REPORT: ARCTIC BATHYMETRY WORKSHOP

September 18-19, 1997
Institute for Geology and Mineral Resources of the Ocean
(VNIIOkeangeologia)
St. Petersburg, Russia
Ron Macnab and Garrik Grikurov

Introduction

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Introduction

The objective of the Workshop was to initiate an international collaboration for the development of a modern bathymetric data base for the Arctic, to be used subsequently in the production of an accurate map. This data base will incorporate in digital form all available bathymetric data north of 64 degrees North, for the benefit of mapmakers, researchers, and others whose work requires a detailed and accurate knowledge of the depth and shape of the Arctic seabed. The rationale and purpose of the proposed data base are outlined in a Project Prospectus circulated earlier in the year by an Interim Steering Committee (Appendix 1).

Funding for the Workshop was provided through a Project Planning Grant awarded by the International Arctic Science Committee (IASC). A Local Organizing Committee chaired by Garrik Grikurov, Deputy-Director, VNIIOkeangeologia, assumed responsibility for encouraging participation by members of the Russian Arctic bathymetry community, and for handling all technical & logistical arrangements.

The Workshop opened under the combined chairmanship of Academician Igor S. Gramberg (Director, VNIIOkeangeologia), Admiral Anatoly A. Komaritsyn (Chief, Head Department of Navigation and Oceanography of the Russian Federation Navy), and Ron Macnab (Geological Survey of Canada). Following the opening presentations, the Workshop was co-chaired by Garrik Grikurov and Ron Macnab.

Presentations on Day One

The first day's presentations (see Agenda in Appendix 2) described existing data sets that could be considered for incorporation in the proposed data base. Abstracts of the presentations are shown in Appendix 3. After group discussion, the information presented in this session was summarized in tabular form showing among other things the level of availability for each data set (see Appendix 4). It was noted that other data sets almost certainly exist, and that it would be useful to expend some effort in identifying these for inclusion in the project. Also, it was pointed out that new, high-quality data continues to accumulate at a significant rate, e.g. information collected by the SCICEX project, so that new data base structure should include provision for incorporating these observations as

they become available.

Discussion on Day Two

The second day's session (see Agenda in Appendix 5) was conduced as a round-table discussion of technnical and organizational issues. Highlights and main conclusions are outlined in the following paragraphs.

Task sharing

In view of potential data volumes and anticipated constraints on the exchange of data sets, it was generally agreed that it would be desirable to divide the processing tasks of the project into components that could be allocated to two or more participating institutions. Such an arrangement would achieve two things: (a) it would spread the technical burden among participants who were prepared to assume the responsibility; and (b) it would resolve questions related to data sensitivity by allowing institutions to retain control over the handling and distribution of their proprietary observations. This arrangement would also entail some form of data division along geographic lines, so that all data sets within any given region could be processed together. Clearly, the approach outlined here would require special care to ensure consistency of data treatment between processing cetres, as well as the compatibility of their output products so all could be merged seamlessly to produce a coherent data base for the entire study region.

Issues relating to the designation of data processing centres, to the scheme for geographical data division, and to the mechanism for coordinating the processing operations, were discussed at varying levels of detail. It was agreed that these matters could be more effectively resolved in a smaller forum, so they were referred to a committee of technical experts (see *IASC Project Group* below) which would begin at the earliest practicable date to review options and to devise an overall work plan that would meet all concerns.

Funding

The need for adequate funding was a constant theme throughout the discussions, with resources required to meet expenses in four main categories: (1) communications and travel, to permit exchange of information and discussion among participants; (2) technology upgrades (including training), where needed to furnish selected processing centres with the expertise and equipment to handle the anticipated workload; (3) personnel costs, which may or may not be adequately covered by existing institutional budgets; and (4) preparation and distribution of final products.

Clearly it is unlikely there will be an overall budget for the entire project, and support will most probably have to be obtained ina variety of forms: new money acquired for specific project components; institutional funding from existing budgets; and in-kind contributions from participating institutions, such as manpower and processing services. It will be up to each participating institution to determine the level of support that it tis willing to provide to the operation out of its own resources. In the meantime, various potential sources will be approached in a coordinated fashion with a view to obtaining new money.

Suggested IOC affiliation

Intiated under the auspices of IASC, this project has also been proposed as an activity within the framework of GEBCO (General Bathymetric Chart of the Oceans) component of the International Hydrographic Organization (IHO). In light of the latter's affiliation with the Intergovernmental Oceanographic Commission (IOC), there was brief discussion concerning the feasibility of establishing a direct link between IOC and the project, in line with a recent IOC resolution concerning the development of a new bathymetric map of the Arctic. This would most likely be achieved through the creation of an Editorial Board that would oversee the production of a map based upon information extracted from the new data base. It was suggested that the proposed IASC Project Group (see below) could fulfill some or all of the functions of the IOC Editorial Board, but it was agreed that further action on this front would require prior consultation with IASC.

IASC Project Group

IASC per se does not engage directly in technical operations, rather it maintains linkages to specific activities through the Project Group structure. Membership in any particular Project Group usually consists of subject matter experts working to achieve a well-defined objetive. In keeping with standard IASC procedure, Workshop participants were asked to nominate members for a proposed Project Group for Arctic Bathymetry. Seven nominations were proposed and seconded, with three more to follow shortly after consultation with national authorities (see Appendix 6). The final list of nominees will be forwarded to IASC for consideration and approval.

Future activities

In addition to preparing and submitting the usual reports, the following were identified as action items to be accomplished within various time frames:

- immediate - seek IASC approval for the proposed Project Group.
- immediate - undertabke a coordinated search for new funds to underwrite the costs of specific project components
- 1 month - consult with IASC concerning the potential implications of the suggested IOC affiliation through involvement in an IOC Editorial Board.
- 2-3 months - address the issues identified above under *Task sharing* and develop a comprehensive work plan.
- 1 year- convene a follow-up Workshop to review progress and to discuss significant developments in the project; ICAM III (the Third International Conference on Arctic Margins, 12-16 October, 1998 in Celle, Germany) has been suggested as a possible venue.

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DEVELOPMENT OF A MODERN BATHYMETRIC DATA BASE FOR THE ARCTIC

An earlier version of this document was widely circulated in early 1997 by the Interim Steering Committee for the proposed IASC Working Group for Arctic Bathymetry

Objective

The goal of this initiative is to develop a digital data base that contains all available bathymetric data north of 64 degrees N, for use by mapmakers, researchers, and others whose work requires a detailed and accurate knowledge of the depth and the shape of the Arctic seabed.

Background

Ample anecdotal evidence exists concerning the inadequacy of published charts of the Arctic Ocean. Numerous field investigators have reported significant differences between observed and charted depths, which have resulted in planning and operational difficulties.

The lack of accurate bathymetry in the Arctic is no less a disadvantage for shore-bound investigators who require reliable, detailed information. Oceanographers need to know more about underwater relief to improve their models of Arctic Ocean circulation. These studies advance our understanding of the global weather machine and help predict the transport of contami- nants. Detailed bathymetry is essential for environmentalists who study the sometimes destructive interactions between Man and the sea floor, e.g. the dispersion of toxic wastes, or the impact of moving ice on seabed installations. Geoscientists need detailed information for a wide range of investigations that range from the present distribution of bottom sediments, to the tectonic history of oceanic regions. Marine boundary specialists need precise locations of key features on the sea bed for the preparation and evaluation of national claims for jurisdiction over seabed resources beyond 200 nautical miles, according to the provisions of Article 76 of the Law of the Sea.

There are several reasons why the floor of the Arctic Ocean is so poorly known: the permanent ice cover has made it difficult and costly to collect soundings; climate and remoteness have posed formidable logistical problems; and perhaps most significantly, the region has until recently served as a theatre for superpower politics. Improved technology coupled with significant political developments are changing this picture, raising the possibility of dramatic improvements to the description of the Arctic seabed.

A preliminary inventory of available data sets

Unlike some other oceanic regions, public-domain bathymetry is sparse in the Arctic Ocean. Sheet 5.17 of the General Bathymetric Chart of the Ocean (GEBCO; Canadian

Hydrographic Service, 1979) is widely used to portray the sea floor north of 64 degrees N. (This is a standard paper chart, however a digital version is now available in hardcopy and computer-readable form, as seen on the Cover). Sheet 5.17 was developed in 1979 from the very limited data set shown in Figure 1, which illustrates sounding track lines extracted from the GEBCO Digital Atlas (Jones et al, 1994). Observations along these tracks were used to develop manually-drawn contours portrayed north of 64 degrees N in the GEBCO sheets (although not all track lines shown between 64 degrees N and 72 degreesN in the Norwegian-Greenland and Barents Seas were used in the construction of Sheet 5.17). The data used in this chart was collected in analog form, with poor navigation. We believe however that this data adequately documents the approximate positions and orientations of the major bathymetric features in the basin.

Since the late 70's, a number of cruises have operated in the Arctic Ocean. The data collected during these efforts, combined with data anticipated over the next few years from improved observations, makes 1997 an ideal time to develop a new Arctic data base.

