



SAB MEETING

MADISON, WI
MARCH 6, 2017

IDDO UPDATES

KRISTINA SLAWNY – PROGRAM DIRECTOR

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IDDO STAFFING CHANGES

Electrical Engineer Position Filled:



- **Zack Meulemans** – Officially hired on May 1, 2016 following nearly 2 years as a Research Intern with IDDO
 - Deployed with SPICE Core during the 2015-2016 field season and recently deployed to Qatar with the Air National Guard
 - Zack is IDDO's only EE on staff. His current focus is the redesign and building of new control boxes and readout boxes for the Eclipse Drill systems

Field Support Manager Vacancy/Hire:



- **Rory Holland** – Resigned from IDDO effective August 31, 2016 to pursue another position within UW-Madison Facilities, Planning & Management
- **Anna Claussen** – Joined the IDDO team on February 1, 2017. Anna has a Construction Engineering Background and customer service experience from her time with Epic, a local medical software company with worldwide reach.
 - Anna is quickly coming up to speed on proposal support, equipment preparation and shipping, PI feedback and Driller coordination

Project Manager Vacancy:

- **Alex Shturmakov** – Resigned from IDDO effective October 31, 2016 to pursue a position within private industry

DEVELOPMENT PROJECTS

IDDO

DEVELOPMENT PROJECTS

AGILE SUB-ICE GEOLOGICAL DRILL (ASIG) DRILL

- System testing conducted at the UW Physical Sciences Lab (PSL) south of Madison
 - 4-week test
 - Trained Drillers
 - Tested Basic Functionality
 - Defined Operating Parameters
 - Drilled 32m in Ice
 - Cored 0.9m Ice
 - Cored 4.5m Sediment
 - Cored 1.5m Granite and Concrete
- Modifications made following the February 2016 testing at PSL
 - Filtration modifications
 - Water-swivel improvement
 - Revised Documentation
 - Other minor improvements identified in testing
- Virtual review of ASIG drill construction & pre-field test completed with IDPO and community scientists on April 28, 2016
- Verification and Validation paperwork completed with UW SSEC
- Pre-Ship Test Report completed
- Failure Modes & Effects Analysis completed and revised



DEVELOPMENT PROJECTS

AGILE SUB-ICE GEOLOGICAL DRILL (ASIG) DRILL

- System shipped to Antarctica on September 16, 2016
- Three-year system development project completed on time and within the budget laid out in the 2014 Conceptual Design document



March 6, 2017

WINKIE DRILL

WINKIE DRILL

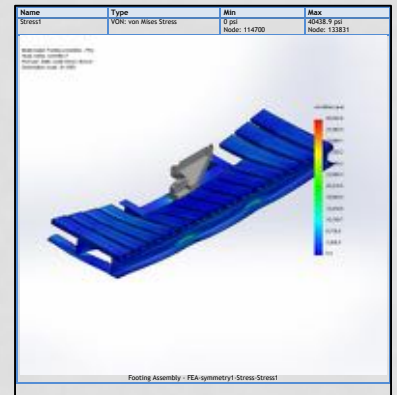
- System testing conducted at the IDDO warehouse in spring/summer 2016
- Invited industry expert Earl Maynard to Madison for a few days of hands-on training



WINKIE DRILL

WINKIE DRILL

- Modifications made following testing
 - Unipress modifications
 - Modular extensions added to the legs to ensure a full 5 feet of power-head travel
 - 7,000 lb. hi-lift jack added for supplemental pull-back force on core breaks
 - Power-Head modifications
 - Upgraded exhaust and muffler for operator comfort
 - Brake handle modified for easier operation
 - Pull cord handles replaced for use with mittens
 - Rig Footing designed
 - Custom aluminum pallet with UHMW bottom and grip tape surface
 - Air Circulation System added
 - For drilling access holes through ice only – air does not have the cooling capacity required for rock coring
- System shipped to Antarctica on September 16, 2016



