WISSARDs and GLiDErs:

Season Recap and Forecast

*WISSARD Project Members**

*See http://www.wissard.org/ for authors & affiliations

WAIS Meeting 2013

WISSARD: Whillans Ice Stream Subglacial Access Research Drilling











PENNSTATE 1855

LSU

ST. OLAF

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NIU Northern Illinois University

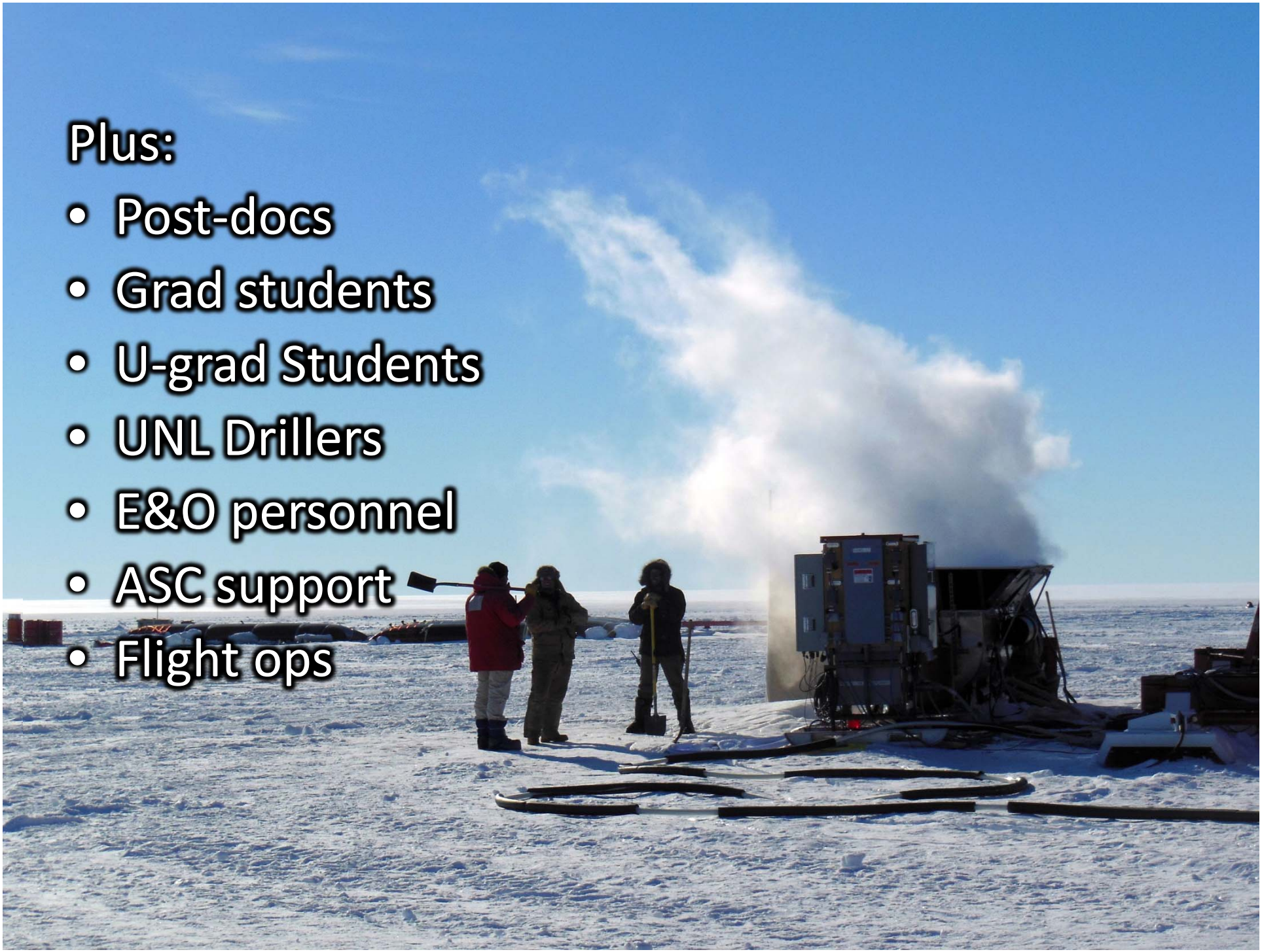
UC San Diego

THE UNIVERSITY of TENNESSEE UT KNOXVILLE

NYU

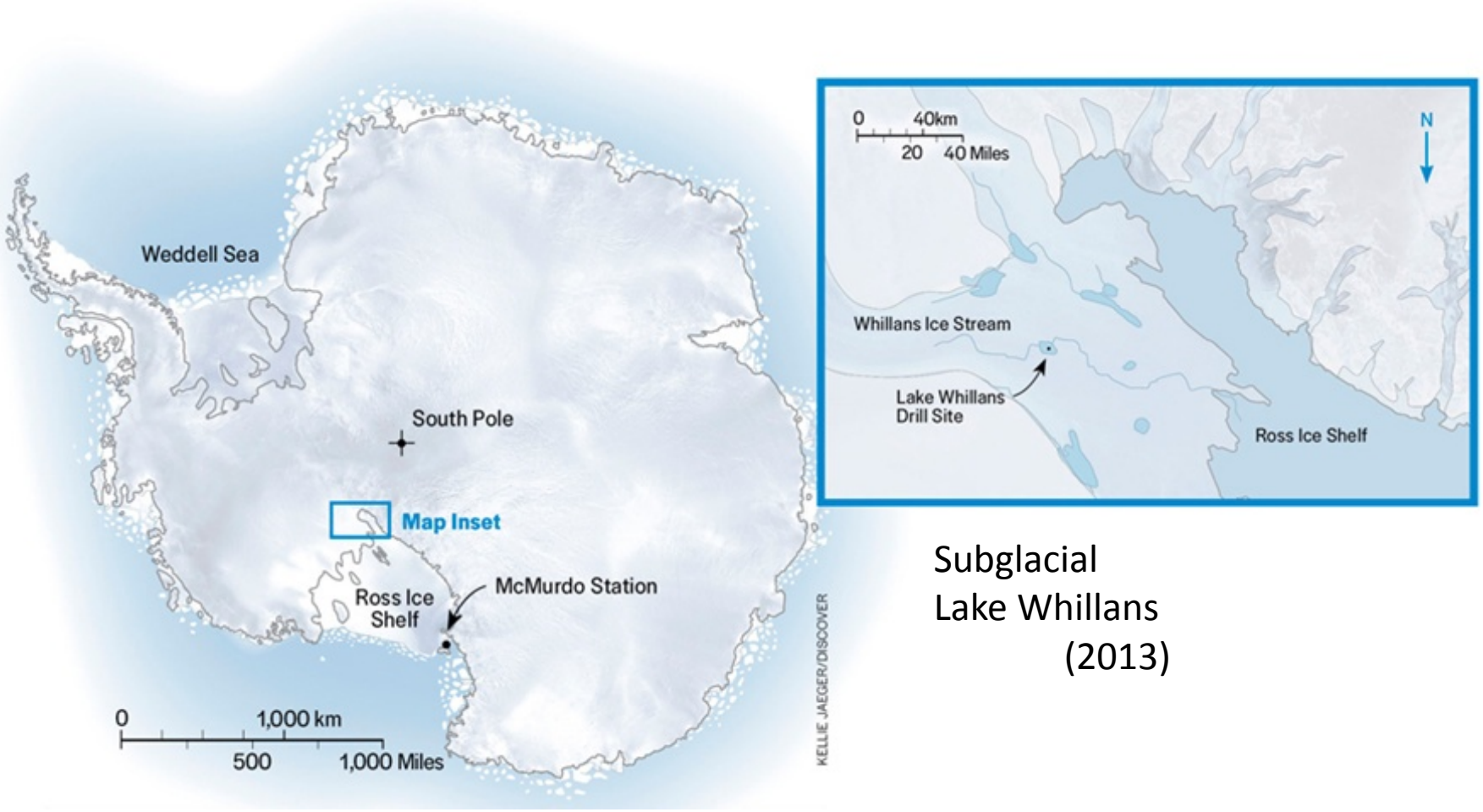
Nebraska Lincoln

GORDON AND BETTY MOORE FOUNDATION


Plus:
• Post-docs
• Grad students
• U-grad Students
• UNL Drillers
• E&O personnel
• ASC support
• Flight ops

