical meteorological data.
   - Consequences for different types of infrastructure.
   - Climate scenarios and how they affect extreme events (in collaboration with Chapter 4)
3. Hazards including: freezing/thawing; sea ice changes; floods, erosion, avalanches (geohazards); wind/snow/ice storms; ultra violet.
4. Infrastructure:
   - Natural resources (oil, gas, mining) and energy production, storage, transportation.
   - Communities (waste disposal, water supply, settlement relocation).
   - Transportation systems (land, air, sea, roads, ports, airports, railroads).
   - Military activity.
5. Engineering design, government responses, and building code:
   - Permanent foundations or essential structural elements of a community.
   - Facilities that form the basis for a country's economical growth.

During the ACIA Steering Committee meeting in April 2001, a schedule for report production was proposed with a first draft completed and reviewed by 4th quarter 2003; and final printed report in 3rd quarter 2004. As a Canadian contributor to the ACIA report, Branko Ladanyi attended the Canadian ACIA Workshop in Calgary in October. The authors of Chapter 15 conducted a workshop in Anchorage, Alaska in November 2001.

WG members participated in the June conferences in Pushchino and Moscow and cochairs presented papers at both meetings (see Russian report for additional information). During the Pushchino conference interesting results were presented on the abnormal deformations of pipelines at transitions in small river valleys and on research on energy transfer using thermal pumps. The engineering geocryology reports presented at the Moscow conference marked the following achievement for the past five years:

- new method of soils cooling with the help of cooling embankments;
- new design of the year-round thermal siphon;
- methods for stabilization of geocryology conditions during building construction;
- new methods for installing piles in frozen ground;
- locations on a map for possible places for disposal of nuclear wastes in the Russian North.

The University of Alberta Geotechnical Centre, Canada conducted a five-day Permafrost Engineering Course in May 2001. Attendees came from the geotechnical consulting companies, pipeline companies, mining companies, Northern regulators and government staffs. Plans are underway to repeat the course in the future. For more information contact: Dave Sego (dcsego@civil.ualberta.ca); Kevin Biggar (kwbiggar @ civil.ualberta.ca); or Sally Petaske (spetaske@ civil. ualberta. ca).

The Second Biennial Workshop on Assessment and Remediation of Contaminated Sites in Arctic and Cold Climates (ARCSACC) was held in Edmonton on 7-8 May 2001. Both the 1999 and 2001 workshops were chaired by Kevin Biggar (University of Alberta Geotechnical Centre), and co-chaired by Mike Nahir (PWGSC Environmental Services Division). Approximately 230 attendees heard presentations on a wide variety of topics relating to cold regions contaminated site assessment and clean-up. Sessions included: risk assessment and site characterization (8 papers); site remediation (8 papers); bioremediation (8 papers); mining (5 papers); and contaminant fate and transport (4 papers). Copies of the proceedings (305 pages) are available for $100 CA from the Geotechnical Centre. Contact either Kevin Biggar or Sally Petaske. Plans are underway to host the third workshop in 2003 (www.merlin.civil.ualberta.ca/ARCSACC).

Members of the Working Group plan to meet in May 2002 during the 11th International Cold Regions Engineering Conference, in Anchorage, Alaska. As reported elsewhere, Ted Vinson is completing the report 'Strategic Plan for Cold Regions Engineering Research in the New Millennium', based on the June 2000 conference.

Cochair Ladanyi has registered his name in the roster of the University of the Arctic, with its Arctic Coordinating Office, University of Lapland, Rovaniemi, Finland (uarctic@urova.fi). His participation will provide IPA with a link to these activities.

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Cryosols

The objectives are to establish interactions between geocryology and soil science, prepare a Cryosols monograph and global Cryosols classification and circumpolar soil database, and organize the Third International Conference on Cryopedology which was held in Denmark in 2001. Charles Tarnocai (Canada) and Sergey Goryachkin (Russia) are the WG cochairs.

The major activities of the Cryosols Working Group (CWG) in 2001 involved co-organising the Third International Conference on Cryopedology (see separate description earlier in this issue) and working group meetings in Russia (Moscow and Pushchino), Austria (Laxenburg) and Denmark (Copenhagen).

The January 2001 meeting in Moscow was held during the visit of Charles Tarnocai. The five members from Russia and Canada discussed the future of the CWG in IPA and International Union of Soil Science, its priorities, the problems to be focused on, and the future scope and name of the IPA group dealing with permafrost-affected soils following the 2003 permafrost conference. Several ideas for the future direction of the group were discussed, mostly concerning the ecological significance of Cryosols. It was decided that the discussions should continue at ensuing CWG meetings.

The March 2001 meeting in Laxenburg followed the International Circumpolar Soil Database Workshop, which was also organized by the CWG. Five members of the working group from Norway, Germany, Russia, Denmark and Canada attended. It was agreed that the Eurasian portion of the Circumpolar Soil Database should be updated in cooperation with the EU Soil Bureau and other interested groups and agencies. Charles Tarnocai subsequently presented this multi-authored work, together with the 1:15 million scale Northern Circumpolar Soils map at the Copenhagen conference in August 2001. It was also decided that four separate Circumpolar Soil Maps, based on the WRB, U. S. Soil Taxonomy, Canadian and Russian soil classifications, would be prepared for presentation at the 17th International Congress of Soil Science to be held in Bangkok in August 2002. The programme for the Third International Conference on Cryopedology was finalized. Progress on the Cryosol book was reviewed and changes were made to various chapters. The technical edit of the chapters should be completed in early 2002. The future of the Cryosol Working Group was again discussed. Members felt that the name of the working group should not be changed.

The June 2001 meeting in Pushchino was held during the International Conference on Conservation and Transformation of Substance and Energy in Earth Cryosphere. Five members from Russia and Germany attended. Results of the CWG meeting in Austria and the future of the CWG were discussed with Russian colleagues. Members felt that the future name of the IPA working group should contain the word 'soil'.

The last meeting of the CWG in 2001 was held in August in Copenhagen, following the Third International Conference on Cryopedology. CWG members from Canada, Denmark, Finland, Germany, Russia and the USA participated. They decided that a home page for Cryopedology and the CWG should be developed to ensure that activities and expertise could be made known to other disciplines via the internet. The CWG supported the idea of taking an active part in the 8th International Conference on Permafrost, and to emphasize the importance of Cryosols, and the application of the Circumpolar Soil Database to determining carbon stocks in permafrost-affected soils at this conference. It was decided that 1:10 million scale maps showing the spatial distribution of (1) soil and permafrost, (2) soil organic carbon contents (kg/m^2), and (3) soil organic carbon stocks or mass (Gt) would be generated. It was also decided that the Fourth International Conference on Cryopedology would be held in Apatity, Kola Peninsula, Russia in 2005 and that a field excursion to northern Finland and Norway should be organized as part of the conference. It was concluded that the future direction and name of the CWG should be reviewed prior to the conference in Zurich.

The Workshop on the Northern Circumpolar Soil Database and Relevant Soil Maps is planned to take place in Lincoln, Nebraska, on 6-7 March 2002. The workshop is part of the annual meeting of the joint IUSS and IPA Cryosols Working Groups. Cochair Goryachkin is participating on a Fulbright Fellowship in the Lincoln laboratories.

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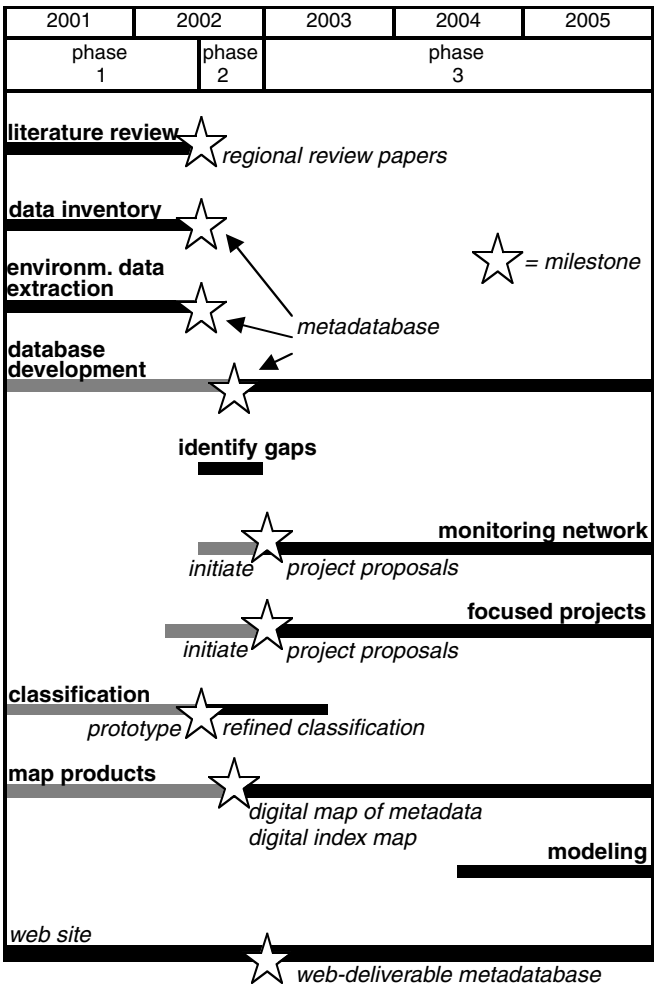
Coastal and Offshore Permafrost

The objective is to encourage the interaction of investigations on the subjects of onshore, transitional and offshore permafrost and hydrates. Hans Hubberten (Germany) and Nikolai Romanovskii (Russia) are cochairs of this WG. Steven Solomon (Canada) chairs the Coastal Erosion Subgroup.

A special session on ' Coastal and Marine Environments' was held at the 1st European Permafrost Conference in Rome in March 2001. The session was chaired by Hubberten and consisted of eight oral presentations and three posters. Another special session on 'Land-Ocean Interactions in Polar Regions (Arctic and Antarctica)' was held during the annual Pushchino conference, 1-5 June 2001. Romanovskii and Hubberten cochaired the session. Eleven papers and one plenary lecture were presented. Felix Are (Russia) and

Volker Rachold (Germany) organized a roundtable on 'Arctic Sea Coasts Thermoabrasion'. Future strategies within the framework of the IPA-IASC ACD programme were discussed with special emphasis on the incorporation of Russian institutions into this programme. As a follow up several INTAS proposals were developed by the ACD secretariat to support the collaboration in Russia. Another session related to the WG titled 'Gas Hydrates and Natural Gases in the Earth Cryosphere' was held in Pushchino, and chaired by V.S. Yakushev and A.N. Nesterov (Russia).

Major progress has been achieved in the Coastal Erosion Subgroup, especially with respect to the Arctic Coastal Dynamics Program. The ACD aims to develop and coordinate a multi-national, multi-disciplinary programme of circum-Arctic coastal research. During the Arctic Summit Week in Iqaluit, Nunavat, Canada, 23-27 April 2001, V. Rachold presented several ACD reports. The Council of the International Arctic Science Committee (IASC) approved funding for a second annual ACD workshop. The printed version of the ACD five-year Science and Implementation Plan was distributed in Iqaluit, and is available from the secretariat in Potsdam (http://www.awi-potsdam.de/www-pot/geo/acd.html) or from the IASC secretariat (http://www.iasc.no).



Arctic Coastal Dynamics (ACD) working plan.

Coastal erosion at Lykhovsky at the Laptev Sea coast. Photo: Hans Hubberten.

The second ACD workshop took place in Potsdam (Germany) from 26-30 November 2001, and included presentations and discussions according to Phase 1 of the Implementation Plan (see table) and a meeting of the ACD Steering Committee (contact: vrachold @ awi-potsdam.de). Twenty-five abstracts were submitted and are available on the ACD web. Results of the workshop, including extended abstracts, are planned to be published in a dedicated issue of the AWI journal *Reports of Polar and Marine Research*. The AWI data management system PANGAEA was adopted for ACD. Plans for future workshops and meeting were developed including the next year's workshop in Oslo and sessions at the Zurich conference and at the Halifax Arctic Margins Conference in 2003.

The Russian-German Cooperation Otto Schmidt Laboratory (OSL) for Polar and Marine Sciences established at the Arctic and Antarctic Research Institute (AARI) in St. Petersburg was officially inaugurated by representatives of the German and Russian Ministries of Science and Technology on 12 October 2000. A second year programme on the evolution of past and recent states of terrestrial and offshore permafrost, land-ocean interactions, coastal and other processes was started. As part of the Fellowship Programme–2001 the project: 'State and evolution of the upper part of the offshore permafrost and subsea periglacial processes in condition of recent thermal regime of the bottom water Layer: Laptev Sea Region, Russia' was initiated by Nikolai Romanovskii and researchers Alexander Kholodov and Vladimir Tumskoy, Department of Geocryology, Moscow State University. Several other U.S. NSF projects under the Russian-American programme are related to gas hydrates (Tom Osterkamp and N. Romanovskii) and investigations on Jochov and Novaya Semlia Islands by Vladimir Tumskoy with joint NSF and OSL support.

Several other field projects were active along the Russian and North American coasts in summer 2001.

During July-August 2001 the joint Russian-German

expedition studied coastal processes in the Lena Delta region. The special task during the expedition LENA 2001 was the investigation of the complex coastal dynamics along the west coast of the Lena Delta, the so called Arga complex. David Gilichinsky led field investigations on the Quaternary geology and permafrost of the Bykovsky and Sviatoy Nos peninsulas, Laptev Sea region. Andrei Sher's research team continued field investigation of the Ice Complex of Bykovsky peninsula.

A Canadian coastal field programme was undertaken in the Beaufort Sea in order to develop a better understanding of coastal stability at a major archaeological site (Kittigazuit). Surveys were also undertaken to assess the impact of a major storm that occurred in August 2000. Oil and gas exploration in the Mackenzie Delta and along the Beaufort coast is expanding rapidly and the demand for coastal information is growing. Consulting companies operating on behalf of oil companies have collected information on coastal water temperatures and currents for input into coupled thermal-hydrodynamic erosion models. Collaborative investigations of storm surges on the U.S. and Canadian Beaufort Sea coasts were continued this field season with the deployment of 10 temporary water level gauges.

