

# 60 Years of Marine Nuclear Power: 1955 – 2015

## Part 5: Arctic Operations

Peter Lobner  
August 2015

# Foreword

This is Part 5 of a rather lengthy presentation that is my attempt to tell a complex story, starting from the early origins of the U.S. Navy's interest in marine nuclear propulsion in 1939, resetting the clock on 17 January 1955 with the world's first "underway on nuclear power" by the *USS Nautilus*, and then tracing the development and exploitation of nuclear propulsion over the next 60 years in a remarkable variety of military and civilian vessels created by eight nations.

I acknowledge the great amount of work done by others who have posted information on the internet on international marine nuclear propulsion programs, naval and civilian nuclear vessels and naval weapons systems. My presentation contains a great deal of graphics from many internet sources. Throughout the presentation, I have made an effort to identify all of the sources for these graphics.

If you have any comments or wish to identify errors in this presentation, please send me an e-mail to: [PL31416@cox.net](mailto:PL31416@cox.net).

I hope you find this presentation informative, useful, and different from any other single document on this subject.

Best regards,

Peter Lobner  
August 2015

# Arctic Operations

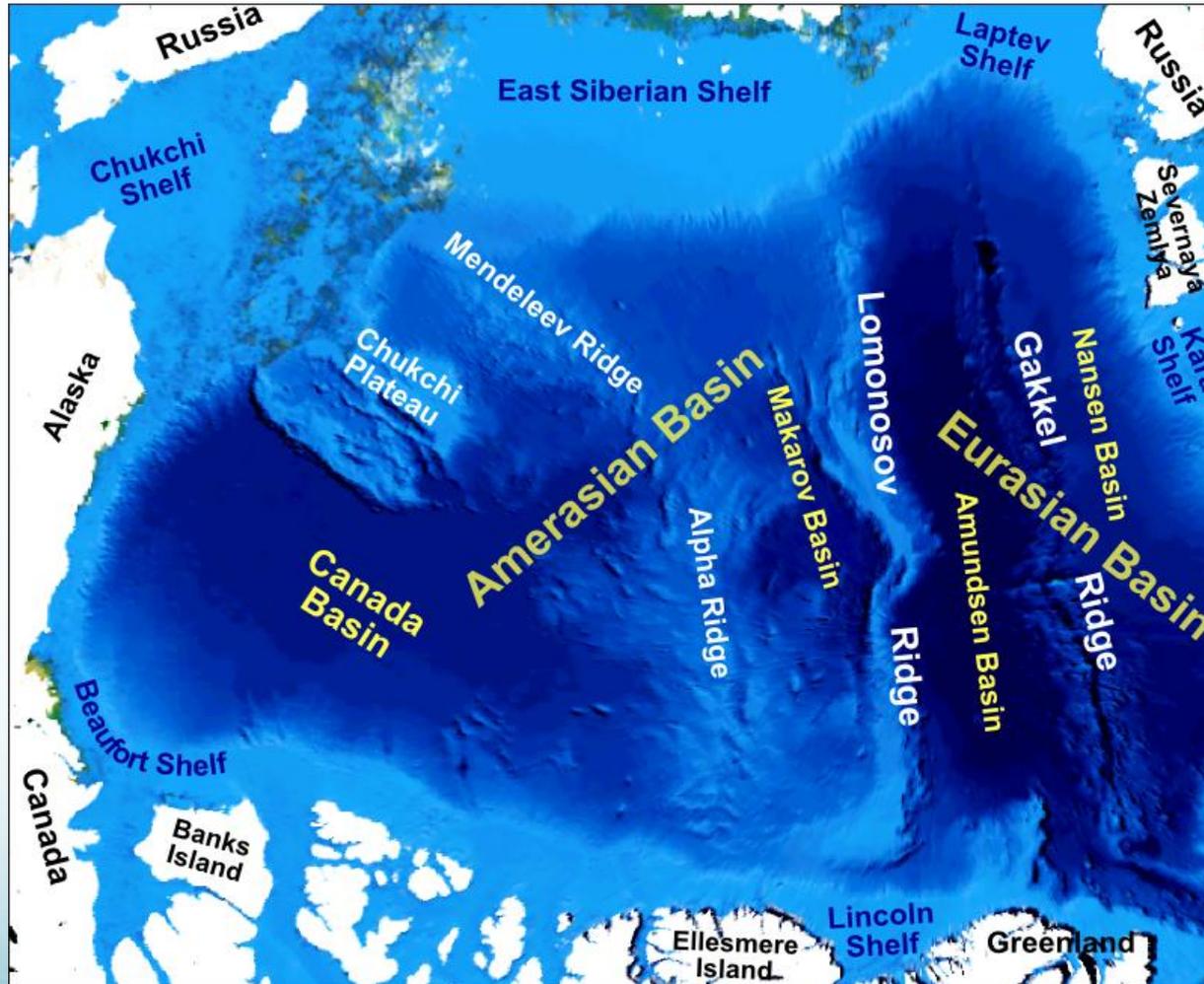
- Basic orientation to the Arctic region
- Dream of the Arctic submarine
- U.S. nuclear marine Arctic operations
- Russian nuclear marine Arctic operations
- Current trends in Arctic operations

# Basic orientation to the Arctic region

# Arctic boundary as defined by the Arctic Research and Policy Act

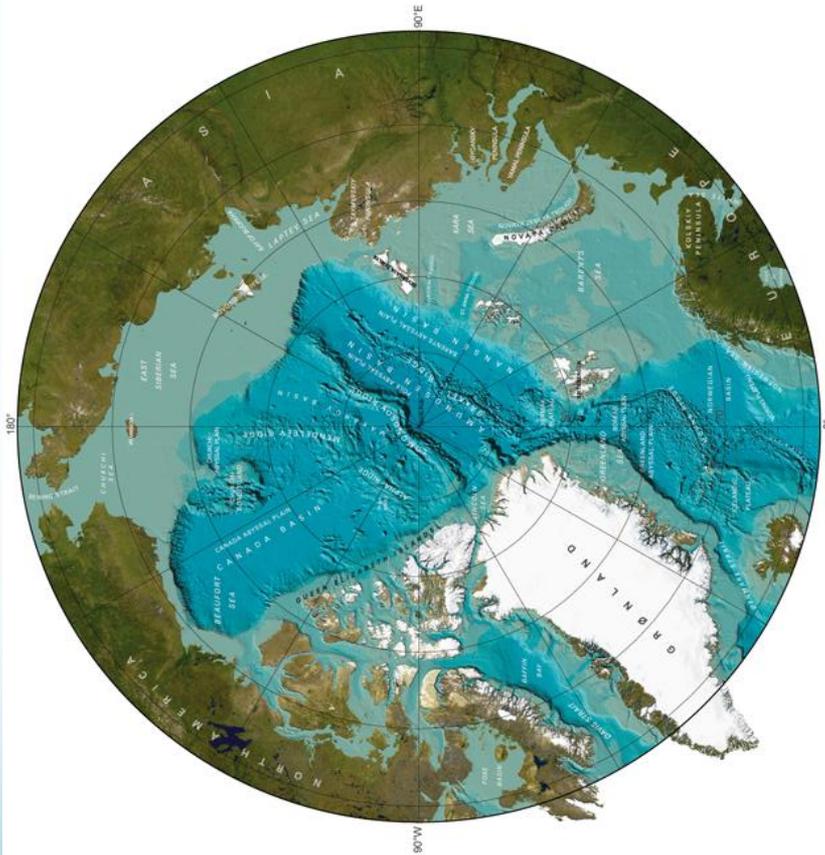


# Bathymetric / topographic features in the Arctic Ocean

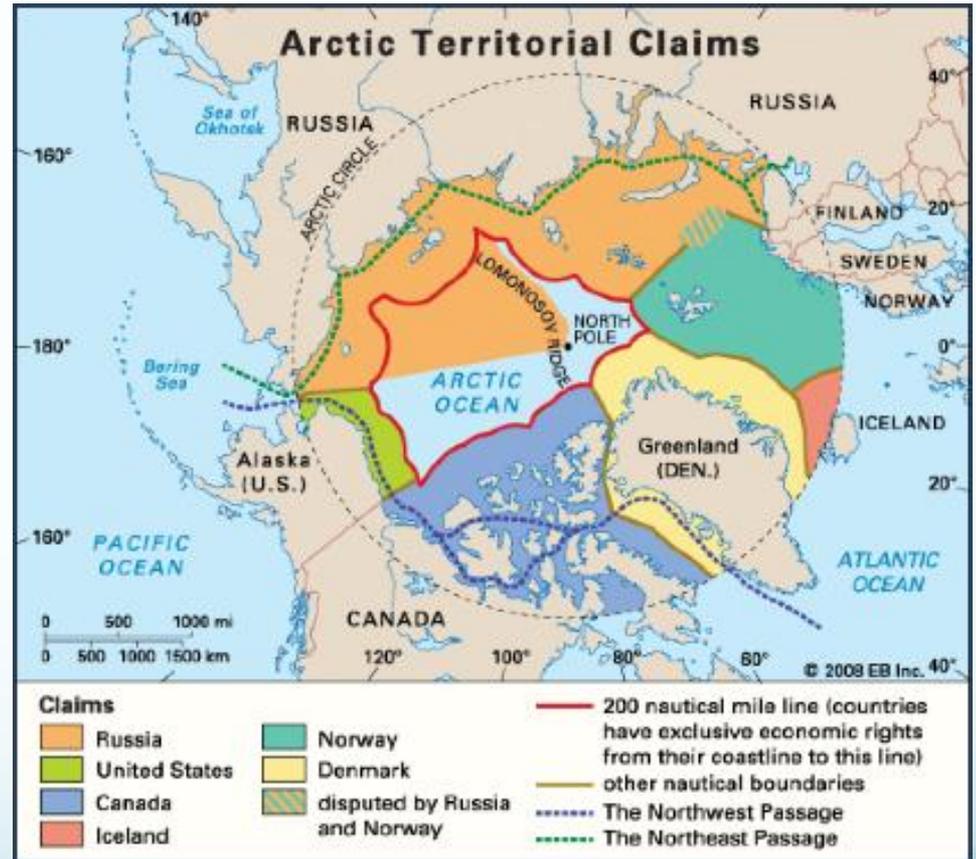


Source: [https://en.wikipedia.org/wiki/Mendelev\\_Ridge](https://en.wikipedia.org/wiki/Mendelev_Ridge)

# Arctic territorial claims

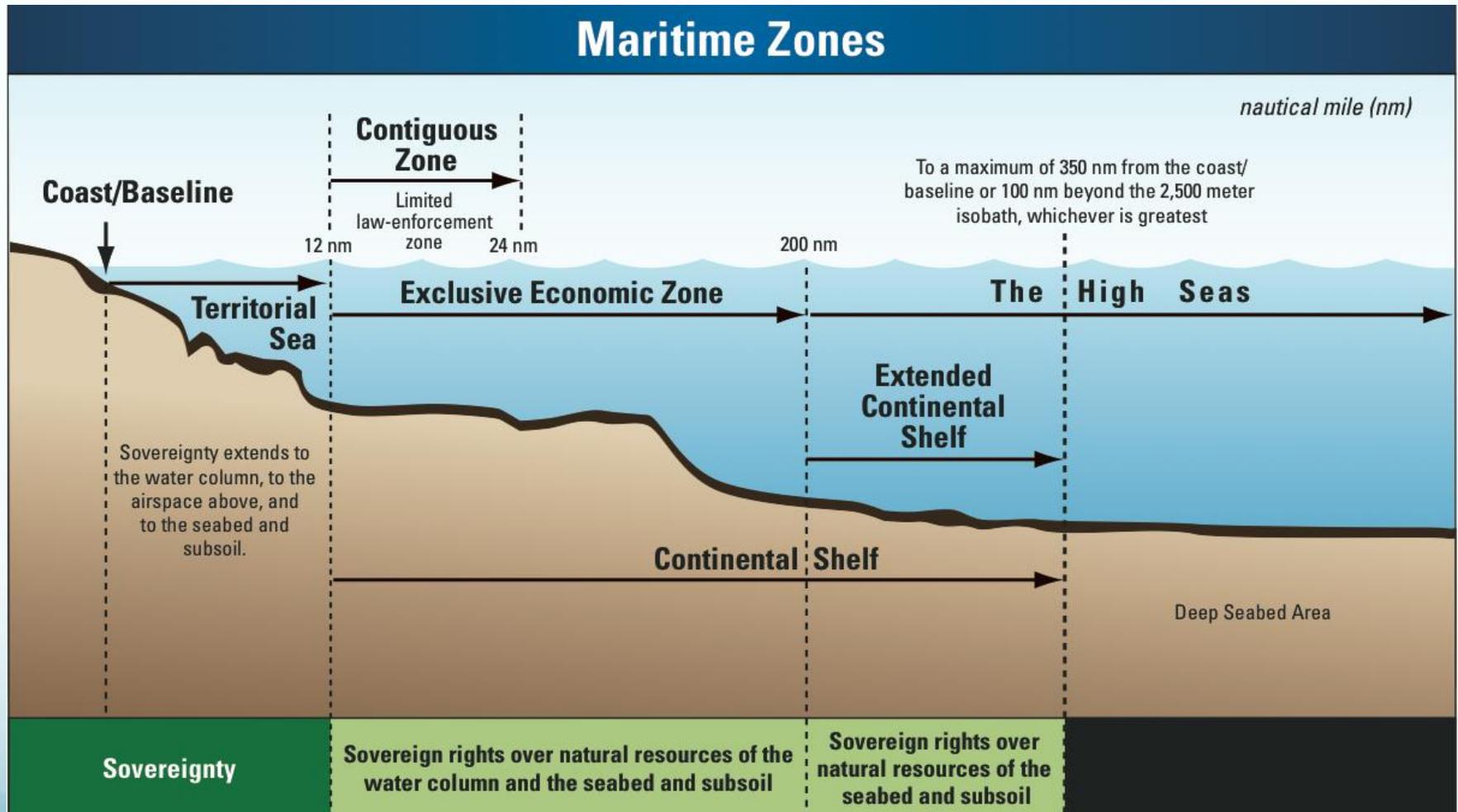


Source: [www.wired.com](http://www.wired.com)