- December 2012: Ops process shakedown, HWD and tool testing at McMurdo Ice Shelf

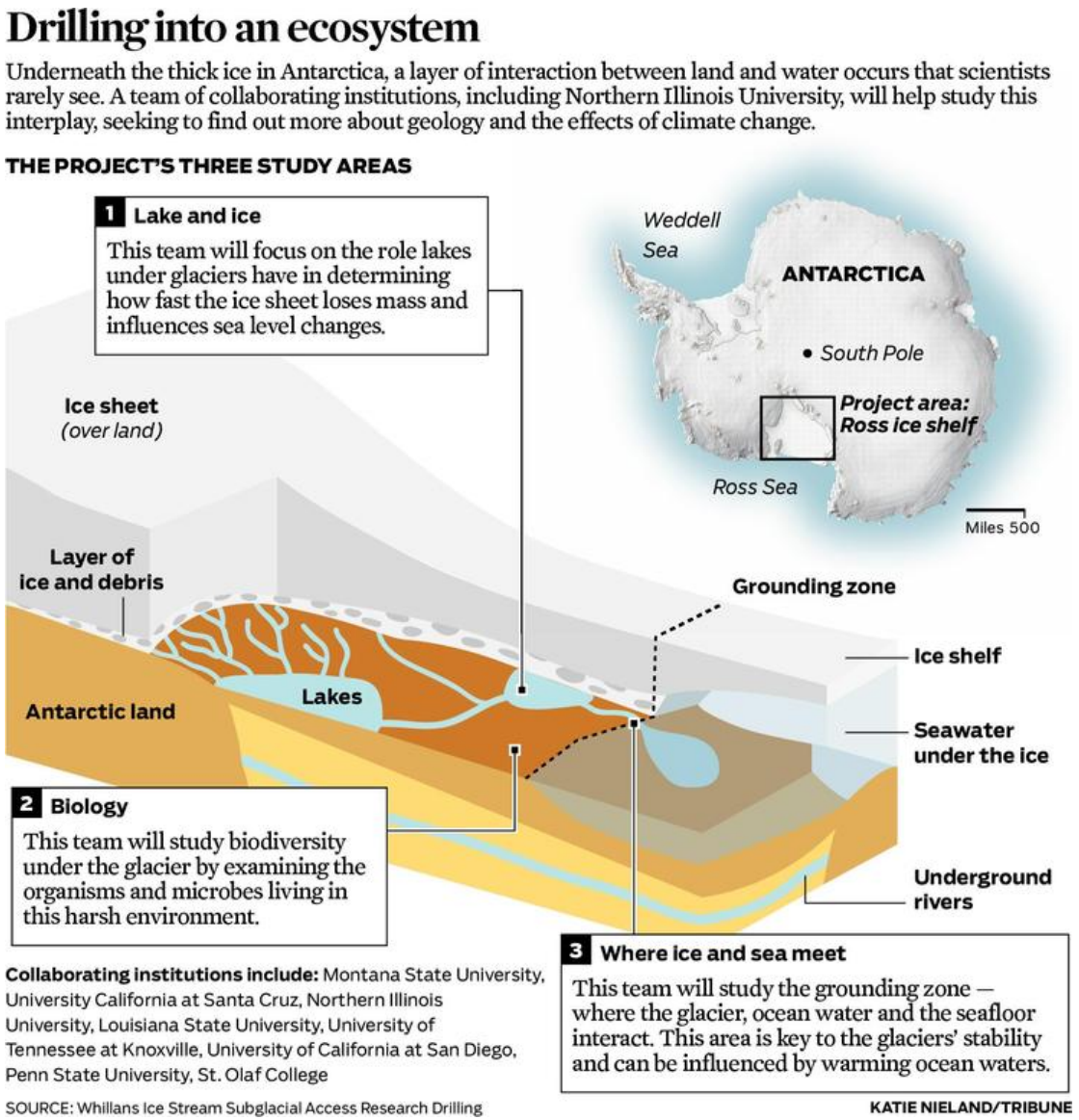
(near ANDRILL-MIS drill site)



Subglacial
Lake Whillans
(2013)

(Discover Magazine, 6, 2013)

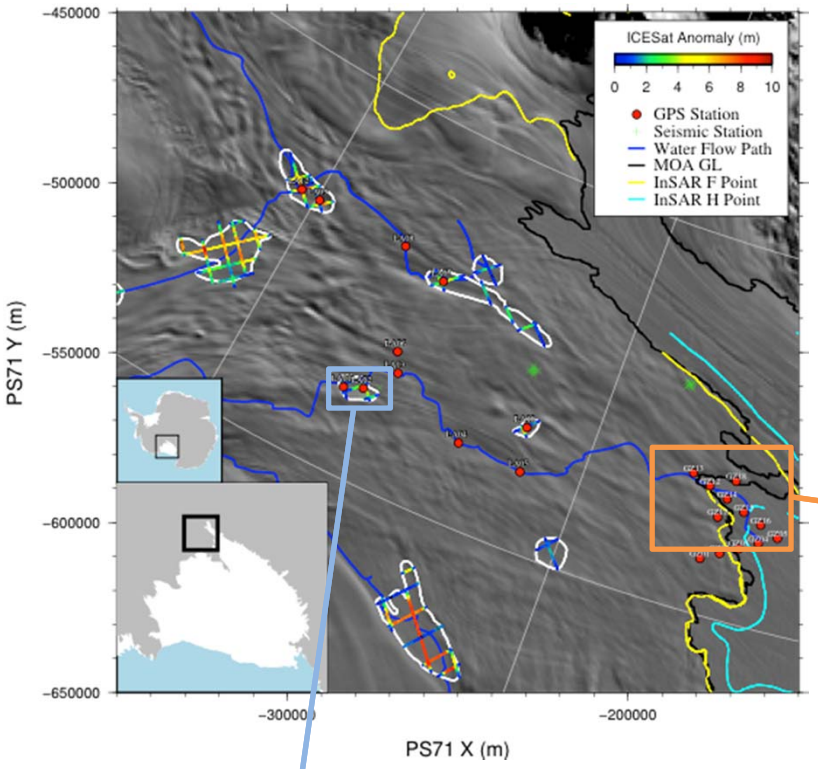
- Microbiology & geochemistry
- Ice, subglacial hydrology, lake physiography, geophysics, geothermal flux, etc.
- Geology, sediment chemistry, sediment flux, paleontology, mineralogy

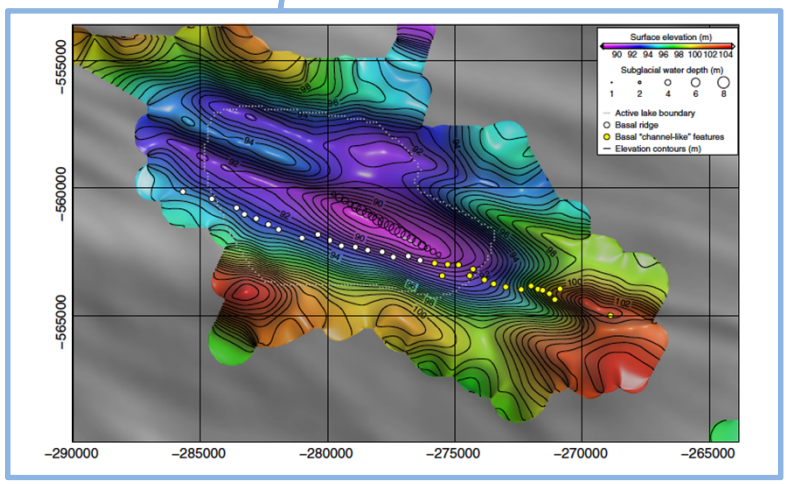


(Chicago Tribune, 11, 2012)