Figure 2 illustrates public-domain bathymetry that is available in digital form from data centres in Canada and the USA. The density of these data sets is inhomogeneous and totally inadequate for an accurate portrayal of the sea floor in the main part of the Arctic Ocean. Other data sets exist. Negotiations for the release of new or uncirculated information will help paint a more accurate picture. The Russian Navy is known to have accumulated numerous soundings throughout the Arctic Ocean, which are currently being used to develop a 1:5 million contour map; there are indications that these soundings may also be converted eventually to grid form. Investigations are underway to determine if the US Navy holds a similar data set, and if so, what is the likelihood of its release for this project.

Perhaps the most promising development in Arctic bathymetry is the US Navy's SCICEX program, which commits specific submarine missions to unclassified mapping and research beneath the permanent polar pack. The general policy is to release data into the public domain no later than two years after the cruise completion date. So far, cruises in 1993, 1995, and 1996 have collected single-beam soundings in key areas selected on the basis of scientific priorities (Figure 3); in 1998, the program is expected to include a swath mapping capability. SCICEX represents a significant advance in Arctic bathymetry supported by relatively modern positioning systems; every effort will be made to incorporate this new information into the proposed data base, as it will no doubt figure heavily in the consolidation and adjustment of other observations.

Expected participation and means of support

All organizations that hold or use Arctic bathymetric data are encouraged to participate, e.g. members of the International Hydrographic Organization, naval and hydrographic services, data centres, national research laboratories, universities, etc. The basic criteria for involvement in the project are: (a) a strong interest in developing an improved description of the sea floor in the Arctic; and (b) a willingness to contribute actively to the attainment of that objective through funding, data contributions, or the provision of scientific and technical expertise. Preliminary discussions with potential participants have revealed a high level of enthusiasm for the objectives of this initiative, as well as a readiness to take part in a constructive fashion. In this context, an early version of this proposal has been presented to Member States of the International Hydrographic Organization, and has met with favourable

response.

Details concerning project staffing and management will be resolved through early discussion among committed participants. In establishing the core group of workers and the terms of reference for this initiative, due care will be exercised to ensure that all project activities and policies are well coordinated with those of other undertakings that have related objectives.

No individual source of funding has been identified to underwrite the entire cost of the initiative. Support for the project will most likely consist of cash and in-kind contributions from participating organizations and from interested sponsors. For example, IASC has agreed in principle to partially sponsor an initial participants' Workshop (Item 1 in the following section). In-kind contributions (staff salaries, use of technical facilities, etc) will be sought from participating agencies as appropriate. Nominal fees may be charged to defray the cost of distributing final products to the end users, but that proposition is subject to further discussion.

Proposed implementation: major tasks and preliminary time table

1. Organize Workshop to review candidate data sets and to develop work plan (September 1997);
2. Assemble all available sets of bathymetric observations (September 1997 to August 1998);
3. Merge the observations into a digital data base (January 1998 to December 1998);
4. Use the new data base to produce improved maps (December 1998 to June 1999);
5. Place the data base, maps, and documentation into public circulation (September 1999);
6. Recommend priorities for future mapping and research (September 1999).

Reporting and data management

The project operators will implement a reporting mechanism to ensure that participants, sponsoring organizations, and other interested parties are kept aware of progress through the regular circulation of newsletters and/or postings on the Internet. Also, participants will be encouraged to report developments through presentations at international meetings and/or publications in the appropriate journals. All data sets used in the final products, as well as the procedures followed in their handling and processing, will be fully documented.

Particular attention will be directed to data management issues, as the intent is to create a live' data base that can be expanded and upgraded whenever new sets of observations become available. Data will be preserved in both raw and corrected form, in case it should prove necessary at some future date to re-process original observations.

Data release and distribution

The main objective of the compilation is to develop a coherent data base that incorporates all available bathymetric observations, which will be used to construct a regular grid of depth values. This grid will be placed in the public domain for free and unrestricted use by anyone. If past experience is any guide, many of the original observations will already be in

the public domain, so relatively few problems are expected in releasing them along with the gridded values; other original data sets may be proprietary and hence may remain unavailable for open circulation in the near future.

The grid will also be circulated in map form, most notably a 1:6 million Polar Stereographic map of the Arctic region north of 64 degrees N.

The Interim Steering Committee

At the time this proposal was originally circulated, the Interim Steering Committee consisted of four volunteers:

- Norman Cherkis, US Naval Research Laboratory, Washington DC, USA Tel: (202)402-1103; E-mail: fiveoceanscon at yahoo.com
- Bernard Coakley, Lamont-Doherty Earth Observatory, Palisades NY, USA Tel: (914)365-8552; E-mail: bjc at ldeo.columbia.edu
- Ron Macnab, Geological Survey of Canada, Dartmouth NS, Canada Tel: (902)426-5687; E-mail: ron.macnab at ns.sympatico.ca
- David Monahan, Canadian Hydrographic Service, Ottawa ON, Canada Tel: (613)995-4666; E-mail: monahand at ccom.unh.edu

At the same time, the Committee was seeking to include a fifth member who would represent the Russian bathymetric community and assist with local arrangements for the proposed Workshop in St. Petersburg.

References

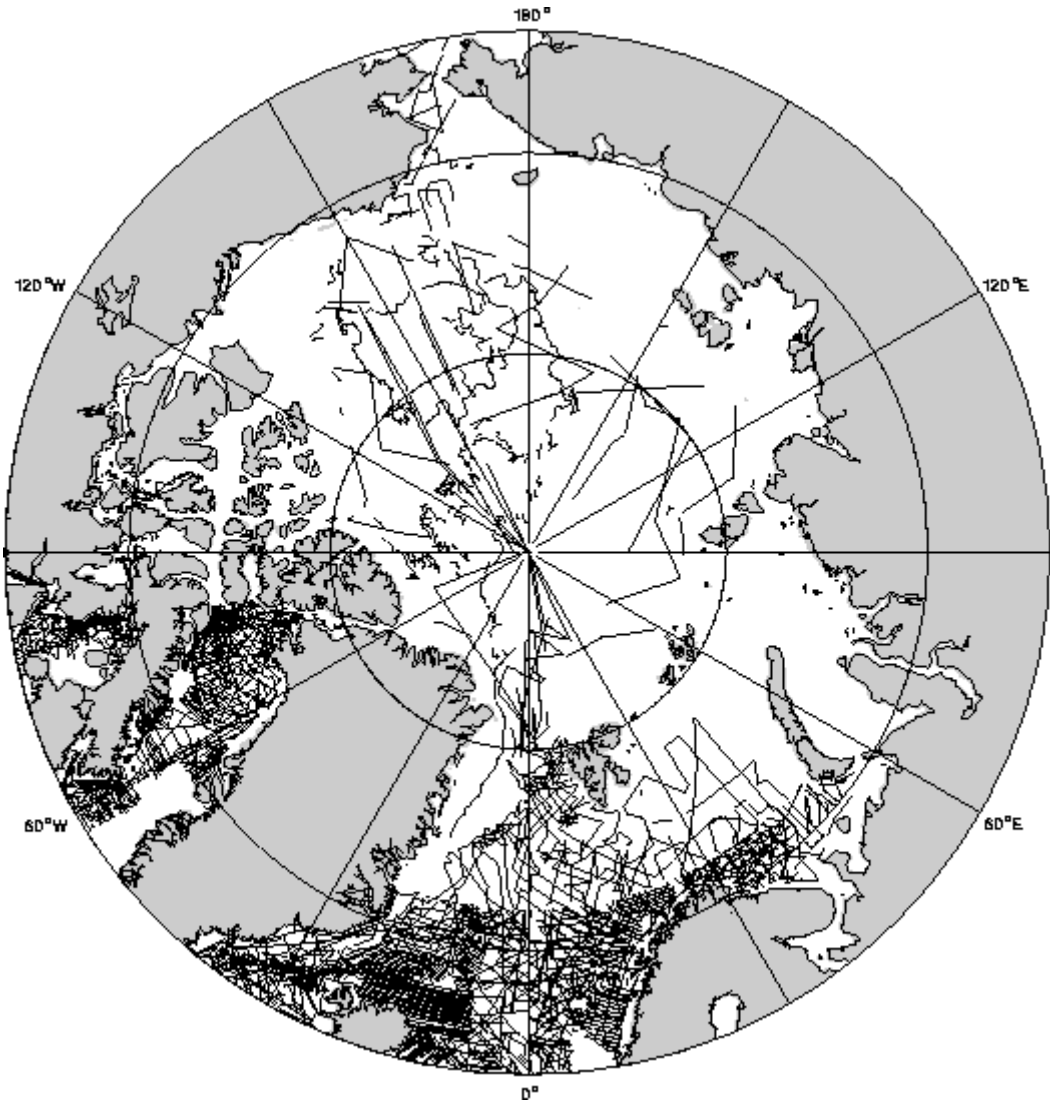
Canadian Hydrographic Service, 1979. General Bathymetric Chart of the Oceans (GEBCO) Sheet 5.17, 5th edition; Scale 1 to 6 million. Scientific Coordinators: G.L. Johnson, D. Monahan, G. Gràlie, and L. Sobczak. Published under the authority of the International Hydrographic Organization and the Intergovernmental Oceanographic Commission. Canadian Hydrographic Service, Ottawa, Canada. Reprinted 1983.

Geological Survey of Canada, 1994. Bathymetric and Topographic Shaded Relief North of 64 degrees; Polar stereographic projection, variable scale, distributed in digital or hardcopy form. Coordinator: R. Macnab. GSC Open File 2900, Geological Survey of Canada, Dartmouth NS.