Source: Encyclopedia Britannica

# Maritime zones & sovereignty



Source: <http://continentalshef.gov/media/ECSposterDec2010.pdf>

# Northern Sea Route

The New York Times

September 11, 2009

## A Shortcut Across The Top of the World

The Northeast Passage, across the Arctic Ocean, provides a shorter alternative for cargo vessels travelling between Europe and Asia than using the Suez Canal. It is shorter than the Panama Canal route for some voyages between the North American west coast and Europe.

LENGTH OF A VOYAGE TO ROTTERDAM FROM:

YOKOHAMA, JAPAN  
12,894 miles via Suez Canal,  
8,452 miles via Northeast Passage

SHANGHAI, CHINA  
12,107 miles via Suez Canal,  
9,297 miles via Northeast Passage

VANCOUVER, CANADA  
10,262 miles via Panama Canal,  
8,038 miles via Northeast Passage



THE NEW YORK TIMES

SIGN IN TO RECOMMEND

Source: The New York Times

# Northern Sea Route



- Northern Sea Route, also known as Northeast Passage, is a water route along the northern coast of Russia, between the Atlantic and Pacific oceans.
- First traversed by Nils A. E. Nordenskjold of Sweden in 1878-79.
- Regular use of this route was first established in the 1930s by the USSR.
- This route enables shipping to support Russian cities and industrial infrastructure along the north coast and cuts the distance between Russian Atlantic and Pacific ports in half, relative to routes through the Suez Canal.
- A fleet of Russian icebreakers, aided by aerial reconnaissance and by radio weather stations, keeps the entire Northern Sea Route navigable from June to October, and the route from Murmansk to Dudinka open all year.

# Northwest Passage



Source: <http://www.britannica.com/place/Northwest-Passage-trade-route>

# Northwest Passage

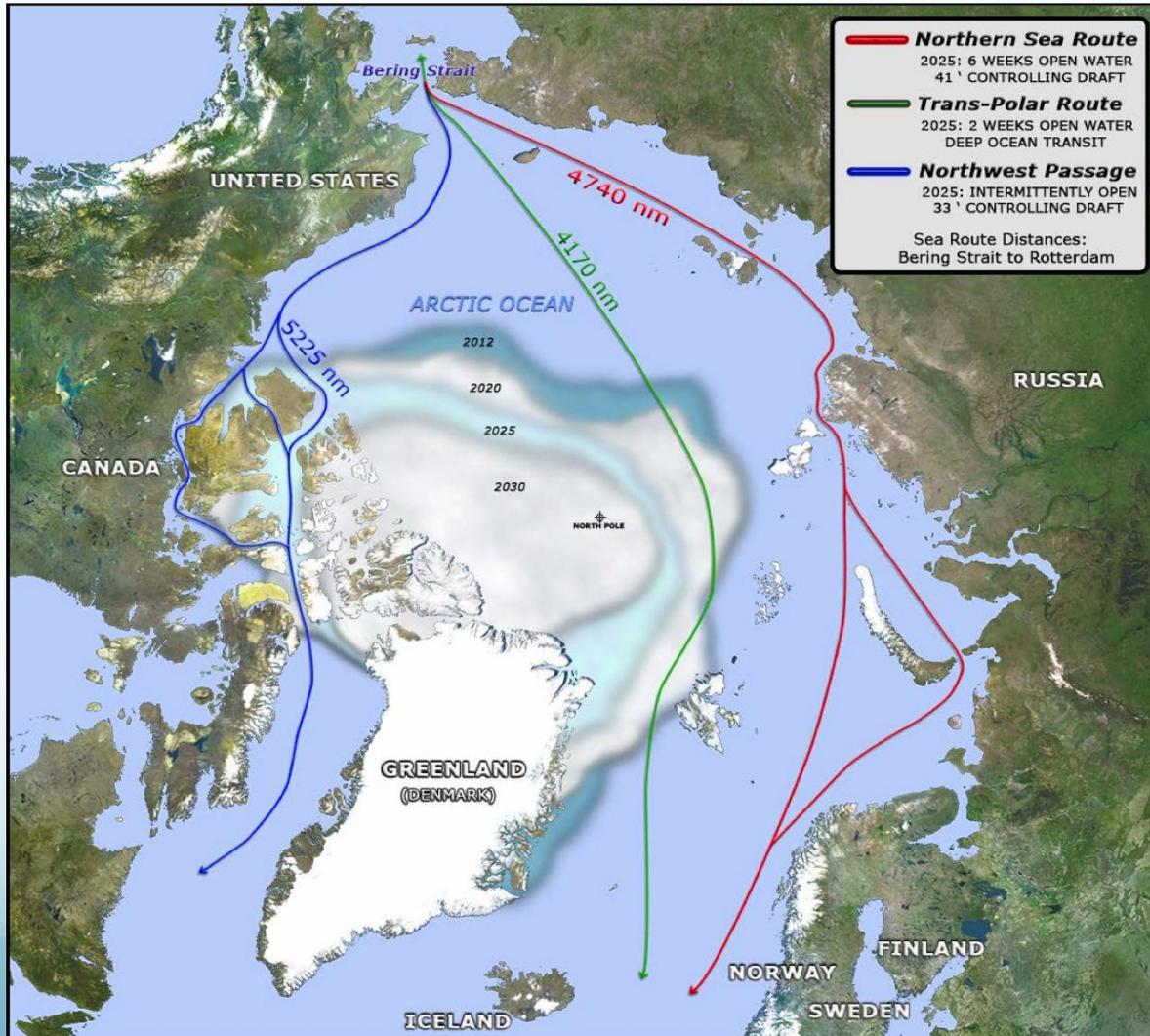
- The Northwest Passage is a sea route connecting the northern Atlantic to the Northern Pacific via sea lanes in the Arctic Ocean, some of which are in Canadian territorial waters.
  - The U.S. position is that the Northwest Passage is an international strait open to shipping, and does not require permission from Canada for transit.
  - In 1985, the U.S. Coast Guard icebreaker *Polar Star* transited the Northwest Passage after notifying the Canadian government of the voyage, but without seeking formal authorization from the Canadian government for the voyage.
  - In 1986 the Canadian government officially claimed the Northwest Passage as internal Canadian waters through the application of straight baselines.
  - In 2009, Canada re-named this waterway the “Canadian Northwest Passage.”
- The Canadian Coast Guard was formed on January 26, 1962 as a subsidiary of the Department of Transport (DOT).
  - Among its many missions, the CCG is responsible for icebreaking and Arctic sovereignty protection.
  - CCG icebreakers do not maintain a commercial shipping lane through the Northwest Passage.
- Despite plans in 2007 to establish a deep water facility at Nanisivik (north end of Baffin Island), Canada does not have one deep water port in the high Arctic as of mid- 2015.
  - In contrast, Russia has 16 ports along its Northern Sea Route.

# Extent of Arctic Ice Pack



Comparison of 30-year sea ice minimum average with the 2012 historical minimum, inside the red line

# Anticipated future Arctic transit routes



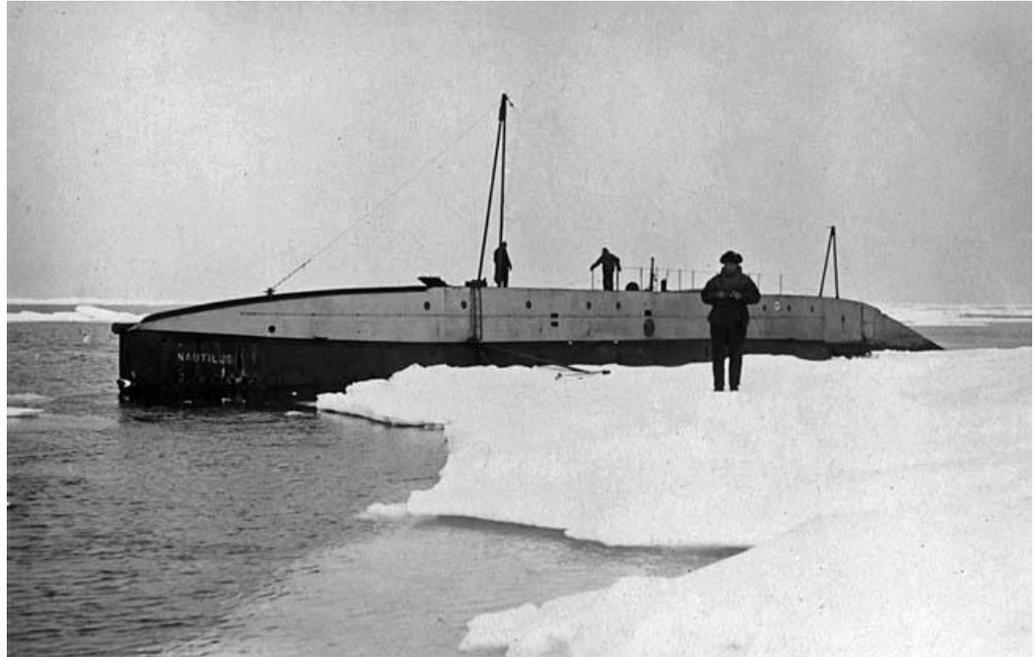
Routes superimposed over U.S. Navy consensus assessment of sea ice extent minima

