

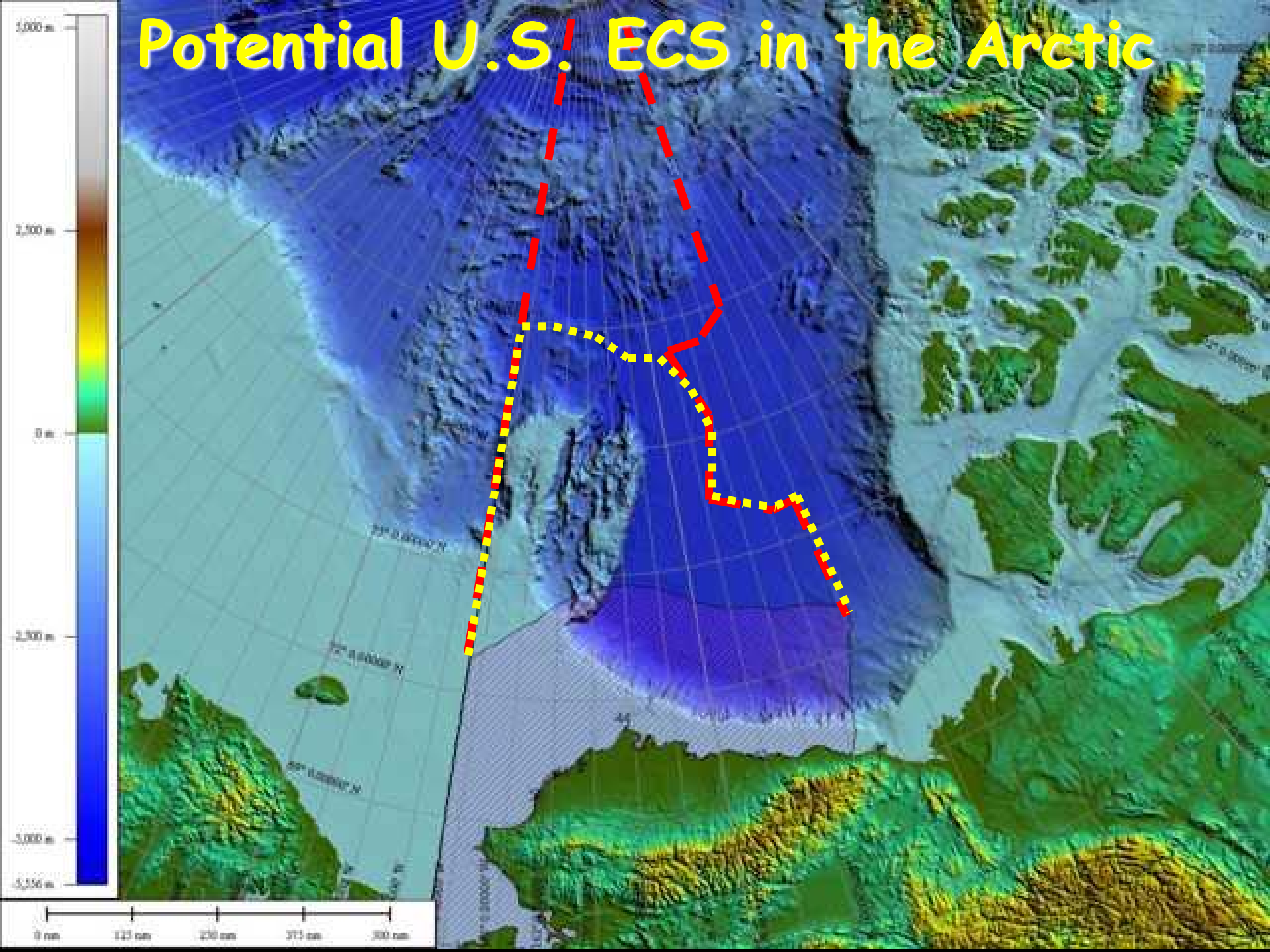


Mapping in the Arctic Ocean in Support of a Potential U.S. Extended Continental Shelf

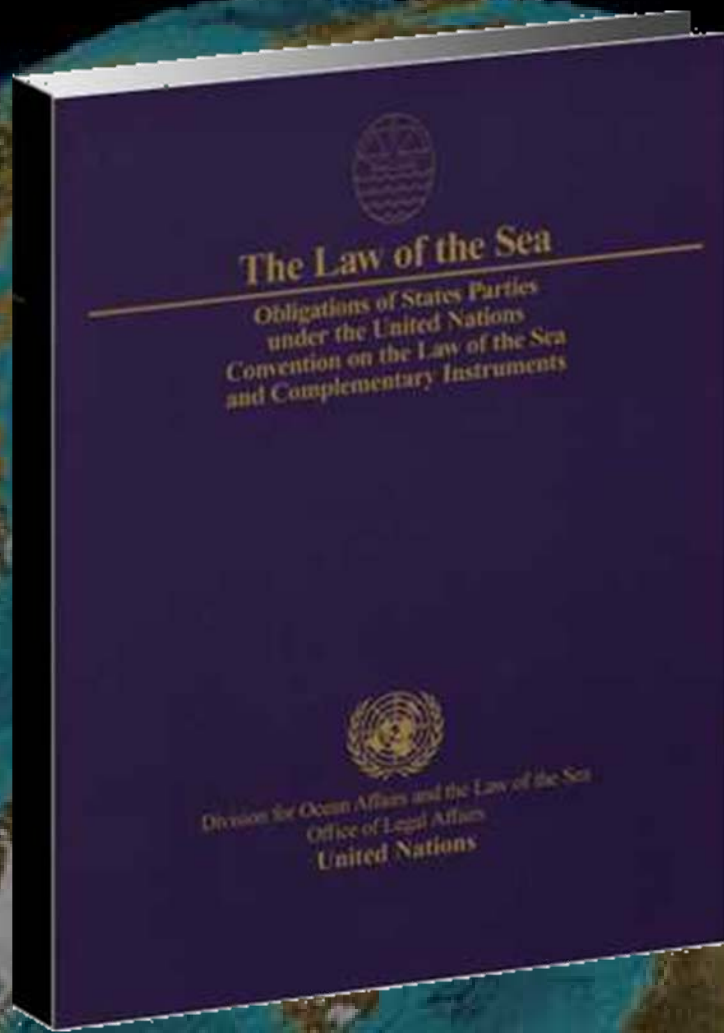
Larry Mayer, Andy Armstrong and
Jim Gardner

Center for Coastal and Ocean Mapping / NOAA-
UNH Joint Hydrographic Center University of
New Hampshire, USA

Potential U.S. ECS in the Arctic

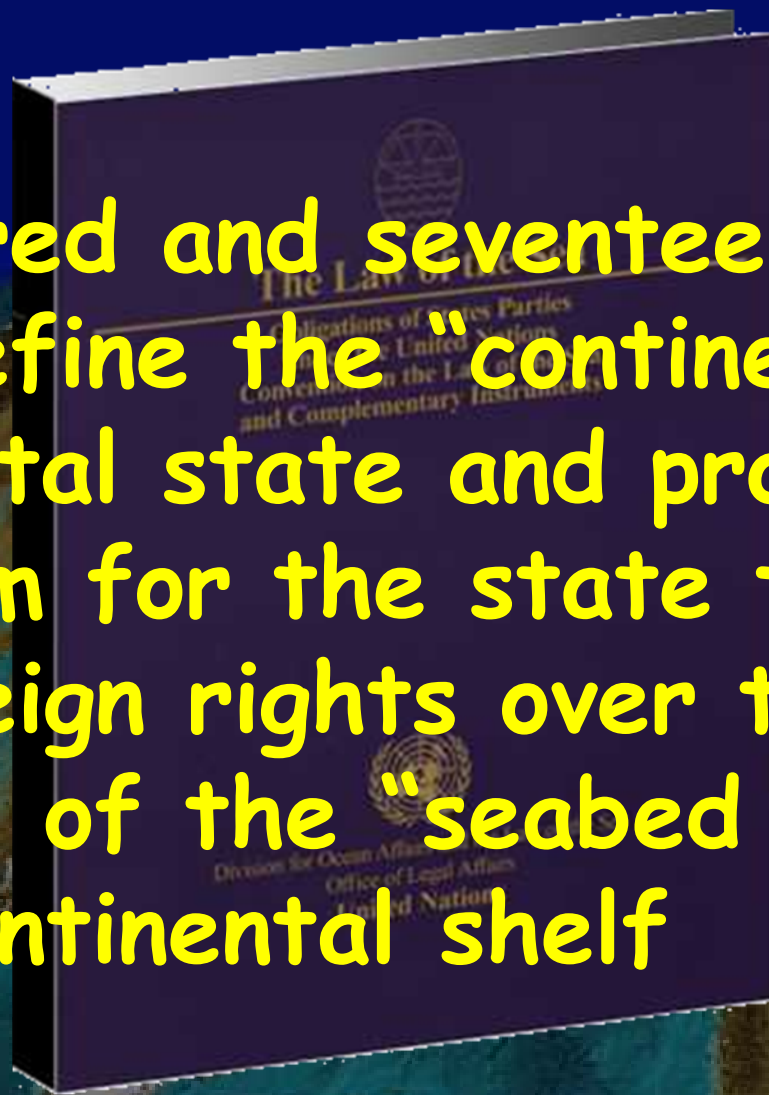


THE CONVENTION ON THE LAW OF THE SEA

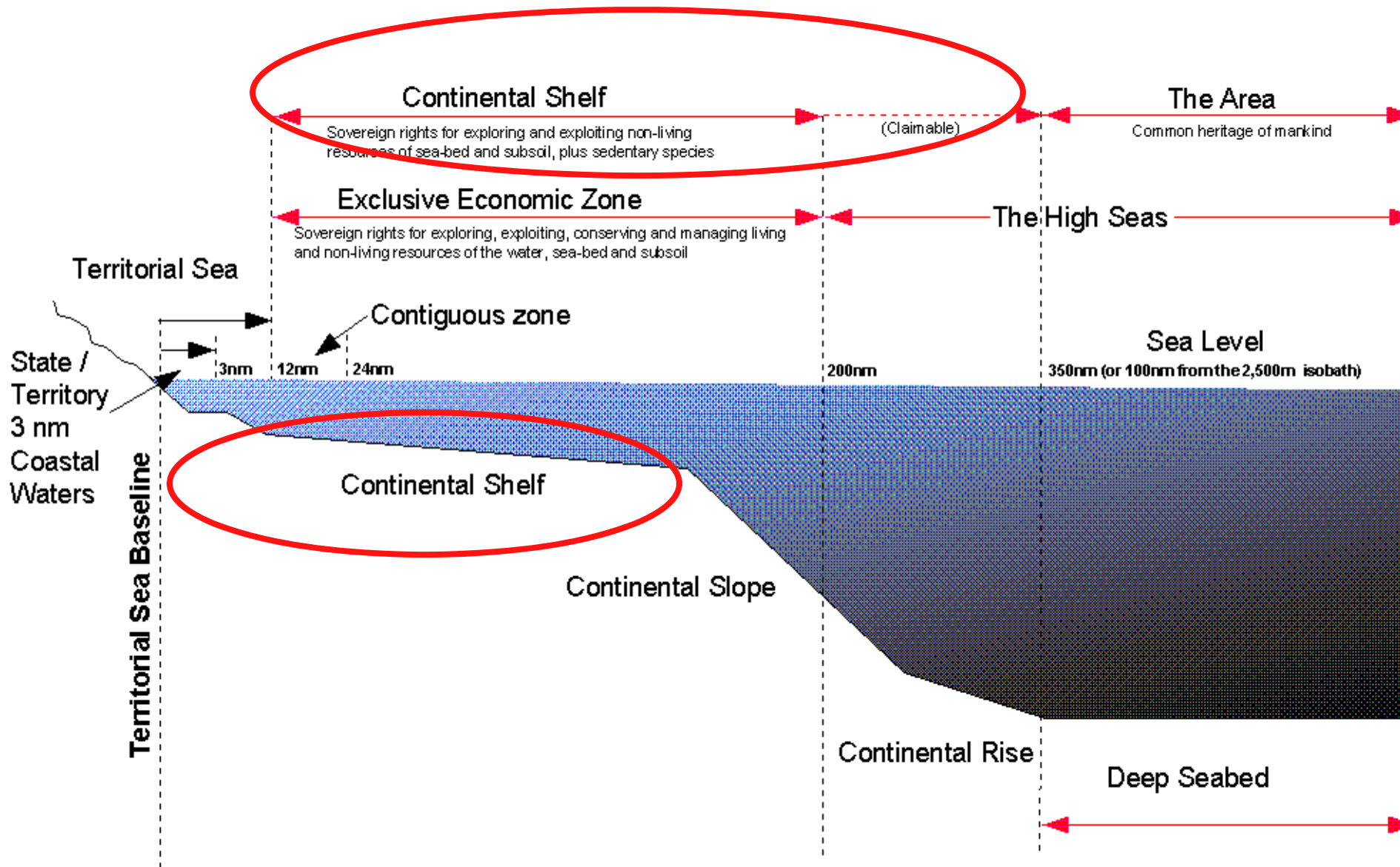


ARTICLE 76 of UNCLOS

Six hundred and seventeen words that redefine the "continental shelf" of a coastal state and provide a mechanism for the state to extend its sovereign rights over the resources of the "seabed and subsoil" of the continental shelf



MARITIME ZONES





Data Required

- To establish an extended continental shelf a coastal state must demonstrate that region is “natural prolongation” of continental landmass – limits are then determined by
 - depth and shape of the seafloor (FOS and 2500m contour)
 - the thickness of the underlying sediments (1% line)
 - distances from the territorial sea baselines (350 nm line)