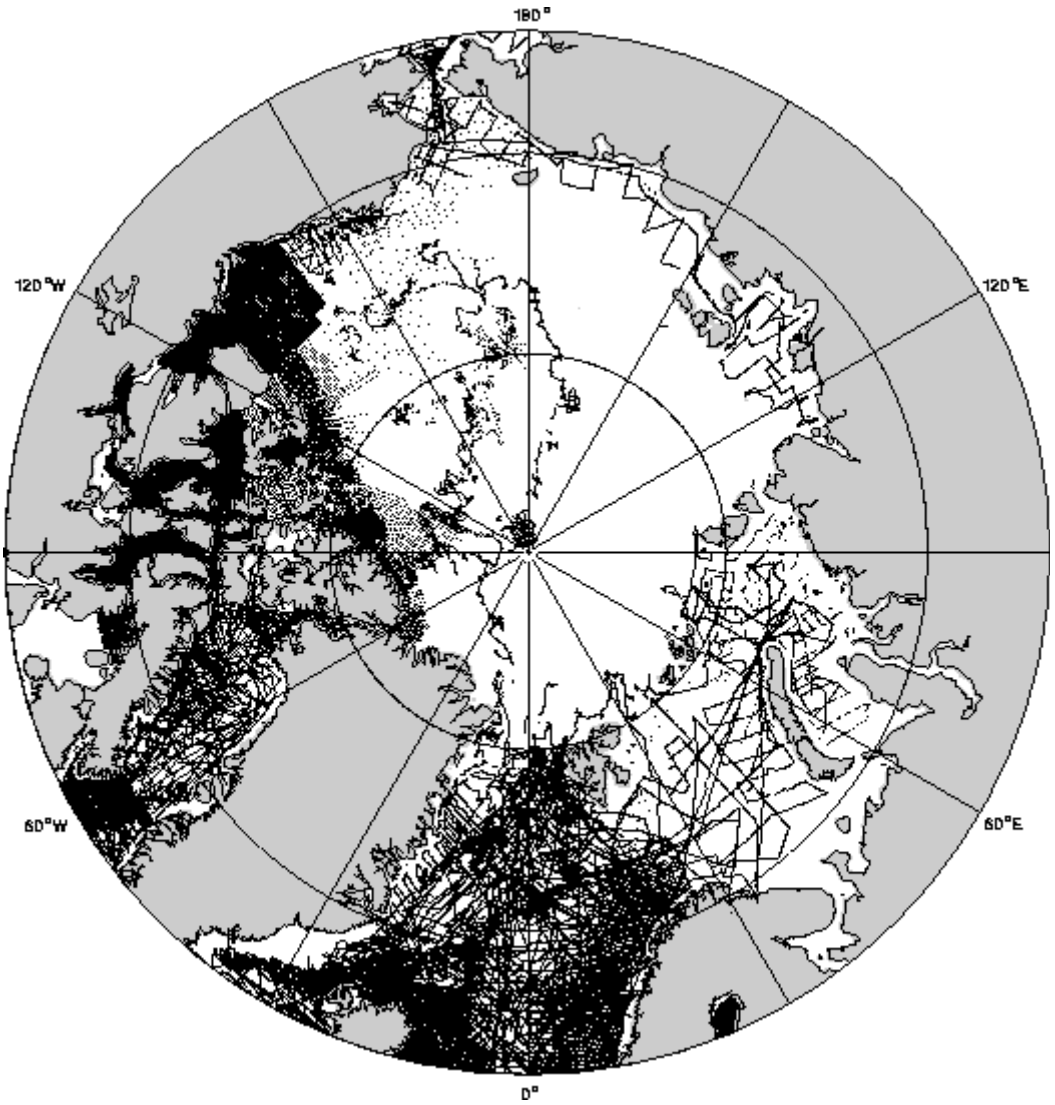
Jones, M.T., A.R. Tabor, and P. Weatherall, 1994. GEBCO Digital Atlas: CD-ROM and Supporting Volume. British Oceanographic Data centre, Birkenhead, UK.

FIGURES AND CAPTIONS

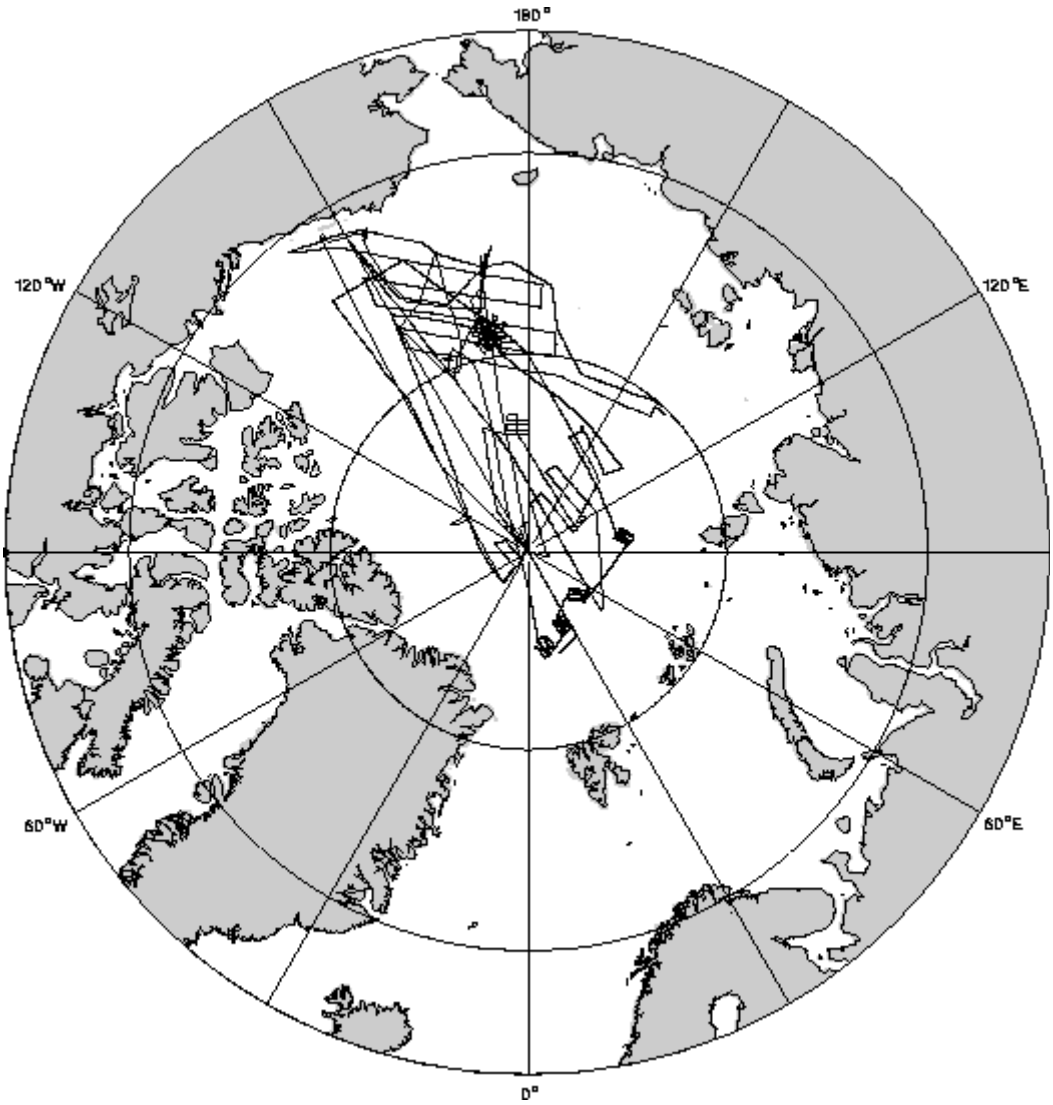
- **Cover**. Computer-drawn version of Sheet 5.17 of the General Bathymetric Chart of the Oceans (GEBCO), which has provided a standard for Arctic bathymetry since its publication in 1979. The original Sheet 5.17 portrayed depth by means of manually-drawn contour lines, whereas this digital replication features an enhanced portrayal of bottom texture through a shaded-relief presentation with simulated illumination from the upper lefthand corner of the image.



