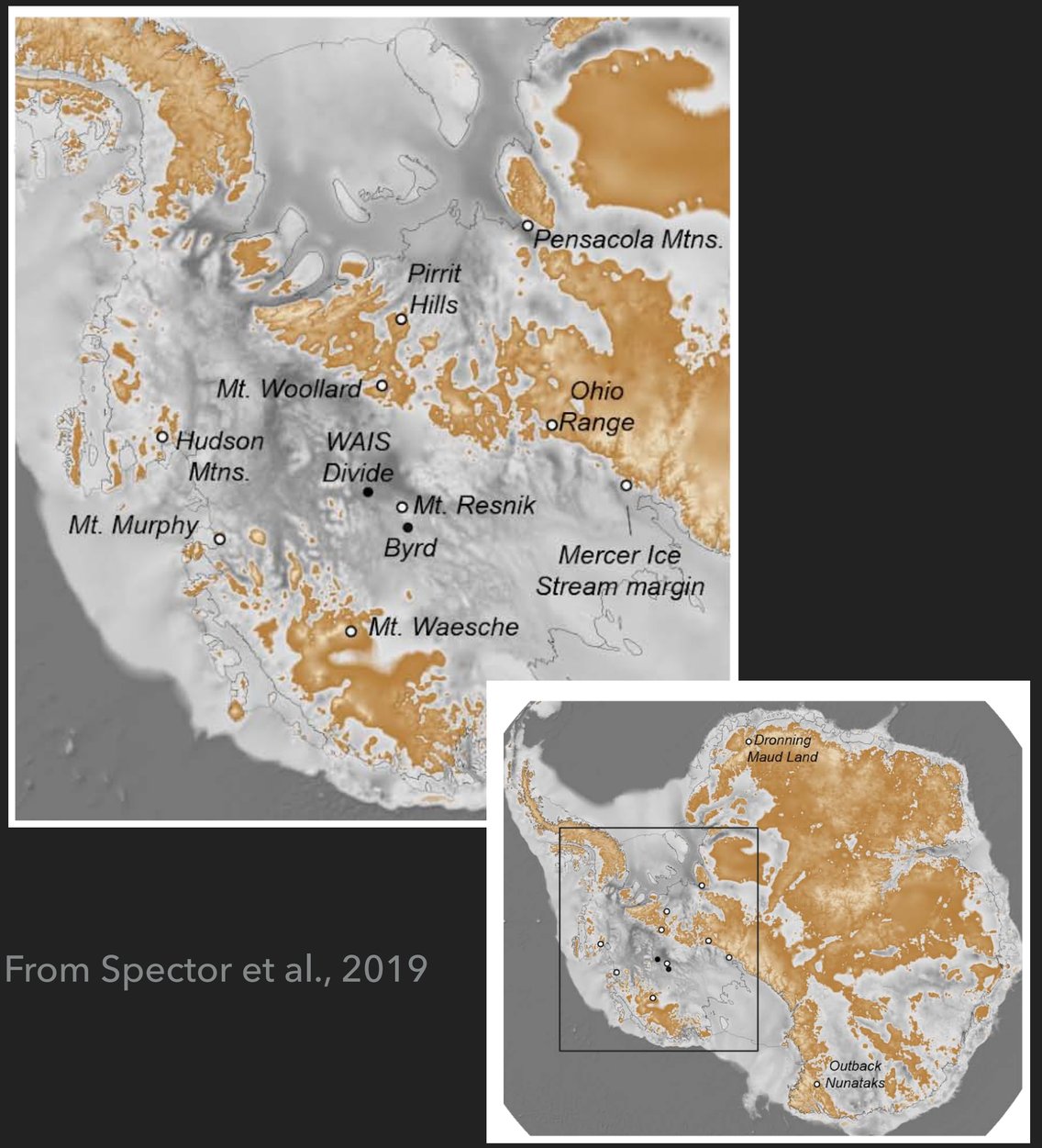
SUBGLACIAL ACCESS WORKING GROUP – GLACIAL HISTORY

GLACIAL HISTORY SUBGROUP

- Detection of exposure events (i.e., marine based ice sheet collapse, large-scale melting)
- Recovery of rock core for cosmogenic nuclide and luminescence measurements
- Dating of basal ice
- in situ observations (e.g., heat flow)
- Underlying geologic and geophysical properties, including rock collection

TARGETS – ANTARCTICA

- Mt Waesche (active)
- Wilkes Subglacial Basin/Outback Nunataks (reconnaissance field season planned)
- Mt Woollard
- Mt Murphy/Hudson Mtns (active)
- Ohio Range (complete)
- Mt Resnik (dreaming)
- Dronning Maud Land (dreaming)
- Mercer Ice Stream Margin (dreaming)
- Pensacola Mtns (dreaming and Brits)