Need to map the seafloor



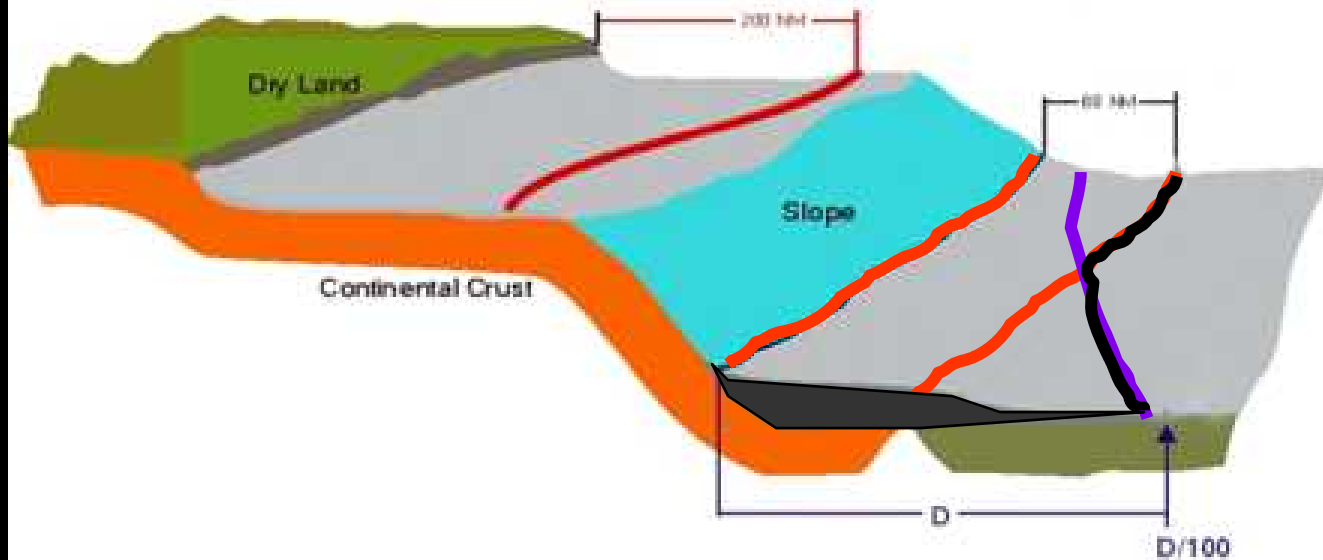
Formulae Lines:



Foot of Slope + 60 nmi - bathy

Gardiner line - sediment thickness less than 1% of distance back to FOS - seismic and bathy

Determining the Outer Limit of the Continental Shelf



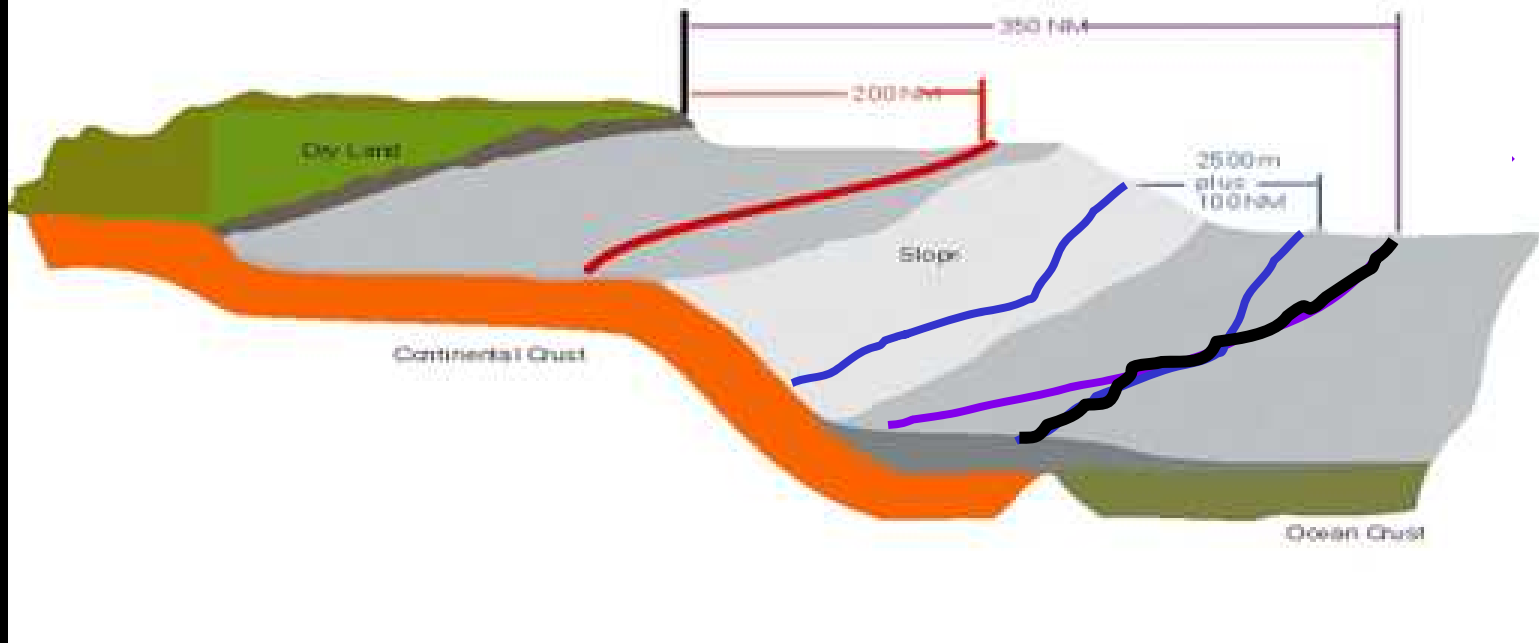


Cutoff Lines:

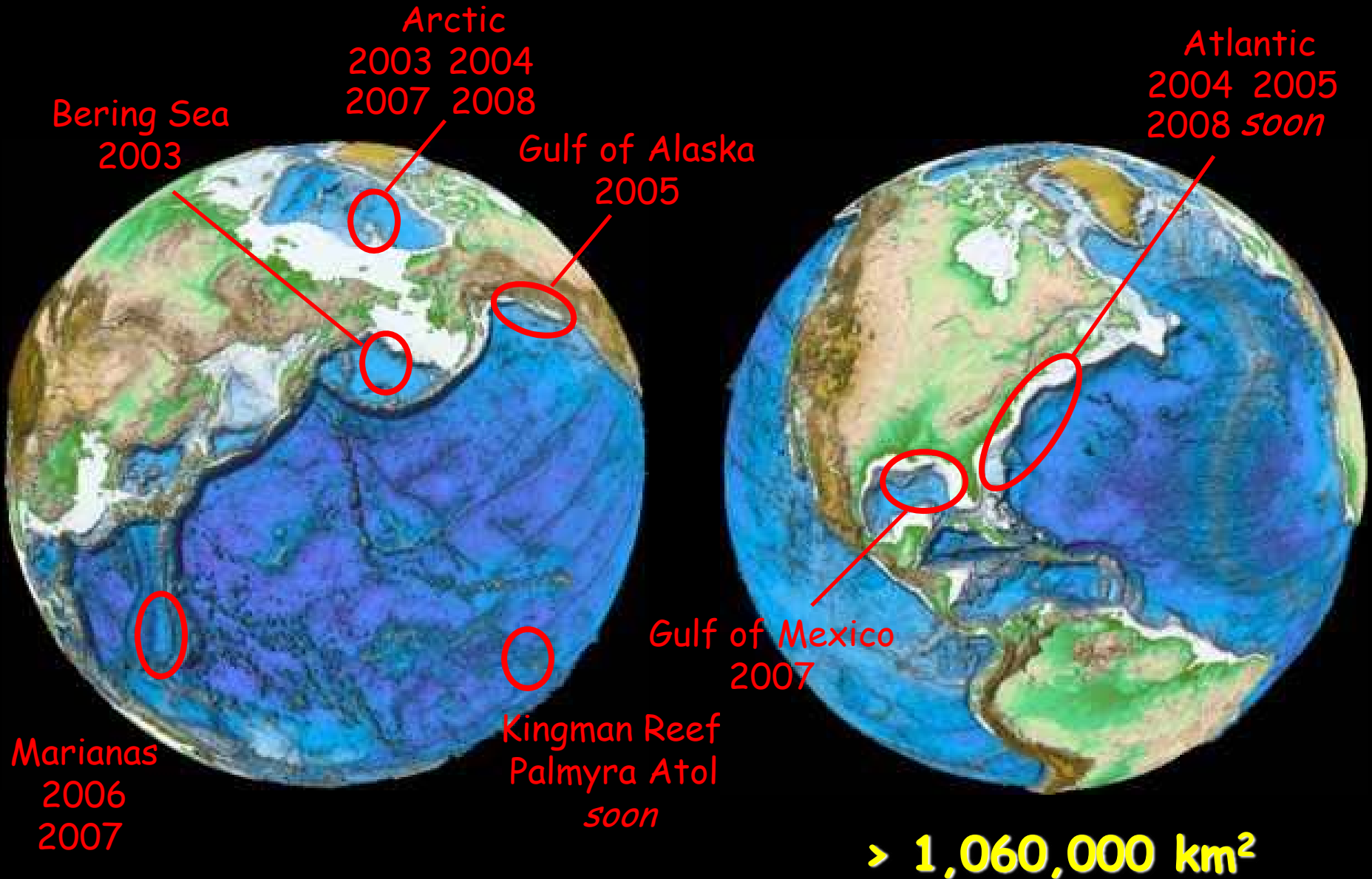
2500 m contour+100 nmi - bathy

350 nmi from baseline - distance

Constraining the Outer Limit of the Continental Shelf



UNH CCOM-JHC U.S. Law-of-the-Sea Bathymetric Mapping to Date





Arctic is unique as an ocean basin in that >52% is made up of shelf (geologic)

Five nations having potential extended shelves

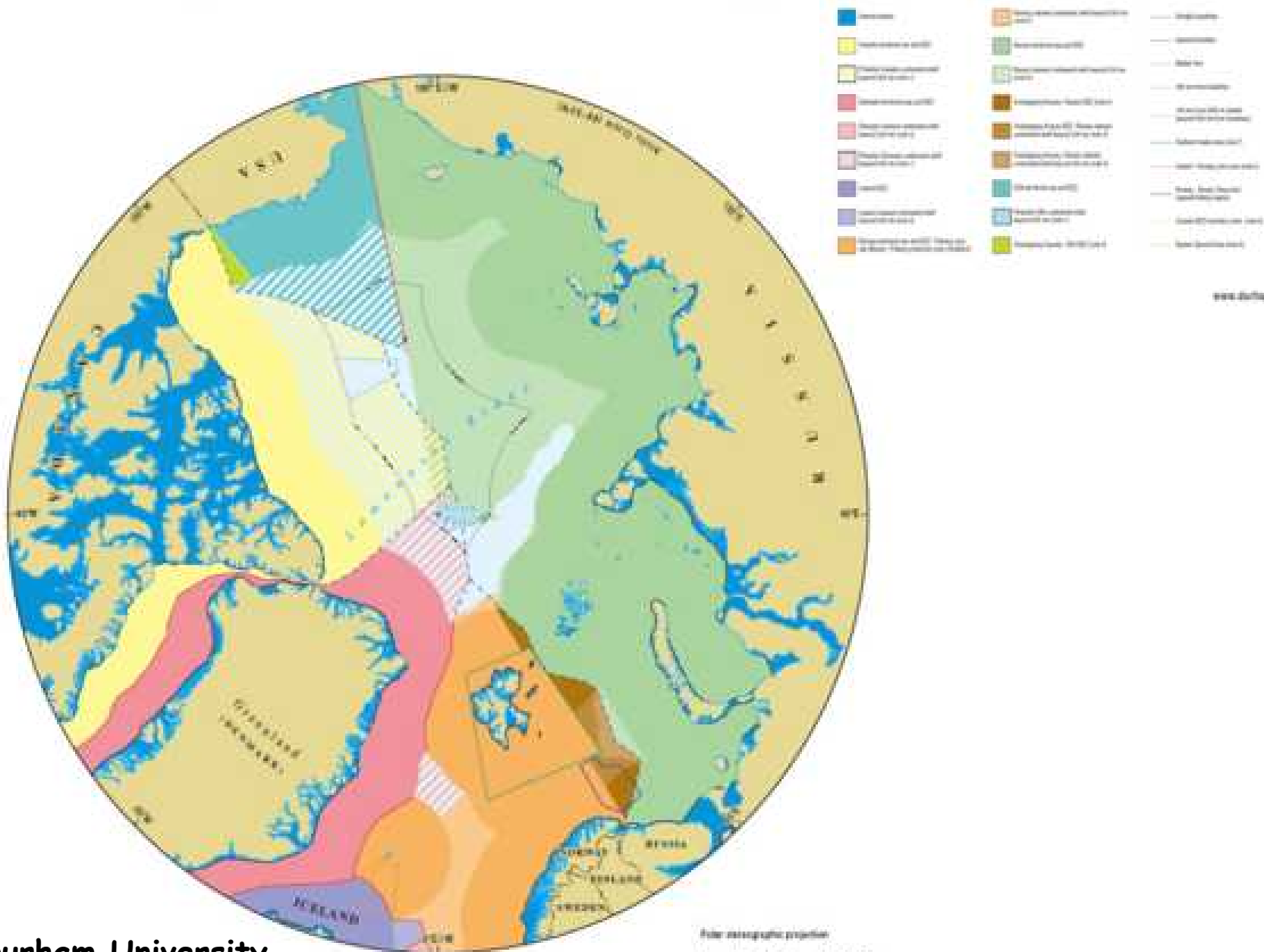
PRINCIPAL PHYSIOGRAPHIC FEATURES OF THE ARCTIC OCEAN

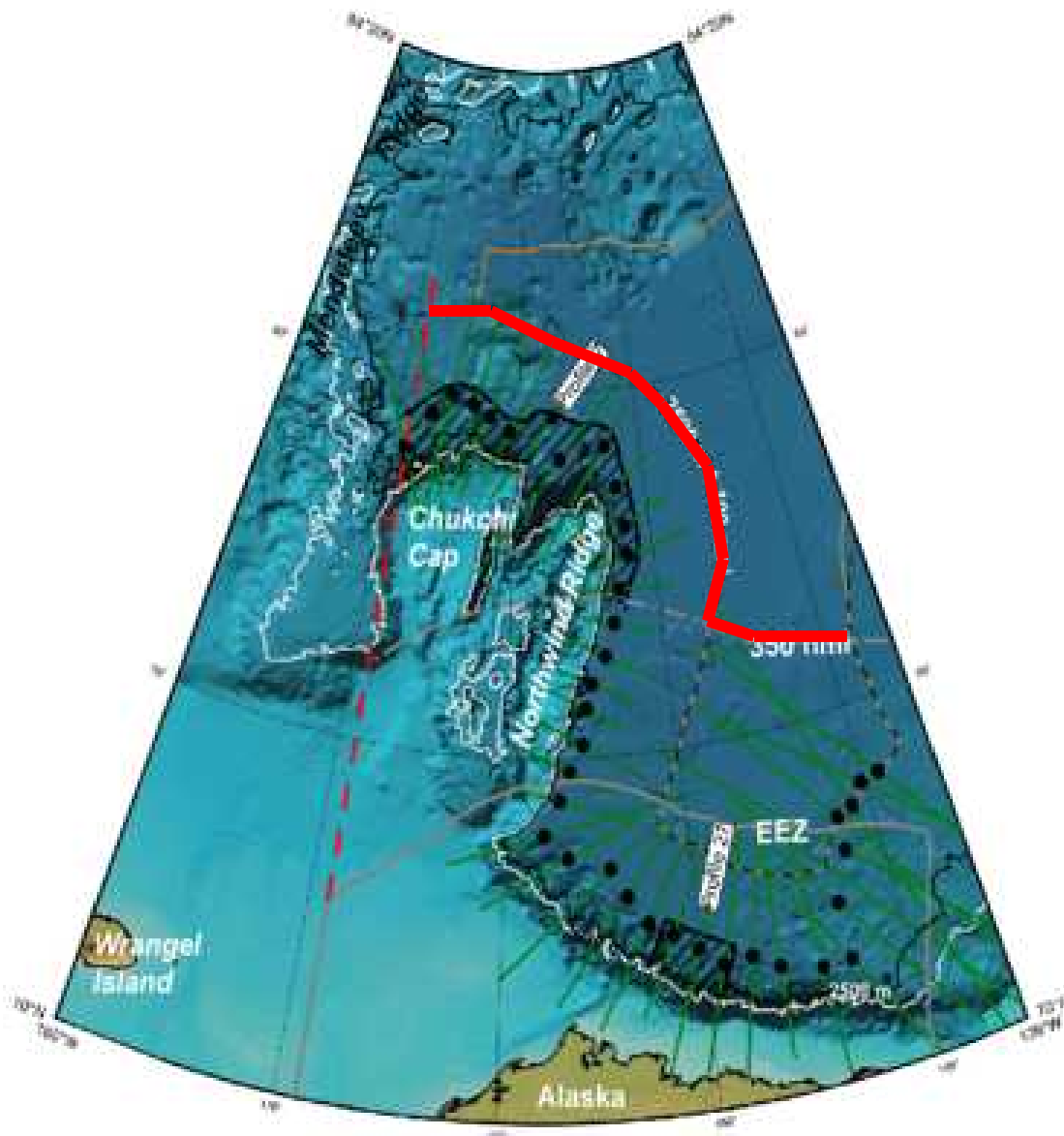


From Ron McNab

DM, RM & GC, GSC Atlantic, June 1997, (Revised)