# Dream of the Arctic submarine

# The dream of the Arctic submarine



Sir Hubert Wilkins



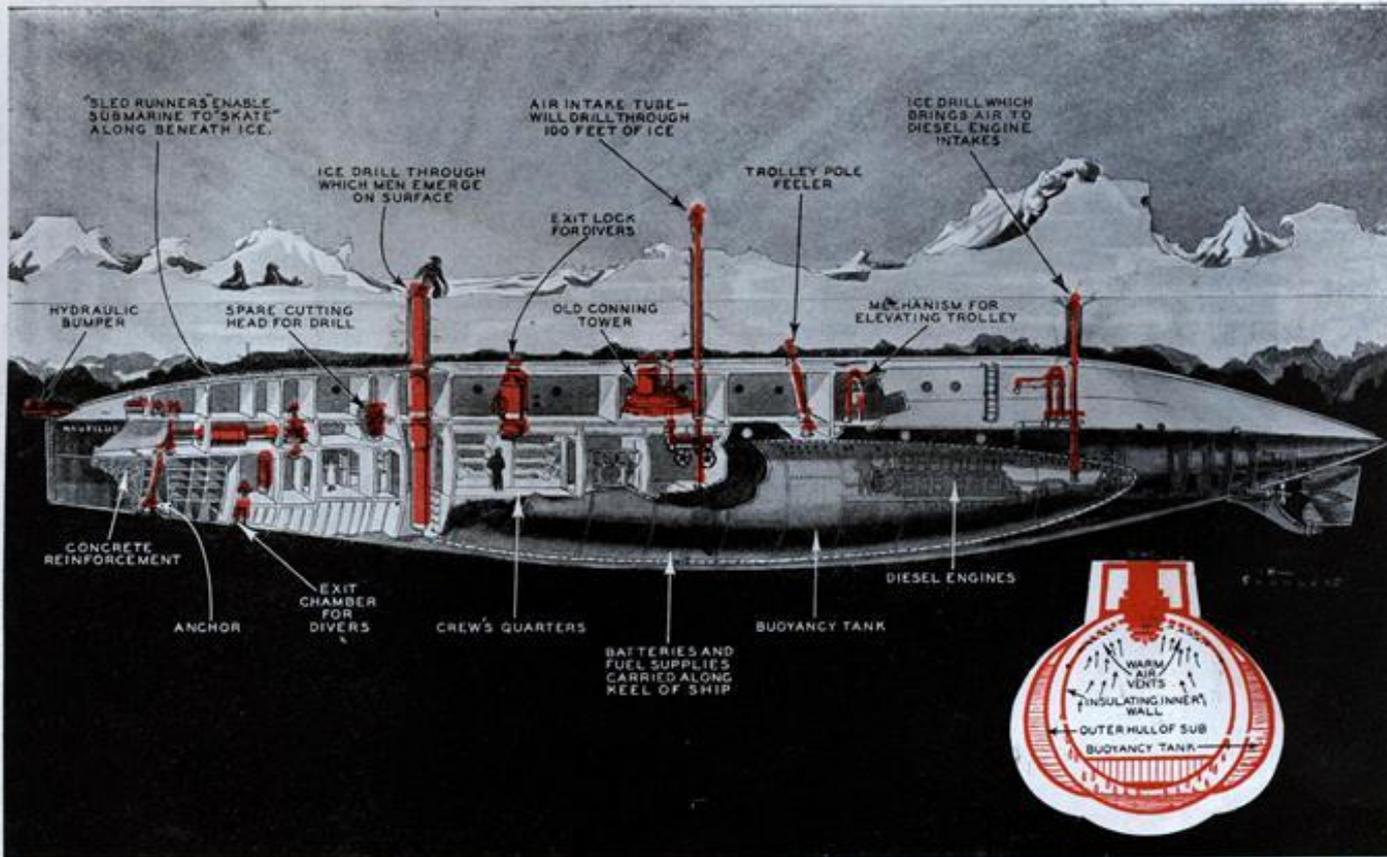
Source: <http://www.polarhistorie.no/personer/Wilkins,%20George%20Hubert>

In 1931, Sir Hubert conducted an Arctic expedition in the research submarine *Nautilus* (former U.S. sub O-12), intending to explore under the ice and reach the North Pole. *Nautilus* operated briefly under the ice, but could not sustain operations for long.

Source: <http://rsgs.org>

# Sir Hubert Wilkins' Nautilus

48



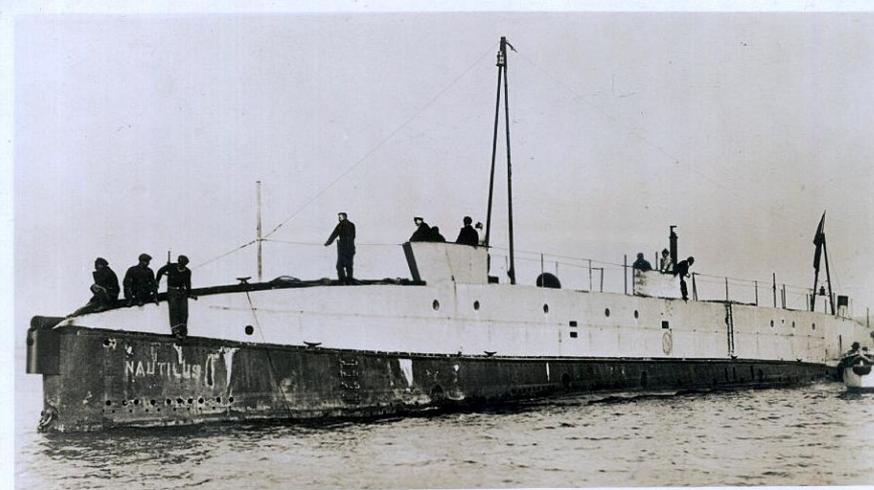
Modern Mechanics and

Cross-section drawing of the Nautilus, showing disposition of special devices which will enable the sub to operate in ice-choked seas. In the lower right corner is a diagram showing the method of insulating the walls which keeps the interior of the huge submarine reasonably warm and dry at all times.

Length: 175 ft (52.1 m)  
Beam: 16.6 ft (5.05 m)

Source: <http://blog.modernmechanix.com/will-the-nautilus-freeze-under-the-north-pole/2/>

# Sir Hubert Wilkins' *Nautilus*



Copyright 2018 NORTH POLAR EXPEDITIONARY SUBMARINE "NAUTILUS," PLYMOUTH, JUNE 26TH, 1931. Abrahams, Devonport  
COMMANDERED BY SIR HUBERT WILKINS.

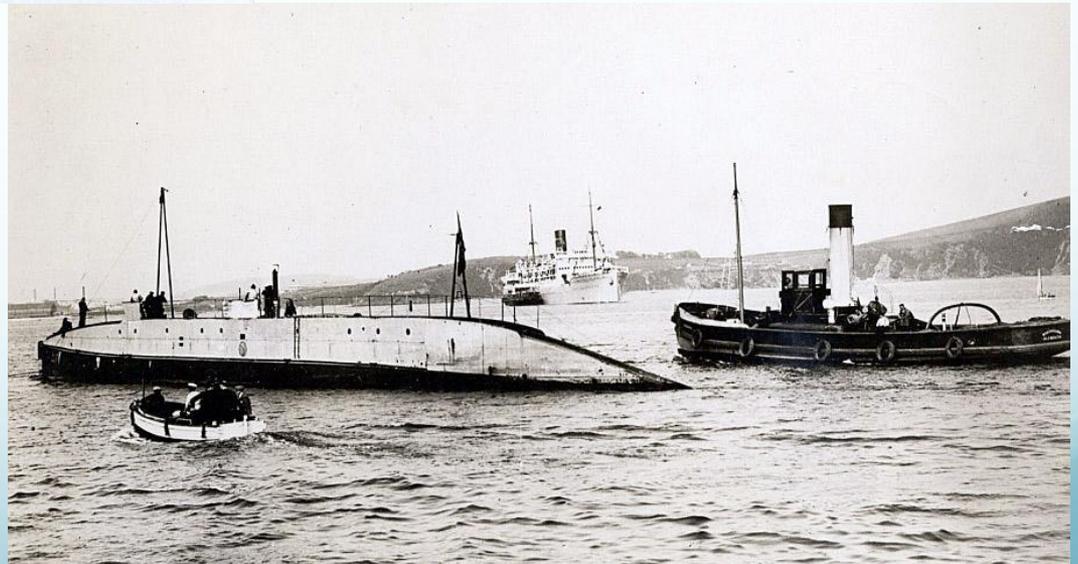
Source: <http://www.delcampe.net/>

## Other features included:

- A cushioning bowsprit 12 feet long to act as a bumper,
- An ice drill to provide access to the surface in case the submarine was unable to break through the ice,
- An emergency air intake system, and
- A diving chamber

## Main external features included:

- The conning tower and periscope were modified to be retractable.
- Added wooden superstructure four feet wide and six feet high to house extra buoyancy chambers intended to prevent loss of stability when surfacing through the ice.
- Iron-shod "sledge runners" were installed in top of the superstructure to permit the sub to slide along the bottom of the icepack.



Source: <http://www.dvrbs.com/camden/camdennj-mathisshipyard.htm>

# U.S. nuclear marine Arctic operations

# USS Nautilus (SSN-571)

## The 1<sup>st</sup> nuclear submarine Arctic under-ice missions

- Under the command of Capt. William R. Anderson, sailing from New London, CT on 19 Aug 1957, *Nautilus* conducted the first extended Arctic under-ice voyage (1,202 nm) by a nuclear submarine.
  - *Nautilus* became lost due to failures of its navigational equipment and ultimately had to turn back.
  - At the time, the *Nautilus* was equipped with relatively primitive navigational aids, namely, a gyrocompass and magnetic compass, both of which were ineffective at high latitudes.
- In response to navigational failures on its first attempt, a new navigation system was installed on the *Nautilus*, an N6A-1 inertial guidance system, originally produced by North American Aviation for the Navaho supersonic intercontinental cruise missiles.
  - There were concerns about this system's capability on the *Nautilus* as it was designed to support missiles traveling at fast speeds and for short periods of time, whereas a submarine moves slowly for weeks or months.

# USS Nautilus (SSN-571)

## The 1<sup>st</sup> nuclear submarine Arctic under-ice missions

- Other modifications made to *Nautilus* included a hardened sail to help in penetrating the Arctic ice sheet and upward looking sonar and video systems developed by the Navy's Arctic Submarine Laboratory (ASL).
- 9 Jun 1958: Under the code name Operation Sunshine, *Nautilus* departed Seattle, WA for the polar ice pack, but was turned back by thick ice conditions blocking all paths through the shallow Chukchi Sea to the deep Arctic Ocean and the North Pole.
- After departing Pearl Harbor on 3 Aug 1958 on its second Operation Sunshine mission voyage, *Nautilus* encountered improved ice conditions near point Barrow, Alaska, allowing it to enter deep water and complete the voyage across the North Pole.
  - The *Nautilus'* position log at the North Pole reads, Latitude: "90° 00.0' N", representing the North Pole, and longitude "Indefinite" as the great circles representing the lines of longitude all converge at the Poles and thus longitude is undefined.

