MINUTES

Ice Drilling Program Office – Science Advisory Board Meeting

March 17 & 18, 2011

Attendees: Ryan Bay (UC Berkeley), Linda Morris (IDPO-Dartmouth), Mary Albert (IDPO-Dartmouth), Julie Palais (NSF), Karl Kreutz (U. Maine), Gary Clow (USGS), Alex Shturmatkov (IDDO-U. Wisc), Don Lebar (IDDO-U. Wisc.), Charles Bentley (IDDO-U. Wisc.), Jill Mikucki (Dartmouth), Krissy Dahnert (IDDO-U. Wisc.), Sridhar Anandakrishnan (Penn State), Howard Conway (SAB Chair, U. Wash.), Joe Souney (IDPO-UNH), Mark Twickler (IDPO-UNH), Jay Johnson (IDDO-U Wisc), Alicea Bursey (Dartmouth).

Thursday, March 17, 2011

Welcome from Howard Conway and Mary Albert. Dr. Conway chaired the meeting, which started out with self-brief introductions by all attendees.

NSF Update (Julie Palais):
Solicitation for Antarctic has been released with a proposal target date of June 6, 2011. If submission extensions are required, applicants will need to contact the program manager.

Some changes in the staffing at NSF have occurred. After Eric Chang retired, his position was filled by Will Colston, who was formerly affiliated with the Pentagon rebuild after 9-11. Sadly and unexpectedly Will Closton passed away about 1.5 months ago. Brian Stone was his acting replacement, and has now been selected to take over the role permanently in the Antarctic Infrastructure and Logistics Division. Roberta Marinelli will be leaving NSF for a new position at the University of Southern California. Tim McGovern will be replacing Al Sutherland for shipping issues.

IDPO had its mandated (per the cooperative agreement) site visit, March 16, 2011 for its 3rd-year in operation. The site review was generally positive and the data collected during the review will serve the community well.

IDPO/IDDO Update (Mary Albert):
Note: This would have been Eric Saltzman's 2nd year as chair of this meeting, however he was unable to attend and he named Howard Conway to chair in his place.

Slides 1 – 4: Mary Albert gave a brief overview of the IDDO/IDPO organization. For IDPO there was a review of the vision and mission statements, organization chart and the two main cooperative agreements (IDPO and IDDO). Of the two cooperative agreements, IDPO is a collaborative arrangement; Mary Albert is the lead investigator of IDPO and oversees the Science Advisory Board (SAB). Charles Bentley (University of Wisconsin) is the principle investigator of the IDDO cooperative agreement and is the overseer of the Technical Advisory Board (TAB).

Slides 5-7: An overview was presented of the IDPO facilities at Dartmouth and UNH, and the IDDO facilities at University of Wisconsin. The IDDO facilities at University of Wisconsin provide the drills and drillers and the facilities include laboratories, large storage space and a planned walk in cold laboratory. Also shown were activities funded by Dartmouth College, including Provost funding for an ice coring science booth at the Science Fest on the Mall in Washington

D.C., and a web programmer funded out of Dartmouth overhead for the Climate Expeditions site (http://climate-expeditions.org/), which is the Educational Outreach part of IDPO's Icedrill website.

Slides 8-11:Dr. Albert further reviewed the purpose of the SAB and current elements of its Terms of Reference and membership, including its representation of the scientific community, identification of upcoming scientific developments, contributions to the 10-year planning matrix in the science plan, and advice for IDPO.

Albert presented the SAB membership in terms of the scientific areas that they represent. She noted that chairs of existing working groups are members of the SAB:
Ice Core – Karl Kreutz, Eric Saltzman, Dorthe Dahl-Jensen, Ed Brook
Bore-hole Logging – Gary Clow
Physics – Ryan Bay
Sub-ice environments – Ross Powell
Geophysics – Sridhar Anandakrishnan
Ice Dynamics – Howard Conway
Microbiology – Jill Mikucki

Albert also presented the IDDO Technical Advisory Board (TAB) and its purpose, including response to technical issues, technical review of the Long Range Drilling Technology plan, and the TAB's ability to provide additional input and to serve on other technical review panels for IDDO as requested by IDDO. Membership of TAB includes four ice-drilling experts from overseas (original members) and in early 2011 Hideaki Motoyama from Japan join the TAB. There will also be two guest drilling engineers from China at the upcoming April 2011 meeting.

Slides 12 - 13: **TAB Members** are Peter Doran (U. Illinois at Chicago), Alfred Eustes (Co. School of Mines), Steffen Bo Hansen (U. Copenhagen, Denmark), William Harrison (U. Alaska), Hideaki Motoyama (Nat'l Inst. of Polar Research, Japan), Marshal Pardey (QD Tech, Inc.), Alex Pyne (U. Wellington, NZ), Pavel Talalay (St. Petersburg Mining Inst., Russia), Frank Wilhelms (Alfred Wegener Inst., Germany), and Kris Zacny (Honeybee Robotics, NY).