RAM DRILL

RAPID AIR MOVEMENT (RAM) DRILL

- New Science Requirements developed in 2016 by IDPO through an iterative process with community scientists and IDDO
 - Two distinct visions – RAM Drill and RAMARA Drill
 - RAM Drill – Make modifications to the current system to dramatically reduce its weight and logistical requirements
 - Shot holes 40 or 100 m depth in a wide variety of firn types
 - Minimum hole diameter of 7.5 cm (5.5 cm diameter cartridges)
 - Longest acceptable drilling time per each 100 m hole is 40 minutes
 - Ambient temperatures down to -30 C (+/- 5 C) and winds up to 25 knots
 - Goal for the total system weight with packaging is < ~4,000 lbs
 - Current RAM Drill weight: ~23,000 lbs
 - The drill should be very field portable and able to be towed over rough terrain; goal is to tow the 40 m system by a single snowmobile, and the 100 m system by several snowmobiles or a Tucker
 - Setup time for the drill should be within 8 hours after initial unpacking on site
 - No more than 1 drum of one type of fuel should be required for 12 hr operation



RAM DRILL

RAPID AIR MOVEMENT (RAM) DRILL

- RAMARA Drill – Potentially upgrade or expand the new RAM Drill design
 - Interest expressed by the physics community and ARA (Askaryan Radio Array) group at UW-Madison; RAM + ARA = RAMARA
 - Produce holes 10 cm to 15 cm to depths between 50-200 m at the South Pole
 - The drill should be capable of drilling 3 to 10 holes per 10 hour work day including transportation to/from the field site, daily startup, movement between holes, and daily shutdown
 - The drill shall be operable in ambient temperatures down to -30° C and winds of up to 20 knots
 - Should be designed for use in ice with temperature ranges from -25°C to -55°C
 - Should be easily maintainable in the field by drill operators, and instructions and parts for maintenance in the field should be included with the drill
 - Should be transportable with no more than one LC-130 flight, or with ground traverse
 - Hole sidewall must be smooth to allow for deployed equipment to smoothly slide down into place
 - The hole must be plumb within the diameter of the hole

SEDIMENT LADEN LAKE ICE DRILL

SEDIMENT LADEN LAKE ICE DRILL (SLLID)

- Design in progress at IDDO
- Science Requirements:
 - Drilling speed should be less than 30 minutes for a 5-inch hole through 6 m of ice
 - Setup time should be within a half hour after initial unpacking on site
 - Modules less than 50 lbs that can be carried by one person
 - Upper weight of the system must be less than the weight of a 5 kW generator including its protective case (estimated at 265 lbs)
 - Materials used should be non-corrosive from fresh to sea water salinities
 - Easily maintainable in the field by scientists to avoid freeze damage
 - Require very little water to start the drilling, and would preferably recirculate the ice melt and seed water to avoid loss or contamination to the environment

SEDIMENT LADEN LAKE ICE DRILL

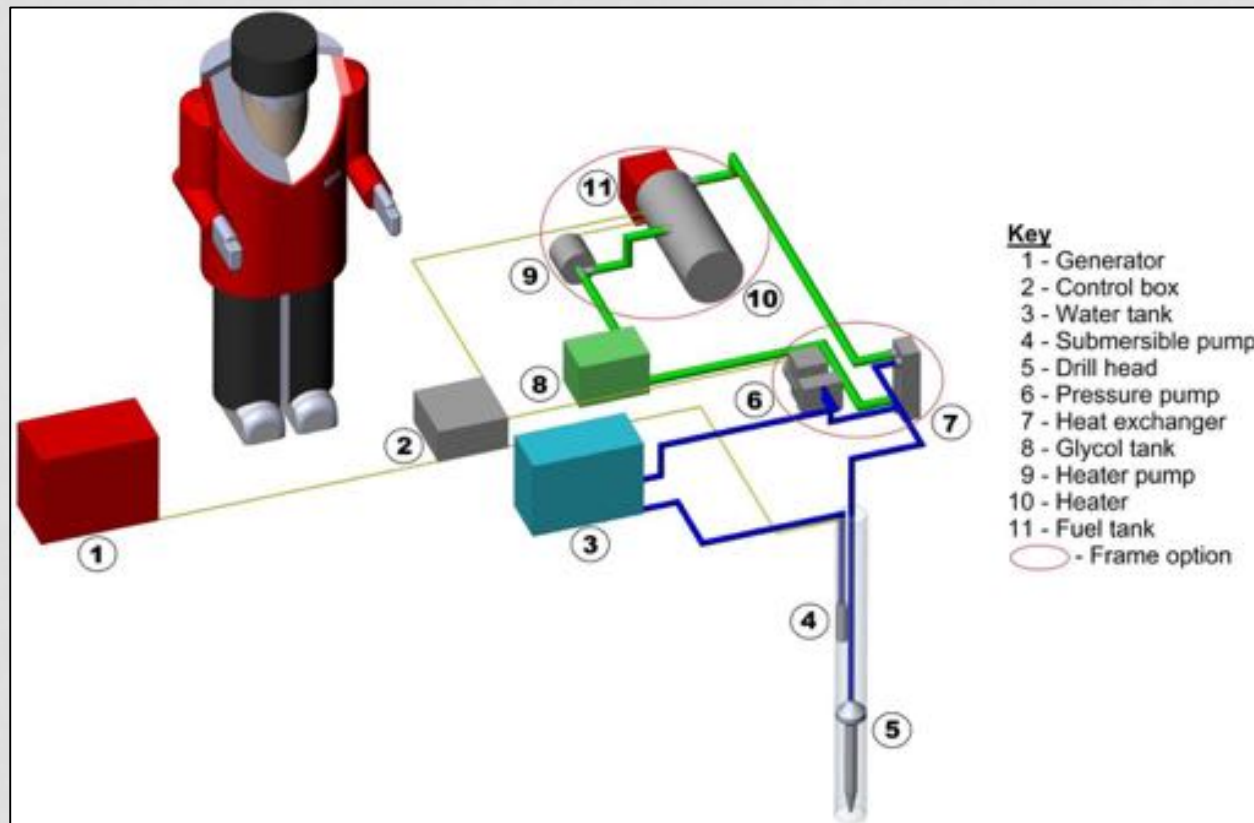
SEDIMENT LADEN LAKE ICE DRILL (SLLID)