The Canadian Panel on Energy Research and Development has funded a project to investigate vertical motions on Arctic coastlines. Permanent GPS receivers were installed at three sites along the Canadian Arctic coast (Resolute Bay, Holman, and Inuvik). Iceberg scours, habitat mapping and granular resources were the focus of a two-week Geological Survey of Canada (GSC) sidescan and multibeam cruise to the inner shelf (10 m to 50 m) waters of the Canadian Beaufort Sea. The GSC also has a programme to investigate the origin and distribution of subsea permafrost in the Beaufort Sea region, but no fieldwork was undertaken this year. Finally, the Canadian Climate Action Fund has contributed funding in support of the installation of Arctic tide gauges. Present plans are to install co-located tide gauges and GPS receivers at three as-yet-to-be-determined sites on the Canadian coast.

Several ACD key sites were established in the Alaskan Beaufort Sea at Elson Lagoon (Barrow) by Jerry Brown and Orson Smith in cooperation with the Barrow Arctic Science Consortium (BASC), and in Beaufort Lagoon (Katovik) by Torre Jorgeson in cooperation with the U.S. Fish and Wildlife Service (FWS) and the Geological Survey of Canada. A five-year, U.S. NSF-funded project on Climate Variability on the North Slope was initiated this year by personnel from the University of Colorado in Boulder, Colorado (Amanda Lynch, PI). The purpose of this project is to enable the people of this coastal region to make more informed decisions in response to climate variability including changes in temperatures, extent of sea ice, and permafrost over years and decades. Analyses of large storm events and impacts of coastal erosion on local communities are part of the programme. Mesurements of shoreline changes along the Chukchi Sea coast were initiated by William Manley.

The Canadian Climate Impacts and Adaptation Research Network (C-CIARN) agreed to fund a coastal node, located at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia. The function of the coastal node will be to coordinate and facilitate research on coastal impacts and adaptation. The Canadian Arctic is one of the foci of planned activities and interaction with ACD is anticipated during the development of the node's activities.

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Southern Hemisphere Permafrost and Periglacial Environments

The objectives are to create a scientific platform to stimulate interaction between permafrost and periglacial researchers in the Southern Hemisphere, and to synthesise permafrost and periglacial data and information, including existing IPA initiatives in the region. Jan Boelhouwers (Sweden) and Kevin Hall (Canada) are cochairs.

The publication of the reviews on Southern Hemisphere permafrost and periglacial research, initially presented at the 1999 INQUA Congress, is in its final stages with the *South African Journal of Science*. A synthesis of these papers is in preparation for publication in *Permafrost and Periglacial Processes*. A second activity of the WG is the preparation of a Southern Hemisphere bibliography. A draft copy was compiled and contains close to 1000 references. The final copy will be included on the CAPS CD II. Our next focus is to compile an initial inventory of maps containing information on the permafrost and periglacial landform distribution in the Southern Hemisphere.

Several developments have taken place regarding the advancement of permafrost science in the Antarctic. Following the May 2000 presentation to the Scientific Committee for Antarctic Research (SCAR) programme on Regional Sensitivity to Climate Change (RiSCC) in Antarctic Terrestrial Ecosystems, active layer monitoring was accepted within the RiSCC science plan. Monitoring protocols for the Antarctic are in the process of beginning finalised. Objectives for Antarctic permafrost science were formulated as follows:

1. Monitoring of the permafrost spatial distribution, temperature and active layer thickness (GTN-P, CALM).
2. Monitoring and analysis of environmental parameters

(especially temperature, radiation, moisture) that act as controls on permafrost and periglacial processes.
3. Field-based monitoring of permafrost and periglacial processes in soil/rock, and the rates at which these operate.
4. Field-based analysis of the physical/chemical manifestations/morphology that result from these processes.
5. Past climate reconstructions using permafrost indicators.
6. Permafrost and periglacial process interactions with other abiotic (hydrological, pedological) and biotic components of ecosystems.

During the 1st European Permafrost Conference in Rome the relationship of IPA with the SCAR was further discussed. As the scientific objectives are unlikely to be accommodated in a separately funded scientific activity a working relationship with the RiSCC programme was seen as an appropriate approach. This was proposed and accepted at the RiSCC workshop in Amsterdam in September 2001. Temperature monitoring in the active layer and soil disturbance measurements were included in the RiSCC methodology descriptions; protocols are being prepared by Mauro Guglielmin and Jan Boelhouwers, respectively. Where appropriate, geomorphological expert input will be invited for studies at the RiSCC core sites.

A further development is that the IPA will table a document at the SCAR 2002 meeting in Shanghai, China, that proposes the establishment of a formal working relationship between the SCAR and IPA. The documentation will include information on current and planned permafrost activities by national programmes in the Antarctic. Scientists involved in such programmes should send this information to Jan Boelhouwers by early 2002.

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Kevin Hall (hall@unbc.ca)

TASK FORCES

Rock Glacier Dynamics and Permafrost Creep

The objectives are to establish the basis for and initiate numerical modelling concerning flow of ice/rock mixtures on slope. Wilfried Haeberli (Switzerland) is the TF chair assisted by Bernard Hallet (USA). The activities are jointly organized by IPA and the International Commission on Snow and Ice (ICSI).

The Task Force had its main meeting at the 1st European Permafrost Conference in Rome. Session 3 of the conference was devoted to presentations and discussions on permafrost creep and rock glacier dynamics. Following the introduction by W. Haeberli, the programme included state-of-the art reports on thermal conditions (D. Vonder Mühll), internal composition (N. Matsuoka), geometry and kinematics (A. Kääb) and rheology (S. Springman). A total of 27 posters (two on thermal conditions, five on composition, ten on geometry and kinematics, three on rheology and six on distribution and climate) were orally introduced and presented for extensive discussions. Task Force members are planning a final report. The most likely form of this report would be a collection of extended abstracts with selected key graphs and extensive references. The product would to be available at the ICOP 2003.

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Mapping and Distribution Modelling of Mountain Permafrost

The objective of the TF is to develop systematic strategies for mapping and modelling the distribution of mountain permafrost at different scales. The Task Force builds on the accomplishments of the former WG on Mountain Permafrost. Bernd Etzelmüller (Norway) and Martin Hoelzle (Switzerland) are cochairs of the TF.

Mountain permafrost mapping and distribution modelling is a research field of high interest, because of its linkage to climate change and hazard assessment. The TF was founded during the IPA Yellowknife meeting in 1998. An e-mail list of about 50 interested colleagues is maintained at the University of Oslo from http://www.geografi.uio.no/ipa. Participation is open to all interested persons.

During the past year the TF has concentrated on its formal meetings and symposium during the 1st European Conference on Permafrost in Rome. The TF session included 10 oral presentations and 15 poster presentations. All participants were invited to give a paper in a special issue in the *Norwegian Journal of Geography* on 'Mountain permafrost mapping and distribution modelling'. Twelve papers were finally accepted following the scientific reviews.

The objective of this special issue is to give a sort of state-of-the-art within high-mountain mapping and modelling of permafrost, together with recent studies within this field. The contributions in this special issue are in three major fields. The process studies describe interactions between permafrost occurrence and external factors, such as glaciers or snow. The modelling methods show different approaches of modelling past and present permafrost distribution. The regional studies focus on fieldwork and apply modelling to delineate the permafrost occurrence in certain regions. This special issue provides an introduction on recent research conducted within this field and is scheduled to appear in December 2001. The content of the special issue (in alphabetical order) is as follows:

Etzelmüller, B., Hoelzle, M., Heggen, E., Isaksen, K., Mittaz, C., Vonder Mühll, D., Ødegård, R.S., Haeberli, W. & Sollid, J.L. - Mapping and modelling the occurrence and distribution of mountain permafrost .
Frauenfelder, R., Haeberli, W., Hoelzle, M. & Maisch, M - Using relict rock glaciers in GIS-based modelling to reconstruct Younger Dryas permafrost distribution patterns in the Err-Julier area, Swiss Alps.
Heggem, E.S.F, Etzelmüller, B. & Berthling, I. -Topographic radiation balance models – sensitivity and application in periglacial geomorphology .
Ishikawa, M. & Sawagaki, T. – GIS-simulation of the spatial distribution of snow cover and observed ground temperatures in the Daisetsu Mountains, Japan.
Lambiel, C. & Reynard, E. - Regional modelling of present,past and future potential distribution of discontinuous permafrost based on a rock glacier inventory in the Bagnes-Hérémence Area (Western Swiss Alps).
Lugon. R. & Delaloyé, R. - Modelling alpine permafrost distribution, Val de Réchy, Valais Alps (Switzerland).
Marchenko, S.S. – A model of permafrost formation and occurrences in the intracontinental mountains.
Moscicki, J.W. & Kodzia, S. – Investigation of mountain permafrost in Kozia Dolinka valley, Tatra Mountains, Poland.
Oberman, N.G. & Mazhitova, G.G. - Permafrost dynamics in the north-east of European Russia at the end of the 20th century.
Serrano, E., Agudo, C., Dalaloyé, R. & Gonzáles-Trueba, J.J. - Permafrost distribution in the Poset Massif (Cebtral Pyrenees).
Tannaro, L.M., Hoelzle, M., García, A., Ramos, M., Gruber, S., Gómez, A., Piquer, M. & Palacios, D. - Permafrost Distribution Modelling in the Mountains of the Mediterranean: Corral del Veleta, Sierra Nevada, Spain.
Zhang, T, Barry, R.G. & Haeberli, W. - Numerical simulations of the influence of the seasonal snow cover on the occurrence of permafrost at high latitudes.

The TF was represented by B. Etzelmüller at the International Symposium on Arid Land Permafrost, in Ulaanbataar, Mongolia, in September 2001. A main focus of the symposium was devoted to the permafrost distribution mapping and modelling of the central-Asian mountain permafrost, which was introduced to the participants both in presentations and the field trips.

With the TF meeting in Rome and the publication of the special issue on mapping and modelling of mountain permafrost, the official work of the TF is completed. A report of the TF will be presented at the 8th ICOP, as will be a discussion of the future continuation of the efforts. Input and opinions from the TF participants are highly welcome prior to the ICOP. Meanwhile, the TF plans to pursue recommendations of the Mongolian symposium and field trips. These include application of modern GIS-based permafrost distribution modelling approaches. Finally, we hope to see many contributions resulting from the TF activities at the 8th ICOP.

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Isotope/Geochemistry of Permafrost

The objectives are to promote application of isotope geochemical methods in permafrost research, to identify the main gaps in knowledge for successful application of isotopic methods in permafrost studies, and to develop an internationally accepted protocol. Rein Vaikmae (Estonia) is the TF chair assisted by Hans Hubberten.

Informal discussions concerning the scope of activities continued. Rein Vaikmae and Hans Hubberten met in April and agreed that the TF should develop a questionaire for distribution to interested participants. Information on type of investigations, working areas, special interests, etc. would be requested. The next steps would be preparation of an inventory of sites that have employed isotopes in the Arctic and a bibliography. A TF secretariat was established at AWI in Potsdam with Hanno Meyer undertaking the activity. These plans were reviewed at a meeting between Hubberten and Vasilchuk in June during the Pushchino conference.

The textbook *Principles of Isotopic Geocryology and Glaciology* by Vasilchuk and Kotlyakov was published in 2001 by Moscow University Press. Vasilcuk has entered into bilateral agreements related to isotope analyses with Austria and South Korea.

Under the umbrella of an INTAS project on the 'Late Pleistocene history reconstruction based on the massive ground ice origin in the Arctic coastal zone' (H.-W. Hubberten, Potsdam; M. O. Leibman, Russia) important information concerning the genesis of ground ice bodies on Yamal and Yogorsky Peninsulas was obtained by stable hydrogen and oxygen isotope studies. Stable isotope investigations on the ice complex of Bykovsky Peninsula and the Big Lyachov Island of the Laptev Sea (H. Meyer) contributed to the climate history of that area since the middle Weichselian. A changing atmospheric circulation pattern at the Pleistocene Quaternary boundary could be shown by the d-excess values of these sequences.

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News from Members

Austria

In the Austrian Alps permafrost research takes place at selected sites of the Hohe Tauern Range and the Tyrolean Alps. Special emphasis is placed on annual measurements of the following parameters on active rock glaciers: temperature measurements on the surface and within the active layer of permafrost areas, hydrological investigations (temperature, water storage and discharge, hydrochemical characteristics), and geodetic and photogrammetric monitoring of surface velocity and vertical changes of active rock glaciers.

Especially Karl Krainer (University of Innsbruck) and Viktor Kaufmann (Graz University of Technology) are involved in these activities which have recently been documented by several publications and on the homepages of their institutions (www. uibk. ac. at /projects/rockglacier and www. cis. TUGraz.at/photo/viktor.kaufmann/publications). In addition, the permafrost relevant data collected in the last years (temperature data logging) will be available for downloading at www. kfunigraz. ac. at/geowww in early 2001.

Hanns Kerschner (University of Innsbruck) and his co-workers investigated relict rock glaciers and moraines in the Western Austrian Alps for reconstructing palaeoclimatic conditions. The main results are that the climate within the Younger Dryas changed from cold and wet to cold and was significantly drier in this region. Several stades of rock glacier formation can be distinguished; the last of which may be contemporaneous with the Preboreal oscillation.

Some further activities are going on within the framework of diploma and Ph.D. theses. Among these are several local studies dealing with permafrost mapping in the field, permafrost modelling using remote sensing and GIS techniques, and the evaluation of the continuous measurements mentioned above. Recently the Geological Survey of Austria has also started geophysical soundings in a permafrost area of the Hohe Tauern range. Finally, some investigations are carried out outside Austria partly dealing with permafrost, e.g. glacier research in Iceland (University of Innsbruck) and geoecological activities in the Russian Arctic (University of Vienna).