Slide 14: An overview was given of IDPO interaction with IPICS members from 2009 to 2011. Much of this was associated with the need for a U.S. intermediate drill and the invitation of a Danish engineer to WAIS Divide. In addition drilling information was shared with Japan, China, New Zealand, Germany, Russia and Denmark.

Slide 15: IDPO – IDPO Collaboration: Mary Albert organized the AGU Town Hall on Scientific Drilling in the Polar Regions, which also involved Andrill participation, and IDPO-Andrill collaboration on several educational outreach activities. A hot water drill was provided by IDDO for Andrill use. Other agencies that IDPO-IDDO have interacted with include NASA, USGS and NOAA.

Slide 16: *IDPO-IDDO Interaction with logistics providers* –Raytheon (Antarctic) interacted with IDPO on the WAIS divide actions and provided IDDO with clothing, cargo movement, supplies, training and field camps. IDPO worked with NSF Arctic logistics and also with CH2MHill (Artic) to get approval and transport of an IDDO engineer to NEEM to observe testing of the new NZ intermediate drill. CH2MHill also provided transport, cargo, supplies, air and camp support for funded science drilling activities in the Arctic.

Slide 17: IDPO Planning examples: The Long Range Science and Drilling Technology plans are coordinated, and they guide formation of the IDPO-IDDO Annual plans. The science community is involved with the planning through the SAB, web input on the draft Science Plans, AGU town hall, and also through the upcoming community workshop. One example is the community-driven need for an Intermediate Drill, which was voiced in the Long Range Science plan, pursued by IDPO-IDDO through IPICS partnering with Denmark, and IDPO-coordinated iterations on science requirements with the research community. IDPO and IDDO are working on possibility of project and baseline funding for 2012 to start on the engineering.

Slide 19: IDPO Communications examples: The Icedrill website (www.icedrill.org), quarterly news letter (Ice Bits), and listserv announcements (http://www.icedrill.org/listserv.shtml), along with IDPO/IDDO presentation and interactions at community meetings make information readily available to all.

Slide 20: IDPO Education and outreach examples: High-visibility venues are the focus, such as IDPO formation of the ice coring booth at the U.S. Science Festival (held on the mall in D.C.), creation of new educational website (http://climate-expeditions.org/), developing outreach skills in graduate students by involving them in the outreach, also including community involvement in IDPO-organized NSTA teacher workshops and outreach.

Action Point: Julie Palais suggests posting SAB terms of reference to the website.

Slides 1 - 6: Krissy Dahnert, field project support supervisor for IDDO, gave an overview of the DISC drill challenges, lessons learned, records set and timeline.

Slides 2 – 4: DISC drill challenges included instrument and motor pump sections with leaks or other performance issues, weight-on-bit housing leakages and a cable kink. The cable kink may have been caused by ice chips or by too rapid a descent rate holding up the drill; a descent rate of 1.2 m/s was determined to be too fast especially in the narrows (below 1530m).

Lessons learned this season with regards to the DISC drill included the need for:

-attention to detail during assembly
-pre-field testing to fullest extent possible
-on site trained personnel
- facilities and materials to make in-field repairs
- multiple solutions to potential in-field problems
-teamwork and compatibility

Slide 5: The DISC drill had a record season with a final depth of 3,331.538 meters.

Slide 6: A preview of the WAIS Divide timeline was reviewed for 2011 – 2016.

2011 – 2012: Set up of bore logging equipment, deepen main borehole as needed, re-spool and terminate longer cable as needed, replicate coring and testing.

2012 – 2013: Borehole logging (half season), replicate core up to 400 m.

2013 – 2014: Borehole logging, removal of drilling equipment, begin interior demolition of Arch facility.

2014 – 2015: Complete interior demolition of Arch facility, disassemble Arch facility.

2015 – 2016: Load and traverse camp and Arch materials back to McMurdo.

Slide 8: The Blue Ice Drill, developed under an ARRA economic stimulus project to UCSD, was designed by Tanner Kuhl and Jay Johnson, and is used for large volumes of ice (gas studies). Cracking in the upper 5 meters of glacier means that the 9.5 inch core samples must be taken below that depth. The science requirements for the drill included a maximum drill weight of 500kgs, minimum core length of 1.0 meter and a maximum length of 1.6 meters, samples that are free of contamination from oils, greases, exhaust and any carbon-containing fluids, easy transportability in one Bell 212 helicopter load and ice that can be processed in the field.

Slide 9: During the development of the Blue Ice Drill it was noted that drill development benefitted from science requirements defined up front, followed by research/testing on core breaking strengths, chip transport and ice properties of the field site. Further engineering designs were reviewed, pre-field testing was achieved at CRREL, and then modifications were made based on the testing and a pre-deployment system review.

Slide 10: Some challenges that were encountered included warm temperatures (-2 --5°C), which caused an ice coating on the drills (core barrel and locking pins) and direct sunlight (refreezing of chips).

The core dogs were not reliable for breaking core when used without the magnetic-released slide hammer. The concept worked very well but a redesign is needed. A core recovery tool (CRT) was used for most breaks.

