

SCICEX '98 Arctic Exploration Program: Evaluation of the SCAMP Acquisition System and Initial Analysis of Geophysical Data Sets.

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The 1998 SCICEX cruise onboard the USS Hawkbill spent 31 days from August 01 - September 01 conducting Oceanographic and Geophysical surveys throughout the Arctic Ocean. The installation of the SCAMP (Seafloor Characterization And Mapping Pods) geophysical acquisition system enabled us to conduct the first ever systematic bathymetric surveys in the Arctic basin. The gravity, sidescan, swath bathymetry, and chirp sub-bottom data collected allow us to study and better define the geology of the Arctic basin. While the geophysical objectives of the cruise were focused on the ultra-slow spreading Gakkel Ridge, data was collected continuously during all phases of the program, the cross-Arctic transit, the Alpha-Mendeleyev Ridge, the Lomonosov Ridge, and the Chukchi Cap. These data sets provide the first detailed characterization of these features, significantly increase the geologic database for the Arctic Basin.

SCAMP is one of the most complicated civilian instruments ever installed on a U.S. Navy submarine. Its installation required the coordinated efforts of personnel from LDEO, APL, Electric Boat, and Norfolk Naval Shipyard; and the unfailing cooperation of the Navy personnel of USS Hawkbill, Submarine Squadron One, and COMSUBPAC. Funded by multiple organizations, both private and government, SCAMP represents a significant effort by the U.S. science community to examine the nature, origin, and evolution of the Arctic basins. The data collected by SCAMP while crossing of Arctic Ocean provides a geophysical cross-section of the entire Arctic Ocean from the North American continent to the Nansen Basin. The five day survey of the Gakkel mid-ocean ridge, one of the slowest spreading centers on the planet, has produced detailed swath bathymetry, sidescan, sub-bottom, and gravity data for 100km across-axis and 280km along-axis from 86°N 30°W to 86.5°N 75°W . The Atlantic-Pacific frontal survey over the Alpha-Mendeleyev Ridge has provided multiple crossings of the ridge crest along the eastern portion of the ridge. The two phase SHEBA ice survey and the final exit from the Arctic covered the northern edge and western edges of the Chukchi Cap.

Bathymetry shows the Gakkel ridge to have extreme bathymetric relief typically in the 1,000-2,000 meter range with highs as shallow as 600m of water depth and deeper regions down to ~5,200m of water depth. The ridge axis is defined by gravitational variations and a 4-6km wide valley at ~5,000m water depth with steep slopes 1,000-1,500m in height. Minimal to no sub-bottom penetration and strong acoustic returns from the sidescan system indicate an absence of sediment along the axial-valley floor typical of young volcanic regions.

Trackline bathymetry shows a ridge crest composed of multiple distinct peaks rather than the more uniform ridge crest suggested by the ETOPO5 database. Sidescan and sub-bottom data indicate a decrease in sediment cover to the west and increasingly steeper slopes dropping into the Canadian Basin to the south.

Canadian Basin, Chukchi Cap, Alpha-Mendeleyev Ridge, Makarov Basin, Lomonosov Ridge, Amundsen Basin, Gakkel Ridge, and the Nansen Basin

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Swath Mapping the Arctic Ocean from US Navy Submarines; Installation and Performance Analysis of SCAMP Operation During SCICEX 1998

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It has been widely recognized that the stability, silence, range and independence from surface conditions render a nuclear submarine a nearly ideal platform for geophysical measurements. The submarine's independence from surface ice is a particular advantage in the Arctic. The SCICEX program, in which the Navy provides Arctic submarine services to conduct science projects, enabled us to conduct the first ever systematic bathymetric surveys in the Arctic basin.

\par In recognition of this unique opportunity, NSF's Office of Polar Programs funded the fabrication, testing, installation and operation of a SeaMARC\aa-type sidescan swath bathymetric sonar and a data acquisition and quality control system. In support of NSF's commitment, a private organization, the Palisades Geophysical Institute, funded acquisition of a chirp, swept-frequency sub-bottom profiler.

\par The ODEC sub-bottom profiler and Raytheon sidescan swath bathymetric system were delivered in early 1998. The transducer pods, which had been designed by the Applied Physics Lab (APL) of Johns Hopkins University, and Electric Boat Company, were fabricated in machine shops at APL and Twin Manufacturing. The data acquisition system had been developed by LDEO and tested earlier on the 1997 SCICEX cruise of USS Archerfish.

\par SCAMP is one of the most complicated civilian instruments ever installed on a U.S. Navy submarine. Its installation required the coordinated efforts of personnel from LDEO, APL, Electric Boat, and Norfolk Naval Shipyard; and the unfailing cooperation of the Navy personnel of USS Hawkbill, Submarine Squadron One, and COMSUBPAC. Installation was accomplished in two phases: Hard mounting points were welded to the submarine hull during a drydock period in July 1997; in May 1998 the massive transducer pods were installed dockside by divers, using purpose-built handling gear and crane support. Inboard electronics portions of the system were installed with the rest of the SCICEX science equipment in May 1998. The combined sonar systems were tested in May and June during shakedown cruises. Some problems were identified and corrected during port stops prior to arrival of USS Hawkbill in the Arctic Ocean.

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While the geophysical objectives of the cruise were focused on the ultra-slow spreading Gakkel Ridge, where more than 3300 km of track data were collected over the ridge axis, underway data was collected during all phases of the program, across the Chukchi

Plateau, the Alpha Ridge and the Lomonosov Ridge. The data collected during SCICEX 98 provide the first detailed characterization of these features. Samples of the data collected over these features as well as documentation of the installation process will be shown in this poster.

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ICAM Talk

1 - SCICEX98

Basics of the SCICEX program

- Joint program by NSF / ONR / NAVY
- Oceanographic & Geophysical data collection
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2 - Arctic Map

Basics of SCICEX98

- 32days 01 Aug - 01 Sep '98 in the data release area
- SCAMP system
- four focus regions

3 - Arctic Map w/ zooms

Focus regions

- Gakkel Ridge
- Alpha-Mendev Ridge frontal survey
- Sheba ice survey
- Chukchi Cap survey
- Surface & spiral stations

4 -Data Set example

Basics of Data collected

- Swath Bathymetry & sidescan (12.5 kHz)
- Gravity
- Sub-bottom (4kHz chirp)
- Oceanographic data (temp, salinity,oxygen,etc...)

5 - Alpha - Gakkel Regions

Geophysical focus

- preliminary data
-

6 - Gakkel Bathymetry

- Gakkel Mid-Ocean Ridge (spreading rate)
- Defined by a deep valley
- depth ranges : 600 m - 5200 m , ? - ?km wide
- extreme bathymetric relief, >2km

7 - Gakkel RAW Gravity

- the
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8 - Gakkel Temperature

- Unexpected temp front
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9 - Alpha Temperature

Frontal zone between the Atlantic & Pacific water masses

- Primary : salinity & temp gradients
- Secondary : geophysics

10 - Alpha Bathymetry

Comparison of Etopo 5 dataset vs. trackline bathymetry

- etopo datasets based on ????
- trackline shows numerous individual peaks

11 - Arctic Map w/ zooms

Summary

12 - USS Hawkbill

Thank you slide