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Canada

Ongoing, newly funded, as well as recently completed permafrost research activities are highlighted in this report, with major contributions by the Geological Survey of Canada (GSC) and the Centre d'Etudes Nordiques, Laval University.

Monitoring Networks: The GSC received funding in 2001 for four years from the federal government's Action Plan 2000 to develop and implement the framework and infrastructure for a national permafrost monitoring network. This project is a component of a successful larger multi-partner submission on Systematic Climate Observations – Atmosphere, Oceans and Cryosphere. This initiative will allow Canada to make progress in meeting its obligations to provide systematic cryospheric observations under the World Meteorological Organization's (WMO) Global Climate Observing System (GCOS) and to address the recommendations and concerns raised at the Canadian permafrost monitoring workshop (http://sts. gsc. nrcan. gc.ca/permafrost/pfworkenter.htm). A data management node and web site will be established at the GSC which will coordinate submission and dissemination of active layer and permafrost thermal data from network sites as well as forming a link to other cryospheric nodes such as the Global Terrestrial Network for Permafrost (GTN-P), the Canadian Cryospheric Information Network (CCIN), CRYSYS (CRYospheric SYStem) and its related State of the Cryosphere in Canada web sites (http://www. socc. uwaterloo.ca/permafrost/permafrost_current.cfm) and (http://www.crysys.uwaterloo.ca/education/permafrost/permafrost_edu.cfm).

The GSC continues to actively contribute to the development and implementation of the IPA's GTN-P, an international programme of systematic observations of active layer and permafrost temperatures under GCOS . The GTN-P's web site is hosted by the GSC (http://sts.gsc. nrcan. gc.ca/gtnp). A status report submitted in March 2001 and the borehole inventory and metadata can be accessed on the site. Contacts: M. Burgess and S. Smith.

National permafrost databases: The GSC published a Canadian permafrost thickness database (Smith and Burgess, 2002) which is a compilation of publicly available information for about 1000 sites. This database will also soon be made accessible through the GSC permafrost web site. The Canadian Geothermal Data Collection - Northern Wells contains subsurface temperature data collected by the GSC from boreholes of depths greater than 125m within the Canadian permafrost region. Ground temperature logs from this collection as well the national summary permafrost temperature database (GSC Open File 3954) may now be accessed through the National Database section of GSC permafrost web site (http://sts.gsc.nrcan.gc.ca/permafrost/). Contact: S. Smith.

Regional and national syntheses: The GSC recently published two regional bulletins summarizing the results of two of its three 1990s Integrated Research and Monitoring Areas Programmes: the Mackenzie Valley (Dyke and Brooks, 2000) and the Fosheim Peninsula of Ellesmere Island (Garneau and Alt, 2000). These synthesis reports summarize baseline environmental conditions, examine the environmental

response to climate change, and include several papers of interest to permafrost scientists. The GSC also published a synthesis of geological hazards in Canada, a document which includes two papers on permafrost related hazards (Smith et al., 2001; Smith, 2001).

Gas-Hydrate Research: During the winter of 2002 a consortium of seven international partners will undertake a gas-hydrate research, well programme at the Mallik site in the Mackenzie Delta. The project will include the drilling of a 1200 m deep main production research well and two nearby science observation wells. Full-scale field experiments will be conducted to monitor the physical behavior of the gas hydrate deposits to depressurization and thermal production stimulation. The spud date for the first observation well is expected to be in December 2001, with completion of the programme in early April 2002. A wide ranging science and engineering research programme is proposed with extensive research geophysics (including open hole logging, X-hole studies and VSP surveys), core studies and long-term monitoring of in-situ conditions. These are being coordinated and managed by the GSC. The scientific and engineering research objectives for the production research will focus on two themes: (1) the assessment of the production and geotechnical properties of gas hydrates, and (2) an assessment of the stability of permafrost gas hydrates given warming trends predicted by climate change models. Contact: S. Dallimore (sdallimore@nrcan.gc.ca).

Onshore Hydrocarbon Transportation Corridors: Both the Alaska and Mackenzie Delta Gas Producers groups have been actively examining possible pipeline routes for bringing Prudhoe Bay and Mackenzie Delta gas, respectively, to southern markets, via the western Canadian Arctic. Reconnaissance level field programmes and surveys are being conducted by industry to aid in route selection and for planning and scoping of future studies. Hydrocarbon exploration activity has dramatically increased in the Mackenzie Valley and Delta especially the offshore. The GSC received funding from the Federal Panel on Energy Research and Development (PERD) to undertake permafrost research relevant to several of the important technical issues for pipelines along these transportation corridors in the onshore western Arctic. Slope stability, pipeline-permafrost interactions, and data availability and syntheses are the major thrusts of the project. New field studies examining creep on warm permafrost slopes in the Mackenzie Valley were initiated in March 2001. A slope along the Norman Wells pipeline in the Central Mackenzie Valley was instrumented with inclinometers and temperature cables in collaboration with Enbridge Pipelines. This new site expands a programme on cold permafrost creep initiated some 10 years ago in the Mackenzie Delta. The synthesis of existing geological, geotechnical, geothermal data relevant to pipeline routing and design will involve consolidation and upgrading of existing databases into GIS compatible formats and increasing the accessibility of these databases and syntheses to stakeholders. The first product will be the re-release of the Mackenzie Valley geotechnical database, a compilation of data from over 12,000 boreholes, in MS access format. Contacts: L. Dyke (ldyke @ nrcan.gc.ca), M. Burgess, and S. Smith.

Infrastructure Adaptation: The GSC, in conjunction with municipal and territorial partners, undertook a community based approach to assess current and potential future permafrost, geotechnical conditions, and infrastructure performance and sensitivity in two pilot communities: Norman Wells and Tuktoyaktuk, Northwest Territories. Digital geotechnical databases were compiled for each community, as well as baseline information on infrastructure, foundation systems, climate, etc. The project incorporated thermal modelling of typical permafrost and soil profiles under both natural and disturbed (developed) conditions, as well as under scenarios of climate warming. Permafrost-related infrastructure problems currently exist in both communities, but evolving construction and maintenance practices have minimized the impacts to date. The goal of the pilot project was to develop an approach and framework to provide stakeholders with the geoscience knowledge and tools needed for decision-making regarding the assessment of impacts on infrastructure and potential adaptation measures to minimize the impacts. Several digital GSC Open Files (3913, D3912, and D3867) are either published or in press. Contacts: R. Couture (rcouture@nrcan.gc.ca) and M. Burgess.

Degradation of permafrost-affected peatlands: An analysis of a 50-year time series of aerial photos and high-resolution satellite images was undertaken to quantify magnitude and rates of thaw of six permafrost-affected peatlands sites in the Mackenzie Valley from latitude 60° to 64°N in 2000-2001 with support from CCAF and the GSC. The study also examines the impacts of degradation of peatlands on drainage and carbon accumulation rates. Contact: S. Robinson (formerly GSC, presently at St Lawrence University, Canton, N.Y.).

Extreme Warm Summer of 1998: Recent studies have documented warming during the 1980s and 1990s in the high latitudes, but 1998 was conspicuous for the unprecedented warmth and length of the melt season over the Canadian Arctic. This warming was associated with significant anomalies in many components of the cryosphere. This multi-partner multidisciplinary project, funded by the Government of Canada's Climate Change Action Fund (CCAF), allowed the Canadian cryospheric community to document the magnitude of the cryospheric change, to

place this in the context of the observed variability, and to develop insights into the processes and feedbacks associated with extreme warm years. The project also provided the opportunity to compile and consolidate a large number of cryospheric data sets that were widely dispersed amongst various government, university and industry researchers. The individual project reports examining the response of various components of the cryosphere are available on-line through the meetings sections of the CRYSYS web site (http://www.crysys.uwaterloo.ca/science/meetings/2001_meeting/).

Contributions to the permafrost component include:

Active layer and permafrost temperatures in the Mackenzie Delta, Alert and Baker Lake (Smith, Burgess and Nixon, GSC);

Recent warming impacts in the Mackenzie Delta and northern Yukon coastal areas (Wolfe, Kotler and Nixon, GSC);

Active layer detachment slides on the Fosheim Peninsula (Lewkowicz, University of Ottawa).

The first two contributions were published as GSC Current Research papers.

Mackenzie Valley spatial ground temperature modelling: GSC researchers have developed a GIS-resident, ground temperature modelling capability to facilitate the investigation of ground thermal conditions in northern regions. The physically-based numeric model generates predictions of ground temperature based on available information about local/regional climate and terrain conditions. The model provides estimates of the equilibrium distribution and thickness of permafrost under 'current' climatic conditions, and can predict changes in response to future climate scenarios. Initial low resolution (1km) modelling has produced preliminary maps depicting permafrost characteristics in the broader Mackenzie River Valley (CCAF Report A073). Work is continuing on the consolidation of a high-resolution (30m) digital database to support detailed modelling of ground thermal conditions in the vicinity of major communities in the Valley. This work was funded by PERD, CCAF and GSC. Contact: F. Wright (fwright@nrcan.gc.ca).

Coastal Investigations: See the report of the Working Group on Coastal and Offshore Permafrost for GSC investigations based at the Bedford Institute of Oceanography. Contact: S. Solomon (solomon @agc.bio.ns.ca).

Centre d'Ètudes Nordiques (CEN) research: The collaboration between CEN and the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) continued in the field in Northern Québec in June 2001 with data recovery from thermistor strings and data loggers in a series of drill holes in a lithalsa. Data from a gauge that measures water pressure at the base of the permafrost was also recovered (see the German report in this issue of Frozen Ground). A comprehensive series of measurements were also made in cased drill holes at the sites in the lithalsa (a clay permafrost mound), and a sandy permafrost mound using thermal profiling and GPR tomography. Results were presented and described at the 1st European Permafrost Conference in Rome.

The GPR tomography work is the focus of a masters thesis project. A new approach combining field cone penetration tests (CPT) through permafrost with seismic tomography was also applied in the study area and forms the basis of another masters thesis project. Analysis and interpretation of core data, in-situ CPT tests from 2000, and thermal modelling applied to the clay permafrost mound is underway as a doctoral thesis. A regional sampling of ground ice, to depths down to 6 m, was performed east of Hudson Bay with portable drilling equipment, and is the subject of a doctoral dissertation aimed at understanding the processes of permafrost aggradation in uplifted marine sediments through cryofacies analysis and isotopic analysis of ground ice and trapped gases.

Drilling operation in Northern Quebec. Photo: Michel Allard.

Work on another doctoral project took place on Bylot Island in the High Arctic. The project involved drilling in low-centered polygons to reconstruct the palaeoclimatic changes recorded in the stratigraphy of aeolian and organic sediments in syngenetic permafrost. Pingos were also cored and described in sections along river banks. GPR profiling of polygon fields and pingos was conducted.

CEN is making a special effort to bring up to date and verify the quality of data from many thermistor cables and automatic meteorological stations across northern Québec. It appears that the trend of change in the Ungava peninsula changed from cooling to warming between 1995 and 2001. Contact: Michel Allard (michel.allard@cen.ulaval.ca).

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China

The Qinghai-Tibet Railway is now under construction on the Qinghai-Tibet Plateau. Construction of the railway at its northern and southern sections, which are within non-permafrost regions, is being conducted by a number of construction companies of China. The First Survey and Design Institute of the Ministry of the Railway of China is surveying and designing the sections of the railway in the permafrost regions. Research on the design, construction and operation of this railway in the permafrost region on the plateau has primarily been carried out by the State Key Laboratory of Frozen Soil Engineering, CAREERI, CAS, the Northwest Branch of the China Academy of Railway Sciences, and the First Survey and Design Institute of the Ministry of Railway of China.

The Chinese Society of Glaciology and Geocryology plans to organie the Sixth National Conference on Glaciology and Geocryology, which will be held 27-29 March 2002 in Lanzhou, China. This conference is organised to summarize and exchange the achievements and experience on scientific research and engineering practice in cold regions in recent years and to select a number of papers to be submitted to the next International Conference on Permafrost in 2003. Scientists and engineers who are interested in this field from China and other countries are welcome to participate in this conference.

A new book entitled ´Fracture Mechanics of Frozen Soil and Its Application´ written by Prof. Li Hongsheng and Prof. Zhu Yuanlin will be published in the end of 2001. This book is written in Chinese, but with English contents, abstracts and figure and table texts.

The book ´Geocryology in China´ published in 2000 in Chinese, was reviewed extensively by Tingjun Zhang, University of Colorado, USA, in *Permafrost and Periglacial Processes.*

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Denmark

Research in Disko Island (70°N) relating to rock glacier dynamics and surface climate has been continued by Ole Humlum, University of Copenhagen. Both air temperatures, ground surface temperatures, as well as active layer temperatures, are being measured. The snow cover duration has been studied at two rock glaciers by use of automatic digital cameras. Measurements of precipitation close to the rock glacier initiation line (RILA) are carried out on an experimental basis. Also the headwall weathering rate and the rock glacier role as a transport agent in high-relief arctic regions is investigated. Five active rock glaciers located in various meteorological settings in Disko Island are now included in this general monitoring programme. A CALM site near the Arctic Station (Disko Island) has been in operation since 1997.

In the Ammassalik area in SE Greenland (65°N) a similar programme on periglacial geomorphology and climate was initiated in 2000 by Ole Humlum. In 2001, this programme was extended with additional dataloggers measuring air temperature, ground temperatures and BTS. Also precipitation is being measured at various sites within the study region. Additionally, an automatic digital camera was installed in September 2001, in order to obtain insight in the importance of wind for redistributing snow. The Ammassalik area is of special interest, as MAAT at sea-level is close to 0°C and various types of permafrost therefore may be expected in transects from sea level to the highest summits (around 1100 m asl).

