Ice Core Science Community Planning Workshop 2020

Portable ultralight ice core drilling system for high altitude and polar glaciers research: planned application in Sub-Antarctic Islands

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Introduction

Light-and ultralight ice core drilling systems (< 50 kg) are needed for:

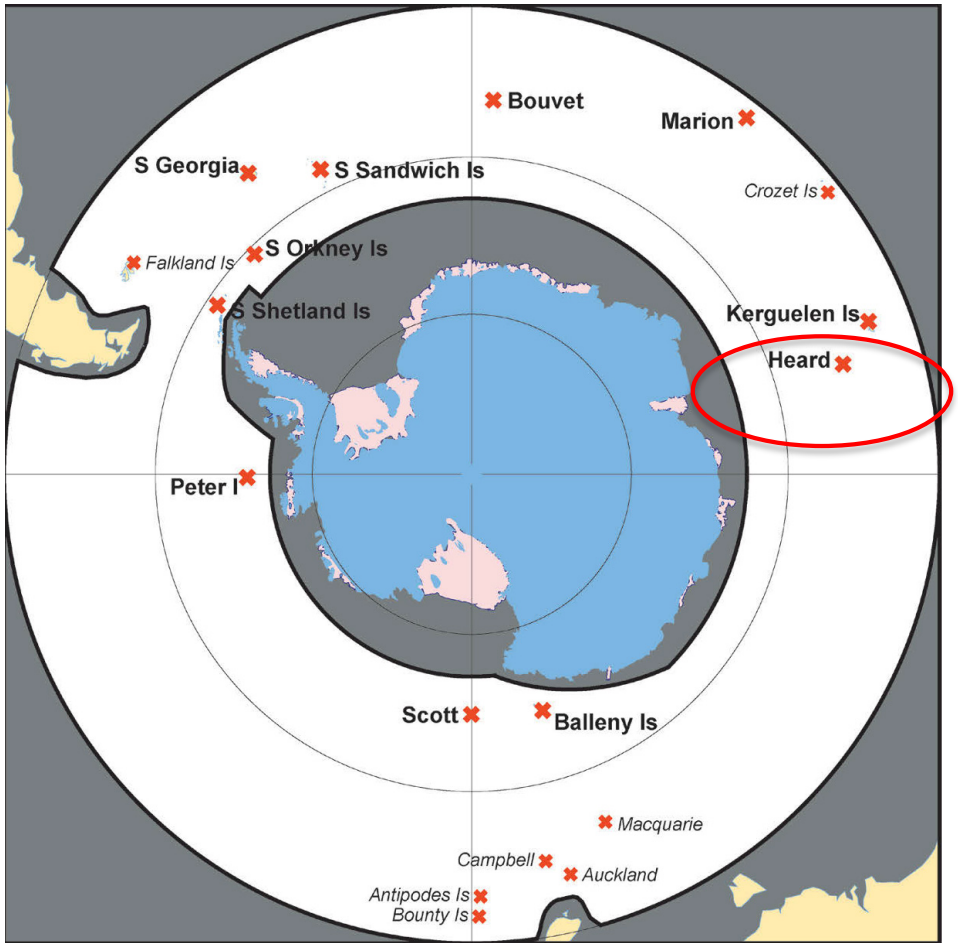
- Logistically difficult/“impossible” sites of high scientific interests:

- high altitude glaciers
- polar glaciers
- drilling sites without helicopter support (above 6000 m)