# Nautilus 90° North

3 Aug 1958



SHIP'S POSITION  
U. S. S. NAUTILUS  
TO: COMMANDING OFFICER

Date of Day: 1958 3 August 1958

LATITUDE: 90° 00.0' N LONGITUDE: Indefinite

By (Indicate by check in box):  
 NGA  MK19  OTHER

SET: — DRIFT: — DISTANCE MADE GOOD SINCE (LAST) FIX: Honolulu 4844

DISTANCE TO: North Pole Zero VARIATION: —

TRUE MAG. ERROR: 180 MK19 3E MK19 0° 170° E

MAGNETIC COMPASS READING (LAST FIX):  
 STD  STEADY  SWAY  OTHER 244 359

DEVIATION: 126E TRUE TABLE DEVIATION: 3° W

REMARKS:  
NGA DR  
σ = 0  
μ = 0  
NGA  
R1 = 0  
R2 = 0  
R3 = 1°

RESPECTFULLY SUBMITTED (Signature):  
LT Shephard M. Gember, USN



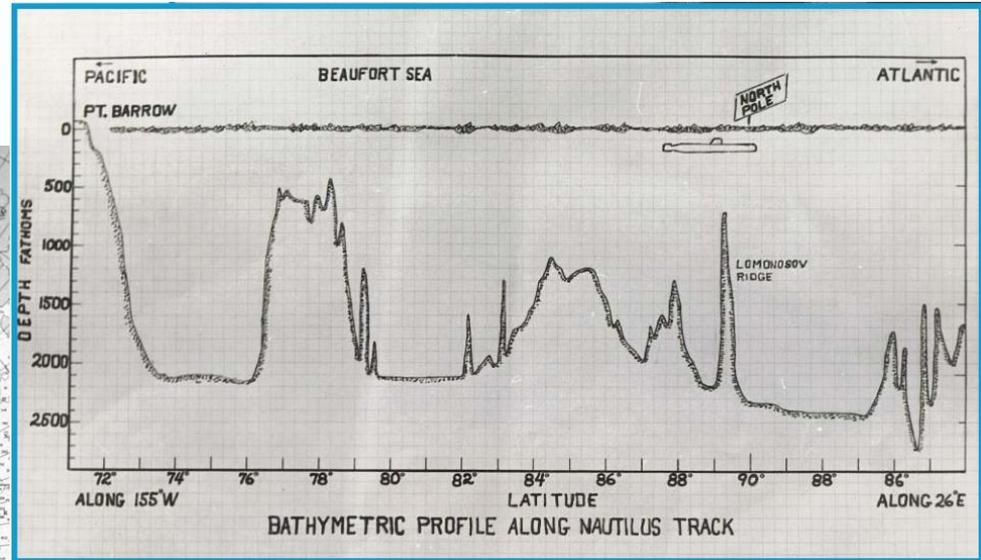
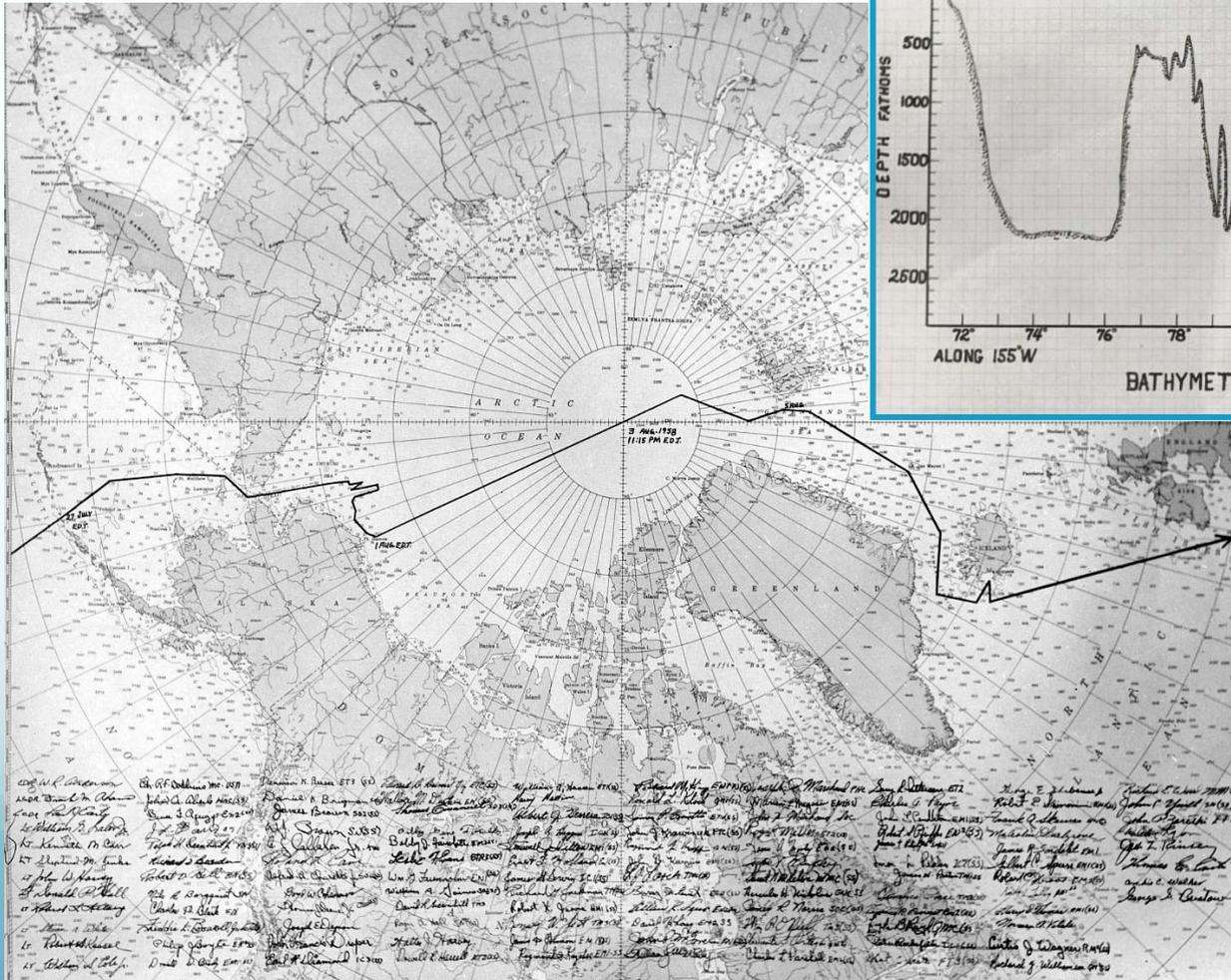
Dr. Waldo Lyon & Nautilus'  
2<sup>nd</sup> CO, Capt. William Anderson

Source: <http://www.navy.mil/navydata/>

# Nautilus 90° North

3 Aug 1958

Nautilus' track through the Arctic Ocean



Source: <http://www.navy.mil/navydata/>

Source: <http://www.navalhistory.org/category/arctic>

# USS Skate (SSN-578)

11 Aug 1958: 2<sup>nd</sup> submarine under the North Pole

17 March 1959: 1<sup>st</sup> submarine to surface at the North Pole



Capt. James Calvert

Source: US Navy

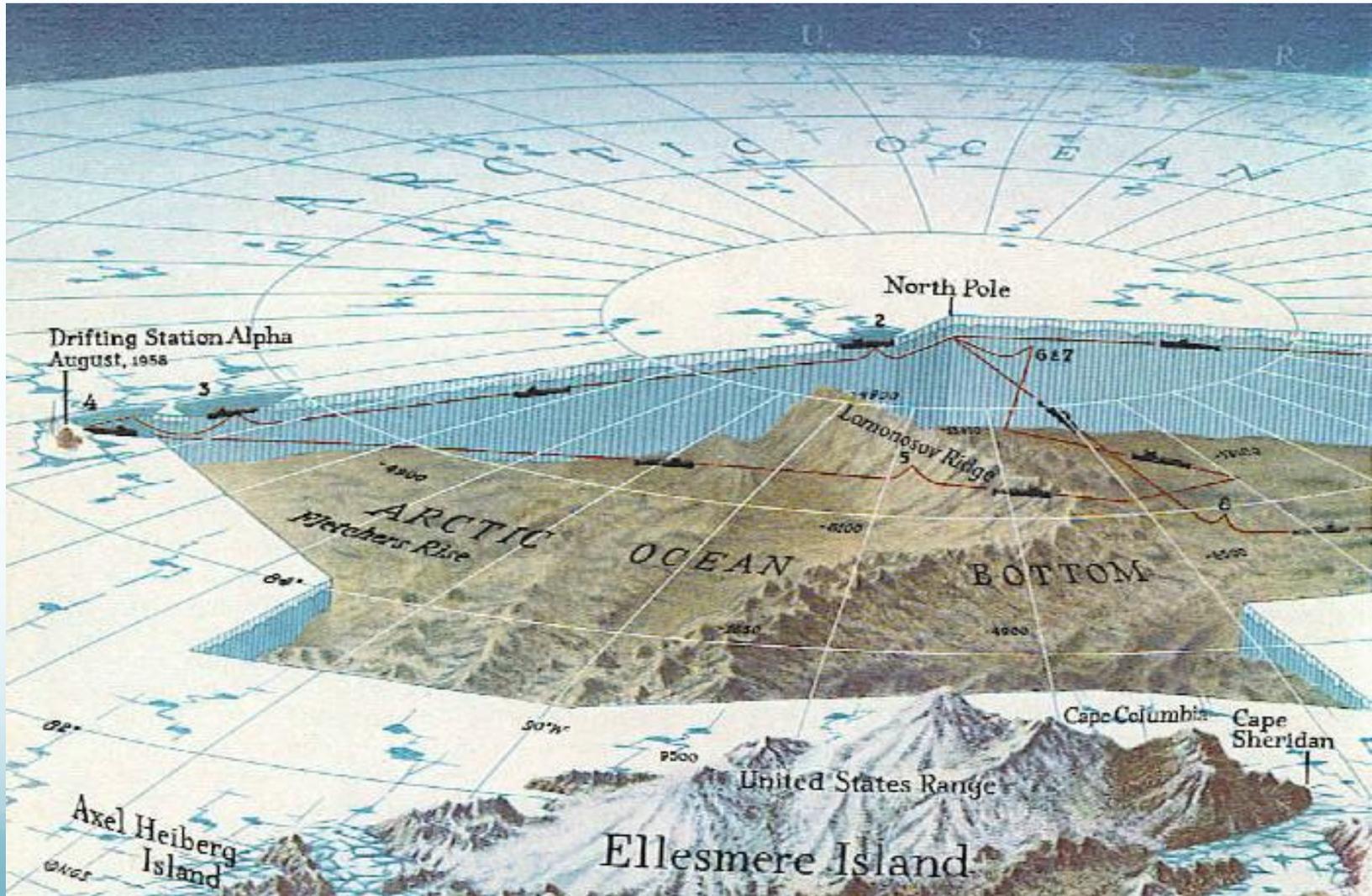


Source: <http://archive.constantcontact.com>

The crew held a ceremony for the late Arctic explorer Sir Hubert Wilkins and spread his ashes at the North Pole

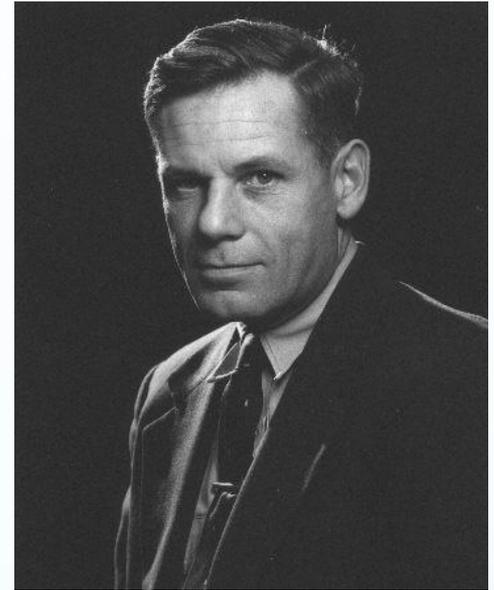
# USS Skate (SSN-578)

Aug 1958 E – W crossing of the Arctic Ocean



# Dr. Waldo K. Lyon and the Arctic Submarine Laboratory (ASL)

- Founder (1947) and chief research scientist of the ASL.
- Developed Battery Whistler (a converted mortar battery at NEL on Point Loma) as a unique arctic laboratory:
  - Grow sea ice and study its physical properties
  - Test equipment and techniques to enable submarine operation in the Arctic.
- Also established an ASL field station at Cape Prince of Wales, Alaska in 1951
- Embarked on *Nautilus* for 1<sup>st</sup> crossing of North Pole, and *Skate* for 1<sup>st</sup> surfacing at North Pole. Also embarked on scores of later under-ice cruises to gain scientific knowledge essential to Arctic submarine operations.



Source: ASL



# Dr. Waldo K. Lyon and the Arctic Submarine Laboratory (ASL)

- Examples of ASL's contributions to submarine Arctic operations:
  - Developed upward looking sonar and video systems for early Arctic voyages
  - Developed sonar technology for remote acoustic measurement of ice thickness and detection of ice ridges, including forward-looking under-ice sonar for Sturgeon (SSN-637)-class submarines
- Dr. Lyon's ashes were scattered at the North Pole by *USS Hawkbill* on 3 May 1999
- Today, ASL is a Fleet Support Detachment of Commander, Submarine Forces U.S. Pacific Fleet (COMSUBPAC).
  - "Center of Excellence" for arctic matters for the U.S. submarine force.
  - Responsible for developing and maintaining expertise in arctic-specific skills, knowledge, equipment, and procedures to enable the submarine force to safely and effectively operate in the unique Arctic Ocean environment.

# USS Sargo (SSN-583)

## 1960 Arctic exploration mission

- Based on experience with the 1957 – 59 Arctic voyages by *Nautilus* and *Skate*, *Sargo* was modified for Arctic operation during construction and after it's first shakedown cruise.
  - Hardened sail
  - Autonetics A6A-1 inertial navigation system,
  - Under-ice sonar,
  - Scientific equipment, and more.
- 18 Jan 1960: *Sargo*, under the command of LCDR J. H. Nicholson, departed Pearl Harbor and headed north for an extended submerged exploration of the Arctic Ocean.
  - 25 Jan 1960: Reached Arctic ice pack in the vicinity of St. Matthews Island.
  - 10 Feb 1960: 2nd sub to surface at North Pole.
  - 17 Feb 1960: Visited Ice Island T-3 and conducted tests with scientists there.



Sargo at North Pole

Source: US Navy



Source: <http://www.navalhistory.org/2011>

# USS Sargo (SSN-583)

## 1960 Arctic exploration mission

- 3 Mar 1960: *Sargo's* winter mission, which covered over 11,000 miles, 6,003 miles under ice, returned to Pearl Harbor. Major accomplishments were:
  - Surveying previously uncharted shallow areas of the Bearing, Chukchi and Beaufort Seas.
  - Refining techniques for surfacing through the Arctic icepack and operating in shallow, ice-covered water.



