

FROZEN GROUND



The News Bulletin of the International Permafrost Association

Number 30, December 2006



INTERNATIONAL PERMAFROST ASSOCIATION

The International Permafrost Association, founded in 1983, has as its objectives to foster the dissemination of knowledge concerning permafrost and to promote cooperation among persons and national or international organisations engaged in scientific investigation and engineering work on permafrost. Membership is through national Adhering Bodies and Associate Members. The IPA is governed by its officers and a Council consisting of representatives from 26 Adhering Bodies and Associates 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 organise and coordinate research activities and special projects.

The IPA became an Affiliated Organisation of the International Union of Geological Sciences (IUGS) in July 1989. Beginning in 1995 the IPA and the International Geographical Union (IGU) developed an Agreement of Cooperation, thus making IPA an affiliate of the IGU. The Association's primary responsibilities are convening International Permafrost Conferences, undertaking special projects such as preparing databases, maps, bibliographies, and glossaries, and coordinating international field programmes and networks. Conferences were held in West Lafayette, Indiana, U.S.A., 1963; in Yakutsk, Siberia, 1973; in Edmonton, Canada, 1978; in Fairbanks, Alaska, 1983; in Trondheim, Norway, 1988; in Beijing, China, 1993; in Yellowknife, Canada, 1998, and in Zurich, Switzerland, 2003. The Ninth conference will be in Fairbanks, Alaska, in 2008. Field excursions are an integral part of each Conference, and are organised by the host country.

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Academician Cheng Goudong, China (1993-1998)
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Data, Information and Communication
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Coastal and Offshore Permafrost
Cryosol
Glacier and Permafrost Hazards in High Mountains
Isotopes and Geochemistry of Permafrost
Mapping and Modelling of Mountain Permafrost
Periglacial Landforms, Processes, and Climate
Permafrost and Climate
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Permafrost Young Researchers Network (PYRN)

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Cover: The Qinghai-Tibet Railway (QTR), 1,142 km from Golmud to Lhasa, crosses 632 km of permafrost terrain and 950 km at elevations above 4,000 m. The photograph is the northern portal of the Fenghuoshan mountain tunnel constructed in permafrost with a length of 1338 m and altitude of between 4926 and 4996 m a.s.l. The tunnel's maximum burial depth is 100 m with a permafrost temperature of -3.6° C and estimated permafrost thickness between 100 and 200 m. The tunnel design incorporated an insulation layer to protect against thawing of permafrost. Photograph by Stuart Harris, August 2006.

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INTERNATIONAL PERMAFROST ASSOCIATION
NUMBER 30 • DECEMBER 2006

Frozen Ground, the News Bulletin of the International Permafrost Association, is published annually.

The IPA is a non-governmental association of national organisations and associates representing 26 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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All issues of *Frozen Ground* are also available as PDF files on the IPA web site (<http://www.geo.uio.no/IPA>). This issue of *Frozen Ground* was compiled and edited by Angélique Prick, Jerry Brown and Hanne H. Christiansen.

The IPA Secretariat is supported by The Research Council of Norway and The University Centre in Svalbard, UNIS.

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EXECUTIVE COMMITTEE REPORT

A major highlight of the year was the Asian Conference on Permafrost (ACOP) held in Lanzhou, China, with field excursions on and across the Qinghai-Tibet Plateau. A total of 262 participants from 17 countries including 100 non-Chinese attended the Conference. A pre-conference workshop on classification and mapping of Asian permafrost helped clarify approaches to distribution issues and the assessment of recent and predicted changes. Details are reported elsewhere, but suffice to say the combined conference, field excursions, and workshop provide new insights into research and engineering problems and opportunities in this region of Planet Earth. Three monetary awards were given to young researchers for best presentations.

Major activities throughout the year focused on planning the IPA involvement in the International Polar Year. As previously reported, IPA is providing the coordination for four approved cross-cutting activities that total more than 60 individual projects. Planning to develop a coordinated implementation plan continued in Potsdam in March. The draft plan, with its components for thermal state of permafrost, arctic coastal processes, carbon pools sequestered in soils and permafrost, and Antarctic soils, permafrost and periglacial, is undergoing final revisions and depends in part on funding by national programmes for specific projects. Our outreach activities focus on a compilation of International University Courses on Permafrost (IUCP). To date, 129 courses within the science and engineering disciplines and organized for 2007 to 2009 in both hemispheres have been identified in 17 countries. Details are available on our webpage <www.geo.uio.no/IPA>. The Permafrost Young Researchers Network celebrated its first anniversary <www.pyrn.org>.

IPA and its working groups participated in a number of international conferences; The Arctic Science Summit Week in Potsdam, the European Geosciences Union meeting in Vienna, the annual Russian permafrost conference in Tyumen in southern Siberia, the SCAR Science Conference in Hobart, Australia, the World Congress of Soil Science in Philadelphia, Pennsylvania, the IGU Regional Conference in Brisbane, Australia, the First Asia CliC

Symposium in Yokohama, Japan, the International Conference on Cold Regions Engineering in Orono, Maine, the International Symposium on Cryospheric Indicators of Climate Change in Cambridge, England, and a planning workshop on the International Conference on Arctic Research Planning (ICARP II) in Potsdam. Members of the Antarctic, Cryosol, and Periglacial Working Groups convened sessions and met at the SCAR, Soil Science, and IGU conferences, respectively.

The IPA Council approved, by mail ballot, a number of changes to the Constitution. These include (1) changes in the nomination and election process for officers and (2) the frequency of international conferences to once every four years with approved regional conferences in the intervening period. These changes will start to be implemented for the 2008 Council meeting in Fairbanks.

Members of the Executive Committee met during the conference in Tyumen and approved a plan to review activities of the working groups prior to the 2008 Council meeting. The EC met again at the American Geophysical Union Fall Meeting in San Francisco and reviewed planning for the NICOP with members of the international advisory and U.S. organizing committees.

The coming year promises to be even more busy with a number of international conferences including the annual Russian permafrost conference to be held in Salekhard, northwest Siberia in June (see Planning Calendar). Preparation for NICOP will be well underway with abstracts due starting in early summer and manuscripts of approved abstracts due in early Fall. A second NICOP circular will appear on websites and in the mail in early 2007. It will have details on abstract submission, and estimated costs of field trips.

Many permafrost colleagues attended the 90th birthday celebration for J. Ross Mackay at the University of British Columbia in February. It was a memorable event for Ross and his students and colleagues. Finally, we welcome as an interim member of the Executive Committee, Ma Wei replaced Zhu Yuanlin who recently resigned for personal reasons.



Opening ceremony of Asian Conference on Permafrost. Left to right: Ma Wei, N. Sharkhuu, Vladimir Zaitsev, Zhu Zhensheng, Shi Yafeng, Jerry Brown, Governor Hao Lu (Gansu Province), Cheng Guodong, Hans Hubberten, Wang Tao (Director CAREERI), Douglas Kane, Stuart Harris, Aldar Gorbunov. Photograph provided by Shuping Zhao.

A CELEBRATION OF THE 90th BIRTHDAY OF PROFESSOR J. ROSS MACKAY

Chris Burn, Carleton University, Ottawa, Canada



A symposium in honour of Professor J. Ross Mackay was held at the University of British Columbia in Vancouver, on February 17, 2006, to mark his 90th birthday. The celebration was designed to recognize the many accomplishments of Canada's senior permafrost scientist, and to gather his friends and colleagues in tribute to his example and influence. Seventy-two people attended the symposium, reception and evening dinner, from Europe, and across North America. The guests were colleagues and several former field assistants and collaborators, who came out of respect for the personal touches Ross has extended throughout our community. Graduate students, a new generation to read Ross' papers with awe, said they were delighted to be included at this historic gathering. The longest journey was made by Matti Seppälä, from Helsinki, who gave a seminar on February 16 about his experiments with palsas. Four generations of the «Clan Mackay» were represented: the Chief himself, his students, students of his students, and students of the students of his students.

The meeting was organized jointly by the Department of Geography at UBC and the NSERC Northern Research Chair at Carleton University. The day's program was hosted by Ross' UBC colleagues of over 35 years – Dr. Graeme Wynn, Head of Department, and Drs. Michael Church, Olav Slaymaker, Tim Oke, and John Stager. All spoke with affection and admiration of his intellectual and personal contributions to life in their academic home. The program was arranged to provide ample time for discussion, examination of posters, meals and presentations. The timetable was constructed with the age of our laureate in mind, but everyone was grateful for the opportunities it presented, in contrast with the ridiculously hectic schedules of most research conferences. As a result, the discussions were full and lively and the day was thoroughly enjoyed.

The program was developed to reflect various components of Ross' influence on Geocryology. The day began with a presentation by Sam Outcalt (former graduate student), Ken Hinkel and Fritz Nelson entitled *The spatial tradition in permafrost science*, representing Ross' influence on physical geography and cartography in the United States. This was followed by Chris Burn (former post-doctoral fellow), who discussed the evolution of an experimentally manipulated ice wedge at Illisarvik, the full-scale field experiment initiated by Ross in 1978. Later in the morning, Steve Blasco and Scott Dallimore, representing the Geological Survey of Canada, and Ross' association with the GSC for over 25 years, provided a remarkably illustrated account of gas seeping from submarine pingo-like features on the floor of the Beaufort Sea. The illustrations included a photograph taken by Ross in 1963 of a gas seep bubbling up through a channel of the outer Mackenzie delta. Yuri Shur, representing Ross' long association with Russian geocryologists, and his interest in the Russian literature, then spoke about the origin of earth hummocks and aggradational ice, both topics being familiar to readers of Mackay's papers.

The first presentation after lunch was given by Don Hayley of EBA Engineering and the IPA Executive Committee, representing the professional practice influenced by Ross' scientific contributions. The topic was convective heat transfer in a tailings dam at the abandoned Colomac Mine, 220 km north of Yellowknife. Convection has been harnessed in an attempt to keep the dam frozen and tailings impounded for over 75 years, in the context of climate warming. The final presentation was by Hugh French, Antoni Lewkowicz, Wayne Pollard, and Julian Murton, representing the school of permafrost sci-

ence at the University of Ottawa, and the Canadian contribution to the IPA, for Hugh followed Ross' 10 years as Secretary-General with service as Vice-President and then President. The topic was *The geomorphological principles of J. Ross Mackay*, and provided a perspective on Ross' unique approach to field science in a remote environment.

John Stager, Ross' field assistant on Cornwallis Island in 1952, and a long-time colleague at UBC, controlled the dinner proceedings with aplomb, reading many messages of congratulations and friendship from around the world. Brian Moorman, Chair of the Canadian National Committee for the IPA, extended recognition to Ross on behalf of his Canadian colleagues, and Jerry Brown, President of IPA, presented a personal tribute on behalf of us all.

The day ran smoothly from start to finish, due to the meticulous care and planning of Sandy Lapsky, Administrator of the Department of Geography. Contributed papers from the meeting were solicited for a dedicated issue of *Permafrost and Periglacial Processes* to be published in 2007. We learned that careful selection of presentations and seating arrangements at dinner contribute to memorable events.

A photograph album of the celebration is at <www.geog.ubc.ca/~holberg/mackay>. In closing, I present a paragraph of Ross' biography prepared for the celebration and available at <www.geog.ubc.ca/mackay2006>.

«Ross has published over 200 scholarly works, over half of which are in refereed journals, and over 150 of which are single authored. Two of these contributions are government memoirs, on the Anderson River area (1958) and the Mackenzie Delta area (1963). Fifty of the papers were published after his formal «retirement» in 1980. He is identified internationally with the literature on pingos and ice wedges. His rigorous method is described in *Field and Theory*, the Festschrift edited by Michael Church and Olav Slaymaker, published in 1985. The combination of field observation, experimental design, and analytical interpretation was revolutionary for physical geography in the 1950s and 1960s, and provides magisterial examples of the earth systems approach to understanding the behaviour of permafrost terrain.»



J. Ross Mackay at his 90th birthday celebration, 17 February 2006. Photograph by Detlef Holberg, UBC.

GLOBAL AND REGIONAL ACTIVITIES



ASIAN CONFERENCE ON PERMAFROST

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Jerry Brown, International Permafrost Association, Woods Hole, MA (jerrybrown@igc.org)



Photograph provided by: Zhaohui (Joey) Yang, University of Alaska Anchorage.

The first Asian Conference on Permafrost (ACOP) was convened in Lanzhou, China, August 7-9, and was followed by a field excursion, August 10-16, 2006, that included the crossing by train of Qinghai-Tibet Plateau (QTP). The principal conference organizers and co-sponsors were the State Key Laboratory of Frozen Soils Engineering (SKLFSE) of the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), the Geographical Society of China (GSA), and the International Permafrost Association (IPA). The Conference was co-chaired by Academician Guodong Cheng, Chinese Academy of Sciences, and Jerry Brown (IPA).

A total of 262 participants from 17 countries including 99 non Chinese and accompanying persons attended: Australia (1), Austria (1), Belgium (2), Canada (6), Germany (7), Japan (9), Kazakhstan (2), Korea (4), Mongolia (3), New Zealand (2), Norway (3), Romania (1), Russia (24), Sweden (1), Switzerland (1), United Kingdom (4), and USA (28). The majority of the 163 Chinese attendees (89) were from the hosting organizations (CAREERI and SKLFSE). A 214-page volume containing 233 abstracts and the final programme was published and is available on the IPA web site along with the final technical programme.

The Conference presentations were organized according to five main themes:

1. Frozen ground engineering including railroad and highway embankments, pipelines and foundations

2. Frost hazards and periglacial environments in mountain and plateau regions
3. Climatic and environmental controls of the cryosphere
4. Permafrost hydrology, cold regions water resources and land use
5. Monitoring, mapping and modeling of permafrost

Following the opening welcoming speeches lead by the Governor Hao Lu of Gansu Province, the first-day plenary presentations consisted of a series of keynote presentations:

Guodong Cheng: Applications of the Roadbed-Cooling Techniques in Building the Qinghai-Tibet Railway

Jerry Brown: Status of International Permafrost Projects

Douglas L. Kane, Larry D. Hinzman and Robert E. Gieck: Extreme High and Low Streamflow in Permafrost Catchments

Jef Vandenberghe: Permafrost Extension in Central China During the Last Glacial Maximum

Wei Ma, Guangli Feng, Qingbai Wu, Guodong Cheng: Analyses of Temperature Fields under the Air Convective Embankment of the Crushed Rocks Structures along Qinghai-Xizang Railway

Hans-W. Hubberten, N.N. Romanovskii: The Evolution of Permafrost during the Last Climatic Cycle in the Coastal Lowlands and Shelf Areas of Eastern Eurasia

Tingjun Zhang, Mark A. Parsons, and Roger G. Barry: Statistics of Global Permafrost Distribution

Douglas J. Goering, Jianfeng Xu: Experimental Validation of Passive Permafrost Cooling Systems

Michael C.R. Davies, F.K Günzel: Stability of Rock Slopes in Warming Permafrost

A total of 90 oral papers and 38 posters were presented in a series of three concurrent sessions. The non-Chinese papers dealt with a variety of scientific and engineering topics including several sessions devoted to paleoenvironmental and periglacial topics. Conference reports were presented by scientists and engineers from 33 Chinese research and design institutions, construction companies and universities and represented innovative concepts, designs and the initial results. The majority of the Chinese papers were focused on the scientific and innovative engineering aspects of construction of Qinghai-Tibet Railway (QTR), which traverses 632 km of «warm» (-1 to 0° C) permafrost on its 1,142-km route between Golmud and Lhasa. The design and construction challenges involved: (1) high elevation terrain with most of the route above 4,000 m and a small portion above 5,000 m; (2) «warm» permafrost and how to preserve the permafrost as a long-term, stable foundation for the relatively high-speed railway under the existing climatic conditions and (3) consequences of a projected climatic warming of about 2.6° C on average over the QTP by 2100.

The Permafrost Young Researchers Network (PYRN) organized the first annual «Outstanding Presentation Awards». These awards are planned to be presented annually at the primary permafrost conference of that calendar year. The 2006 awards were sponsored by generous contributions from the International Permafrost Association (IPA), the Climate and Cryosphere (CliC) programme, and the International Union for Quaternary Research (INQUA). The competition drew applications from approximately two dozen young scientists from seven different countries. A review panel consisting of three eminent permafrost researchers judged each of these competitors based on both the scientific merit and the quality of the presentation. The three award recipients were:

Dmitry Kaverin (Institute of Biology, Komi Science Centre - Ural Division, Russian Academy of Science, Russia), for «Local-level processes associated with progressive permafrost thaw as exemplified from CALM grid»

Guoyu Li (State Key Laboratory of Frozen Soil Engineering, CAREERI, CAS, China), for «Heat transfer characteristics of Qinghai-Tibet Railway embankment with crushed-stone side slope in permafrost regions»

Fumiaki Takakai (Laboratory of Soil Sciences, Graduate School of Agriculture, Hokkaido University, Japan), for «CH₄ emissions from a Siberian alas ecosystem near Yakutsk, Russia»

Following the Conference 56 participants visited the northern portion of the Qinghai-Tibet Highway and the recently established Beiluhe Permafrost Engineering Experimental, Testing and Monitoring Station by bus. They then returned to Golmud to take the train traversing the new rail route from Golmud to Lhasa, traveling at about 100 km/hour; the trip taking approximately 14 hours. A final series of discussions were held in Lhasa. A brief field guidebook covering the route from Lanzhou to Lhasa was prepared for excursion.

The Conference was preceded by a 1.5-day workshop on the distribution, mapping and monitoring of permafrost in Central and eastern Asia (see China and Working Group reports for additional details). The pre-conference mapping workshop was sponsored in part by a grant from the International Union for Quaternary Research (INQUA).

In addition to the State Key Laboratory of Frozen Soils Engineering (SKLFSE) of the Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), the Geographical Society of China (GSA), the following Chinese organizations and institutions supported the conference:

Chinese Academy of Sciences

Ministry of Railway, PR China

Natural Science Foundation of China

The First Highway Survey and Design Institute of China Transportation Corp., Limited

Highway Survey and Design Institute of Qinghai Province

China University of Mining & Technology

Chongqing Jiaotong University

The following non-Chinese organizations and institutions provided direct support or agreed to be named as sponsoring organizations:

International Permafrost Association

International Union of Geological Sciences

International Geographical Union

International Union for Quaternary Research

International Union of Soil Sciences

WCRP Climate and Cryosphere

Scientific Committee for Antarctic Research

International Arctic Science Committee

IUGG Commission for Cryospheric Science

International Polar Year Programme Office

U.S. National Science Foundation

University of Alaska and the International Arctic Research Center

Results of the Conference and workshop will contribute to the IPA planning and implementation for both the International Polar Year and the International Year of Planet Earth (2007-2009).

THE INTERNATIONAL UNIVERSITY COURSES ON PERMAFROST (IUCP)

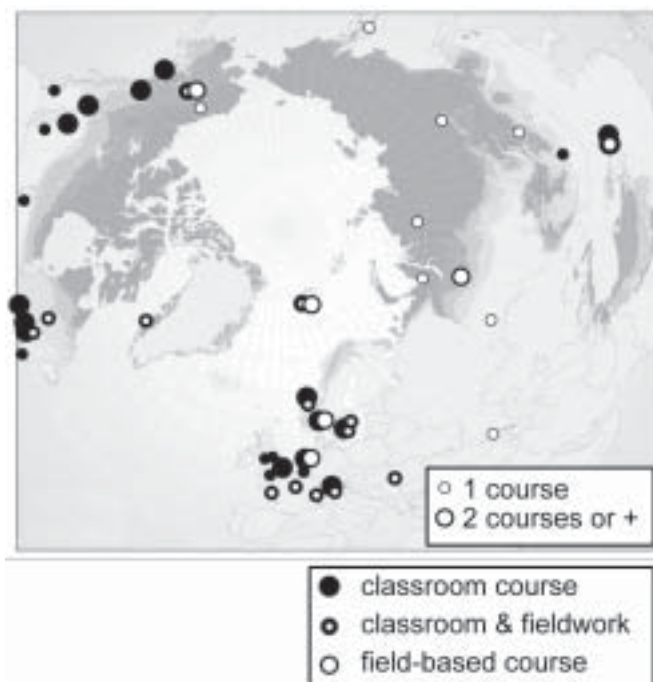
Angélique Prick and Hanne H. Christiansen,
The IPA Secretariat, Geology Department, the University Centre in Svalbard, UNIS,
Longyearbyen, Norway (IPA@unis.no)



Worldwide only very few courses dedicated specifically to permafrost exist at university level today, and mostly in Russian universities. This significantly limits the training of the next generation of permafrost researchers. Therefore, the International Permafrost Association is collecting a catalogue of International University Courses on Permafrost (IUCP), as part of its participation in the IPY. An important component of the IPA legacy to the IPY is to foster the development of the next generation of permafrost researchers. This polar-related educational initiative covers cross-cutting activities of the four IPY-IPA endorsed cluster projects that constitute the IPY permafrost programme:

- The Permafrost Observatory Project: A Contribution to the Thermal State of Permafrost (TSP; Project 50);
- The Antarctic and sub-Antarctic Permafrost, Periglacial and Soil Environments (ANTPAS; Project 33);
- The Arctic Circumpolar Coastal Observatory Network (ACCO-Net; Project 90);
- Carbon Pools in Permafrost Regions (CAPP; Project 373).

The IUCP collects information about permafrost courses worldwide offered internationally, to encourage a broad international student participation in the existing



courses and in the courses specifically organized during the IPY. All courses dealing with permafrost and periglacial geomorphology within the science and engineering disciplines and organized in 2007 to 2009 in both hemispheres qualify for IUCP. The IUCP web presentation with its search tools allow easy access to detailed course contents, with search by keyword, location, course level and type of course.

The IUCP courses are distributed by countries as follows in December 2006: Canada (30), Norway (22), USA (21), China (11), Russia (8), Japan (7), Switzerland (7), UK (6), Sweden (5), Netherlands (4), France (2), Argentina (1), Belgium (1), Denmark (1), Mongolia (1), New Zealand (1), Romania (1). A total of 129 courses organized in 17 countries are in IUCP. So far there is only two IUCP courses on the southern hemisphere.

All course levels are taken into account, from undergraduate to doctorate level. 56 undergraduate courses and 73 graduate courses are presently included in IUCP.

Nineteen courses are exclusively field-based, and take place in various polar and alpine regions, offering students a unique opportunity to gather field experience. Most courses are theoretical and classroom-based, with either no time in the field (78 courses) or with limited field work (32 courses). Several IPA-IPY field courses are currently under active development, e.g. the International University Course on High Arctic Permafrost Landscape Dynamics in Svalbard and Peary Land (In SPE: EoI 24). Russian universities are organizing seven field courses starting in summer 2007, as part of their contributions to the IPY; these courses will be university accredited and will take place in various permafrost regions of Russia: Western Yamal, Southern Taimyr, the Tyumen region, Mount Elbrus in the Central Caucasus, Khakassia, Yamburg, and the Southern and Central Yakutia. An international, pre-conference workshop for teachers and students and several short courses are under consideration at the University of Alaska for June 2008, as part of the Ninth International Conference on Permafrost.

Visit the IUCP courses on the IPA web page
<<http://www.geo.uio.no/IPA>>.

If you have comments, or if you wish to submit other permafrost courses for integration in the IUCP database, please contact <IPA@unis.no>

THE PERMAFROST YOUNG RESEARCHERS NETWORK (PYRN)

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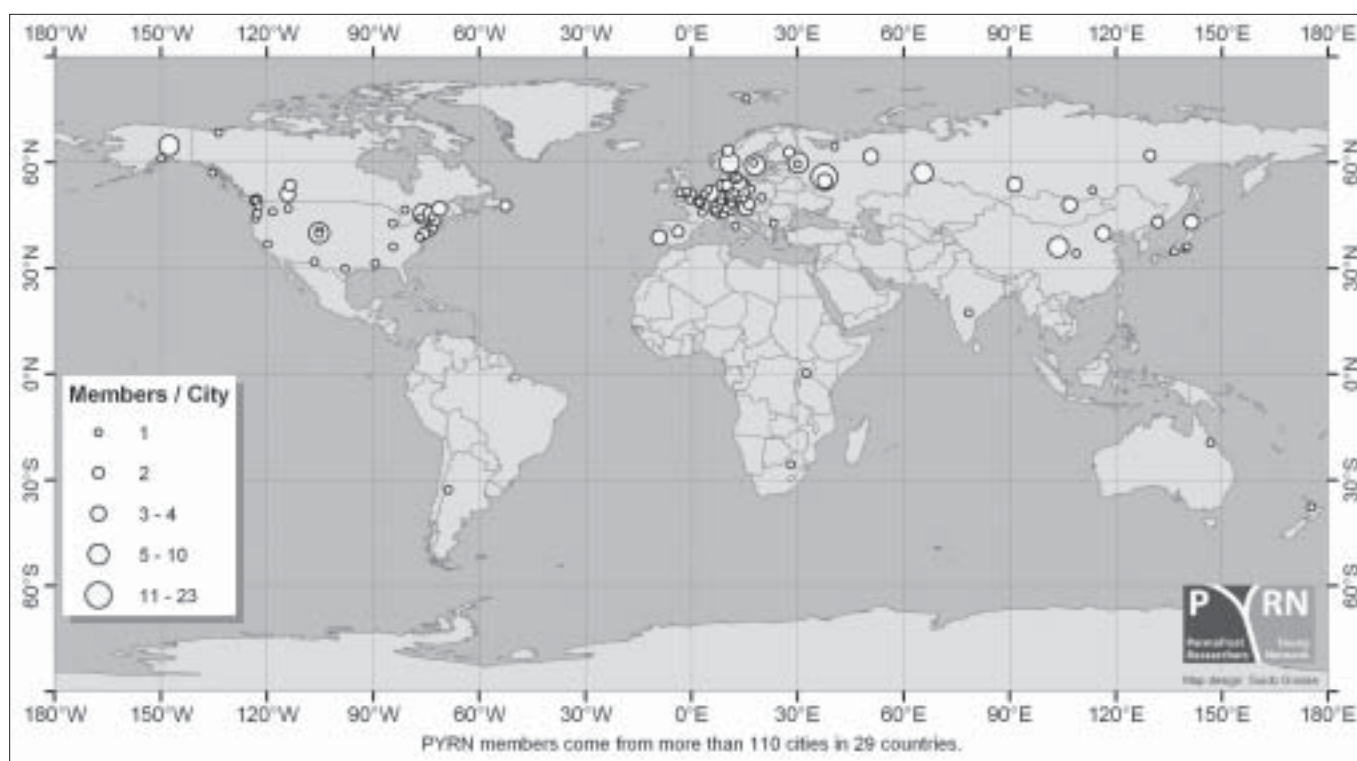
The Permafrost Young Researchers Network, PYRN <www.pyrn.org>, launched officially in November 2005 at the ICARP II conference under the auspices of the International Permafrost Association (IPA), has celebrated its first anniversary. Gathering now more than 250 young researchers from 29 countries involved or interested in permafrost research, PYRN has initiated a wide range of actions for the young permafrost community during its first year of existence.

In the past year, PYRN reported on job opportunities and events in its monthly newsletter and on its website, which attracted over 1000 visitors. As reported earlier, PYRN awarded the first annual «Outstanding Presentation Awards» at the Asian Conference on Permafrost.

PYRN also initiated PYRN-Bib (Guido Grosse, University of Alaska Fairbanks), which lists masters and PhD

theses related to permafrost research and is available online. It now seeks to collect more information on theses completed during the past sixty years, and hopes that senior permafrost researchers will contribute to the bibliography.

PYRN plans on developing new activities during the upcoming year, fulfilling its role as an approved IPY activity (EoI #1111) and a part of the IPA-IPY coordinated activities. In particular PYRN plans to convene a workshop for the 21 national PYRN representatives at the Abisko Scientific Research Station February 23-25, 2007. PYRN plans to become involved in the broader young researcher activities taking place during the International Polar Year (e.g. Early Career Polar Scientists Network and IPY Youth Steering Committee), and activities for the 2008 International Conference on Permafrost.



Location of the 248 PYRN members

STANDING COMMITTEE AND WORKING GROUPS REPORTS

The following are brief summaries of Working Parties activities for the past year. See *Frozen Ground 27* for Working Parties goals and other annual reports on the IPA web.

STANDING COMMITTEE ON DATA, INFORMATION, AND COMMUNICATION

Co-chairs

Roger G. Barry, U.S.A. (rbarry@nsidc.org)

Sharon Smith, Canada (ssmith@nrcan.gc.ca)

The SCDIC maintains several on-going activities; oversight of data activities for circumpolar observatory networks, facilitation of recovery, archiving and dissemination of data, and the permafrost data and management responsibilities for the International Polar Year.

IPA is coordinating four approved IPY projects as discussed in *Frozen Ground 29*:

- Project 50: Permafrost Observatory Project: A Contribution to the Thermal State of Permafrost (TSP)
- Project 33: Antarctic and sub-Antarctic Permafrost, Periglacial and Soil Environments (ANTPAS)
- Project 90: Arctic Circumpolar Coastal Observatory Network (ACCO-Net)
- Project 373: Carbon Pools in Permafrost Regions (CAPP)

Approximately 60 individual projects involving over 200 researchers in 25 countries are potentially involved in these four activities.

The IPY Data Management and Policy Subcommittee (DMPS) has completed the IPY policy of free and open access. The ICSU/WMO Joint Committee for IPY requires all IPY projects adhere to this policy <www.ipy.org/Subcommittees/final_ipy_data_policy.pdf>. The IPY data policy states that all projects will have timely access to necessary data from other projects and to essential operational data from many sources, and to ensure national and international support for data preservation and management. The Data Subcommittee requested that the IPY coordinated projects, approximately 225 projects, complete a IPYDIS form identifying data and management plans. Through the SCDIC and its predecessors, IPA has a long tradition of data recovery and management. The IPA is developing an Implementation Plan for these four projects and its participating partners. The SCDIC plans to provide direction and coordination for the IPY-IPA data activities, building on the past and existing activities. SCDIC member, Mark Parsons, co-chairs the IPY DMPS and he has agreed to be our IPA-SCDIC contact with the Committee.

The Global Terrestrial Network for Permafrost (GTN-P) provides the framework for managing data for thermal state of permafrost and active layer (CALM related data). Borehole metadata has been compiled for approximately 70% of the boreholes that were previously identified for inclusion in the GTN-P. Summary historical data (including maximum, minimum and mean temperature where available) has been provided for several Canadian sites and a number of sites in Alaska, Europe and Asia. The Geological Survey of Canada continues to release data sets from its permafrost monitoring program and continues to gather information/metadata on additional boreholes. At the present time investigators may submit mean monthly temperature data (or lower frequency data) to Sharon Smith (see <www.gtnp.org>). Higher frequency data may be archived with NSIDC. Data from existing CALM sites are compiled annually <www.udel.edu/Geography/calm>. An IPY data node for Russian and Alaskan data is under development in the Permafrost Laboratory, Geophysical Institute, UAF, based on agreements with ten Russian sponsored organizations (contact Vlad Romanovsky: ffver@uaf.edu). The web site for the Canadian Permafrost Monitoring Network <www.canpfnetwork.com> has also been updated. The site now provides access to summary historical ground temperature data for several Canadian boreholes and to active layer data for monitoring sites in the Mackenzie Valley.

Many IPA data activities continue to be served by the National Snow and Ice Data Center and its Frozen Ground Data Center (FGDC), University of Colorado. Over the period September 2005 to August 2006, an average of 179 distinct users (IP addresses) downloaded data from the FTP site each month <<http://nsidc.org/fgdc>>. A total of 2,014 distinct users ordered 18.4 GB of data via FTP during that period. The most popular product continues to be the Circum-Arctic Map of Permafrost and Ground-Ice Condition followed by the Northern Circumpolar Soils Map. These are both major IPA products. In addition to FTP, 39 users contacted the User Services Office directly for assistance, usually to order the CAPS2 CDs. Tingjun Zhang and Mark Parsons attended the U.S.-China Data Exchange Roundtable Discussion Meeting and the CODATA Meeting in Beijing in October 2006.

