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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of Unesco)

INTERNATIONAL HYDROGRAPHIC ORGANIZATION

Seventh Meeting of the GEBCO Sub-Committee on Digital Bathymetry

Alfred-Wegener-Institut, Bremerhaven

28 - 30 May 1990

SUMMARY REPORT

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ANNEXES

1. OPENING OF THE MEETING

1 The Chairman, Dr. Meirion T. Jones, opened the meeting at 10.00 on Monday, 28th May 1990, at the Alfred-Wegener-Institut, Bremerhaven. Participants were welcomed by Dr. Dieter Fuetterer on behalf of the Director AWI, Dr. Gotthilf Hempel.

2 A List of Participants is given in Annex II. Apologies for absence were received from Mr. Peter Hunter, Mr. Shin Tani and Mr. Denis Toustou.

2. ADOPTION OF THE AGENDA

3 The Agenda was adopted without alteration (see Annex I).

3. ARRANGEMENTS FOR THE MEETING: DOCUMENTATION

4 The following documents were tabled for the consideration of the meeting:

* Project proposal in support of the GEBCO Digital Atlas from the NERC Marine and Atmospheric Sciences Directorate
* Stable transparencies of GEBCO sheets 5.01 and 5.02 as digitized by HDNO, Leningrad
* Screen dump of GEBCO sheet 5.05 as digitized by BGI, Toulouse
* IHO Circular Letter 1/1990 - A Proposal for Creating an IHO Data Centre for Digital Bathymetry
* Summary of the replies of IHO Member States to IHO Circular Letter 1/1990
* IHO Letter S3/2516 on the Terms of Reference of the IHO Working Group on Oceanic Plotting Sheets
* Draft specification for a DBASE-III file to support the IHO/IOC Gazetteer of Geographic Names of Undersea Features at the IHB
* Information note on a PC-compatible disc of the IHO/IOC Gazetteer of Geographic Names of Undersea Features as reformatted by BODC
* Study Reports for the Digital Chart of the World
* Comparative plot of the coastline of the Antarctic Peninsula from the World Vector Shoreline and the GEBCO (5th Edition)
* Summary of the digital bathymetric data incorporated into the NGDC Underway Geophysics Data Bank in the period 12 May 1989 to 23 May 1990
* Brochure on Multibeam Survey Maps available from the NOS, Washington
* Provisional Report on the Status and Plan of Action of the 'Circum-Atlantic Project' - dated January 1990
* Draft Bathymetric Chart of the Barents and Kara Seas prepared by Mr. N.Z. Cherkis, US Naval Research Laboratory

4. REVIEW OF RELATED ACTIVITIES OF OTHER INTERNATIONAL AND NATIONAL GROUPS

4.1 IHO COMMITTEE ON EXCHANGE OF DIGITAL DATA (CEDD)

5 Mr. Donald E. Pryor reviewed the activities of CEDD, which continued to collaborate with the IHO Committee on ECDIS (Electronic Chart Display and Information Systems) as well as the International Maritime Organization (IMO) and the Radio Technical Commission for Marine Services (RTCM) in matters of digital hydrographic data exchange.

6 The proposed format for these purposes was being termed "DX-90", and a draft version of this format was expected to be given provisional status by CEDD at its next meeting in November 1990. It was intended to publish the format's specification as an appendix to IHO Special Publication 52, "Specification for ECDIS", along with two other appendices on feature coding (IHO object catalogue) and updating the electronic chart.

7 Mr. Pryor explained that the work of CEDD was primarily aimed at the exchange of nautical chart data rather than source data obtained from surveys. Due to the difference in information content there was little overlap between the work of the Sub-Committee and CEDD, although the technical procedures for exchange of digital data were of common interest. In this area one notable aspect of the proposed CEDD format was its use of ISO 8211 to provide a "self-describing" capability through the use of a standardized data dictionary. It was noted that the format was geared primarily for data exchange on magnetic tape and disks rather than over telecommunication networks.

4.2 IUGS CIRCUM-ATLANTIC PROJECT (CAP)

8 The Chairman reported that he had spoken with Dr. Terry Edgar whose position as Secretary of the CAP Steering Group had been taken over recently by Dr. Paul Teleki at USGS, Reston, Virginia. Four regional working groups had been set up for CAP with chairmen as follows:

Western North Atlantic W.G.	-	Dr. Kim Klitgord, USGS, Woods Hole
Eastern North Atlantic W.G.	-	M. Claude Salle, Institut Francais du Petrole
Western South Atlantic W.G.	-	Mr. Jose de Andrade Ramos, Federal University of Rio de Janeiro
Eastern South Atlantic W.G.	-	Prof. Cornelius Kogbe, Geoscience Consulting Associates, Paris

9 The entire Atlantic Basin would be displayed on CAP compilations on single sheet maps at 1:17 million scale (Lambert Azimuthal Equal Area projection) and on four sheets at 1:10 million scale (Lambert Conformal projection). CAP had decided to use GEBCO bathymetry as the base for both scales and were keen to have final versions of the GEBCO (5th Edition) digitized contours as soon as possible, recognizing that there may be some delay in the provision of GEBCO Sheet 5.12. It was understood that the pre-release digital versions of Sheets 5.01, 5.04 and 5.08 provided to CAP by BODC had been successfully read at Woods Hole.

10 In order to meet the needs of CAP the meeting agreed that, in scheduling further work on digitizing the GEBCO (5th Edition), priority would be given to finalizing the contours on the Atlantic Sheets and to commencing digitization of the trackline control on these sheets.

4.3 IOC INTERNATIONAL BATHYMETRIC CHART OF THE MEDITERRANEAN (IBCM)

11 The Chairman reported that he had received a magnetic tape of the digitized contours of the IBCM, prepared by HDNO, Leningrad, and would be evaluating it shortly with a view to including its contents in the GEBCO Digital Atlas in place of the earlier digitization by the Petroconsultants company. It was understood that the HDNO digitization also included land contours in addition to bathymetry and coastlines.

12 Dr. Viktor Sedov informed the meeting of plans to produce a gridded version of the IBCM by the end of 1990, at a fixed grid size of 0.25 miles. This work was being carried out jointly by Dr. John Hall of the Geological Survey of Israel, and Professor Jannis Makris of the Institute of Geophysics, Hamburg.

13 Dr. Sedov further stated that a gravity anomaly chart of the Mediterranean was printed last year and that a seismicity chart was planned for this year. The next charts would cover bottom sediment type and magnetic anomalies, and were likely to be accompanied by digital versions. The next edition of the IBCM was scheduled for 1995 and would be based on improved data coverage, including multibeam surveys. Soundings sheets would be compiled at 1:250,000 scale, with responsibility for specific areas being undertaken by France, Greece, Italy, Spain, Turkey, UK and USSR. The revised bathymetry would be collated, edited and printed in Leningrad at a scale of 1:1,000,000.

4.4 OTHER IOC REGIONAL OCEAN MAPPING PROJECTS

14 Dr. Sedov reported on the status of the various IOC Regional Ocean Mapping Projects and stressed the need for a close link between these Projects and the Sub-Committee - not only was the Sub-Committee a source of valuable expertise in the use of digital techniques to the Editorial Boards of the Projects but, in return, the Projects would be a source of high quality regional bathymetric maps suitable for incorporation into the GEBCO Digital Atlas. These maps would have the added advantage of being at the larger scale of 1:1,000,000 compared with the 1:10,000,000 scale of the GEBCO (5th Edition).

15 The meeting fully supported the need for close links with the Regional Ocean Mapping Projects, and suggested that the GEBCO Bathymetric Editor, Mr. Peter Hunter, should be responsible for developing such links directly with the respective Editorial Boards. It was also suggested that a representative from each of the Editorial Boards be invited to forthcoming meetings of the Sub-Committee. In addition to the well established IBCM, three further International Bathymetric Charts were under development (see Annex III for coverage):

16 IBCCA (Caribbean Sea and Gulf of Mexico), with Dr. Nestor Duch Gary (Mexico) as Chief Editor, would consist of 17 sheets at a scale of 1:1 million. Four had already been compiled and it was planned to have nine sheets printed by 1992.

17 IBCEA (Central Eastern Atlantic), with Ing. Gen. Andre Roubertou (France) as Chief Editor, would comprise 12 sheets at 1:1 million - five to be printed in Portugal and seven in France by SHOM. It was anticipated that, by the time of printing, the contour vectors would be available in digital form. It was planned that Portugal would print 1 sheet/year and France 2 sheets/year.

18 IBCWIO (Central Western Indian Ocean) would include 18 sheets at 1:1 million to be compiled, edited and printed in Germany with Dr. Werner Bettac as Chief Editor. Details of the planning and time scales for the sheets would be discussed at the next meeting of the Editorial Board in July 1990.

19 A Group of Experts to discuss the possibility of creating an International Bathymetric Chart of the Western Pacific (IBCWP) was being convened in China in June 1990.

4.5 ICA AD-HOC COMMISSION ON MARINE CARTOGRAPHY

20 The Chairman reported that he continued to liaise with Mr. Ron Linton, the Chairman of the International Cartographic Association's Commission on Marine Cartography, and to receive copies of the Commission's Newsletter. The Commission held a meeting during the ICA Conference in Budapest in August 1989, and items discussed included a) the Review of Yachting and Small Boat Charts, b) a proposed reference book on 'Advances in Marine Cartography' to be published by Elsevier Science Press, c) a proposal by Dr. Matyas Marton to prepare a 'Multi-lingual Gazetteer of Undersea Features', and d) the planned Commission Seminar to be held in Darwin on 29 April 1990 immediately prior to the Australian Institute of Cartographers 8th. Conference.

4.6 COMMISSION OF TIIE EUROPEAN COMMUNITIES (CEC)

21 The Chairman reported that the Commission of European Communities was considering what steps should be taken to improve the management and availability of oceanographic data on a European scale. Particular attention was being given to the assembly of quality controlled regional datasets and, in this context, priority was likely to be given to the development of a digital terrain model of the continental shelf areas around Europe - it being recognized that the GEBCO and IBCM communities were well advanced in establishing the bathymetry in deeper waters. It was anticipated that a DTM of the European continental shelf would usefully complement the GEBCO Digital Atlas. The Chairman stated that considerable volumes of bathymetric data were available to support the creation of such a DTM, as illustrated by the sounding data collected in the UK area by the British Geological Survey (see Annex IV) - these data had already been supplied to BODC in digital form.

4.7 SOPAC

22 The Chairman reported that he had received a magnetic tape from Dr. Yves Morel of SOPAC containing the digitized bathymetric contours from the CCOP-SOPAC Bathymetric Chart of the South West Pacific covering the area from 40° S. to 5° N. and from 140° E. to 155° W. Unfortunately, an evaluation of this data set had shown up many errors in the digitization which had been reported back to Dr. Morel.

4.8 SERVICE IIYDROGRAPIIIQUE ET OCEANOGRAPIIIQUE DE LA MARINE (SIIOM), FRANCE

23 Ing. en Chef Jean Laporte recalled that when, about two decades ago, SHOM started to build up its digital bathymetric database, it was primarily geared to providing the cartographer with quality controlled data in areas relevant to French interests. It was also used for handling more conveniently the growing input of soundings in the French areas of responsibility for GEBCO Oceanic Plotting Sheets in the Pacific and the North East Atlantic. In the process, SHOM experienced difficulties in assimilating data from certain organisations and had to make decisions concerning:

a) sampling of data - this was now donc automatically along a sounding track so as to selcct data at every 2 to 5mm at a scale of 1:250,000

b) data quality - two staff were engaged, full time, cleaning up erroneous data from the data base, identified through analysis in conjunction with neighbouring data

24 It was planned that the database would eventually find its place in the GIS system that SHOM intended to develop during the next few years. At present, for the French GEBCO area of responsibility, all sounding data held by SHOM in the Pacific had been digitized and validated, with a corresponding figure of 80% for their North East Atlantic sheets.

25 Ing. en Chef Laporte stated that SHOM no longer published bathymetric charts in conventional form but used its digital database to automatically generate maps as and when required (see sample in Annex V). In the process the data were double sampled (each depth being given a radius of 'influence' of 0.4cm and then 1.5cm), with isolines computed by triangulation, and significant depths selected out for display on the output plot. Different colours and line thicknesses were used on the output plot to aid contour identification. Gridded data sets could also be produced if required.

4.9 ALFRED-WEGENER-INSTITUT (AWI), BREMERIIAVEN

26 Dr. Hans-Werner Schenke reported continued progress at AWI, both in detailed bathymetric mapping of the Weddell Sea and in researching new techniques for manipulating digital data (see items 5.3 and 7.2). The CARIS and HIFI88 packages were now installed and being used at AWI. At present they were finding the BLUEPAK package to be rather slow for their requirements, but would be investigating it further.

27 Dr. Schenke stated that AWI had now surveyed much of the southern part of the Weddell Sea by multibeam echosounder from R/V 'Polarstern' (see Annex VI). Considerable effort was now required to work these data up into appropriate mapping products, although good progress was being made in compiling new bathymetric maps for GEBCO Plotting Sheets 553, 554 and 568 i.e. the area between 25° W. and 25° E. and from 66° to 78° S. This work would form a base for updating the southern half of GEBCO Sheet 5.16 and its extension into Sheet 5.18. As a complement to this a revised coastline was being defined between the Antarctic Peninsula and 30° E. using LANDSAT imagery. It would be released in digital form and had an estimated accuracy of 100m.

4.10 DEUTSCHES HYDROGRAPHISCHES INSTITUT (DHI), HAMBURG
(from 1 July 1990 renamed as: Bundesamt fur Seeschiffahrt und Hydrographie (BSH))

28 Dr. Horst Hecht reported that DHI had little experience in the field of digital bathymetry except for shallow water survey data. A national working group consisting of the DHI, University of Hannover, and other surveying authorities had been set up to work on a DTM for the German coastal zone in the North Sea. Recently, at the request of DHI, these activities had been expanded to include the whole of the German EEZ. It was hoped that this group would provide a platform for contributing to the proposed CEC project for creating a DTM of the European continental shelf (see item 4.6).