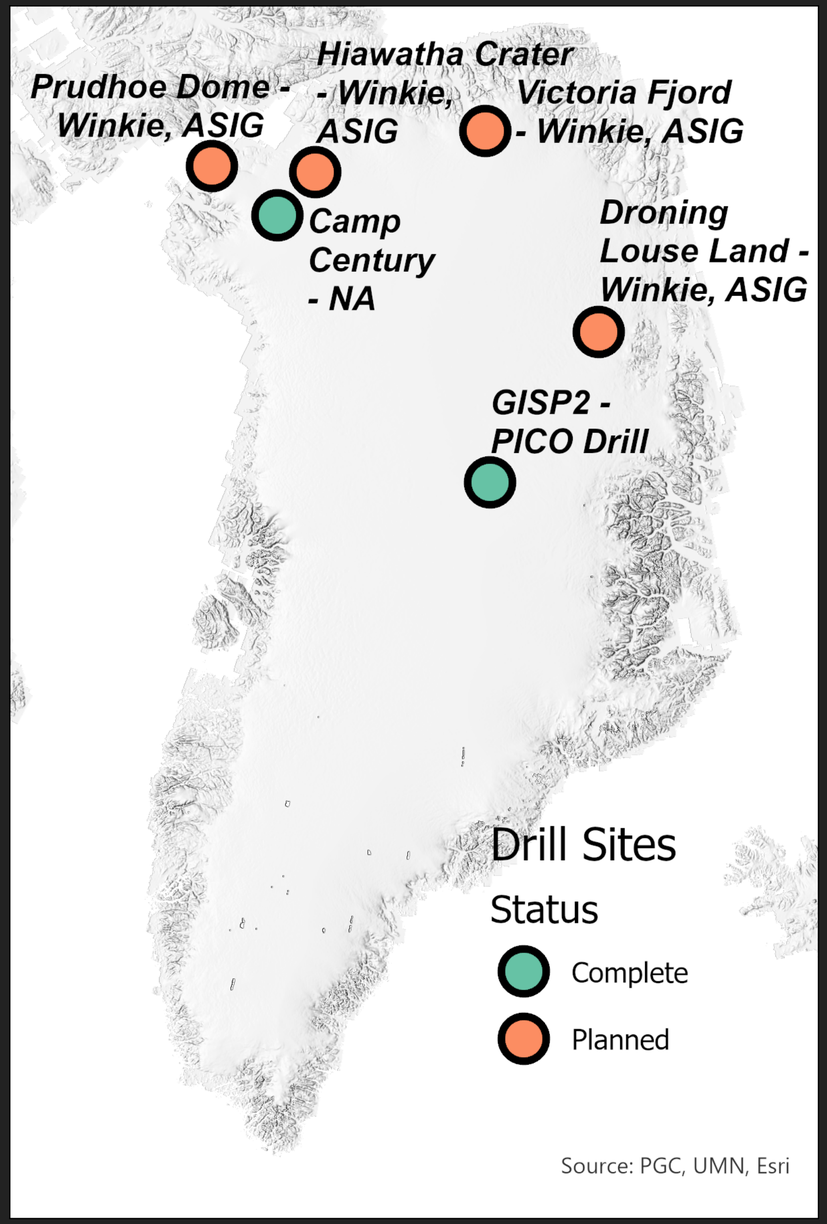


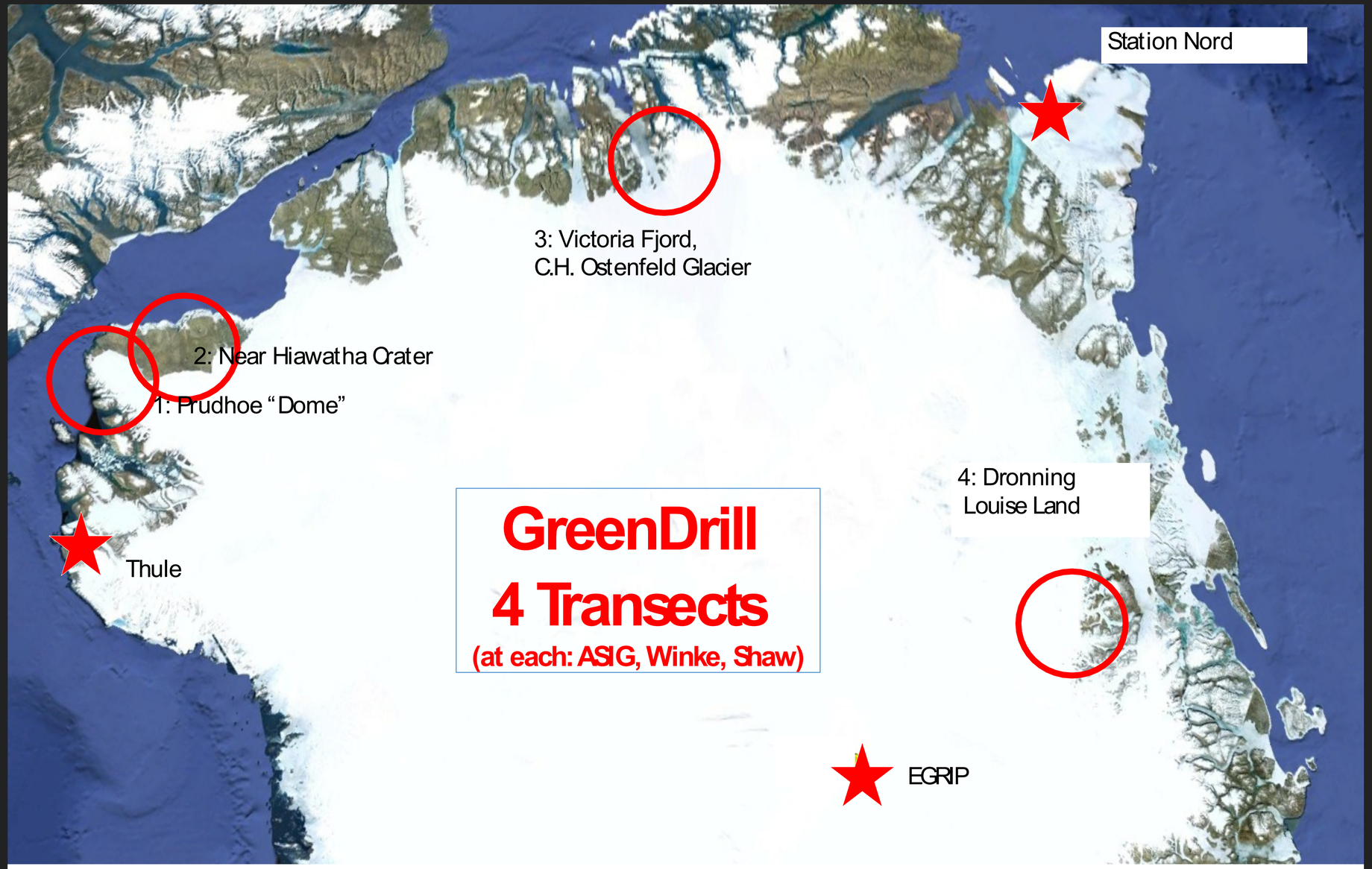
From Spector et al., 2019

TARGETS – ANTARCTICA

TARGETS – GREENLAND

- Northern GIS Margins
  - NW Greenland (active?)
