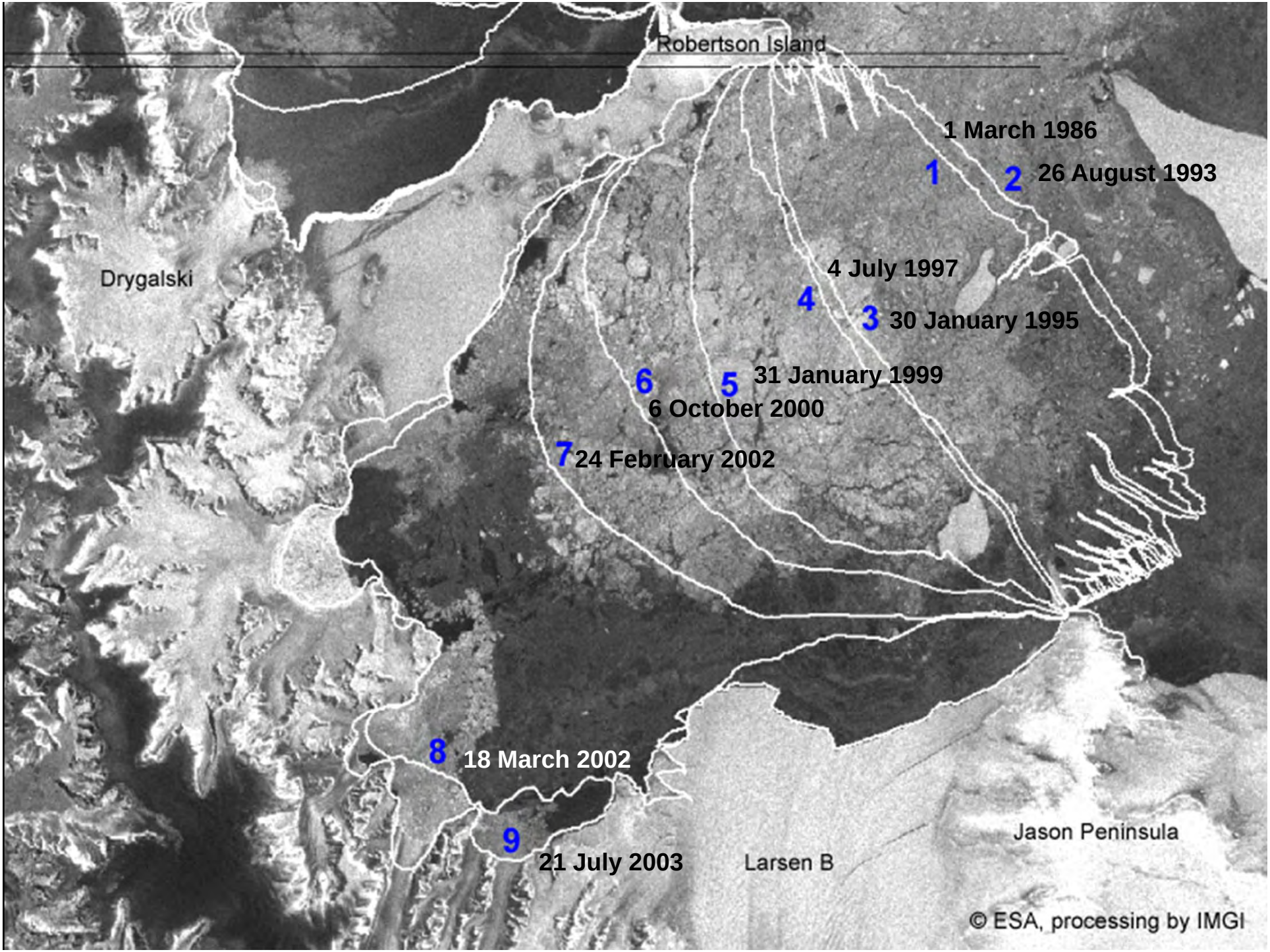
LARISSA

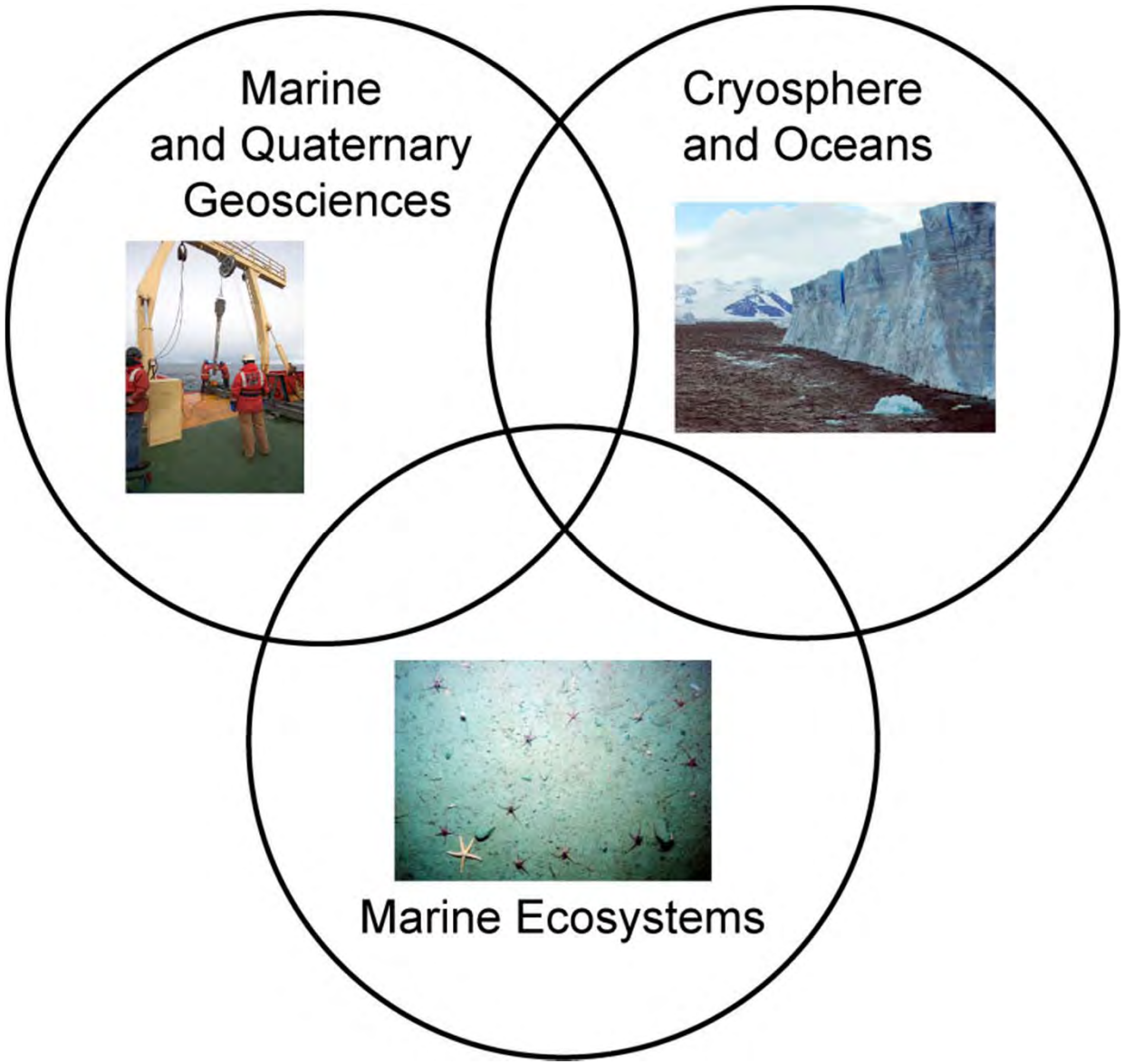
Antaretic Integrated System Science

"…projects that transcend disciplinary boundaries, are highly integrated and address questions broader in scope than those typically supported by the disciplinary programs…"

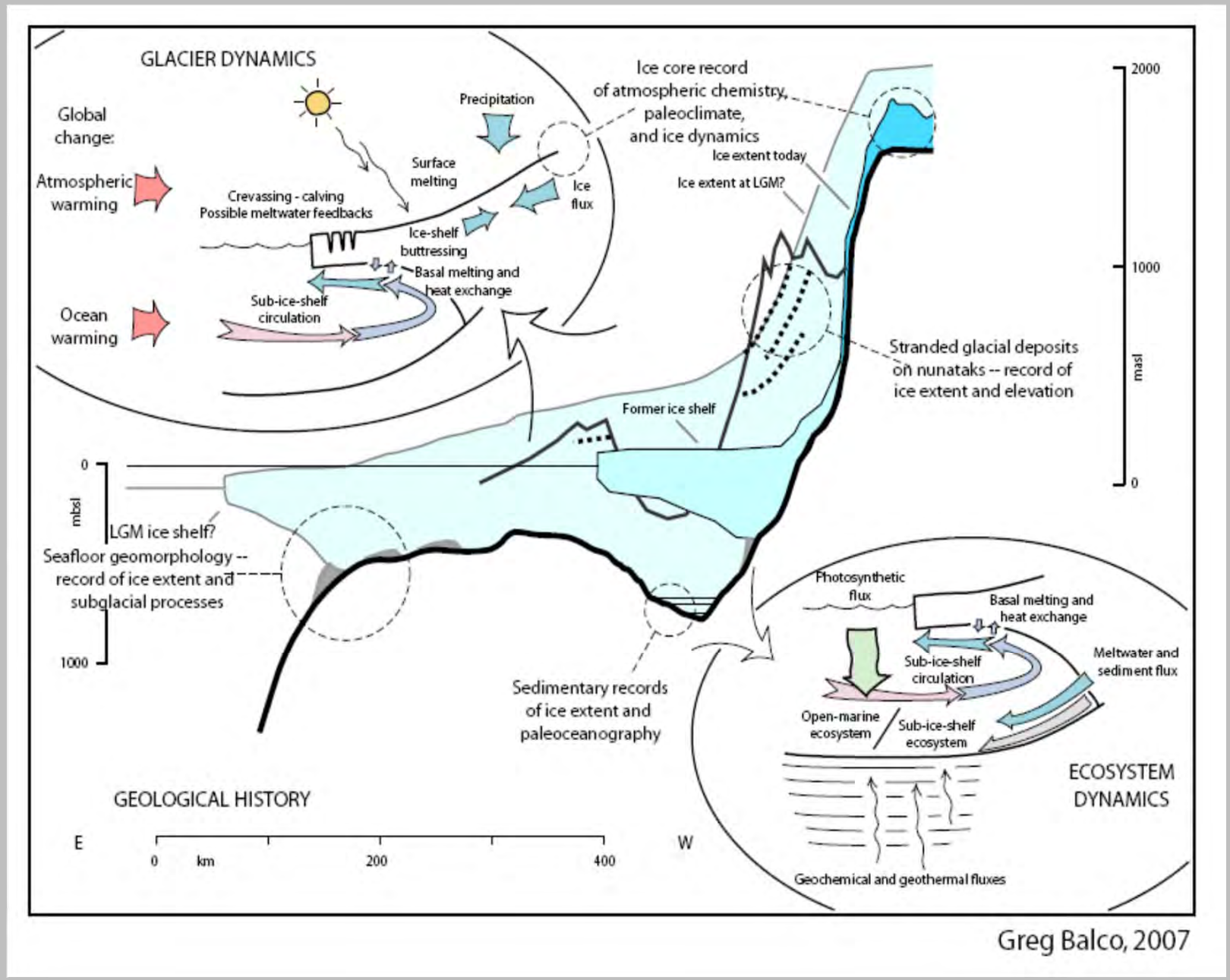
- **What is LARISSA?**
- **Why is it appropriately funded through AISS?**
- **What are some of the preliminary results?**


Robertson Island
1 March 1986
1
2
26 August 1993
Drygalski
4 July 1997
4
3
30 January 1995
6
5
31 January 1999
6 October 2000
7
24 February 2002
8
18 March 2002
9
21 July 2003
Larsen B
Jason Peninsula
© ESA, processing by IMGI

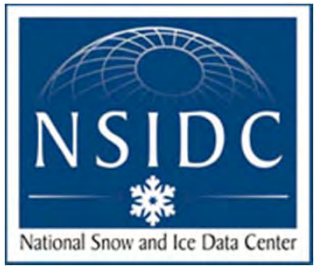
LARISSA: LARsen **I**ce **S**helf **S**ystem **A**ntarctica



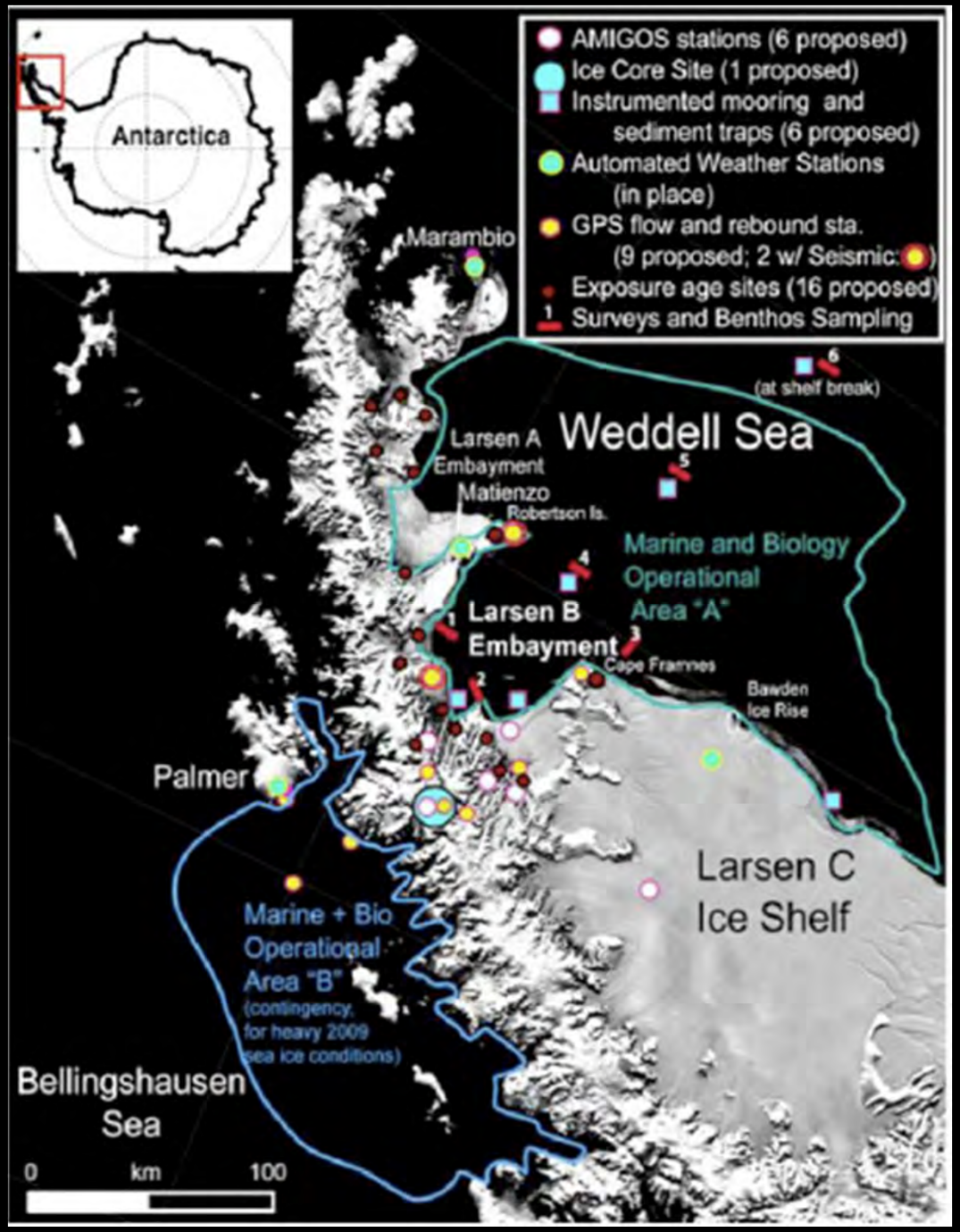
LARISSA: LARsen Ice Shelf System Antarctica

