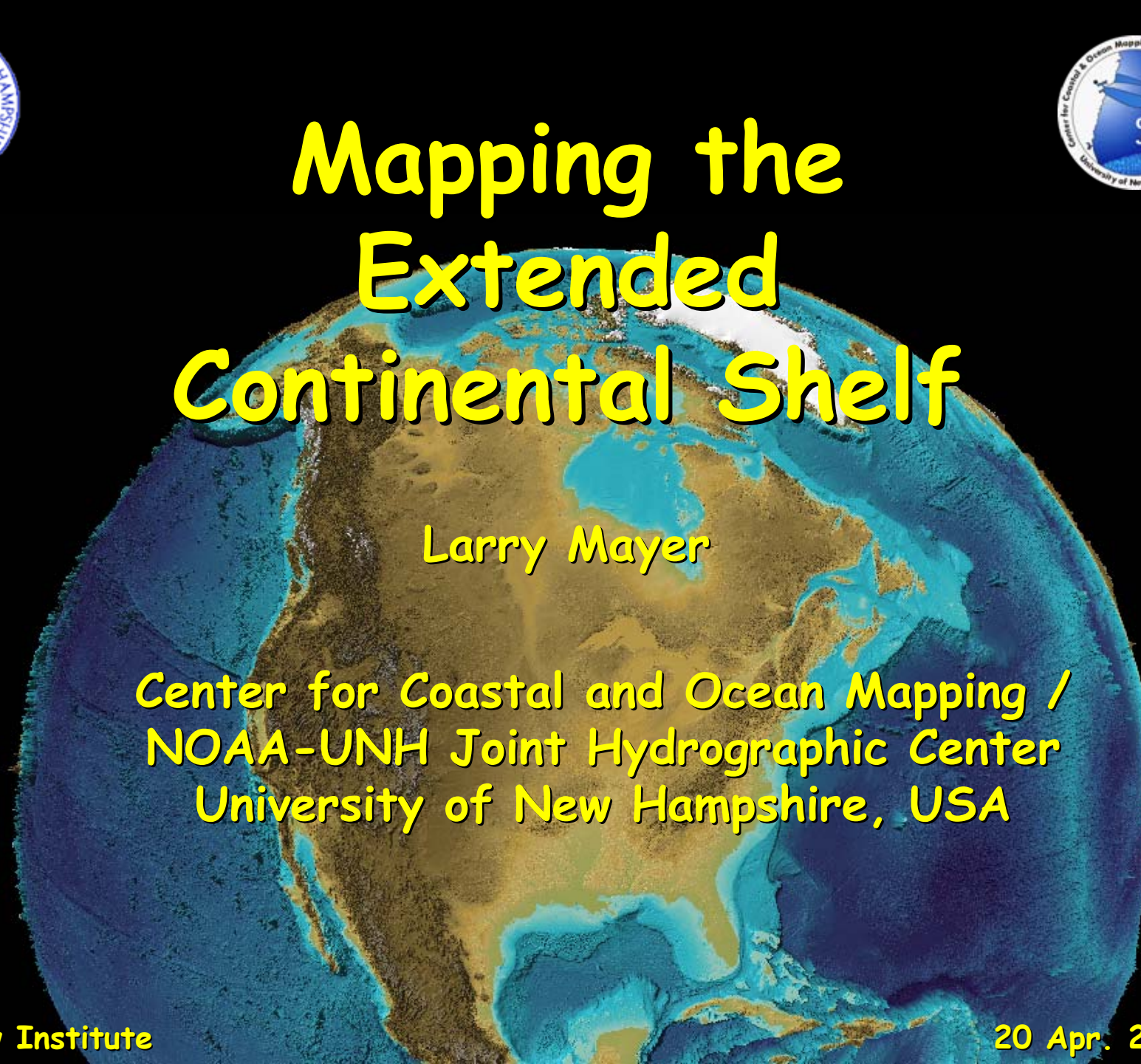
Mapping the Extended Continental Shelf



Larry Mayer

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

United Nations Convention on the Law of the Sea

Article 76

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

UNCLOS Article 76

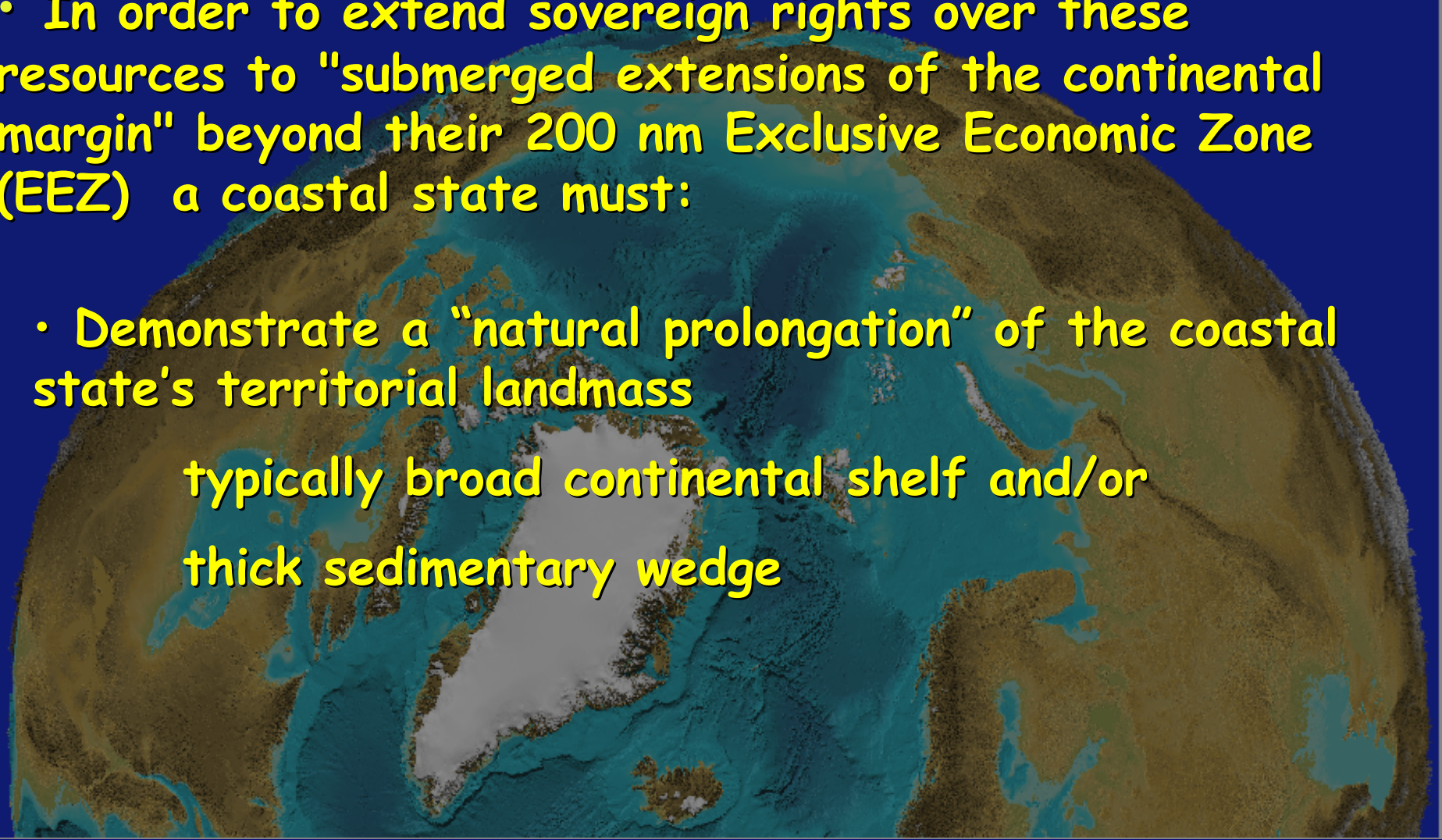
The Process

- In order to extend sovereign rights over these resources to "submerged extensions of the continental margin" beyond their 200 nm Exclusive Economic Zone (EEZ) a coastal state must:

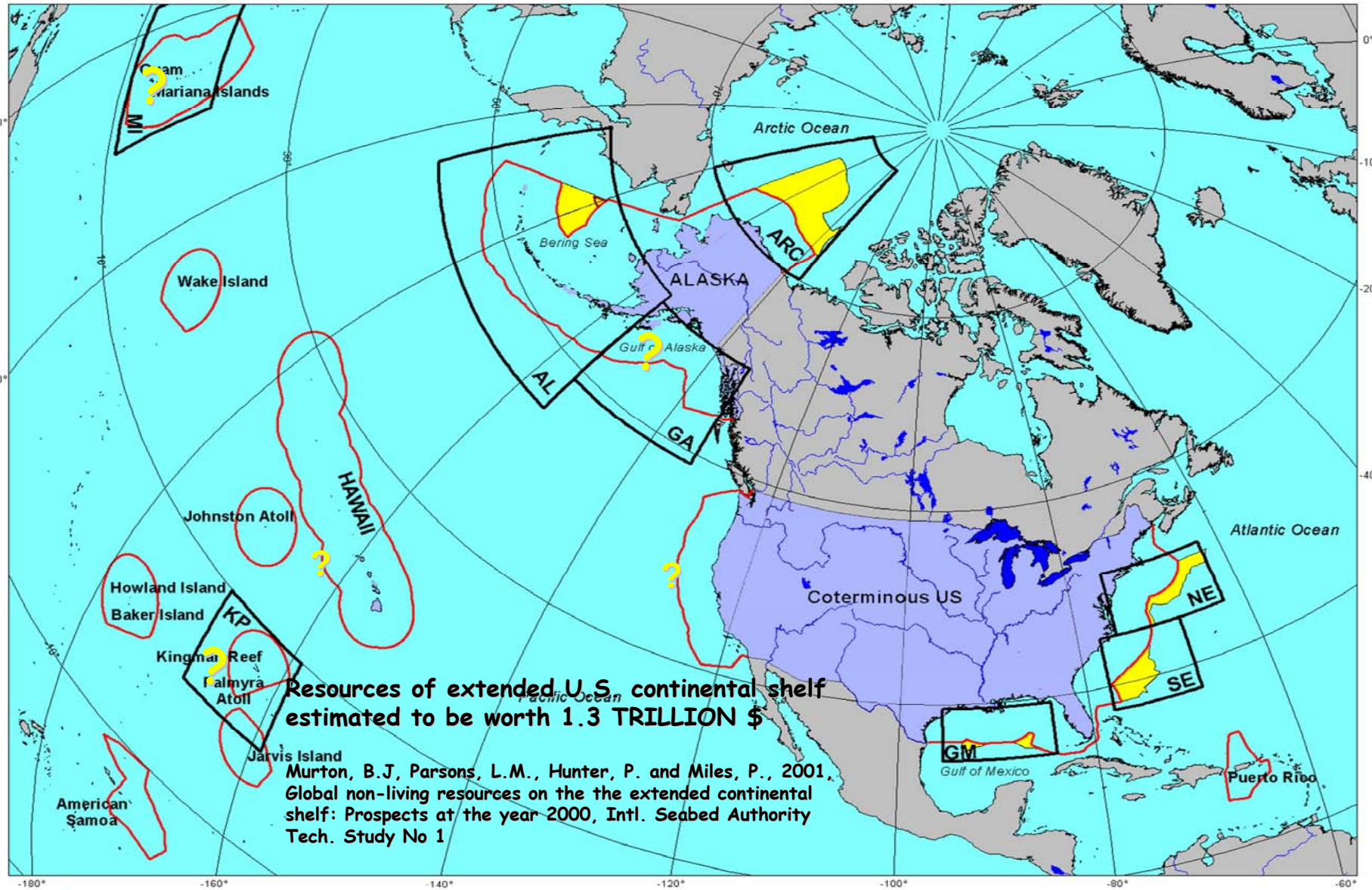
- Demonstrate a "natural prolongation" of the coastal state's territorial landmass

  typically broad continental shelf and/or

  thick sedimentary wedge



POTENTIAL EXTENSION OF U.S. CONTINENTAL SHELF UNDER UNCLOS ARTICLE 76



POTENTIAL EXTENSION OF U.S. CONTINENTAL SHELF UNDER UNCLOS ARTICLE 76

This figure shows the current U.S 200 nautical mile EEZ limit (red lines) along with eight areas preliminarily identified as having potential for an extended claim and for which further survey work has been recommended (black boxes). Yellow areas represent a very rough preliminary estimate of the potential extension of the juridical shelf limits under Article 76 guidelines for five of these regions (total additional area beyond existing EEZ is approximately 960,000 sq. km). For the other three regions (Guam/Marianas, Kingman/Palmyra, and the Gulf of Alaska) sufficient information to estimate a potential claim has not yet been collected. Potential claim areas have been estimated without regard for international boundary treaties. Both treaty negotiations and new data collection may alter these estimates. The limits presented in this figure are the result of an academic study and do not represent the position of the United States Government. Further details on the recommended survey areas can be found in Mayer, L.A., Jakobsson M., and Armstrong, A., 2002, The Compilation and Analysis of Data Relevant to a U.S. Claim under UNCLOS Article 76: A Preliminary Report, http://www.ccom.unh.edu/unclos.

Projection: Lambert Azimuthal Equal Area
Datum: WGS 84

Map compiled by:
Martin Jakobsson,
Andy Armstrong and Larry Mayer
Center for Coastal and Ocean Mapping
Joint Hydrographic Center
University of New Hampshire, NH, USA

Data Required

- Once the natural prolongation is established the extended continental shelf beyond the 200 nm EEZ is determined by a set of formulae and limit lines defined from the:
  - 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)

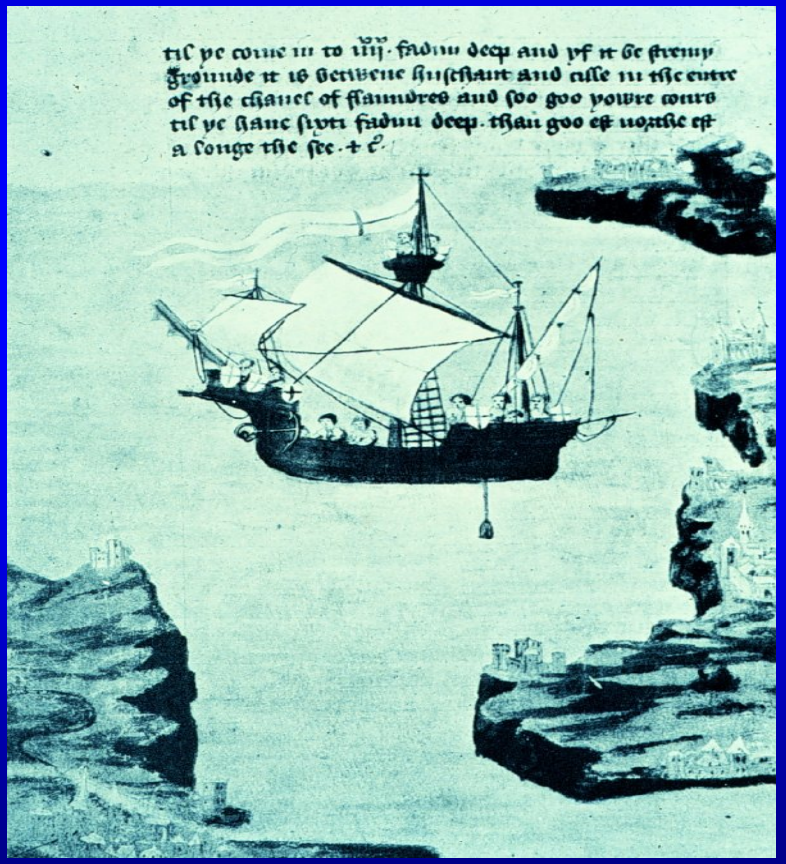
Need to map the seafloor!!

The Lead Line

Boat model retrieved from the tomb of Meket-re who was buried at Thebes in about 2000 BC. From, The Ocean Basins:Their Structure and Evolution , The Open University

The History of Ocean Mapping

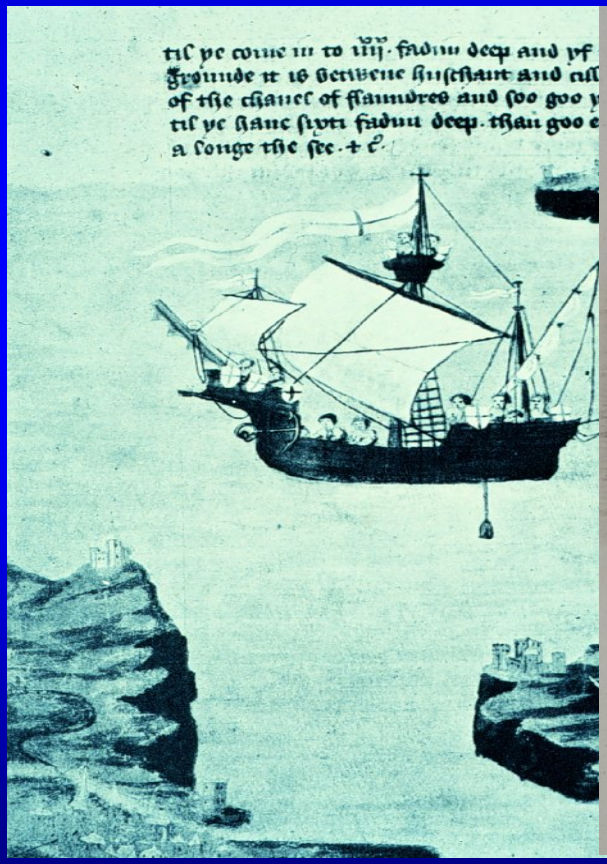
Lead Line:



1450

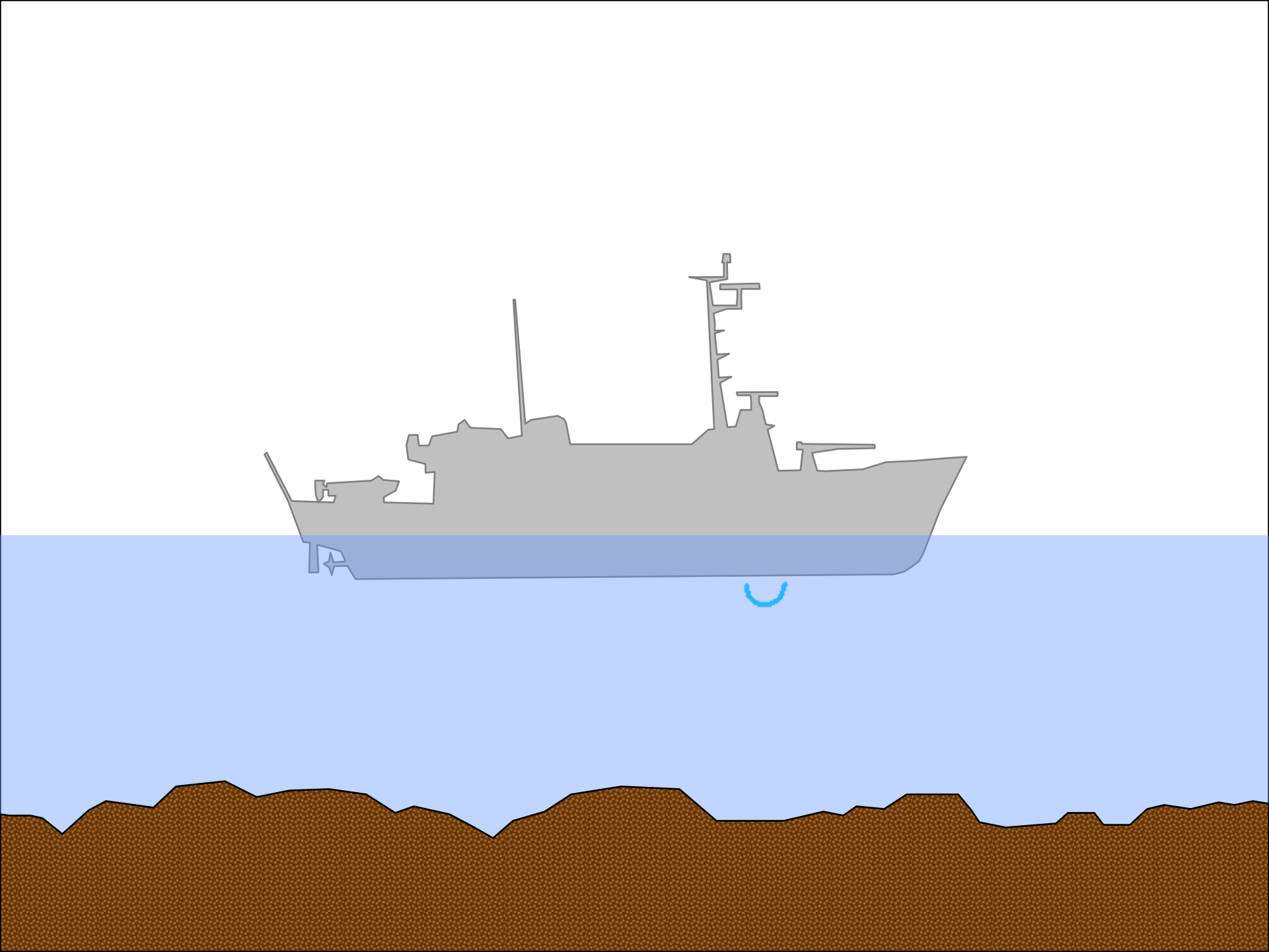
The History of Ocean Mapping

Lead Line:

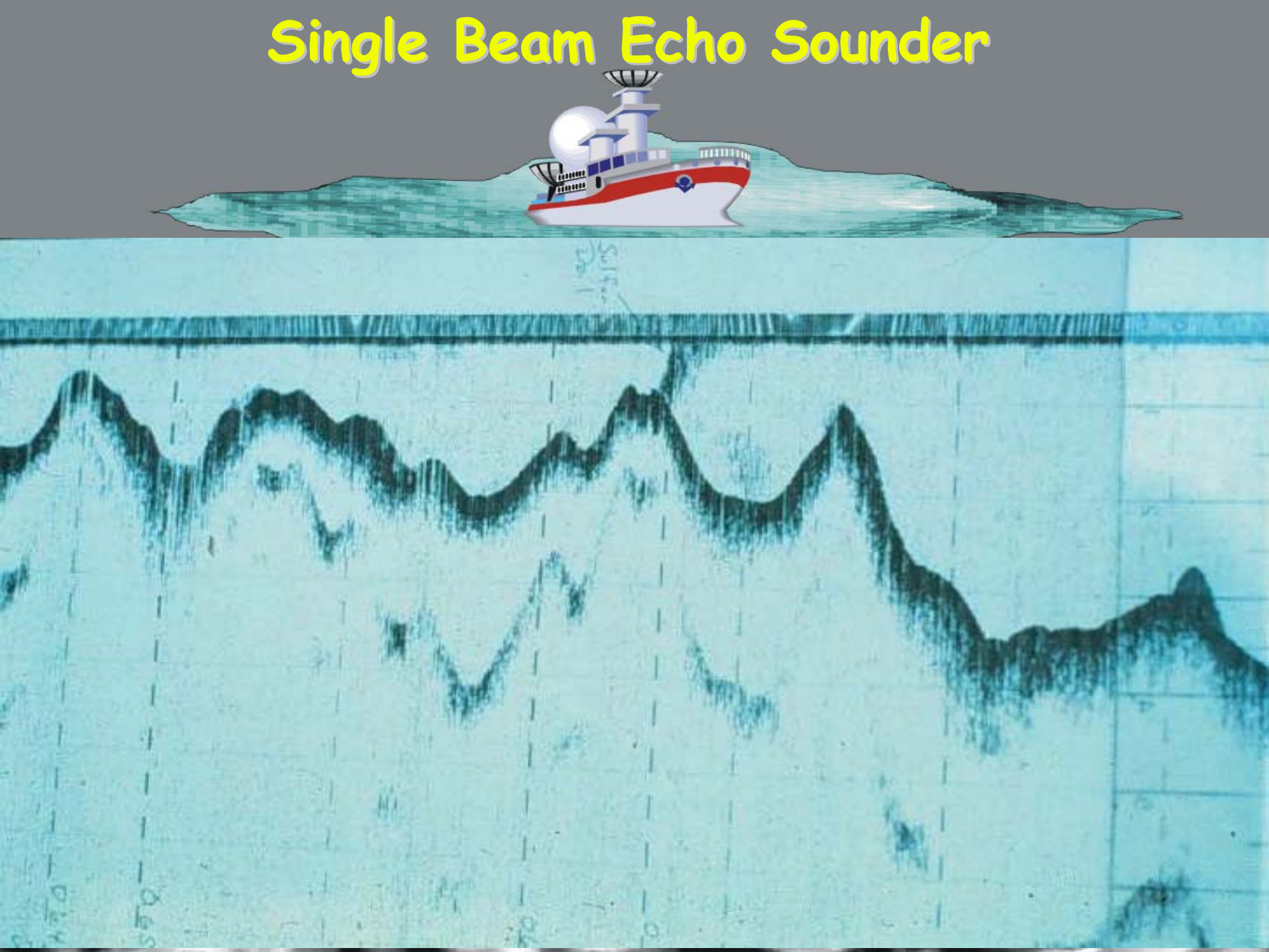


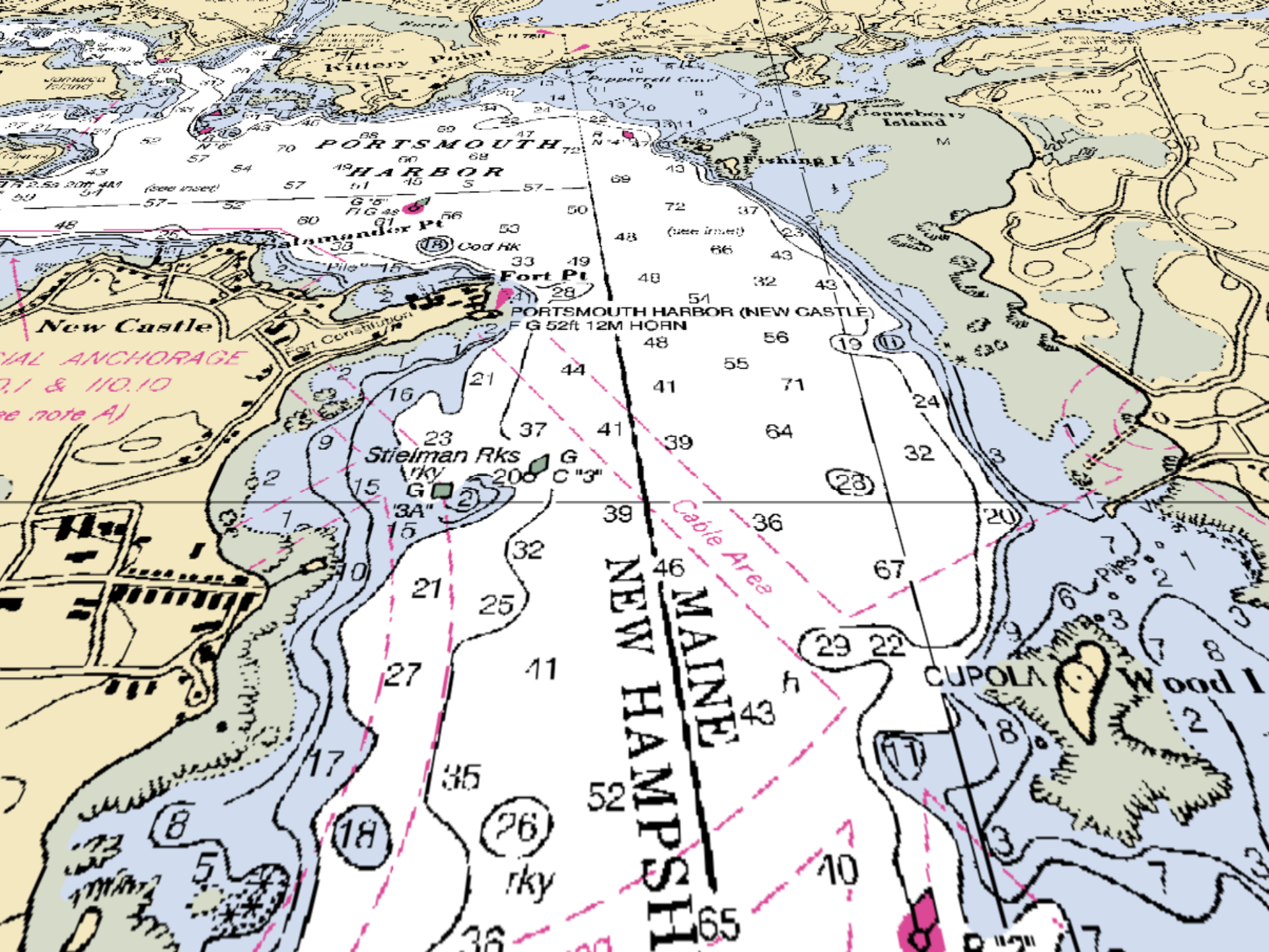
1450

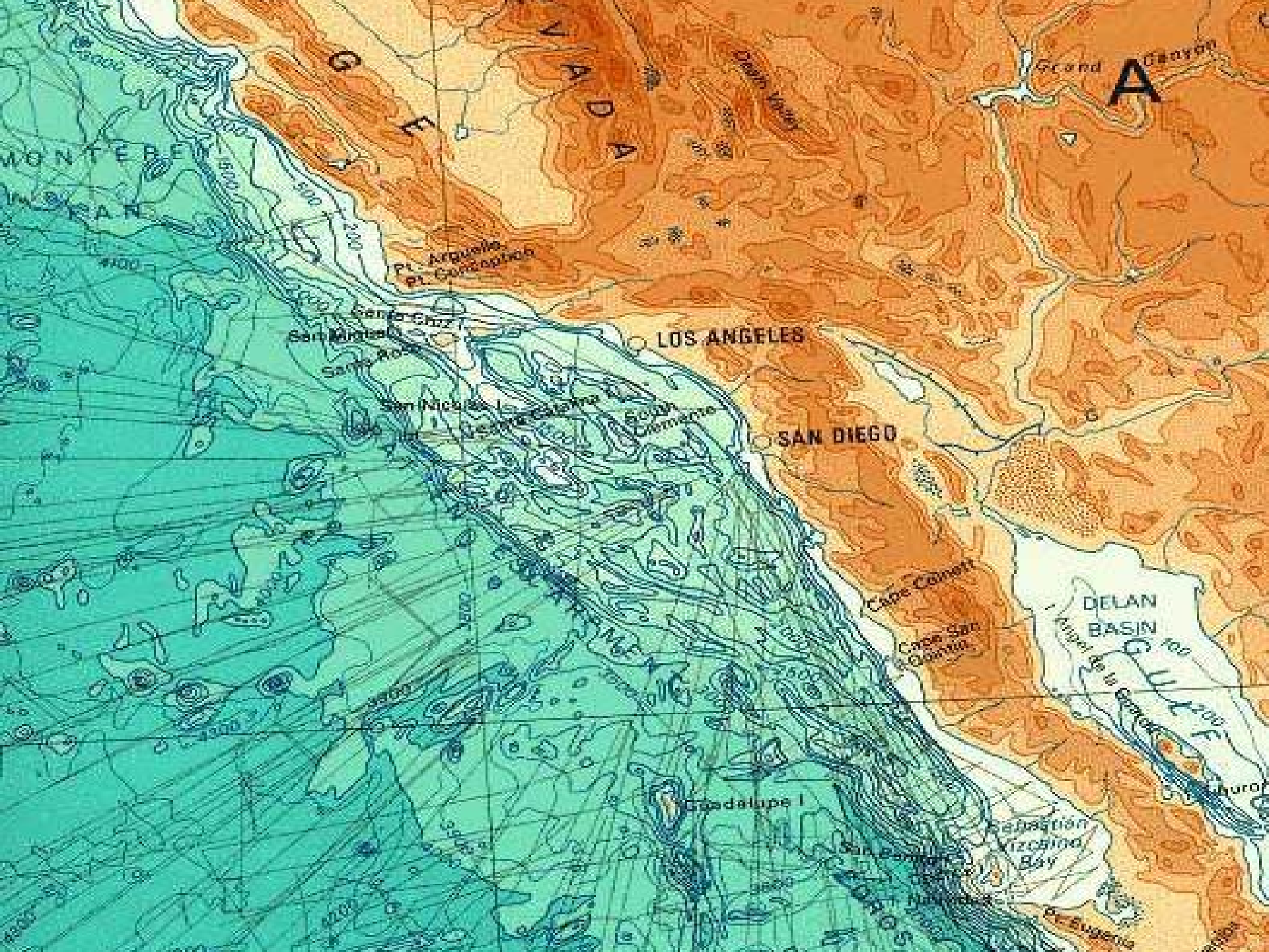
1940



Single Beam Echo Sounder




PORTSMOUTH HARBOR
Kittery Point
Gooseberry Island
Fishing I
(see inset)
Fl G 4s
Palmyndor Pt
Cod Rk
Fort Pt
PORTSMOUTH HARBOR (NEW CASTLE)
F G 52ft 12M HORN
New Castle
Fort Constitution
Stielman Rks
rky
G
C "3"
"3A"
Cable Area
MAINE
NEW HAMPSH
CUPOLA
rky


SIERRA NEVADA
Death Valley
Grand Canyon
A
MONTEREY
Pt. Arguello
Pt. Conception
Santa Cruz I.
San Miguel I.
Santa Rosa I.
LOS ANGELES
San Nicolas I.
Santa Catalina
SAN DIEGO
Cape Colnett
Cape San Quintin
DELAN BASIN
Guadalupe I.
Sebastian Vizcaino Bay
San Benito I.
Natividad
Pt. Eugenia


Multibeam Sonar

Single Beam Sounding

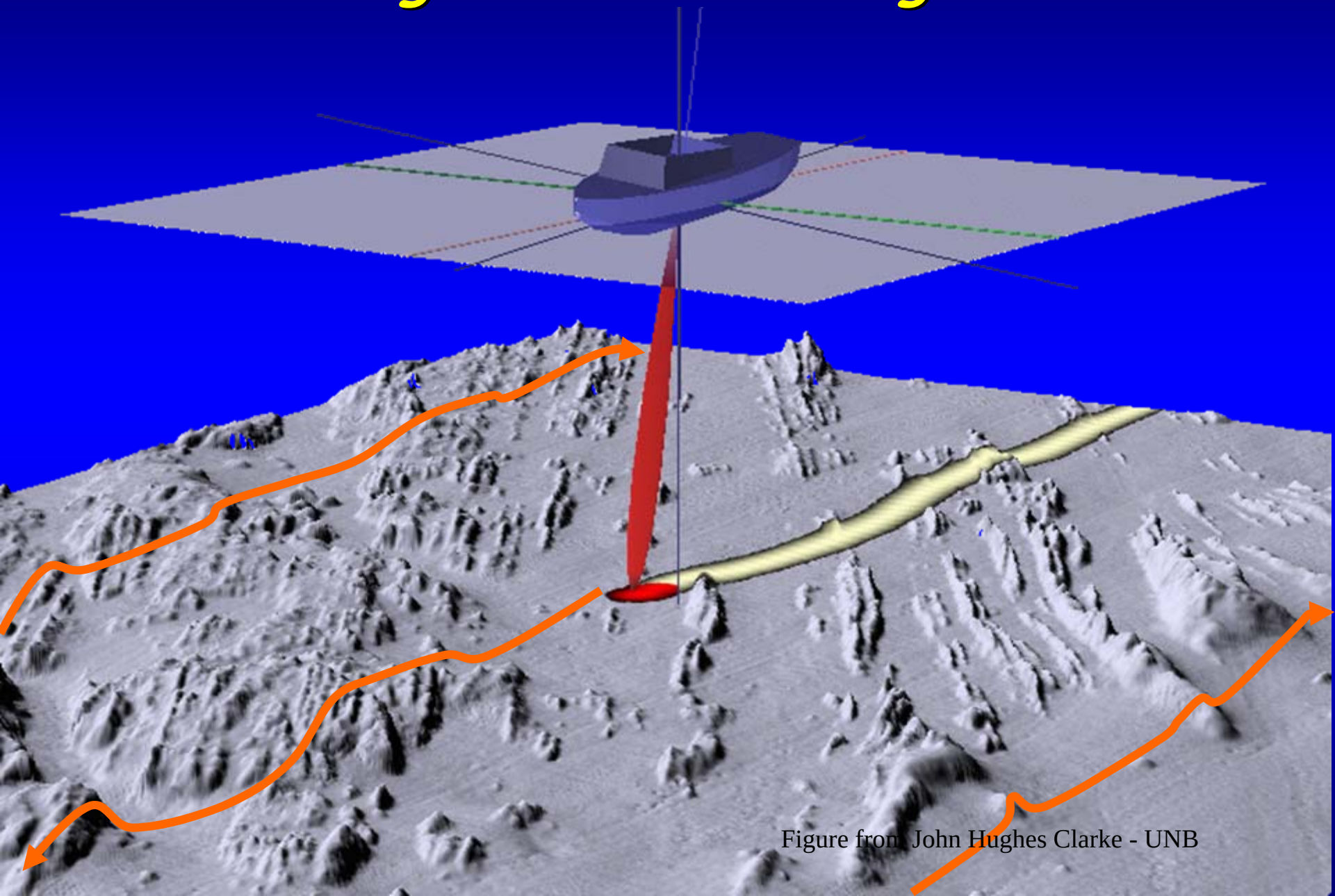


Figure from John Hughes Clarke - UNB

Multibeam Sounding

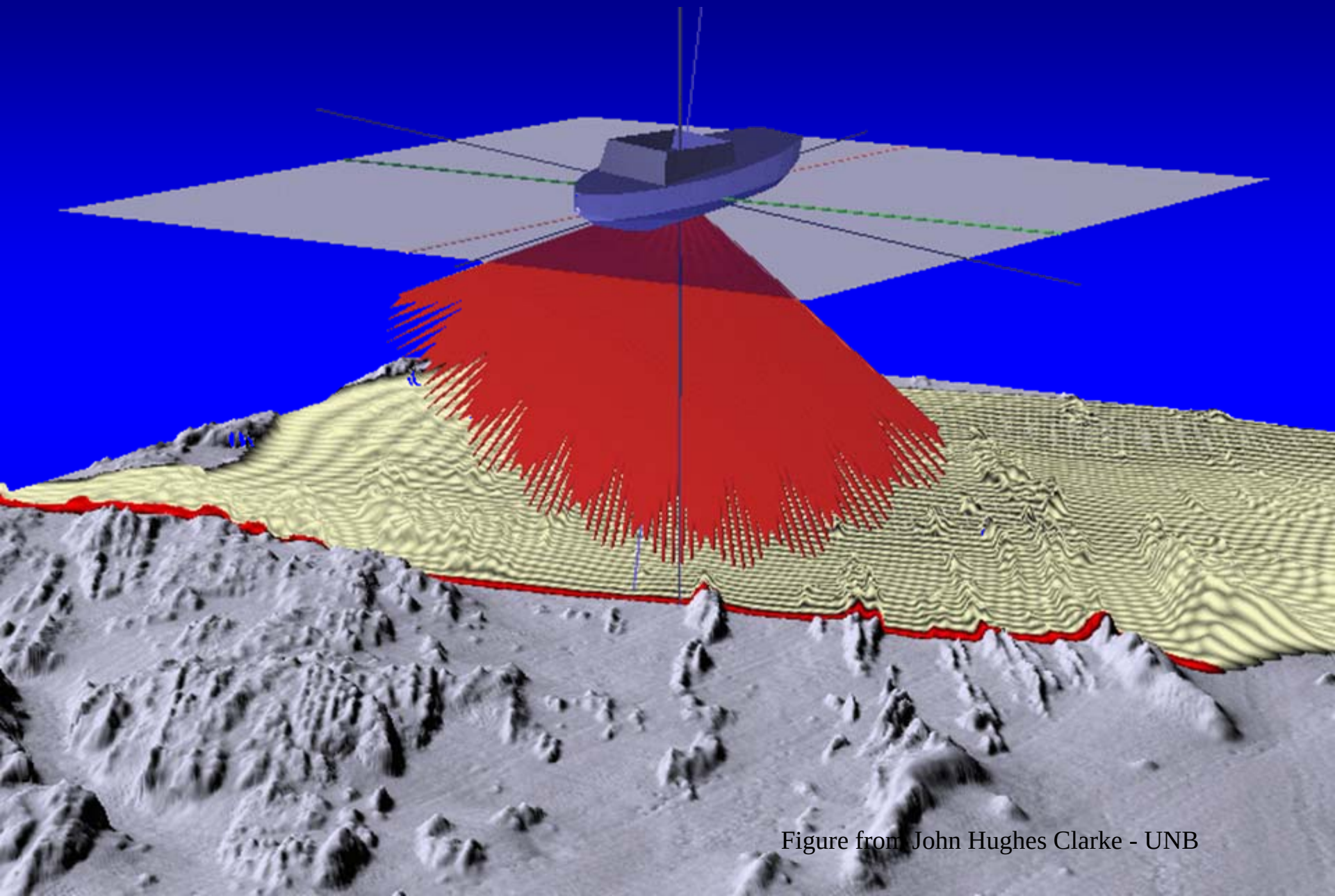
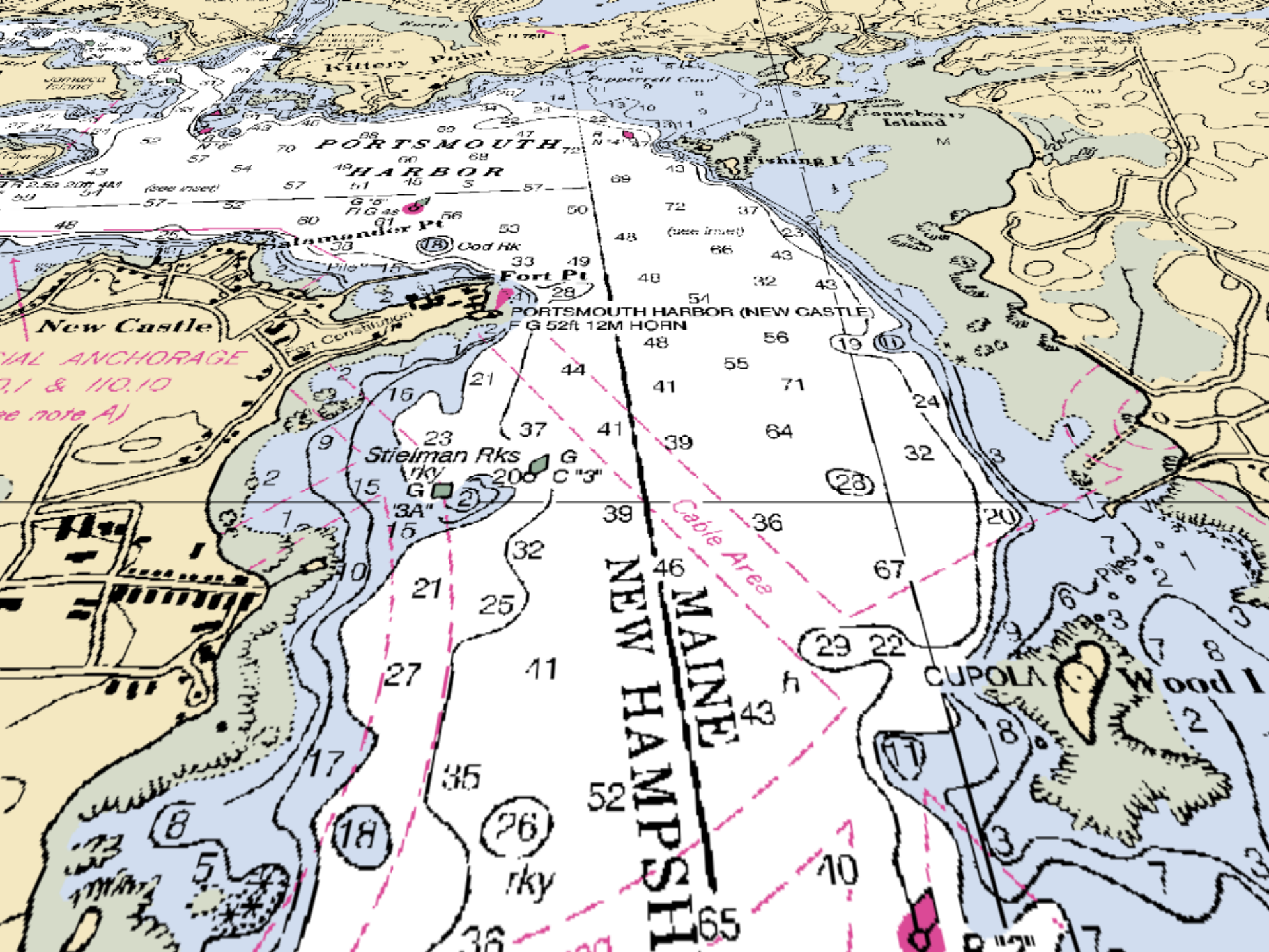


Figure from John Hughes Clarke - UNB


PORTSMOUTH HARBOR
Kittery Point
Gooseberry Island
Fishing I
(see inset)
Fl G 4s
Palmyndor Pt
Cod Rk
Fort Pt
PORTSMOUTH HARBOR (NEW CASTLE)
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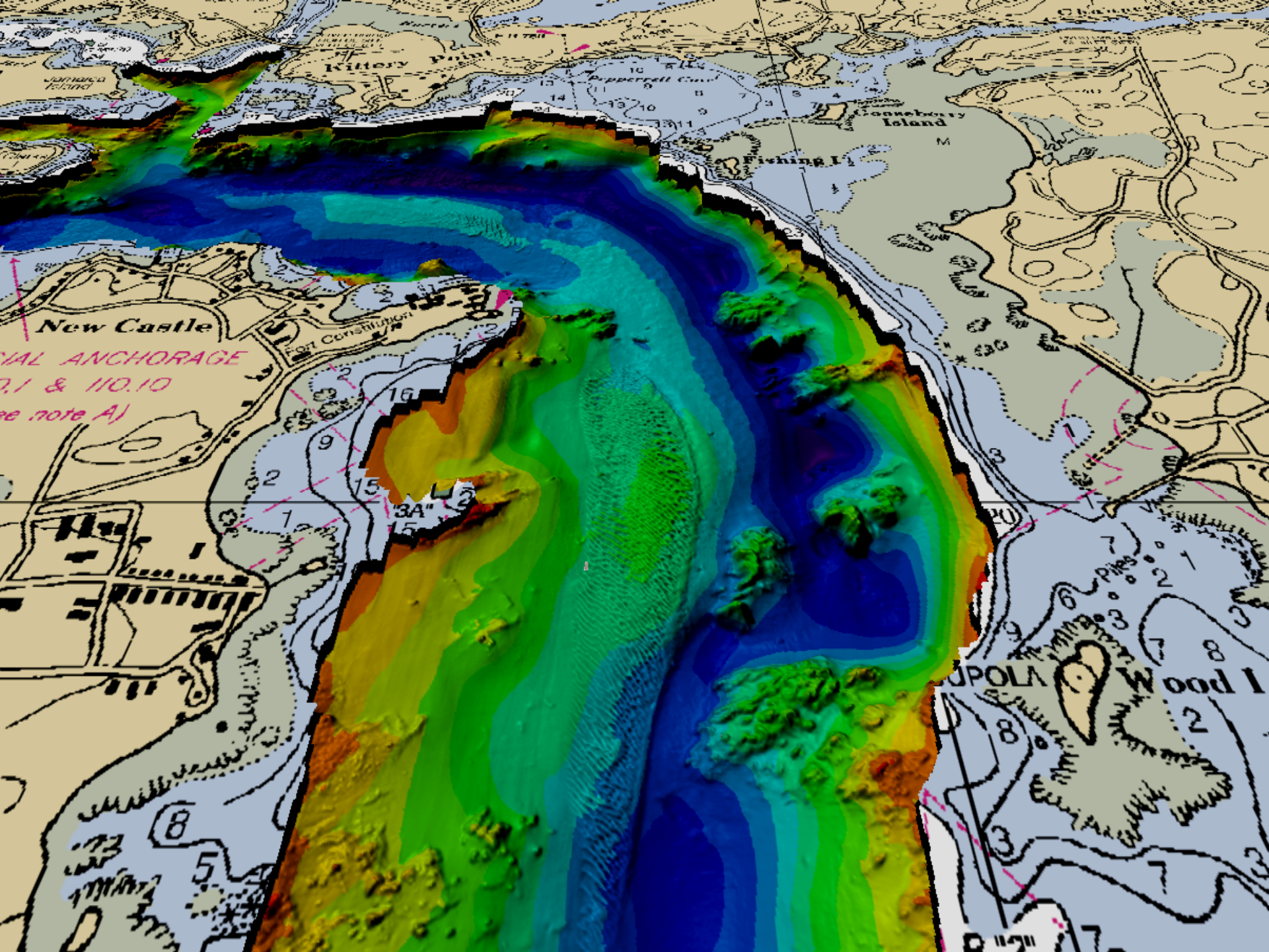
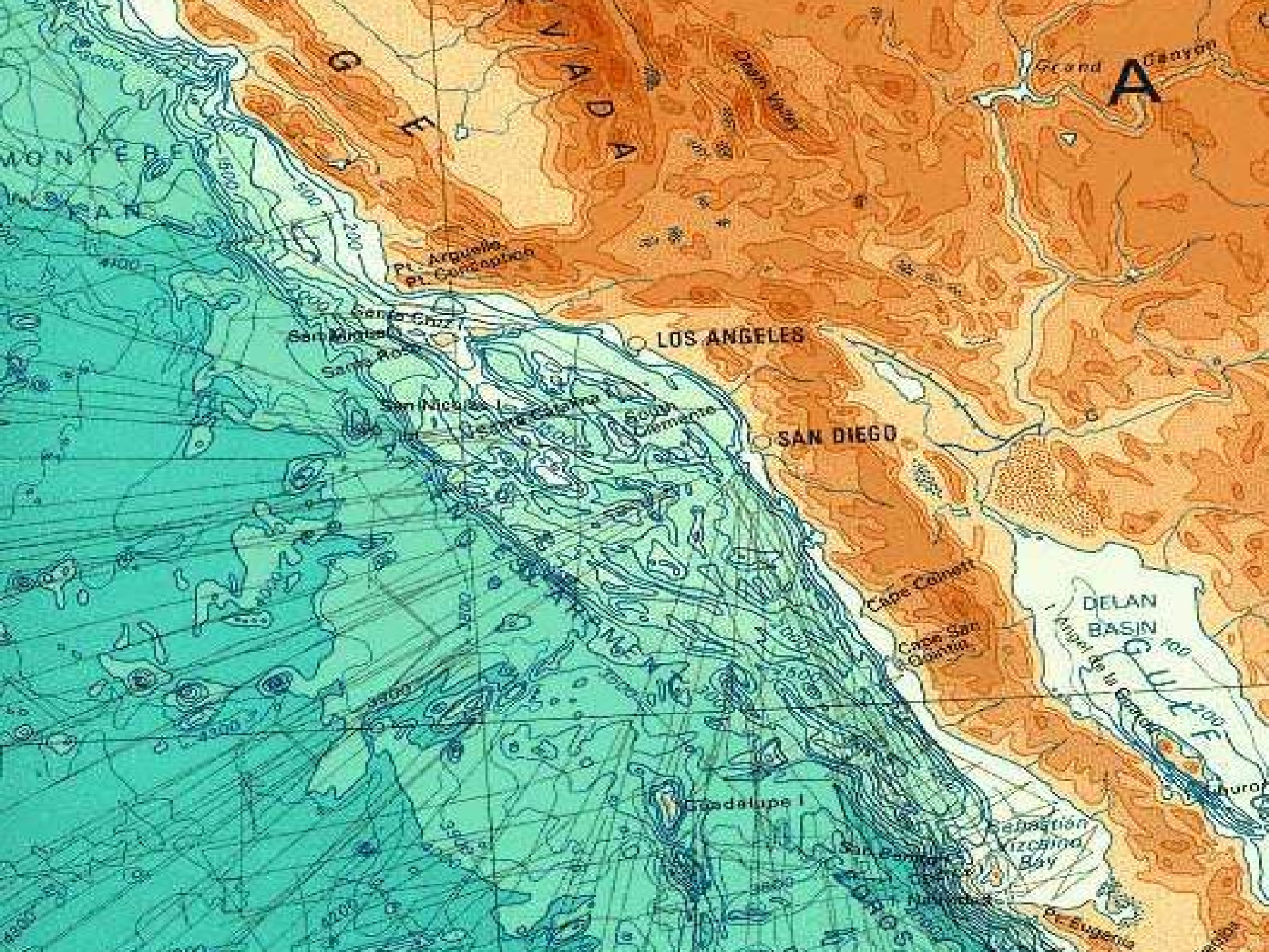
rky