Ground surface temperature monitoring site at 444 m asl in the Ammassalik area, SE Greenland. Photo: Ole Humlum

At the Faroe Islands periglacial research is continued as part of the LINK research project (http://www.geogr.ku.dk/link) carried out by Hanne H. Christiansen, University of Copenhagen and Lis Mortensen, Geological Survey of the Faroe Islands together with students. Mapping is carried out on the lower limit and the dynamics of active patterned ground, a very widespread periglacial landform in the islands. Preliminary permafrost modelling indicates small patches of permafrost to exist in the northern side of the highest mountain Slættaratindur (882m asl). During the summer 2001 a subhorisontal borehole was drilled 5m into the northern top of Slættaratindur, enabling ground temperture registration in the modelled permafrost patch. Data from the first complete year (2000) of operation of the mountain meteorological station at Sornfelli (740 m asl.) show a MAAT of 1.7°C and a MAGT at 11 m depth in a borehole of almost a constant 3°C. The Sornfelli station is the only mountain meteorological station in the Faroe Islands. A new project called ´Measuring Arctic Climate on the Faroe Islands´ started in the summer of 2001. This will enable the continued operation of the Sornfelli Station in cooperation with Faroese institutions until 2004. This new project is financed by the Danish Environmental Protection Agency as part of the environmental support programme Dancea – Danish Cooperation for Environment in the Arctic. The Sornfelli station has together with the Zackenberg station in NE Greenland become part of the SCANNET EU project (see description of SCANNET in Other News).

At the Danish Meteorological Institute, Martin Stendell and Jens H. Christensen have analysed the ability to simulate the global permafrost distribution with the coupled atmosphere-ocean general circulation model ECHAM4/OPYC3. They have found good agreement between modelled and observed distribution of permafrost zonation for this course resolution model. Analysis of the ability to describe the distribution of the active-layer depth also appears promising. Projections of possible future distributions of permafrost have succesively been analysed in two transient climate change simulations with the same model.

The Danish Technical University has in co-operation with Sanaartornermik Ilinniarfik (The Building Educational Centre of Greenland) started a Center for Arctic Technology in Sisimiut in West Greenland ARTEK (www.arktiskcenter.gl). In September 2001 ARTEK initiated the education of Arctic Engineers in Civil and Environmental Engineering at BSc and MSc levels. Half of the teaching is carried out in Greenland in Sisimiut, while the rest takes place in Denmark at the Danish Technical University. As part of the ARTEK major geoscience research topics are the activities of Niels Foged and coworkers. They are studying geotechnical and engineering geological properties of Quaternary marine sediments in uplifted basins (and in the sea) that were subjected to variable permafrost conditions due to changing climatic conditions during the Holocene, and the implication to foundation design and major constructions. Arne Villumsen and Francois Baumgartner , also from ARTEK, are studying ground water resources in sediments and fracture zones in bedrock below the permafrost and seasonal frost layers, using geophysical methods i.e. MEP (multi-electrode geoelectrical profiling) and georadar in time and frequency domain. Water resource prospecting has been carried out in Kangerluk (Disko Island) and Sisimiut in the discontinuous permafrost zone and at Nuuk (Godthåb) and Narsarsuaq in Southern Greenland. ARTEK intends to establish and maintain a fruitful co-operation with other research institutes in fields of common interests.

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Germany

The Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, and the Centre d'Ètudes Nordiques, Université Laval, Québec (Georg Delisle), joint-project on investigation of the permafrost development in emerged marine sediments near the eastern shore of the Hudson Bay continues into its second year. Monitoring of subsurface temperatures of a (mineral) palsa east of Umiujaq, Nunavuk shows a mean annual temperature of -0.6°C. A pressure transducer positioned near the bottom of the palsa (at the freezing front) provides a continuous record of the pore pressure indicating a strong hydraulic gradient into the palsa. Numerical modeling to simulate annually the thermal processes within the palsa is in progress. Since the frozen core of the structure is rather close to the melting point of ice, this site offers a unique opportunity to observe the effect of climatic change in the Arctic. Therefore, it is planned to extend the monitoring beyond 2003.

The Potsdam Research Unit of the Alfred Wegener Institute for Polar and Marine Research (Hans-W. Hubberten) co-ordinates the multidisciplinary terrestrial part of the joint German-Russian project 'System Laptev Sea 2000'. An expedition to the Lena Delta took place in July-August 2001 (Expedition leaders: Eva-Maria Pfeiffer and Mikhail N. Grigoriev), consisting of eight German and eight Russian scientists and technicians from Moscow, St. Petersburg, Yakutsk and Tiksi. One team focused on modern processes in permafrost soils and the underlying frozen sequences and worked from the biological station of the Lena Delta Reserve on Samoylov Island in the central part of the Lena Delta. Since 1998 the energy and water balances of the active layer are registered year round at four sites. During the field season the pedogenic and soil microbial parameters, which control the produc-

tion, oxidation and emission rates of trace gases, were studied as well as the carbon flux. The emission of CH_4 and CO_2 from other possible sources, such as lakes and ice complex deposits, have been studied. Surprisingly high methane emissions have been observed from the frozen soil as well as from the ice wedge part of the ice complex. Several cores were drilled down to 8.5 m into the permafrost, which will mainly be used for microbial and molecular biological investigations.

Under the umbrella of the IPA-IASC project ACD (Arctic Coastal Dynamics, Project leader: Volker Rachold, (http://www.awi-potsdam.de/www-pot/geo/acd.html), another team studied the coastal dynamics at the west coast of the Lena Delta from a field camp at Babaryna Island. After investigating the coastal processes at the eastern and western coasts of the Laptev Sea in 1999 and 2000, three weeks were dedicated to studying the complex system of the coast of the sandy Arga Complex, which is separated from the open ocean by shallow lagoons and tens of kilometers long north-south extending sand barriers. An unexpected result was the importance and dominance of wind erosion and accumulation compared to wave action. Apart from geodetic measurements to compare the actual coastline with older aerial photographs in order to determine the rate of coastal retreat, shore face profiles were measured from the barriers to the 10 m isobath and sediment samples were taken. Some results of this project are presented in 14 articles in press in a special volume of the journal *Polarforschung*, to be printed early next year. A small group from the Alfred Wegener Institute performed geocryological studies in Central Yakutia between the middle Lena and the Aldan rivers in cooperation with the Permafrost Institute, Yakutsk.

Test field at the biological station Samoylov Island. Photo: Hans W. Hubberten.

The Department of Physical Geography, University of Trier (Christof Kneisel) has continued investigating a mountain permafrost occurrence below the timberline in the Upper Engadine, eastern Swiss Alps. Geophysical measurements were carried out and monitoring of ground temperature is now maintained for the third year to study the physical processes controlling the interaction of permafrost with the environment at this sporadic permafrost site. The measurements of the near surface ground temperature are extended along altitudinal belts from the subalpine zone to the periglacial/subnival zone.

After completion of the PACE project the Giessen PACE group (Lorenz King) continues mountain permafrost research in the Mattertal, Valais, Swiss Alps. Temperature data from the borehole at Stockhornplateau (3410 m) near Zermatt, indicate a permafrost thickness of about 160 m, and an active layer thickness of about 2 m. Coldest ground temperatures of -2.6°C were reached at a depth of 22.5 meters. Further ground temperature measurements have been started at the lower part of the discontinuous permafrost belt in the Gornergrat area above Zermatt. The data will contribute to the project of Thomas Herz concerning the influence of a coarse-grained debris cover on energy transfer processes between atmosphere, lithosphere and ground temperatures in the alpine periglacial belt. In late September 2001, the test area Grächen-Seetalhorn was instrumented with a 30m borehole and a meteorological station.

Mountain permafrost investigations are also carried out in the neighbouring Turtmanntal, Valais, Switzerland by a research group of the Department of Geography at the University of Bonn (Richard Dikau). This valley is characterized by a high density of rock glaciers at all stages of activity. A main objective of the project is to assess the scale dependent significance of rock glaciers to determine the sensitivity of high mountain geosystems to global environmental change. Through the combination of different approaches and methods in various spatial and temporal scales, a holistic approach is planned to be achieved. A sediment budget for the catchment may support the hypothesis that the rock glacier process was the dominant sediment flux in alpine regions during the Holocene. A monitoring programme was started in 1990 with the following objectives:

Reconstructing past and present permafrost distribution (Dikau, Nyenhuis, von Witsch)
Rock glacier distribution (Nyenhuis), geophysical methods (Nyenhuis, Pfeffer)
Rock glacier movement rates applying remote sensing and terrestrial surveying (Roer, von Elverfeldt)
Rock glacier movement pattern modelling by process based models (Hoffmann)
Bioindication of rock glacier systems (Roer)
Periglacial system components and their coupling/decoupling with the glacial situation (Otto),
Quantifying sediment storages (Knopp, Nyenhuis)
Surface analysis by remote sensing (Schreiner) and morphometric landscape analyses (Rasemann).

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Drilling operations at Stockhornplateau. Photo: Thomas Herz

Japan

The wildfire research experiments named Frostfire (Alaska) and Icefire (Siberia) were safely and successfully completed in the summer of 1999 and 2001. The research group from Japan was based in Hokkaido University (M. Fukuda). Extensive pre-burn surveys throughout the watersheds and extensive instrumentation installed before the fire enabled us to collect data before, during, and after the burn. The three-year (1999-2001) research projects have highlighted the impact of fire on the permafrost and the dynamics of the physical properties after the fire. Many of these results were presented in the 2000 American Geophysical Union fall meeting and at the 2001 Russia/Japan joint symposium for climatic warming in Sapporo.

The Yukon energy and water exchange research group (YuWEX Leader: N. Ishikawa) has studied in the Caribou Poker Creeks Research Watershed, Alaska since 1997 in cooperation with L. Hinzman and K. Yoshikawa. They have performed a variety of field observations and measurements in the watershed including soil moisture content, soil temperature, evaporation, humidity, air temperature, CO_2 flux, stream temperature, geophysical exploration, groundwater level, groundwater temperature in the talik, and snow depth.

Surface energy balance studies were conducted in Kevo, Finland (Nagaoka Institute of Snow and Ice Studies, National Research Institute for Earth Science and Disaster Prevention (NIED) group (leader: A. Sato and T.Sato in cooperation with S. Neuvonen)), Tiksi (GAME: Y.Kodama) and CPCRW (YuWeX, NIED group; leader: A. Sato and T.Sato in cooperation with S. Neuvonen); Tiksi (GAME: Y.Kodama); and CPCRW (YuWeX, NIED). All of these sites have a meteorological observation tower with ground temperature and soil moisture sensors in the active layer.

The Mountain Permafrost Research Group in the Association of Japanese Geographers continued studies on permafrost distribution, rock glacier characteristics and periglacial processes in the Japanese mountains including Hokkaido (M. Ishikawa, Y. Sawada, T. Sone and K. Hirakawa), northern Japanese Alps (K. Fukui, M. Aoyama and S. Iwata), southern Japanese Alps and Fuji volcano (A. Ikeda and N. Matsuoka). The four-year (1998-2002) research projects have highlighted several types of permafrost distribution in the Japanese mountains, which are controlled by landforms, snow distribution and depth, geothermal activity and surface materials. Since 1994, members of the research group have also conducted an overseas project on permafrost and periglacial processes in the Swiss Alps in cooperation with W. Haeberli, A. Kääb and F. Keller. The topics in the last two years included dynamics of small pebbly rock glaciers, differential frost heaving on sorted patterned ground and Holocene environmental change on mountain slopes. Many of these results were presented in the 1st European Permafrost Conference in Rome (March 2001) and at the 5th International Conference on Geomorphology in Tokyo (August 2001).

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Kazakhstan

The Kazakhstan Alpine Permafrost Laboratory of the Permafrost Institute SD, RAS continued monitoring of the thermal regime of the permafrost and the depth of seasonal freezing ground in the northern Tien Shan (basin of river Bolshaya Almatinka, Transili Alatau Ridge). This monitoring were extended during 2001 when more automatical stations were started. The laboratory continues to carry out measurements of the dynamics of the active rock glacier of the Gorodetsky's glacier, including solifluction processes and kurums.

An estimation of the underground/permafrost ice volume of the northern Tien Shan was carried out as a first attempt for the mountains of Central Asia. It was determined that the volume of permafrost ice is the same as the volume of the glaciers. There is the ten-

dency for a faster degradation of glacier ice compared to the permafrost ice in this area. The laboratory also continues to carry out expeditional investigations of the influence of the construction of a highway on alpine permafrost hear the Kolalmaty Pass, Trausili Alatau Ridge.

The digital geocryological map of Burenkhaan Area (Mongolia) was compiled by S. S. Marchenko in cooperation with Mongolian scientists. The book entitled ´Mudflows near Almaty- Looking at the Past´, was published in Kazakhstan in 2001. It includes dates of mudflow activity during the last 300 years and information on alpine permafrost and underground ice in the Transili Alatau Ridge, northern Tin Shan. A.P.

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Mongolia

See Symposium Report p. 6-11

Norway

The Norwegian Geotechnical Institute (NGI) has continued the research project 'Arctic oil spills on Russian permafrost soils' which is a co-operation project between NGI, Moscow State University and the Earth Cryosphere Institute. Fieldwork with experimental oil spills is carried out at Cape Balvanskij, Nenets, Northwest Russia, where the Earth Cryosphere Institute started investigations of permafrost in 1983. Laboratory tests are performed at Moscow State University and at the Earth Cryosphere Institute. NGI also runs another research programme entitled 'Permafrost response to industrial and environmental loads'. The programme was initiated in 1999 and will continue until 2003. This year's work was focused on fieldwork in Longyearbyen and Svea, Svalbard, and on laboratory work in Oslo (www.ngi.no/SIP/SIP7/index.htm).

Evgeny Chuvilin, Moscow State University (right) and Arne Instanes, UNIS and NGI (left) and thousands of mosquitos during field work on the tundra near Cape Balvanskij (Russia).

The new road on the Höganäs glacier. Photo: Truls Mølmann.