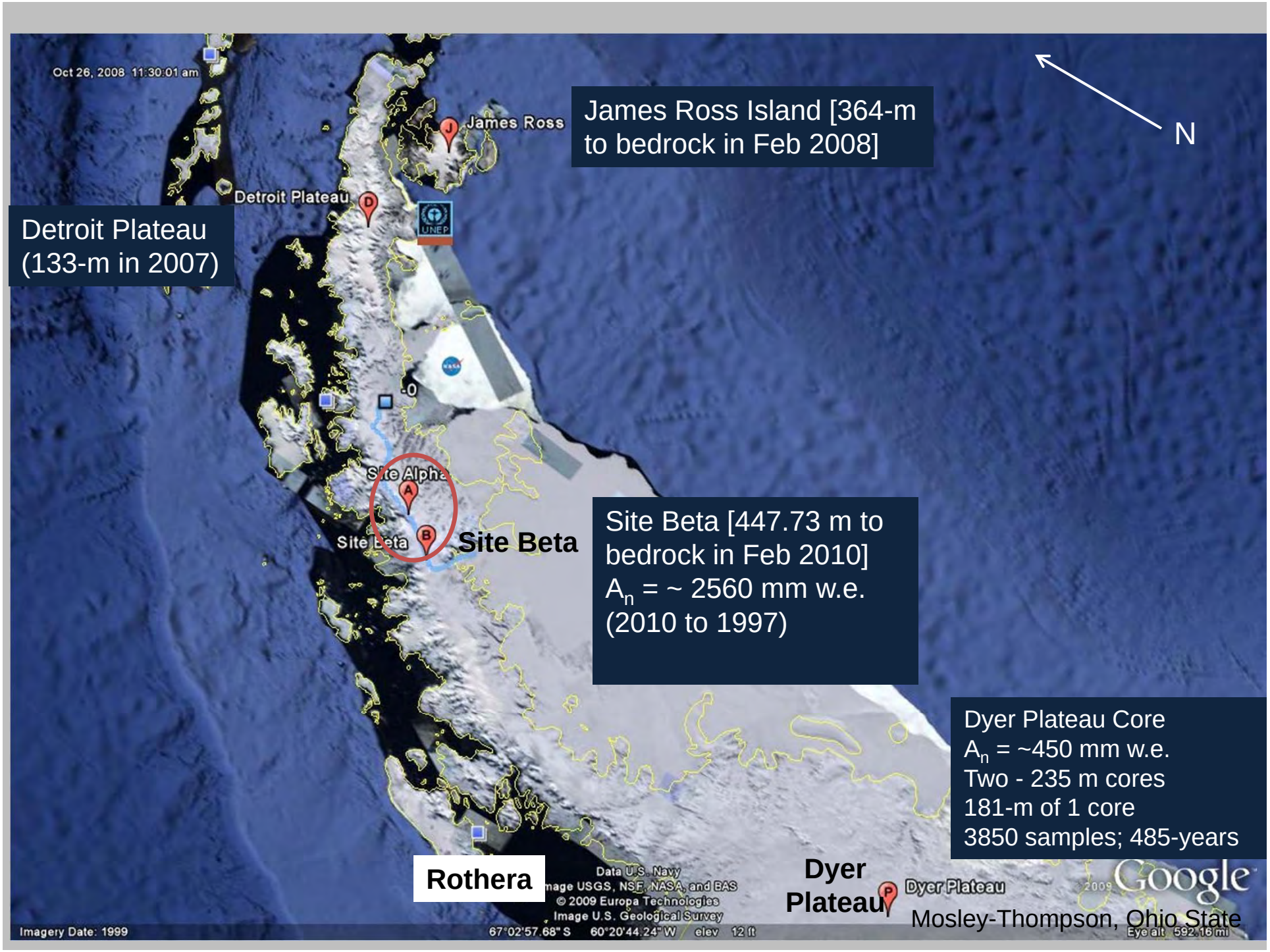


LARISSA: LARsen **I**ce **S**helf **S**ystem **A**ntarctica




Courtesy of Greg Balco
PALMER


Antarctica
AMIGOS stations (6 proposed)
Ice Core Site (1 proposed)
Instrumented mooring and sediment traps (6 proposed)
Automated Weather Stations (in place)
GPS flow and rebound sta. (9 proposed; 2 w/ Seismic:)
Exposure age sites (16 proposed)
Surveys and Benthos Sampling
Marambio
Weddell Sea
(at shelf break)
Larsen A Embayment
Matienzo
Robertson Is.
Marine and Biology Operational Area "A"
Larsen B Embayment
Cape Framnes
Bawden Ice Rise
Palmer
Larsen C Ice Shelf
Marine + Bio Operational Area "B" (contingency for heavy 2009 sea ice conditions)
Bellingshausen Sea
0
km
100

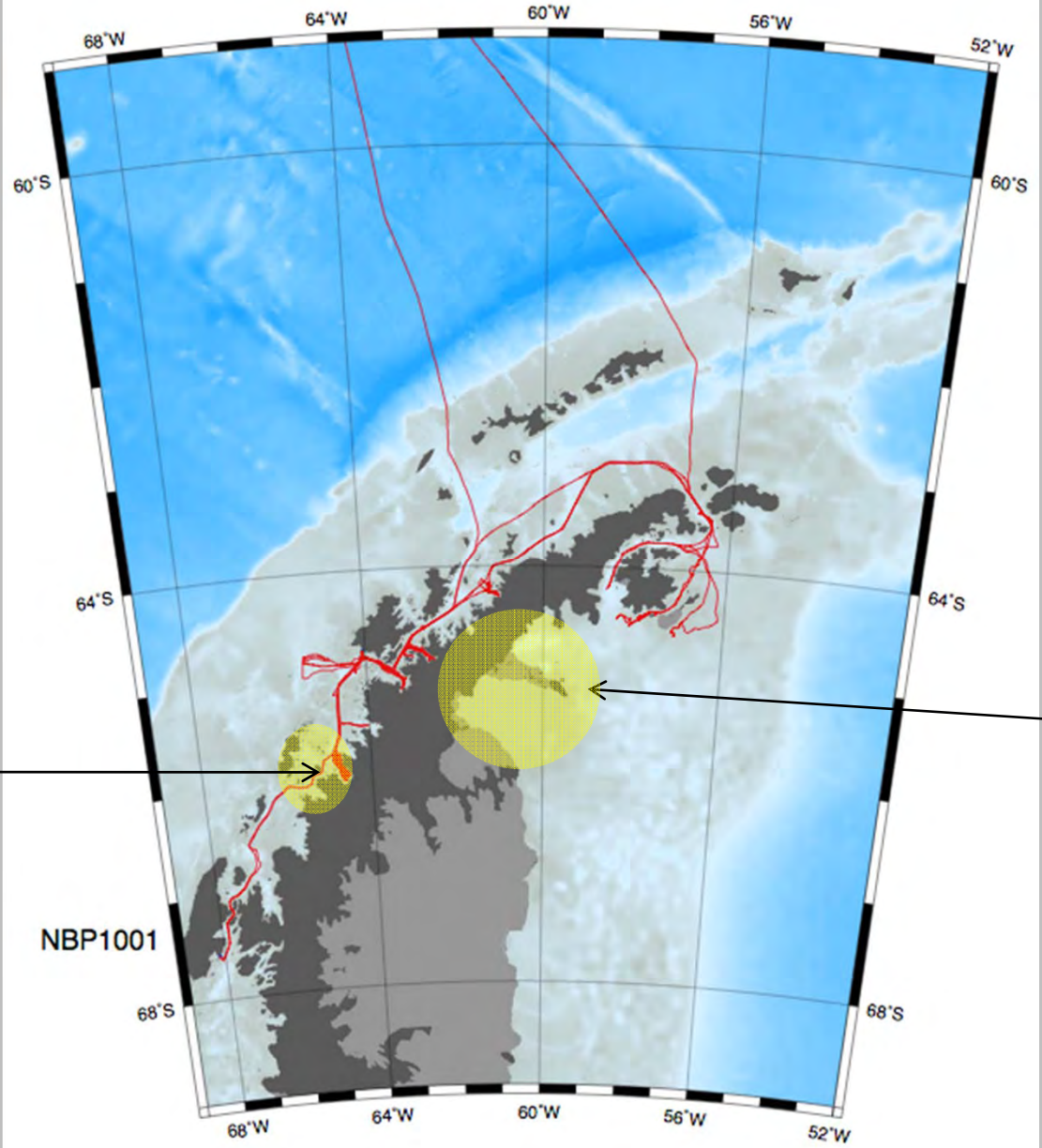

Oct 26, 2008 11:30:01 am
James Ross
James Ross Island [364-m to bedrock in Feb 2008]
N
Detroit Plateau
Detroit Plateau (133-m in 2007)
UNEP
Site Alpha
Site Beta
Site Beta [447.73 m to bedrock in Feb 2010]
A_n = ~ 2560 mm w.e. (2010 to 1997)
Dyer Plateau Core
A_n = ~450 mm w.e.
Two - 235 m cores
181-m of 1 core
3850 samples; 485-years
Rothera
Dyer Plateau
Dyer Plateau
Data U.S. Navy
Image USGS, NSF, NASA, and BAS
© 2009 Europa Technologies
Image U.S. Geological Survey
Google
Imagery Date: 1999
67°02'57.68" S 60°20'44.24" W elev 12 ft
Eye alt 592.16 mi
Mosley-Thompson, Ohio State

Site Beta

Courtesy of Mike Clark

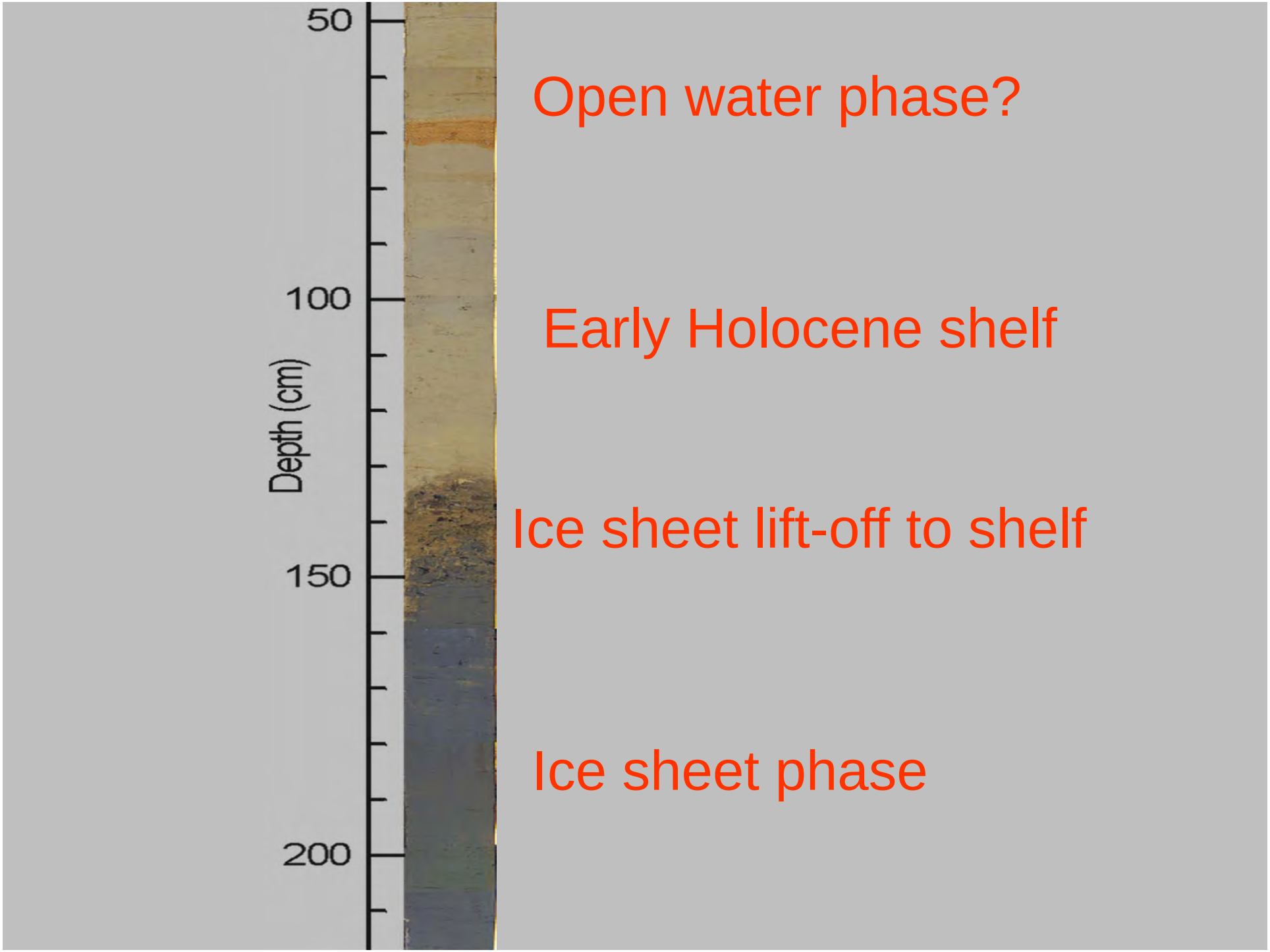
Courtesy of Mike Clark

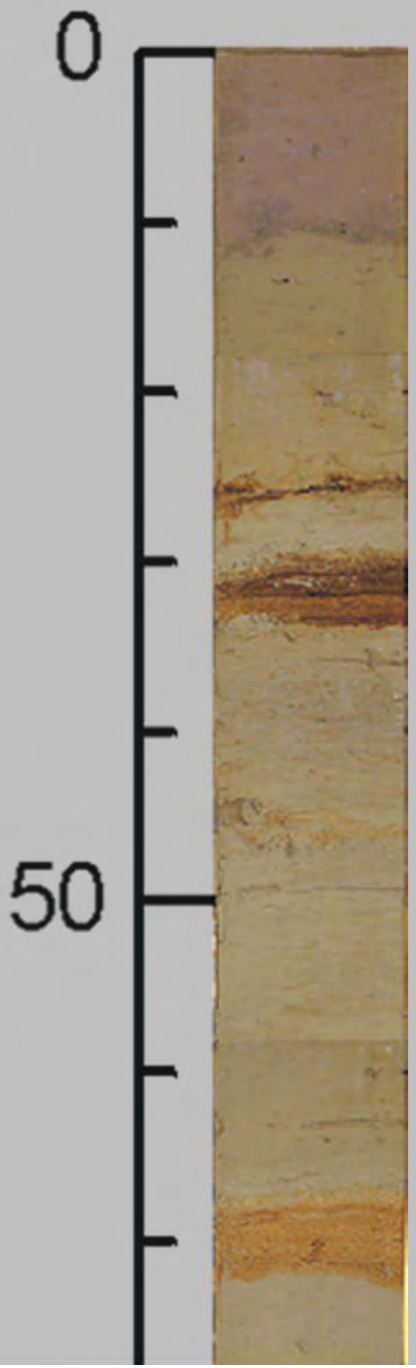
NBP1001



Barilari Bay

LIS A and LIS B

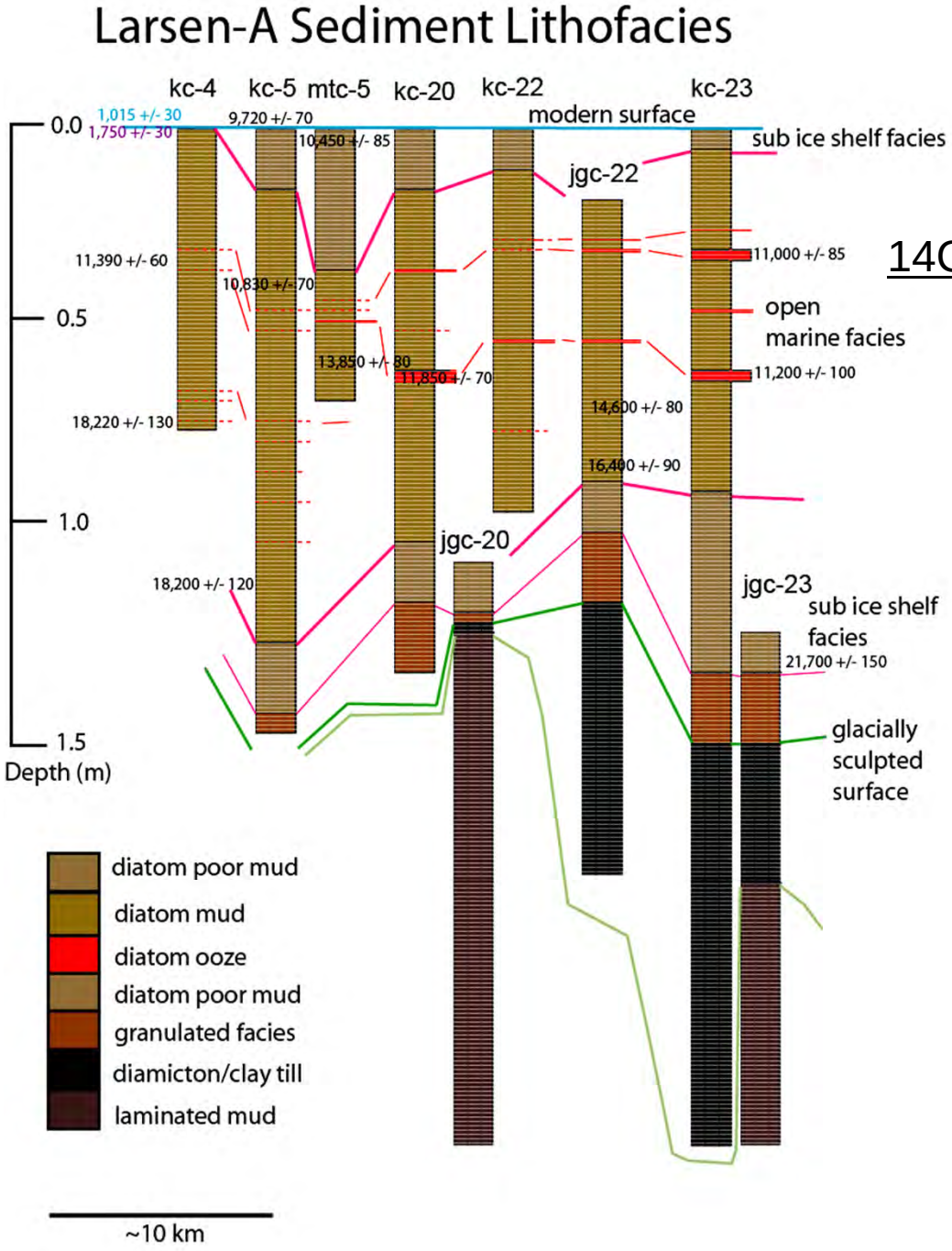

50
100
150
200
Depth (cm)
Open water phase?
Early Holocene shelf
Ice sheet lift-off to shelf
Ice sheet phase



} LIA ice shelf reformation

Corethron layers

Holocene open water?