Maritime jurisdiction and boundaries in the Arctic region





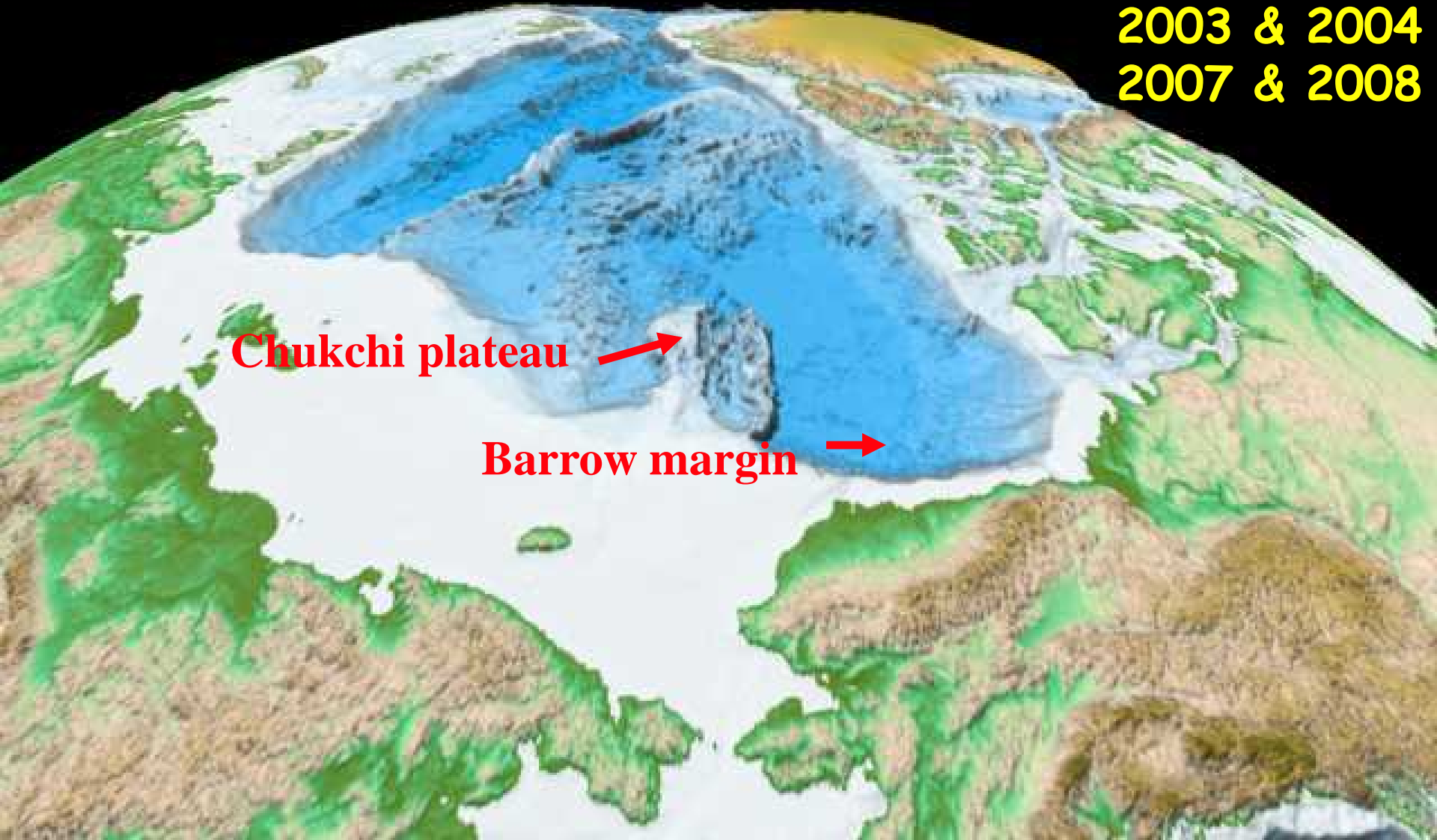
5.10B. Bathymetry from IBCAO in detailed area ARC, drawn bathymetric profiles, and possible locations of the FOS. Labeled profile is shown in figure 5.11. Note that the orange line, which represents the 2500 m + 100 nm, makes use of the 2500 m contour of the Alpha-Mendeleev Ridge as well as the Canadian shelf.

Chukchi Region and Barrow Margin

2003 & 2004
2007 & 2008

Chukchi plateau →

Barrow margin →



Arctic - Chukchi Plateau mapping

USCGC Healy



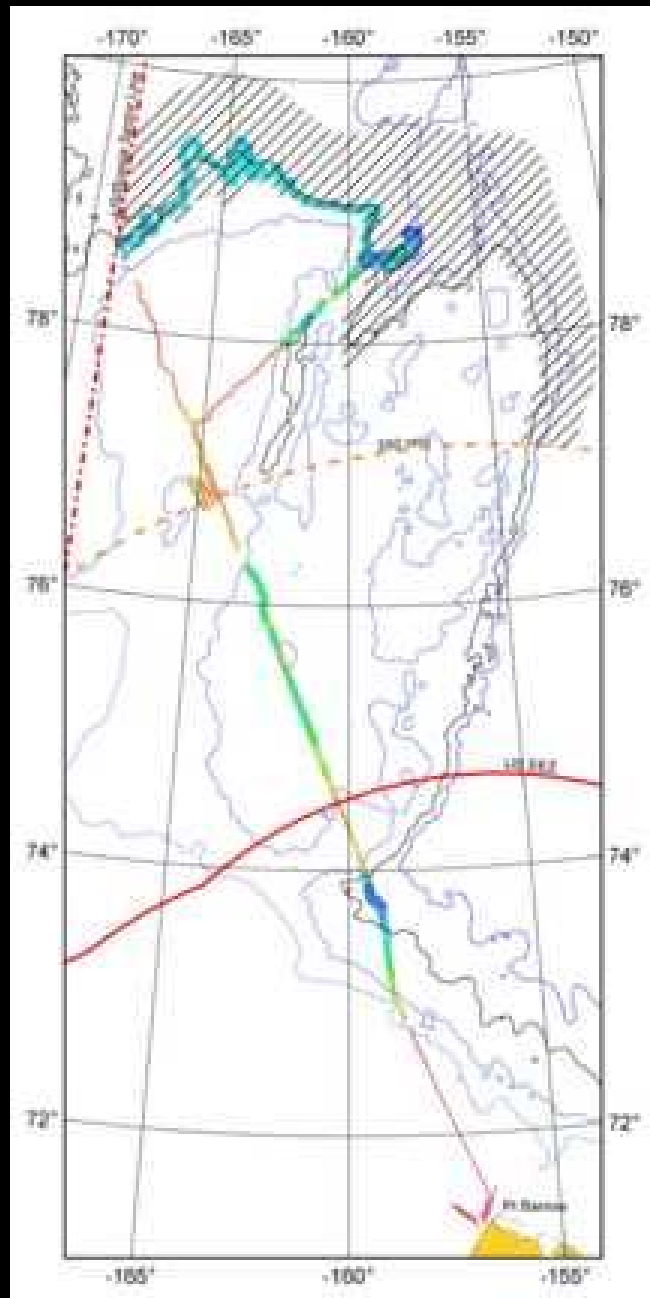
Seabeam 2112 - 12 kHz, 121-2° receive beams
bathymetry & acoustic backscatter
Knudsen 320BR 3.5-kHz chirp profiler

UNH: bathymetry, backscatter & 3.5-kHz processing at sea

Arctic Mapping 2003, 2004, 2007, 2008 cruise statistics

operations.....	65 days
transits.....	24 days
<i>average speed (in ice).....</i>	<i>4 kts</i>
<i>average sea-ice state.....</i>	<i>9/10</i>
tracklines.....	~24,300 km
Area mapped.....	~135,000 km ²

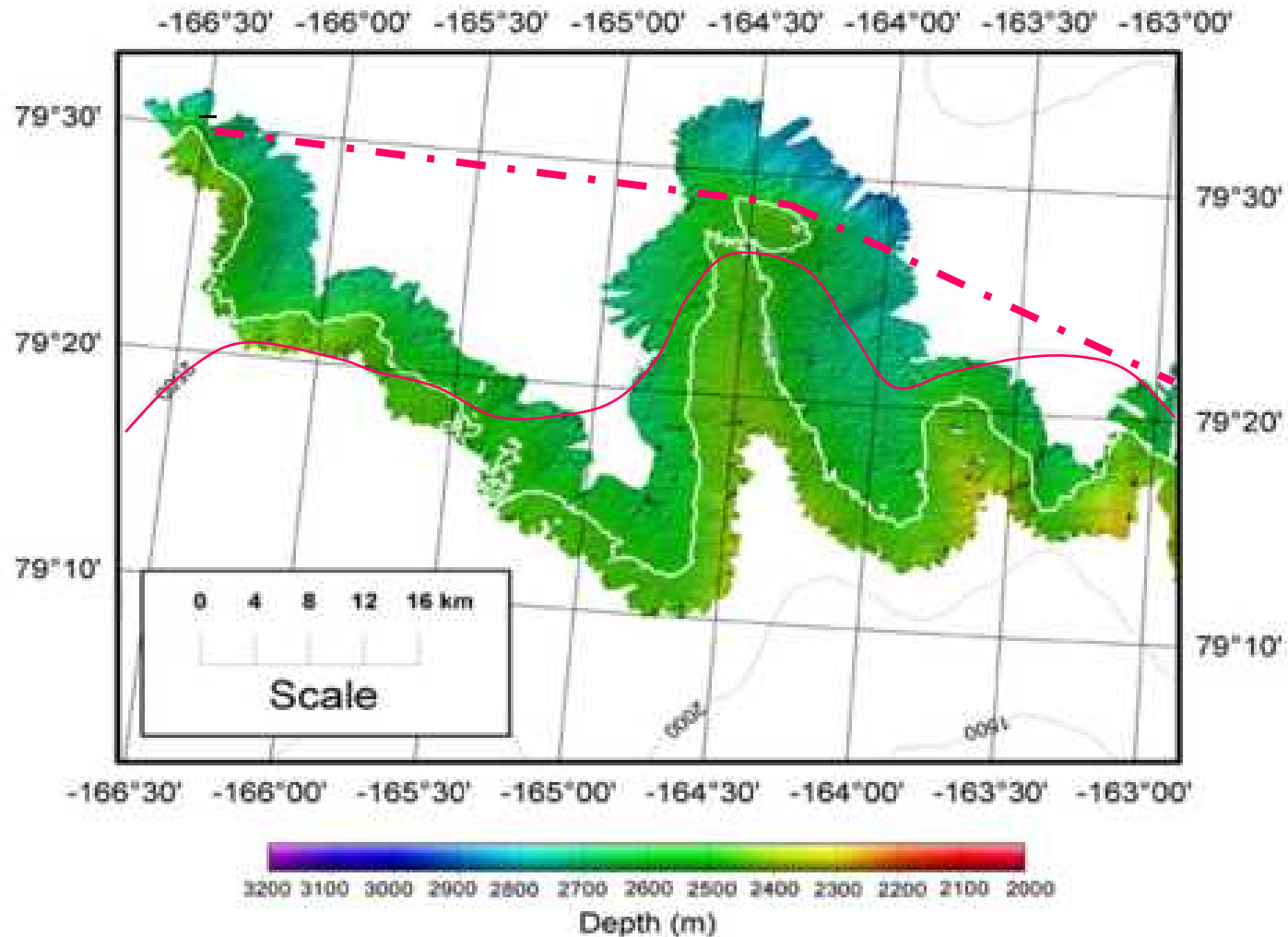
Healy 03-02
~3000 km of
multibeam
sonar
bathymetry
1-11 Sept 03
8/10 ice