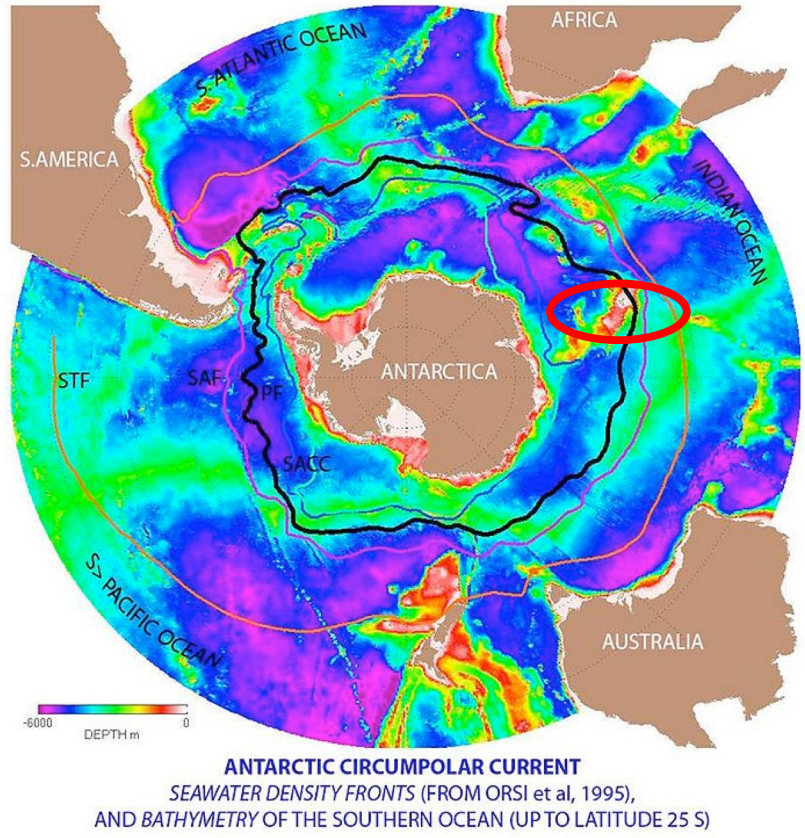
- Reconnaissance for ice coring operations (site selection)

- Relatively inexpensive field projects to obtain relatively small size/volume ice samples

Potential application to low altitude Sub Antarctic Islands as observatories of changes of the polar front and the westerlies



From J. G. Cogley et al. 2014



ANTARCTIC CIRCUMPOLAR CURRENT
SEAWATER DENSITY FRONTS (FROM ORSI et al, 1995),
AND *BATHYMETRY* OF THE SOUTHERN OCEAN (UP TO LATITUDE 25 S)