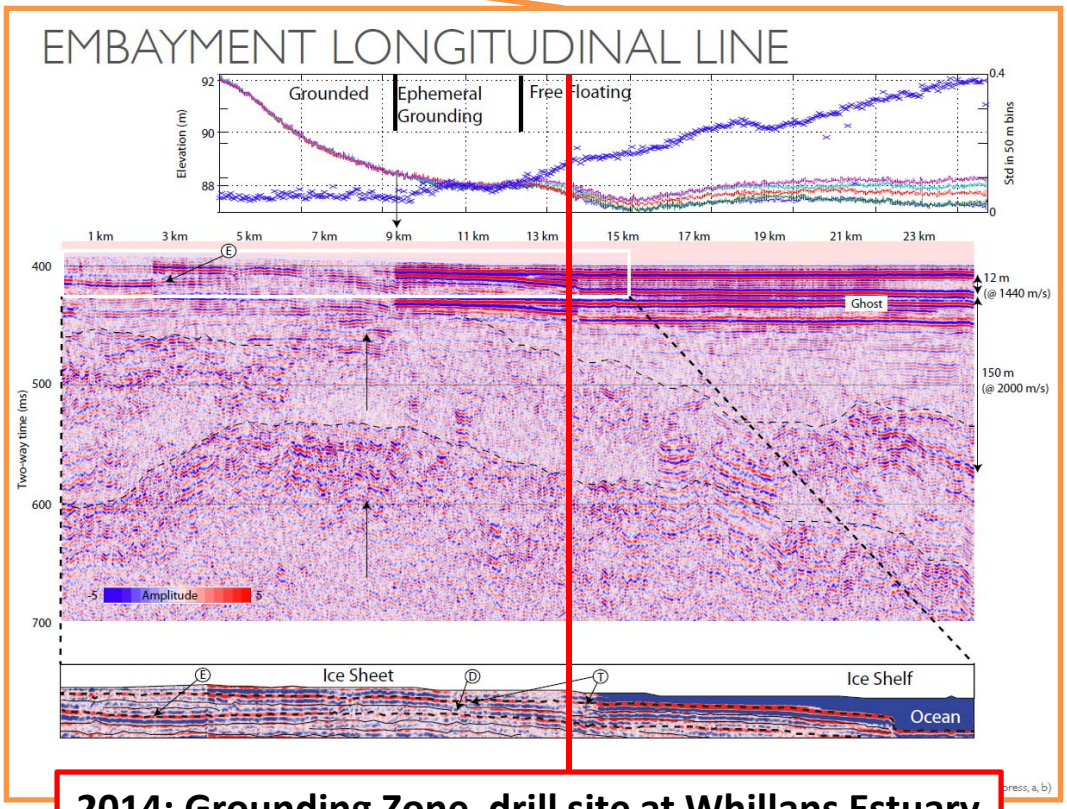
Whillans Ice Stream downstream

Subglacial Lake Whillans (2013)
&
Grounding Zone Subglacial Estuary (2014)

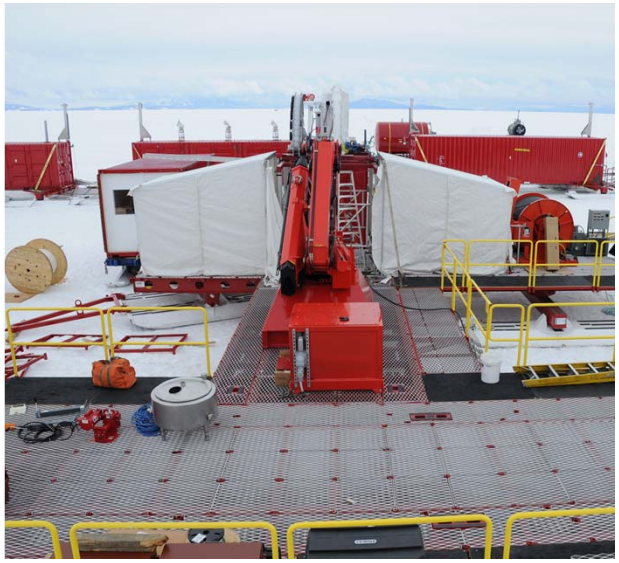




2013: SLW - Subglacial Lake Whillans

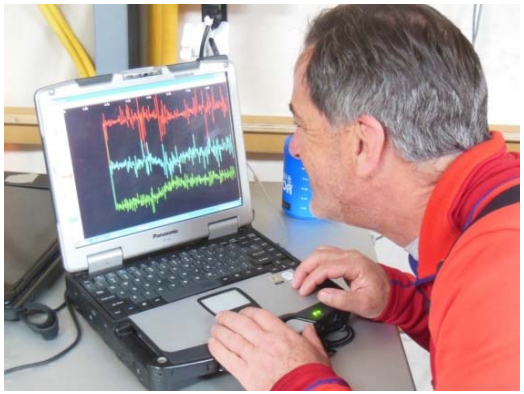


2014: Grounding Zone drill site at Whillans Estuary




NORTHERN
ILLINOIS
UNIVERSITY

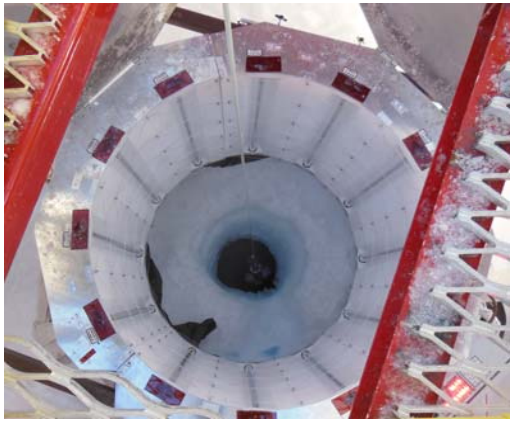
Slawek will discuss passive and active remote sensing, lake and GZ physiography, GPS, hydrology, seismics, ice studies & geothermal flux



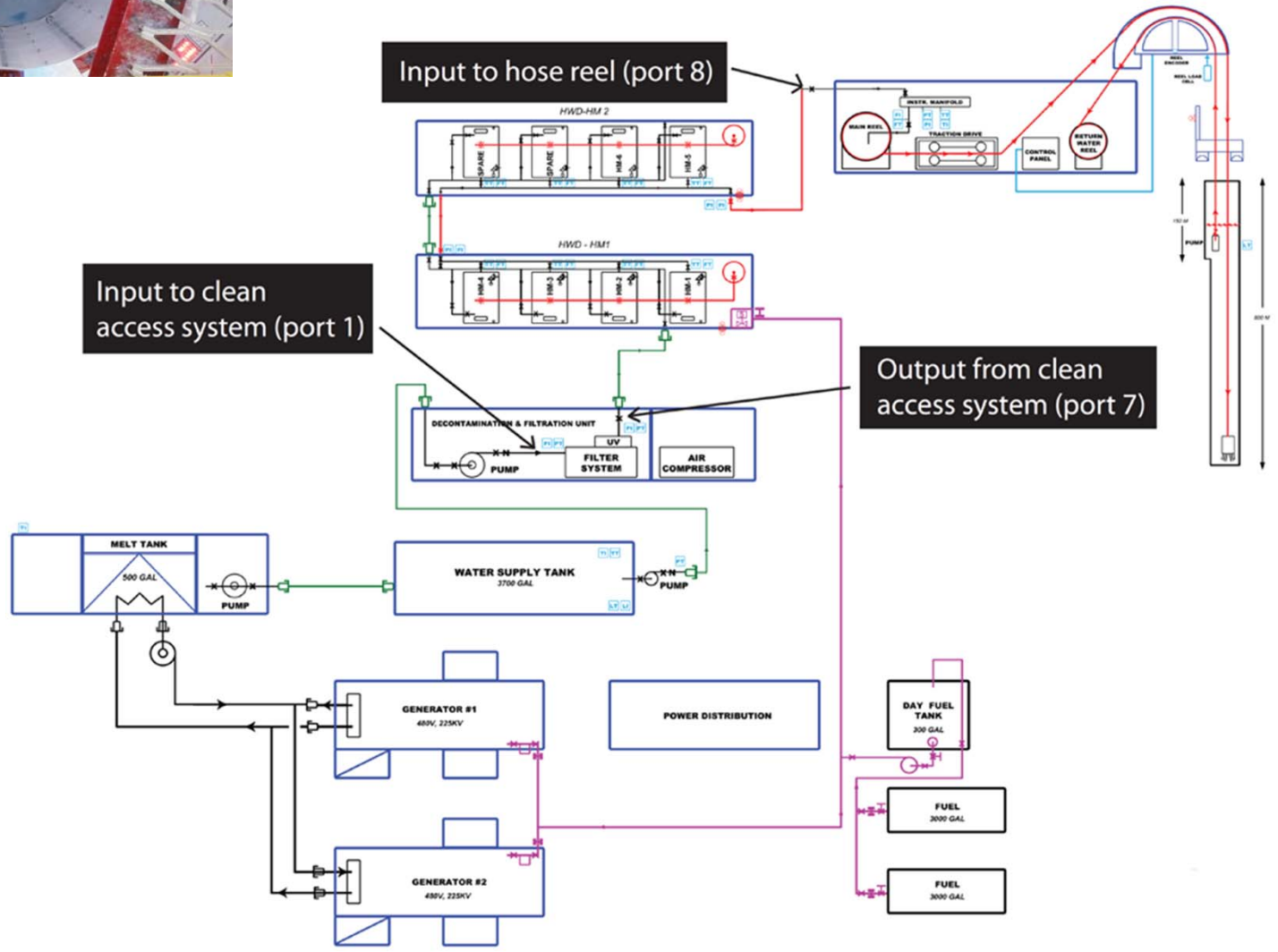
Knut, Bob, Sasha, Helen, etc. will discuss other aspects of geophysical and modeling studies and Alberto will discuss subglacial imaging and robotics