29 Little activity had taken place in recent years in maintaining the GEBCO Oceanic Plotting Sheets in the northern N.E. Atlantic for which DHI had assumed responsibility as a VHO. Virtually no new data had been received for this area since 1984 - this was a reflection of both the increased use of digital techniques and the increased resolution of data, particularly from multibeam echosounding systems. It did not appear to be a particularly meaningful exercise to reduce and maintain these data on hard copy sheets. Dr. Hecht stated that the soundings for a number of Meteor cruises (up to 1984) had been digitised by the US Naval Research Laboratory and were available for exchange.

30 Dr. Hecht reported that the DHI, as the national hydrographic service, was planning to establish a national bathymetric data centre to provide a centralised archival, referral and exchange service for digital bathymetric data collected by German laboratories, particularly the research institutions. He was hopeful that this would provide a mechanism for ensuring a regular supply of German bathymetric data for international exchange, particularly through the GEBCO system and the IHO Data Centre for Digital Bathymetry.

4.11 UK HYDROGRAPHIC OFFICE, TAUNTON

31 Mr. Brian Harper reviewed activities at the UK Hydrographic Office in support of GEBCO and highlighted the growing problems in maintaining the GEBCO Oceanic Plotting Sheets using both analogue and digital data. The UK HO had been developing a system to convert incoming analogue data (particularly from Royal Navy ships) into digital form. The whole of GEBCO Oceanic Plotting Sheet 345 in the Indian Ocean had been digitized as a trial using a digitizing table cursor to pick up the coordinates of each sounding and 'voice over' input to record the depth value. A software package to convert IFF to MGD77 format was awaited.

32 Mr. Harper stated that the UK HO continued to gather and maintain bathymetric data in its VHO areas of responsibility, and made particular use of IHO publication BP-0004 as a mechanism for tracking and supplying data. He was particularly pleased to report the excellent service provided to UK HO by the National Geophysical Data Center (NGDC), Boulder, in the supply of digital data. The UK HO now used these data on a routine basis in the preparation of nautical charts.

33 Over the past year the UK HO had provided assistance to the Chief Editor of the IBCWIO Project by supplying sounding data on Oceanic Plotting Sheets, and processing digital data provided by NGDC, Boulder. Other assistance had been given to Mr. Carl Brenner for his revision of the southern part of GEBCO Sheet 5.12.

4.12 DEFENSE MAPPING AGENCY - DIGITAL CHART OF THE WORLD (DCW)

34 Mr. Pryor provided a progress report on the Digital Chart of the World being developed by the Environmental Systems Research Institute (ESRI) of Redlands, CA, under contract to the US Defense Mapping Agency. The DCW project would prepare a digital GIS database for the entire world, selected from data symbolized on the 1:1,000,000 scale Operational Navigation Charts (ONCs). Approximately 10 gigabytes of data would be arranged in a topologically-based vector structure on 20-30 CD-ROMs.

35 As part of the construction of the database, a set of standards for gathering, processing and transferring the available ONC source data onto the DCW were being developed. This development was being planned as a series of four prototype studies covering the selected geographic areas shown in Annex VII. The second of these prototypes was released for evaluation in April 1990. Although, the first prototype was based on ESRI's ARC-INFO system, it was not envisaged that the ARC-INFO format would be part of the final product. Reports had been produced on several aspects of the initial studies for the project including:

Initial Elevation Data Study February 1990

Initial Data Storage Structure Study April 1990

Prototype 2 Evaluation Documentation April 1990

36 The ONCs essentially contain land based information and do not include bathymetry. However, in order to test the suitability of the proposed system design for more general usage, the prototypes would also include depth contours from nautical charts produced by NOS and the UK HO. From initial studies it seemed likely that the land elevation data in DCW would be stored as contour vectors rather than in gridded form.

4.13 NATIONAL OCEAN SERVICE (NOS), WASHINGTON

37 Mr. Pryor reported on bathymetric work at NOS which, although concentrating primarily on the U.S. Exclusive Economic Zone, also included work with other NOAA activities in ridge-crest areas and in the Antarctic. A total of five multibeam survey systems were being used with the work currently concentrated in the Gulf of Mexico, the Gulf of Alaska, and off California, Washington, and Oregon. The latest system, a Hydrochart II sonar with new data acquisition and processing equipment and software, was installed on the NOAA Ship 'Whiting' in the spring of 1989.

38 Mr. Pryor described the Multibeam Survey Maps being produced by NOS for the U.S. EEZ. Each map was based on fully overlapped multibeam echosounding and covered an area of 1/2 degree of latitude by one degree of longitude. In general multibeam data were only collected in areas of depths greater than 100m. The data were digitally processed onto a 250m interval fixed grid from which the contours were generated automatically, together with negatives for printing. The maps were printed at a scale of 1:100,000 on a UTM projection with a 20m contour interval. In addition to the printed map, the 250m gridded data were also available on floppy disc - each map being released on a single MS-DOS compatible, high density 5.25 inch disk.

39 By way of demonstration Mr. Pryor presented the Chairman with the Monterey Canyon map and its grid of soundings on floppy disk. He explained that this was the first map in the series, and that to date a total of 7 maps had been issued together with their gridded data sets. A further 22 maps were available in blueprint form. Gridded data for the Monterey Bay area off California had also been included on a CD-ROM along with other earth-surface data including GLORIA and LANDSAT imagery, geodetic data and terrestrial digital line graph (DLG) and digital elevation model (DEM) data.

40 Mr. Pryor reported that a group of scientists from U.S. academic institutions had begun work towards adopting a common format for seafloor swath-mapping data including full-resolution data. The aim was to accommodate data from the many varieties of swath mapping systems and to provide easy network access to the data bases. A draft version of the desired information content had already been prepared. Use of NetCDF (Network Common Data Format, public domain

software developed by the Unidata Program Center at the University Corporation for Atmospheric Research) was being considered as a possibility for network transfer. Version 1.05 of a NetCDF User's Guide by Russell Rew (January 1990) was now available from the Unidata Program Center, Boulder, Colorado.

4.14 NAVAL RESEARCH LABORATORY, WASHINGTON

41 Mr. Norman Z. Cherkis reported that, since the last meeting, his Bathymetric Chart of the South Atlantic had been published by the Geological Society of America at a scale of 1:5,737,447. The chart extended from South America to the African continent in the latitude range from 3° S. to 40° S., with depth contours at intervals of 200m expressed in uncorrected metres at an assumed sound velocity of 1500m/s. Work was now in hand modifying and extending the chart for eventual publication of a revised GEBCO Sheet 5.12, although progress to date had been slow due to lack of funding.

42 Mr. Cherkis further informed the meeting that NRL had just completed compilation of a new bathymetric chart, **'Bathymetry of the Barents and Kara Seas'** covering the area 68° to 82° N. and 0° to 80° E. with depth contours at 50m intervals expressed in uncorrected metres at 1500m/s. The project was being driven by a) the need for accurate bathymetry in the area, and b) NRL's intention to revise and enlarge the coverage area of its 1980 product **'Bathymetry of the Norwegian, Greenland and Western Barents Seas'**. The projected date for completion of the new product was late 1991/early 1992. NRL planned to produce digital contours of both products, the first by October 1990 at which time the Barents and Kara Seas chart would be submitted to the Geological Society of America for publication in their map and chart series.

4.15 US NAVAL OCEANOGRAPHIC OFFICE

43 Mr. Francis L. Marchant reported that resources were not available at present to update the DBDB5 product, although he was hopeful that if, in the future, modern scanning digitizers became available then time might be found to update those areas most in need of revision.

5. DIGITIZATION OF THE GEBCO (5TH EDITION)

5.1 PROGRESS REPORT FROM THE BUREAU GRAVIMETRIQUE INTERNATIONAL (BGI)

44 The Chairman stated that, following the last meeting, he had received a magnetic tape from BGI containing the digitized contours from Arctic Sheet 5.17. Unfortunately, he had been unable to check out the data, although with the recent recruitment at BODC he was hopeful that this task would be carried out shortly.

45 The Chairman was pleased to report that, with manpower provided by IGN, BGI had been able to restart their GEBCO digitizing work in early 1990, and that immediately preceding the meeting he had received a magnetic tape from Mr. Denis Toustou containing digitized bathymetric contours for Sheet 5.05 in the northern Indian Ocean. Mr. Toustou had informed him that BGI was planning to digitize Sheet 5.09 before the end of 1990.

5.2 PROGRESS REPORT FROM THE HEAD DEPARTMENT OF NAVIGATION AND OCEANOGRAPHY (HDNO), LENINGRAD

46 Mr. Andrey Popov reported that, over the past year, HDNO had carried out a full digitization of all the information on Sheet 5.02. This data had been transferred onto magnetic tape in GF3.2 format, and Mr. Popov presented a copy of the tape to the Chairman for evaluation. The tape included files with the following digitized data: i) bathymetric contours, ii) ship's tracklines and spot points, iii) spot depths, iv) land contours, v) rivers, rapids and waterfalls, vi) lakes and reservoirs, vii) centres of population, viii) geographic names on land, and ix) geographic names of underwater features.

47 Mr. Popov stated that, except for the ships' tracks and geographic names which had been manually digitized, the information on Sheet 5.02 was digitized using an automatic scanner. Following digitization, all the data were plotted out on high stability plastic (to within 0.1mm), and then overlain on the source sheets. All discrepancies of greater than 0.3mm were redigitized. Mr. Popov estimated that all data on the final tape were accurate to within 0.4mm.

48 Mr. Popov reported that HDNO had also completed the digitization of the ships' tracks on GEBCO Sheet 5.01, and presented a copy to the Chairman on magnetic tape for evaluation.

49 The HDNO had found that, by fully digitizing Sheet 5.02, they had gained invaluable experience in digital techniques which would be put to good use in support of their development of nautical charts. At this stage they would prefer not to commit further effort to digitizing GEBCO bathymetry as their scanning equipment was now in great demand. However, Mr. Popov stated that they would be pleased to continue manually digitizing ships' tracks from the GEBCO Sheets. The meeting agreed that, rather than proceeding with the bathymetry on Sheet 5.10, the next priority at HDNO should be the digitizing of ships' tracks from Sheets 5.04 and 5.08 in the North Atlantic.

5.3 PROGRESS REPORT FROM THE ALFRED-WEGENER-INSTITUT (AWI)

50 Dr. Schenke reported that, in order to support his research work into the development of digital techniques for interpreting bathymetric data (using the Weddell Sea as a test bed for these studies), he had arranged for the ships' tracklines to be digitized from Sheet 5.16 and its southwards extension onto Sheet 5.18. Stable colour separate transparencies of these sheets had been provided by the Canadian Hydrographic Service and raster scanned in Berlin. The raster output had been converted into vector form at Hannover, and transferred onto the computer at AWI. Dr. Schenke stated that, subject to finding the necessary resource to convert the data from the internal AWI format, he would be pleased to submit them on magnetic tape to BODC in due course.

5.4 PROGRESS REPORT FROM THE NERC UNIT FOR THEMATIC INFORMATION SYSTEMS (NUTIS)

51 Dr. Gary J. Robinson reported that he had virtually finished digitizing and labelling the bathymetric contours and coastlines from Sheet 5.03. All three East Pacific Sheets 5.03, 5.07 and 5.11 had been raster scanned by a bureau in London using a Scitex Scanner. The scanning had been completed within two days at a cost of 70 dollars per sheet, and provided binary images at 30 lines/mm. This resolution was chosen so as to produce 2-3 pixels per contour line on the Laser-Scan equipment used at NUTIS to process the raster output.

52 Dr. Robinson explained that NUTIS acted as a beta-test site for Laser-Scan software, and for the GEBCO digitization he made use of two main packages - VTRAK and LITES2. The VTRAK system was a particularly powerful and flexible system for automatically generating contour vectors from the scanned binary images - in particular it enabled the user to interactively monitor the contours in real time on a large graphics screen and to slow the process down in areas of complex bathymetry so as to manually control the line following. At this stage the user could label the main control contours (e.g. 1000m interval contours) and allow the system to interpolate the depths of intermediate contours. About 80% of contours could be labelled using VTRAK, although the final checking and editing of contour labels was carried out using the LITES2 system, which also provided the facility for spline fitting contours through gaps due to contour labels. At this stage it was also possible to ensure a consistent direction of digitization along the contour e.g. high ground to the right.

53 Dr. Robinson stated that Sheet 5.03 had required 1 man-week of effort using the VTRAK software and 3 man-weeks work using LITES2. He estimated that about 4-6 weeks effort per sheet would be required to complete the digitization of Sheets 5.07 and 5.11. Although covering less sea area, progress on Sheet 5.03 had been slowed down by large areas of complex coastline, occasionally overlapped by shallow depth contours. Dr. Robinson noted a slight discrepancy of 0.1mm between the registration of the graticule and grid on Sheet 5.03 although this was well within expected tolerance. In general, he estimated that 80% of the digitized contours fell within a quarter of a line width.

54 The meeting congratulated Dr. Robinson on his contribution, and were pleased to note the great advances that had been made in the software and hardware available for digitizing GEBCO since the work was first started in Toulouse 6 years ago. Such advances augured well for the future updating of the GEBCO Digital Atlas with new compilations.

5.5 FUTURE WORK PRIORITIES

55 An overview of the current status of digitizing the coastlines, contours and ships' tracklines from the GEBCO (5th Edition) may be found in Annex VIII. The meeting agreed that it was important to attempt to complete the digitization of the contours and coastlines from all sheets by the time of the next meeting and agreed the following workplan:

IGN/BGI, Toulouse : bathymetry and coastlines for Sheet 5.09

NUTIS, Reading : bathymetry and coastlines for Sheets 5.07, 5.11 and 5.10

JODC, Tokyo : bathymetry, coastlines and tracklines for Sheet 5.06

BODC, Bidston : a) evaluate HDNO digitization of IBCM

b) check registration of digitized contours on Sheets 5.01, 5.04, 5.08 and correct as necessary

c) check the digitization of Sheets 5.17, 5.03, 5.02 and 5.05, and edit as necessary

d) check, and edit as necessary, additional sheets submitted by BGI, NUTIS and JODC

e) prepare, and release for distribution, GF3 files for each sheet, as and when final edited versions of the data become available

HDNO, Leningrad : digitize ships' tracks on Sheets 5.04 and 5.08

56 In addition to the above, special attention would need to be given to Sheet 5.12 which was currently being revised for re-publication. It was anticipated that the revised sheet would be digitized prior to re-publication and that the digitized dataset would be used in the publication process.

