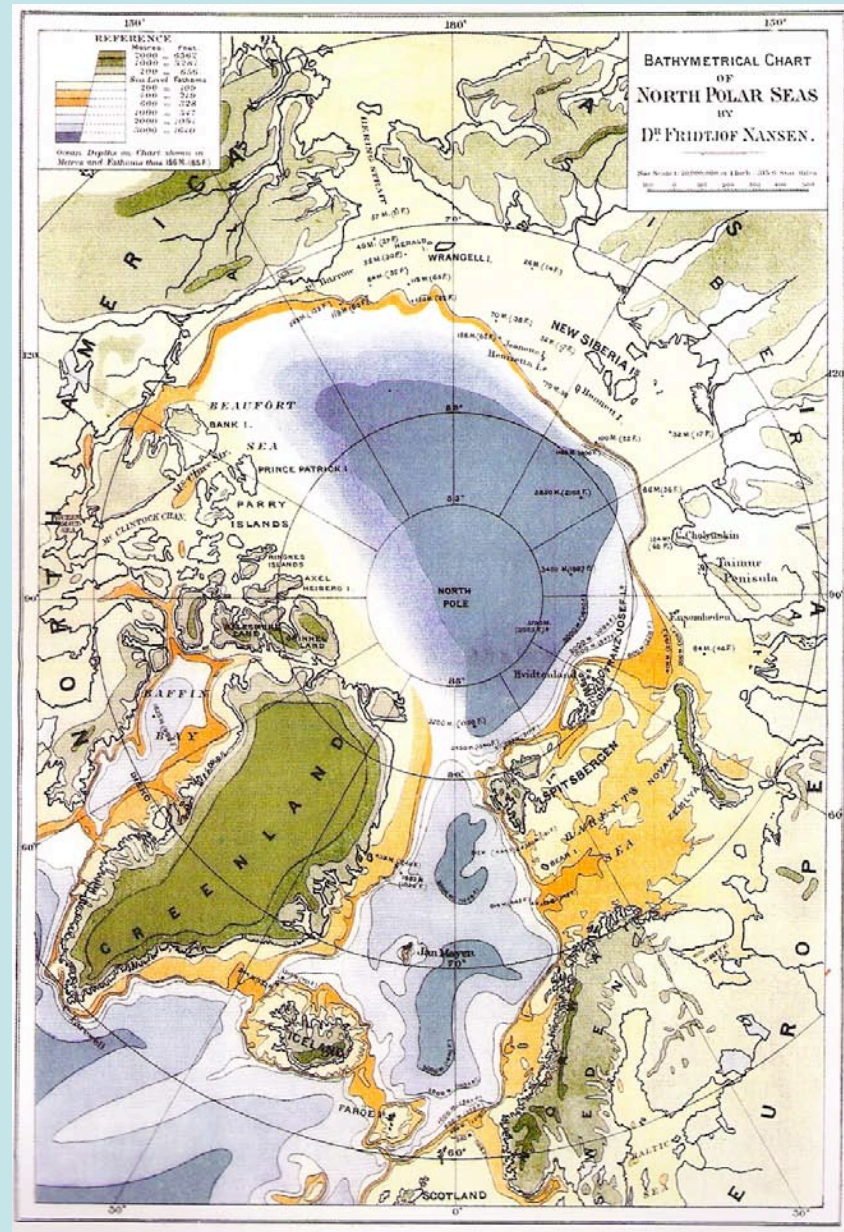


Cooperative Mapping of the Arctic Ocean for Science and for Sovereignty

International scientific collaboration
and changing legal regimes in the
Arctic Ocean

21 September 2009
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Associate Professor
University of Alaska
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The 1st Bathymetric Map of the Arctic Ocean