- **Figure 1**. The track lines in this figure indicate the distribution of the mostly analog soundings that were used to construct depth contours north of 64 degrees N in the GEBCO series. Not all track lines between 64 degrees N and 72 degrees N were used in the construction of GEBCO Sheet 5.17. (Information extracted from the GEBCO Digital Atlas)



- **Figure 2**. North of 64 degrees N, numerous sets of bathymetric observations are now available in digital form for potential use in developing an improved Arctic map. Some of these data sets replicate portions of the analog observations that were used in the construction of GEBCO Sheet 5.17, and which are shown in Figure 1. (Information extracted from the archives of the Geological Survey of Canada, and from the GEODAS CD-ROM issued by the US National Geophysical Data Center)



- **Figure 3**. Under the auspices of the SCICEX program, the US Navy in 1993, 1995, and 1996 deployed nuclear-powered submarines on unclassified mapping and research missions beneath the Arctic pack. On those missions, bathymetric observations were collected along the tracks shown here; they are destined for the public domain, as are observations that will be collected on proposed missions in 1997 and subsequent years. (Information provided courtesy of Bernard Coakley of Lamont-Doherty Earth Observatory)

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APPENDIX 2

ARCTIC BATHYMETRY WORKSHOP

St. Petersburg, VNIIOkeangeologia, 18-19 September 1997

FIRST DAY - PROGRAM

9:00 - 9:45 Registration of participants

9:45 - 10:05 Director **Academician I.S.Gramberg -** Welcome and introductory comments

10:05 - 10:20 **Ron Macnab -** Introduction to workshop general objectives and specific goals

10:25 - 10:25 **G.E.Grikurov -** Practical information

10:25 - 10:45 **Komaritzyn A.A. & Fomchenko V.D. (GUNiO) -** Bathymetric Maps of the Arctic Basin

1

10:45 - 11:00 **Ron Macnab (GSC) & David Monahan (CHS) -** Bathymetric Data Holdings in the Canadian Arctic

2

11:00 - 11:30 *Coffee break*

11:30 - 11:45 **Komaritzyn A.A. (GUNiO), Bocharova E.V., Daniel E.D., Zaionchek A.V., Kaminsky V.D., Maschenkov S.P. (VNIIO), Sorokin M.Yu., Kartelev A.A. (PMGRE) -** Computer-Derived Bathymetry Map of the Central Arctic Basin

3

11:45 - 12:00 **Bernard Coakley (LDEO) -** Arctic Bathymetry Data Acquired from US Navy Sturgeon-Class Submarines

4

12:00 - 12:15 **Poselov V.A. (VNIIO) -** Bathymetry Component in Seismic Reflection Data Obtained at

5 North Pole Drifting Stations during 1973-1983

12:15 - 12:30 **Sorokin M.Yu. and Zamansky Yu>a. (PMGRE) -**
6 Seismic Evidence from Transarctic and North Pole Expeditions (1984-1992) as Possible Contribution to International Digital Data Base for the Arctic Basin

12:30 - 12:45 **Troy L. Holcombe (NGDC NOAA) -**
7 Arctic Bathymetric Data at the US National Geophysical Data Center

12:45 - 13:00 **Academician Matishov G.G. (MMBI) -**
8 bathymetry of the Barents-Kara and Norwegian-Greenland Basins from Data Bases Held at MMBI and the Importance of This Evidence for the Proposed IASC Project

13:00 - 14:00 *Lunch*

14:00 - 14:15 **Naryshkin G.D. (VNIOkeangeologia) -**
9 New bathymetry Map of the Arctic Basin

14:15 - 14:30 **Norman Z. Cherkis (NRL)-**
10 Bathymetry in the Northern Polar Regions: Data Handling at the Naval Research Laboratory

14:30 - 14:45 **Bocharova E.V., Daniel E.D., Zaionchek A.V., Machenkov S.P. (VNIIOkeangeologia) -**
11 Computer Derived Bathymetry Maps of the Northern Eurasia Shelf Seas

14:45 - 15:00 **Ole B.Kvamme & Gerhard Heggebo (NHS) -**
12 Status of the Bathymetric Data Base in the Norwegian Hydrographic Service - an overview

15:00 - 15:15 **Corresponding member of RAS Udintzev G.B. (Vernadsky Institute) -**
13 Potential of the Vernadsky and Shirshov Institutes of RAS for Contributing to International Digital Bathymetric Data Base in the Arctic Ocean

15:15 - 15:30 **Arne Nielsen & John Woodward (RDANH) -**
14 Status Report on RDANH Data Bases for Greenland Basin

15:30 - 16:00 *Coffee break*

16:00 - 16:15 **Grishin M.N. (MAGE) -** Bathymetry Data Base Held by MAGE for the Arctic Basin

15

16:15 - 16:30 **Martin Jocobsson (Stockholm University) -** Swedish Contribution to Arctic Bathymetric Data Base

16

16:30 - 16:45 **Kathleen Crane (NRL) -** Comparison of NRL and Russian Bathymetry for the Barents and Kara Seas

17

16:45 - 17:00 **Hans Werner Schenke (AWI) -** Summary of Multi- and Single-Sonarbeam Surveys

18

17:00 - 17:15 **Valery Gataullin (NIIMorgeo) -** Bathymetry of the Southeastern Barents and Southwestern Kara Seas

19

18:00 - 20:00 *Ice-breaker*

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APPENDIX 3

Submitted abstracts for Day One

(in order of presentation)

2

Ron Macnab (Geological Survey of Canada - GSC)
David Monahan (Canadian Hydrographic Service - CHS)

Bathymetric Data Holdings in the Canadian Arctic

For several decades, CHS and GSC have carried out joint or independent mapping operations in four primary regions of the Canadian Arctic: (1) portions of the deep Arctic Ocean basin within Canada's 200 nautical miles limit; (2) the continental shelf and slope of the Beaufort Sea and north of the Canadian Arctic Archipelago; (3) the channels between the islands of the Canadian Arctic Archipelago; and (4) Baffin Bay.

A significant percentage of the observations in the first three regions consisted of point measurements taken through ice, with observers and instruments transported to the observation sites by helicopter. Remaining measurements in these regions, as well as all measurements in Baffin Bay, were acquired by surface vessels equipped with conventional echo sounders.

For the most part, observations were carried out systematically over rectangular grids or closely spaced survey lines, with the exception of Baffin Bay where the majority of soundings were acquired on an opportunity basis by vessels that were either in transit or deployed in other kinds of operations. Whether through-ice or shipborne, measurements were positioned for the most part with shore-based radio-location systems in the early years of the mapping program, but in later years these systems were phased out and replaced with GPS.

Significant portions of the CHS and GSC data bases are freely available in the public domain, and may be readily incorporated in the proposed Arctic compilation. Other portions will be released when their final processing is complete, and when they are published in chart form or in the scientific literature.

3

A.A.Komaritzyn (GUNiO),
E.Bocharova, E.Daniel, V.Kaminsky, S.Maschenkov, A.Zayonchek (VNIIOkeangeologia),
M.Yu.Sorokin, A.A.Kartelev (PMGRE)

Computer Derived Bathymetry Map of the Central Arctic Basin

Bathymetry data base of the central Arctic region contains sea-floor depth measurements carried out in the course of Russian and foreign (J.K.Hall, 1970) field investigations. Point observation distance varies from 10x10 km to 40x40 km. Trackline measurements with distance of 5-10 km between observation points were acquired during high-latitudinal geotransect studies from De Long Islands to Makarov Basin. Celestial, radiogeodetic and satellite positioning provided maximal error in determination of site locations +/- 600 m. Sea-floor depths were measured using echosounding and seismic observations with an error not exceeding 2% of depth. For initial data processing original software (Korneva, 1994) and Autocad (AUTODESK Inc., 1992) were employed.

Sea-floor depth grid was calculated by gridding with continuous curvature spline in tensions (Smith & Wessel, 1990). Such digital bathymetry model is considered best approximation to initial depth field.

From calculated grid a coloured structural (pseudo-shadow) bathymetry map at 1:2,500,000 scale was compiled. Software "Potential fields data processing" (Blue Vajra Computing, GSC Atlantic, 1994), ER MAPPER (Earth Resource Mapping Pty Ltd., 1995) was used.

Presented bathymetry data significantly supplement the existing knowledge of the bathymetry of central Arctic region.

4

Bernard Coakley (Lamont-Doherty Earth Observatory)

Arctic Bathymetry Data Acquired from US Navy Sturgeon-Class Submarines

The Arctic Ocean is the least known of all the ocean basins. The Arctic has been explored from ice islands, icebreakers, airplanes and satellites. Every survey has revealed more of the Arctic Ocean basin, but operated under the restrictions imposed by ice and weather. Only a submarine can cruise below the ice, independent of surface conditions.

A nuclear-powered submarine can operate autonomously anywhere in the Arctic Ocean basin. A submarine can survey the seafloor, collecting co-registered data sets for mutual analysis. In principle, any of the underway data sets collected from surface ships can be gathered from a submarine. The speed, stability and silence of the submarine make it an ideal platform for underway geophysical measurements.

Three times since 1993, the US Navy has provided a Sturgeon class fast attack submarine for an unclassified science cruise. Under this program, a nuclear-powered submarine was deployed to the Arctic Ocean in 1993, 1995 and 1996. Approximately 100 science days in the Arctic Ocean operational area have yielded about 50,000 kilometers of continuous underway bathymetry and gravity data. Three additional cruises are scheduled for 1997, 1998 and 1999.

On the SSns PARGo, CAVALLA, POGY and ARCHERFISH (1997 cruise) cruises, geophysical instrumentation consisted of a narrow-beam bottom sounder (standard shipboard equipment) and a Bell BGM-3 gravimeter. Although these instruments have returned valuable data from unexplored areas, the information they provide on the morphology and structure of the sea floor is meager compared to data collected from a typical modern research vessel.

Development, fabrication and testing of sonar instrumentation for the remaining cruises is underway. Three components make up this instrumentation; two sonars; an optimized SeaMARC-type sidescan swath bathymetric sonar; a chirp-type high resolution sub-bottom profiler; and a data acquisition system. The transducers for the two sonars will be carried in two instrument pods attached to the underside of the submarine. Cables, routed through the ballast tanks, will deliver signals from the transducers to outboard processors in three pressure tight cases secured in a freeflood space. After initial processing, the signals will be brought in board, processed, logged and archived.