During those 12 months, the FGDC through the research efforts of Tingjun Zhang and collaborators released four new products:

- Geocryology and Geocryological Zonation of Mongolia
- Northern Hemisphere EASE-Grid Annual Freezing and Thawing Indices, 1901 – 2002. Version 2 of this data set greatly extends the temporal coverage

and makes use of data from SMMR as well as SSM/I.

- Northern Hemisphere Seasonal and Intermittent Frozen Ground Areas 1901-2001
- Arctic EASE-Grid Freeze and Thaw Depths, 1901-2002

Planning for a CAPS 3.0 CD Rom is under discussion for late 2009 or early 2010 and to include initial data products from IPA IPY projects.

NSIDC has initiated a project entitled Discovery, Access, and Delivery of Data for IPY (DADDI), a working prototype focused on Arctic coastal data <<http://nsidc.org/daddi>>. DADDI is a NASA-supported project to improve the availability of arctic coastal data. The goal is to develop a system that can be readily extended to support the International Polar Year (IPY). Collaboration with the Arctic Coastal Dynamics (ACD) project and the interagency Study of Environmental Arctic Change (SEARCH) is welcomed. NSIDC is developing an Atlas of the Cryosphere that includes permafrost maps.

R.G. Barry and J. Brown attended the 9th meeting of the Terrestrial Observation Panel for Climate (TOPC) of GTOS in Ispra, Italy in March 2006. A report on the GTN-P by S. Smith and J. Brown was published in the GTOS Biennial Report 2004-2005 (pp. 32-33) <www.fao.org/gtos>. S. Smith and J. Brown are lead co-authors of the Permafrost and Seasonally Frozen Ground of the Cryosphere theme of the Integrated Global Observing Strategy (IGOS). J. Brown participated in the Third IGOS Cryosphere Workshop, 16-18 October 2006, at the European Space Research and Technology Centre, Noordwijk, The Netherlands. The IGOS-C report is scheduled for publication in mid 2007 <<http://igos-cryosphere.org>>.

Information on the WCRP CliC Data and Information Service for CliC is available <<http://clic.npolar.no/disc/disc.php>>. CliC is incorporating GGD/CAPS into its data activity.

The IPA website is maintained by Ole Humlum at the University of Oslo, and news and other information may be submitted directly <<http://www.geo.uio.no/IPA>>. It should be noted that through the work of Angelique Prick all past issues of *Frozen Ground* have been scanned and are now on the IPA web. These documents provide a history of the IPA. Discussions are underway with the publishers of the all eight ICOP proceedings for permission to include all conference papers on a common electronic product for the NICOP.

The Wiley Journal *Permafrost and Periglacial Processes* has invited IPA to contribute two short articles each year on topics of our choice. The first report appeared in the December 2006 issue. *PPP* is now designated as «A journal affiliated with the IPA». Our Russian colleagues inform us that its journal *Earth Cryosphere* will soon be produced in English.

1. ANTARCTIC PERMAFROST AND PERIGLACIAL ENVIRONMENTS

Co-chairs

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Our major achievements during 2006 include: (1) maintaining the Antarctic Permafrost and Soils (ANTPAS) website and mail list <<http://erth.waikato.ac.nz/antpas>> through the efforts of M. Balks; (2) submitting individual and group proposals to national agencies in support of «Antarctic and Sub-Antarctic Permafrost, Periglacial and Soil Environments (ANTPAS)» for the International Polar Year; (3) participating in international conferences and meetings, including the NCEAS-sponsored workshops on «Vulnerability of Carbon in Permafrost» in Santa Barbara, CA in March and December 2006 and the Scientific Committee on Antarctic Research (SCAR) meeting in Hobart, Australia in July 2006; (4) developing protocols for describing, sampling and classifying Antarctic soils and a borehole and active-layer monitoring network for the Southern Hemisphere (see web site); and (5) preparing preliminary maps of permafrost and soils of Taylor Valley and the McMurdo Sound region.

The activities of the Working Group are jointly sponsored by the IPA and the Expert Group on Permafrost and Periglacial Environments (EGPPE) of the SCAR Standing Scientific Group on Geosciences. During the year Jan Boelhouwers stepped down as co-chair of both groups and was replaced by Mauro Guglielmin. On behalf of the IPA, SCAR and our members we express our appreciation to Jan for his outstanding leadership and contributions. J. Bockheim represented IPA at the July 12-14, 2006, 29th SCAR Open Science Conference, Hobart, Tasmania. An ANTPAS paper session and meeting took place during the Conference.

Our proposed future activities include hosting a symposia on Antarctic permafrost at the 10th International Symposium on Antarctic Earth Sciences, August 26-September 1, 2007, at the University of California, Santa Barbara and for the NICOP and completing a special issue for the journal, *Geoderma*, on «Antarctic Soils and Soil-Forming Processes in a Changing Climate.» Seven papers are currently under review. We have partnerships with SCAR (J. Bockheim), the International Union of Soil Sciences (IUSS; J. Kimble), CliC and other international organizations.

The following countries submitted Expressions of Intent (EoI) or have additional projects under the approved IPY Project 33: Antarctic and sub-Antarctic Permafrost, Periglacial and Soil Environments (ANTPAS): Argentina, Canada, Korea, Italy, Poland, Portugal, Spain, Russia, United Kingdom, and United States. In most cases fund-

ing for these and other Antarctic activities are pending. Two projects coordinated by Miguel Ramos were funded (2006-2009) by the Spanish Antarctic Programme in collaboration with the University of Alcalá de Henares (Spain), Univ. of Lisbon (Portugal) and Univ. of Zurich (Switzerland) and titled «Permafrost and Active Layer Monitoring and Modelling in Livingston and Deception Islands (Antarctic)». Italy and the United Kingdom plan to drill (30 m deep) boreholes on Signy Island and Anchorage Island (close to Rothera station). New Zealand and Italy drilled three 30 m deep boreholes in Victoria Land to monitor permafrost thermal regime. New Zealand and the USA continue its joint soil mapping and database activities.

2. COASTAL AND OFFSHORE PERMAFROST

Co-chairs

Pier Paul Overduin, Germany

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Nikolai Romanovskii, Russia (nromanovskiy@online.ru)

During the past year, the leadership of both the WG and its Arctic Coastal Dynamics (ACD) project changed, as Volker Rachold has left these positions to become IASC Secretary in Stockholm. Pier Paul Overduin of the Alfred Wegener Institute for Polar and Marine Research (AWI), Potsdam, Germany, was asked by the IPA Executive Committee to assume the co-chairman of the WG on an interim basis until NICOP. ACD is now co-chaired by Overduin and Nicole Couture of the Department of Geography, McGill University in Montreal, Quebec. The ACD was a featured project at the Arctic Science Summit Week (ASSW) held in Potsdam, on March 22-29, 2006. IASC decided in its spring Council meeting that ACD would be considered a part of the International Conference on Arctic Research Planning II (ICARP II) - IPY processes and it receive continued IASC support for planning activities. Overduin joined the IPA-IPY Steering Committee, which met during the ASSW.



The 6th ACD Workshop held at the Arctic Centre, University of Groningen, Netherlands, October 22-26.

The 6th ACD Workshop was held at the Arctic Centre, University of Groningen, Groningen, Netherlands on October 22-26, 2006. The workshop was attended by 30 participants from Canada, Germany, the Netherlands, Russia, and the United States. The Arctic Circumpolar Research International Science Plan (ACRISP) Workshop met concurrently with the 6th Workshop and was chaired by the ACD co-leaders. Objectives of the workshop were to develop a science and implementation plan within the context of the ICARP II, and, in particular with Working Group 3 «Coastal Processes». Emphasis in Groningen was placed on integrating the disciplines active in coastal research in permafrost regions and to further develop the proposed network of coastal observatories and process studies in the nearshore zone. The establishment of a set of coastal observatories is a central concept of the IPY initiative for the Arctic Circumpolar Coastal Observatory Network (ACCO-Net, Project #90), and includes social, biological and riverine components.

A full day of presentations on some of the 32 studies submitted in abstract form opened the workshop. Breakout session for five working groups developed specific plans: (1) Transitions Between Offshore and Onshore Permafrost, (2) Coasts and People, (3) Environmental Forcing Factors, (4) Remote Sensing and Geophysical Tools, and (5) Fluxes in the Coastal Zone. Final plenary sessions led to an outline for a science and implementation plan and specific recommendations for the design of the coastal observatory network. The Science Plan for the second phase of ACD is expected in the first quarter of 2007. Four young scientists received support from IASC for participation the workshop: Nataliya Belova, Alexander Makarov, Alexei Noskov, and Roy Shirokov. IASC Vice President and Director, Arctic Centre, Louwrens Hacquebord hosted the workshop.

Extended abstracts and results of the workshop will be published in the AWI Reports on Polar Research series. Reports of the previous meetings are available online at the ACD website <www.awi-potsdam.de/acd>. An expedition report of the successful 2005 campaign at Cape Mamontovy Klyk is being published by the Alfred Wegener Institute.

Editing continued on the compendium of twenty papers on regional and process-based Arctic coastal studies to be published by McGill University Press (*Arctic Coasts - Circum-Polar Processes and Dynamics* edited by W. Pollard, N. Couture, H. Lantuit and V. Rachold). All papers have been reviewed and publication is expected in the first half of 2007. The circum-Arctic coastal segmentation database created in ACD's first phase has been exported to an ARC-Internet Map Server and was demonstrated and discussed at the 6th ACD Workshop. Data quality analysis and release of the database are planned for the summer of 2007, following the acceptance of a data release licensing model by the data providers.

The Coastal and Offshore Working Group plans to sponsor at least one special session at NICOP, with the working title «*Processes and Modelling in the Nearshore Zone*». Plans for special sessions and a meeting of the ACD community at NICOP will be finalized at the 7th ACD Workshop to be held in Fall 2007.

The ACD is an affiliated project of the Land-Oceans Interactions in the Coastal Zone (LOICZ) program, which has entered its second funding phase. As a LOICZ-affiliated project, ACD is officially affiliated with the international Geosphere-Biosphere Programme (IGBP) and the International Human Dimension Programme (IHDP).

3. CRYOSOL

Co-chairs

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In January, the Cryosol Working Group (CWG) applied for two IPY cluster projects. The first one includes almost all CWG-members and its title is «Response of Arctic and Subarctic Soils in a Changing Earth: Dynamic and Frontier Studies» (RASCHER); the project leader is Sergey Goryachkin (Russia) and co-leader is John Kimble (USA). The second project, «Carbon Pools in Permafrost Regions» (CAPP) has as leader Peter Kuhry (Sweden) and as co-leader Eva-Maria Pfeiffer (Germany). The ICSU/WMO Joint Committee for the International Polar Year supported both these projects. The future activity on the IPY was discussed by CWG co-chairs in St. Petersburg in February and during several meetings of CWG-members in Santa Barbara, Tyumen, and Philadelphia. The special expeditions to carry out the IPY studies were organized for different permafrost regions of Russia (Arkhangelsk, Komi, Kolyma and Baikal).

In March, several CWG-members (S. Goryachkin, C. Tarnocai, G. Mazhitova, P. Kuhry, J. Bockheim) took part in a research synthesis on the «Vulnerability of carbon in permafrost: pool size and potential effects on the climate



Participants in the CWG symposium on «*Soils of Northern, Southern Polar Region and Soils of High Elevations and Their Relationship to Global Climate Change*» at the 18th World Congress of Soil Science in Philadelphia, U.S.A., July 9-15.

system» organized by C.B. Field and J.G. Canadell at the National Center for Ecological Analyses and Synthesis (NCEAS) in Santa Barbara, USA. This meeting was co-sponsored by the IPA and CliC (WCRP-Climate and the Cryosphere).

The goals of this workshop process were to:

- Compile a catalogue of vulnerable carbon (C) pools in frozen ground and their global distribution;
- Quantify the extent of these vulnerable pools and their C content;
- Assess the processes affecting the balance and release of C, including the identification of «thresholds» that push the system rapidly to dangerous climate change;
- Test algorithms for integrating the carbon dynamics of permafrost pools in terrestrial biogeochemical models and coupled climate/carbon models;
- Provide algorithms for other modelling efforts that will address the climate/carbon and other climate/ecosystem feedbacks.

A second workshop was held at NCEAS in December 2006.

The CWG meeting in Tyumen, Russia, was held in May during the International conference «Theory and practice of evaluation of status of Earth cryosphere and prognosis of its change». The two CWG co-chairs and the CWG-members J. Brown, D. Gilichinsky, D. Konyushkov and S. Iglovsky discussed the activity of the CWG within IPY and took part in the Cryosol Section of the conference.

The CWG participated in the 18th World Congress of Soil Science in Philadelphia, July 9-15, and organized a symposium on «*Soils of Northern, Southern Polar Region and Soils of High Elevations and Their Relationship to Global Climate Change*». Conveners were S. Goryachkin, J. Kimble and C.L. Ping. The 3 sessions included 28 papers (10 oral presentations and 18 posters).

The main oral session included an invited paper on «Latitudinal Zonation of Polar Soils» by the most senior polar soil scientist J.C.F. Tedrow (USA), and papers from Poland, Russia, and the U.S.A. The second oral session included two papers from Canada, two from Brazil and one from Russia. More than 80 specialists attended these oral sessions, including the well-known polar soil scientist F. Ugolini. The CWG meeting organised during the symposium was attended by nine CWG members (S. Goryachkin, J. Brown, C. Tarnocai, O. Arnalds, G. Broll, M. Drewnik, J. Kimble, D. Konyushkov, C.L. Ping). The CWG-members officially confirmed the nomination of E.-M. Pfeiffer (Germany) as CWG-chair and of G. Mazhitova (Russia) as vice-chair (co-chair for IPA) for the next term period of the IPA (from 2008) and of the IUSS (2006-2010). Ed de Mulder, IUGS Past President, informed the audience on the International Year of Planet Earth. CWG-members agreed to participate in this programme, particularly in the theme of soil and related topic of soil and permafrost carbon.

4. GLACIER AND PERMAFROST HAZARDS IN MOUNTAINS

Joint IPA and Commission for the Cryospheric Sciences (CCS)

Chair

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The joint Working Group on Glacier and Permafrost Hazards in Mountains (GAPHAZ) of the IPA and the Commission of Cryospheric Sciences (CCS) of the International Union of Geodesy and Geophysics (IUGG) organized its third scientific session on glacier and permafrost hazards «Climate change impacts on glaciers, permafrost and related hazards» within the European Geosciences Union (EGU) General Assembly 2006 held in Vienna. The session was listed in the assembly sections on Cryospheric Sciences, Natural Hazards, and Climate. Twelve talks and 24 posters were presented, about a third of which focused directly on glacier and permafrost hazards. Further information and the abstracts can be found at <www.copernicus.org>. A similar session is planned for the EGU'07.

A special issue of «Global and Planetary Change» resulting from the EGU'05 session is in press. Under the title «Climate change impacts on mountain glaciers and permafrost» it contains 15 papers, of which about a third focusses directly on glacier and permafrost hazards. Further information will be available through <www.sciencedirect.com>.

One of the aims of the WG is to set up an internet-based data base of worldwide glacier and permafrost hazards in mountains. The related initial data collection has been completed by M. Flubacher (Univ. of Zurich) and will be available online. Similarly, general recommendations regarding glacier and permafrost hazard assessments are in a second feedback round of review among working group members and will be published soon.

Following the change of the WG chair Andreas Käab from the University of Zurich to the University of Oslo, the GAPHAZ webpage has moved to Oslo.

Visit the GAPHAZ website at <http://jern.uio.no/remotesensing/gaphaz>

5. ISOTOPES AND GEOCHEMISTRY OF PERMAFROST

Co-chairs

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The Working Group activities during 2006 consisted of informal discussions via email, among members at the Asian Conference on Permafrost and during the excursion to Tibet. This conference was attended by R. Sletten.

Close collaborations established among its various members continued in 2006 including: the study of oxygen isotopes in lacustrine diatoms of Greenland (Alfred-Wegener Institute (AWI) and University of Washington); ground ice studies in the permafrost in Alaska (University of Alaska, Fairbanks; AWI) and field work on Herschel Island (new cooperation AWI-McGill) and near Longyearbyen (AWI-UNIS). The latter involved the implementation of «Stable water isotopes in permafrost» to an UNIS course.

A circum Arctic network for the sampling of precipitation continues based on the GNIP (Global Network of Isotopes in Precipitation) protocol provided by the IAEA-WMO program <www.iaea.org>: «Routine sampling and analytical protocol for stable oxygen and hydrogen isotope in precipitation in the Arctic regions». Stations in this network are running in Yakutsk and Tiksi. In the framework of this network, a climate and soil station has been installed on Yamal Peninsula (new cooperation AWI-Tyumen State University of Oil & Gas). Individuals or groups sampling of arctic precipitation on a regular basis are invited to join this network and should contact Hanno Meyer or Ron Sletten.

We encourage interested individuals to join the working group; instructions for joining are on the web site <www.awi-potsdam.de/www-pot/geo/isochem-wg.html>. The next planned meeting of the working group is at the International Polar Year (2007-2008) International Conference, Salekhard, West Siberia in June 2007.

6. MAPPING AND MODELLING OF MOUNTAIN PERMAFROST

Co-chairs

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During the International Conference in Tyumen in May 2006 several members of the WG met to continue

the discussion on classification and mapping of permafrost in Central Asia.

Under the auspices of the IPA and State Key Laboratory of Frozen Soils Engineering (SKLFSE), a one- and a half-day workshop on Central Asia permafrost was convened in Lanzhou, China, August 5-6, 2006. The workshop aimed to develop a common (unified) classification of permafrost of Central Asia, to plan for the preparation of a regional permafrost map, and review current status permafrost observatories. There were 39 participants from Canada, China, Germany, Japan, Kazakhstan, Mongolia, Russia, United Kingdom, and U.S.A. Reviews and latest progress were presented on the classification, mapping and monitoring of permafrost in mountain regions and Central Asia. The new «Map of Glaciers, Frozen Ground and Deserts in China» (CAREERI, CAS, 2006) was presented. Following the conference a small group visited Golmud Station and spent two days on the northern end of the Qinghai Tibet Plateau reviewing monitoring sites and permafrost conditions and visiting the Beiluhe Field Station and the railroad test sections (J. Brown, S. Harris, S. Marchenko, N. Sharkhuu, N. Shiklomanov, T. Zhang).

Workshop participants agreed to recognize the two major classes of permafrost as altitudinal and latitudinal, and also sub-classes of mountain and plateau permafrost within the altitudinal zonation. The latitudinal zonation is represented traditionally as continuous, discontinuous and sporadic types of distribution. However, the permafrost continuity classification schemes (percentage of permafrost coverage) within the each of sub-classes still differ. A consensus was agreed that permafrost mapping in the Central Asian region should include both modelling and traditional approaches based on our knowledge of permafrost distribution. The map will delineate permafrost altitudinal and latitudinal zones, sub-zones, calculated and observed ground temperatures and active layer thicknesses, and where available estimates of ground ice.

Discussions with Xin Li, Director, World Data Center for Glaciology and Geocryology (WDCGG-CAREERI) and S. Marchenko, N. Sharkhuu and J. Brown led to agreement on the following next steps:

- Xin Li to organize the digitizing of the Russian 1:2,500,000 permafrost map sheets bordering Mongolia and China. The digitized base maps and present legends for the four-country region will be compiled and the team will then reconciled discrepancies in boundaries and units.
- S. Marchenko to prepare a modelled map (5x5 km grid) of the four-country, Altai Mountain region showing the computed extent of permafrost and estimated MAGTs at 20-m depth.
- N. Sharkhuu to prepare a table of ground temperatures data from approximately 100 Mongolian boreholes, including year(s) measured and elevation to serve for future latitudinal and mountain model validation.

- In preparation for the regional geocryological map, a new index map of Central and Eastern Asia including Japan and showing all major mountain ranges and plateaus (WDCGG) to be compiled.

The International Union for Quaternary Research (INQUA) provided a grant to support some of these workshop, conference and field activities.

In other WG activities, permafrost mapping approaches for the Nordic region continue including delineation of the lower altitudinal limits of permafrost distribution in Norway and Iceland.

WG members plan to meet in Salekhard in June 2007 to review progress and discuss details with Russian colleagues.

7. PERIGLACIAL LANDFORMS, PROCESSES AND CLIMATE

Co-chairs

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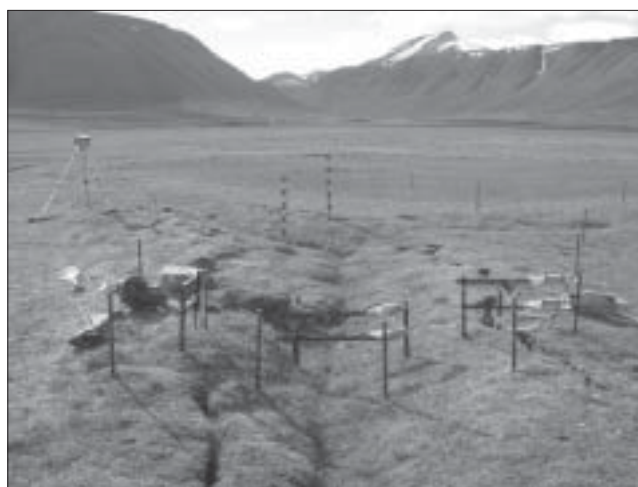
Norikazu Matsuoka, Japan

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Subgroup chair, Spatial Variability

Achim A. Beylich, Norway (Achim.Beylich@ngu.no)

The Working Group addresses periglacial processes and their coupling to climate, and new methodologies to investigate and monitor such geomorphic processes. The WG will contribute toward a better understanding of the periglacial geomorphic effects of climatic variations, past, present and future. This is carried out on the background of increasingly awareness of a series of modes of variability within the global climate system, which operate over a range of temporal and spatial scales.



An ice-wedge monitoring site in Adventdalen, Svalbard. Photograph by Norikazu Matsuoka.

The project «Global network for monitoring periglacial processes and associated environmental parameters» was initiated in 2004. The aim of the project is to standardize periglacial process monitoring techniques. The model experimental sites constructed in Adventdalen, Svalbard, were revisited several times during 2005-2006 to collect data and reinforce the monitoring system. Data from an ice-wedge site showed an intensive cracking activity during a short, cold period in late winter, although the winter was overall very warm. An inclinometer installed in a borehole dug in a rock glacier indicated slight creeping in an ice-rich layer of the uppermost permafrost. In mid August 2006, a group of periglacial researchers (C. Harris, A. Lewkowicz, J. Murton, H. Christiansen, M. Luetsch, F. Smith and N. Matsuoka) visited these monitoring sites and discussed further improvement of monitoring techniques. The project rationale is described in: Matsuoka, N. 2006. Monitoring periglacial processes: Towards construction of a global network (*Geomorphology*, 80, 20-31).

In order to investigate the coupling between various periglacial processes to climate, a project on collecting meteorological data series from periglacial regions was launched when the WG was established in 2004. This work has been continued, and now data from more than 500 individual stations has been collected and are updated annually by O. Humlum.

A multi-authored field manual on periglacial field techniques can be downloaded from the IPA web site. This field manual continues to receive new contributions and updates.

Since last reporting the following periglacial meetings were held:

- Third SEDIFLUX Science Meeting in Durham, UK, December 16-19, 2005. Main theme: Sediment budgets and rates of sediment transfer across cold environments in Europe.
- Second meeting of CRYONOR, the Norwegian group of cryosphere scientists. Folldal, Norway, September 21-24, 2006. Main theme: Weichselian glaciation and permafrost in Norway; a new scientific paradigm for geosciences in the Nordic countries?

Liaison continues with the IGU *Commission on Cold Region Environments*, co-chaired by Martin Gude (Germany) and Christer Jonasson (Sweden). This IGU Commission consists of a steering committee with one member each from 11 members countries. N. Doubleday, M. Gude, and X. Yang attended the regional IGU conference in Brisbane in July. N. Doubleday, J. Vandenberghe and X. Yang participated in the Lanzhou conference.

8. PERMAFROST AND CLIMATE

Co-chairs

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Subgroup Chairs

Model Inter-comparison: V. Romanovsky, U.S.A.

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Monitoring: S. Smith, Canada (SSmith@NRCan.gc.ca)

Working Group activities continue with several of them connected with international commissions and bodies concerned with climate change and its impacts.

The Intergovernmental Panel on Climate Change (IPCC) continues work on its Fourth Assessment Report (FAR), which in 2006 underwent review of its Second-Order Draft. T. Zhang is Lead Author on Chapter 4 of the IPCC Working Group I chapter concerned with changes in snow, ice and frozen ground. O.A. Anisimov is Coordinating Lead Author of the IPCC Working Group II chapter on the polar regions. Several Working Group members have acted as reviewers of FAR chapters.

The WG members are involved with many of the permafrost-oriented International Polar Year activities primarily through the IPY projects designated *Thermal State of Permafrost* (TSP) and *Antarctic Permafrost and Soils* (ANTPAS). V.E. Romanovsky is developing a protocol for borehole instrumentation and data collection under the *Thermal State of Permafrost* component of GTN-P and has produced a preliminary map showing the adequacy of the existing borehole network. Similar analytic treatment is underway to assess adequacy of geographic coverage in the Circumpolar Active Layer Monitoring (CALM) network and refine a CALM protocol for the Antarctic. Other progress in the CALM program is reported on its redesigned website <www.udel.edu/Geography/calm>.

A number of countries have submitted proposals for IPY permafrost activities. V. Romanovsky has received support to provide instrumentation in Eurasian boreholes and to process past and current data. The Norwegian geoscientist team (H. Christiansen, Leader) received funding for its TSP project. Canadian scientists (S. Smith, A. Lewkowicz and C. Burn) submitted an IPY proposal to support Canadian contribution to TSP. Spain, Portugal, New Zealand, Italy and the United Kingdom are developing new boreholes in the Antarctic and subantarctic islands.

Nikolay Shiklomanov (Univ. of Delaware) is collaborating on the permafrost-model inter-comparison project funded by the U.S. National Science Foundation (see *Frozen Ground* No. 28, p. 19). Co-investigators on the project are Tingjun Zhang (Univ. of Colorado), V.E. Romanovsky (Univ. of Alaska, Fairbanks), and O.A. Anisimov (Russian State Hydrological Institute). The research is focused

on evaluating the consistency between active layer predictions produced by a series of spatial permafrost models for northern Alaska and estimating the uncertainties in gridded air temperature fields and their effect on predictive permafrost modeling. Results were presented at 2006 meetings of the American Geophysical Union, the Association of American Geographers, and the first Asian Conference on Permafrost.

The International Geographical Union's Commission on Cold Regions Environments primary aim is to develop and disseminate information about sustainable land use in changing cold environments. The hazards associated with thawing permafrost are a central concern of this work. The Commission presented its interim results at the 2006 meeting of the Association of American Geographers, IGU regional conference in Brisbane, and Asian Conference on Permafrost.

Several WG members attended the workshops on «Vulnerability of Carbon in Permafrost.» The workshops were attended by experts in permafrost, high-latitude ecosystems, Arctic soils, carbon cycling, and carbon / climate interactions.

Permafrost continues to be a major focus at the Fall Meeting of the American Geophysical Union. A special issue of the Earth Surface section of *Journal of Geophysical Research* based on conference presentations from the 2005 AGU conference will be published in early 2007.

Members participated in report preparation Integrated Global Observing Strategy (IGOS) Cryosphere Sections related to permafrost observations were prepared by S. Smith and J. Brown with contributions from T. Zhang, G. Grosse, and O. Anisimov.

9. PERMAFROST ASTROBIOLOGY

Co-chairs

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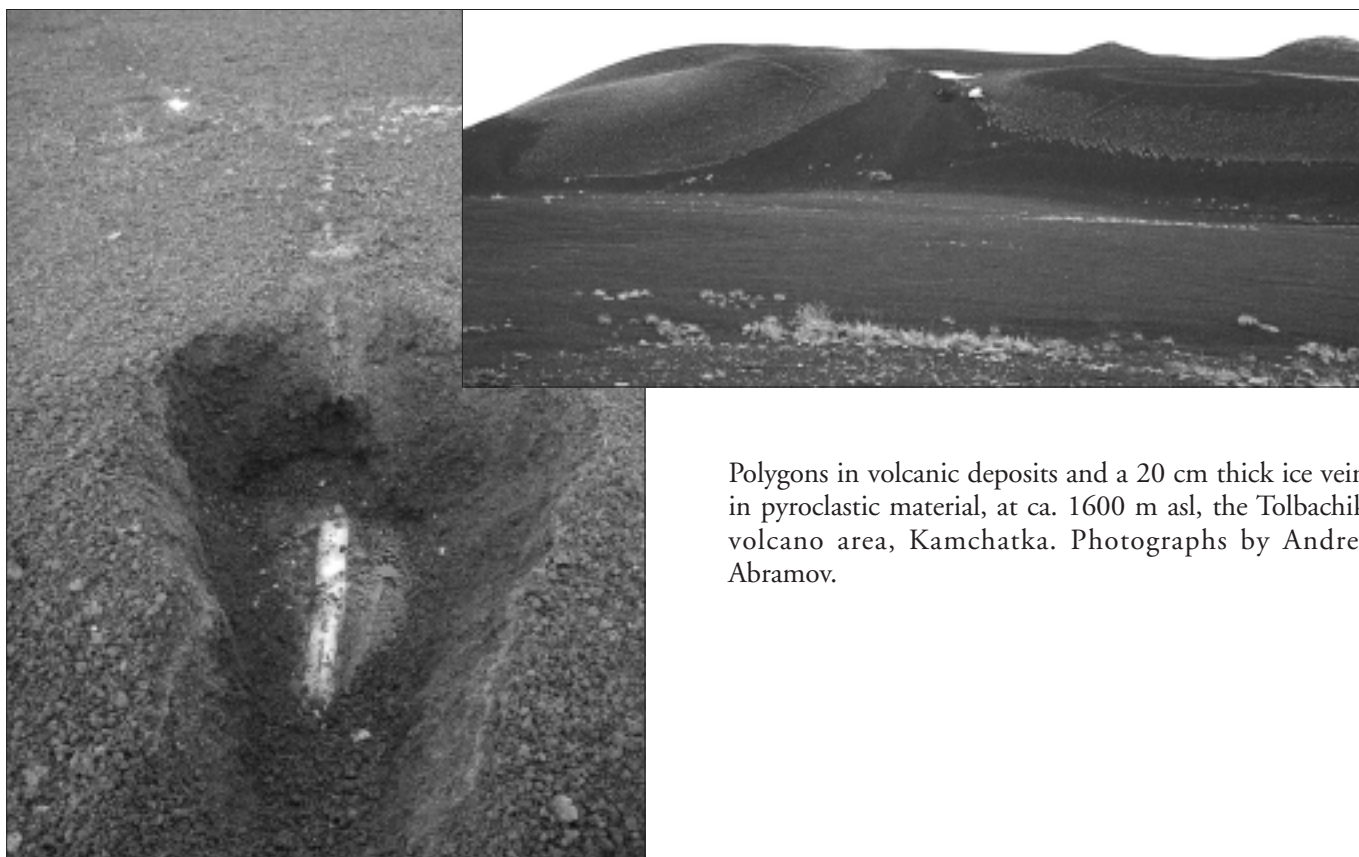
Two sessions «Astrobiology and ice microbiology» (Session Chair: D. Gilichinsky) and «Astrobiology and permafrost microbiology» (Session Chair: J. Deming) were organized at the International Conference on Polar and Alpine Microbiology, Innsbruck, Austria, March 2006. The following oral presentations were presented (see <www.alpine-polar-microbiology2006.at>):

- J. Deming, Viral dynamics in ice: a safeguard against extinction?
- Buford Price, Metabolic rates, attachment to clay grains, and production of greenhouse gases by microbes in Greenland glacial ice
- Adrian Ponce, Quantification of bacterial spores capable of germination in GISP2 ice cores using a novel endospore viability assay

- Sergey Bulat, Deliberations on microbial life in the subglacial Lake Vostok, East Antarctica
- James Tiedje, Genomic insights into cryoadaptation in permafrost bacteria
- Tatiana Vishnivetskaya, Microbial diversity in Lupin Mine and Siberian permafrost
- Nicolai Panikov, Microbial activity and growth in permafrost and frozen soil: facts, artifacts and environmental implications
- Vladimir Mamykin, Space conditions influence on permafrost microbial community
- Daria Morozova, Methanogenic Archaea from terrestrial permafrost as potential candidates for possible life on Mars
- David Gilichinsky, Terrestrial permafrost models of extraterrestrial habitats and inhabitants.

