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Reports of Meetings of Experts and Equivalent Bodies

IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series

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1. OPENING

The Chairman, Professor Carlo Morelli, opened the Seventh Session of the Editorial Board of the International Bathymetric Chart of the Mediterranean (EB-IBCM-VII) at 09:05 on Tuesday, 2 June 1998. The Session was held in Room V of the Hotel Croatia in Cavtat. The venue was occasioned by the 35th meeting of the International Commission for the Scientific Exploration of the Mediterranean Sea (ICSEM).

Present were Prof. Carlo Morelli, Dr. John K. Hall, Prof. E. M. Emelyanov, Eng. Capt. Hüseyin Yüce representing Rear Admiral G . Angrisano of the International Hydrographic Bureau (IHB), Capt. 1st Rank Andrey Popov, and Mr. Dmitri Travin. Also in attendance were Prof. P. N. Kuprin, Dr. K. M. Shimkus, the authors of IBCM-SED, as well as others from the marine geology/geophysics and hydrographic communities. Attendees are listed in the appended List of Participants (Annex IX).

The Chairman welcomed the participants, giving a brief history of the IBCM. He noted that the Session would be particularly fruitful, in that the IBCM-SED sheets were printed and available for viewing, and since discussions on the Second Edition (IBCM-II) would be held in association with the ICSEM Round Table on Multibeam Swath Mapping of the Mediterranean.

11. ADMINISTRATIVE ARRANGEMENTS FOR THE SESSION

2.1 ADOPTION OF THE PROVISIONAL AGENDA

After the addition of an Item 2.4, Election of the Vice Chairman, the provisional agenda was adopted.

2.2 DESIGNATION OF THE RAPPORTEUR

Dr. Hall was unanimously drafted into the position of rapporteur.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

It was agreed that the planned Thursday morning session would be advanced to Tuesday afternoon and that in its place there would be a joint meeting with the swath mappers during their Round Table session.

2.4 ELECTION OF THE VICE-CHAIRMAN

The five members of the Editorial Board present, representing a quorum of the nine members of the EB-IBCM, met to elect a Vice-Chairman. Present were Chairman Morelli, Dr. Hall, Eng. Capt. Yüce representing Rear Admiral Angrisano of the IHB, Prof. Emelyanov and Capt. Popov.

(1) After careful discussion it was noted that the current Vice Chairman, Prof. Jannis Makris, has not been involved over the past 4½ years. Considering the fact that the contributions of a Vice-Chairman are increasing constantly, especially now in connection with work on the IBCM Second Edition, it was imperative to elect a replacement Vice-Chairman.

(2) For the post of Vice-Chairman the proposed solution was the nomination of Dr. John K. Hall. Voting was held and he was elected with two votes and two abstentions.

(3) A second nomination was presented, in faxes appended to this report, proposing the election of Ing. General Patrick Souquiere, Deputy-Director of SHOM. After discussion the members, agreed on the establishment of posts for two Vice-Chairmen, one representing the scientific community and the second the hydrographic. However, it was noted that IOC presently limits IBCM membership to nine. In the absence of a vacancy, or of approval of a request to IOC to increase the number of members, it will be necessary to wait until a vacancy appears or the number is increased. In addition, IOC requires that nominees present a current Curriculum Vitae, which was not done.

While the Board views the nomination of Ing. General Souquiere positively, certain procedural steps will have to be followed. It was recommended that Ing. General Souquiere be invited to attend the next session of the Editorial Board.

3. EXPLANATORY BROCHURES-LEAFLETS FOR THE IBCM GEOLOGICAL/GEOPHYSICAL SERIES

3.1 ELECTRONIC PUBLISHING THROUGH INTERNET

The Chairman reported that in general, past attempts at advertising have been disappointing. On a positive note, the Chief Editor noted that of 2,000 sets of the 1:1M IBCM bathymetry printed, some 1,500 sets had been distributed and sold.

The Chairman reported that IOC was maintaining an Internet website. The possibility existed of listing the brochures among the publications listed by IOC. This would allow access to the material as well as the opportunity to order hard copies.

3.2 BATHYMETRY

The Chairman related how the first brochure had been published first in 1988, and then reprinted by Dr. Hall in 3,500 copies with updated information in 1997.

Eng. Capt. H. Yüce, referring to this brochure, again expressed Turkish opposition to what was claimed in the original scheme of responsibility for the 1:250,000 scale plotting sheets shown in Figure 2 of the brochure. He stated that the plotting sheets covering the eastern Aegean Sea were still pending agreement and indicated that Turkey is continuing to maintain and update the plotting sheets shown in the new IHO Catalogue of Bathymetric Plotting Sheets (Index G).

The Chairman acknowledged this opposition. Dr. Hall expressed the hope that both Turkey and Greece would continue to supply excellent data for these areas. The more complete texts of the Greek and Turkish positions are appended. (Annexes I and VII).

3.3 IBCM-G

The Chairman then reported that he had been successful in finding a scientific review journal which could publish the remaining five brochures. The Bolletino di Geofisico Teoretica e Applicata of the Osservatorio Geofisico Sperimentale (OGS) in Trieste was resuming publication, with a new international Editorial Board and Referees and E. Klingelè of Zurich as Editor-in-chief. This journal offered to publish the IBCM-G, IBCM-M, IBCM-PQ, and IBCM-S brochures in a professional and timely manner. The peer-reviewed articles would have the colour centerfolds of each series at 1:10M scale prepared by Dr. Hall, and an appropriate number of reprints would be printed carrying the IOC logo. This offer was accepted by the Board.

To this end all materials for the IBCM-G brochure held by Dr. Hall were returned during the meeting to Prof. Morelli.