Initial preparations for SCAMP instalation on the SSN HAWKBILL (the submarine designated for 1998) were completed on schedule in early July in Honolulu. The mounting points that will hold the transducer pods were placed and welded to the hull. An internal cable was installed, the pod foundations were fitted to the mounting points and the divers, who will do the final installation, were familiarized with the hardware. The transducer pods and foundations will be installed dockside by divers with crane support in Spring 1998.

5

Victor Poselov (VNIIOkeangeologia)

Bathymetry component of the seismic reflection observations at "North Pole" drifts stations during 1973-1983

Seismic observations along the drift track of research stations "NP-21" - "NP-26" were carried out by specialists of Ministry of Geology - employees of VNIIOkeangeologia - in the course of expeditions conducted by AARI. Nearly 30,000 individual reflectionseismic soundings were implemented during this period.

Research methods were aimed to study regional features of the bottom topography and sedimentary cover structure along the drift track which crossed the major morphostructures of the Eurasian and Amerasian Basins, such as Amundsen, Podvodnikov and Makarov Basins, Lomonosov Ridge, Mendeleev Rise, etc. Satellite and celestial positioning systems were used for position control of observation sites. In addition to geological information, the initial analog seismic reflectiondata contain significant bathymetric component which is currently being digitized along with other information. The presentation demonstrates location of observation points and first examples of digital bathymetry data processing obtained by VNIIOkeangeologia by the time of the workshop.

6

Mikhail Sorokin, Uri Zamansky
(Se PMGRE)

Seismic data from TRANSARCTICA and NORTH POLE expeditions (1984-1992) as possible component of international Arctic bathymetry digital data base

SE PMGRE holds seismic data obtained in the course of Arctic expeditions during 1984 - 1992, including:

- Seismic reflection survey at drift stations North Pole (NP-26/northern part of drift/NP-28, NP-31);
- Aircraft-supported seismic reflection soundings on sea-ice acquired during TRANSARCTICA expeditions along lines of the geotransects;
- Base seismic reflection observations during TRANSARCTICA expeditions.

Investigations were mainly conducted in deep-water part of the Amerasian subbasin of the Arctic Oean (Chukchee Dome, Mendeleev Rise, Makarov Basin, Lomonosov Ridge).

The data are still mostly preserved in analog form, although the technologies for their digitization have already been worked out and successfully tested.

Over-ice streamers (12-24 channels of cross or angular configuration) and analog recorders SMOV-0-24 were used to obtain seismic data. Seismic impulse was initiated by explosion of 3-5 detonators at the depth of about 8 m. Recording time was 12 sed. Observation interval on drifing stations was about 1-2 km, during aircraft-supported trackline survey close to 5 km. Satellite positioning accuracy of coordinating observation points within 100 m.

In the nearest future PMGRE is planning to continue TRANSARCTICA expeditions along the geotransect crossing the Mendeleev Rise from Makarov Basin to Canadian Basin. Seismic reflection survey will constitute an important part of the program and allow to obtain accompanying bathymetry information.

Spherical form of seismic impulse is an important feature of seismic technology which puts certain constraints on use of seismic data for surveying sea-floor depths.

SE PMGRE encourages the idea to compile the Arctic bathymetry digital data base as an important contribution to geological-geophysical study of the region and also in connection with the need to approach delimitation of the coastal states' shelf zones on the basis of unified cartographic approach.

7

Troy L. Holcombe
NOAA National Geophysical Data Center

ARCTIC BATHYMETRIC DATA FROM THE US NATIONAL GEOPHYSICAL DATA CENTER

The US National Geophysical Data Center has accumulated and assimilated into its global trackline geophysical data base about 700,000 Arctic bathymetric soundings from 630,000 line km of ship track from 183 cruise legs of data collected by 16 oceanographic institutions located in eight countries. Most of these bathymetric data were collected from regions of the Arctic which are ice-free or periodically traversible by ship. Additional bathymetric data from several cruise legs are waiting to be assimilated. All these data were collected between 1961 and 1995 and the depth measurements are believed to be relatively accurate, ranging from earlier soundings digitized from precision depth recorder records, to more recent soundings collected by narrow beam and multi-beam systems. Navigation accuracy is that of earlier celestial navigation and/or transit satellite, and, more recently, the global positioning system.

In addition NGDC has assimilated in separate data bases 1) an estimated 20 million depth soundings collected with a multi-beam bathymetric sounding system; 2) depth soundings digitized from Russian and Norwegian nautical charts; 3) depth soundings collected on Canadian gravimetric surveys from helicopter; and 4) depth soundings collected from a US station on an ice island.

8

G.G.Matishov (MMBI RAS)

Sea-Floor Topography of the Barents-Kara and Norwegian-Greenland Basins from the Bathymetry Data Held by MMBI and Importance of This Evidence for the Planned IASC Project

Extensive bathymetry information has been accumulated in the course of geomorphological survey and sea-floor echosounding carried out by PINRPO and MMBI since early 60-ties until the present time. These data constituted the basis for compilation of series of bathymetry maps at scales from 1:200,000 to 1:2,000,000. including original bathymetry map of the Barents Sea at a scale of 1:1,500,000 compiled in 1975 and upgraded in 1992. Individual bathymetry maps of north-western and north-eastern Atlantic were published as well. Bathymetry map of Franz Josef Land at a scale of 1:5,000,000 was published in 19995 in cooperation with the US Geological Survey.

The maps are of significant importance in terms of problems relevant to history of Quaternary glaciation of the Arctic and Northern Atlantic and formation of specific category of morphostructures - glacial and periglacial shelves. In our opinion the maps contain information which proves existence in recent times of thick (1-2 km) glacial sheet on the Barents-Kara shelf.

The maps were compiled manually and can now be used in the planned IASC project in two ways: 1) digitizing isolines for developing grids for appropriate sea-floor areas; 2) selection of the most reliable depth values from initial data used for isoline compilation and incorporation of these values in a digital format in the International bathymetry data base.

9 *G.D.Naryshkin (VNIIOkeangeologia)*

New Bathymetry Map of the Arctic Basin of the Arctic Ocean

Joint compilation by VNIIOkeangeologia and GUNiO of bathymetry map of the Arctic Basin (1:5,000,000 scale, stereographic projection, contour interval 200 m) is nearing completion. The map is based on all national bathymetry data obtained during several decades of regional investigations of the Arctic Basin bottom topography.

The level of detail in depicting the topography allows to state with confidence that the Gakkel Ridge occupies an isolated position in the Eurasian Basin and is not connected with mid-oceanic ridge system of the north-eastern Atlantic. Contour interval chosen for compilation emphasizes a distinct link between the topography of the central oceanic basin with that in adjacent continental margins, thus suggesting their morphostructural unity. At the same time the map helps to identify least studied areas where additional studies are necessary to obtain reliable topographic evidence.

The map is manually compiled but can subsequently be digitized and used for the purposes of proposed IASC project as background information which would supplement initial data grids and may help to control interpretation of gridded data during compilation of final maps.

10 *Norman Z. Cherkis,*
Naval Research Laboratory

Bathmetry in the Northern Polar Regions: Data Handling at the Naval Research Laboratory

The Naval Research Laboratory (NRL) holds over 21.5 million datapoints of single and multibeam trackline bathymetry in the northern Polar Regions.

These data include all research trackline bathymetry data held by the US National Geophysical Data Center, and many other US and non-US sources. The Laboratory has informal bilateral agreements with a number of non-US institutions, which allow us to use the data. However, under these agreements, we are unable to disseminate those data. Rather, the originator of the data is responsible for that task. In cases where bathymetric data come to NRL in raw form, i.e., on echosounding rolls with accompanying navigational files or lists, those data are hand-digitized. After completion of the digitization, error-checking and comparison with existing bathymetric data, the digital data and original materials are returned to the source.

Analysis of NRL Arctic bathymetry data base has resulted in the compilation and publication of five north polar region bathymetric charts: four have been published (after peer review) by the Geological Society of America in their Map and Chart series, and one has been used as the basemap in an atlas published by the Norwegian Polar Institute.

The bathymetry is printed on the obverse, and the tracklines are registered to and printed on the reverse of the map. Some non-US sources of data have agreed to permit showing these tracklines, as long as the sounding data themselves remain held in a proprietary sense.

When the NRL science program dictates the necessity for up-to-date bathymetry of a specific area, the data are plotted at very large scales, e.g., 1:125,000, permitting all or almost all of the data points to be plotted in a legible scale. The data are then contoured in the traditional sense, i.e., by hand, by a qualified and experienced bathymetry specialist.

Digital bathymetry collected along transit tracks under the Arctic ice pack and marginal ice zone by US nuclear submarines between 1957 and 1982 are being readied for release into the public domain later this year. These bathymetric data will be available to the science community as a whole and will significantly enhance the Arctic bathymetry database.

* Unless otherwise stated, the expressed views are my own. They may not be the opinions of the US Navy, the Department of Defense, nor the US Government.

11 *E.Bocharova, E.Daniel, A.Zayonchek, S.Maschenkov (VNIIOkeangeologia)*

Computer Derived Bathymetry Maps in the Northern Eurasian Shelf

Bathymetry data base of the northern Eurasian shelf contains sea-floor depth measurements carried out inthe course of aircraft-supported and ship-borne surveys of the area at scales of 1:1,000,000, 1:2,000,000. These surveys cover nearly entire area of the Russian Arctic shelf seas. Point observation distance varies from 10x10 to 40x40 km. During shipborne suveys the distance between tracklines accoounted for 10-20 km with 3-5 km between points at trackline. Celestial, radiogeodetic and satellite positioning was employed with error in determination of site locations not exceeding +/- 600 m. Sea-floor depths were measured using echo-sounding and seismic observations with an error not exceeding 2% of depth. For initial data processing original software (Korneva, 1994) and AUTOCAD (AUTODESK) were employed.