- Iceland Hotspot track
- Northeast Greenland Ice Stream region
- west flank of eastern ranges (initial ice inception?)





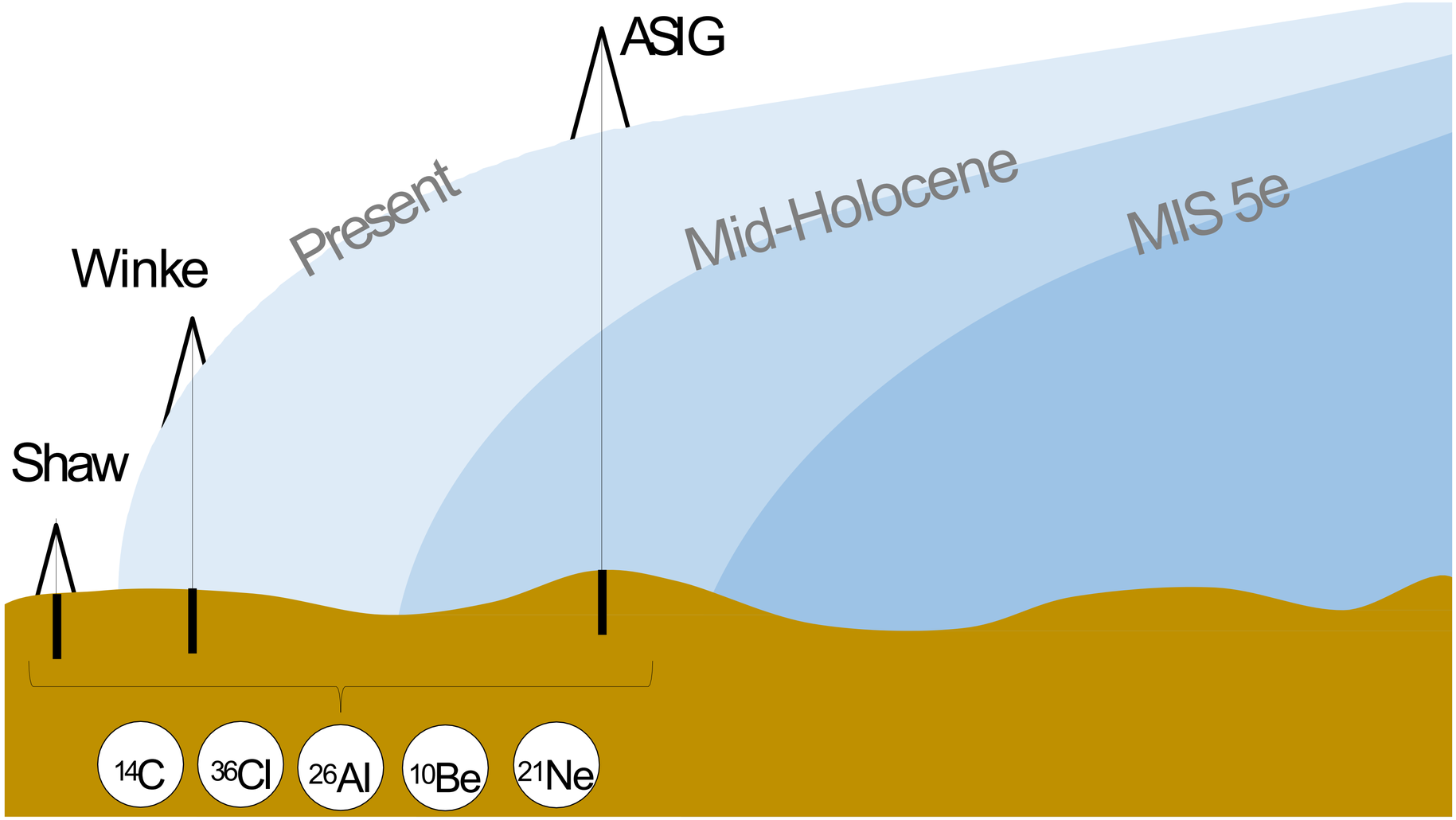
AISG Drill site: 500-300 m ice thickness.