3.4 IBCM-PQ

This brochure will be published in the Bolletino di Geofisico teoretica e applicata (see 3.3 above). To this end all materials for the IBCM-PQ brochure held by Dr. Hall were returned during the meeting to Prof. Morelli.

A fax was received from Prof. Gennesseaux to the effect that three years had passed since the manuscript was completed, and that some updating might be necessary. He requested that he be sent the final English version of the edited manuscript before publication noting that his co-author Prof. Burollet concurred on this. The Chairman indicated that he would do this, and Mr. Scott agreed, if necessary, to check the English.

3.5 IBCM-S (PREPARATION OF CATALOGUE)

This brochure will be published in the Bolletino di Geofisico teoretica e applicata (see 3.3 above). To this end all materials for the IBCM-S brochure held by Dr. Hall were returned during the meeting to Prof. Morelli.

The catalogue will be put out on the Internet - this data is not only important for its complete information on over 30,000 epicenters, but also for its methodologies and the meaning of the seismicity.

3.6 IBCM-SED

The text of this brochure in English is in the hands of Dr. Hall. The Chairman suggested that the authors of this sheet (Drs Emelyanov, Shimkus, and Kuprin) find a review journal specializing in sedimentology. Prof. Fabricius could be of help in this matter.

Dr. Hall indicated that as a last resort he would be ready to print this brochure if no journal could be found. In this case Prof. Emelyanov was requested to supply Dr. Hall with copies of the figures. However, he noted that the 1:5M reduction would be needed for generating colour separations for the brochure centerfold at 1:10M scale, as well as even further reductions for publication of a series postcard.

3.7 IBCM-M

This brochure will be published in the Bolletino di Geofisico teoretica e applicata (see 3.3 above). To this end all materials for the IBCM-M brochure held by Dr. Hall were returned during the meeting to Prof. Morelli.

Dr. Hall noted that a 1:5M reduction would be required for scanning and production of the colour separations for a 1:10M centerfold as well as a further reduction for publication of an IBCM-M postcard.

Prof. Kuprin presented a brief paper on the production of a revised magnetic compilative chart for the Black Sea (see Section 7.1 below). In the event that this compilation is an improvement over the version originally submitted, the Board agreed that this text should be included as an appendix to the IBCM-M chapter. It is appended to the Summary Report.

4. COMPLETION OF THE GEOLOGICAL/GEOPHYSICAL SERIES

4.1 IBCM-SED - 1 :1M

The ten sheets of this recently printed set were displayed for the members of the Board and other participants. The members congratulated the authors (Prof. Emelyanov, Dr. Shimkus, and Prof. Kuprin) and the Chief Editor for doing an excellent job on a very difficult compilation.

Prof. Emelyanov noted the blank areas in parts of the Eastern Adriatic, Turkish and Greek Aegean and French coasts. He requested that marine geologists assist him in filling these gaps. Contact was immediately made with Dr. Z. Grzetic of the Croatian State Hydrographic Institute in Split. The Board discussed the matter of possible updates, and found that while it was impossible to add corrections to the printed maps, it might be possible to print small correction 'patches' within the explanatory brochure.

Prof. Emelyanov raised the possibility of entering the IBCM-SED and the other series into competition for international prizes. The Board considered it an interesting idea, but indicated that the members had no experience in these matters.

4.2 IBCM-SED - 1 :5M

The Chief Editor and Prof. Emelyanov indicated that production of the 1:5M reduction would be difficult in that the large number of symbols would have to undergo a process of cartographic generalization.

The Chairman and Dr. Hall strongly suggested that this not be attempted, but rather that the ten sheets be reduced photographically, merged, and reproduced as is. They noted that the purpose of the 1:5 M reduction was not to convey data with all the detail and clarity of the 1:1 M, but rather to make available on one sheet the 'look' and highlights of the larger chart. It was noted that the legend of the 1:5 M chart was essentially illegible at that scale, so why should the more complex legend of the IBCM-SED be any better?

Dr. Hall indicated that in the event that the Chief Editor and HDNO encountered difficulties with this reduction, he would attempt the scanning, joining, and production of colour separations at 1:5 M scale. The separations for the 1:10 M brochure centerfold and for the ~1:23 M scale postcard would be prepared at the same time.

After consulting with Prof. Emelyanov, the Chief Editor announced that he would take up Dr. Hall's offer to produce the colour separation films at 1:5 M. A complete set of the IBCM-SED charts were then provided to Dr. Hall by Mr. Scott.

4.3 DIGITIZATION OF THE GEOLOGICAL/GEOPHYSICAL SERIES

The Chairman reviewed the history in which the bathymetry was digitized both by Petroconsultants (for sale at SFr. 10,000) and the HDNO for distribution to the Board members and interested scientists. The Petroconsultants dataset was later modified and is available as a separate dataset on the GEBCO Digital Atlas CD-ROM put out by the British Oceanographic Data Centre (BODC). He noted that IBCM-II would not require such treatment, being from the start an all-digital product.

It was noted that the IBCM-G was derived from a digital file, which is available from the Bureau Gravimétrique International (BGI) in Toulouse.

On the other hand, the magnetic data in the IBCM-M had no such central depository, and is available only from the OGS in Trieste, the originators of the original compilation.

The IBCM-S was also derived from digital files, prepared under the direction of Prof. Bonnin at the Euro-Med Seismological Centre in Strasbourg. As stated above, the seismic epicenter data catalogue will eventually be available on the Internet.

The Chairman noted that the IBCM-PQ and IBCM-SED represented the most difficult overlay sets to digitize since each represented several layers which were compiled in analog form. Dr. Hall noted that the IBCM-PQ isophases and structural contours could be represented by gridded datasets, while his investigations of the earliest IBCM-SED version at 1:5M scale had indicated that 4 bytes per pixel would be required to describe all the sedimentary parameters presented on the sheets.

