TAB MEETING – Notes on discussions during presentations
March 6, 2018
Skyview Room – Fluno Center
University of Wisconsin – Madison

Technical Advisory Board Members:

Jeff Cherwinka	Physical Sciences Lab University of Wisconsin – Madison
Steff Bo Hansen	University of Copenhagen
Keith Makinson	British Antarctic Survey
Dennis Nielson	DOSECC Exploration Services
Marshall Pardey	QD Tech, Inc.
Alex Pyne	Antarctic Research Centre Victoria University of Wellington
Jakob Schwander	University of Bern
Frank Wilhelms, Chair	Alfred Wegener Institute for Polar and Marine Research
Kris Zacny	Honeybee Robotics

Other

Terry Benson	Physical Sciences Lab University of Wisconsin – Madison

Ice Drilling Program Office

Mary Albert	Dartmouth College
Blaise Stephanus	Dartmouth College (via phone)
Joe Souney	University of New Hampshire (via phone)
Mark Twickler	University of New Hampshire (via phone)

Ice Drilling Design and Operations

Grant Boeckmann	Space Science & Engineering Center University of Wisconsin – Madison
Chris Gibson	Space Science & Engineering Center University of Wisconsin – Madison
Josh Jetson	Space Science & Engineering Center University of Wisconsin – Madison
Jay Johnson	Space Science & Engineering Center University of Wisconsin – Madison
Jim Koehler	Space Science & Engineering Center University of Wisconsin – Madison
Tanner Kuhl	Space Science & Engineering Center University of Wisconsin – Madison
Zack Meulemans	Space Science & Engineering Center University of Wisconsin – Madison
Mark Mulligan	Space Science & Engineering Center University of Wisconsin – Madison
Chris Niendorf	Space Science & Engineering Center University of Wisconsin – Madison
Kristina Slawny	Space Science & Engineering Center University of Wisconsin – Madison
Anna de Vitry	Space Science & Engineering Center University of Wisconsin – Madison
Kyle Zeug	Space Science & Engineering Center University of Wisconsin – Madison

Opening Remarks & Chair Comments – Slawny & Wilhelms

- A moment of silence was observed for Charlie Bentley.

Update on the IDPO Science Advisory Board – Albert

- IDPO-IDDO renewal proposal going in; paradigm will shift a bit; IDDO will do less development work during the next Cooperative Agreement (CA).

- Zacny: Added a freezer in the new Honeybee Robotics warehouse facility; would be tremendously valuable for IDDO; the Honeybee freezer is ~18 ft. tall, -20°C, $25K.
- Bo Hansen: CRREL had a test well ~50 years ago; it is time for another one.

IDDO Field Program Update – de Vitry

- Zacny: Where are the projects in Greenland this spring?
    - De Vitry/Slawny: One near Summit Station and one is a traverse in SW Greenland.

Winkie Drill 2017-18 Season – Boeckmann

- Zacny: Who supplied the motors?
    - Boeckmann: Sonceboz Corp. from Germany.
- Zacny: Could you fit the ice core pucks back together?
- Zacny: Temp at bottom of hole?
    - Boeckmann: -25°C at bottom of 10 m hole.
- Pyne: What is the rig capacity with the new, larger drill rod?
    - Boeckmann: Unsure, but the rods are about twice as heavy as the aluminum rods
- Pyne: Afraid of losing fluid around the edges of the polygons?
    - Boeckmann: Yes, drilled in the center of the polygons for this reason.
- Zacny: Did some polygon testing in Greenland on the edges, near the walls and in the center; Mars has polygons as well.
- Pyne: NZ had luck with the PDC bits. The quality of the core looks equivalent to what we're getting. NZ penetration rate is slightly faster.
- Nielson: Any loss of circulation?
    - Boeckmann: No, all forward circulation.
- Zacny: How did the chain sawing work?
    - Boeckmann: Blades quickly dulled. Ruined the tungsten blade.
    - Zacny: Gasoline chainsaw has more torque than the electric.
- Nielson: Wireline or conventional?
    - Boeckmann: Conventional; samples were cut into 20 cm lengths and stored/transported in Nalgene bottles.