Winke Drill site: 100 m ice thickness

Shaw Drill sites: pro-glacial landscape

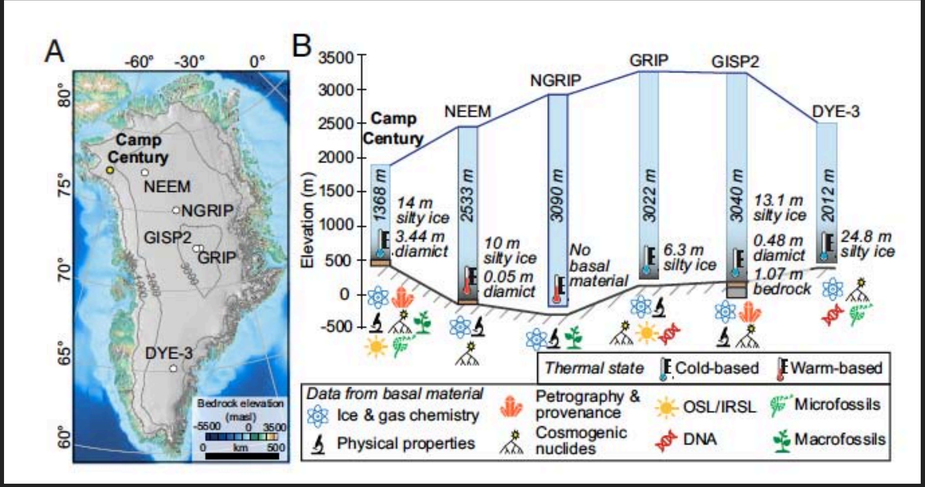
We will target 4+ m-long rock cores

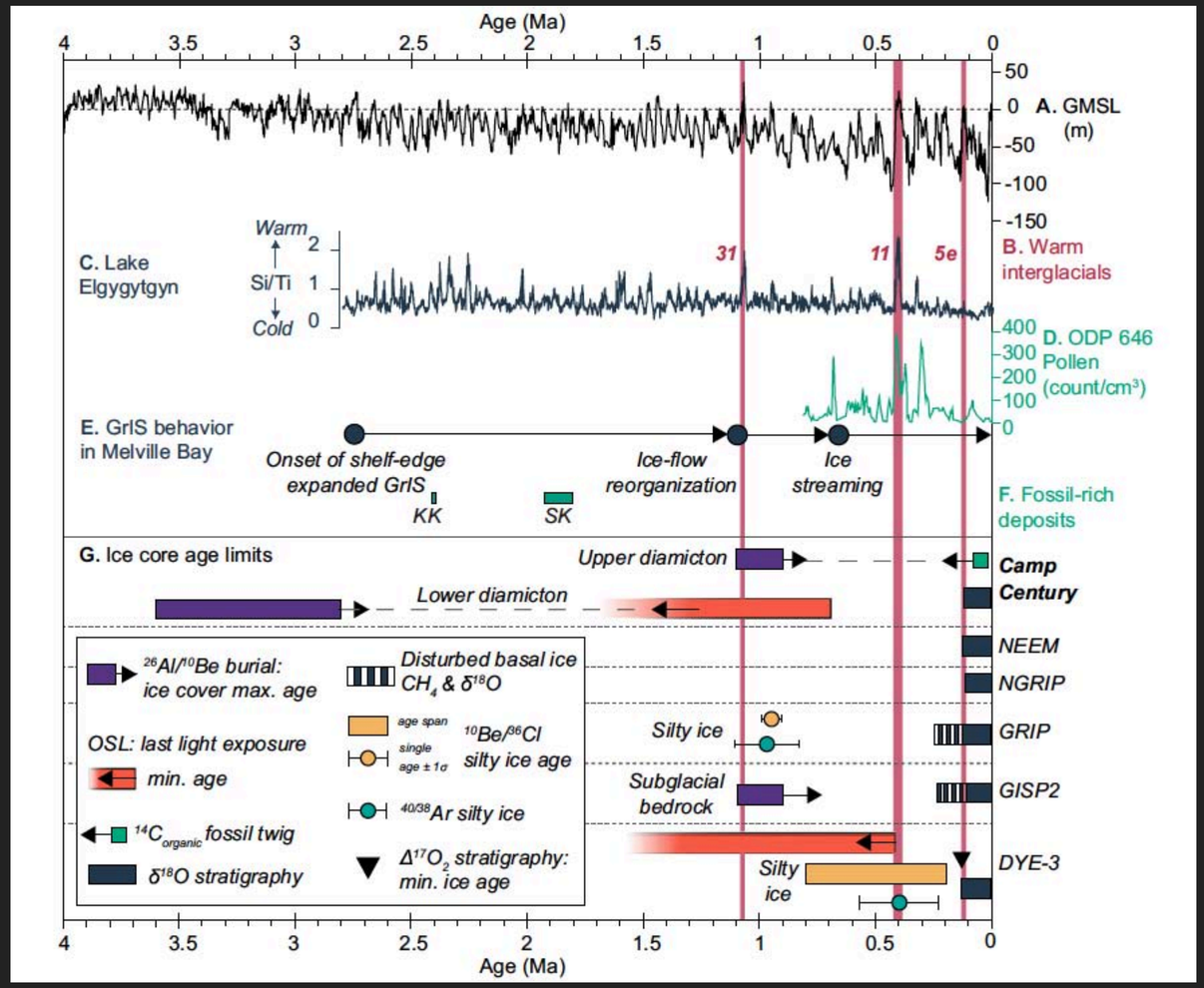
Courtesy: Joerg Schaefer



Courtesy: Joerg Schaefer

CAMP CENTURY – CHRIST ET AL., 2021

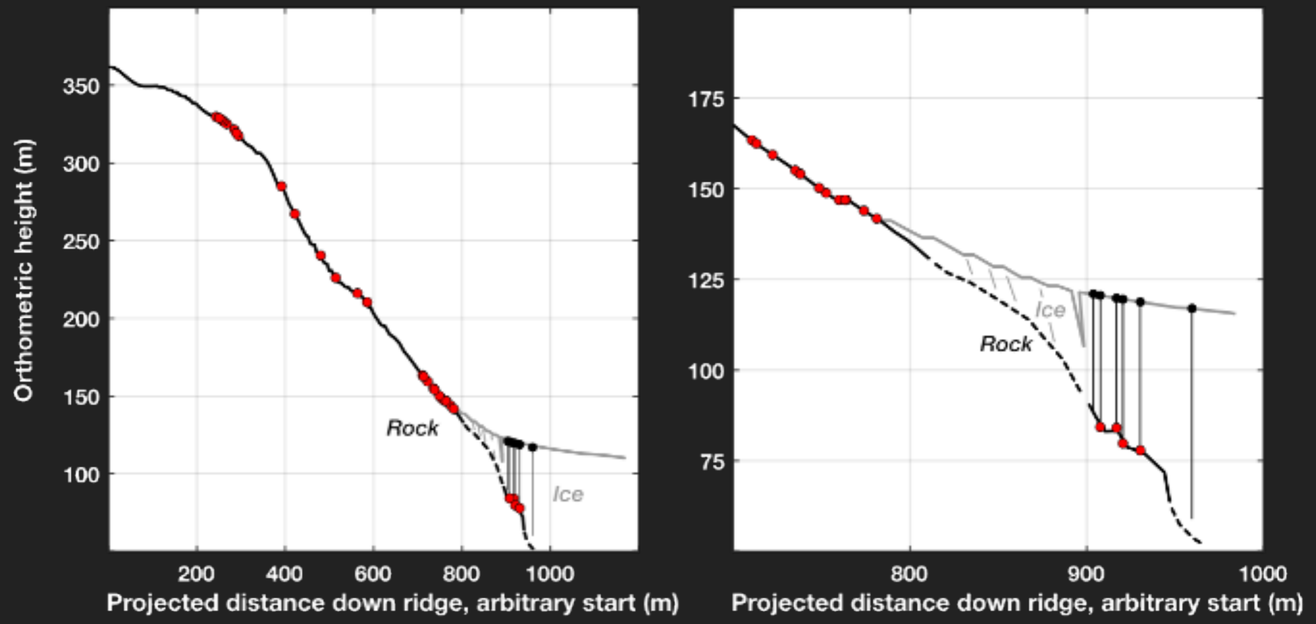


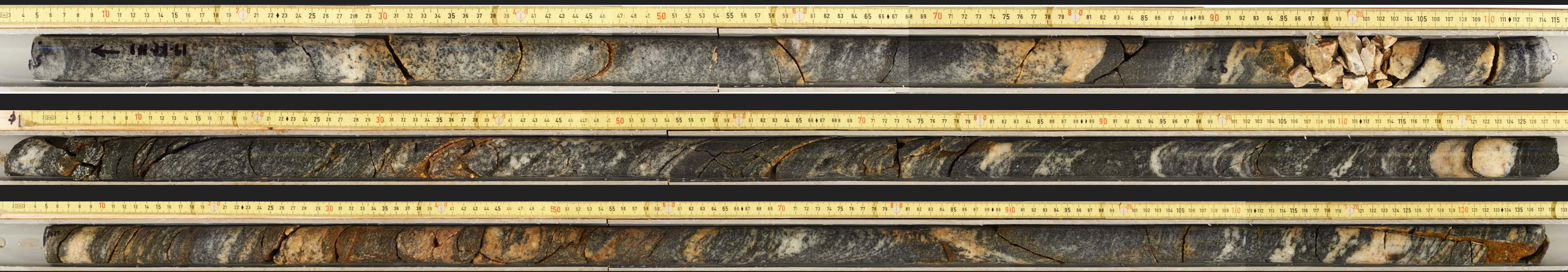


UPDATES FROM THE FIELD (HA!) AND LAB

- Mt Murphy, West Antarctica
- Pirrit Hills
- Ohio Range
- Ong Valley

MT MURPHY


Orthometric height (m)
350
300
250
200
150
100
Rock
Ice
200
400
600
800
1000
Projected distance down ridge, arbitrary start (m)
175
150
125
100
75
Ice
Rock
800
900
1000
Projected distance down ridge, arbitrary start (m)



MT MURPHY

- Initial measurements underway, with some early results
  - in situ ^{14}C, ^{10}Be, ^{26}Al, 36Cl
  - IRSL
- Ice core analyses planned for summer 2021
- Till analyses TBD