Mr Scott reported that one of his customers had inquired whether the IBCM-PQ was available in digital form. When told that no such version was available, the customer indicated that he would be ready to produce a digital variant as layers on a GIS within a period of several months. The Board members, realizing that a number of sensitive issues such as copyright (HDNO), intellectual property rights, financial considerations etc., agreed that it would be wise to delay acting on the matter until it could be given detailed consideration by the appropriate bodies.

5. SECOND EDITION OF IBCM

Dr. Hall made a half-hour presentation on his work on the Second Edition of the IBCM. An incomplete colour reedition of Sheet 10 was shown, with 50 m colour interval, showing the land topography and interpolated bathymetry for the margins of southern Turkey, Cyprus, and northern Egypt, as well as some of the deepwater areas.

While viewing this work in a positive light, the hydrographers in attendance (representing Turkey, Croatia, the Ukraine, Russian Federation, Spain, and France) were insistent that a clear statement of the

Terms of Reference for the project should be prepared for consideration by the VHOs. There followed much discussion and attempts to define ways and means by which the hydrographic community could contribute to the success of the project while protecting their interests and acknowledging their sensitivities.

Finally, a copy of a letter from Dr. Hall to the Chairman, Prof. Morelli, dated 29 June 1997 was located, copied and read out to the participants. This letter restated what was formulated as the possible Terms of Reference at the Xth Conference of the MBSHC held in Istanbul between 16-20 June 1997. It included a draft list of technical specifications for the IBCM-II. This letter, with minor changes, is appended to the summary report.

In the following year, several technical changes appear likely:

(1) The situation with the land topography is not static. The GLOBE dataset has since been superseded by the USGS EROS GTOPO30 data-set, which is better behaved, and includes data for land areas below sea-level such as the Dead Sea depression and Qattara in western Egypt. During 11 days in August 1999, the NASA space shuttle Endeavour is expected to remap all land areas between 60°N and 60°S using C band synthetic aperture radar interferometry techniques. Funded by NIMA with processing by JPL, this is expected to generate a 30 m DTM which will be available worldwide at 100 m spacing. This data is expected to be available in time for release of the entire IBCM-II in several years time.

(2) It is likely that elevations and depths will be carried at 1 m rather than 0.1 m resolution. This despite a cautionary note raised by Dr. Troy Holcombe of NGDC who noted that 1 m resolution had caused his organization problems when visualizing quite flat areas.

(3) It is important that the VHOs be requested to supply accurate and detailed WGS-84 coastlines for their areas of responsibility. This is important to make the IBCM-II totally compatible with the datum of the Global Positioning System.

In the discussions, Eng. Capt. Yüce indicated that in the past, IHO Member States that volunteered to produce bathymetric data, as requested by the IHB, had made available bathymetric data and support (digital or analog), which was provided or was intended to be provided to the Chief Editor (Russian Federation), as well as to the IHO Data Centre for Bathymetry (Boulder, Colorado, USA). He indicated the necessity of elaboration/evaluation of the existing situation before taking further steps, with the view that good quality data, and its exchange, is vital for the success of IBCM.

Eng. Capt. Yüce especially noted the need for terms of reference regarding how to proceed with the IBCM-II. He stated that there were two issues where the VHOs role and position need to be clearly specified, in order to justify their participation. These are:

(1) data collection and verification - it is under the HOs responsibility, and
(2) processing and production.

The participants agreed that the terms of reference and draft technical specifications in the appendix would be circulated by Eng. Capt. Yüce to the VHOs. The members of the Board requested a reply with comments by the end of October 1998 so that it could be taken up at the next informal meeting in November 1998.

Dr. Hall reiterated that on all matters related to IBCM-II there was great flexibility on the part of the Editorial Board. This was forcefully brought to the attention of the participants by the preview of the IFREMER's l'Atalante swath mapping data for the area of Sheet 10. These data, when they presumably become available sometime in the next few years, will render academic the matter of harmonization of the many different types of data present in the deepwater parts of the 1:250,000 scale plotting sheets. These data will simply be discarded in favour of the new data.

In conclusion, the Chairman stressed that IBCM-II would represent the optimum that could be reached in the available time and with the available data. We could hope for no better.

6. COPYRIGHT, ADVERTISING AND SALE OF IBCM

6.1 COPYRIGHT AND WORDING OF CREDIT LINE

Mr. Scott reported that one of his customers, Mr. Hughes-Clarke, was writing a book 'Geology of the Maltese Islands' and wished to reproduce in it a part of the IBCM bathymetry. He had been given permission to do this, subject to inclusion of an appropriate credit note, the wording of which would be provided by the EB-IBCM. It was agreed that this should read as follows: "*Part of the International Bathymetric Chart of the Mediterranean (IBCM), a series of the Intergovernmental Oceanographic Commission (IOC) of UNESCO. Reproduced with permission of the copyright holder: The Head Department of Navigation and Oceanography, St. Petersburg, Russian Federation.*"

6.2 ADVERTISING, SALE AND DISTRIBUTION OF IBCM

The participants held an animated discussion on this subject. While the Chairman acknowledged that the results to date had been discouraging, Mr. Travin described how the IOC was advancing in the business of advertising. The IOC has a homepage on the Internet, with news of developments and the various ocean mapping programmes.

It was noted that the Musée Océanographique in Monaco, visited by over a million people each year, had a full-size display of the IBCM bathymetry. At the various meetings relevant to IBCM activities, Mr. Travin, Prof. Morelli, Dr. Hall and other members are continuing to distribute the IBCM, IBCM-G, IBCM-S, and IBCM-PQ postcards printed by Dr. Hall in 1995.