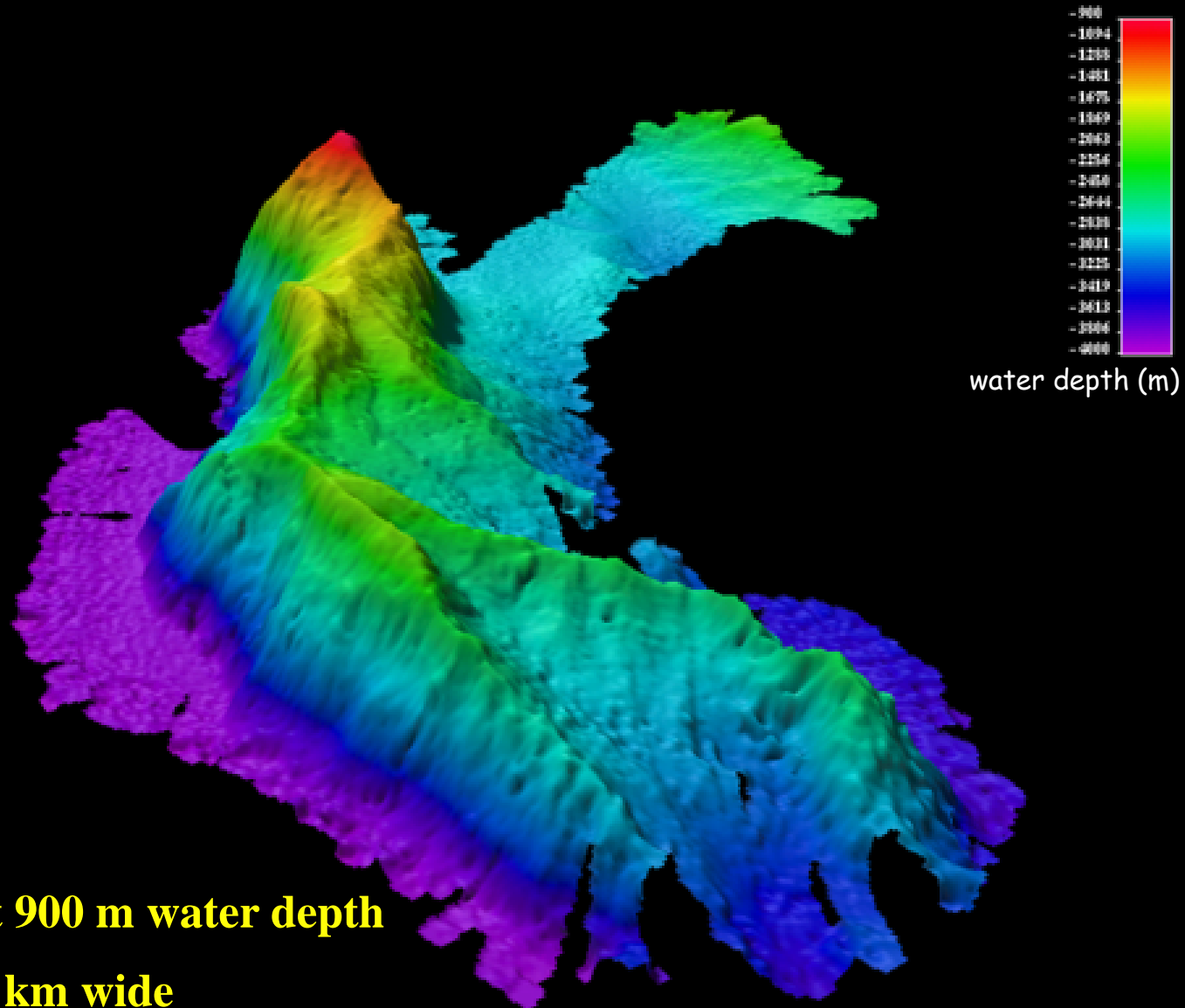
typical ice conditions
2003
8/10 "cheesy" ice



Redefinition of the 2500 m contour



Healy Seamount looking S, ve=6x

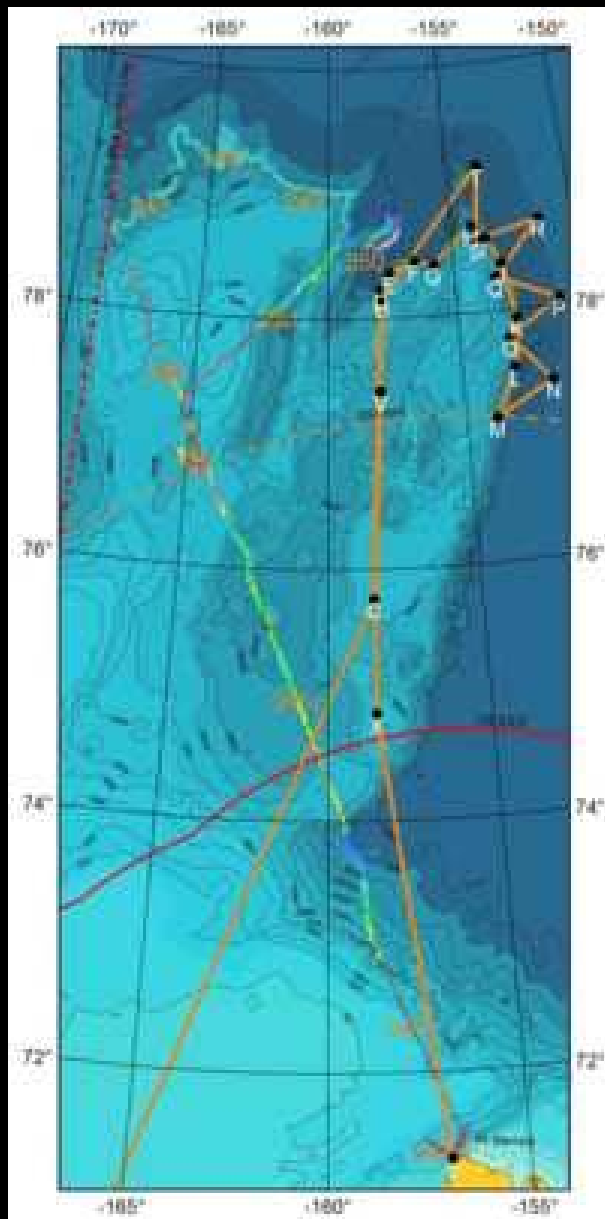


3100 m high, summit at 900 m water depth

45 km long x 15 km wide



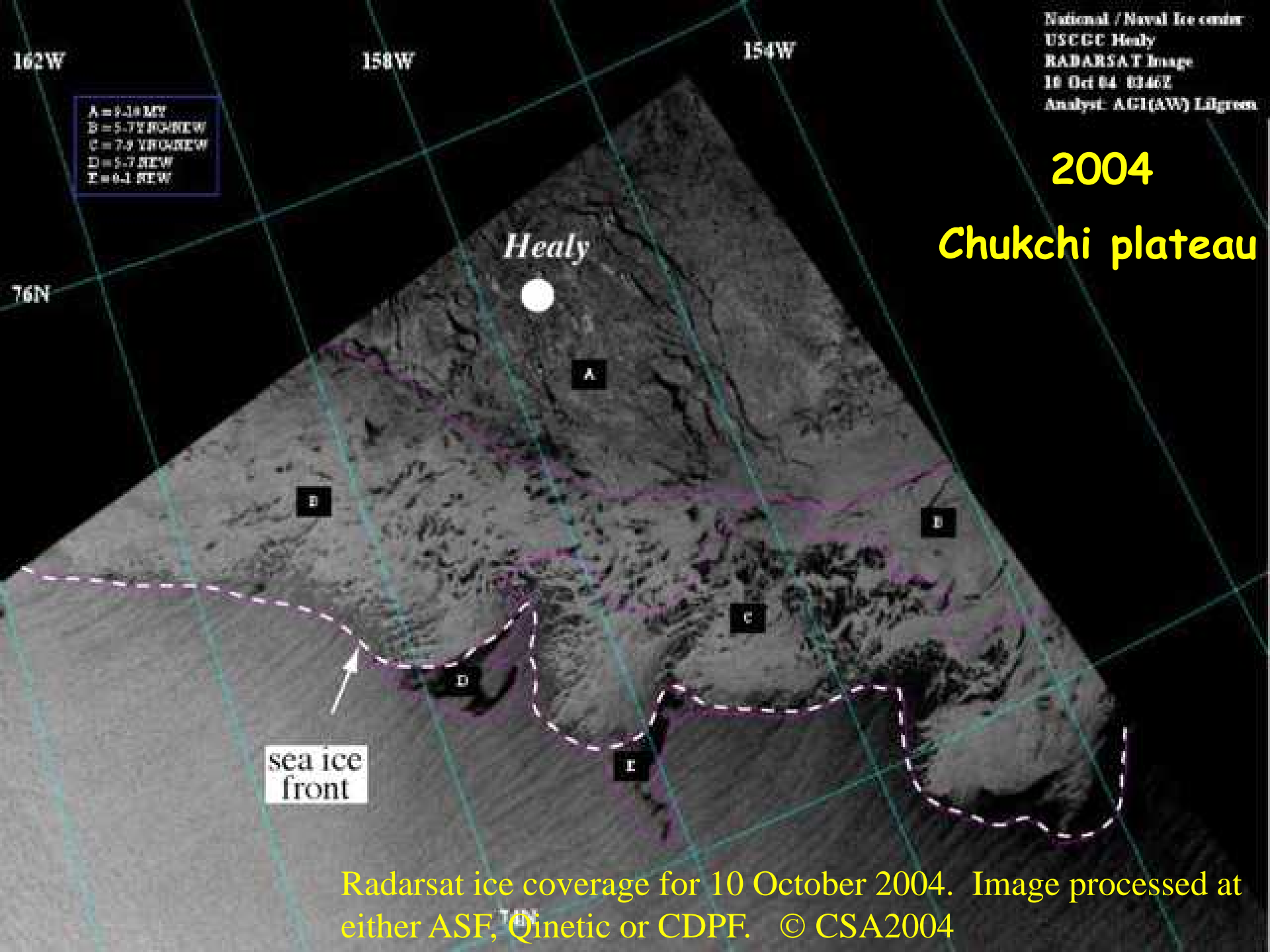
HEALY 2004 - Plan



National / Naval Ice center
USCCC Healy
RADARSAT Image
10 Oct 04 0346Z
Analyst: AC1(AW) Lilgrom

2004

Chukchi plateau



162W

158W

154W

A=9.38 MY
B=5.72 VROSEW
C=7.9 VROSEW
D=5.7 NEW
E=6.1 NEW

Healy

A

B

D

C

D

E

sea ice front

Radarsat ice coverage for 10 October 2004. Image processed at either ASF, Qinetiq or CDPF. © CSA2004

How do we map in this?



Photo from M. Jakobsson

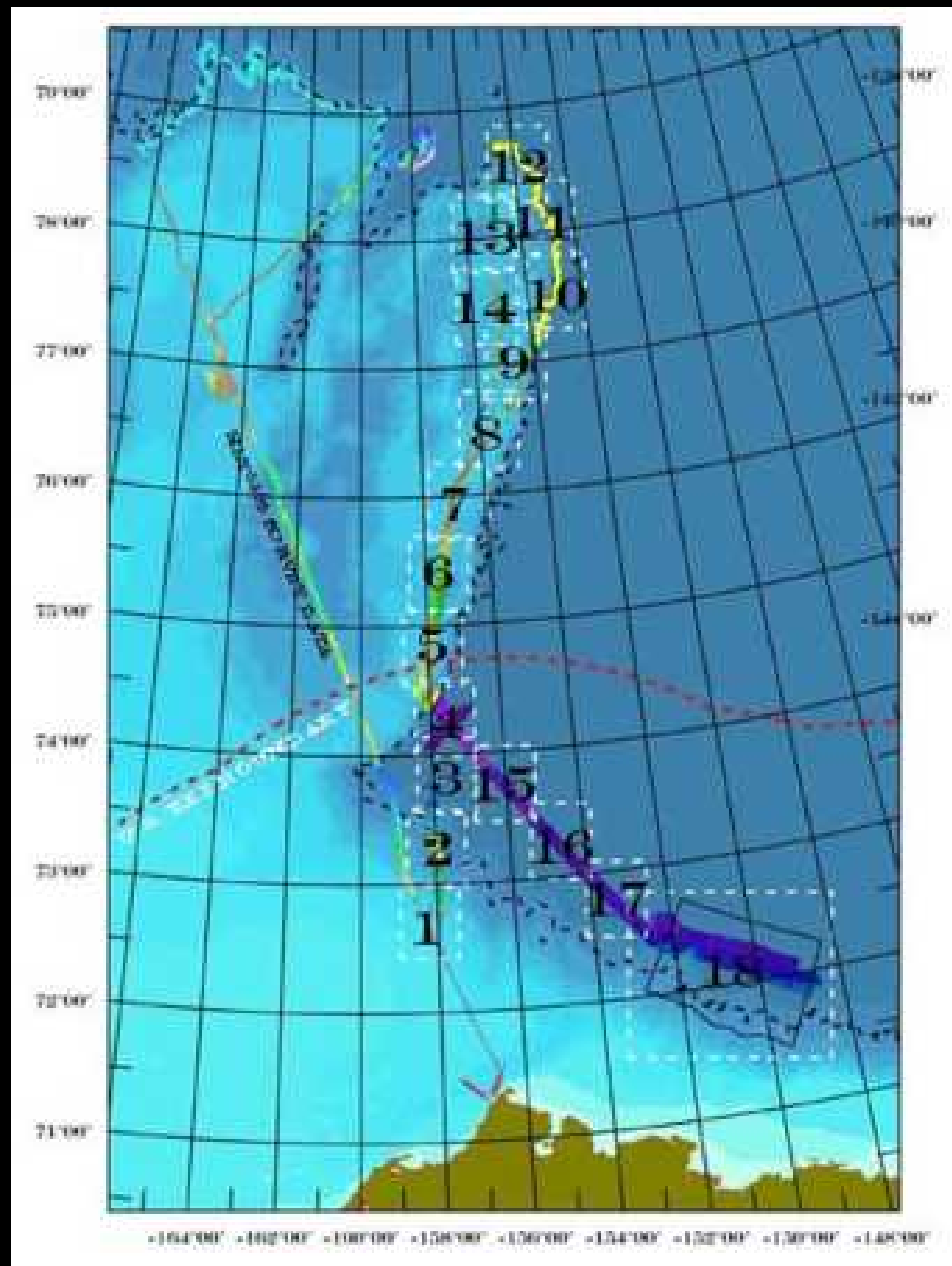
HEALY 04-05 TRACK

6-26 Oct.
2004

6700 line km

"Ratchet Surveying"