Foro / Foro 3000 Drill Development & Fabrication – Johnson

- Johnson: Adding a slide hammer, which could result in smaller winch motors/drums in the future.
- Pyne: Does the slide hammer spline shaft have a stop on it?
    - Johnson: Yes.
- Zacny: How hard can you pull?
    - Johnson: With all 6 magnets, you could pull over 30 kN, which is likely enough to destroy the motor, so we may only use a few magnets.
- Pyne: Are there covers around the magnets to keep chips out?
    - Johnson: Things are generally shrouded; haven't witnessed many chips in that area.
- Pyne: Can you rotate backwards?
    - Johnson: Yes.

- Pyne: Still plan to deploy a trained driller with the Foro Drill?
    - Johnson: Yes.
- Pyne: Do the core dog windows go all the way through the drill head?
    - Johnson: No.
- Wilhelms: Do the wet drill heads already have the core dog windows?
    - Johnson: Yes. They're not quite as deep.
- Johnson: Accelerometer chip in the control system could be changed out to add a core orientation feature.
- Wilhelms: For the cutter head, you might need to open up a channel in front of the core dog cages in addition to the path recently added at the back of the cages. Maybe round up the top of the core dog cage?
- Pardey: Can you shape the core dogs so they don't allow a cavity when recessed into their cages?
    - Johnson: Did consider this, but it didn't seem possible.
- Bo Hansen: This looks like a dry head design. Is this for wet drilling?
    - Johnson: IDDO used the dry head design for the duration of SPICEcore.
- Pyne: Were the dry and wet heads the same outer diameter?
    - Johnson: Yes; they were 126mm; we plan to drill 129.6mm going forward.
- Bo Hansen: We have a head where you can close the core dog windows; this is useful for warm ice, where undesirable channels could be cut into the ice core by the window openings.
- Johnson: The idea is to only perform multiple core breaks down hole in the brittle ice zone.
- Wilhelms: Will the additional fuel needed to run the chips melter offset the reduction in the amount of drill fluid needed?
    - Johnson: There may be a small fuel penalty, but the melter will only run when other loads are low through use of a load shedding panel.
    - Could you use the winch brake resistor to create heat for melting chips?
        - Johnson: Likely not, as the brake resistor is currently housed in the control room for back up heat.
- Pyne: The idea is to maintain the melting chips/fluid in a liquid state?
    - Johnson: Yes, but we don't want it too warm; can drain off the water and fluid at different levels of the tank.
- Cherwinka: So the centrifuge will be eliminated?
    - Johnson: Yes, though we'll likely bring it along as a backup for the first season of melter use.
- Pyne: Can the Bicon shop option fit in a Herc?
    - Johnson: Yes, they make either 8ft or 8ft 6in height containers
- Wilhelms: Ran an oil stove in our machine shop; were also able to treat metal using the stove.
- Johnson: For the Herc Dome project, everything will likely be traversed; Hercs will only be used for resupply.
- Pyne: What is the accumulation rate at Herc Dome?
    - Johnson: Less than WAIS, but more than South Pole; will need to work to keep the tent clear; some drifting on the tent ends was experienced at South Pole, but not much on the sides; the tent is rated to approximately 70 lbs./sf.

- Souney (via phone): Bob Jacobel has a related paper out; thinks the accumulation rate is 15-20 cm ice equivalent accumulation per year.
- Johnson: Plan to use traverse vehicles to clear snow around camp.

