

Notes from ICWG meeting 3/2/98, Arlington, VA

PLEASE NOTE: THESE NOTES WERE WRITTEN AS THE MEETING WAS IN PROGRESS. SOME OF THE DISCUSSION ITEMS WHERE NAMES ARE ATTRIBUTED TO PEOPLE MAY NOT BE ACTUAL QUOTES BY THOSE PEOPLE BUT COVER THE GENERAL DISCUSSIONS.

Monday Morning, 3/2/98

#### Introductions

P. Mayewski - a little historical perspective on the ICWG

#### \* NSF Update:

Julie Palais: No current director for OPP, Acting is John Hunt working part time in OPP, part-time in educational directorate. Ad for position is in short list stage. Acting Exec. Officer (new position) is Maryellen Cameron from Earth Sciences Division. Many staff changes in the offing. Jane Dionne on a detail for Arctic Polar Sciences. Neal Lane has been nominated as new Science Advisor in OSTP. Rita Calwell (former deputy) will be stepping in to replace Lane.

Budget: no budget in programs or directorates yet. Indications are that Julie's budget may go down slightly this year.

Joint NSF/NASA research announcement in CBD imminent. Opening Mar 20, closing May 20. Topic is for research in remote sensing on Antarctic ice. Posting should be on the web soon too.

By next June, recommendation to incorporate operational support costs into proposals for Antarctic work will be followed. Expect to see changes in proposal procedures.

Chapman Conference on West Antarctic Ice Sheet, Sept. 13 - 18 in Orono.

Greenwave has been delayed due to mechanical problems. Retro will be late.

OPP is about to promulgate a policy regarding data. More discussion later in this meeting. Data reporting requirements will become a requirement in funding proposals.

Smithsonian Institution course "Polar Connections, Arctic & Antarctic" coming up. NSF packet on polar topics coming out. Obtain by requesting through the web.

Zimmerman: Earth System History (ESH) Program Coordinator (Atmospheric, Oceans, Earth coordination + paleoclimate program from NOAA). Jan 15 deadline for all proposals. Handles ice coring in temperate regions and arctic paleoenvironmental studies portion of ARCSS. PALE and GIPSP2 handled through ESH. Call him if advice is needed on where to submit an ice coring proposal in the Arctic. ESH may not be appropriate for all ice coring activities in the Arctic.

Jane Dionne: Has past experience in polar ice issues and programs. Present at meeting for introduction to ICWG.

Paul Mayewski: A reminder that one of the ICWG's members' responsibilities is to take the information heard here back to their individual constituencies.

NICL Update: Fitzpatrick

Facility is now at 97% capacity. There is enough room for the 97/98 retro but approximately 1200 meters of core must be deaccessioned to make room for the main SDM retro next year. (We will have more time if the brittle ice is left to winter over at the end of the season.)

8 boxes of GISP2 chips deaccessioned recently. Pathway for deaccessioning now well defined. Three subsets of the chips were sent to interested PI's after e-mail announcement of availability. These shipments went to 1) the cosmic dust group at LBL, 2) Marge Winkler at U. Wisconsin, and 3) Jeff Bada at Scripps. This same pathway should work well for core deaccessions too.

ICWG needs to establish criteria for deaccessioning.

General discussion ensued about what these criteria should be. The criteria listed below and used in the test cases were agreed upon by the group.

Mayewski: Suggests using an Arctic and Antarctic core as examples and "walk-through" the ranking process with the group. This discussion follows:

Camp Century

on a scale of 1 to 5 (1 being least favorable, 5 being most favorable)

age - 1  
continuity/volume - 3  
dating - 3  
published information -  
number of requests - 1  
core quality - 2  
duplication - 1  
drilling method - 0 in sections  
specific utility - 1  
uniqueness / site accessibility (0)

Total 17 (0)

n.b. Some sections of core (e.g. firn) may be useless for some measurements. It may be desirable to deaccession the firn sections of some cores (e.g. J-9), but keep the rest.

J-9

age - 2  
continuity / volume: 3  
dating: 3

published information : 3  
requests - 1.5  
core quality - ?  
duplication - 5  
drilling method - 1  
specific property value - 4  
uniqueness - 5

Total 29.5

Interest was expressed in the basal congelation ice from this core. Gow made the argument that the core is unique in several aspects. Fitzpatrick points out that NICL does not have the basal section of this core. Meese suggests that the missing section (which is at CRREL) be sent to NICL. General agreement that the core should be kept.

Mayewski requests that individuals knowing something about remaining cores on the deaccession list volunteer to rank them within the next 24 hours. The following assignments were made:

Tony Gow : CC61,62, and Dye-3

Mark Twickler: Dominion and Newall cores

Eric Steig : Milcent, Crete, and Dye-2

Todd Sowers: GISP-G2 and Site A

Mark Twickler: Report on ad hoc ICWG meeting at WAIS

Mark reports that there was an ad hoc meeting of the ICWG at the last WAIS meeting. Several issues were raised at that meeting which related to NICL operations which Mark wanted to raise again at this meeting.

Outstanding issues which need to be finalized.

Sample and data accessibility issues: A two-year proprietary limit is proposed on cores. Exceptions to the regular data or core accessibility limit should be dealt with at the time of the proposal. Julie Palais would like ICWG to draft a statement saying that in the absence of other arrangements investigators will be expected to share the core with the community after two years after the end of the grant. Core should be offered to NICL at the end of the two year period.

A lengthy discussion ensued. No final decision was made on the actual length of the proprietary period. Zimmerman points out that this kind of policy is easy to set up but difficult to work out on a practical basis. He suggest we look at the IMAGES policy for guidelines. Will bring this document to the meeting

tomorrow and the group will review the language. This information and a continuation of this discussion occurs later in these notes.