Slide 11: Lessons learned about the Blue Ice Drill include: science/field requirements must be fully defined prior to drill design and P.I. involvement is important. Changes to the requirement and project scope have financial consequences, while good planning up front results in a good product and the importance of pre-field testing cannot be stressed enough.

Slide 12: Successes from the Blue Ice Drill include an anti-torqueing concept for shallow drilling (20 meters – 30 meters) and a separate tool for core breaks (CRT) which works well at shallow depths (would be time-consuming at greater depths). Further successes include the magnetic-released slide hammer, which should be 100% effective for breaking core after a redesign and lastly a proved concept of drilling large diameter core with a fast and light system.

Slides 13 - 15: The RAM drill was loaned to Askaryan Radio Array (ARA) as is. The ARA engaged an experienced driller and the project test results were provided to IDDO. Multiple equipment configurations were tested; approximately 40 holes were drilled of which a maximum depth of 63 meters was reached. Three compressors were used for the project.

Some lessons learned included that drill performance is site specific (need to model which issues contribute to air loss in the firn), more research is needed to optimize drill performance and there are still modifications to be made.

WAIS DIVIDE REPLICATE CORING (Jay Johnson)

Slides 1 - 4: Jay Johnson (U. Wisc.) presented an overview of the replicate coring. During replicate coring a modified DISC drill was used, deviation from the parent borehole occurred, recovery of core at selected depths (1 – 2 meters), and we are now ready for the 2011 – 2012 field season.

Modifications to the DISC drill include new components (actuator module and two PCB's) further modifications include a reduction in the diameter of screen and core barrels and a review of the actuator module assembly.

Slide 5: When ascending/descending there is deviation over ~25 meters, actuators are used to force cutters to high side of parent hole while direction and magnitude of force is controlled by a surface command. Adjustments can be made in real-time through the use of an onboard controller. Currently there are no plans for a camera in the module.

Slide 6: A prototype actuator is currently under going testing and being rated for stick-slip, anti-torque and lever force; lever options are being explored. This prototype can generate 1,200 lbs. of force at the actuator head.

Slide 7: A prototype deviation cutter is currently undergoing testing. There will be two heads (broaching and milling), which put chips into the hole and allow a fluid to run on the outside. A coring head is an added modification to the DISC drill, which will hopefully eliminate kink problems.

Slide 8: On-going development includes instrument section modifications, on-board and surface software modifications, mechanical assembly/verification testing, and system integration and testing. A concept test with full assembly will be done at WAIS Divide in the next field season.

When warm ice drilling occurs, one area of concern is how to get glycol into the deviated hole. The solution is to create a balloon with glycol that can be used as a fail safe.

The drill will produce a 134 mm hole and there will probably not be any issues with logging tools.

Slide 9: The timeline shows that the 2011/12 WAIS Divide season will see a system test in January 2012. In 2012/13 there will be a production season with a coring total of up to 400 meters in 4 deviations. Jeff Severinghaus is the Chief Scientist who will determine lengths/depths of core.

Action Point: Julie Palais suggests adding drilling terms to website along with additional detail and this would also make a nice highlight for the NSF.

INTERMEDIATE DEPTH DRILL (Jay Johnson)

Slides 1 - 4: The intermediate drill system can be a simple lightweight design with a 1500 meter drilling capacity in two Antarctic field seasons. The system will be Twin Otter transportable, have a core size of 98 mm (+/- 3 mm) x 2 meters long, capable of operating down to -55°C in either a wet, dry or semi-wet borehole. This drill comprises modifications to the Hans Tausen drill design, which operates to a depth of 400m (may go up to 700 meters) in either a dry or semi-wet environment.

The drill uses positive displacement, and we are looking to make a dry drill with a spiral to bring chips back to surface. It would use a bigger motor but would fit in the same space and work beyond rating in a cold environment, with a possible use in the future for sediment drilling. The data from this system would be load pin and cable payout. There maybe a possibility for some

data logging as well as the addition of an electronic data transmitting system (works thru power system). The borehole could be filled with drilling fluid during the off-season to reduce closure.

The proposed timeline is as follows:

2011: Meet with Center for Ice Climate (CIC) to generate engineering requirements based on the H-T and NEEM Deep drill, work up a plan for building drill; one option could be partnered with CIC (pending NSF, other approvals and agreement with Danes). The determination of cost and schedule for building the drill will be done this spring.

2012: Design the drill and sub systems, purchase long lead-time items.

2013: Build the drill system.

2014: Test system, possibly in Greenland and possibly in collaboration with the Danes, and have it ready for deployment to Antarctica in the fall.

IPICS UPDATE (Ed Brook, via phone)
http://www.pages-igbp.org/

Slides 1 – 2: Until 2014 Brook/Wolff will continue as co-chairs of IPICS. There are five initiatives for future projects including IPICS 2K, IPICS 40K, Last Interglacial, Oldest Ice, and Technology.