The University Courses on Svalbard (UNIS), Department of Arctic Technology (www.unis.no) runs eight courses on undergraduate and graduate level. The programme offered at UNIS is unique as the courses have the advantage of being given in an Arctic environment where technology has been applied for decades. Investigations on geomorphic activity, bedrock weathering rates and rock glacier dynamics are continued by Ole Humlum (UNIS), Department of Geology. Research on bedrock weathering in cold climate has been initiated by Angelique Prick (Belgium). Humlum has continued measurements of precipitation and temperature (air, ground surface and within the active layer). Two meteorological stations are established, one of these at the PACE borehole on Janssonhaugen. A precipitation sampling scheme (initiated in 1999) has been continued. In addition, three automatic cameras are providing daily visual information on geomorphic phenomena. A CALM site was established in 2000 was by Mette Oht (UNIS). A new CALM site has been established near Ny Ålesund (79ºN) by Ole Humlum in 2001. Investigations on ice-wedge development, dynamics and oxygen isotope stratigraphy in Adventdalen was continued by Jon W. Jeppesen (UNIS). In the Operafjellet area, a short distance north of Adventdalen, investigations on the evolution of an ice-cored glacier was continued by Sisse Korsgaard (UNIS).

In 1996 the Norwegian coal mining company, Store Norske, asked permafrost scientists on Svalbard if it was possible to construct and operate a road on the Höganäs glacier, for access to a new mine. The glacier is located outside the mining community Svea. No literature or documented experiences on similar projects existed, and a feasibility study was initiated early in 1997, focussing on issues related to glaciology and road construction methodology on sensitive frozen terrain. Field investigations and road design went on until construction started in 1999, and the 3-km long road was ready and in operation from early 2000.

The road is placed on pure glacier ice on the central moraine ridge of the Höganäs glacier. Substantial glacier ablation cause an increasing height difference be-

tween the road grade and the glacier, and the side slopes become unstable. Since construction, road modifications have been made to cope with drainage and erosion problems. Smaller channels are seasonally active and runoff usually is high because there is no infiltration. It is impossible to place culverts to convey the surface runoff across the embankment and seepage through the fill is inevitable. The costs of operation and maintenance are relatively high, especially for erosion control. The annual road maintenance cost is well within the limit for a profitable coal mining operation at 78°N.

The Department of Physical Geography, University of Oslo (www.geografi.uio.no), arranged a two-week field course for doctoral students on permafrost mapping in Jotunheimen and on Dovrefjell, southern Norway, in August. The Nordic Council (NorFA) financed course was conducted by J. L. Sollid and B. Etzelmüller. Teachers and students from all Nordic countries participated. The department has established a field station at Hjerkinn, Dovrefjell, in southern Norway, for permafrost studies. In October J. L. Sollid and K. Isaksen, in co-operation with the Norwegian Geological Survey (NGU), drilled 11 boreholes, 9 m deep. All boreholes are instrumented with temperature dataloggers. A CALM site will be established there as well. Permafrost mapping (BTS measurments, DC resistivity soundings, seismic surveys) was carried out in eastern parts of southern Norway (E. Heggem). On Svalbard, T. Eiken and K. Isaksen continued studies of rock glaciers in the Nordenskiöldland area, and K. Isaksen collected borehole temperature data from the Janssonhaugen PACE borehole.

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Poland

Research on permafrost and periglacial phenomena is carried out on Spitsbergen, Svalbard in the Arctic and at the H. Arctowski Polar Station on King George Island in the Western Antarctica and in the alpine zone of the Tatra Mountains in Poland.

The geomorphological studies in Poland focus on relief evolution and deposits formed in the periglacial conditions of the Pleistocene. Research in polar areas focuses on thermal conditions and dynamics of the development of permafrost and active layer; periglacial processes (weathering, mass movement, the development of frost forms and structures); hydrological regime; frost heave and cryochemical processes and their role in shaping the polar geoecosystems; ecological effects of climate changes and anthropogenic effects in periglacial ecosystems. The programmes are carried out by expeditions organised by the Polish Academy of Sciences (Department of Antarctic Biology, Institute of Geophysics) and the Silesian University in Sosnowiec, the Adam Mickiewicz University in Poznan, the Mikolaj Kopernik University in Torun and the Maria Curie-Sklodowska University in Lublin. Research is mainly performed on Svalbard in the Polish Polar Station in Hornsund and at university stations on the western coast of Spitsbergen.

Monitoring of the active layer in the Calypsostranda area continues. Research is done by Janina Repelewska-Pekalowa, Department of Geomorphology, Maria Curie-Sklodowska University, Lublin. It begun in 1986 and is now part of the CALM programme. Since 2000 it has been part of a project entitled 'Functioning of periglacial geoecosystems under the influence of climate changes and anthropopression'. The project is financed by the Science Research Committee.

Results of the research on periglacial phenomena are presented at conferences organised by the Committee on Polar Research, the Polar Club of the Polish Geographical Society, and the Associations of Polish Geomorphologists. They are also published in several periodicals: *Polish Polar Research and Studies and Landform Analysis*. The *Biuletyn Peryglacjalny* No 38 (by *Societatis Scientiarum Lodziensis*) included papers presented at the Lódz Symposium on 'Periglacial Environments, Past, Present and Future', to celebrate 50 years of periglacial research under the aegis of the International Geographical Union.

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Russia

The Fourth International Circumpolar Arctic Vegetation Mapping (CAVM) Workshop was held in Moscow, 10-12 April 2001. The leader of the CAVM project is Skip Walker, University of Alaska. The workshop was organised and hosted by Evgeny Melnikov, Natalia Moskalenko and the Earth Cryoshere Institute, Russian Academy of Sciences, Siberian Branch. Twenty-eight participants from Germany, Iceland, Russia, and the United States took part in this meeting. The focus was on presentation of integrated vegetation maps for Alaska, Canada, Alaska, Greenland, Iceland, Svalbard, and Russia; presentation of vegetation legends; development of a plan for the final map synthesis (June, 2002); and possibilities for publication. Soils, surficial and bedrock geology, and percent water cover were considered in preparing the map.

The International Symposium on Conservation and Transformation of Matter and Energy in Earth Cryoshere was held on 1-4 June 2001, in Pushchino. Approximately 160 scientists from Canada, France, Germany, Japan, Russia, the United Kingdom and the United States and others attended the symposium. Russian participants represented 35 different organi-

zations (both academic and industry) from 20 cities. The symposium consisted of seven sessions:

1) Modern microscopic methods for studying microorganisms in permafrost as well as their bio-diversity, metabolic activity at low temperatures, and interaction with unfrozen water;
2) Formation and dynamics of gas hydrates and natural gases including the metastable status of gas hydrates, conditions of formation and evolution of hydrates in ice covers, experimental study of the formation of hydrates of natural gases in the dispersing deposits, and methods of determining physical properties of ground changes due to hydrate formation;
3) Physical and chemical bases of behavior of matter in heterogeneous media;
4) The value of experimental and natural data in our understanding of processes of heat and mass transfer in active layers including the existence of subaerial taliks;
5) Influence of cryogenic processes on morphology and properties of modern soils of tundra and taiga zones;
6) Interaction of various artificial buildings with permafrost, and the pollution of the environment by petroleum and radionuclides;
7) Exchange of matter and energy between land and ocean in the Arctic areas.

The Second Russian Conference on Geocryology was held on 6-8 June 2001, at the Lomonosov Moscow State University. The conference attracted 284 participants from 58 scientific, educational and industrial organizations across Russia, and scientists from Canada, France, Germany, Japan and the United States. A wide range of problems of modern geocryology was discussed on five sessions:

1) Physicochemistry and mechanics of frozen ground: Among the reports presented were specific topics devoted to the investigation of a genetic nature of durability, new methods of determination of the mechanical characteristics of frozen grounds, gas-hydrate-containing deposits, and the determination of heat conductivity of large volumes of frozen grounds.
2) Lithogenetic geocryology: Among the reports presented were specific topics on the composition and the structure of cryolithogenic and frozen ground, and the genesis of massive ice sheets of the Arctic cryo-lithozone.
3) Dynamic geocryology: Of 28 reports most attention was given to modern and past, long- and short-term fluctuations of climate and various methods for forecasting these phenomena.
4) Regional and historical geocryology: The 35 reports were divided into two groups of presentations; actual conditions and theoretical generalisations.
5) Engineering geocryology: the 25 reports covered topics of management of permafrost conditions in developed territories; safety of natural-technical systems; ecology and protection of the environment; new ways in the building on frozen grounds; new building technologies.

A total of 186 reports were submitted, and 103 of these were presented. The conference concluded that the following problems are most urgent in geocryology:

1. Development of the physicochemical theory of mass transfer in the frozen, freezing and thawing grounds, and the development of appropriate mathematical models;
2. Investigation of mass exchange properties of frozen grounds and the electrokinetic phenomena in freezing and frozen grounds;
3. Development of techniques for the determination and study of physicomechanical properties of frozen macrogeoterogenic and detritus grounds;
4. Development of ecologically safe physicochemical methods for the stabilization of frozen ground in order to prevent undesirable exogenous processes and to strengthen foundations;
5. Improvement of methods for palaeo-reconstruction of temperatures of the ground surface and thickness of cryolithozone;
6. Study of interrelations between climate warming and development of destructive processes in cryolithozone;
7. Development of the scientific bases for new construction methods on the frozen grounds;
8. Improvement of engineering protection for the environment and buildings from destructive geocryological processes;
9. Development of the legal regulations of the complex approach to the development of the North and to the creation of a system of ecological safety.

The Conference on the Results of Geocryological Research in Yakutia and Prospects of their Further Development was held 9-11 October 2001, in Yakutsk. This conference was organised by the Permafrost Institute of the Siberian Branch, Russian Academy of Sciences, and the Permafrost Department of the Yakutsk State University (R. M. Kamensky, chair of the organizing committee; A. N. Kurchatova, secretary). Post-graduate students of the Institute and the Department were active participants. Of the 69 submitted reports, 50 were presented (five plenary and 45 in sections). The plenary reports were devoted to summarizing studies of: thermal fields in cryolithozone of Yakutia (V. T. Balobaev); geocryological investigations (V. V. Kunitsky); physico-chemical processes on the migration of elements in the frozen grounds (V. I. Fedoseeva); engineering geocryology (R. M. Kamensky); and mountain geocryology (Batutin,S.A.).

The reports were presented in the following five sessions:

1. General and regional geocryology, geocryology and hydrogeology of cryolitozone (co-chairs: V. V. Shepelev and V. V. Kunitsky);
2. Geothermal, thermophysical, geophysical and heat balance researches (co-chairs: V. Y. Balobaev and M. N. Zheleznyak);
3. Geoecological research and problems of rational management of the cryolithozone (co-chairs: V. N. Makarov and M. M. Shats);
4. Engineering-geocryological problems of buildings and engineering structures on the permafrost (co-chairs: A,. N. Tseeva and R. V. Chzhan);
5. Development of deposits of minerals in the cryolithozone (co-chairs: S. A. Batugin and G. P. Kuzmin).

Over the past three years, integrated cryolithological-isotopic investigations were undertaken at sites on the Yugorsky, Yamal and Chukotka peninsulas within the framework of the INTAS project. Analyses of isotopes, macro- and micro-elements, and ice petrography are leading to publications on the reconstruction of the origin of tabular ground ice. Six teams from Russian and European institutes participated in the field and laboratory investigations: Alfred Wegener Institute for Polar and Marine Research-Potsdam (H.-W. Hubberten); Earth Cryosphere Institute (M. O. Leibman, A. A. Vasiliev); Lomonosov Moscow State University (I. D. Streletskaya); Shirshov's Institute of Oceanology (A. Yu. Lein); VNIIO kean-geologia (B. G. Vanshtein); and the Earth Science Center, Gothenborg University, Sweden (O. Ingolfsson and H. Lokranz).

The Melnikov Permafrost Institute published four books on permafrost engineering in 2001 in Russian:

- V. V. Torgashev. Piles in Conditions of High-temperature Frozen Grounds;
- I. E. Gurianov. Beginning of Permafrost Engineering;
- G. P. Kuzmin. Underground Structures in the Permafrost Area;
- V. I. Makarov et al. City Norilsk (Experience of Construction)

The Pushchino conference in 2002 is planned to be held on 12-15 May in honor of the 70th birthday of Evgeny Melnikov.

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Spain

The Spanish IPA group held a three-day workshop at Potes (Cantabrian Mountains), 27-29 June 2001. The workshop was organised by the Department of Geography, University of Valladolid, co-sponsored by the Castilla y León Regional Government, the National Park of Picos de Europa and the Spanish Geomorphological Society. On the first day the workshop subject was mountain periglacial environments, while on the second day a field trip across the high mountain in Picos de Europa visited an oceanic high mountain periglacial environment, and finally, the last day was devoted to the periglacial environment at high latitudes. Daniel Vonder Mühll delivered the opening lecture entitled Mountain Permafrost in Europe: an overview based on the PACE project. The meeting had twenty nine participants from Norway, Portugal, Spain, and Switzerland.

Participants of the Spanish IPA group during the workshop at Pico de Europa. Photo: Augusto P. Alberti.

Twenty talks were presented emphasizing Quaternary periglacial environments in the Iberian Mountains, principally in the northern mountains and Central System, and modern periglacial environments and processes in the Iberian Mountains and in the Arctic and Antarctic. The topics include the presence and distribution of permafrost in the Pyrenees and in the Sierra Nevada; and nival and mass movements related to periglacial proccesses in the Central System (Gredos, Guadarrama and La Estrelha); and application of new techniques to study periglacial processes such as permafrost modelling and BTS and ground temperatures measurements at Sierra Nevada, La Estrelha and Pyrenees. Permafrost, active-layer dynamics and slope processes, linked to geomorphological mapping in periglacial environments in the Arctic and at the South Shetland Islands (Antarctic) by Spanish, Portuguese and Norwegian researchers, were the mains topics on high latitudes. A booklet containing summaries of the

Nivation hollow in the Central Mountains of Spain, Guadarrama. Site studied by David Palacios. Photo: Hanne H. Christiansen.

presentations was available and a formal publication is in preparation. Two workshop topics were highlighted. First, the differences between oceanic and mediterranean mountains in the Iberian Península, with a particular emphasis on dynamic of the mediterranean high mountain and a strong importance of nival processes in the mountains of central Spain (Cantabrian Ranges and Central System). Second, the use of advanced technologies in periglacial environment and the participation of the IPA Spanish group members on Arctic and Antarctic research groups.