CPL after hours access: This issue is best left to the PI's working on the CPL, not the ICWG. Advance planning is key to making this work. If PI's want NICL to staff the core handling positions for the CPL and run the CPL for extended hours, then Joan needs to know about it by October of the season ahead of the cpl in order to get it into her budget request. PI's wanting to hire local students to help on the CPL need to let NICL know well in advance so that they have the opportunity to seek these students from the Metro State pool.

Non-NSF and non-USGS/GD clients: Demands of these types of clients to date have not been intrusive. Non-NSF or non-USGS visitors should contact NICL regarding compensation if large amounts of time or resources are required. NICL should contact NSF if another federal agency makes this kind of request. A statement should be drafted to this effect and put on the web page.

Mark Twickler then went over the NICL-SMO web page. Requested any photographs, data, or information ICWG members may have to help complete the page. Julie Palais suggested that Mark send out an e-mail message requesting this kind of information. Fitzpatrick exhorts the group about the importance of contributing this kind of information to the overall ice core outreach activity.

Julie Palais requests that ICWG put together a statement of philosophy regarding long term storage issues. This issue is revisited later in these notes.

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Julie Palais introduces Erik Chaing, Maryellen Cameron, Odile de la Beaujardiere.

#### International Deep Drilling Programs:

DOME C: French had a successful season. Cased hole, station not yet in full operation. 360 m TD now. They will return next season.

DOME F: Isotope record published recently through Eemian. Drill stuck at 2600 m, hole and drill abandoned. Drilling portion of project is over. Core will produce a high resolution record. Meeting in China Sept. 5 - 8 will showcase research results.

VOSTOK: Todd Sowers reports Vostok drilling completed at 3623 meters. Ice/water interface at about 3700 in hole 5G. Ice temperatures at TD too warm to continue drilling. Cored through a layer of dirty ice on the way. Record goes back 4 full climate cycles to 450,000 ybp (Stage 11). Isotopes go flat at about 3400m down. Greenhouse gases follow deuterium signal. Record below 3400

m may be scrambled. 5 - 7 Km of ice are stored at Vostok. This constitutes a large stockpile, bear it in mind. Some of the older cores may no longer be accessible due to extensive drifting over of storage structures.

NORTH GRIP: Kuivinen reports Danish drill stuck at about 1000 m. Left overtensioned & backfilled. Didn't free up over winter. During the upcoming season a) if drill comes free they will continue in current hole or b) if drill still stuck, cut cable leaving 100 m at the surface and start new hole about 23 m from present hole. Drillers believe that the reason the drill got stuck is due to cementation of chips from new densification fluid. (No one was certain as to what flavor of freon was being used.)

LAW DOME: Finished project. Hit bedrock a number of years ago. YD near the base. High accumulation rate core (70 - 80 cm / yr). Excellent resolution, short record. Isotopes and hydrogen peroxide data completed. Firn and upper ice were contaminated by cement dust from storage facility. Those sections were redrilled. Not much more data to date. Two other cores drilled in the past.

Lonnie Thompson recovered 3 cores (to a max of 167 m) from Tibet. Thermal and electromechanical used.

Canadians will be drilling another core to 300 m at the Devon Ice Cap this spring. The Russians & Japanese will be drilling at Svalbard. Russian/German project drilling at Severnaya Zemlya this year.

#### Siple Dome Update - Ken Taylor

16 funded projects now. WAISCORES meeting was held in September. Gave list of science participant in field season this year. This information is posted on the web page.

Hot water core, 160m 4" core at 30 S taken, plus a small amount of 5.25" core. CPL for these cores will be run at NICL this summer.

Ice which is brittle is scheduled to remain at the Dome next year unless it shows signs of relaxing quickly.

ASA support lauded.

-18C warmest recorded temperatures during ice retro to McMurdo.

HW drilling shows that there is no fluid at the bed at Siple Dome but it is close to the pressure melting point.

Poor preparation of drilling equipment blamed for failure to recover the complete core this season.

Current drill breaks core into 60 cm pieces at shallow depths. This needs to get fixed.

Next year's plan: Fix drill (it has been completely retroed). Go back and finish core.

Tony Gow offers that the core recovered with the hot water drill relaxed enough to handle safely within 3 - 4 days showing large volume dilation (3%) by bubble splitting, microcracking and fracturing. He suggests that the mechanical core may relax before the end of the season.

The issue of possible stratigraphic disturbance on the basis of early results on hot water core was raised again. Gow clarified that early reports of deformed bubbles proved to be an artifact of hot water drilling. The annulus of disturbed bubbles extends less than 1 cm into the core

Clear annual layers down to 300 m. Not visible in the field below this depth. Layers 6 - 8 cm apart down to 300 m. No volcanic dust in sections recovered from the hot water core.

Tony feels that the fracturing is happening after unloading ice from barrel. Kendrick feels that fracturing happened during drilling with possible incursion of drilling water into the cracks.

600 m marks major change in orientation and crystal size.  $-13^{\circ}\text{C}$  (annealing temperature) hit at this point.

90 sq. cm. crystals near the bottom.

Small amount of dispersed dirt found at base of summit HW core.

Recrystallization may be happening above the H/W transition. This may have implications for the ultimate resolution of several of the measurements.

Radar reflectors may be disappearing by annealing process.

Discussion held on whether it is worthwhile to proceed with the project given various issues (disappearance of radar reflectors, recrystallization above H/W transition, temperature profile, etc.) Everyone agrees to continue.

PICO Update: Karl Kuivinen

Gave outline of structure and mission of PICO. New starts in Alaska this season.