Lunch

Rapid Air Movement (RAM) Drill Upgrades – Gibson

- Nielson: Geometry of the hole?
  - Gibson: Very smooth/clean; a bit of enlargement/erosion at the top of the hole
    - Koehler: Hole expansion at top from 4in to maybe 8in.
- Nielson: Losses to the firn are about 75%?
  - Gibson: Yes.
- Old RAM used 2 x 400 cfm compressors; RAM 2 will use 4 x 100 cfm compressors; can decrease the cfm needed by decreasing the hole diameter.
- Cherwinka: Are the compressors electric?
  - Gibson: They're gasoline, but are connected to the generator via the E-stop loop.
- Gibson: Working to maintain the proven geometry of the old sonde design.
- Nielson: Issues with hole collapse?
  - Gibson: No, the hole stays open.
- Zacny: Rock drilling uses mud to form a coating/casing in the hole; could use a thermal probe to create an ice casing.
- Schwander: What size chips are you creating? If you created finer chips, perhaps they could fill in the firn gaps and naturally case the hole.
- Nielson: If the hole could be expanded, this could go in front of RAID?
  - Albert: Looked at a larger RAM hole for Albrecht Karle, but the infrastructure needed was sizeable.
- Cherwinka: How much power do you need?
  - Gibson: Less than 2000 W.
- Pyne: So the drill is suspended by the cable and not the hose?
  - Gibson: The hose supports the drill at first, but near the bottom of the hole, the cable takes over the weight. The intent is to pre-tension the hose.
- Cherwinka: As the hose stretches, does the diameter change?
  - Gibson: Very little; there's a helix coil in the hose.
- Pyne: What is the winch weight with hose?
  - Gibson: About 800 lbs.
- Cherwinka: How many hose layers?
  - Gibson: 3.5.
- Pyne: Does each compressor have its own water separator on it? Could consider taking the water out at each compressor.
  - Gibson: Did consider removing the water in stages; looked at various dryers with desiccant or deliquescent.
- Gibson: If we test in Greenland, we'll have to re-jet the engines and adjust the screw speed.
  - Cherwinka: So the test may be at high altitude, but the anticipated field project is at lower altitude?

        - Gibson: Yes.
- Cherwinka: The snowmobile pull test at South Pole was conducted with similar sleds to what you'll use in the field?
    - Gibson: Yes; they're all wide track; they also make a super-wide track version.
- Pyne: Tried to make cold air for drilling rock using similar heat exchangers to those highlighted for the RAM 2; one was used to cool the air and the other two were used to grow ice; the warm air from the air compressors would flow through and melt the ice off
    - Pyne: May want to consider putting the oiler in front of the radiator to keep ice from growing in there; you might be growing ice accidentally and you'll want to help clear it.
- Benson: Mary had a student that studied RAM Drill air flow; was that research published?
    - Albert: Yes, it was published in Cold Regions Science and Technology.

Ready for Issue: Stampfli Drill & Sediment Laden Lake Ice Drill (SLLID) – Jetson

Stampfli Drill

- Zacny: How long did it take to drill to 58 m in Greenland?
    - Jetson: ~3-4 days; this was the drillers' first time out with the drill.
- Bo Hansen: What was the price of the Stampfli Drill?
    - Jetson/Slawny: $60-70K.
- Pyne: What was the core length?
    - Jetson: 1 m core barrel; Mike Jayred and Elizabeth Morton were collecting cores ~0.85m long.
- Pyne: Is the winch backpackable?
    - Jetson: Yes, when dismantled, the largest piece is about 60 lbs.
    - Pyne: Is it intended for backpacking?
        - Albert: Yes, or man-hauling on a sled.
- Boeckmann: What were the differences in their operation of this drill in an Eclipse style versus the recommended procedures in the Stampfli manual?
    - Jetson: The difference had to do with the amount of time the drill was left running at the bottom of the hole.
- Bo Hansen: Did you only drill in firn or also in blue ice?
    - Jetson: Only firn, but Dieter Stampfli says he has drilled into blue ice.
    - Bo Hansen: Concerned about not having an outer barrel, but if it works, we could maybe get rid of our outer barrels; however, instead of just getting packing around the cutter head, you now risk packing chips around the entire length of the drill/flights.
        - Jetson: Stampfli noted they run it at higher rpm (~200 rpm); we run our drills at around 60 rpm.
        - Wilhelms: Margit Schwikowski presented on the Stampfli Drill at a recent conference; there is a paper available.
- Schwander: Do you have any penetration control (e.g. shoes)?
    - Jetson: No, the design didn't have any and we didn't add them; we've only performed minimal testing.