A collaborative effort between the NASA Astrobiology Institute (J. Maule, team leader, and P.L. Morrill, both from Carnegie Institution of Washington, and A.M. Shaw, Woods Hole Oceanographic Institution), Russian Astrobiology Center (A. Abramov, team leader, Institute of Physicochemical and Biological Problems in Soil Sciences (IPBPSS), and students of Moscow State Univ. Z. Tsygankova and E. Gostev), and Australian Center for Astrobiology Macquarie University (S. Leuko and R. Anitori) was established to carry out an expedition to Kamchatka during August-October 2006. A key area of collaboration between the interdisciplinary teams was the investigation of biological and geochemical signatures within permafrost samples. The site chosen for this investigation was situated at the base of Tolbachik volcano, Kamchatka, at an altitude of 1450 m (55°45'N, 160°17'E). Six drill-core samples (approximately 10 cm in diameter) were obtained from a depth of 18-23 meters below the surface. The external and internal surfaces of these samples were analyzed on-site immediately upon surfacing. Surfaces were quantitatively analyzed for Adenosine Tri-Phosphate (ATP) - a universal energy molecule of life - and proteins, with ATP luminometry and Portable Test System (PTS) bicinchoninic acid (BCA) assay. Both ATP and proteins are exclusively biological in origin and good indicators of biological processes. Internal and external core surfaces at all depths were found to contain 20-40 micrograms protein per cm² of core and zero relative light units (RLUs) of ATP; indicating that biomass is present at depth, but is largely inactive. On-site analysis provides a useful 'ground-truth' from which to compare analyses in the laboratory.

Two other astrobiological aspects of permafrost investigations at Tolbachik Volcano were: (1) to study characteristics of permanently frozen pyroclastic deposits as characteristics of microbial habitat; and (2) to find thermophilic microorganisms associated with volcanoes and deposited together with products of eruption that then survived in permafrost after the freezing of scoria and ash.



Polygons in volcanic deposits and a 20 cm thick ice vein in pyroclastic material, at ca. 1600 m asl, the Tolbachik volcano area, Kamchatka. Photographs by Andrei Abramov.

This concurrent program was focused on peculiarities of forming permafrost temperature field in the areas with active volcanism. For this goal the long-term observations on two CALM sites at different elevation were continued and the boreholes for year-round temperature measurements were equipped with loggers. Interesting polygonal nets on the surface of volcanic deposits were observed, as well as ice veins within the pyroclastic material. One of the drill holes (mean annual temperature -3°C) at the depths of 6 to 18 m contained the snowfield that was buried by scoria and ash in the 1975/76 eruption.

The Mars Odyssey observations revealed huge water-ice regions poleward of 60N and 60S latitudes and significant excess of subsurface water in some equatorial regions of Mars. In order to study regional variations of water content in Martian subsurface N. Demidov, PhD student (IPBPSS) is using the observational data gathered by the High Energy Neutron Detector (HEND) onboard the Mars Odyssey and the Mars Orbital Laser Altimeter (MOLA) onboard Mars Global Surveyor. In both hemispheres, he found correlation between neutron flux and albedo increases from the equator to the boundary of polar water-ice reach deposits.

10. PERMAFROST ENGINEERING

Co-chairs

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The following report covers both 2005 and 2006 activities.

Planning continues for the documentation of the impact of climate change on Arctic infrastructure and related observations, monitoring, case-studies, and back-calculations. The Arctic Climate Impact Assessment report (2006) included a chapter devoted to Infrastructure: buildings, support systems and industrial facilities (see <www.acia.uaf.edu>). The WG proposes to critically analyze the engineering community's ability to make site specific forecasts of climatic factors which affect engineering projects. An important component of this work is to provide a transition from deterministic to probabilistic approaches when future climate is incorporated as a design parameter. A report will be prepared on the «best practices» for engineers to incorporate climate change in their design criteria and presented at the 2008 NICOP.

The U.S. Department of Transportation, Federal Highway Administration (FHWA) has produced a computer-based multimedia instructional presentation entitled *Road Engineering and Construction Practices for Cold Regions*. The

author is Ted S. Vinson. The CD provides sufficient information to successfully complete a cold regions road/railroad project in a permafrost environment. It contains 159 photographs, 248 figures, Powerpoint slide shows, clickable Internet links, downloadable software, and 175 complete reference documents. Guest speakers describe cold regions problems and solutions in the «Expert Speaks» series of twenty audio clips and fifteen video clips. The presentation is available from the FHWA, complimentary, as a two-CD set, which will play on a PC or Mac computer. Requests may be directed to <Rich.Barrows@fhwa.dot.gov> or <Gary.Evans@fhwa.dot.gov>.

Hannele Zubeck at the University of Alaska Anchorage (UAA) serves as the lead contact for the IPY engineering activity (EoI 1103) *Adaptation of Transportation Infrastructure on Degrading Permafrost (TIP)*. The project goal is to develop expertise and procedures for the mitigation of permafrost instability under transportation infrastructure in the context of climatic change affecting permafrost environments. TIP objectives are: (1) Improve knowledge of factors affecting thermal regime in pavement and other infrastructure built on thaw-sensitive permafrost; (2) Develop techniques to detect sensitive permafrost areas; (3) Develop frozen soil characterization (i.e. sensitivity to degradation) in the context of transportation infrastructure construction or rehabilitation; and (4) Develop adaptation methods that mitigate infrastructure distress resulting from permafrost degradation. The project plans

to establish a network of thermal regime observation sites on built infrastructure, especially roads, and will include new and existing structures that incorporate mitigation techniques. Several projects have been submitted for national funding. The international collaboration team consists (as of July 2006) of Guy Doré, University of Laval, Canada; Karen Henry and Kevin Bjella, CRREL, USA; Anastasia Tseeva, Yakut Design and Research Institute for Construction, Republic of Sakha (Yakutia), Russia; Arne Instanes, Opticonsult Engineering Consultant, Norway; Seppo Saarelainen, VTT, and Pauli Kolisoja, Tampere University of Technology, Finland; Ma Wei, CAREERI, China; Sven Knutsson, Luleå University of Technology, Sweden. Membership is open and prospective TIP collaborators are encouraged to contact H. Zubeck <afhcz@uaa.alaska.edu>.

WG members have met frequently at international meetings and conferences, and most recently at the 13th International Specialty Conference on Cold Regions Engineering. Both the Asian Conference on Permafrost (Lanzhou, China) and the Orono conference provided opportunities to review current status of engineering design and construction, including mitigation for climate change. Members are following or are directly involved in several proposed gas line projects in Alaska and Canada. We continue to maintain liaison with the International Society on Soil Mechanics and Geotechnical Engineering, Technical Committee 8 Frost (ISSMFE TC8).

NEWS FROM MEMBERS

Members are encouraged to submit periodic updates of activities for posting on the IPA Web site.

ARGENTINA (AND SOUTH AMERICAN PARTNERS)

In February 2006 the working group directed by Ana L. Ahumada (Inst. of Quaternary Geology and Palaeoclimates, Miguel Lillo Foundation) installed data loggers on the cryoplanation surface (27°7' S, 66°2' W) at Abra de la Apacheta, Sierra de Aconquija, Tucumán, at 4825 m asl, to monitor temperatures, as air temperatures above 2000 m asl were not available in that region.

In March, Dario Trombotto (Argentinean Institute for Snow, Ice and Environmental Research IANIGLA, Mendoza, Argentina) led an expedition to the peak of the Peteroa volcano (35°15' S) in the southern Mendoza Province, on the Chilean boarder. The volcano is active and belongs to a volcanic group with a maximum height of app. 4100 m asl. The top, which has been almost entirely glaciated until a few years ago, today is periglacial with high mountain permafrost clearly observable from a height of 3400 m asl. Hidden massive ice alternates with sediments of fluvio-glaciogenic origin and moraines. New cryogenic forms with deformations caused by the pressure of ground ice were discovered. Glaciers show a remarkable retreat, at the peak and on the slopes of the Argentine side, this favours formation of new permafrost. The retreat is assumed to be partly due to the general warming observed in the Central Andes of Mendoza, but doubtlessly also caused by volcanic activity. The area is crucial for future geocryological research.

The CONCORD Symposium «Climate Change: Organizing the Science for the American Cordillera» was held



Massive ice underlying sediments of fluvio-glaciogenic origin. Photograph by D. Trombotto.

April 4-6, 2006 at IANIGLA, Mendoza. More than 160 researchers attended, discussed mountain ecosystems data and defined the use of resources and the role of institutions related to mountain management to preserve the social and economic well-being of mountain communities in this part of South America. Changes in the alpine cryosphere may represent some of the earliest signs of large-scale climate change. The reduction of the snow- and ice-covered areas not only functions as an indicator of change, but also provides powerful feedbacks through changes in albedo. Moreover, permafrost thawing destabilizes slopes in high relief areas, leads to landslides and rockfalls and endangers water supply of arid areas. Conference materials including abstracts and presentations are available at: <<http://mri.scnatweb.ch/content/category/7/44/66>>.

In Chile, the team lead by Hilmar Schröder (Univ. Humboldt, Berlin, Germany) is developing research in two directions, as a part of an ongoing programme on present and former periglacial environments: (1) Comparative morphogenesis of Richter denudation of slopes in periglacial and frost-free environments; and (2) Genesis of lake basins dating from the late Quaternary and Holocene in the Tinguiririca Valley and in the basin of Cancosa. Another joint project of the Humboldt University and the Unit of Geocryology, Mendoza (D. Trombotto, IANIGLA) entitled «Comparative periglacial morphology for quantification of solifluction movement in times of climatic change» is planned to start in 2007. This project will take place in the Chilean and in the Argentine Andes, collaborating with specialists, who studied solifluction in the Swiss Alps and the mountains of Kazakhstan.

In Ecuador, Bolívar C. Correa (National Institute of Meteorology and Hydrology INAMHI, Quito) is carrying out glaciological and geocryological research of the volcano Antisana in the Equatorial Andes (0°28'30" S, 78°08'55" W, 5760 m asl). Glaciers on the Antisana are undergoing large retreat. Observations of the dynamics of the terminal part of the Los Crespos Glacier reveal retreat and movement of the ice-cored moraine, creeping down the valley probably by creeping of the dead ice they contain. Such landforms can be observed in most valleys of the Equatorial Andes, and is now studied by new research programmes.

In Europe, D. Trombotto is collaborating with Victoria Alonso (Univ. of Oviedo, Asturias, Spain). The Miro region in the Cantabrian Cordillera has been mapped and studied geomorphologically, displays a great variety of fossil periglacial landforms including rock glaciers, giant sorted stripes and cryogenic slopes. Intense cryogenic activity is observed since the ice retreat after the Last Glacial Maximum; when ice thickness in the valleys was up to 400 m. Periglacial forms seem to have been very active during the Postglacial age, including different Neoglacial periods.

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AUSTRIA

Most permafrost related research in Austria is carried out by the University of Innsbruck, the two Universities in Graz, Joanneum Research (Graz), the Geological Survey of Austria (Vienna), and the Central Institute for Meteorology and Geodynamics (Vienna & Salzburg).

The Innsbruck group (Karl Krainer) is continuing rock glacier monitoring in the western Stubai and Oetzal Alps (hydrology, GPS-measurement of surface flow velocities) at the three rock glaciers Reichenkar, Ölgrube, and Kaiserberg. Furthermore, investigations in northern Italy / South Tyrol focus on mapping, temperatures, BTS, and hydrology of active rock glaciers in the Ulten and Schnals Valleys (Central Alps) and in the Mt. Hohe Gaisl area (eastern Dolomites).

The University of Graz (Inst. of Geography and Regional Sciences; Inst. of Physics – Dep. of Geophysics, Astrophysics and Meteorology; Inst. of Earth Sciences – Dep. of Geology and Palaeontology) and the Graz University of Technology (Inst. of Remote Sensing and Photogrammetry) started in June 2006 a new three year project highly relevant for permafrost research in the central Alps of Austria: «ALPCHANGE - Climate Change and Impacts in Southern Austrian Alpine Regions», which is led by Gerhard K. Lieb and supported by the Austrian Science Fund. ALPCHANGE aims to quantify past and present landscape dynamics in climate-sensitive glacial and periglacial alpine environments caused by the ongoing climate change. ALPCHANGE provides an integrative and comprehensive analysis of monitoring data describing four dynamic landscape parameters - permafrost, snow, geomorphology and glaciers - in terms of the ongoing climate change. For this project, meteorological stations and temperature data loggers were installed on the surface, below the surface or in close vicinity of active and inactive

rock glaciers as well as slopes underlain by permafrost (www.uni-graz.at/alpchange).

The Institute of Remote Sensing and Photogrammetry (Graz Univ. of Technology) continued annual geodetic measurements on Doesen, Hinteres Langtalkar and Weissenkar rock glaciers. Furthermore, the front of the highly active Hinteres Langtalkar rock glacier was resurveyed (annually since 2000) by terrestrial laser scanning (Riegl LPM-2k Long Range Laser Scanner and the software GeoScanner) by Joanneum Research, Graz (Arnold Bauer), and ALPCHANGE research fellows (Michael Avian, Andreas Kellerer-Pirklbauer). Beside the activities in the Hohe Tauern, the Graz group is continuing permafrost related research (rock glacier mapping, temperature data loggers, BTS) on lower mountains of eastern Austria (Niedere Tauern).

Within the framework of ALPCHANGE, the Geological Survey of Austria carried out geoelectrical surveys (led by Alexander Römer) in the Mt. Hoher Sonnblick summit (3106 m asl). This mountain is famous for its long standing meteorologically observatory (since 1886) located at the mountain summit and operated by the Central Institute for Meteorology and Geodynamics.

The Central Institute for Meteorology and Geodynamics and the Sonnblick Association started recently a permafrost research project (led by Michael Staudinger and Wolfgang Schöner). Ongoing slope instability problems in the summit area are the main reasons for the initiation of this project. Three 20 m and one 10 m boreholes were drilled in September 2005 along a sloping north-south profile. In 2005, the 10 m borehole was equipped with 6 extensometers; in August 2006, each of the three 20 m boreholes were instrumented with five geophones and 25 temperature sensors. Miniature temperature data loggers and the BTS-method will also be used for permafrost studies in the Hoher Sonnblick area.



Participants of the 9th International Symposium on High Mountain Remote Sensing Cartography (HMRSC-IX), Graz, Austria. Photograph by Walter Krämer (Graz University of Technology).

The 9th International Symposium on High Mountain Remote Sensing Cartography (HMRSC-IX) was organised in Graz by Viktor Kaufmann (Graz Univ. of Technology) and Wolfgang Sulzer (Univ. of Graz), September 14-22, 2006, with 80 scientists from 18 countries attending. This bi-annual symposium had two days of paper and poster presentations and a four-day field excursion. 63 contributions were presented in sessions on: remote sensing (RS) techniques, morphological mapping, monitoring of environmental and global change, permafrost studies and rock glacier monitoring, high mountain cartography and 3D relief models, hybrid solutions of GIS and RS, methodological improvements concerning HMRSC and education. Further information at <www.uni-graz.ac.at/geowww/hmrsc/hmrsc_9>.

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BELGIUM

A team from Ghent University (Jean Bourgeois and Wouter Gheyle, Dep. of Archaeology; Rudi Goossens and Alain D. Wulf, Dep. of Geography) investigated frozen tombs (kurgans) in the Altai Mountains, in collaboration with Sergei Marchenko (University of Alaska, Fairbanks). Hundreds of such tombs lie scattered across an area straddling Russia, Kazakhstan, Mongolia and China. These tombs, a major archaeological find dating back to the 1920s, belong to the lost Scythian civilization, which flourished 2500 years ago. Inside the tombs in the frozen ground lie well preserved bodies, often with the tattoos on their skin intact. For thousands of years, the Altai Mountains were an important passage between the Mongolian and Kazakh steppes. The area is a rich source of archaeological information on commercial routes and other exchanges between populations. On the nearby Silk Road and, buried in the graves of the Scythians, one can find Chinese vases, Persian carpets, Indian silks, etc. As the Scythian populations inhabited the entire Eurasian Steppe stretching from the Black Sea to Mongolia, the frozen tombs are a unique source of information about one of the most intriguing cultures of their time.

The kurgans are literally embedded in ice. After burial, each tomb was covered with stones, formed as a permeable mound. Rainfall could penetrate into the tomb where it froze. Over time, this process created an ice block, which preserved the tomb and its contents. Grave robbers and fortune hunters have been the tombs' traditional enemies but, today, a new threat is added. Climatic change is causing the permafrost in this part of Siberia to thaw. With the permafrost that preserves the kurgans now gradually thawing, the frozen tombs and their contents risk to disappear. Measurements from meteorological stations, borehole monitoring and research on glaciers all indicate



Scythian kurgan in the Valley of Yustyd (Altai Republic, Russian Federation). Photo: Wouter Gheyle.

significant climatic changes in the Altai. Permafrost could disappear completely in some areas of the Altai by the middle of this century. After 2500 years of perfect preservation, the remaining frozen kurgans can now be lost. UNESCO and the University of Ghent are helping teams in Russia and Kazakhstan to pinpoint locations of the remaining tombs.

Ghent University and Gorno-Altai State University have conducted joint research in the Altai Mountains since 1995. Their research has focused both on excavating burial mounds and on thorough surveys of other archaeological heritage in the mountains. Satellite images are used to create a cartographical archaeological inventory that fuses traditional field work, satellite image interpretation and GPS. In 2003 and 2004, the research team studied the organization of ritual and funerary sites in the Altai landscape through time, and recorded over 3000 archaeological monuments, in an area of about 600 km². In 2005-2006, a project put together by Ghent University with the support of UNESCO and a generous contribution from the Flemish Community of Belgium is continuing this survey, assessing climatic change in the Altai to analyse the threats which climatic change poses to the frozen tombs. Recent images compared to historic imagery from the 60's are expected to indirectly provide insights into climatic change, and the rate at which frozen ground is thawing.

In 2006, the University of Ghent surveyed the Yustyd Valley (Russia) and the valleys of Kara-Kaba and Bukharma (east Kazakhstan), in collaboration with the Gorno-Altai State University and the Margulan Institute of Archaeology of Almaty. Sergei Marchenko assisted the team with the permafrost investigations. Thermistors with data loggers were installed in several places in the valley, at different depths. After one year, temperature measurements will provide insights on the maximum depth of thawing during the short summer in different parts of the valley. Based on this information, local conservationists will be able to establish priorities for preserv-

ing each of the tombs. They will be able to determine which tombs lie in the areas where permafrost is thawing fastest. Modern approaches to archaeology seek to avoid excavating tombs, and to study ways of preserving the tombs creating a system of 'air conditioning' that would keep the tombs frozen.

An International Conference was held in Ghent December 4-6, 2006, on the problems of the frozen tombs and on Scythian archaeology. An exhibition will present the frozen tombs and the Altai Mountains to a larger public, first in Ghent, then in Paris (March 2007) and in Gorno-Altai (May 2007). Further information at <www.archaeology.ugent.be/altai>.

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CANADA

At the University of Ottawa, Antoni Lewkowicz and students carried out several permafrost-related projects in the Yukon. The largest is on modelling permafrost probability for mountainous parts of the southern Yukon, an area of about 200,000 km². This project uses a newly installed ground and air temperature monitoring network with more than 70 sites in five climatic regions spread across 3° of latitude and 7° of longitude. A combination of the BTS method, GIS modelling and ground-truthing is planned in collaboration with Ottawa colleague Mike Sawada and graduate students Philip Bonnaventure and Emily Schultz. Support has come from the Canadian Foundation for Climate and Atmospheric Sciences, NSERC, the Yukon Geological Survey and Natural Resources Canada. Other projects in the Yukon concern the development of palsas and thermokarst lakes in mid-elevation valleys, and landsliding and permafrost degradation following the 2004 forest fires around Dawson. Bernd Ertzelmüller (U. Oslo), who was a visiting researcher at the University of Ottawa in 2006, contributed both his expertise and his DC resistivity equipment to explore permafrost conditions at these sites. In the High Arctic, detachment slides that occurred on Ellesmere Island in 2005 were re-visited and numerous intact samples were retrieved for geotechnical analyses by graduate student Pauline Favero. In addition, a small collaborative project was initiated with Hanne Christiansen (UNIS, Norway) to test a new solifluction measurement technique on Svalbard.

At Carleton University, Kumari Karunaratne (PhD student) completed her fieldwork on permafrost conditions in the Slave Province, north of Yellowknife, including data collection at the abandoned Colomac Mine. Pascale Roy-Leveillee (MSc) has been working at the south end of the Dempster Highway in association with Environment Yukon to determine the relations between topography, vegetation and snow in this mountainous envi-

ronment. The project is associated with determining the rate of ground freezing and snow accumulation, and therefore the conditions under which snow machine access may be managed in this remote area. Chris Burn has been preparing to contribute to the IPY project on the Thermal State of Permafrost, and has now installed deep surface temperature cables at Herschel Island (42 m), Illisarvik (50 m), Paulatuk (28 m), Old Crow (20 m), and Mayo (40 m) in preparation for obtaining a full suite of data during the IPY.

McGill University's permafrost research programme (lead by Wayne Pollard) currently has three scientific themes: landscape dynamics related to ground ice processes, the biophysical analysis of groundwater and perennial springs in cold polar deserts, and the Arctic as an analogue for space exploration. In 2006 research was international through collaborations with colleagues from Germany and the United States.

The McGill team has four projects focusing on ground ice related systems. The first is an investigation of erosion and thermokarst along the Beaufort Sea coast. Largely the PhD research of Nicole Couture, this project looks at current rates of coastal erosion and soil organic carbon flux as a function of wave induced thermo-mechanical erosion of ground ice and ice-rich permafrost. The aim of this research is to predict future erosion patterns and feedbacks related to climate change. A sub-component is concerned with the analysis of block failures linked to thermo-erosional niche development and ice wedges (M.D. Hoque). The 2006 field programme included a joint expedition with researchers from the Alfred Wegener Institute, concerned with massive ice origin near Wisconsinan glacial limits on the Yukon Coastal Plain. This project has strong ties to ArcticNet and to the IASC project on Arctic Coastal Dynamics. The second project involves the mapping of massive ice in coarse-grained fluvio-glacial deposits in the Mackenzie Delta using a combination of GPR and resistivity techniques. This research is undertaken in partnership with Robert Gowan (DIAND) under the PERD Northern POL. The third project is concerned with the analysis of ice wedge polygon patterns in the high Arctic and their relationship to superficial geology and ice contents (Tim Haltigin). A new project is looking at retreat rates of high arctic retrogressive thaw slumps as a function of surface energy relationships and slump morphology (J. Grom). This project is part of ongoing research on massive ice and thermokarst in the Eureka Sound Lowlands.

The team of McGill researchers and graduate students working on the hydrogeology, microbiology and geomorphology of perennial springs on Axel Heiberg Island has now mapped eight distinct spring groups in a variety of settings. Research includes analysis of mineral precipitates and ice deposits related to the discharge of cold (-6 to +4° C) and highly mineralized groundwater, and led to the successful identification of distinct micro-

bial communities linked to the springs (D. Andersen, N. Perreault and L. Whyte), to permafrost (B. Stevenson and L. Whyte) and to local sandstones (C. Omelon).

Study of the Arctic as an analogue for space exploration at McGill included in 2006 the last year of field testing in the Eureka area of a NASA (ASTID) funded Mars autonomous deep drilling systems in collaboration with US colleagues from NASA Ames (G. Briggs) and JSC (J. George). The second year of fieldwork involved the integration of geophysical data collected using a RAMAC GPR rough terrain system and a Geometrics OhmMapper capacitive coupled resistivity system. It is a CSA funded Mars instrument concept study focusing on the delineation of ground ice. The third project involves the establishment of a CSA Canadian Analogue Research Network site at Expedition Fiord on Axel Heiberg; this site hosted three CSA funded CARN projects in 2006.

Personnel from Geological Survey of Canada (GSC), Geodetic Survey of Canada, University of Calgary and McGill University undertook field surveys in March 2006 to investigate aspects of coastal and nearshore permafrost in the Mackenzie Delta and Yukon coast regions (Steve Solomon). Spring surveys concentrated in areas of bottomfast ice and involved ground penetrating radar, electrical resistivity surveys and seabed drilling and sampling. The highlight of the survey was the successful recovery of a year of ground temperature data from thermistor cables buried beneath the bottomfast ice. As anticipated, small changes in ice thickness (water depth) above the seabed result in dramatic changes in temperature history and thermal properties. The geophysical data collected will permit extrapolation of cryostratigraphy between ground temperature locations. High resolution GPS occupations of previously established benchmarks were undertaken as part of an ongoing investigation of subsidence in the delta.

GSC personnel collaborated with Chevron Canada to investigate breakup processes in the outer Mackenzie Delta in May and June 2006. Remotely sensed data revealed that over ice flooding is at least partially controlled by the distribution of bottomfast ice. Time lapse video of flooding at several outer delta sites will be used to determine the depth and duration of flooding at the coast. July-August field activities included surveys of coastal stability on the Yukon coast and the Mackenzie Delta along with sidescan, multibeam and subbottom surveys to examine ice-seabed interaction, especially strudel and ice scour. Yukon coast and Pingo Canadian Landmark surveys involved collaboration between the GSC and Parks Canada.

Since 2005, the GSC through its Secure Canadian Energy Supply Programme's project on regional landslide hazards mapping, has been contributing to providing geoscience information towards the hydrocarbon exploration and development in the Beaufort Sea, Mackenzie River Delta, and Mackenzie Valley (Réjean Couture and Simon Riopel). This regional landslide hazards mapping initiative aims, with funding support from the federal

Northern Energy Development Memorandum to Cabinet to: (i) provide baseline knowledge on the types, regional distribution, and control of landslides through a compilation of existing and new information; (ii) assess the potential influence of environmental factors (e.g. climatic parameters, forest fires) on frequency and magnitude of landslides; (iii) monitor zones of potentially unstable slopes along the proposed gas pipeline route using remote sensing technologies; and (iv) map susceptibility to landslides in a permafrost environment. A preliminary landslide susceptibility map was developed using a qualitative parametric method driven by expert judgment and taking into account environmental parameters, such as geology, land cover, permafrost, and slope angle and aspect. During summer 2006, ten corner reflectors were installed for the first time in Canada at various landslide sites in a permafrost environment to monitor active landslides and slopes through a remote sensing technique, InSAR (Interferometric Synthetic Aperture Radar).



Example of a monitoring site located above tree-line at an elevation of about 1580 m asl, Faro area, Yukon Territory. Photograph by Antoni Lewkowicz.

The GSC (Baolin Wang) has been conducting geotechnical investigations on landslides in the Mackenzie Valley to improve the understanding of triggering mechanisms. Two landslide sites have been instrumented to monitor ground condition changes in test plots adjacent to the selected landslides. Field and laboratory tests for geotechnical and geothermal parameters are being carried out.

Modellers at the GSC (Caroline Duchesne, Fred Wright) are conducting a regional assessment of climate change impacts to permafrost along all-season highways and winter roads in Canada's Northwest Territories (NWT). The major objective of the research is to assess the future viability of the northern transportation system given the expected increase of MAAT throughout the NWT by as much as 3-5° C by 2050. A GIS-integrated finite-element transient ground thermal model developed at the GSC generates predictions of climate-induced impacts to permafrost terrain along major transportation corridors over time spans of 20 to 50 years. The modelling results provide a basis for evaluating likely future trends in roadbed stability, maintenance frequencies and remedial activities, and associated future costs. The two-year project, sponsored by the Climate Change Action Fund (CCAF) in partnership with the Government of the NWT (Dep. of Transportation), Environment Canada, and Transport Canada is scheduled for completion late in the fiscal year 2006-07.

GSC researchers Scott Dallimore and Fred Wright are conducting a detailed characterization of several large methane seeps occurring in stream channels and shallow lakes in the outer extent of the Mackenzie River delta. Seasonal and/or annual measurements of gas discharge rates, water and gas geochemistry, structural morphology, and fluid temperature anomalies provide insight into the genetic origins of the source gas (shallow biogenic vs. deep thermogenic), structural stability and temporal consistency, and volumetric estimates of annual methane discharge to the atmosphere. Scientific and anecdotal evidence suggest that at least some of these seeps have been continuously active for more than 40 years.

Scientists and engineers from the GSC (contact: F. Wright, S. Dallimore) are working to characterize the geotechnical and geothermal properties of sediments in deep permafrost environments of the Mackenzie-Beaufort region of the NWT, an area slated for intensive hydrocarbon resource development within the next few decades. Production of these resources will involve the installation and operation of production strings and well casings extending through deep permafrost, and in some cases, through thick deposits of thermodynamically unstable gas hydrate overlying conventional oil and gas reserves. Distributed Temperature Sensing (DTS), conducted in collaboration with GeoForschungsZentrum (Potsdam, Germany) has enabled the acquisition of continuous high-resolution ground temperature profiles through more than

600 m of permafrost, extending to depths of greater than 1 km. Planned future work will investigate the possibility of significant occurrences of intra-permafrost gas hydrates (hydrates within permafrost), a phenomenon that is thermodynamically likely, but as yet undocumented.

With funding received through Northern Energy Development Memorandum to Cabinet, the GSC is enhancing its permafrost monitoring network in the Mackenzie corridor to address knowledge gaps regarding permafrost and terrain conditions in support of the assessment, planning and management of hydrocarbon extraction, production and transmission in the Mackenzie corridor. A major field campaign will be carried out during winter 2006-07. Temperature cables will be installed to depths of up to 20 m and information on soil properties and ground ice conditions will be collected. Monitoring sites were recently established in the central Mackenzie valley in collaboration with Enbridge Pipelines and this included additional instrumentation to monitor slope movements. GSC (Sharon Smith) and the Department of Indian and Affairs and Northern Development (DIAND; Steve Kokelj) have collaborated on the establishment of field sites in the Mackenzie Delta region to assess environmental conditions in the Kendall Island Bird Sanctuary and across the treeline transition.

The Water Resources Division of DIAND acquired science funding through the Northern Energy Memorandum to Cabinet to investigate «Permafrost and Terrain Conditions across Treeline in the Mackenzie Delta Region» (Steve Kokelj). This research investigates interactions between ground temperatures, vegetation, snow and terrain processes across the subarctic boreal - tundra transition zone in the Mackenzie Delta region. Several study sites were established in the tundra uplands along the proposed Mackenzie Gas Pipeline corridor and in the Kendall Island Bird Sanctuary. The breadth of environmental data collected at these locations is the result of collaboration with Chris Burn and Carleton University students Mike Palmer, Peter Morse, Julian Kanigan and Thai Nguyen; Trevor Lantz (Univ. of British Columbia), and Jill Johnstone (Univ. of Saskatchewan). Peter Morse (PhD student) returned to the outer delta to continue investigations of the relations between topographic and vegetation factors and ground temperature, and to determine if there are any variations in ground ice conditions that are associated with such variations in ground temperature. Julian Kanigan (MSc student) has been trying to delineate permafrost temperatures and established a network of 20 sites to monitor ground temperatures at 20 m depth throughout the delta. Thai Nguyen (MSc) has been working to delineate the extent of permafrost in the delta. He visited over 100 sites to determine the relations between vegetation communities and permafrost occurrence. He will use these relations to interpret permafrost extent in the area from SPOT satellite images acquired in July. Trevor Lantz (PhD candidate) is studying the distribution and

changes in the aerial extent of thermokarst disturbance along the proposed pipeline corridor north of Inuvik, and an examination of the effects of natural disturbance on ground-thermal conditions. In partnership with Sharon Smith (NRCan/GSC), deep thermistor cables were placed at several of these locations and will contribute data to the Mackenzie Valley Permafrost Monitoring Program. Specific aspects of this research that are in press or preparation include: (a) an examination of the effects of thaw slumping on the variation of water chemistry in tundra lakes (S. Kokelj); (b) development and validation of a model of hummock growth and degradation (S. Kokelj, C. Burn and C. Tarnocai); (c) assessment of the morphology and activity of ice-wedges in Mackenzie Delta (S. Kokelj, M. Pisaric and C. Burn); (d) examination of the spatial structure of active-layer depths across treeline (T. Nguyen, C. Burn and S. Kokelj); and (e) assessment of permafrost and vegetation conditions at abandoned drilling mud sumps in the Kendall Island Bird Sanctuary (J. Johnstone and S. Kokelj).