The Spanish IPA group will meet next in the Gredos Range in June 2003, organised by the Department of Geodynamics of the Universidad Complutense de Madrid. Before then Spanish periglacial geomorphologists will meet at the Symposium on Mountain Geomorphology in the VII National Meeting of the Spanish Geomorphological Society, 19-20 September 2002 at Valladolid.

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Sweden

The main IPA related research activities in Sweden during this reporting period were those under the PACE project which is reported elsewhere. Other universities have additional projects dealing with permafrost in alpine, arctic and antarctic environments.

The Department of Earth Sciences, Physical Geography, Uppsala University carries out cold climate research concerning landforms, processes and dynamics, and their relationship to environmental conditions in the past and present. Else Kolstrup has set up a research programme on boundary constraints of geomorphological forms and processes in past and present periglacial environments. Subprojects include studies of boundary constraints of thermal contraction cracking and a research student, Frieda Zuidhoff, works with a subproject on palsa dynamics in Lapland. Further, investigation of 'stone growth' in a boreal environment with winter frost is underway. Relict periglacial forms are being investigated in formerly periglaciated areas in Europe.

Phil Wookey, Else Kolstrup and Göran Possnert are conducting a Swedish Natural Science Research Council (NFR) funded project: Climate change, soil organic matter lability and decomposer metabolism in high latitude soils, with fieldwork in northern Iceland. Wookey is also participating in an EU project: Dynamic response of the forest-tundra ecotone to environmental change (DART). As a component of this project, research student, Sofie Sjögersten is investigating soil processes and trace gas fluxes in relation to tree-line dynamics in Fennoscandia. Phil Wookey remains chair of the International Tundra Experiment (ITEX). Jan Boelhouwers, recently moved from South Africa to Uppsala, has completed a five-year project on past and present periglacial processes on the Subantarctic Marion Island. A new proposal has been submitted to continue the Subantarctic work, while a separate project aims to expand the study on environmental controls on solifluction and frost heave to seasonal frost and discontinuous permafrost areas in Lapland. Achim A. Beylich, funded by the post doctoral programme of Deutscher Akademischer Austauschdienst (DAAD) carries out process geomorphological research within the project 'Recent sediment budget and relief development in Latnjavagge, Swedish Lapland'. This project is combined with the interdisciplinary NFR-project 'Tundra landscape dynamics'. It is in cooperation with Else Kolstrup, Christer Jonasson (Abisko Scientific Research Station), Ulf Molau (Botanical Institute, Göteborg University), Johan Kling (Swedish Environmental Protection Agency), and Laust Pedersen (Uppsala University). Financial support is from the DAAD, the Royal Swedish Academy of Sciences, NFR, and Uppsala University.

At the Department of Physical Geography, Lund University, no major projects dealing with permafrost have received funding for the last four years and only minor activities have been continued through private funding initiatives and through basic departmental funds and staff input. Prof. emeritus J.O. Mattsson continue editing the *Geografiska Annaler* from Lund. Active projects are;

- Abisko area active layer transect. In co-operation with The Abisko Research Station J. Åkerman is maintaining the CALM sites along the east-west transect in the Abisko area. The ten active layer sites have now been monitored since 1978, and annual basic data is presented within the CALM reporting system.
- Active periglacial procesess and their climatic significance in the Kapp Linne' area, Svalbard. J. Åkerman is maintaining a limited monitoring programme of the processes and the climate within this area, with an annual visit.
- Active layer monitoring in the Kapp Linne' area, Svalbard. This monitoring programme, which started in 1972, is still maintained and now within the CALM network. It is run in cooperation with UNIS, Ole Humlum.
- Vegetation mapping over the Kapp Linne' area, Svalbard. A MSc study by T. Josefsson and I. Martensson supervised by J. Åkerman is in its finals stages of reporting.
- A digital elevation model with analyses of the vertical and horizontal distribution of vegetation and geomorphological forms and processes in the Kapp Linne' area, Svalbard. A MSc study supervised by J. Åkerman was finished in 1998 and awaits publication.

Rolf Nyberg of the Department of Earth Sciences, University of Karlstad is maintaining serveral projects in the Abisko area. One involves dynamics of the Kårsa glacier and one on permafrost and slope processes in the Pallenvagge and Nissunvagge valleys, assessing the importance of extreme erosional events as geomorphological hazards and as climatic indicators in the Abisko area.

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Switzerland

The 'Permafrost Monitoring Switzerland (PERMOS)' is in the first of three years of the pilot phase. Activities comprise temperature measurements at ten drill sites, BTS-surveys to determine permafrost distribution patterns in ten areas, and organising aerial photographs to document surface characteristics, allowing for later photogrammetrical studies. The following institutes are responsible for the field surveys: Universities of Bern, Fribourg, Lausanne and Zurich, Swiss Federal Institute of Technology (ETH) and the Swiss Federal Institute of Snow and Avalanche Research (SFISAR, Davos). The network is sponsored by the Swiss Academy of Sciences, the Swiss Forest Agency and the Federal Office for Water and Geology. Annual reports are published by the Swiss Glaciological Commission.

The PACE project with the two Swiss partners (University of Zurich: Wilfried Haeberli, Martin Hoelzle, Catherine Mittaz; and VAW-ETH Zurich: Daniel Vonder Mühll, Christian Hauck) has come to an end. Christian Hauck finished in spring his Ph.D. thesis entitled 'Geophysical methods for detecting permafrost in high mountains'. Collection of borehole temperature data and meteorological data from climate stations are continued at Murtèl, Schilthorn and Zermatt within the national PERMOS-network.

At ETH Zurich the ETH-Mini-Poly project of the three institutes Geotechnics (IGT: Sarah Springman, Lukas Arenson), Geophysics (Hansruedi Maurer, Martin Musil), and VAW (Daniel Vonder Mühll) has reached its third and final year. Both doctoral theses by Arenson and Musil are in their final stages, which means that the collected data are being processed. The triaxial creep tests, which are mainly performed with cores from the recent drillings at the Murtèl-Corvatsch rock glacier, show the expected, exponential influence of the stresses on the creep rates. However, one of the most surprising observations of the current field measurements was the presence of water within the rock glacier. It seems as if the cavities within the frozen body allow water to leak through the system. Not only does the water reduce the strength of the material, it is also an additional heat flux, which must be taken into account. Detailed information about the deformation within the rock glacier is expected from the new measurement system (time domain reflectometry), which was installed at the Murtèl-Corvatsch site. Until now, the deformation is not large enough to show a signal, but for the future, the system is very promising. A modelling work regarding the dynamics of rock glaciers arose from the ETH-Mini-Poly project (Hilmar Gudmundsson, Gwendolyn Leysinger). A numerical model has been developed describing the advance and retreat of a gravity driven creeping viscous medium, which is used to investigate the flow field close to the rock glacier terminus.

The Glaciology and Geomorphodynamics Group at University of Zurich is working on the following projects: 'Permafrost distribution modelling based on energy-balance data' (Catherine Mittaz, Martin Hoelzle); 'GIS-based modelling of creeping mountain permafrost' (Regula Frauenfelder); 'Analysis and spatial modelling of permafrost distribution in cold-mountain areas by integration of advanced remote sensing technology' (Stephan Gruber); 'Investigation of perennial ice patches' (K. Schulz, R. Frauenfelder); and 'Analyses of permafrost creep using digital photogrammetry' (Andraes Kääb). Markus Lerjen finished his MSc. thesis on 'Frozen talus slopes', and Sonja Oswald finished a MSc. on 'Relation between permafrost and debris flows in the Valais Alps'. Research results were presented at the 1st European Permafrost Conference in Rome, March 2001 and at the 5th Conference on Geomorphology in Tokyo, August 2001. Temperature conditions in steep rock slopes, especially as related to instability problems in warm and degrading permafrost, are being parameterised by combined single-channel temperature datalogger measurements and spatial modelling (Wilfried Haeberli, Stephan Gruber, Jeannette Nötzli and Marco Peter).

The Swiss Federal Institute for Snow and Avalanche Research (SLF) is continuing to investigate snow-supporting structures in permafrost terrain by monitoring ground temperatures and slope movements at three high altitude permafrost sites equipped with

Snow-nets retaining rocks in summer. In winter the nets prevent the triggering of avalanches. Photo: Marcia Philips.

avalanche defence structures. The aim of the project, which started in 1996, is to determine whether snow-supporting structures modify the thermal regime of the ground and whether slope stability is affected. Different types of structures and foundations are being tested for their efficiency on steep slopes in unstable, frozen sediments. Federal guidelines for the construction of snow-supporting structures in permafrost terrain were published by SLF in 2000 and used for current building sites. The project is supported by the Swiss cantons Valais and Graubünden.

The Institutes of Geography, Universities of Lausanne (Christophe Lambiel, Emmanuel Reynard) and Fribourg (Reynald Delaloye, A. Turatti) have focused on four types of sites: glacier forefields, rock glaciers, talus slopes and low altitude places. Investigations are performed by applying geoelectrics and surface thermal methods at various sites. Glacier forefields are studied in particular in the Verbier area in collaboration with the Institute of Geophysics at the University of Lausanne (L. Baron, R. Monnet, and L. Marescot). A joint project between the Institutes of Geography of Fribourg and Lausanne, the University Institute Kurt Bösch at Sion (Ralph Lugon) and the Department of Geography at the University of Valladolid, Spain (Enrique Serrano) aims at understanding the glacier/permafrost relationships in the Little Ice Age moraines systems in the Posets Massif, Central Pyrenneas (Spain).

Several projects related to permafrost are in the phase of implementation, which is guided by the Academia Engadina (Felix Keller). At Pontresina a combined avalanche – debris flow dam is being constructed to protect the village against natural hazards. The University of Bern (Group for Applied Geomorphology, Dragan Mihajlovic) continued the studies on radiation- and energy balance at Fruggentälti/Gemmi.

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United Kingdom

Julian Murton (University of Sussex) and Mark Bateman (University of Sheffield) initiated a project on sand-sheet development in the Tuktoyaktuk Coastlands, Western Canadian Arctic, in July 2001, and funded by the Royal Society. The project is determining the temporal relationships between sand-sheet formation and known changes of climate, active-layer depth, vegetation and glaciation, in order to establish the natural controls on and timing of aeolian sand-sheet development during the last glacial-interglacial cycle in the Tuktoyaktuk Coastlands. Samples were collected for luminescence and radiocarbon dating, and stratigraphic and sedimentological observations were recorded. Interestingly, multiple levels of sand veins and wedges were observed in the sand sheets, the highest syngenetic wedges recorded within the Kittigazuit Formation on Richards Island exceeded 9 m. Future work seeks to clarify the complex stratigraphic relationships between sand-sheet, sand-dune and glacigenic deposits along the northern coast of Liverpool Bay, beyond the mapped limit of Wisconsinan glaciation.

Charles Harris (University of Cardiff) and Michael Davies (University of Dundee), in collaboration with Johan Ludvig Sollid (University of Oslo) established a process monitoring station at Steinhoi, Dovrefjell, Norway in July 2001, funded by the British Natural Environment Research Council. A steel frame was installed on which is mounted a pair of Linear Voltage Displacement Transducers (LVDTs), to record ground surface movements (heave/settlement and down slope displacement). Thermistor strings and Druck miniature pore water pressure transducers were also deployed to monitor seasonal ground freezing and thawing, and associated pore water pressure variations. Data is recorded by a Campbell logger that is linked to Cardiff and Dundee via a mobile phone, making it possible to interrogate the station on a daily basis. Rudberg columns were also installed for long-term measurement of displacement profiles. The aim is to generate field data for validation of recent laboratory simulation studies.

Linear Voltage Displacement Transducers at monitoring site at Dovrefjell, Norway. Photo: Charles Harris.

The IPA web site continues to be maintained by Julia Branson at the Geodata Institute, University of Southampton UK and may be found at http://www.geodata.soton.ac.uk/ipa. Any queries should be e-mailed to j.branson@soton.ac.uk

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United States of America

The U.S. Permafrost Association (USPA) was officially established in 2001 to better enable U.S. scientists to contribute to the International Permafrost Association

and to promote permafrost science and engineering in the U.S. The fledgling organisation currently serves about 75 individual members, several corporate and institutional members. Activities during this first year have been primarily aimed at becoming firmly established as a legitimate non-profit organisation with clearly defined goals and by-laws. Larry Hinzman and Rupert 'Bucky' Tart are serving as interim officers until the first elections are completed in early 2002. The new organisation met at the Annual AGU Fall meeting in San Francisco in December. A web page is under construction with links to other national and international organizations (http://www. uspermafrost.org/). University of Alaska President Mark Hamilton officially invited the IPA to convene the Ninth International Conference on Permafrost in 2008 in Fairbanks.

Numerous permafrost related research efforts are currently active in the Alaskan Arctic and Subarctic and in the Russian Arctic. The U.S. National Science Foundation Arctic System Science (ARCSS) programme (http://www. nsf. gov/od /opp /arctic/ system.htm) supports several projects that examine permafrost dynamics and influence on ecosystem processes and their response to climatic variability:
ATLAS (http://www. laii. uaf. edu /projects.htm#atlas)
ITEX (http://www. systbot. gu. se/research/itex/itex.html)
CALM (http://www. geography.uc.edu/~ kenhinke /CALM/) and RAISE programmes (http://www. raise. uaf.edu/). A series of ATLAS and RAISE meetings were held in Salt Lake City in November to review progress and develop future plans. Additional information on these programmes and individual projects is available through the web addresses.