Sediment Laden Lake Ice Drill

- Pyne: What is the heat exchanger made of?
    - Jetson: Stainless steel?
        - Pyne: We found that hot sea water (60°C and up) seemed to still cause corrosion with stainless steel; may want to be able to open your heat exchanger to inspect it; we ended up using a titanium heat exchanger.
- Cherwinka: 22 kW out of the heater?
    - Jetson: 22 kW out of the nozzle.

Downhole Electronics & Noise Issues – Meulemans

- Meulemans: In a VFD-specific power cable, the ground is split between 3 smaller wires.
- Cherwinka: Where do you connect the external shield?
    - Meulemans: Ideally at both ends, but this could create a ground loop; they recommend grounding everything at the VFD.
- Pyne: Is this for 3-phase or single phase?
    - Meulemans: For either; this example is for single phase; our plug has 4 pins (3 for conductors, 1 for ground).
        - Pyne: Our connectors have 5 pins, so you always have one pin for ground to the generator.
        - Meulemans: Thinks there's also 4 pins on our 3-phase connectors.
- Zacny: We use fiber for communication and copper for power.
- Wilhelms: Had some issues with our generators in Greenland; likely the same GFCI issue as IDDO experienced.
    - Meulemans: In the past, we've disabled the GFCI's on the generators in the field, but ASC/USAP no longer want us doing this to their generators.
- Cherwinka: For IceCube, had to use 30 mA for 240V and 10 mA for 120V.
- Wilhelms: The regulations are overbearing; if you run the load on the cable jacket, you could procedurally state that you should not touch the cable.
- Meulemans: Fixes are adding more complexity to the system.
- Benson: ARA cable was 200m long, 480V, 3-phase; the manufacturer recommended adding a load reactor; this overheated; mitigated this by changing the chopping frequency of the drive; well-placed capacitors can also mitigate the issues.
    - Meulemans: Agreed, for low power solutions.
    - Cherwinka: Important to be able to change the VFD frequency in the field.

Thermal Drill Upgrades – Zeug

- Pyne: Will you need a different control system than for the electromechanical drills?
    - Zeug: You don't need one, but we'll likely have a separate control system so we can integrate the thermal sonde with other drills (e.g. Eclipse, Foro).
- Cherwinka: What is the sonde diameter?
    - Zeug: 4" OD heat ring.

ASIG Drill Modifications – Kuhl

- Zacny: Is the continuous auger just for firn?

    - Kuhl: Yes; firn drilling is time consuming, so it's important to dial in an efficient method.
- Pyne: What is the firn depth limit for augering with ASIG?
    - Kuhl: Went to 30m at Pirrit Hills, but the rig can theoretically pull/hold 100m of augers.

Drilling: How Do We Access Subsurface On Mars – Zacny

- Zacny: Freezer unit recently installed at HoneyBee Robotics.
    - Pyne: Any circulation system in the freezer?
        - Zacny: No. Personnel spend only ~30 minutes in there; it's -20°C; can go down to -30°C.
    - Pyne: Do you pump any liquids in there?
        - Zacny: Have LN2 tank inside to cool specific components.
    - Pyne: How big is the equipment you're testing?
        - Zacny: Our big drill is ~2.5m.
    - Zacny: Mechanical cooling capacity?
        - Zacny: Unsure, but this is just a standard commercial meat freezer.
    - Zacny /Albert: Should have a small man door for people to go in/out, so you keep the big door closed and the cold air inside.
- Mars Drilling
    - Spent a lot of time designing bits that can drill both hard volcanic rock and softer sedimentary rock.
    - Have drilled 5cm on Mars thus far; hoping to drill up to 5m in the coming year.
- Pyne: It has been mentioned that salts in the ice increase the freezing point. Is this the same with clays in the ice?
    - Zacny: Yes, we witnessed this issue with clay from Ellesmere Island.
        - Pyne: May have been marine clay with salt in it.