Prof. Emelyanov reported that in discussions with Dr. Frédéric Briand, the ICSEM Director-General, it had been agreed that the IBCM-SED would be included in the ICSEM website.

Dr. Troy Holcombe of the IHO Bathymetric Data Center at NOAA's National Geophysical Data Center (NGDC) in Boulder CO, described how the IBCWIO (Western Indian Ocean) project was linked to IOC webpages which are maintained by the NGDC. He showed four sample pages with Hyperlinks which describe the IBCWIO. Dr. Holcombe agreed to add pages on the IBCM if he were provided with materials by Mr. Travin and Dr. Hall. Copies of the four IBCM postcards were immediately supplied for scanning. Pictures and reports of meetings, as well as names and addresses of the people to be contacted, make good material for inclusion. He indicated that NGDC should have no problem handling the expected volume of IBCM material.

Mr. Scott said that under the title "Ocean Mapping (IOC)" he was continuing to act as the Sales Agent for all IOC's Ocean Mapping products. Details are as follows: OCEAN MAPPING (IOC), Cumbers, Mill Lane, Sidlesham, Chichester, West Sussex PO20 7LX, UNITED KINGDOM, Tel: & Fax: +44 1243 641222. E-mail address to follow. Sales Price: Sterling £5 per sheet plus packing and postage.

7. OTHER MATTERS

7.1 MAGNETIC ANOMALIES MAP OF THE BLACK SEA PRESENTED BY PROF. P. KUPRIN (RUSSIAN FEDERATION)

Prof. Kuprin presented a revised magnetic anomaly chart for the Black Sea with 50 nT contours. A three page report describing the merger of a number of problematic surveys was submitted and appears in the Appendix.

The Chairman asked Prof. Kuprin and the Chief Editor to compare this new compilation with that submitted for the IBCM-M. If similar, then this version would not be used. If different then it should replace the earlier version, and the text presented should be appended to the text of the IBCM-M journal article/brochure.

7.2 SEDIMENTOLOGICAL MAP OF BOTTOM SEDIMENTS OF THE BLACK SEA - PRESENTED BY DR. N. PANIN (ROMANIA)

The Editorial Board appreciated the contribution which has been done by the Institute of Marine Ecology and Geology of Romania in the development of knowledge in sedimentology of the Black Sea.

7.3 MULTIBEAM SWATH MAPPING ROUND TABLE

At the invitation of Dr. Jean Mascle (Géosciences, Director of the CNRS Geodynamic Laboratory, Villefranche-sur-Mer), the co-ordinator of the Round Table on Multibeam swath mapping of the Mediterranean, the members attended a joint session of the morning of 4 June in Sipun Hall. They heard nine presentations on the swath mapping activities of Werner Heike and IFREMER in the central and eastern Mediterranean.

In the general discussion at the end of the meeting the participants recognized the necessity to incorporate these exciting new findings into the IBCM-II.

Dr. Mascle suggested that the IBCM Chairman contact the appropriate person at IFREMER to find out the best way in which the gridded digital terrain model from these data could be included in the IBCM-II.

8. DATE AND PLACE OF THE NEXT SESSION

A number of proposals were considered by the Board. Various opportunities for informal meetings were discussed, based upon other activities at which members might be present. One such possibility might be the upcoming meeting of the IOC Consultative Group on Ocean Mapping (CGOM - the heads of GEBCO and the regional IBCs), which will be hosted by Dr. Hall over five days in Israel in May 1999. Finally, it was agreed that the following three venues constituted the best opportunities to meet, ending in the eighth formal meeting.

(1) Informal meeting over one weekend during the IOC Executive Council in Paris in November 1998.

(2) Informal meeting during the meeting of the Mediterranean Black Sea Hydrographic Commission in Split, Croatia, during the first week of June, 1999.

(3) Formal meeting in Kaliningrad, Russian Federation, in September, to be organized by Prof. Emelyanov and Mr. Travin.

Another invitation to be considered in the future was that of Prof. N. Panin, General Director of the National Institute of Marine Geology and Geo-Ecology in Romania. He suggested a meeting aboard a vessel which could be moored at various places in the delta of the Danube.

9. ADOPTION OF THE DRAFT SUMMARY REPORT

The draft summary report was read out by the Rapporteur, Dr. Hall, and was accepted at 13:08 on 4 June 1998.

10. CLOSURE

The Chairman declared the meeting closed, after warmly thanking the participants for their attendance, and the ICSEM Director-General and the Croatian hosts for their warm hospitality.

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ANNEX II

STATEMENT ENTERED BY CAPT. A, SKLAVIDIS, HNHS

Production of IBCM Plotting Sheets by the Hellenic Navy Hydrographic Service

Greece participates actively in the compilation of the IBCM, having undertaken since 1976 the production of the Aegean Sea plotting sheets according to the decisions of the Third Meeting of the *Ad-Hoc* Group of Experts of the IBCM that took place in Monaco from 5 to 8 April 1976. After the Fourth Session of the IBCM Editorial Board (Paris, 11-13 December 1989) a number of plotting sheets in the Ionian and Cretan Sea were added, raising the total number to 12.

The plotting sheets produced by Greece are shown on the diagrammatic index of the report of the Fourth Session of the IBCM Editorial Board (Paris, 11-13 December 1989).

The above plotting sheets have been compiled and distributed since 1978, while in the middle of the eighties, updating was carried out, based on additional data from Greek and other sources.

Production Responsibilities for the IBCM Plotting Sheets

The decisions of the 5th and 6th sessions of the IBCM Editorial Board (Trieste, 26-18 June 1991), changed the production responsibilities of IBCM plotting sheets 6303, 6307, 6311, 6315, and 6316 giving joint responsibilities to Greece and Turkey, thus lending political dimensions to a purely technical issue.