Sargo visited ice station T-3

Source: [dauntlessatsea.wordpress.com](http://dauntlessatsea.wordpress.com)

# USS Seadragon (SSN-584)

## 1960 Exploration of Northwest Passage

- Seadragon was the first sub to be equipped with what would become the standard under-ice suite for future U.S. subs.
  - The major change from *Sargo*, was the 1<sup>st</sup> Arctic use of the Sperry Ships Inertial Navigation System (SINS) in place of the Autonetics N6A-1 used on prior Arctic subs.
- 1 Aug 1960: *Seadragon*, CDR George P Steele commanding, departed New London, CT, deploying via the Northwest Passage and the North Pole to Pearl Harbor.
  - Enroute, charted poorly known portions of the Northwest Passage; conducted first-ever examination of the undersides of many icebergs in Baffin Bay and Lancaster Sound
  - 25 Aug 1960: 3<sup>rd</sup> sub to surface at the North Pole.
  - Visited Ice Island T-3 and conducted tests with scientists at the station
  - 14 Sep 1960: Arrived Pearl harbor.
- Accomplishments include refining techniques for Arctic submarine operation, improving knowledge of Arctic hydrography and validating the SINS for Arctic operation.



Under-ice view from bow video camera

Source: US Navy

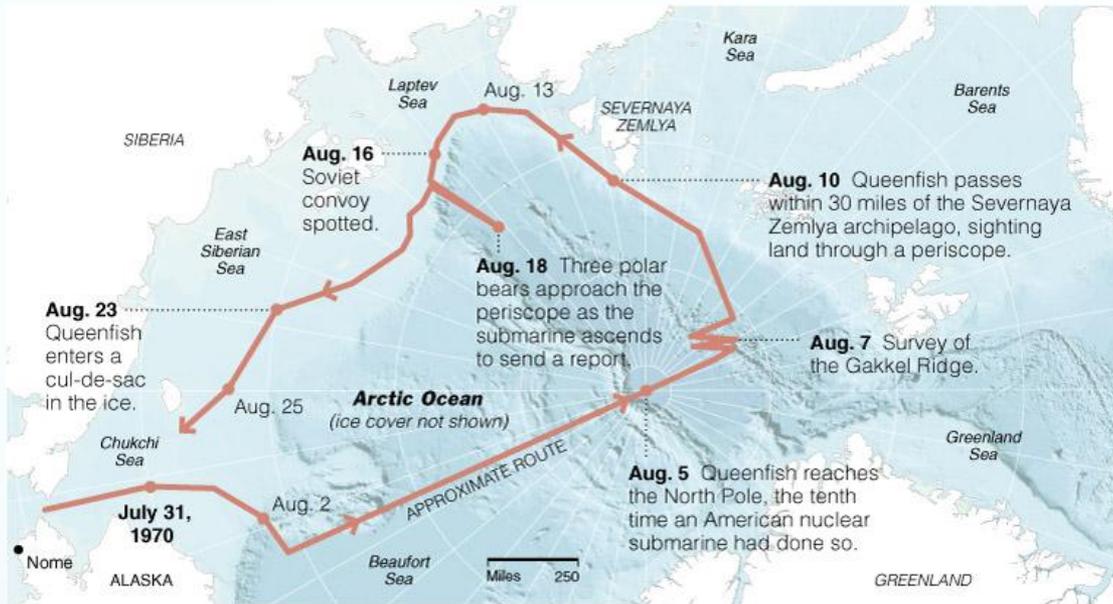


Baseball at the North Pole

Source: US Navy

# USS Queenfish (SSN-651)

1970 Exploration of Laptev, East Siberian, and Chukchi Seas



- Sturgeon-class subs are all Arctic-capable subs equipped with under-ice sonar, a hardened sail and fairwater planes that rotate 90° for surfacing through the icepack.

- Recommended reading: *Unknown Waters. A Firsthand Account of the Historic Under-Ice Survey of the Siberian Continental Shelf by USS Queenfish (SSN-651)*, 2008, Captain Alfred McLaren



# Rendezvous at the North Pole



Source: <http://www.csp.navy.mil/asl/1960.html>

1<sup>st</sup> 2-sub (both Skate-class) rendezvous:  
*USS Skate* (SSN-578) and *USS Seadragon* (SSN-584) on 31 July 1962.

Both subs were outfitted with the standard Arctic suite used by *USS Seadragon* in 1960.



Source: <http://web.mst.edu/>

1<sup>st</sup> 3-sub (all Sturgeon-class) rendezvous:  
*USS Archerfish* (SSN-678) (top), *USS Ray* (SSN-653) (center) and *USS Hawkbill* (SSN-666) (bottom) on May 6, 1986.

# Ice Exercises (ICEX)

- Arctic Submarine Laboratory (ASL) is the Navy command that specializes in Arctic operations for submarines.
  - Approximately every two years ASL and Applied Physics Laboratory at the University of Washington (APL-UW), under the command of Commander, Submarine Force (COMSUBFOR), set up an ice camp on the pack ice to support an ICEX.
    - Recent ICEXs were conducted in 2001, 2003, 2004, 2007, 2009, 2011 and 2014
  - APL-UW provides field engineers to support every aspect of logistics at the camp—from building the camp, to providing and cooking food, to the recovery of any torpedoes fired by the submarines.
  - A key advantage of establishing a camp on the ice itself is the stable venue it provides for deploying a tracking range and sensors for testing underwater weapons under the ice pack.
- Purpose:
  - Regular Arctic exercises are the only way to ensure that each new submarine class and system upgrade that becomes available for employment in real-world operations has been tested in the unforgiving conditions of the Arctic Ocean.
  - Each successive ICEX also helps ensure that the Submarine Force continues to have a sufficient number of officers and enlisted personnel with experience operating under those conditions.

# Science Ice Exercises (SCICEX)

- The SCICEX program is a federal interagency collaboration among the operational Navy, research agencies, and the marine research community to use nuclear-powered submarines for unclassified scientific studies of the Arctic Ocean.
  - Following a feasibility demonstration cruise in a 1993, five dedicated Arctic science cruises occurred from 1995 – 99.
  - Since then, a modified approach has been taken, where some time is set aside for the collection of unclassified scientific data during otherwise classified Arctic submarine exercises.

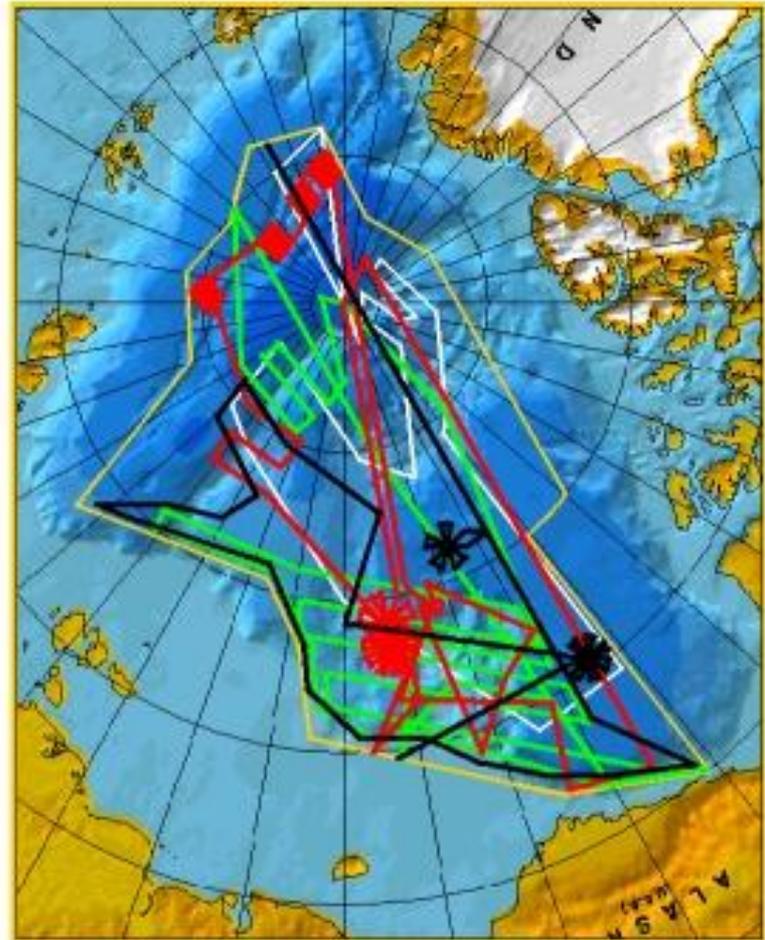


Source: <http://nsidc.org/scicex/history.html>

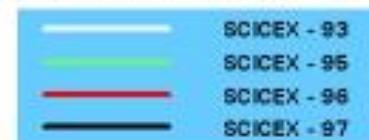
- The goal of the SCICEX program is to acquire comprehensive data about Arctic sea ice, water properties (biological, chemical, and hydrographic), and water depth (bathymetry) to improve our understanding of the Arctic Ocean basin and its role in the Earth's climate system.
- Unclassified civilian research activities and supporting submarine operations occur in the “Data Release Area” (DRA), which is the portion of Arctic waters outside the economic exclusion zones of neighboring countries.

# SCICEX

- From 1993-1999, the Navy made available a Sturgeon-class, nuclear-powered attack submarine for unclassified science cruises to the Arctic Ocean.
  - Test mission in 1993
  - Regular missions 1995 - 99
- The unmatched mobility of submarines in ice covered oceans allowed data to be collected from over 100,000 miles (160,934 km) of shiptrack in the Arctic, providing samples from some regions that have never before been visited.
- On the last SCICEX cruise, *USS Hawkbill* (SSN-666) surfaced at the North Pole on 3 May 1999 and scattered the ashes of the Arctic submarine pioneer Dr. Waldo Lyon.



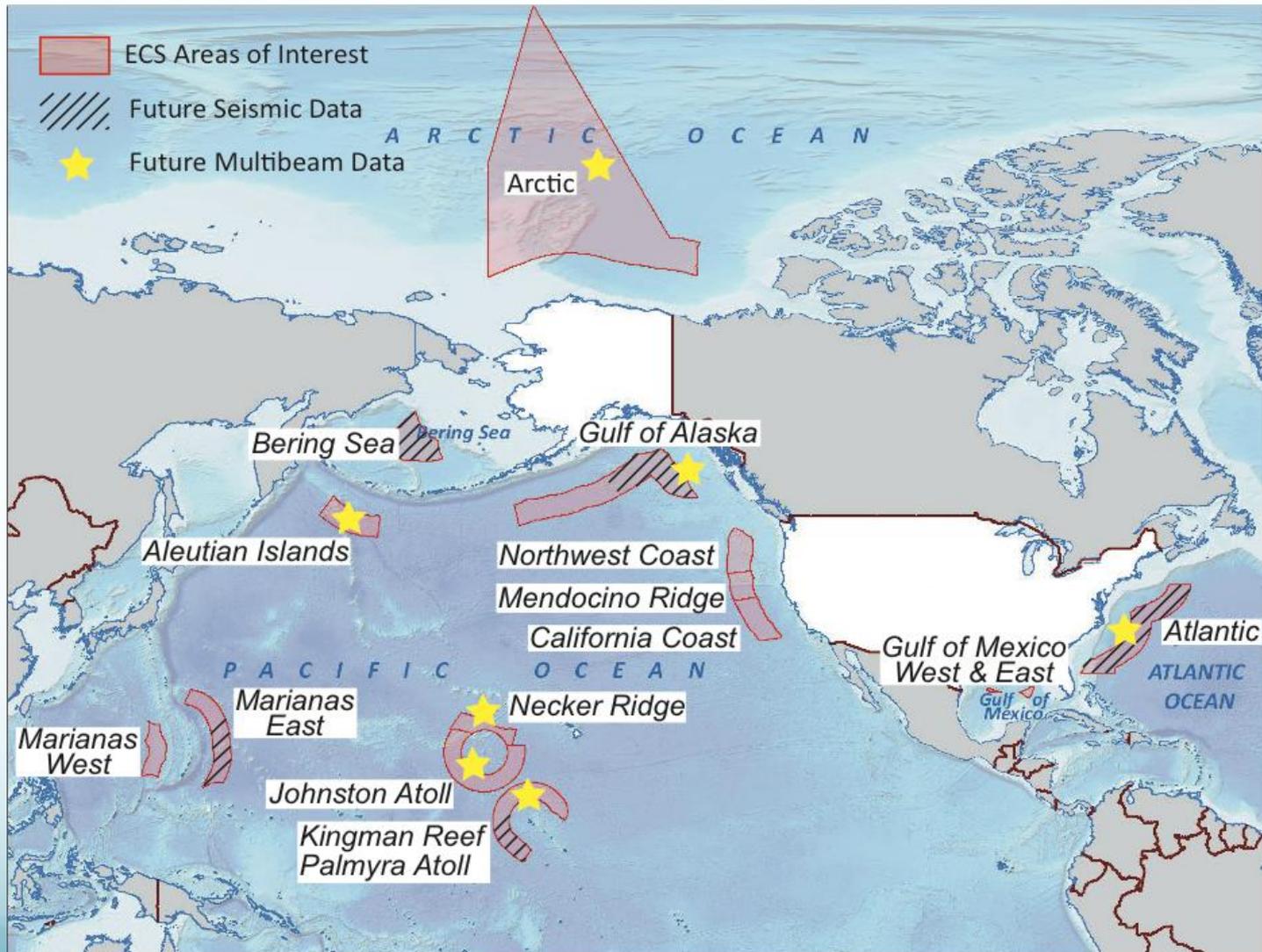
COMPOSITE SCICEX TRACKS



# U.S. Extended Continental Shelf (ECS) Project

- The U.S. Extended Continental Shelf Task Force directs and coordinates the Extended Continental Shelf Project, which is an effort to delineate the U.S. continental shelf beyond 200 nautical miles.
  - A nation has sovereign rights over the resources on and under the seabed, including petroleum resources (oil, gas, gas hydrates), “sedentary” creatures such as clams, crabs, and corals, and mineral resources, such as manganese nodules, ferromanganese crusts, and polymetallic sulfides.
  - Defining those rights in concrete geographical terms provides the specificity and certainty necessary to protect, manage, and/or use those resources.
  - International recognition is important in establishing the necessary stability for development, conservation and protection of these areas.
- Since 2003, U.S. agencies have been engaged in gathering and analyzing data to determine the outer limits of the U.S. ECS.