5.6 DIGITIZATION OF TRACKLINES

57 The meeting noted that, whereas good progress was now being made in digitizing the coastlines and contours from the GEBCO (5th Edition), the digitization of the sounding control (i.e. ships' tracks, box survey limits and position of isolated sounding points, on which the contours were based) was lagging far behind. To date, the sounding control had only been digitized from 2 sheets.

58 Mr. Popov stated that the major problem experienced at HDNO, in using scanning techniques to digitize the sounding control, was in trying to convert the scanned binary image into coherent trackline vectors. As considerable effort was required to resolve the individual tracks from the binary image, HDNO had resorted to manually digitizing the tracklines on a conventional digitizing table. The meeting recognized that, by the very nature of track coverage on the GEBCO sheets, it would always be difficult to trace individual cruises consistently, and queried whether this was really necessary. One possibility might be to store the sounding control in some form of raster image.

59 The meeting agreed that Dr. Robinson should be requested to investigate techniques for digitizing and storing the sounding control information and, in particular, to ascertain whether an automated method could be developed for processing the scanner output using, for example, Laser Scan's VTRAK system.

5.7 DIGITIZATION OF UNDERSEA FEATURE NAMES

60 The Chairman reported that BODC had managed to read the Framework II word-processor files supplied by the IHB following the last meeting. These files had been used at the IHB in the preparation of the First Edition of BP-0008 'Gazetteer of Geographical Names of Undersea Features shown (or which might be added) on the GEBCO and on the IHO Small-scale International Chart Series (1:2,250,000 and smaller)' published in November 1988. BODC had reformatted them from Framework II internal format into comma delimited ASCII format on MSDOS compatible floppy disks. An information note was available from BODC describing how these files could be easily read onto any IBM PC compatible system. Dr. Jones stated that, in analysing the Gazetteer files, BODC had provided feedback to the IHB as to how the information might be reorganised for future use.

61 Mr. Michel Huet reported that IHB was now planning to maintain their Gazetteer in digital form using DBASE-III. He presented a draft specification of the fields that might be included in the data base and invited comments from the meeting. Proposed fields included:

Name of feature (e.g. Algerian-Tyrrhenian)
Type of feature (e.g. Basin)
Geographic Position
Chart Reference(s) (e.g. GEBCO 5.02)
Source which proposed Name (e.g. AWI - Dr. Schenke)
Date of Proposal
Name of Ship which discovered (surveyed) the Feature
Date of Discovery (or Survey)
Supporting Material
Authority which accredited the Name
Date of Accreditation
Additional explanation or comments

62 The two aspects that gave rise to greatest discussion were the assignment of geographic coordinates to named features, and the automatic placement of feature names on digital maps. Other issues that arose were the difficulties in maintaining, in a common character set, names based on different alphabets, and the requirement for language translations. On the latter point Mr. Huet stated that features only had one name irrespective of language, although the generic component of the feature name might require translation (e.g. ridge, abyssal plain, trough) - however this only involved a limited list of standard terms.

63 It was agreed that any attempt to associate a feature's name with the geographic coordinates delineating the extent of the feature would give rise to problems of definition and interpretation. Furthermore, as more data become available, the shape and extent of the feature would evolve and require regular updating. For the time being it was considered preferable simply to store the position of the centre of the feature, or a pair of positions (or more) in the case of a linear feature.

64 Mr. Pryor reported that attempts had been made at NOS to develop rule-based systems for the placement of names on maps but they had found it to be a very complex problem, particularly when dealing with changes to the scale and geographic coverage of maps. Mr. Monahan suggested that GEBCO should adopt a more basic approach by simply storing a general position (e.g. at the centre of the feature) for each feature, and letting the map producer manipulate the name on his graphics screen as appropriate. In the final analysis name placement was a matter of subjective judgment.

65 The meeting agreed that Dr. Robinson should be requested to investigate techniques for handling feature names for use in the GEBCO Digital Atlas, and to recommend a suitable approach at the next meeting. Consideration should be given to the information available in the gazetteers of the IHB and the US Board on Geographic Names, both of which were available in digital form.

6. DIGITAL WORLD COASTLINE

66 The meeting clearly recognized the need for a standard, digital coastline of the world at a scale of 1:1 million or greater for use in the GEBCO Digital Atlas, and was pleased to learn that the Defense Mapping Agency (DMA)'s World Vector Shoreline (WVS) could be used in GEBCO products without affecting their release to third parties.

67 A description of the WVS may be found in the January 1990 edition of the International Hydrographic Review. The WVS was developed by DMA as a digital data file, at a nominal scale of 1:250,000, to replace the earlier World Data Base II produced at a working scale of 1:3,000,000 by the CIA (see Annex IX for comparison). In addition to shorelines it also included international boundaries and country names. Worldwide coverage of the data set was completed in July 1989 with a specification that 90% of all identifiable shoreline features be located within 500 metres (2mm at 1:250,000) of their true geographic position with respect to the World Geodetic System (WGS-84) datum.

68 The main source material for the WVS shoreline was DMA's Digital Landmass Blanking (DLMB) Data which was derived primarily from the Joint Operations Graphics and coastal nautical charts produced by DMA. The DLMB data consists of a land/water flag file on a 3 by 3 arc-second interval grid. This raster dataset was converted into vector form to create WVS. For areas of the world not covered by DLMB data (e.g. the Arctic and Antarctic), the shoreline was taken from the best available hardcopy sources at a preferred scale of 1:250,000. The WVS data are stored in chain-node format, and include tags to indicate the landside/waterside of the shoreline so as to facilitate colour filling.

69 The Chairman reported that he had received from DMA a sample of the WVS on magnetic tape covering the Eastern North Atlantic, the Mediterranean and Europe, and would shortly be receiving the worldwide version. He remarked that, from sample comparisons with a 1:600,000 digital coastline of the UK produced by the UK Ordnance Survey, he had found WVS to be an impressive product. However, concern was expressed that the accuracy specification (500m - see above) for 90% of WVS gave no indication of the accuracy for the remaining 10% of the world shoreline or where the areas with lesser accuracy occurred. For GEBCO purposes it would be important to identify these areas, and participants were invited to request copies of WVS from BODC for evaluation in their specialised geographic areas of interest, and to report their findings back to the Chairman.

70 One area where WVS was thought to be less reliable was around Antarctica. Dr. Schenke reported that, having initially used WDB II, AWI now tended to use the Scott Polar Research Institute (SPRI)'s coastline of the Antarctica as digitized from the GEBCO (5th Edition). He had compared WVS with the SPRI coastline and had noted some differences, primarily in the definition of the ice edge, although the comparison was fairly good in the area of the Antarctic Peninsula (see e.g. Annex X). He stated that AWI were currently digitizing the ice edge, grounding lines etc. from Landsat images for the area between 30° E. and 70° W. to an accuracy of 100 metres. The international glaciological community had access to Landsat imagery for the whole of the Antarctic ice edge, although information was not available on whether the remainder would be digitized.

71 Dr. Sedov stated that the WVS would be used for the IOC Regional Bathymetric Projects: IBCCA, IBCWIO and IBCEA, and that he would be requesting BODC to provide the relevant extracts of the WVS for these projects.

72 It was understood that DMA would be issuing a CD-ROM version of WVS which would also include reduced data sets at scales of 1:1 million, 1:3 million and 1:12 million. The meeting felt that it would also be useful to include these reduced versions in the GEBCO Digital Atlas. It was understood that DMA would be using the Douglas-Peucker algorithm for generating these lower resolution products.

7. FUTURE DEVELOPMENT OF THE GEBCO DIGITAL ATLAS

7.1 UK SUPPORT FOR THE GEBCO DIGITAL ATLAS (GDA)

73 The Chairman was pleased to report that the Marine and Atmospheric Sciences Directorate of the UK's Natural Environment Research Council (NERC) had agreed to fund 2 posts and a research project in support of the GDA over the next 4 years. The Project would be coordinated by the Director of BODC under the guidance of the GEBCO Guiding Committee, and would be accomplished by:

a) the appointment of Mr. Peter Hunter as full-time GEBCO Bathymetric Editor based at the IOS Deacon Laboratory with duties as listed in Annex XI. He would have day to day responsibility for identifying and coordinating the supply of new bathymetric compilations relevant to the GDA from the international community and for ensuring their scientific quality. He would advise the Digital Atlas Manager on the method and priorities for assimilating them into the GDA.

b) the creation of the full time post of GEBCO Digital Atlas Manager at BODC with duties as listed in Annex XI. Following a recruitment exercise Miss Pauline Weatherall had been appointed to the post and would start work on 25 June 1990. Her main duty would be to establish, maintain and regularly update the GDA as a high quality database representing the 'state of the art' of global bathymetry. She would also develop and disseminate output products from the database.

c) the establishment of a project at the NERC Unit for Thematic Information Systems (NUTIS) to research into, and advise on, techniques for the development of the GDA and its output products, and to search for new techniques of handling and presenting bathymetric data (see Annex XI). Dr. Gary Robinson would take the lead in this research at NUTIS and work in close collaboration with IOSDL and BODC.

74 The following programme of work had been proposed:

a) Phase One - construct a quality controlled digital version of the GEBCO (5th Edition) including bathymetric contours, coastlines, feature names and trackline control, by June 1991. This dataset would be used to initialize the GDA.

b) Phase Two - regularly update the GDA with new blocks of data, and ensure the quality of these data and their proper integration with the current contents of the GDA. This would include the substitution of the GEBCO (5th Edition) coastline with the DMA World Vector Shoreline, and the inclusion of new, regional, bathymetric maps as and when they became available. Revised bathymetry would be incorporated at larger scales than 1:10 million as appropriate. New versions of the GDA would be issued periodically.

c) Phase Three - supply all necessary compilation material to the relevant establishment which has undertaken to produce and print the GEBCO (6th Edition), as traditional paper charts, for publication in 1995.

d) Coordinate the scientific efforts of the bathymetric community worldwide towards producing revised and up-to-date bathymetric compilations for inclusion in the GDA.

e) Research and develop new data products to exploit the potential of the GDA, giving particular consideration to the creation of Digital Terrain Models of the seafloor, including gridded datasets, and to the electronic publishing of the GDA on, for example, CD-ROM. Research would also be undertaken into techniques for automatically generating internally consistent models of the sea floor using sounding data, coupled with other types of sea-bed (side-scan sonar) or geophysical data, and for their integration into the GDA.

f) Take on special responsibility for working up the bathymetry of the North-east Atlantic in digital form at a scale of 1:1 million, building on the earlier work of IOSDL and ensuring that it is regularly (e.g. annually) kept up-to-date.

g) Act as the international focus for the dissemination of the GDA and its data products.

75 The meeting welcomed the UK's plans for supporting the GDA and looked forward to collaborating in the work.

7.2 RESEARCH INTO TECHNIQUES FOR DEVELOPING THE GDA

76 Dr. Schenke outlined the research being carried out at AWI into the automatic generation of bathymetric maps and DTMs using the south eastern area of the Weddell Sea as a study area. The research involved use of the HIFI88, TASH and CARIS software packages, and the problems of integrating new single and multibeam data with existing digital contour maps and gridded data sets. He stressed the importance in this work of having digitized tracklines to accompany digital contour maps so as to give appropriate weighting to points at the intersection of tracklines and contour vectors. As a starting off point they had studied the generation of DTMs from contour vectors followed by recontouring the resultant DTM - initial results in comparing the two contour maps were promising.

77 Dr. Heinrich Hinze, AWI, presented the results of a detailed study in the area of Maud Rise covering an area of 375km by 278km around 65° S., 3° E., and using a fixed gridding interval of 500m. In the initial study, DTMs were computed using three separate data sets;

set 1 - GEBCO Sheet 5.16 digital contour vectors

set 2 - the DBDB5 subset of the ETOPO5 data set

set 3 - single beam soundings from the NGDC data base and 'Polarstern', and multibeam data (Seabeam) from 'Polarstern'

78 He noted that the DTMs computed from GEBCO Sheets 5.16 and 5.18 compared well with that from DBDB5 but major differences were noted in comparison with that computed from the sounding data (set 3). Much of this was due to the effect of suspect data and highlighted the need for carefully selecting out data according to quality, reliability and useability. The second phase of the study involved the elimination of suspect data, and restricting the use of DBDB5 to those areas without track data and to areas where it was compatible with existing sounding data. In December 1989 a new DTM was computed giving equal weighting to each of the following data sources:

source 1 - Seabeam data from 'Polarstern'

source 2 - single beam soundings from 'Polarstern'

source 3 - selected single beam data from the NGDC data base

source 4 - selected digitized soundings from UK Nautical Chart 3170

source 5 - selected extracts from DBDB5

79 Dr. Hinze reported that the contours derived from the resultant DTM were in good agreement with the 'Polarstern' Hydrosweep measurements taken in the area in April 1990. He was pleased to note that many of the smaller features (hills or seamounts, often surrounded by moats) appearing on a smooth sea floor on the DTM derived map were confirmed by the Hydrosweep measurements. However, there were considerable discrepancies between the Hydrosweep contours and the DTM in those areas where DBDB5 was the only source of data.

80 Dr. Hinze stated that, in future, he would experiment with using varying weights for the data from different sources when deriving his DTMs e.g. for sources (1,2,3,4,5 above) one might assign weightings of (5:5:5:2:1). Weightings could be assigned to input data according to their internal accuracy (e.g. as submitted by the data donors), and to their reliability in comparison with other data (e.g. by cross over track checking). Due to their high data density multibeam data were likely to have a greater influence than single beam data in the present approach. Dr. Hinze stated that, in future studies, he would also investigate the bathymetry of Gunnerus Ridge.

81 The meeting expressed great interest in the research being carried out by Dr. Schenke and Dr. Hinze and anticipated that the ideas generated by this work would contribute to the future development of the GDA. However, it was recognized that, in its initial development, the GDA would probably have to rely on the more conventional technique of storing and updating bathymetry in the form of contour vectors.