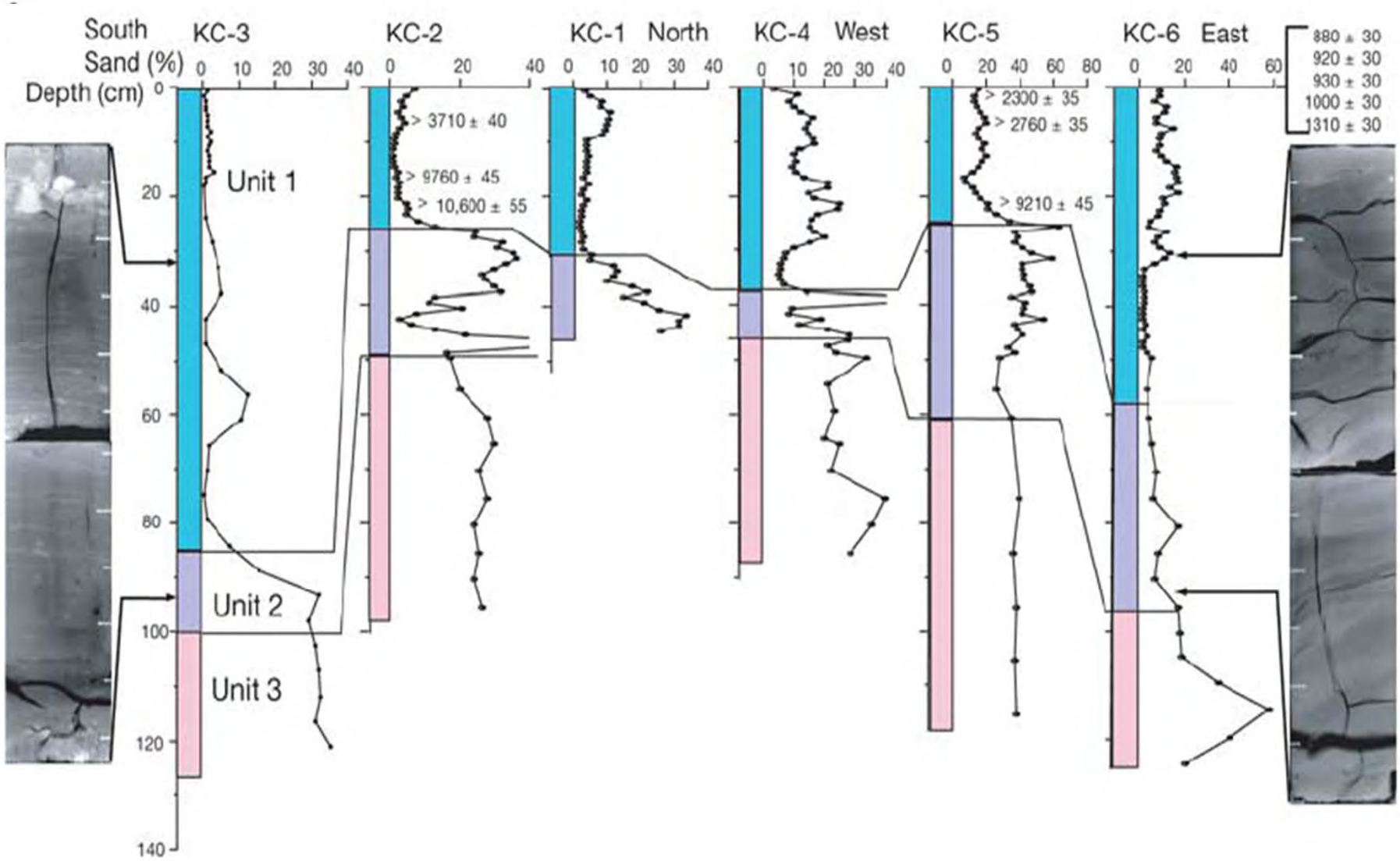


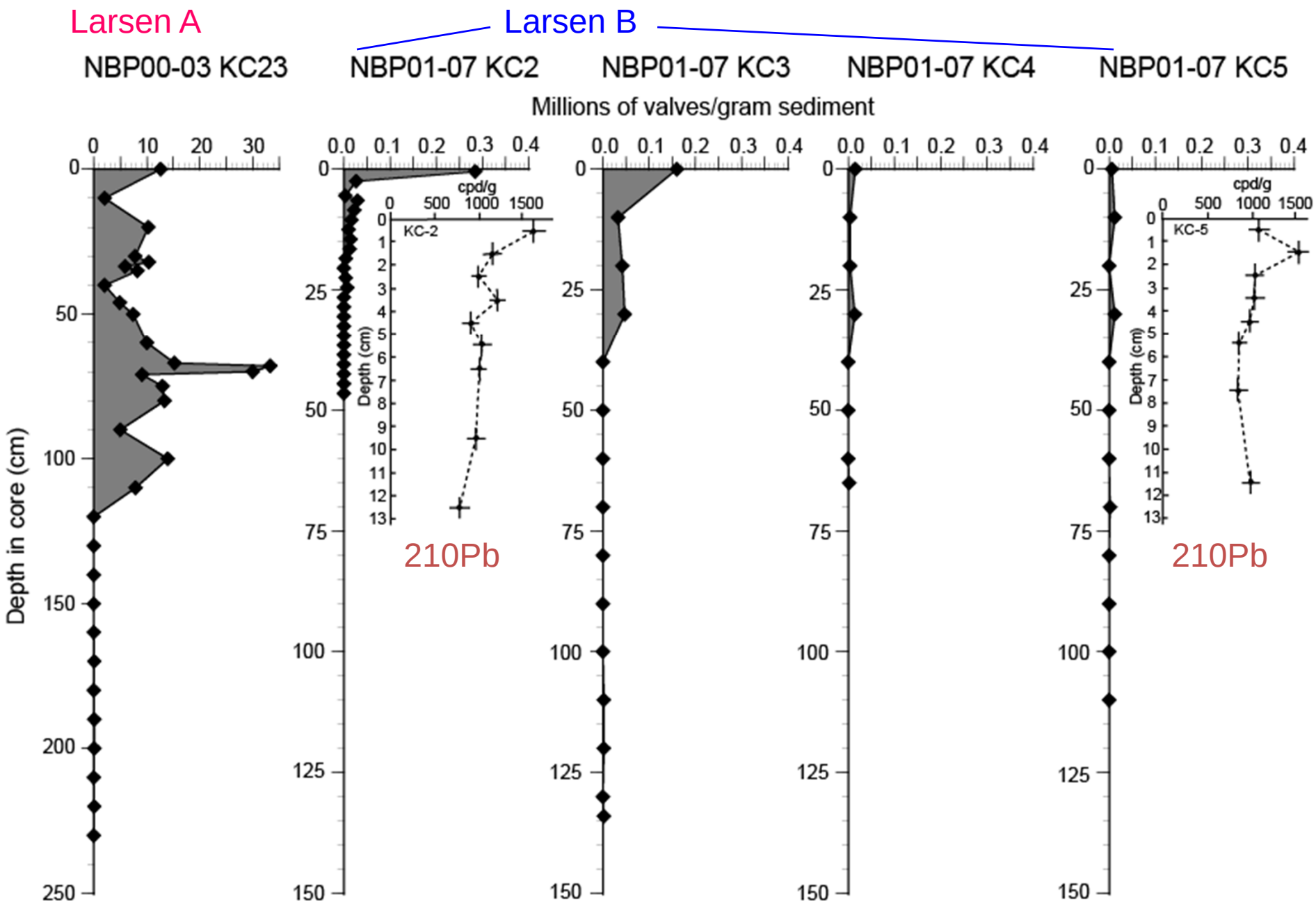
14C Chronology Problems

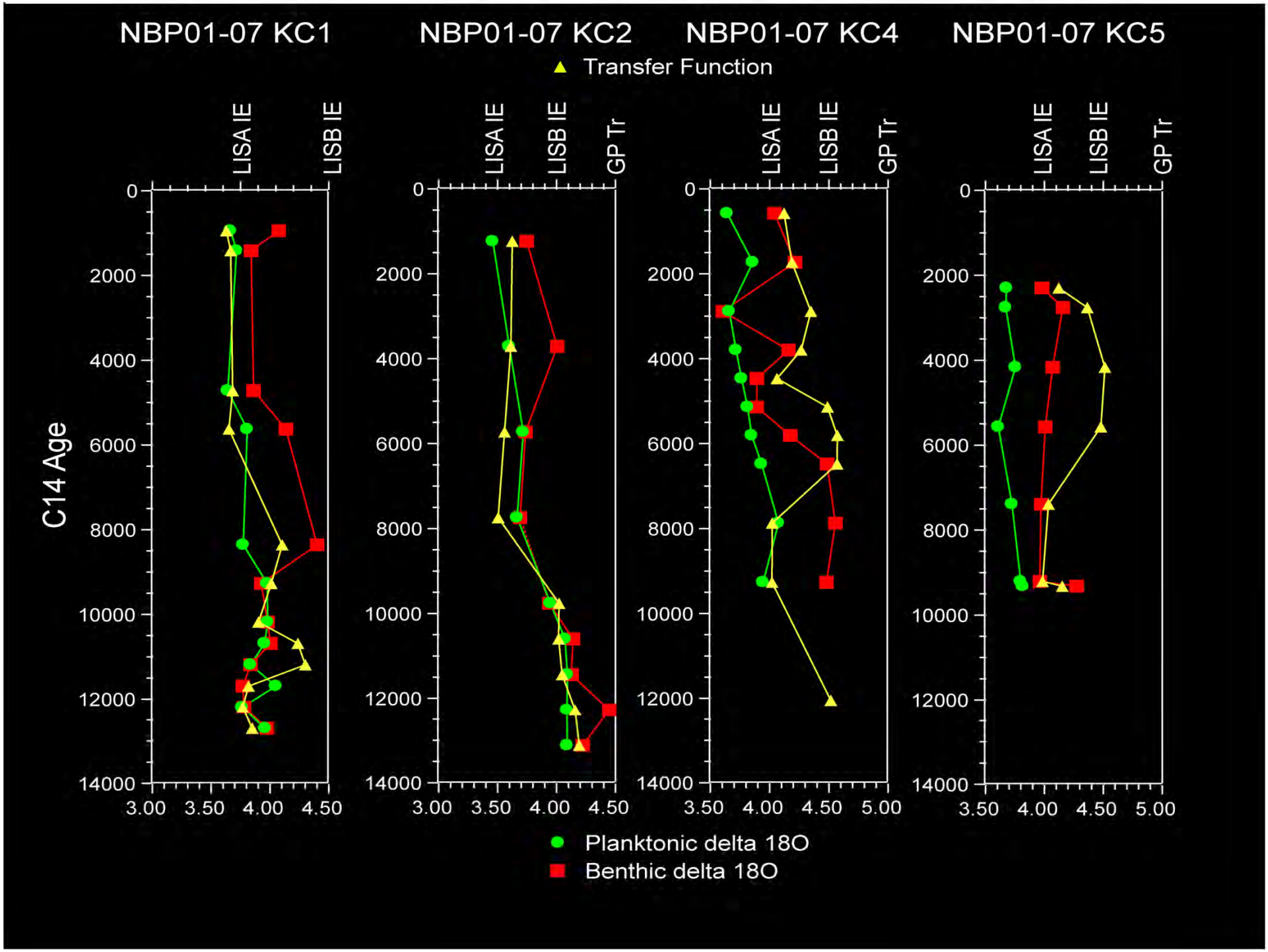
-concentrate upon calcite fractions

-improve organic matter dating

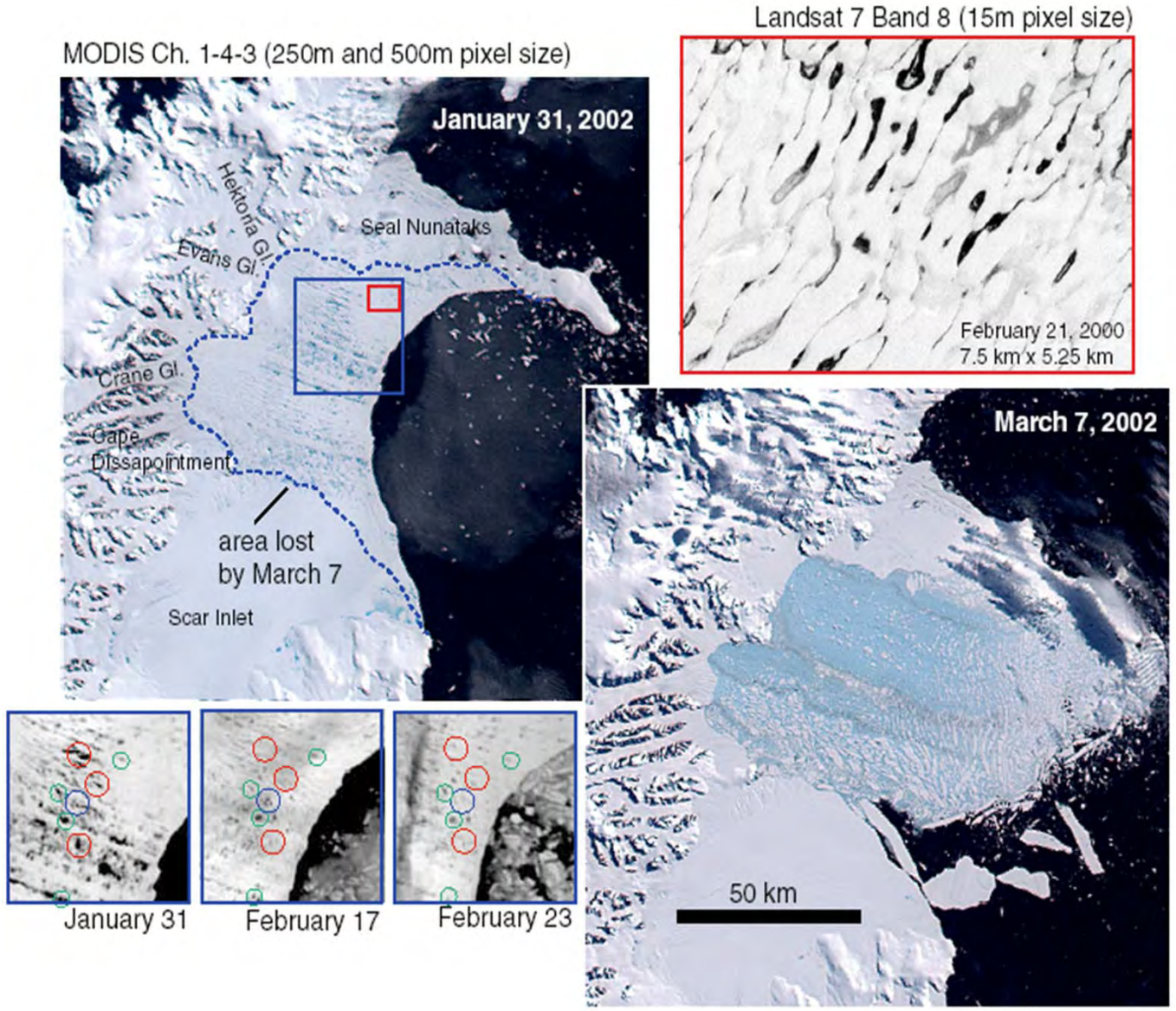
-utilize independent methods


South
Sand (%)
Depth (cm)
KC-3
KC-2
KC-1
North
KC-4
West
KC-5
KC-6
East
0 10 20 30 40
0 20 40
0 10 20 30 40
0 10 20 30 40
0 20 40 60 80
0 20 40 60
> 3710 ± 40
> 9760 ± 45
> 10,600 ± 55
> 2300 ± 35
> 2760 ± 35
> 9210 ± 45
880 ± 30
920 ± 30
930 ± 30
1000 ± 30
1310 ± 30
Unit 1
Unit 2
Unit 3
0
20
40
60
80
100
120
140