The 2012 Ice Core Science Symposium will be held in Giens, France (10/1/2012 – 10/5/2012, local organizer: Jerome Chappellaz). IPICS will continue to foster international collaboration while pushing for site selection with regards to oldest ice and data synthesis for last interglacial, 2K, 40 K and existing data and new records. IPICS has worked thus far as a way of focusing the international community.

Slide 3: IPICS Initiatives and drilling (dreams and needs):

IPICS 2K: Bi-polar network of 2ka records
There is a need for easily deployable "shallow" drilling equipment (2ka = 480 m @WAIS, 800 m @Law Dome (DSS), 86 m @ EDC). There will be a pages 2K Network meeting at INQUA (Bern, July 2011).

NEEM/Last Interglacial: high quality/resolution deep ice core records of the last interglacial. There is a need for a deep drill like DISC or perhaps an intermediate drill for possible new records at NEEM, Talos Dome and WAIS. New sites in Greenland and Antarctica (S. Pole, Hercules Dome, Renland and possibly south of NEEM).

IPCIS 40ka: There is a need for either an intermediate drill or the DISC drill. New records at Talos Dome, WAIS Divide, NEEM and Roosevelt Island (drilling 2011-2013). Possible new sites in Greenland and in Antarctica (S. Pole, Hercules Dome, Renland, south of NEEM?)

Synthesis papers: Stenni et al (2011, Nature Geosciences) and Pedro et al. (in review, CPD)

Stenni et al, 2011 paper: http://www.nature.com/ngeo/journal/v4/n1/full/ngeo1026.html

Pedro et al, 2011 paper: http://www.clim-past-discuss.net/7/comments.html

Oldest Ice: For oldest ice we will possibly need the DISC drill, but what fluid and what about the access drill? Site selection for this project is ongoing, with the anticipation of multiple cores. EU might consider making it a "grand challenge"?

Chinese are currently drilling on Dome A.

Possible special session soon (EGU?)

NSF PIRE from ORISE and OPP (Ed Brook, via phone):
PIRE: ICE-ICS = International collaboration and Education in Ice Core Sciences, Oregon State University is Lead. This project will support American students and post-docs in Switzerland, France and Japan for focus on gas records (laser spectroscopy), firn-ice transition issues, modeling, and abrupt transitions.

Website for ICE-ICS: http://iceics.science.oregonstate.edu/

DISCUSSION:
Mount Moulton for blue ice, more continuous stratigraphy of ice. (HC)
IPICS: Site selection, what formula done in advance? (SA)

No specific formalization, more project-by-project but would have target numbers for accumulations rates. (ED)

Technology and Development? (JP)

Not been a recent issue in IPICS organization, some who were previously involved with the IPICS organization have dropped out, but this needs to be revisited. (EB)

International partnering is ongoing with IDPO/IDDO/Danes and collaboration with drillers from other countries. (MA)

Communicate more of this, perhaps have Charlie as a U.S. representative, and then link this to IPICS. (JP)

Jacob Schwander is looking at a tool for site selection for the oldest ice using a fast access drill. (GC)

Community workshop in April has many scientists coming who need fast access drilling. (MA)

Project with Schlumberger sounds like it is not funded. (EB)

To use DISC drill for oldest ice, possible modifications of some parts may be needed for drilling in extremely cold conditions (2015-2016) (CB).

POTENTIAL FUTURE U.S. ANTARCTIC DEEP ICE CORING (Karl Kreutz)

Slides 1 - 4: The overview included "big questions" such as trace gas composition, spatial climate patterns, did WAIS collapse 130kyr ago (last interglacial sea level 7-9 m higher than present) and why did the ice ages cycle at 41 kya periods >1 million years ago (was it CO_2)? The weather comes over the Antarctic so this chemistry should be reflected in the ice.

Slides 5 – 6, 8 - 14: The scientific rationale for sites selections at Herc Dome/South Pole is that these sites sit downstream of major weather trajectory over WAIS. A South Pole ice core can test if the WAIS collapsed and reveal gas preservation/records, physical properties and fabric studies.

Gas preservation would be excellent at the South Pole due to -50°C temperature and clean ice. This would enable trace/ultra-trace gas studies of past atmosphere. A physics core could also be pulled from the South Pole location.

Additional advantages of a South Pole ice core include synergy with IceCube, the ability to tie surface instrumental record to past records, contrast with EAIS deep cores and link to IPICS 40K and Eemian goals.

Rationale for the "Oldest Ice" core would allow testing the hypothesis that falling atmospheric CO_2 caused the "41K world" to turn into the "100K world". This core would also allow for the testing that the 41K marine $d^{18}O$ signature was caused by a land-based Antarctic ice sheet margins that were sensitive to precession-band local insolation forcing (Raymo); also, for testing the prediction that Antarctic temperature proxies (dD_{ice}) should have strong local insolation signature in 41k despite the absence of precession in deep sea.

For an "Oldest Ice" core the site needs the following characteristics: accumulation rate <2 cm a^{-1}, ice thickness >3500m, low heat flow at base (~50mW m^{-2}), surface temperature (<-55°C), flat bottom topography and slow ice velocity.