Greenland: PICO in Kangerlussuaq has moved from the fire station into two warehouses. Thule operation may be expanding. 109th will be operating more training missions out of the Dye-2 skiway now that they are taking over Herc-ops in Antarctica. Mission at GISP2 this season is to retro much of the equipment from the dome and extend the casing to the surface. Living facilities provided for winter overs at GISP2 this season.

NASA / PARCA update: 200 sites with GPS stations surveyed and shallow cores recovered. New modifications made to lightweight drill design which includes powerhead & winch. Showed design for Filbert probe. Proposals in development for NASA to develop submersible probes for Lake Vostok. Ultimate goal is development of Europa probes. Drill / equipment information available on PICO web page.

Antarctica: AMANDA activities: 60 cm holes produced by current hot water system. Fuel intensive. Siple Dome Issues: drill not redesigned, just rebuilt. Drill suffered from damage after GISP2 and Taylor Dome. Had 5 month rebuild schedule. Some parts late in arriving in Nebraska and thence to SDM. Barrels manufactured out of round & possibly not straight. Some damage in

shipping possible but probably a fabrication problem. New testing planned for reworked old barrels to insure roundness. Drill will be tested in test hole at Nebraska before shipping this season. Field post-mortem on Thursday.

General comments/observations by Kuivinen: There seems to be a scale problem. 4" holes and small projects seem to work better than large scale 5.25" projects. Bigger project require more planning and lead time. Look at tasking, funding lead time, maintaining continuity (personnel and equipment). Staffing continuity on projects a problem. No core group of the same people always available. Shift in planning. We're not planning major field seasons the same way they used to be planned (more structured in past). No field ops plans. (contested by Mayewski) Feels that PICO suffers from this lack of detailed planning.

Julie Palais: Points out that PICO has diversified quite a bit recently. What percentage of time is spent supporting ice coring activities vs. other activities? Subtext: is sufficient time being spent on supporting ice coring operations?

Karl Kuivinen: Difficult to know where to draw the lines. What about AMANDA and GISP2 now? Do these activities support the ice coring community? Feels that everything being done by PICO supports the ice coring community one way or another.

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Julie Palais: Defines activities more narrowly.

Eric Chaing: Points out that PICO is not captive, but can diversify. How does Karl select his priorities among the activities?

Kuivinen: Limited staff, have to move people around to keep them covered.

Chaing: "So, you follow the money?"

Kuivinen: Yes

Zimmerman: When you have an agreement with NASA (for example) how does NSF stay in the loop?

Kuivinen: No official agreement through NSF, but program manger kept aware. NSF contract is cost reimbursable. Other contracts may not be. This results in different projects being approached differently.

Zimmerman Who is your main point of contact in NSF?

Kuivinen: Simon Stephenson and Mike Ledbetter main points of contact within NSF. PICO has concerns with level of tasking by NSF. Wants imposition of overall structure for coordination and accountability on projects.

Discussion will continue this afternoon. Individual Siple Dome concerns /comments should be channeled through Ken T. for resolution on Thursday.

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LUNCH BREAK  
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Monday Afternoon

ICWG Member Presentations

Gordon Hamilton: Rep. for Glaciology

43 holes drilled with the hot water drill this season. Potential for using this drill at more sites where deep ice cores are planned.

Ice Streams: marginal and bed processes: which controls flow?

Mass Balance: precision GPS work for mass balance

2000 m traverse in Greenland; Bob Thomas, NASA: flux & mass balance study; finding enormous variability in mass balance of Greenland ice sheet from these sites.

NASA will launch ICESAT to measure thickness changes in Greenland & Antarctic ice sheets

RAMP - radar mosaic of Antarctic generated during October - November of 1997. 5 meter / pixel resolution. Exciting results: no new ice streams in East Antarctica, hidden features revealed (e.g. South Pole), repeat passes for interferometry to generate ice flow information.

Bindschadler/Vornberger: Comparative Antarctic satellite photography yields new results on ice streams in West Antarctica

GLIMCE / LANDSAT7 - new satellites being launched

Metadata required for datafiles with contact person name. Standardize metadata form for each ice core? This issue revisited during discussion on data formats later in these notes.

Ted Scambos - Working on mega-dune features in West Antarctica

Joe McConnell: Atmospheric Chemistry

Concentrating on transfer functions. For most species, transfer functions still not well known.

Photochemically produced species: progress in post-depositional exchange characterization. Models for decreased in concentration of hydrogen peroxide with depth mimic amplitudes well now, but not phasing.

Bill Munger: Polar nitrates: Eddy correlation measurements of NO<sub>y</sub> and mist charger measurements of HNO<sub>3</sub>. Nitrogen arrives at GISP as PAN, goes to NO<sub>x</sub>, thence to HNO<sub>3</sub>.

High flux of HNO<sub>3</sub> from the snow by evaporation

Changes in ice core HNO<sub>3</sub> may reflect changes in PAN rather than NO<sub>x</sub>.

Mike Bergin: Long term measurements of atmospheric aerosols at South Pole related to snow/firn measurements.

Research should be directed toward model development. Need coordinated, multi-parameter & multi process field experiments involving both atmosphere & snow.

Long-duration, year-round measurements in atm, surface and near-surface snow and firn

Integrated physically based models:

atmospheric photochemistry

atmospheric transport

snow pack ventilation & energy balance

chemical transfer

More field monitoring - perhaps at South Pole which is manned year round.

Debra Meese - Physical Properties

Efforts of physical properties group focused on Siple Dome

Last summer focused on cpl

Fitzpatrick : Digital copy stand designed & built; SDM & hot water cores photographed & up on web. Visual of apparatus shown. Update on progress in image processing given.

Alley - Modeling of elongated bubbles; elongated bubbles do not necessarily indicate that a core will not be useful for paleoclimatology.