Open Discussion

End of Day Wrap-Up

Group Dinner at HopCat

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March 7, 2018
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University of Wisconsin-Madison

TAB Membership and Next TAB Meeting – Slawny

- Bo Hansen: Would be good to use this group (TAB/IDDO) to solve common problems; we could select a topic and everyone could do research throughout the year and bring their findings to the meeting.
    - Makinson: The VFDs may be a common problem.
    - Slawny: Identifying a new drilling fluid is an ongoing challenge.

    - Makinson, as the new TAB Chair, will solicit input from the TAB and IDDO several months prior to the next meeting.
- Krissy will talk with Hideaki Motoyama and Peter Doran to see if they would like to remain on the board or rotate off.
- Keith will take over as TAB Chair in 2019; thank you, Keith!
- Thanks to Frank for serving as Chair in recent years!

CIC Field Activities – Hansen

- Drilled to 900m in 2017; had hoped to get to 1200m and through the brittle zone.
- Wilhelms: What was the snow cover over the balloon/cabling trench?
    - Bo Hansen: ~20 cm.
- Gibson: Diameter of the cabling tunnel?
    - Bo Hansen: ~60 cm?
- Sag in the roof of the drill trench was not caused by creeping of the snow over time, but by the initial installation/process for covering the balloon, where snow was blown too hard and straight at the balloon, caving it in on one side.
- Used a 3D printer in the field to make a three-blade booster; this has an added function of acting as a plug for the chips during ascent.
- Estisol 240 does not separate from water as well as Estisol 140 does; ended up pouring the Estisol 240 + water mixture into buckets and letting the water freeze into chunks overnight; the Estisol 240 could then be poured off and the ice discarded.
- Bo Hansen: We now have a means of controlling/correcting inclination for a double-barrel system.
    - Boeckmann: How did you orient the inclination-controlling spring in the borehole?
        - Bo Hansen: We had a navigation package, but if the outer barrel wasn't oriented correctly at the bottom, you could continuously raise and lower the drill a few times to get the outer barrel to turn.
- Albert: How did you ventilate your drill trench?
    - Bo Hansen: Large ventilation tubes and a fan running up to the surface; drilled another hole to the surface and started pumping in replacement/outside air.
        - Pyne: Did the replacement air cause the trench to heat up too much?
            - Bo Hansen: It didn't matter, since the core was immediately unloaded into a cold Viessmann.
- Meulemans: What was the ambient temp in the trench?
    - Bo Hansen: -10° to -15°C, but this fluctuates.
- Nielson: What material did you use to make your booster?
    - Bo Hansen: Polyethylene.

Status of the University of Bern Rapid Access Drill "RADIX" – Schwander

- Drill bit is 20mm diameter.
- Electric-driven firn drill; cuttings removed by vacuum; made a hole to 70m in 1.5 days; should be possible in 5-6 hours.
- Worked well to 50m, but had some chip transport issues when going to 100m.

- Modified drill head penetrates at ~10mm/sec.
- PE tube casing of only 21-25mm diameter.
- Summer 2018 drilling planned to 2500m at NEGIS margin.
- Plan to use a thermal drill for the first 10m, to seal off the sugary firn.
- Logger has a 15mm outer diameter.
- Logger cable has a breaking strength of ~900N.
- Inflatable Axion 7m x 7m tent; about 90kg as packaged in a duffle bag.
- Nielson: Can you explain how you use the vacuum system?
    - Schwander: Supercharger can go down to about 1/3 an atmosphere; rigid PE hose; done while drilling. Chips go through bearing, which is 3D printed with holes. They pass along the motors and cool them, then exit through the tube. The electric power for the motor goes down the outside.
- Pyne: How much air goes down through the hole and how much comes through the firn?
    - Schwander: Need the air flow from within the firn to help move chips out of the hole, but you can go into the ice below the firn/ice transition and it will still work. There is about 50 m/s air flow in the hole. When we extended from 50-100 meters, chips started to clog around the motor.
- Pyne: So the narrow hose and the pressure drop across the hose caused the chip clogging in the motor section?
    - Schwander: Yes; increased the hose now from 16mm to 19mm.
    - Cherwinka: They do make conductive polyethylene if you want to solve your sparking issues.
        - Schwander: We like white polyethylene.
            - Cherwinka: The conductive PE is not white.