Slides 7: The logistical advantages of a South Pole ice core are: the camp already exists (can do prep work long before drill arrives), drilling can go all winter long, good weather for flights, no refrigeration needed for core processing, ice can be archived on site which puts less pressure on NICL and sample retro can be done on an as-needed basis.

Slide 15: What drill should be used? DISC drill? For >2000 meters depth the DISC drill, with modifications to increase per run ice recovery may work. But what fluid should be used and how will it work in the cold?

Replicate coring maybe important for any deep core effort (extremely limited sample size in bottom 10's of meters of ice sheet, so replicates will be needed). The DISC design is well suited for "oldest ice" and may have replicate abilities, use of DISC would also establish US leadership role on the Oldest Ice project, which will most likely be an international collaboration.

Slide 16: Currently funded DISC schedule at WAIS Divide, 2010/2011 will include drilling to near bed, 2011/2012 will include the start of borehole logging and then the DISC drill can be removed.

If replicate coring happens this will be the potential WAIS-D schedule:
2010/2011: Drill to near bed
2011/2012: Borehole logging #1, arch work
2012/2013: Borehole logging #2, arch work, possible replicate coring *
2013/2014: Borehole logging #3, replicate coring*
2014/2015: remove DISC drill*
2015/2016: remove DISC drill

*There maybe a need for a lightweight thermal drill, but the intermediate drill has many applications.

FUNDAMENTAL PHYSICS & ASTROPHYSICS WITH ICE (Ryan Bay)

Slides 1: Ice can be used as an observatory or detector, advantages of polar ice for sub-atomic particle detection include: transparency, stability, and low-background, copious, clean low noise. Long distance experiments (no drilling) similar to ANITA and ARIANNA could be conducted.

Slides 2 - 5: The IceCube enhanced hot water drill is a great tool, with specifications at 200 gallons/min, 1000 psi and 80°C water, however it does not work for all applications. The IceCube array is geared toward neutrinos of the mid to high energies. Drilling required 86 holes x 2500 meters = 215 km >> all deep ice cores combined.

Within IceCube low energy physics work could be conducted with the backfilling of IceCube and DEEPCORE. The physics would include neutrino oscillation, dark matter, proton decay, supernovae detection, and neutrino beams; there would also be a large photo cathode area (trick would be to embed these into ice) and composite optical modules.

The current placement of two holes is within 10 meters; this would actually need to be cut down to within 5 meters. This will be hard to do as ice pulls holes together.

Slide 6: For very high-energy (radio) neutrino detectors there is a need to move beyond IceCube. For this work 100 km^3 of ice is needed to detect 100 events in a 3 – 5 year period. Radio technology would be the choice option for this as cores would required 100 meter detector spacing (Askaryan cone) to image radiation, the holes would need to be deeper than 100 meters and wider than 6 inches. Within the holes, firn air loss would be a serious concern/problem. Another concern is that ice would need a constant density, which occurs deeper than 150 meters.

Slides 7 – 8: For drilling, the RAM drill has the potential but will probably not be well suited for ARA, we are moving toward a reverse circulation drill but for now the mini-hot water drill will work. The RAM drill as expected had firn air loss issues and mechanical modifications (casing of the borehole) were unsuccessful.

Slide 9: Research with a high power radio beacon (Bob Morse, U. Hawaii) would required a minimum 1 km deep hole to illuminate the ARA (200 meter array x 5 km radius). The system would be passive-down hole with all active electronic on the surface with bat-wing and discones antenna, low-loss 2" and foam cable (100 MHz – 1 GHz), and a 20-year service life. These could also serve as anchor points to drop pulsers or lasers.

The South Pole ice core would be ideal for radio, optical, acoustic ice characterization and a borehole access point for beacons.

WISSARD (Sridhar Anadakrishanan, no ppt available)

Looking below the ice at ice shelves, ice sheet stability and sub-glacial environments. Alaska and Greenland have drilling projects to put instruments into the ice shelf. WISSARD to drill through Ross Ice Shelf, but we need the technology to go to 1 km. Currently, hot water drilling is what scientists are looking at for drilling through the ice shelf. WISSARD plans ultimately to

put an ROV thru the ice and go under the shelf, but the hole would need to stay open and be large (~3 feet).

For sub-glacial environments, the hot water drill would be good to just get through the ice and then to drop an instrument down the hole or collect a sample from down-hole.

The ICDS has been tasked to produce a drill for WISSARD but the process hasn't yet gelled, we need a new group for this. We would need very clear specifications for this, excellent communications with the client, and someone on the other side to watch mission creep.

The IDDO does not have good deep hot water drilling equipment; this would be of value, but a major logistical challenge in deep ice.

WISSARD is unique in that it needs a big hole (~3 feet) but a seismometer would need a large hole as well. Hot water drilling equipment (were it available) would make cost determination easier. Part of the cost issue is that there is $3.5 million available and the rest would need to be subsidized, and that may not be possible.

Questions:

IDPO overseas large part of IDDO budget, where does the SAB fit into larger budgetary/management issues?