In situ lake measurements

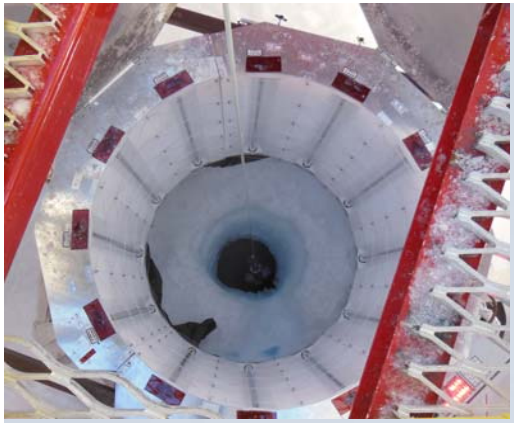
- CTD
- In situ filtration unit
- Water sampling
- IPSIE - POP instrument array with real-time data stream
  - Altimeter
  - Down & side cameras
  - CTD
  - Transmissometer
  - DO, other sensors
  - Doppler current meter
  - Particle size analyzer
- MSLED & Doctor camera systems

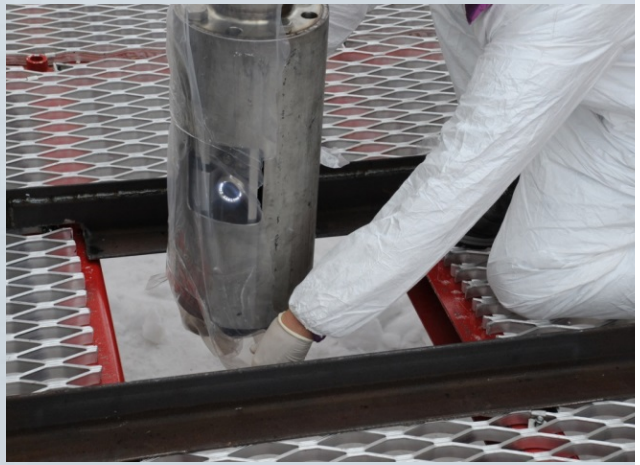


Clean Access protocols for environmental protection and microbial sampling



Clean Access protocols for environmental protection and microbial sampling





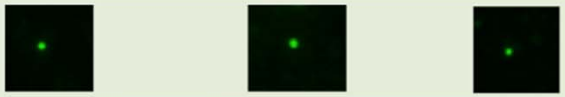
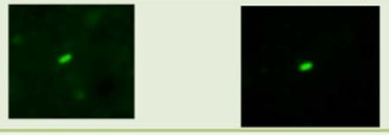
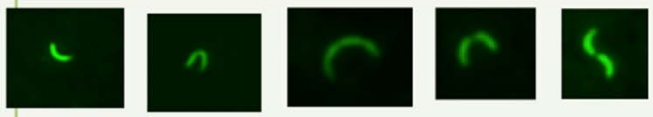
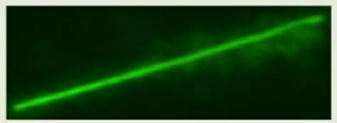
Major ion chemistry of lake water

Major ion chemistry of SLW waters from casts 1-3. All units are µeq L^{-1} except for $\delta^{18}O$ values that are in per mille and reported relative to V-SMOW. Also shown is the non-seawater contribution to SLW waters from Cast 3 assuming all Cl^- is from seawater and making corrections to the raw data for individual ions for Cast 3 based on standard seawater ratios.

	Na^+	K^+	Mg^{2+}	Ca^{2+}	Cl^-	Br^-	SO_4^{2-}	PO_4^{3-}	HCO_3^-	$\delta^{18}O$
Cast 1	5118	175	473	1034	3657	5.1	1228	4.5	2095	-38.0
Cast 2	5285	177	477	1020	3827	5.8	1255	4.3	2130	-38.0
Cast 3	5389	178	486	1023	3904	6.6	1272	5.5	2109	-38.1
Cast 3 Non-seawater solute	2037	105	-276	877	0	0	868	5.5	2109	

SLW water Geochemistry

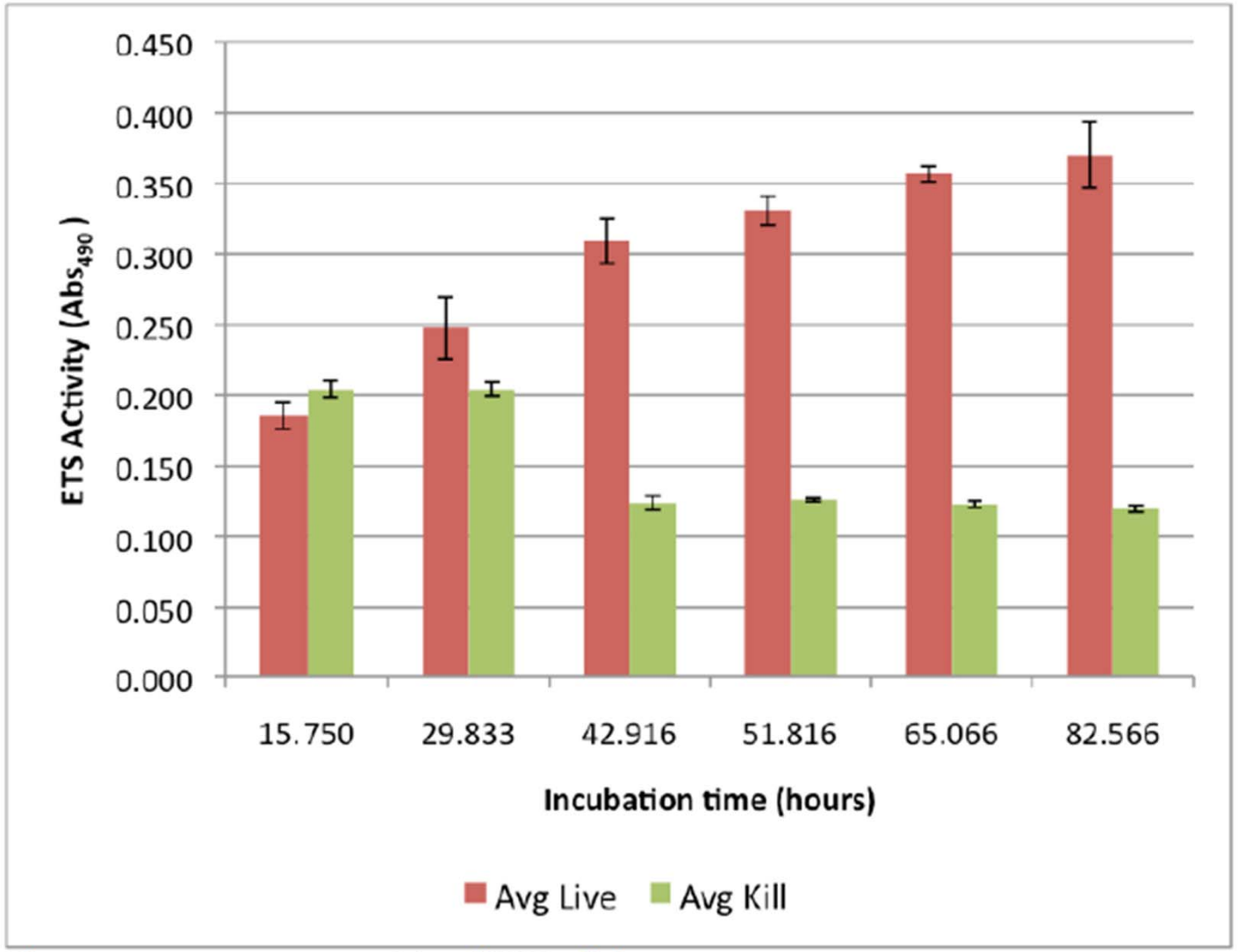
Sample		pH	EC (25°C) μS cm^{-1}
Snow (n=3)		6.0	3.3
Post filtration system & boiler (n=2)		5.3	6.4
Borehole water pre-breakthrough (n=1)		5.4	5.3
Subglacial Lake Whillans	Cast 1	8.0	702
	Cast 2	8.2	732
	Cast 3	8.1	721