News from individual projects include the following highlights:

Several NSF-sponsored, active-layer projects led by Ken Hinkel and Frederick Nelson continued in northern Alaska and included observations on the influence of enhanced snow accumulation on seasonal thaw and the deployment of 60 air-soil temperature dataloggers in the Barrow peninsula to assess the extent of the urban heat island. Wendy Eisner, Ken Hinkel, Jim Bockheim and others conducted a programme of intensive spring coring and a ground-penetrating radar (GPR) survey of drained thaw-lake basins near Barrow. A project sponsored by the International Arctic Research Center (IARC) at Barrow and coordinated by Jerry Brown resulted in installation of new thermistor cables by Kenji Yoshikawa and Vladimir Romanovsky in several boreholes. The boreholes were originally instrumented and observed during the 1950s and early 1960s by Max Brewer. With the assistance of the Barrow Arctic Science Consortium (BASC) a key coastal site was established along Elson Lagoon as part of the Arctic Coastal Dynamic (ACD) programme.

The extensive thermokarst features near Council on the Seward Peninsula are being studied by Larry Hinzman, Douglas Kane and Kenji Yoshikawa. These investigations relate changes in hydrologic processes and permafrost to climatic dynamics, and seek to develop better prognostic tools for predicting future hydrological responses. Initial results indicate that under a warming climate, the thermokarst ponds will drain as permafrost degrades.

Gary Clow, USGS, revisited the climate-monitoring stations in the northern Alaska and installed several new stations. There are now nine stations monitoring active layer temperatures, air temperatures, snow depth, and solar radiation all with Campbell data-loggers. Two deep drill holes were relogged, East Teshepuk and North Inigok, and both showed a very significant warming during the 1990s.

Tim Collett, USGS, reports that as a continuation of the 1998 Mallik 2L-38 gas hydrate research-drilling effort, activities are underway to reoccupy the Mallik site in the Canadian Mackenzie River Delta and drill three additional gas hydrate research wells during the 2001-2002 winter season (see Canadian report for more information).

Permafrost engineering activities are increasing as a result of two major projects, which are taking place in Alaska. First, the Trans Alaska Pipeline right-of-way (ROW) must be renewed in 2004. The original ROW agreements were for a period of 30 years beginning in 1974. This renewal will require the pipeline owners to participate in the preparation of an Environmental Impact Statement (EIS). Many of Alyeska Pipeline Service Company's long-time consultants will be busy with this work; and the Bureau of Land Management has retained its own EIS consultant. The second major effort in Alaska is the new gas pipeline study that has been initiated by the Alaskan gas producers. This study should continue for 12 to 24 months and it is hoped that it will lead to the design and construction of a gas pipeline from Prudhoe Bay to Calgary or further south.

The American Society of Civil Engineers (ASCE) and its Technical Council on Cold Regions Engineering (TCCRE) remain active in promoting permafrost engineering research and knowledge. They continue to sponsor engineering representation to the US Permafrost Committee. TCCRE is in the final planning stages for the 11th International Conference on Cold Regions Engineering, which will be held in Anchorage, Alaska, May 20-22, 2002. Over 130 abstracts have been submitted. For more information contact Kelly Merrill (KMerrill@CH2M.com). TCCRE is also actively pursuing updating several Cold Regions Engineering Monographs over the next several years. Ted Vinson is completing the report 'Strategic Plan for Cold Regions Engineering Research in the New Millennium', based on the NSF-sponsored, June 2000

conference.

The American Society of Mechanical Engineers (ASME) supports two technical areas that are of interest to cold regions engineers – the Heat Transfer Division has a K-18 Committee that focuses on low temperature heat transfer and is chaired by Zhoumin Zhang (zmzhang@ufl.edu), and the Ocean, Offshore, and Arctic Engineering Division (OOAE) sponsors the annual Offshore Mechanics and Arctic Engineering (OMAE) conference. The conference scheduled for 2002 will be held in Oslo, Norway, 23-28 June. Information on the conference can be found at http://www.omae.org.

Tingjun Zhang is leading the International Arctic Research Center (IARC) funded Global Geocryological Database (GGD) project, a continuing task for the international permafrost community. GGD is based at the National Snow and Ice Data Center, Boulder, Colorado, and is coordinated with the IPA Standing Committee on Data, Information and Communication. An objective of GGD is to establish a one-stop center for dissemination of frozen ground data and information. Version II of the CAPS CD-ROM Conference is under preparation and will be available for the Zurich Conference in 2003. Organisations, institutions, and individuals are encouraged to contribute frozen ground related data and information to GGD. For more information http://nsidc.org/frozen ground/.

The 25th Anniversary of the National Snow and Ice Data Center was honored by hosting a special session at the AGU Fall Meeting in San Francisco, California. The session is entitled 'Monitoring an evolving cryosphere' and the moderators were Anne Nolin and Ted Scambos. The session will focus upon the use of cryospheric data sets and new monitoring and measurement techniques to investigate the earth's cryosphere, including floating ice, snow cover, glaciers, frozen ground, polar climate, and ice sheets.

A comprehensive river discharge database for the entire pan-Arctic drainage system, is now available (http://arcss.colorado.edu/Catalog/arcss062.html). This database covers the entire pan-Arctic drainage system, and is available on CD-ROM. The collection comprises data from 3713 gauges and contains monthly river discharge data extending from the 1890s (for four Canadian and five Russian gauges) through the early 1990s, but the majority of data was collected between 1960 and 1990.

The NSF ARCSS programme requested members of the research community to assess the current status and research priorities related to hydrological processes in the Arctic Basin. In September 2000, thirty-three researchers active in studies related to arctic hydrology met in a workshop in Santa Barbara to define the most pressing research needs and formulate an approach to address those needs. The resulting research strategy, including topics related to permafrost, has been published and is available via the internet at (http://www.arcus.org/ARCSS/hydro/index.html) or from the Arctic Consortium of the United States (ARCUS).

The U. S. participation in the Global Terrestrial Network-Permafrost (GTN-P) programme was summarised in the August 2001 NOAA GCOS report to the Conference of Parties to the United Nations Framework Convention on Climate Change. The report is available from http://www.eis.noaa.gov/gcos or contact howard.diamond@noaa.gov.

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OTHER NEWS

Iceland

Olafur Arnalds, Agricultural Research Institute, Department of Environmental Science, attended the Third International Conference on Cryopedolgy in Copenhagen, and expressed Iceland's interest in becoming a member of the IPA. A formal letter requesting membership has since been received.

The most comprehensive permafrost related research in Iceland to date was done in the Thorsarver palsa-area, south of Hofjökull in Central Iceland by Thora Ellen Thorhallsdottir (Reykjavik University). The extent of this palsa area was surveyed in the summer 2001 by the National Power Company. The Natural Research Centre of northwest Iceland and the Agricultural Research Institute initiated a new research effort this year in the Orravatnsrustir palsa area in North Iceland. Little is known about the extent of permafrost in Iceland, but a beginning of a new long-term effort is scheduled for 2002.

The Agricultural Research Institute is investigating cryoturbation of soils and the formation of hummocks in cooperation with Texas A&M University. A new soil map of Iceland has recently been completed by the Agricultural Research Institute (see www.rala.is/desert).

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New Zealand

Several New Zealand programmes were commenced or continued during the past year in the area of permafrost and periglacial processes in both New Zealand and Antarctica. M. B. Scott, K. J. M. Dickinson, A. F. Mark, B. I. P. Barratt, B. J. Sinclair (University of Otago) initiated a study of the invertebrate diversity of three-types of alpine patterned ground on the Old Man Range of Central Otago. They are investigating how biodiversity and distribution of invertebrates may be dictated by environmental variables extant in solifluction terraces, soil hummocks and soil stripes. They are also examining microhabitat temperature data to examine seasonal freeze-thaw events responsible for maintaining the patterned ground ground, and thus enable them to develop a better appreciation of the periglacial features and their indigenous biota.

Warren Dickinson (Victoria University of Wellington) is continuing his programme of shallow permafrost drilling in the Dry Valley area of Antarctica. Shallow permafrost drilling was commenced in November 2000 and aims to recover a climate record from Antarctic ground ice, which potentially holds a detailed record spanning 15 million years. The cored material will be used to elucidate climate history from the geochemistry of the ground ice, as well as to provide stratigraphic information.

David Nobes (University of Canterbury) is also working in Antarctica with a project that involves testing the geophysical response of contaminants in soils and permafrost near Scott Base. The aim of his work is to use near-surface geophysical methods to map the vertical and horizontal extent of contaminants in the soil and permafrost.

Iain Campbell and Robert Gibb (Landcare Research) are developing an Antarctic Soils Database with data currently included from around 550 sites ranging from Cape Hallett to the Ellsworth Mountains. When completed, there will be data from about 800 sites from New Zealand soils research in the Transantarctic Mountains and East Antarctica spanning the period 1964 to 1999. The compiled data is held in the New Zealand Landcare Research National Soils Database. Consideration is presently being given as to how other significant soils data sets that have accumulated, and were gathered under the programmes of other countries working in the Antarctic, might be incorporated into this database to enable development of a comprehensive Antarctic Soils Database. Consequently, they ask that scientists planning to describe or sample Antarctic soils could use their format for site and soil description and compile their data in a form that would be readily accepted into the New Zealand Comprehensive Antarctic Soils Database. For enquiries, contact Iain Campbell (iaincampbell@xtra.co.nz) or Robert Gibb (GibbR@landcare.cri.nz)

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Portugal

Research on periglacial dynamics is conducted in the project 'Geomorphological and biophysical dynamics and landscape units in Mediterranean mountains (1999-2001), Sierra da Estrela'. The main topics include air, ground and rock temperature monitoring, geomorphological mapping of relict features, and monitoring of contemporary periglacial dynamics in the area above 1600 m asl. The control of the cryogenic processes on the vegetation are studied, and the identification of the plant associations adapted to different cryogenic dynamics is estimated by A.B. Ferreira, G. Vieira and C. Mora (Lisbon University) J. Jansen, (Nijmegen University, The Netherlands), M. Ramos (Alcalá de Henares University, Spain).

The collaboration between G. Vieira (University of Lisbon) and M. Ramos (Alcalá University) for studying Antarctic permafrost and active layer in the Livingston and Deception Islands continues, and new results were presented at international meetings.

In 2001 a Portuguese Association of Geomorphologists was constituted (email: geomorf @ ceg. ul. pt). This is an important milestone for Portuguese geomorphology.

Gonçalo Vieira (gtvieira@ceg.ul.pt)

South Korea

In February 2001 a new collaborative study was started entitled 'Recent and future distribution of permafrost in the Korean Peninsula, based on studies of recent permafrost forms in the mountains and plains of the Korean Peninsula and precise AMS-dating of Siberian ice-wedge ice'. The participants were Jong Chan Kim (Seoul National University, Director of the AMS-Laboratory), Uk Han (Korea Military Academy), Yurij K.Vasil'chuk (Geocryology and Glaciology Department, Lomonosov's Moscow State University,) and Alla Vasil'chuk (Lomonosov's Moscow State University).

The activities in 2001 included dating Late Pleistocene ice wedges from 2 cross-sections of the lower Kolyma River (Duvanny Yar and Zelyony Mys) using AMS. Future AMS studies will be performed dating ice-wedge ice complexes in three representative cross-sections of Yakutia (Plakhinski Yar, Bykovsky Peninsula, and Mamontova Gora). In August 2001 Jong Chan Kim, Yurij K.Vasil'chuk and Alla Vasil'chuk undertook field trips supported by the Seoul National University. At Jilmoe Bog in the Odae Mountain National Park at 1060 m a.s.l. they studied recent hummock formation in cooperation with Keyong Park from the National Park Authority and Son Myong Won (Taegu University). Also cross-sections of multistage ground wedges at the archeological Chongok Paleolithic site (designated as the National Monument N268) was studied in cooperation with Kidong Bae and Miyoung Hong (Hanyang University). Several scientific papers are in preparation on precise radiocarbon dating of permafrost features based on these studies.

Jong Chan Kim (jckim@phya.snu.ac.kr)

PACE Final Report

As reported in previous issues of Frozen Ground, the Permafrost and Climate in Europe (PACE) was funded by the EU 4th Framework Contract ENV4 CT97 0492. The major objectives were:

- To establish a framework for monitoring the impact of global climate change on permafrost in the mountains of Europe.
- To develop methods of mapping and modelling the distribution of thermally sensitive mountain permafrost, and predicting modifications in this distribution resulting from climate change
- To provide new, process-based, methods for assessing environmental and geotechnical hazards associated with mountain permafrost degradation.

The PACE borehole network comprises eight, instrumented deep boreholes, of which seven were drilled during the project period from December 1997 to March 2001 (see Frozen Ground 24, 15). In order to optimise comparability, and to ensure that thermal properties were not excessively complex, all PACE boreholes were drilled in bedrock, in the main ridge-crest or plateau locations where winter snow accumulation is minimal. In all cases 100mm diameter air flush rotary drilling was used. The PACE standard borehole depth is at least 100m, but since the borehole is protected with a covering structure at the surface, an additional 20m-deep borehole is drilled adjacent to the main borehole for measurement of active layer properties under undisturbed conditions. Boreholes are lined with plastic tubing and instrumented with standard thermistor strings assembled by F. Stump AG, Nänikon, Switzerland. Negative temperature coefficient thermistors (Yellow Springs Instruments 44006) with a relative accuracy of 0.02°C are placed on a Colorflex CY chain. Thermistor strings may be retrieved from the boreholes for recalibration and essential maintenance. Data archiving from each borehole is initially by the national group responsible for installation. Central PACE archiving is through the University of Zurich, Switzerland. Initial results are reported in *Permafrost and Periglacial Processes* 12(1) 2001, the Special PACE volume prepared for the 1st European Permafrost Conference in Rome. Data will be finally archived through GTN-P.