PIRRIT HILLS

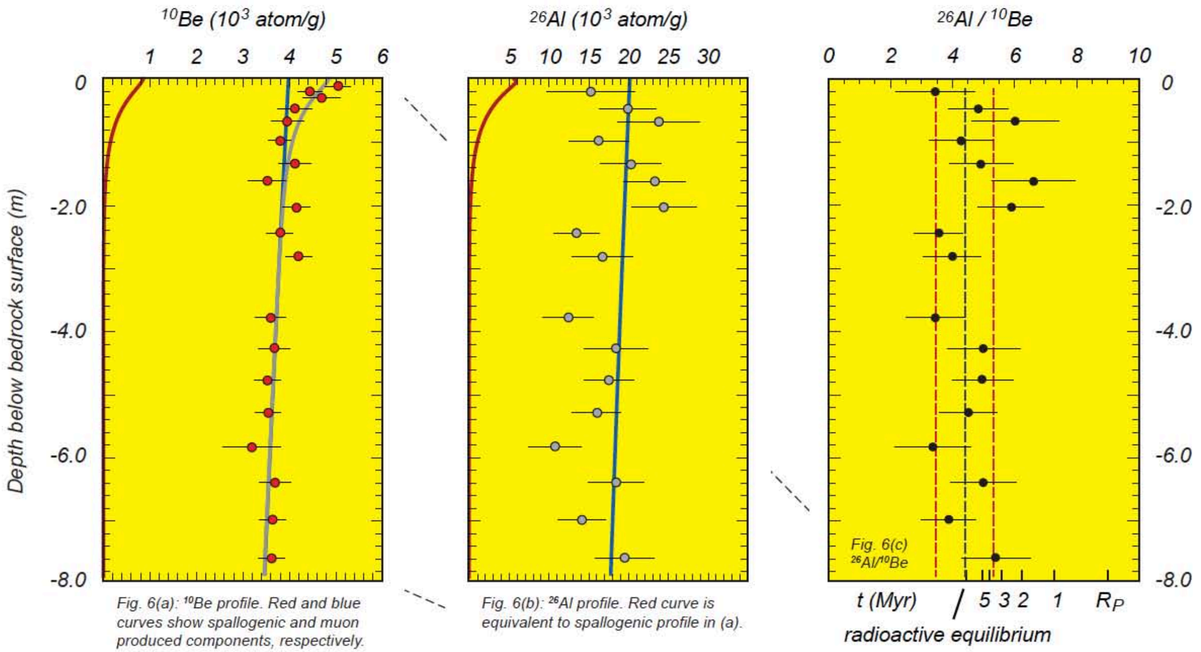


Fig. 6(a): ^{10}Be profile. Red and blue curves show spallogenic and muon produced components, respectively.

Fig. 6(b): ^{26}Al profile. Red curve is equivalent to spallogenic profile in (a).

Three important results:

(i) Surface has been exposed to cosmic rays.
- Exposure time equivalent to 55 yr at present-day ^{10}Be production rate (red curves).
- No corresponding ^{26}Al profile, so the exposure is old.
- Exposure period(s) total 200–800 years if Pliocene (2.6–5.3 Ma)
  > 800 years if Miocene (>5.3 Ma).

(ii) Muon-produced profile below 2 m measures average ice cover.
- ~ 200–210 m average 'Pleistocene' (2–3 Myr) ice thickness.
- This is 60 m thicker than present.
- Recent glaciations ~ 300 m thicker; must have been balanced by times of thinner ice.

(iii) Deep profile ^{26}Al/^{10}Be ratio measures nuclide grow-in time.
- ^{26}Al/^{10}Be = 4.5 ± 0.9 indicates radioactive equilibrium, hence t > 3.6 Myr.

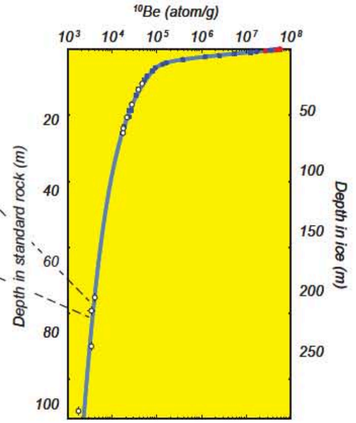


Fig. 7: Steady-state ^{10}Be profile. RB-2 ^{10}Be corresponds to production by muons beneath 200–210 m of ice.

Clip from AGU poster (2019)

Credit: John Stone

OHIO RANGE

- Measurements complete
  - Results somewhat inconclusive, but suggests relatively recent exposure (ice thinning) and more exposure than burial
  - in situ ^{14}C measurements planned
- Manuscripts in preparation

ONG VALLEY

Ong Valley

Over the past million years, Argosy glacier has advanced and expanded into Ong Valley leaving behind debris and till during deglaciation. Three periods of advancement have previously been observed

