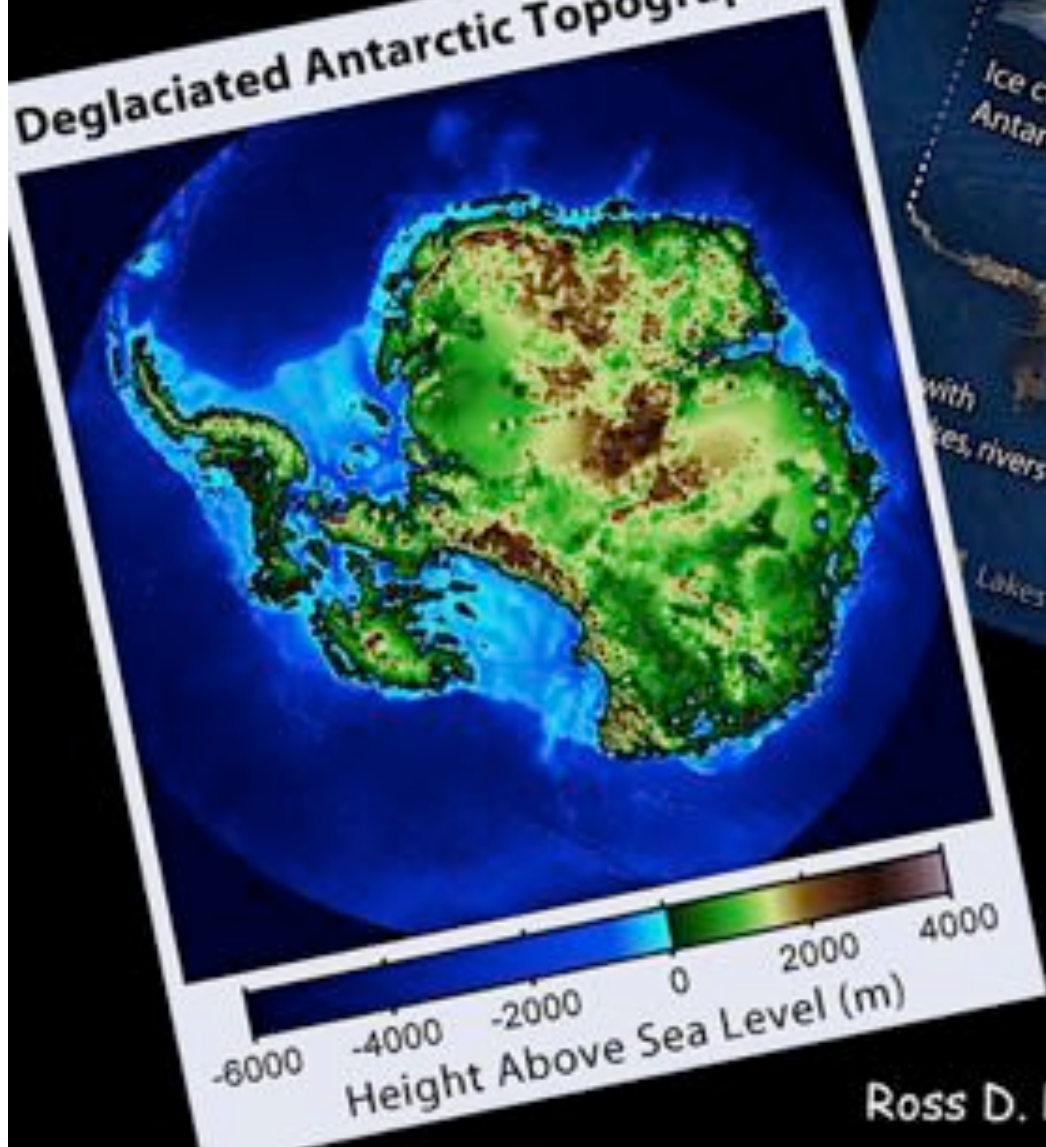


Subglacial Geological Targets

Deglaciated Antarctic Topography



Ross D. Powell - Northern Illinois University

Ice Drilling Program Office
Long Range Science Plan
2012-2022

Theme III: Subglacial Geology, Sediments and Ecosystems

Subglacial environments are the interfaces between ice, subglacial water, basal sediments, and bedrock

Targets:

1. Bedrock geology
2. Bedrock exposure age
3. Subglacial basins: sedimentary records
4. Sub-ice microbial ecosystems and biogeochemistry
5. Subglacial lakes and hydrological systems

Subglacial Geological Sampling and Drilling

Short-term ice dynamics

- ice streams
- grounding zones & ice shelves
- bedrock exposure dating

Deeper time ice sheet and paleoclimate history

- lake basins
- sedimentary bedrock basins
- grounding zones & ice shelves

Geological/tectonic history & paleo-topography

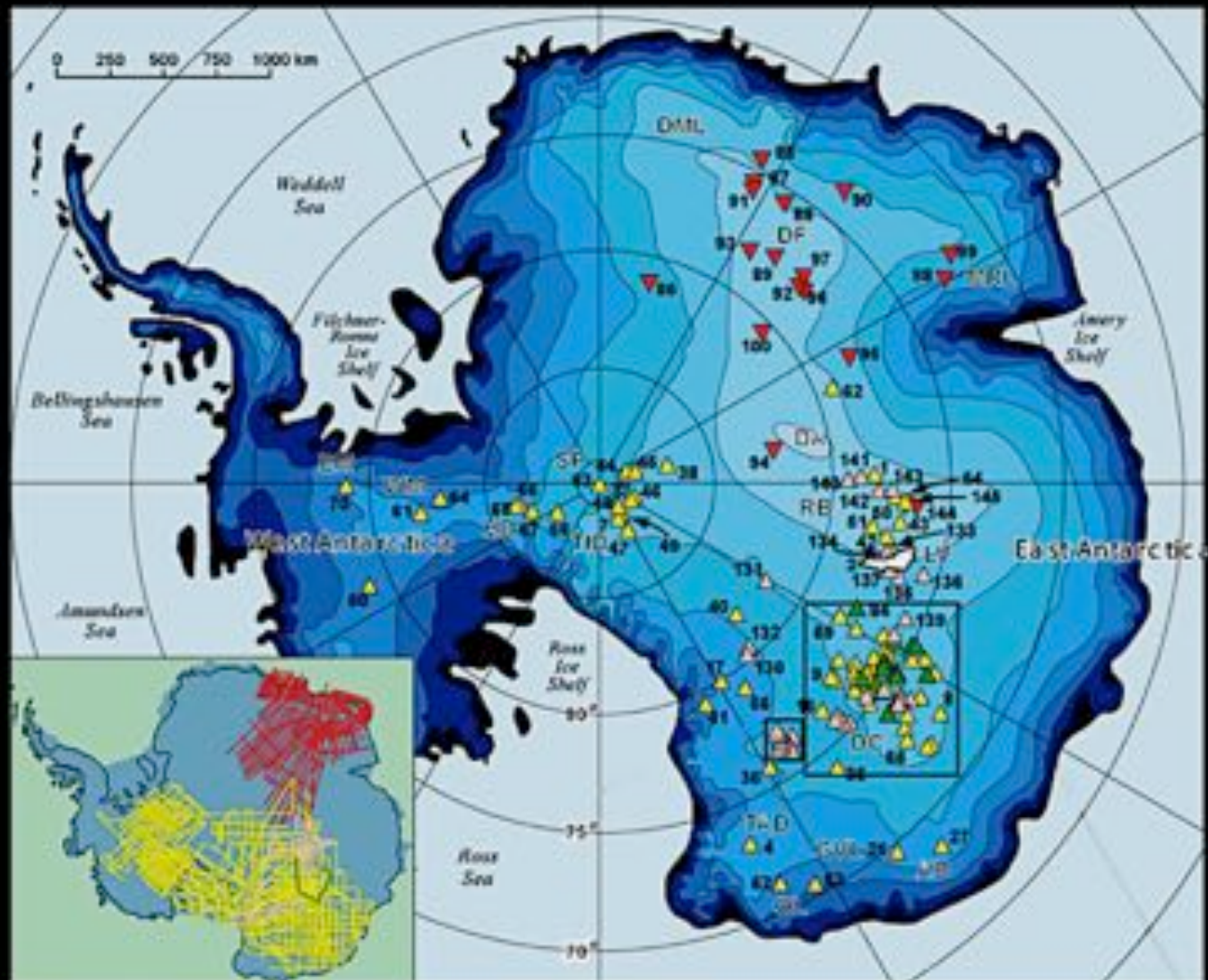
- bedrock highlands
- bedrock basins
- cratonic growth