82 Mr. Pryor stated that NOS was routinely employing DTMs for their fully overlapped multibeam surveys in the U.S. EEZ, in water depths ranging from 150m to several thousand metres. Mr. Monahan stated that the Canadian Hydrographic Service had experimented in the use of DTMs for shallow water mapping as well as the use of 'kriging' techniques and the use of quadtree structures for data storage. He felt that, whatever techniques were used, it was important to ensure that one could always spin off a paper map when required. Furthermore, there would be some users of the GDA who would wish to generate their own special purpose DTMs and who would prefer to receive a base of data rather than a pre-determined DTM.

8. IHO DATA CENTRE FOR DIGITAL BATHYMETRY

8.1 PROGRESS REPORT FROM TIIE US NATIONAL GEOPIIYSICAL DATA CENTER (NGDC)

83 Dr. Michael Loughridge reported that, over the past 12.3 months since the last meeting, a further 170 cruises/legs of data had been assimilated into the Underway Geophysics Data Bank, including almost 1.2 million digital soundings collected over some 440,000 nautical miles of track. The major accessions of data came from U.S. laboratories, although he was pleased to report data submissions from China, France, Japan, South Africa and the UK. The total number of digital soundings in the data bank had now exceeded the 20 million mark. A statistical breakdown of the total holding, and of the data archived over the past 12 months, may be found in Annex XII - these figures do not include the large volumes of US NOS data maintained by NGDC for the U.S. shelf.

84 Dr. Loughridge informed the meeting that NGDC was now well experienced in the production of data sets on CD-ROM and had issued 6 to date. They were currently studying the possibility of putting out the whole of their Underway Geophysics Data Bank on CD-ROM; a print run of a few hundred copies would probably satisfy their customer base. The meeting greeted this possibility with considerable enthusiasm - it would provide an ideal way of distributing soundings for bathymetric mapping projects, and could greatly assist the development of the GEBCO Digital Atlas.

8.2 ESTABLISHMENT OF TIIE IIIO DATA CENTRE FOR DIGITAL BATIIYMETRY

85 Mr. Pryor reported that in November 1989 the U.S. had submitted to the IHO Directing Committee a slightly revised proposal for the Data Centre for Digital Bathymetry to be operated by the US NGDC on behalf of IHO. He stated that the revision had taken into account the comments made by IHO Member States early in 1989, and the subsequent discussion of these comments at the last meeting of the Sub-Committee.

86 Mr. Huet reported that, through IHO Circular Letter 1/1990 distributed in January 1990, the Member States of IHO were requested to register their acceptance or otherwise of the U.S. proposal by 30 April 1990. He informed the meeting that replies had been received from 33 (58% of total) Member States, of which 29 (88%) were in favour of establishing the IHO Data Centre at Boulder. He pointed out that a further 2 Member States were in favour of the proposal providing reassurance/clarification was provided on certain issues they had raised.

87 Mr. Huet stated that, in view of the large positive response to the U.S. proposal, the IHO Directing Committee would be issuing a new circular letter to Member States informing them that the offer to host the IHO Data Centre for Digital Bathymetry at NGDC had been accepted. However, he hoped that the comments raised by the Member States would be taken into account and, with the agreement of NGDC, the meeting was invited to consider these comments:

a) 'Quality control of data'

88 Dr. Loughridge reaffirmed his view that data quality was the responsibility of the data originator, although NGDC did carry out a level of 'blunder' checking on the data before it was banked. Such checks were geared to identifying obvious errors such as instantaneous changes in position, impossibly high ship speeds, large abrupt changes in depth, time sequencing errors, formatting errors, etc., and to ensuring the completeness of labelling and documentation. If errors were detected, a message was sent to the supplying institution requesting a resolution of the errors and a resubmission of the corrected data. Dr. Loughridge stated that facilities existed at NGDC for flagging suspect data and for replacing erroneous files.

89 It was pointed out that the VHOs responsible for maintaining the Oceanic Plotting Sheets were expected to compare incoming new data with neighbouring data already present on their sheets. Concern was expressed that this level of checking would no longer be carried out. The meeting fully accepted the reasoning behind the restricted level of checking undertaken at NGDC, but recommended that a procedure should be established for the VHOs to contribute a higher level of data quality control in close collaboration with NGDC. Similarly, scientists engaged in compiling bathymetric maps from the NGDC data should be encouraged to report any problems of data quality to NGDC for resolution. It was further recommended that NGDC should investigate the possibility of including an additional field in their data header record to allow for inclusion of the 'quality' flag defined in IHO Special Publication 44.

b) 'Interaction with the VHOs'

90 It was recognized that the IHO Data Centre for Digital Bathymetry would exist in parallel with the VHO System of Oceanic Plotting Sheets for some time, at least until the VHOs had developed the capability to handle digital data and outstanding data in the current system had been converted into digital form. Mr. Huet informed the meeting that the IHO had set up a Working Group on Oceanic Plotting Sheets with Mr. Harper as Chairman and with Terms of Reference as given below:

i) to investigate the ways in which the VHOs could keep the GEBCO Oceanic Plotting Sheets (OPS) updated

ii) to investigate ways of ensuring that new bathymetric data is consistent with previous data of the same area or disproves earlier data

iii) to discuss the best way to exchange bathymetric data in order to ensure effective updating data procedures

iv) to investigate how a move towards digital data handling should proceed, and the problems involved

v) to discuss progress in the change-over by the VHOs from OPS to digital data bases

vi) to define the future requirements for OPS and in particular:

* to recommend whether digital bathymetric data should be included on the OPS

* to identify difficulties that may arise if OPS continue to be maintained following the establishment of the IHO Data Centre for Digital Bathymetry

* to identify the future role of the VHOs in maintaining OPS

91 The meeting welcomed the establishment of the Working Group and looked forward to collaborating in its work which covered a number of key areas that were of direct interest to the Sub-Committee and which would clarify the future role of the VHOs. It was important to ensure that the role of the VHOs should be complementary to the role of the IHO Data Centre. Mr. Harper agreed to keep the Chairman of the Sub-Committee closely informed on the Working Group's activities and to provide a discussion paper for the next meeting of the Sub-Committee.

c) 'Regional Data Centres'

92 Mr. Huet stated that 7 of the responding Member States had requested that the establishment of the IHO Data Centre at Boulder should not exclude the creation of additional Regional Data Centres if the need arose. The meeting agreed that, providing such centres worked in close collaboration with the IHO Data Centre using analogous procedures and formats to facilitate digital data exchange, they could well be mutually beneficial in focusing the assembly, quality control and distribution of data at a regional level and in enhancing the role of the Boulder Centre. However, it would be essential to ensure that if other centres were set up they did not inhibit or delay the submission of data to Boulder.

d) 'Data from swath surveys (multibeam echosounders)'

93 Ing. en Chef Laporte felt that the IHO Data Centre should also take into account data collected by multibeam systems, and enquired as to the current status of handling such data at Boulder. Dr. Loughridge responded that his centre already had a system in place to inventory multibeam data. This involved storing the centre beam data in their Underway Geophysics Data Base and setting flags in the data to indicate the availability of associated multibeam data. This system had been used for many years for inventorying seismic reflection data, and was embedded in the current GEODAS inventory where on/off switches were maintained indicating the start and end of each type of measurement.

94 Dr. Loughridge further stated that NGDC had been quite successful in acquiring centre beam data from multibeam surveys. To date they had received very little multibeam data although plans were being developed for the centre to manage the multibeam data collected by U.S. institutions. At present, discussions were being focused on how the data should be formatted and the level to which the data should be processed. Dr. Loughridge stressed that these issues were not trivial due to the very large volumes of data involved, and the understandable reluctance of originators to modify their working systems or reformat their data. Attempts had been made some years ago to develop a subset of the GF3 format to cater for multibeam data although these had been inhibited to some extent by a de facto standard in common use for 16 beam Seabeam data. Since that time multibeam systems had diversified and 60 beam systems were now in use. The Chairman reported that a binary version of GF3 was being developed and would become available as soon as BODC had adapted the supporting GF3-PROC software to accommodate it.

95 The meeting felt that the IHO Data Centre could play a key role in communicating with suppliers and users of multibeam data and in establishing appropriate guidelines and procedures for handling such data. It recommended that, in the process of developing a system for managing U.S. data, the Centre at Boulder should also consult with experts outside the U.S. involved in collecting multibeam data. The meeting requested Dr. Loughridge to prepare a discussion document on the subject for consideration at the next meeting of the Sub-Committee.

e) 'Standards and procedures'

96 Clarification was sought by some Member States on the operational procedures, systems and formats supporting the banking of bathymetric data at NGDC, and the preferred format and medium for data exchange. It was agreed that pertinent information should be written up as a section in the 'Guidelines for GEBCO' and should also include a precise statement on the quality control checks carried out at NGDC. Dr. Loughridge agreed to collaborate with the Chairman in preparing this material. In the meantime Dr. Loughridge stated that a published document was available from Boulder specifying in detail the MGD77 format used at NGDC for storing underway geophysics data including single beam soundings.

97 (At an informal meeting on 31 May between Admiral Civetta, Dr. Loughridge, Mr. Pryor and the Chairman slight modifications were made to the wording of text describing the services to be provided by NGDC on behalf of the IHO. The revised text is given in Annex XIII).

9. REVISION OF THE GEBCO REGULATIONS

98 The Chairman recalled that the First Edition of the GEBCO Regulations, published by the IHB in March 1970, had focused on the VHO system for compiling oceanic soundings on 1:1,000,000 Oceanic Plotting Sheets, and on the cartographic specifications and procedures to be followed in producing the printed version of the GEBCO (5th Edition). After two decades it was now essential to revise these Regulations to reflect the new structure that was evolving for GEBCO brought about by the advent of digital techniques and computing technology.

99 After some discussion the meeting identified the following distinct but interrelated components of the GEBCO system that would need to be addressed in the next edition of the GEBCO Regulations:

I The Joint IOC/IHO Guiding Committee for GEBCO

II GEBCO Map Compilation

III The GEBCO Digital Atlas

IV The IOC/IHO Gazetteer of Geographical Names of Undersea Features

V Publication of the GEBCO (6th Edition) as a paper chart

VI The IHO Data Centre for Digital Bathymetry

VII The Volunteering Hydrographic Offices

100 Peripheral to these components, but closely related to GEBCO, are:

VIII The IOC Regional Ocean Mapping Projects

IX Other international and national mapping projects

X The Originators and Users of Echo-sounding Data

XI The Users of GEBCO Mapping Products

101 A schematic overview illustrating the relationship of these components may be found in Annex XIV.

102 The meeting noted that, with the recent establishment of the UK activity in support of GEBCO (see item 7.1) and the creation of the IHO Data Centre for Digital Bathymetry (see item 8.2), most of the operational elements of the GEBCO system for the 1990s were now in place. However, until the IHO Working Group on Oceanic Plotting Sheets (see item 8.2) had reported, there was still some uncertainty as to the precise role to be played by the VHOs. This would affect the procedures to be adopted to ensure a timely flow of data to the IHO Data Centre, and a proper quality control of the data.

103 The Chairman agreed to prepare a revised version of Parts 3 (Digital Bathymetric Data) and 4 (Geophysical Data collected concurrently with Digital Bathymetric Data) for inclusion in a Provisional Edition of the 2nd Edition of the GEBCO Regulations being prepared by the IHB. Dr. Loughridge agreed to prepare material on the operational procedures and quality control checks carried out at NGDC in banking digital bathymetric data.

104 It was agreed that the next meeting of the Sub-Committee should give careful consideration to ensuring that appropriate guidelines relevant to the handling of digital data were available for inclusion in the revised GEBCO Regulations and to identifying any aspects not covered.

105 (Note: At the GEBCO Officers Meeting, 30 May - 1 June 1990, it was agreed that the revised edition of the GEBCO Regulations should be called 'Guidelines for the GEBCO')

10. CLOSURE OF THE MEETING

106 In closing the meeting, the Chairman thanked participants for their enthusiastic and positive contributions. It was agreed that, in order to maintain the momentum of the Sub-Committee's work, a further meeting should be held in about a year's time, and Mr. Popov's kind offer to host the meeting in Leningrad was accepted with appreciation.

107 The meeting expressed its grateful appreciation to Dr. Schenke and his colleagues for the excellent arrangements made for the meeting, and for their generous hospitality and support.

108 The meeting closed at 12.00 on 30 May 1990.

Meirion T. Jones
Chairman

ANNEX I

AGENDA

1. Opening of the Meeting

2. Adoption of the Agenda

3. Arrangements for the Meeting; Documentation

4. Review of Related Activities of Other International or National Groups

5. Digitization of the GEBCO (5th Edition)

6. Digital World Coastline

7. Future Development of the GEBCO Digital Atlas

8. IHO Data Centre for Digital Bathymetry

9. Revision of the GEBCO Regulations

10. Closure of the Meeting

ANNEX II

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3. International Hydrographic Organisation

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International Hydrographic Bureau,
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PRINCIPALITY OF MONACO.

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Tel: 93 50 65 87
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Captain Nic M. Smit,
c/o International Hydrographic Organisation,
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MC 98011 Monaco Cedex,
PRINCIPALITY OF MONACO.

Telefax: 93 25 20 03
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Tel: 93 50 65 87
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4. IOC Secretariat

Dr. Viktor Sedov,
Intergovernmental Oceanographic Commission,
UNESCO,
7, Place de Fontenoy,
75700 Paris,
FRANCE.

