Three Hot Water Drilling Systems at Nebraska

Antarctic Science Management Office

Hot Water Drilling Operations Group

engineering enabling science

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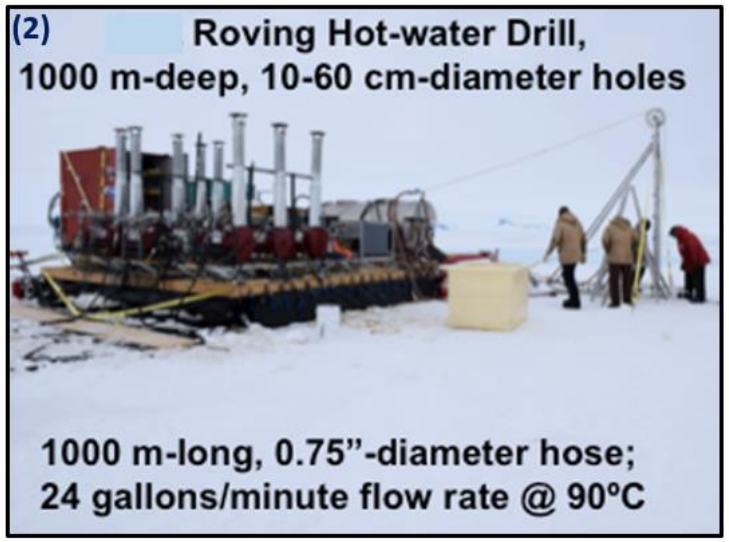
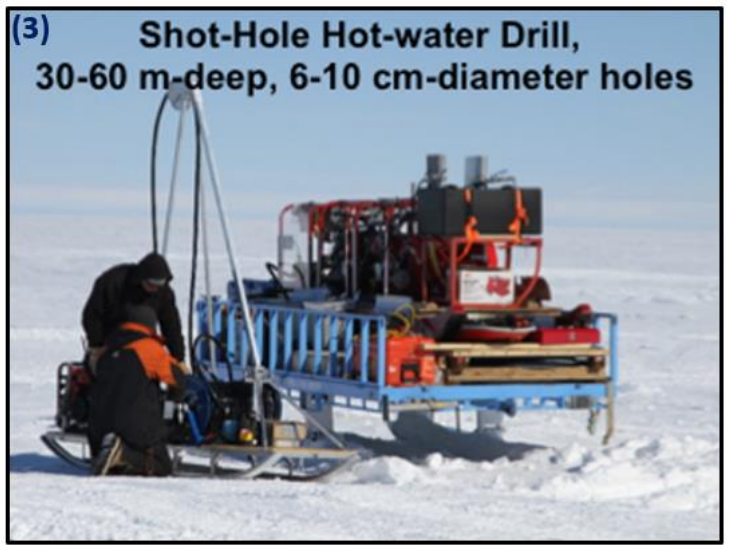
(1) WISSARD / SALSA Drill – CHWDS
Clean-access Hot Water Drilling System

(2) ROVING Hot-water Drill
Upgradable to Clean-access

(3) Shot-Hole Drill Shallow for seismic survey





A team of drillers & engineers with multiple decades of experience in Antarctic Hot Water Drilling for USAP:

IceCube Project at South Pole
ANDRILL - Coulman High Project Site Survey
WISSARD Project:
Subglacial Lake Whillans & WAIS Ice Streams
Ross Ice Shelf Grounding Zone
SALSA Project:
Subglacial Lake Mercer