Logistics Dictates Arctic Opportunities

no single platform is adequate

- Drifting Stations

Fram, T-3, North Pole 1-45, Alpha

- Ice Breakers

Polar Sea, Polar Star, Polarstern, Oden, Healy

- Planes

Naval Research Laboratory's P-3

- Submarines

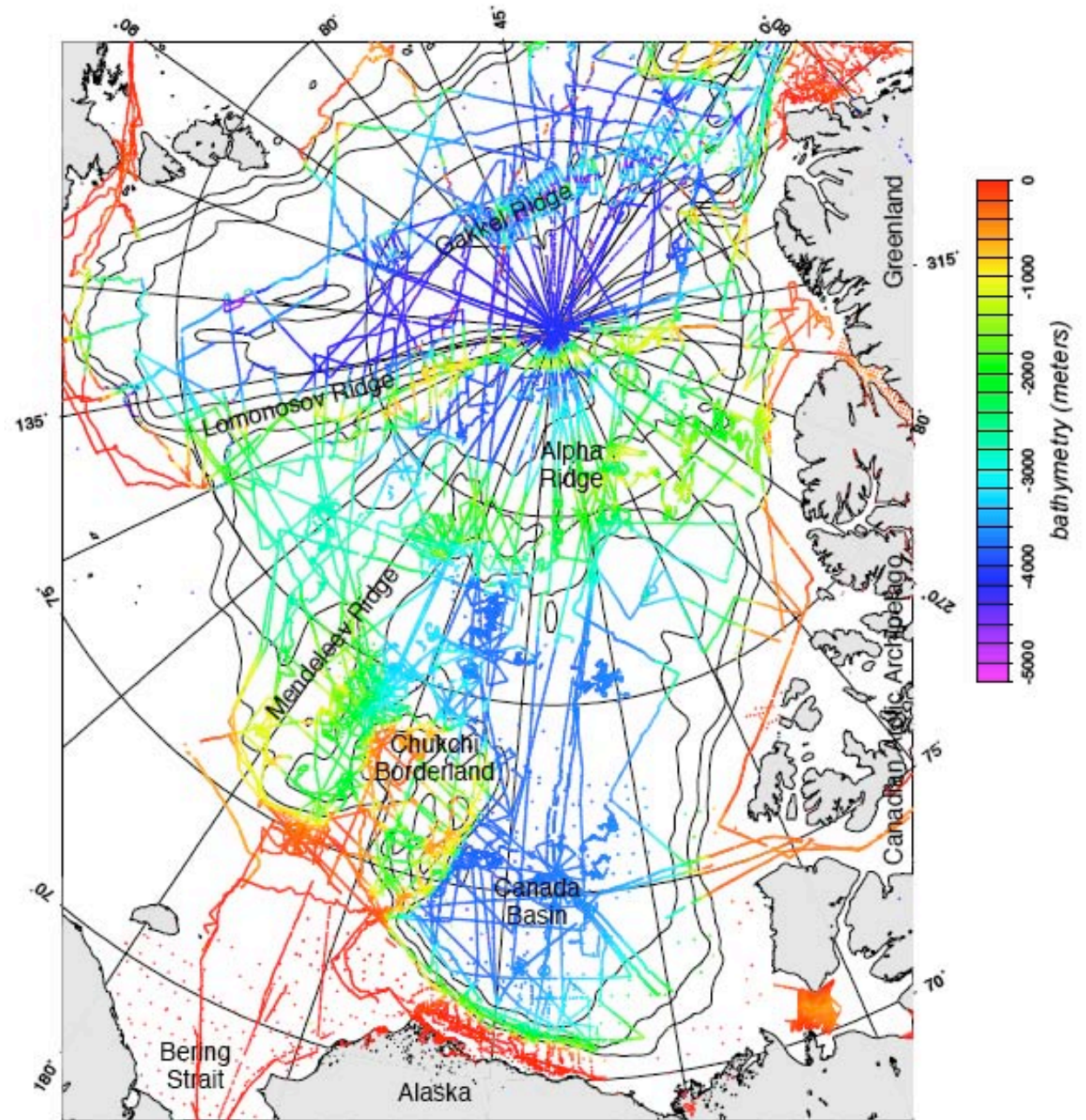
Nautilus, Skate and SCICEX

- Satellites

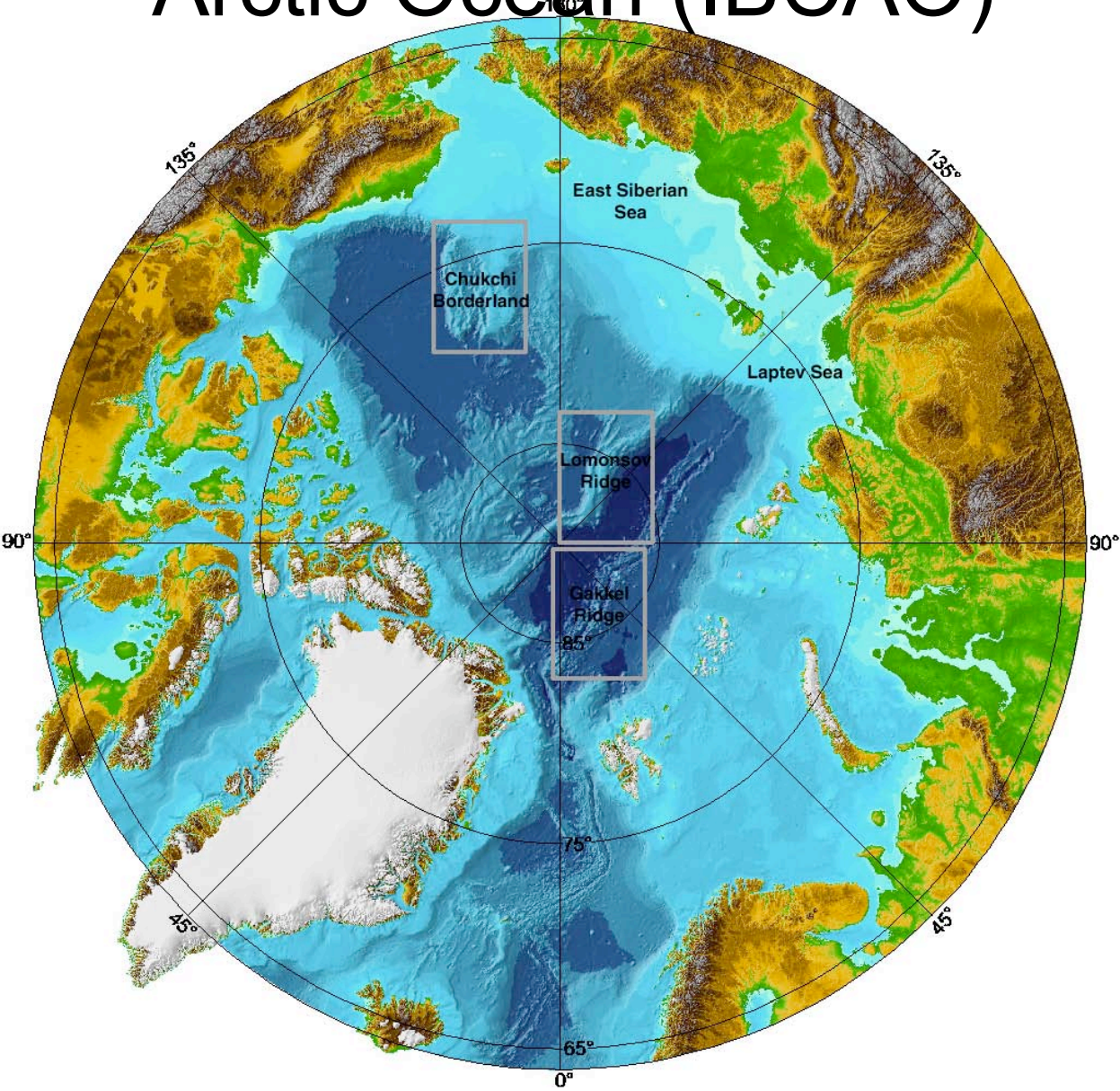


Bathymetric Data Sources

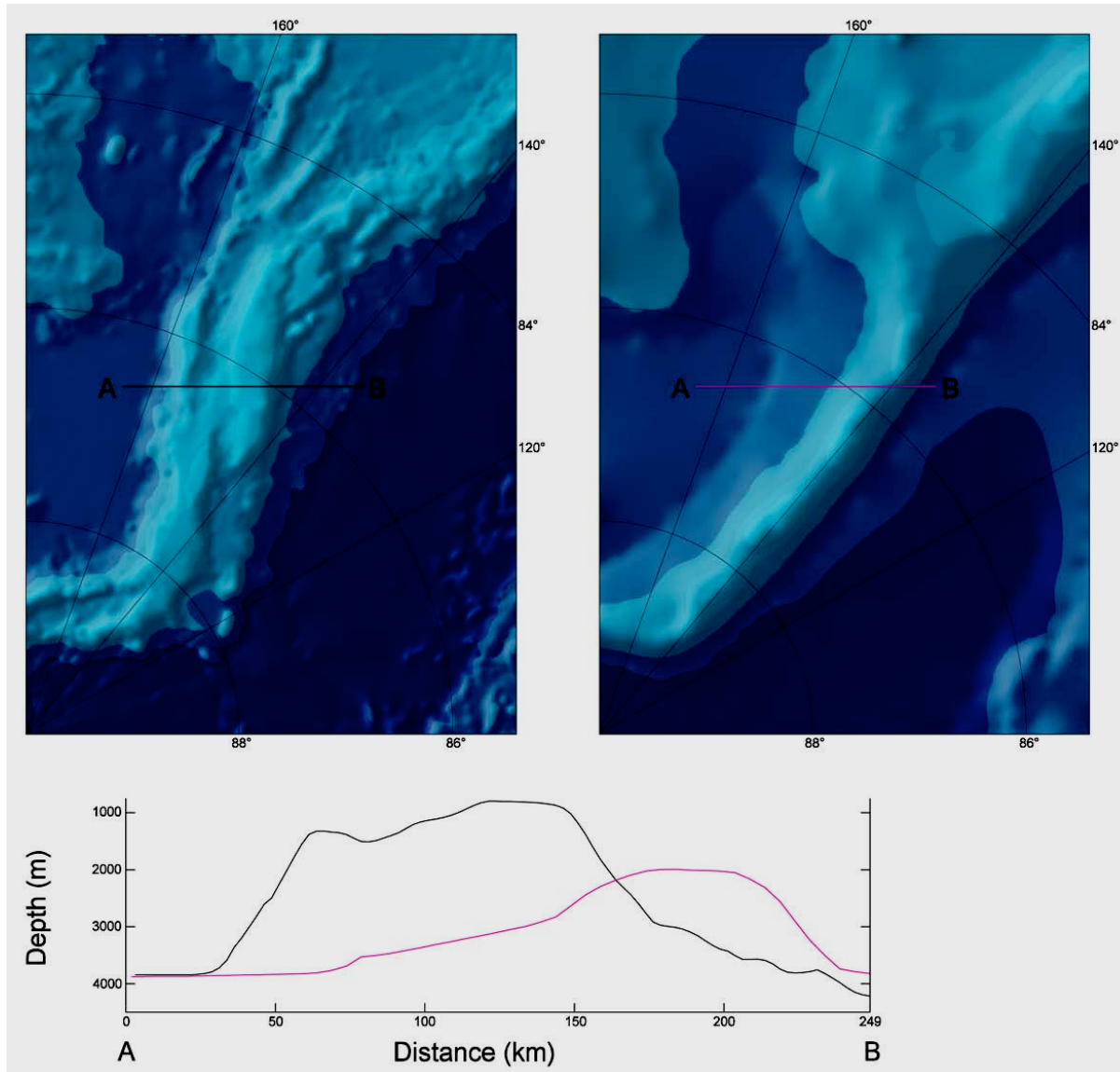
- Ice Islands
- Icebreakers
- Submarines



International Bathymetric Chart of the Arctic Ocean (IBCAO)



Lomonosov Ridge



Arctic Science Cooperation

opportunity and necessity

1998 SHEBA - Surface Heat Budget of the Arctic

Canadian icebreaker Louis St Laurent used as an ice camp

2001 AMORE - Arctic Mid-ocean Ridge Experiment

USCG Healy and Polarstern on Gakkel Ridge

2003 CATS - Canadian Arctic Throughflow Study

USCG Healy transit of the NW passage

2004 ACEX - Arctic Coring Expedition

Vidar Viking, Swedish Icebreaker Oden and Sovetskiy Soyuz

2005 HOTRAX - Healy-Oden Trans-Arctic Experiment

USCG Healy and the Swedish Icebreaker Oden

2007 AGAVE - Arctic Gakkel Vents Expedition

US researchers on Oden

2007 LOMROG - Lomonosov Ridge off Greenland

Joint Danish-Swedish Program with the “50 Years of Victory”

True or False?

1) A “land” grab is under way in the Arctic Ocean.