Larsen A
Larsen B
NBP00-03 KC23
NBP01-07 KC2
NBP01-07 KC3
NBP01-07 KC4
NBP01-07 KC5
Millions of valves/gram sediment
Depth in core (cm)
cpd/g
KC-2
KC-5
Depth (cm)
210Pb
210Pb


NBP01-07 KC1
NBP01-07 KC2
NBP01-07 KC4
NBP01-07 KC5
Transfer Function
LISA IE
LISB IE
GP Tr
C14 Age
0
2000
4000
6000
8000
10000
12000
14000
3.00
3.50
4.00
4.50
5.00
Planktonic delta 18O
Benthic delta 18O

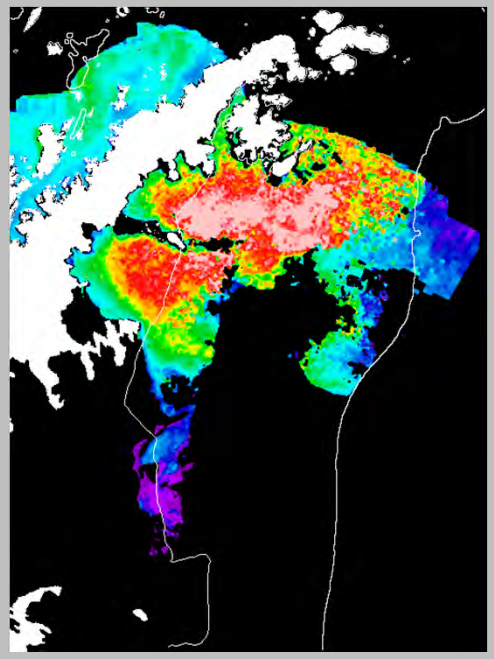
The Larsen-B Event

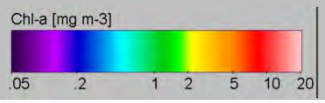


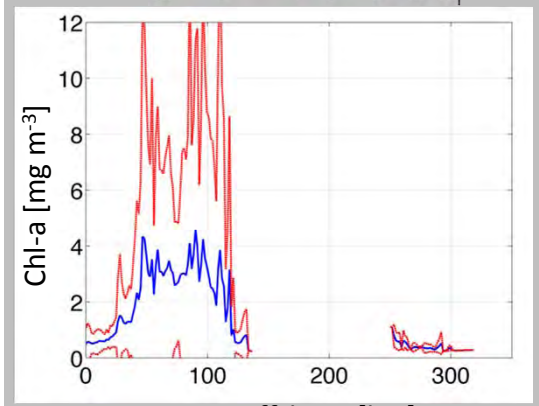
from Scambos et al., (2003)

Phytoplankton dynamics in the Larsen B embayment

Chla 2002-2010

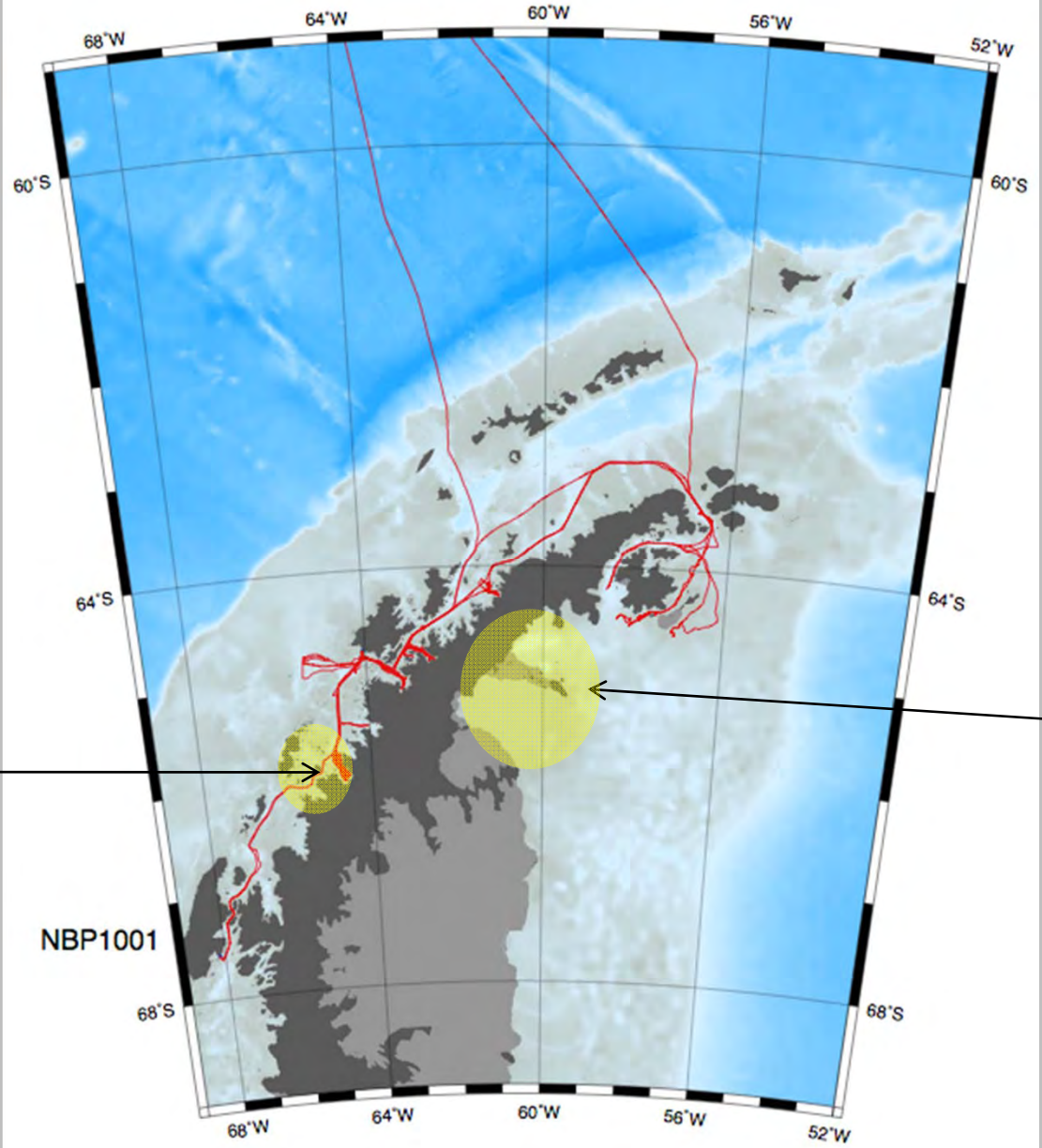






- Phytoplankton gradients appear different from those observed along WAP
- Similar to other glacier and ice shelf influenced regions (Alderkamp, Yager)
- Changes in physical forcing
  - Ocean circulation
  - Climate (winds, temp)
  - Glacial / sediment input
- Gradients may have large impact on pelagic –benthic coupling, evolution of benthic communities