When calculating bathymetry grids by method of gridding with continuous curvature spline in tensions (Smith & Wessel, 1990), the results were correlated with digital data sets: Terrain Base Global 5-minute Both (NGDC, 1985), New Arctic Bathymetry-Topography (Macnab et al., 1995), GEBCO Digital Atlas (IOC & IHO, 1994); digital analogs of maps: Bathymetry of the Barents and Kara seas (Cherkis et al., 1995).

From calculated grid bathymetry maps of the Russian Arctic shelf seas at a scale of 1:6,000,000 were compiled using software "Potential fields data processing (Blue Vajra Computing, GSC Atlantic, 1994), ER MAPPER (Earth Resource Mapping Pty Ltd., 1995).

Presented bathymetry data significantly supplement the existing knowledge of the

bathymetry of Russian Arctic shelf seas.

13

Gleb B.Udintsev (GEOHI)

Potential Contribution of Vernadsky and Shirshov Institutes of RAS to Compilation of International Digital Bathymetry Data Base for the Arctic Basin

Archiving and digitizing bathymetry data is now underway in a consortium which incorporates sea flor laboratories of several RAS institutions. This provides opportunity for computer access to earlier data from the Arctic region and evaluation of their possible use in compilation of an international digital bathymetry data base (analysis of accuracy of positioning of observation point, depth measurements and other parameters characterizing the quality of available information and its suitability for the purposes of the project).

Recently adopted programs of future investigations in the Russian Arctic seas can provide significant contribution to accumulation of additional modern information relevant to studying the bathymetry and geomorphological mapping of the Arctic basin.

15

M.N.Grishin (MAGE)

Bathymetry Data Base held by MAGE for the Arctic Basin

Since 1972 MAGE has been conducting regular surveys in the Arctic seas: Barents, Kara, Laptev, Spitsbergen shelf, Geological and geophysical observations were always accompanied by bathymetry survey of the sea bottom. Bathymetry survey and positioning were carried out in strict accordance with instructions of GUNiO acting for the time of survey implementation.

As a result of investigations the following data were obtained for the Arctic shelf:

- gravity survey at a scale of 1:1,000,000 with line spacing 10-20 km of virtually entire area of the Barents and Kara seas;
- gravity survey of the southern Barents Sea at a scale 1:200,000 with line spacing 2-3 km;
- regional seismic trackline network in nearly entire Barents Sea and partially Kara and Laptev Sea;
- multidisciplinary geological and geophysical data within the boundaries of State Geological map sheets at a scale 1:1,000,000 (R-35,36; R-37; R-38; S-38; S-39; S-40; T-39,40; S-41,42) including high resolution seismic profiling over the areas with line spacing about 20 km.

  All offshore surveys included continuous echosounding. The root-mean-square error of depth measurements accounts for 1-3% of the measured depth value

depending on the type of applied echosounder. The root-mean-square error of coordinate determination by mid-80-ties accounted for up to +/-800 m, and now is reduced to +/-100 m.

All echosounding data set is stored in form of analog records and partially, in table form with interval between measurements 10-20 min depending on type of geological and geophysical survey. Coordinates are given for the same time intervals.

Given some financial support MAGE could participate in compilation of the international bathymetry digital data base for the Arctic basin and submit all information on bathymetry survey for use in the project on the understanding that reprocessing of the data and their conversion to international data base format will be carried out by MAGE itself, and MAGE will get the copies of final documents of joint work which will duly relfect participation of MAGE's specialists in the project.

16

Martin Jakobsson
Department of Geology and Geochemistry, Stockholm University

Swedish Contribution to the Arctic Bathymetric Data Base

In modern times, the Swedish Polar Secretariat has organized three marine expeditions to the central Arctic Ocean, Y mer-80, Arctic Ocean-91 and Arctic Ocean-96. The expeditions were carried out from Swedish ice-breakers and bathymetric data were collected more or less continuously during all three occasions using convential single-beam echo-sounding equipment.

The data fro Ymer-80 and Arctic Ocean-91 has been deposited at the National Geophysical and Solar-Terrestrial Data Center's (NGDSC) marine geophysical data base. The new bathymetric data collected during the Arctic Ocean-96 expedition show that the details of available published bathymetric charts are largely inaccurate inthe eastern part of the Lomonsov Ridge. For example, the bathymetric map compiled by Perry et al. (1986) indicates a ridge depth between 1000 and 1500 m at about 85 degrees 25 minutes N, 152 degrees E where we recorded a shoal with a minimum depth of 607 m. However, Perry's bathymetric map was used as reference to which the data collected during Arctic Ocean-96 were added. Public-domain data from the US Navy SCICEX program were also merged in order to make an update of the bathymetry in the eastern part of the Lomonsov Ridge between 85 degrees 20 minutes N, 135 degrees E and 87 degrees 40 minutes N, 155 degrees E. The compiled bathymetry suggests a somewhat narrower ridge crest than previously published charts and the minimum depth of 607 m is the shallowest depth of the Lomonosov Ridge recorded (in public domain) in the central Arctic Ocean. However, the bathymetric data are still widely spaced in this area and unknown topographic features are likely present.

17 *K. Crane*

COMPARISONS OF NAVAL RESEARCH LABORATORY AND RUSSIAN BATHYMETRY WITHIN THE BARENTS AND KARA SEAS

In 1996, the Naval Research Laboratory funded the processing of bathymetric data originating from many thousand kilometers of lines of seismic reflection data from USSR sources (V. Gataullin). Contours at 25 m intervals are presented, and compared to contour intervals constructed for the whole Arctic Bathymetry Map produced at the Naval Research Laboratory (N. Cherkis). At the degraded NRL contour interval the fit with the USSR bathymetry is relatively good in the Barents Sea and less so in the Kara Sea. Without doubt, the USSR data have improved the detail coverage in the areas mentioned (see attached figures).

18 *Hans Werner Schenke (AWI)*

Summary of Multi- and Single-Sonarbeam Surveys by RV "Polarstern" in the Arctic

The German ice-breaking research vessel "Polarstern" has been operational since 1983. In general, the operation areas are the Arctic during the northern summer and the Antarctic during the austral summer. "Polarstern" was the first ice-breaking research vessel equipped with the Seabeam multibeam sonar system in order to perform high resolution bathymetric surveys in the ice-covered areas of the polar oceans.

Until 1989 an integrated navigation system with standard dead reckoning systems (Gyro, Doppler Sonar) and Transit Satellite System formed the primary navigation and positioning system.

The Global Positioning System (GPS) in high precision on-line Differential Mode is used since the full satellite constellation has been available. For operations in high latitudes, the ship's heading, which is used for the calculation of the beam co-ordinates, is determined using a multi-antenna ship's attitude measuring system.

In 1989 the Seabeam system on "Polarstern" was replaced by the more powerful Hydrosweep System that uses ice-strengthened transducers. The current Hydrosweep installation provides Sidescan Sonar and Backscatter analysis options, which allow recovery of small scale features at the sea floor. The multibeam data from the Hydrosweep system is used to compile large scale bathymetric charts in scales of 1:100,000 and smaller.

Since the summer 1983 "Polarstern" has carried out 35 cruises into the Arctic region. During 14 Legs multibeam surveys were performed in areas of special scientific interest (Fram Strait, Aegir Ridge) and also during transits. During all other cruises single beam sonar data was collected. However, single beam sonar data collected in the Arctic outside

the special study areas never have been processed or checked for quality.

All data are archived together with navigation and time information.

Due to the low quality of the digitsing unit of the Honeywell-ELAC Narrow Beam Sonar System (NGS) on "Polarstern" the data contain large amounts of outliers and blunders. Thus, for scientific use, a detailed analysis of this data must be performed.

During the workshop detailed information about the technical conditions on "Polarstern" and the bathymetric programs of the Alfred-Wegener-Institut in the Arctic will be presented to the workshop in form of differentiated track plots and small scale bathymetric charts of the study areas.

Valery Gataullin

19 *Research Institute for Marine Geology and Geophysics (NIIMorgeo), Riga, Latvia*

BATHYMETRY OF THE SOUTHEASTERN BARENTS AND SOUTHWESTERN KARA SEA

New contour bathymetric maps for the Barents and Kara Seas (south of 76 degrees N and between 32 degrees - 70 degrees E) have been compiled in NIIMorgeo from mainly shallow seismic and borehole data. Shallow seismic data were acquired largely by analog sparker with record frequency varying from 80-300 Hz to 1-2.5 kHz, as well as by means of echosounding and Parasound records with frequency between 3.5 and 9 kHz. Total length of seismic lines obtained in this area by various FSU organizations (NIIMorgeo, AMIGE, Sojuzmorinzhgeologija", VNIIOkeangeologija, MAGE, PMGRE, VSEGEI, several individual profiles by IO RAS) is close to 100,000 km.

In compilation of the maps, data from more than 300 boreholes drilled by AMIGE and numerous gravity cores have been utilized as both spot observations and constraints on depth conversion of seismic evidence.