If we change to a consortium there would be a board of directors and financial board that would take over budget issues but for now its IDPO.

SAB plays an important role in defining the science. The science plan encompasses feedback to the scientists on requirements/logistics versus the science need/desire.

Recommendations for hot water drill and tool kit, though we would need to be clear on what the drill needs to do and make sure that it relates back to the science plan and works with the time table.

Terms of reference need to be updated to clarify the SAB's responsibilities.

MICROBIOLOGY (Jill Mikucki)

Slides 1 - 2: Some of the questions we are looking to answer with ice cores are: cell abundance, diversity and ecology, deposition (correlation with major events), preservation of biological materials, viability of cells in an icy environment, weathering reactions, how life deals in low energy/low light environments, relationships of organisms and sub-glacial environments (diversity/evolution in isolated environment, microbial metabolism, flux of metabolic products).

Slides 3 - 5: There are many concerns over drilling for microbiology cores, first and most important is the issue of sampling and sampling strategies. This includes time in borehole (how much time can we have?), cleanliness and volumes of instrumentation, sample return needs to be clean, intact and representative.

Secondary major concerns include a lack of say when a project is added on.

Slides 6 – 7: There needs to be a clean access/code of conduct, which will be one of the biggest issues in the community. How will drilling fluid perform? Will it act as a microbial substrate or inhibitor, the fluid and instruments need to be clean. In slide 7 of the presentation there is an instrument-cleaning plan provided by WISSARD.

The instrument-cleaning plan shows a system of high pressure, hot water and UV lamps that are used on the instruments. Currently, WISSARD is testing a water filtration set up that runs fluid through a 2μm filter, then through a 0.2 μm filter and finally through a UV (185 nm and 254 nm) filter.

The goals of the community should include clean access, clean sample collection process wide and an explanation of logistical constraints.

Comments:
Check out investigator webinar coming up in April, it covers who to go to and where to go. (JP)

Cleaning materials, how will they affect the instruments?

BORE HOLE LOGGING (Clow, no ppt available)

Preparing to log NEEM on 5/19, temperature and optical in 2011, and sonic in 2012. WAIS divide logging will begin in December of 2011 for temperature, optical, sonic, seismic (vertical) and sonic pulse data.

Seismic: The seismic readings will be used to determine depth of ice remaining. Temperature profile for 3,331 meters of hole and casing will be installed through the firn and above the surface (to find the hole again). Eight frequencies (started with 11) will be tested (1 – 40 KHz) for dispersion and attenuation; the logging should produce better/more clear results. Would like to add more instruments over time. Incoming new tools are the 3D laser scan and Lidar.

Logging platforms: There will be no intermediate logging winch just one deep logging winch and there is the possibility that we are out growing our current winch, which might not be able to handle high speed communications. Currently, the Danish winch costs $30k (Oslog) for 2km.

We also need to let all in the logging community know the logging plans.

Future: Logging of replicate cores for spatial variation and tomography. We would like to extend beyond ice core holes (fast access drill) and map heat flow in Western Antarctica, use the optical tool to map dust/ash layers (this tool works best in fluid) and the laser to polarized technique.

The logging community is highly in favor of a fast access drill and would like to do measurements of borehole deformation (need tool for this).

GEOPHYSICS (Sridhar Anadakrishanan, no ppt available)

Ice coring/drilling for geophysics needs a shot-hole drill, but this drill has large logistics needs.

COMMUNITY WORKSHOP (Mary Albert)
Slides 1 – 4: This workshop will be held in Washington D.C., April 14th & 15th, 2011 for two days in hopes of better identifying future Arctic, Antarctic, and temperate region glacier goals in

regards to drilling/coring sites, ice drilling technology that will be needed, and a timeline over the next decade for conducting scientific endeavors and advancements.

Participants to date (IDDO/IDPO): Gary Clow, Erin Pettit, Bob Hawley, Twit Conway, Ross Powell, Slawek Tulaczyk, Jill Mikucki, Christine Foreman, John Goodge, Jeff Severinghaus, Ryan Bay, Eric Saltzman, Andrei Kurbatov, Vladimir Aizen, Frank Rack, Mark Behn, Julie Palais, Lisa Clough and Jessie Crain.

Long-range science plan: There is a lot of important science in the narrative, but there is not yet identification of much of a plan except for the Climate area. When and where do scientists want to measure geothermal flux, which requires a fast access drill? Ice dynamics in the plan is weak, and physics plans are even more sparse. Scientific discoveries are important but require advance planning. During the Community workshop we plan on conferring on these topics and more with AGU length presentations by the scientists. In the afternoon we will have the participants divide up into working groups who will focus on the questions of what, where, when, with what drill and so forth. Saturday morning groups will finish white papers and discuss the next few steps. The white papers will be used in updates of the Long Range Science Plan that will be finished this summer.

Question: Has this been shared with EAR, Geosciences, and other listserves in the community? Answer: announcements of the meeting went out through ANSWER, Arcticinfo, Cryolist, and the Icedrill listserve.

SAB agrees with setup of the meeting.