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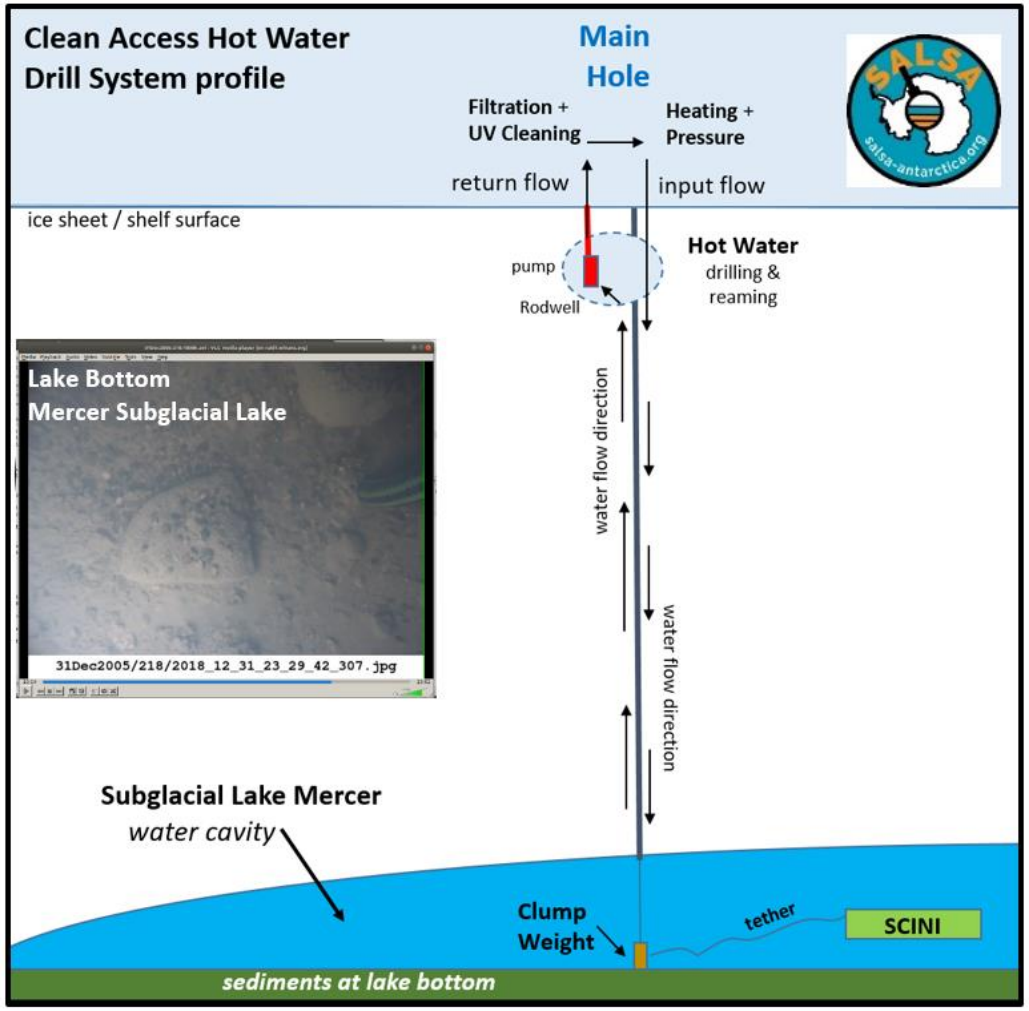
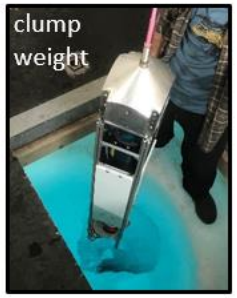
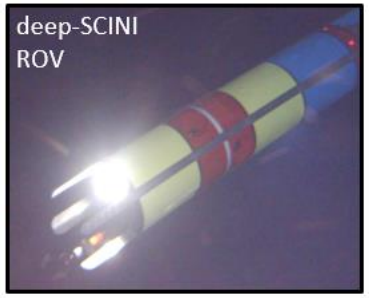
UV light collar