Requires Cores

- sediment water interface
- piston/gravity
- percussion
- short sedimentary/basement/volcanic drill
- long sedimentary rock drill

Subglacial Antarctic Lake Environments

Vostok
Ellsworth
Whillans

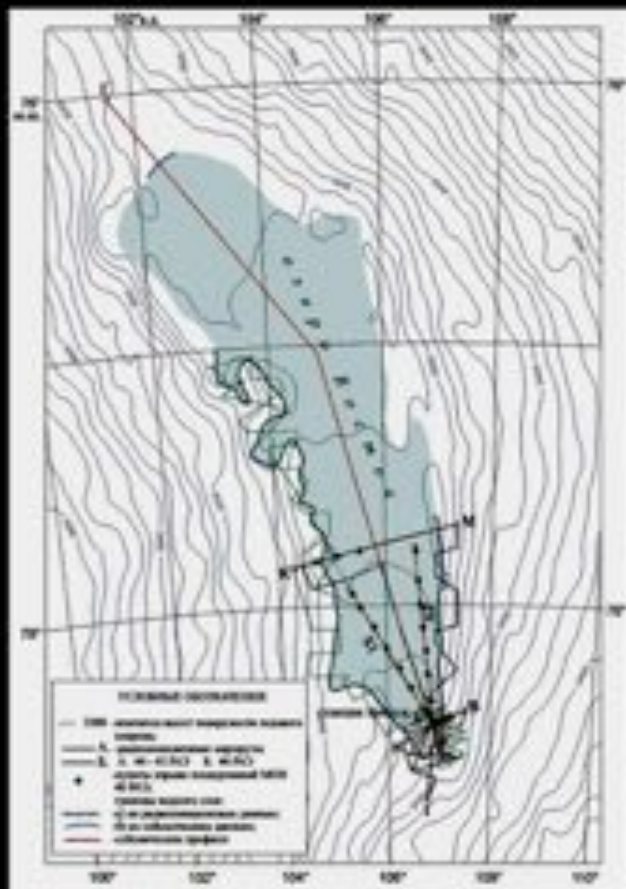


Siegert, et al 2006

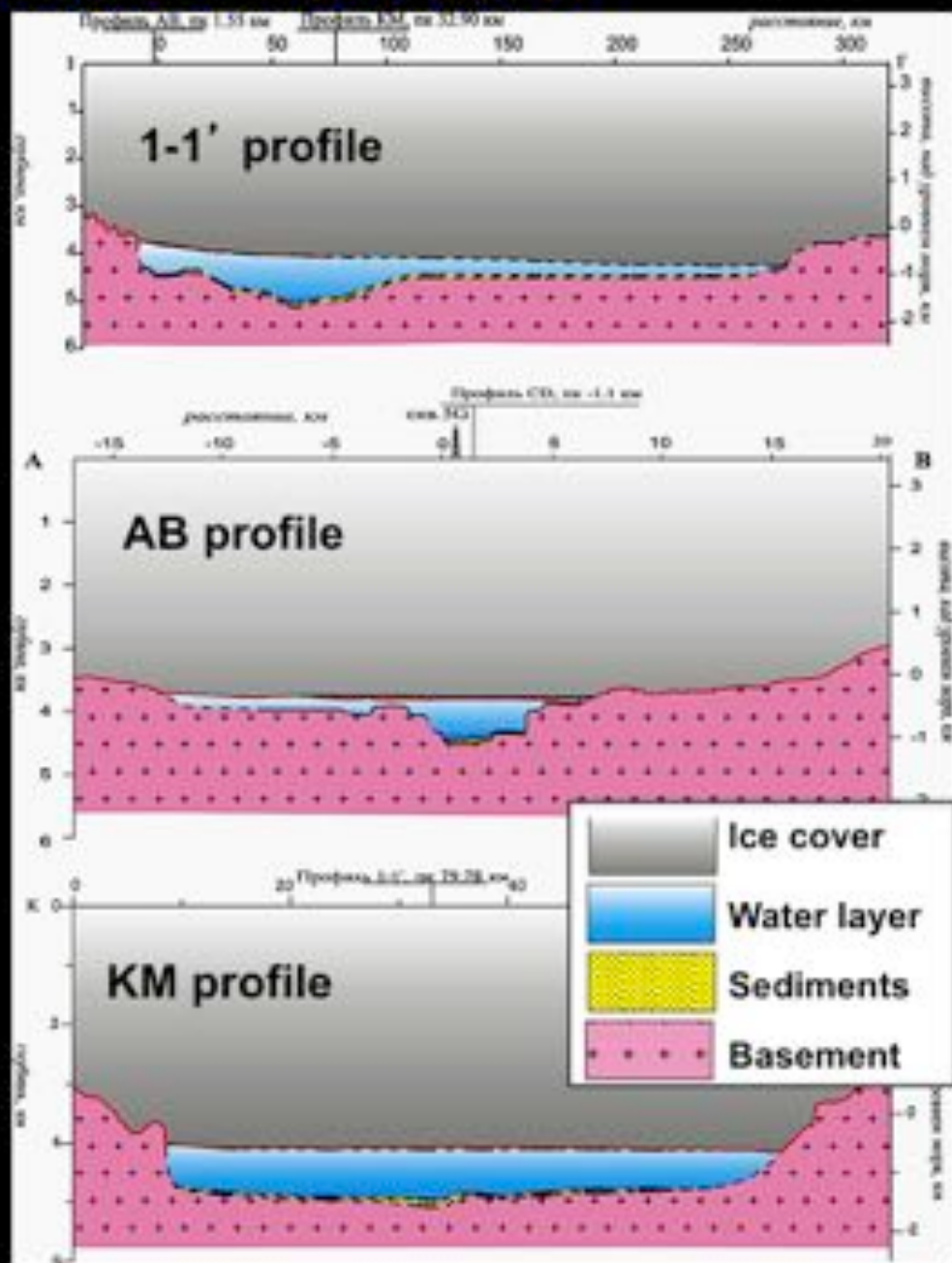
Key to subglacial lake identification

- △ US
- ▲ Italian
- ▼ Russian
- △ UK-US-Danish

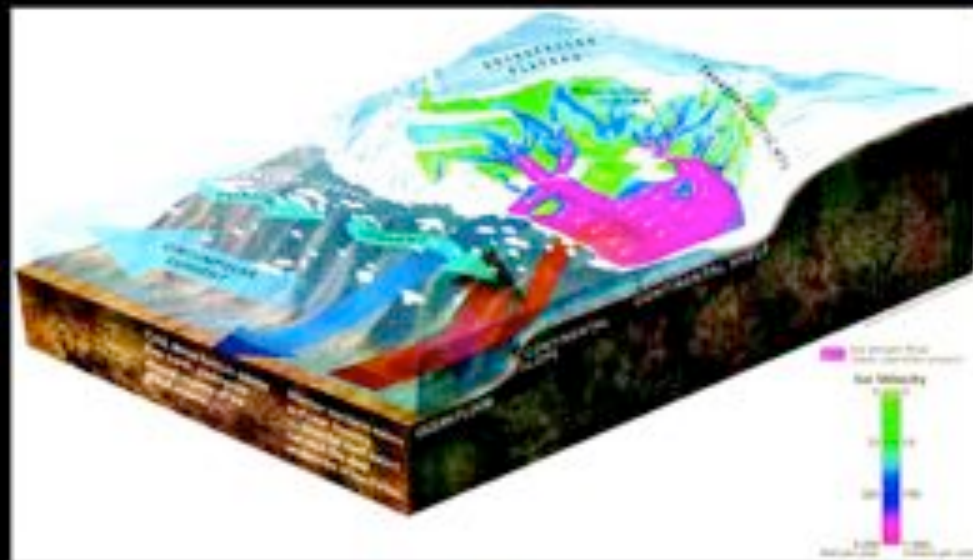
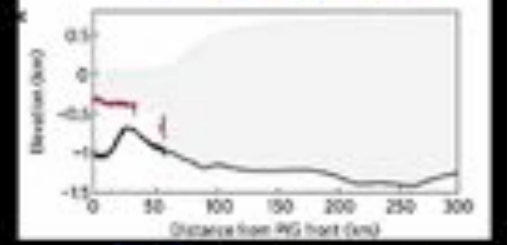
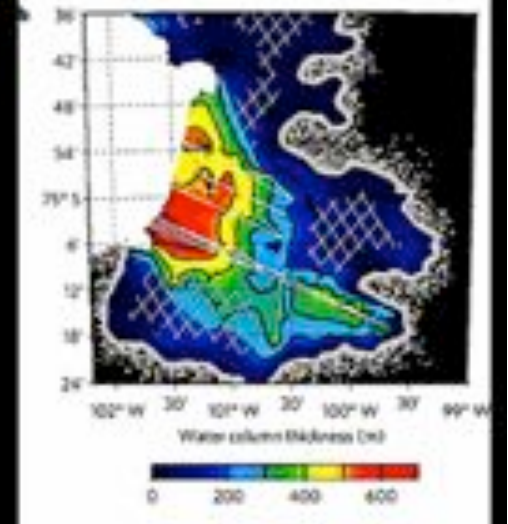
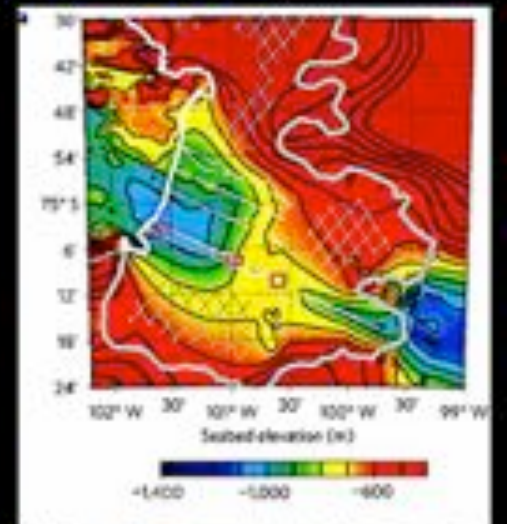
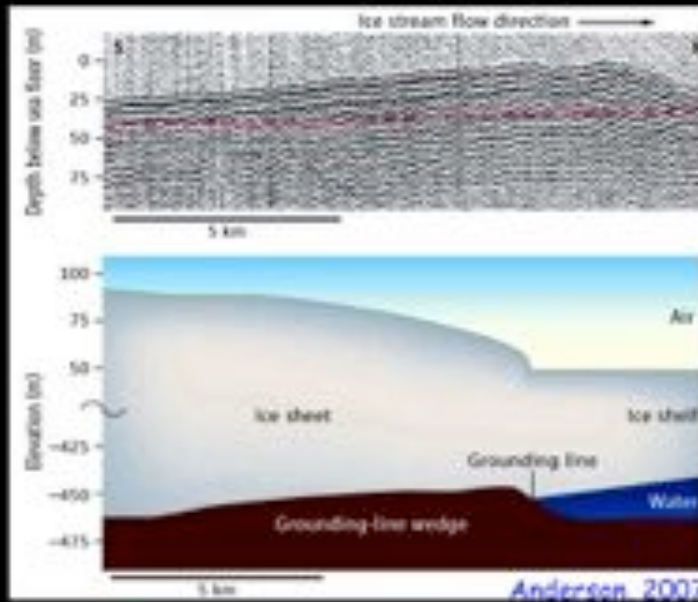
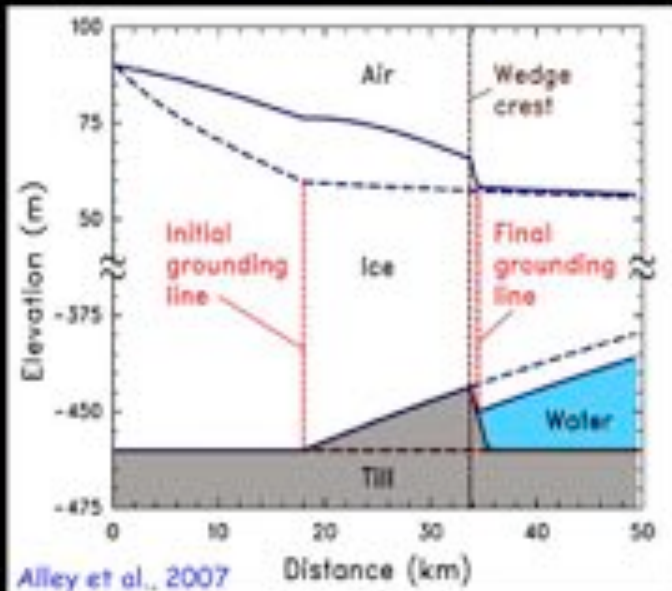
Ultimately long lake sediment cores



e.g. seismic reflection in Subglacial Lake Vostok shows up to 300 m of sediment on lake bed