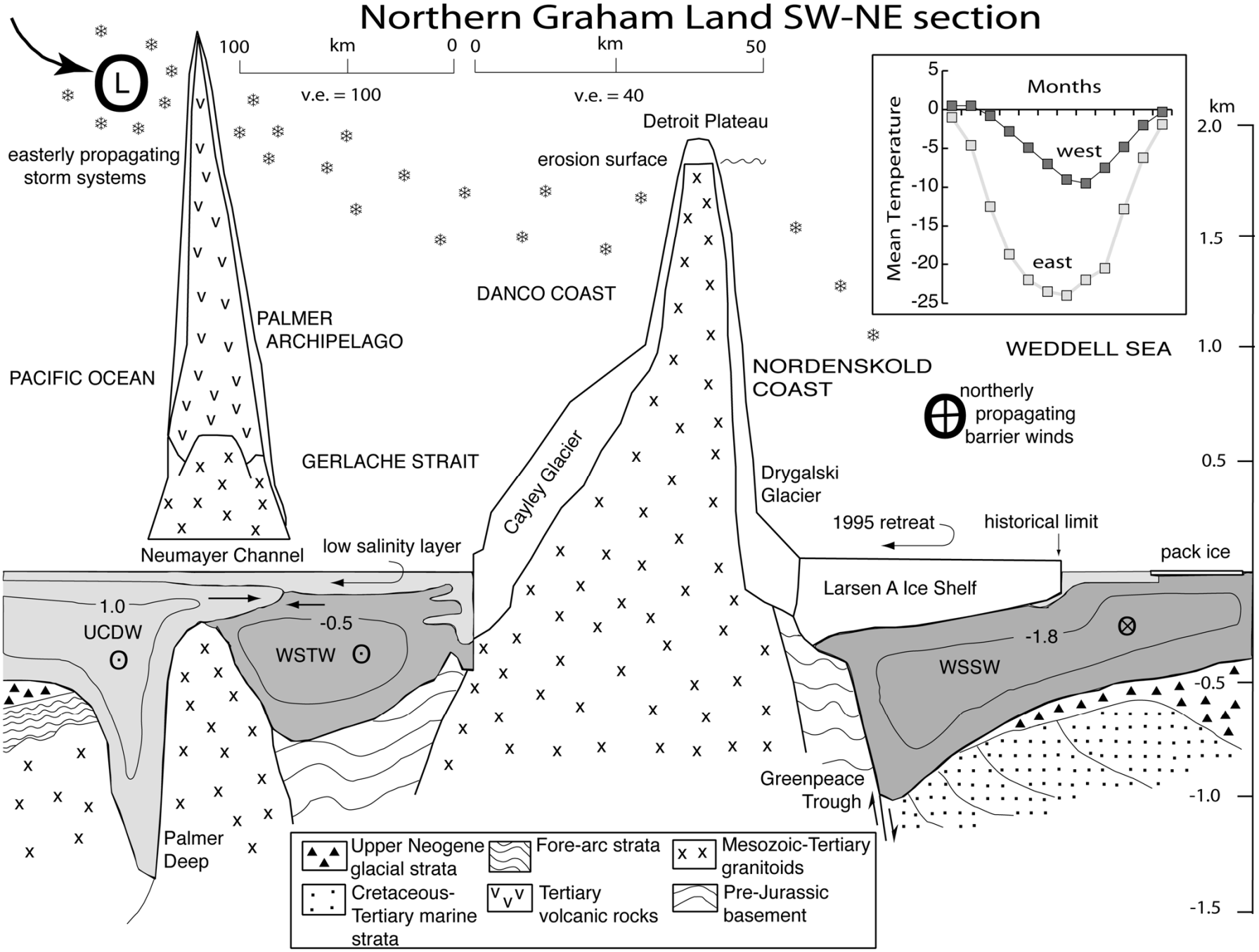
NBP1001

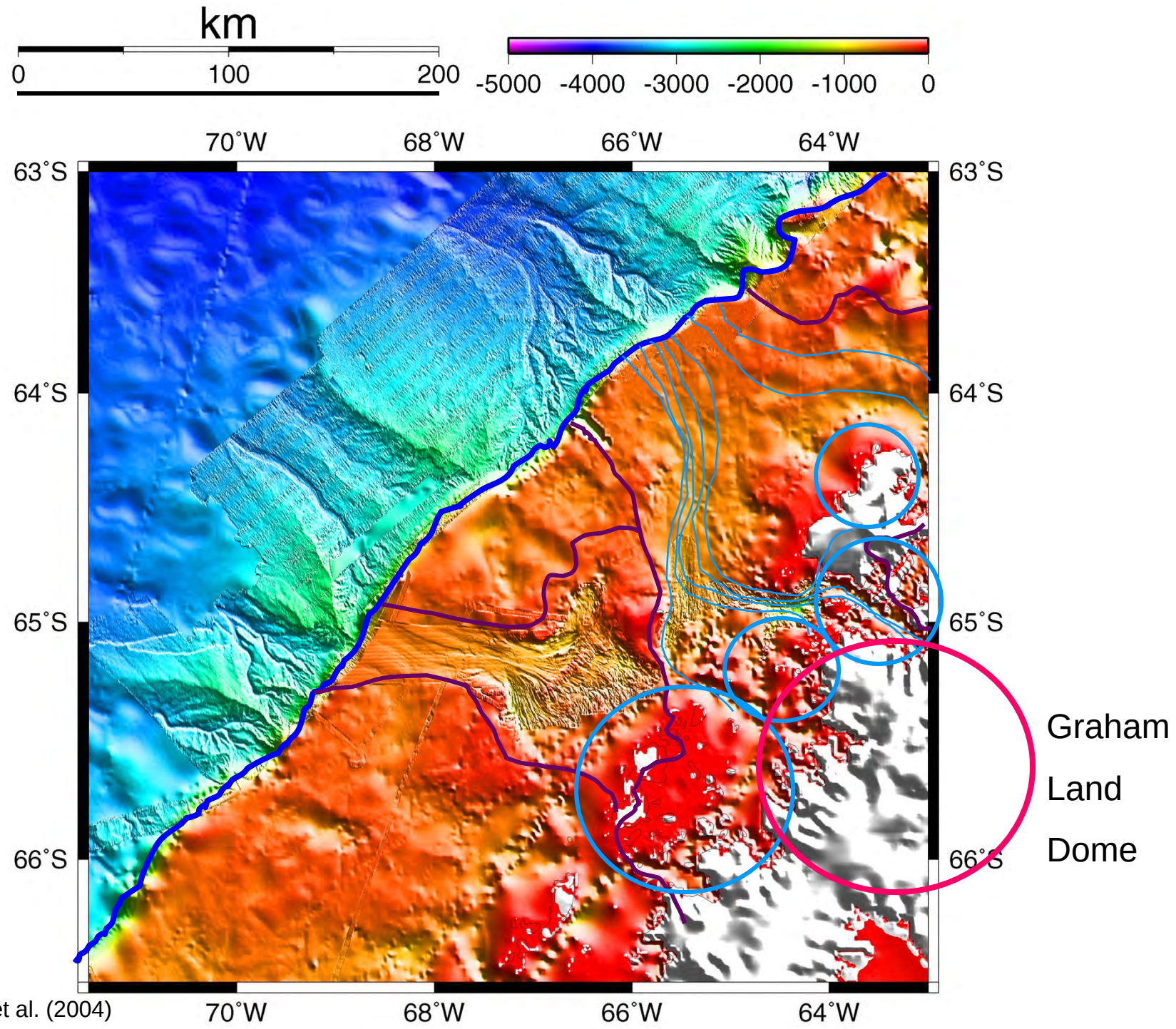


Barilari Bay

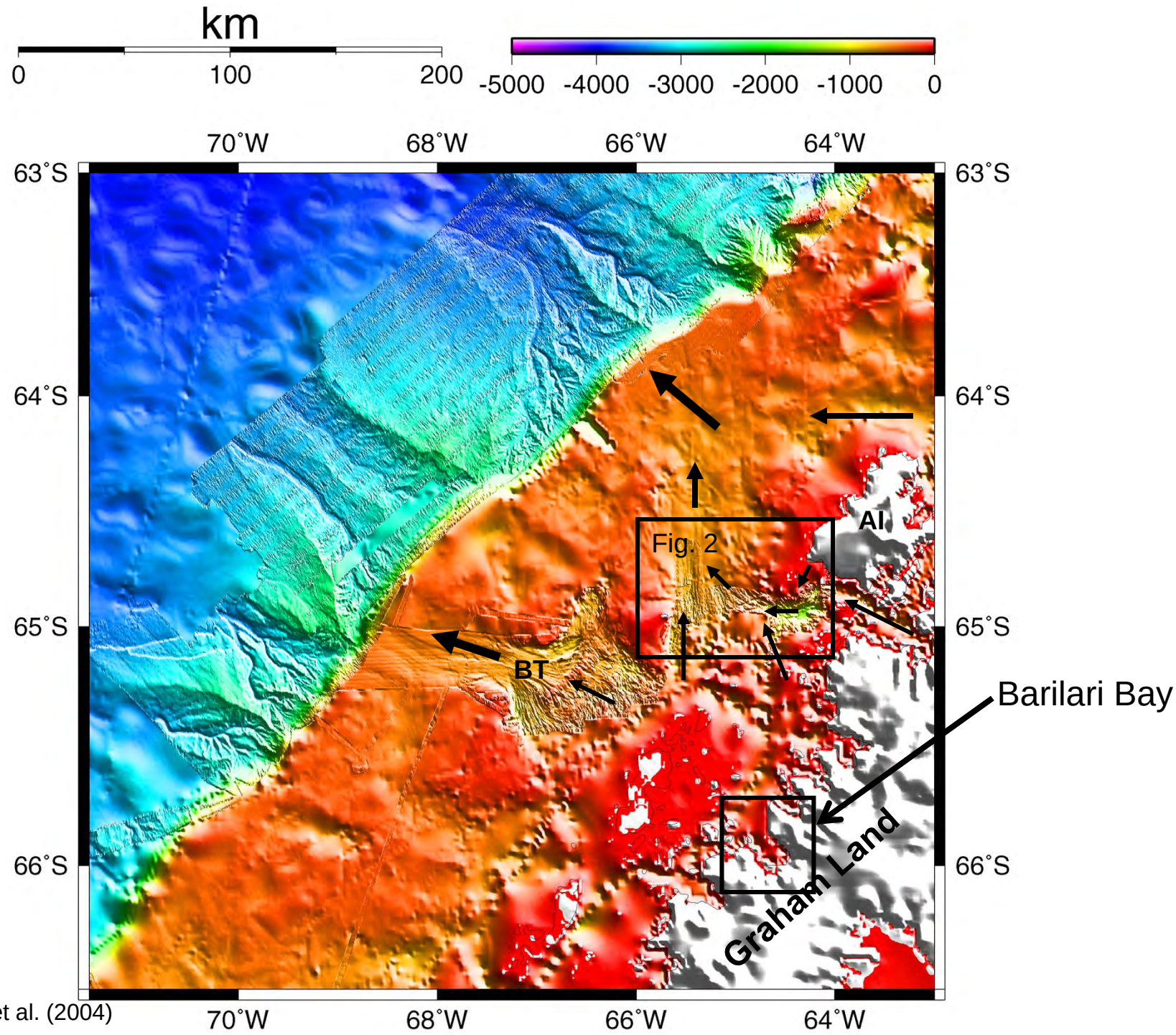
LIS A and LIS B

…. some underway data…

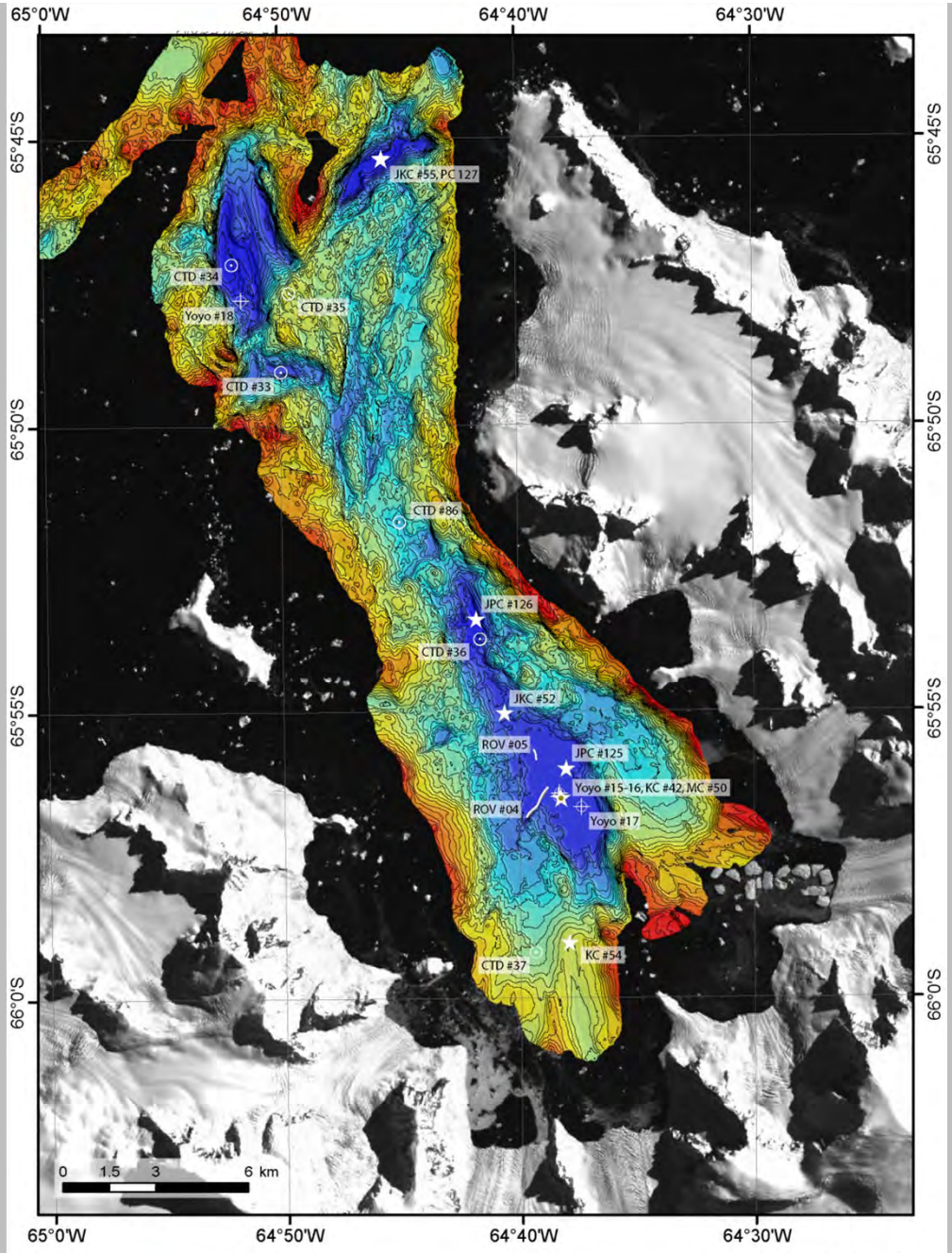

Northern Graham Land SW-NE section
100
km
0
0
km
50
v.e. = 100
v.e. = 40
easterly propagating
storm systems
Detroit Plateau
erosion surface
DANCO COAST
PALMER
ARCHIPELAGO
PACIFIC OCEAN
NORDENSKOLD
COAST
WEDDELL SEA
northerly
propagating
barrier winds
GERLACHE STRAIT
Cayley Glacier
Drygalski
Glacier
1995 retreat
historical limit
pack ice
Neumayer Channel
low salinity layer
Larsen A Ice Shelf
1.0
UCDW
-0.5
WSTW
-1.8
WSSW
Greenpeace
Trough
Palmer
Deep
Mean Temperature
Months
west
east
5
0
-5
-10
-15
-20
-25
km
2.0
1.5
1.0
0.5
-0.5
-1.0
-1.5
Upper Neogene
glacial strata
Fore-arc strata
Mesozoic-Tertiary
granitoids
Cretaceous-
Tertiary marine
strata
Tertiary
volcanic rocks
Pre-Jurassic
basement



from Domack et al. (2004)



from Domack et al. (2004)



Depth (m)

-90 -380 -670

Contour Interval: 20m

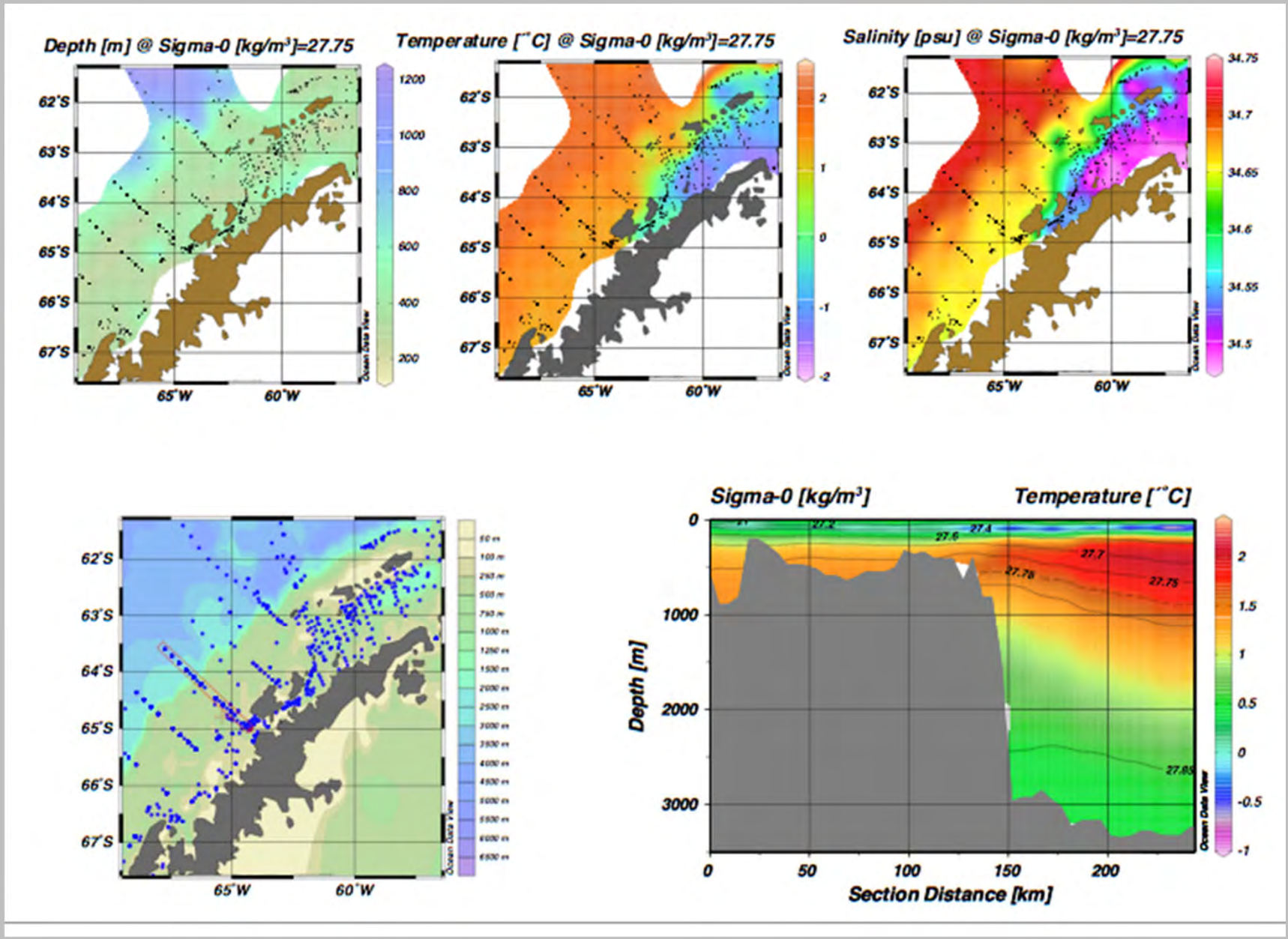
Multibeam data: NBP1001

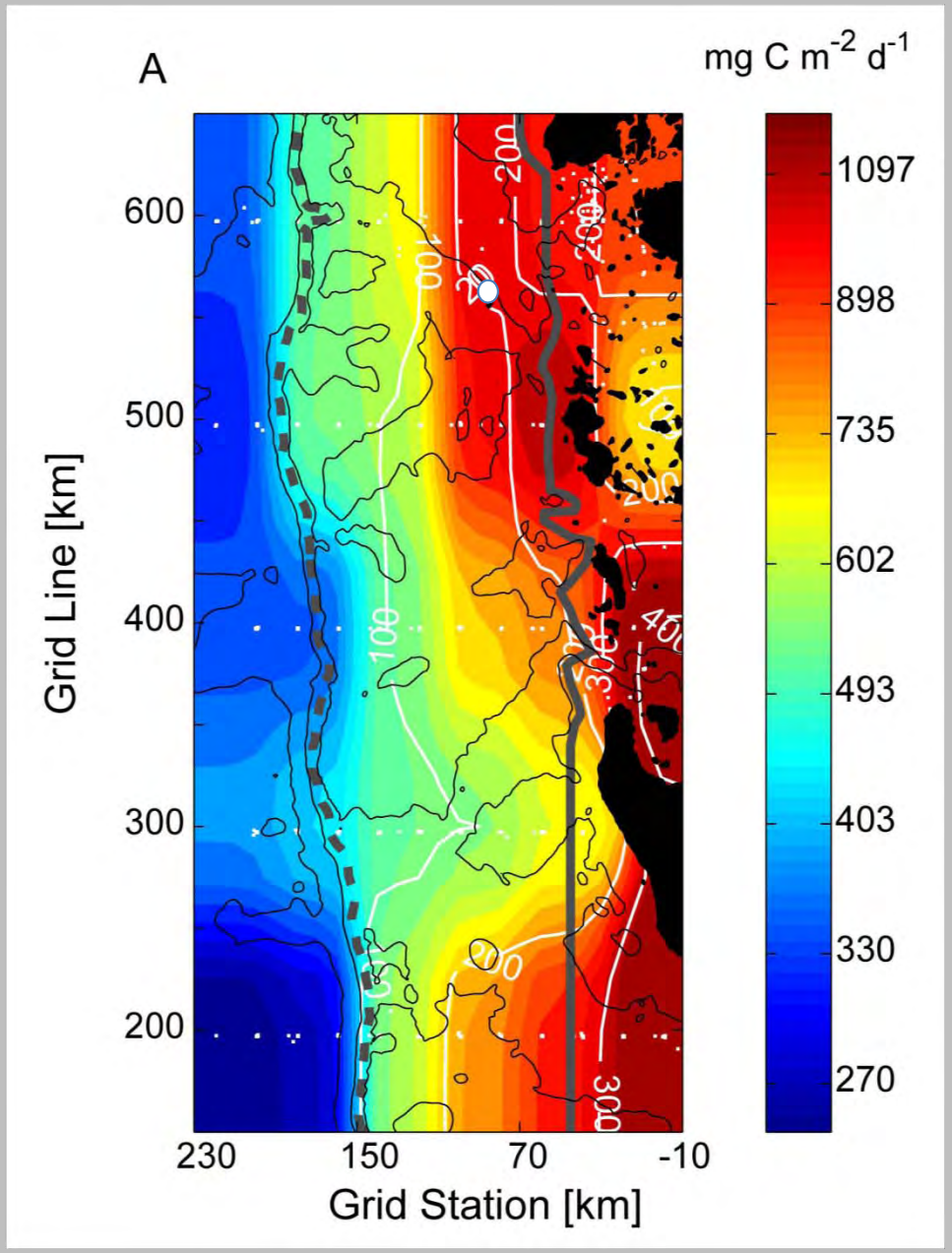
Grid Resolution: 20m

Landsat Scenes, Spatial Resolution: 30m

www.lima.usga.gov

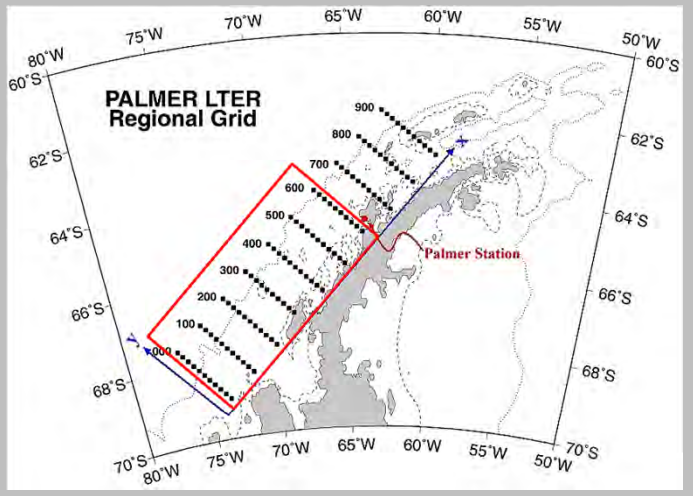
Physical Oceanography - Modern context of paleo perspective