Greece, in order to overcome the problem, and in spite of the fact that since 1976 and for the 15 years thereafter had the responsibility for the compilation of the above-mentioned plotting sheets as shown on the diagrammatic index of the report of the Fourth Session of the IBCM Editorial Board (Paris, 11-13 December 1989), in January 1993 proposed to the Chairman of the IBCM and members of the Editorial Board to split responsibility of these sheets according to the dotted line shown on the attached diagram, so that:

a) The western part A included the area allocated to Greece, containing Greek coasts and territorial waters, as well as the international waters surrounded by them.

b) The eastern part B includes the area allocated to Turkey containing Turkish coasts and territorial waters, as well as international waters surrounded by them.

An arrangement like this is undoubtedly fair and at the same time does not contain any problems in its implementation. Particularly, as far as plotting sheet 6315 is concerned, since it does not contain Turkish territory, it is understood that the decision of the Editorial Board to split this allocation of this sheet between Greece and Turkey has been taken by mistake and therefore it must be allocated to Greece.

Maintenance of the IBCM Plotting Sheets by Greece

During the last 5 years, a major effort has been undertaken by HNHS for the digitization, review and updating of all the IBCM Plotting Sheets of our responsibility in the Arc/Info environment.

The sounding coverages were created by digitization of the original plotting sheets of the First Session of 1976. A few corrections and additions were applied, where necessary, based upon recent hydrographic surveys carried out by the HNHS.

The shoreline coverages were created by digitization of charts produced by photographic reduction of charts of scale 1:50,000 of the Hellenic Military Geographic Service (HMGS).

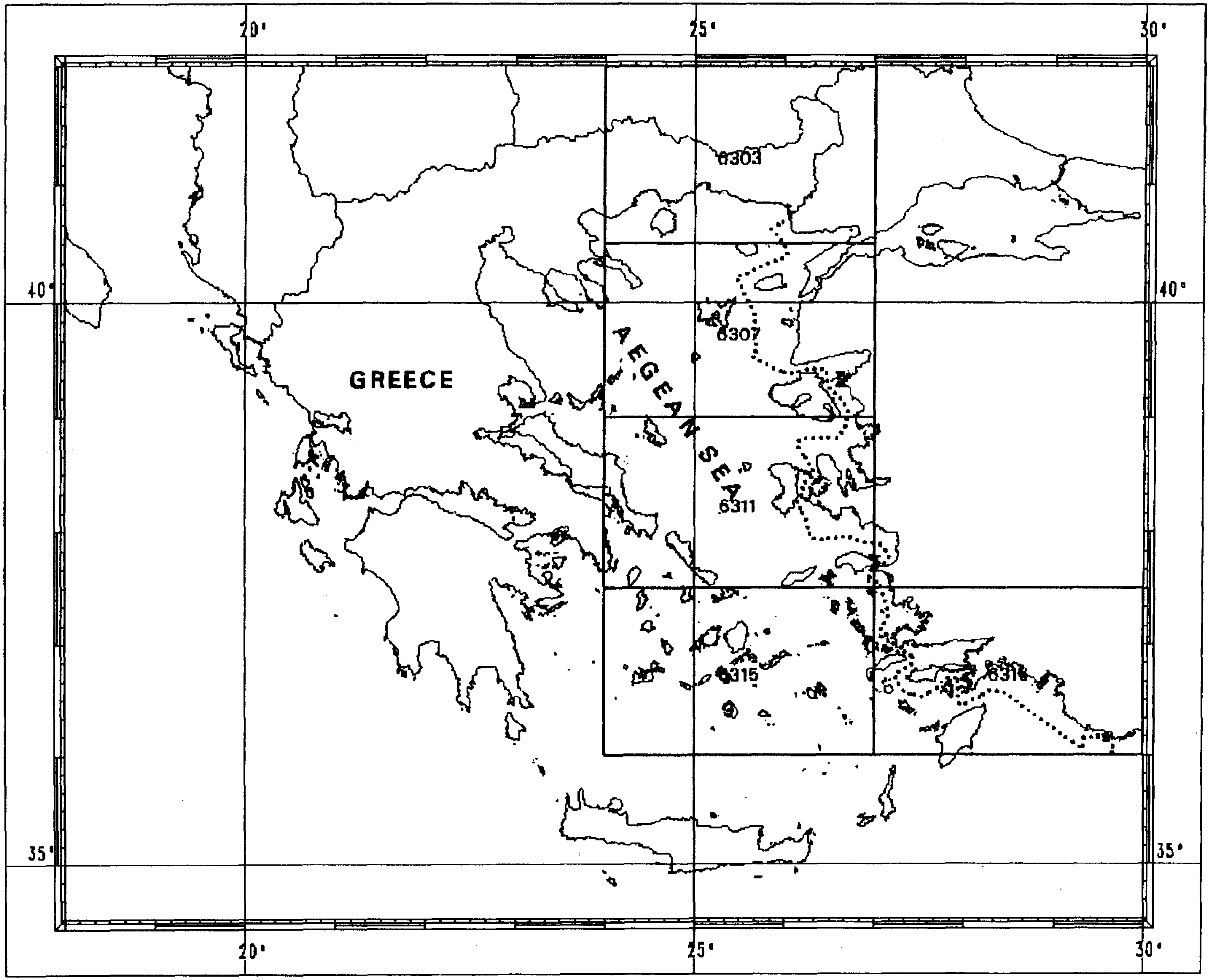
The chart borders, graduation, grids, etc., were calculated by an Arc/Info routine, which was developed in-house, and stored on separate layers for every plotting sheet.