New Castle
Fort Constitution
Kittery Point
Gooseberry Island
Fishing I.
Pepperrell Cove
3A"


SIERRA NEVADA
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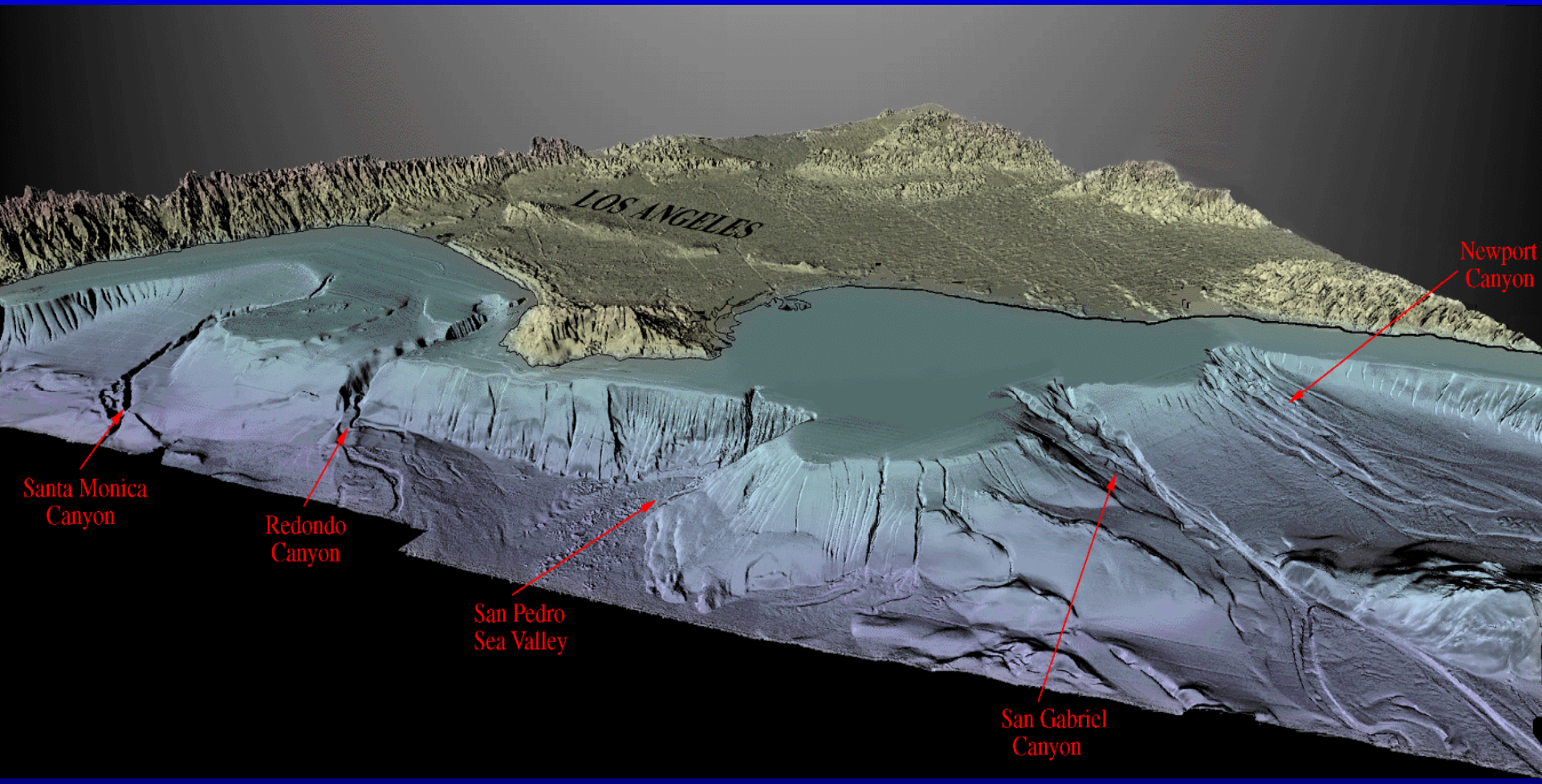
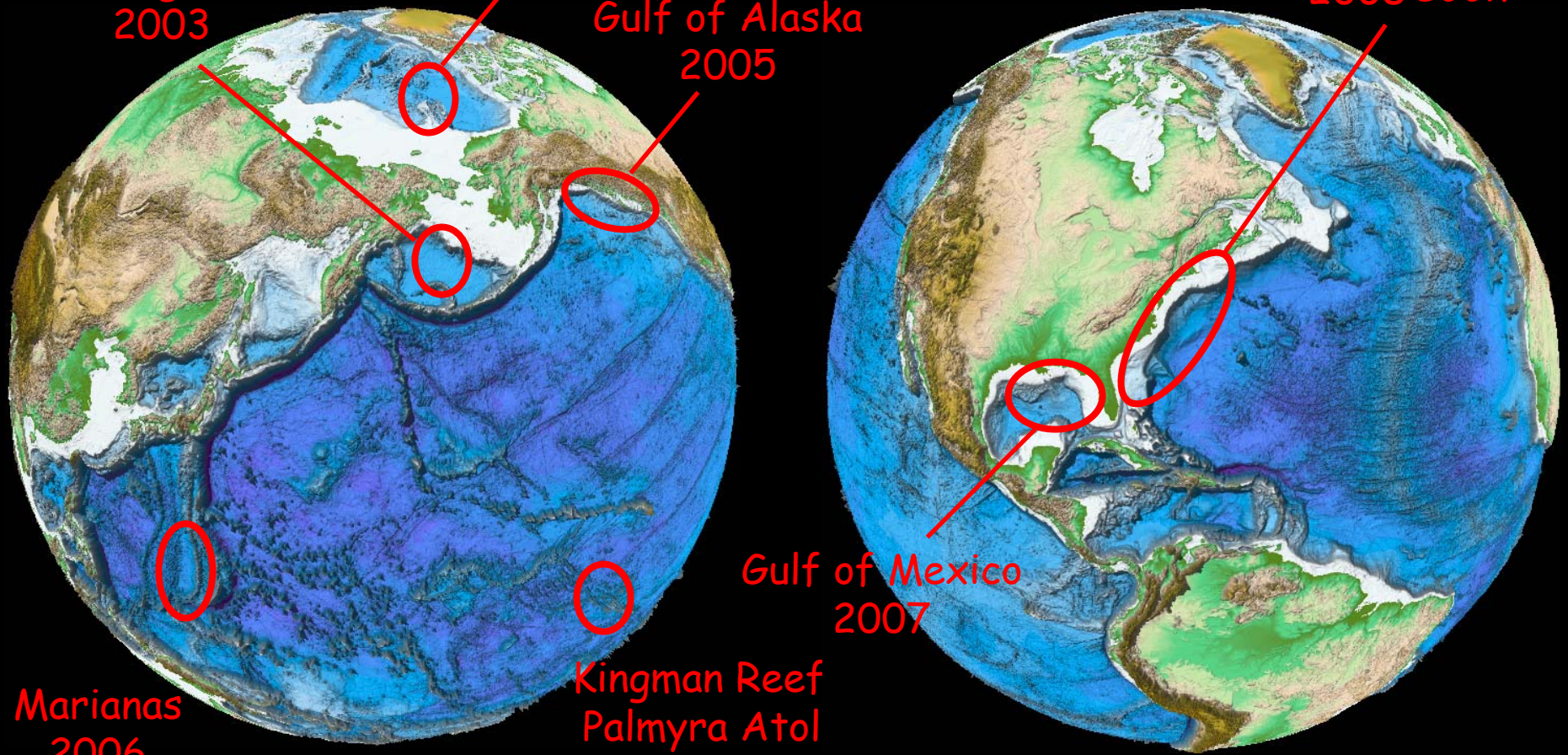
Cape San Quintin
DELAN BASIN
Guadalupe I.
Sebastian Vizcaino Bay
San Benito I.
Natividad
Pt. Eugenia

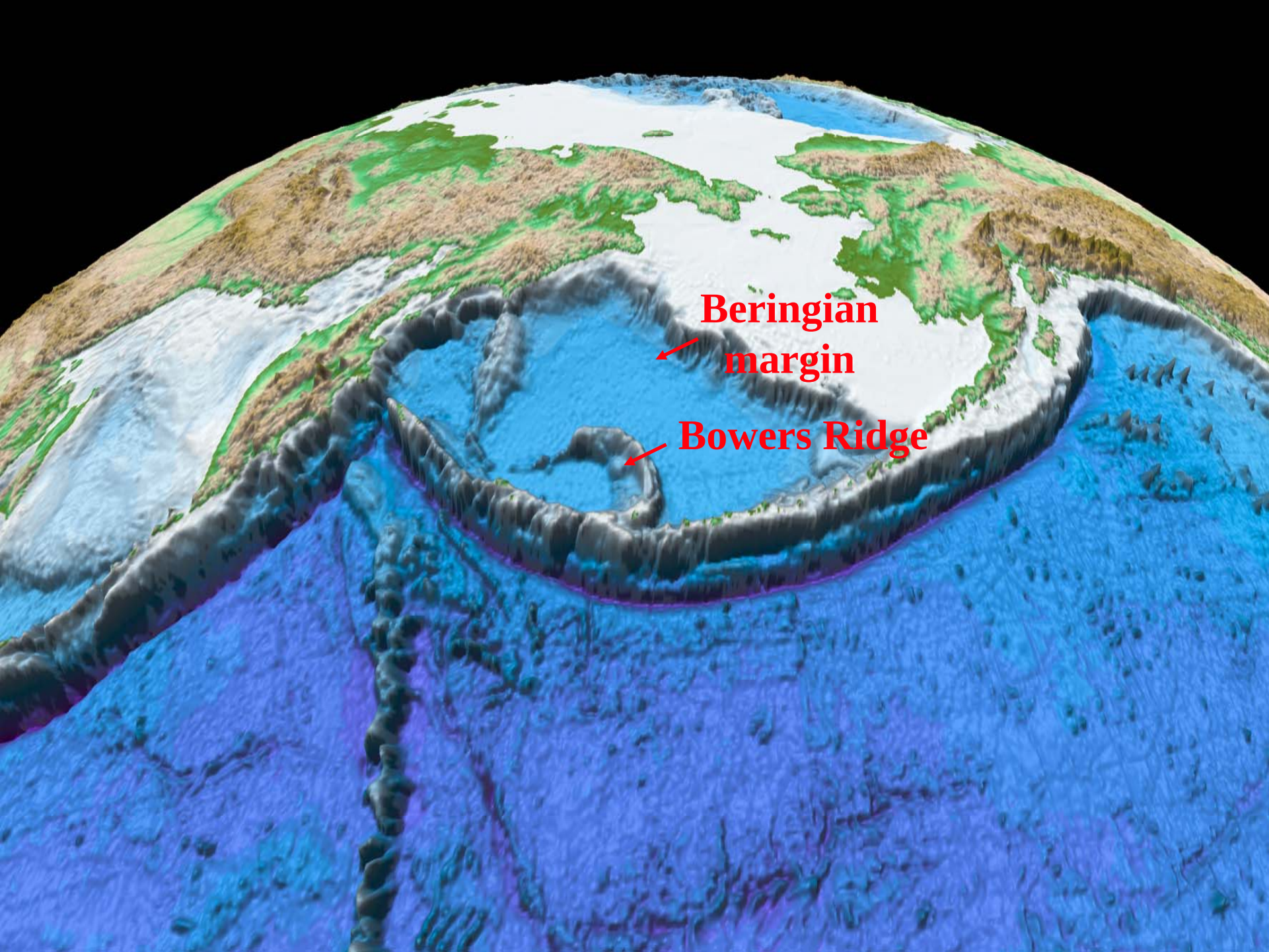
A new perspective → new insights



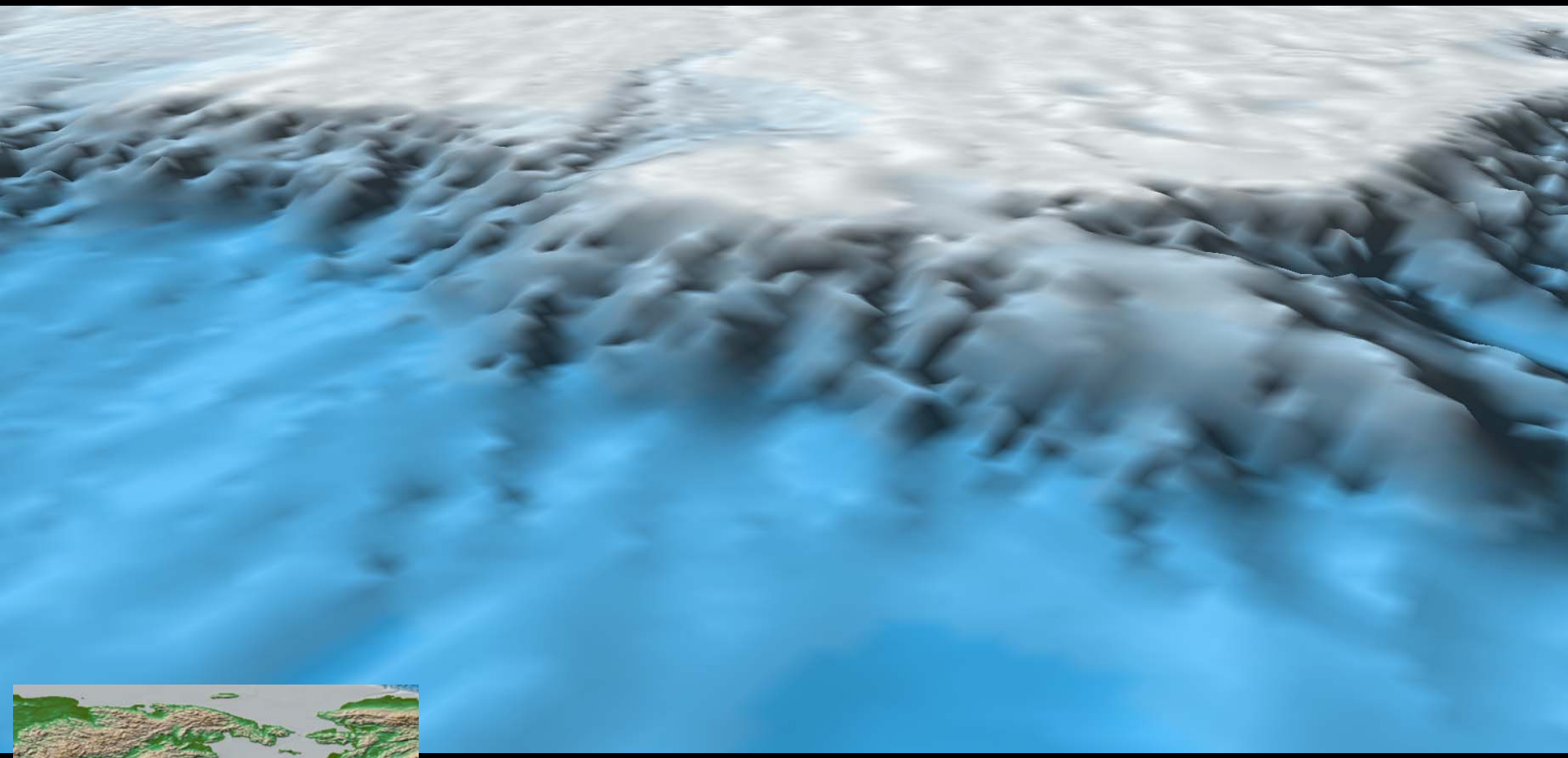
UNH CCOM-JHC U.S. Law-of-the-Sea Bathymetric Mapping to Date



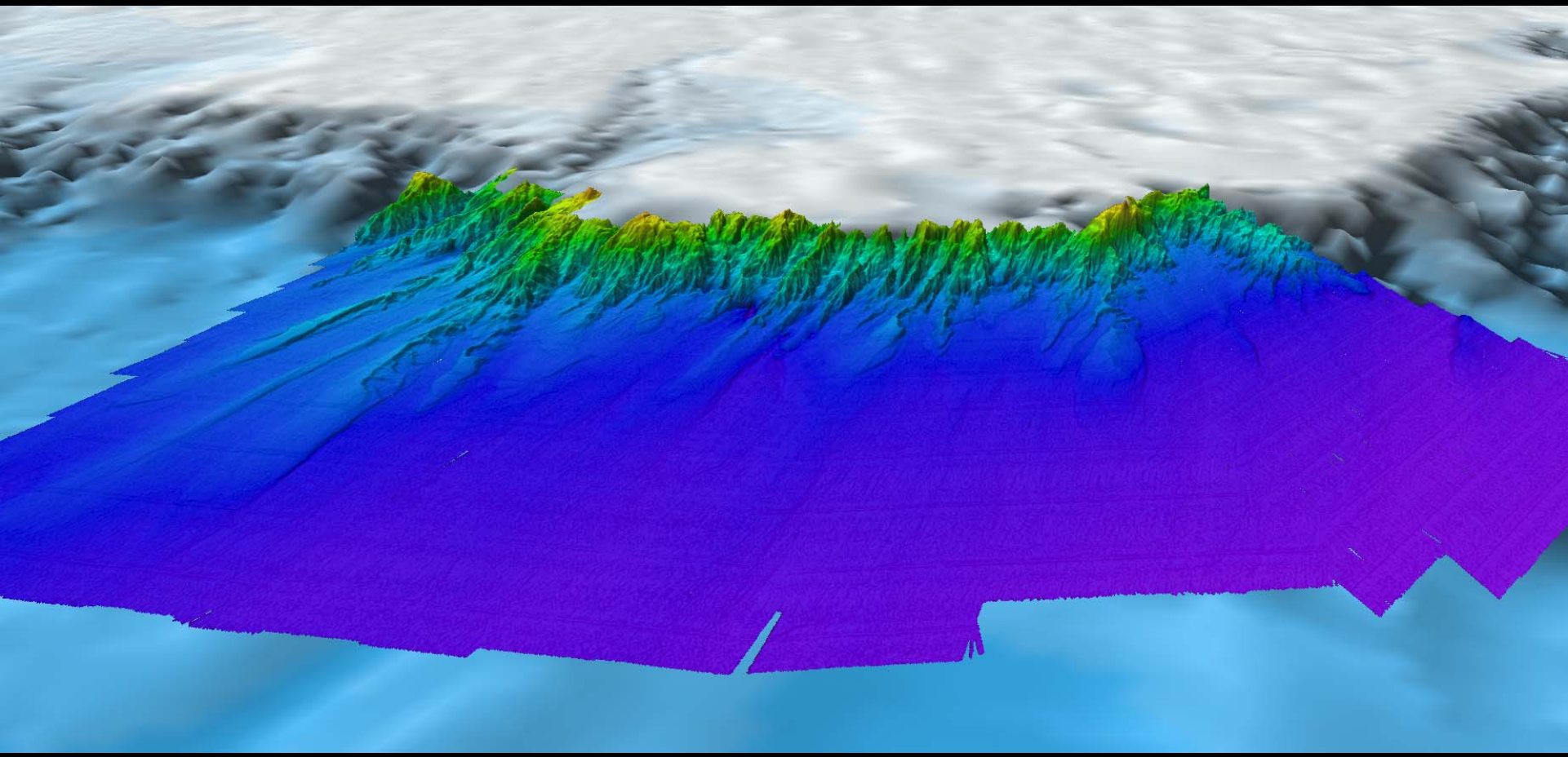
Mayer et al. 2002 U.S. Law-of-the-Sea Desktop Study