Sarah Das: Trying to determine whether melt layers can be used for thermal reconstruction.

Matt Spencer - Firn transformation processes

Debra Meese: Layer count results from Siple Dome directly superimpose on GISP2 with a 25 year shift (making SDM 2 years older). Mayewski comment that this may reflect a periodicity in the data.

Editorial note: Tony Gow's results on the Siple Dome hot water cores were not presented here but reserved for a later session.

Dave Morse - Geophysics

SOAR involved with extensive survey of the WAIS area. Finished with this area now, moving into the Transantarctics. (More complete discussion of the WAIS survey given later in these notes.)

Hot water drilling done in support of vertical strain rates. This drill proving to be a big asset to field work.

Michael Ram - Electrical/Laser/Particle Properties

Numerical simulations of ECM - indicates a fundamental resolution of about 8 mm.

Calibration of dust profile from laser at GISP2. Down to 2800 m they now have an INAA curve which calibrates the dust concentration against the laser signal. (gm/cc of meltwater)

Modulation amplitudes in solar cycle in dust concentration seen.  
Automation of water/ice measurements in progress.

#### Sowers - Gases

Severinghaus - thermal fractionation of gases in ice cores. Correlation between thermal signal in gases and ice isotopes. Allows measurement of how large a temperature change occurs at climate boundaries. Rate of rise in methane concentration with temperature - shows methane in phase or slightly lagging temperature.

GRISP / Chappellez - stable isotopes support the "scrambled eggs" scenario for the bottom of GRIP

CO2 Story: In situ CO2 production is the main question:

Possible in-situ modifications can result from:

- > carbonate generation
- > generate CO2 by hydrogen peroxide attack on organic carbon
- > consume CO2 via weathering product interaction

Greenland CO2 is inherently problematic because of the above possibilities. How about Antarctica? Simultaneous measurement of C13 and CO2 on Antarctic blue ice suggests the organic carbon plus hydrogen peroxide producing CO2 scenario may be an important pathway.

Wahlen/Smith/Deck: Ca, ECM, CO2, layer thickness comparison indicates that in-situ production in CO2 is happening in at least some sections at GISP2.

Ed Brook - Taylor Dome. Methane. Good match in methane record with Byrd. Comparison between northern and southern hemisphere methane records allows identification of interhemispheric gradients and thus better i.d. of source areas. Methane sources turned on in Northern hemisphere at the end of the Y.D.

Question: Any in-situ issues with methane? May be an issue with microfractures allowing present-day methane in and then healing. Bacterial mediation is a possibility but it's not being looked at right now.

#### Eric Steig: Stable & Cosmogenic isotopes

Amplitude of solar variations in Be-10 flux is greater in Antarctica than in Greenland

Minor variations in Be10 at GISP2 are likely 100 to 10000 yr scale solar variability. No evidence of a geomagnetic signal

11-year solar cycle variations detected in Be-10 results

Significant coherence between Be-10 and  $\delta^{18}O$  at GISP

Where we understand production well, models work. If we don't understand production, models problematic. Reconciliation of GCM and measured fluxes on spatial and temporal basis is crucial

Problems to address:

Local and source effects difficult to separate.

High resolution Be-10 needed to determine length of solar cycle in distant pass.

#### Stable Isotopes & Temperatures

18-O - T relationship is variable (Cuffey) because of source region changes, seasonality of precipitation, and perhaps other effects.

GCM simulations show significant heterogeneity in the ocean surface temperature response to ocean circulation forcing.

There is significant solar forcing evident in the GISP2 del O-18 record.

Ice cores from Antarctica appear to be sometimes out of phase with Greenland. Depends on what core you look at. Taylor Dome is in phase with GRISP, Byrd is not. The correlation of the Greenland record to any site in Antarctica may not be justifiable. Ocean circulation is not that simple.

#### Cameron Wake - Major Chemistry

Major step forward: Record of atmospheric circulation now possible from chemistry in ice cores. polar circulation index, sea ice extent (sea-salt sodium), atmospheric pressure systems

Ice core chemical records provide multi-dimensional time series - more variables to document change and identify forcing functions

Spatial surveys - something to be focused on

Recent glaciochemical time series development:

Penny Ice Cap

Siple Dome

Inland WAIS

CWA

Mt. Everest

Mt. Xixabangma

Graham Bell Island, Franz Joseph

Sajama

Planned new cores for glaciochemical analysis:

Devon Ice Cap

ITASE

Wind River Range

Khumbu Himal, Nepal

Tien Shan

Continued development of high-resolution continuous analytical techniques

Future Requirements:

Instrumental records for comparison/calibration

-meteorological

-aerosol chemistry

lightweight ice core drills

Zielinski - Microparticles

Grousset & Biscaye: new isotopic tracer to fingerprint dust using nuclear ion probe O18/16 data from particles. Method to be tested this summer on fine fraction of Saharan aerosols. Possibly distinguish various dust sources (e.g. Tibet, Siberia, Gobi, etc.). Probably very labor intensive.

Volcanics: blue ice tephra layers in west Antarctica and Transantarctics yield tephtras

-----> major oxides, Ar/Ar ages, and trace elements on individual tephra layers (with Kyle & Dunbar)

Visible tephtras from Taylor Dome in process of analysis

Obtain Ar/Ar timelines from WAIS cores.

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PICO Contract Competition - Simon Stephenson / NSF

Wants feedback from the ice coring community on how to structure support from NSF. What things might we want to change in the current PICO contract?

PICO contract is 5 year. The recompetition for the next 5 year contract will look like the last solicitation for the most part unless ICWG recommends changes. Now in the 4th year of the current contract.

How can performance be improved for any vehicle of ice core support?