deep-SCINI ROV


clump
weight


deep-SCINI
ROV

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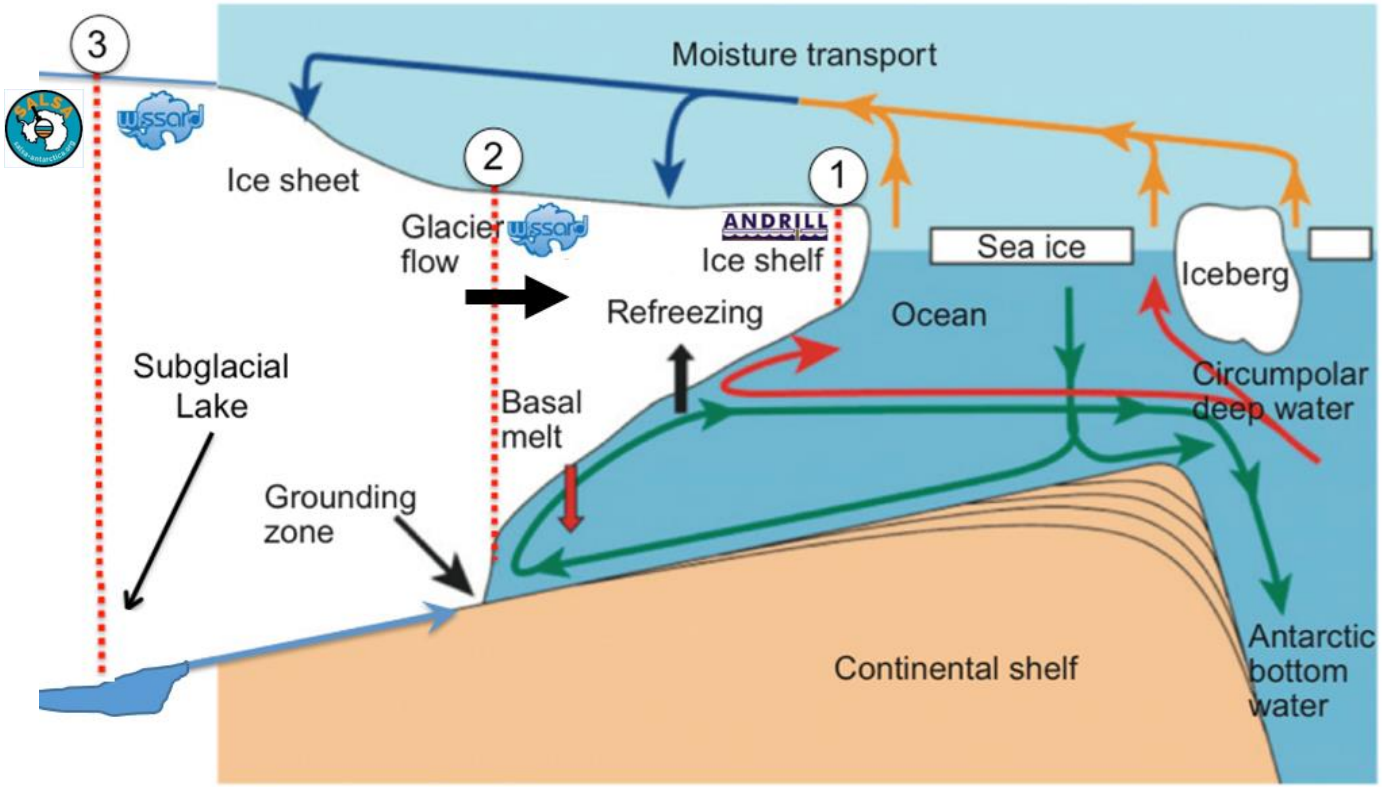
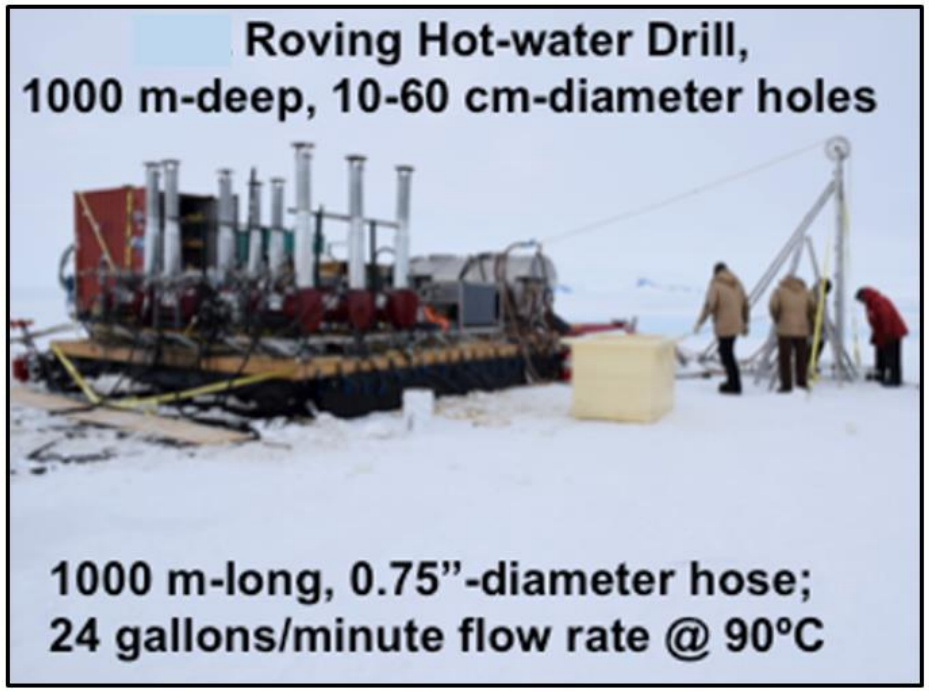
(1) Sub-ice shelf access
(2) Grounding Zone access
(3) Subglacial Lake access