Morphology	SYBR Gold Stain	Cell Size (µm)
Cocci		Diameter: 0.4-0.9
Diplococci		Diameter: 0.4-0.7
Small Rods		L: 0.6-2.9 W: 0.3-0.8
Vibrio		L: 0.9-2.7 W: 0.3-0.6
Long Thin Filament		L: 7.0-43.2 W: 0.3-0.4
Short Thin Filament		L: 2.1-6.0 W:0.3-0.6
Spirals		L: 2.5-6.2 W: 0.4-0.7
Large Rods		L: 2.83-6.0 W: 0.75-1.5

It’s alive!!

Diverse microbe morphologies seen in epiflorescence

Genomic work is underway



Electron transport system activity of SLW cellular extracts

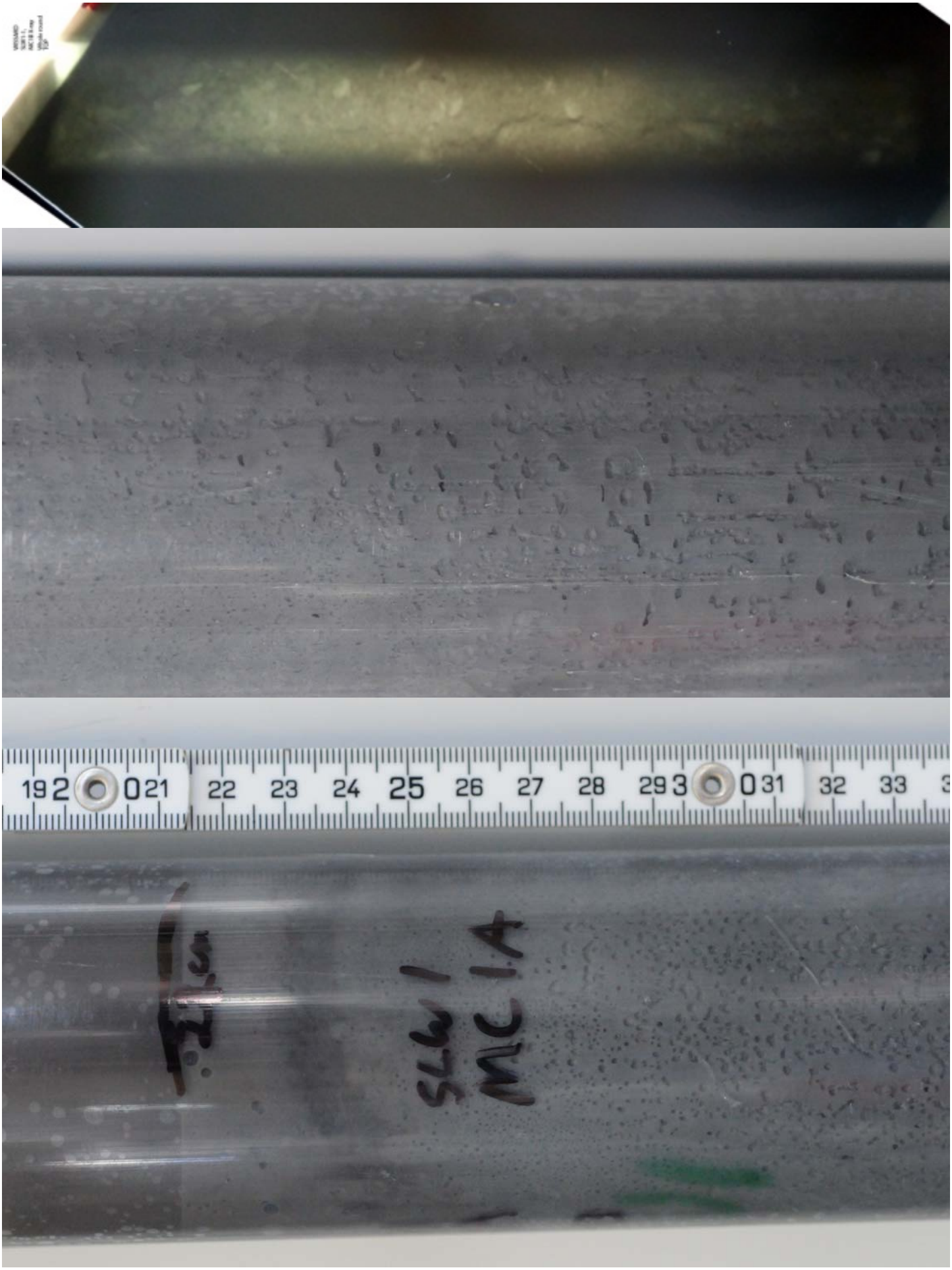
And they're growing, too!!

Sediment recovery

1. NIU Multicorer
   Up to 50cm
   (#6 up to 46 cm)
   Preserves sediment-water interface

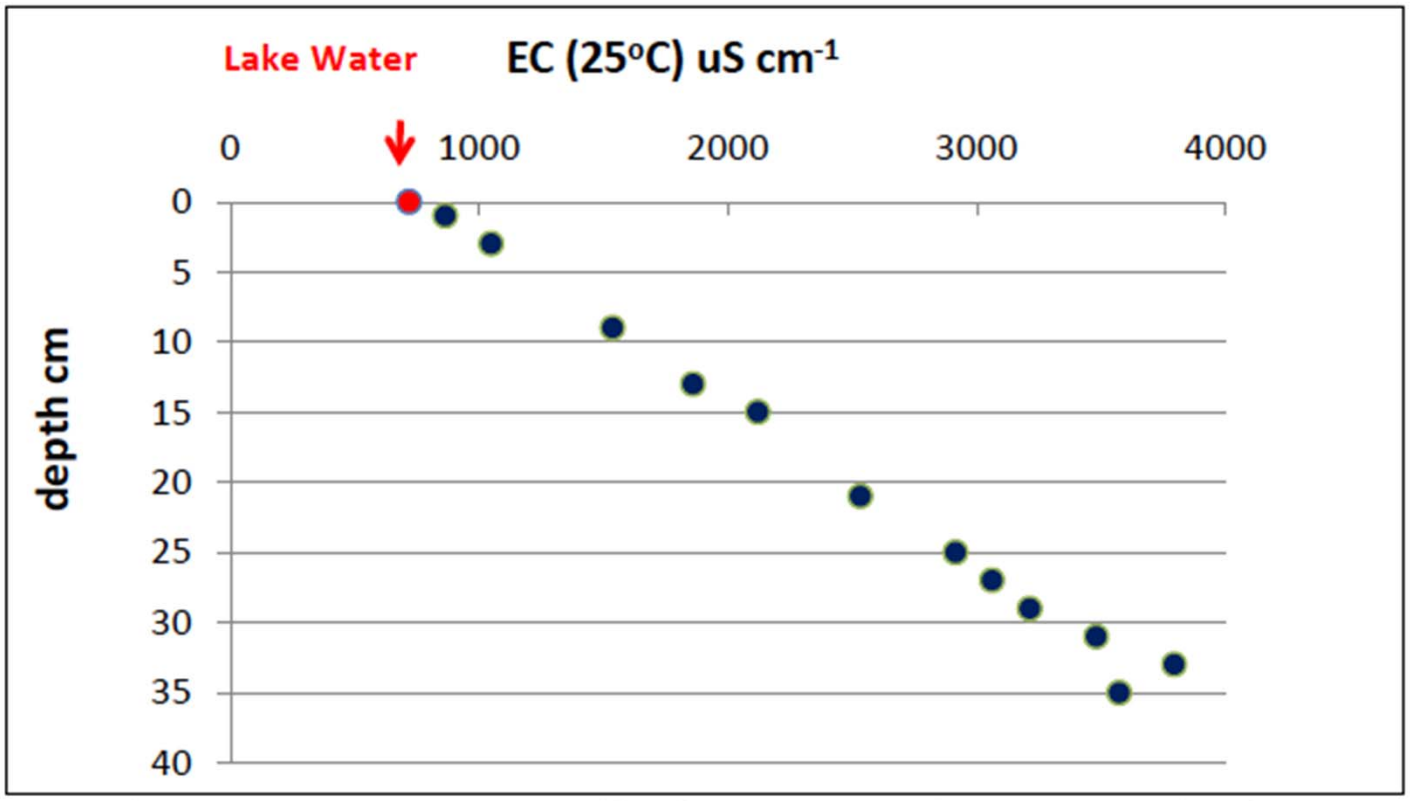
2. UCSC Piston Corer
   Up to 3m
   (#1 at 1.2m)