General discussion ensued:

Steig: PICO needs to "chase the money". This leads to lack of continuity. Maybe we need to follow the ODP example and assume that cores will always be coming and support a plan accordingly.

Kuivinen Lacunae in use of the big drill leads to loss of personnel and loss of corporate memory.

Chang: The NSF ice coring program cannot financially support the use of the 5.25" drill in continuous seasons. Single point management of diverse projects to keep PICO running may keep things on track.

Sowers: Questions PICO competence. Lack of testing of equipment before shipment is poor planning. Break the logistic part of PICO tasking out of the current contract and give it to someone else.

Stephenson: The last solicitation went out in two segments. Several bids did come in split, but the combined bids were more cost-effective. NSF leaning toward sending out the next solicitation the same way.

Ledbetter: Staff at PICO already split out along coring/logistics line. Not clear that the two functions in a single entity is the problem.

Stephenson: In retrospect, the drill should not have been deployed this past season.

Mayewski:: Field seasons over the next few years (after SDM) are liable to require portability, and lots of shallow drilling. Is it worthwhile having a contract which takes into account a more diverse mission or a broader perspective?

Taylor: Contracting with the public sector for 4" drilling is a possibility..

Kuivinen: In the European model a University with a vested interest in ice core research houses the drilling/engineering function. Ohio State is an example of this model.

Taylor: Suggestion made that PICO be associated with something like CRREL or NICL rather than a university. Advantages in having trained personnel if more sharing happens between entities. Good synergy possible if function of core storage with drilling and science are combined.

Steig: (requesting clarification from Stephenson): If the big drill is unused for an extensive period of time, does this mean no funding from NSF will be forthcoming for continuing maintenance of the drill?

Stephenson: Yes, that's the way it's been. Money gets spent on active projects.

Chaing: How about infrastructure development? Isn't this worthwhile? Sometimes investment must be made upfront and science funding be made to follow.

Ledbetter.: Is NSF committed to the future of ice core drilling? Why doesn't NSF support an appropriate level of funding to support a continuous staff?

Steig: Boom-and-Bust is the problem. Is there any way to farm out the overload in boom years in order to keep a core staff with expertise full time at PICO?

Taylor: International cooperation a possible mechanism for keeping the deep drill busy during "bust" years.

Schuman.: Make information base with expertise available on the web?

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Tuesday, March 3

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Mayewski: introductory remarks about today's and tomorrow's agenda  
ITASE Agenda distributed by Twickler

\* Ice Core Contribution to Global Change Research - the new document

Planned release format similar to the PAGES format, planning about 2 more pages.

500 copy in first release -----> ICWG, PI's, funding agencies, appropriate universities, OST and other appropriate federal entities

Proposed schedule addresses only Antarctic

Discussion:

Michael Ram: Suggests his work showing correlation between dust cycles and solar activity should be included in report.

Mayewski: Write & submit the information and it will be included in the document.

Twickler: Next Friday is the deadline for submitting changes/additions to the document. (March 13)

Mayewski: Much of the information presented in the document has already been presented at MESH. Feel free, once the document is released, to use the figures and information from the document in your presentations.

Inland WAIS Update - Dave Morse

Showed radar dataset from inland divide region. (This information is on the web page.) Divide has a prominent dome (A site, 1500 - 3000 m ice depth, highly variable due to complex under ice topography) and saddles on either side (B and C sites). 3500 m ice below Site B (saddle). Unanimous first choice for weather station is on the dome at A site. Weather station didn't get installed this season. There is only limited information about the sites. Much variability in accumulation rate over the possible choices of site. Higher accumulation rates to the inland side of the ice divide. Siting for first AWS based on trying to find a representative site for the region. May wish to add another site at the actual drill site.

Steig: Position of divide may have been somewhere else in the Holocene?

Mayewski: Yes. Remember this site is for the AWS, not necessarily the drill. This is a good choice for the AWS because it has the potential for monitoring weather from both sides of the divide. May have the option to install two AWS sites next season due to delay this past season.

Palais: Is further work anticipated on these data?

Morse: Will be looking for flow features in the ice. Actively extracting the layer information from the data.

Palais: So this work will dictate where the surface investigations will be focused?

Morse: Yes.

Taylor: Any information on which way the ice divide may have been migrating?

Morse: Inland (i.e. away from Siple Dome)

Sowers: Are you planning backing up the isotope information to help determine where the ice divide has been migrating? We should be looking at the data from Byrd to help decipher ice divide migration and elevation changes in the past.

Morse: Have lots of geometry, little flow or temperature data for the inland site now.

Hamilton: Density, bomb layers, accumulation rate information available from Whillians for many sites SipleDome-ward of the inland site.

Mayewski: If someone wants to give input on the location of the AWS, NICL-SMO should be contacted.

Palais: ICWG might want to write up a justification for installing two AWS' this season. Send to Chuck Stearns & Bernie Lettau.

Morse: Results of simple modeling. A,B, and C sites examined using constant modern accumulation rate. Showed calculations for layer thickness vs. age, layer thickness vs. depth and depth-time scales (poor approximation since constant modern accumulation rate assumed). Thicker ice predicts basal melting. The whole region is teetering between basal melting and no basal melting. Oldest ice may be available from the thinnest ice.

Blankenship: Paper in the works on locations of volcanic centers in the area.

Waddington: Possible to use the internal radar layers to help determine whether the bed is melted or not.

Morse: Berhendt has speculated that there are active volcanic centers in this area. The possibility of basal melting should be our major concern in choosing the drill site.

Mayewski: Any plans to extend the data area? (i.e. more flight lines)

Blankenship: For airborne data, the area which has been studied is the complete dataset. No flightlines down the flowlines.

