# Full Proposals for International Polar Year 2007-2008 Activities

## Proposed IPY Activity Details

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### 1.0 PROPOSER INFORMATION

(Activity ID No: 117)

**1.1 Title of Activity**
International Partnerships in Ice Core Science (IPICS)-International Polar Year Initiative

**1.2 Short Form Title of Proposed Activity**
IPICS-IPY

**1.3 Activity Leader Details**
Edward Brook
United States
United States

**1.4 Lead International Organisation(s) (if applicable)**
PAGES (Link with PAGES is still under discussion).
SCAR (Link with SCAR is still under discussion).
NULL
NULL

**1.5 Other Countries involved in the activity**
United States
United Kingdom
Denmark
France
Germany
Russia
Japan
Switzerland
Australia
China
Italy
Canada
NULL
NULL
NULL
NULL

**1.6 Expression of Intent ID #'s brought together in this proposed activity**
203, 40, 434, 890, 184, 561, 944

**1.7 Location of Field Activities**
Bipolar

**1.8 Which IPY themes are addressed**
1. Current state of the environment
2. Change in the polar regions
3. Polar-global linkages/tele-connections
4. Exploring new frontiers
5. The polar regions as vantage points

**1.9 What is the main IPY target addressed by this activity**
1. Natural or social science

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## 2.0 SUMMARY OF THE ACTIVITY

Ice cores have contributed substantially to understanding climate change. They provide convincing evidence of large, abrupt climate changes, demonstrate links between greenhouse gases and climate, and show how humans have altered the atmosphere. However, there is a great deal more to learn. In 2004, representatives of all major ice coring nations agreed on a common agenda for the next decade. This agenda looks beyond established projects and includes coring over all available timescales, with highest feasible resolution. IPY provides an opportunity to launch this initiative. Other ice coring efforts, including some that are part of International Partnerships in Ice Coring (IPICS), are the subject of separate IPY submissions, as indicated below. IPICS-related events planned for IPY include:

1. Searching for the longest possible ice core record. The oldest Antarctic ice core so far extends 800-900 kyr. Before this, Earth's climate had a 40 kyr glacial-interglacial periodicity. IPICS aims to find a 1.2 Myr record and help discover why the period changed. During IPY, initial survey work will occur as part of the TASTE-IDEA ice divides traverses, by French/Italian/Russian teams in the Dome C-North Vostok-Dome B region, by a Chinese team near Dome A, and by US-led radar and remote sensing teams. IPICS will collate results to recommend drilling sites.
2. Initiation of coring to recover the last interglacial and older ice from Greenland. The last interglacial was probably warmer than the present and is an analogue for an anthropogenically-warmed world. We need to learn about the behaviour of climate and the Greenland ice sheet during times of warmer climate. The oldest reliable core only partly penetrates the last interglacial. Drilling in northwest Greenland would start, and possibly finish, in IPY. Danish, US, French, Japanese, UK, Swiss, Swedish, and German groups have expressed interest, and others are expected to join. Note that while this effort is part of the IPICS agenda, it also falls under IPY lead project # 561 (Greenland’s Ice Sheet – reactions to past and present climate change), which will lead IPY efforts related to this element of IPICS.
3. Starting a detailed spatial network of deep and intermediate-depth Antarctic ice cores. The spatial pattern of change is key to climate dynamics. We have cores from central East Antarctica and from a few coastal regions, but additional data are needed from other key areas, including the northern part of Lake Vostok, coastal Antarctica, the Antarctic peninsula, and West Antarctica. New projects like the European drilling at Talos Dome (east Antarctica) will take place during IPY. These programs will provide a springboard for a larger effort to fully sample Antarctic spatial climate variability on all possible time scales.
5. The WAIS Divide Ice Core. This West Antarctic ice core will produce the best climate record covering the past 100,000 years, including highly resolved histories of atmospheric carbon dioxide and other greenhouse gases, and millennial and shorter time-scale climate change in Antarctica. The main drilling starts during IPY, in the 2007/2008 Antarctic field season.
4. Late Holocene climate change. Future change can only be assessed in the context of natural climate variability. Highly resolved compilations of past global climate (timescale up to 2000 years) critically lack polar data. The SCAR project, ITASE, produced 250 cores that cover the last 250 years. Extending this time scale to the last millennium, and expanding the scope in the Arctic, are critical. IPY will engage all countries to complete work in Antarctica and continue the effort in the Arctic.
6. SOFIA (Search for the Oldest Firn Interstitial Air). SOFIA aims to obtain firn air records

spanning more than the last 150 years, encompassing much of the period from the industrial revolution to the present day. Large firn air samples are critical for understanding this period of atmospheric history as they allow measurements (of trace species or isotopic ratios) that are otherwise impossible with ice core samples.