J.D. Mollard and Associates Limited (JDMA) devoted a significant amount of time selecting three competing alternative road route corridors and rights-of way, and mapping their terrain conditions in continuous and discontinuous permafrost zones in Nunavut and northern Manitoba; clients were Manitoba, Nunavut, federal governments. Multiple physical environmental studies (erosion, sedimentation, hydrology and terrain studies) were undertaken in discontinuous permafrost terrain on hydro development projects in Manitoba. Earlier alternative all-weather road routes proposed by JDMA from Yellowknife to the diamond mines in the Northwest Territories and Nunavut were reviewed. None of these routes were constructed owing to less costly winter ice roads being used. The routes were reviewed because global warming had shortened the winter haul season using ice roads. JDMA also acted as a subcontractor investigating the effects of global warming on permafrost degradation in the Northwest and Yukon Territories; clients were C-CORE and ESA.

J.D. Mollard was awarded the Roger J.E. Brown medal for excellence in permafrost engineering. The award was given at the 59th Canadian Geotechnical Society Conference in Vancouver, October 2006.

The Coastal Zone Canada Conference was held in summer 2006 in Tuktoyaktuk. This was the first time the conference was held in the North. Among the many sessions, a joint Coastal Zone Canada-Canadian Coastal Science and Engineering Association session of the impacts of climate change on coastal infrastructure was organized. Papers on western Arctic climate change scenarios, applications of LiDAR and coastal observatories were presented. Abstracts for the conference can be viewed at <www.czc06.ca/e/db/viewAllAbstracts.asp>

The Geological Association of Canada will be holding its 2007 Annual Meeting in Yellowknife in May

(www.nwtgeoscience.ca/yellowknife2007). There will be a symposium on permafrost, partially sponsored by the Canadian National Committee for the IPA. Papers on the following subjects are invited: Permafrost in a changing climate; Permafrost and industrial development; Coastal permafrost and Arctic coastal dynamics; Permafrost and gas hydrates; Permafrost and the International Polar Year.

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CHINA

The following is a summary of an extensive report by China. The complete report is posted on the IPA web site.

The Qinghai-Tibet Railway (QTR), 1,142 km from Golmud to Lhasa, crosses 632 km of permafrost terrain and 950 km at elevations above 4,000 m, and crosses the Tanggulha Mount Pass at 5,072 m, the highest railway station in the world. Most of QTR traverses through uninhabited areas and basically a roadless region except for the paralleling Qinghai-Tibet Highway (QTH). The design and construction of the QTH was challenged by the thaw-unstable permafrost. The total costs for the QTR construction were estimated to be at 4.75 billion USD, in which more than 200 million USD was spent on environmental protection. The QTR was opened to passengers on July 1, 2006. The QTR applied many unique scientific and engineering designs included: thick (about 5 m) roadbed fills; crushed-rock revetments to allow air convection; cross-sectional, large-diameter piping with dampers that open only during cold seasons; tunnels that allowed passage of cold air; extensive (longest 13 km) elevated bridges over ice-rich permafrost, as well as to provide unrestricted passage for wildlife (antelope, wild donkeys, and camels), domesticated sheep, goats, and yaks; tunnelling to protect the railway from rock debris slides and avalanches; and the proactive utilization of the cold winter winds (use of thermosyphons) to preserve or to enhance the heat loss from the roadbed and the underlying permafrost in exceptionally ice-rich areas (see photograph).



Photograph provided by Huijun Jin.

EXPEDITIONS AND OTHER RESEARCH ACTIVITIES

Sino-German Joint Scientific Expedition and Research on the Degradation of Permafrost in the Source Areas of the Yellow and Yangtze Rivers: The project aims at understanding permafrost degradation processes on the Qinghai-Tibet Plateau (QTP), and their ecological, hydrological and environmental impacts. The major participants are Kurt Roth and his team from University of Heidelberg, and Huijun Jin and Qihao Yu, and the team from CAREERI. The joint team of 12 peoples organized a 65-day transect study on the active layer processes and permafrost conditions along the QTH and the connecting highways

Sino-German Joint Expedition on the Quaternary Permafrost and Environmental Evolution to the Donggicuona Lake area: The 10-person joint team from the AWI Potsdam and Free University of Berlin, and CAREERI at Lanzhou conducted a preliminary survey of the Donggicuona Lake on the northeastern QTP during August 15 to September 10, 2006.

Survey of the Connecting Roads between Budongquan (QTH) and Qingshuihe (QKH): The Qinghai Institute of Highway Design and Research, and the Qinghai Department of Transportation, with Yu Sheng (CAREERI), conducted a survey and drilling of permafrost for the upgrade to third-class national highway of the connecting road between the Yushu along the QKH (National Highway No. 214) and Budongquan along the QTH (National Highway 109).

Survey of Permafrost Conditions in the Muli-Jiangcang Coalmine-wetlands Area, Qilian Mountains: The Qinghai Province Government is planning to develop the giant Muli-Jiangcang coal mine area during the next 20 years that would go as deep as 500 m, and affect an area of about 150 km². Yu Sheng is leading a field survey and inspection for feasibility studies and the final environmental impact statement regarding permafrost and cold regions environments.

Research on glacier and permafrost hydrology in Tibetan-Himalayas: This project is jointly supported by the CAS Knowledge Innovation Program, the NSF China project and the Everest Station of the CAS ITP. Jingshi Liu, the lead scientist for permafrost hydrology at the ITP, has established a small glaciated and permafrost watershed, about 284 km² from 4,000-5,800 m in elevation, during 2005-2007.

Sino-EC Joint Scientific Expedition and Research on the Glacier Shrinking and Permafrost Degradation, Tibetan-Himalayas: Under sponsorship of the European Commission's Sixth Framework, 20 scientists from the ITP(CAS), Austria, Czech Republic, Germany, Nepal and United Kingdom conducted an investigation on the role of ground ice (i.e. ice-rich permafrost) in the hydrological cycle. This Sino-EC project will last for three years 2006-2009 (Jingshi Liu, ITP).

Assessment and Adaptation of Cold and Arid Regions in the Northern Part of the Northeast China: Under the lead-

ership of Yafeng Shi, Tao Wang, and Wei Ma, CAREERI is launching a new project to assess the changes of cold and arid regions environmental changes in China during the past 50 years, and their adaptative measures. Huijun Jin and Xian Xue are the lead scientists for the northeastern China subproject. The project would include the database on permafrost, deserts and cold and arid regions, establishment of field monitoring stations, and transect studies during the next five years.

Pipeline from Skovorodino, Russia to Daqing, China: The China-Russia all-temperature crude oil pipeline from Skovorodino, Russia to Daqing, China, was approved in 2006. Huijun Jin, Yu Sheng and Changjiang Tong (CAREERI) are working on the stipulations governing the survey, design and construction of the pipeline, survey on permafrost engineering geology, and related research projects.

Frozen Ground Engineering Research on the Design and Construction of Express Railway from Harbin to Shenyang-Dalian: The 1st Survey and Design Institute of the China Railway Corp., Ltd., and CAREERI, with Wei Ma and Fujun Niu as lead research scientists, are planning to undertake research for mitigating frost hazards along the 500-km-long segment from Harbin to Shenyang.

Scientific Expedition to the Xoh' Xil Mountains on the Southern Qinghai Plateau: CAS scientists from various institutions conducted research on geology, geophysics, ecology and biology, and environmental changes and Quaternary geology for a 50-day period in October and November 2006.

Expedition to the Mountain Everest on the southern Tibetan Plateau: CAS organized a expeditions to the Himalayas starting in 2005. focused on the responses of the Mt. Everest to global change.

Survey and Mapping of Mountain Permafrost in the Sources of the Heihe Watershed, Qilian Mountains, Gansu Province: Led by Guodong Cheng and Xin Li, the CAREERI Research Group on the Water Resources Assessment, Planning and Management in the Heihe Watershed have been conducting research since 1997. A new campaign on alpine regions including mapping of permafrost, and snow cover, glaciers, and their contributions to river runoffs started in 2006, using local airborne radar, surface surveys, and other remote sensing.

MONITORING

Permafrost monitoring network on the QTP: The CAS Cryosphere Research Station on the QTP established a monitoring network on permafrost and its interactions with atmosphere and hydrospher. There are 20 permafrost temperature monitoring boreholes and 13 sites on temperature and moisture monitoring of the active layer, which are distributed in regions with different types of permafrost, landscape, vegetation along the QTH. Five meteorological towers with at least three levels of air temperature, humidity and wind speed measurements were

established to monitor the heat and mass exchange between permafrost and atmosphere. One typical site for studying the CO₂ emission from permafrost was established near the Beiluhe River. Four new projects were initiated to study the thermal and moisture dynamics in active layer, the hydrological processes in permafrost region, the influences of snow cover on permafrost and the CO₂ emission of permafrost which were funded by the NSF China, CAS and the Ministry of Science and Technology, respectively. The Station was successfully upgraded to National Field Observation and Research Station by the Ministry of Science and Technology, China in 2006 under the direction of Lin Zhao and his team. In addition, the QTR has installed about 60 cross-sectional monitoring sites on permafrost and deformation of railway foundations along the railway route, for studying the long-term stability of the railway foundations and rehabilitation in permafrost segments. This 5-million-USD-project is led by Wei Ma, Qingbai Wu, and Yongzhi Liu.

Permafrost monitoring in the Tianshan Mountains, Xinjiang: Starting in the early 1990s, permafrost was monitored by the Tianshan Glaciological Station under the leadership of Guoqing Qiu, and efforts of Chinese (H.J. Jin, Lin Zhao, *et al.*), Kazakhstan (Sergey Titkov), Russian (A.P. Gorbunov) and Japanese (Toshio Sone) scientists. More than 15 years of data have been collected, but only one borehole is still operating. The data are included in *Annual Report of the Tianshan Glaciological Station* (the latest is Vol. 17, 2006).

Permafrost Monitoring in the Xing'anling Mountains, Northeastern China: Many boreholes were drilled for ground temperatures measurements in the Da- and Xiao-Xing'anling Mountains during 1970s and 1980s. Most are abandoned or destroyed, except the borehole in the Yityulihe at (121°292 E, 50°322 N, 732.6 m; designated as the CALM CN 1) which had been in operation by Harbin Railway Department research staff during 1981-2005, but was destroyed in October 2005. Hiujun Jin and his team are working to resume the measurement in 2006-2007. The 25-year data indicate a warming trend of permafrost and deepening of the active layer. Other current measurement on ground temperature measurements, both under natural state and in pavement foundations, are being made at the Mohe Airport (122°302 E, 52°582 N, 435.0 m) that is under construction.

STATIONS AND ORGANIZATIONS

Polar Stations: Experts from the Meteorological Research Institute, China Meteorological Administration completed research at the Huanghe Station in Svalbard. Frozen ground related research include the climatic and environmental processes in tundra environments, ecology and geology investigations. Future research would include permafrost programs. China has two stations in Antarctica: Great Wall Station in the King George Islands and Zhongshan Station in Eastern Antarctica. They include

the studies on glaciers and oceanography, with some permafrost studies.

ITP Kunming Division: CAS Institute of Tibetan Plateau Research (ITP) consists of three parts: Beijing, Kunming and Lhasa. The Kunming Division specializes on plateau biology, ecology and biodiversity. It is jointly established by the CAS ITP and CAS Kunming Institute of Botany in 2005-2006. The new Division will focus on plant species, ecological adaptation, microorganisms in ice cores, and fungi on the QTP.

Mt. Everest Station: CAS ITP established the Mt. Everest Station for atmospheric sciences and alpine environment research. The Everest station consists of several camps from Dingri, the base camps at 4300, 5800, 6500, and 7200 m, and a monitoring transect and small watershed with permafrost, glaciers and heavy snow/rainfall and floods.

Harbin Institute of Technology (HIT) Key Laboratory of Cold Regions Civil and Structural Engineering, China Ministry of Education (CME): The HIT has recently completed the instrumentation of an updated Cold Regions Civil and Structural Laboratory in Harbin, Heilongjiang Province, northeastern China under the support of the CME.

Jilin University Civil / Geotechnical Engineering Laboratory: In support of research needs for the pipeline engineering in Northeast China, Jilin University in Changchun, has advanced a civil/geotechnical laboratory which can accommodate the experiments and testing for frozen soils engineering parameters.

Wanjia Field Station for Seasonally Frozen Ground Experiments and Research: The Station for Seasonally Frozen Ground Experiments and Research, China Hydropower and Water Conservancy Corp., Ltd., near Harbin Airport is mainly designed for field and *in situ* testing and study of soil freezing and thawing related problems and mitigations for building hydraulic infrastructures in northeastern China.

Xi'an Key Laboratory of Highway Engineering in Frozen Ground Affected Regions: Due to the heavy commitments for QTH permafrost engineering and prospects for building the Express Highway from Xi'ning to Lhasa, the China Transportation Corporation, Ltd. plans to build a frozen ground engineering laboratory for highway engineering within the next 3-5 years.

CONFERENCES

During the past year a number of scientific conferences and workshops were held that involved frozen ground research.

Asian Conference on Permafrost (see the Conference report).

International Workshop on Quaternary Glacial Geology, under the sponsorship of the Chinese Academy of Sciences, Institute of Tibetan Plateau Research (ITP), Qinghai Institute of Salt Lake Research (QISLR), and Qinghai-Tibet Plateau Research Society (QTPRS), was successfully

held in Xi'ning, Qinghai Province and Lhasa, during September 9-21, 2006.

Workshop on the Resources, Environments and Ecological Building on the Qinghai-Tibet Plateau, sponsored by the Qinghai-Tibet Plateau Research Society, CAS Institute of Geographic Science and Natural Resources, CAS Institute of Tibetan Plateau Research (ITP), CAS Nanjing Institute of Geology and Palaeobiology, and CAS Nanjing Institute of Geography and Limnology, was held in Shexian county, Anhui Province, China on October 17-18, 2006.

First International Workshop on Energy and Water Cycles over the Qinghai-Tibet Plateau, sponsored by the ITP and CAREERI of CAS, and NSFC, was held in Lhasa on September 3-12, 2006.

Third Sino-Germany Workshop on the Qinghai-Tibet Plateau, under the sponsorship of the CAS ITP, DFG, NSF China and SKLFSE, was held in Ettal, Germany, April 22-24, 2006.

2006 Annual Meeting of Geographical Society of China, under the sponsorship of the Geographical Society of China (GSA), Lanzhou University, CAREERI, Northwest Normal University, Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Science and Technology Council of China, China Ministry of Education, Chinese Academy of Sciences, Chinese Ministry of Science and Technology, National Science Foundation of China and International Geographical Union, was held in Lanzhou on August 19-21, 2006.

Workshop on Physical Geography and Ecological Rehabilitation, sponsored by CAS Xinjiang Institute of Ecology and Geography, International Global Environmental Change-Human Factors China Committee, and IGBP China Committee, was held in Urumqi, Xinjiang, China during August 10-20, 2006.

Earth System Science Partnership (ESSP) Earth Environmental Change Science Conference, sponsored by the Climatic Committee of China, China Meteorological Administration, and the ESSP was held at the in Beijing on November 9-12, 2006.

RECENT FROZEN GROUND RELATED PUBLICATIONS AND DATA INVENTORIES

The Map of the Glaciers, Frozen Ground and Deserts in China (1:4,000,000) was published in Chinese and English in 2006 by the SinoMaps Press.

The Tibetan Plateau Picture Album of Scientific Expeditions was compiled by CAREERI published in Chinese and English in July 2004.

Frozen Ground Foundations Engineering by Ziwan Wu and Yongzhi Liu, was published by the Ocean Press, Beijing in October 2005.

Frost Action of Soils and Foundation Engineering by Xiaobai Chen (SKLFSE), Jiankun Liu (Beijing Univ. of Transportation), Hongxu Liu (Heilongjiang Institute of Cold Regions Architectural Engineering) and Yaqing Wang (SKLFSE), was published by the Science Press, Beijing in

January 2006.

Degradation of Permafrost and Road Engineering on Northeastern QTP compiled by Enmu Zang (Qinghai Institute for Transportation Survey and Design) and Ziwan Wu (SKLFSE), is a systematic summary of frozen ground engineering research along the QKH

Final Environmental Impact Statement for the QTR from Golmud to Tanggulha Mountains, was compiled by the First Survey and Design Institute of the China Railway Corp., Ltd., in 2002.

Eco-environmental geology investigation report (1:250,000) in the source areas of the Yellow River on the Eastern QTP was compiled by the Qinghai Geological Survey in June 2002.

The QTP Permafrost Station has compiled and published the observational data before 2000 under the direction of the former Director Shuxun Li. It includes four volumes: (1) Monitoring and data of permafrost temperature dynamics along the QTH; (2) Monitoring and heat-moisture dynamics of the active layer along the QTH; (3) Monitoring and data on thermal regimes of shallow permafrost under various surface covers in the Fenghuoshan Mountains in the interior of the QTP; and (4) Monitoring and data of atmospheric, surface radiation and other related climatic variables in Wudaoliang in the interior of the QTP. However, the data for the past six years await publication, and not yet available to the permafrost community.

Annual Report of the Tianshan Glaciological Station general includes the research papers and data obtained during the past year on mass balance, hydro-meteorology, permafrost, glacier movements, and data related to ice cores and snow pits. Annual reports of the SKLFSE general includes the activities, projects and major papers of the SKLFSE staff.

The frozen ground related data inventories and management in China mainly include: (1) Digital QTR; (2) Cryosphere of China; (3) Assimilation of land surface processes data; and (4) Digital Heihe Watershed. Contact Xin Li (lixin@lzb.ac.cn) for details.

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DENMARK

As part of the Zackenberg Basic monitoring programme in Zackenberg, Northeast Greenland, the geographical and the climatic programmes, GeoBasis and ClimateBasis collect data of climatic, hydrological and terrestrial variables describing the dynamics of the physical and geomorphological environment in this high Arctic location. GeoBasis is operated by the National Environmental Research Institute in co-operation with the Department of Geography, University of Copenhagen. ClimateBasis is operated by ASIAQ – Greenland Survey.

Monitoring data are summarised in the ZERO Annual Reports published by the Danish Polar Centre, and can be downloaded from the homepage <<http://www.zackenberglab.dk/Data>>. A synthesis of the data from the first ten-year period is being prepared for publication in 2007.

The Arctic Technology Centre (Sanaartornermik Iliniarfik in Sisimiut, Greenland / Dep. of Civil Engineering at the Technical Univ. of Denmark) continued its studies of permafrost related to roads and infrastructure in the discontinuous to continuous permafrost regions between Sisimiut and Kangerlussuaq (Søndre Strømfjord). Thomas Ingeman-Nielsen continued his research project on «Geophysical techniques applied to permafrost investigations in Greenland» (Ph.D. Dissertation, December 2005, DTU). This research focuses on mapping ice-bonded permafrost with electrical methods in Sisimiut, and it was presented at EAGE Near Surface 2006, in Helsinki. Ph.D student at ARTEK, Anders Stuhr Jørgensen studies georadar methods related to infrastructure and worked with Frank Andreasen (Danish Geoservice) on «Mapping of the permafrost surface using ground-penetrating radar at Kangerlussuaq Airport, western Greenland». Jeanette Birkholm and Inooraq Brandt studied permafrost foundations in Thule supervised by Niels Foged and in cooperation with Greenland Contractors and ASIAQ. Geotechnical and georadar investigations elucidate geothermal reasons for differential settlements of 75 to 150 cm of a vehicle maintenance facility and hangars due to malfunctioning cooling ducts, and maintenance and repair recommendations are covered by their thesis which will be published in 2007.

The University of Alaska Fairbanks (Vladimir Romanovsky), the Danish Meteorological Institute (Jens H. Christensen), ASIAQ (the Greenland Survey, Keld H. Svendsen) and ARTEK (the Arctic Technology Centre / BYG-DTU, Niels Foged) have received US National Science Foundation funding for the project «Recent and future permafrost variability, retreat and degradation in Greenland and Alaska: an integrated approach». The project is part of the IPY Project 50 «Thermal State of Permafrost», and also connected to Danish IPY project proposals. The three year project started August 1, 2006. Its objective is to bridge the gap between climate, climate change modelling and permafrost science at the regional scale for the Western Greenland and Alaska regions, which are quite different. The research addresses high-resolution simulation of climate in the permafrost study regions for the present and until 2050. A series of climate and permafrost monitoring sites are under development. Permafrost modelling will be calibrated against field measurements, and will be driven by the output of the regional climate models. This will be used for mapping permafrost conditions for the present and projections for the variability over the two areas. Eventually, documentation of likely changes through 2050, and construction of «risk

maps» for the respective regions will be carried out together with recommendations concerning infrastructure and engineering. This project includes educational and outreach activities.

Since February 2006 Susanne Hanson (sha@spacecenter.dk) has been the national coordinator for the Permafrost Young Research Network (PYRN) in Denmark.

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FINLAND

Some periglacial geomorphology projects were recently completed. Jan Hjort published a major work: «Environmental factors affecting the occurrence of periglacial landforms in Finnish Lapland: a numerical approach» (ISBN 3-8322-5008-5; ordering possible at <www.shaker.de>). The study was performed using a comprehensive empirical data set of periglacial landforms from a remote area of 600 km². A total of 40 different landform types and subtypes were identified. Topographical variables, soil properties and vegetation characteristics were the primary correlates for the occurrence and extent of active periglacial landforms. Generalized linear modelling (GLM) proved to be a useful framework for testing the shapes of response functions and significances of the environmental variables.

Permafrost landforms such as palsas are now degrading in many regions; but new permafrost can also form (M. Luoto & M. Seppälä). Most recent observations of new permafrost are from August 2006, from Vaisjeaggi palsa mire, Utsjoki, where new palsa embryos formed during the last winter (2005-06) because of a very thin snow cover.

Pirita Oksanen presented her thesis (Development of palsa mires on the Northern European continent in relation to Holocene climatic and environmental changes. *Acta Universitatis Ouluensis* A446, 2005) on the basis of six articles published in different international forums. She used the peat stratigraphy of palsa mires as indicator of permafrost aggradation and degradation, and found evidence of permafrost formation around 2500-1900 BP and 700-100 BP.

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FRANCE

The polar research group of the Laboratory of Physical and Environmental Geography of Clermont-Ferrand (GEOLAB – UMR 6042-CNRS) carried out several activities of interest to the periglacial community. Following the SEDIFLUX International Meeting *Shifting Lands* held in Clermont-Ferrand in 2005 (see *Frozen Ground* 29), two special issues of *Geomorphology* and

Géomorphologie were coordinated by Samuel Etienne and Denis Mercier. Field surveys were conducted in Iceland and Svalbard. In North Iceland, Armelle Decaulne investigated slope processes and associated hazards in collaboration with Thorstein Saemundsson (Natural Research Centre of Northwestern Iceland, Saudarkrokur) with two objectives: (1) Quantification of the contribution of avalanches, debris flows and rockfalls to Postglacial development, with a special focus on the Late Holocene fan development; (2) Development of a predictive tool based on the longest runout distances of snow avalanche transported boulders. This approach, which uses the geomorphic evidences in the distal part of remote slopes and transfers the results to inhabited areas, can be considered as a complementary decision tool in hazard assessment. In Northwest Spitsbergen, Myrtille Moreau explored the relationships between glacial retreat, run-off processes and vegetal colonization, in collaboration with Thierry Brossard (THEMA, Besançon) and Dominique Laffly (Pau Univ.). This research project is based on the comparison of two sets of data collected in 1977 and 2006, in various environments (moraines, glaciofluvial deposits, marine terraces). In Svalbard, cooperation is developed between the French Polar Institute Paul-Emile Victor (IPEV) and the German Alfred Wegener Institute (AWI).

The Loven-FLOWS project (2006-2010), endorsed by the IPY Joint Committee, is an interdisciplinary and international project (France, Germany, Spain, Russia) led by Madeleine Griselin (UMR Théma, CNRS - Université de Franche-Comté) and Christelle Marlin (UMR IDES, CNRS - Université Paris-sud XI). The project focuses on the study of the hydrology of a polar glacier of western Spitsbergen (Austre Lovénbreen Glacier), subjected to large ice-retreat at least for the last four decades. Remote sensing data, aerial photographs, meteorological data and hydro-geochemical data will provide information for quantifying the Austre Lovénbreen Glacier reactivity to climatic variations. Two expeditions took place in 2006, one in April and the second in September to set up automatic equipment in the studied area (network of automatic digital cameras stations, hydrological and geochemical sensors and automatic meteorological stations). These data will be used in conjunction with remote sensing. The database (in collaboration with Spain for hydrology) will allow a global approach of spatial and temporal dynamics of the Austre Loven River system. In collaboration with geophysicists of the Alfred Wegener Institute, mapping of the permafrost and of the subglacial river network will take place as well as studies of the littoral progradation (Oceanographic Institute of Moscow) and of the marine sedimentology (Polar Ecology Institute of Kiel).

The periglacial group of the University of Caen (UMR CNRS 6143) investigates the effects of climate warming on periglacial slopes. Physical modelling experiments are carried out in a cold room to analyse the erosion processes and the morphological evolution of experi-

mental slopes that accompanies thawing of the permafrost (J.L. Lagarde, M. Font, J.P. Lautridou and E. Védié). Results from physical modelling will be compared to field data relative to Holocene warming in Western Europe that is characterised by a large scale thawing of the permafrost acquired during the peak of the last glaciation (Wechselian). A new methodology using Particle Image Velocimetry was developed. It provides an accurate understanding of the soil behaviour throughout catastrophic events such as debris flows. This application will also be applied to the physical modelling of Martian gullies (coll. F. Costard, UMR CNRS 8148). The programme «Laboratory simulation of solifluction processes associated with one-sided and two-sided active layer freezing» from the Cardiff group lead by Charles Harris is going on (see U.K. report). Results from the first year of experimental freeze/thaw cycles in a cold room fits nicely with field measurements from Svalbard.

An on-going study of the consequences of climate warming on thermal and mechanical fluvial erosion is being conducted in the Lena River (Yakutia) by François Costard (UMR IDES, CNRS-Université Paris-sud XI) with Emmanuèle Gautier and Daniel Brunstein (Laboratoire de Géographie Physique CNRS UMR 8591). This study is expected to allow a quantitative analysis of the thermal and mechanical erosion: the bank retreat of the Lena River will be measured on the basis of aerial and satellite images (1960-2005) and all data integrated in a GIS. A field study was performed in the Lena River in September 2006 in collaboration with A. Fedorov from the Permafrost Institute (Yakutsk). Various samples were collected on sites with high erosion rates.

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GERMANY

The ninth expedition to the Lena River Delta was carried out from May to September by the Alfred Wegener Institute for Polar and Marine Research (AWI) under the aegis of its Department of Periglacial Research (H.-W. Hubberten and colleagues). Trace gas emissions were recorded over an entire vegetation period; permafrost samples were taken for molecular analyses on methane producing and oxidizing microorganisms; limnological investigations and temperature measurements in permafrost holes were undertaken. These activities were conducted in the context of the Helmholtz-EOS (Integrated Earth Observing System) research network «Land Surface Processes – Carbon Balance». Spectral ENVISAT measurements of vegetation and soil were carried out simultaneously to extrapolate to larger areas the results of local investigations of vegetation models and satellite data. Scientists from the Arctic and Antarctic Research Institute (AARI) and the State University of St. Petersburg (SPbSU), the Lena Delta Preserve (LDR), the Permafrost Institute in Yakutsk (PIY) and the German Aerospace Center (DLR)



International Permafrost Association Constitution and ByLaws

The Constitution was adopted in Ottawa, Ontario, Canada, on 5 August 1987; revised by mail ballot on 1 December 1992; revised in Yellowknife, Canada, N.W.T., on 23 and 26 June 1998; revised by mail ballot 1 March 2003; revised in Potsdam, Germany, on 12 June 2005; revised by mail ballot in May 2006.

PREAMBLE AND DEFINITIONS

During the Fourth International Conference on Permafrost held in Fairbanks, Alaska, in July 1983, the International Permafrost Association (IPA) was founded. The founding countries were: Canada, The People's Republic of China, U.S.A., and U.S.S.R (Russia). The founding of the IPA and the election of its Executive Committee members was announced at the closing plenary session, a set of principles was distributed to the delegates, and other countries with an interest in permafrost were invited to become members of the IPA.

The organizations referred to in the Constitution and By-laws are defined as follows:

- (a) The *Council* is the governing body of the Association.
- (b) An Adhering Body is a representative organization or committee designated to represent in the Council of the Association the interests in permafrost of scientists and engineers of a country.
- (c) The *Executive Committee* and *Secretariat* conduct the day-to-day activities of the Association and implement and communicate the policies and views of the Association's Council between sessions.
- (d) *Standing Committees* and *Working Parties* and *Regional Groups* perform designated activities as approved by the Council.
- (e) *Secretariat* (see Bylaws).

CONSTITUTION

1. Objectives

The objectives of the International Permafrost Association (hereafter called the Association) are:

To foster the dissemination of knowledge concerning permafrost environments and promote cooperation among persons and national or international organizations engaged in scientific investigations or engineering work on permafrost.

2. Activities

The Association will accomplish these objectives by:

- (i) holding an International Conference on Permafrost approximately every four years and regional conferences on permafrost midway between the International Conferences on Permafrost;
- (ii) holding Council meetings at the time of the International Conference and of the regional conferences at approximately two-year intervals;
- (iii) cooperating with other national and international organizations whose aims are complementary to those of the Association;
- (iv) exchanging information through its Adhering Bodies and Associate Members;
- (v) promoting cooperative activities and the development of knowledge concerning permafrost environments;
- (vi) supporting the activities of Committees, Working Parties and Regional Groups.

3. Membership

Membership in the Association is through Adhering Bodies and Associate Members. There shall be only one Adhering Body per country. National or multi-national organizations wishing to join the Association must submit to the Secretariat documentation showing the existence of a bona fide Adhering Body, its mailing address and names of its officers. Membership in the Association must have the approval of two-thirds of the full Council. An Associate member consists normally of up to three persons from a country that does not have an Adhering Body. The Council has the right to terminate the membership of any Adhering Body or Associate Member by a two-thirds majority vote of the full Council.

In countries where no Adhering Body or Associate Member exist, an individual may apply directly to the Association to take part in Association activities as an Individual Member.

4. Adhering Bodies and Associate Members

An Adhering Body is free to establish its articles of association and its organization in accordance with its requirements.

An Adhering Body shall at all times keep the Secretariat informed about its address and the names of its officers and of its

representatives to Council. An Associate Member shall provide to the Secretariat information on its members' names and addresses.

5. Executive Committee of the Association

The Executive Committee of the International Permafrost Association consists of:

- (i) The President and up to two Vice-Presidents,
- (ii) Sufficient Ordinary Members to make up a committee of six or seven.

The Executive Committee shall be nominated in accordance with the rules stated in the Bylaws and shall be elected by the Council. Normally, the Executive Committee members shall be from different countries and represent a range of expertise in permafrost science and engineering.

The members of the Executive Committee of the Association shall serve from the start of the second Council meeting of the ICOP or RCOP to the end of the first Council meeting approximately four years later.

The President shall represent the Association and shall perform the duties pertaining to that office, as well as those entrusted to him by the Constitution and Bylaws or by the Council. The President shall be responsible, in collaboration with the other Executive Committee members of the Association, for the conduct of its affairs.

In the event of the resignation or death of the President, one of the Vice-Presidents will assume the office for the unexpired term of office.