Waddington: This is a very complicated site. Time needs to be taken to determine all the geophysical parameters necessary to nail down the right site.

Mayewski: Maybe this isn't the right place to be drilling since it's so complex.

Blankenship: Maybe it looks complicated because we know so much. It's worth pursuing because it gives us the opportunity to apply all the information we have to the solution of siting the drill correctly.

Taylor: Before we drill with the 5.25", we should consider sending in the hot water drill for screening. If we did recover 4 meters every 200 meters, what kind of criteria would we use to decide whether or not a site was appropriate for the 5.25" drill?

Waddington: Also desirable to acquire temperature during this screening process.

#### Siple Dome Science Update - Gow

Measurements made on the HW core near the summit. Relaxations of up to 2.88% observed in deepest ice 10 days after drilling. This amount of relaxation is usually seen only years after drilling. This degree of relaxation may not be seen in the electromechanically drilled core. Most fracturing doesn't occur until 300m, but continues to bottom. (i.e. the brittle ice zone begins at 300 m and goes to the bed).

Drilling water temperature was about 5°C. Keep the sun off the cores. Plans for unloading next year include doing so directly into the trench.

Visual layering apparent down to 300 m. Examination in the field didn't reveal visual layering below this depth. No apparent ash or dust either in the samples seen. (Doesn't mean they're not there. Sampling was discontinuous.

Thin section: Bubbles become rounded by 99m. Smaller in size at 304. at 405 m, bubbles split during relaxation. Bubble split occurs in <0001> plane of the crystal. At 605 meters, gross fracturing is observed after unloading core from barrel. Cracks will eventually heal.

At 678 m, many closely spaced fractures and microcracks. At 988 m, bubbles still present in ice.

Temperature profile from main drill site. Base looks to be about 1 degree < pressure melting point. Siple Dome temperature profile very similar to Byrd. If you remove the first 1100 meters of the Byrd temperature profile, it look parallel to Byrd. Basal temperature is 1.8°C, about 1 to 0.5 degrees below pressure melting point.

Behavior of mean crystal size with depth is a compressed version of Byrd. Constant size between 300-600 m. Size increases dramatically below 600 m. This has implications for the ultimate resolution of the climate information.

C-axis information: 100 m random, 139, increase in grain size, still pretty random, 302m broad c-axis maximum indicative of divergent flow, 400 m serrated

crystal outline, still approaching c-axis maximum; 402 m ----> shift to girdle pattern ----> convergent flow; 505 - 507 m, still in girdle distribution, 601 - 603 m, grain size increases dramatically, into annealed ice now, statistics not possible, too few grains for reliable c-axis analysis. 676 and below, typical annealed interlocking structure of large grains, fabrics somewhere between c-axis and girdle, stats not reliable.

Annealing appears to be happening above the H-W transition. This may be problematic for some types of analyses.

Taylor: Hermann has proprietary rights to the hot water core but seems amenable to releasing the cores to WAIS.

Most brittle ice occurs between 500 - 700 meters. Major fracturing will be a problem for several type of analyses. We need to look very carefully at what kind of analyses get done on these cores. Don't run analyses which won't yield useful information.

Taylor: Should do ECM to determine homogeneity of chemistry. This will have implications for how useful the chemistry will be.

Gow: Transition should be located around 630 - 640 meters.

Taylor: Reiteration of the idea that we need to determine exactly what kind of information is required to determine whether or not it's worthwhile to recover a 5.25" core.

Mayewski: It would be worth proceeding just for the Holocene record alone.

Gow: Suspicion that the ice at the bed may be quite old based on isotope measurements done by Jean-Robert Petit.

Mayewski: Disagrees that those few measurements can really support this conclusion.

Taylor: What are the pertinent questions to ask about the lowermost ice? e.g. is it worth doing the chemistry on the deepest ice?

Steig: Isotopic signature drops at ~640 m and drops again below 900 m.

Taylor: Is it worth pursuing a third season if we have to just to get to the bottom?

Waddington: It's worth going all the way to the bottom for the temperature profile.

General assent that it's worth going to the bottom, even if it takes a third season.

Palais: Bear these questions in mind about this core when requesting extension and additional funding.

Mayewski/Taylor: Siple Dome PI's should consider changing their sampling resolution due to the extensive annealing below 600 meters. Some reallocation of resources might be considered.

Gow: In drilling the flank core, 10 samples were recovered and the ice sheet was penetrated in only 4 days.

Blankenship: From an ice dynamics perspective, this is a good site. The record is long, bed is frozen, the Wisconsin is there.

Near Surface Snow & Ice / Comparison with Passive Microwave Data : Chris Schuman

Snowpit studies through the Siple Dome site. Isotopes & visual stratigraphy compared to passive microwave record. Showed fence diagram for pit stratigraphy correlating layers on the basis of visual stratigraphy and isotopy. Reliable age scale at 90% confidence can be based on visible stratigraphy. Less reliable on south side of dome. Showed passive microwave scenes which indicate large scale melting events during 12/91.

Annual isotopic & chemical markers are going into the snowpack on the basis of the snowpack measurements.  $\delta$ -D gets damped with depth. Also some apparent offset between the chemistry and isotopy. May create difficulties with multicomponent layer determination. Data become difficult to interpret by 30K south.

Intention is to time calibrate isotopy against known timing of passive microwave data.

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#### Arctic Ice Coring Activities - Discussion

ICAP background: Zielinski - program for PAGES to coordinate ice coring activity in the arctic. Focused on holocene changes across the arctic. See earlier notes for upcoming drilling projects. Gregg Z. will be replacing Deb Meese as ice coring representative to ARCSS. Brief article upcoming in Witness the Arctic about ICAP.

Taylor: Looking at arctic map in the report. Danes are interested in Station Nord, so is Kendrick, so is Jim White.