Telefax: (1) 43 06 11 22
Telx: 204461 PARIS
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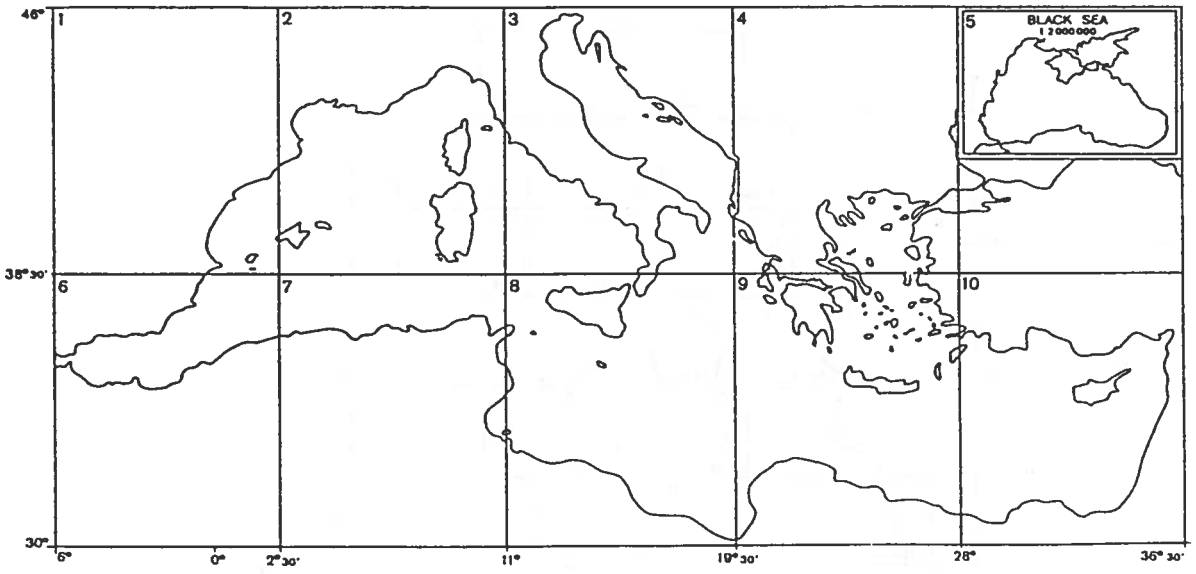
Zone: +1 (Summer +2)

ANNEX III

CHART INDEXES FOR IOC REGIONAL OCEAN MAPPING PROJECTS

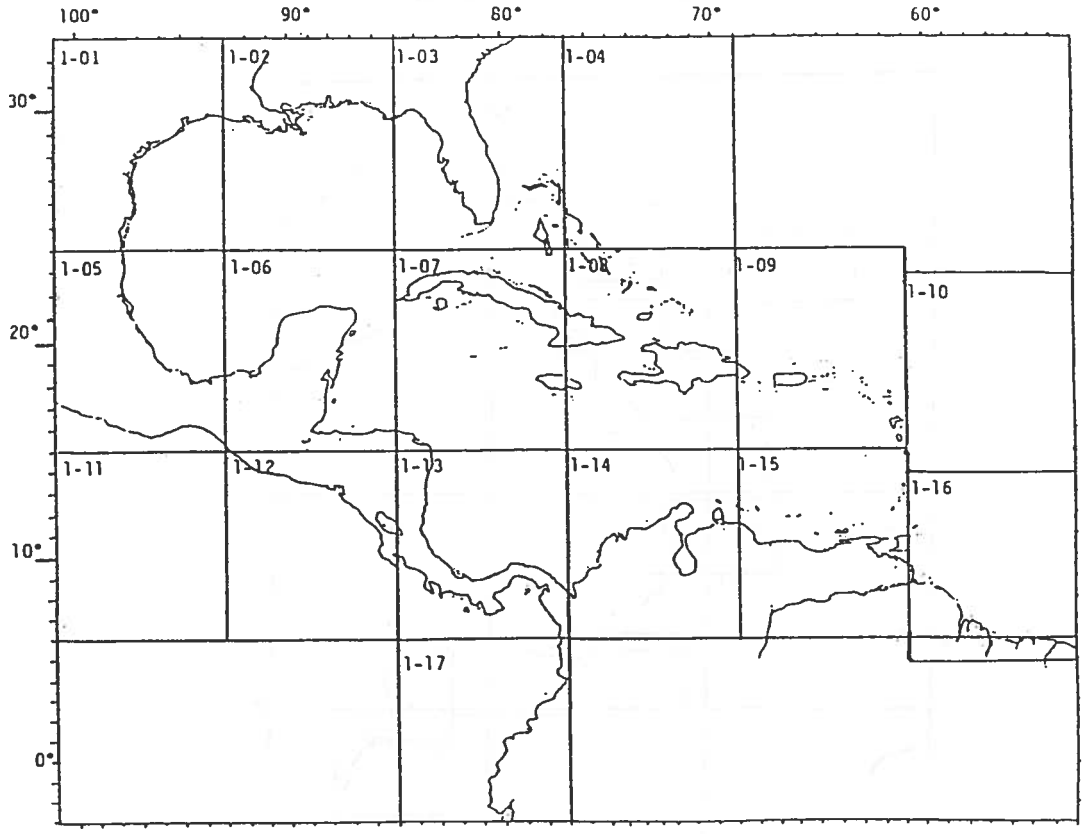
INTERNATIONAL BATHYMETRIC CHART OF THE MEDITERRANEAN

(Scale 1:1 million at 38°N)



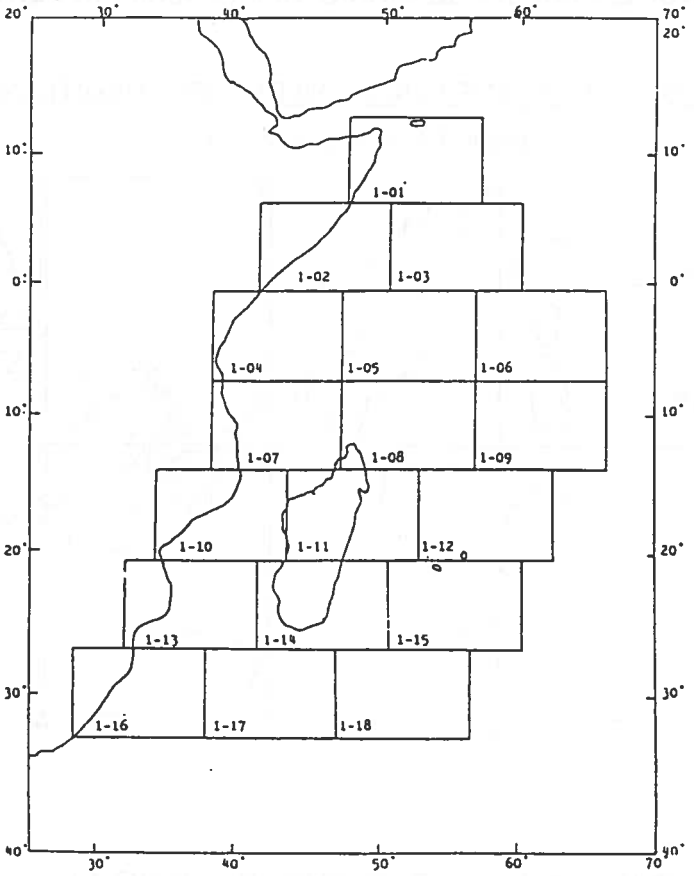
INTERNATIONAL BATHYMETRIC CHART OF THE CARIBBEAN SEA AND GULF OF MEXICO

(Scale 1:1 million at 15°N)



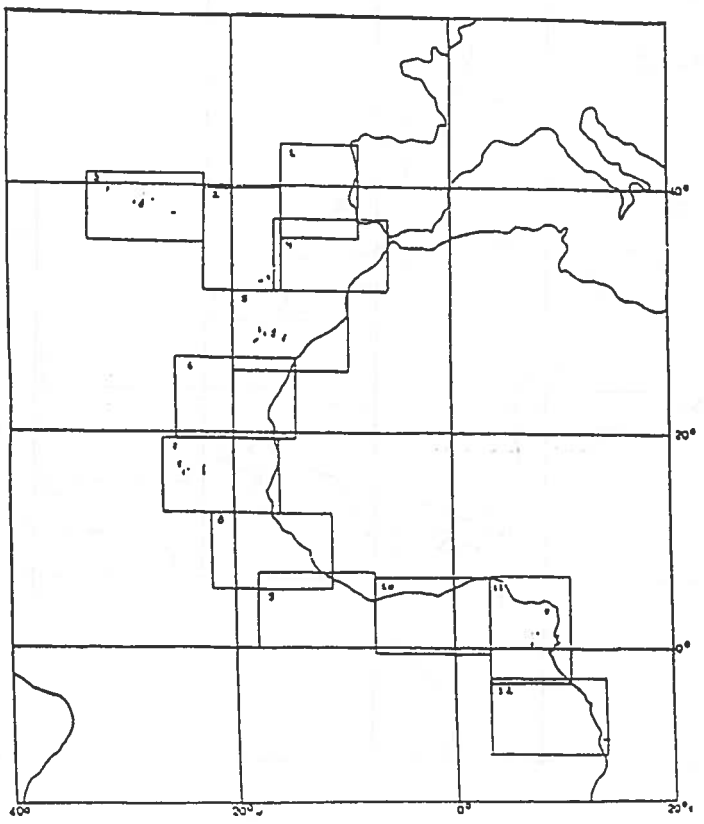
INTERNATIONAL BATHYMETRIC CHART OF THE WESTERN INDIAN OCEAN

(Scale 1:1 million at 0°)



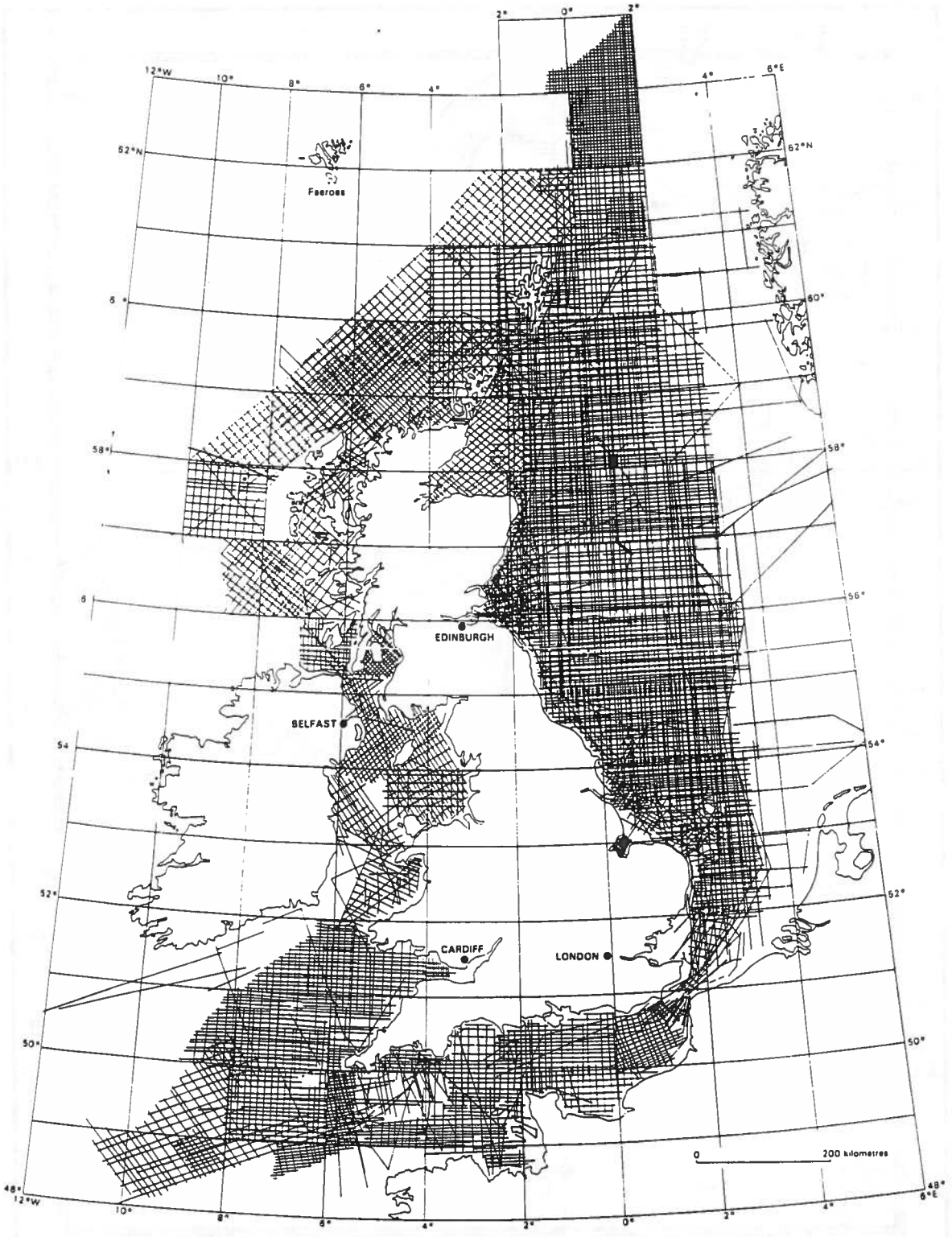
INTERNATIONAL BATHYMETRIC CHART OF THE CENTRAL EASTERN ATLANTIC

(Scale 1:1 million at 20°N)