3. NIU Percussion Corer
   Up to 5m
   (#1 at 84cm)

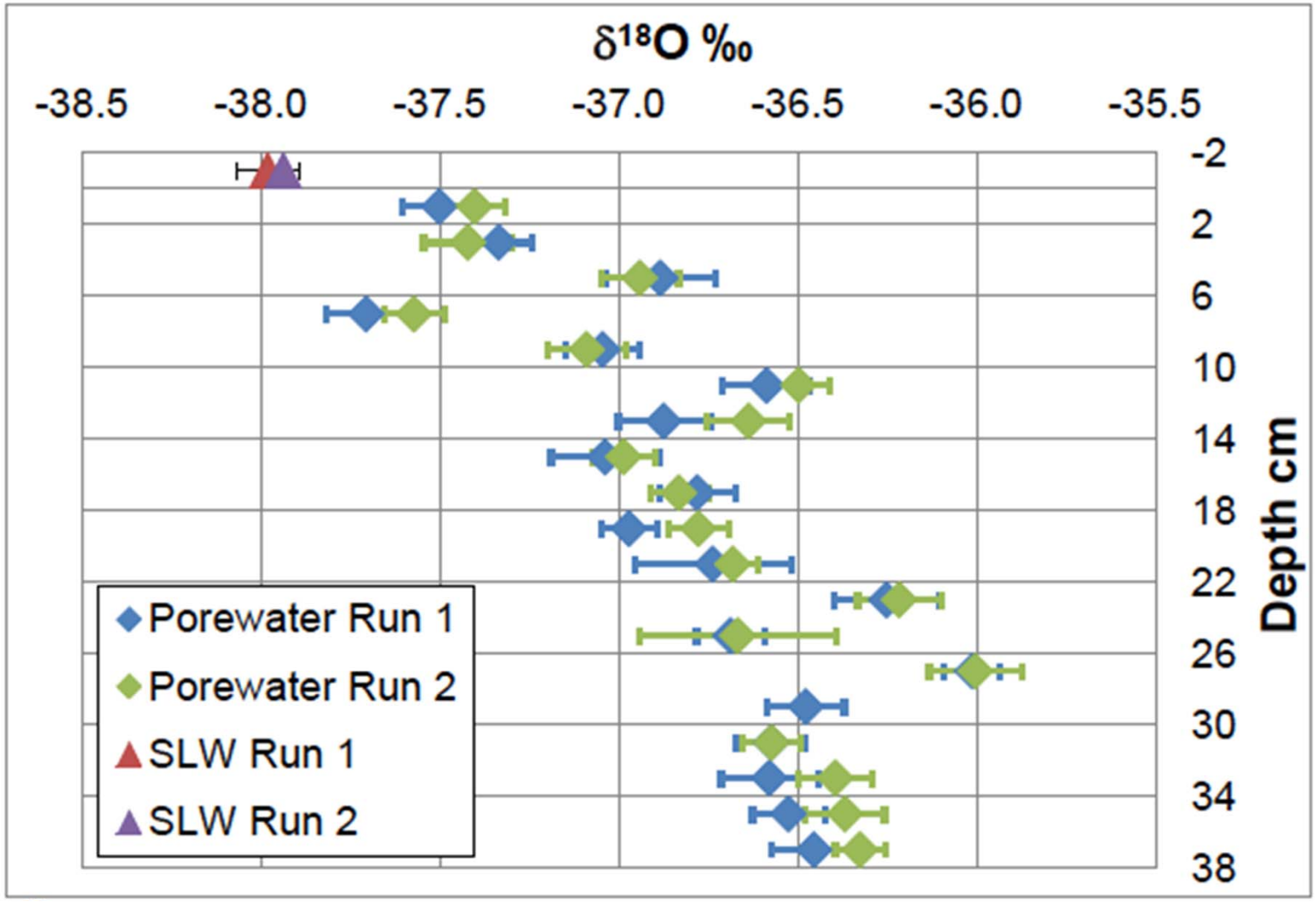

19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
SLW1
MC 1.4

Rhizon pore-water sampling

Electrical Conductivity of lake and pore waters



Pore water at 35cm depth is ~ 5x more concentrated than SLW water

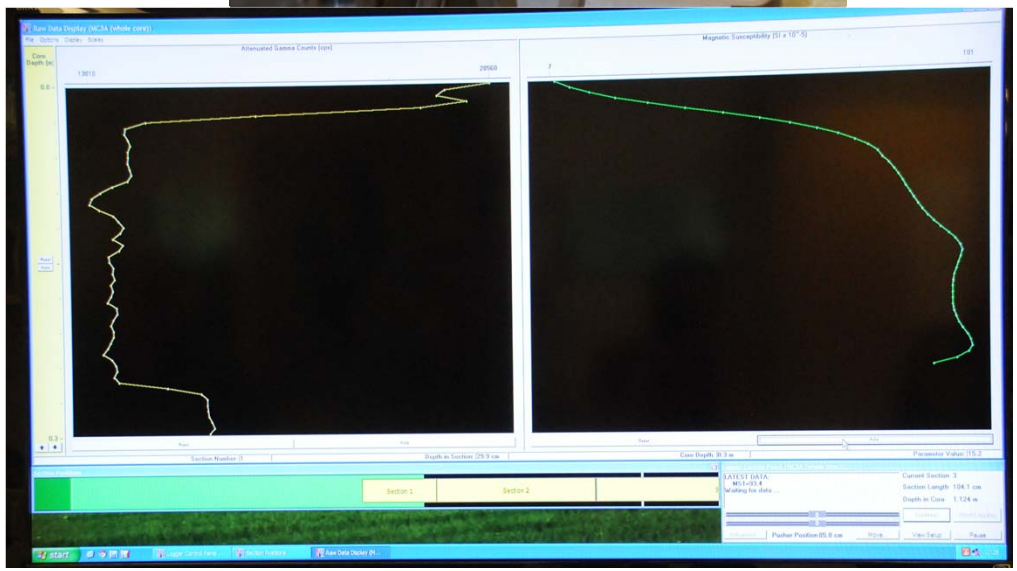


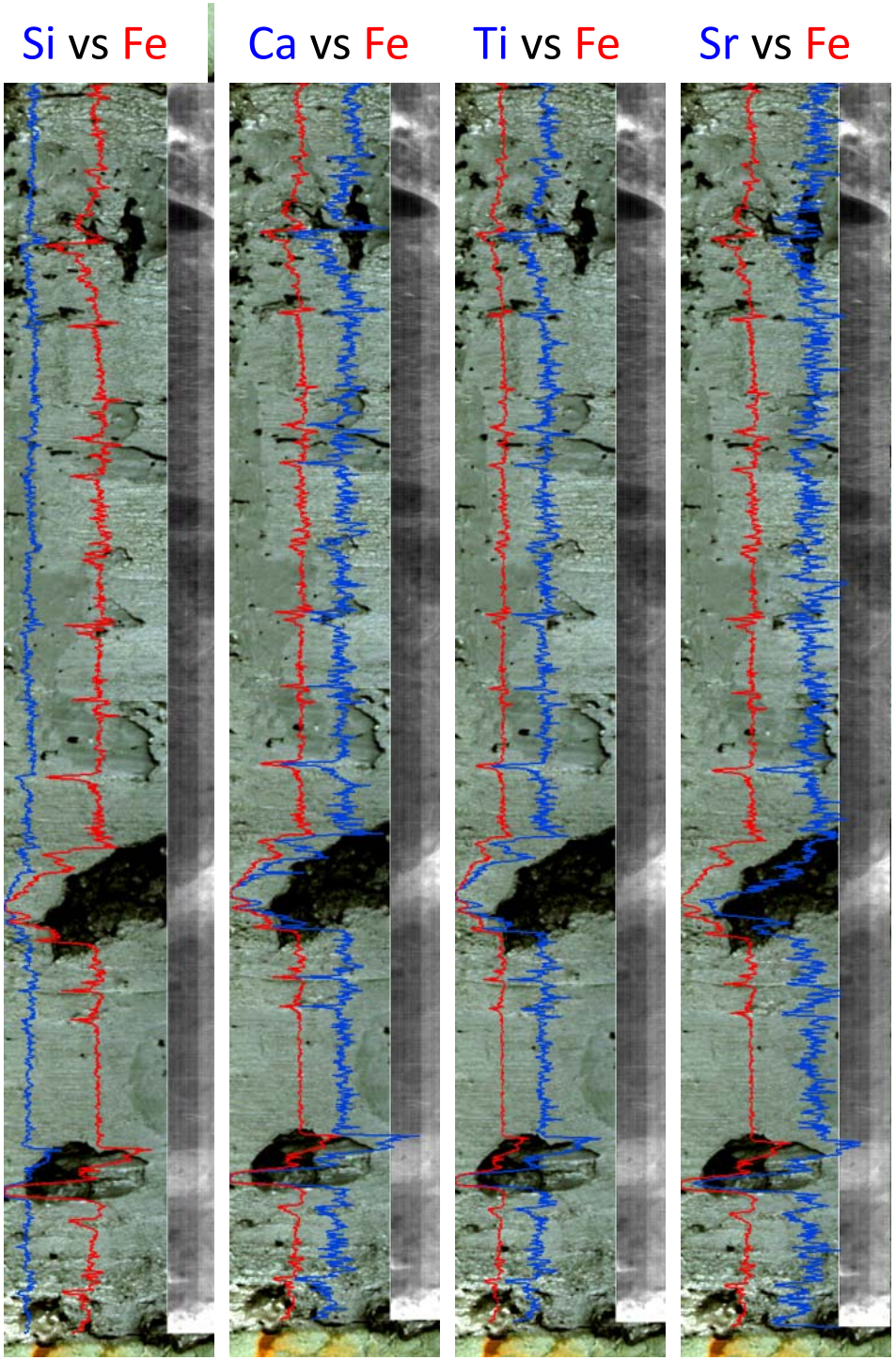
Mixing seawater, $\delta^{18}O$ = 0 ‰ with glacial meltwater -38 ‰ in the proportions 4 % to 96 % results in a $\delta^{18}O$ value of 36.5 ‰.

Sediment analyses