In the event of the resignation or death of one of the Vice-Presidents, or if one of the Vice-Presidents assumes the office of President, the Executive Committee will appoint a successor from among its members who will complete the term of office.

The Secretariat and its location shall be recommended by the Executive Committee and approved by the Council. The Secretariat shall not represent an Adhering Body on the Council.

6. Council

The Council shall consist of the Executive Committee, no more than two representatives from each Adhering Body and a representative of each Associate Member.

Each Adhering Body shall have a vote. If no official representative is able to attend a meeting of the Council, his or her vote may be cast by an authorized proxy designated in writing by the Adhering Body and provided to the Secretariat. An Associate Member may be represented by one person at the Council but shall have no vote.

The Council shall be presided over by the President of the Association, or, in case of his or her incapacity or inability to attend, by a Vice-President. In the event of an equal decision of votes, the President or acting President shall cast the deciding vote.

The Council shall meet in ordinary session at the call of the President normally every two years during an International Conference on Permafrost or a Regional Conference on Permafrost. The Council may meet in extraordinary sessions at the call of the President or at the request of a majority of the Adhering Bodies. The Council may make decisions by written communication on questions put to it through the Secretariat with the approval of the President.

The Council may set up, by a simple majority vote, Standing and Ad Hoc Committees, or Working Parties with whatever powers and terms of reference it may decide.

The Council shall determine, with the advice of the Executive Committee, the annual subscription fee to the Association. The Council shall review the annual budget and, unless there is an objection, the Secretariat, with approval of the Executive Committee, shall disburse the funds. The responsibilities of the Council may be executed by electronic mail ballot, unless there is an objection.

7. International Conference on Permafrost and Regional Conference on Permafrost

An International Conference on Permafrost (ICOP) shall be held approximately every fourth year in a country to be decided upon by the Council. A Regional Conference on Permafrost (RCOP) that is proposed by an IPA council member and sponsored by the IPA will be held in the second year following an ICOP. The organization and financing arrangements of an International or a Regional Conference are the responsibility of the Adhering Body of the host country. The Adhering Body shall follow the principles, rules and procedures for the Conference set out in the Bylaws and any additional procedures approved by the Council. An International Conference Advisory Committee (IAC) for the ICOP shall be appointed by the Council to provide continuity in maintaining Conference policies and to assist in other matters as requested by the hosting member.

8. Entry into Force of Constitution and Bylaws

This Constitution and Bylaws shall come into force at the close of the session at which they receive the approval of at least two-thirds of the full Council.

9. Amendments to Constitution and Bylaws

Amendments to the Constitution and these Bylaws must be proposed by an Adhering Body. Such amendments shall be submitted in writing to the Secretariat early enough to have the proposal submitted to all Adhering Bodies at least six months prior to the Council meeting at which the amendment(s) is to be placed on the agenda. An extraordinary mail ballot can be conducted between Council meetings.

Adoption of an amendment will require an affirmative vote of at least two-thirds of the full Council (Adhering Bodies in good standing).

Amendments to the Bylaws shall follow the same procedure except that a simple majority in favor of the amendments is required instead of two-thirds, as above.

10. Non-Profit Organization

The International Permafrost Association shall be carried on without purpose of gain for its members and any income or other accretions to the International Permafrost Association shall be used in promoting the objectives of the Association.

BYLAWS

1. Council

- (i) A quorum for a Council meeting shall be a simple majority of the Adhering Bodies, except if changes in the Constitution are to be made or a vote is to be held on the acceptance of an application for membership. In these cases, a quorum shall be two-thirds of the full Council (Adhering Bodies in good standing).
- (ii) Any Adhering Body that will not be present for a vote requiring a two-thirds majority may submit its views and vote in advance in writing. In this case that Adhering Body will be regarded as being present for the purposes of the quorum for the vote.
- (iii) Voting shall be by a show of hands except for the election of the Executive Committee, the location of the next International Conference on Permafrost, or for other matters specified at the time by the presiding member of the Executive Committee.
- (iv) Resolutions shall be made by a simple majority of those voting, except for resolutions altering the Constitution or on the acceptance of new Adhering Bodies and Associate Members, for which the assent of two-thirds of the Council is required.
- (v) Adhering Bodies wishing to have items placed on the agenda should submit them not less than six months before a Council meeting. Three months before the meeting the Secretariat will send the complete agenda to each Adhering Body and representative of an Associate Member. The agenda for the ordinary meeting of Council shall generally include the following items:
 - (a) Minutes of previous meeting
 - (b) Acceptance of new Adhering Bodies and Associate Members
 - (c) Business raised by the President
 - (d) Business raised by the Adhering Bodies and Associate Members
 - (e) Business from other sources
 - (f) Financial statement for the preceding period and the draft budget for the ensuing period
 - (g) International Conference and Regional Conference
 - (h) Election of members to the Executive Committee
 - (i) Appointment of Secretariat
 - (j) Review of activities and reports of Committees and Working Parties
 - (k) Items submitted after preparation of agenda, subject to agreement of presiding Executive Committee member
 - (l) Any other business

2. Nomination and Election of Executive Committee

The Executive Committee shall appoint a Nominating Committee of an appropriate number from the Council one year before an ICOP. The Nominating Committee will serve for a period of four years. The Adhering Bodies will call for nominations, including self-nominations, from among their own members. Each Adhering Body can forward a maximum of two candidacies to the IPA Nominating Committee. The Nominating Committee will screen the candidates nominated by the Adhering Bodies and put forward an appropriate number for election by the Council. The Nominating Committee submits to the Secretariat the names of candidates six months before a Conference. The Nominating Committee shall ensure that the nominees are willing to serve if elected. The Secretariat, upon receipt of the report of the Nominating Committee, shall so inform the Adhering Bodies. The IPA Nominating Committee may include candidates that were not forwarded by Adhering Bodies.

Every two years, the IPA Council would elect by secret ballot new members to the Executive Committee, according to the number of open positions. The candidates with the greatest numbers of votes will be elected. If there is a tie in the number of votes for the last position on the Executive, a second vote to consider only the tied candidates would be held.

The newly elected Executive Committee will hold a meeting to appoint from their members the Vice-Presidents. This meeting will be chaired by the President. Two years before the end of the President's term of office a Senior Vice-President is selected by the Executive Committee.

The Senior Vice-President will automatically become the new President of the IPA and serve for four years. If the Senior Vice-President withdraws, the Executive Committee will appoint a new Senior Vice-President. If the President resigns, the Senior Vice-President automatically becomes President or, if there is no Senior Vice-President, the Executive Committee will appoint a new President from within its membership.

After the President and Vice-President positions are filled, if the Executive Committee determines that there is regional or disciplinary imbalance among its members, or if it lacks a member from the country hosting the next International Conference, it may (with unanimous consent) appoint a seventh member to serve until the next election.

3. Secretariat

The Secretariat shall be nominated to the Council by the Executive Committee. The position shall be reviewed on a four-year basis.

The Secretariat shall be responsible, under the general direction of the President, for the conduct of current business of the Association, for the preparation and distribution of the Agenda of the Council meetings and for the preparation and maintenance of minutes.

The Secretariat shall send to each Adhering Body an annual account of the dues owing, and shall ensure that all contributions and dues paid to the Association are placed in a bank account and that a record is kept. The Secretariat, or duly appointed surrogate, is responsible for keeping the accounts of the Association, for the preparation of the annual budget of receipts and expenditures, and for payments on behalf of the Association up to the limit of the approved budget, and shall acknowledge all moneys received. The Secretariat shall prepare a summary of the accounts for each meeting of the Council and shall give any explanation required of expenses incurred.

4. Conferences

(i) Invitations to act as host for an International Conference on Permafrost and the accompanying Council meetings shall be considered at the same time at the meeting of the Council at the time of the preceding International Conference.

The inviting country must provide assurance that no individual will be denied attendance on grounds of nationality, race, creed or political views. If an invitation is received from more than one Adhering Body the final selection shall be made by secret ballot according to proportional voting (based on units paid).

Arrangements for the International Conference on Permafrost shall be the responsibility of the organizing Committee of the host country, in consultation with the Executive Committee and the International Conference Advisory Committee.

(ii) Adhering Bodies or their affiliates, Committees, and Working Parties and Regional Groups are encouraged to organize technical meetings and regional Conferences. These may be designated as co-sponsored by the International Permafrost Association if approved by the Council or the Executive Committee.

5. Committees, Working Parties and Regional Groups

The organization and activities of Committees, Working Parties and Regional Groups are governed by guidelines approved by the Council.

Executive Committee of the International Permafrost Association 1983-2006

	1983	1988	1993	1998	2003
President	P.I. Melnikov U.S.S.R.	T.L. Péwé U.S.A.	C. Guodong China	H.M.French Canada	J. Brown U.S.A.
Vice President	T.L. Péwé U.S.A.	C. Guodong China	N.N. Romanovskii Russia	F.E. Are Russia	C. Harris U.K.
Vice President	K. Flaate Norway	V.P. Melnikov U.S.S.R.	H.M.French Canada	W. Haeberli Switzerland	G. Perlshtein Russia
Sec. General	J. Ross Mackay Canada	J. Ross Mackay Canada	J. Brown U.S.A.	*	*
Ordinary Members				J. Brown U.S.A. T. Mølmann Norway Z. Yuanlin China	H.-W. Hubberten Germany D.W. Hayley Canada Z. Yuanlin China

* Replaced by Secretariat

in Southern Germany participated in the expedition. Two doctoral candidates from AWI and DLR carried out measurements related to the carbon cycle.

L. Schirrmeister and H. Meyer (AWI Potsdam permafrost group) in cooperation with K. Yoshikawa (University of Alaska, Fairbanks) and Jerry Brown in spring 2006 had a field trip to Alaska to continue the fieldwork initiated there in 2004. The main objective was to complete high resolution ice-wedge studies in the buried ice-wedge tunnel near Barrow and sediment studies of the surrounding deposits. Brines were detected by coring in the base of the tunnel at a depth approaching sea level. In addition two local meat cellars were surveyed in Barrow and sampled for stratigraphic and geochronological studies. The second objective was a palaeoenvironmental study of permafrost sequences in a private goldmine near Fairbanks (Vault Creek Valley). Two yet unidentified volcanic ash layers were detected within loess-like deposits. Loess and peat samples were taken for luminescence and U/Th-dating. Blocks of ice-wedge ice were sampled for isotope and trace gas analysis. The upper three meters of the sequence are assumed to be Holocene in age and were sampled by drilling to complete the entire permafrost sequence down to about 40 m deep.

A new cooperation between AWI Potsdam (H. Lantuit, H. Meyer, L. Schirrmeister) and McGill University in Montreal (N. Couture, W. Pollard) began during the Yukon Coast 2006 Expedition based on Herschel Island, west of the Mackenzie River Delta. Field work in July concentrated on permafrost-dominated exposures, their erosion in retrogressive thaw slumps and the subsequent transport and accumulation of sediments in the near-shore zone. The geomorphological survey by helicopter and the research program used DGPS surveys, field spectrometry and soil geotechnical measurements to characterize the shape and surfaces of retrogressive thaw slumps at various stages. Sea bottom sediments and sea water were collected at different near-shore sites around Herschel Island and along the Yukon Coastal Plain to understand the carbon budget in coastal permafrost erosion. Further investigations focused on the various forms of subsurface ice (ice wedges, segregated ice and buried glacier ice) and the surrounding deposits and are expected to provide new results about Late Quaternary history of the Yukon Coastal Plain.

Near surface geophysical measurements were carried out in the periglacial rim of Austre Lovénbreen (West Spitsbergen) as part of a cooperation between AWI Potsdam and the CNRS Remote Sensing of the Polar Environment Group at Théma Besançon (Université Franche-Comté), with as a field base the joint German-French AWIPEV base in Ny-Ålesund. Estimates of glacial run-off characteristics are an essential part of this ongoing environmental monitoring programme. Acquired GPR profiles are expected to reveal frozen ground architecture in the glacier forefield (G. Schwamborn).

A new collaboration between the AWI (A. Morgenstern, G. Grosse, L. Schirrmeister), the Institute for Planetary Research of the German Aerospace Center DLR (E. Hauber, D. Reiss), and the Institute for Geosciences of the Free University Berlin (S. V. Gasselt) was initiated in the spring about morphological features in western Utopia Planitia, Mars. The study region displays polygonally dissected terrain, pits and depressions in a mantling deposit quite similar to terrestrial permafrost features. This study focuses on possible permafrost degradation features and comparison with analogous terrestrial landscapes. High Resolution Stereo Camera (HRSC) and THEMIS-VIS images were used for mapping and spatial analysis in a GIS. Moreover, Mars Orbiter Camera Narrow Angle (MOCNA) images, with a higher spatial resolution, were examined for comparisons with HRSC and closer analysis of permafrost features. Topographic information was derived from individual tracks of the Mars Orbiter Laser Altimeter (MOLA). Observations from the various datasets were compared with field data from Arctic Siberia.

G. Grosse began working in August 2006 on the new research project «Climate-induced permafrost degradation in the Arctic» as an IPY Postdoctoral Fellow for three years at the Geophysical Institute of the University of Alaska Fairbanks. This project focuses on the applications of remote sensing techniques and spatial data analysis methods for the characterization, mapping and quantification of permafrost degradation during the Holocene on a circum-Arctic scale.

A new young researchers group from the Helmholtz Association of German Research Centre (HGF) led by J. Boike (AWI) in April started the project «Sensitivity of permafrost in a changing climate: a multiscale perspective» in cooperation with the University of Heidelberg. The first field experiments were carried out in the Bayelva catchment (Spitsbergen, Svalbard) in the spring and on Samoylov Island (Lena River Delta, Siberia) during the summer. Fieldwork included maintaining the automated soil and climate measuring stations, high-resolution aerial photography (using balloons and kites) and setting up new automated stations. On Samoylov, a 27-meter deep permafrost borehole and a polygonal lake were instrumented to continuously monitor data on thermal dynamics.

Monitoring rock glacier kinematics and permafrost distribution (BTS, geophysics) in the Turtmann Valley (Valais, Switzerland) is continued by the University of Bonn (R. Dikau, I. Roer, M. Nyenhuis). The DFG Research Training Group «Landform - a structured and variable boundary layer» (R. Dikau), investigated paraglacial sediment storage and landform evolution in the same area (J.-C. Otto). Quantification of para- and periglacial landforms was performed using geophysical techniques (refraction seismics, electrical resistivity tomography, ground penetrating radar) combined with GIS modelling. The first 2D ERT (electrical resistivity tomography)

monitoring in solid permafrost rockwalls was installed in 2005 (M. Krautblatter). The ERT-monitoring was extended to a 3D array in 2006 and is supplemented by seismic surveys. A monitoring of rockwall temperature using a network of self-communicating micro-sensors has been installed in summer 2006 at the same site <www.sensorgis.de>. I. Roer (University of Bonn / Swiss Federal Institute WSL) continued monitoring rock glacier kinematics in Valais and started a dendro-geomorphological analysis of trees and shrubs growing on creeping mountain permafrost (funded by the German Academic Exchange Service, DAAD).

The Commission on Cold Region Environments (CRE) of the International Geographical Union (IGU) was established in 2004 and has an agreement of co-operation with the IPA. The commission co-organized various sessions at conferences and will be engaged in the International Polar Year 2007/8, mainly in terms of the proposed research programme LUPOG (Land use impact on polar and sub-polar geosystems: extent, significance, perspectives), submitted to the IPY programme office by the steering committee of the CRE commission. LUPOG became part of several core projects.

Permafrost related investigations at Germany's highest peak, the Zugspitze, continue and focus on geotechnical and hazard aspects. Since former research stressed that the mountain summit is situated close to the limit of permafrost, now – in the context of atmospheric warming – stability is evaluated and the risks connected to rockfalls initiated by permafrost warming or melting are modelled.

C. Hilbich (University of Jena) and C. Hauck (Institute for Meteorology and Climate Research, University of Karlsruhe / Forschungszentrum Karlsruhe) collaborate within the mountain permafrost monitoring project (Geophysical Observation and four-phase Modelling of Ice Content Evolution) with the aim to reliably quantify ground ice contents and its temporal evolution using geophysical monitoring techniques. Permanent electrical resistivity survey lines at several PERMOS (Permafrost Monitoring of Switzerland) sites in the Swiss Alps were installed in 2006 and are monitored on a regular basis.

At the Department of Physical Geography, University of Würzburg, C. Kneisel is continuing his monitoring of permafrost thickness in the Upper Engadin, where shallow boreholes were drilled and instrumented with temperature sensors. His continued collaboration with T. Saemundsson (Natural Research Centre of Northwestern Iceland, Saudárkrokur) on mountain permafrost in central Iceland extended into new ground temperature measurements. Permafrost investigations in a subarctic alpine environment in the Abisko mountains in northern Sweden also continued, with a new altitudinal logger transect spanning from 700 to 1450 m asl. In collaboration with I. Roer (WSL, Zurich), he started new investigations on solifluction and gelifluction process activity. C. Kneisel is collaborating with the EU-funded project SuPerForm

(Subarctic Periglacial Landforms), launched in Abisko in September 2006.

A collaboration of several European institutes from the Universities of Bonn (M. Krautblatter, M. Nyenhuis, J.-C. Otto), Jena (C. Hilbich), Karlsruhe (C. Hauck), Würzburg (C. Kneisel), Zurich/WSL (I. Roer), Graz (A. Kellerer-Pirklbauer) and Oslo (H. Farbrot, J. Tolgensbakk, R. Frauenfelder) currently investigates the connection between rock glacier speed up and electrical resistivity decrease using geodetic and geophysical monitoring techniques. The aim is to detect and quantify the processes causing the observed increase in rock glacier velocity in recent years.

Based on meteorological and soil temperature monitoring data compiled by the Department for Geography, Giessen University (L. King), in the Swiss Matter Valley, J. Kuhl investigates the geomorphological changes in the Gornergrat-Stockhorn region. He continues the monitoring of small-scale pattern of permafrost distribution between 3000 and 3400 m asl, with the perspective of a diachronic synoptical mapping of geology, geomorphological changes, permafrost distribution and mass-movement hazards.

As a main outcome of the international symposium organized by L. King and R. Wang (Giessen), in Urumqi, China from August 27 to September 2, participants agreed to apply for an interdisciplinary research project entitled «Water Resources in the Aksu-Tarim River Catchment and the effects of Climate Change» intending to investigate the regional water cycle within the framework of interrelated modules addressing atmospheric, cryospheric and hydrospheric processes and their changes with time. The regional permafrost distribution and especially the role of active layer dynamics will be treated within the cryosphere module.

T. Raab from the group Landscape Ecology and Soil Science (University of Regensburg) started investigations in the valley of the Gállego River, one of the type regions for the reconstruction of Pleistocene glaciations in the Central Spanish Pyrenees. In June and September 2006 field work began on soil sections in the Sabinánigo-Biescas basin to describe and characterise soil development since the retreat of the Gállego glacier from its LGM-moraines (supposedly 60 ka yrs old). Soil profiles excavated in sediments of different ages provided insight into the pedostratigraphy of landforms. Special attention was paid to the identification of new periods with periglacial dynamics since the LGM.

The Regensburg group carried out research on sites with relict and active periglacial activity in the Front Ranges of Colorado, U.S.A., in the summers of 2005 and 2006. In the framework of a DFG-funded project, M. Leopold, J. Völkel and T. Raab tried to locate permafrost patches at active solifluction lobes and to establish a subsurface model of the weathered zone above the bedrock at the long term ecological research site (LTER) at Niwot Ridge (-3600–

4000 m asl). Combining ground penetrating radar and shallow seismic refraction gave indications about ice lenses. This research continues to give detailed subsurface information of the study area. This project is in cooperation with the University of Colorado at Boulder and the Institute of Arctic and Alpine Research (INSTAAR) represented by N. Caine and P. Birkeland as well as by D. Dethier.

At the Department of Physical Geography (IPG), Freiburg University, S. Vogt continues to host the SCAR King George Island GIS (SCAR KGIS) project of the SCAR Permanent Committee on Antarctic Geographic Information. This project provides a spatial database for King George Island (South Shetland Islands, Antarctica) with a focus on high-resolution data sets for the periglacial areas. Remote sensing is used to map the permafrost areas as a contribution to IPY/ANTPAS activities.

A. Reuther (Department of Earth Sciences, Dalhousie University, Halifax) dated glacial deposits from various mountain systems. Surface exposure ages from the type section of the Würm glaciation at the former Isar-Loisach glacier west of Munich showed that the glaciers reached their maximum extent at the time of the last glacial maximum. However, the measured age distribution showed that the moraines were exposed to moraine degradation due to the melting of dead ice or periglacial slope processes, exhuming erratics from the moraine matrix during the late glacial (18-15.4 ka). This study illustrated that surface exposure dating can also be used as a capable tool for deciphering times of periglacial surface activity and melting of dead ice.

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ICELAND

Cryoturbation is very active in Iceland due to frequent freeze-thaw cycles in the oceanic sub-arctic climate, and most soils and land surfaces show some geomorphic sur-

face features that result from frost activity. Permafrost is, however, most evident as palsas in vegetated wetland areas in the highlands. Construction of hydropower reservoirs in the Icelandic highlands has been the focus of environmental debates in Iceland for some years. In 2007, a new 57 km² reservoir will be filled in the North-East highlands. It will submerge many cryoturbation features, such as palsa areas, which have been degrading during the last decades with warming climate. The unique Thorsarver palsa area south of Hofsjökull glacier has been spared from further hydropower development for the time being. This area are studied by Thora Thorhallsdottir and her colleagues. Measurement activities continued in the Orravatnsrustir palsa area north of Hofsjökull (Náttúrustofa Norðurlands Vestra and Agricultural University of Iceland in co-operation with other partners). Three-year period data from Orravatnsrustir indicate very dynamic surface processes and permafrost thickness exceeding six meters.

The Agricultural University of Iceland (Berglind Orradottir and Olafur Arnalds) now has maintained two years of detailed monitoring of frost activity in a lowland desert ecosystem in south Iceland. Soil and surface temperatures, snow cover and climate are monitored, and the influence of frost activity on surface stability is quantified in relation to land cover and soil water content. The formation of soil ice and its characteristics is studied in relation to land cover and soil water content. The influence of the soil ice on water infiltration in the desert soils is quantified. Joint research activities were initiated in 2005 between the Agricultural University of Iceland (Rannveig Guicharnaud) and the University of Aberdeen (U.K.) aiming at assessing the influence of freezing and thawing on microbial biomass in Icelandic andosols. Iceland also participated in the ITEX Arctic research programme, under the leadership of Ingibjörg S. Jónsdóttir and coworkers.

Olafur Arnalds (oa@lbhi.is)



One of the Orravatnsrustir palsas in North Iceland. They are commonly 2-4 m high. Photograph by Berglind Orradottir.

ITALY

The activities of the Italian IPA group continued both in the Alps and in Antarctica.

In the Alps the project «CryoAlp» funded by IMONT (Italian Mountain Research Institute) continued with the installation of three permafrost monitoring stations in Upper Valtellina (two on the Foscagno rock glacier, respectively at ca. 2500 and 2700 m asl., and one close to the scar edge of the Val Pola landslide; resp. M. Guglielmin), with the logistic support of the Centro Monitoraggio Geologico (Sondrio) of ARPA Lombardia. Within the national project «Disintegration of Alpine glaciers and dynamics of deglaciated areas in the Maritime and Central Alps» led by C. Smiraglia, M. Guglielmin (Univ. of Insubria, Varese), C. D'Agata, M. Belò, and C. Smiraglia (Milan University) started a GPS monitoring program of the Foscagno rock glacier and using a RKT GPS carried out a new high definition Digital Elevation Model of the rock glacier (0.5 m pixel) in order to model the snow distribution, the GST and the active layer thickness. In the same project, N. Cannone and M. Guglielmin analyzed the impacts of the recent climatic change on some rock glaciers of the Upper Valtellina, carrying out several DC soundings and vegetation surveys in the exact locations examined 10 years earlier.

Adriano Ribolini (Pisa Univ.) continued his research on the rock glaciers in the SW Alps: in cooperation with D. Fabre (CNAM, Paris), he sketched permafrost distribution in this part of the Alps, and compared his results with evidence from over 100 geoelectrical resistivity soundings undertaken in the last 20 years. In cooperation with M. Guglielmin, the Schiantala rock glacier in the Argentera Massif (SW Alps, Italy) has been investigated by DC resistivity tomography and ice petrographic analysis; the

results enabled to reconstruct the dynamic relations between the Schiantala rock glacier and a glacier existing during the Little Ice Age and nowadays totally debris covered. In cooperation with A. Carton and R. Seppi (Univ. of Pavia), DC resistivity tomographies were carried out on the Val d'Ultimo rock glacier (Ortles Cevedale area), where results of surface ground temperature and geodetic monitoring are already available. To monitor the effect of freeze-thaw cycles in a marginal Mediterranean sector of the Alps, A. Ribolini installed a multichannel temperature datalogger on a block field at about 2600 m asl.

At the Earth Science Department, University of Pavia, Roberto Seppi finished his PhD on rock glaciers in the Italian Central Alps (Adamello-Presanella Group and E. sector of the Ortles-Cevedale Group). His research used both a regional approach (rock glacier inventory) and several specific techniques to determine the presence of permafrost in selected rock glaciers whose morphodynamics was defined (by carrying out BTS-measurements, multi-temporal topographic surveys, ground surface temperature and spring temperature measurements).

Two working groups of the AIGEO (Italian Association of Geomorphology) finished their work respectively on permafrost mapping and monitoring, and on the distribution of relict periglacial features. For the last three years, both working groups organised several meetings and some field excursions to stimulate knowledge exchange. Moreover, the second working group produced a book, sponsored by IMONT that reviews the state of the art knowledge on the relict periglacial landforms in Italy, including some new data collected during the last three years (*Testimoni di una montagna scomparsa: Contributo alle metodologie d'indagine delle forme periglaciali relitte. Problematiche e applicazioni in differenti ambienti*



Participants in the workshop «Permafrost and Climate Change in Aosta Valley». Photograph by Jerry Brown.

morfodinamici; Bononia Univ. Press. ISBN: 88-7395-171-6).

The workshop «Permafrost and Climate Change in Aosta Valley» organized by ARPA Valle d'Aosta and Insubria University was held on March 30-31 at Saint Vincent (Valle d'Aosta). More than 80 participants from whole Italy, but also France, Switzerland and other countries attended. The 12 oral presentations mostly referred to results on permafrost distribution research carried out at Insubria University and at ARPA Valle d'Aosta. Jerry Brown presented a global perspective on the permafrost and climate research worldwide. The workshop included a visit to the new permafrost monitoring site close to the Plateau Rosa Glacier (around 3100 m asl) where a CALM Grid and a 6 m deep-borehole are continuously monitored.

In Antarctica, a very productive research campaign was carried out at Mario Zuchelli Station (MZS) in northern Victoria Land. M. Guglielmin and A. Strini carried out research on granite weathering processes and landforms in cryotic conditions, in cooperation with Kevin Hall (Univ. Northern British Columbia, Canada). For what concerns permafrost and active layer monitoring program a new 31 m deep borehole was drilled by F. Bajo and M. Guglielmin close to MZS; this borehole it is the first of the new network planned by the IPY project ANTPAS. According to an agreement between Landcare Ltd (resp. J. Aislabie) and Insubria University (resp. M. Guglielmin) another two 30 m deep boreholes were drilled at Marble Point and Bull Pass in southern Victoria Land in cooperation with M. Balks (Waikato Univ., New Zealand). Moreover, some permafrost cores were collected in the same localities to analyse ground ice content and composition in relation to the occurrence of bacteria and other organisms. R. Raffi continued her research on the presence of ice wedges in northern Victoria Land. Many ice wedges or veins were found in sites with different geomorphologic, lithologic and topographic conditions. Ice wedges size appears correlated to the age of the raised beaches analysed. Isotopic analyses performed on an inland ice wedge established the origin of the ice by hoar-frost accretion and suggest that most of them are still active under the present climatic conditions. A monitoring program of the thermal conditions of the ice wedges started since 2004 at three different sites between the coast and 1269 m asl.

Moreover, Antarctic activities involved a continued cooperation with BAS in active layer monitoring within a CALM grid at Signy Island, and in analysing relationships between ground surface temperature, active layer and vegetation (N. Cannone, C. Ellis-Evans, M. Guglielmin, R. Worland).

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JAPAN

In Alaska, the project named «2004 Forest Fire Impacts to Hydrological Cycles, Permafrost and Eco Systems in Central Alaska» started in 2005 was carried out in the summer of 2006 to monitor permafrost conditions after a severe wildfire (M. Fukuda, K. Harada, Y. Sawada and K. Narita). Observations were carried out at Poker Flat near Fairbanks in July and August, and at Kougarok near Nome in August. In 2006, water and thermal conditions in the active layer were investigated by electrical soundings and pit surveys. These data will be compared with those in 2005 and 2007, and will be used for the prediction of the impacts of wildfire on permafrost.

In eastern Tibet, the final field campaign was undertaken in the mid-summer of 2006 for the five-year Japan-China joint project on «Permafrost Hydrology in the Source Area of the Yellow River» (N. Matsuoka, A. Ikeda, T. Sueyoshi, T. Ishii, C. Gao, Z. Han, and J. Ding). The fieldwork involved data collection from the frozen ground observatory at Madoi (4273 m asl) established in 2004 and seismic sounding at a number of localities on the Tibetan Plateau (4000-4700 m asl). The observatory data suggest that the Plateau ground quickly responds to the change in air temperature because of the minimum snow cover (< 20 cm thick) and generally dry active layer. This condition accounts for the rapid degradation of permafrost and resulting lowering of the groundwater level during the last 20 years, which is indicated by drilling and geophysical sounding.

In Adventdalen, Svalbard, permafrost and periglacial processes were investigated as a part of the Japan-Norway joint project on «Constructing model experimental sites for periglacial processes» (N. Matsuoka, A. Ikeda, T. Watanabe, M. Kobayashi, H.H. Christiansen and O. Humlum). In July 2006, continuous data on ice-wedge cracking, rock weathering and rock glacier creep were acquired from the experimental sites. Subsurface structure below periglacial topography (polygons and hummocks) was also explored with two-dimensional geoelectrical profiling and ground penetrating radar.

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KAZAKHSTAN

Geothermal research on permafrost and seasonally frozen rocks continued at fixed control points in the Zailiyskiy Alatau Mountains (Northern Tien Shan) and on the foothill plain. During the second 10 days of July 2006, hot and dry weather led to more severe permafrost thawing than the average perennial behaviour.

According to the Hydrometeorological Service data,

the zero average daily air temperature rose up to 5000 m asl in the second decade of August, leading to high glacier ablation, a severe glacier degradation, high discharge in the river basins. On moraines and debris-covered glaciers, newly formed lakes caused intense thermokarst erosion. Moreover, cryogenic landslides and rapid solifluction were widespread.

Edward Severskiy took part in the international archaeological expedition in the framework of the UNESCO project «Frozen Tombs of the Altai Mountains: strategy and prospects» by invitation of the Bureau of UNESCO in Almaty (cf. Belgium country report). Geocryological researches were carried out in the upper part of the Karakaba River, the Katonkaragai district of the East Kazakhstan region (49°05'N; 86°00'-86°10'E; 1650-1900 m asl). The fieldwork area is in a sub-zone of island permafrost; permafrost patches are widespread in the moss-larch forests on the northern slopes and on the flat bottom of the wide Karakaba depression. Temperature inversions are well marked there during the colder months. Geothermal research is carried out on and adjacent to stone tombs (kurgans) located on a sandy terrace composed of weakly-cemented loam up to a depth of 0.6 m. In that location, seasonal thawed layer has been measured to be 3.7 m on July 24-29, the estimated position of the top of permafrost. Under the tombs, active layer thickness decreases because of the cooling influence of the porous stone fill, and the top of permafrost is higher. Therefore, it was established that: the thicker the stone fill, the closer to the surface is the top of permafrost. So, under a 0.9-1.0 m high tomb, permafrost lies at a depth of 2.7 m, i.e. 1 m closer to the ground surface than in the surrounding area.