BAS Rapid Access Isotope Drill (RAID) and Future Drilling Activities – Makinson

- Outer barrel is 3” OD.
- Onboard analysis of chips for temperature and age.
- Tall 10m tower.
- Discharges chips on the surface into a tray; no core collected.
- Once the drill goes back down hole, no driller intervention is needed; the motor controller stops the drill a few cm above the borehole bottom.
- Drilled to 461m; world record for dry electromechanical drilling.
- Wilhelms: What cable was used?
    - Makinson: 5mm steel coaxial cable.
    - Drill was stuck/abandoned in the ice, but were able to lower a thermistor cable for logging.
- Pyne: Do they know why they got stuck?
    - Makinson: Unsure; the outer barrel was still spinning and wasn’t stuck; possibly stuck near the anti-torques (AT).
        - Wilhelms: Do they record AT rotation?
            - Makinson: No.
- Drill run: Just over 2 minutes drilling, ROP 45 cm/min, ~50 seconds to empty on surface.

- Planning for BigRAID; 220mm (8.66in) diameter hole; more automation with no drilling intervention after initial setup.
    - Albrecht Karle (UW Physics) is very interested in this system for rapid creation of the ARA array at South Pole.
- P-RAID (Percussive RAID) in development.
- BEAMISH
    - Drilling 2018-2019; 2 sites, 2-3 km apart; total 4 holes, each 2160 m deep.
- Meulemans: Upgraded from 250W to 400W motor; who is the manufacturer?
    - Makinson: Will check with Julius.
- Meulemans: Three combined motors for the percussive motors; are these brushed or brushless?
    - Makinson: Will check with Julius.
- Pyne: Do you expect the bed to be wet?
    - Makinson: Yes. Intend to core at the bed.
- Benson: Can you change the pitch of your level wind?
    - Makinson: Yes, just change the angle of the bearings and they walk along the drive shaft; perfect for hoses that may change diameter with tension.

Hot Water Drilling on the Ross Ice Shelf – Pyne

- Drilling on the Ross Ice Shelf ~350 km from McMurdo on the South Pole route.
- Wilhelms: How heavy is the little snow tractor w/ bucket?
    - Pyne: About 600 kg, but could be disassembled for transport in a Twin Otter; can switch to forks to lift a 250 kg load.
- Wilhelms: What company built the generators?
    - Pyne: We built them.
- Wilhelms: The generator is run separately?
    - Pyne: Yes; fuel from barrels is sent to a bladder, then to a pressure unit that feeds the generators.
- Wilhelms: How much fluid do you pump down?
    - Pyne: 90-100 L/min; have 3 pumps that can theoretically pump 50 L/min each.
- 60 cm sediment corer from AWI.
- Nielson: How much water is between the ice and the sea floor?
    - Pyne: ~400m.
- Wilhelms: How much did the salinity increase? To keep a hole open, could you suck sea water into the hole and let it freeze to the walls?
    - Pyne: The ice that grows on the side of the hole is quite soft.
        - Wilhelms: You could remove some of that slush mechanically.
            - Pyne: You could, but the slush then floats to the top of the column and freezes solid, causing a blockage.
- Wilhelms: How much does this system cost?
    - Pyne: Keith's initial budget looked good, but BAS had adapted equipment from other drills and the cost of sourcing materials in NZ is higher; ~800,000 NZD ($580,000 USD).
- Cherwinka: We run our JP8 through a heat exchanger inside a 65°-70° degree container; improves the atomization in the burn.