- Physical description
  - (physical stratigraphy, color, geotechnical properties, water content, reflectance, structure, clast distribution, magnetic susceptibility, paleomagnetics, microfabrics)
- Clast & clay mineralogy
- Clast and sand shape, surface texture
- Micropaleontology

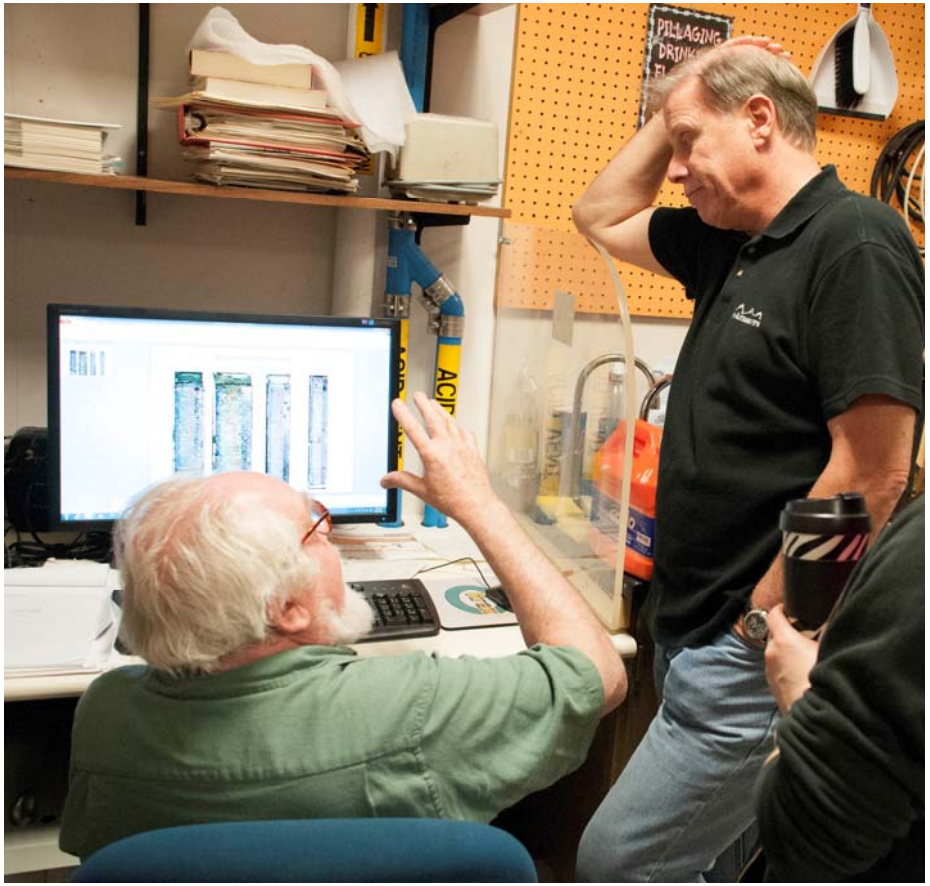
UMass Geotek
Physical properties scanner





UMass ITRAX Scanning XRF

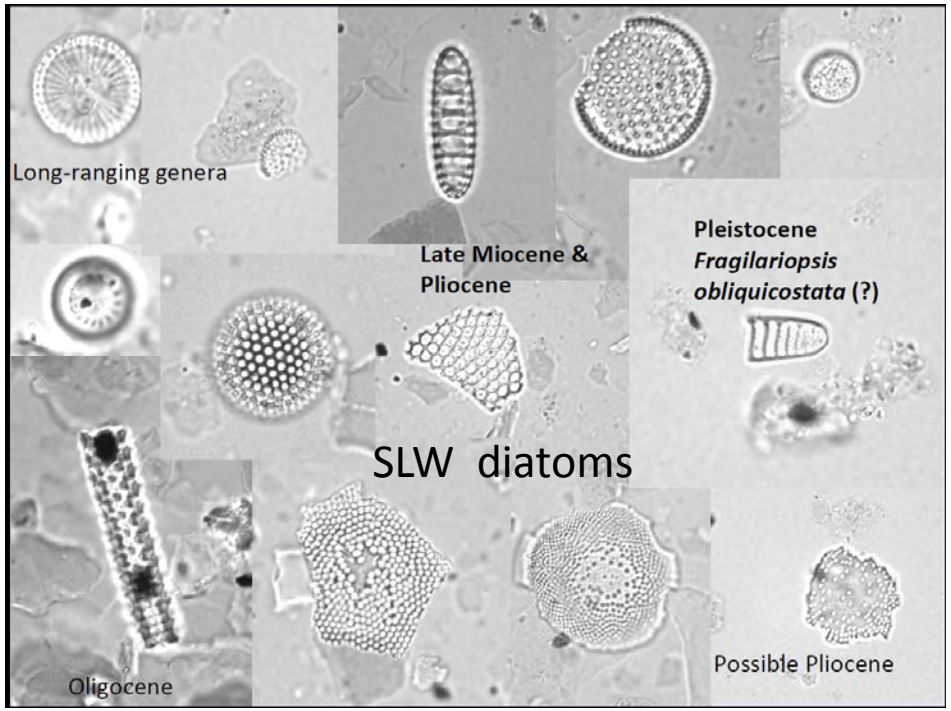
Quantitative chemistry of surface



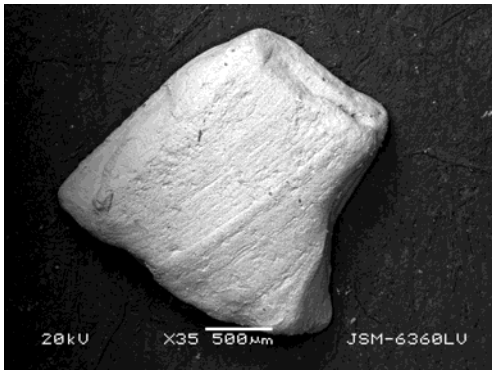
Guess what? It's a till!