Techniques for mapping and characterisation of mountain permafrost developed during the PACE project are largely based on geophysical surveys. The main methods tested and developed were two-dimensional electrical resistivity tomography, conductivity surveys, seismic surveys (including tomography), GPR, and radiometry. Combinations of techniques were shown to be most effective in permafrost detection and characterisation. Major progress has also been made in numerical modelling of permafrost distribution, the development of physically based numerical models of thermal interactions between atmosphere-active layer-permafrost, and the integration of remotely sensed data with Digital Terrain Models (DTMs) in a GIS environment for the analysis of mountain permafrost processes. Current status reports are contained in *Permafrost and Periglacial Processes* 12(1). Work on geophysical mapping was mainly centered at ETH, Zurich (Daniel Vonder Mühll) and TerraDat UK (Nick Russill), and on numerical modelling at the University of Zurich (Martin Hoelzle) and the University of Oslo (Bernd Etzelmüller).

Mountain Permafrost Geotechnical Hazard Assessment in the Context of Global Warming Integration of work packages within the PACE programme has led to the development of hazard assessment protocols. These include recommendations on site investigation procedures for permafrost detection, assessment of the nature and character of associated hazards, and recommendations on detailed ground investigations.

The protocols are designed for engineering practitioners. It is hoped that the PACE Permafrost Hazard Assessment Protocols will be published by the European Commission in 2002. The compilation of protocols involves all PACE Partners, but is coordinated by Charles Harris (Cardiff) and Michael Davies (Dundee). A review of hazard assessment developed in this project is given in *Permafrost and Periglacial Processes* 12(1).

The work of permafrost mapping, modelling and monitoring in Europe encompassed by the PACE Project will be continued through the informal PACE 21 group. See the following Open Letter from Charles Harris for information.

PACE Partners are: University of Cardiff, University of Stockholm, University of Oslo, University of Giessen, Third University of Rome, University Complutense Madrid, University of Zurich, VAW at ETH Zurich, TerraDat UK Ltd Cardiff.

Charles Harris (harrisc@cardiff.ac.uk)

Permafrost and Climate in Europe in the 21st Century: Open Letter to European Permafrost Scientists

Dear Colleagues,

The EU 4th Framework PACE project was completed in March 2001, and as many of you are aware, this was marked by the 1st European Permafrost Conference in Rome, 26-28 March 2001.

The PACE permafrost borehole monitoring network has been established and data is being collected, analysed and archived. It is critical that this international research programme is continued into the 21st Century, to foster a regional-scale approach to permafrost research, and in particular, long-term permafrost monitoring within the GTN-P programme of the Global Climate Observing System.

The Coordinating Committee of PACE therefore proposes that the research infrastructure established under the PACE programme be continued under the title Permafrost and Climate in Europe in the 21st Century (PACE 21). PACE 21 is initially organised through a Coordinating Committee chaired by Charles Harris at the University of Cardiff. The programme is open to all who wish to participate in European Permafrost Research. It is hoped that in addition to providing an organisational framework for European permafrost monitoring, PACE 21 will promote new international funding initiatives, provide a forum for discussion and research development, and act as a source of information on permafrost research opportunities.

Please e-mail Charles Harris (HarrisC @cardiff. ac. uk) to indicate your interest in participating in the activities of PACE 21, and to place your name on an electronic mailing list to receive information on future PACE 21 projects and programmes.

The PACE 21 Coordinating Committee is: Charles Harris, University of Cardiff, UK; Michael Davies, University of Dundee, UK; Wilfried Haeberli, University of Zurich, Switzerland; Dani Vonder Mühll, University of Basel, Switzerland; Johan Ludvig Sollid, University of Oslo, Norway; Bernd Etzelmüller, University of Oslo, Norway; Lorenz King, University of Giessen, Germany; David Palacios, University Complutense Madrid, Spain; Francesco Dramis, 3rd University of Rome, Italy; and Per Holmlund, University of Stockholm, Sweden.

On behalf of the PACE 21 Coordinating Committee,

Charles Harris

SCANNET

A new three-year EU project entitled 'The Scandinavian – North European Network of Terrestrial Field Bases' (SCANNET) was initiated in the spring 2001. SCANNET is a network of field site leaders, research station managers and user groups in northern Scandinavia and Europe that are collaborating to improve comparative observations and access to information on environmental change in the North. SCANNET partners provide stability for research and facilitate long-term observations in terrestrial and freshwater systems. The SCANNET network of research facilities includes a wide range of geographical, geophysical, climatic, vegetation, faunal, hydrological, soil and land-use conditions. The location in the north Atlantic Region means that within the SCANNET region there are strong environmental and land use gradients that enable focus on various drivers of global change.

The nine SCANNET partners are: Abisko Scientific Research Station in northern Sweden; Kilpisjarvi Biological Station in northwest Finland; Kevo Subarctic Research Institute in northern Finland; Norwegian Institute for Water Research´s site at Dovrefjell in southern Norway; Zackenberg Research Station in northeast Greenland; the Centre for Ecology and Hydrology´s research site in the Cairngorm Mountains in central Scotland; the Norwegian Polar Institutes field base at Ny Ålesund at Svalbard; the Litla-Skard site in Iceland; and the Sornfelli Station at the Faroe Islands.

Among the aims of SCANNET are the improvement of the geographical coverage and comparability of long-term observations and experiments related to environmental change, and the identification of gaps in observations and experiments and stimulation of new, coordinated and comparable measurement programmes within the network.

SCANNET participants are studying different grid points in the CALM grid at Ny Ålesund, Svalbard. Photo: Hanne H. Christiansen.

The users of SCANNET include international organisations like the IPA, particularly with its GTN-P. The IPA and GTN-P activities were presented at the SCANNET Users Meeting in Torshavn, the Faroe Islands, in November 2001. The needs for data on soil temperature, active-layer thickness and permafrost and borehole temperatures were identified. During their meeting at the Ny Ålesund site in August, the SCANNET Station Managers were introduced in the field to the standard CALM measurements on the newly established CALM grid.

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

Northern Research Basins

The 13th Northern Research Basins International Symposium and Workshop took place 19-24 August, 2001 in Saariselkä, Finland and Murmansk, Russia. The general theme of the Symposium and Workshop was 'Climate Change and Impacts in Northern Hydrology'. Hosted by Esko Kuusisto of Helsinki, Finland, the Symposium and Workshop was attended by 43 people representing 12 countries.

International Commission on Snow and Ice

The Bureau of the International Commission on Snow and Ice (ICSI) met at Maastricht, Holland, 18 July 2001. H.G. Jones follows E.M. Morris as the president of the Commission. Major points of discussion covered the question of adequate funding for the Global Terrestrial Network for Glaciers (GTN-G) and a restructuring of WGMS to include other institutes and centres in order to adjust to the rapidly increasing task, especially in view of the advanced monitoring technologies (remote sensing, digital terrain analysis). Concerning the position of ICSI within IUGG, possibilities of closer contacts with the IPA are envisaged. The example of the AGU Snow, Ice and Permafrost Committee was referred to as an excellent mechanism of how the reorganisation and restructuring of the original AGU Snow and Ice Committee of the Hydrological Section had allowed greater coordination between the glaciological and permafrost communities. Corresponding contacts are being established between the presidents of ICSI and IPA.

ICSI-sponsored conferences/workshops included, among others, the 'International symposium on sea ice and its interaction with the ocean, atmosphere and biosphere' (Fairbanks 2000), the 'International workshop on debris-covered glaciers' (Seattle 2000) and the 'International symposium on snow, avalanches and impact of forest cover' (Innsbruck 2000). ICSI will also be a cosponsor of the ICOP 2003.

Wilfried Haeberli (haeberli@geo.unizh.ch)

Climate and Cryosphere

CLiC: At the ICSI meeting, Roger Barry, Co-Vice Chair of the Arctic Climate System (ACSYS)/Climate and Cryosphere (CliC) Science Steering Group, presented the objectives of the new WCRP project. CliC aims to provide a globally integrated approach to the study of the role of the cryosphere in the climate system. CliC would like to maintain close links with the SCAR and ICSI. ACSYS ends in 2003 and CliC will then continue for about 15 years. Information can be obtained via the CliC web site (http://clic.npolar.no).

Roger Barry (rbarry @kryos.colorado.edu)

Publications

Antarctic & Cold Regions Database
The American Geological Institute (AGI) is continuing the Antarctic Bibliography and the Bibliography on Cold Regions Science and Technology as part of the Cold Regions Bibliography Project. These bibliographies provide coverage of:
- Antarctic research and exploration
-Cold Regions engineering and physical science information.

AGI compiles the Cold Regions Bibliography based on sources provided by U.S. and overseas scientists, the Cold Regions Research and Engineering Laboratory (CRREL), the National Science Foundation (NSF), and libraries and polar and research institutions worldwide. In addition, through a cooperative agreement with AGI, the Scott Polar Research Institute (SPRI) provides information on the Antarctic materials housed in the SPRI library at the University of Cambridge. The database is searchable online. Modest subscription rates apply (coldregions @ agiweb .org).

Permafrost Response on Economic Development, Environmental Security and Natural Resources
Roland Paepe and Vladimir Melnikov (eds.), Proceedings of the NATO Advanced Research Workshop, Novosibirsk, Russia, 12-16 November 1998. NATO Science Series, 2. Environmental Security-Vol. 76, 636 pages. Kluwer Academic Publishers. Hardcover US$/EUR 245; paperback US$/EUR 95.

This state-of-the-art book on permafrost discusses the topic in terms of geology, biology, chemistry, physics, climatology, engineering, land development, environmental management, social and economic impacts. Topics discussed include on- and offshore data assessment, past and future permafrost evolution according to global climate change, engineering effects on permafrost, and new dimensions in geocryology, including gas hydrates, microbiology, and information technology.

Permafrost: A Guide to Frozen Ground in Transition
Neil Davis, 2000, University of Alaska Press, Fairbanks, Alaska, 352 pages (US$ 35.95) www.uaf.edu/uapress

Karl Ernst von Baer (1842): Materials for the Study of the 'Eternal Ground-Ice' in Siberia
This book in German on the origin of permafrost research has for the first time been published in 2001. The book has an introduction and comments by Erki Tammiksaar, Tallin. The price is EUR 35 including shipping. It can be ordered from erki@zbi.ee or lorenz. king@geogr.uni-giessen.de.

Permafrost Investigations by Geophysical Methods
This book in Russian is by V. S. Yakupov, Yakutsk. It summarises knowledge and experience of geophysical method applications to the study of frozen strata structure, composition, properties and morphology and of solving problems of geological survey and prospecting, water supply and construction in permafrost areas. The price is $US 25 including shipping. It can be ordered by emailing the author (yumaguja @aport.ru) who can provide further information on payment.

Forthcoming meetings

2002

32nd International Arctic Workshop
14-16 March, Institute of Arctic and Alpine Research (INSTAAR), University of Colorado at Boulder, USA. Contact information: ArcticWS@colorado.edu or look at http://instaar.colorado. edu/meetings/AW2002.

6th National Conference on Glaciology and Geocryology
27-29 March, Lanzhou, China. Reseachers, scientists and engineers from China and other countries are welcome to participate in this conference. Contact: zhuyl@ns.lzb.ac.cn.

Extreme Phenomena in Cryosphere: Basic and applied aspects
12-15 May, Pushchino, Russia,
Contact: vsorok@ issp.serpukhov.su

Arctic Summit Week
21-27 April, The Arctic Centre, University of Groningen, The Netherlands. More information: http://www.let.rug.nl/assw.

12th International Society of Offshore and Polar Engineering (ISOPE)
26-31 May, KitaKyushu Convention Center, Japan. More information: http://www.isope.org.

19th Polar Libraries Colloquy
17-21 June, Danish Polar Center, Denmark. Contact: vsj@dpc.dk.

Climatic Change and Periglacial Environments
4-7 August, Durban, South Africa. Dr Ian Meiklejohn (Pretoria, South Africa) will organize a symposium and excursion during the Regional IGU Conference in Durban, South Africa. The excursion will include a visit to active periglacial features at South Africa´s only ski resort, Tiffindell. More information: http://www.turners.co.za/igu/

5th International Symposium on Permafrost Engineering
10-12 September, Yakutsk, Russia.
Contact: o.i. alekseeva@mpi.ysn.ru

2003

Cryospheric Systems
13-14 January, Geological Society, Burlington House, London. Conference aims: To promote exchange of ideas, methods and data relating to glacial and periglacial processes, landforms and sediment associations in the context of climate change, at different temporal and spatial scales. Joint meeting of the British Geomorphological Research Group and the Quaternary Research Association. Contact: harrisc @ cardiff.ac.uk.

8th International Conference on Permafrost
21-25 July, University of Zurich, Switzerland.
See inside back cover for further information.

XVI INQUA Congress
23-31 July, Reno, Nevada, USA. More information: http://www.dri.edu/DEES/INQUA2003/inqua _ home.htm

International Conference on Arctic Margins
29 September-3 October, Dartmouth Nova Scotia, Canada. Contact: Ruth Jackson: jackson @ agc.bio. ns. ca

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December 2001

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www.geo.unizh.ch/ICOP2003/

IPA web site:
http://www.geodata.soton.ac.uk/ipa

Global Georyological Database (GGD) and CAPS CD-ROM:
http://nsidc.org/frozenground/

Periglacial Environments and Processes (IGU Commission and IPA Working Group):
http://www.cpes.susx.ac.uk/igu

Manual of periglacial techniques (IPA Permafrost and Periglacial Processes Working Group)
http://www.unis.no/research/geology/Geo_research/Ole/PeriglacialHandbook/HandbookMain.htm

IPA Task Force on Mapping and Distribution Modelling of Mountain Permafrost:
http://www.geografi.uio.no/ipa

Cirumpolar Active Layer Monitoring:
http://www.geography.uc.edu/~kenhinke/CALM

Global Terrestial Network on Permafrost (GTN-P):
http://sts.gsc.nrcan.gc.ca/gtnp

Arctic Coastal Dynamics (ACD) Initiative:
http://www.awi-potsdam.de/www-pot/geo/acd.html

Permafrost and Climate in Europe (PACE):
http://www.cf.ac.uk/earth/pace/

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