Beringian
margin
Bowers Ridge

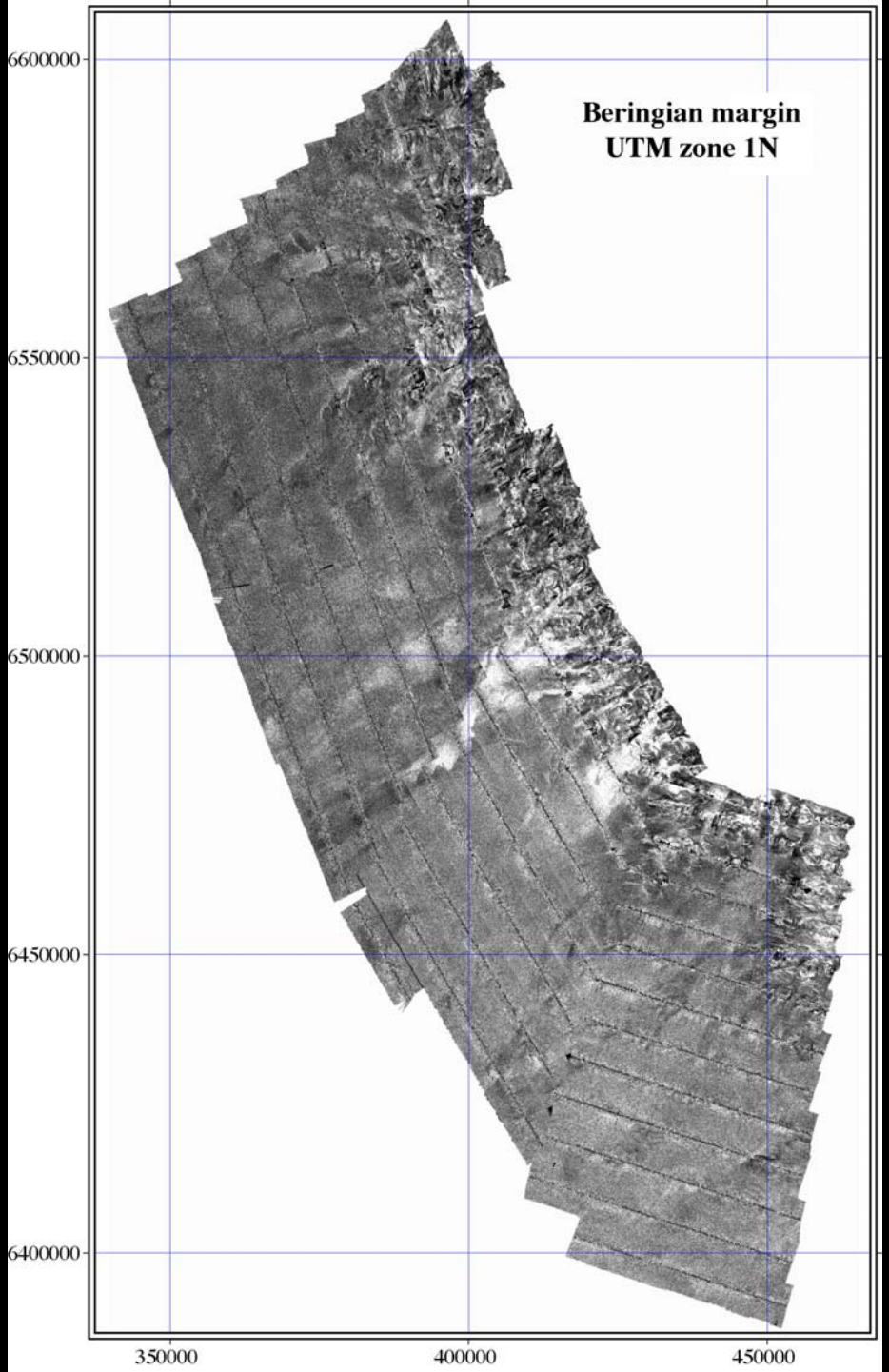
Beringian Margin



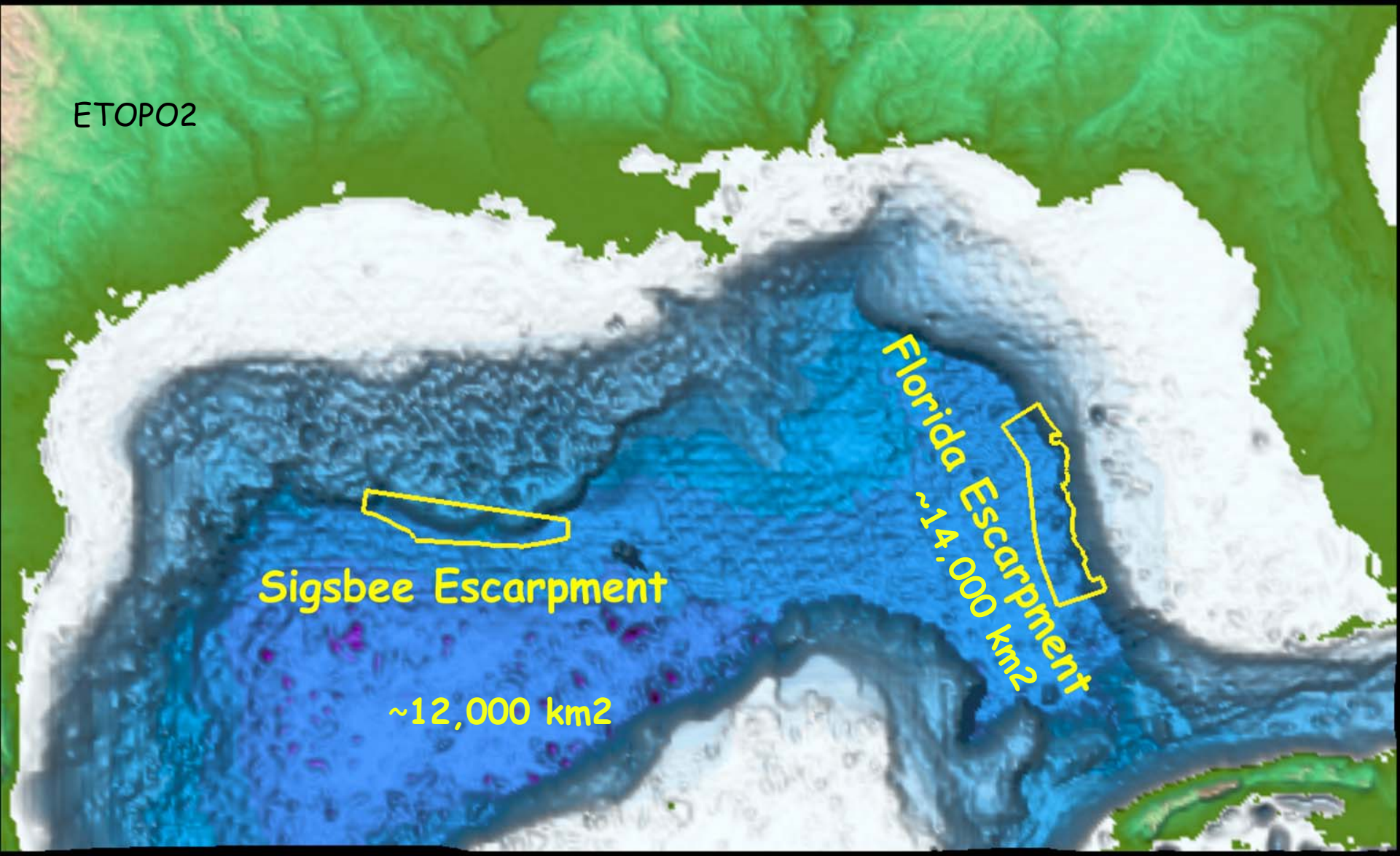
Beringian Margin



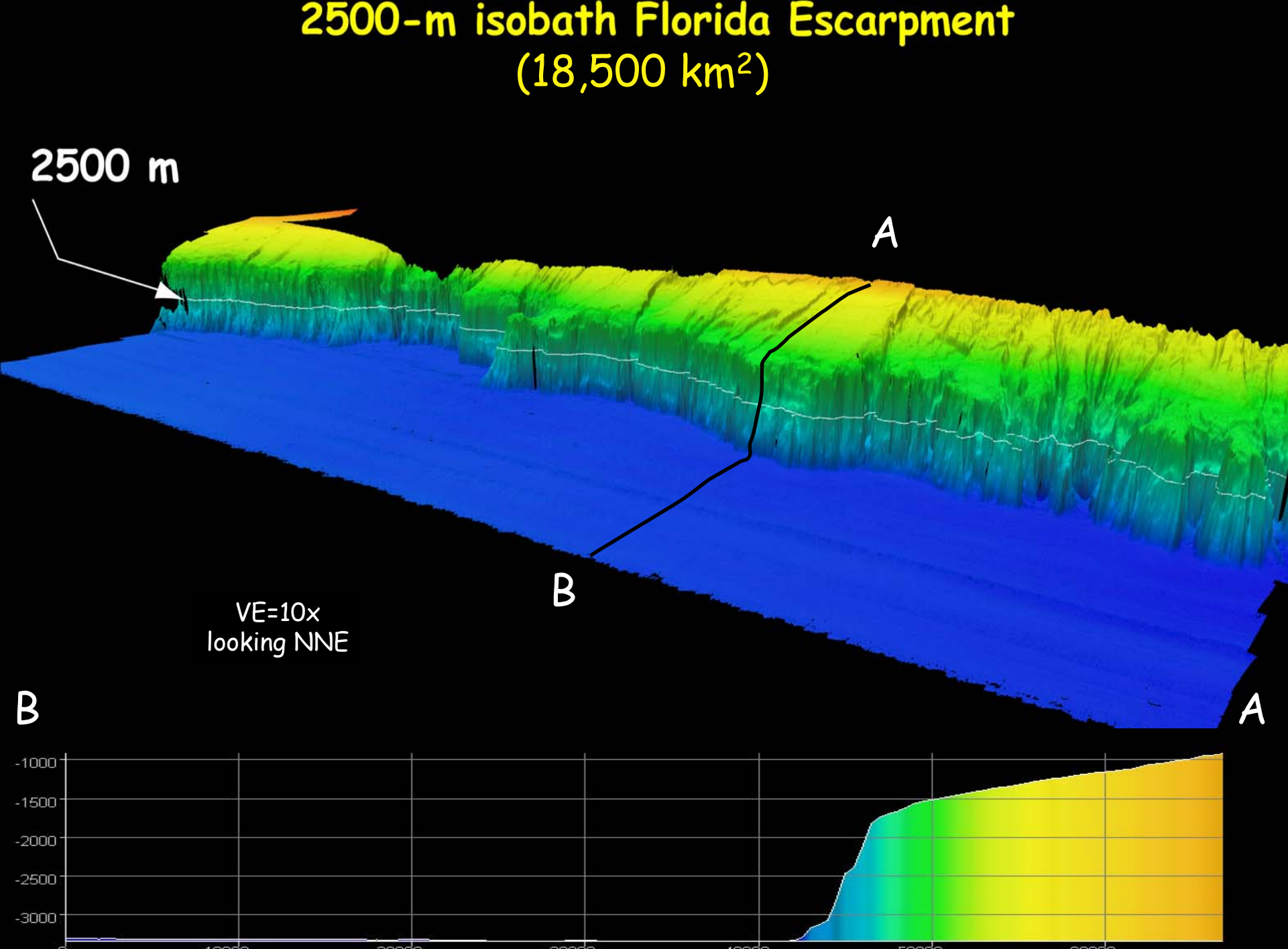
uncalibrated beam-average acoustic backscatter



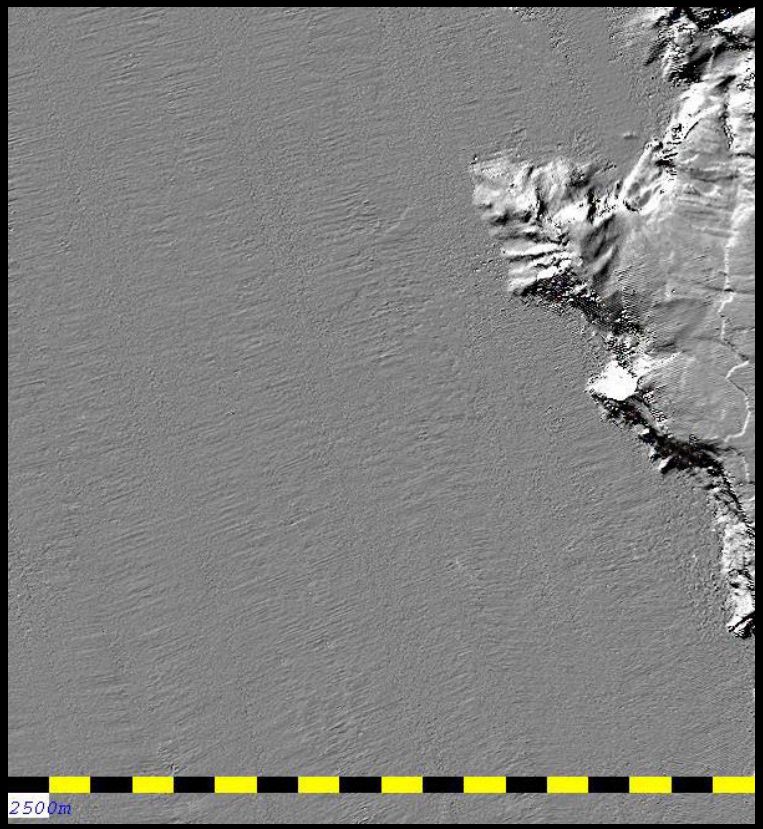
U.S. UNCLOS Gulf of Mexico bathymetric mapping



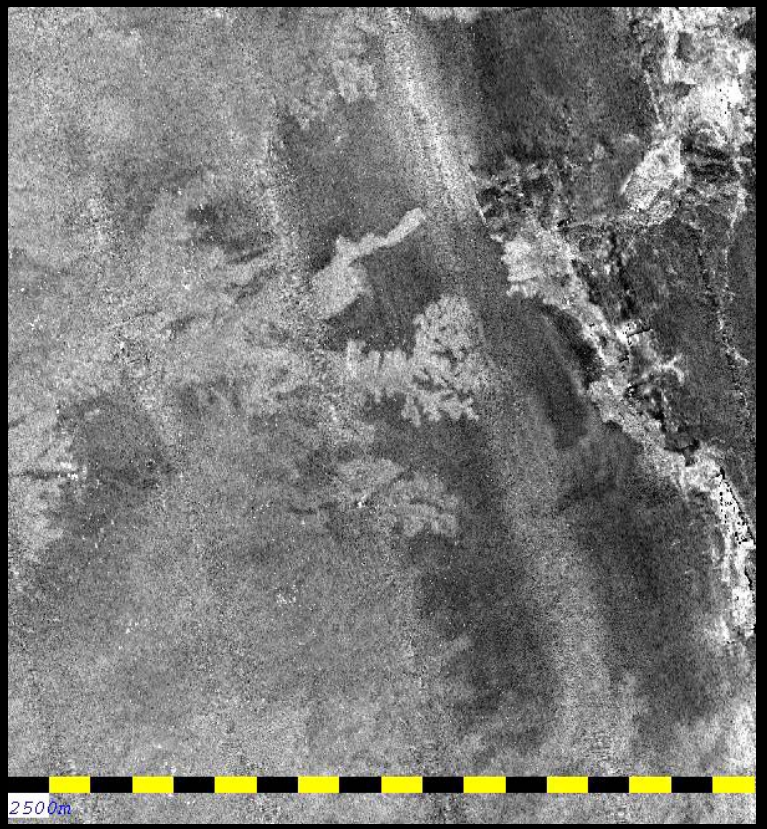
2500-m isobath Florida Escarpment
(18,500 km^2)