ANNEX IV

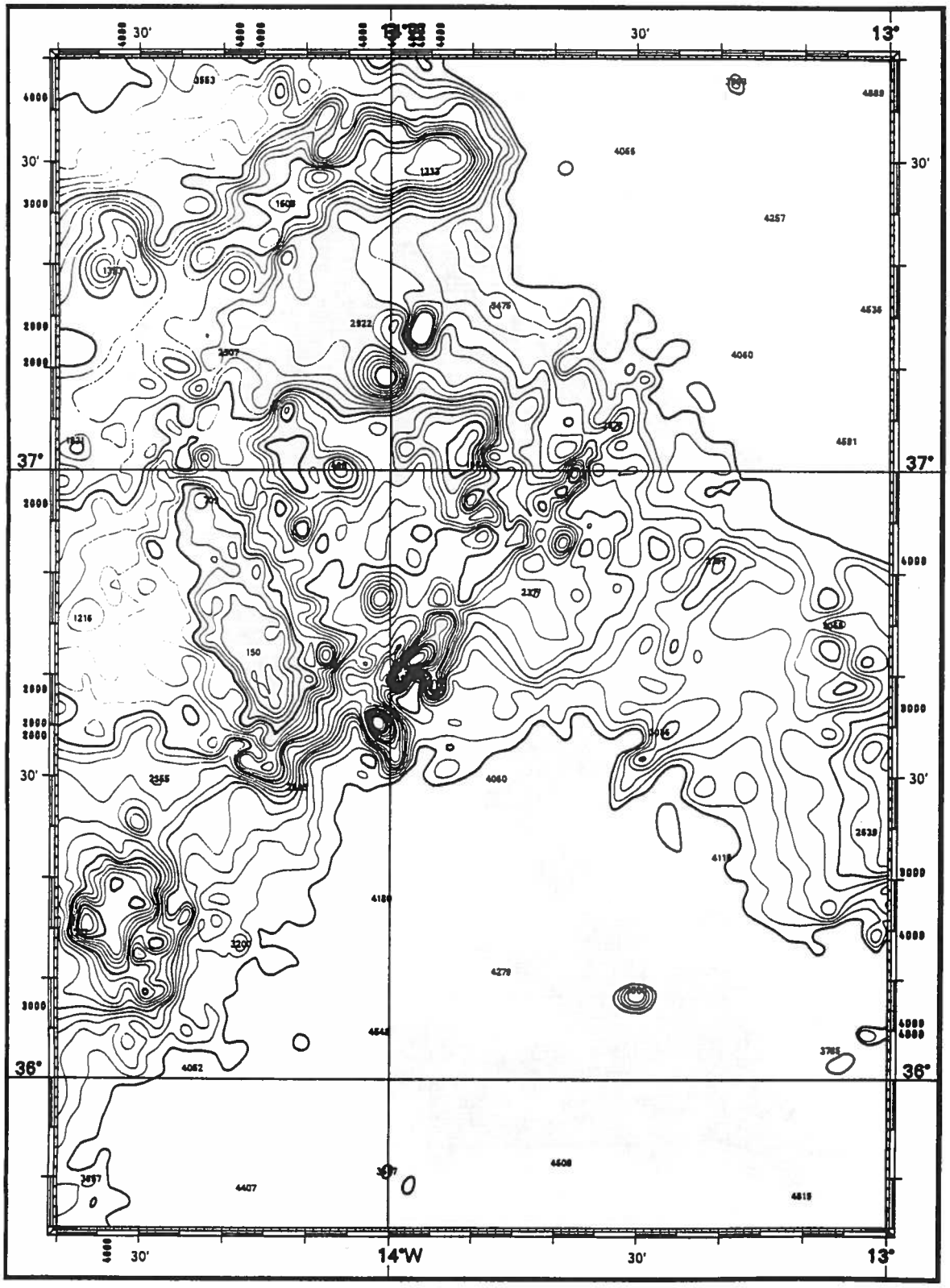
TRACKLINE COVERAGE OF BATHYMETRIC DATA COLLECTED BY THE BRITISH GEOLOGICAL SURVEY AROUND THE UK (1966-87)



ANNEX V

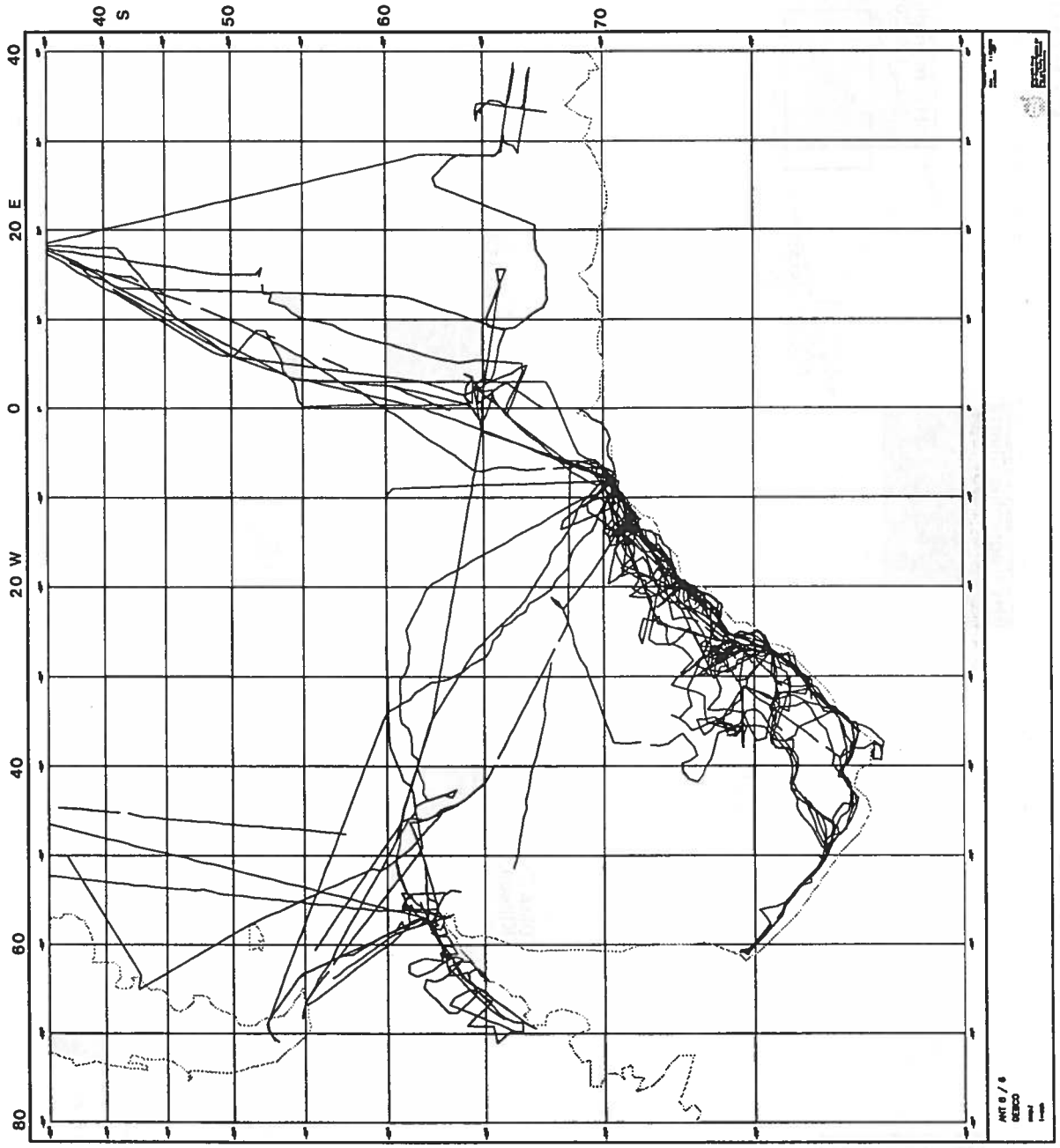
SAMPLE BATHYMETRIC CHART GENERATED AUTOMATICALLY BY THE SERVICE HYDROGRAPHIQUE ET OCEANOGRAPHIQUE DE LA MARINE (SHOM), FRANCE

(copied from colour original)



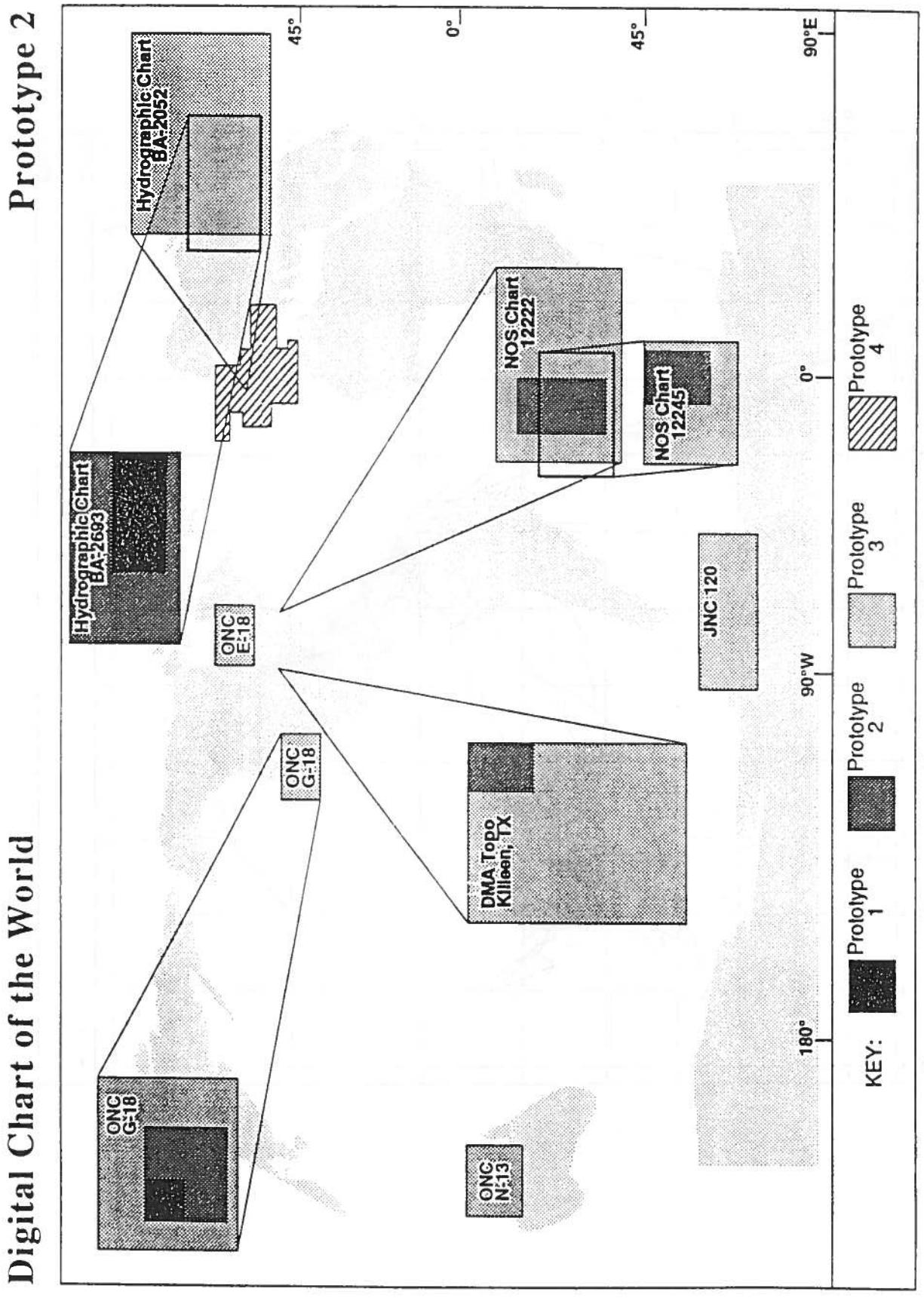
ANNEX VI

TRACKLINES OF MULTIBEAM SOUNDING DATA COLLECTED BY 'POLARSTERN' IN THE WEDDELL SEA



ANNEX VII

PROTOTYPE STUDY AREAS FOR THE DMA DIGITAL CHART OF THE WORLD

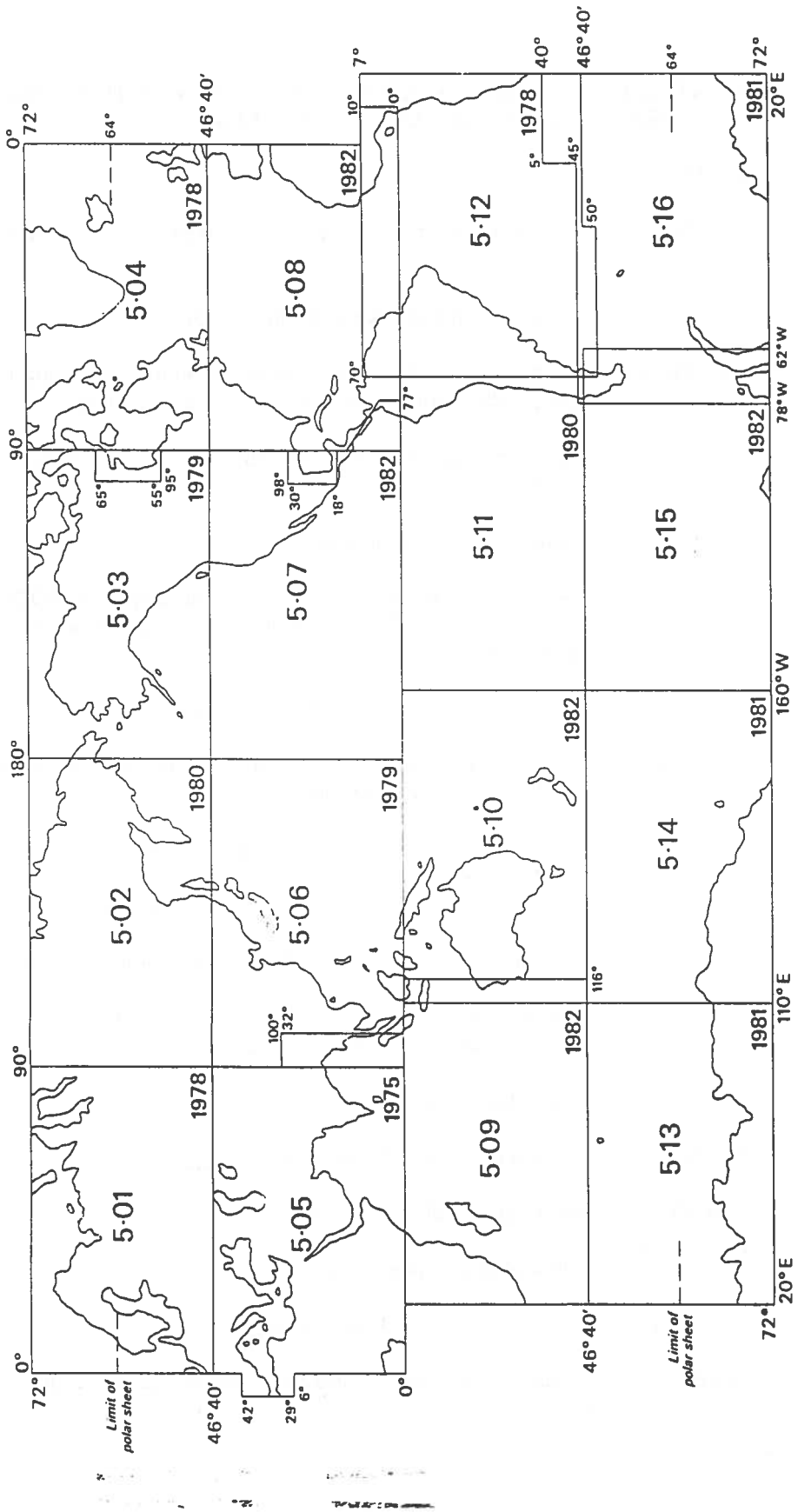


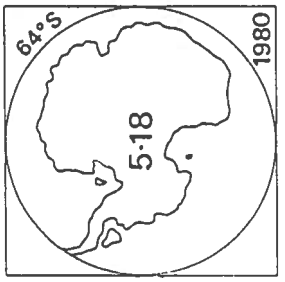
ANNEX VIII

CURRENT STATUS OF DIGITIZING THE GEBCO (5TH EDITION)