Continuous geological cross-sections at a horizontal scale 1:500,000 were constructed along all seismic profiles using 1460 m/s as sound velocity value in water for depth conversion. Next step was to plot these continuous geo-seismic cross-sections on bathymetric work maps and to draw lines of thalwegs and ridges. Only after thisinterpolation of contour lines (isobaths at 25 m interval) was performed with full account of information contained in marine navigation charts, expecially for shallow water. All work maps were compiled in Universal Transverse Mercator (UTM) projection at 1:500,000 scale, then digitized in the Naval Research Laboratory (Washington, DC) and reduced to a smaller scale in the process of plotting.

Compilation of bathymetric maps of the southwestern Kara Sea are as yet only half accomplished. The data base for the Kara Sea is by far less complete and includes only about 15,000-20,000 km of shallow seismic lines and 20 boreholes. On the other hand, some new detailed navigation charts released by CUNiO in 1993-1995 are now available

in public domain and allow to construct additional bathymetric contour maps.

In general, sea floor topography in the eastern Barents Sea is very diverse. In the shallower southeasternmost area the prevailing depths are less than 100m, while in the Central Deep area they exceed 300 m. Between these two areas there is a series of shallow banks (Murmansk, South and North Kanin, Geese Bank, Moller Plato, etc.) separated by narrow deeps. At water depth more than 100-150 m (below the level of wave/storm erosion) the relief displays linear features, directed south- to north-westward from Novaya Zemlya. These features are believed to be caused by moving grounded ice. As opposed to this trend, the banks west of Novaya Zemlya bear transverse elongated lows and highs up to 200-300 km inlength and 100 m in relative relief. The major ridges are subparallel to the Navaya Zemlya coastline and are thought to mark the main stillstand inthe ice-sheet retreat.

No similar features related to ice movement are observed in the south-western Kara Sea. The only exception is the East Novaya Zemlya Trough where strongly marked linear orientation of relief reflects glacial movement along the Novaya Zemlya. The main part of the region, the West Kara Plain, shows chaotically oriented, intensively rugged hummocky relief withintricate, winding patterns of isobaths. The most important uncertainty is the existence of specific short and narrow incisions up to 100-200 m depth.

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APPENDIX 4

Candidate data sets for inclusion in the compilation

(listed in order shown on Day One Agenda)

See end of table for explanation of header terms and institutional acronyms

	COUNTRY	INSTITUTION	DATA LOCALITY	DATA FORMAT	D/A	P/R	STA
1	Russia	GUNIO	Arctic Ocean Basin	Paper charts(points)	A	P	1
2	Canada	GSC/CHS	Baffin Bay, Arctic Archipelago, Arctic continental shelf, Central Arctic Basin	Points, profiles	D	P	1
3	Russia	BUNIO/VNIIO /PMGRE	Central Arctic Basin	Points	D	R	4 3
4	USA	LDEO/USN	Central Arctic Basin	Submarine profiles	D	P	1/2
5	Russia	VNIIO	Central Arctic Basin	Seismic profiles	D/A	R	3
6	Russia	PMGRE	Central Arctic Basin	Seismic profiles	D/A	R	2/3
7	USA	NGDC	Baffin Bay, Norwegian and Greenland Seas, Central Arctic Basin, Alaska coast, Bering Sea	Points, profiles	D	P	1
8	Russia	MMBI	Barents, Norwegian and Greenland Seas, Kara Sea	Contour maps, profiles	A	P	1 2
9	Russia	BUNIO/VNIIO	Central Arctic Basin	Working contour maps	A	R	2
10	USA	NRL	Barents and Kara Seas, Central Arctic Basin	Points, profiles	D	P R	1 2
11	Russia	VNIIO	Eurasian Shelf	Points, profiles, contours	D	R	3
12	Norway	NHS	Barents and Norwegian Seas, Greenland Sea	Single-beam points, contours, grids	D/A	R	4 3

13	Russia	RAS (4 inst'ns)	Norwegian and Greenland Seas, Arctic Shelf	Contour maps, Post 1986	A D	P/R	1 2/3
14	Denmark	RDANH	Greenland Sea, Greenland Shelf	Points	D/A	P	1
15	Russia	MAGE	Barents, Kara, and Laptev Seas, Svalbard	Profiles, points	A	P	3
16	Sweden	Univ Stockholm	Lomonosov Ridge, Central Arctic Basin	Profiles	D	P	2
17	USA	NRL/LDEO	Barents and Kara Seas	Points, contours	D	R	2
18	Germany	AWI	Fram Strait, Greenland Sea, Arctic Basin, Laptev Sea	Multibeam Single-beam	D	P	2
19	FSU	NIIM	Barents and Kara Seas	Contour maps	D	R	2/3

Table Headers

D/A Digital/Analog

P/R Public/Restricted

STA Status of data in terms of availability, e.g.

1: immediately available

2: work in progress (available in <1 year)

3: available after permission granted for release

4: available with restrictions

Institutional Acronyms

AWI	Alfred Wegener Institute; Bremerhaven, Germany
CHS	Canadian Hydrographic Service; Ottawa ON and Dartmouth NS, Canada
GSC	Geological Survey of Canada; Dartmouth NS, Canada
GUNIO	Head Department of Navigation and Oceanography, Russian Federation Navy; St. Petersburg, Russia
LDEO	Lamont-Doherty Earth Observatory; Palisades NY, USA
MAGE	Murmansk Arctic Geology Expedition; Murmansk, Russia
MMBI	Murmansk Marine Biological Institute; Murmansk, Russia
NGDC	National Geophysical Data Center; Boulder CO, USA
NHS	Norwegian Hydrographic Service; Stavanger, Norway
NIIM	Research Institute for Marine Geology and Geophysics; Riga, Latvia
NRL	Naval Research laboratory; Washington DC, USA
PMGRE	Polar Marine Geosurvey Expedition; Lomonosov, Russia
RAS	Russian Academy of Sciences; Moscow, Russia
RDANH	Royal Danish Administration of Navigation and Hydrography; Copenhagen, Denmark

USN	United States Navy; Washington DC, USA
VNIIO	Institute for Mineral Geology and Resources of the Ocean; St. Petersbury, Russia

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APPENDIX 5

SECOND DAY - ROUND TABLE DISCUSSION OF TECHNICAL AND ORGANIZATIONAL ISSUES (9:00 - 17:00 hrs)

(POINT AGENDA)

PROJECT GOAL AND OBJECTIVES

- Brief review, in light of information presented the previous day

SOFTWARE AND ANCILLARY DATA

- Standard processing software and methods:

  can all or most participants use a common set of tools?

- Standard coastline and continental topography:

  which data sets are most appropriate for mapmaking purposes?

- Sound velocity profiles:

  are these available for restoring soundings to original form of measurement (ie two-way time)?

DATA ACCESS ISSUES

- Which data sets are presently available for the project?
- What form are they in - digital or analog, original or gridded?

DATA TREATMENT AND DIVISION OF LABOR

- Treatment of national data sets:

  will owners of national data sets do their own processing?

- Treatment of public-domain data sets:

  how will public-domain data be merged with national data sets?
  how can this be shared?

- Merging of different national and public-domain data sets:

  how will this be accomplished?

- What will be the form of the products?

LOGISTICS

- Funding and support prospects:

  what are participants' funding and infrastructure needs?
  can participants obtain support from their government or institution?

- Project timetable:

  validation of bathymetry tracks
  merging of data sets
  creation of products for distribution
  proposals for exchange visits

- Data products and distribution:

  in what form will digital and map products be released?
  how can the entire process be documented effectively?
  what services can data centres provide?

THE FUTURE

- Next Workshop:

  purpose
  where and when?
  prospects for funding support

- Prospects for long-term follow-up action:

  maintaining the data base as new observations become available
  who will assume the responsibility?

- IASC Project Group:

  nominations for membership in the Project Group

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APPENDIX 6

Nominations to the proposed IASC Project Group for Arctic Bathymetry

Country	*Institution/Organization*	*Nominee*
Canada	Geological Survey of Canada (Atlantic)	Ron Mcnab*
Denmark		To follow
Germany	Alfred Wegener Institute	Hans-Werner Schenke
Norway		To follow
Russia	GUNIO	Valery D. Fomchenko
Russia	VNIIOkeangeologia	Garrik E. Grikurov
Russia	VNIIOkeangeologia	Sergei P. Maschenkov
Sweden	University of Stockholm	Martin Jakobsson**
USA	Lamont-Doherty Earth Observatory	Bernard Coakley
USA	Naval Research Laboratory	Norman Cherkis