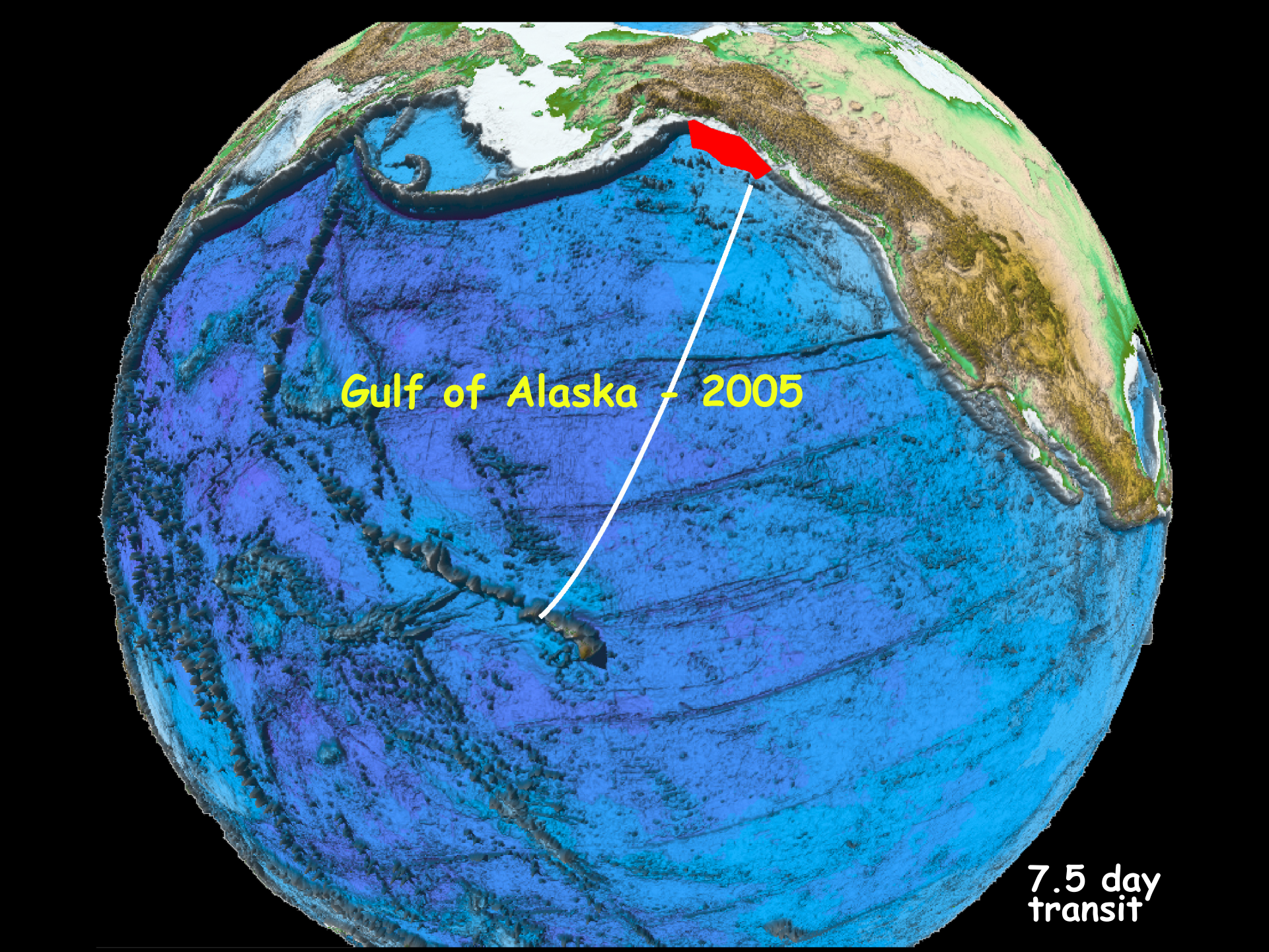
depositional lobe of Mississippi Fan



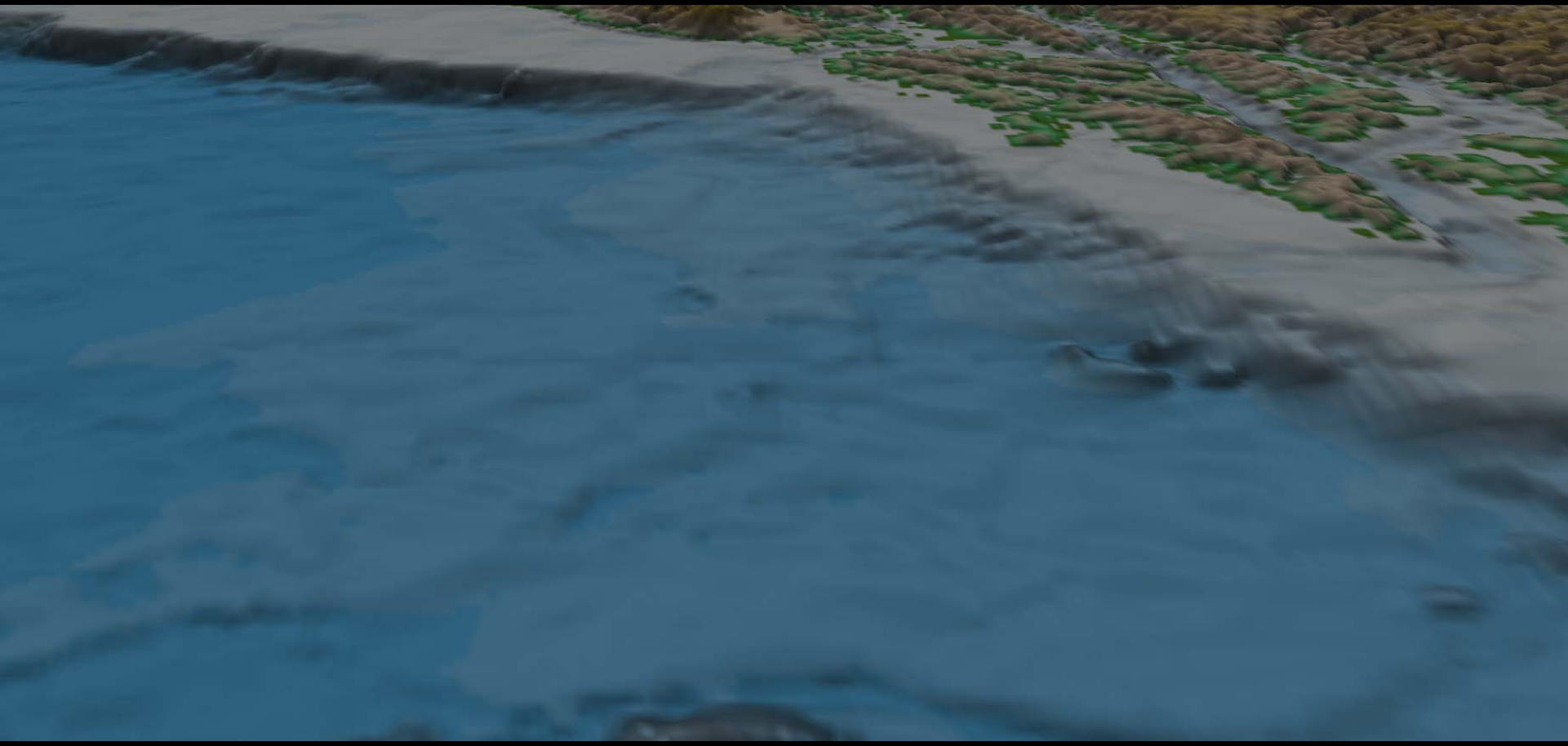
bathymetry



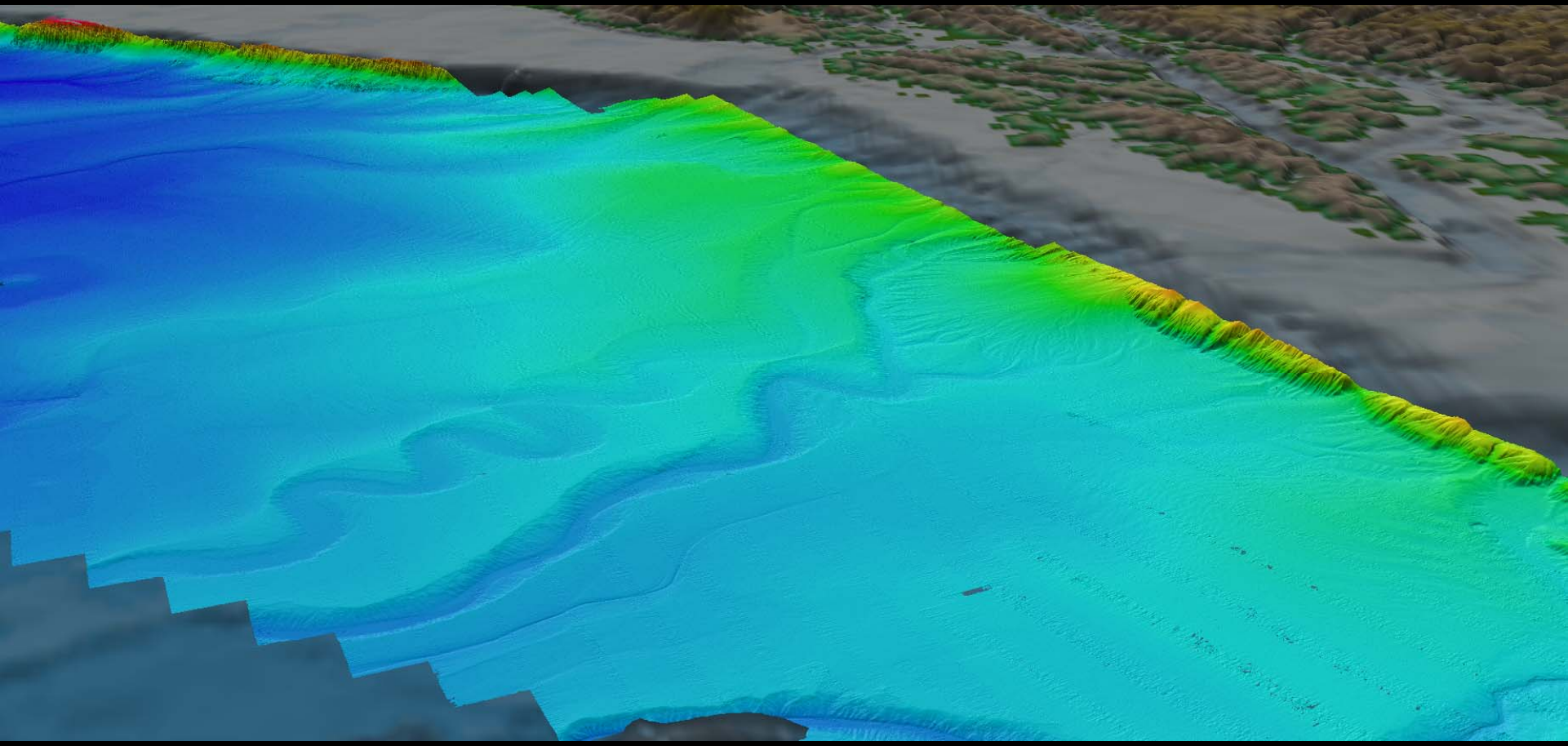
acoustic backscatter

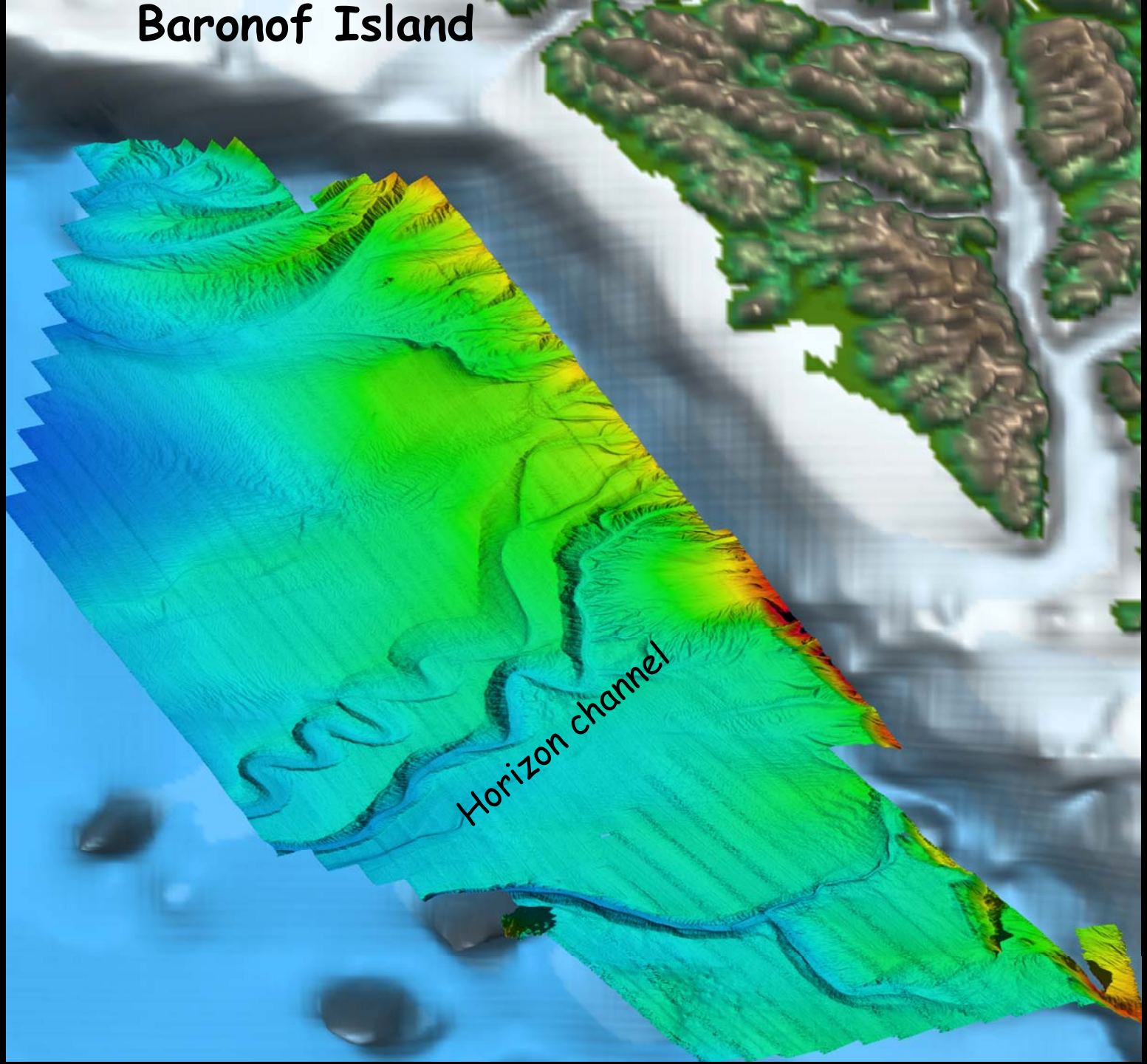

Gulf of Alaska - 2005
7.5 day
transit

Gulf of Alaska



Gulf of Alaska

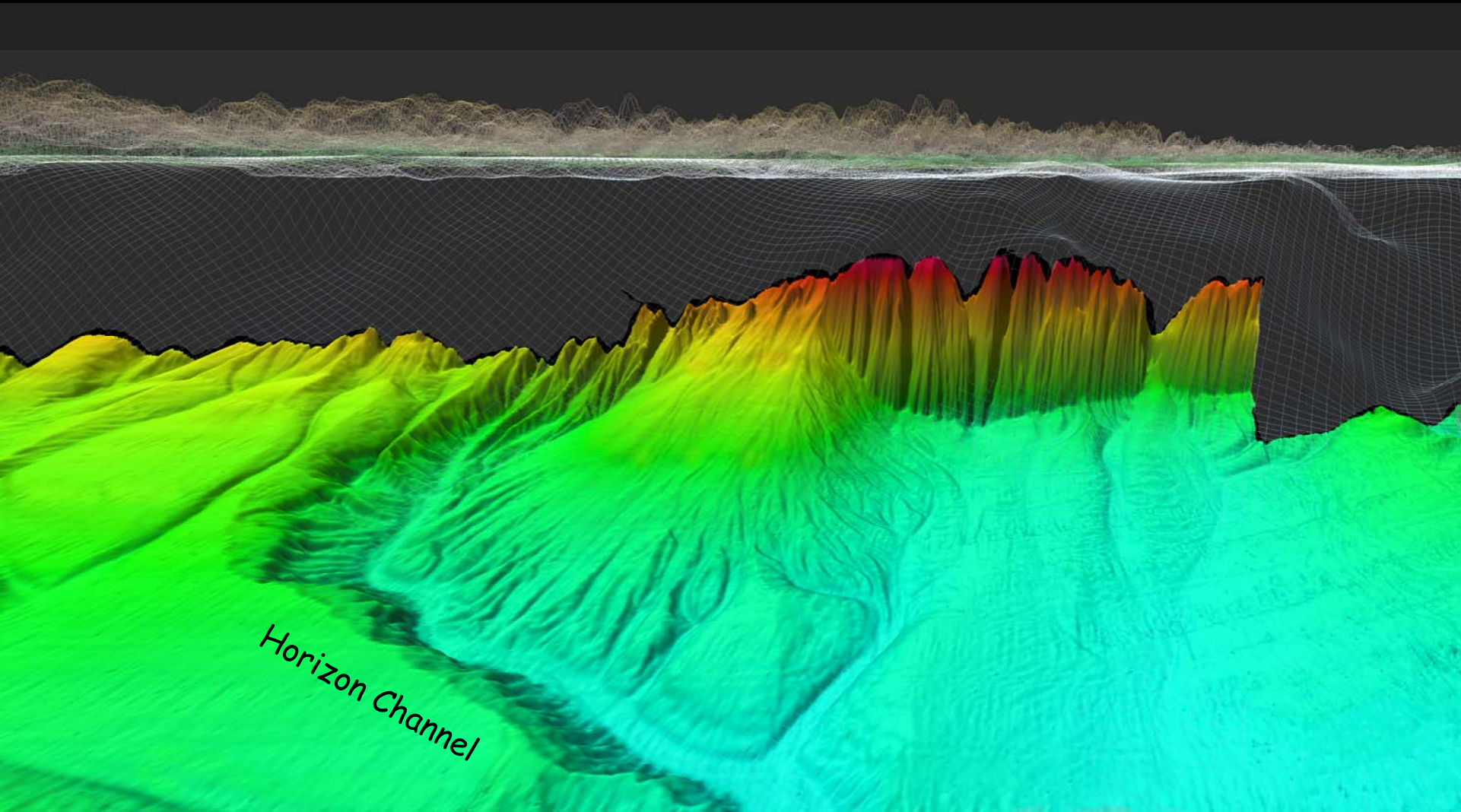


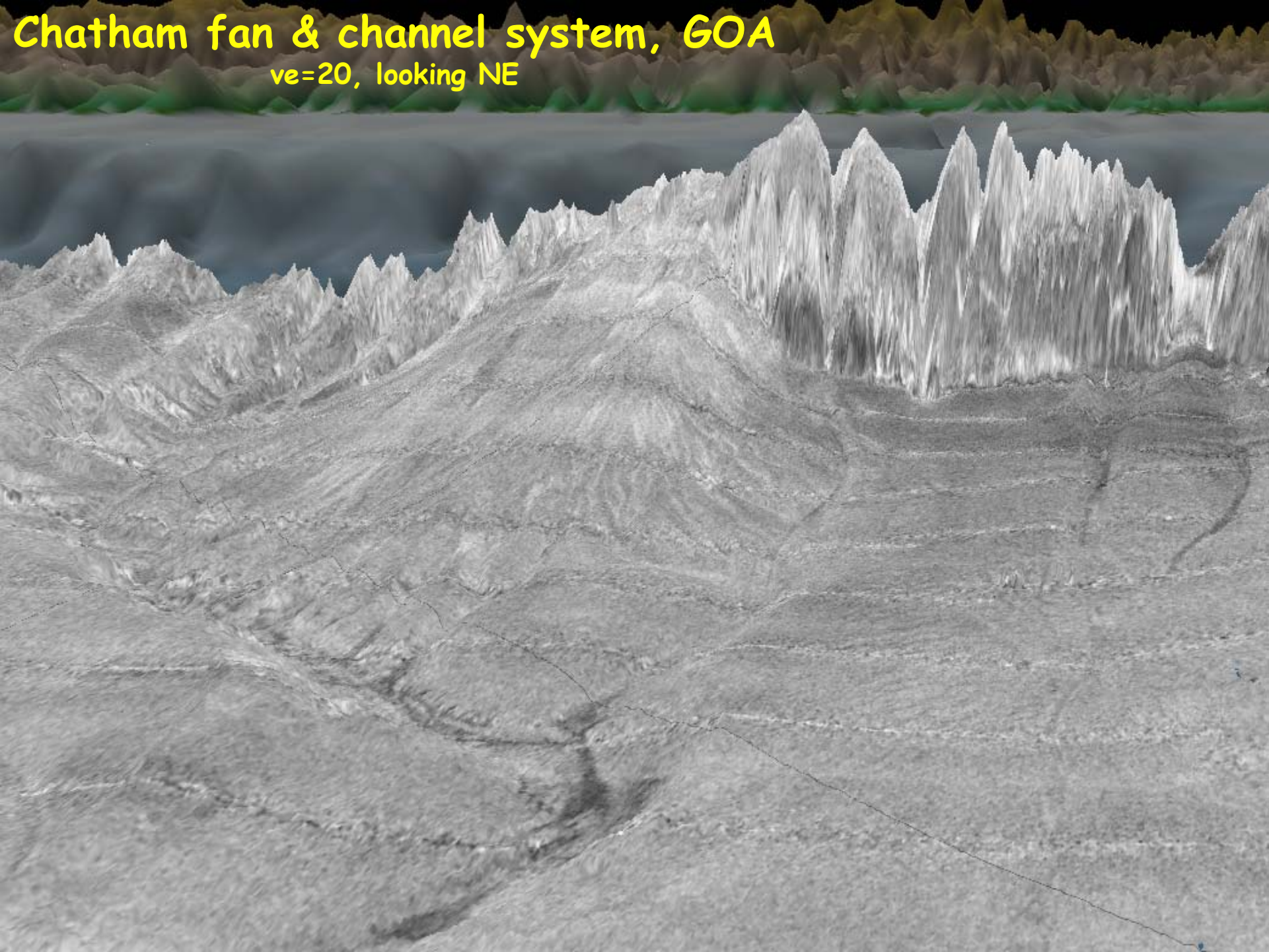

Baronof Island
Horizon channel

Chatham fan, southern GOA

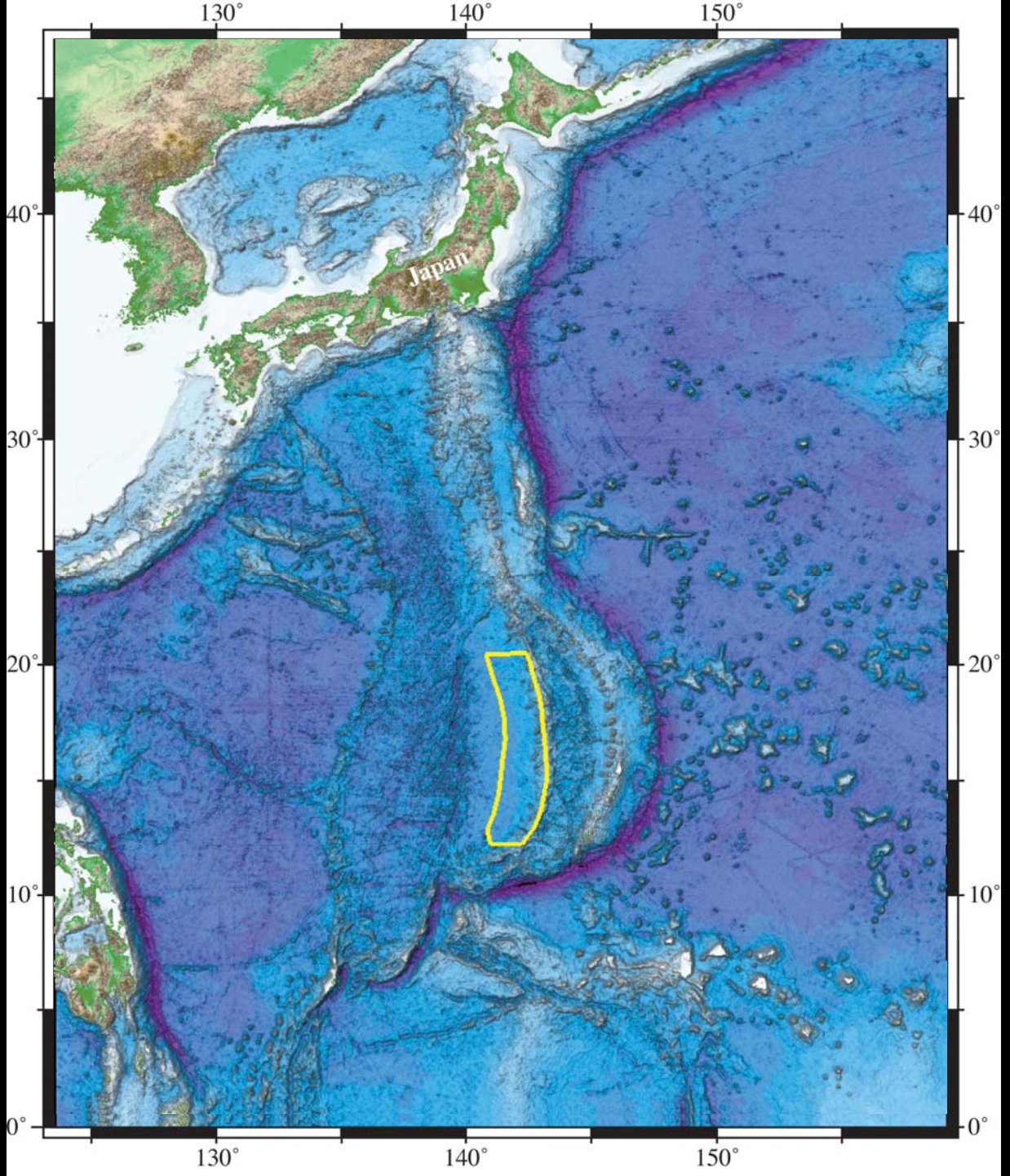
oblique view, ve=20x

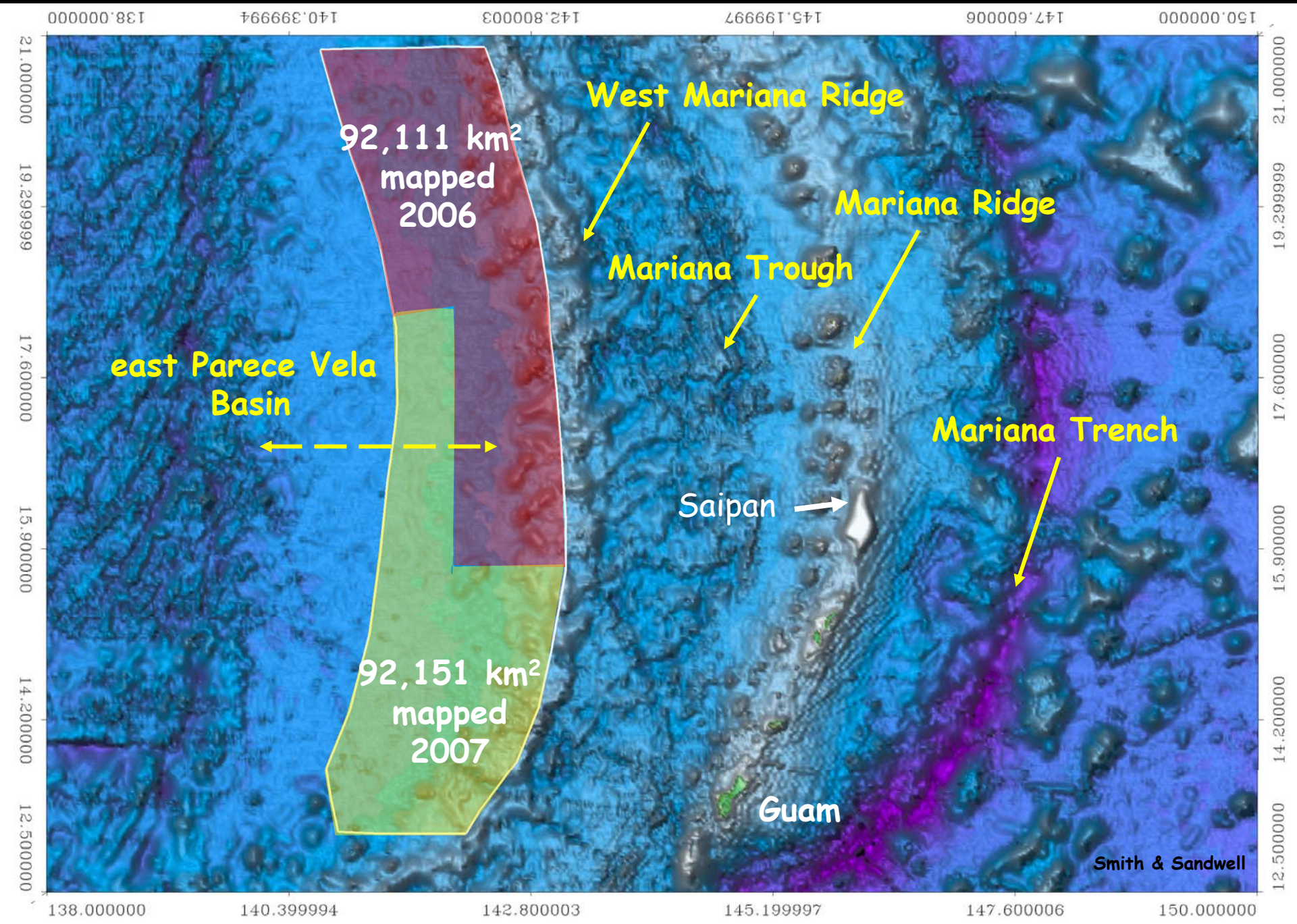
looking NE



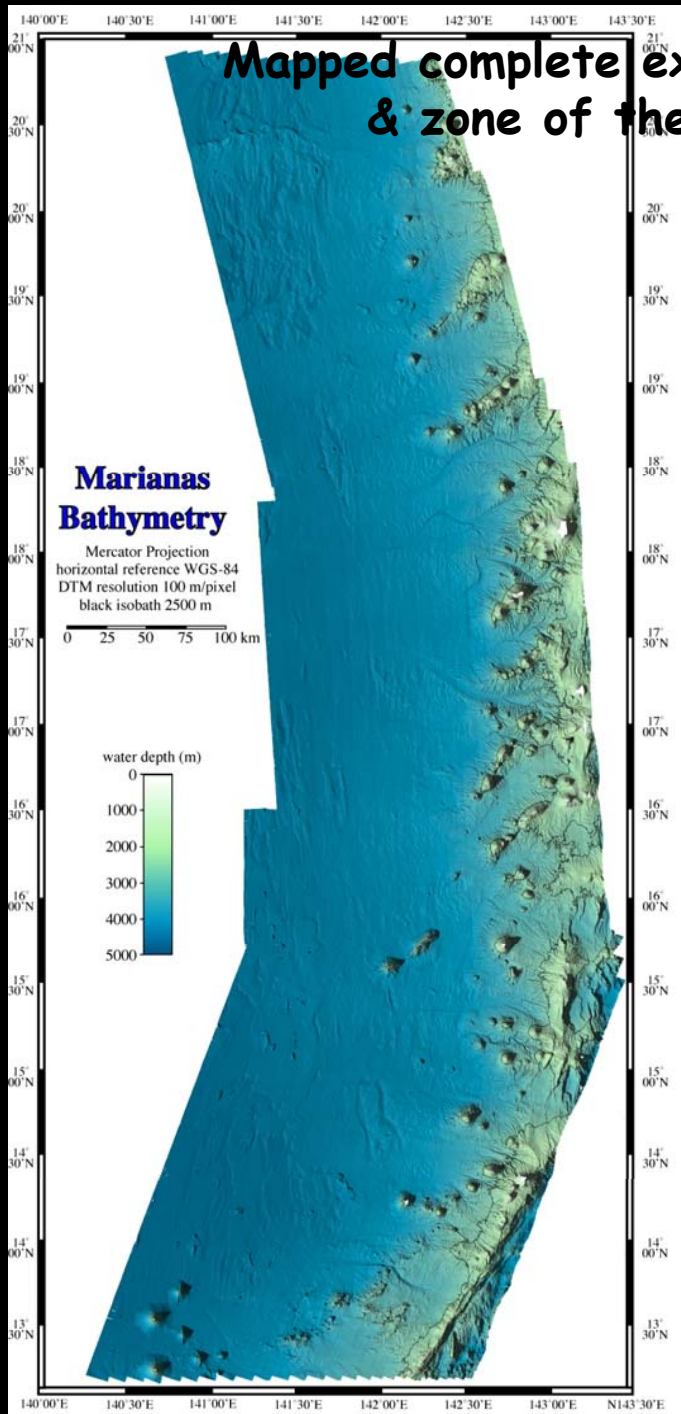

Chatham fan & channel system, GOA
ve=20, looking NE

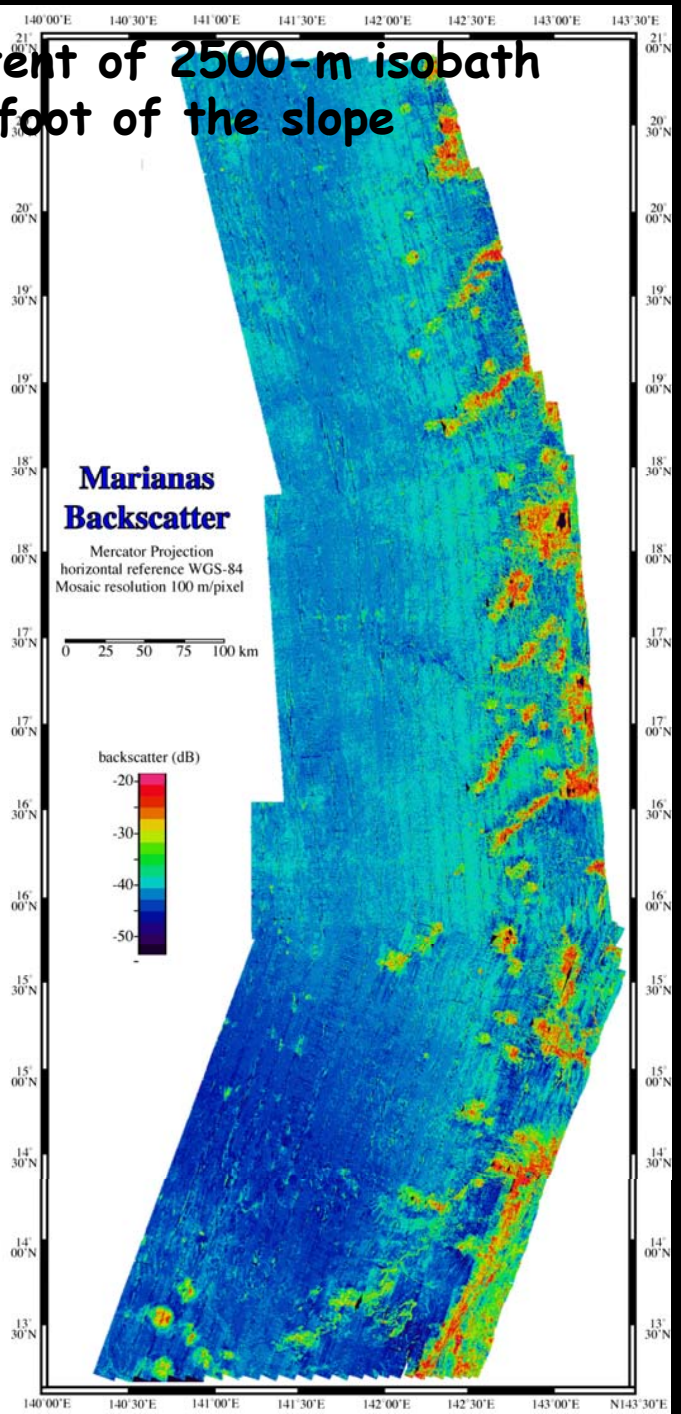
West Mariana Ridge & eastern Parece Vela Basin

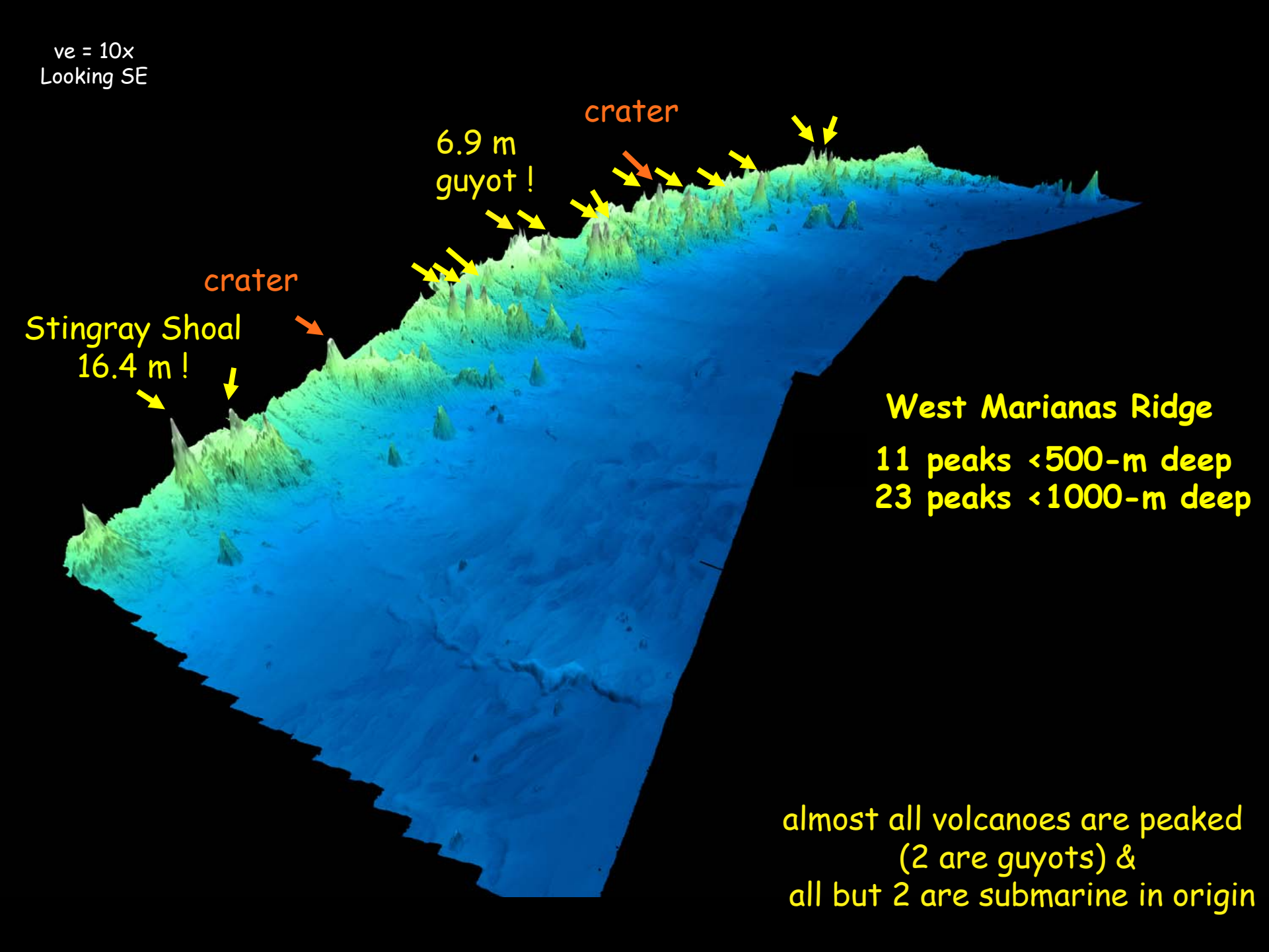



92,111 km²
mapped
2006
West Mariana Ridge
Mariana Ridge
Mariana Trough
east Parece Vela
Basin
Mariana Trench
Saipan
92,151 km²
mapped
2007
Guam
Smith & Sandwell
138.000000
140.399994
142.800003
145.199997
147.600006
150.000000
21.000000
19.299999
17.600000
15.900000
14.200000
12.500000