Geocryological research was also carried out in the Karkaraly Mountains (49°20'N; 75°30'E) in the Karaganda region. The Karkaraly Mountains lie at 800-1400 m asl. The mean annual air temperature in the foothills is 1.4 °C; the MAAT 0° C isotherm lies at 1000-1100 m asl. Information reported by workers of the Karkaraly National Natural Park in August 1997 about permafrost thickness in pine forests has not proved accurate. Fieldwork carried out in August 2006 concluded that there is a possibility to develop seasonally frozen ground (pereletok) only in favourable years.

A Regional Workshop on «Assessment of Snow-Glacier and Water Resources in Asia» was held in Almaty, November, 28-30, 2006. It was organized by the International Hydrological Programme (IHP), Man and the Biosphere (MAB), the UNESCO Cluster Office in Almaty, The Regional Environmental Centre for Central Asia (CAREC), the European Commission, and the Institute of Geography, Republic of Kazakhstan, in close cooperation with the Beijing, Jakarta, Moscow, New-Delhi, and Tashkent UNESCO Offices.

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MONGOLIA

The Hovsgol GEF/WB (Global Environment Facility/World Bank) project was completed successfully after implementing its investigations during the last four and half years in the six valleys along the eastern shore of Lake Hovsgol. Permafrost studies within the framework of this project have been carried out by Norwegian and Mongolian permafrost researchers (B. Etzelmuller, E.S.F. Heggem, Sh. Anarmaa and N. Sharkhuu). Permafrost conditions in the project area have been studied, mapped and monitored on the basis of initial data from characteristics of 20, 5-10 m deep boreholes, surface and ground temperature recordings (for four years) from more than 40 data loggers, resistivity tomography soundings at 23 sites and leveling measurements. Field studies in summer 2006 were focused on experimental observations for estimating thermal insulation effect of vegetation cover on active layer and soil moisture content at six sites. Main results from the permafrost studies are published in proceedings of abstracts and in international journals. The results show that the permafrost in the Hovsgol Mountain region is degrading more intensively than in the Hangai and Hentei mountain regions. This region, especially including Darhad depression, is very suitable for conducting permafrost studies and monitoring in the southern fringe of Siberian continuous permafrost zone. Therefore, permafrost studies and monitoring in this region will be continued within the frameworks of the LTER (Long Term Ecological Research) and CALM projects.

During the last ten years, permafrost monitoring in Mongolia has been conducted by N. Sharkhuu within the frameworks of CALM and GTN-P projects. There are currently 37 CALM and GTN-P boreholes in the country, with depths ranging mostly from 5 to 15 m. Twelve boreholes are equipped with temperature data loggers; in most of the other boreholes, ground temperatures are measured monthly by permanent thermoresistor strings. In addition, we found this year both a 135 m and a 200 m deep dry boreholes, drilled in the mid 1980's on the north-facing slope of Burenkhan Mountain (at 1715 m asl) and on a watershed (at 2095 m asl) of Ardag Mountain, in the Hovsgol region. Ground temperatures are measured by movable thermistor strings. Permafrost thicknesses in the boreholes were 58 and 148 m, respectively. The boreholes are protected from damage and are used for further monitoring of permafrost thermal state. These temperature curves seem suitable to reconstruct palaeotemperatures.

Every year, initial data of permafrost monitoring in Mongolia are submitted to the web based international database <<http://gsc.nrcan.gc.ca/permafrost/gtnp/index.html>>, which is part of GTN-P project. Mongolian Expression of Intent #1129, is of the Thermal State of Permafrost IPY Project 50.

The joint Japanese and Mongolian IORGC (Institute of Observational Research for Global Change) project continues for its fifth year in the Nalaikh and Terelj areas near Ulaanbaatar. D. Battogtokh and N. Sharkhuu par-

ticipate in collaboration with M. Ishikawa and T. Kadota. G. Davaa and N. Sharkhuu organize the National Committee for CliC activities in Mongolia. Mongolian Initial data compilation for the permafrost map of Central and Eastern Asia is being developed by N. Sharkhuu.

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THE NETHERLANDS

The Institute for Biological Problems in the Cryolithozone, Siberian Division of the Russian Academy of Sciences, Yakutsk, and the Vrije Universiteit, Amsterdam (Dep. of Hydrology and Geo-Environmental Sciences) are investigating the carbon and water exchange of taiga and tundra ecosystems in eastern Siberia. Measurements are using eddy correlation systems and soil flux chambers in a larch/birch forest near Yakutsk (Spasskaya Pad Field Station) and at a tundra site near Chokhurdakh in the Indigyrka lowlands (Kytalyk reserve). From 2004 onwards, this research has been extended with flux chamber measurements of methane fluxes and a survey of active layer thickness and temperature. The aim is to estimate the annual exchange rates and their interannual variability, and to determine the sensitivity to environmental factors of the fluxes. The present flux data show considerable annual variations. The 2005 and 2006 campaign has been funded by the Vrije Universiteit and NWO (Dutch Organization of Scientific Research) and is a continuation of research in the EU TCOS (Terrestrial Carbon Observation System) project. In the fall of 2006 this research is continued for three years as a Darwin Centre for Biogeology project (NWO funded). Cooperation with the Alfred Wegener Institute in Potsdam, operating a research station in the Lena Delta, has been established and resulted in an INTAS grant application. Further grant applications have been submitted (Dutch-Russian Scientific Cooperation Fund) to establish a more permanent research facility at the tundra site that will provide a longer time series of carbon exchange data, hydrology and permafrost dynamics.

In collaboration between the Vrije Universiteit Amsterdam and the Gent University in Belgium (P. Van den Haute and D. Vandenberghe) Optical Stimulated Luminescence dating has been performed on the Late Weichselian (periglacial) coversand series in the southern Netherlands. The timing of aeolian deposition and permafrost degradation has been established. The results will be published in the *Journal of Quaternary Science*. In addition, the Late Weichselian coversand - loess transition in the southern Netherlands has been sampled for a methodological study to date both sediments that are supposed to be of the same age, as they occur in the same stratigraphical position, and to compare the luminescence properties of the different aeolian sediments.

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NORWAY

ORGANISATION OF CRYOSPHERE SCIENCE IN NORWAY

CRYONOR, the network of Cryosphere scientists at Norwegian universities, had its first annual workshop at the Finse Research station, Southern Norway in September 2005, with 16 persons attending a two-day meeting with field excursions and presentations on ongoing research. The main purpose of CRYONOR is to facilitate cooperation and exchange of data relating to research and education on all cryospheric themes. CRYONOR is led by four representatives from the main Norwegian universities, including UNIS. At the 2005 workshop it was decided to invite members also from other Norwegian research and educational institutions with cold-climate research interests. Now the number of active Norwegian geoscientists in the CRYONOR network is around 30. The 2006 workshop was held at Folldal, Hedmark, September 20-22, focusing on the extent of permafrost, glaciers and periglacial environments in the Rondane mountain area in southern Norway during the Weichselian.

Based on the CRYONOR collaboration the IPY application TSP NORWAY was coordinated by Hanne H. Christiansen, UNIS, together with 17 scientists from six Norwegian research, education or private institutions, and government agencies. It was submitted to the Research Council of Norway (RCN). In autumn the TSP NORWAY project was partly funded by RCN, and hopefully also in the future from other sources to complete the project.

The University Centre in Svalbard (UNIS) has expanded into new space in the Svalbard Science Park, which was officially opened in April 2006 by the Norwegian King HM King Harald V of Norway. This expansion has significantly improving the logistics facilities, and the amount of scientific field equipment and laboratory facilities. UNIS now has a new freezing laboratory, among the largest in Europe.

The Secretariat of the IPA is still located at UNIS, funded by the Research Council of Norway. The Secretariat is led by Hanne H. Christiansen, with A. Prick op-



The newly opened Svalbard Science Park in Longyearbyen. UNIS is now the largest institution in this largest building on Svalbard. Photograph by Hanne H. Christiansen, May 2006.

erating it on part-time basis. The Secretariat is working with IPY education and outreach, in particular developing the IPY initiative called the University Courses on Permafrost, IUCP (see page 7).

PERMAFROST BOREHOLE TEMPERATURES IN SOUTHERN NORWAY AND SVALBARD

On Dovrefjell, southern Norway, temperature data was collected from 11 boreholes (9 m deep) along an altitudinal transect across the mountain permafrost transition zone. These boreholes were drilled and instrumented in October 2001. The objective of the study is to model the trend and variability of mean annual ground temperature (MAGT) and to evaluate the influence of the snow cover on mean annual ground surface temperature (MAGST) in a high mountain terrain. The trend and variability of MAGT and MAGST are of particular relevance in the interpretation of ground temperature measurements from just a few seasons. This work is also relevant to understand the climate/cryosphere interactions in general. An additional deep (> 100 m) borehole is planned to be drilled on Dovrefjell in the near future (R.S. Ødegård, K. Isaksen, T. Eiken and J.L. Sollid). Also at Dovrefjell data from temperature data loggers was collected as part of a Norwegian monitoring programme for palsa peatlands, co-ordinated by the Norwegian Institute for Nature Research (A. Hofgaard, K. Isaksen and J.L. Sollid). In Jotunheimen, southern Norway, temperature data from the Juvvasshø PACE borehole (established in 1999) was collected and in Svalbard data from the Janssonhaugen PACE borehole (established in 1998) was collected. Collection of the temperature data from the PACE boreholes is organized in a long-term monitoring programme for climatic research. The programme is run by the Norwegian Meteorological Institute (K. Isaksen) and the national databases are linked to the GTN-P database.

PERMAFROST AND ROCK SLOPE STABILITY

In the Møre and Romsdal area of southern Norway and in the Troms and Finnmark areas of northern Norway, temperature data are collected as part of a permafrost and climate monitoring project on unstable rock slopes in Norway. The project was established in 2001 and is organized by the Geological Survey of Norway (L.H. Blikra). A series of temperature data loggers monitor the ground, surface and air temperature. Exposed sites with minimal winter-snow accumulation are preferred to optimise comparability and to ensure that the thermal properties are not extensively complex (K. Isaksen, L.H. Blikra, T. Eiken and J.L. Sollid). In the mountains of Troms and Finnmark the temperature data from two new 30 m deep boreholes were collected in August 2006 (K. Isaksen, L. H. Blikra, H. Farbrot, R. Frauenfelder). DGPS monitoring of the unstable rock slopes in Troms were continued in cooperation with University of Oslo (T. Eiken). The first full year of continuous monitoring

data on movement, crack temperatures and daily photographs of snow conditions in an unstable rock slope in Troms was collected in cooperation with UNIS (H.H. Christiansen).

PERMAFROST AND PERIGLACIAL ACTIVITIES

Permafrost and periglacial activities of the Geology Department at UNIS (H.H. Christiansen, O. Humlum, L. Kristensen & H. Juliussen) centre around various basic types of field data on snow cover dynamics, geomorphic activity and active layer (UNISCALM) and permafrost borehole temperatures in the Longyearbyen and Adventdalen valleys, and surrounding mountains. All field data are available for research and education. During summer a new portable permafrost drill was constructed and tested drilling several shall boreholes. In the summer and autumn of 2006 two new online mountain meteorological stations were installed at Janssonhaugen next to the PACE 102 m borehole, and at Gruvefjellet were a new shallow borehole will be drilled enabling for the first time ever on Svalbard online borehole permafrost temperatures. A new avalanche research and education site above Longyearbyen airport was added to the UNIS interdisciplinary funded research, education and monitoring programme, Observations on Snow avalanches in Svalbard (OSS). In OSS the focus is on acquiring data on the meteorological control on snow avalanches, avalanche types and to provide updated webpage information on the occurrence of avalanches in central Svalbard. The permafrost monitoring programme at Kapp Linné, on the west coast of Spitsbergen, was extended to also include a shallow 2 m deep borehole with temperature recording. N. Matsuoka (University of Tsukuba, Japan) and H.H. Christiansen added new field instrumentation to the ice-wedge study site in Adventdalen in Summer 2006. A. Lewkowicz (University of Ottawa, Canada) installed new experimental equipment to measure soil creep at two sites in the Adventdalen area, one close to the solifluction station operated by C. Harris (University of Cardiff). Thermal conditions of ice-cored moraines deposited by late Holocene surges of the Paulabreen Glacier are investigated by L. Kristensen, by means of several boreholes and geoelectrical resistivity.

The IPY EoI 24 called the *International University Course on High Arctic Permafrost Landscape Dynamics in Svalbard and Peary Land*, which is part of the TSP Project 50, held a planning workshop at UNIS in August. Scientists from Denmark, Canada, Japan, UK, U.S.A. and Norway planned on establishing and running in summer 2008 this special IPY permafrost university course, starting in Svalbard and going to Pearyland in North Greenland. Two logistics employees from UNIS and the Danish Polar Centre joined the workshop logistics planning.

In northern Norway and on Svalbard, A. Prick continued research on rock temperature monitoring and weathering processes across Troms, in cooperation with



Participants in the In SPE workshop at UNIS August 19, 2006 from left: J. Murton (UK), B. Elberling (DK), A. Lewkowicz (Canada), A. Werner & S. Roof (USA), H.H. Christiansen (Norway), N. Matsuoka (Japan), J. Skafte (DK) & J. Haagensli (Norway). Photograph by Hanne H. Christiansen.

UNIS. In addition, extensive ground surface temperature measurements and DC resistivity soundings were continued in the Lakselv region, Finnmark (H. Farbrot, B. Etzelmüller, Univ. of Oslo), as part of a larger survey of permafrost distribution in Finnmark in collaboration with the Norwegian Meteorological Institute (K. Isaksen). The work was extended to rock glacier surveys in northern Troms this year (H. Farbrot, R. Frauenfelder, K. Isaksen).

In southern Norway, research on mountain meteorology, snow cover and ground temperatures initiated in 2004 were extended by a number of supplementary research sites, making use of automatic digital cameras and data loggers (H. Juliussen, O. Humlum, Univ. of Oslo). The project now covers a transect ranging from the maritime environment at the west coast (Sognefjorden - Ålesund) to more continental regions near the Swedish border (Femunden - Trysil). Data from this research scheme are used for validation of a numeric model (VW4W: O. Humlum, Univ. of Oslo), being developed for calculating the dimensions and temporal-spatial distribution of permafrost and seasonal frost in complex, mountainous terrain, as well as in lowlands. Two research sites specifically addressing the interaction between permafrost and glaciers were established in western Jotunheimen and near Finse, respectively. At Finse, special attention is paid to the importance of permafrost for rapid growth of small glaciers during periods of deglaciation (K.S. Lilleøren, O. Humlum, Univ. of Oslo). Investigations on the ground surface thermal regime above and below the natural tree limit has been extended with new sites (O. Humlum). In the Follidal area (Hedmark), ground temperatures in palsa areas are monitored since September 2006 (M. Ferbarlein, O. Humlum, Univ. of Oslo). At the Department of Geography, Norwegian University of Science and Technology

(NTNU), investigations regarding process dynamics and sediment transfer were initiated in the Vinstradalen catchment on the northern part of Dovrefjell (I. Berthling, A. Beylich, G. Vatne). Studies on rock fall frequency started in Erdalen summer 2006 (I. Berthling, A. Beylich). In South-Central Norway, thermal regime of a lowland coarse block slope system is being investigated since 2005 (I. Berthling). Currently, we have also initiated cooperation with the Department of Structural Engineering, NTNU (S. Jacobsen) aiming at utilizing expertise on frost action in concrete for studies of frost weathering of bedrock.

At the Geological Survey of Norway, the long-term research continued on mass transfers, denudation, sediment budgets and relief development in four catchments in subarctic and arctic environments in Iceland and Lapland (A. Beylich). Research is focussed on an integrated study of source-to-sink-sediment fluxes, including monitoring of surface processes, analysis of sinks, permafrost analysis, analyses of surface processes-vegetation cover-permafrost interactions. The research is carried out in cooperation with several partners in Norway, Sweden, Iceland, Germany and Finland. A. Beylich is coordinating the ESF Network SEDIFLUX and Chair of the IAG/AIG Working Group SEDIBUD.

In Iceland, the University of Oslo (B. Etzelmüller, H. Farbrot, T. Eiken) continued studies on permafrost distribution and slope dynamics in the permafrost zone in collaboration with A. Gudmundsson (Jardfrædistofan EHF, Iceland) and H. Björnsson (Univ. of Iceland). Four shallow boreholes are equipped with temperature dataloggers, and ground surface temperatures are measured at approximately 40 sites in northern and eastern Iceland. Velocity, mass flux and age estimates are obtained for rock glaciers in northern Iceland (B. Wangenstein).

In the Yukon Territory, northern Canada, B. Etzelmüller (Univ. of Oslo) participated in field work headed by A. Lewkowicz (Univ. of Ottawa) to study mountain permafrost distribution. DC resistivity surveys were carried out in numerous locations mostly related to palsa sites and in source zones of large debris flows, which were triggered in the mountain permafrost zone. The latter work was in co-operation with the Yukon Geological Survey.

ARCTIC TECHNOLOGY

The Department of Arctic Technology at UNIS, monitors ground temperatures in the permafrost zone at many profiles in Svalbard, mainly around Longyearbyen and Svea. Information about coordinates, installation dates and on storage and operations of the strings installed by different organizations in Svalbard was gathered and assembled in a report this summer. A number of thermistor strings are installed below the new Svalbard Science Centre along some of the construction piles for the building, and in the field outside the building for reference. These strings will be connected to the computer network for easy access to the data.

Understanding the physics and mechanics of different sea ice phenomena is extremely important for marine activities in cold regions. The formation and the mechanical properties of one year rubble ice are studied as well as ice forces on quays and other structures, partly with foundations in the permafrost zone. Large scale experiments have been performed on ice ridges hitting the seabed and on sea ice sheets hitting a steel pile. The rock material found in Svalbard is of low strength and is thus not well suited for construction of erosion barriers. Tests are in progress on other structures which are utilizing local materials rather than imported blasted rock from mainland Norway.

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POLAND

The research project of the Committee for Scientific Research entitled: «Structure, Evolution and Dynamics of Lithosphere, Cryosphere and Biosphere in the European Sector in the Arctic and in the Antarctic» (PBZ-KBN-108/P04 /2004) continued in 2006. This project is based on the interdisciplinary research, partly in connection with the IPY and coordinated by international collaboration. One of the main research topics is the response of continental cryosphere (glaciers and permafrost) to global climate change.

In the summer of 2006, research was carried on Spitsbergen (Svalbard Archipelago) in the following regions: from the Polish Polar Station in Hornsund in the region adjacent to Isbjornhamna (SW part of Wedel Jarlsberg Land); from the base of Maria Curie-Skłodowska University in Lublin, in the area south of Recherche Fiord (NW part of Wedel Land), Bellsund, Calypsostranda; the station of Nicolas Copernicus University in Torun, in the Kaffiøyra coastal plain (Oscar II Land), in the field area of Adam Mickiewicz University (Poznan), in the region Billefjorden (Petuniabukta). In these areas, measurements of permafrost thickness and active layer dynamics were carried out within the CALM II program, and periglacial slope dynamics are investigated. Monitoring of mass balance is continued on selected glaciers.

Climate change and its effect on natural environment in polar and subpolar regions became recently such a concern from both scientific and utilitarian points of view that a conference was organized on that theme by researchers from the Department of Meteorology and Nautical Oceanography, Faculty of Navigation, Gdynia Maritime University, under the supervision of A.A. Marsz and A. Styszynska. This Conference on «Changes of climate in the Arctic and the Antarctic during the last 50-year period and their environmental implications» was held on May 11-13 in Gdynia. Presentations were made in the fields of meteorology, climatology, geomorphology,

glaciology, cartography, oceanography and biology by scientists from Polish universities and research institutions working in the Arctic and the Antarctic. Most papers dealt with climate change through meteorological and climatological data. Much attention was paid to sea ice cover changes, whose dynamics can be inferred from the analysis of satellite imagery, to the characteristics and extent of contemporary glacier cover changes in the Arctic and the Antarctic, as well as to the symptoms of permafrost reaction to climate change. Other papers tackled changes in marine and continental geo- and ecosystems of the Arctic and the Antarctic. The papers will be published by the Maritime University in Gdynia Publishing House.

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RUSSIA

In 2006, Russian research covered regional permafrost conditions, cryolithozone dynamics under natural and human impact, cryogenic processes and phenomena, permafrost mapping and zonation.

The Permafrost Institute, Siberian Branch of Russian Academy of Sciences (SB RAS) analyzed the oxygen isotopic composition of deep sediments from the Pacific Ocean. The time-and-frequency analysis shows that the temperature began to drop 3.5 million years ago. 700,000 to one million years later, glaciation and permafrost formation began in high-latitude continental areas. During the Pleistocene, between 40,000 and 100,000 years ago, these processes had a self-oscillating character (Balobaev *et al.*). A period of continuous permafrost degradation in the zone between 59 and 62° N coincides with thermochrone (127,000-117,000 BP). In the frozen deposits formed earlier pseudomorphs replaced syngenetic ice. A multifactor model of cryogenic processes dynamics was developed. According to its results, around the middle of the 21st century the 2-4° C warmer atmosphere will induce a significant unsteadiness of the Arctic permafrost. That can lead to catastrophic acceleration of cryogenic processes, especially in the regions of intensive nature management. Partial or full degradation of the ground ice massifs is expected in the upper layers of the Arctic coastal cryolithozone.

The Institute of Earth Cryosphere (SB RAS) established some data-based cartographical models for contemporary climate changes and cryolithozone. The mean annual air temperature increase was subdivided into four categories, from very weak ($\leq 0.3^\circ\text{C}$) to strong ($> 1^\circ\text{C}$). Half of the northern Russian territory was characterized by strong warming; a fifth by a moderate warming; a third by a weak or very weak warming. Air temperature trends are linked to the dynamics of the permafrost at its southern border, and to geological and landscape characteris-

tics (A. Pavlov, G. Malkova). The patterns of marine coastal dynamics within the Russian cryolithozone were highlighted. In the western sector of the Russian Arctic, the sediment discharge caused by coastal erosion is comparable to the sediment derived from the large rivers (A. Vasiliev). A set of maps on permafrost dynamics in Siberia during the last 18,000 years was prepared on the basis of the complex method including frozen facies analysis (E. Slagoda *et al.*). Cryolithological and cryochemical field studies at the Kara sea coast allowed to conclude that tabular ground ice bodies exposed at the coastal sections and found in the multiple boreholes of Yamal peninsula are resulting as a rule from joint action of water migration and intrusion resulting in ice accumulation at the interface of underlying sandy and covering clayey deposits of deltaic to marine origin. These mechanisms can explain deformations in the horizontal ice beds, as well as dome-shaped complications within these beds. (M.O. Leibman).

At the Permafrost Institute (SB RAS), an engineering system was developed for flooding control and cryogenic processes protection in the area of Yakutsk city.

At the Department of Geocryology, Moscow State University (MSU) the new scenario of Laptev Sea transgression in late Pleistocene-Holocene was worked out. It takes into account lake thermokarst and thermal abrasion as factors of the ice complex destruction on the shelf (A. Gavrilov *et al.*). Frozen and thawed soils were sampled on Bykovsky peninsula (northern Yakutia) while drilling the bottom sediments of the thermokarst lakes and lagoons. Their chemical and mineral composition, cryogenic structure and basic physical properties were investigated (V. Cheverev, I. Vidjapin, V. Tumskoy). The influence of the swamps on the permafrost temperature regime during Holocene was investigated by E. Ospennikov.

The Department of Glaciology and Cryolithology (MSU) established that river run-off in permafrost area has a higher content of soluble components. This could be explained by cryogenic weathering. The losses of soluble components during repetitive freezing and thawing of the ground were calculated for various types of rocks and minerals. For the regions of Yenisei Gorlo and the Yenisei Gulf, new data were received (in collaboration with the Institute of Earth Cryosphere) on the ice complex distribution and deposits of the massive ice.

At the Faculty of Geography (MSU), theoretical and experimental modeling of intrusion massive ice formation was undertaken. It was shown that in the coastal zone, when seafloor clayey sediments start freezing and form frozen patches, pressure appears in the yet unfrozen subsea clay to produce effect of water intrusion into the frozen zone forming massive ice bodies of 'pingo' origin. (V. Golubev).

Various projects are carried out on permafrost engineering. A survey in Norilsk has showed that almost 40 % of all buildings have deformations or disturbances associated with ground temperature of foundations. It is

established that cryogenic weathering and the high corrosive impact of ground water play a large role in the destruction of foundations and surface structures (Dept. of Glaciology and Cryolithology, MSU).

For the northeastern part of European Russia and the northern part of West Siberia, a geocryological forecast for the next 300 years (E. Ershov, S. Parmuzin, L. Khrustalev *et al.*; Dept. of Geocryology, MSU) indicates that, due to climate warming, a significant rise in ground temperature is expected, accompanied by permafrost degradation. These processes lead to the destruction of the northern infrastructures.

PNIIS provided the engineering-geological zonation of cryogenic hazards for the territory of projected railroad in West Siberia, near the Ural Mountains. It gave recommendations for the engineering protection of construction.

The technique and equipment has been developed for the S-waves seismic survey of high resolution. This allows revealing ice bodies on the slopes and shallow shelf (A. Skvortsov, Institute of Earth Cryosphere, SB RAS).

Questions linked to the physics and chemistry of frozen ground continued to attract the attention of researchers. The Department of Geocryology, MSU, conducted experimental studies of frozen ground durability and creep, and studied in parallel the main physical properties in-



Frozen deposits outcrop with a 7-m deep syngenetic ice wedge in Chara Region (56.6 N, 118.2 E). Photograph by D. Sergueev.

cluding unfrozen water content as related to temperature (L. Roman, S. Volokhov, L. Shevchenko). By analyzing desulphatization curves, I. Komarov and N. Volcov presented a method for estimating the temperature of solution formation. It was applied to the evaluation of the temperature conditions of cryopeg formation and natural waters in the Yamal Peninsula. This showed that cryopegs induce a warming in the underlying deposits. Its total mineralization may change twice and more per season. Experimental researches were carried out on the physical properties and phase composition of soils polluted by oil products, with consideration for the pollutant type and the duration of contamination. This research takes into account the influence of coagulation contacts and the role of microorganisms. Continuous efforts are aimed at developing combined measurements of electric and acoustic properties of frozen soils. Electrometric equipment was tested under field conditions (Y. Zykov, R. Motenko, A. Koshurnikov, I. Anisimova).

The studies of gas hydrate continued. At the Institute of Earth Cryosphere (SB RAS), the surfactant admixture effect on the gas-hydrate crystallization was ascertained. This expands the possibilities of hydrate technologies for natural gases storage and transportation (A. Nesterov). E. Chuvilin and his colleagues (Department of Geocryology, MSU) experimentally established the temperature-pressure characteristics and kinetics of hydrates CO_2 and CO_4 in ground saturated with porous gas. They experimentally tested gas hydrates self-conservation in frozen deposits. Resulting data indicate the influence of temperature, ice content and soil type on the kinetics of gas hydrates dissociation in the soils artificially saturated with hydrates. Full attenuation of the dissociation and self-conservation of CO_2 hydrate becomes apparent only at temperatures below -13°C . Gas hydrates self-conservation is favoured by the porous ice (not transferred into hydrate).

Instrumental observations and monitoring presented an important part of the current Russian activities. PNIIS prepared a document entitled «Regulations of the engineering - geocryological monitoring at the construction

development of territories». This standard was utilized in the oilfields in northeastern part of European Russia, and in the Koryak District's heat stations.

The Permafrost Institute (SB RAS) conducted projects within a program for Northern Asia geocryological monitoring. For the northwestern part of the Siberian platform, a set of geothermo-geocryological cross-sections was established to depths down to 3000 m. New data were collected at the permafrost stations and polygons located in Eastern Siberia: moisture and temperature regime of the cryolithozone upper horizons, greenhouse gas emissions, intensity of cryogenic processes and dynamics of the man-induced cryopegs. Using temperature measurements in boreholes allowed evaluating permafrost thickness in Mesozoic depressions of the Aldan shield. Non-uniformly scaled maps were drawn for Yakutia's cryogenic landscapes and their resistance to human impact.

The Institute of Environmental Geoscience (RAS) started geothermal research in cooperation with the University of Alaska, Fairbanks. It is conducted in the Chara Region (Northern Transbaykalia) within the IPY Permafrost Observatories Project: Thermal State of Permafrost (IPY EoI-125 and Project 50). The Chara Region is characterized by extremely varying periglacial features, including kurums, thermal erosion forms, rock glaciers, icings, ice-wedge polygons. The 2006 surveys focused on early Holocene syngenetic ice wedges. A group of four researchers studied the zones with active, passive and relict periglacial phenomena in different altitudinal levels. They restored two old 20-m deep boreholes as a part of the Northern Transbaykalia Mountain Permafrost Observatory. A specially isolated pit-camera was also installed in the kurum body for detailed observation of the active layer and its thermal and hydrologic conditions. These equipments are monitored by automated loggers' thermometric systems.

Research on planetary cryology are pursued at the Department of Geocryology (MSU) in collaboration with the Institute of Geochemistry (RAS). Comparison of data on polygons from Mars (Northern Plains, Plateau Utopia, etc.) and the Earth (Novosibirsk Islands, Yamal Peninsula, archipelago Novaya Zemlya Archipelago, Victoria Land in Antarctica, etc.) and modelling these polygons size suggest that polygonal features in high latitude regions on Mars result from frost cracking. Ongoing research is developing a feature classification and a map on frost cracking distribution on Mars (I. Komarov, V. Isaev and R. Kuzmin).

The International Conference «Earth Cryosphere Assessment: Theory, Applications and Prognosis of Alterations» was held in Tyumen, May 29-31, 2006. Many important problems related to geocryology and cold region development were discussed. The participants particularly appreciated the good organization of scientific excursions and the interesting cultural program. A number of Russian specialists took part in the first Asian Conference on



Students attending the International Conference in Tyumen, May 2006. Photograph by Jerry Brown.

Permafrost, in August in Lanzhou; and they were impressed by the Conference organization, the progress of Chinese colleagues in permafrost sciences and engineering, and the traditional Chinese hospitality.

The annual review of Russian projects for the International Polar Year took place at Scohi, October 2006. Reports included progress on thermal state of permafrost and coastal projects.

The Tyument State Oil and Gas University (TSOGU) educates specialists in oil and gas engineering for the Ural region and Siberia. Its Department of the Earth Cryology, created in 2002, is organizing an educational Subarctic Center, aiming to educate MSc and PhD students in the natural and technical aspect of cryogenic environments. This center has also five monitoring observatories, collecting meteorological data and temperature data from the upper permafrost. The gas company «Nadymgasprom» is supporting TSOGU at installing a Soil-Climat Station on the Yamal Peninsula and at organizing a summer Field Permafrost Courses within the IPY (Infrastructure Action INTAS # 04-87-689).

We announce with deep regret the death of prominent Russian researchers Anatoly Frolov, Andrey Sadovsky, Anatoly Kotov and Evgeny Melnikov.

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SPAIN

This report encompasses Spanish permafrost activities in 2005 and 2006.

Spanish research on geomorphologic processes associated with frozen ground and snow is ongoing in several mountain regions of the Iberian Peninsula and in other parts of the world.

A number of teams are monitoring ground temperature in the Pyrenees in order to detect permafrost. Enrique Serrano and his team from the University of Valladolid has been working in the Posets Massifs monitoring rock glaciers, Javier Chueca and the group from the University of Zaragoza is in the Telera, Madaleta and Guara massifs, and Antonio Gómez, heading the team from the University of Barcelona, is in the eastern Pyrenees.

Several studies in the Iberian Range focus on ploughing blocks as a unique feature of the periglacial belt. When active, these blocks become a distinctive element of high mountain environments. Fifty were measured in the area of Picos de Urbion (Iberian Range, province of Soria) and ten samples have been monitored to detect movement and measure displacement. The search for ploughing blocks in other areas included mountainous regions above 2000 m asl in Castile-Leon (Central Range, Galician-Leonese Mountains and the Catabrian Range). Any blocks from these areas that appeared active were also monitored. Partial results from this research were presented in a poster at the VI International Geomorphology Conference held in

2005 in Zaragoza. Members of this working group include Pablo Arroyo Perez, Alberto Gandia Fernandez and Alipio Garcia de Celis, from the Department of Geography of the University of Valladolid.