GEBCO SHEET NO.	SHEETS RASTER SCANNED?	CONTOUR VECTORS AND LABELS?	CURRENT STATUS OF DIGITIZING BATHYMETRIC CONTOURS AND COASTLINES
5.01	Yes(BGI)	Yes(BGI)	Contours have been checked/edited at BODC - about to be released
5.02	Yes(HDNO)	Yes(HDNO)	Awaiting final checking/editing at BODC
5.03	Yes(NUTIS)	Yes(NUTIS)	To be submitted to BODC in July 1990 for conversion to geographic coordinates and final checking/editing
5.04	Yes(BGI)	Yes(BGI)	Contours have been checked/edited at BODC - awaiting final check on registration
5.05	Yes(BGI)	Yes(BGI)	Awaiting final checking/editing at BODC
5.06	-	-	BODC to obtain updated digital contour maps from JODC for area east of 120deg E. and to investigate area 100 to 120deg E.
5.07	Yes(NUTIS)	-	Awaiting vectorization and labelling of contours at NUTIS
5.08	Yes(BGI)	Yes(BGI)	Contours have been checked/edited at BODC - awaiting final check on registration
5.09	Yes(BGI)	-	Awaiting vectorization and labelling of contours at BGI
5.10	-	-	Not yet started - may be carried out at NUTIS
5.11	Yes(NUTIS)	-	Awaiting vectorization and labelling of contours at NUTIS
5.12	-	-	Bathymetry currently being revised prior to reissuing printed sheet - contours to be digitized during this process
5.13	Yes(BGI)	Yes(BGI)	Final dataset already released
5.14	Yes(BGI)	Yes(BGI)	Final dataset already released
5.15	Yes(BGI)	Yes(BGI)	Final dataset already released
5.16	Yes(BGI)	Yes(BGI)	Final dataset already released
5.17	Yes(BGI)	Yes(BGI)	Awaiting final checking/editing at BODC
5.18	Yes(BGI)	Yes(BGI)	Final dataset already released (south of 72deg S. only)

INDEX TO GEBCO (5TH EDITION) SHEETS

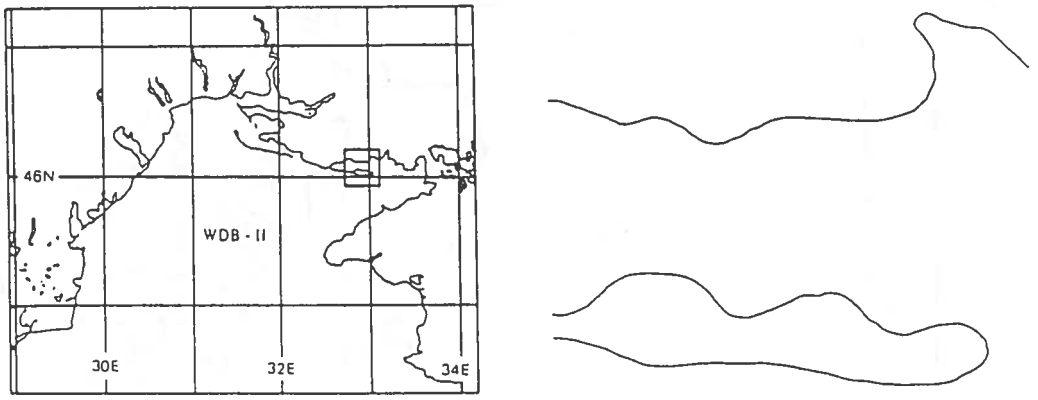




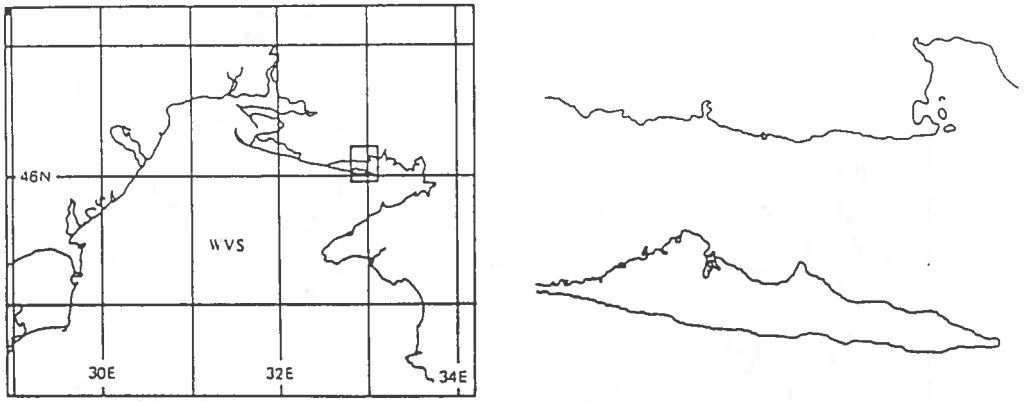
ANNEX IX

COMPARISON OF THE RESOLUTION OF THE WDBII AND WVS SHORELINES

(a) WDB II



(b) WVS



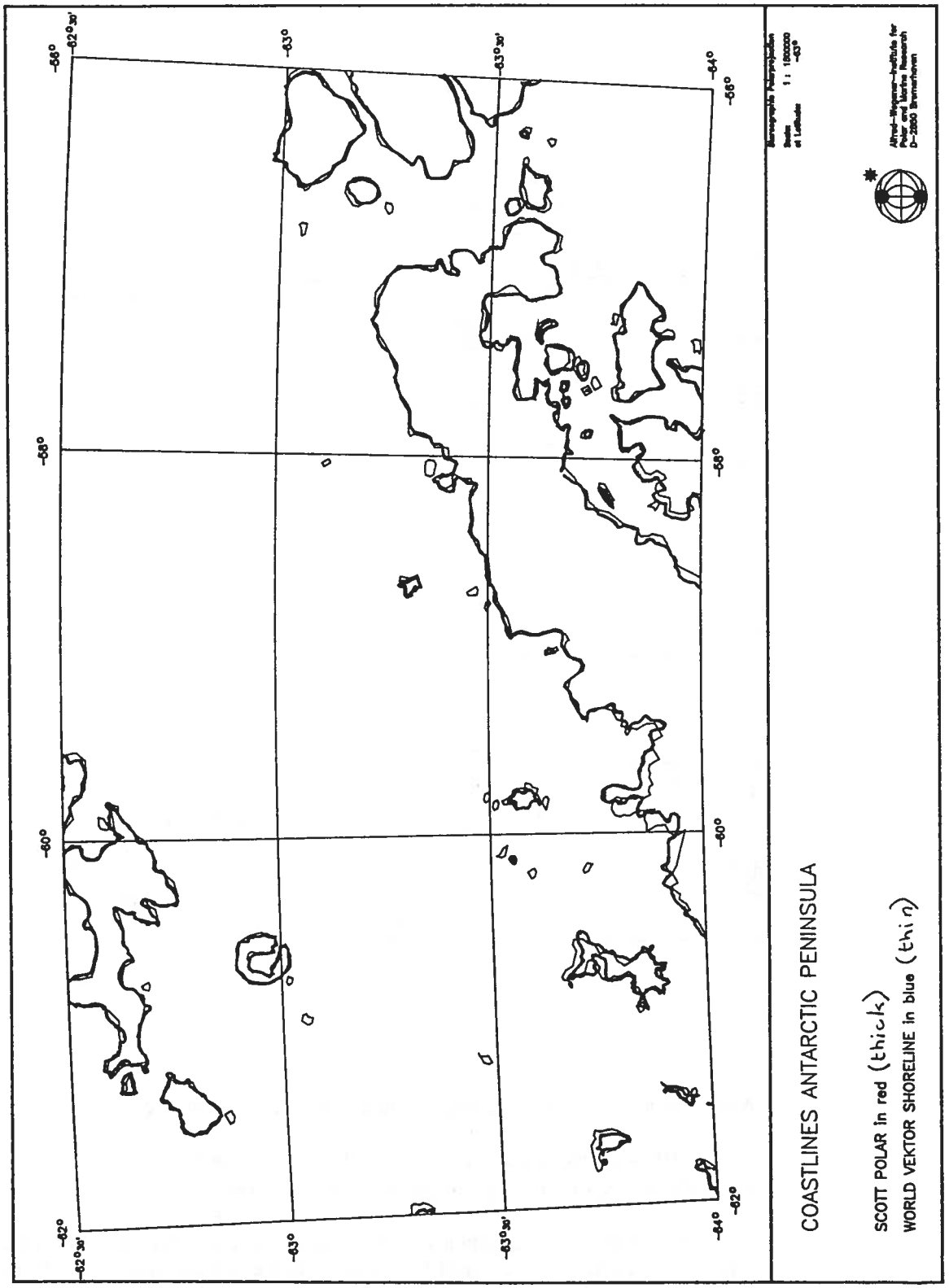
Area shown is the Odessa region in the northern Black Sea

a) WDBII was digitized at an average scale of 1:3,000,000
b) WVS was digitized at an average scale of 1:250,000

Maps on the right are enlargements (approximately 16 times) of maps on the left. Figures are courtesy of the Naval Ocean Systems Center and reproduced from the International Hydrographic Review, Monaco, LXVII(1), January 1990.

ANNEX X

COMPARISON OF THE WVS AND SPRI COASTLINES AROUND TIIE ANTARCTIC PENINSULA



ANNEX XI

UK SUPPORT OF THE GEBCO DIGITAL ATLAS

TERMS OF REFERENCE FOR THE GEBCO BATHYMETRIC EDITOR

(Mr. Peter Hunter, IOS Deacon Laboratory, Wormley, UK)

The GEBCO Bathymetric Editor will be responsible for maintaining a supervisory role over the flow of data relevant to GEBCO by:

1. searching out new data sources and ensuring that, within the limits of propriety for publication by originating investigators, all available data are deposited in data banks in timely fashion;

2. keeping himself informed of ongoing and planned field bathymetric programmes throughout the world;

3. be acquainted with and maintain contact with those academic and agency geoscientists and hydrographic services demonstrably interested in and actively researching the geomorphology of the world's oceans, as well as the technical groups engaged in the forefront of processing and manipulation of such data;

4. to receive and assess recommendations from the network of reviewers for the upgrading of the GDA and to negotiate for the acquisition of the data and its transmission to the GEBCO Digital Atlas Manager;

5. to identify possible compilers of revised blocks of contours, make recommendations to the Guiding Committee and subsequently to liaise with the compilers;

6. to develop close links with the IHO as the World Data Centre for Bathymetry, and the IHO Data Centre for Digital Bathymetry at Boulder, USA;

7. to liaise with national and international organisations involved in ocean mapping (e.g. IOC, IHO, IGN, ICA, WDDES & CGMW);

8. to provide active support to the GEBCO Guiding Committee;

9. to work closely with the Digital Atlas Manager and to supply all necessary material to the appropriate establishment which has undertaken to produce and print the GEBCO (6th Edition) printed chart series.

TERMS OF REFERENCE FOR THE GEBCO DIGITAL ATLAS MANAGER

(Miss Pauline Weatherall, British Oceanographic Data Centre, Bidston, UK)

The GEBCO Digital Atlas Manager will be responsible for:

1. receipt of digital tapes from IGN/BGI, HDNO, JODC, IHB and elsewhere, of digitised contours, ships tracks and geographical names from the 5th edition GEBCO;

2. receipt of tapes of digitised data from other sources (e.g. IOC regional mapping projects);

3. examination and editing of all tapes received for errors, ambiguities and inconsistencies;

4. merging inputs into a unified database in a standard format suitable for subsequent distribution and sales;

5. maintenance and periodical updating of the GDA by the integration of new blocks of data when supplied through the GEBCO Bathymetric Editor, and digitising where necessary;

6. substitution of the existing coastline in the GDA by the new USA-DMA coastline (World Vector Shoreline) making necessary adjustments to nearshore bathymetric contours;

7. researching and implementing new data files such as gridded databases (DTMs);

8. researching and implementing new output presentations from the GDA to meet the needs of users and to demonstrate its flexibility;

9. advising on programmes of output presentations that could be available to users;

10. preparing for conversion of GDA to (e.g.) CD-ROM.

RESEARCH PROJECT PROPOSAL FOR 'BATHYMETRIC MODELLING USING AUTOMATED TECHNIQUES'

(Work to be carried out at the NERC Unit for Thematic Information Systems under Dr. Gary Robinson and in collaboration with IOSDL (Wormley) and BODC (Bidston))

Objectives:

The primary objective of this project is to investigate suitable techniques for the generation of internally consistent models of the sea floor automatically using bathymetric sounding data, coupled with geomorphological information input by a bathymetrist. Secondary objectives are:-

i) To design the system in such a way that new information can be used to update and improve the models as and when it becomes available.

ii) To allow 'traditional' contour charts to be generated at a variety of scales (e.g. 1:10M GEBCO).

iii) To provide a consistent, secure environment for the storage, manipulation, dissemination and analysis of bathymetric data.

iv) To provide a mechanism for the comparison of other data sources, e.g. magnetic, gravity, acoustic imaging (e.g. GLORIA) and comparison with computer simulated models of ocean circulation (WOCE). In particular, this would allow the data sets to be investigated for anomalies - real or due to errors.