Orsi, Whitworth & Nowlin 1995

Heard Island, Australian territory

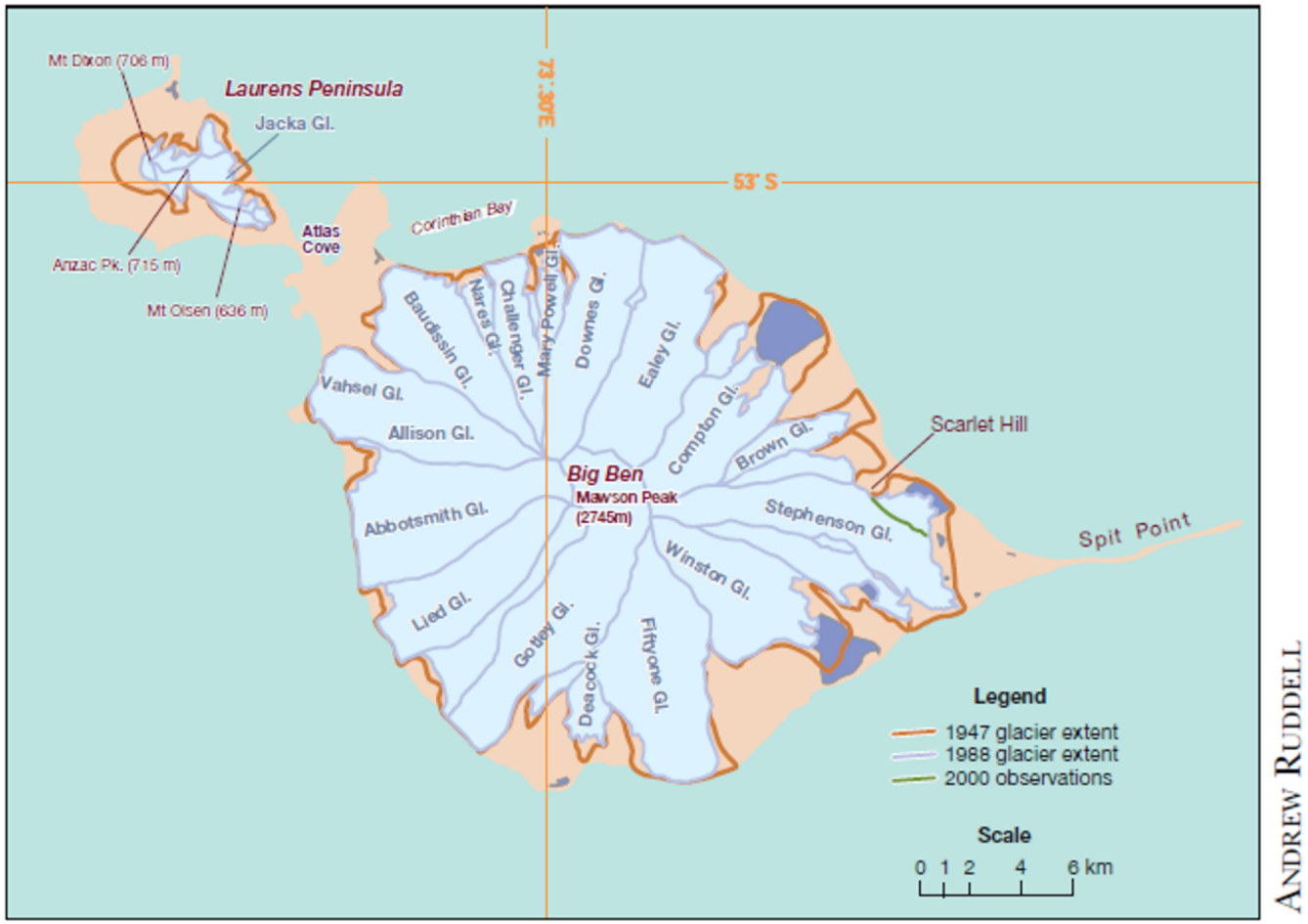
Area: 368 km^2

Highest elevation: 2,745 m

Volcanic island

Population: 0 (unhabited)

Various past expeditions



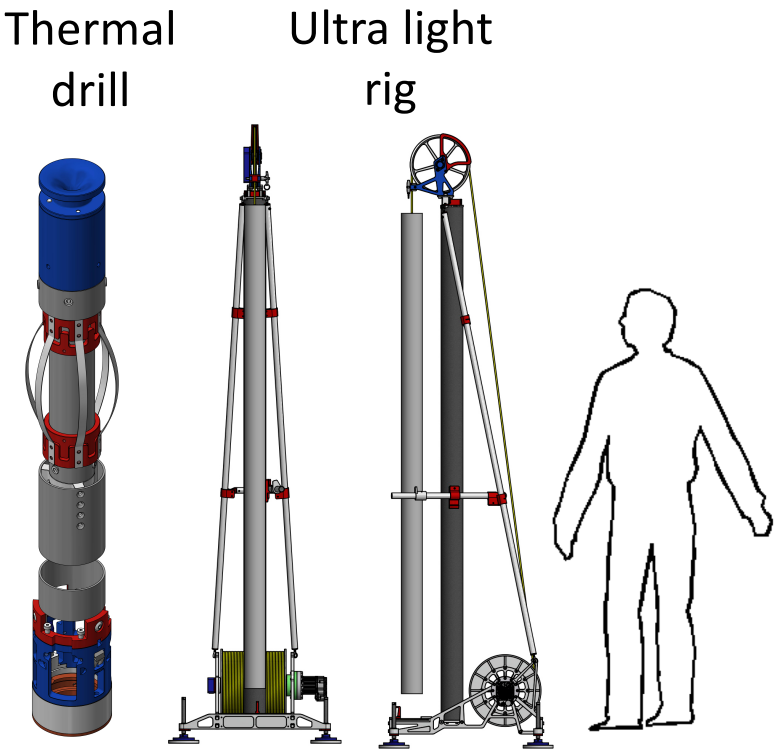
The extent of glaciers on Heard Island in 1988. The retreat since 1947 and the change in the Stephenson Glacier (1988–2000) is indicated.