FALSE - A process for establishing territorial limits based on data collected in the oceans is being pursued.

2) The circum-Arctic states are in conflict due to the resources that are available beneath Arctic Ocean waters.

FALSE - These states are cooperating to acquire the data necessary to establish their territorial claims.

3) Planting a Russian flag on the seafloor at the North Pole has consequences for any territorial claims in the Arctic Ocean.

FALSE - We live in the 21st century, not the 17th. The Law of the Sea dictates how Extended EEZs are described and verified.

Law of the Sea

- Distinguishes the seabed from Extended Continental Shelves (ECS).

based on “natural prolongation”

The “area” belongs to humanity.

Ownership creates incentives for management

Applies to the seabed and resources below it

- Claims established by mapping

Observing these features; 2500 m; FOS, sediment thickness

Evaluated and validated by the Technical Commission

- Distinguishes the juridical from the physiographic shelf

Geophysical Data Sets for ECS Determination

Swath Bathymetry

- 2500 meter isobath
- Foot of Slope

Swath Backscatter

- Seafloor texture/composition

Gravity Anomaly

- Sediment Thickness/Crustal Structure

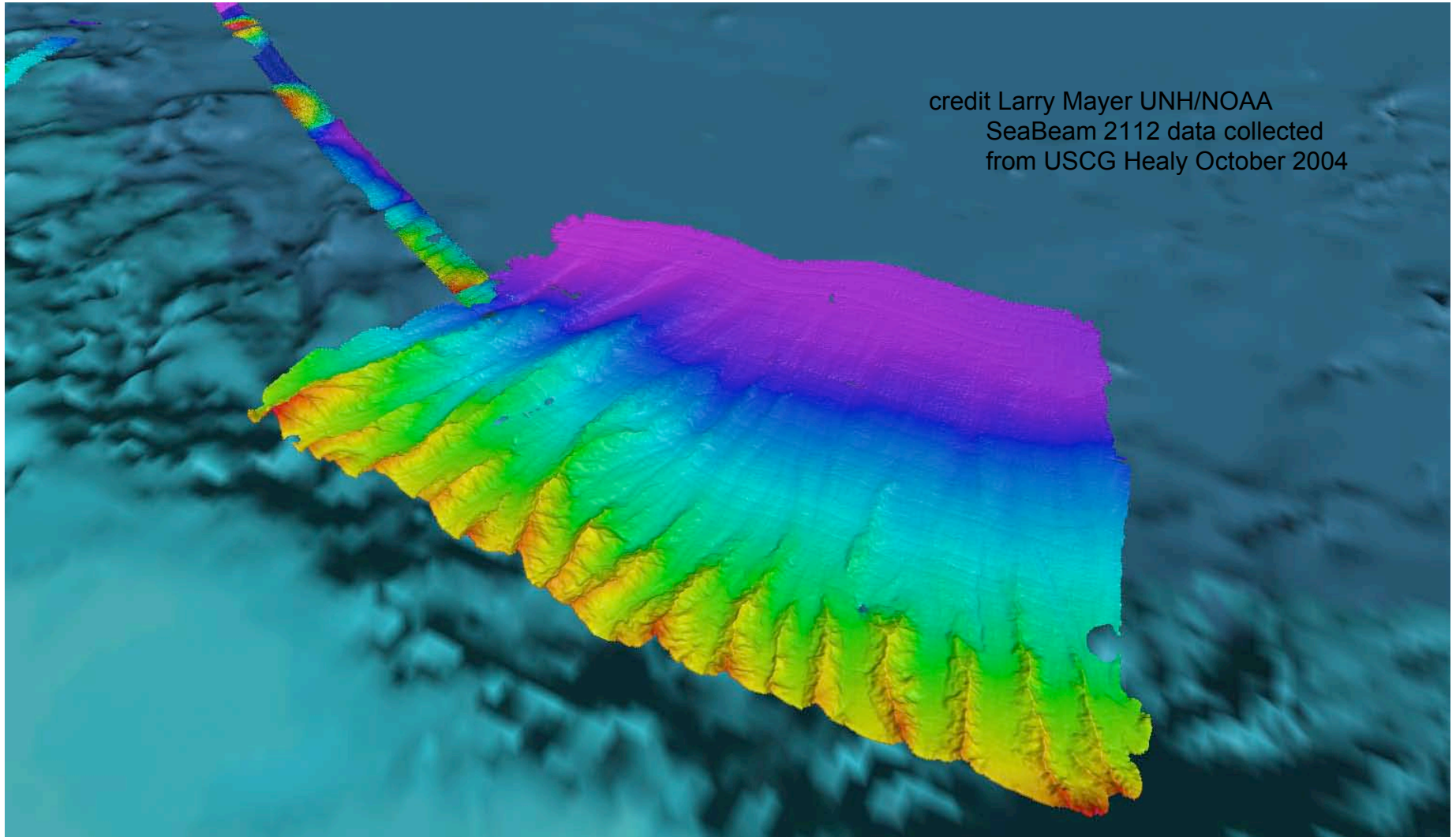
Multi-Channel Seismic Reflection (MCS)