- Pyne: Our fuel isn't quite coming in cold, but is a little above 0°.
- Pyne: NZ has a burner register/approval process; have yet to get the burners approved; will likely be approved for diesel instead of kerosene; may try for an exemption based on how cold the kerosene will be kept.

RAID System Test Update – Nielson

- System is capable of drilling to 3300m.
- Switched the Boart-Longyear rig from diesel to electric power.
- Lessons learned:
  - Holes should have at least 100m of separation to prevent hydrofracture.
  - Traverse needs GPR for crevasses.
  - The ISO III sleds are better than the ISO II sleds.
  - Had issues with ice in the Fluid Recirculation System (FRS).
  - Need to hone augering operations.
- Pyne: Will you continue with the auger system for firn?
  - Nielson: Not our decision, but likely so.
    - Pyne: Would be desirable to set the packer at the bottom of hole, as opposed to above 30m of chips left in the hole; the small-diameter drill rods won't like the larger diameter made by the augers; may have rod whipping.
- Cherwinka: What is the fluid flow rate?
  - Nielson: Unsure; fluid comes down the annulus and up the center of the drill; trying to keep hole pressure to less than 75 psi.
- Nielson: Not funded for next year; the system is in cold storage for at least a year.
- Bo Hansen: Why not just use a coring drill to make the pilot hole; you wouldn't have excess chips in the hole?
  - Stephanus: Hope to modify the auger bit design to decrease the amount of chips left in the hole.
- Slawny: How quickly do you auger to 100-130m?
  - Stephanus: Unsure.
  - Kuhl: About 8 hrs.
  - Slawny: Takes about 30 hours to reach 100m with IDDO's 4-Inch Drill.
    - Kuhl: The 4-Inch Drill could go ahead of the RAID and take density measurements on cores along the way.
  - Pyne: Could use reverse circulation (RC) rods and compressed air to drill the pilot hole; cut chips and bring them up through the center.

Lunch

ARA Drilling – Benson

- Pyne: What sort of precision was required for hole location?
  - Benson/Gibson: Not totally critical; consistently got within 3 ft. of desired location; there's a survey team onsite that determines the as-built configuration of the holes.
- Water level is near the bottom of the hole; this puts a lot of load on the hose.

- ARA HWD will likely no longer be used for ARA, but the drill might be repurposed for IceCube Gen2 to replace the equipment that was loaned to WISSARD.
- Pyne: How did you get stuck?
    - Benson: The firn carrot became tilted in the hole; sent the side-spraying nozzle down for recovery; 'cold slugs' can also cause narrow spots in the hole.
- Pyne: At what depth do you start recovering water?
    - Benson: Water starts pooling at about 40m.
        - Cherwinka: It's an air-filled hole, so we have plenty of water.
        - Benson: Have to dump the exit water far away from the hole, so it doesn't flow back in through the firn; about 100 ft. away; also filled an insulated backup tank.
- Meulemans: What sort of info are you monitoring with the digital-to-analog converter (DAC)?
    - Benson: Drill flow pressure, temperature, load cell, speed, penetration rate, up flow, temperature on all heaters.
    - Meulemans: Do you monitor in real time?
        - Benson: Yes. There's a wireless link back to the MECC for monitoring on cell phones.

Beyond EPICA - Oldest Ice (BE-OI) – Wilhelms

- 4 km logging winch weighs less than 300 kg (660 lbs.).

Drill Development at AWI – Wilhelms

- Used Pavel's sediment corer with a hot water drill; was supposed to be only soft sediment, but contained small pebbles; wasn't a perfect test for the corer.

Open Discussion

- The TAB voted Keith Makinson as the next Chair and thanked Frank Wilhelms for his recent efforts in this role.
- Bo Hansen: The 8th International Workshop on Ice Drilling Technology will be held in Copenhagen in 2019; likely in October.
    - Looking for planning members; Frank Wilhelms and Pavel Talalay have signed up; Krissy will be in touch with Steff and the other coordinators.

End of Meeting Discussion & Summary

Meeting Adjourned