The long-range science plan should help to capture larger variety of scientists who would be new to the community.

Action point: Email ocean drilling for listserves. Alicea has already done this and is awaiting a response.

Technology should be a shared science, what about oceanographers?

Long-range plan has been broken down into separate components which should be updated as assigned below, the document has been uploaded to Google docx and all members granted access to edit.

Executive Summary: (Jill Mikucki, lead, with Sridhar Anadakrishanan and Ryan Bay)
Intro (Mary Albert and Jill)
Logistical principles and drilling technology investments (Howard Conway)
Associated logistical challenges, section 4 (Ryan)
Climate (Karl Kreutz and Eric Saltzman)
Recommend targets (Gary Clow, Karl and Ryan)
Ice dynamics and history (Howard and Sridhar)
Add section on physics and dates to matrix (Ryan)
Borehole logging (Ryan, Gary, Bob Hawley)
Holes for remote sensing (NASA) & assoc. challenges (Sridhar, Mark Twickler, Joe)
Conclusions (each person to their own specialty)
Remote Sensing, needs sentence added about 200 year arrays
Astrobiologists

Suggestions: More graduate students are needed to work on drilling, how can we make that happen? REU students? Want-to-be driller list from Bill Eustis, Internships with schools like Colorado School of Mines?

Writing style in the Science Plan needs to be geared towards a broad audience of scientific community, funding agencies, congressional people, TAB, etc.

Friday, March 18th, 2011

How do we prioritize? Each year when the science plan is updated a review of future requirements is performed and prioritized by IDDO/IDPO resources. Julie Palais suggests looking at the science separately and then integrating it into the plans or creating a single plan and having the changes made in conjunction with the NSF and TAB since it is a cooperative agreement.

Terms of Reference:
In the SAB terms of reference, Mary suggested that it should be expanded to include description of a process for making new SAB member nominations, voting, and visibility in the community. After the cooperative agreement ends we will need to apply for NSF funding, and one of the possibilities should be formation of a consortium. SAB should consider what mode makes sense, small community cooperatives versus a consortium.

Sridhar suggested elections as a topic of discussion during the workshop.
Julie suggests formalizing structure to avoid funding for when she retires and new project manager takes over.

Ice core community representatives have been on the OPP advisory committee for ten years or so. Discussion followed on whether it is the job of the SAB to identify how the community will sustain in the future?

For next SAB meeting, collect details for possible consortium, Jim Davies at Harvard is an example (UNAVCO).

Action point: Sridhar suggested and others on the SAB agreed that IDPO should work with Eric Saltzman for feasibility of consortium. Mary Albert agreed and noted that she had started on it.

Action point: Jill Mikucki will review terms of reference, including addition of a call for nominations from the community, in addition to nominations by the SAB, for new SAB members. She will invite additional SAB input when she has the initial edits.

Drilling technology needs:

Intermediate drill requirements are being updated after IDDO engineer visits Denmark. SAB members agreed that an instrument package is needed, and the community needs to know the implications of each tool in the field on the functionality, portability, logistics, and cost of the drill. The community also needs to know the maximum depth and inclination of the system needed and if the drill will be Twin Otter transportable. We need to be making informed decisions on depth and discussing method of transport to most restrictive areas. Science requirements need to be discussed on length of use and size. Mary stated that documentation of restrictions and requirements arising from draft science requirements for intermediate drill development will be

useful to the community if considering modifications of the requirements. IDDO is working on it now and will send to the IDPO, who will share it with SAB and others.

The Borehole Logging Working group came up with requirements/needs then determined the long-term needs. Intermediate depth logging winch will be needed. Ryan Bay's tool is not currently working with the winch. If the USGS backs out of the project, the winch goes to the University of Washington. Currently there is no intermediate winch, but there is a serious need. The Borehole Logging Working group should work on this and additional assignments. Gary Clow is the Chair of the Borehole Logging Working Group, and will be the point of contact on this issue.

Hot water drilling (Ross Powell): WISSARD is developing an interface for communication needs and the working group needs to come up with the science driven requirements. WISSARD already has 2 proposed holes, one on the Ross Ice Shelf and one on a subglacial lake. The working group needs to be formed and needs to create science/technology requirements for a possible future hot water drill acquisition/development (SA). The old CalTech hot water drill is currently in Madison in pieces, is not in good shape, and safety may be an issue with its design (DL).

The IDDO is not currently working on the fast access drill issues. TheY need defined requirements to consider for the fast access drill. Draft requirements can come out of the upcoming community workshop. Ryan Bay, Gary Clow, and Jeff Severinghaus are putting together a strawman.

Clean Access (JM) pointed out that the filtration system is large and there maybe a need to develop new drilling fluid. Jill Mikucki to work with Christine Foreman and Brent to create a strawman for the community. Jill will also lead the Microbiology Working Group.

SAB webpage:

The science plan will be put up on the homepage, meeting minutes will be posted to the public website (after group review and approval). The SAB will have a link put on the webpage for SAB actions.