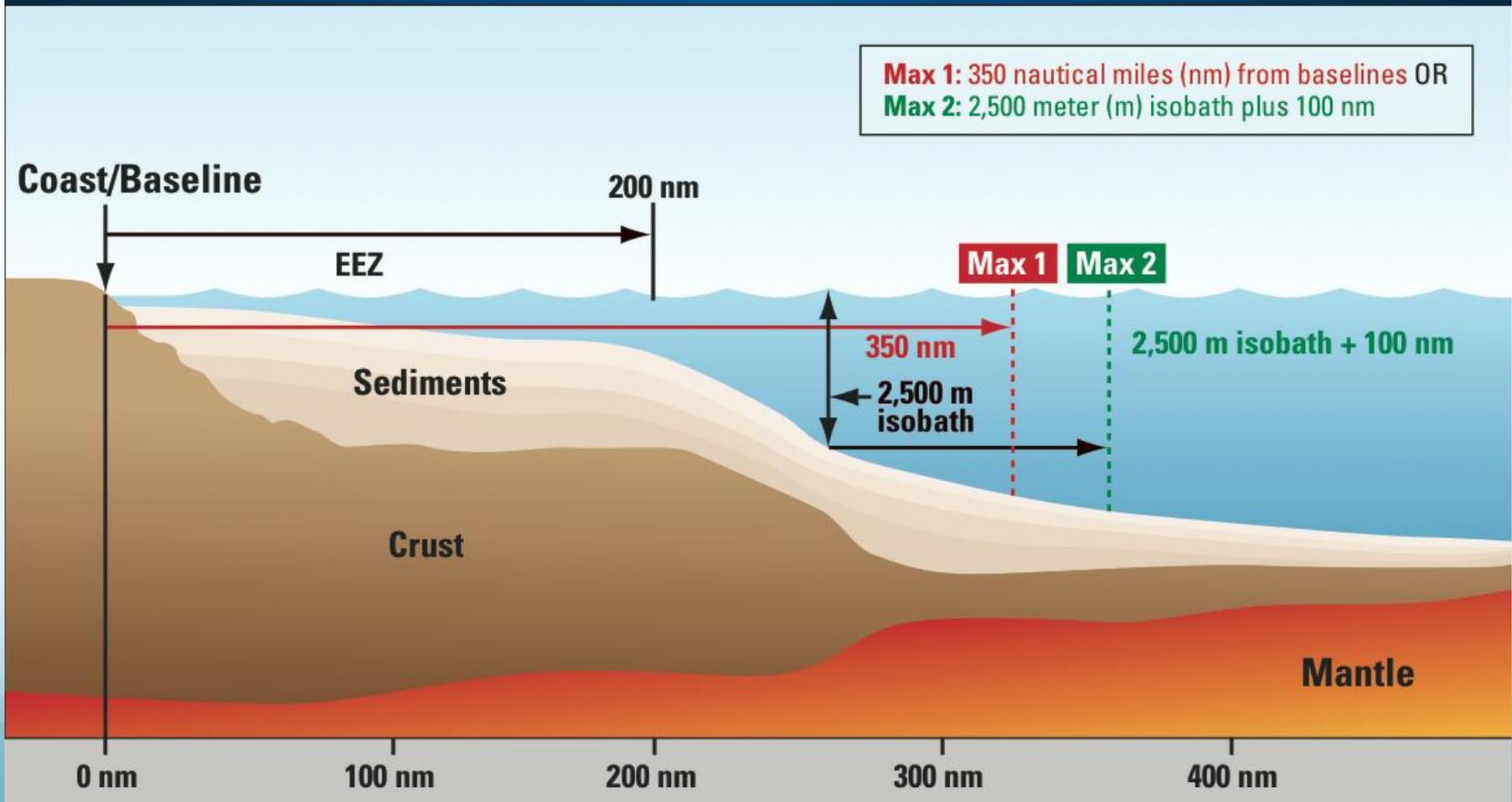
# U.S. ECS areas of interest



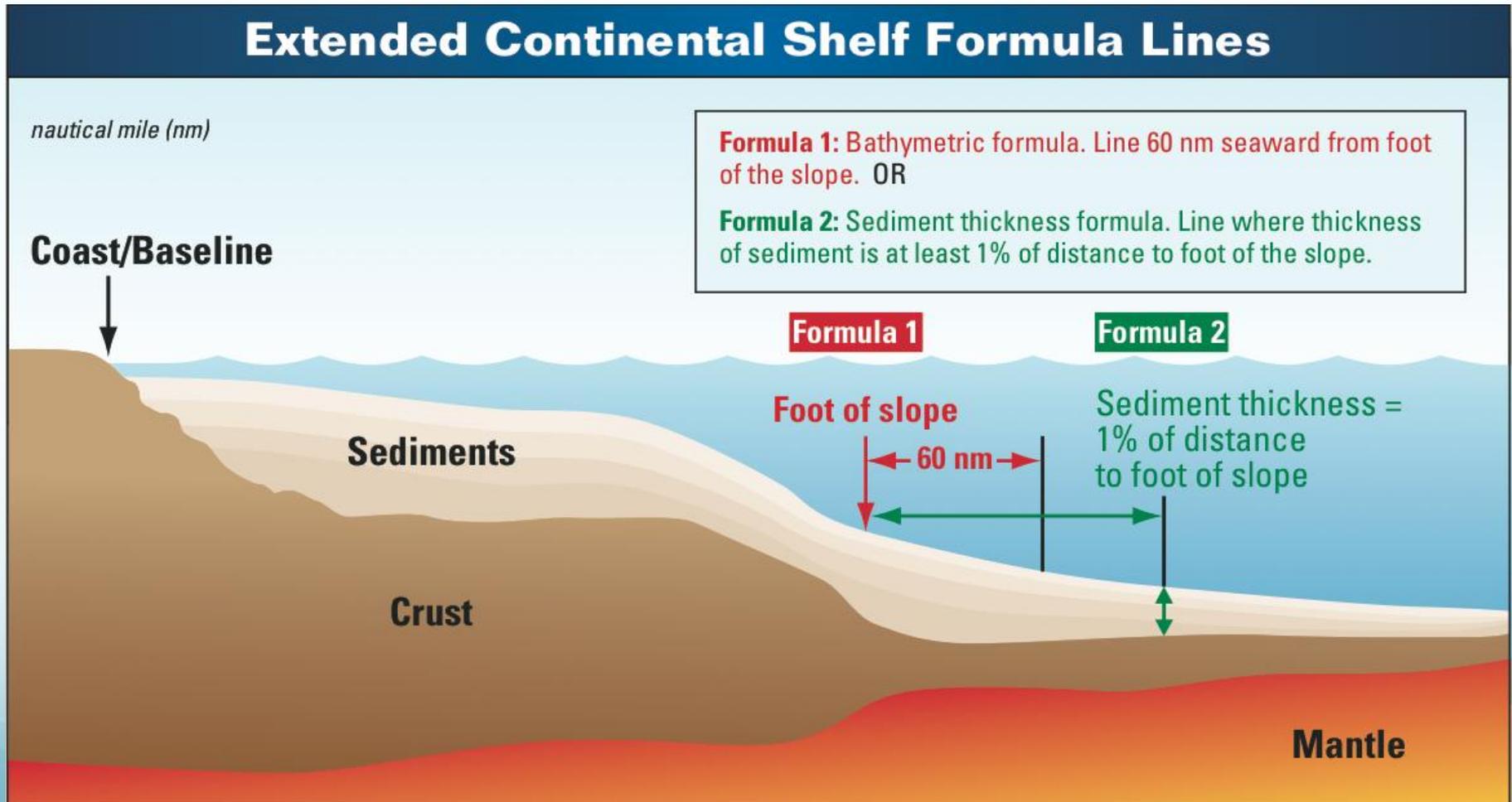
Source: <http://continentalshef.gov/media/ECSposterDec2010.pdf>

# Basis for an extended continental shelf (ECS) claim

## Extended Continental Shelf Constraint Lines



# Basis for an extended continental shelf (ECS) claim



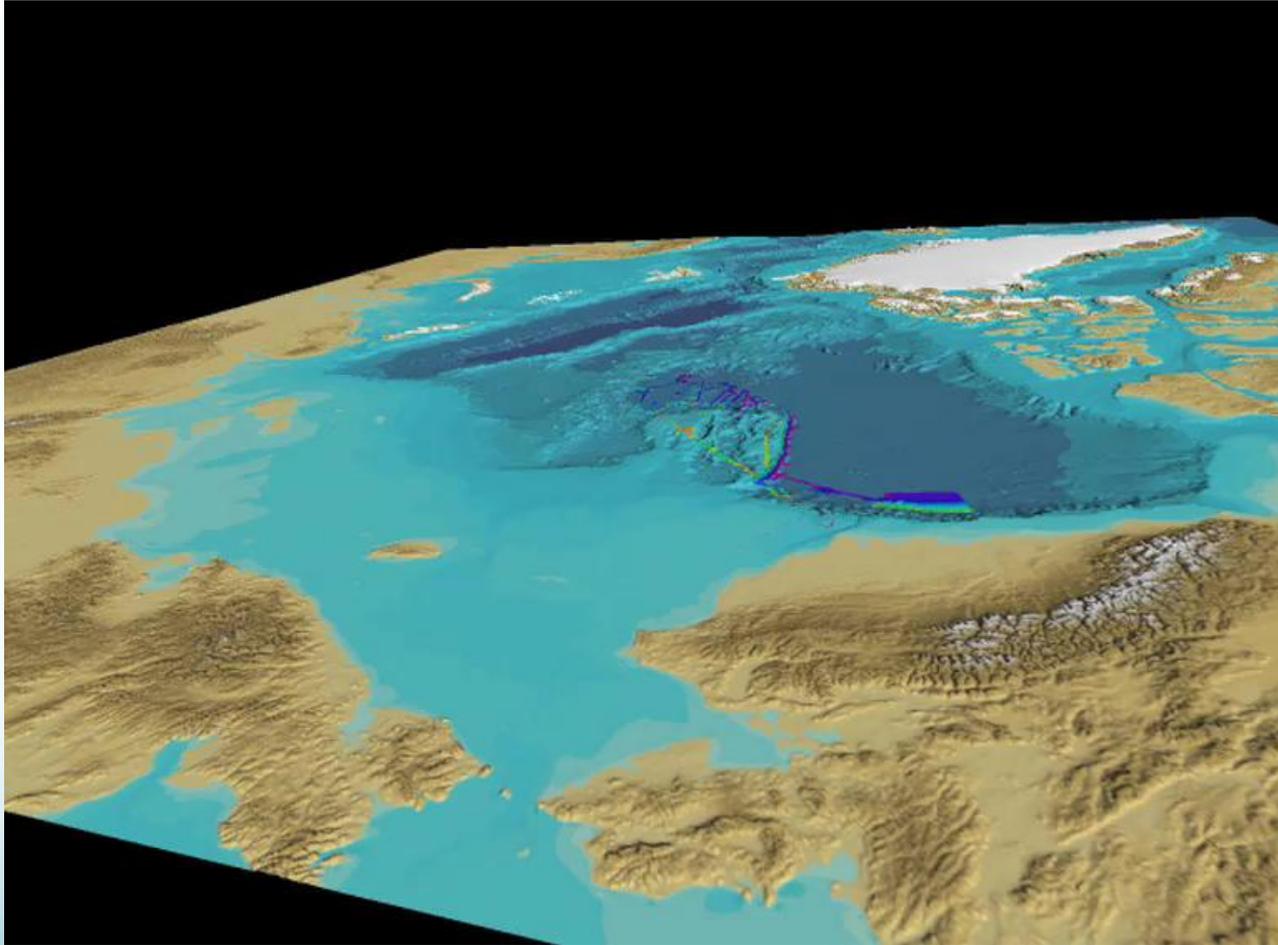
# U.S. ECS survey areas in the Arctic Ocean