Hamilton: There is a lot of shallow coring activity in Greenland now. This needs to be factored into the report and connected to ICAP.

de la Beaujardiere: How is the north Greenland drilling work related to ICAP? Is duplication happening?

Wake: ICAP is focused on the entire Arctic, not Greenland.

Mayewski: ICAP should include the Greenland work. Maybe Greenland PI's should buy into ICAP.

Hamilton: Much of the shallow work happening in Greenland now is funded by NASA.

Zielinski: It was never intended to omit Greenland from ICAP.

Mayewski: Maybe ICAP needs a rep for Greenland from PARCA?

Wake: Canadian cooperation in the Arctic has been very fruitful. Logistical support has been good for the US community. Cost effective approach.

McConnell: Winter-over program at Summit available on web. Joe brought a copy for perusal. Contact Joe for more information.

de la Beaujardiere: Seeking European cooperators for the winter-over program. Resources uncertain for continuation of program. Proposal deadline in August.

#### Future Coring Philosophy - Mayewski

Steig: Deaccessioning won't get any easier. Rolling rack system seems to be the next logical choice.

Mayewski: Tasks NICL to fill in the blanks we are capable of filling in on the ranking sheets for all cores. Cost-benefit analysis on storing vs. redrilling.

Taylor: 4" cores shouldn't be considered more expendable than deep cores. They should be run through the deaccessioning criteria like all other cores.

Continued discussion on deaccession of NICL Cores:  
Camp Century 1962:

Age 2  
Continuity (1)  
Dating (1)  
Published Information (1)  
No. of Requests 0  
Core Quality 1  
Duplication 1

Drilling Method 1  
Spec. Properties Value 2  
Uniqueness / Accessibility 1

Deaccession this core.

Dye -3

Age 2  
Continuity 3  
Dating 2  
Published Information 2  
No. of Requests 1  
Core Quality 2  
Duplication 1  
Drilling Method 2  
Spec. Properties Value 3  
Uniqueness / Accessibility 1

May want to retain upper ice below f/i transition. Look at how much cross section is left. If a sufficient cross section is left, keep the section between the f/i transition and the top of the good ice from the Dye-3 main core. Since PICO maintains a camp at Dye-2, the Dye-3 site is accessible. Check cross sections remaining.

Milcent

Age 1  
Continuity 1  
Dating 2  
Published Information 2  
No. of Requests 0  
Core Quality 2  
Duplication 3  
Drilling Method 0  
Spec. Properties Value 2  
Uniqueness / Accessibility 3

Crete

Age 1  
Continuity 2  
Dating 2  
Published Information 2  
No. of Requests 0

Core Quality 2  
Duplication 3 (1)  
Drilling Method 0  
Spec. Properties Value 2  
Uniqueness / Accessibility 2

Dye 2

Age 1  
Continuity 4  
Dating 3  
Published Information 2  
No. of Requests 0  
Core Quality 1  
Duplication 3  
Drilling Method 5  
Spec. Properties Value 2  
Uniqueness / Accessibility 1

Deaccession all 3 (Contact Europeans)

Dominion Range

Age 2  
Continuity 2/3  
Dating 3  
Published Information 2.5  
No. of Requests 1  
Core Quality 2  
Duplication 5  
Drilling Method 4  
Spec. Properties Value 2  
Uniqueness / Accessibility 5/4

Keep this core. Unique location. Good comparison with Taylor Dome. The H/W transition is present in this core. Bottom of the core is poker chips.

Newall Glacier

Age 3  
Continuity 3/4  
Dating 2  
Published Information 2.5  
No. of Requests 1  
Core Quality 3  
Duplication 1

Drilling Method 4  
Spec. Properties Value 2  
Uniqueness / Accessibility 5/2

Deaccession this core.

GISP2/G2

Age 4  
Continuity 4  
Dating 5  
Published Information 0  
No. of Requests 1  
Core Quality 5  
Duplication 0  
Drilling Method 5  
Spec. Properties Value 3  
Uniqueness / Accessibility 1

Recommend to deaccess, but check that this isn't the core Gisela Dreschoff requested.

SITE A

Age 3  
Continuity 3  
Dating 2  
Published Information 3.5  
No. of Requests 0  
Core Quality 3  
Duplication 0  
Drilling Method 4  
Spec. Properties Value 2  
Uniqueness / Accessibility 2

Deaccession this core

Issues relating to Future US Ice Coring Activities (resumed)

Antarctica - Dennis Peacock

Focus will be on the new South Pole station for the next few years. Budget pressures have resulted from the Augustine Report recommendations. \$20M needs to be found from science monies to support the new station costs.

Cost savings are supposed to result from the transition between VXE-6 to the 109th but short term savings are not possible during the transition period

during which both structures will be supported. The 109th wants 2 - 3 VXE-6 planes converted to 109th configuration. This will cost \$\$\$\$\$\$ too. More drain on the science budget.

Some political pressure to increase activity in the arctic possibly at the expense of Antarctic. FY99 has a large increase in funding for arctic science.

Field programs depending on Herc support will face severe problems in Antarctica during the 99/00 and 00/01 seasons. 01/02 will probably be a bad season too because of the backlog of work needing to be done.

The Gould has now been leased to replace the Polar Duke. NASA/NSF solicitation will be out shortly.

NSF is looking for a Director of OPP. Any volunteers out there?

Don't necessarily give up hope for field work during the bad years. A cessation of pressure to get the field work done may generate a negative feedback situation.

Paul M. gave Dennis an update on the plans for the upcoming field seasons including Siple Dome, ITASE, and the inland WAIS site.