Our future plans for the IBCM Plotting Sheets are:

1. To enhance the sounding coverages with data provided by domestic and foreign institutions.

2. To calculate the sounding contours and create appropriate layers using the Triangular Irregular Network (TIN) utility provided by Arc/Info.

3. To substitute the existing shoreline by the World Vector Shoreline (WVS) to be provided by DMA, refining it where necessary, by the 1:50,000 coastline of Greece, in digital form, which is under the last phase of development.


20°
25°
30°
40°
35°
GREECE
AEGEAN SEA
6303
6307
6311
6315

ANNEX III

NOTES ON PREPARATION OF THE SECOND EDITION OF THE IBCM (IBCM-II)

DR. JOHN K. HALL
GEOLOGICAL SURVEY OF ISRAEL
JERUSALEM, ISRAEL

I. DTM PHILOSOPHY:

1) Detailed grid information gives the best approximation to nature, since every place on the Earth's surface has an elevation or depth. This grid must be seamless, with some sort of data at every point.

2) Grid spacings were once determined by *what the data would justify*. Because of the generally sparse nature of regional bathymetry, these grids (*e.g.,* DBDB5 or ETOPO5 every 5' or 9 km) were usually too coarse to adequately represent those areas where detailed data exists. The present philosophy is to define a grid spacing *which will provide a place for all but the most detailed data.*

However, the grid spacing should not be so fine as to infringe upon proprietary/military/tactical sensitivities. Deep-water Mediterranean swath mapping can generally produce a grid of about 100 m. Inshore tactical surveys are around 0.05' or 90 m. Hence the 0.1' grid spacing (185 m at the Equator) chosen for the IBCM-II will contain about 25% of the information in these finer 100 m datasets.

3) Detailed grids allow all types of presentation and manipulation of the data. The simplest computers and software can easily interpolate elevation/depth points, profiles, and surfaces anywhere on the grid. If necessary, contours at any interval and datum can be produced by a variety of computer methods and software packages.

It is worth noting that the use of grids can also be very useful in concealing information about where and why surveys were carried out, and in obscuring fine details by providing a mathematical basis for filtering.

4) The future thrust of DTMs is to finally integrate land and marine data based upon the unifying element of GPS positioning and its single WGS-84 datum. Land data will be getting much more precise within the next few years, as will swath techniques in the deep sea. Although less than 5% of the world's oceans have been mapped to date, the time has finally come to attempt a compilation which will give a best estimate of elevations and depths in a format which is easily ungradable as new information will inevitably become available.

II. WHAT NO LONGER MATTERS:

A DTM vastly simplifies certain problems which are inherent in other compilations such as GEBCO, the General Bathymetric Chart of the Oceans. These are:

1) Scale independence: A grid is much less susceptible to scale dependence. At the basic IBCM scale of 1:1,000,000 at 38°N, the 0.1' grid means that the grid spacing will be (110.938/600) 0.185 mm in latitude and (87.835/600) 0.146 mm in longitude. At 1:100,000 scale this would be points every 1.85 and 1.46 mm respectively. At 1:10,000 scale this would be points every 1.85 and 1.46 cm. All of these spacings convey a great deal of information, and all of these can be smoothly interpolated if necessary. For topography, a spacing of 0.1' or 185 m at the Equator means that *most* of the major landforms that occur in nature are faithfully produced.

2) Contours: Contours are an inefficient method of portraying topography. They are tied to a particular datum. Hence the contours of uncorrected meters used by the U.S. Navy are incompatible with the corrected meters used by almost all others. For flat areas not near a contour interval, there is essentially no information (while flat areas falling on a contour should in principle be all black). Furthermore, the correct interpolation of data between contours is a difficult task unless slopes are uniform. Contours are also strongly scale dependent. For small scale charts (those showing a large area) a large contour interval is required to prevent the contours from merging, thus limiting what can be shown.

It is worth noting that not using contours also means that the amount of cartographic work required is vastly reduced.

3) Track lines: Both IBCM and GEBCO have shown the availability of data through solid lines denoting ship's tracks. However, this representation obscures the fact that most historical Track lines had spot soundings at intervals of one or more miles, and sometimes significant gaps over which soundings were not made. A DTM with some indication of data density on a relatively fine scale gives a much better feel for the amount of data. For instance, in most work with fair sheets on the shelves, it would be difficult to define tracks. Similarly, for swath surveys, a single track could represent over 4,000 spot soundings (12 kt, 162 beams, a swath every 12 sec) for every mile of track shown.

III. IBCM-II DESCRIPTION:

The Second Edition of the IBCM is to consist of a digital terrain model (DTM) of the areas covered in the First Edition. The DTM will consist of seamless data for both land and sea.

Basis:

DTM of land and sea - grid spacing 0.1' (185 m at the Equator).

Depth/Elevation resolution:

The Depth/elevation resolution will be 1 m.

Datum:

World Geodetic System 84 (WGS-84).

Coastline:

A line of co-ordinates in the WGS-84 datum taken from the most up-to-date measurements or digitized from the most detailed nautical charts that are available.

Areal Breakdown:

Ten IBCM sheets, each 8½° by 8½°, plus the inset of the Black Sea on Sheet 5 which is 7½° by 15°-52.5'. The entire area presently under this inset, will be represented in the DTM for Sheet 5. For the ten sheets of the IBCM, each sheet will be a file of 5101 rows, each with 5101 columns. At two bytes per depth or elevation (-32,768 to +32767), each file will be 26,020,201 elevations/depths, plus header, or 49.63 Mbyte of binary data. The Black Sea will be 4501 rows, each with 9526 columns, or 42,876,526 grid points, taking 81.78 Mbytes of binary data. Thus all the ten sheets plus the Black Sea will be 578.09 Mbytes. It is also planned that there will also be a file for each sheet giving the vectorial coastline as an ASCII string of geographic co-ordinates in the WGS-84 datum. Assuming a coastline of around 120,000 km, with up to 5 points per kilometer, this would be 600,000 co-ordinates. If each has an ASCII field like xx.xxxxxx xx.xxxxxx CR/LF comprising 21 characters, this will take 12.02 Mbyte. Hence all 590.1 Mbytes can easily fit on one 650 Mbyte CD-ROM.