Schematic Representation of Fluid Circulation Under an Ice Shelf / Ice Sheet



Modified from Holland, 2013. Ocean Circulation and Climate, Vol. 103: Chapter 16 - The Marine Cryosphere, p. 413-442; http://dx.doi.org/10.1016/B978-0-12-391851-2.00016-7



The ‘Roving’ Hot Water Drill is:

- a scalable drill, w/modular components
- upgradable to a clean access system
- transportable - Twin Otter or Bassler
- requires a drill crew of 3 to 4 drillers
- field tested with success

Contact for more info:

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U.S. ICE DRILLING PROGRAM

https://icedrill.org/meetings/subglacial-access-working-group-science-planning-workshop-2019

SUBGLACIAL COMMUNITY

Subglacial Access Science Planning Workshop

March 29-30, 2019
Herndon, Virginia

White Paper:

Assessment of East Antarctic Ice Sheet sensitivity to warming and its potential for contributions to sea level rise

Targets:

Subglacial sedimentary basins
- stratigraphic drilling

Crystalline bedrock highs
- spot coring

Wilkes Subglacial Basin

Aurora Subglacial Basin

Aims:

Pliocene EAIS history

Sensitivity to Pliocene warming

Exposure history

Crustal evolution

Geothermal flux survey

Drilling systems:

RAID

WISSARD/SALSA

Roving Drill

others…

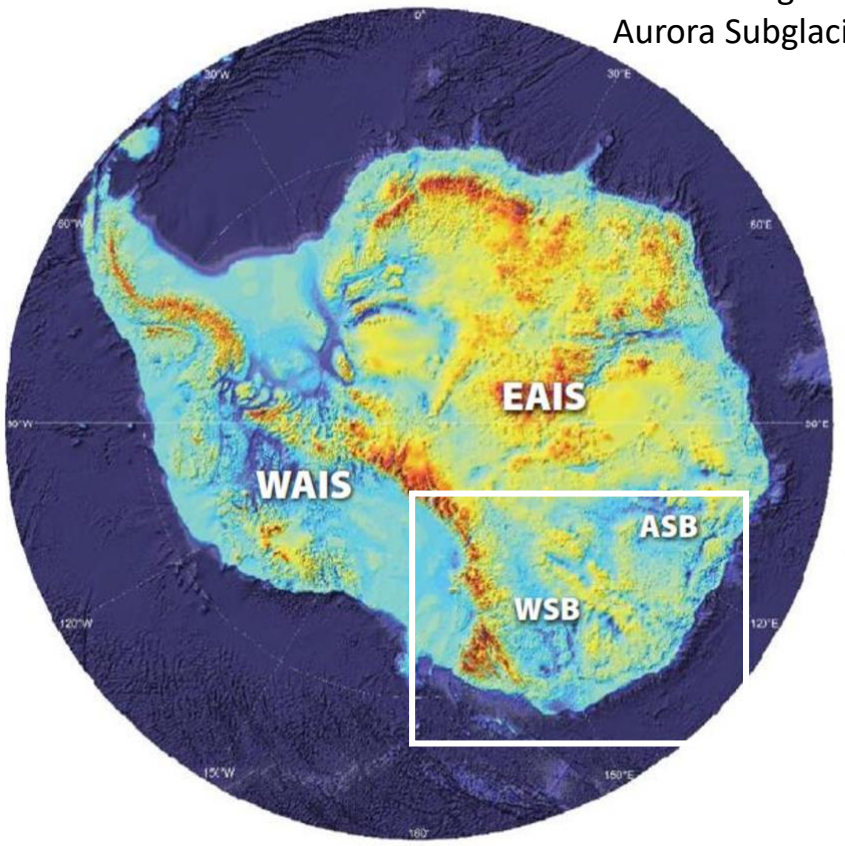

Figure 1. Bedmap2 image showing bedrock topography and highlighting regions of Antarctica where bedrock is below sea level (cool colors). Ice sheets covering bedrock include the East Antarctic Ice Sheet (EAIS) and West Antarctic Ice Sheet (WAIS); major subglacial basins in East Antarctica include Wilkes Subglacial Basin (WSB) and Aurora Subglacial Basin (ASB). From Escutia et al. (2019), after Fretwell et al. (2013).