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Issues relating to Future US Ice Coring Activities (resumed)

Sample Management issue: Zimmerman gave an example from IMAGES policy promulgating a two year proprietary limit for cores.

Steig: What would be the consequences of failure to meet this requirement?

Palais: The requirement would be stated as part of the grant conditions. Failure to comply could result in exception from further institutional funding. Pg. 24 of NSF Grant Proposal Guide already has some verbiage on this topic. Wants a reiteration of sample release / data release policy from ICWG with specific language.

NICL-SMO will draft up a policy statement on this topic and send it out for review via e-mail. Resolution of 2 years after collection or 2 years after end of grant? General discussion ensued. Term agreed upon is 3 years after availability.

Ice Core Data Collection : Steig

Goal:

Data sharing within and outside the immediate community.

Requirements:

PI's willing and capable of providing data  
Expertise at data centers

PI's having time or incentive to interact with data centers.

NSIDC is the GISP2 archive site. Most of the European data is at NGDC. Jim White was requested by NGDC to help set up ice core data. The Data Coop was established to help get the ice core data into a form NSIDC or NGDC could use.

Successes:

Obtaining the major records from the best known cores

GRISP CDROM

Convincing the community (internationally) that data sharing is important

Needs work:

Transfer of expertise from the co-op to the data centers

Suggestion:

1) oversight

2) double and triple checking with P.I.'s on data quality

Discussion:

Palais: Only recently aware of the International Data Cooperative. Overlap in functions seem to exist. Why are there two groups doing these activities?

Steig: Difficulties apparent in double checking data with PI before publication. Two groups are not doing the same thing. There is confusion in the ice core community about where to send data. Feels that he is doing some of NSIDC's job.

Scambos: It is outside the scope of NSIDC's program to do the level of work Eric suggest they should be doing.

Steig: Intervention requested to straighten out who (NSICD or NGDC) is in charge of publishing the ice core datasets. ICWG should lay out who the data goes to, what the data should look like, what format it should take..... etc. The ice core community should take control of how the final product should look.

Taylor: The Siple Dome datasets are being posted on the SCO web page as acquired. The plan is to keep updating that page and, at the end of the project, the page will ideally contain the final datasets to be transmitted to the appropriate entity for archiving.

Palais: WDC-A should be repository for deep ice core data  
Shallow ice data should be submitted to NSIDC

Mayewski: Eric needs to provide ICWG with information on how datafiles should be structured in a uniform fashion.

Steig: The data archiving situation requires oversight by NSF to prevent further confusion on this issue.

Palais: Linda Dugai (Mark, please check this name ((sp?) working on metadata policies. We will be seeing these policies in the coming proposal round. There will be a statement in the award letters with a list of responsibilities of the PI in regard to the disposition of data.

Hamilton: Certification of core depth and densities. Ian Whillans requesting these data in a standard format. Should include depth of drill run from reference point. Relation of reference point to snow surface..... estimates of core loss.....core diameter..... plus more.... full error estimations.....name of responsible scientist.

Taylor: The information is available from SDM.

Mayewski: Would like these specific requests outlined for ITASE.

Waddington: Precise density measurements are important to the geophysical community which is now building firn densification models to extract paleoclimate information.

Palais: Global Change Master Directory with Sample DIF's at:

<http://gcnd.gsfc.nasa.gov>

Contains sample metadata files. Look at them & see what might work in your data.

Giles: Observes that different 4" crews deal more thoroughly with their cores than others. Are we going to promulgate some standard procedures for handling cores in the field? Should the equipment required to make complete measurement be included with the PICO equipment?

Mayewski: Yes, that's the intention. It's the PI's responsibility to see to it that the equipment is available, either by bringing the equipment into the field or asking PICO to obtain it.

Gow: CRREL has many of these types of protocols already in place.

Palais: Possibly ASA can maintain a stock of requestable equipment to help fulfill these requirements.

Issues relating to Future US Ice Coring Activities (resumed)

Mars Polar Pathfinder

Due for launch early January 1999. Target is north polar Martian ice sheet. (Some disagreement about whether the 1999 mission is intended to land on or near the ice body.) This body contains substantial CO<sub>2</sub>. A seasonal CO<sub>2</sub> sublimation happens in the summertime. Layered structures have been seen in this ice cap.

If you have an interest in getting involved, contact one of the science team (Lonnie Thompson, Charlie Bentley, Barclay Kamb, Ellen Moseley-Thompson.....)

#### Deep Ice

Buford Price PI, Physics, Cal Berkeley. Has submitted letters of intent for establishment of a deep ice Science & Technology Center. Includes participation of many entities and disciplines. 1000 m core proposed. Winter drilling proposed. Early indications are that there is probably a good Holocene record. There is a website for this STC. (Mark, please insert the website address and password I sent you for the STC here)

#### High Elevation Cores:

Wake: New lightweight augers available should help logistics at high altitude drill sites. They have drilled down to 330m successfully in a dry hole and recovered good core with this rig. No reason they couldn't have gone deeper.

Taylor: Has PICO been tasked to buy one of these drills?

Kuivinen: Already asked for the \$\$\$ for this drill, but the money got reprogrammed for AMANDA. Asking for the money again this year. Need to know which options are preferable for the ice coring community.

Wake : Weight difference between options is negligible.

Kuivinen: Scheduling & manufacture might be a problem too.

Taylor: The ice coring community should look at the options and decide what PICO should buy.

Kuivinen: PICO recognizes the value of this drill. No configuration has been defined by PICO in their funding request. How can they get feedback from the community on what configuration is most desirable?

Palais: Her understanding that Simon intends to fund the acquisition of this drill. It's up to PICO to solicit recommendations from the coring community.

Mayewski: This should be discussed tomorrow during ITASE. May need more than one drill in order to meet everyone's needs.