- Options considered:
 - Steam drill
 - Not feasibly scalable to this size, Heucke steam drill is 5% of our required borehole area
 - Custom lightweight pressure washer heater
 - Cannot get weight below 65 lbs
 - One loop hydronic vehicle heater
 - 30 psi max, designed for glycol mixture only, 20 gpm min
 - Two loop heat exchanger with hydronic vehicle heater

SEDIMENT LADEN LAKE ICE DRILL

SEDIMENT LADEN LAKE ICE DRILL (SLLID)

- Proposed layout



STAMPFLI DRILL



Photos courtesy of Icedrill.ch

STAMPFLI DRILL

(formerly the PORTABLE FIRN CORING DRILL)

- In late October 2016, IDDO placed an order with Icedrill.ch (Stampfli) for purchase of a 2-Inch backpack drill
- Key Features:
 - Drilling depth down to 100 m
 - Winch(electric drive)
 - Solar panel
 - Tower
 - Falling weight
 - Spare parts and tools
 - System also includes a second spare solar pack (total 4 panels and 2 charger units)
 - Drill is a complete ready-to-use system
 - Total weight: ~130 lbs without cases; ~175 lbs with provided cases
 - IDDO will explore lighter weight bags for shipping

OTHER DEVELOPMENT PROJECTS

WINCH SIMULATOR

- Preliminary discussions occurring between IDPO, IDDO and community scientists
- Winch simulator units, if built, would be shipped to PI institutions for pre-season communications testing of their logging tools
- Individual simulators may mimic the three winches in IDDO inventory
- Use of simulators likely won't replace the benefits of testing on the actual winches in Madison, but may expose a problem that can be addressed prior to testing with the winch
- The simulator will not eliminate field issues that we currently have, even with the winch testing, such as dirty generator power or grounding issues
- IDPO plans to initiate and complete development of the Science Requirements by late May 2017

MODULAR 2500M CLEAN HOT WATER DRILL

- IDPO plans to initiate and complete development of the Science Requirements by late October 2017

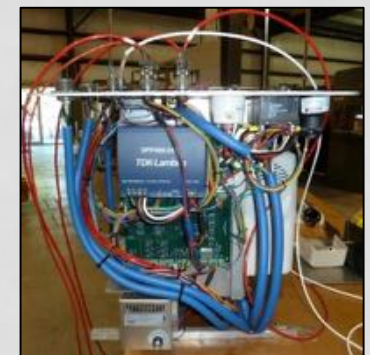
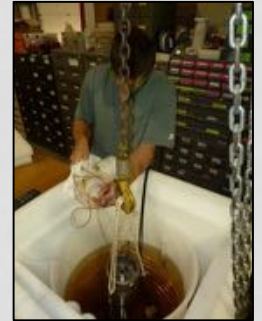
MAINTENANCE & UPGRADE PROJECTS