- Youngest < 0.2 Ma
- Middle > 1.1 Ma
- Oldest > 2.6 Ma

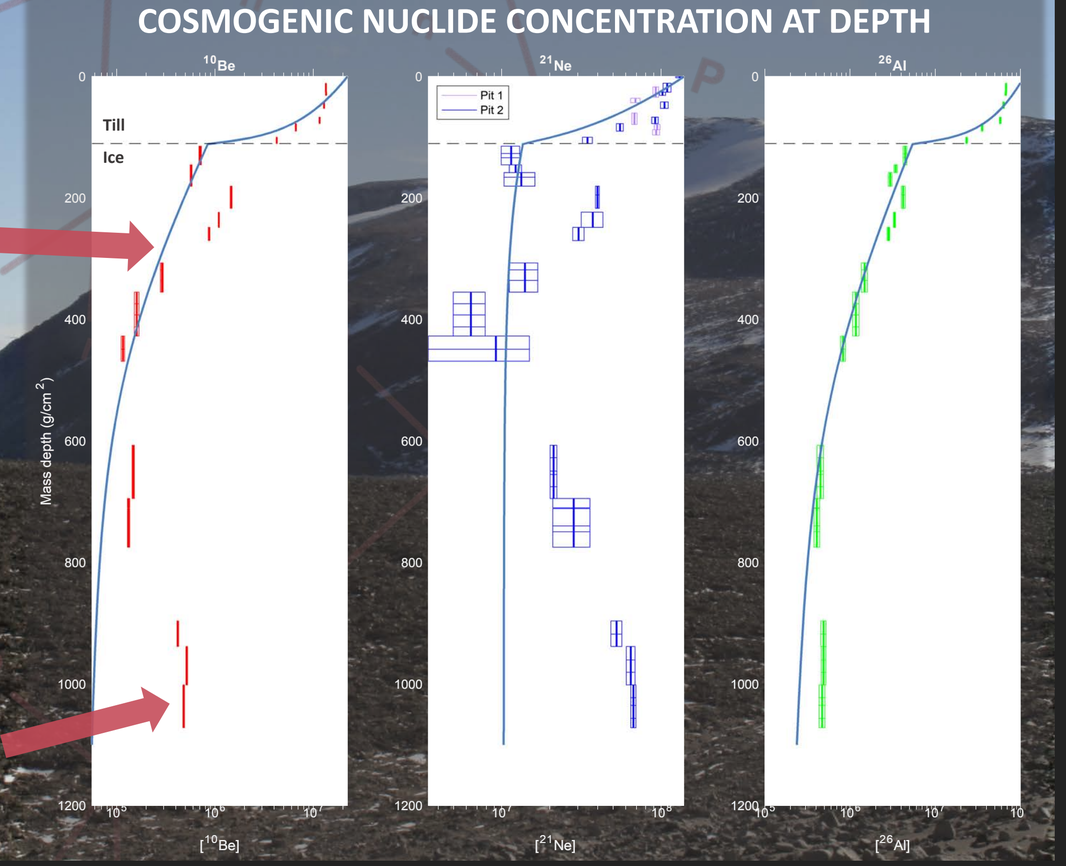
RESULTS

In **THEORY**, if the ice mass has been exposed in Ong valley for **> 1.1 Ma**, with sublimation and erosion occurring we expect a decrease in nuclide concentration with depth following the simple model line (blue line).

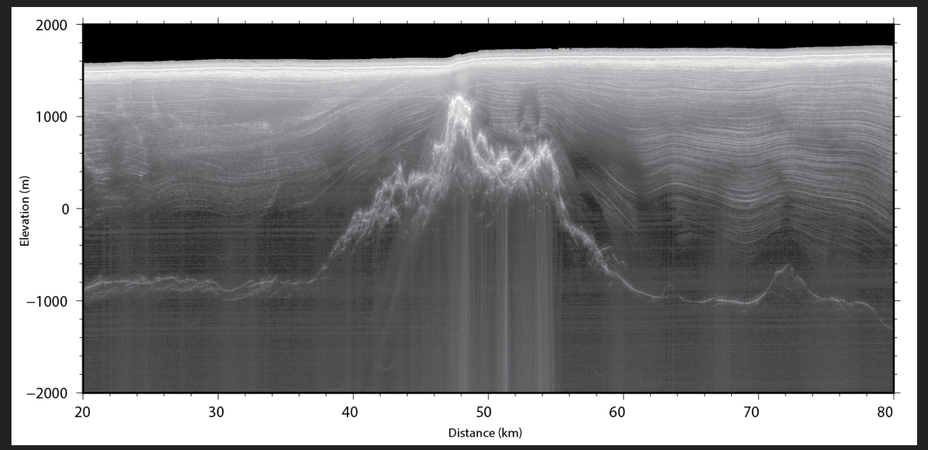
BUT we see an increase in cosmogenic nuclide concentrations at the bottom of the ice core, which is incompatible with the simple model

Mixing of previously exposed surface till with englacial sediment in ice during glacial advancement into Ong Valley can explain the observed concentration better than the simple model