Areas surveyed north of Alaska by NOAA and UNH researchers during expeditions in 2003, 2004 and 2007

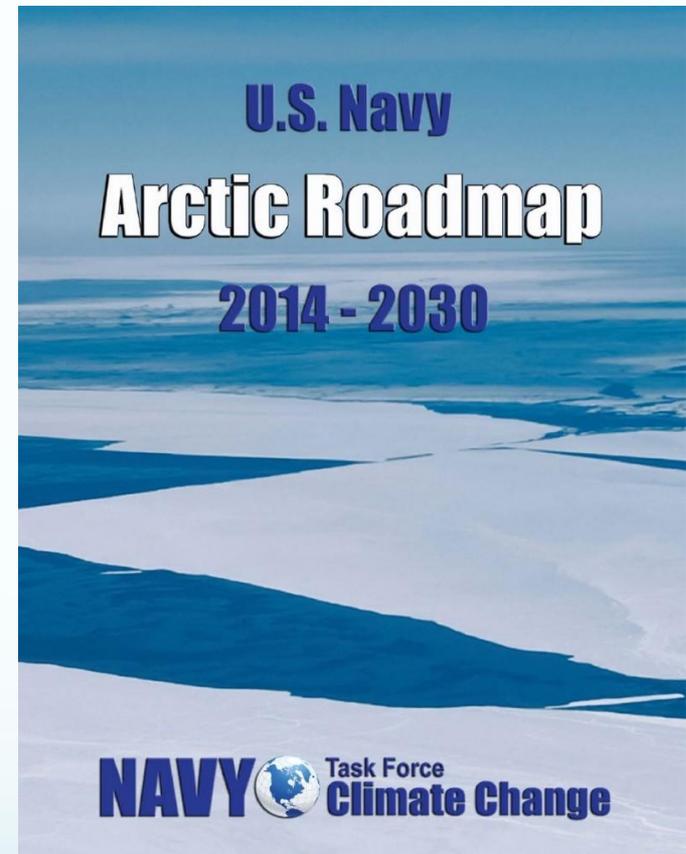
# Arctic basin flyover video

Highlights show areas mapped by 2003, 2004 & 2007  
UNH/NOAA Arctic expeditions



# U.S. Navy Arctic Roadmap

- U.S. Navy expects the Arctic “to remain a low threat security environment where nations resolve differences peacefully.”
- It sees its role as mostly a supporter of U.S. Coast Guard (USCG) operations and responder to search-and-rescue and disaster situations.
- However, the presence of vast resource endowments and territorial disagreements “contributes to a possibility of localized episodes of friction in the Arctic Region, despite the peaceful intentions of the Arctic nations.”
- “Navy functions in the Arctic Region are not different from those in other maritime regions; however, the Arctic Region environment makes the execution of many of these functions much more challenging.”



Source: U.S. Navy

Russian  
nuclear marine  
Arctic operations

# Leninsky Komsomol (K-3)

## 1<sup>st</sup> Russian sub to reach the North Pole

- November 1959: Initial Arctic under-ice voyage by November-class sub K-3 ended with a damaged periscope. K-3 did not reach the North Pole on this voyage.
  - The early mission showed that improvements were needed in ice monitoring instruments and training for Arctic operations. This was similar to the results of *USS Nautilus*' first attempt to reach the North Pole.
- 17 July 1962: K-3, under command of Captain III Rank Lev Zhiltsov, reached the North Pole and surfaced nearby.
- K-3 performed 14 long-range cruises and covered 128,443 miles over 30 years (1958–1988).



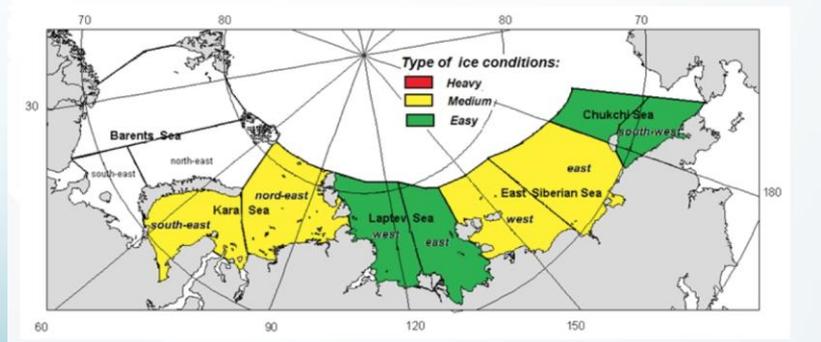
# Northern Sea Route Information Office



- NSR Information Office is owned and operated by the Center for High North Logistics (CHNL) as a joint venture between CHNL and Rosatomflot, the Russian nuclear-powered icebreaker fleet operator.
- The mission is to provide businesses and international organizations with relevant and practical information in English for planning and arranging transit voyages on the NSR.
  - All of the requirements of the Russian NSR Administration are available in English on the NSR Information Office website.
- Provides ice forecasts for the NSR and maintains NSR traffic statistics
- Links to ARCTIS: Arctic Resources and Transportation Information System database.



Long-term ice forecasts for the Arctic seas on the first half of navigation (June-August), 2015



Source: <http://www.arctic-lio.com/node/230>



# Russian floating ice stations

- Russia has had floating research stations in the Arctic since 1937.
  - Normally a station was established on an ice floe in September-October, and about two dozen scientists would spend the winter there, measuring climate and weather conditions.
  - The stations have had numbers from North Pole-1 to North Pole-40.
  - In 2005, the nuclear-powered icebreaker *Arktika* evacuated North Pole-33.
  - The last station, North Pole-40, had to be evacuated ahead of schedule, because the ice floe the station was placed on started to break apart.
- After two seasons with no floating research stations, Russia announced that floating research station “North Pole-2015” would be established this year.
  - 205 million rubles (about \$3.5 million) budgeted for the hydrometeorology authority, Roshydromet
- Russian authorities have earlier announced plans for construction of self-propelled, ice-strengthened floating platform to replace the natural ice floes for future research stations.
  - In 2013, 1.7 billion rubles (about \$29 million) were allocated to this project, but since that, there has been no news about the platform.

# Russian icebreaker *Arktika*

1<sup>st</sup> surface vessel to reach the North Pole

- On 17 Aug 1977, the Russian nuclear-powered icebreaker *Arktika* became the first surface ship to reach the North Pole.
  - This voyage was not reported, or repeated, for about a decade.
- The previous record for northernmost voyage by a surface ship was set at 85°57'N during the 1893–1896 Arctic expedition by Norwegian explorer Fridtjof Nansen's in the steam-powered sailing ship *Fram*.
  - *Fram* was purposely frozen in the Arctic ice pack and proved the existence of an east-to-west current in the Arctic Ocean as it slowly drifted northwest with the ice pack.



Source: peterstamps.com



Source: en.wikipedia.org

# Russian commercial cruises to the North Pole



Commercial polar cruises from Murmansk to the North Pole aboard Arktika-class nuclear icebreakers have been offered since 1989.



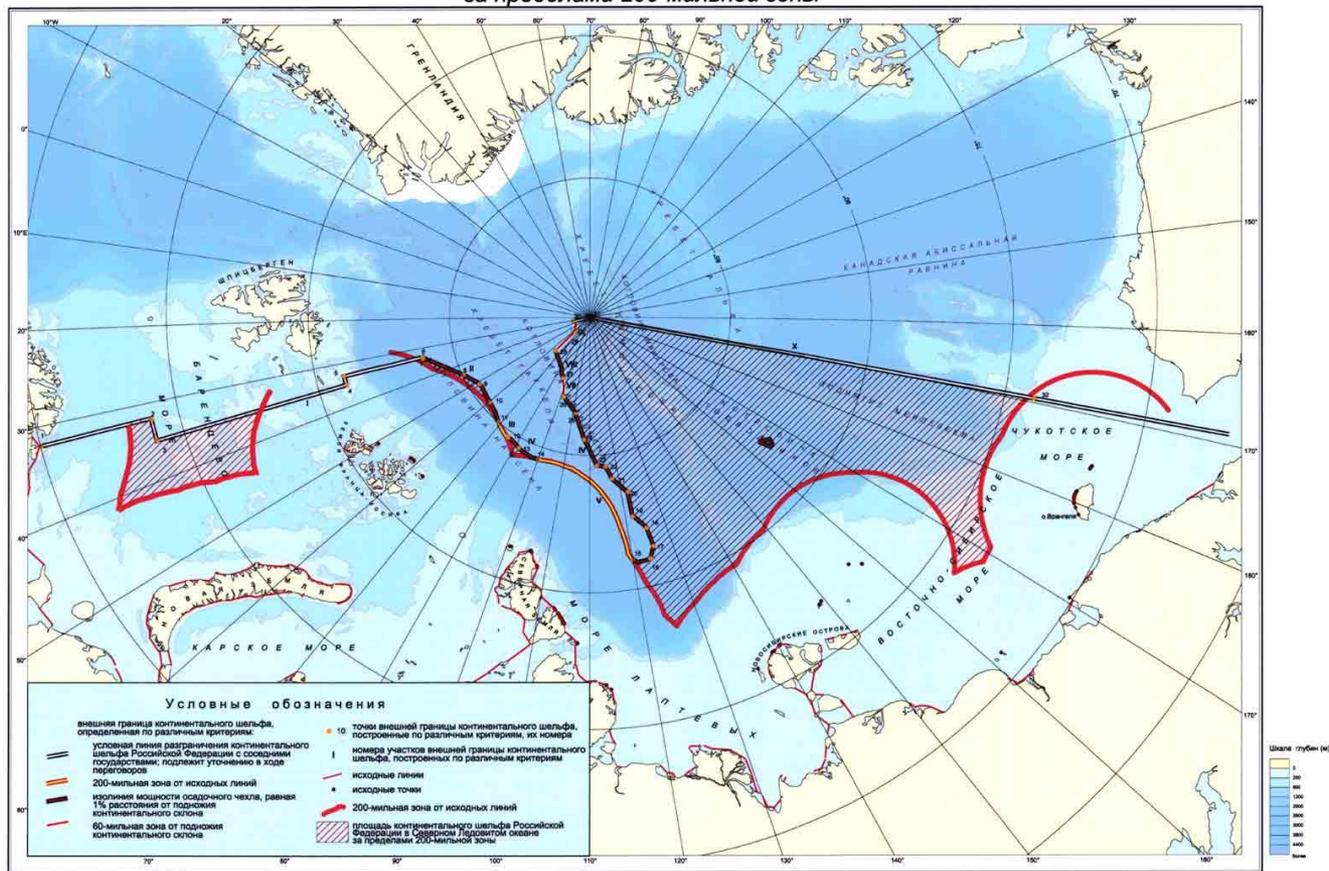
Source: [picsant.com/11814528-north-pole-expedition.html](http://picsant.com/11814528-north-pole-expedition.html)

# Russian 2001 Arctic extended continental shelf (ECS) claim

- On 20 December 2001, Russia made a submission through the UN Secretary-General to the Commission on the Limits of the Continental Shelf, pursuant to Article 76 of the UN Convention on the Law of the Sea.
  - The submission contained information on the proposed outer limits of the Russian continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.
  - The matter has been under consideration, and further research is being conducted by Russia, U.S. and other nations.
- There are two basic methodologies for defining the extent of the “extended continental shelf”:
  - Constraint lines
  - Formula lines

# Russian 2001 Arctic extended continental shelf (ECS) claim

Площадь континентального шельфа Российской Федерации в Северном Ледовитом океане за пределами 200-мильной зоны



# Expedition Arktika 2007

- This expedition was described as a research program to support Russia's 2001 extended continental shelf claim to a large swathe of the Arctic Ocean floor.
- The expedition was led through the Arctic icepack by the Arktika-class nuclear-powered icebreaker *Rossiya*.
- Floating ice station North Pole-35 was established.
- 2 August 2007: first ever manned descent to the ocean floor at the North Pole, to a depth of 4,261 m (14,061 ft).
  - The descent to the ocean floor was accomplished in two Mir mini-sub.
  - A Russian flag was planted on the ocean floor at the North Pole.
- *USS Nautilus'* 1958 measurement of the sea depth at the North Pole was only 4,087 m (13,410 ft).