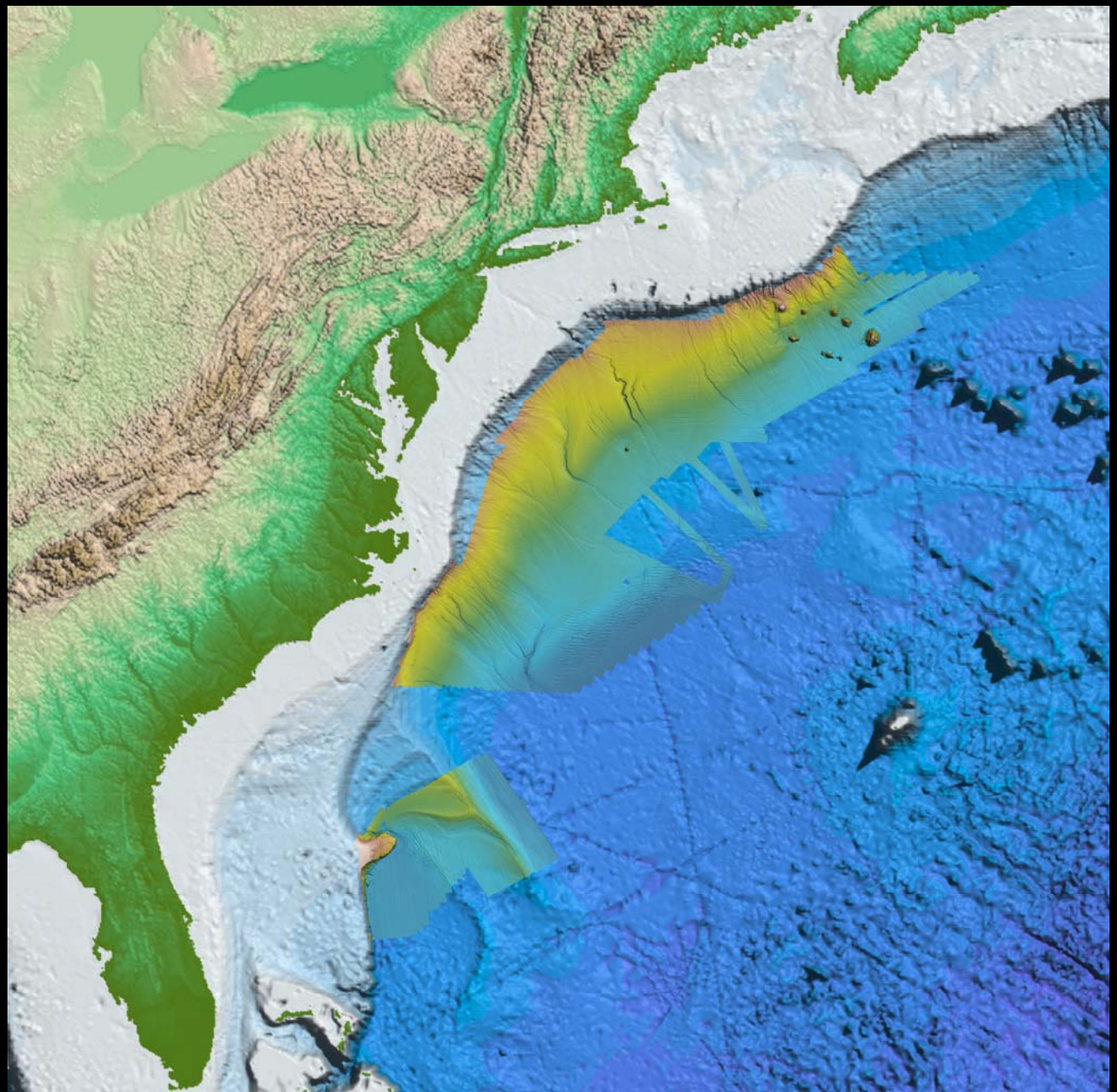
Mapped complete extent of 2500-m isobath & zone of the foot of the slope

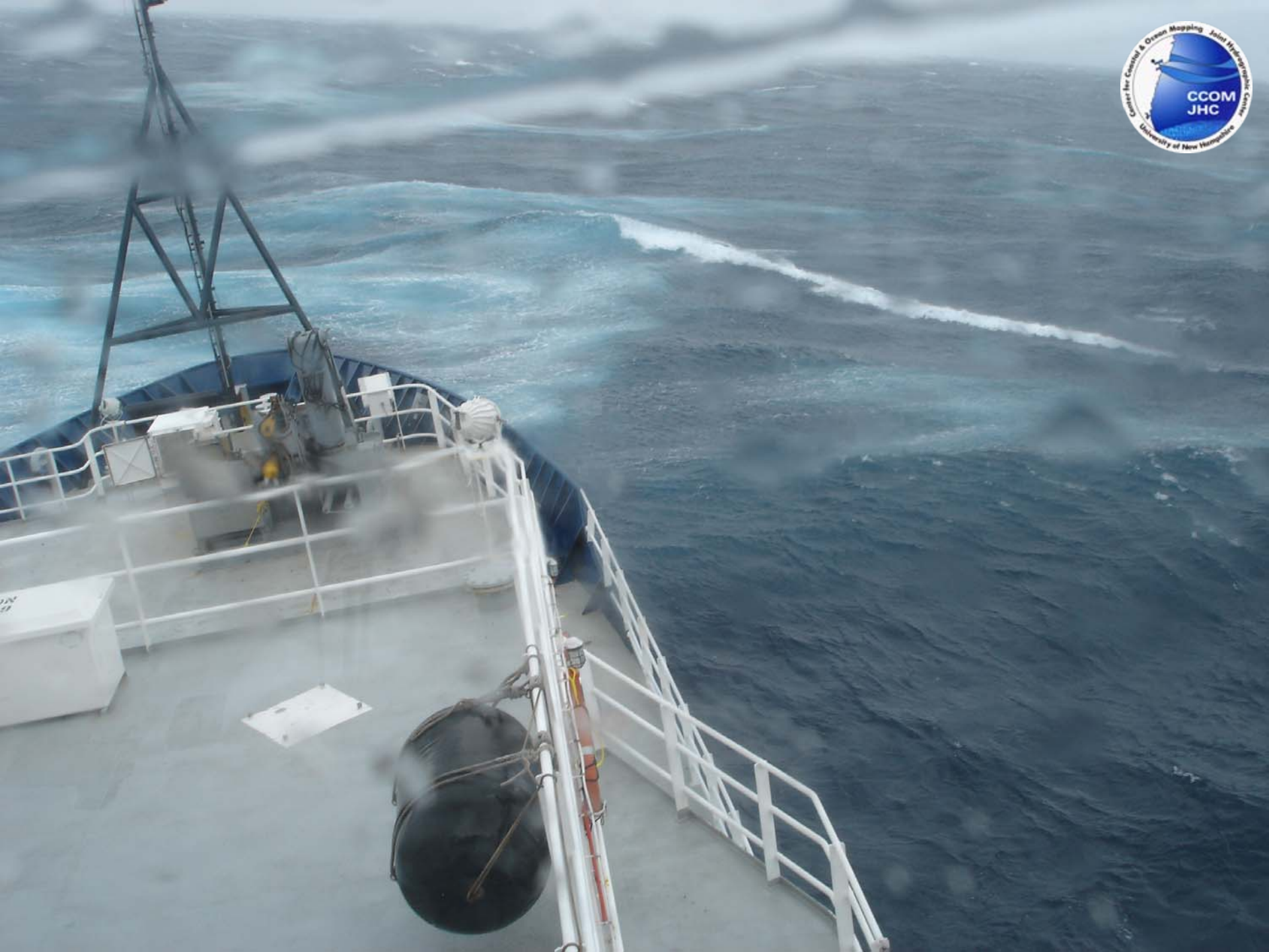


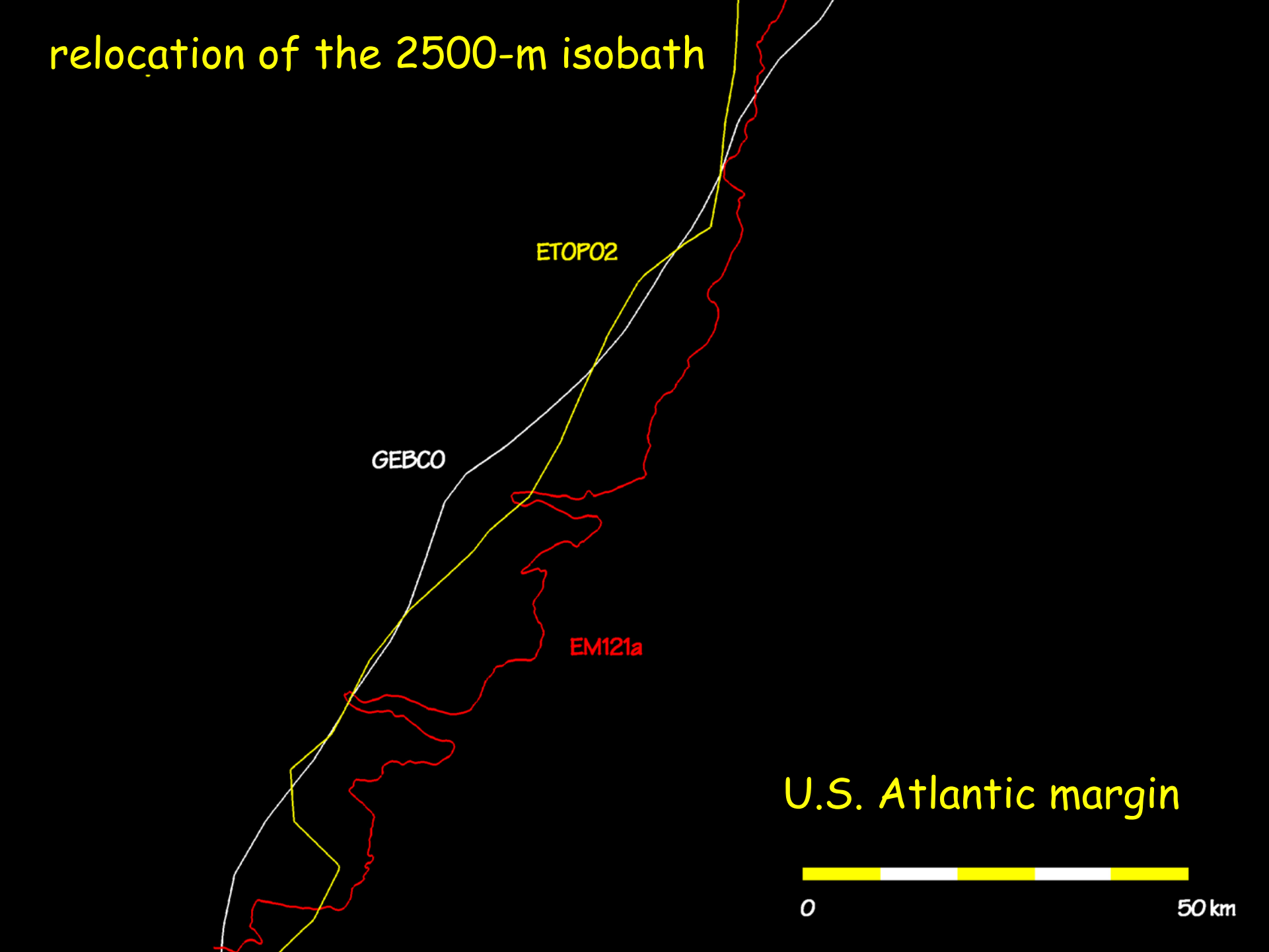



ve = 10x
Looking SE
crater
6.9 m
guyot !
crater
Stingray Shoal
16.4 m !
West Marianas Ridge
11 peaks <500-m deep
23 peaks <1000-m deep
almost all volcanoes are peaked
(2 are guyots) &
all but 2 are submarine in origin

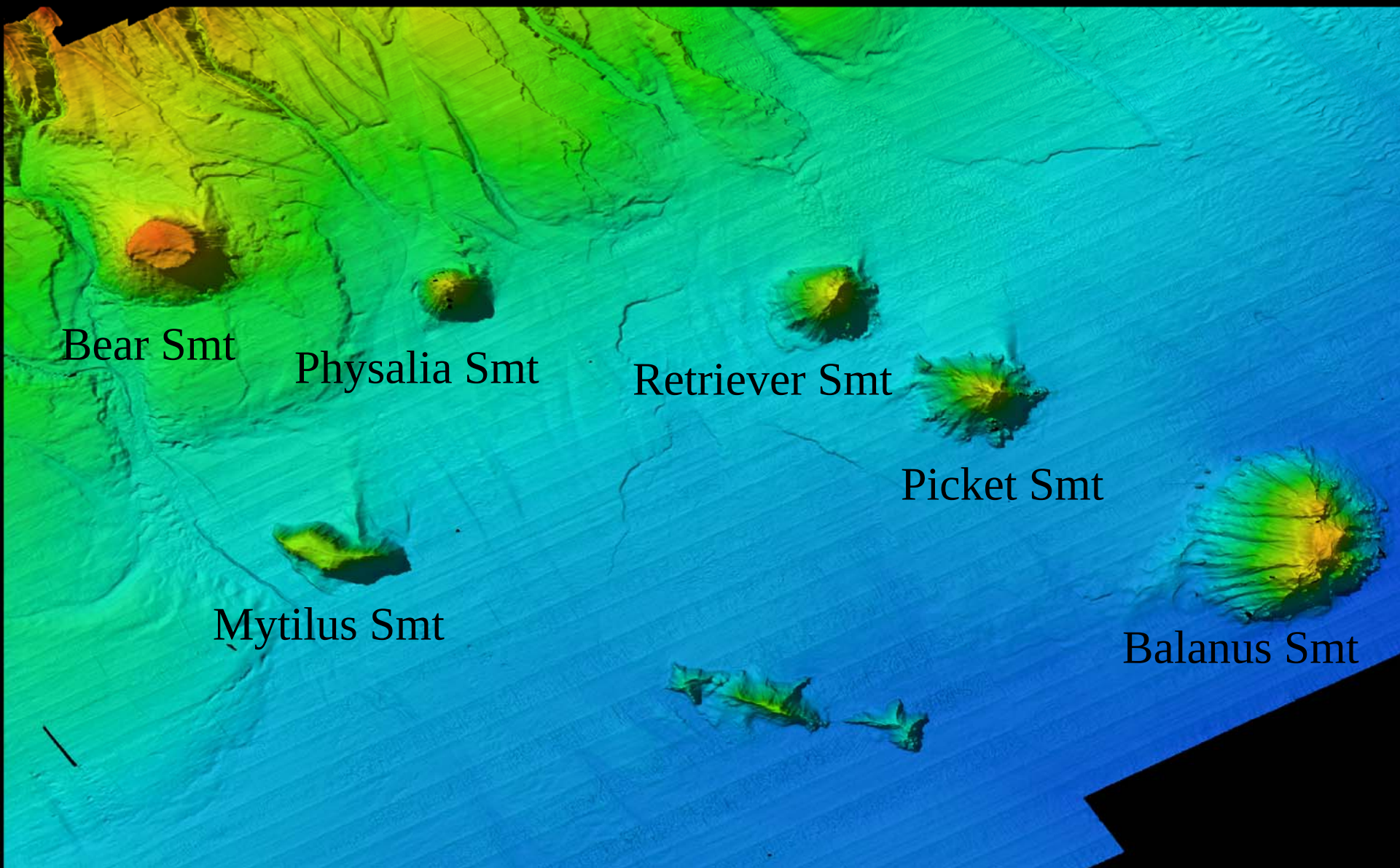
Atlantic Margin – 2004, 2005, 2008

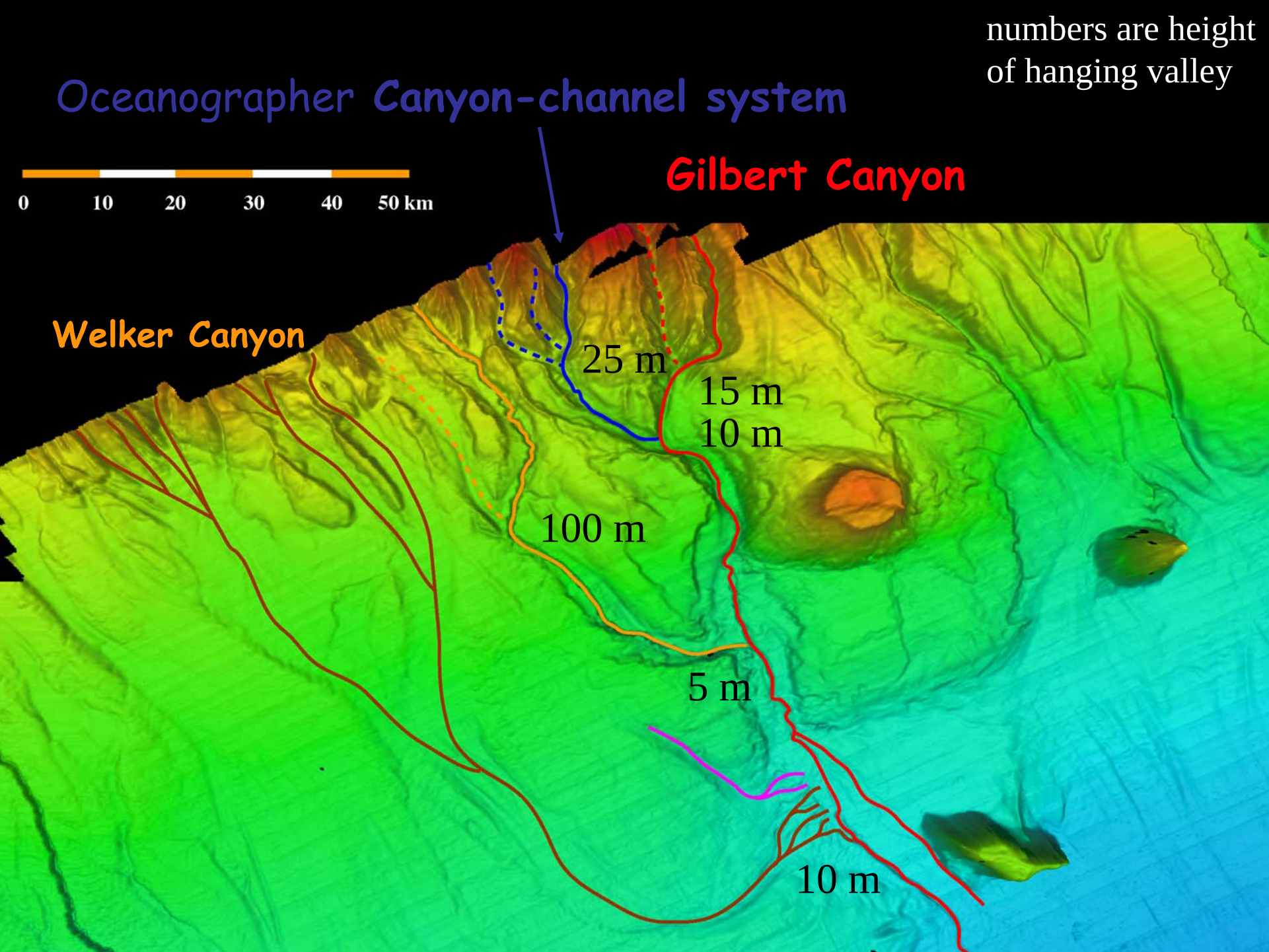


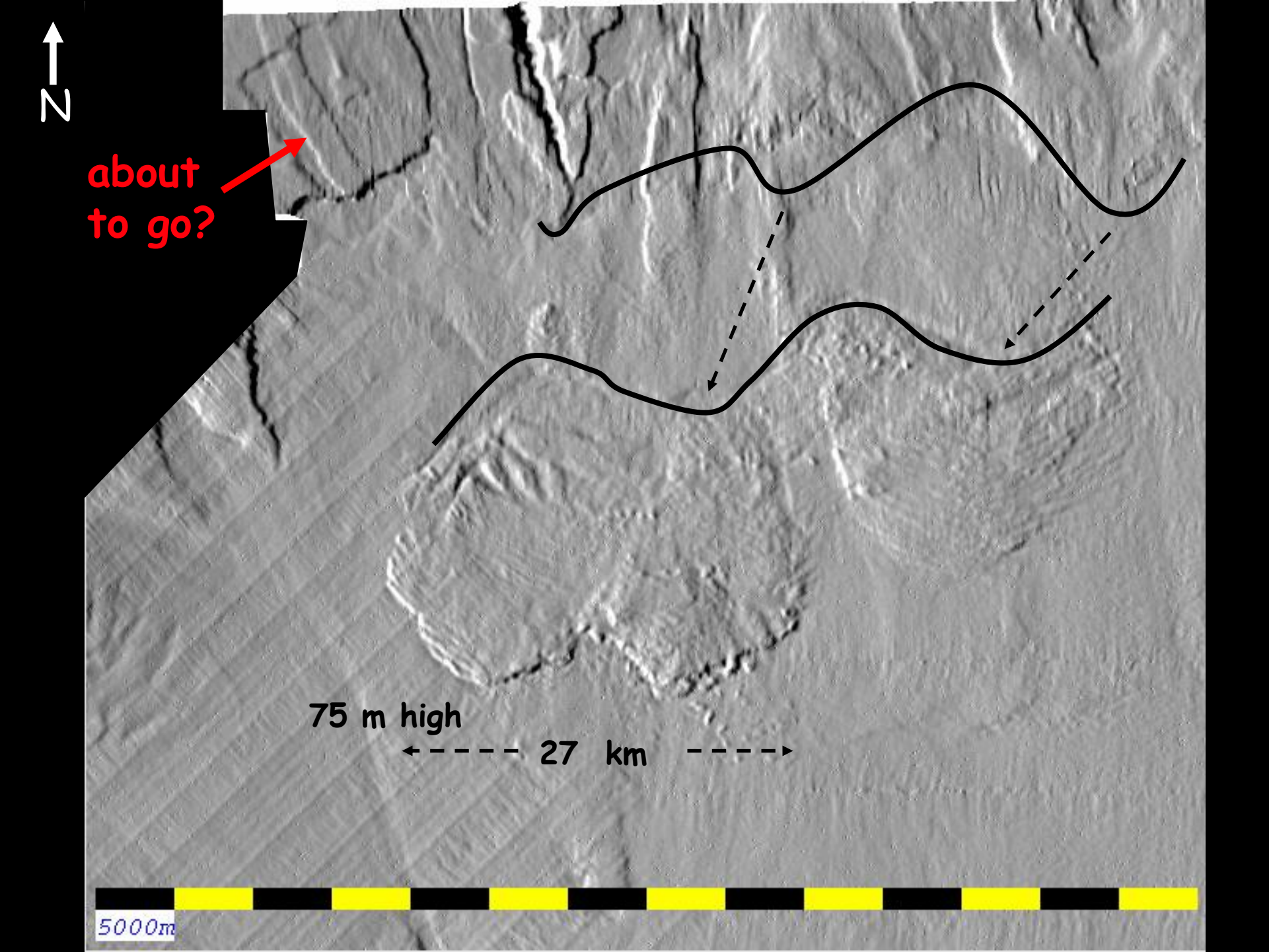

CCOM
JHC

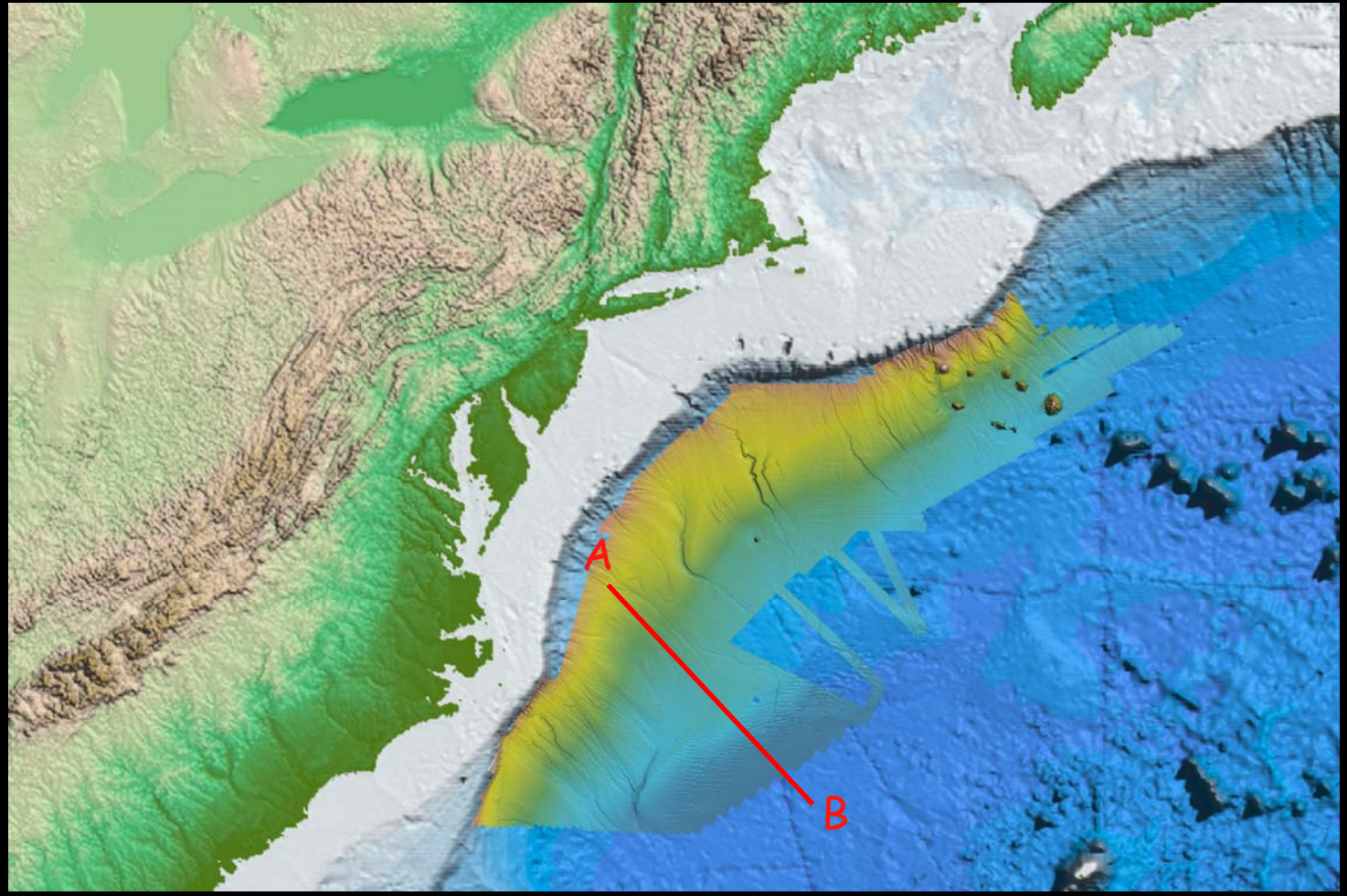

relocation of the 2500-m isobath
ETOPO2
GEBCO
EM121a
U.S. Atlantic margin
0
50 km