IDDO

INTERMEDIATE DEPTH DRILL

INTERMEDIATE DEPTH DRILL (IDD)

- Currently working on system upgrades identified during completion of the SPICE Core drilling effort in 2015-2016
 - Motor Section Testing
 - Test setup built at IDDO to simulate the conditions under which the motors were failing in the field
 - Motor sections tested in air and submerged in -40°C Estisol 140
 - Motor Power Supply (MPS) is not current limiting properly
 - Only one brush holder failed in the 12 test runs conducted
 - Brush holder failure is not due to defective motors or thermal issues in the motor section
 - Operator is not able to monitor from the surface the actual power being delivered to the motor
 - Downhole Control System
 - The MPS and communication systems are being replaced by Makar Technologies Limited and Mage Controls in Scotland to improve reliability and robustness of the control system
 - Replaced Drill Cables
 - Rochester replaced the damaged 1,900 m cable under warranty; credit applied to new cable
 - Original 'spare' cable was found to be damaged during 2016-2017; extrusion of cable insulation
 - A new custom 4-conductor cable and a spare have been purchased
 - Surface Control System Upgrades



SMALL HOT WATER DRILL (SHWD) UPGRADES



SHWD

- Completed desired system upgrades in late 2016
 - System testing completed at the IDDO warehouse
- One system capable to 30m depth and the other to 60m depth
- Thanks to Paul Winberry and Sridhar Anandakrishnan for helpful input/feedback



FORO DRILL

FORO DRILL

- Continued development of the Foro Drill system
 - Combines proven components of the aging 4-Inch Drill with new components from other IDDO drill designs (e.g. Intermediate Depth Drill)
 - Focus on decreasing system weight, simplifying operation and increasing/maintaining safety for operators



	Foro Drill Weights, lbs.	4-Inch Drill Weights, lbs.
Sonde	134	192
Complete sled, winch, and tower assembly (no cable), including	280	503
• Sled assembly w/o winch and hitch	41	141
• Winch assembly w/gearbox	90	174
• Tower assembly	123	135
• Winch motor	26	48
Winch gearbox	28	45
Winch cable (400 meters)	108	152
Control and readout boxes	80	115
TOTAL WEIGHT OF MAJOR COMPONENTS	551	893



CONTINUED MODIFICATION/UPGRADE PROJECTS

BADGER-ECLIPSE DRILLS

- New control boxes and read-out boxes designed and fabrication is nearly complete
- Purchased a second Mountain Hardwear Space Station tent



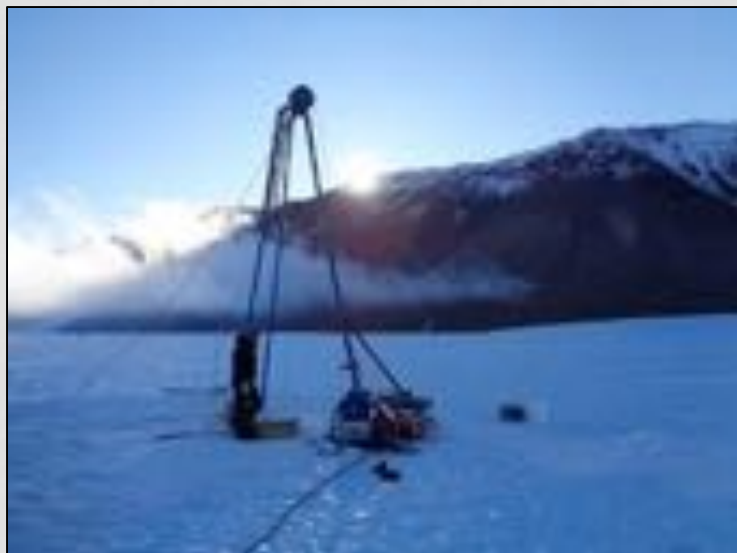
HAND AUGERS

- Currently fabricating two additional copies of the IDDO 4-Inch Hand Auger
 - This will bring the total 4-Inch kit count to three
- Some PICO kits are nearing the end of their useful life

CONTINUED MODIFICATION/UPGRADE PROJECTS

LOGGING WINCHES

- Deployed the new IDDO Deep Logging Winch for the first time in 2016-2017



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BLUE ICE DRILL

- Initiated fabrication of a second BID-Deep system, per the Long Range Science Plan
 - Largely a copy of original BID-Deep, but with very minor modifications (e.g. more robust electrical connection, new tripod foot plates, etc.)