**2.1 What is the evidence of inter-disciplinarity in this activity?**
Ice core research is inherently interdisciplinary as it involves glaciology, remote sensing, polar engineering, atmospheric chemistry, paleoclimatology, polar biology, climate modelling, ocean and atmospheric dynamics, geochemistry, geology, geochronology, and a variety of other fields. Many or all of these disciplines are represented in the IPICS group as it exists so far.

**2.2 What will be the significant advances/developments from this activity? What will be the major deliverables? What are the outputs for your peers?**
1.International unification of ice coring research and training of the next generation of chemists, geologists, glaciologists, atmospheric scientists, biologists, and engineers involved in ice coring.2.Site selection for a major new project - the first Antarctic ice core record reaching > 1 million years. This includes developing a new understanding of ice dynamics in interior east Antarctica. Expected deliverables include probable drilling locations, at least one workshop report, and peer reviewed papers. 3.The first ice core record of the last interglacial period in Greenland, a possible analogue for future warming of the northern Hemisphere. Expected deliverables include the ice core and climate records from it published in peer reviewed papers, and the borehole itself.4.Initiation of drilling of a major new high resolution ice core covering the last 100,000 years in West Antarctica (WAIS Divide). 5.Improved understanding of polar climate variability on time scales from latest Holocene through the last glacial period, including climate change of the last millennium, the role of greenhouse gases in climate change, evolution of the anthropogenic impact on the atmosphere, and the manifestation of abrupt climate change in Antarctica. 6.Broader understanding in the general public of polar science and the role of polar science in studying environmental change, through IPICS outreach efforts (web sites, collaboration with museums and educational institutions, etc.).

**2.3 Outline the geographical location(s) for the proposed field work (approximate coordinates will be helpful if possible)**

| Locations | Coordindates |
|---|---|
| Antarctica, WAIS Divide Ice Core site | S 79.468, W112.086 |
| East Antarctica, Dome C-North Vostok-Dome B | |
| Northwest Greenland | |
| Various locations on the Greenland ice sheet | |
| Various locations on the Antarctic ice sheet | |

**2.4 Define the approximate timeframe(s) for proposed field activities?**

| Arctic Fieldwork time frame(s) | Antarctic Fieldwork time frame(s) |
|---|---|
| 05/07 - 09/07 | 11/07 - 03/08 |
| 05/08 - 09/08 | 11/08 - 03/09 |

**2.5 What major logistic support/facilities will be required for this project?**
Fixed wing transport aircraft
Ice drilling capability
New field station
Snow terrain vehicles
Fuel depots
Existing field stations
Fixed wing transport aircraft
Fixed wing geophysical aircraft

**Further details** – Drilling camps potentially can offer support for other activities on the ice sheets. No large advances in technology are envisioned, apart from advances in ice drilling and analytical tools. Funds have already been committed for some projects: WAIS Divide drilling (U.S.), Talus Dome (Europe).

**2.6 How will the required logistics be supplied? Have operators been approached?**

| Source of logistic support | Likely potential sources | Support agreed |
|---|---|---|
| Consortium of national polar operators | Y | |
| Own national polar operator | Y | |
| Another national polar operator | Y | |
| National agency | Y | |
| Military support | Y | |
| Commercial operator | Y | |
| Own support | Y | |
| Other | | |

**2.7 If working in the Arctic regions, has there been contact with local indigenous groups or relevant authorities regarding access?**

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## 3.0 STRUCTURE OF THE ACTIVITY

**3.1 Origin of the activity**
This activity is the start of a new programme that will outlive IPY

**3.2 How will the activity be organised and managed? Describe the proposed management structure and means for coordinating across the cluster**
IPICS developed from an international meeting (Washington, April 2004). The meeting included scientists from Great Britain, Denmark, France, Russia, United States, Germany, Japan, China, Switzerland, Italy, and Australia. IPICS builds on existing successful multinational projects such as GRIP, EPICA, Vostok, NGRIP, and ITASE. IPICS has a small steering committee, and has established two international writing groups. A report from the first workshop is now available (http://nicl-smo.unh.edu/IPICS).
Organization will be discussed fully at the second IPICS meeting, arranged by ESF for Oct. 16-19, 2005, in Brussels. Representatives of NSF, EPB, and other national logistic operators were present at IPICS I and are involved in the planning of IPICS II meeting The existing steering committee (set up initially to organise the first meeting) will be expanded. Its role will be to define the target drill sites, collate the outcomes, and maintain overall IPICS structure and momentum. Individual activities will be organized and run by separate national and international consortia – a method that has worked well in successive previous projects.

We expect that steering committee activities will be supported by individual nation's funding agencies. Coordination across the cluster will be facilitated by including members involved in each EOI activity on the IPICS steering committee. The initial IPICS meeting and IPY EOI included individuals from the main cluster components.