After edits of 2010 meeting minutes are approved they will be posted to the website. Sridhar Anadakrishanan moves to approve the 2010 minutes and Karl Kreutz seconds it, action approved.

Action Point: SAB web will be removed from terms of reference in the update being created.

OUTREACH (Linda Morris)

Linda Morris gave an overview of the IDPO Educational Outreach program goals, its creation and progress. In the first year of the program, the focus was on creating the program, outreach to scientists and teachers, developing partnerships (Andrill, NSTA, etc), development of materials, curriculums (the year without a summer) and proposals.

In the second year of the program the focus will be on delivery and expansion. Workshops at the U.S. Science festival (Washington, D.C.) were successful, Polar Detectives (sulfur data and Earth Science).

Linda had written and submitted a proposal on global climate change/ice records, which included partnerships with the Governor of NH, DES, NSTA, Harvard, CReSIS, 4H at UNH, and Geoff Haines Stiles Inc. The proposal had favorable reviews but was not funded. Partnerships developed may lead to another version which could possibly be submitted in another forum.

A new website was created (http://climate-expeditions.org/) to aid in the dissemination of activities, findings, teaching materials, etc. This website will also be used as a collaboration tool, classroom tool, and a career page (to expose kids to career profiles). In furthering the dissemination of work, brief summaries of published scientific articles by the community will be "translated" into language accessible to the public, reviewed by the original authors, and then will be posted on this site.

Currently, Linda is looking for materials to add to this website.

Action Points: Link to this site for SAB page, add Krissy Dahnert to the career profiles.

In the future, Linda would like to have an NSTA SciPack created for our work, the cost would be ~$300,000 and a proposal would have to be written in order to fund this. Another idea was suggested, which would also need funding, an informational kiosk geared toward the public, something that might be seen in a museum.

Action Points: Find out how the science requirements/standards for K-12 education are made, and how do we get our science into those standards (SA->LM).

How do we go about getting a more adult impact (i.e., voters, policy groups, etc.)? (JM ->LM). Aiming materials at a middle school level will be suitable for a large part of the greater public. Putting our working into popular science magazines (SA), Science Illustrated was suggested by AB (http://www.scienceillustrated.com/),

Linda Morris said that she is willing to help write and be added to proposals as the broader outreach component to help community scientists.

SAB Chair and composition:

Eric Saltzman's time is up for SAB (2 year limit), which means it is now time for a new chair.

Action: SAB appointed Howard Conway to continue as chair also for next year's SAB meeting.

Rotations in the SAB would occur after July to keep continuity on the current science plan revisions. SAB needs an international member, possibly add a new one but consider keeping Dorthe Dahl-Jensen on board. Nancy Bertler was suggested as an additional member. The current SAB would like to see the future SAB contain members from areas such as solid Earth, ice dynamics, physics, biology, bore hole logging, geophysics, hard rock and sub-glacial environments. Some suggestions include: John Goodge, Mark Vachon, Ellen Mosanto, Ginny Catania, early career, minority and possibly a student representative. There is a need to increase diversity on the SAB (JP). The community itself is not very diverse; SAB members discussed asking NSF for a list of minorities in these fields that SAB can use to pick from. Ask

Sam Mukasa before Dave Marchant, Jim Owattem (suggested by Jill Mikucki) and Heddy Edmonds. Sridhar Anandakrishnan moved to ask Dave Marchant.

Karl Kreutz, Howard Conway, Sridhar Anandakrishnan and Ross Powell are all at the 3-year point and could now rotate off the board, but all are interested in remaining on the board. Discussion suggested future SAB board is Ryan Bay, Jill Mikucki, Ed Brook, Dorthe Dahl-Jensen, Gary Clow, Sridhar Anandakrishnan, Eric Saltzman, Ross Powell, and Karl Kreutz.

Action Points: The SAB will email and continue to discuss membership and rotation in the coming months, and possibly change the Terms of Reference so that SAB members may serve more than three years. SAB will sort it out by summer. Howard Conway will lead the discussion.

ADDITIONAL ACTION ITEMS

-Long Range Plan (all, on Google docx)
-Terms of Reference (Jill will lead)
-Preparation for Community Meeting in April
-Science Requirements (Sridhar -> Hot water drill, Gary -> Winches, Ryan -> Fast Access, Jill -> Clean Access)
-Narrative from IDDO for science reqs on the drills -> Mary -> Community
-Linda will work to identify ways of getting ice science into school curriculums.
-Mary and Eric to get info on becoming a consortium
-Linda will work on getting the science into national standards
-Request analysis to make sure we are aware of all science (Twickler)
-NSF membership stats (Conway)
-SAB to identify new members and get back to Mary
-SAB recommends that IDPO merge the Long Range Drilling Plan in with the Long Range Science Plan, Mary to check with NSF first.
-SAB to identify second international member
-Representative from SAB to go to the next TAB meeting on 4/20 and 4/21 (either Eric Saltzman or Ed Brook; Howard Conway will contact them)
-Science plan SAB edits due 4/1 to the document on Googledocs, which is before the Community Workshop

Meeting adjourned.