* also nominated as Project Group Chairman

** nomination received September 25

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APPENDIX 7

Workshop Participants

Amended October 8, 1997

Country	*Affiliation*	*Individual*	*E-mail*	*Tel*	*Fax*
	EMaPS	Carol Williams	cwilliams at esf.org	+33 8876 7145	+33 8837 0532
	IOC	Dmitry Travin	d.travin at unesco.org	+33 1 4568 4044	+33 1 4568 5812
Canada	GSC	Ron Macnab	macnab at agc.bio.ns.ca	+1(902)426-5687	+1(902)426-6152
Denmark	RDANH	Arne Nielsen	arn at fomfrv.dk	+45 3268 9500	+45 3154 1012
Denmark	RDANH	John Wodward	jjw at fomfrv.dk	+45 3268 9500	+45 3154 1012
Latvia	NIIM	Valery Gataullin	gtln at russcl.edu.lv		
Norway	NHS	Gerhard Heggebo	heggebo at sjo.statkart.no	+47 5156 8700	+47 5156 3740
Norway	NHS	Ole Kvamme	kvamme at sjo.statkart.no	+47 5156 8700	+47 5156 3740
Russia	GUNIO	Valery Fomchenko		+7(812)277 8410	+7(812)213 6377
Russia	GUNIO	Anatoly A. Komaritsyn		+7(812)277 8410	+7(812)213 6377
Russia	MAGE	Mikhail Grishin		+47 789 10469	+47 789 10469
Russia	MNR	Yuri Sorokin	more at rosnedra.msk.ru	+7(095)254 7500	+7(095)254 3361
Russia	PMGRE	Vladimir Kruykov	sorm at adm.polarex.spb.ru	+7(812)422 1282	+7(812)423 1900
Russia	PMGRE	Mikhail Sorokin	sorm at adm.polarex.spb.ru	+7(812)422 0494	+7(812)423 1900
Russia	PMGRE	Yuri Zamansky		+7(812)423 1501	+7(812)423 1900
Russia	RAS(MMBI)	G.A. Tarasov	mmbi at mun.rospac.ru	+7(812)523 0032	+47 789 10288
Russia	RAS(VI)	Gleb Udintsev	vernadsky at glas.apc.org	+7(095)137 8648	+7(095)938 2054
Russia	VNIIO	Sergei Andrianov	sand at vniio.nw.ru	+7(812)210 9454	+7(812)114 2088
Russia	VNIIO	Elena Bocharova	boch at vniio.nw.ru	+7(812)210 9454	+7(812)114 2088
Russia	VNIIO	Anatoly Bursky	Bursky at g-ocean.spb.su	+7(812)114 5941	+7(812)114 1470

Russia	VNIIO	Elena Daniel	dani at vniio.nw.ru	+7(812)210 9454	+7(812)114 2088
Russia	VNIIO	Igor S. Gramberg	garrik at g-ocean.spb.su	+7(812)113 8379	+7(812)114 1470
Russia	VNIIO	Garrik Grikurov	garrik at g-ocean.spb.su	+7(812)114 3113	+7(812)114 1470
Russia	VNIIO	Valery Kaminsky	kamin at g-ocean.spb.su	+7(812)219 5318	+7(812)114 1470
Russia	VNIIO	Sergei Maschenkov	mascha at vniio.nw.ru	+7(812)114 5892	+7(812)114 2088
Russia	VNIIO	Elena Miloradovskaya	helen at g-ocean.spb.su	+7(812)1143113	+7(812)114 1470
Russia	VNIIO	Yevgeny Musatov	vniio at g-ocean.spb.su	+7(812)114 4042	+7(812)114 1470
Russia	VNIIO	Victor Poselov	vap at vniio.nw.ru	+7(812)114 2470	+7(812)114 2088
Russia	VNIIO	German Naryshkin	vniio at g-ocean.spb.su	+7(812)210 9470	+7(812)114 1470
Russia	VNIIO	Andrei Zayonchek	andrew at g-ocean.spb.su	+7(812)210 9454	+7(812)114 2088
Sweden	U Stockholm	Martin Jakobsson	martin.jakobsson at geo.su.se	+46 8 164732	+46 8 345808
USA	LDEO	Bernard Coakley	bjc at lamont.ldgo.columbia.edu	+1(914)365-8552	+1(914)365-8156
USA	NGDC	Troy Holcombe	Troy.L.Holcombe at noaa.gov	+1(303)497-6390	+1(303)497-6513
USA	NRL	Norman Cherkis	cherkis at qur.nrl.navy.mil	+1(202)404-1103	+1(202)767-0167
USA	NRL	Kathy Crane	kathyc at qur.nrl.navy.mil	+1(202)404-1107	+1(202)767-0167
USA	U Alaska	G. Leonard Johnson	gljgergl at aol.com	+1(301)464-6724	+1(301)286-0240

Postal addresses (note that in some cases, personal and not institutional addresses are listed)

AWI
Alfred Wegener Institut fur Polar under Meeresforschung
Postfach 120161
D-27515 Bremerhaven
Germany

EMaPS
Eurpean Boards for Marine and Polar Sciences
1 quai Lezay-Marnesia
67080 Strasbourg Cedex
France

GSC	Geological Survey of Canada P.O. Box 1006 Dartmouth NS B2Y 4A2 Canada
GUNIO	Head Department of Navigation and Oceanography Russian Federation Navy 8,11 Liniya, B-34 199034 St. Petersburg Russia
IOC	Intergovernmental Oceanographic Commission UNESCO-IOC 1 rue Miollis 75732 paris Cedex 15 France
LDEO	Lamont-Doherty Earth Observatory 107 Oceanography Palisades NY 10964 USA
MAGE	Murmansk Arctic Geological Expedition 26 S. Perovsky St. Murmansk 183012 Russia
MNR	Ministry of Natural Resources 4/6 Bolshoya Gruzinskaya Moscow 123812 Russia
NGDC	National Geophysical Data Center NOAA E/GC3 325 Broadway Boulder CO 80303 USA
NHS	Norwegian Hydrographic Service Statens Sjokartverk PO Box 60 4001 Stavanger Norway
NIIM	Reearch Institute for Marine Geology and Geophysics Brivibas 308-14 (*personal*) Riga, LV-1006 Latvia

NRL	Naval Research Laboratory 4555 Overlook Avenue, SW Washington DC 20375-5320 USA
PMGRE	Polar Marine Geosurvey Expedition 24 Pobeda Street St. Petersburg - Lomonosov 189510 Russia
RAS(MMBI)	Russian Academny of Sciences Murmansk Marine Biological Institute 17, ulitsa Vladimirskaya Dalnie Zalentsy 183023 Murmansk Region Russia
RAS (VI)	Russian Academy of Sciences Vernadsky Institute of Geochemistry 19 Kosygina Street 117975 Moscow Russia
RDANH	Royal Danish Administration of Navigation and Hydrography Farvandsvaesenet Overgaden o. Vandet 62B DK-1023 Kobenhavn K Denmark
U Alaska	7708 Lake Glen Drive (*personal*) Glenn Dale MD 20769 USA
U Stockholm	Department of Geology and Geochemistry Stockholm University S-10691 Stockholm Sweden
VNIIO	Institute for Geology and Mineral Resources of the Ocean 1 Anglisky Avenue St. Petersburg 190121 Russia

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APPENDIX

Proposed Data Specification for Arctic Bathymetric Compilation

This Appendix suggests a data format for contributions of bathymetric observations.

A data set from each cruise or expedition (e.g. ice island) should be stored in its own ASCII file. The file should be assigned a six-character file name that identifies both the platform (Oden, Polarstern...) and the year of acquisition (e.g. Oden96.dat; Prst95.dat). Each data point should appear in the file in time sequential order, occupying one line in the file in the following format:

Timetag Longitude Latitude Depth

The Timetag should be of the form: yyyy+ddd:hh:mm:ss where yyyy is the year of acquisition. The date is indicated by the Julian day ddd, which ranges from 001 to 365 or 366. The time hh:mm:ss ranges from 00:00:00 to 23:59:59. Longitude should be geodetic (0 degrees to 360 degrees increasing in the easterly direction), Latitude should range from 60 degrees N to 90 degrees N; each position coordinate should be reported to the full precision that can be attributed to the navigation source. Depth should be reported in metres.

To assist with qualification and documentation of the compilation, contributors are requested to provide certain collateral information with each data set. This additional information will ensure that data sets are properly attributed; it will also comprise a heritage that can be used to eliminate redundant measurements, to assess the quality of the data, and to represent and rescale data in a uniform manner for crossover analysis and error identification.

Accordingly, for each data set contributors are requested to prepare a supplemental file which uses a similar six character descriptor (e.g. Oden96.doc or Prst95.doc) and which contains: the type and estimated accuracy of navigation; the sound velocity that was used to convert two-way acoustic travel time to depth; a summary of post-cruise processing (including the application of sound velocity corrections); a listing of any known defects or errors.

Compiling the Arctic bathymetry will be a major undertaking, but the availability of supplemental files will simplify the processes of evaluating and integrating the many and diverse data sets that are anticipated. The accumulated documentary information will be included as part of the final data release to assist investigators who might wish to work with this data in the future.

Data may be forwarded on digital media to one of the following addresses, or alternatively by direct transfer via the Internet to a subdirectory in one of the Anonymous FTP accounts shown below (in which case contributors should also alert recipients of the transfer):

Ron Macnab
Geological Survey of Canada
PO Box 1006
Dartmouth NS, B2Y 4A2 Canada

Tel: (902)426-5687
Fax: (902)426-6152
E-mail: (macnab@agc.bio.ns.ca)
Anonymous FTP account:
agc.bio.ns.ca
subdir /pub/macnab

Bernard Coakley
Lamont-Doherty Earth Observatory
107 Oceanography
Palisades NY, 10964-8000 USA

Tel: (914)365-8552
Fax: (914)365-8156
E-mail: (bjc@ldeo.columbia.edu)

Anonymous FTP account:
lamont.ldeo.columbia.edu
subdir /home/ftp/pub/BBC