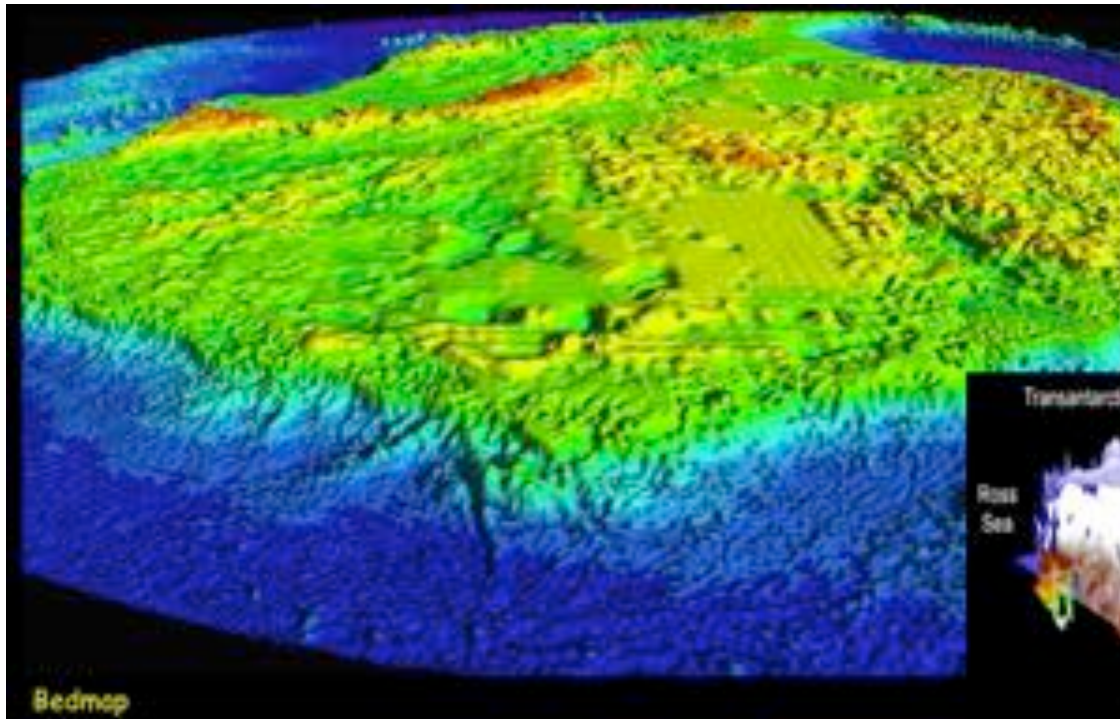


Grounding-zones and ice shelf ocean cavities



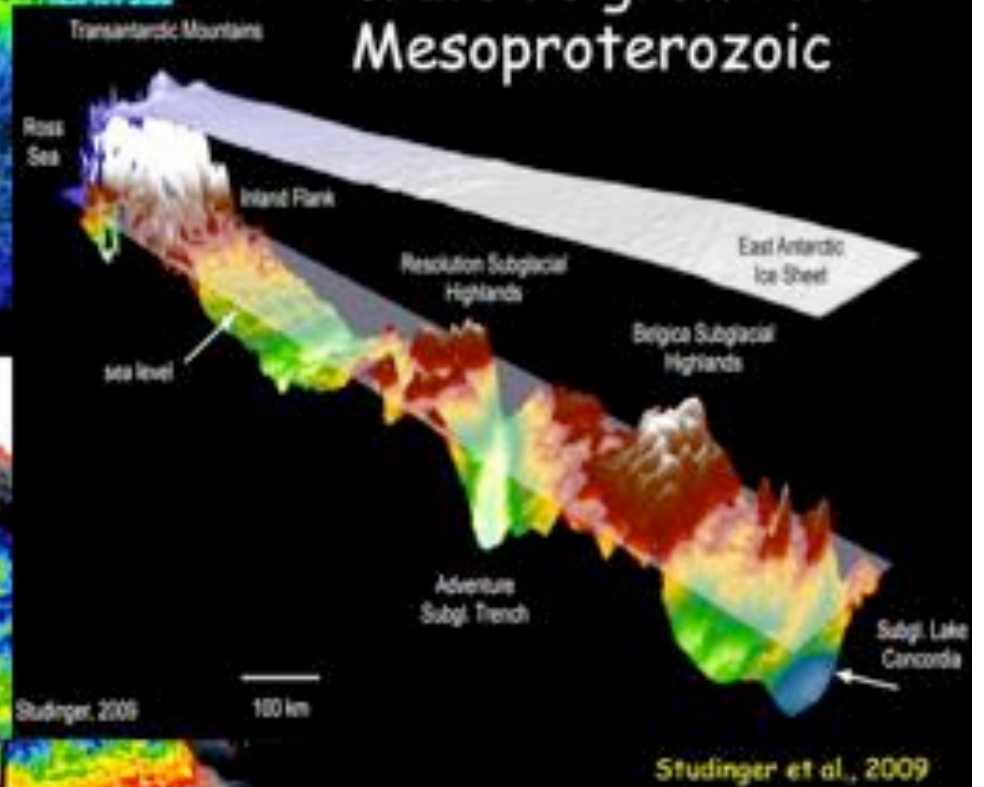
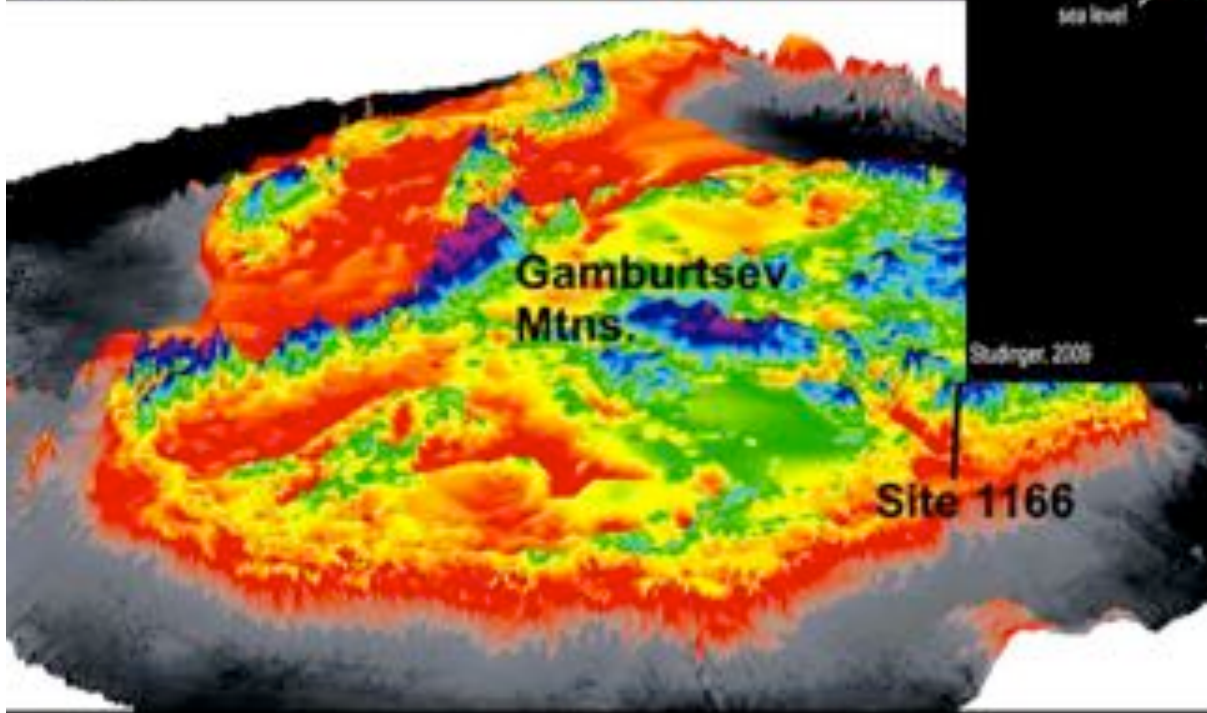
Siple Coast & RIS - Nat. Geog.

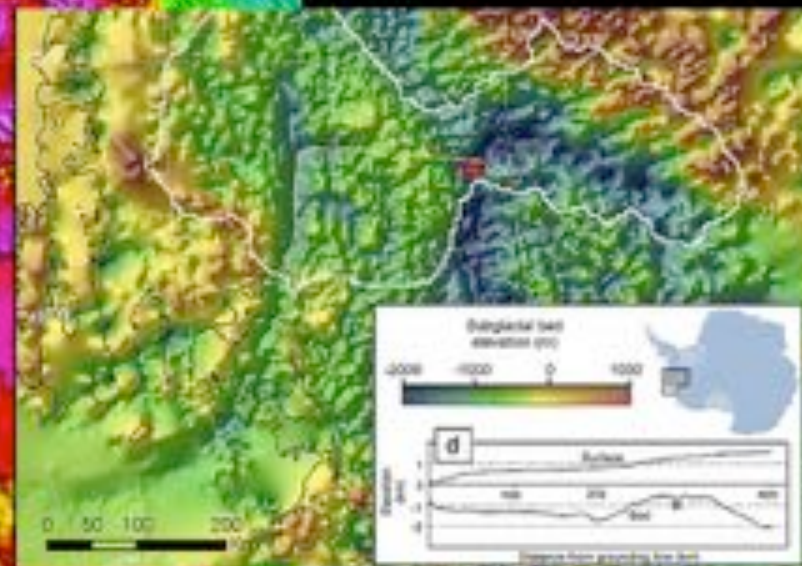
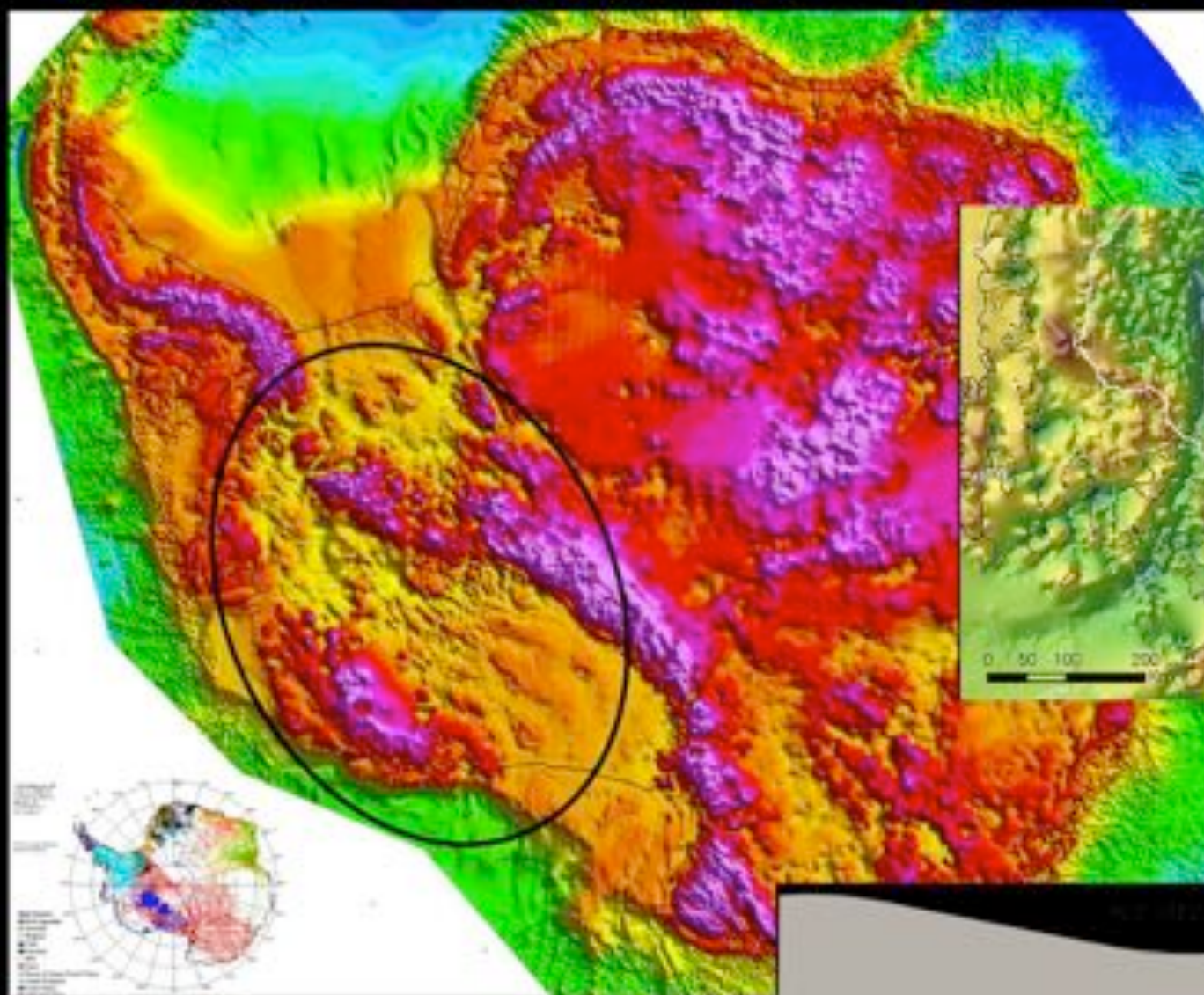
PIG - Jenkins et al. 2010