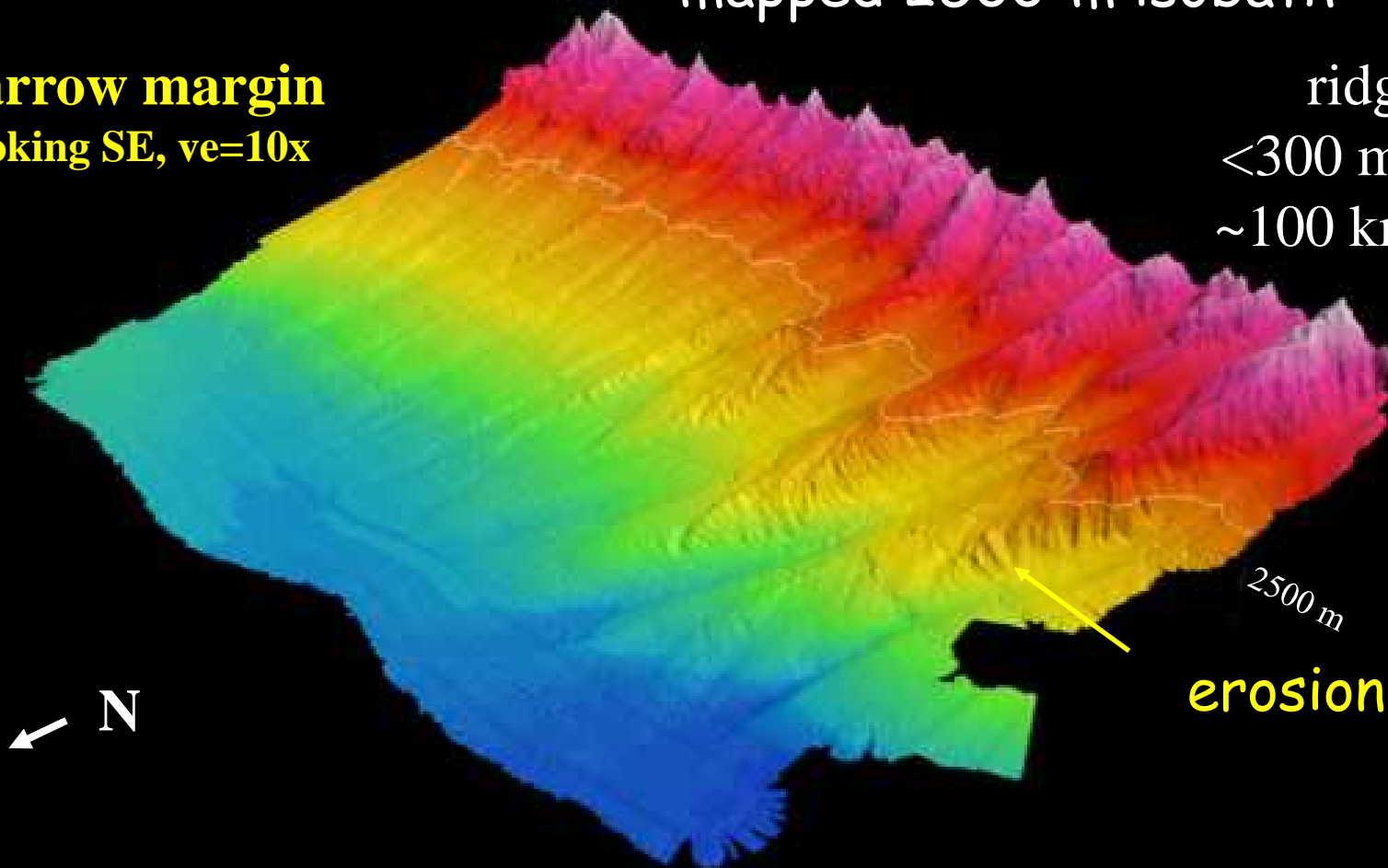
"Pirouette Surveying"