For the purposes of quality control, there could also be a file giving a single byte (0-255) denoting the distance (in 0.1' node spacings) to go to the nearest data point. These distances are automatically calculated during the proposed Hardy multiquadric gridding process. However, this would require files one half as large as the DTM files, and thus require a second CD-ROM. A solution would be to instead specify the number of data points per each 1' square, which would require slightly over 3 Mbytes for the entire Mediterranean and Black Sea.

IV. Making the DTM: Inputs:

Land:

GTOPO30 average land elevations at 30 arcsec (0.5') spacing. Unlike the earlier GLOBE dataset, GTOPO30 has negative elevations for depressions like the Dead Sea, Qattara, etc.

Coastline:

WGS-84 coastlines provided by the VHOs or derived from digitization of the most detailed marine charts available for each area.

Marine areas:

1) IBCM Quarter Million Plotting Sheets maintained by the VHOs. In most cases these have transit data for deep water areas. Digitization shows that these sheets generally have from 1,000-8,000 soundings. Hence, the total number of soundings from this source for the Mediterranean (88 sheets) and Black Seas (22 sheets) is on the order of 450,000 soundings.

2) Hydrographic fair sheets from surveys by the VHOs. In the eastern Mediterranean, historical coverage by the UKHO has been used to define the inner shelf bathymetry of Mandatory Palestine (80,000 soundings), Cyprus (183,000 soundings), and Egyptian Nile Delta (250,000 soundings). One of the tremendous contributions that the VHOs could make is to make available the fair sheets for the earlier reconnaissance surveys in areas which today are generally not well-traveled. It is important to realize the contribution of early survey work which was carried out with an eye to providing refuge to sailing ships or fueling stops for coal/wood fired steamships. These little surveys now provide good detail in areas which modern navigators never approach.

3) Standard published hydrographic navigation/piloting charts: Over 800 published hydrographic charts have been digitized to date for the Mediterranean east of 10°E (and for the Red and Black Seas). These charts, at scales of from 1:7,500 to 1:200,000, include from a few hundreds to over 5,000 soundings each. These charts generally provide sufficient data to produce a contingency DTM (in the absence of better data). The data distribution is of course skewed in favor of populated areas serviced by ships.

These charts also show bottom sediment types (related to anchor holding capability) in numbers that can range from 1-30% of the number of soundings.

4) Proprietary/military surveys: These data exist for various areas in the Mediterranean. They will be used where available. However, their existence will not be acknowledged unless the data providers specifically request acknowledgment. Existence of these datapoints could be hinted at in the data density calculations.

5) Digital data in the NGDC GEODAS and IHO Digital Bathymetry databases: Much of the earlier data is already on the Admiralty Quarter Million IBCM Plotting Sheets. Later data (essentially post 1992) is not on these sheets. However, the post 1992 period coincides with that in which many non-geophysical cruises unfortunately did not operate their echo-sounders.

6) Scientific tracks not in the NGDC and IHO databases: These consist of scientific cruises where data was taken, but never digitized and submitted. These results are only available if one takes the trouble to track them down, digitize, and evaluate them. For the eastern Mediterranean, there is perhaps an amount equal to what is the databases.

7) Scientific swath mapping: This is the technology which is producing the biggest breakthroughs. As the CIESM Round Table on Multibeam Swath Mapping has shown, within the past few months perhaps 50% of the deep eastern Mediterranean has been systematically covered by IFREMER's l'Atalante with its swath coverage of seven times the water depth. This coverage is changing the whole process of compilation in several ways. These are:

a) Because it is scientifically based, the areas of coverage are immediately known. Therefore, these areas can be regarded as *done*, with no further need to compile essentially random data.

b) Initially this data can only be considered as proprietary. The funding agencies paying some US $1000 per hour of 10 knot survey are not about to give the data away. However, there is little reason to believe that within several years the data will not become available, especially for a compilational effort which is sure to enhance the overall scientific understanding of the survey area within its regional setting.

c) Because of its geometric constraints (0.7 to 7 times the water depth), swath mapping will be primarily devoted to deep areas where it is much more efficient. These are by far the largest areas to be covered, and have the poorest coverage by passage soundings (due to the larger area, to larger depths requiring relatively sophisticated sounding techniques, to the distance from shore producing poorer navigational accuracy in pre-GPS times etc.). In addition, they are international areas which are not of highest interest to any of the VHOs.

8) Availability of Swath Data to the IBCM-II: There are three ways in which the agencies gathering this swath mapping data can accelerate the process whereby the data can be used in compilation of the IBCM-II. None of the three detract from its proprietary nature, with respect to theses in preparation, scientific findings in preparation or in press, etc. These are:

a) Providing the exact limits of the polygons which have been covered. Basically complete swath coverage renders any older random data useless. In this way it is possible to concentrate on areas outside these polygons.

b) Providing the data in gridded form on 0.1' spacing for eventual dropping into the compilational DTM, once proprietary considerations are invalid.

c) Might it not be possible to accelerate the early transfer of swath data to IBCM-II by providing a low-pass filtered dataset in which the depths are smoothed so that short-wavelength features of up to 50-100 m amplitude are obliterated? This would allow compilational efforts to proceed within and around the polygons, without revealing the sedimentary and neotectonic features which originally spurred on such detailed and expensive mapping. The actual non-filtered data could then be transferred at a much later date.