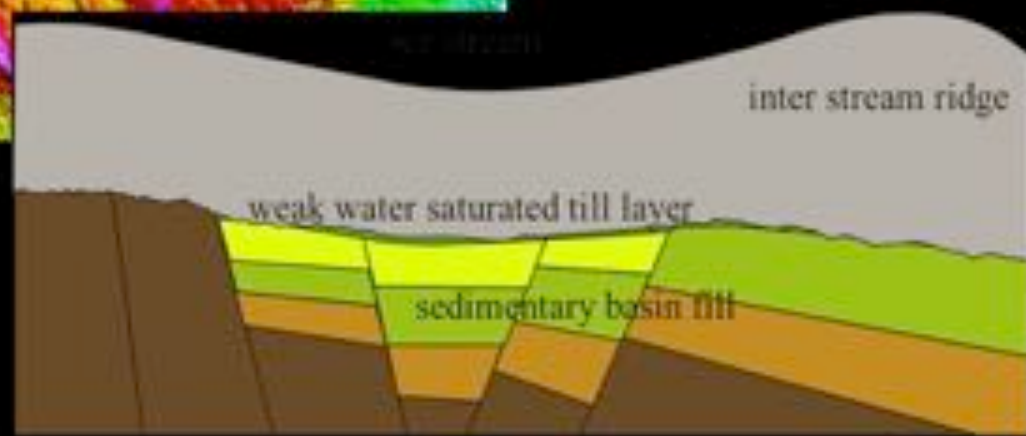
Subglacial highlands (RAID)

- reliable ice sheet models
- validate models of cratonic growth in Mesoproterozoic