**3.3 Will the activity leave a legacy of infrastructure and if so in what form?**
Yes. 1. Location for the oldest possible Antarctic ice core. 2. Drilling camp and possibly core through the full interglacial in Greenland. 3. Drilling camp and shallow sections of WAIS Divide ice core. 4.The backbone of a major network of cores.5.New ice drilling technology including replicate coring, lightweight drills, and next generation drilling fluid. 6.The next generation of ice core scientists and drilling engineers.

**3.4 Will the activity involve nations other than traditional polar nations? How will this be addressed?**
IPICS involves all nations with interests in ice coring. All nations with polar presence or interest can conceivably contribute to the late Holocene network, and possible to other aspects of IPICS.

**3.5 Will this activity be linked with other IPY core activities? If yes please specify**
Yes. We will have direct links with EOI 62 (BIPOMAC: A study of the interplay of northern and southern polar processes in driving and amplifying global climate variability), EOI 561 (Greenland's ice sheet – reactions to past and present climate change), EOI 301 (TASTE-IDEA Traverses), and EOI 607 (State and Fate of the Cryosphere). Links with these and other projects (as the latter develop) will be facilitated by IPICS members who are also involved in the other IPY initiatives.

**3.6 How will the activity manage its data? Is there a viable plan and which data management organisations/structures will be involved?**
Major ice coring projects have traditionally deposited their datasets at WDC for Paleoclimate in Boulder, USA, Pangaea, and/or NSIDC in Boulder. This will continue for the IPICS elements. The IPICS steering committee will take an active role in creating effective data management structures. Data management and the structure of a data sharing and archiving agreement will be one of the agenda items for the Oct. 2005 meeting. Note that there are existing data management structures (e.g., within US NSF and European collaborative projects) that will be integrated with IPICS data management.

**3.7 Data Policy Agreement**
**Will this activity sign up to the IPY draft Data Policy (see website)**
Yes

**3.8 How will the activity contribute to developing the next generation of polar scientists, logisticians, etc.?**
IPICS provides a long-term plan for ice coring science that should provide the field with continuity and a stable future, which will be attractive to graduate students and junior scientists and engineers embarking on careers in this area. International cooperation is particularly relevant here, as the IPICS structure should make it possible for scientists and engineers to move between projects spearheaded by different national operators or consortia of national operators.

**3.9 How will this activity address education, outreach and communication issues outlined in the Framework document?**
Ice coring is a very publicly visible scientific activity. The preservation of ancient snowfall, air, and biological material is captivating and easily understandable. IPICS includes a number of talented individual public communicators (including the authors of several popular books about polar science), as well as several groups with established records of outreach to K-12 education, museums, and other venues. IPICS is planning outreach in a number of ways:

1) The IPICS steering committee will coordinate outreach. Developing a formal outreach plan will be an agenda item at the Oct. 2005 IPICS meeting.
2) Individual projects will develop outreach with organizations that specialize in these efforts. For example, the WAIS Divide project is proposing collaboration with scientists leading undergraduate students in glaciology field research, museums developing permanent and travelling exhibits, and university education faculty developing curricula for K-12 schools.
3) Print, television and other media will visit IPICS field and laboratory sites.
4) Individual investigators will conduct local outreach.
5) IPICS projects will recruit graduate students, postdocs, and junior researchers.

**3.10 What are the proposed sources of funding for this activity?**
As with previous ice core drillings, funds will be obtained for each sub-component from national operators, as well as from international funding sources such as the EU. Coordination of funding and project logistics between nations will be required. Support for some elements of IPICS is

already in place (for example, WAIS Divide drilling, Talus Dome drilling).

**3.11 Additional Comments**
The project components were agreed on as a consensus plan at the IPICS meeting in April 2004. The U.S. Ice Core Working Group has also endorsed the IPICS plan. The PAGES International Project Office has expressed enthusiasm for the proposed efforts and welcomes opportunities to facilitate international links to IPICS activities. IPICS is pursuing links with SCAR. The second IPICS meeting takes place in October in Brussels, where individual project plans, and overall coordination, will be discussed further.

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## 4.0 CONSORTIUM INFORMATION

### 4.1 Contact Details

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### 4.2 Other significant consortium members and their affiliation

| Name | Organisation | Country |
|---|---|---|
| Dominique Raynaud | LGGE, Grenoble | France |
| Dorthe Dahl-Jensen | Niels Bohr Institute, Dept. of Geophysics | Denmark |
| Heinz Miller | Alfred Wegener Institute | Germany |
| Hideki Motoyama | National Institute of Polar Research | Japan |
| Kendrick Taylor | Desert Research Institute | USA |
| Massimo Frezzotti | ENEA CLIM-OSS | Italy |
| Thomas Stocker | Climate and Environmental Physics, Univ. Berne | Switzerland |
| Vin Morgan | Antarctic CRC and Australian Antarctic Division | Australia |
| Yoshiyuki Fujii | National Institute of Polar Research | Japan |