The team of researchers from the University of Barcelona, the Complutense University of Madrid, and the University of Extremadura, headed by Antonio Gomez, has been monitoring temperatures in the active layer at varying depths, and is tracking the movement of the rock glacier at Corral del Veleta (3120 m asl) in Sierra Nevada. Results so far show variations in the ground temperature regime with a surprisingly broad interval between high and low values, and evidence of advancement and collapse of the glacier body. Ongoing observations of the snow cover during the summer also suggest that the rock glacier dynamics and the temperature variations detected within this rock glacier are probably related to the snow cover amount.

Juan Ramon Vidal Romani and Daniel Fernandez Mosquera (Institute of Geology, Univ. of Coruña) coordinated dating studies in the Galician-Portuguese mountain ranges, the Central Range (Guadarrama) and in other regions of the Iberian Peninsula using cosmogenic isotopes ^{10}Be and ^{21}Ne in granite massifs exposed to periglacial processes during the late Pleistocene. The results have been useful in determining the rates of deterioration in conjunction with the structure of the massif. Well-fractured massifs have undergone intensive periglacial processes while non fractured massifs in the same area have not been affected at all. The studies also revealed that the glaciated areas that had been affected by glacial scouring maintained the characteristics of their origin. These traits tend to disappear, however, in adjacent zones due to periglacial action. The findings demonstrate that surfaces that were originally thought of as having the same age were actually very different.

Fernando Diaz del Olmo (Univ. of Seville) coordinated studies in the Betica Range on the relationship between karstic and periglacial processes, and particularly, karren and doline formations in connection with travertine geosystems. F. Diaz and Guillermo Brenes (Univ. of Costa Rica) have been collaborating in a study to re-evaluate the periglacial formations on the summits of the Talamanca Range (Costa Rica) in the Cerra de la Muerte and Cerro Buena Vista massifs (3490 m asl). The characteristics of the surface formations and the existing vegetation recall inherited periglacial dynamics that are very different from the conventional identification established for the neighbouring summits of Cerro Chirripo in the Talamanca Range (K.H. Orvis and S.P. Horn).

The team led by Jose Maria Redondo Vega from the University of Leon has been conducting surface analyses of the fabric of 20 relict rock glaciers in the western sector of the Cantabrian Range. Collected data is being analyzed statistically. Ground temperatures are recorded near some rock glaciers.

Augusto Perez, Marcos Valcarcel and their group have been monitoring geomorphologic activity and microclimatic conditions in an active nival niche in Sierra Ancares (Galicia). They have also initiated studies on periglacial and permafrost dynamics in Tierra de Fuego in collaboration with Jorge Rabassa.

The team headed by David Palacios (Complutense Univ. of Madrid) continues to monitor cryonival processes in several nival niches in the Central Range. This group is also involved in surveying and locating permafrost on volcanoes in Mexico (Popocatepetl and Iatacihualt) and Peru (Misti and Coropuna).

A team from the University of Alcalá de Henares, the University of Lisboa and the University of Zurich, led by Miguel Ramos, is monitoring permafrost thermodynamics on Livingston Island (Antarctica). Two projects coordinated by Miguel Ramos and funded by the Spanish Antarctic Programme will be carried out in the Antarctic in collaboration between the Universities of Alcalá de Henares (Spain), of Lisbon (Portugal) and of Zurich (Switzerland). Plans include drilling new 20-m deep boreholes. These projects Permamodel 2006-07 and Permamodel 2007-09 are entitled «Permafrost and Active Layer Monitoring and Modelling in Livingston and Deception Islands (Antarctic)» and are part of International Polar Year and the IPA TSP Project 50. Other requests for IPY funding in Spain are pending and will be reported on in 2007.

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SWEDEN

The Polar Research Secretariat, SWEDARCTIC 2007 and SWEDARCTIC 2008 organised in September 2006 a planning and coordination meeting regarding subarctic research during IPY, with 23 participants. More than 20 research projects with planned activities in northern Sweden during IPY were presented and discussed. Various coordination issues were discussed. It was agreed that there is a need for both formal and informal coordination and that an institution like the Polar Research Secretariat potentially could facilitate such coordination.

The 13th scientific conference of the International Boreal Forest Research Association (IBFRA) entitled «New Challenges in Management of Boreal Forests» was held in Umeå, Sweden, August 28-30. One of the topics of this conference was «Peatlands and Permafrost» <www.sfak.slu.se/ShowPage.cfm?OrgenhetSida_ID=4763>.

At Stockholm University, within the PhD project «Temporal and Spatial Dynamics of Subarctic Peat Plateau / Thermokarst Lake Complexes» (Britta Sannel, Peter Kuhry), a monitoring station which collects climate and ground data in a peat plateau / thermokarst lake complex in Taavavuoma, northern Sweden, has now been operating for a full year. The monitoring station consists of a meteorological station measuring air temperature, relative humidity, precipitation, wind speed and wind direc-

tion and eight cables with altogether 50 thermistors measuring the ground temperature down to 2-m deep in different parts of the peat bog. A stationary digital camera that registers one image a day is overlooking eight stakes for snow depth measurements as well as the thermokarst erosion bank.

At Uppsala University, Hanna Ridefelt, Jan Boelhouwers, Christer Jonasson and Johannes Förster are collaborating to investigate the permafrost distribution in the Abisko region, northern Sweden. BTS field campaigns have been undertaken during March 2005 and 2006. Statistical analyses are under way to define the correlation of BTS-values to topographic parameters (altitude and slope) and to vegetation and aspect. Preliminary results indicate no dramatic thaw of mountain permafrost during the last decades, as reported from investigations in the peat permafrost in the Abisko area. This BTS-project will be part of a national mountain permafrost project, submitted for funding by Per Holmlund at Stockholm University. In the same region a study on the spatial variability of solifluction processes is also being undertaken (H. Ridefelt and J. Boelhouwers). It makes a first attempt to evaluate the spatial distribution and variability of solifluction processes and associated landforms from the micro- to the regional level (landscape) and to provide a better quantitative understanding of associated environmental parameters.

The GeoBiosphere Science Centre of the Lund University continued and expanded its activities in the Abisko area. The «Nordic Centre for Studies of Ecosystem Carbon Exchange and its Interaction with the Climate System» (NECC, <www.necc.nu>) has two monitoring sites in the Abisko / Stordalen area. The CARBOMONT project «Effects of land-use changes on sources, sinks and fluxes of carbon in European mountain areas» and the ELSA project «Exchange processes between the land surface and the atmosphere» have intensive and important field activities in the Abisko area, especially in and around the Stordalen bog, with a special emphasis on the status and dynamics of the active layer and the permafrost in the bogs.

The Abisko area active layer transect is maintained in co-operation with the Abisko Research Station. Jonas Åkerman and Margaretha Johansson continue maintaining 10 of the originally 12 CALM sites along the 100 km-long E-W transect. Two sites have been abandoned as all permafrost has disappeared. The active layer sites have now been monitored since 1978 and annual basic data is presented within the CALM reporting system.

Torbjörn Johansson successfully finalised in September 2006 his PhD dissertation «Temporal and spatial variability of carbon cycling in a subarctic landscape». This project constitutes a continuation with measurements of the active layer dynamics of the Stordalen mire and with an intensified and expanded greenhouse gas exchange monitoring programme.

M. Johansson is continuing her PhD project «Permafrost dynamics and its implications for biodiversity and ecosystem functioning» (supervisors: Torben R. Christensen, J. Åkerman). This project is jointly financed by the Abisko Research Station and Lund University. Installations of snow cover manipulation plots, snow cover depth, soil temperature measurements, a daily camera survey and a complete microclimatic station are operating next to one of the CALM grids. The snow manipulation experiment at Storflaket has been running for a year and already after one year we could detect a difference between the six plots with snow fences and the six without. At the plots without snow fences the AL was slightly shallower than last year, in contrast at the plots with snow fences AL was either at the same depth as last year or deeper. Soil temperature records were collected from all 12 plots. The snow fences are now reinstalled for yet another season.

J. Åkerman and Sarika Mittra are investigating and modeling the permafrost distribution and recent development in the Abisko region using remote sensing and as «base line» data the geomorphological mapping from the 1970's and the input data for the IPA Permafrost Map (1997).

At the University of Karlstad, Dep. of Earth Sciences, Rolf Nyberg is maintaining a few small projects in the Abisko area: The dynamics of the Kårsa glacier; Permafrost and slope processes in the Pallenvagge and Nissunvagne valleys; The assessment of the importance of extreme erosional events as geomorphological hazards and as climatic indicators in the Abisko area.

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SWITZERLAND

The Swiss Society on Snow, Ice and Permafrost was founded in June 2006. It is open to everybody interested in cryospheric research in Switzerland. The president, Martin Hoelzle (hoelzle@geo.unizh.ch), is happy to receive applications for membership. The Society will soon be part of the Swiss Academy of Sciences (SAS), and closely work together with the SAS commission responsible for monitoring networks for snow, glaciers and permafrost.

The «Permafrost Monitoring Switzerland» <www.permos.ch> has been established for the next four years. The Swiss Academy of Sciences (SAS), the Federal Office for Environment (FOE) and the Federal Office for Meteorology (MeteoSwitzerland) signed a contract to support PERMOS, which allows PERMOS to establish a 50 % coordination position, to implement a methodological/technological standard at all approved PERMOS stations and ensure the ongoing operation by the eight Swiss university institutes involved in permafrost research. MeteoSwitzerland is responsible as well for the GTOS/GCOS, which tightens the link to GTN-P. Besides the borehole, surface and bedrock temperatures and the aerial

photographs, six electrical resistivity tomography (ERT) profiles were permanently installed at permafrost sites in the Swiss Alps within the PERMOS monitoring project in collaboration with the University of Jena (C. Hilbich) and the University of Karlsruhe (C. Hauck). By monitoring the electrical resistivity, the ground ice content evolution can be adequately determined over longer time spans with high spatial resolution.

The Federal Office for Environment (FOE) published a set of maps (1:50 000) which indicate permafrost distribution and potential zones of natural hazards. The maps were produced by a collaboration of the SMEs Academia Engadina, Getest and Geo7, supported by a scientific advisory panel.

An interdisciplinary project within the National Center of Competence in Research (NCCR) named «Mobile Information and Communication Systems» has been developed with the Universities of Zurich and Basel in collaboration with ALPUG <www.mics.ch>. It involves a new generation of specialized sensor rods that measure temperature and conductivity in solid or fractured bedrock at four different depths down to 90 cm. The sensors are employed in order to investigate freeze/thaw and advection



Two 60 m vertical boreholes instrumented with thermistors in the Matterhorn Hörnli ridge at 3300 m asl. Photograph by M. Philips, August 2006.

of heat by water circulation near the surface. The instruments communicate using wireless technology and a central GPRS downlink, and thus reduces maintenance cost and time (A. Hasler, I. Talzi, S. Gruber, H.U. Gubler, D. Vonder Mühl, Chr. Tschudin).

The Swiss Federal Institute for Snow and Avalanche Research (SLF) in Davos has extended its network of monitoring sites, with a horizontal borehole through the Gemsstock ridge at 2950 m asl and two vertical ones in the Matterhorn Hörnli ridge, at 3300 m. These boreholes in frozen rock walls complete a network of well instrumented sites located in various types of complex alpine terrain, as well as in the vicinity of buildings or on construction sites. Rock wall dynamics are being investigated using the 3D-laser scanning technique and internal deformation measurements. There is now a ten-year data series for Arolla and Pontresina, where the suitability of different types of avalanche defence structures and anchoring systems continues to be monitored (M. Phillips). A series of laboratory shear box tests have been carried out to determine active layer stability under varying hydro-thermal conditions – combined with field investigations. These have delivered valuable information on potential scree slope failure mechanisms (A. Rist, M. Phillips). The model ALPINE-3D has been successfully adapted and used to predict permafrost occurrence and evolution for sites in the Italian and Swiss Alps (M. Lehning, I. Völksch).

The University of Zurich is active in the following projects. In order to use Regional Climate Model data in permafrost modelling, a downscaling methodology has been established and a possible range of changes in ground surface temperatures in steep rock walls has been assessed by driving an energy balance model with output gained from a set of 12 different regional climate models for a number of different topographical situations. Results show a significant influence of topography (mainly aspect) on the temperature changes (N. Salzmann, J. Noetzli, S. Gruber, M. Hoelzle).

Over 40 locations of near-surface rock temperatures in steep topography are monitored (S. Gruber, R. Delaloye, J. Noetzli, M. Hoelzle). The complex 4-dimensional thermal conditions in high mountain topography (e.g. peaks and ridges) are investigated using an energy balance model coupled to a 3D heat conduction scheme. Time-dependent simulations are based on scenario data gained from RCM output. Results indicate complex 3-dimensional temperature patterns below mountainous topography for equilibrium conditions, which are additionally perturbed by transient effects. Permafrost can thus be found at many locations where temperatures at the surface do not indicate this and that traditional 2D maps would not be sufficient (J. Noetzli, S. Gruber, N. Salzmann, M. Hoelzle).

Rock fall events from periglacial areas are currently inventoried and investigated in the perspective of permafrost degradation in steep rock walls together with the geological, geomechanical and climate-related parameters

and involved processes controlling the stability of high-mountain rock walls (L. Fischer, J. Noetzli, S. Gruber, Ch. Huggel). The extreme thaw during the summer of 2003 is regarded to be the prime reason for the many observed rock fall events between June and August of that year. Purely conductive thaw however would have resulted in active-layer thickening much later in the year at the observed locations, possibly hinting at decisive influence of advective heat transfer. Monte-Carlo simulation of temperatures and thaw depth between 1985 and 2003 was used to investigate this process (T. Handschin, S. Gruber). A simplified energy-balance model for deterministic-probabilistic (Monte-Carlo) assessment of the spatial temperature distribution in steep terrain is currently developed and tested. (S. Gruber).

3D-modelling of realistic thermal conditions within alpine mountain peaks is still a major challenge. To achieve better information of the subsurface conditions as an input for the modelling, an intensive 2D-resistivity tomography was performed at the Schilthorn mountain top (C. Hilbich, M. Krauer, C. Hauck, J. Noetzli, M. Hoelzle).

Validation of permafrost modelling against measured data must be an integral part of the model development process. Some process models contain an energy balance module which allows the calculation of surface temperatures as used as an input for thermal ground modelling. On specific sites, where meteorological stations and boreholes are available, important climate variables, such as air or ground temperatures, height of snow cover or radiation can be used as validation for the modelled energy balance variables (M. Hoelzle, S. Gruber).

In several small projects energy exchange at the surface and within the active layer was investigated at the Murtel-Corvatsch site Upper-Engadin, Switzerland. Energy fluxes at the surface (including snow) and within the active layer are still poorly understood, but play an essential role in process-oriented research and sensitivity studies with respect to complex interactions and feedback mechanisms within the alpine permafrost system. Circulation of water, and especially air, can cause important lateral fluxes of mass and energy within coarse blocks on steep slopes and result in highly variable and sometimes extreme thermal offsets between the ground surface and the permafrost table. Measuring and modelling such fluxes together with coupling time-dependent surface and subsurface ground thermal conditions in characteristic alpine materials (bedrock, ice-rich debris, blocky debris and fine-grained deposits) constitute main challenges (S. Bircher, E. Frey, M. Panz, S. Gruber, S. Hanson, J. Noetzli, M. Hoelzle).

Geophysical measurements as well as mechanical probing of the active layer were used during a Spanish field campaign to enhance understanding of permafrost distribution and characteristics on the Antarctic islands of Livingston and Deception. This prepared a later drilling campaign and the establishment of a S-CALM site. Rock

temperature monitoring instruments were installed (C. Hauck, S. Gruber, G. Vieira, J. Blanco, M. Ramos, M. Hoelzle).

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UNITED KINGDOM

As part of the UK Engineering and Physical Sciences project «Modelling pre-failure shear strain (solifluction) in freezing and thawing soil slopes» at Cardiff University, Charles Harris and Martina Luetschg have undertaken two series of scaled centrifuge modelling experiments designed to provide high-resolution calibration data for developing numerical modelling of solifluction processes. Full-scale modelling is also in progress at the cold laboratories of UMR CNRS 6143 M2C, Caen, France, in a collaborative project between Charles Harris, Marianne Ertlen-Font, Julian Murton and Michael Davies, funded by the UK Natural Environment Research Council. Two 5-m-long slope models have been constructed, one with one-sided freezing to simulate deep seasonal frost, the second with two-sided freezing to simulate the active layer above permafrost. Equivalent field monitoring stations have been established at Steinhøi, Dovrefjell (Norway) and Endalen (Svalbard). Both stations are providing continuous records of soil and air temperatures, soil pore water pressures and soil surface displacements due to frost heave, thaw settlement and solifluction.

Steve Gurney (Univ. of Reading) is continuing to monitor periglacial processes in the Okstindan region of northern Norway. Research foci include the role of perennial snowpacks in the landscape and the environmental controls on earth hummock formation. This latter work is being led by Sally Hayward (Univ. of Southampton). The Okstindan area is also being used by Steve to introduce undergraduate students to periglacial geomorphology through a 10-day final-year fieldclass.

A cold room for experiments on permafrost processes has just been constructed at the University of Sussex, funded by the university. The cold room will permit two-sided freezing of large samples of rock, soil and concrete at different inclinations, to simulate permafrost developing within lowlands, mountains or building foundations.

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UNITED STATES OF AMERICA

Planning for the Ninth International Conference on Permafrost is well underway. The first Bulletin was prepared and mailed in early 2006 and posted on several web sites. The Local Organizing Committee at the University of Alaska began the initial logistic preparations. Field trip leaders met and revised the venues and schedules. Fund raising was begun and a proposal submitted to federal

agencies The U. S. National Committee for NICOP met on December 10, 2006, in San Francisco and reviewed plans for abstract and paper review, and the second Bulletin. Conference plans and pre-registration information are posted at: www.nicop.org.

The U.S. Permafrost Association (USPA) continues to attract new members. Visits to the USPA website exceeded 8000 «hits» during 2006 (www.uspermafrost.org). At the annual USPA meeting the following new members were elected to the Board of Directors: Ken Hinkel (President-Elect), Oliver Frauenfeld (Secretary), and Yuri Shur (Board Member).

The Fall Meeting of the American Geophysical Union was held in San Francisco, California, December 11-15, 2006. More than 80 reports and posters on permafrost, frozen ground, periglacial processes and hydrology were organized under the theme «Biocomplexity, Hydrology, Frozen Ground in Cold Regions» and other sessions.

A special session on the International Polar Year was organized by J. Brown and F. E. Nelson for the Annual Meeting of the Association of American Geographers (AAG) held in Chicago in March 2006. The Cryosphere Specialty Group organized a total of five sessions, including the IPY session, with a total of 24 presentations. Several awards were presented for the best poster presentations by young investigators.

Tom Krzewinski and Jon Zufelt provided the following report on recent and continuing activities of the American Society of Civil Engineers (ASCE) and its Technical Council on Cold Regions Engineering (TCCRE):

- The TCCRE Executive Committee members are: Jay Bergman (Chair), Tom Krzewinski (Vice Chair), John Woodworth, Jim Allen (Secretary), Bucky Tart (Past Chair), Jon Zufelt, (Journal Editor), and David Prusak (representative Technical Activities Committee).
- The ASCE 13th International Specialty Conference on Cold Regions Engineering took place July 23 - 26, 2006 on the campus of the University of Maine, Orono, Maine, with 175 attendees presenting 82 pre-published papers. ASCE President Dennis Martenson attended, addressed the participants and presided over the awards ceremony. The conference included an International Symposium on Ground Freezing. The Finnish Association of Civil Engineers (RIL) sponsored several sessions and the International Symposium on Soil Mechanics and Ground Engineering (ISSMGE) had their Frost Committee TC8 Meeting at the Conference. The conference was also cosponsored by the U.S. Permafrost Association.
- TCCRE Committees and ASCE are working with the organizers of the International Symposium on Cold Regions Development (ISCORD 2007); Tom Krzewinski and Hannele Zubeck are the official ASCE representatives. The conference theme is Cold Climate Resource Development <www.ril.fi/

iscord2007>. TCCRE is a cosponsor of NICOP and will assist with the permafrost engineering sessions, technical reviews of papers, and the field trips to Red Dog Mine.

- Tom Krzewinski and Ed Clarke are working with the Standards Committee on the Standard on Frost Protected Shallow Foundations (FPSF). TCCRE is representing ASCE in supporting a new PBS Documentary «Challenges of Transportation Infrastructure Design and Construction in Alaska». The focus will be on highways and railroads.
- Recent publications: The proceedings of the 12th Conference are available from the Construction Research Institute of Canada. Available from ASCE Headquarters are: Proceedings of the 13th Conference on CD Rom; TCCRE Monograph «Thermal Analysis, Construction and Monitoring Methods for Frozen Ground» published in April 2004; and the Quarterly *Journal of Cold Regions Engineering*.
- The following TCCRE monographs are in the preparations: Field Properties and Site Investigations - Frozen Ground; Hydraulics and Hydrology; Monograph on River Ice; Water Treatment in Cold Regions; Specialty Foundations in Cold Regions; Cold Regions Ports and Harbors.
- The ASCE 14th International Specialty Conference on Cold Regions Engineering will be in Duluth, Minnesota in 2009. The very successful 9th conference was held there in 1998.

Scott Huang (University of Alaska Fairbanks UAF) organized the 1st International Workshop on Geotechnical Engineering in Permafrost Regions Related to Pipeline Construction that was held on the Fairbanks campus on October 1-4, 2006. The workshop was a joint effort of the International Arctic Research Center (IARC), the Institute of Northern Engineering (UAF) and Hokkaido University, and with the Tyumen State Oil and Gas University. About 90 researchers, scientists and engineers from seven countries (U.S.A., Canada, Japan, Russia, UK, the Netherlands, and Korea) attended. During the two-day technical program, two keynote speeches and 15 papers were presented. Pre- and post-workshop field trips were conducted to the CRREL permafrost tunnel and to the Trans Alaska Pipeline System site at the Denali Fault crossing. A CD proceedings, including abstracts and presentations slides, is being prepared by Hokkaido University, and will be available in mid November 2006.

Vladimir Romanovsky reports on behalf of the Geophysical Institute/International Arctic Research Center of UAF permafrost group including Kenji Yoshikawa, Sergei Marchenko, Dmitri Nicolsky, Ronald Daanen, and Guido Grosse. We continue to record active layer and permafrost dynamics at our more than 60 sites within Alaska. Permafrost temperatures in all deeper boreholes (60 to 80 meters) within the northern portion of the transect were also measured. Generally, active layer thickness was slightly

greater this summer compared to the last year, and it is still larger than the average for the last 15 years. Temperatures in permafrost continue to increase in the northern Alaska, but at a lower rate compared to the 1990s. In Interior Alaska permafrost temperatures are approaching the highest level that was recorded during the mid-1990s. At many locations mean annual temperatures at the permafrost table are within several tenths of a degree of the melting point of ice. At one location, the depth of the permafrost table increased to 1.5 m (as compared to 1.0 m in 2005); this could be an indication of a new talik development. A new permafrost observatory (Imnaviat 1) was established in the vicinity of Toolik Lake, Alaska, as a part of a new collaborative project with Danish and Greenland colleagues. Another observatory is under development at the southern end of the transect in Gakona, Alaska. Our program received NSF and NASA funds to support the observatories in Alaska and Russia as part of the IPY activities. Guido Grosse joined the group as an IPY post doc who represented permafrost remote sensing and thermokarst development interests at the ICARP II workshop in Potsdam in November.

Kenji Yoshikawa and Tohru Saito (Institute of Northern Engineering, UAF) drilled and instrumented shallow (6 m) boreholes for temperature measurements in conjunction with local schools at Barrow, Noatak, Nome, Fairbanks, Beaver, Healy, Glennallen. The program is part of the NSF ESPCoR permafrost health outreach headed by Doug Goering. Additional installations are planned next year for Circle, Arctic Village, Fort Yukon, and a few more native villages. Borehole metadata and raw data are available at <www.uaf.edu/permafrost>. Yoshikawa and graduate student Sarah Seelen conducted permafrost hydrological research in the eastern Brooks Range. Ground water and spring samples were analyzed for isotopes and chemical models.

Fritz Nelson and Kolia Shiklomanov report on recent activities of the University of Delaware Permafrost Group (UDPG). Ground-penetrating radar investigations in Barrow during April provided new insights into the three-dimensional geometry of ice-wedge networks. CALM-related investigations in northern Alaska continued through the summer of 2006. UDPG has been actively involved in comparison of spatial permafrost models in collaboration with Oleg Anisimov, Tingjun Zhang, Vladimir Romanovsky and Sergey Marchenko (UAF). The research is concerned with comparing active layer predictions for northern Alaska produced by a series of spatial permafrost models, estimating the uncertainties in gridded air temperature fields, and evaluating their effects on predictive permafrost models. Two manuscripts resulting from this work are under review. In May, Jon Little defended his MSc thesis on the use of differential GPS to monitor frost heave and thaw settlement, and results are being readied for publication. Meixue Yang is completing a review of permafrost investigations on the Tibetan Plateau and

has submitted a series of manuscripts and proposals concerned with Tibetan permafrost. Silvia Cruzatt is using data from her network of climate stations in the Peruvian Andes to characterize the distinctive thermal regime of high-altitude subtropical soils. UDPG is increasingly active in Quaternary studies: Hugh French and Mark Demitroff submitted a review of their work on periglacial and permafrost features in southern New Jersey to a special issue of *Permafrost and Periglacial Processes* honoring the contributions of J. Ross Mackay. Kim Gregg (Univ. of Minnesota), who finished a MSc degree at UD several years ago, collaborated with F. Nelson and UD graduate student Mike Walegur on a paper for the Mackay volume. The work used Virtual Globes technology and data from Walegur's high-elevation climate network to assess the palaeoclimatic significance of blockfields in the Appalachian Mountains. UDPG is in the process of organizing a 2007 workshop on late-Pleistocene periglacial conditions in the eastern USA.

Ken Hinkel, University of Cincinnati, completed two, long-term projects near Barrow. The village relies on local natural gas fields to meet all energy requirements for building heat and electrical power generation, and dissipation of this energy results in a pronounced urban heat island (UHI) in winter. Since 2001, a 150 km² area in and around Barrow has been monitored using ~70 data loggers recording air temperature at hourly intervals. The UHI is most pronounced in winter months (December-March), with temperatures in the urban area averaging 2° C warmer than in the surrounding tundra and occasionally exceeding 6° C. Integrated over the home heating season, there is an 8 % reduction in freezing degree days in the village. However, it is unlikely that anthropogenic heat contributes to the forward shift in the snow meltout date that has been observed near Barrow over the past 60 years. The second project was initiated in autumn 1997, on an existing 2.2 km-long, 4 m-high snow fence located to the east of Barrow. A large drift develops each winter on the downwind side of the fence, and a smaller drift forms upwind. The results of the six-year study indicates that soil temperatures beneath the drift are 2-14° C warmer than the control in winter due to the insulating effects of the snow. The ground surface has experienced 10-20 cm of thaw subsidence in many places, and widespread thermokarst is apparent where snow meltwater ponds. Graduate student John Hurd participated in this project.

Wendy Eisner, Ken Hinkel, Chris Cuomo and colleagues (Kim Peterson, Eric Maurer, Richard Beck, Jim Bockheim, Ben Jones and graduate student Bill Mellman) are conducting a multidisciplinary study of landscape processes on the Arctic Coastal Plain. Comparison of Landsat-1 (MSS) imagery from the mid-1970s to Landsat-7 ETM+ imagery from around 2000 shows that 50 lakes completely or partially drained over the approximately 25-year period. Analysis of satellite images and aerial photos from the 1950s suggests that humans have intentionally or in-

advertently triggered lake drainage near the village of Barrow. Efforts to understand landscape processes and identify events have been enhanced by interviewing Inupiaq elders and others practicing traditional subsistence lifestyles. They can often identify the year and process by which individual lakes drained, thereby providing greater dating precision and accuracy in assessing the causal mechanism. Hunters, berry pickers and elders have identified areas where permafrost thaw has been extreme, and places where the sea and river bluffs are eroding. Indigenous knowledge has provided insights into events, landforms and processes not previously identified or considered.

Ron Sletten reports on permafrost research at the University of Washington. The fourth year of the NSF «Biocomplexity of Carbon Cycling in the High Arctic» was completed at Thule Air Base, Greenland. Investigations continued on the physical, chemical, and biological interactions and feedbacks on carbon flux, weathering, and ecosystem dynamics. Jennifer Horwath completed her PhD and found that soil organic carbon in the High Arctic has been substantially underestimated. Active monitoring sites at Thule include microclimate, soil temperatures to 1.4 m, TDR soil water content, river stage, and snow depth. Cooperation continues with the Alfred-Wegener Institute in Potsdam to study oxygen isotopes in lake diatoms. Two new NSF studies in Antarctica started in 2006 focus on the study of salts in soils in order to better understand ground ice dynamics and for interpreting geomorphology (collaborative proposal with M. Prentice, Indiana University). A NASA-funded study started in 2006 (D. Winebrenner, R. Sletten, B. Hallet, J. Putkonen, B. Hagedorn) that utilizes remote sensing to study snow cover using visible spectra and thermal properties using microwave. This study compliments the Dry Valleys studies to interpret remotely-sensed images and



UDPG-sponsored field trip, led by graduate student Mark Demitroff, Fritz Nelson, and US Geological Survey scientist Wayne Newell, held July 13, 2006 in association with the World Congress of Soil Science held in Philadelphia. Photograph by Del Levia.

spectra of Mars. Detailed modeling studies of ground ice utilizing climate data and stable isotopes of ice have been completed and are in press (Hagedorn *et al.*). For further information visit the web site <<http://depts.washington.edu/icylands>>.

Corien Bakermans, Center for Microbial Ecology, Michigan State University, reports that researchers from the Indiana-Princeton-Tennessee Astrobiology Initiative (IPTAI) and the Finnish Geological Survey completed in July 2006 a scientific drilling expedition in an Archean, mafic volcanic belt that is frozen to a depth of ~400 meters, near High Lake, Nunavut Territories, Canada. Permafrost at this location serves as an excellent analog of the Martian deep subsurface because of its low temperatures; host matrix of volcanic basalts with fractures and pore spaces; the presence of both saline and fresh groundwater; the very low organic content; and microbial communities and processes that may be independent of the surface. The borehole was drilled to a depth of 535 meters and the final 200 m of core containing the permafrost-subpermafrost boundary was collected and catalogued. Samples were taken for extensive geological and microbiological analysis (pore water composition, pore gases, isotope analysis, fluid inclusion analysis, DNA extraction, PLFA extraction, cell counts, microbial enrichments, etc.).

Jim Bockheim (Univ. of Wisconsin-Madison) has been working with a group of New Zealand scientists from Land Care Research and the University of Waikato mapping soils and permafrost features in selected ice-free areas of Antarctica (see Working Group report).

Torre Jorgenson (ABR Inc.) Chien-lu Ping, Yuri Shur, Michael Kanevskiy, Gary Michaelson, Fugen Duo, Daniel Fortier, and Lorene Lynn (Univ. of Alaska) and visiting student Eva Stephanie returned to the Alaskan Beaufort Coast during late July and early August 2006 to complete their sampling of soil and permafrost characteristics at 50 sites along the coast. The data from these sites will be used in their study of the flux and transformation of carbon along the eroding coastline to calculate carbon stocks, erosion rates, and fluxes of carbon into the nearshore environment. The helicopter-supported sampling was based out of Prudhoe Bay and Kaktovik. In addition, C. Ping, L. Lynn, F. Duo, and D. Fortier did more intensive sampling at Barrow in mid-August. In September, T. Jorgenson visited the village-based monitoring sites at Barrow, Colville Delta, and Kaktovik to download his time-lapse cameras, water-level recorders, and soil temperature recorders and to resurvey the coastal erosion transects. The project is part of the NSF Study of Northern Alaska Coastal Systems (SNACS) program.