CONTINUED MODIFICATION/UPGRADE PROJECTS



Photo courtesy of news.ucsc.edu

WISSARD

- Drill system currently under the custodianship of the University of Nebraska-Lincoln
 - UNL is now a subaward under IDPO
- Per the Long Range Science Plan, IDDO is working this year to “evaluate the practicality of acquiring the WISSARD Drill system and operating it under IDDO”.
 - Equipment inventory lists recently provided to IDDO by Blaise Stephanus
 - IDDO engineers plan to visit UNL in March

FIELD PROJECTS

IDDO

COMPLETED FIELD PROJECTS

ARCTIC 2016

- **GreenTrACS** - PI Osterberg
 - PI Osterberg and his team successfully collected six cores to 27-31 m in depth, and a 7th core to 22 m depth, using an IDDO Hand Auger and Sidewinder
 - Only stopped short of the 30 m goal on every core because they were running out of ISC boxes
 - The science team provided excellent feedback on the relatively new IDDO hand auger kit
 - Engineer Josh Goetz responded by purchasing new core dog springs, cutters, gloves, and by making updates/additions to the Sidewinder Operator's Manual

ANTARCTIC 2016-2017

ANTARCTIC 2016-2017 SHIPPING



COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **HAND AUGER & SIDEWINDER EQUIPMENT**

- PI Michelle Koutnik - IDDO 3-inch, IDDO 4-inch, Sidewinder
- PI Steven Barwick - IDDO 3-inch, Sidewinder
- PI Steven Schmidt – SIPRE
- PI Michael Gooseff - (2) SIPRE
- PI John Priscu – SIPRE
- BFC Spares - PICO 3-inch, IDDO 3-inch, SIPRE



COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **Cosmogenic Nuclide Analysis at the Ohio Range** –
PIs Sujoy Mukhopadhyay and Robert Ackert

- IDDO Personnel: Grant Boeckmann
- IDDO Equipment: Winkie Drill
- Location: Ohio Range
- Deployment Dates: November 10, 2016 through January 10, 2017
- Recovered 6 core samples
 - 5 bedrock cores
 - One frozen unconsolidated debris core
 - Bedrock samples ranged in length from 28 cm to 67 cm
 - Drilled access holes to depths between 12.0 m and 28.3 m
 - Created a 55 m access borehole, but were unable to retrieve stuck equipment in the bottom



COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **Cosmogenic Nuclide Analysis at the Ohio Range** –
PIs Sujoy Mukhopadhyay and Robert Ackert



COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **Exposed Rock Beneath the WAIS** – PI John Stone
 - IDDO Personnel: Tanner Kuhl – Lead, Mike Jayred, Clayton Armstrong
 - IDDO Equipment: ASIG Drill
 - Location: Pirrit Hills
 - Deployment Dates: October 31, 2016 through January 26, 2017
 - Successfully drilled subglacial bedrock core at a depth of 150 m
 - Attempted two holes
 - Difficulty drilling pilot hole with PICO 4-Inch hand auger barrel driven by the ASIG rig
 - Retrieved ~1.5m of ice core in Hole #1, but lost fluid pressure due to a crack in the ice; had to abandon the hole
 - Moved to a nearby site and quickly drilled second pilot hole with augers shipped from Madison
 - Collected ~7 m of ice core and 8 m of bedrock core from Hole #2
 - All equipment returned to WAIS Divide and on to MCM
 - Currently on the cargo vessel bound for Port Hueneme
 - List of required repairs and desired modifications made