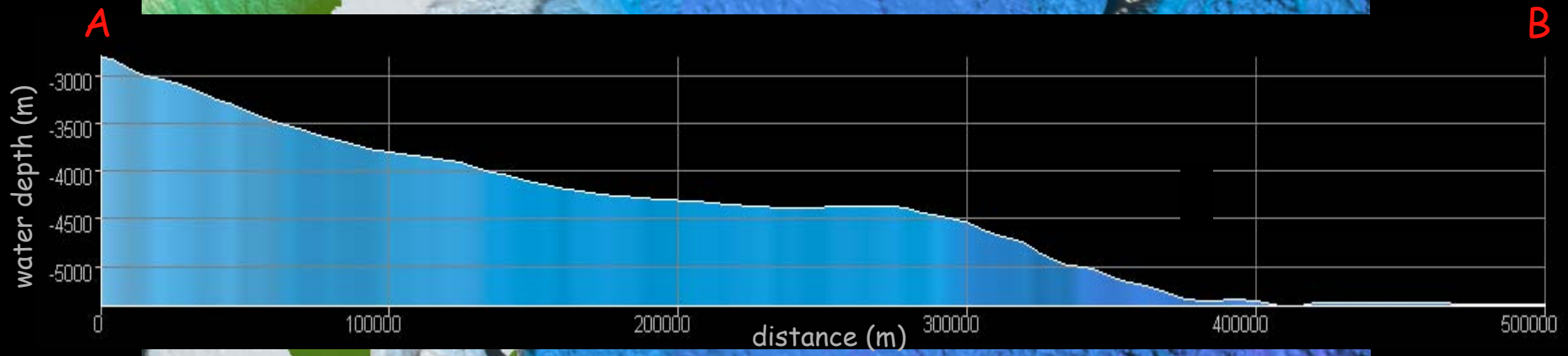
New England Seamounts



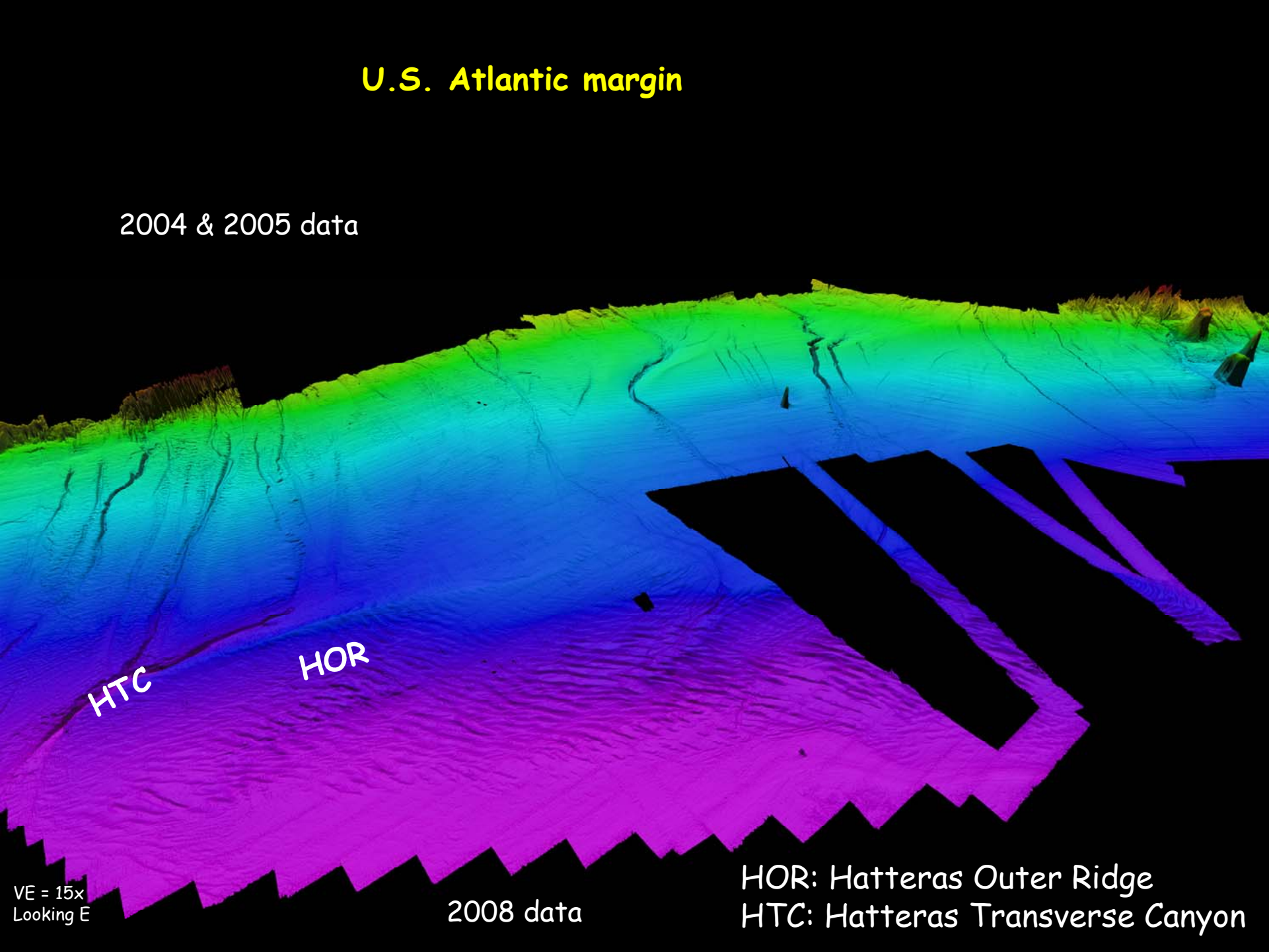

numbers are height of hanging valley
Oceanographer Canyon-channel system
Gilbert Canyon
0 10 20 30 40 50 km
Welker Canyon
25 m
15 m
10 m
100 m
5 m
10 m


N
about to go?
75 m high
27 km
5000m


A
B


A
B
water depth (m)
-3000
-3500
-4000
-4500
-5000
0
100000
200000
300000
400000
500000
distance (m)

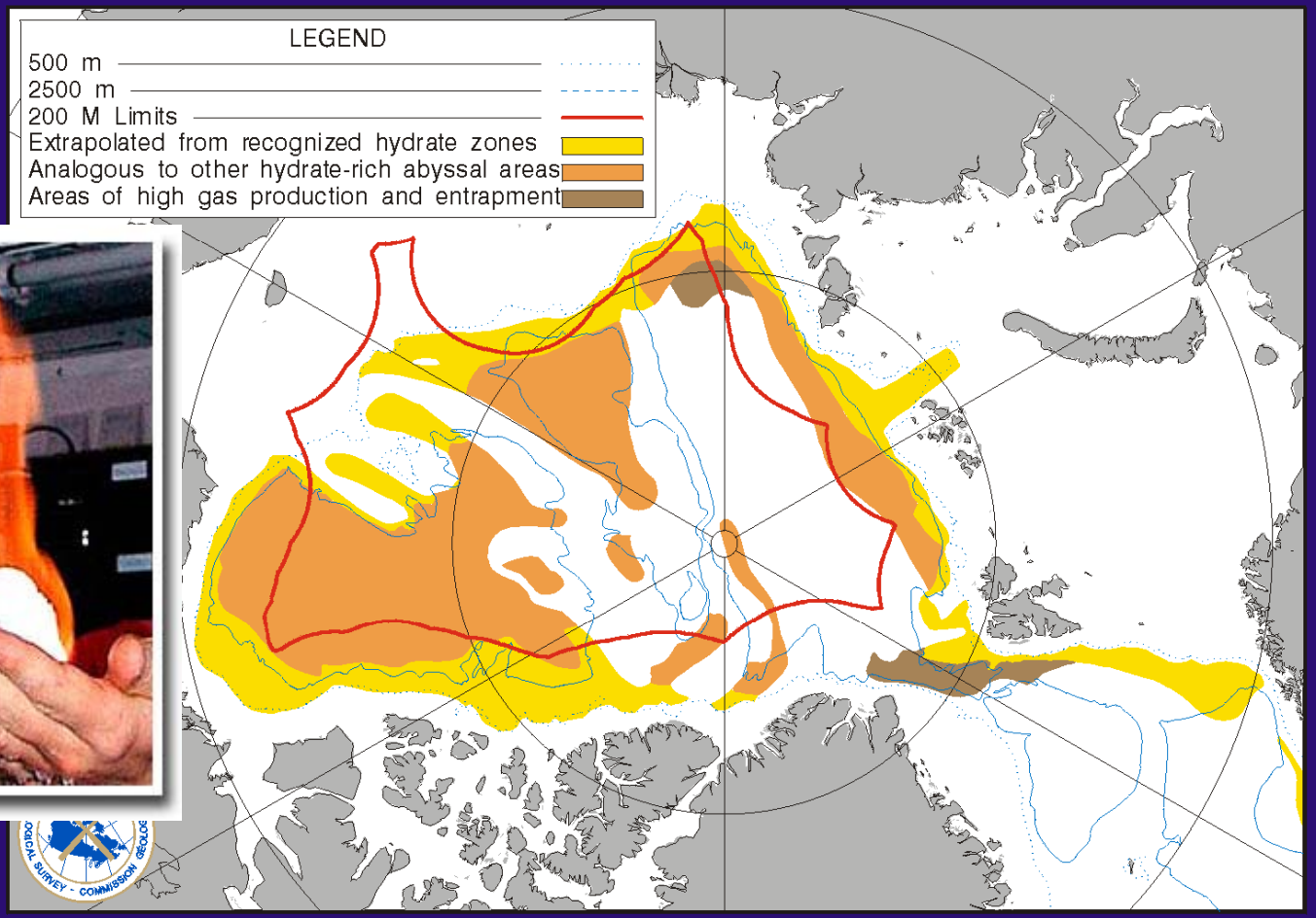
U.S. Atlantic margin



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

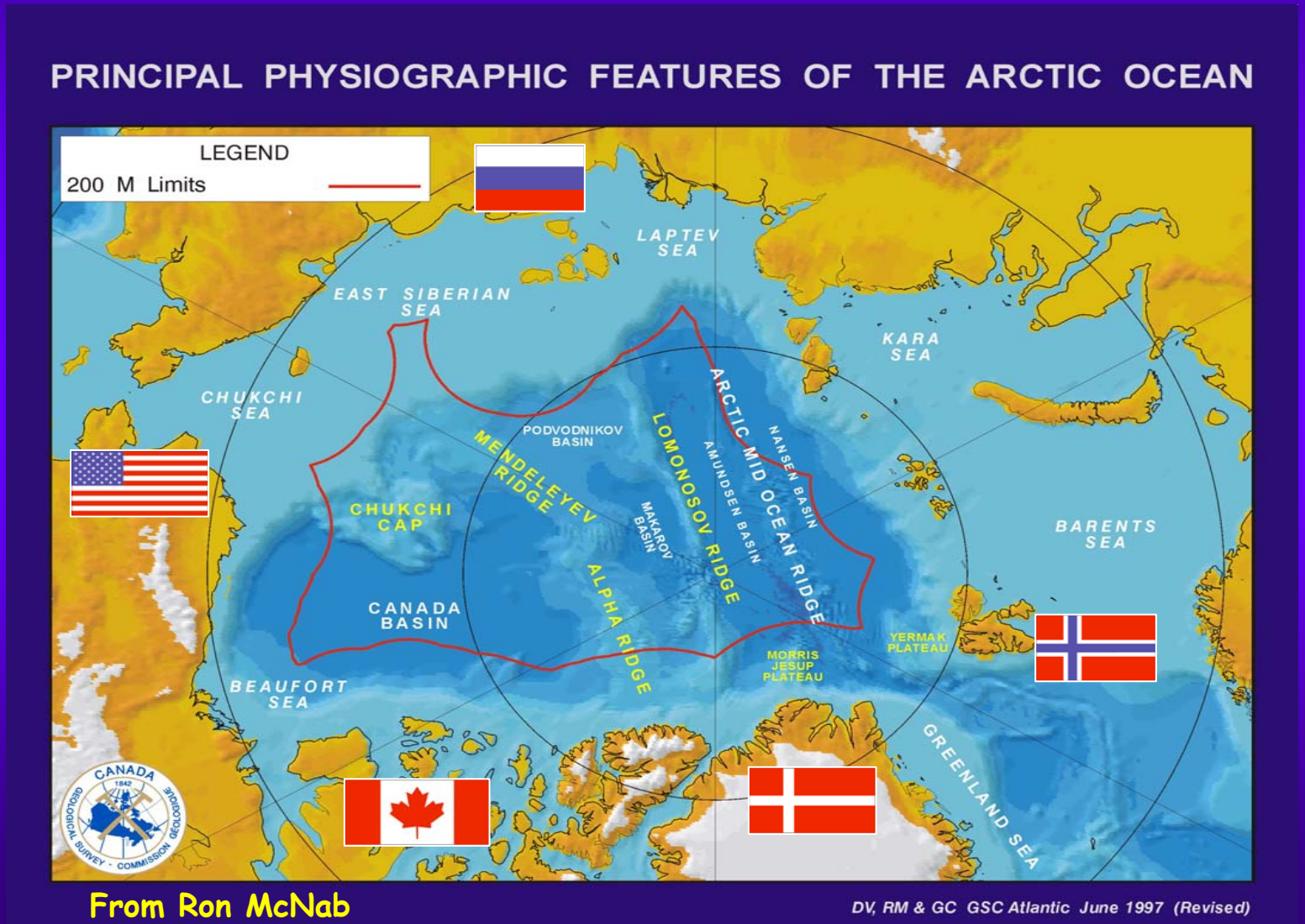
Potential for Oil and Gas in the Arctic

USGS (2009) 13% of world's undiscovered oil, 30% undiscovered gas, 20% undiscovered natural gas liquids



Slide courtesy Ron McNab

Five nations having potential extended shelves

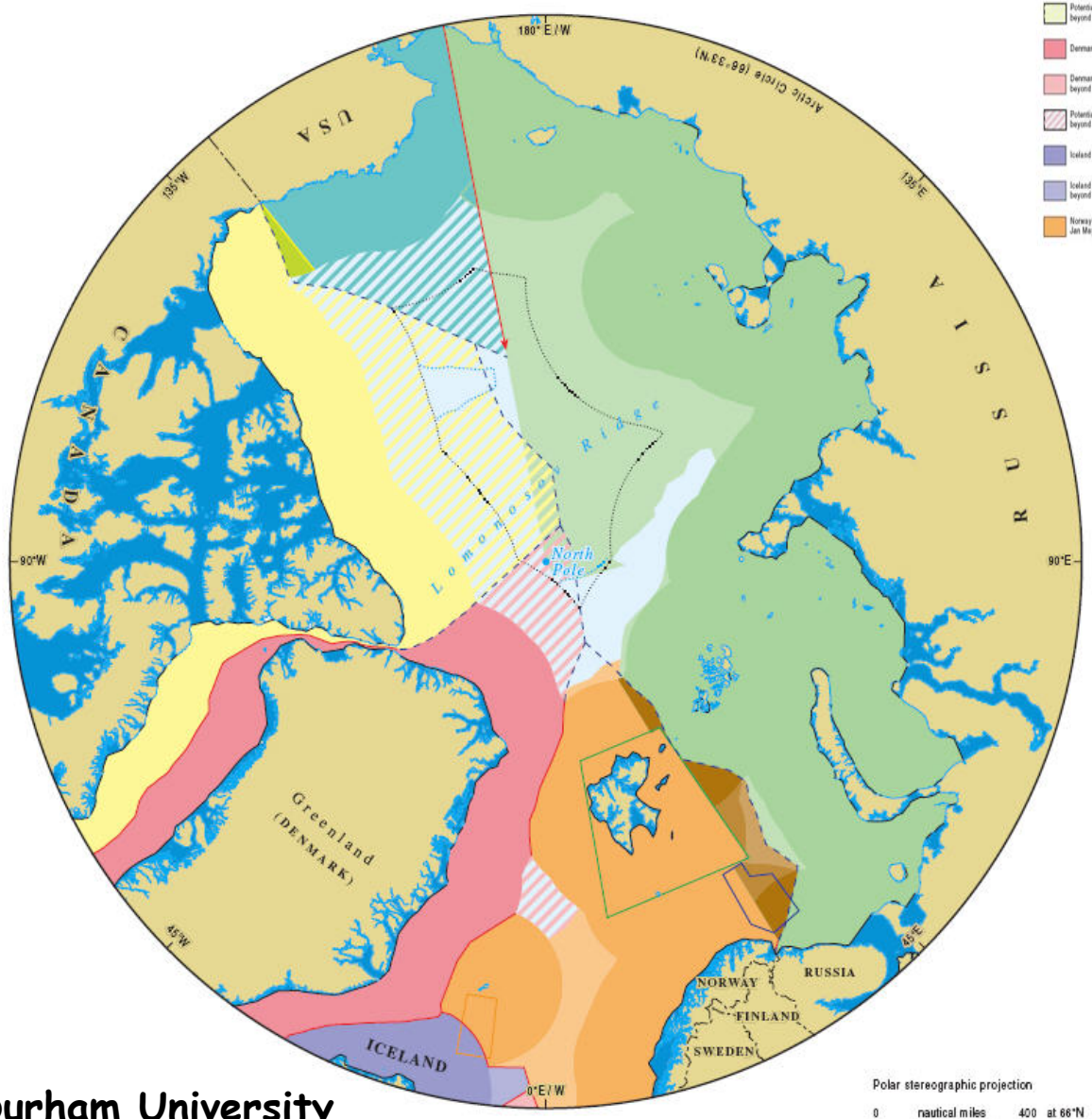


From Ron McNab

IBRU International Boundaries Research Unit

Durham University

Maritime jurisdiction and boundaries in the Arctic region



Internal waters
Canada territorial sea and EEZ
Potential Canada continental shelf beyond 200 nm (note 1)
Denmark territorial sea and EEZ
Denmark claimed continental shelf beyond 200 nm (note 2)
Potential Denmark continental shelf beyond 200 nm (note 1)
Iceland EEZ
Iceland claimed continental shelf beyond 200 nm (note 2)
Norway territorial sea and EEZ / Fishery zone Jan Mayen) / Fishery protection zone (Svalbard)
Norway claimed continental shelf beyond 200 nm (note 3)
Russia territorial sea and EEZ
Russia claimed continental shelf beyond 200 nm (note 4)
Overlapping Norway / Russia EEZ (note 5)
Overlapping Norway EEZ / Russia claimed continental shelf beyond 200 nm (note 5)
Overlapping Norway / Russia claimed continental shelf beyond 200 nm (note 5)
USA territorial sea and EEZ
Potential USA continental shelf beyond 200 nm (note 1)
Overlapping Canada / USA EEZ (note 6)
Straight baselines
Agreed boundary
Median line
350 nm from baselines
100 nm from 2500 m isobath (beyond 350 nm from baselines)
Svalbard treaty area (note 7)
Iceland - Norway joint zone (note 5)
Norway - Russia 'Grey Area' (agreed fishing regime)
Canada EEZ boundary claim (note 6)
Eastern Special Area (note 8)