Upper Ocean Biology

Modern context from which to interpret sedimentary record

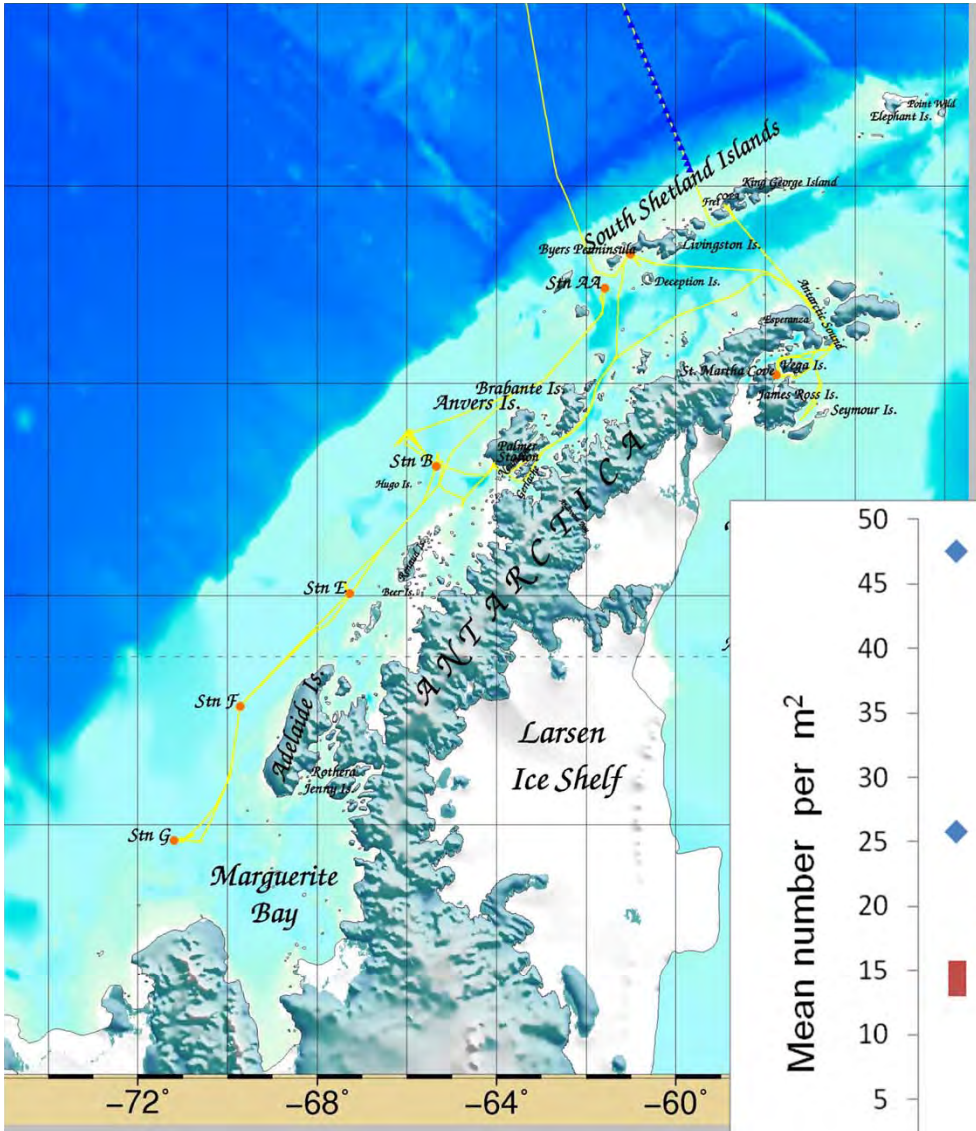


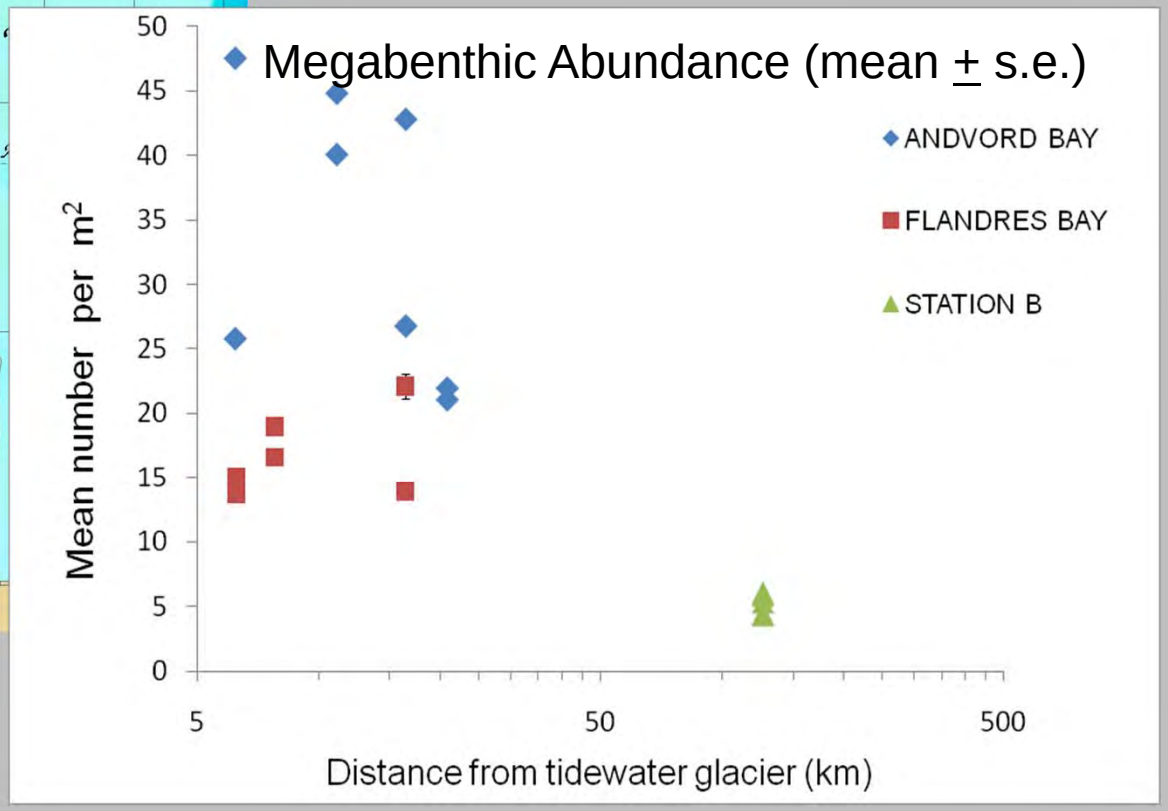
http://pal.lternet.edu/sci-research/sampling-grid/grid_regional.jpg

Vernet et al. 2008 Deep Sea Research: Average primary production in January on the western AP

Benthic Biology

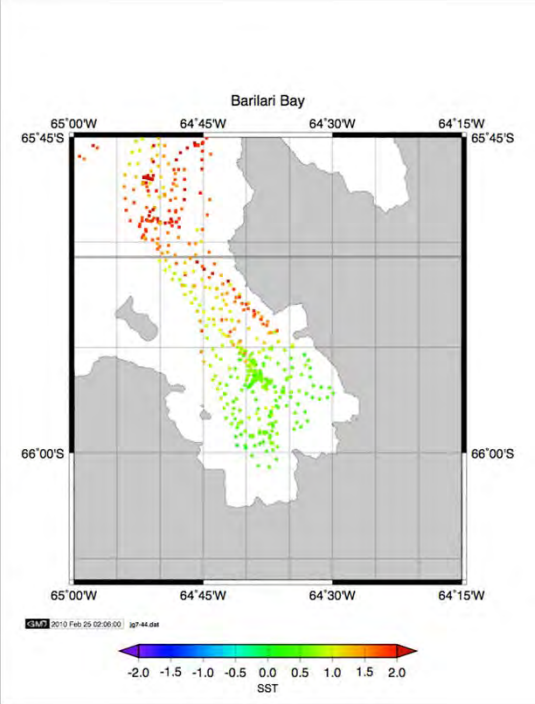
Modern context from which to interpret sedimentary record