mapped 2500-m isobath

Barrow margin
looking SE, ve=10x

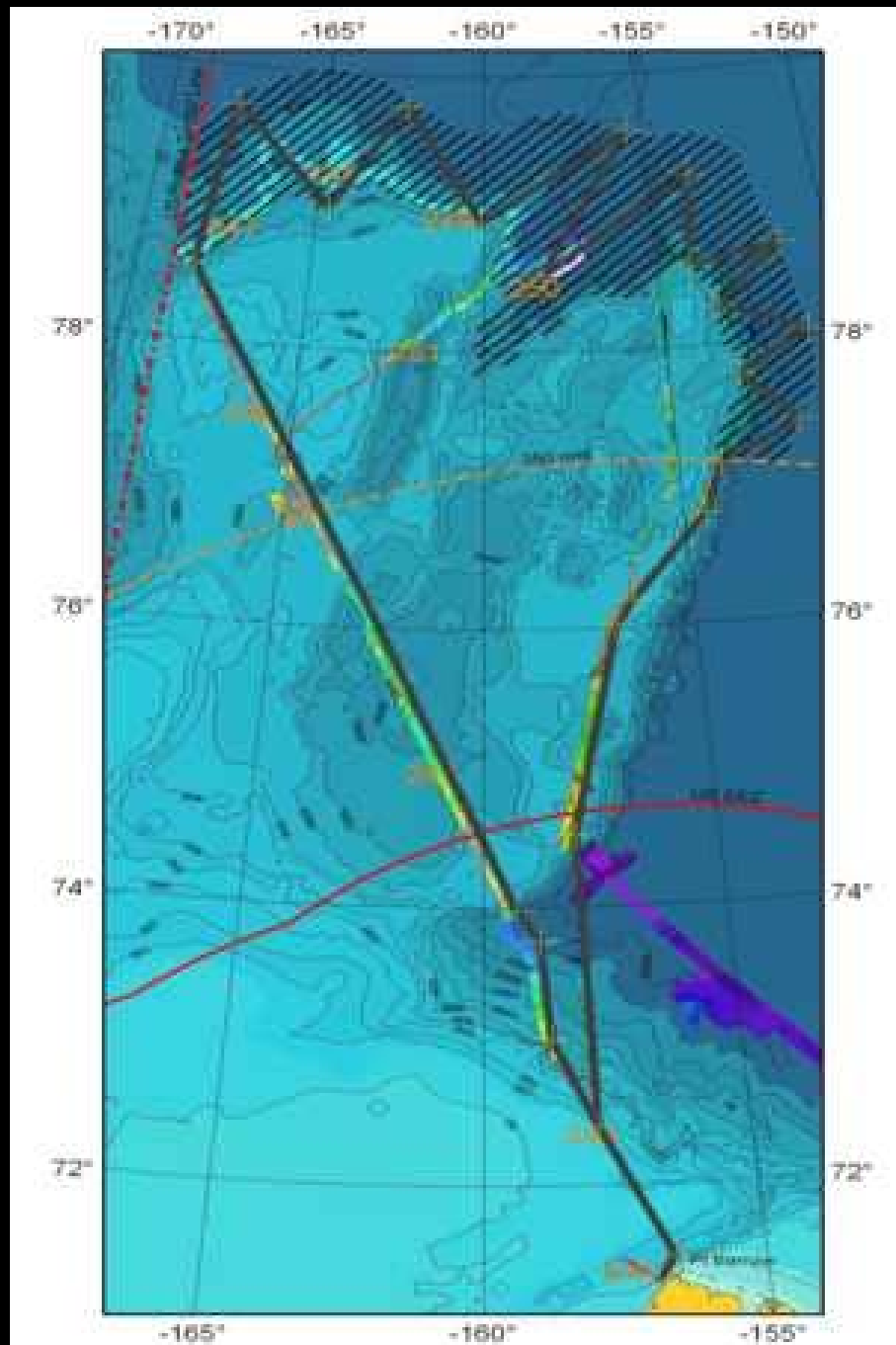
ridges
<300 m high,
~100 km long



2500 m
erosion

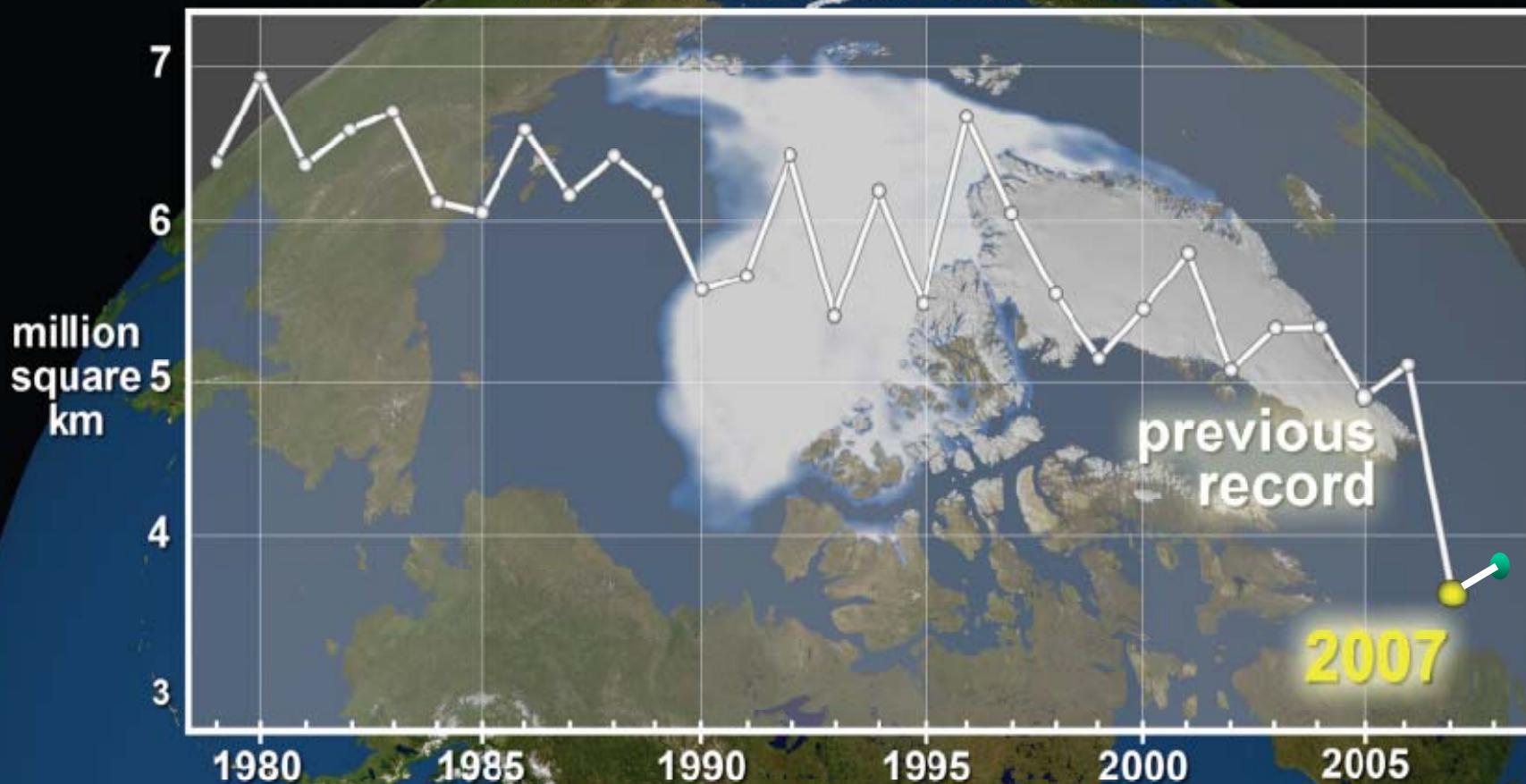
**HEALY 07-03
Plan**

**Depart Barrow:
17 Aug. 07
Return Barrow
15 Sept. 07**





Annual Sea Ice Minimum

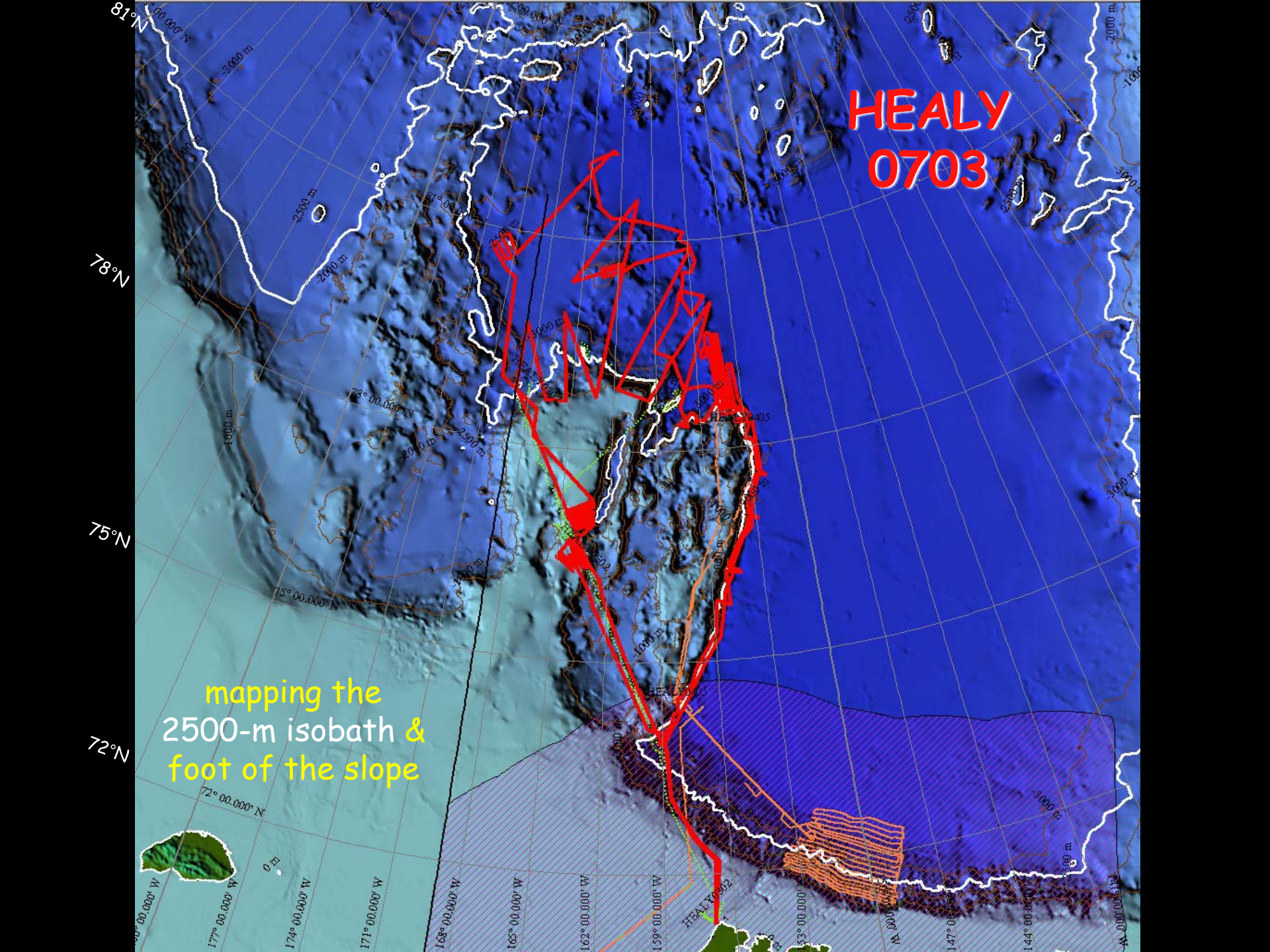




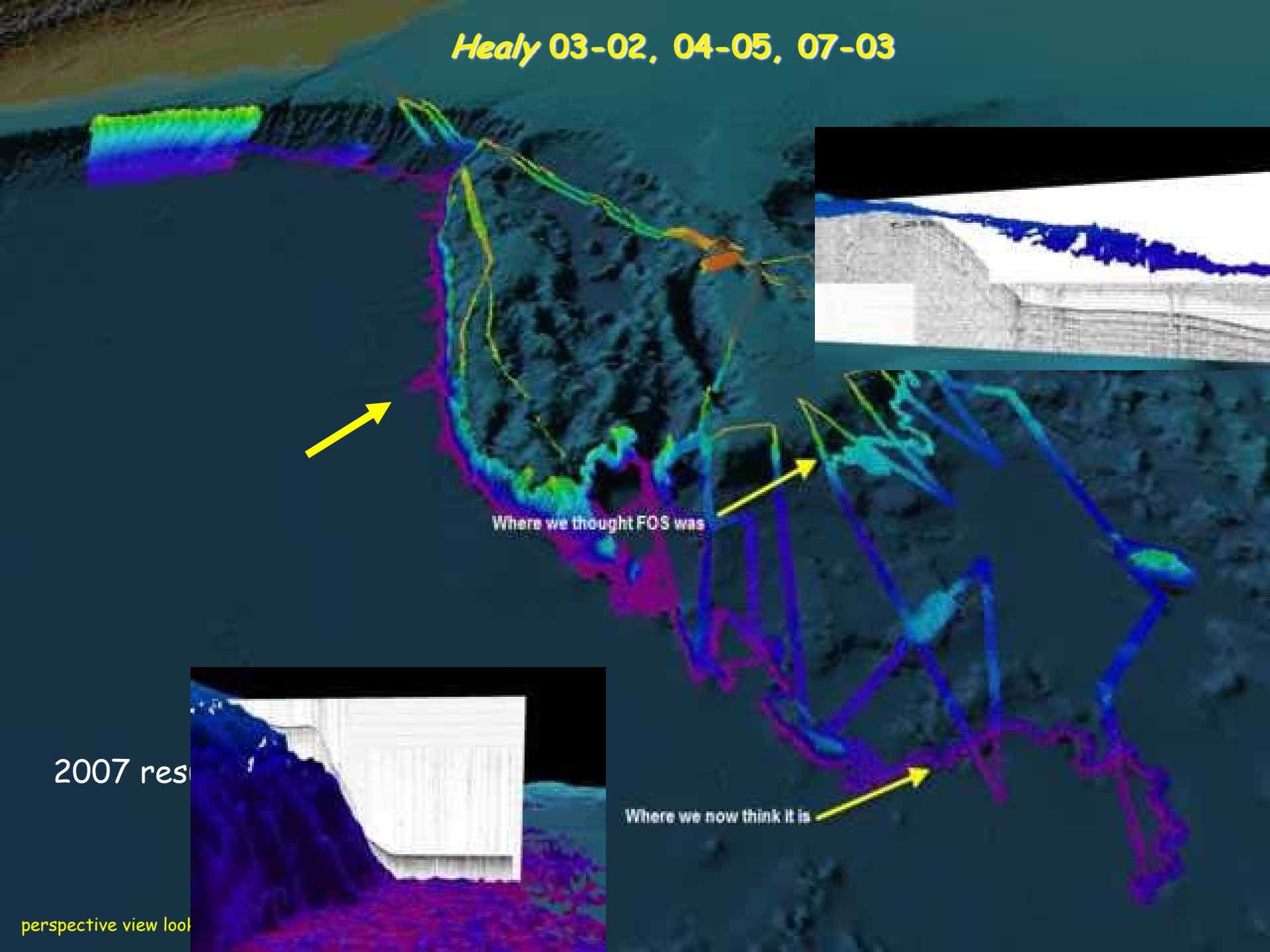


**HEALY
0703**

mapping the
2500-m isobath &
foot of the slope



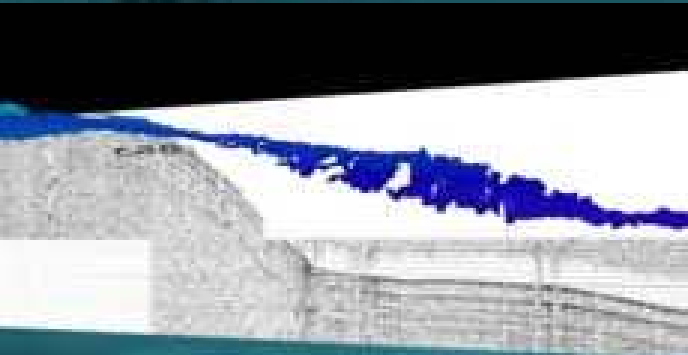
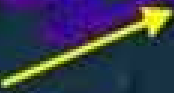
Healy 03-02, 04-05, 07-03