Y. Shur, M. Kanevskiy, and D. Fortier (UAF), T. Jorgenson (ABR Inc.), Vladamir Tumskey (Moscow State University), and visiting student E. Stephanie sampled permafrost characteristics at Matanuska Glacier, Cape Espenberg, Old Man, Koyukuk Flats, Tanana Flats, Sheenjek River, King Salmon, and the Fairbanks perma-

frost tunnel. T. Jorgenson and T. George (Terraterpret) completed their acquisition of high-resolution aerial photography at 1000 sites across central and northern Alaska for quantifying the nature and extent of thermokarst. The project is funded by NSF with addition support from the National Park Service, and the Fish and Wildlife Service.

Y. Shur also reports on the NSF-EPSCOR program for Alaska to facilitate research in the area of permafrost and frozen ground engineering. Two postdoctoral fellows are actively involved in research on coastal dynamic and carbon release and on aggradation and degradation of ground ice. A new experimental site at the UAF campus is under construction to study the effectiveness of thermosyphon (heat pipes) in warm permafrost. Graduate students are studying creep properties of frozen soils, impact of earthquakes on frozen soils, geotechnical problems associated with chilled gas pipelines and others.

Nicole Mölders and Pai Mazumder (UAF) evaluated the active layer depth and soil temperatures predicted by the Common Land Model, the land surface model used in the Community Climate System Model version 3.0 by means of observations for Russia. They found that the annual mean temperatures are well captured, but soil temperatures are overestimated in winter and underestimated in summer. Reasons for the discrepancies can be pointed to incorrect prediction of precipitation and snow depth as well as the choice of the soil parameters.

Zhaohui (Joey) Yang, He Liu (School of Engineering) and Utpal Dutta (Environment & Natural Research Institute) from University of Alaska Anchorage (UAA) continue to work on the seasonally frozen ground effects on the engineering structures by using seismic data recorded on bridges and high-rise buildings. Joey Yang and Utpal Dutta have recently received two grants from Advanced National Seismic System of U.S. Geological Survey to instrument a bridge and a high-rise building in Anchorage. State-of-the-art seismic sensors and data acquisition systems will be installed for collecting building performance data in cold conditions and during seismic events.

Hannele Zubeck (UAA) conducts an on-line graduate program on Arctic Engineering. The program includes courses on a variety of cold regions engineering issues taught by the faculty at the UAA and the affiliate faculty at the USACE Engineer Research and Development Center, CRREL. Prospective students desiring to obtain Masters of Science in Arctic Engineering in an on-line environment using Blackboard learning system are invited to visit <<http://www.engr.uaa.alaska.edu/programs/arctic/index.cfm>> or contact H. Zubeck (atafhkz@uaa.alaska.edu).

Gary Clow and Frank Urban (U.S. Geological Survey) continued development of the U.S. Department of the Interior's contribution to the GTN-P monitoring program. Significant improvements were made to the radio-telemetry network in the eastern portion of the U.S. National Petroleum Reserve (NPR-A) in northern Alaska.

Of the 15 automated stations in the DOI/GTN-P active-layer network, five are now available via real-time telemetry and eight are co-located with deep boreholes. As yet another sign that conditions in the Arctic are rapidly changing, one of the wells (J.W. Dalton) was lost to coastal erosion and another three are threatened. Given the anticipated loss of wells along the arctic coast, a major successful effort was made to restore a 735-m deep well (West Fish Creek) about 30 km inland to a state where it could be logged again. In preparation for the IPYTSP campaign, the USGS Polar Temperature Logging System is being upgraded. The standard uncertainty of the temperature measurements with the upgraded system is expected to be less than 3.3 mK for temperatures below 0° C.

Tom Douglas (CRREL) reports on the status of recent permafrost research at the Farmers Loop Permafrost Research Site near Fairbanks, Alaska. The second year of active layer measurements were made on CALM site (121 probe points on a grid with 3 meter spacing). Average active depths including moss were 57.5 cm in 2005 and 53.5 cm in 2006. A meteorological tower has been in operation for over a year. Torre Jorgenson and Yuri Shur selected sites a series of boreholes that were drilled and instrumented in November with the assistance of V. Romanovsky. Included are the 1946 surface disturbance sites. Additional collaboration on the project is encouraged; contact Thomas.A.Douglas@erdc.usace.army.mil

Kevin Bjella (CRELL) reports that the 100-m long permafrost tunnel in Fox, Alaska, is being upgraded. The tunnel, constructed in 1963–69, provides a unique facility for research and education. Modifications to the cooling system are being initiated to reduce air temperature and to slow deformation to ensure that the tunnel will be useable for decades to come. The University of Alaska is assisting financially in the renovation and Yuri Shur and associates are conducting research on the stratigraphy and properties of frozen ice-rich slits. The tunnel will be available for visits by NICOP participants.

Jack Hébert reports that the Cold Climate Housing Research Center (CCHRC), located on the UAF lower campus, completed construction of the new Research and Test Facility (RTF) in September and held its Grand Opening on September 23. CCHRC chose an area of degrading permafrost for a construction site to use the RTF building itself as the basis for research. The foundation is designed to be adjustable with a series of 50-ton hydraulic jacks in the event that differential settlement occurs as permafrost degrades. An extensive monitoring system was installed, in partnership with GW Scientific (Michael Lilly) and Campbell Scientific (Austin McHugh), to help monitor permafrost and active layer conditions, groundwater conditions, and thermal and unfrozen soil-moisture conditions in the sub-grade portions of the basement. The CCHRC RTF will help provide valuable information for building construction techniques in permafrost conditions <<http://www.cchrc.org/RTF%20guide.pdf>>.

Sheldon Shaw and Ed Clarke, report that Soils Alaska (Fairbanks) performed geotechnical investigation at over 150 sites in Interior Alaska during 2006. Foundation design projects included driven steel pilings with thermoprobe refrigeration for radio towers; structurally enhanced foundations for installation on frozen gravel and recently thawed soils; and post and pad foundation design for use on high-moisture frozen silts. Shaw designed a non-conventional on-site wastewater disposal systems for installation where separation distances are too small and soils conditions unstable. The Fairbanks region is experiencing a housing boom and many sites previously deemed unsuitable for development are being investigated with an eye toward development via unconventional arctic foundation systems. Ed Clarke is serving as Editor of the upcoming TCCRE Cold Regions Monograph on «Arctic Foundations – State of the Practice».

During July 16-22, 2006, Chien Lu Ping (UAF) led the World Congress of Soil Society post conference tour «Cryosols and Arctic Tundra Ecosystems». Assisting C.L. Ping with the field trip were, Ed Packee (Professor Emeritus of Forestry, UAF), Joe Moore (AK State Soil Scientist) and Gary Michaelson (Logistics Coordinator, UAF). Twenty participants representing seven countries participated and were accompanied by a support team of seven. The tour included ten stops from Fairbanks to Deadhorse of the Coastal Plain region of Alaska and return. Soil pits were dug and cryogenic features investigated at Coldfoot, Galbraith Lake, Toolik Lake, Sagwon and other sites along the way. Participants had a first hand view of permafrost and ground-ice features in the CRREL permafrost tunnel, viewed the destruction of fire in boreal forests soils, learned about patterned ground, and had the chance to view the oil fields of Prudhoe Bay. A guidebook is available from the University of Alaska Experimental Station.

Other projects reported in previous issues of *Frozen Ground* continue in 2006 and information can be obtained directly from the investigators or from the U.S. Permafrost Association web site <www.uspermafrost.org>.

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Participants in the Alaska field tour of the World Congress of Soil Society *Cryosols and Arctic Tundra Ecosystems*. Photograph by Chien Lu Ping.

ASSOCIATE MEMBER: PORTUGAL

Activities of the Portuguese group during 2006 focused on (1) palaeoenvironmental reconstruction of permafrost environments, (2) permafrost of the Maritime Antarctic, (3) preparation of the International Polar Year.

The Centre for Geographical Studies of the University of Lisbon group (CEG-UL) continued the research in the Serra da Estrela mountain range with the objective of developing the chronology of the glaciation of the mountain and to identify the palaeo-altitudinal zoning of permafrost and frozen ground conditions in the mountain range. The coordinator of these activities is Gonalo Vieira. A project focusing on these objectives, but including all the glaciated mountains of Portugal has been prepared and submitted for evaluation. The project involves the universities of Lisbon, Aveiro, A Corua (Spain), Complutense de Madrid (Spain) and Bordeaux (France). If funding is received the project will enable a strong development of the glacial and periglacial chronology and, new insight into the palaeoenvironmental conditions of the Portuguese mountains. Maria Lusa Rodrigues (CEG-UL) has prepared a glossary of karst landforms that includes a significant part on periglacial features. This glossary will be published in the forthcoming months.

Permafrost research in the Maritime Antarctic has been a major field of research in 2006. Gonalo Vieira has been organising the Research Group on Antarctic Permafrost and Climate Research (GIPCA) at the CEG-UL that includes six researchers and three collaborators. The group has conducted research in Livingston and Deception Islands in January-February 2006 (CALM-S sites installation, geophysical surveying of permafrost and permafrost and active layer surveying and monitoring). In December 2006, Alexandre Trindade is participating in the Bulgarian Antarctic Campaign in collaboration with the Bulgarian Antarctic Institute (C. Pimpirev and R. Kendorova) that aims at studying permafrost distribution and at installing active layer monitoring sites in Hurd Peninsula (Livingston Island). Mario Neves will be participating in the Spanish Antarctic Campaign to continue the permafrost and active layer research in Deception and Livingston

Islands and will also install several Traverse Micro-Erosion Meter sites to measure coastal platform erosion rates. Two projects coordinated by Miguel Ramos (University of Alcal, Spain), one for the period 2006-07 and another for 2007-09 have been funded by the Spanish Antarctic Programme. These projects are included in the initiative PERMAMODEL – Permafrost and Active Layer Monitoring and Modelling in the Maritime Antarctic, that is part of the IPY core projects ANTPAS and TSP. A project proposal led by G. Vieira was submitted for funding to the Portuguese National Science and Technology Foundation aiming to install new boreholes in the South Shetlands (Antarctic). Other objectives are permafrost and active layer mapping and modelling, construction of a database of ground physical properties and research on the coupling between mesoscale climate models and the ground temperatures. The project includes researchers from the Centres of Geophysics of the universities of Lisbon and vora. Besides the collaborations with the Spanish and Bulgarian Antarctic programmes, collaborations within the Argentinian and Brazilian programmes are under preparation.

The preparation of the International Polar Year has occupied a significant part of the work of the members of IPA-Portugal. Due to this effort, the country that despite the historical leading role in polar discoveries has no tradition in polar science research, has now a IPY committee and a document with a proposal for the guidelines for the Science Strategy for the IPY. In this document, Antarctic permafrost research occupies a major role, together with Antarctic biology. The effort also resulted in the national membership of SCAR since July 2006. A significant amount of work is being conducted in E&O activities with a strong presence of permafrost research in all national media. The national E&O programme for the IPY LATITUDE60! counts with the collaboration of several members of GIPCA and already involves more than 100 teachers from kindergarten to university level. Information in Portuguese can be found at <<http://anopolar.no.sapo.pt/latitude60/index.html>>.

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OTHER NEWS

ROMANIA

During the past year, Romanian researchers have developed glacial, periglacial and permafrost research in the Romanian Carpathians. The Geography Department of the West University of Timisoara works on the Research Project financed by National Council for Superior Education Scientific Research (CNCSIS) entitled «Geographical risk phenomena in the alpine belt of the Southern Carpathians: use of GIS technique and the achievement of maps of risk phenomena» (Mircea Voiculescu). Under the leadership of Petru Urdea, another research project, «The impact of the climatic changes upon the Holocene and present dynamics of the alpine environment from the Romanian Carpathians: implications in the risk management and landscape's arrangement (MEDALP)» started. The project is in collaboration with scientists from other institutions (West Univ. of Timisoara; Univ. of Bucharest; National Inst. for Forest Research, Campulung-Moldovenesc Branch; Inst. of Geography of the Romanian Acad., National Authority of Meteorology). The project has two major research directions: (1) the Holocene to present evolution of the alpine landscape in the Romanian Carpathians; (2) the analysis of the present geomorphologic processes, including the monitoring of permafrost and periglacial processes, and drawing of large scale maps of the landscape and geomorphologic risks in order to conserve the natural environment.

Glacial and periglacial relief and relict permafrost indicators were studied by Smaranda Simoni (Univ. of Pitesti) in Zarna-Leoata area (Fagaras Mts.), by Marcel Mandrescu (Univ. of Suceava) in Suhard and Tibles Mts. (Eastern Carpathians) and in Calimani Mts. by a team from «Univ. of Budapest, Hungary, lead by Nagy Balaz. Alexandru Onaca (West Univ. of Timisoara) started investigations in the Capatanii Mts. (Southern Carpathians).



The Doamnei valley, Romania. Photograph by Petru Urdea.

The Second International Workshop «Alpine Geomorphology and Mountain Hazard» took place September 14-17, 2006, at Bălea Cascada (Fagaras Mountains). This workshop was organized by the Department of Geography, West Univ. of Timisoara, under the scientific coordination of the Carpatho-Balkan Geomorphologic Commission, Romanian Association of Geomorphologists, and the Institute of Geography of the Romanian Academy. Participants were from Germany, Italy, Hungary, Bulgaria, Greece, Czech Republic and Romania. The field trip was held in the Doamnei valley, an area with expressive late glacial and periglacial landforms.

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SOUTH KOREA

The Korea Polar Research Institute has carried out geothermal measurements in three boreholes at Dasan station, Svalbard, and at King Sejong Station, Antarctica since 2003 to obtain data on changes in ground temperature. We are prepared to obtain engineering data and parameters for permafrost technology including thermal conductivity (diffusivity) of soils and heat transfer mechanisms.

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CLIMATE AND CRYOSPHERE (CliC)

During the last year, the Climate and Cryosphere (CliC) project of the World Climate Research Programme (<http://wcrp.wmo.int>) has supported many new cryosphere-related initiatives. IPA is a close partner of CliC in many initiatives.

CliC is for example working with the IPY cluster *Carbon Pools in Permafrost Regions (CAPP)*, a core IPA project. In conjunction with the Arctic Monitoring and Assessment Programme AMAP <www.amap.no>, CliC is supporting an initiative on Arctic Carbon Cycle Assessment, in which permafrost specialists are involved.

An activity particularly relevant to frozen ground specialists is the Integrated Global Observing System for Cryosphere (IGOS Cryosphere Theme). The Theme Report (<http://igos-cryosphere.org>) is the first document to bring all cryospheric components together in a comprehensive manner to be used by decision makers for prioritizing needs and for use by scientists for proposing science and observing initiatives. Implementation of the CryOS (cryosphere observing system) will be a focus for IPY. During IPY and as part of CryOS observing networks are being developed in both polar regions, for example the Pan-Antarctic Observing system (PanthOS) currently under discussion.

CliC is developing regional groups such as Asia-CliC. The 1st Asia CliC Symposium «The State and Fate of Asian



Cryosphere» held in Japan in April engaged researchers from over a dozen countries to define collaborative initiatives in Asia that address regional priorities and contribute to CliC goals and objectives. A CliC support office is being established in Japan and Asia-CliC meetings are being planned for 2007 (including a workshop March 21–24 in Japan on hydrology in eastern Eurasia). A CliC regional group is under development in Latin America, on the basis of an existing Latin-American Snow and Ice Working Group partly sponsored by the International Hydrological Programme (UNESCO). Involvement of specialists with other cryospheric interests, including frozen ground, is encouraged.

The CliC project office maintains a website <<http://clic.npolar.no>>, and publishes a newsletter approximately twice per year. CliC has established a cryosphere 'specialist' list to help find experts to provide advice and serve on panels and committees. Permafrost / frozen ground specialists are most welcome to register in the database (information provided will be used for official CliC purposes only): <<http://clic.npolar.no/specialists>>.

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IUGG/CCS NEWS

The first event organized by the newly formed IUGG Commission for the Cryospheric Sciences (UCCS) was the International Symposium on Cryospheric Indicators of Global Climate Change, held in Cambridge, UK, 21–25 August 2006, and co organized with the International Glaciological Society (IGS) and the WCRP Climate and Cryosphere. A total of 224 delegates attended, 292 abstracts were submitted, 111 talks and 105 posters were scheduled, and approximately 80 papers were finally submitted for the proceedings volume to be published in the *Annals of Glaciology* 46. Professor Richard Alley was awarded the IGS Seligman Crystal. Student awards were presented to Peter Kuipers Munneke for the best oral presentation and to Matthias Huss for the best poster presentation.

In October the UCCS bureau met at the WMO in Geneva. The joint IPA-UCCS working group GAPHAZ continued its strong activity (see Working Group report for details). The XXIV IUGG General Assembly will be held in Perugia, Italy, June 2 – 13, 2007, and the UCCS will contribute to some thirteen sessions. IPA is a co-sponsor of the symposium JHW002 on Climate-Permafrost-Hydrology Interactions. During the past year, planning for a joint assembly in Montreal (July 20 – 29, 2009) was discussed with the International Association of Meteorology and Atmospheric Sciences (IAMAS) and the International Association for the Physical Sciences of the Oceans (IAPSO).

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THE SECOND INTERNATIONAL CONFERENCE ON ICE CAVES

After the Capus, Romania, meeting in the 2004, the Second International Conference on Ice Caves (IWIC-II) was held in Demanovska Dolina, Slovak Republic, May 8–12, 2006. The conference was in collaboration between the Slovak Caves Administration, Earth Science Dept. of University of Milano (Italy), the Worclaw University (Poland) and the Environmental Sciences Dept. of Univ. of Milano-Bicocca, and under the auspices of UIS-GLACKIPR Commission. About 60 scientists and students from 12 countries participated with around 50 papers and poster covering the full range of the ice caves studies in the world. Topics included hydrological and climatic formation processes, structural and crystallographical characteristics, climatic significance of the ice deposits, biological and ecological studies, conservation and tourism impact. In the five days of conference the most important Slovak ice caves from different karst contexts and origins were visited with important discussion in the field. New joint collaborations developed for the future works.

Information on the conference may be obtained from the web site <<http://users.unimi.it/icecaves/IWIC-II>>.

The Scientific Commission decided to accept the invitation for Kungur (Ural) Russia for the next IWIC-III Conference in 2008.

Valter Maggi (valter.maggi@unimib.it)

TWENTY-FIFTH ANNIVERSARY: CANADA–FRANCE GROUND FREEZING PROJECT

This year marks the twenty-fifth anniversary of the Canada–France Ground Freezing Project which was officially launched in December 1981 with joint French-Canadian governments funding through to 1989, and in collaboration with industry support through 1994. The project was co-ordinated by Carleton University, Geotechnical Science Laboratories under the leadership of Professors Peter Williams and Michael Smith in cooperation with a team of French researchers Dupas, Dumoulin, Guillemet, Letavernier, Jean and Delhomme led by Dr. Michel Fremont and Dr. Jean-Pierre Lautreidou representing the Laboratoire Central des Ponts et Chaussées and the Centre de Géomorphologie; Centre National de la Recherche Scientifique.

Over this twelve-year period, six long-term buried chilled pipeline frost heave test cycles were conducted at a research laboratory operated by the CNRS in Caen, France, including free/unrestrained heave and differential heave. This international project successfully highlighted the significant challenges of the construction and performance of gas pipelines in cold regions characterized by permafrost-affected terrain. The project also left a legacy of

young permafrost scientists and engineers who while pursuing graduate research assumed managerial roles in France overseeing the ground freezing experiments.

The ground freezing experiments undertaken in France concerned primarily with an examination of the interdependence of a buried chilled pipe with freezing soils and permafrost. Buried chilled pipelines are subject to stresses imposed by the freezing process wherever there are spatial differences in frost heave. Variations in frost heave can be due to differences in the properties of the soil, or to differences in the thermal transition between perennially frozen and seasonally frozen soil and hydrological conditions.

The project clearly demonstrated the effects of differential frost heave combined with the resistance to deformation by the non frost-susceptible soil that will result in bending stresses in the pipe. At the same time, the resistance of the pipe to bending was shown to transfer stresses to the soil, which were observed to alter the thermodynamic conditions governing the process of ice segregation.

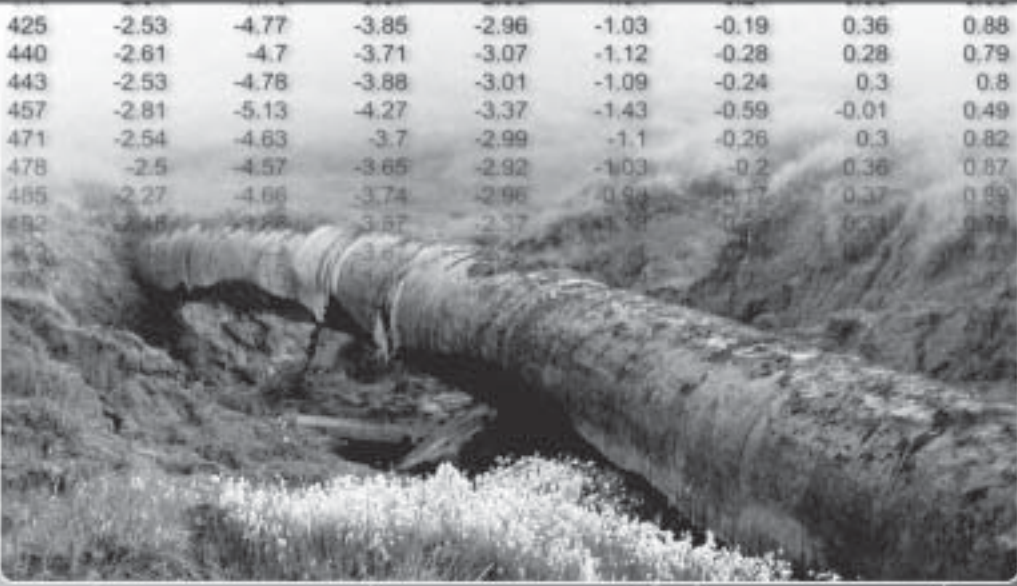
Although the tests results from Canada-France Pipeline Ground Freezing Experiment have been described in the literature found in the public domain, additional information is now required from the data produced from

these experiments in order to carry out the necessary modelling of frost heave of chilled gas pipelines in permafrost and for frost bulb growth predictions.

Permafrost Environmental Consulting, a cold regions research company, developed from the former Research Unit at Carleton University, Geotechnical Science Laboratories, which managed the Canada-France ground freezing experiments has over the last five years undertaken the task of finding and then preserving this legacy of research through the retrieval of raw data produced from the six ground freezing experiments. Six databases containing raw data sets for each of the ground freezing experiments and an accompanying fourteen volume resource library consisting of a user manual, reports and an assortment of publications are being released this year to commemorate the twenty-fifth anniversary of the inauguration of this project. A portion of the proceeds from these databases will be used to fund an endowment for a Northern Research Scholarship at Carleton University.

For further information contact: Thomas L. White, Permafrost Environmental Consulting <white@permafrost.ca>.

425	-2.53	-4.77	-3.85	-2.96	-1.03	-0.19	0.36	0.88
440	-2.61	-4.7	-3.71	-3.07	-1.12	-0.28	0.28	0.79
443	-2.53	-4.78	-3.88	-3.01	-1.09	-0.24	0.3	0.8
457	-2.81	-5.13	-4.27	-3.37	-1.43	-0.59	-0.01	0.49
471	-2.54	-4.63	-3.7	-2.99	-1.1	-0.26	0.3	0.82
478	-2.5	-4.57	-3.65	-2.92	-1.03	-0.2	0.36	0.87
485	-2.27	-4.66	-3.74	-2.96	-0.99	-0.17	0.37	0.89
492	-2.46	-4.68	-3.67	-2.97	-0.99	-0.17	0.37	0.89



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PUBLICATIONS

All past issues of **Frozen Ground** have been scanned and are now on the IPA web <www.geo.uio.no/IPA/IPA%20FrozenGround.htm>

Practical Dictionary of Siberia and the North (Severnaja entsiklopedija) - Akbaljan E., Golubchikova V., Khvtisiashvili Z., Paris: Publications Maecenas 2004. 1200 pages, with CD-ROM. ISBN 5-98797-002-4. EUR 92.59 / USD 117.82. In Russian: Moscow: Evropejskie izdanija 2004. ISBN 5-98797-001-6. Title nr 101407. EUR 138.89 / USD 176.71. E-mail: andreas.agopov@ruslania.com. Ordering possible at: www.ruslania.com

This book embraces the history, nature, geography, economy of the northern areas of the whole world (Siberia, Scandinavia, Canada, Alaska, the North Pole, Northern Russia, Greenland), including the ethnography of indigenous people. The dictionary contains 500 black-and-white illustrations and three color inserts with Northern maps, flora and fauna, and clothing of Northern peoples.

It is published in two languages, English and Russian, both have an attached CD-ROM containing more than 2,000 illustrations, pictures, and maps, as well as sound tracks of Northern ethnic music.

Los Fenómenos Periglaciales. Identificación, Determinación y Aplicación (Periglacial Phenomena. Identification, Determination and Application) - Dario Trombotto & Ana-Lía Ahumada, Opera Lilloana, 2005, Nr. 45: 131 pages. (ISBN number 9506680108). 18 USD (including postage). In Spanish. Available from: María Ángela Prieto <biblioteca@lillo.org.ar>, Sección Venta de Publicaciones. Centro de información Geo-Biológica del NOA. Fundación Miguel Lillo. Miguel Lillo 251, 4000 San Miguel de Tucumán, Argentina.

The **International Glaciological Society** launched a new practice in which they publish Journal and Annals papers on their website <www.igsoc.org> as soon as the authors have proofread the article and it has been corrected and proofed by the IGS house editor.

The Arctic Institute of North America (AINA) launched an **Arctic Science and Technology Information System (ASTIS)** database containing 60,000 records describing publications and research projects about northern Canada < www.aina.ucalgary.ca/astis>; for information & suggestions, contact: Ross Goodwin <astis@ucalgary.ca>.

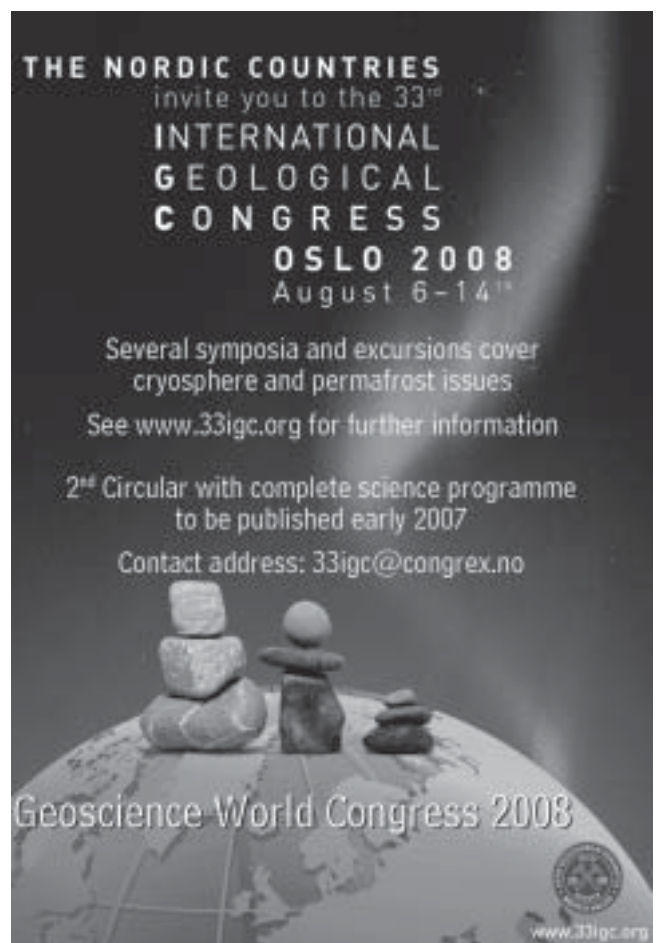
The **Cryosphere Glossary at NSIDC** <<http://nsidc.org/cgi-bin/words/glossary.pl>> contains general and scientific terms related to Earth's frozen places, including permafrost terms.

PLANNING CALENDAR

The following meetings share common interests with the IPA Membership and Working Parties. The list is not all inclusive, but is intended to help avoid overlaps in scheduling future IPA and other international meetings. Please send corrections and additions to the IPA secretariat (ipa@unis.no). Readers are referred to web sites or individual email contacts for more information.

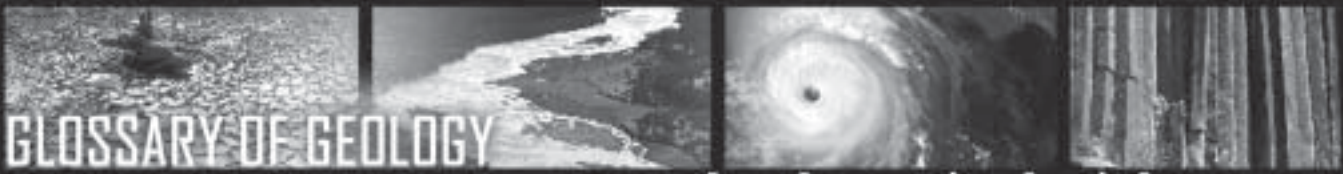
2007

- January 15-16, Periglacial and Paraglacial Processes and Environments, Past, Present and Future, Meeting of the Geological Society of London, London, U.K. <www.geolsoc.org.uk>
- March 14-21, Arctic Science Summit Week, Hanover NH, U.S.A. <<http://www.dartmouth.edu/~arctic/ipy>>
- April 15-20, European Geosciences Union, Vienna, Austria <www.copernicus.org/EGU>
- June 17-20, Cryogenic Resources of Polar Regions, Salekhard City, Polar Circle, West Siberia. Excursions (Polar Ural, Mare-Sale and Salekhard area): June 21-22 <www.ikz.ru/permafrost>
- June 25-27, 1st Iberian Conference of the IPA, Guarda, Portugal <www.ceg.ul.pt/ipa_iberia>. Contact: <gtvieira@ceg.ul.pt>
- July 2–13, 24th General Assembly of the International Union of Geodesy and Geophysics (IUGG), titled «Earth Our Changing Planet», Perugia, Italy <www.iugg2007perugia.it>
- July 28–August 3, XVII INQUA Congress, Cairns, Australia <www.inqua2007.net.au>
- August 26 – September 1, 10th International Symposium on Antarctic Earth Sciences (ISAES-2007), University of California, Santa Barbara, U.S.A. <<http://isaes2007.geol.ucsb.edu>>
- September 2-7. Joint meeting of the Austrian Commission on Geomorphology and the IAG Working Group on Geomorphology and Global Environmental Change «Research frontiers in Geomorphology», Obergurgl, Austria <www.geomorph.org/wg/wggcg.html>
- September 3-7, International Symposium on Snow Science, Moscow, Russia <www.igsoc.org>
- September 25-27, 8th International Symposium on Cold Region Development, Tampere, Finland <www.ril.fi/iscord2007>
- December 10–14, American Geophysical Union Fall Meeting, San Francisco, California, U.S.A. <meetinginfo@agu.org>; annual meeting of U.S. Permafrost Association and U.S. National Committee for NICOP <www.uspermafrost.org> and <www.nicop.org>



2008

- April, European Geosciences Union, Vienna, Austria <www.copernicus.org/EGU>
- May, Pushchino, Russia. Contact: <gilichin@issp.serpukhov.su>
- June 29–July 3, Ninth International Conference on Permafrost, Fairbanks, Alaska, U.S.A. <www.nicop.org>
- July 8-11, SCAR Open Science Conference, St. Petersburg, Russia <www.scar.org>
- August 6–14, 33rd International Geological Congress, Oslo, Norway <www.33igc.org>
- August 15–20, 31st Congress of the International Geographical Union, Tunis <www.igu-net.org> <www.agt.org.tn>
- December, American Geophysical Union Fall Meeting, San Francisco, California, U.S.A. <meetinginfo@agu.org>; annual meeting of U.S. Permafrost Association <www.uspermafrost.org>




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