Mir mini-sub



Source: en.wikipedia.org

# Expedition Arktika 2012

- The "Sevmorgeo" expedition was conducted by Russia in Aug - Oct 2012 to clarify the high-latitude boundary of the Russian continental shelf in the Arctic, focusing on the Mendeleev Ridge.
  - The neighboring Lomonosov Ridge was researched in 2010 and 2011 by the State Research Navigation and Hydrographic Institute of the Ministry of Defense of the Russian Federation.
- Vessels in the Arctic 2012 expedition were icebreaker *Dikson* serving as a research vessel and icebreaker *Kapitan Dranitsin*.
  - It is believed that the nuclear-powered submarine "mothership" BS-136 (Project 09786) and the nuclear-powered small, deep-diving submarine AS-12 (Project 10831) were part of the expedition (based on reference to the subs in expedition reports) and that they reached the North Pole.

# Expedition Arktika 2012

- Results:
  - The seismic survey of the ocean bottom yielded results proving that the Mendeleev Ridge has the same nature as the continental structures.
  - The expedition performed the first deepwater drilling on the Mendeleev Ridge. About 22,000 rock and sediment samples were obtained from the bottom of the Arctic Ocean during the three months of work.
- All-Russian Research Institute of Geology and Mineral Resources of the World Ocean (VNII Okeangeologia) prepared an updated application of the Russian Federation, drawn up in compliance with the requirements of the UN Commission on the Law of the Sea, to claim expansion of the continental shelf borders.
  - That updated claim was filed in 2015.

# Russian 2015 Arctic extended continental shelf (ECS) claim

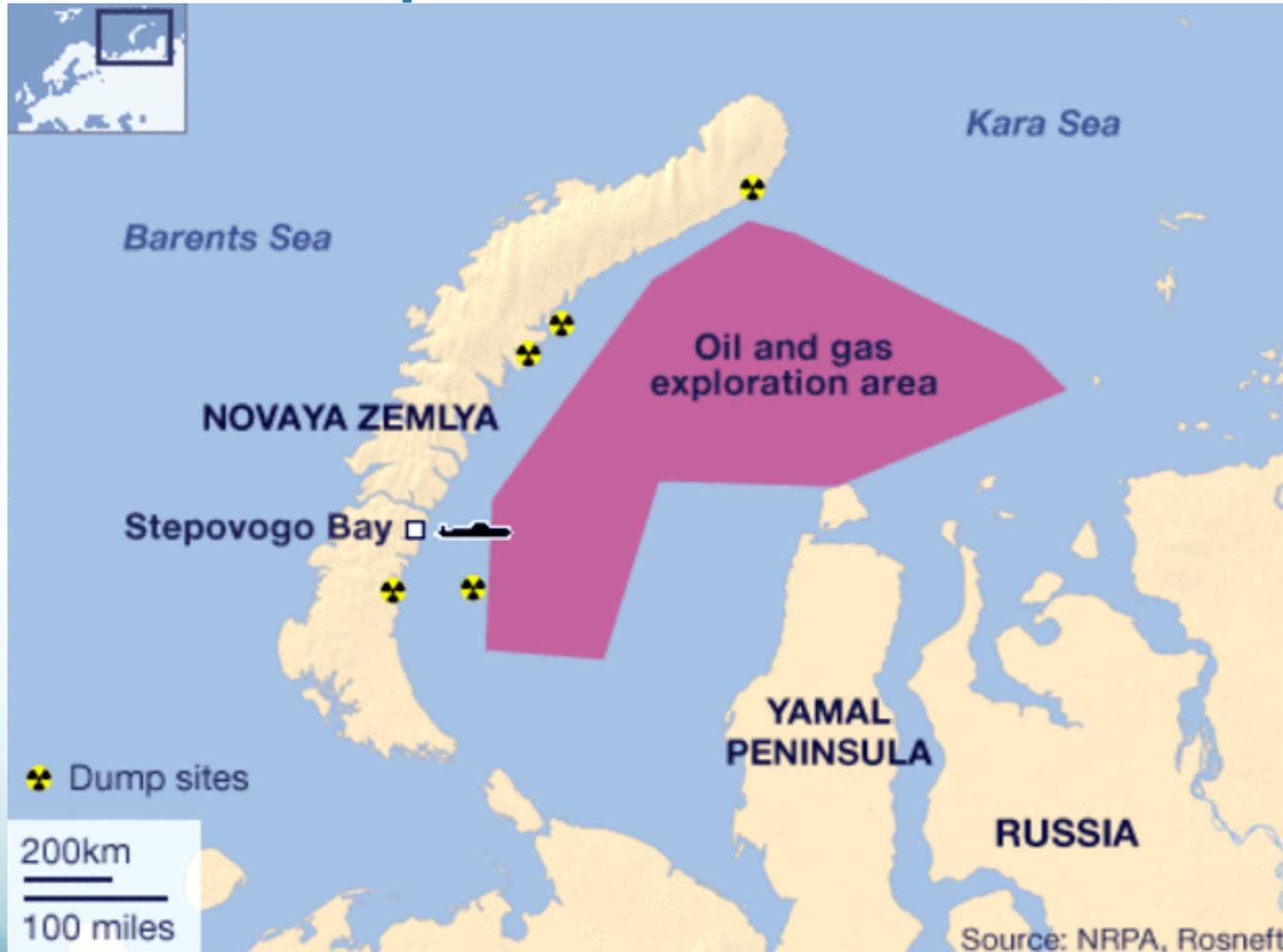
- On 4 August 2015, Russia's Foreign Ministry confirmed that Russia had re-submitted its extended continental shelf claim.
  - Russia is claiming seeking recognition for its formal economic control of 1.2 million square kilometers (463,320 square miles) of Arctic sea shelf extending more than 350 nautical miles from the shore.
  - The updated application cites the Lomonosov Ridge, Mendeleev-Alpha Rise and Chukchi Plateau as belonging to "submarine elevations that are natural components of the continental margin."
  - The Podvodnikov and Chukchi Basins separating the three areas are also listed in the claim.

# Russian 2015 Arctic extended continental shelf (ECS) claim

- In November 2014, Artrur Chilingarov, Vladimir Putin's representative on international Arctic cooperation, stated at the 7<sup>th</sup> annual Arctic Development Conference, that, "Developing resources in the arctic zone of Russia has been called a fundamental national interest."
- The area covered by Russia's 2015 ECS claim is estimated by Bellona Foundation to hold 258 billion tons of fuel equivalent, representing 60% of Russia's total hydrocarbon reserves. The area also is fertile fishing territory.
  - Bellona Foundation believes these oil and gas reserves, "would hardly be worth pursuing because its extraction from the central Arctic would simply cost too much."



# Russian Kara Sea Oil & Gas Exploration Area



# Arctic radioactive contamination

## from marine nuclear power operations

- Kara Sea:
  - According to a report issued in 2012 by the Norwegian Radiation Protection Authority (NRPA), Russian nuclear waste in the Kara Sea includes:
    - 19 ships containing radioactive waste;
    - 14 nuclear reactors, including five that still contain spent nuclear fuel;
    - 735 other pieces of radioactively contaminated heavy machinery;
    - 17,000 containers of radioactive waste, and
    - Sunken submarine K-27, at a depth of 33 m (108 ft)
- Barents Sea:
  - Two sunken Russian submarines; currently no indication of significant radioactive contamination of the ocean environment.
    - November-class K-159, at a depth of 248 m (814 ft)
    - Mike-class K-278, at a depth of 1,680 meters (5,510 ft)

# Sunken nuclear submarines



Above:  
Sunken nuclear  
submarines in  
the Atlantic



Right:  
Sunken nuclear  
submarines in the  
Arctic.

Note that K-141,  
Oscar II-class *Kursk*,  
was raised and  
salvaged.

Source, two maps: Wikipedia

# K-27 Kara Sea disposal site



Source: <http://bellona.org/>

- The liquid metal coolant in each of the two reactors solidified around the fuel assemblies and control rods, forming a single, solid object that could not be removed from the reactor vessel.
- Before sinking the K-27, the reactors were sealed with a bitumen compound to isolate their 90 kg (198 lb) of highly enriched uranium fuel from seawater.
- K-27 was scuttled in the Kara Sea on 6 Sep 1982.
- Studies by the Kurchatov Institute have shown the bitumen seal is not performing as expected, posing the danger of seawater ingress to the reactor cores.
- Norway's Bellona Foundation has raised the concern of an uncontrolled criticality from water ingress to the reactor.
- In 2012, Justin Gwynn, an expert with the Norwegian Radiation Protection Authority (NRPA) said the K-27 is resting upright on the bottom and the hull is in good condition. These factors improve the chance of a successful salvage of the vessel.

# Recent Russian military activities in the Arctic region

- 1 December 2014: Russia's new Arctic Joint Strategic Command became operational.
  - This provides central management of all Russian military resources in the Arctic, and there are a lot of them.
  - The new command, based on the Northern Fleet and headquartered at Severomorsk, will acquire military, naval surface and strategic nuclear subsurface, air force and aerospace defense units, assets, and bases transferred from other Russian Military Districts
- 15 – 20 March 2015: Russia conducted a massive, five-day military exercise in the Arctic involving about 80,000 troops, 220 aircraft, 41 ships, and 15 submarines.
  - The exercise likely was a demonstration of the Arctic Joint Strategic Command's ability to coordinate Russian military forces in the region.

# Current trends in Arctic operations

# Trends in Arctic operations

- For research:
  - Access will continue at current or greater levels for studies related to Arctic bathymetry, hydrography, resource characterization and environment, including the impact of the Arctic on the broader matter of global climate change.
    - This includes research to support Extended Continental Shelf (ECS) claims by all nations bordering the Arctic Ocean.
  - Continuing use of floating “ice camps” by the U.S. and Russia will support various research and military activities.
- For commercial exploitation:
  - Increasing use by commercial shipping firms of the shorter sea routes through Arctic waters, particularly the Northern Sea Route.
  - Commercial development along Russia’s Northern Sea Route will be significant
    - There are many Russian deep-water ports along the Northern Sea Route
    - Russian deployment of a new generation of nuclear-powered icebreakers will support expanded use of the Northern Sea Route.
    - Commercial expansion of natural resource development along Russia’s north coast will benefit from greater shipping traffic on the Northern Sea Route to deliver needed supplies and bring resources to market.
    - Russian deployment of small, floating (barge mounted) nuclear power plants to bring reliable electric power to support economic development at remote sites along it’s north coast
    - Increasing near-term Russian oil and gas exploration and development will occur in the Kara and Barents Seas, and exploration will occur in other areas of the Russian continental shelf.

# Trends in Arctic operations

- For commercial exploitation (continued):
  - In the longer-term, similar commercial exploration and development will be undertaken by other Arctic nations, but they lack Arctic port infrastructure and nuclear-powered vessels to support work in remote Arctic regions.
- For military activities:
  - With the formation of the Arctic Joint Strategic Command in 2014, and a large-scale Arctic military exercise in 2015, Russia has taken clear steps to militarize its Arctic region.
    - This may be a prelude to Russia's behavior toward its Arctic neighbors if its 2015 Extended Continental Shelf claims are upheld, thereby expanding its Exclusive Economic Zone (EEZ) in the Arctic.
  - U.S. nuclear submarine Arctic operations will continue as in previous years. No other U.S. naval vessels can access ice-covered Arctic waters without support from an icebreaker.
    - The current U.S. icebreaker "fleet" consists of one heavy (polar) icebreaker and one medium icebreaker. These ships are managed by the National Science Foundation and also support U.S. Antarctic operations.
- For environmental cleanup:
  - Pressure on Russia from Arctic nations will continue for removal and/or remediation of sunken Russian nuclear submarines, nuclear waste and other radioactive items dumped in the Arctic.