Heard Island physical- climatic characteristics

- Latitude: 53 S
- Glaciers elevation: 0-2400 m
- Snow Equilibrium Line Altitude: 100-700 m
- Mean air temperature at 2400 m: -10 C
- Mean precipitation at sea level: 1380 mm/year
- Days of precipitation per year: 276
- Mean annual wind speed at sea level: 8.3 m/s

Concept of light-and ultralight ice core drill

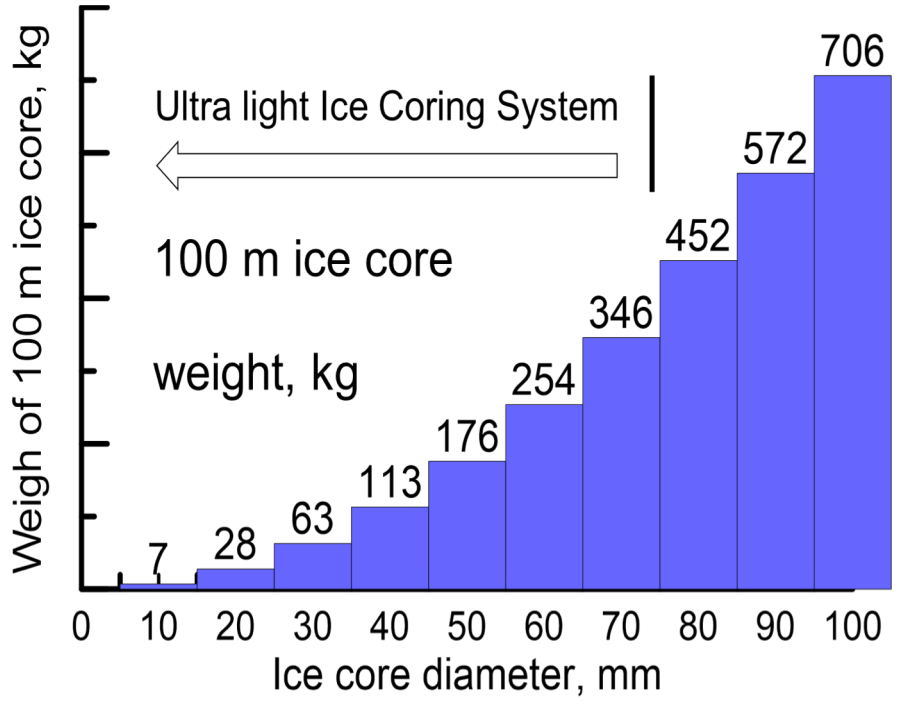
- Lightweight equipment can be deployed by a small group of porters (3-4) up to 8000 m a.s.l.
- High ice coring production rate to reduce logistic (time on site and supplies)
- Power efficient drilling equipment (less fuel and pollution on site)



Ultra light system prototype constructed and lab tested by Victor Zagorodnov

Characteristics and Performances of the Ultra Light Drilling System

Maximum depth	170 m
Weight (rig+drill)	20 kg
Power (300-400 Vdc)	0.3-1.0 KW
Fuel	8 Liter/100 m core
Production rate	40 m/day
Core diameter	42…75 mm



Conclusions

Ultralight ice core drilling allows:

- Economical and quick field operations
- Reducing greatly the logistic
- Ice coring down to 170 m depth at logistically difficult sites

Additional perspectives……

1. Thermal drill for cold ice
2. Electro Mechanical drill for dry borehole (core <80 mm)
3. Electro Mechanical drill for fluid borehole
4. Compact controller
5. Hot point drills (borehole diameters: 15, 25, 35 mm)
6. Winch configuration for geophysical studies (560 meters depth; 2.5 mm cable)