- Sediment Thickness and Crustal Structure
- Scaled in Two-way Time (thickness/sound velocity)

Wide Angle Seismic Refraction

- Sound Velocity as a function of depth
- Needed to re-scale MCS data into depth (for 1% rule)

Canyons on the Beaufort Slope



This data used for this image were collected in ice-free waters from USCG Healy.

Canadian-Danish ECS Program

Despite conflict over Hans Island

Cooperation is ongoing

Lomonosov Ridge Test of Appurtenance (LORITA)

Established Ice Camps

Collected seismic reflection and refraction data

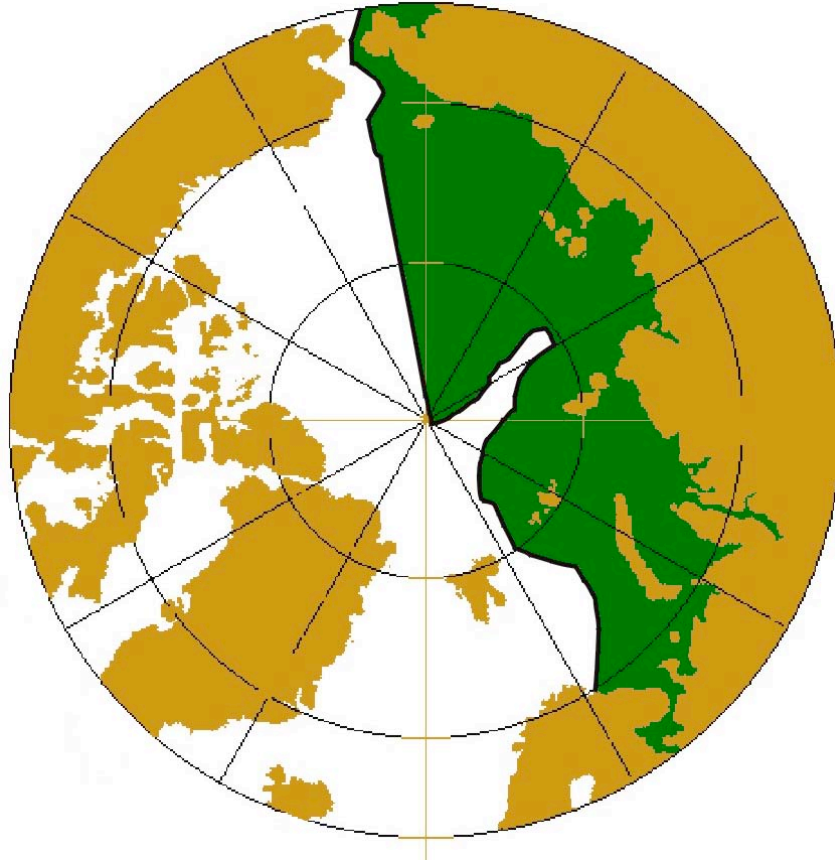
Joint cruise to the North Pole in 2009

Canadian - US Cooperation

Despite unresolved mutual boundary in the Beaufort Sea

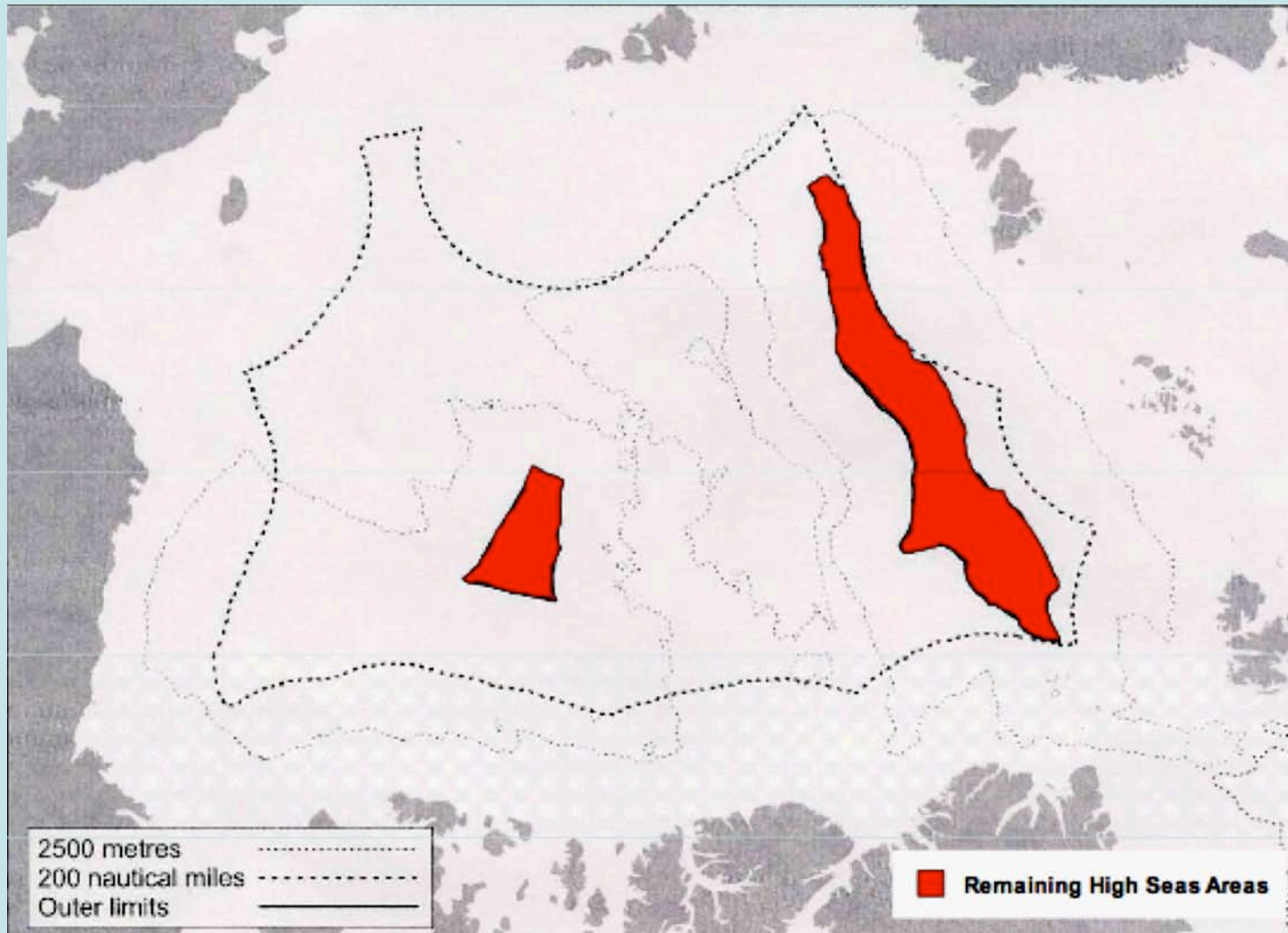
Utilizing the USCGC Healy in 2008 and 2009 to support seismic reflection data acquisition for the Canadian icebreaker, the Louis St Laurent.

Russian Claim



This claim, the 1st submission to the technical commission, was returned due to a lack of supporting data.

Estimated Remaining International Waters



From Ron Macnab - Geologic Survey of Canada (retired)

Cooperation?

Arctic Cooperation is driven by necessity and opportunity.

Self interest has already caused the circum-Arctic states to jointly collect and share data sets.

This self-interested cooperation could be the basis for a joint submission on the Arctic Ocean. The cooperating nations could:

- Sidestep boundary disputes
- Maximize the enclosed area

Could this be a basis for circum-Arctic scientific cooperation?