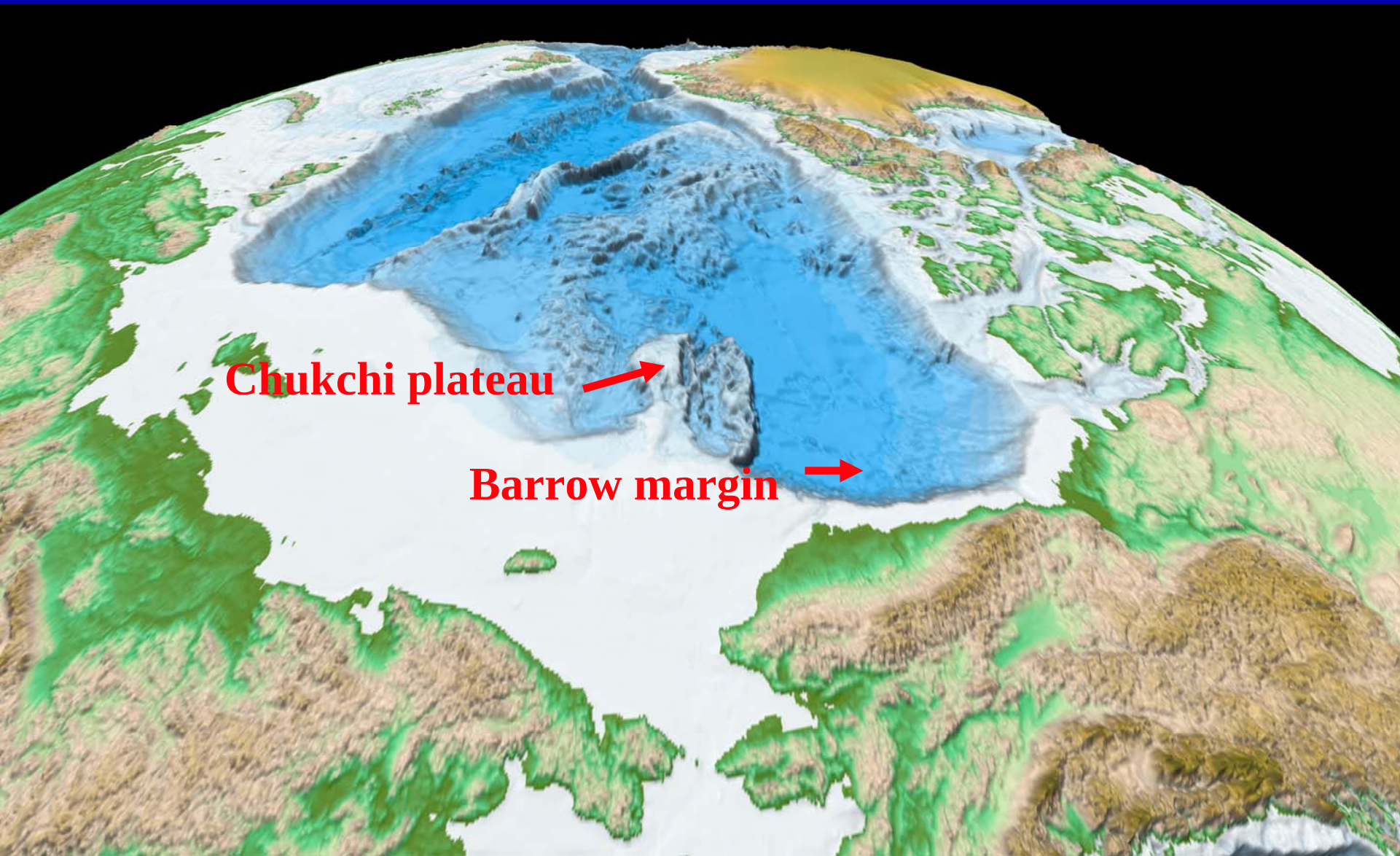
www.durham.ac.uk/ibru

Polar stereographic projection

0 nautical miles 400 at 66°N

From Durham University

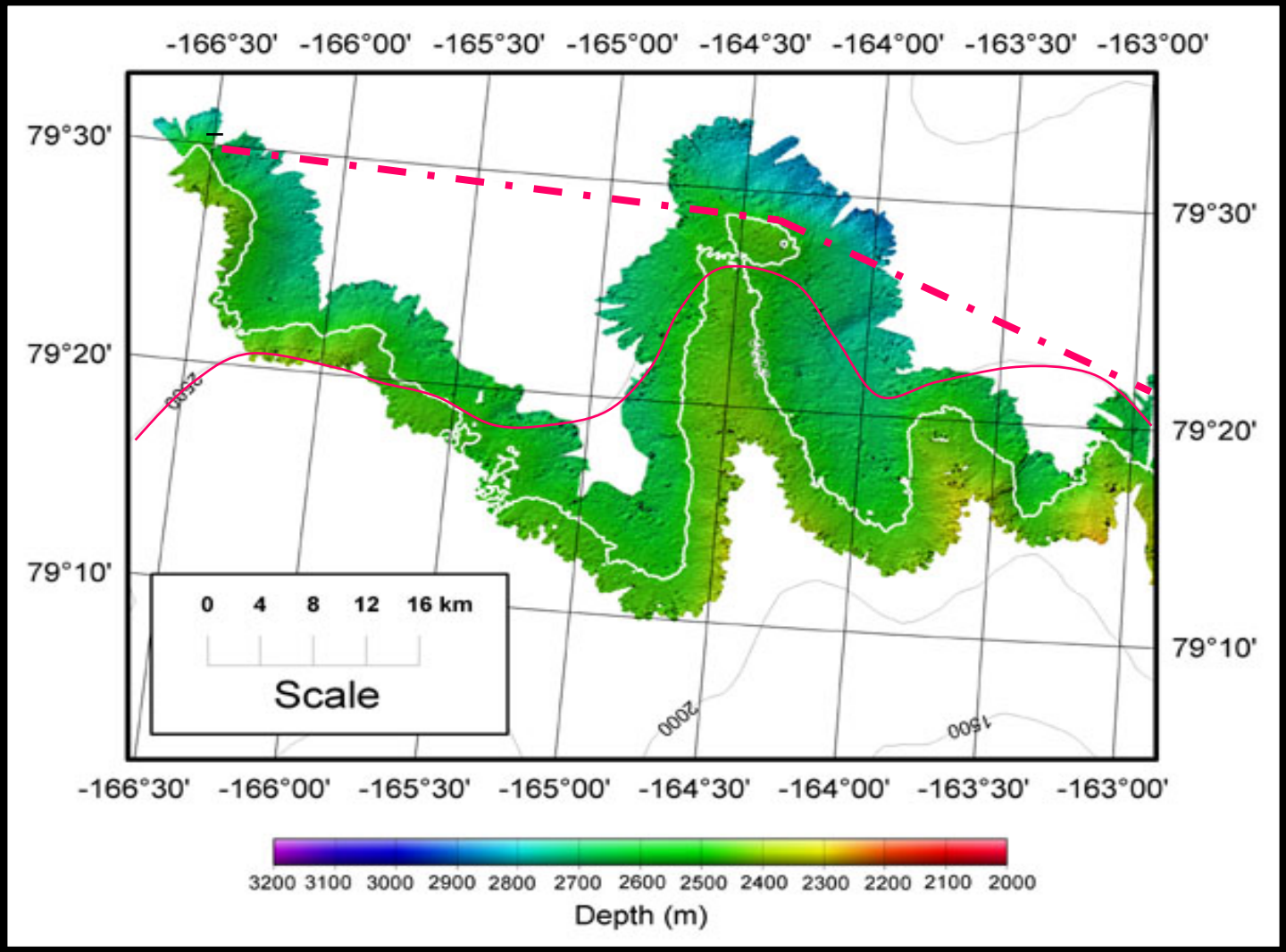
2003 & 2004 & 2007 & 2008



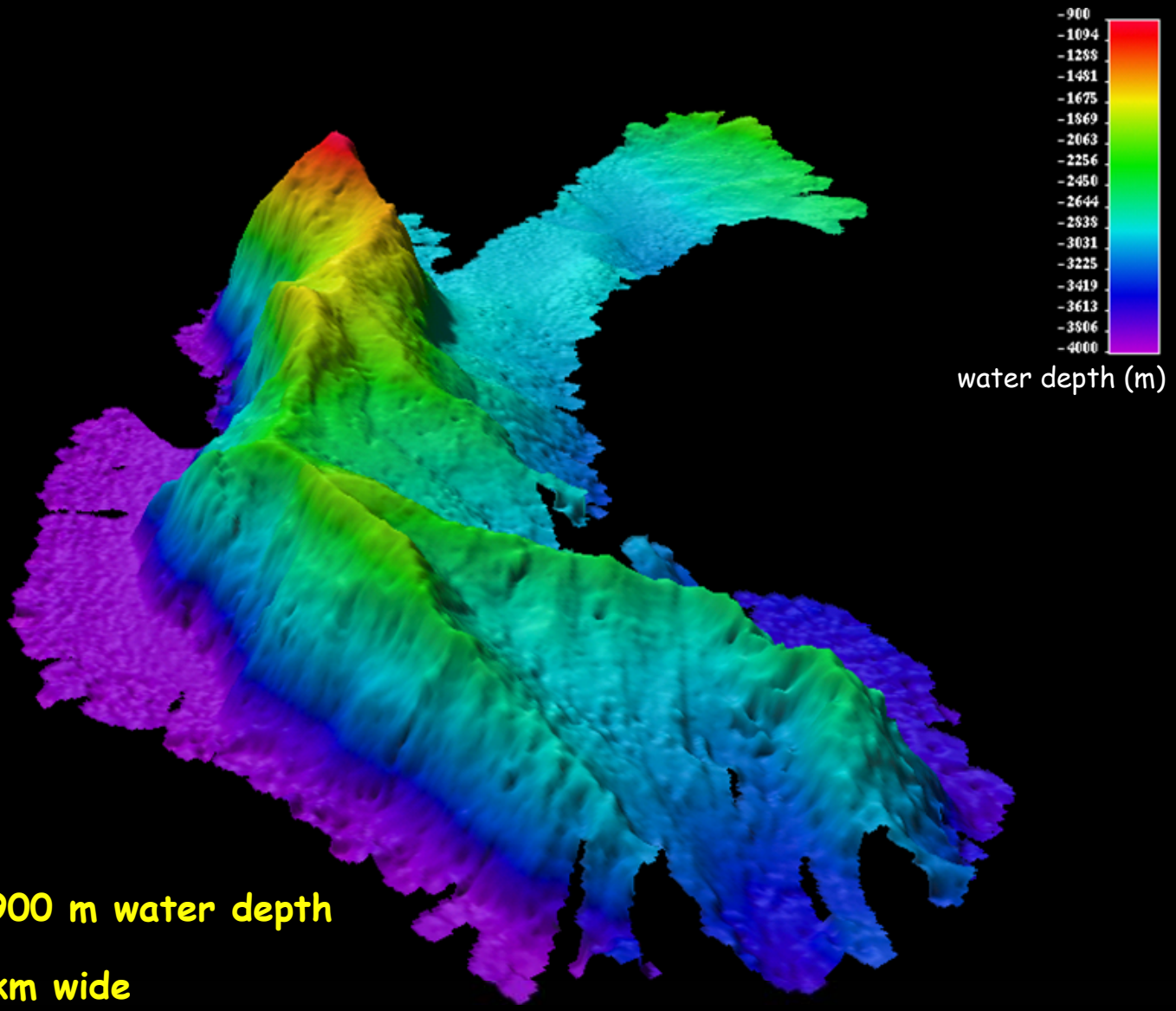

How do we map in this?

USCG HEALY

Redefinition of the 2500 m contour



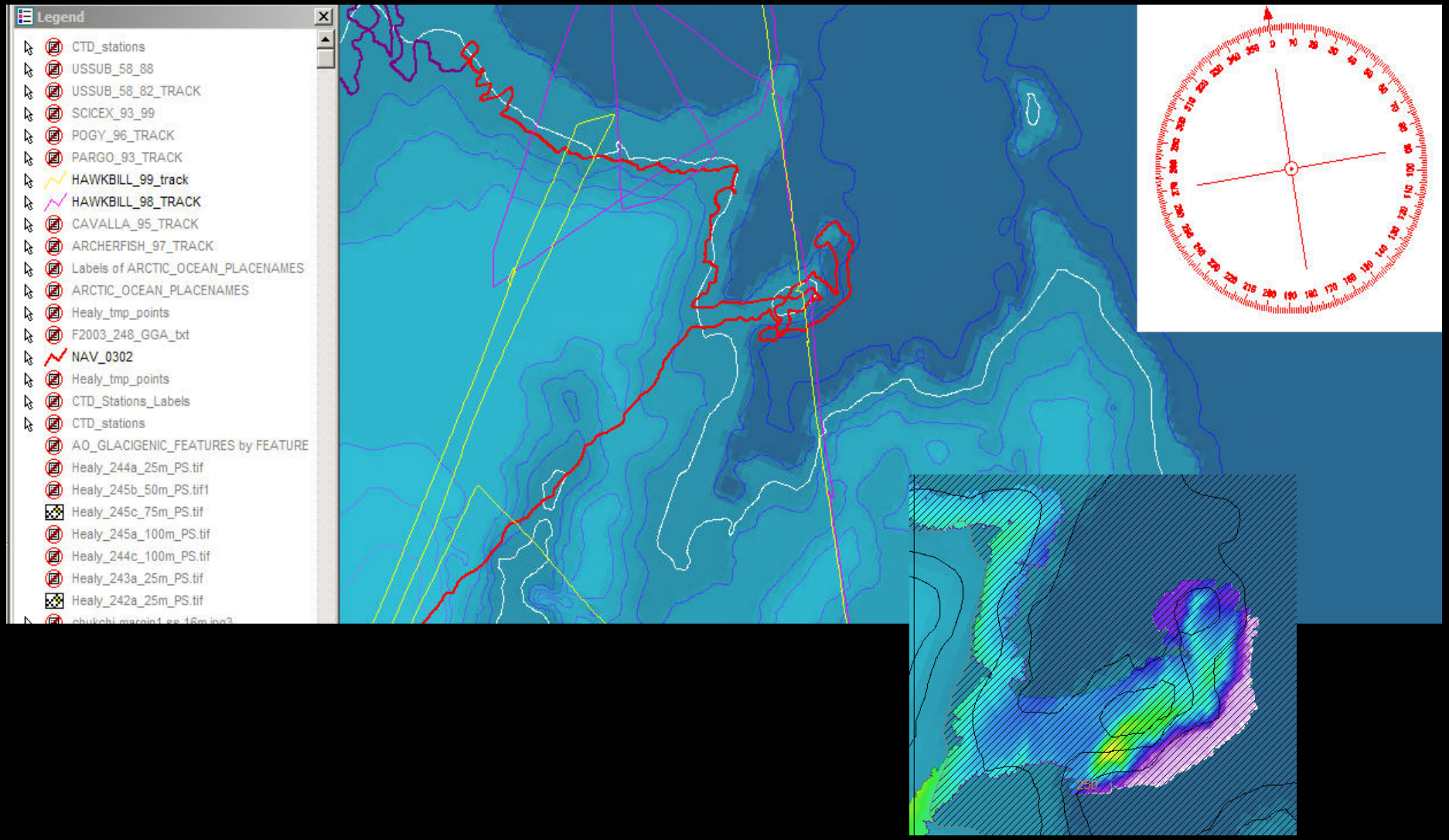
Healy Seamount
looking S, ve=6x



3100 m high, summit at 900 m water depth

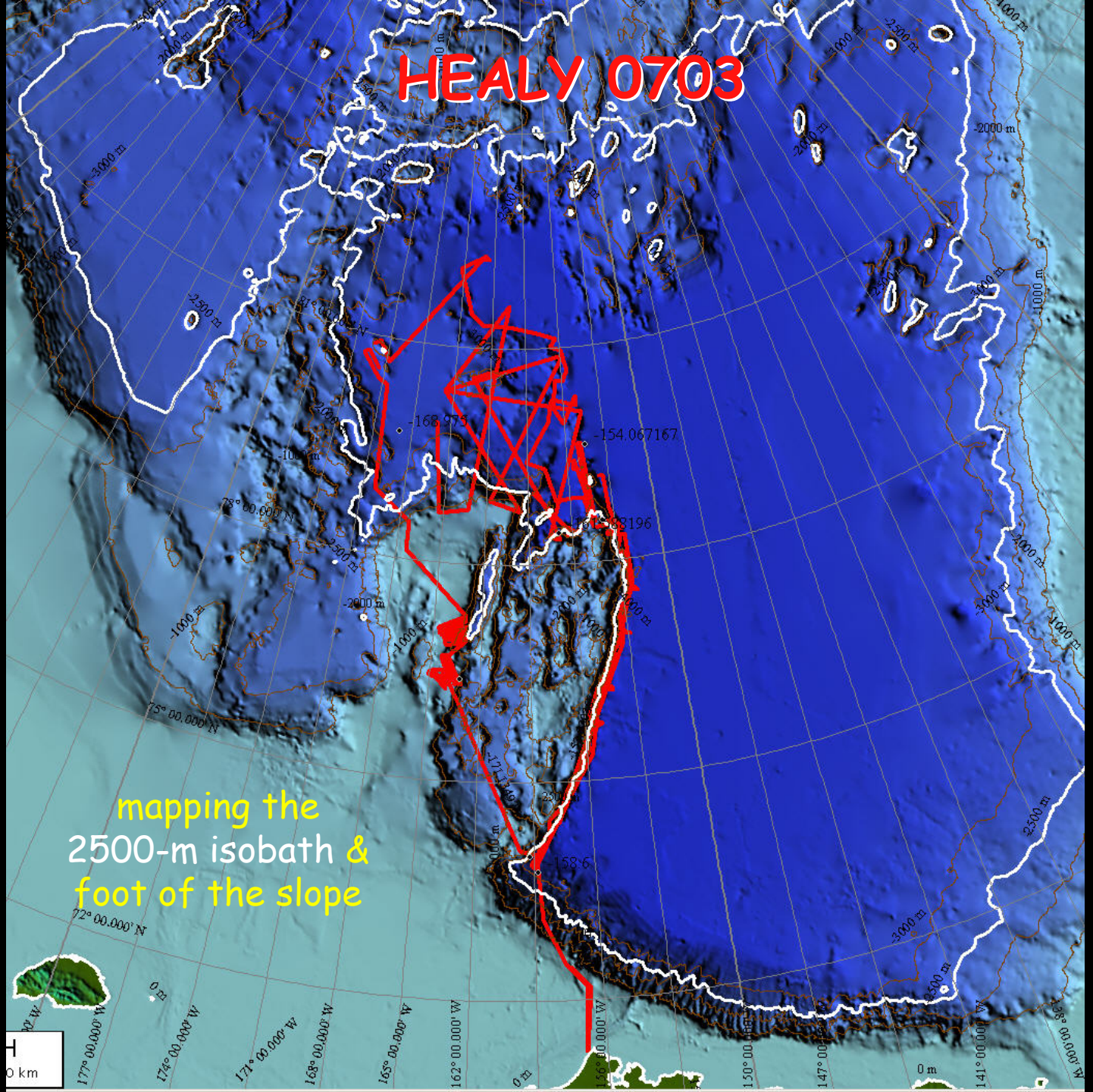
45 km long x 15 km wide

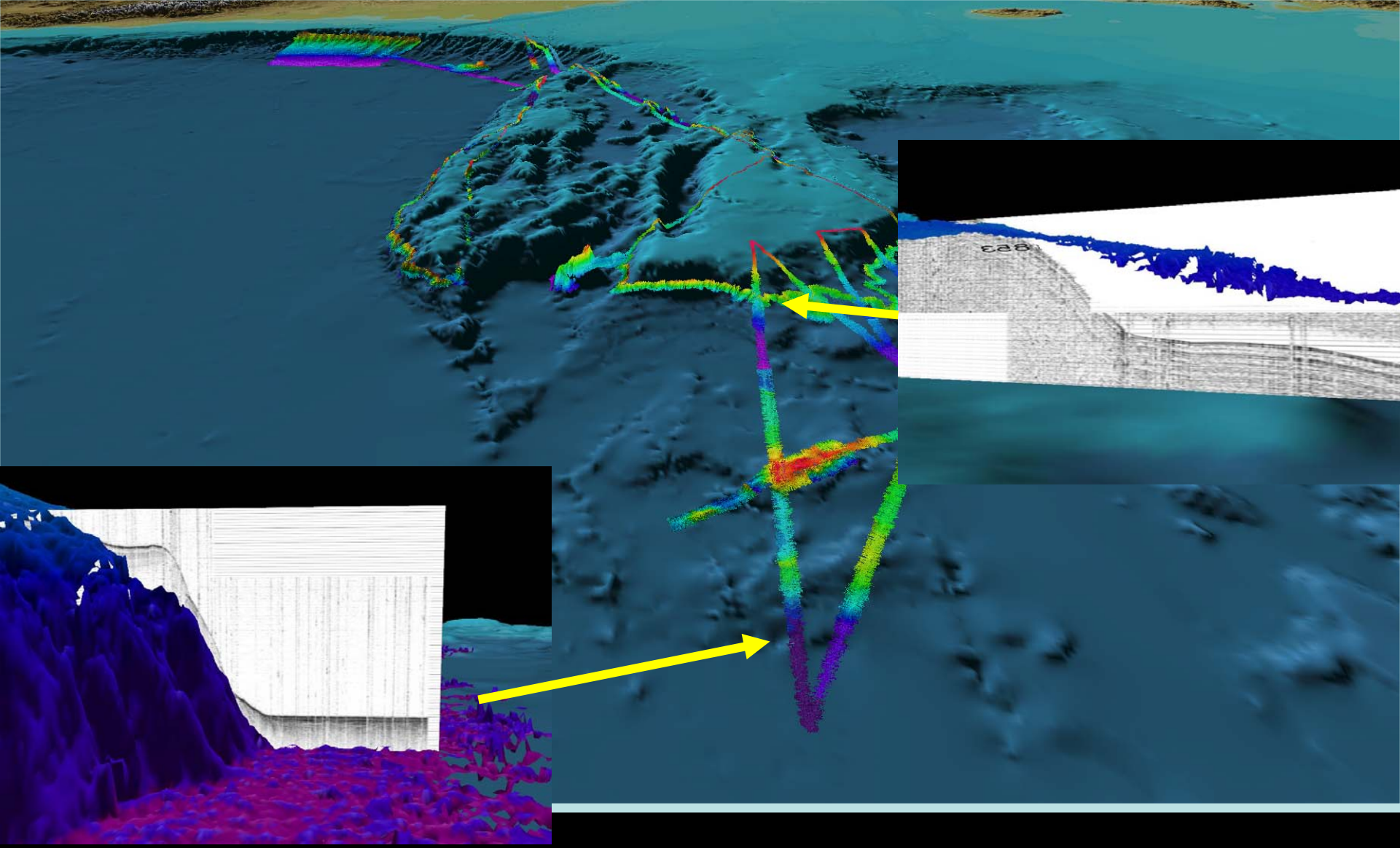
Healy Seamount Survey



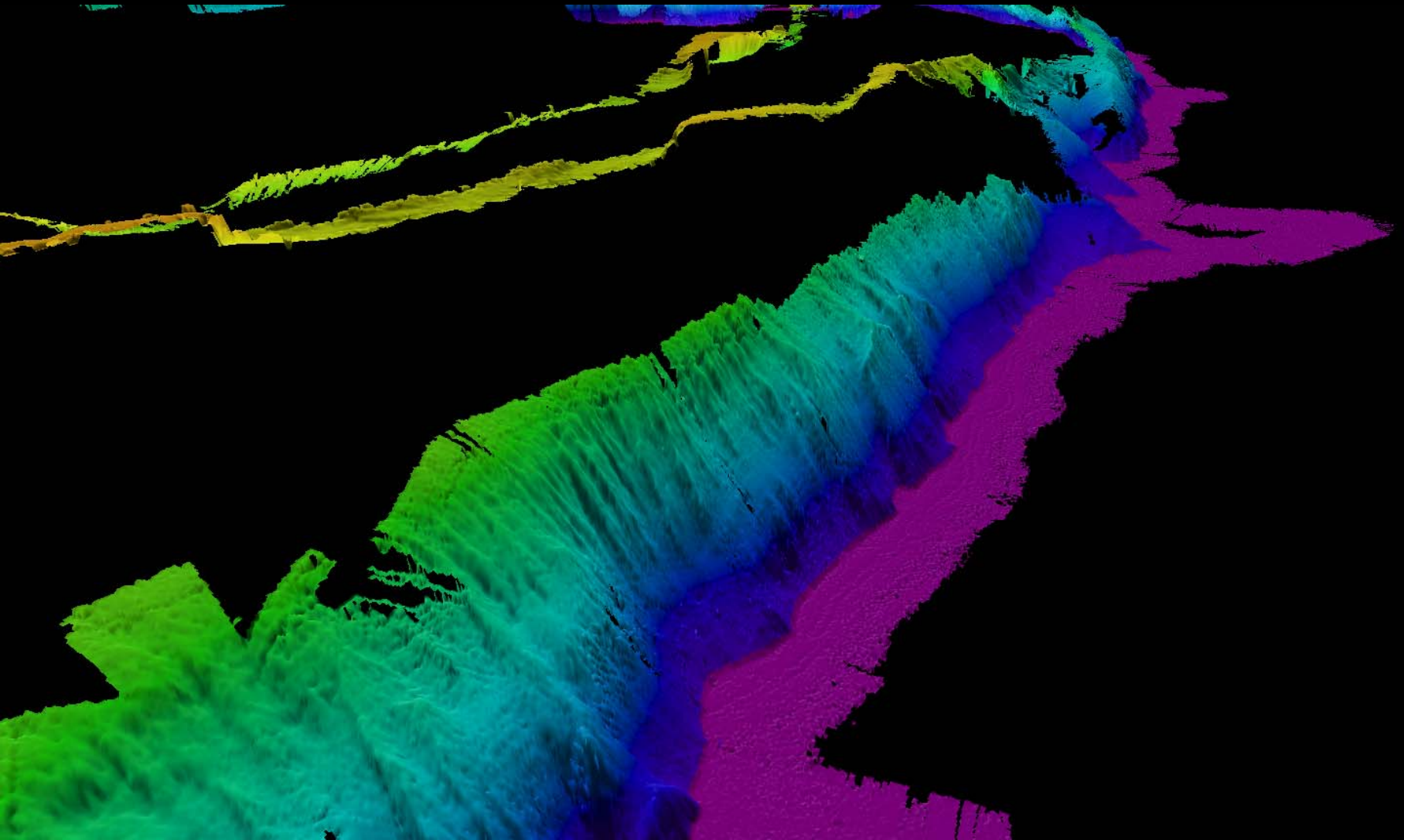
HEALY 07-03

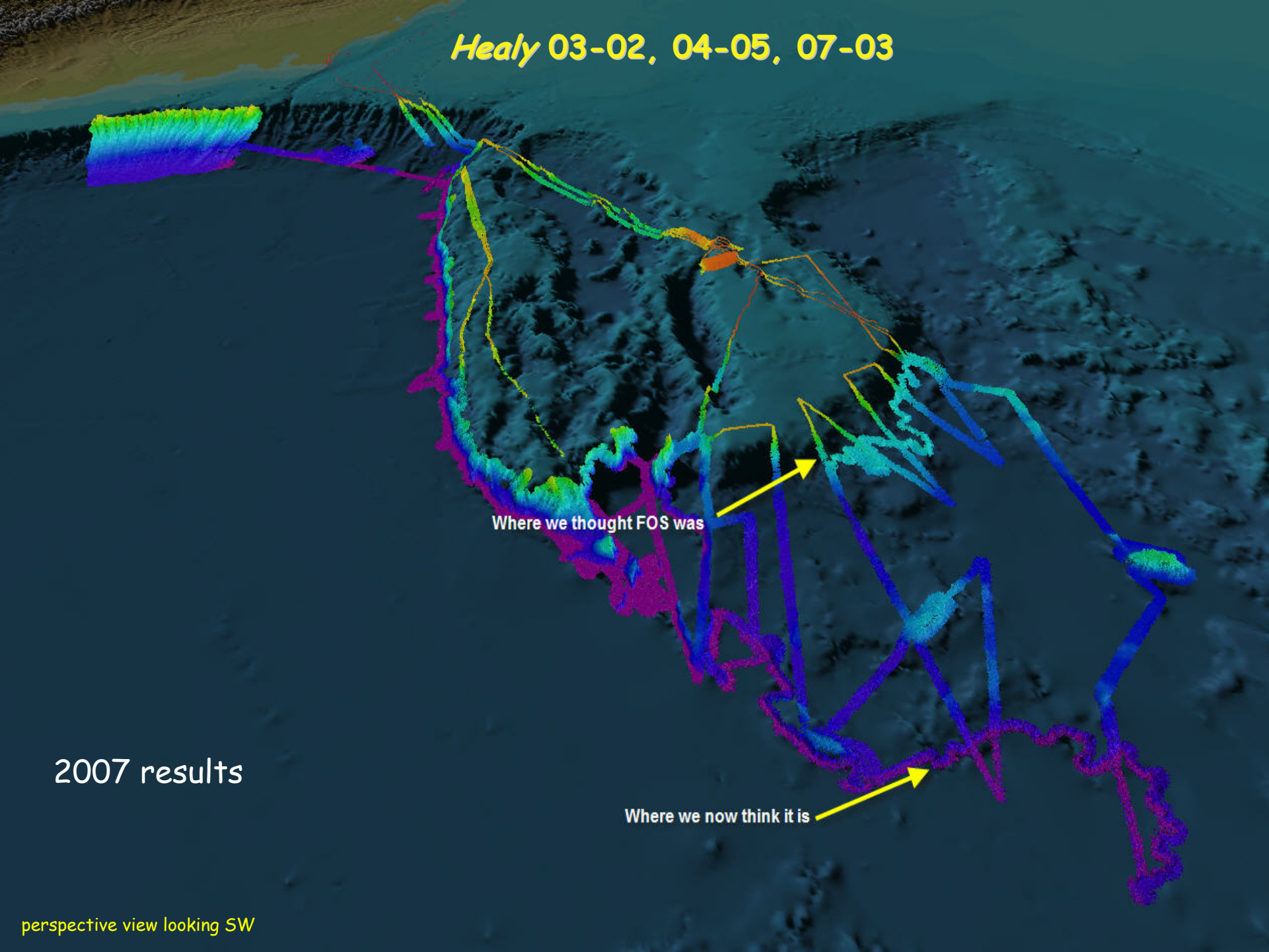

Center for Coastal & Ocean Mapping
Joint Hydrographic Center
CCOM
JHC
University of New Hampshire


HEALY 0703
mapping the
2500-m isobath &
foot of the slope
81°N
78°N
75°N
72°N



Healy 07-03– where's the real FoS?




Healy 03-02, 04-05, 07-03
Where we thought FOS was
Where we now think it is
2007 results
perspective view looking SW

HEALY 0805 - SHIPTRACK AND DREDGE SITES