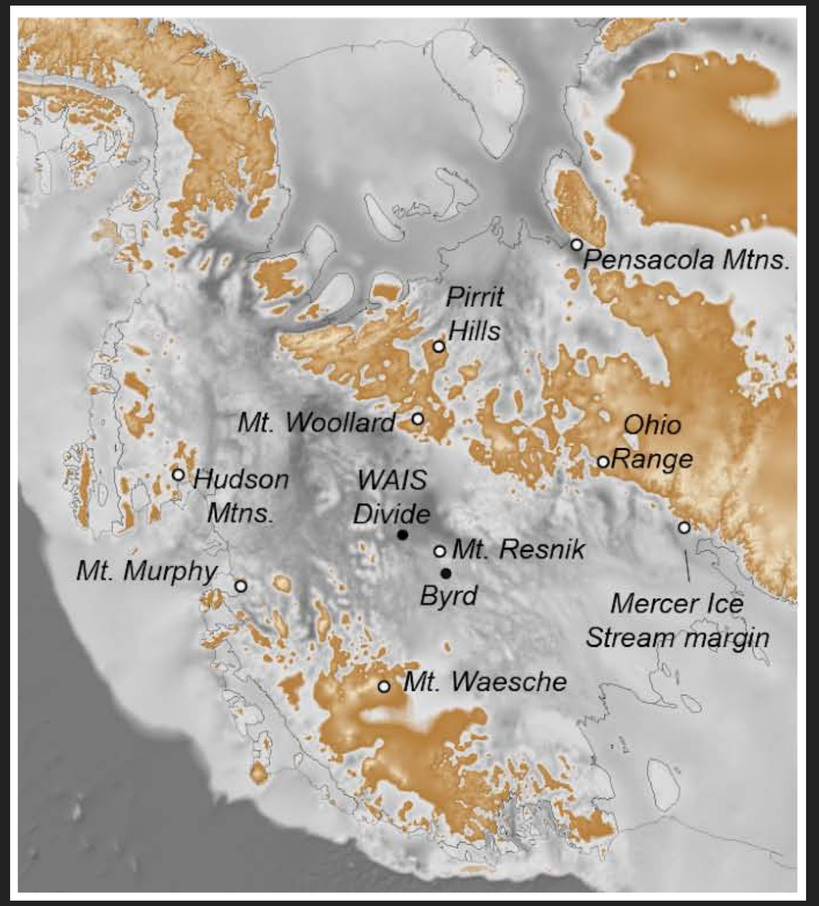
Potentially **>> OLDER ICE** at the bottom



FUTURE TARGET? – MT RESNIK



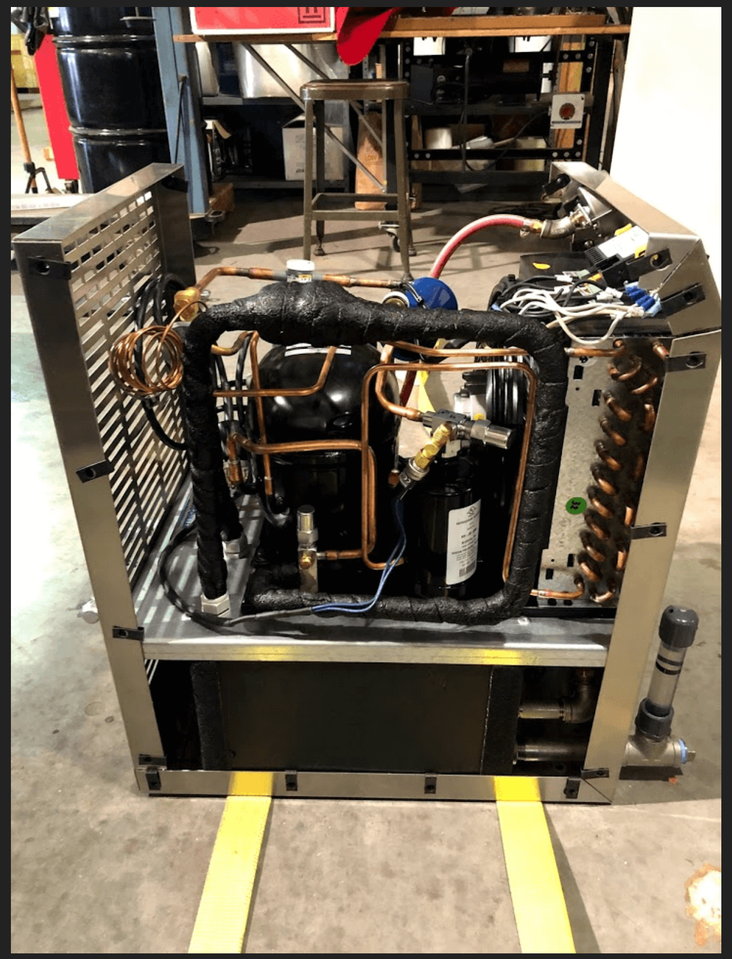
Courtesy UTIG



WINKIE MODIFICATIONS

FLUID CHILLER

- Details to be determined. Warm ambient temps
  - ASIG style liquid-air system
  - Salt Bath with liquid-liquid chiller
  - Dedicated Eclipse borehole for fluid storage
- Filter Tank and Mud Pump
  - Multi-stage filter tank with settling chamber
  - Rebuild triplex pump and verify flow rate
- Eclipse Cutters
  - Sufficient spare cutters for minimum of one set per borehole
- Packer
  - Determine cause of packer failure - mitigate cause and repair/replace
  - Hose reel for nylon inflation line
- Chip Transport
  - Drill Runs were hampered by lack of particle transport - across the bit and up the drill string.
    - **CAN THIS BE THE RESULT OF ICE IN THE PRESENCE OF THE HYDROPHOBIC DRILL FLUID? DOES THE CLAY NATURALLY FLOCCULATE IN THE DRILL FLUID?**
  - Limited testing with surfactants is scheduled prior to the the 2020-21 drill season



Icebits Newsletter