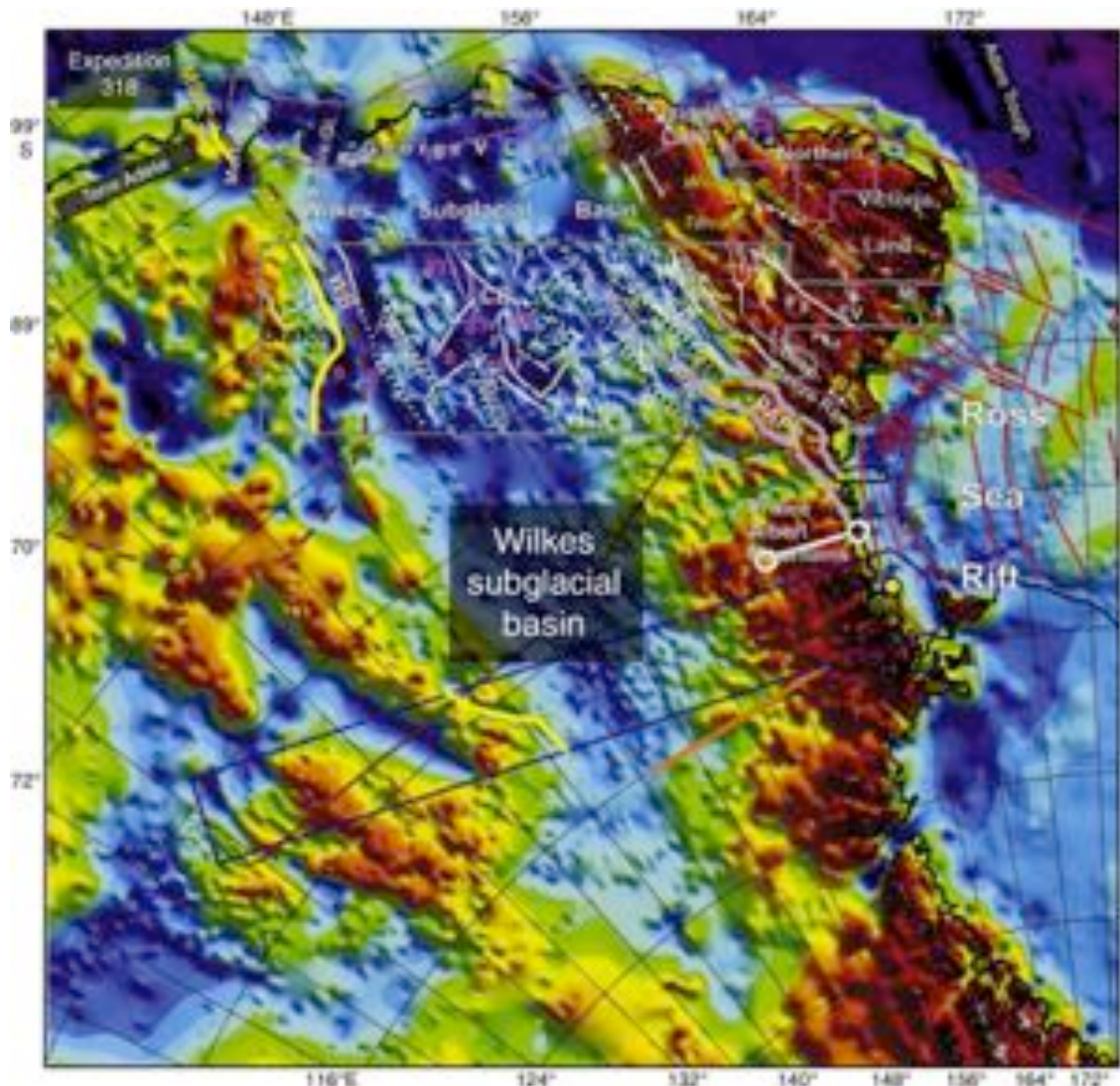


PIG Basin



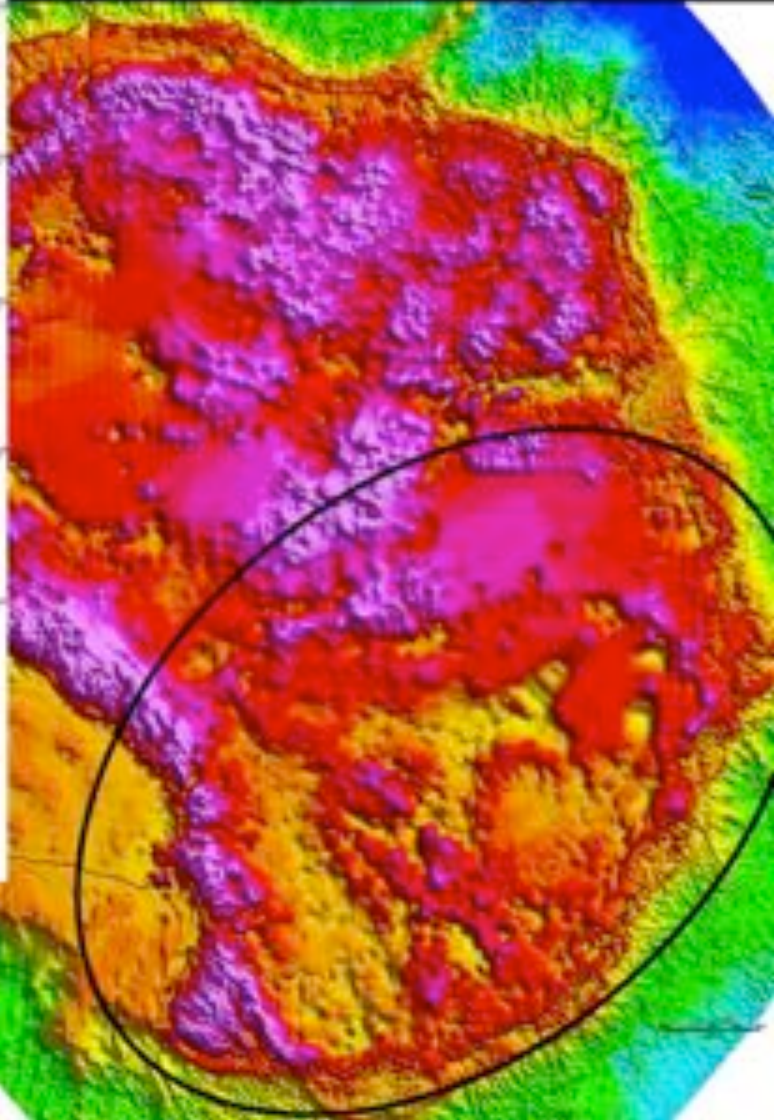
USGS

WAIS subglacial basins



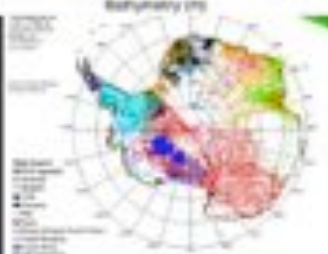
EAIS subglacial basins