Microfossils: Consistent with Upstream B & C samples, but even lower concentration

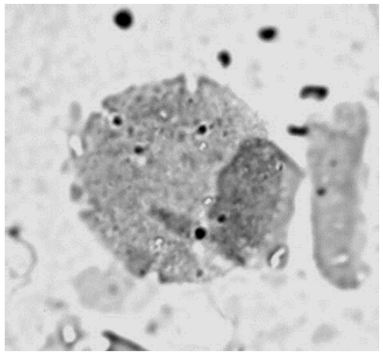
- Pleistocene sediments present among Miocene, Pliocene & older
- Pleistocene indicate past WAIS retreat
- Sediments have undergone strong shearing, based on experimental taphonomic studies with Neal Iverson



SLW diatoms



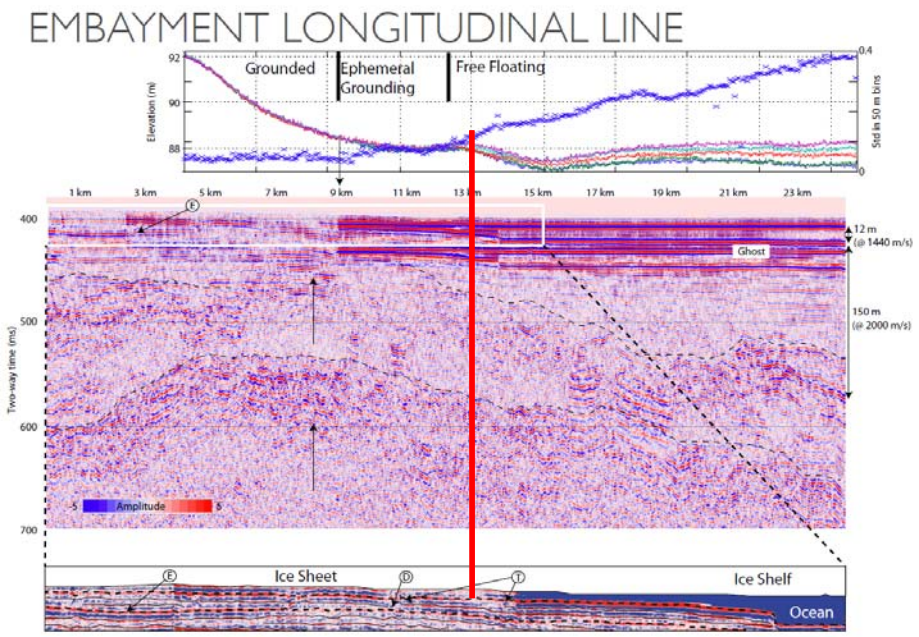
SLW mollusc shell fragment



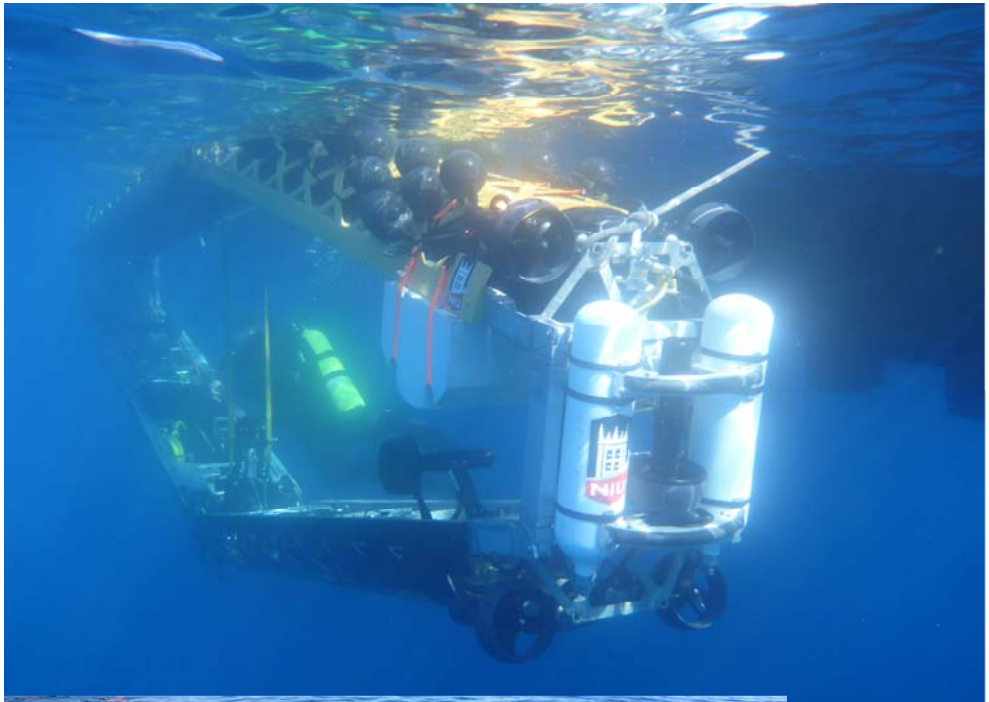
Late Paleozoic Nothofagides (beech) pollen

GZ investigations in Jan. 2014

- Water & sediment chemistry & biology of a subglacial estuary
- Tidal influence on the environment and sediment transport
- Find out why isn't there a big grounding zone wedge here
- Evaluate lake drainage events and suspended sediment flux
- Find lotsa other cool stuff



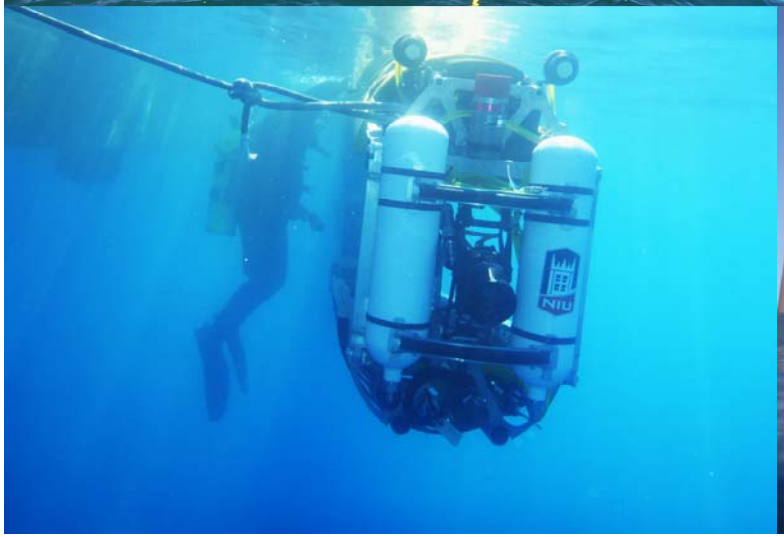
(Horgan et al., in press, a, b)

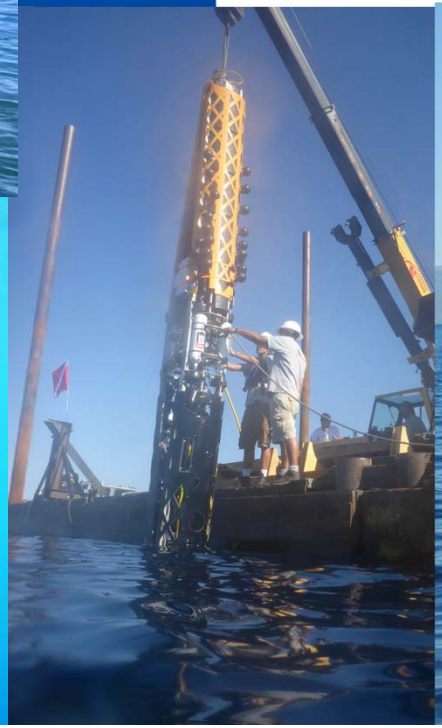


Life after WISSARD?

Sub-ice shelf environments

- SIR (Sub-Ice ROV)
- Oceanography
- Integrated modeling






ANTARCTICA