COMPLETED FIELD PROJECTS

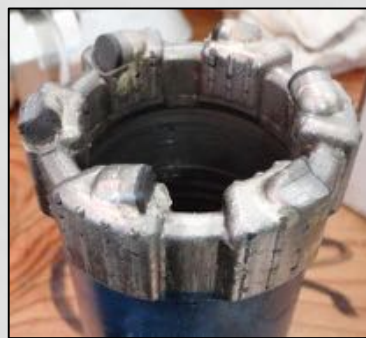
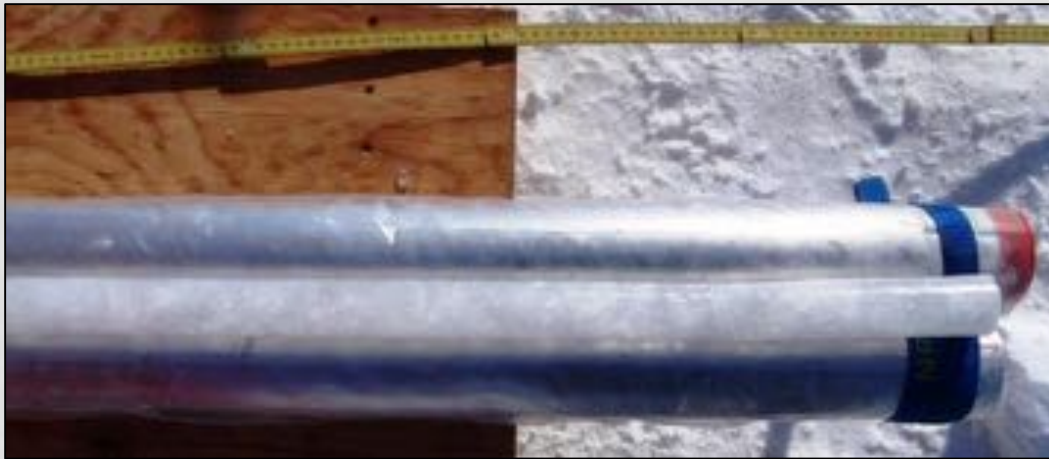
ANTARCTIC 2016-2017

- **Exposed Rock Beneath the WAIS** – PI John Stone
 - Participated in a Lessons Learned telecon with the RAID team
 - Coring of pilot hole at depths exceeding ~15 m is inefficient
 - Continuous-flight augering with subsequent chips bailing is efficient for deeper pilot holes
 - An efficient means of taking ice samples to verify density is needed
 - Ice and rock coring is feasible at acceptable fluid pressures for most sites
 - Additional development may be needed for sites with weak ice to avoid hydrofracture
 - PCD-type coring bits work well for both ice and granite
 - Ice core quality may suffer from drilling dynamics (or may be stressed near the bed?)
 - Hydrofracturing of ice is a major concern, especially at shallow or topographically-complex sites
 - Fluid recovery should normally be possible after a hydrofracture in ice
 - Packer inflation with air (160 psi) or liquid (200 psi) works well
 - No leakage of fluid was detected past the packer set in ice $>0.87 \text{ g/cm}^3$ density.
 - Air inflation was significantly faster and less complex
 - Filtration throughput capacity must be sufficient to keep up with drilling progress
 - Highly experienced driller of critical importance to system efficiency and safety

COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **Exposed Rock Beneath the WAIS – PI John Stone**



COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **WAIS Divide Borehole Logging** – Pls Pettit, Obbard
 - IDDO Personnel: Elizabeth Morton (replacement for Jim Koehler due to issues with UTMB)
 - IDDO Equipment: IDDO Deep Logging Winch
 - Location: WAIS Divide
 - Deployment Dates: December 4–22, 2016
 - Collected two complete data sets with the acoustic televiewer
 - Performed a test of the new sonic logger (Anandakrishnan)



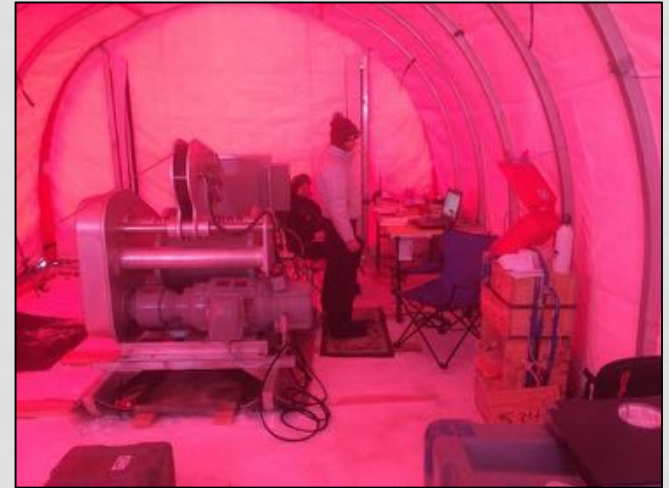
COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **WAIS Divide Borehole Logging** – Pls Pettit, Obbard



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COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **South Pole Firn Strain Rates #2** – Pls Koutnik, Conway