USGS

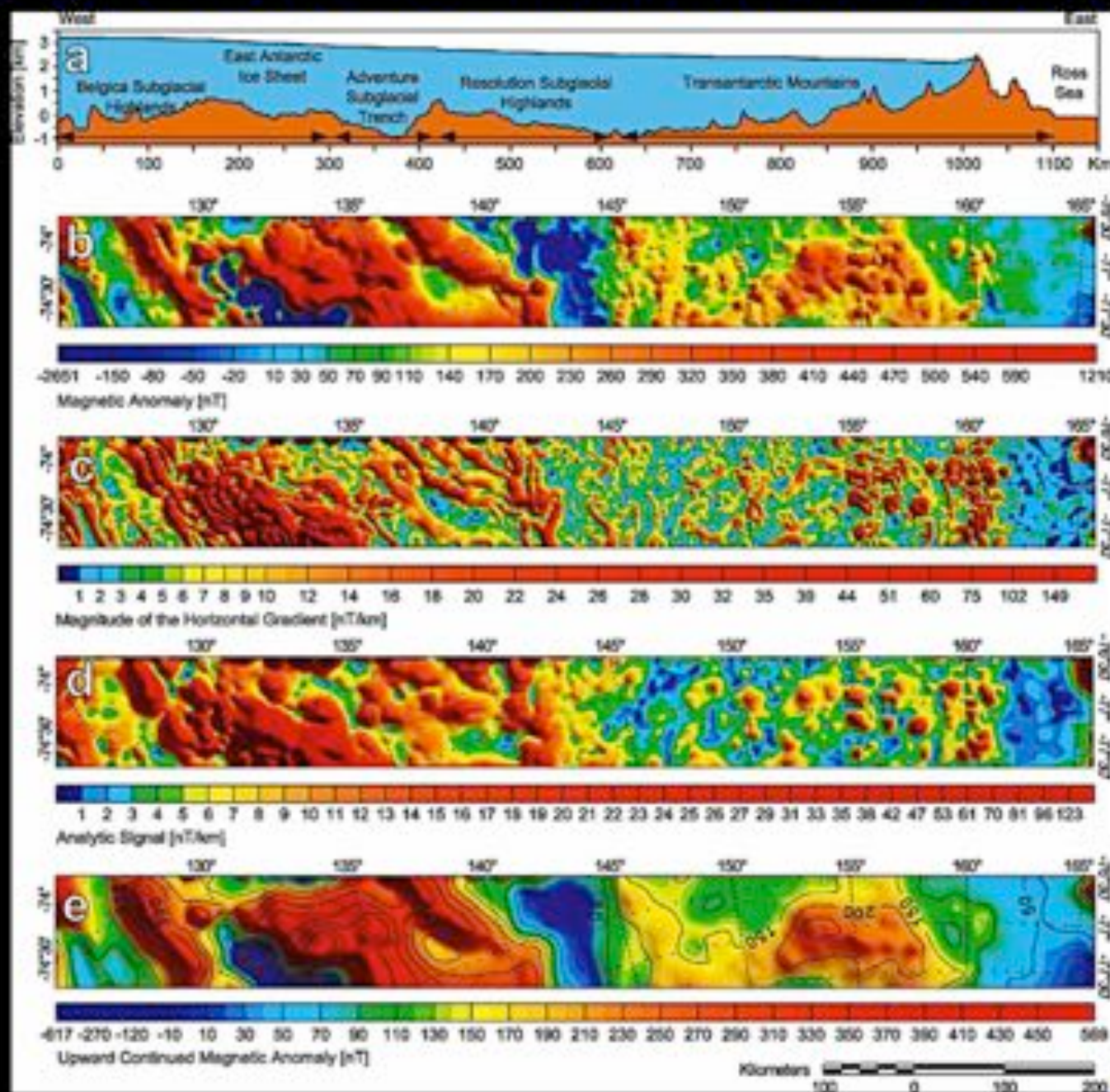


Wilkes subglacial basin

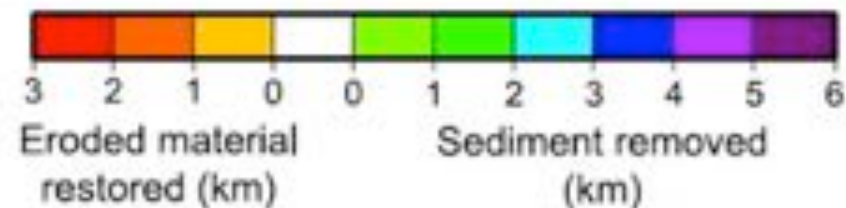
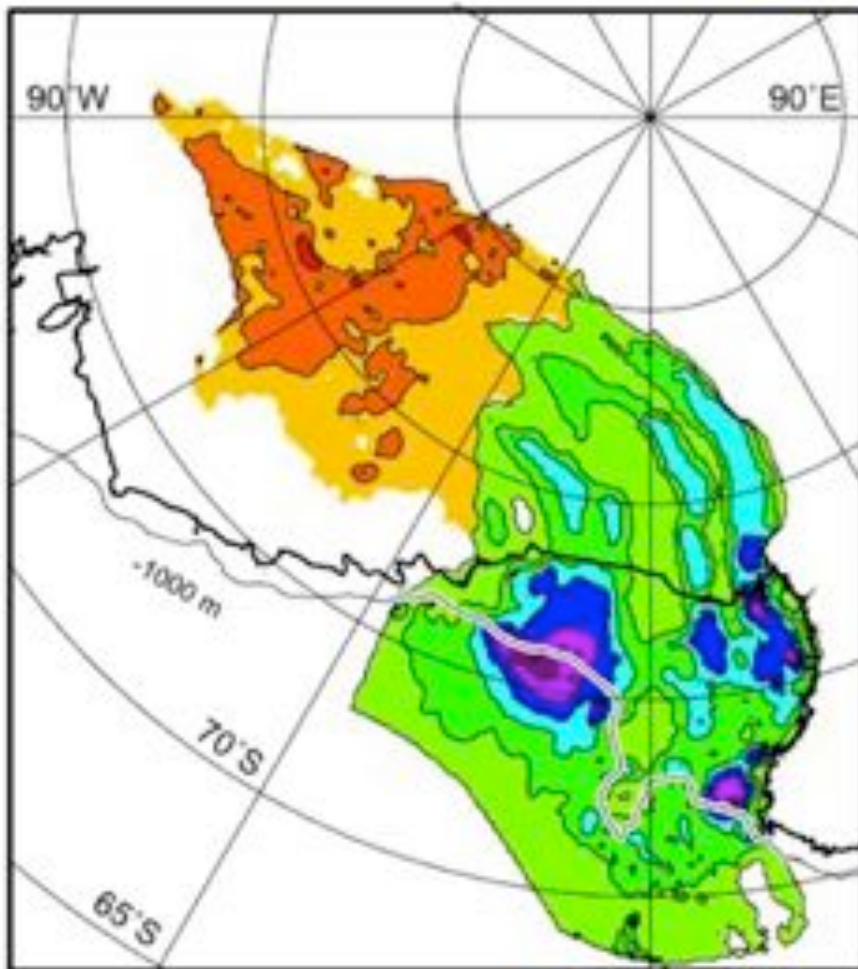
Ferrocciali et al., 2009