Where we thought FOS was

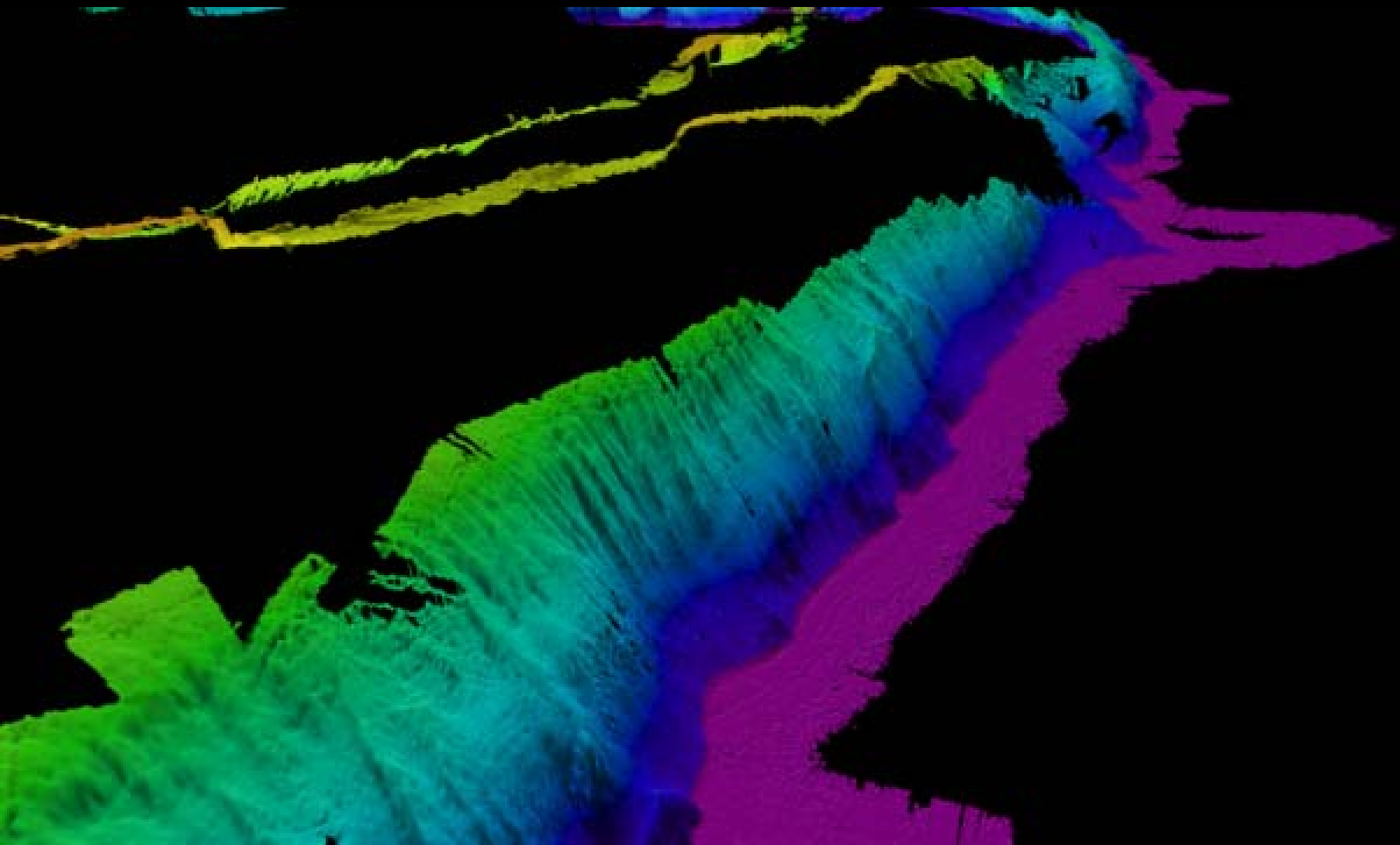


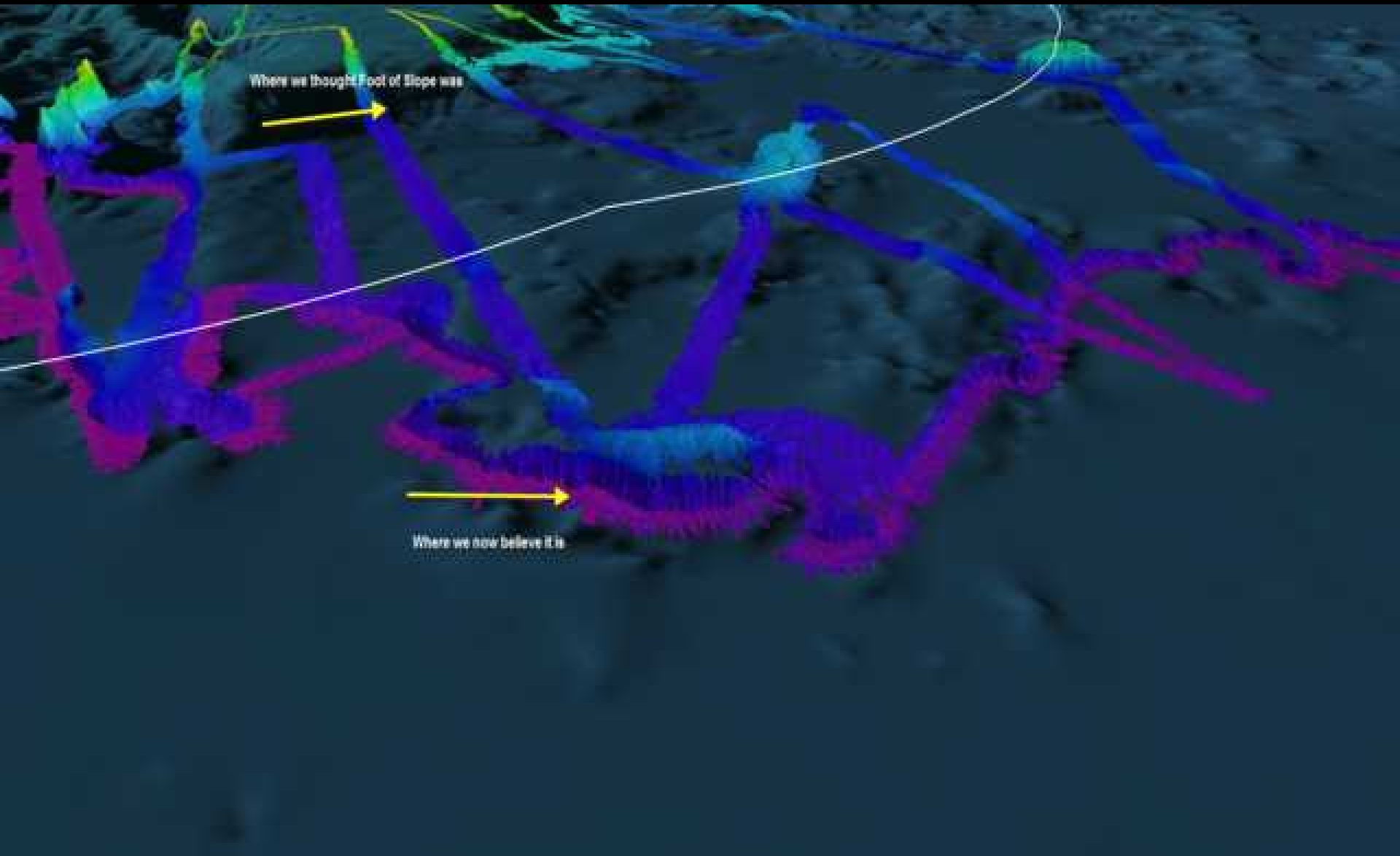
Where we now think it is



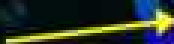
2007 res

perspective view look





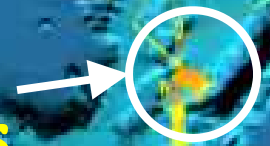
Where we thought foot of slope was



Where we now believe it is

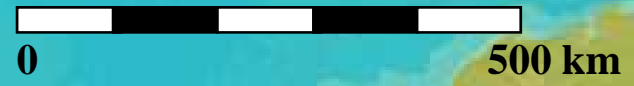
2003, 2004 & 2007
Arctic surveys

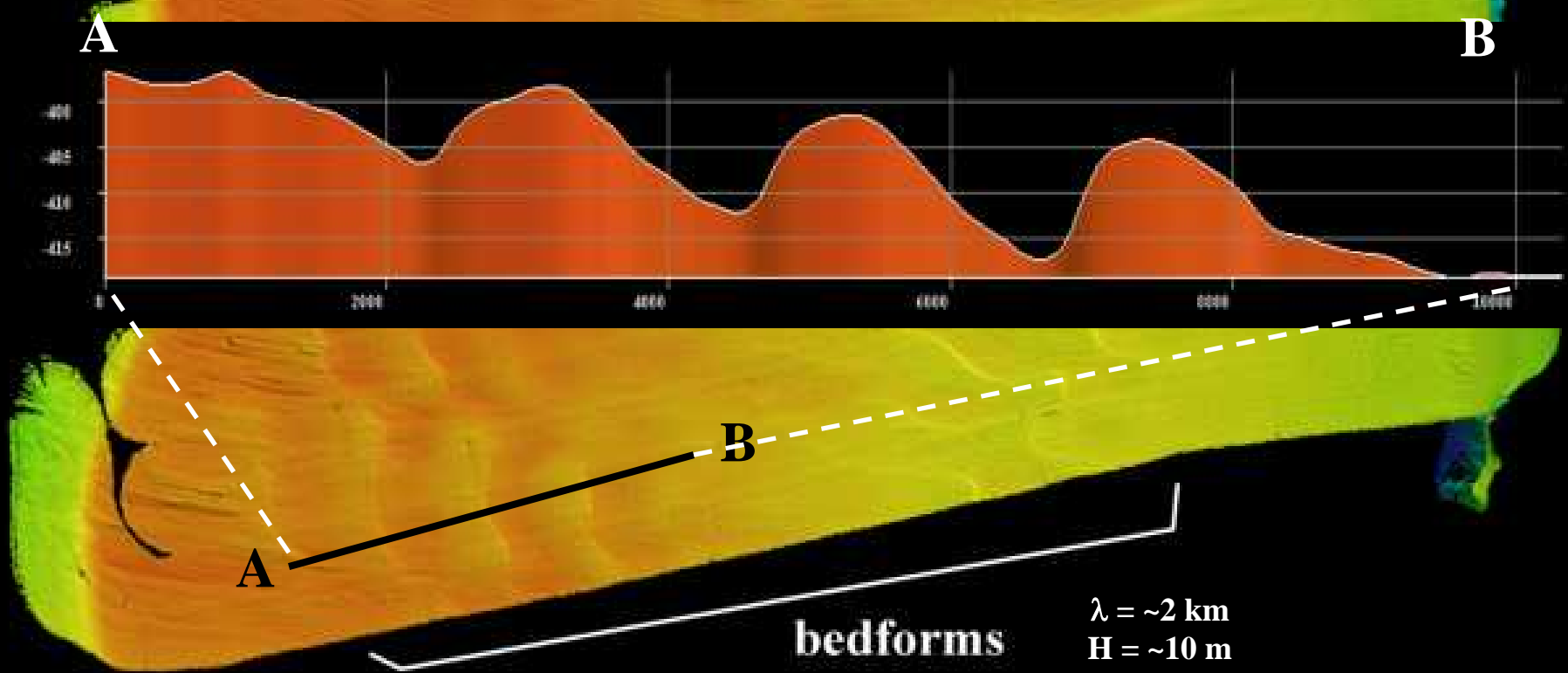
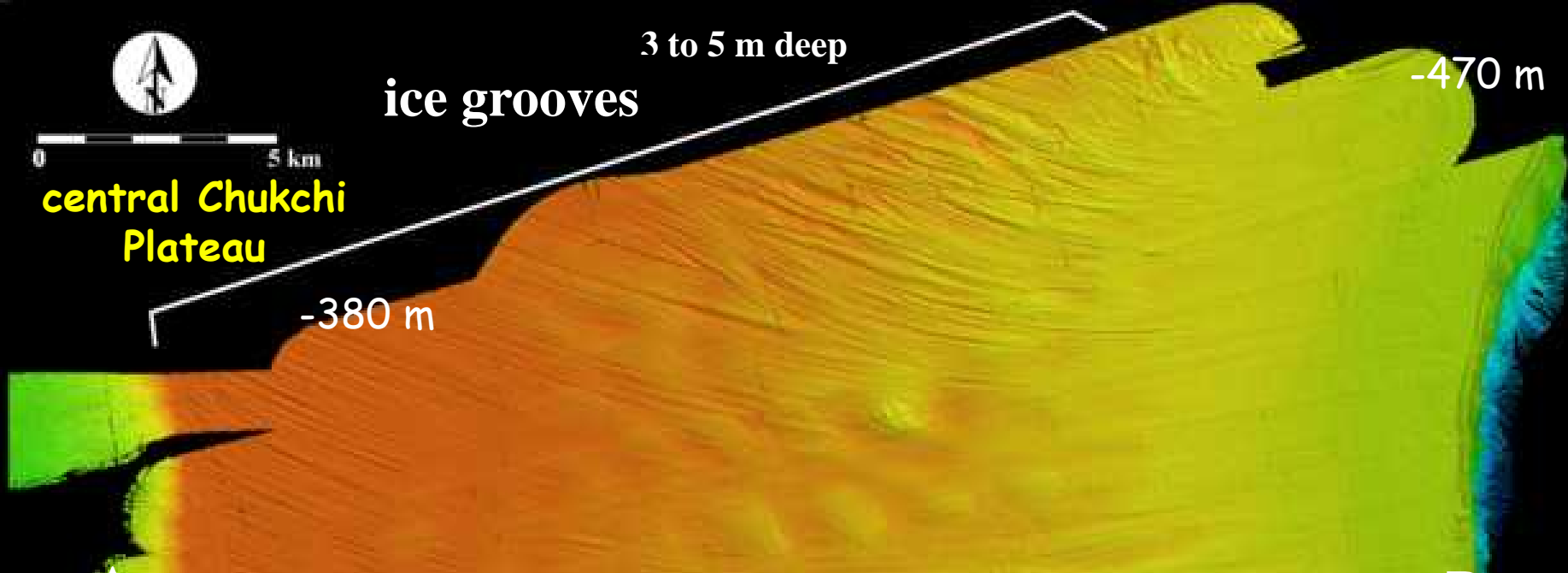
scours
& bedforms