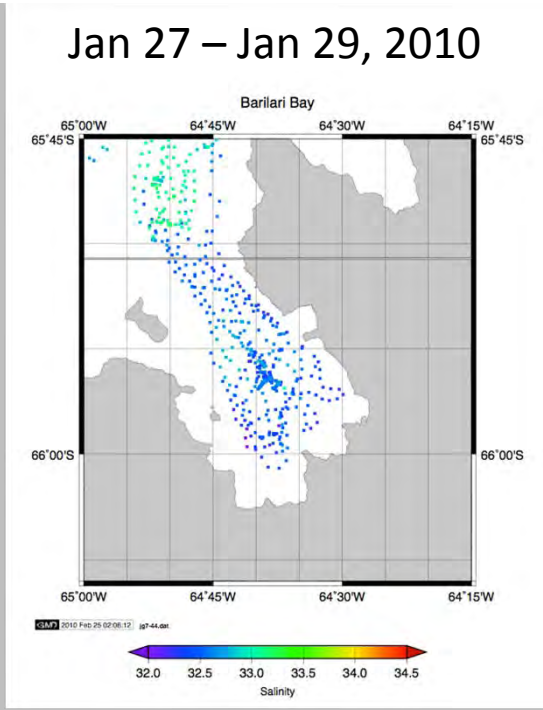


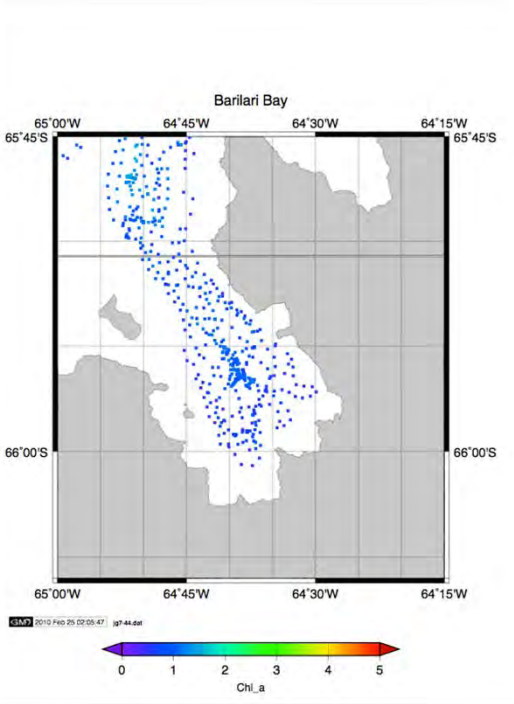


Smith, Grange and Clark, 12th Deep-Sea Biology Symposium, Reykjavik, June 2010

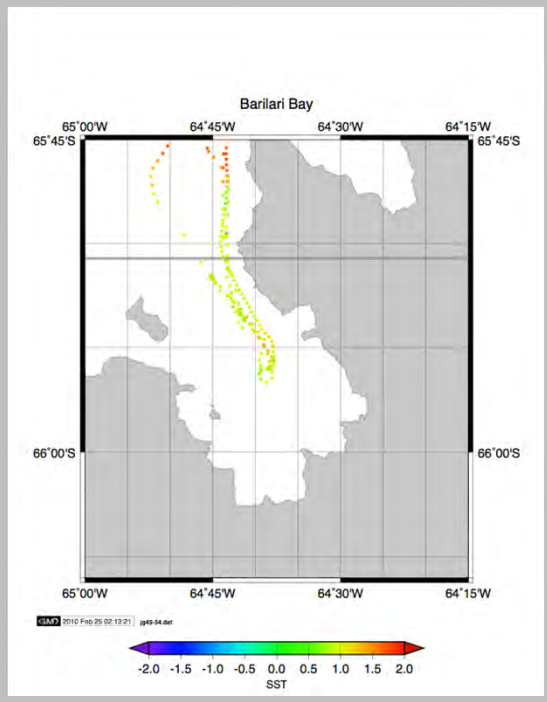
Jan 27 – Jan 29, 2010

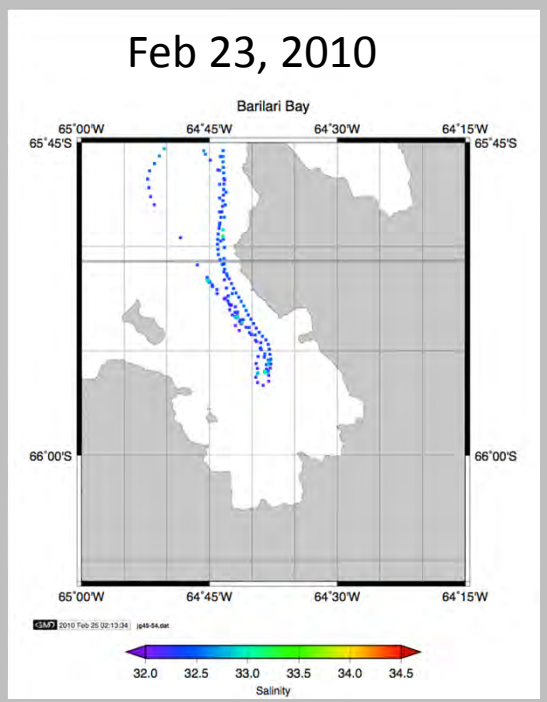


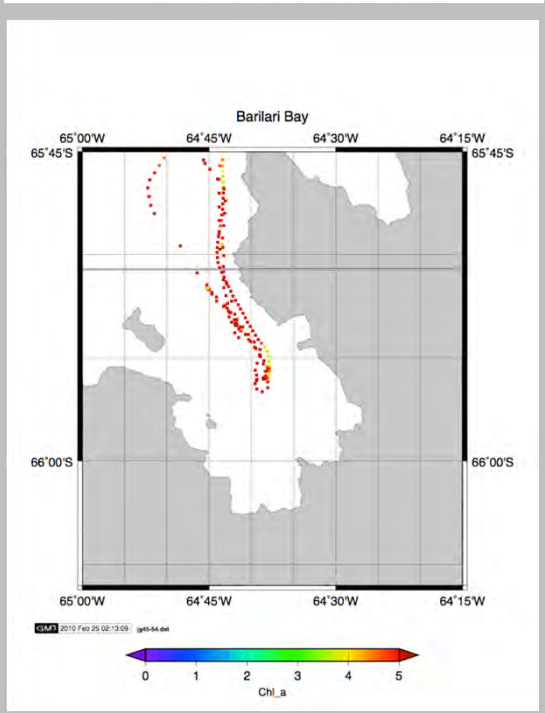


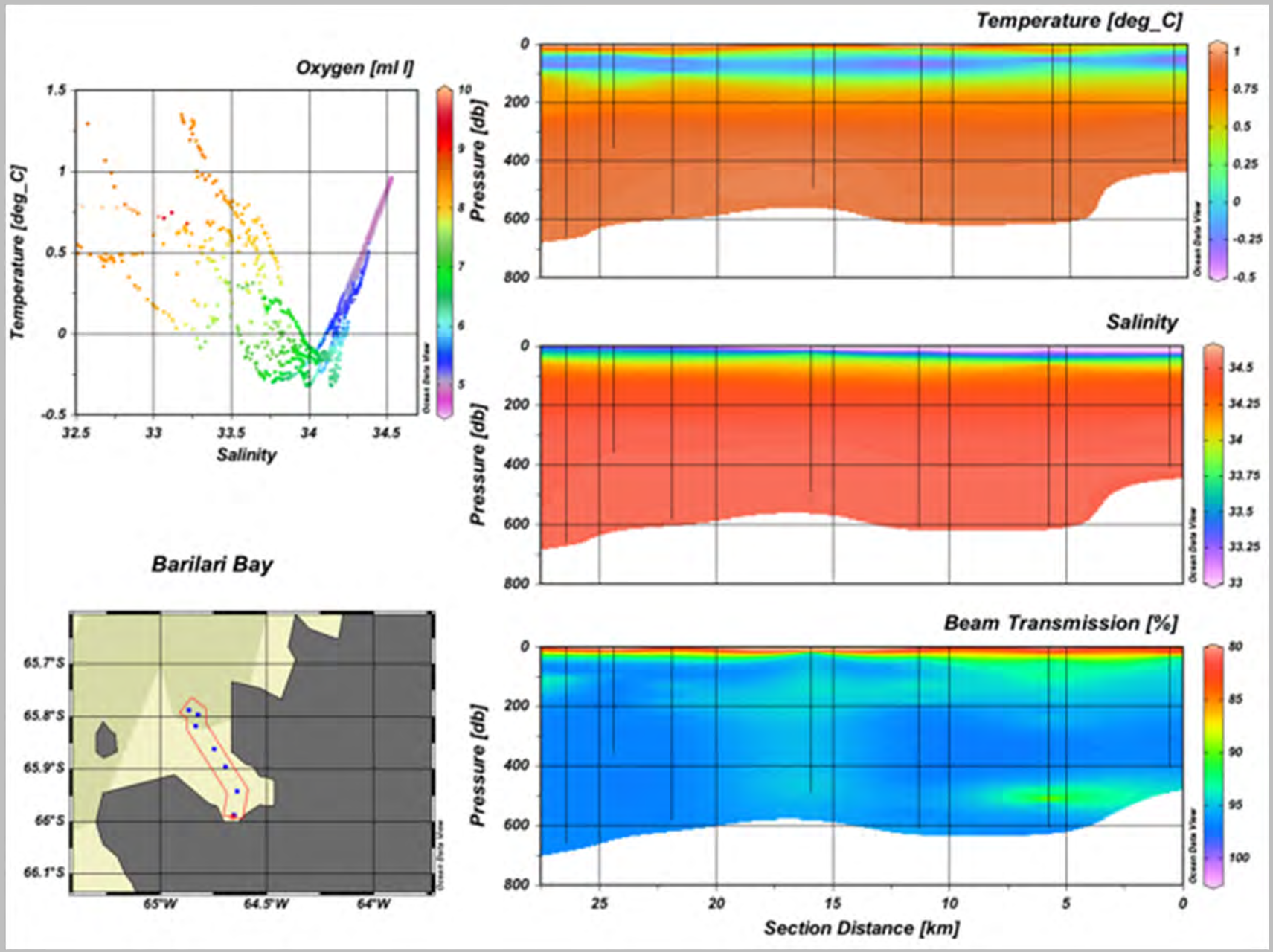


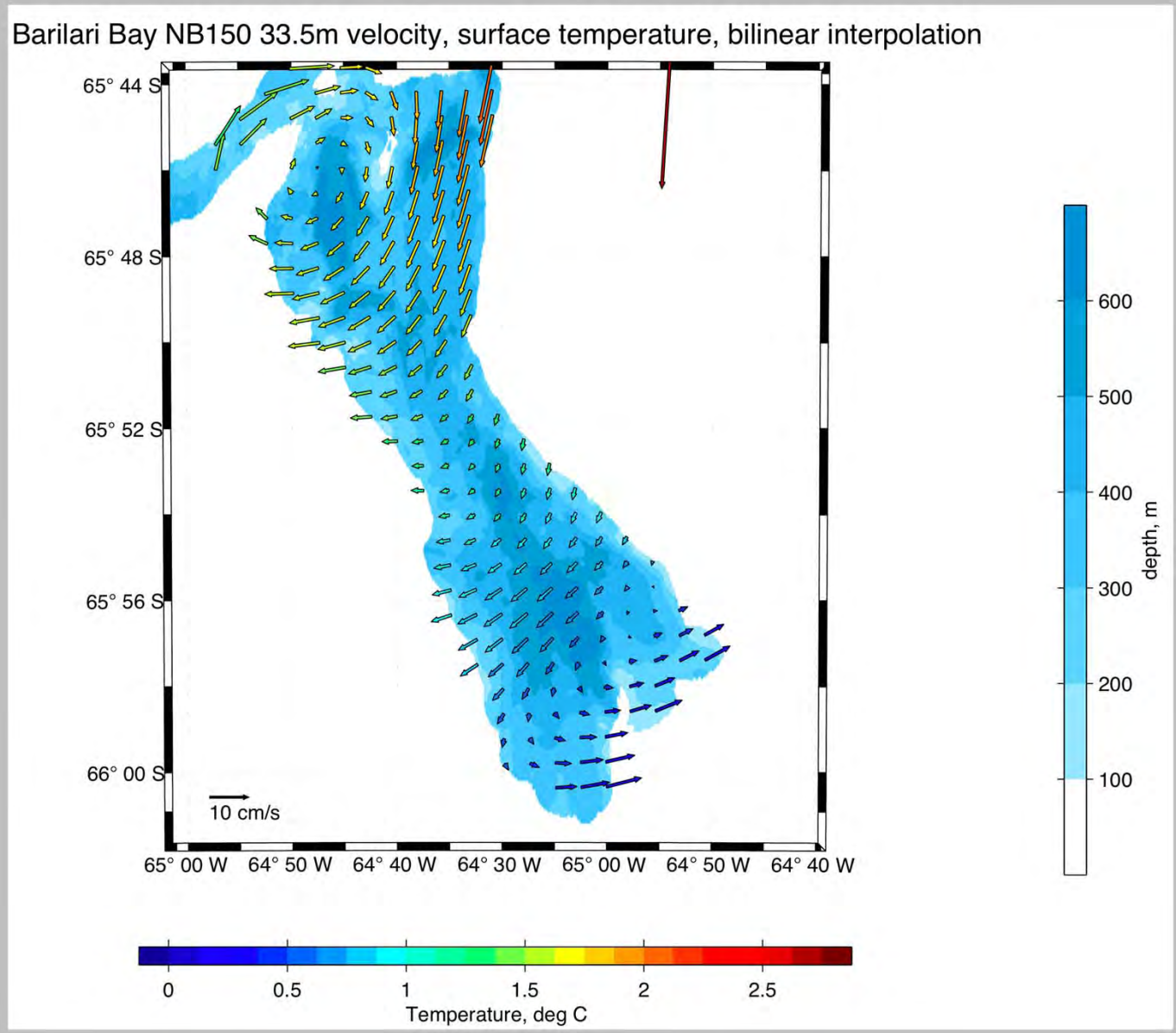
Feb 23, 2010

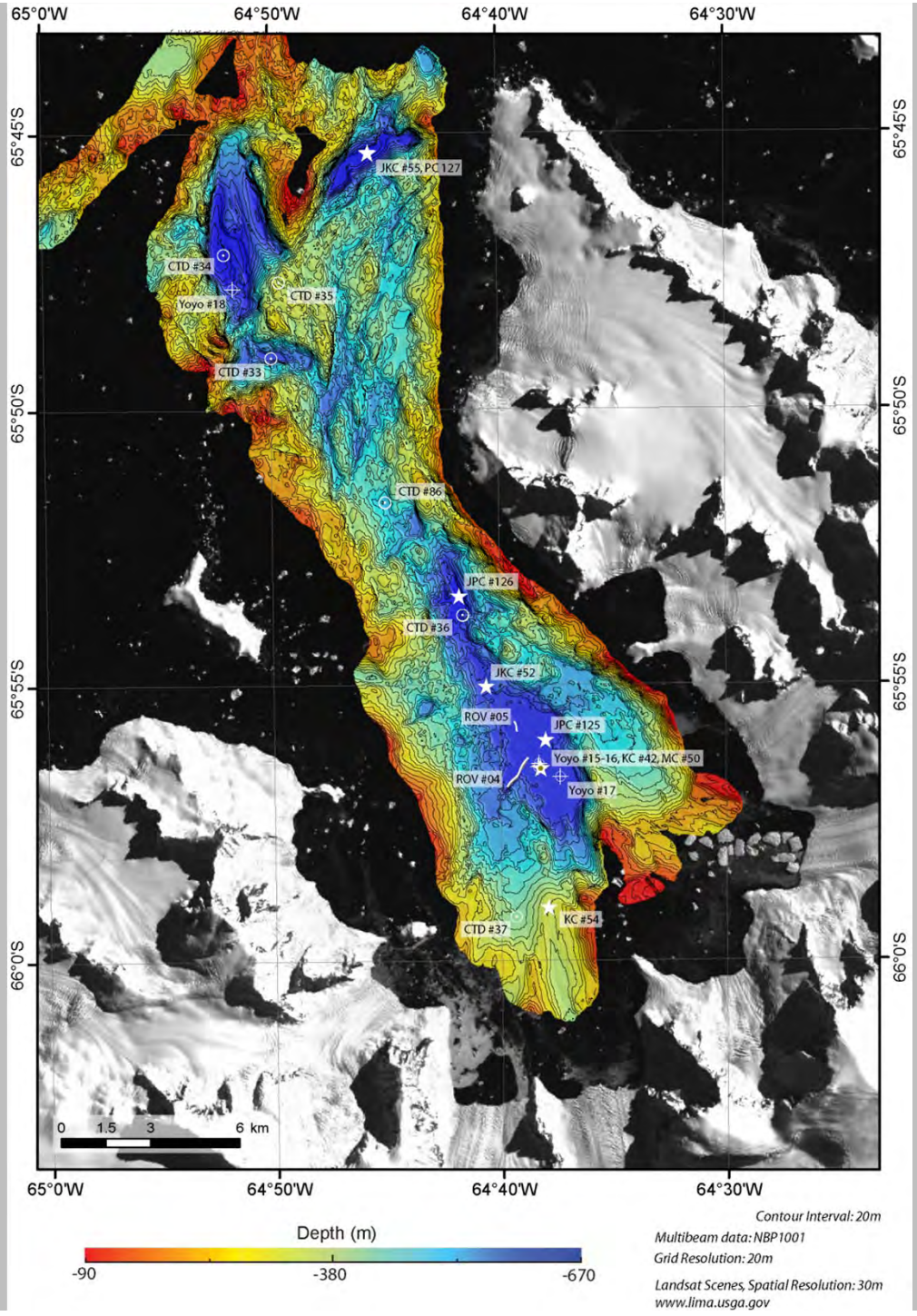







Oxygen [ml l]
Temperature [deg_C]
Salinity
Pressure [db]
Temperature [deg_C]
Salinity
Barilari Bay
Beam Transmission [%]
Section Distance [km]
65.7°S
65.8°S
65.9°S
66°S
66.1°S
65°W
64.5°W
64°W
Ocean Data View


Barilari Bay NB150 33.5m velocity, surface temperature, bilinear interpolation
65° 44 S
65° 48 S
65° 52 S
65° 56 S
66° 00 S
10 cm/s
65° 00 W
64° 50 W
64° 40 W
64° 30 W
65° 00 W
64° 50 W
64° 40 W
600
500
400
300
200
100
depth, m
0
0.5
1
1.5
2
2.5
Temperature, deg C



