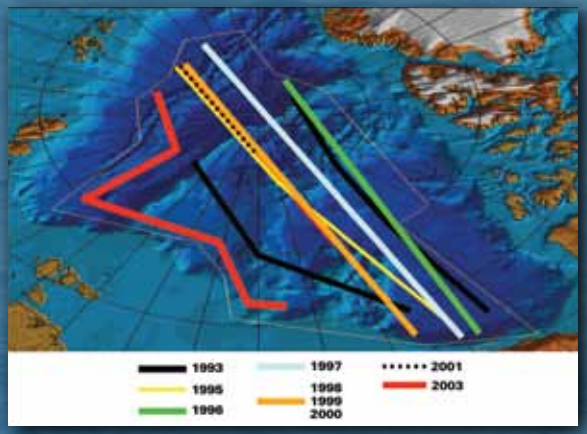
# ABOUT SCICEX

The SCience ICe EXercise (SCICEX) program is a collaboration between the US Navy and the marine research community to use nuclear-powered submarines for scientific studies of the Arctic Ocean. Unlike surface ships, submarines have the unique ability to operate and take measurements regardless of sea ice cover and weather conditions. The goal of the 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 Earth's climate system.

SCICEX was officially launched in 1994 after a successful feasibility test in 1993 where civilian scientists joined Navy personnel on a submarine to acquire scientific data. From 1995–1999, five more dedicated science cruises were completed aboard nuclear-powered submarines. Since then, a modified approach has been taken, where some time is set aside for the collection of unclassified scientific data during otherwise classified submarine exercises (Science Accommodations Missions).




Summary of SCICEX cruise tracks to date.

# SCICEX DATA

http://nsidc.org/noaa/scicex/data_inventory.html

SCICEX data are openly available to the public from the National Snow and Ice Data Center.

- Conductivity-Temperature-Depth (CTD) profiles and other sensor data taken from hull-mounted probes
- CTD profiles from expendable probes (XCTD)
- Chemical, physical, and biological data from water samples
- Sea ice underside topography and draft profiles from upward-looking sonar
- Bathymetry from fathometers
- Supporting navigation from the submarine's inertial navigation system, and operational data at a nonclassified level

SCICEX is supported by the US Navy, National Science Foundation, and US Arctic Research Commission.

HTTP://NSIDC.ORG/NOAA/SCICEX

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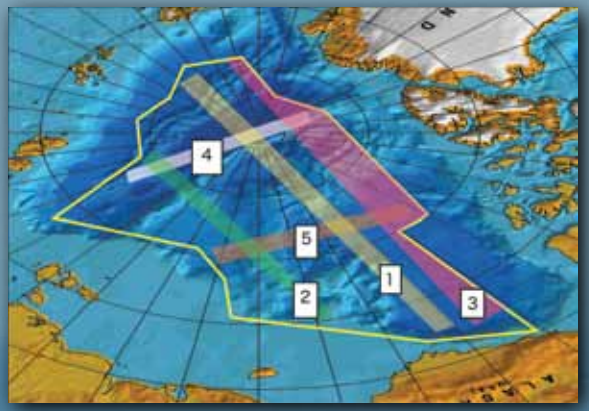
# SCICEX

## THE US NAVY SUBMARINE ARCTIC SCIENCE PROGRAM

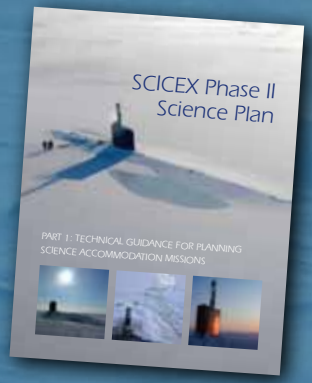



Recommended sampling corridors. The SCICEX Data Release Area is outlined in yellow.

## SCICEX PHASE II SCIENCE PLAN

### Part 1: Technical Guidance for Planning Science Accommodation Missions

http://www.arctic.gov/publications/scicex_phaseII.html



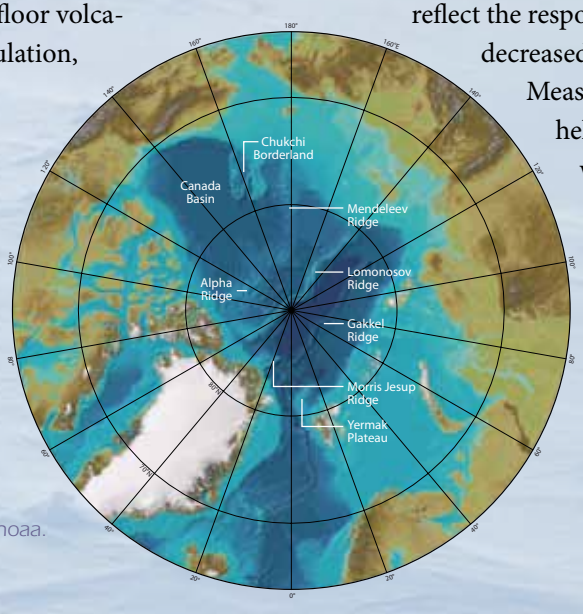

This 2010 technical science plan provides the US Navy with a detailed list of priorities for Science Accommodation Missions (SAMs), including measuring sea ice thickness, ocean hydrography, and bathymetry, and measuring and sampling ocean biology and chemistry. The plan is built around five sampling corridors, within an agreed-upon SCICEX Data Release Area, that represent the most likely Navy scenarios under which SAM time will be available. Using the science plan as a guide, the Navy's Arctic Submarine Laboratory will work with the operational Navy to identify and plan SCICEX SAM opportunities.

# SCIENTIFIC HIGHLIGHTS

Data from SCICEX cruises are central to improving scientific understanding of the complex Arctic Ocean environment and to defining the scope of recent changes. These data also contribute to the safety, stability, and success of Arctic military and civilian marine operations.

- Sea Ice Thinning. Profiles of sea ice draft obtained from the upward-looking sonars of submarines transiting the Arctic Ocean have provided the bulk of our current knowledge of ice thickness, and how it varies over the Arctic basin. By comparing ice draft data collected by SCICEX with previously published data, scientists established that sea ice has thinned significantly within the Data Release Area between 1950–1970 and the 1990s.

- Bathymetry. SCICEX data contributed to the new International Bathymetric Chart of the Arctic Ocean, which led to first-order changes in the mapped positions and depths of major bathymetric features. Knowledge of seafloor topographic features is important for studies of Arctic Ocean circulation, seafloor volcanism, and hydrothermal circulation, and has informed a scientific ocean drilling expedition dedicated to understanding Arctic climate over the past 65 million years.




International Bathymetric Chart of the Arctic Ocean from http://www.ngdc.noaa.gov/mgg/bathymetry/arctic

- Warming of Atlantic Waters. Hydrographic data provide definitive, synoptic evidence of upper ocean circulation pathways, and evidence of warming and penetration of Atlantic water as it propagates along basin peripheries and ridges. As the SCICEX data archive has grown, it has played a greater role in climate and modeling studies to validate model results of temperature and salinity distributions.

- Ocean Acidification. Chemistry data show that the rate of $CO_2$ uptake by the Arctic Ocean is twice the average for the global ocean, leading to acidification of the Arctic Ocean.

- Biological Response to Reduced Summer Ice. Sensor estimates of chlorophyll and oxygen reflect the response of Arctic productivity to decreased sea ice extent during summer. Measurements of organic material help to define transport pathways of carbon from shelves to basins. Current biological approaches can characterize the microbial communities that impact the ecological dynamics and biogeochemical fluxes of the Arctic.