Barrow margin

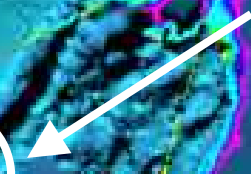
Pt Barrow





2003, 2004 & 2007
Arctic surveys

pockmarks

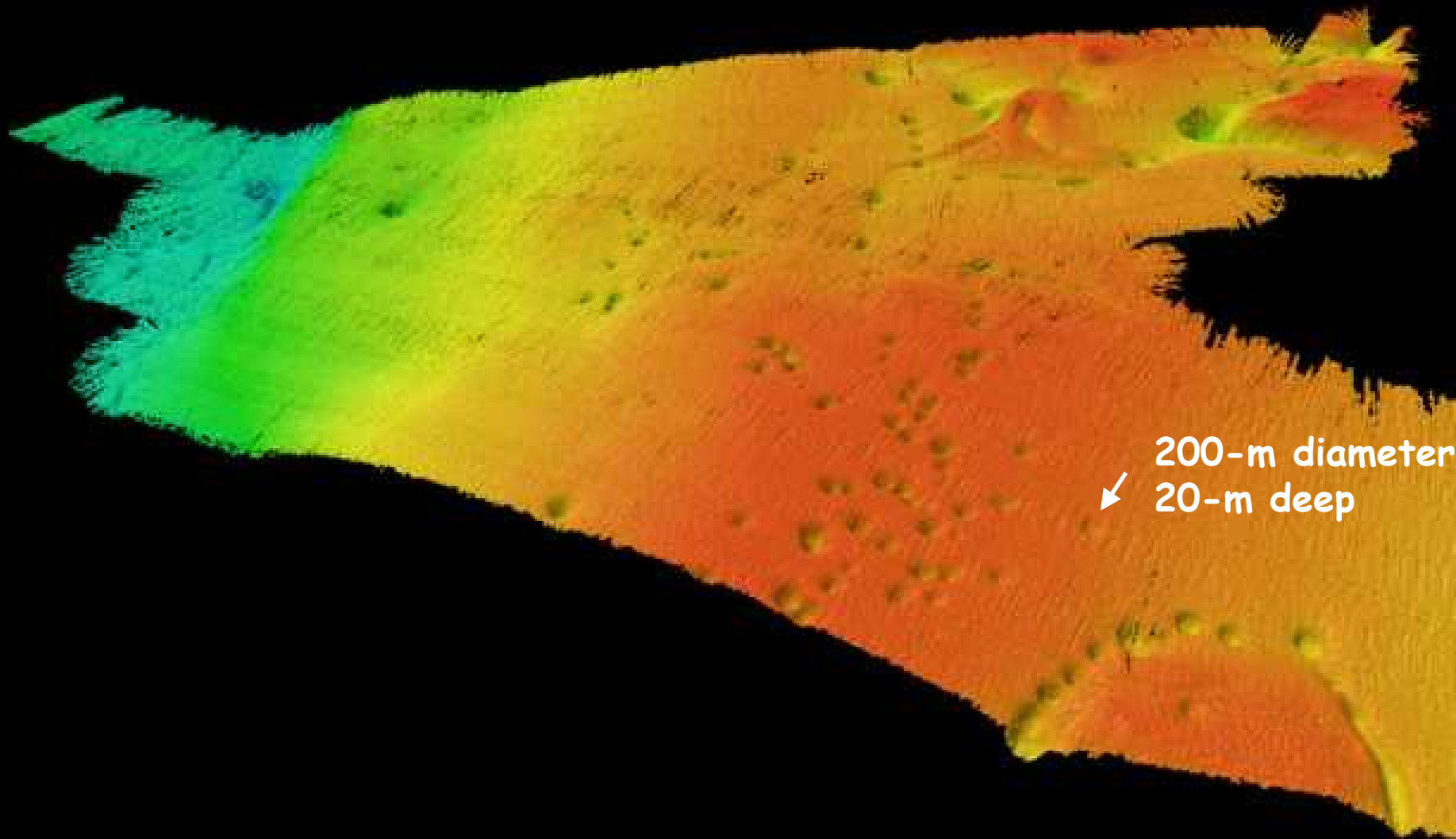


Barrow margin

Pt Barrow



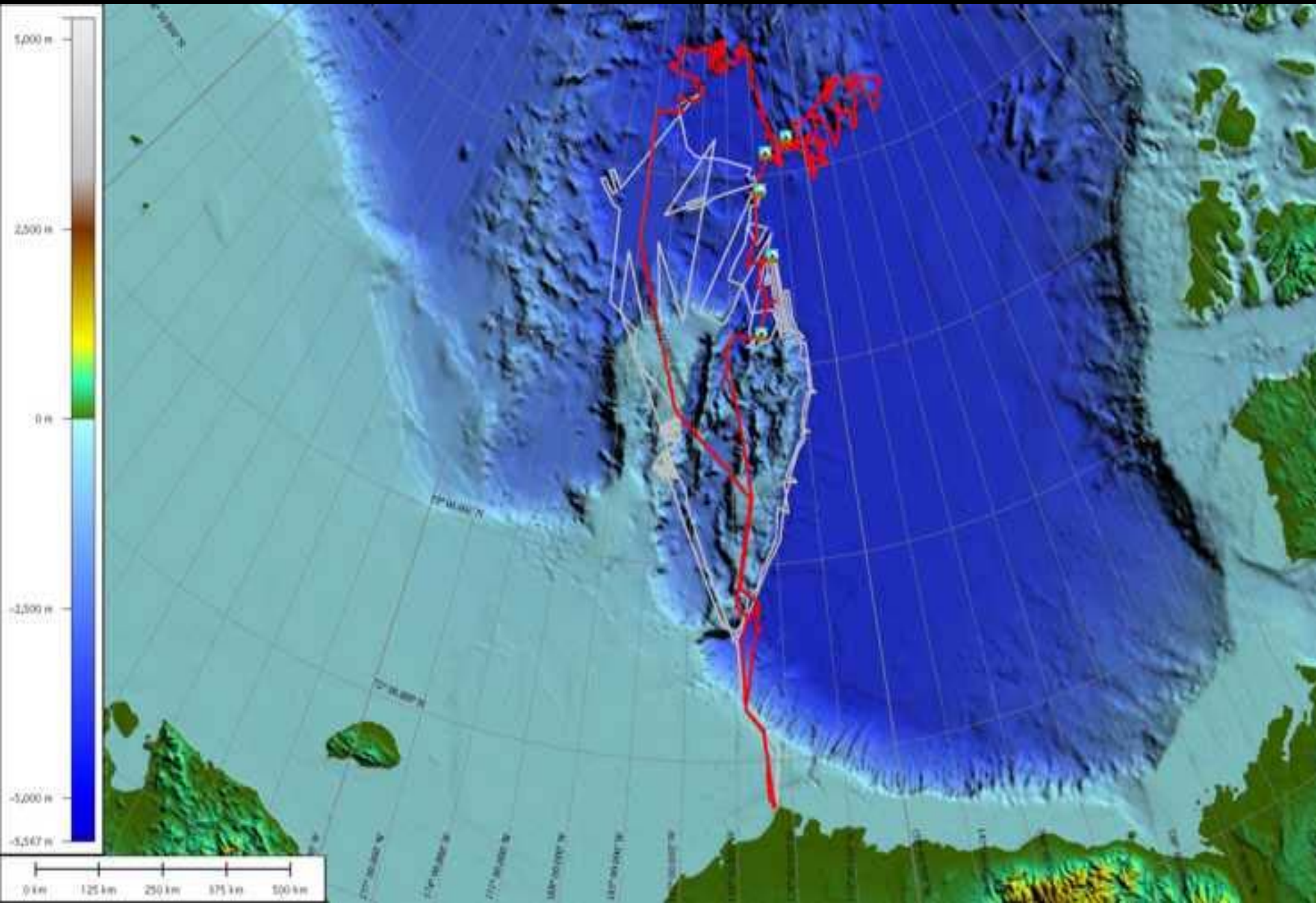
central Chukchi Plateau pockmarks



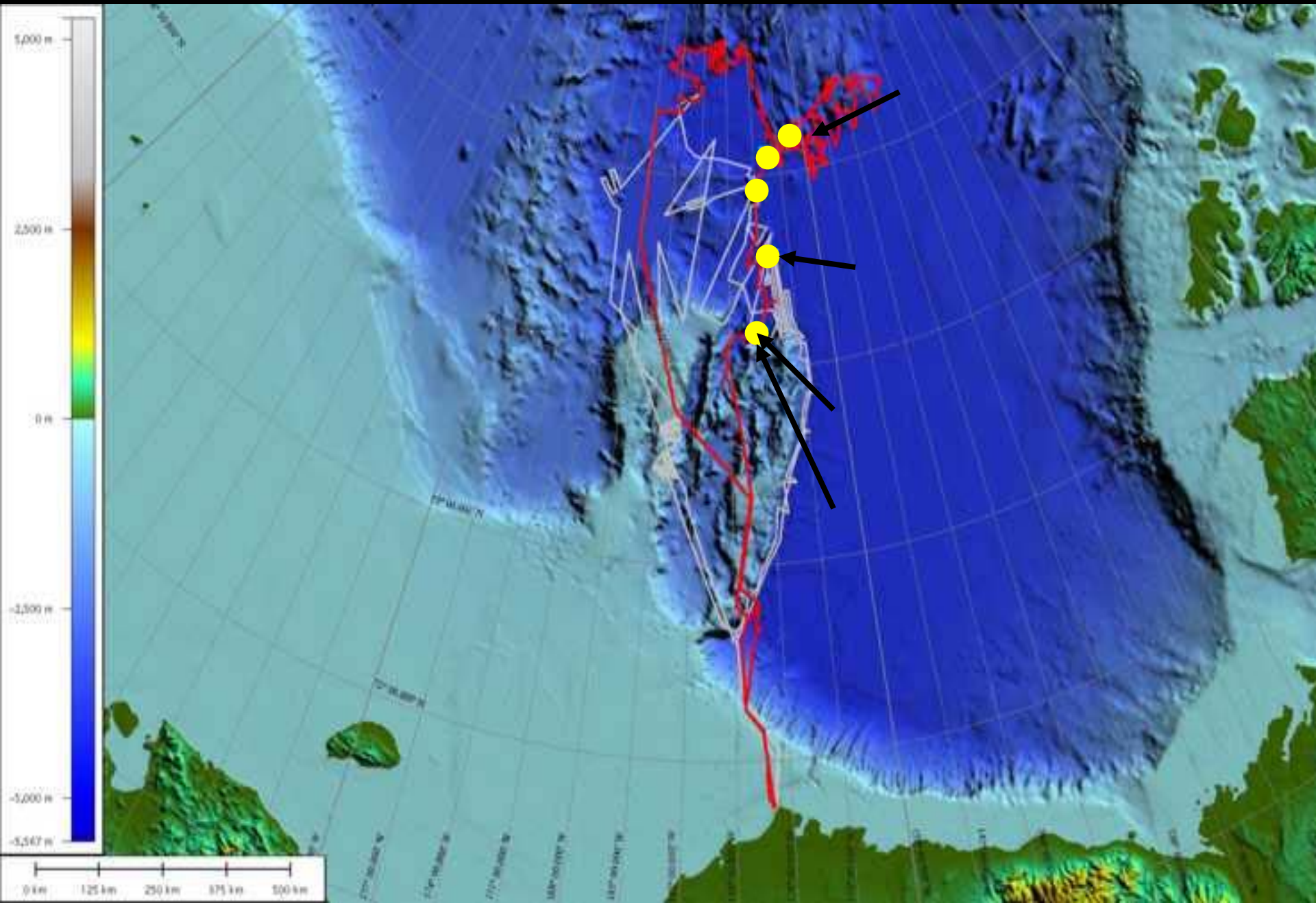
200-m diameter
20-m deep

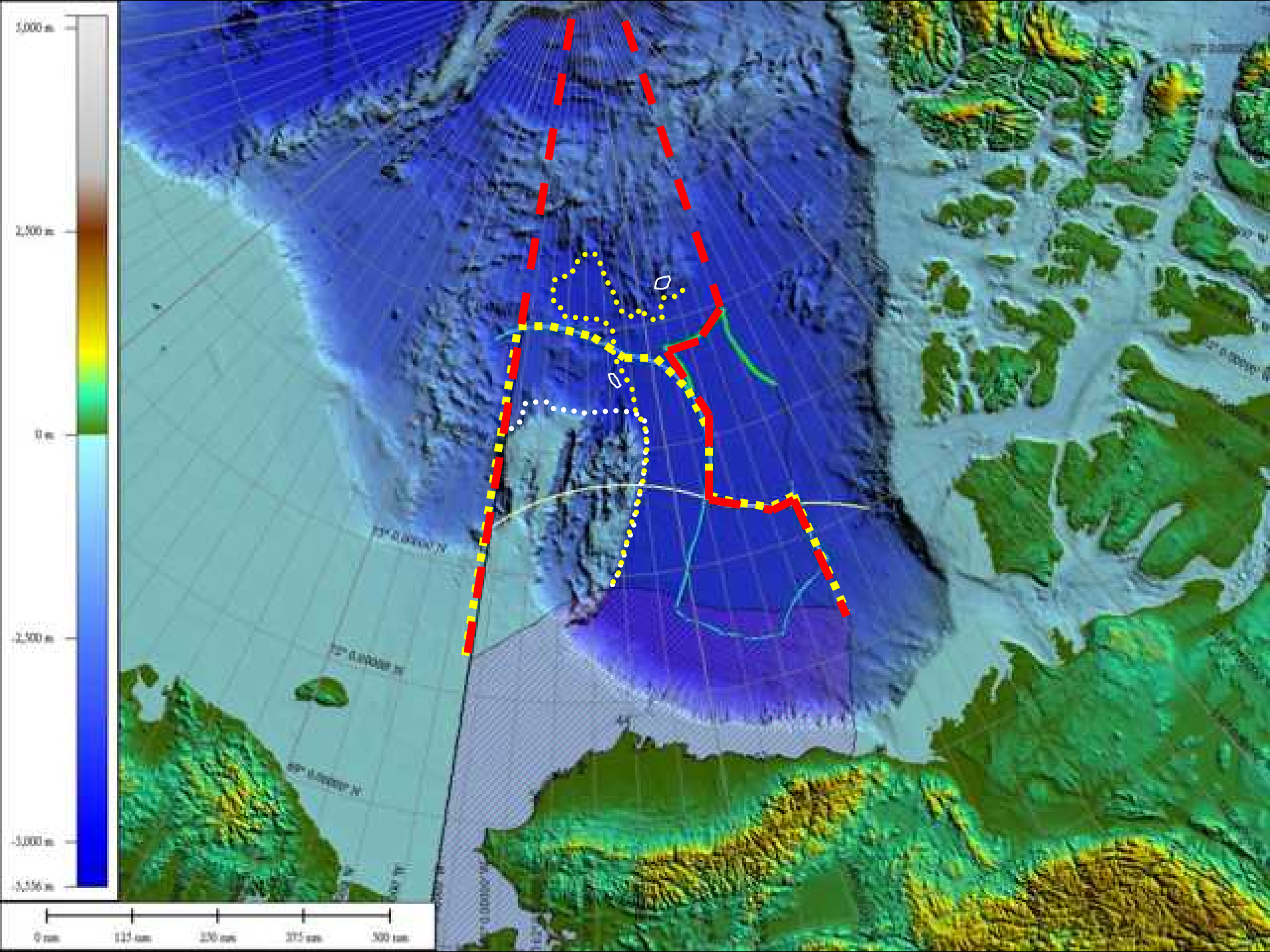
VE = 10x
looking SW

HEALY 0805 - SHIPTRACK



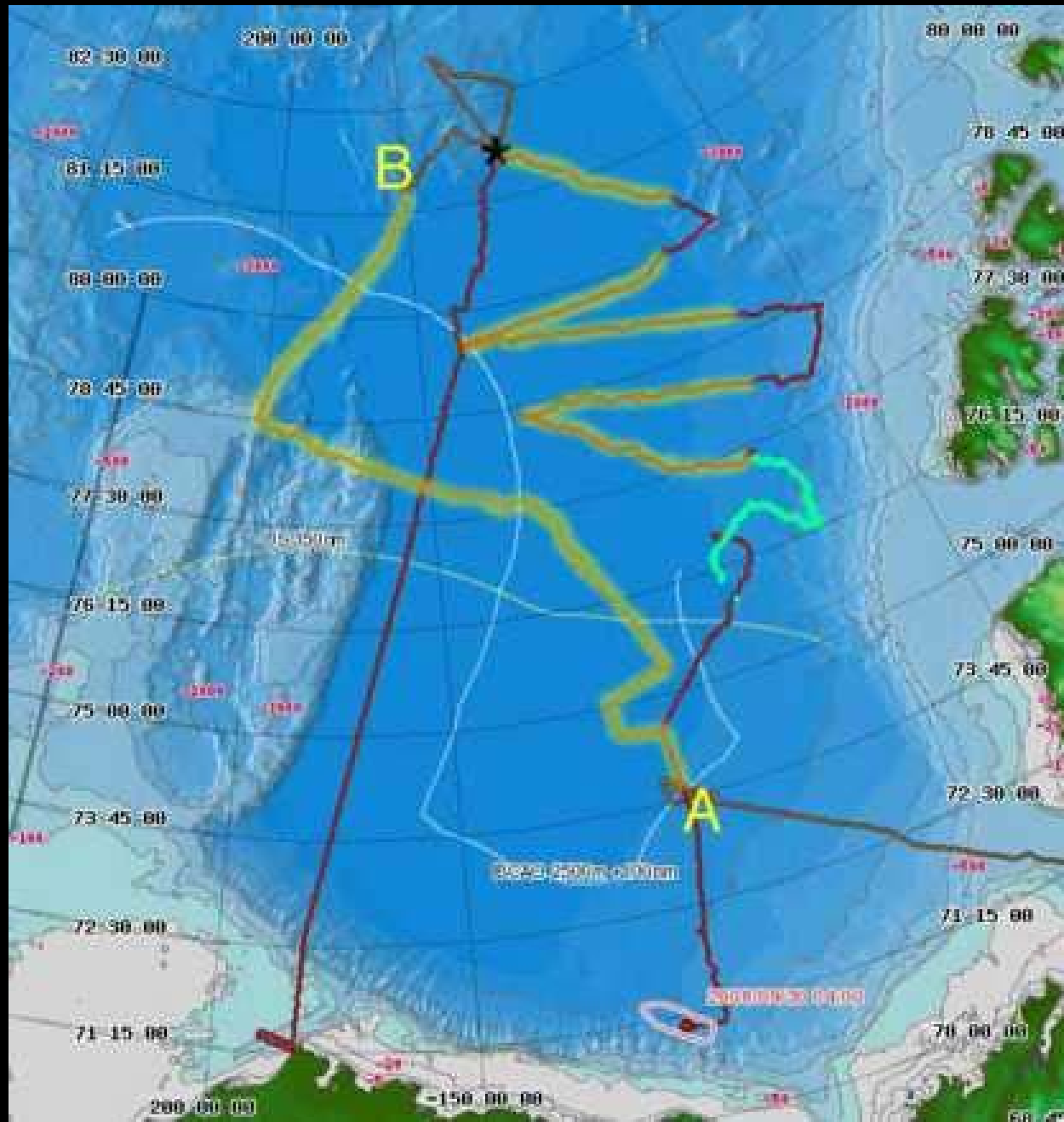
HEALY 0805 - SHIPTRACK AND DREDGE SITES







HEALY 0806 and LOUIS St. LAURENT WORK



165°E 170°E 175°E 180° 175°W 165°W 150°W 135°W 120°W 105°W 95°W 85°W 80°W 75°W

Explanation

- Multibeam
- Singlebeam
- Healy08050DredgePts
- MCS2008
- MCS2007



Barrow, Alaska

Kilometers
0 150 300 600

www.ccom.unh.edu

**Center for Coastal & Ocean Mapping
Joint Hydrographic Center**

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Resources

Today at CCOM JHC is: **Tuesday - January 18, 2006**

The documentary of the Sumatra Earthquake and Tsunami Offshore Survey (SEATOS 2005) will be on the Discovery channel 12/22 and 12/23/05.

The North Pole Heats Up - 12/1/05 Newsweek International Edition.

As Polar Ice Turns to Water, Dreams of Treasure Abound - 10/10/05 N.Y. Times

Lost City Expedition - to study the hydrothermal vent field, located in the middle of the Atlantic. July 2005.

The Center for Coastal and Ocean Mapping (C-COM) Joint Hydrographic Center (JHC) is a recently established University of New Hampshire program aimed at creating a national center for expertise in ocean mapping and hydrographic sciences. Guided by a Memorandum of Understanding with the National Oceanic and Atmospheric Administration (NOAA), the JHC operates in partnership with NOAA's National Ocean Service. The C-COM is a University Center that expands the scope of interaction and cooperation with the private sector, other government agencies and universities. In addition to NOAA support, C-COM currently has projects underway funded by the US Geological Survey, the Office of Naval Research, the Naval Research Lab, DARPA, NSF and several private sector partners. The centers focus their activities on two major tasks, an educational task, aimed at creating a learning center that will promote and foster the education of a new generation of hydrographers and ocean mapping scientists, and a research task aimed at developing and evaluating a wide range of state-of-the-art hydrographic and ocean mapping technologies and applications.

The Center's graduate degree program in ocean mapping has been awarded Category A Recognition by the International Federation of Surveyors /International Hydrographic Organization /International

HEALY 03-02 cruise

GREAT BAY ESTUARY, NH

LAW OF THE SEA STUDY

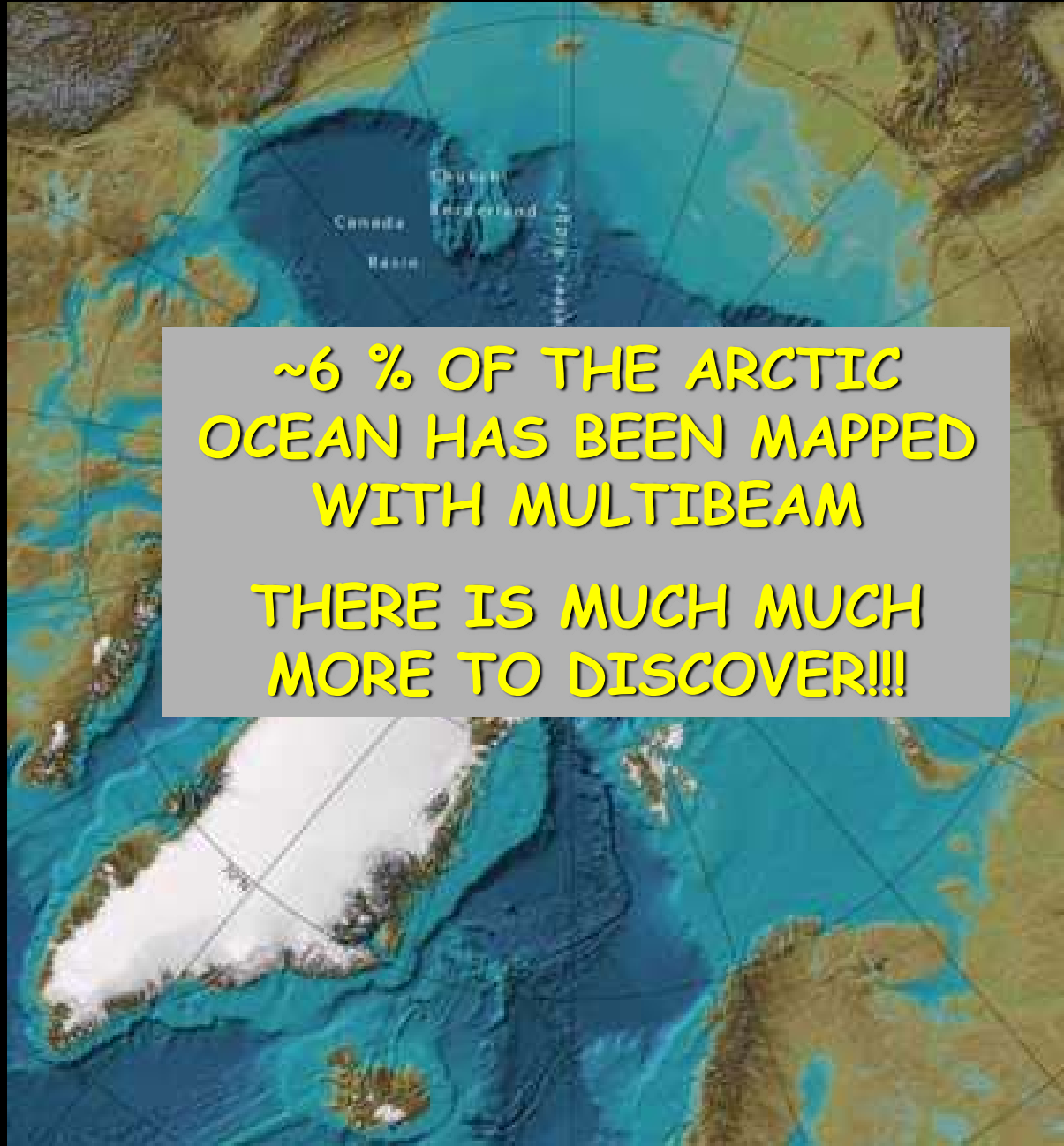
ScapaMAP

DATA VISUALIZATION RESEARCH LAB

D-Day 1944

ALSO
available
through
NGDC
and
LDEO
GeoMapApp

IBCAO 2008



**~6 % OF THE ARCTIC
OCEAN HAS BEEN MAPPED
WITH MULTIBEAM**

**THERE IS MUCH MUCH
MORE TO DISCOVER!!!**