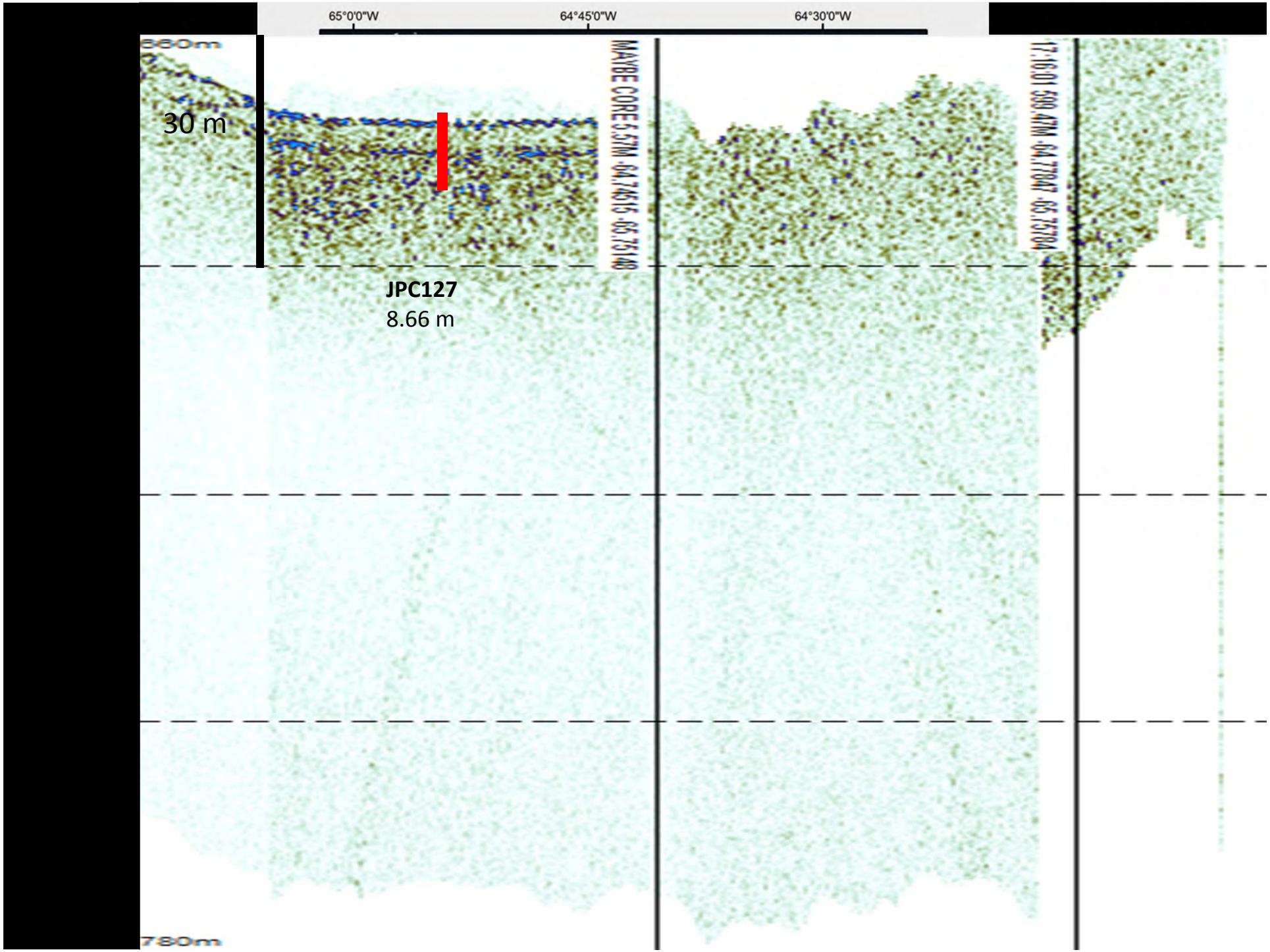
Accomplishments

Swath mapping
Sub-bottom profiling

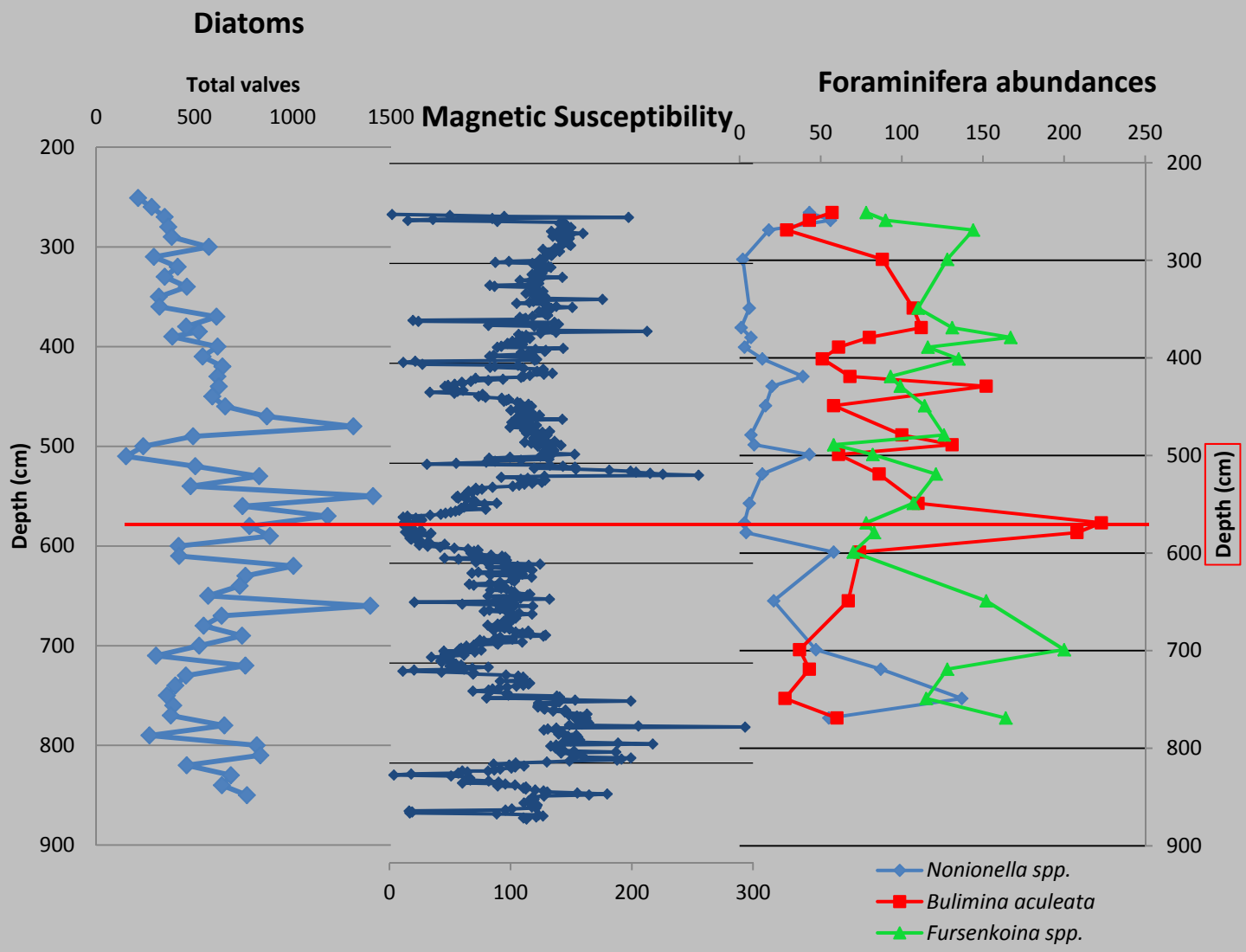
5 CTDs

4 YoYo Camera

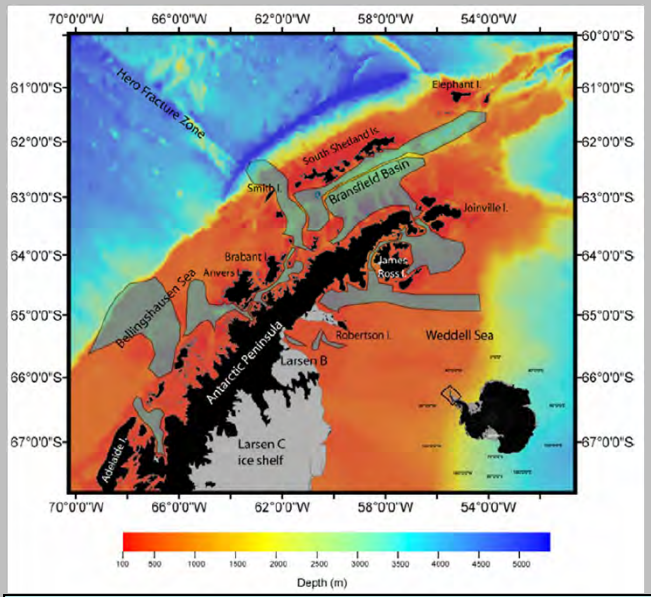
3 Jumbo Piston Cores
4 KC/JKC
1 Mega Core


65°0'0"W
64°45'0"W
64°30'0"W
660m
30 m
MAYBE CORE 5.57M -64.74515 -65.75149
17:16:01 599.47M -64.77847 -65.75784
JPC127
8.66 m
780m

NBP 10-01 JPC 127 – Barilari Bay



What do these data tell us about timing of deglaciation? How do these data contribute to our understanding of configuration of Antarctic Peninsula Ice Sheet during LGM and subsequent retreat?



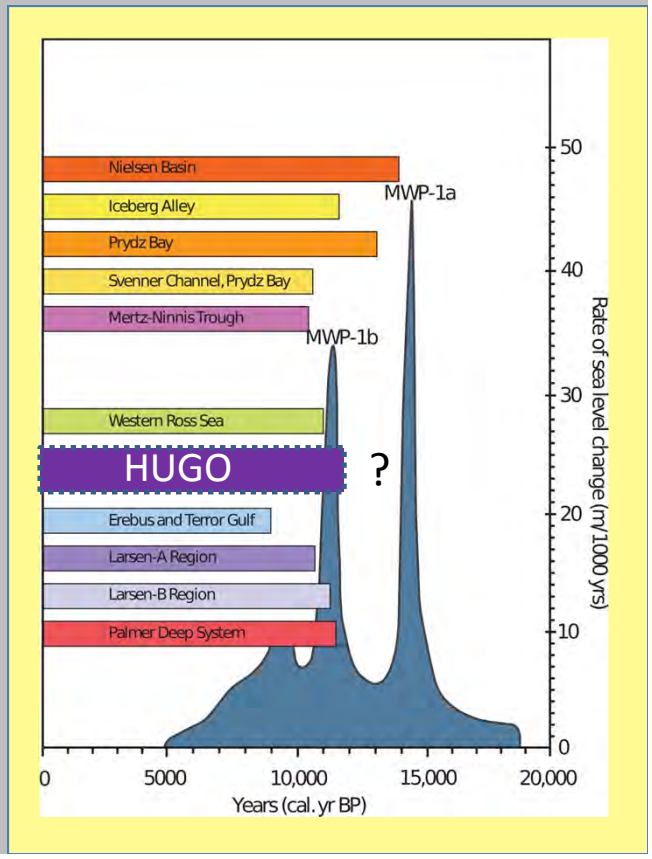
From Domack et al., 2005, Fall AGU and MacIntosh et al., submitted, Nature.

Land based geomorphology / cosmic exposure age dating

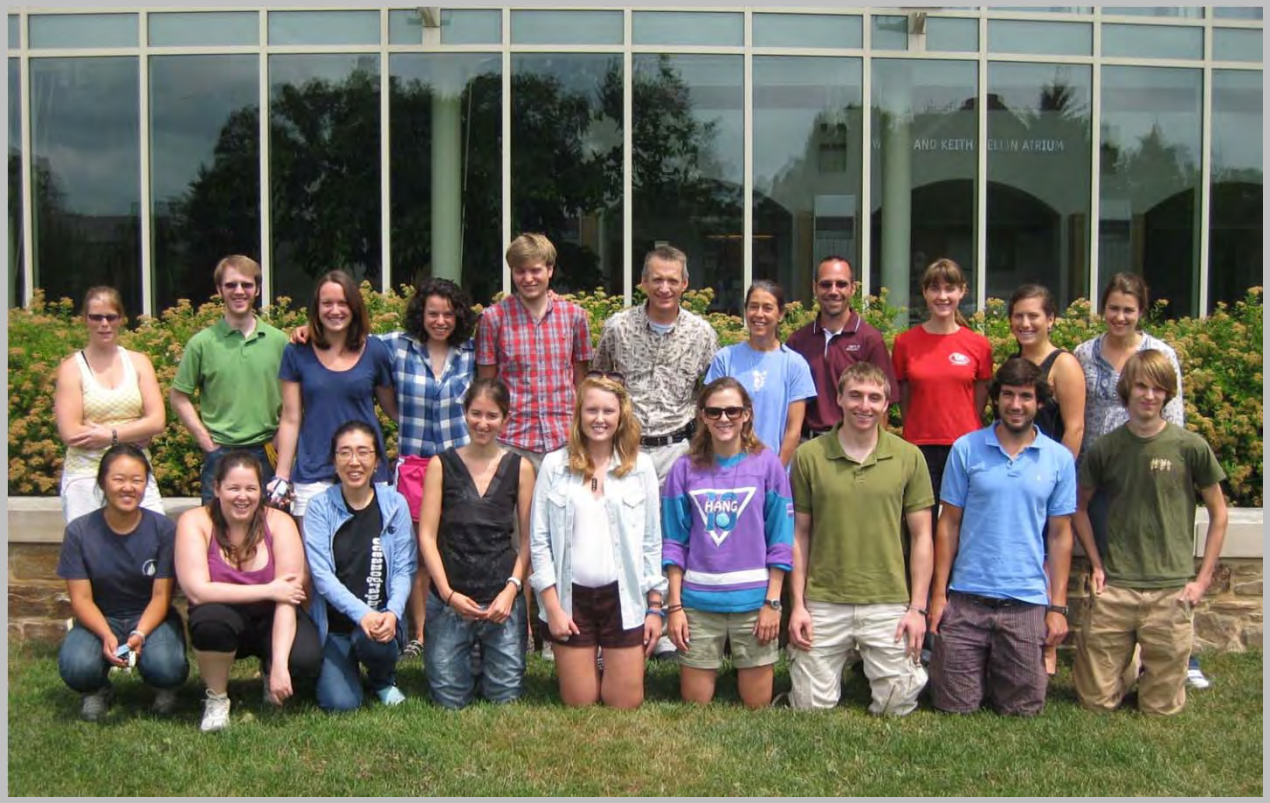
Seafloor morphology (swath mapping) stratigraphy (sub-bottom profiling and coring) **MGG TEAM**

Reconstruction APIS ↔ cGPS – crustal rebound study

Plenty more sites to add to this!



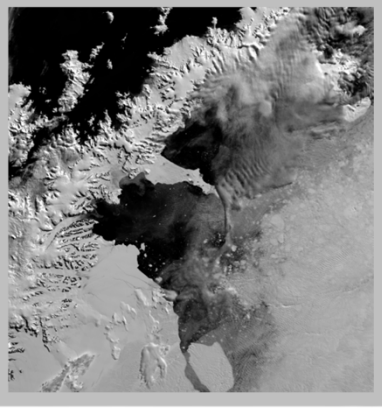
OUTREACH



Students and faculty are:,back row, left to right, Wencke Verryedt (University of Ghent, Belgium), Dexter Reardon (SUNY-Albany), Theresa Allinger (Hamilton College), Manique Talia-Murray (Hamilton College), Andrew Christ (Hamilton College), Faculty: Eugene Domack (Hamilton), Amy Leventer (Colgate), Scott Ishman (Southern Illinois), students Dubrava Kirievskaya (St. Petersburg State University, Russian Federation), Alexandra Kirshner (Rice University), Camille Peers (Royal Holloway University of London, UK). Front row: J. Sue Gao (Harvard University), Christina Sanchez Cervera (University of Barcelona, Spain), Sun Mi Jeong (Korean Polar Research Institute, Republic of Korea), Patricia Povea de Castro (University of Barcelona, Spain), Natalie Elking (Hamilton College), Madeleine Gunter (Hamilton College), Mitch Ward (SUNY-Geneseo), Garrett Armbruster (Hamilton College), and Alex Crawford (Colgate University)

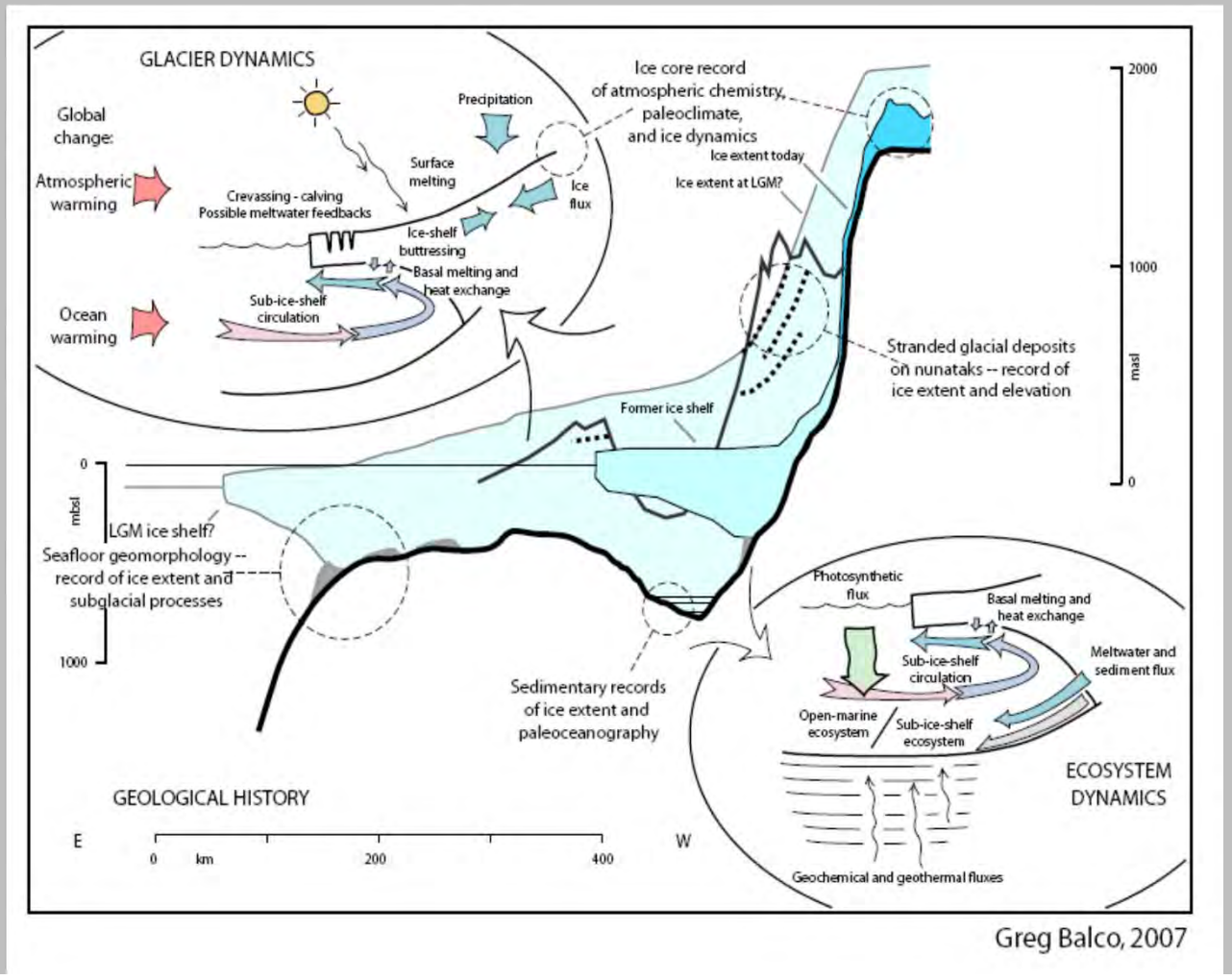
LARISSA

Larsen Ice Shelf System, Antarctica



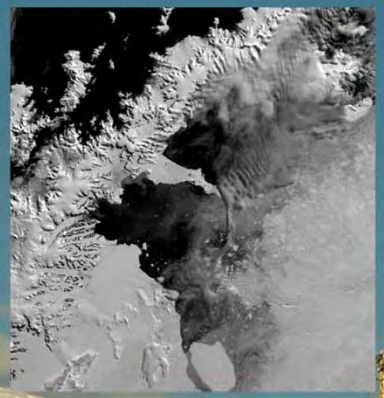
In the words of Amy Leventer:

“The whole really is more than the sum of the parts!”



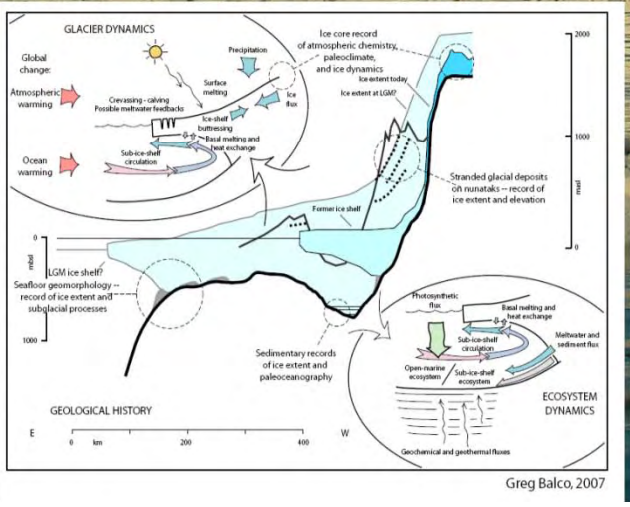
LARISSA

Larsen Ice Shelf System – Antarctica



What next?

Looking forward to 2012 in the Larsen B!



Greg Balco, 2007