Approach:

Penetration into subglacial targets where water is present will require clean-access approach, which is available with the WISSARD system (presently at 1500 m, but upgradable to 2500 m depth capability) or Roving Drill (1000 m depth capability). Clean-access capability could be incorporated into the next iteration of a RAID Drill. Technological advances in coring should be explored to allow for improved recovery of basal sediment-rich ice, for examination of those sediments, but also as a means of clearing debris from the bottom of a drill hole, and for the recovery of a sequence of sediment cores (i.e., 10s to 100s of meters). A systematic regimen of filter replacement of hot-water drilling systems would allow for recovery and sampling of englacial and basal sediment debris, including soft sediment clasts that may contain marine microfossils of use in dating past marine incursions. The potential to use water from a hot-water drill to drive an electrical generator at the bottom of a borehole to power a drilling system to recover ice or sediment cores could be explored.

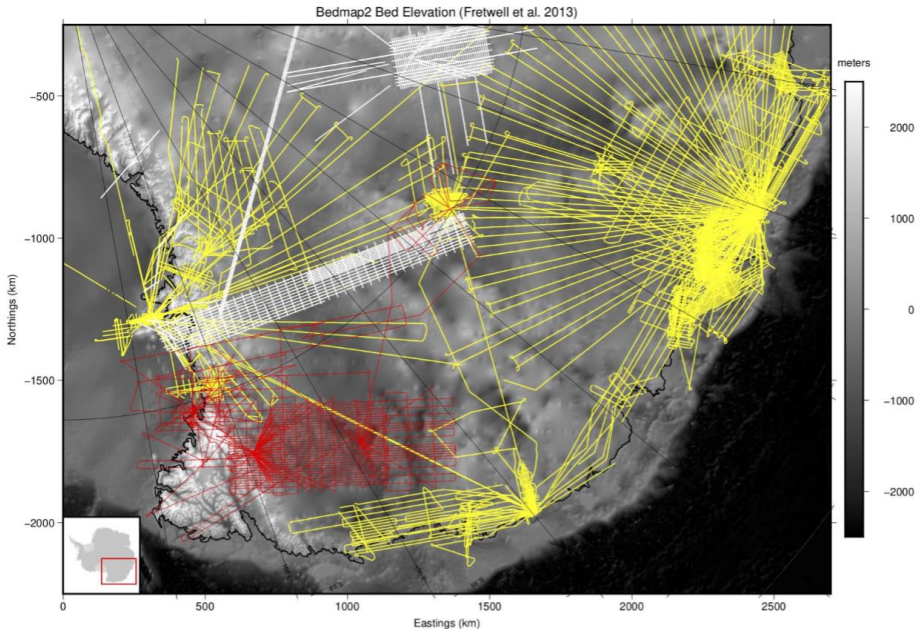

Figure 4: Existing aerogeophysical coverage of Wilkes and Aurora subglacial basins (SOAR in white, ISODYN-WISE in red, and ICECAP in yellow) over Bedmap2 (Fretwell et al., 2013). While some regions of the WSB have excellent coverage, significant gaps remain along the length of the WSB. Much of the ASB has been has been surveyed at low spatial resolution, with varying radiometric quality.

White Paper:

Allie Balter , Lucas H Beem, John W Goodge, Sean Gulick, Chloe Gustafson, David Harwood, Jennifer Lamp, Amy Leventer, Amelia Schevenell, Matthew R Siegfried, Perry Spector, John Stone, Slawek Tulaczyk, Sophie Warny, Paul Winberry, Dale Winebrenner, Duncan Young (2019) White Paper: Assessment of East Antarctic Ice Sheet sensitivity to warming and its potential for contributions to sea level rise. *Ice Drilling Program Subglacial Access Working Group Science Planning Workshop, March 29-30, 2019, Herndon, Virginia, USA* , 1-18 .