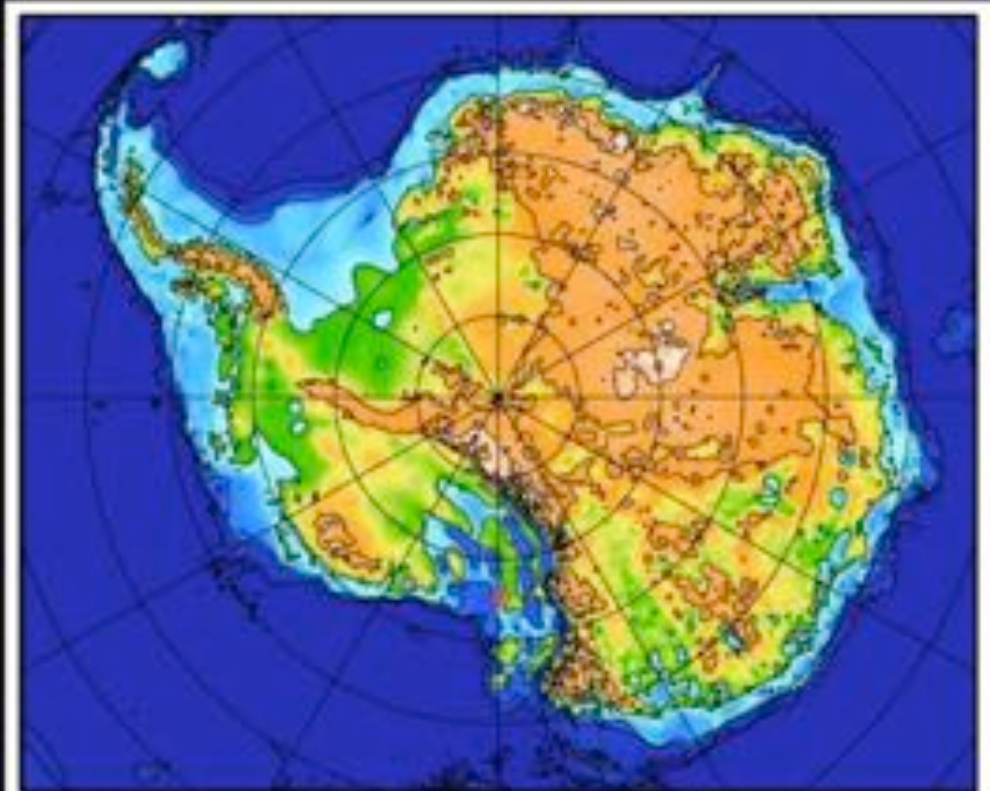
Basins inside the Transantarctic Mountains



Reconstructed topography for West Antarctica



Eocene ~34Ma





Also important questions and targets in Greenland

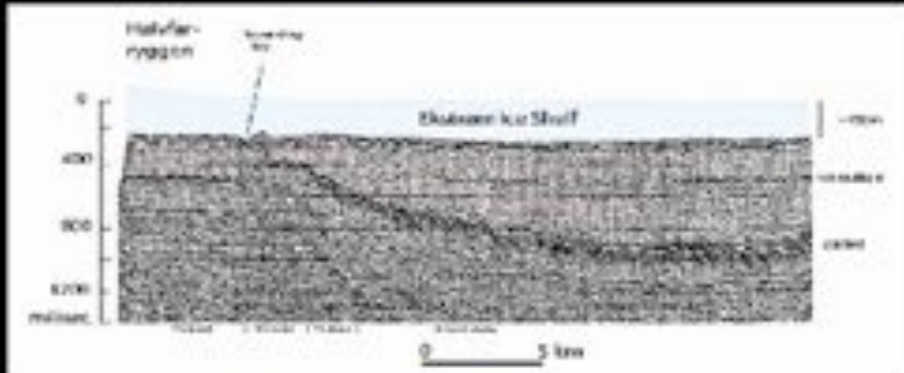
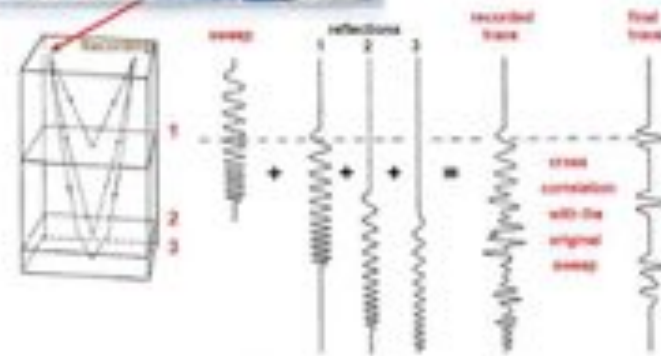
Greenland ice free for the last time?

Svend Funder

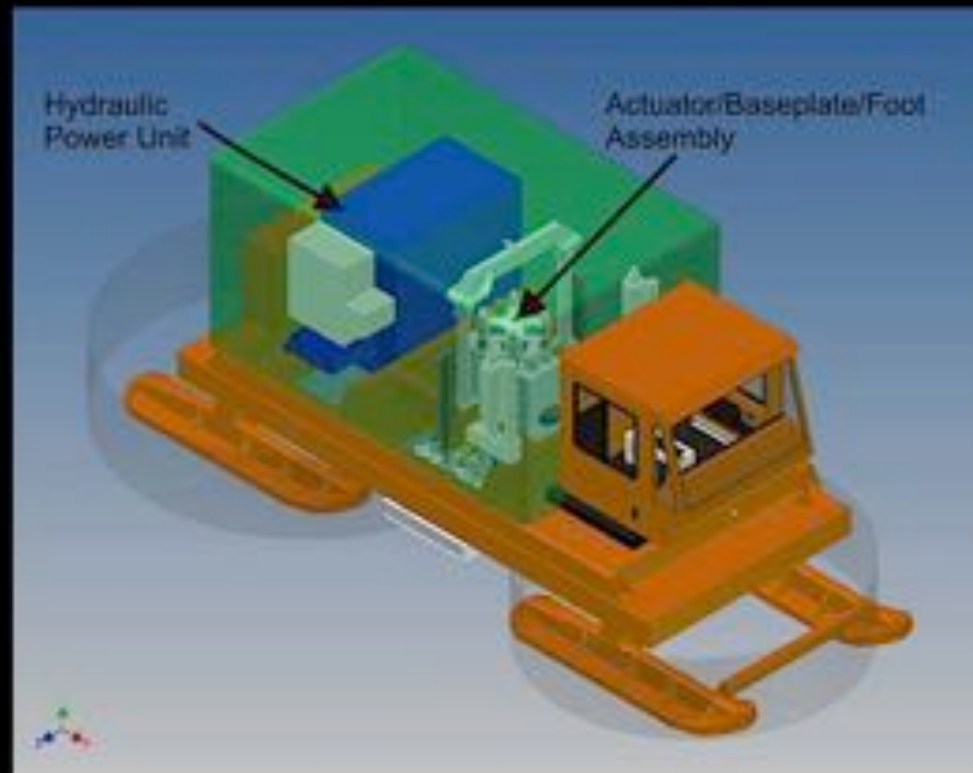
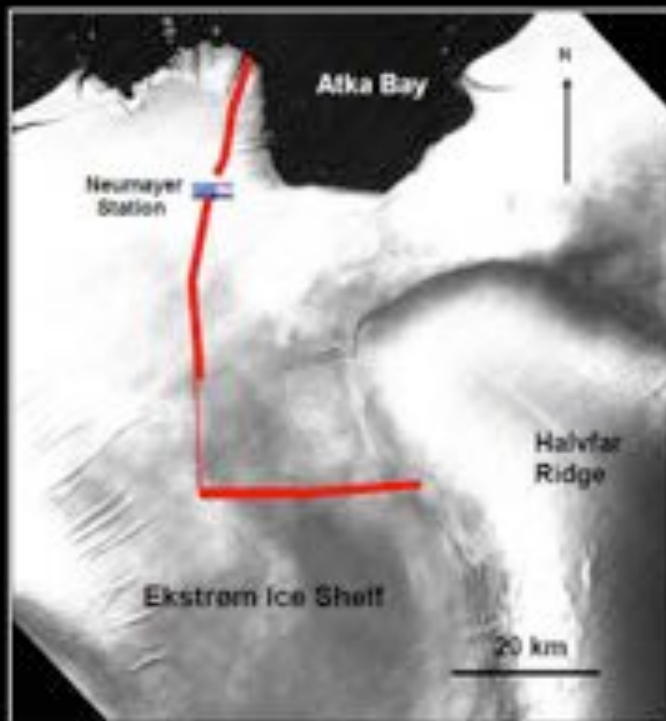
Detailed site surveys with vibroseis