Method:

The project would involve the following tasks:-

i) Select suitable test areas which are representative of the different characteristics of the sea floor, e.g. Mid-Ocean Ridge, Abyssal Plain and Continental Margin. Ideally these should be of areas where geophysical and other data sets are readily available.

ii) Develop a database system (probably relational) for the storage, update and retrieval of the data.

iii) Develop software to access and update the database.

iv) Develop a set of suitable algorithms for processing the data to generate internally consistent values.

v) Develop or use existing software to produce bathymetric models.

vi) Compare the bathymetric models with other data sets, possibly using existing image analysis techniques.

vii) Tasks iv, v and vi will also involve an investigation of the feasibility of using parallel computing techniques, given the large volume of data in an operational system (10-50 million samples).

ANNEX XII

SUMMARY OF DIGITAL BATHYMETRIC DATA HELD IN THE UNDERWAY GEOPHYSICS DATA BASE AT THE US NATIONAL GEOPHYSICAL DATA CENTER

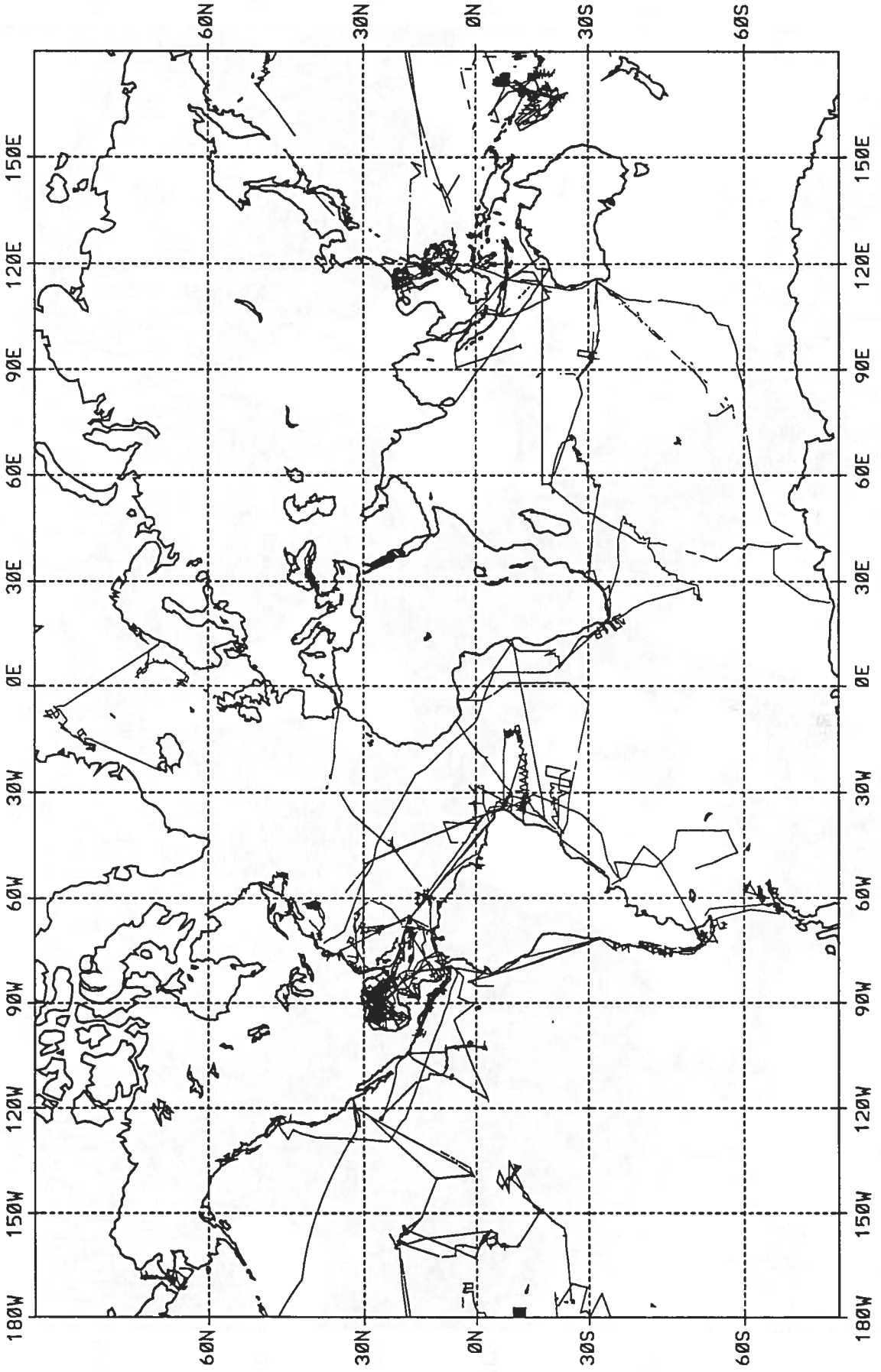
TOTAL HOLDINGS

SOURCE	NO. OF CRUISES /LEGS	TRACKLINE IN NAUTICAL MILES				NO. OF BATHYMETRIC SOUNDINGS
		TOTAL	BATHYMETRY	MAGNETICS	GRAVITY	
Lamont (LDGO)	538	2275876	2194836	1926878	1708854	3450745
Woods Hole O.I.	144	532190	516481	343592	297771	931663
NOAA	84	593730	585633	550600	341990	652702
US Geol. Survey	146	293770	213766	135726	138960	1419659
Oregon St. Univ.	70	175745	166195	125886	115550	251092
Hawaii Inst. Geo.	166	585178	556579	330134	335981	1181707
US Navy	202	919646	887904	364500	35390	2933132
Univ. of Texas	55	108828	92595	75521	0	171261
Rice Univ.	2	7681	7681	0	0	3558
Univ. of Conn.	4	4533	3893	0	4533	2183
Scripps Inst. Oc.	495	1925144	1769757	1377182	93057	3212739
U Rhode Island	22	85568	81669	7164	0	514221
U Washington	9	12865	12865	0	0	34311
Texas A & M Univ.	29	74386	46788	43815	0	75260
Defense Map. Ag.	85	367670	366531	0	0	687628
Min. Manag. Serv.	7	43168	43168	0	0	402174
NEW ZEALAND	15	27388	26344	21258	17306	20219
CANADA	198	732895	715499	18488	13685	635173
CHINA	9	34704	34319	6848	32725	24845
UNITED KINGDOM	41	136792	127365	91365	91348	278959
AUSTRALIA	3	29899	21262	26748	9242	150821
USSR	17	188444	160046	0	188444	65367
JAPAN	138	718804	685900	423099	489633	542067
NETHERLANDS	2	9755	9755	0	9755	45289
FRANCE	167	415473	376367	266147	151159	2034543
SOUTH AFRICA	18	53004	45920	49964	0	56456
BGI (TOULOUSE)	9	59828	59057	0	59817	29738
F.R. GERMANY	1	7562	7562	0	0	3634
ORSTOM NEW CAL.	28	85872	82257	69838	47539	199480
GRAND TOTAL	2704	10506400	9897994	6254753	4182739	20010626

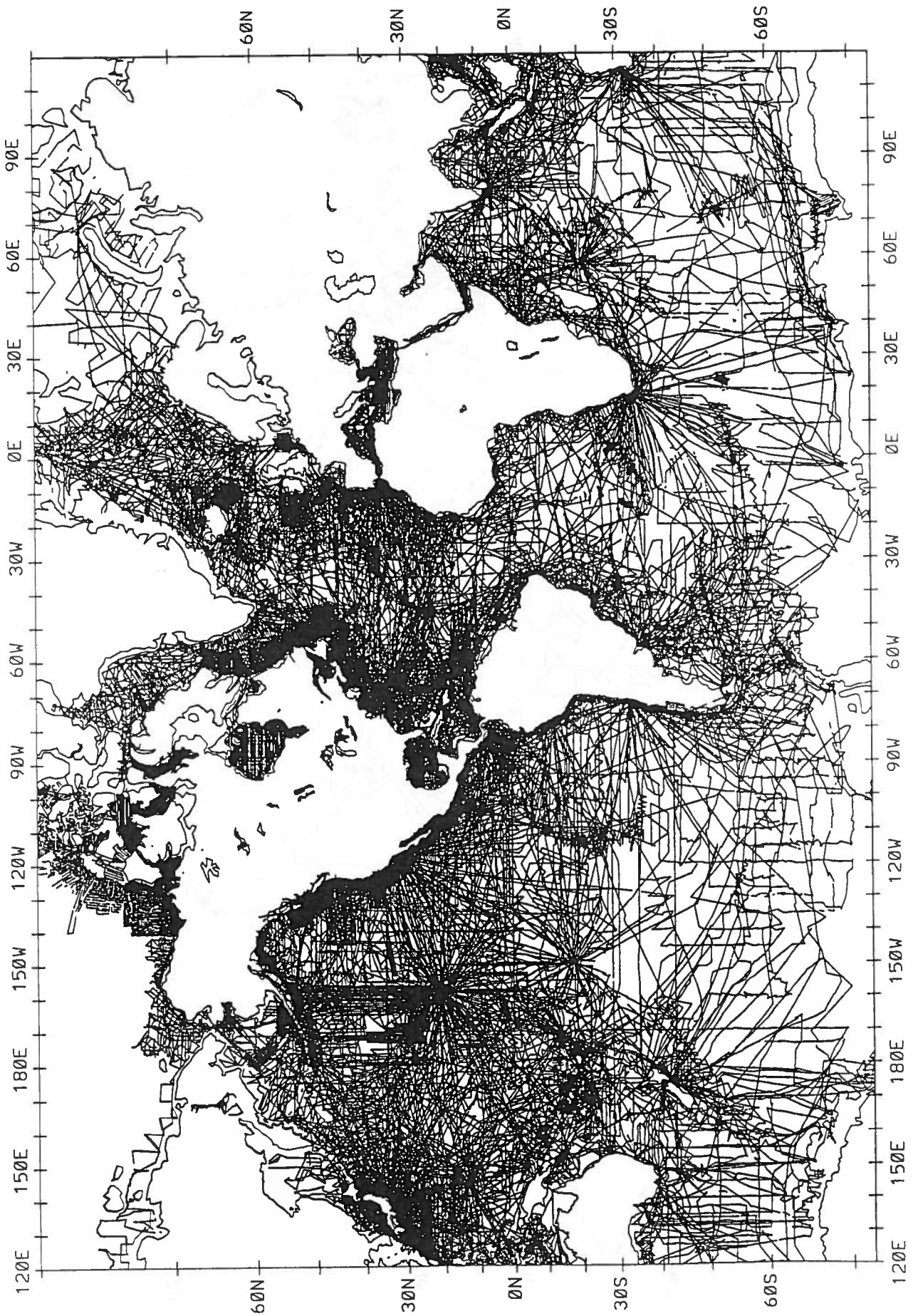
DATA BANKED BETWEEN 12/5/89 AND 23/5/90

SOURCE	NO. OF CRUISES /LEGS	TRACKLINE IN NAUTICAL MILES				NO. OF BATHYMETRIC SOUNDINGS
		TOTAL	BATHYMETRY	MAGNETICS	GRAVITY	
Lamont (LDGO)	34	98037	84991	45541	48714	193866
Woods Hole O.I.	4	16452	16397	12823	4845	31693
US Geol. Survey	15	15392	14903	12170	0	164081
Oregon St. Univ.	1	3156	3013	0	0	3225
Hawaii Inst. Geo.	6	19366	17896	0	0	78333
US Navy	8	29351	29351	0	0	139557
Univ. of Texas	49	84587	73463	53592	0	139960
Scripps Inst. Oc.	13	54692	49952	27137	6975	199154
U Rhode Island	2	3072	3072	0	0	19805
U Washington	7	8430	8430	0	0	28778
Texas A & M Univ.	6	23872	14075	18819	0	15542
CHINA	8	32560	32310	6848	30579	24233
UNITED KINGDOM	1	4220	4220	4220	4220	12194
JAPAN	1	7032	7024	0	0	1606
SOUTH AFRICA	2	5738	5328	5014	0	8990
ORSTOM NEW CAL.	13	36520	34474	32006	19092	134833
GRAND TOTAL	170	442477	398899	218170	114425	1195850

TRACKLINE PLOT OF DIGITAL BATIIYMETRIC DATA ASSIMILATED INTO NGDC UNDERWAY GEOPIIYSICS DATA BANK (12 MAY 1989 TO 23 MAY 1990)



TRACKLINE PLOT OF TOTAL IIOLDINGS OF DIGITAL BATIIYMETRIC DATA IN TIIE NGDC UNDERWAY GEOPIIYSICS DATA BANK (MAY 1990)



ANNEX XIII

SERVICES TO BE PROVIDED BY THE IHO DATA CENTRE FOR DIGITAL BATHYMETRY

Services to be provided by NGDC on behalf of IHO will include but not be limited to:

1) Operation of the data centre with a focus of activity on oceanic regions with depths greater than 100 metres.

2) Provision, free of charge, to the IHO for use by its Member States, the data needed for their national or international projects. The IHO Member States will submit their requests for data through the International Hydrographic Bureau. Member States' Hydrographic Offices (HOs) will provide the centre with the digital bathymetric data collected by their nation's institutions in oceanic regions.

3) Maintenance of a quality control facility whereby data provided to the centre are at least subjected to simple checks for violation of physical principles (instantaneous changes in position, impossibly high ship speeds, etc.) and completeness of labelling, referring detected obvious errors back to suppliers of data for possible corrections. Member States' Hydrographic Offices may be requested to assist in resolving matters of quality control concerning data originated by their nation's organizations.

4) Maintenance of inventories in digital form of all digital bathymetric data including digital contour data and the production of an annually updated catalogue of recently acquired bathymetric data. The centre will provide this catalogue to the IHB in a form analogous to the present IHO publication BP-0004.

5) Maintenance of trackline catalogues of newly collected data to be provided upon the request of a Volunteering Hydrographic Office (VHO) for its area of GEBCO responsibility.

6) Collaboration with various international organizations in the development of exchange formats and standards to expedite bathymetric data exchange, including digital bathymetric contours.

ANNEX XIV

SCHEMATIC OVERVIEW OF THE GEBCO SYSTEM
(as of June 1990)