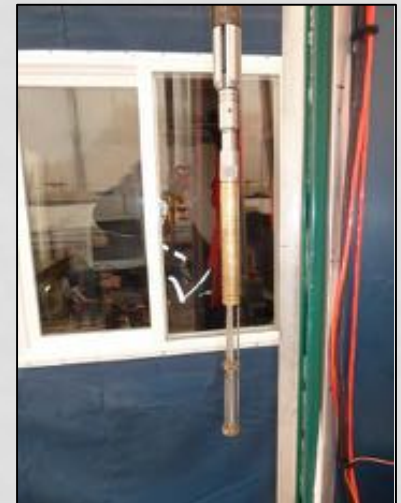


- IDDO Personnel: Mike Waszkiewicz – Lead, Elizabeth Morton
- IDDO Equipment: 4-Inch Drill
- Location: 50 km from South Pole Station
- Deployment Dates: December 5, 2016 through January 20, 2017
- Drilled six holes to depths of 25m, 2x40m, 80m, 106m, 125m
- All drilling and instrument installation successfully accomplished

COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **Laser Logging of the SPICE Core** – Pl Bay
 - IDDO Personnel: Josh Goetz, Jay Johnson
 - IDDO Equipment: Intermediate Depth Logging Winch (IDLW)
 - Location: South Pole Station – SPICE Core Camp
 - Deployment Dates: November 15, 2016 – December 21, 2016
 - Two thermal logs to the bottom (1751 m) using the IDD winch and tower
 - Two dust logs to 1587 m using the IDLW
 - One video log to the bottom (1751 m)



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COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **SPICE Core** – Pls Aydin, Neumann, Saltzman, Souney, Steig, Twickler
 - IDDO Personnel: Jay Johnson, Josh Goetz
 - Location: South Pole Station
 - Deployment Dates: November 15, 2016 through December 21, 2016
 - 124 ice core boxes packed and shipped from Pole
 - The borehole casing was extended to ~4' above grade level
 - All drilling equipment was packed and removed from the site
 - One 10 ft section of casing was left at Pole for extending the casing in the future
 - Decommissioned the drill site



COMPLETED FIELD PROJECTS

ANTARCTIC 2016-2017

- **SPICE Core** – Pls Aydin, Neumann, Saltzman, Souney, Steig, Twickler



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COMPLETED FIELD PROJECTS

U.S. 2016-2017

- **Midwest U.S. Ice Cores** – PI Mike McKay
 - Unable to utilize the SIPRE hand auger again this year due to the 'poor excuse for a Midwestern winter'
 - Equipment will now be returned to Madison in spring 2017

UPCOMING FIELD PROJECTS

ARCTIC 2017

- **Influence of Natural Ice Microstructure on Rheology in General Shear**
 - PIs Gerbi, Campbell, Kreutz, Koons
 - IDDO Personnel: Mike Waszkiewicz
 - IDDO Equipment: Eclipse Drill
 - Location: Jarvis Glacier, Alaska
 - Deployment Dates: March 20 – May 5, 2017
 - Plan to drill three holes to depths of approximately 50m, 80m and 120m
 - Plan to place temperature and strain gauges in the holes, allowing them to freeze in place
- **Dynamic Observations of the Microstructural Evolution of Firn under Load**
 - PI Baker
 - IDDO Personnel: Mike Jayred – Lead, Elizabeth Morton - Training
 - IDDO Equipment: Eclipse Drill
 - Location: Summit Station, Greenland
 - Deployment Dates: June 2 – 30, 2017
 - Plan to drill one firn core to 80m

UPCOMING FIELD PROJECTS

ARCTIC 2017

- **GreenTrACS** – PI Osterberg
 - Objectives similar to 2016 fieldwork
 - Planned deployment dates: April 25 – June 29, 2017
 - Snowmobile traverse of western Greenland
 - Plan to collect ~9 cores, each 30 m long, using an IDDO hand auger and Sidewinder system
- **Refreezing in the firn of the Greenland ice sheet** – PI Rennermalm
 - Plan to collect firn cores to investigate the stratigraphy, density, temperature and liquid water content of the firn cover
 - Snowmobile traverse from Camp Raven
 - Planned deployment dates: April 25 – May 31, 2017
 - Two-year drilling effort; same equipment and similar timeline planned for 2018

DISCUSSION/QUESTIONS

THANK YOU FOR YOUR CONTINUED SUPPORT OF IDDO!