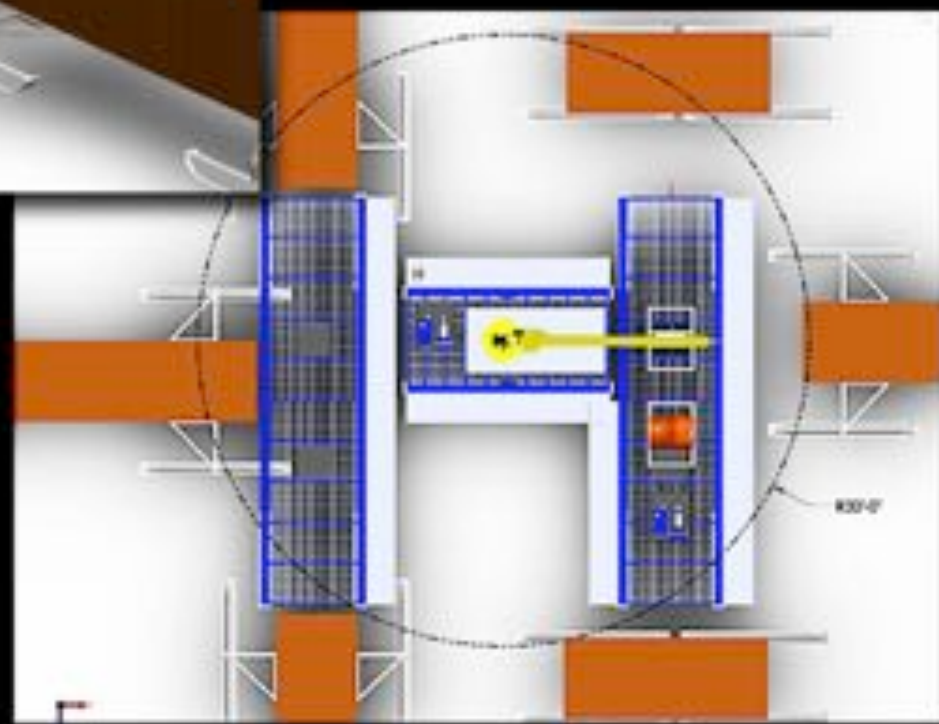
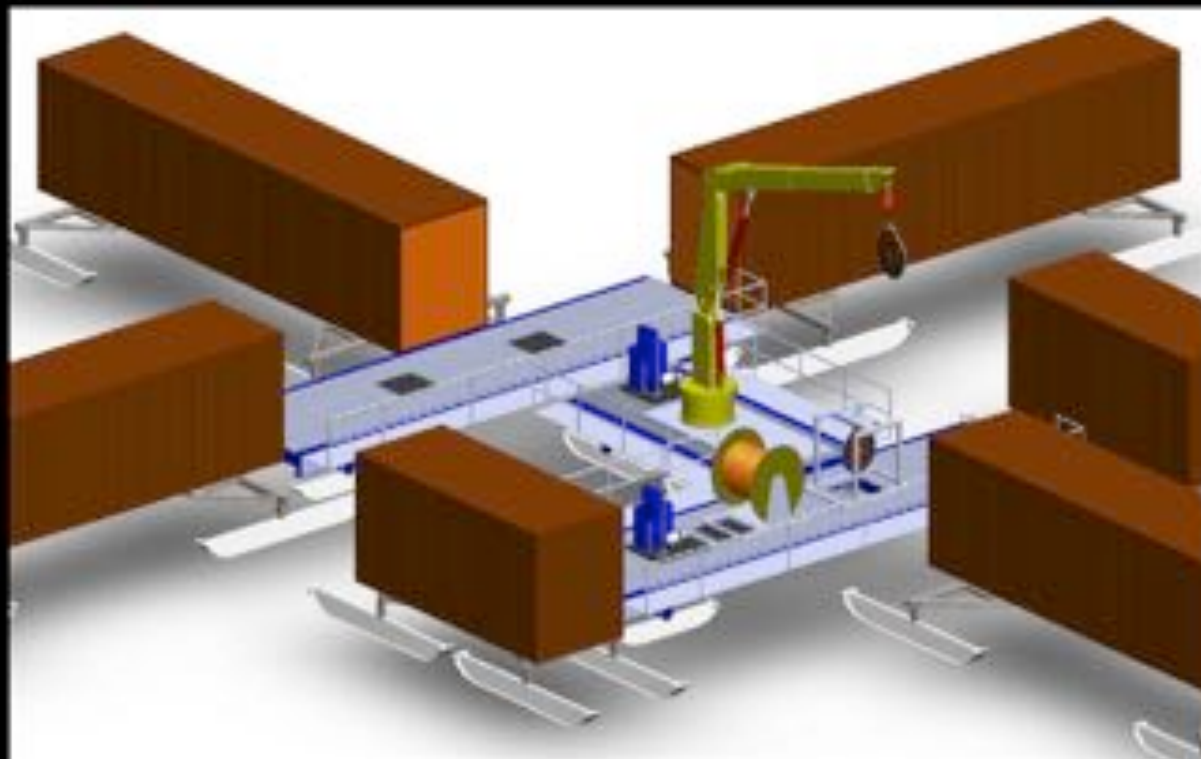
The vibroseis principle



Eisner et al., 2010
Kristoffersen et al., 2011



Field operation layout around access hole





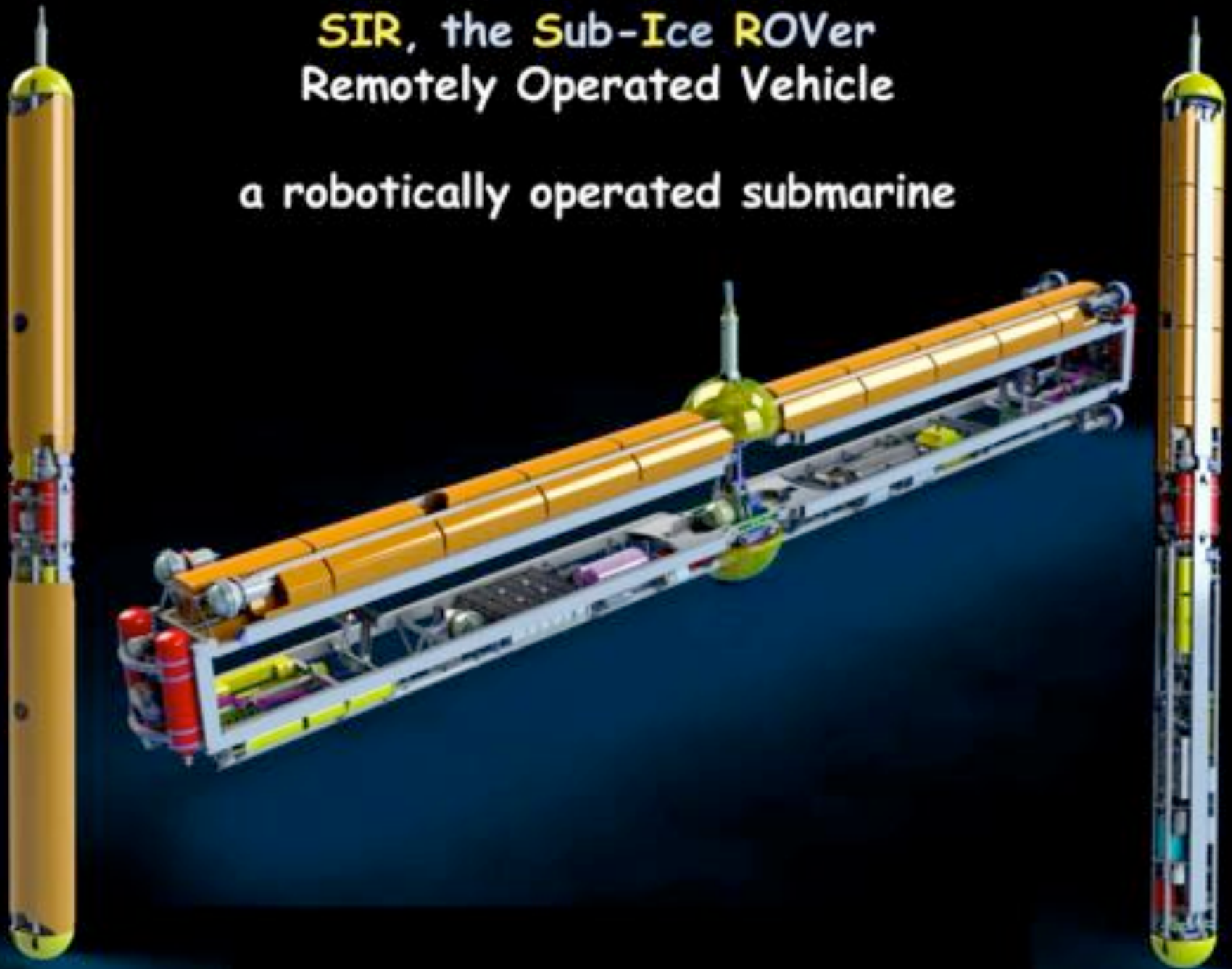
Maintenance workshop in insulated ISO shipping container



3km of tethered umbilical
for the SIR

SIR, the **Sub-Ice ROVer**
Remotely Operated Vehicle

a robotically operated submarine





Hardware/software engineers working on IPSIE
Instrumentation Packages for Sub-Ice Exploration