V. IBCM-II END PRODUCT - 'DELIVERABLES':

1) The digital DTMs and the WGS coastlines for the eleven sheets (ten sheets plus the Black Sea) will be on a single CD-ROM. Possibly this would include two more files, one for the Mediterranean and one for the Black Sea, giving the original data density per 1' square.

At this stage it is envisaged that the CD-ROM software would consist of:

a) A PC programme to generate an elevation/depth for any lat/long.
b) A PC programme to generate profiles at given spacing between any two points
c) A PC programme to generate a raster grid file for any area at the 0.1' spacing or any multiple thereof, for any area. This file could be the format of commonly used off-the-shelf manipulation and visualization programmes such as Surfer® (.GRD), Arc/Info® (.ARC), AutoCAD® (.ACD), etc.

2) It is uncertain what form a printed version of the IBCM-II would take, for the CD-ROM allows almost unlimited visualization possibilities to a computer-equipped user. The idea of any sort of traditional contour chart is totally unrealistic. However, it would be a straightforward matter to produce another set of ten hypsometrically colored shaded relief sheets at 1:1,000,000 scale. However, the scale independence of the DTM removes the original justification of having a set of relatively large scale basemaps on which to work.

Hence, at this stage it seems reasonable to imagine printing a single sheet of the IBCM-II with hypsometrically colored shaded relief presentation, where color transitions mark prominent isobaths. This could be done at a scale of 1:3M or 1:4M, and at a variety of smaller formats for postcards, centerfolds, and advertising. A recent example of such presentations is the Undersea New Zealand poster and postcard published in 1996 by the New Zealand National Institute for Water and Atmospheric Research Ltd. (NIWA).

The amount of cartographic work would be minimal, since the digital data would be used to prepare raster TIFF files for generation of color separations, and the legend, graticule, and minimal nomenclature would be from a separate scalable PostScript® file.

VI. HOW THE DTM IS PRODUCED - EXPERIENCE 1987 TO PRESENT:

Land:

The U.S. Geological Survey's EROS Data Center has made an elevation dataset from the Distributed Active Archive Center (DAAC) available to the public, free of charge. GTOPO30 is a global digital elevation model (DEM) developed through a collaborative effort involving the EROS Data Center (EDC), NASA, the Geographical Survey Institute of Japan, and other organizations from the United Nations, Mexico, and New Zealand. It contains elevation data from around the world at horizontal spacings of 30 arc seconds (approximately one kilometer) and can be downloaded from the Internet (<http://edcwww.cr.usgs.govlanddaac>). A set of five CD-ROMs can also be ordered from EDC, at no cost to the user. [*Abstracted from announcement by Devra Wexler, AGI Geotimes, Vol. 42(11), Nov. 1997, p. 10. Telephone orders may be placed to (605) 594-6116 or Faxed to (605) 594-6589. Delivery time for the five CDs is about two weeks*].

1) The GTOPO30 data must be read from the appropriate CD-ROM, and its two-byte integers transformed from the Motorola byte order to that of Intel. The transformed data are placed in a file on disk ready for reinterpolation.

2) The GTOPO30 elevations are averages for 0.5' square areas. For each IBCM sheet an array of 1024 by 1024 values is prepared (with two rows/columns of elevations outside the area of the sheet to allow smooth interpolation to the edge of the sheet). These are reinterpolated 20:1 using the bi-directional third-degree parabolic blending functions described in Doytsher and Hall (1997b). Every second column value from every second row is then taken, to produce spot heights every 0.1'. This is not exactly the ideal way of producing correct elevations, but the results look good and agree with the contours in the original IBCM. The resulting 5101 by 5101 array is stored as two-byte integers in a binary file using the MSF format used in the Israeli DTM work. This format uses 1024 byte blocks for the storage of 512 integers, with an initial 1024 byte header giving information on the file. The file is written W to E line by line, from N to S, beginning in the northwest corner and ending in the SE corner of the sheet. This is according to the usual coordinate conventions used in the Scitex and IBM PC systems.

3) The file with the land data is kept separately from that of the marine until the marine component is completed.

It should be noted that use of GTOPO30 is a stopgap measure. The land DEM community is awaiting the production of a totally revolutionary land DEM in the coming years. NASA and NIMA (the National Imagery and Mapping Agency which replaced the old Defense Mapping Agency) are planning an 11 day mission on the Space Shuttle Endeavor in August 1999 which will use INSAR or Interferometric Synthetic Aperture Radar to produce a DEM of all the land areas between 60°N and 60°S. A 60 m boom will be constructed from the shuttle cargo-bay, to separate two C band radars which will provide interferometry to generate a DEM on a 30 m grid. The data processing will be done at the Jet Propulsion Laboratory. Those involved in the project promise (personal communication, ESA FRINGE meeting, Zurich, 1996) that the data for outside the US will be available to the public on a 100 m grid. If this is so, this dataset will probably constitute the land segment for the final IBCM-II.

Note:

It is instructive to note the difference between Digital Elevation Model (DEM) or Digital Terrain Elevation Model (DTED), and Digital Terrain Model (DTM). DEMs and DTEDs include the ground cover, or those things such as buildings and tree canopies which reflect the radar signals, and which could interfere with flight. DTMs represent the contact of the earth's rocky surface or *regolith* with the atmosphere.

Marine areas:

To define these, the WGS-84 coastline is used to delineate the dividing line between land and sea. This is done in the same rudimentary way that the Israel DTM was prepared (Hall et al., 1990). A matrix of PC EGA format (640 by 350 pixel) screens is set up, each represented by its own file on disk. To cover the area of 5101 by 5101 pixels, a matrix of white screens 8 wide and 15 high (120 total) is needed. The digital WGS-84 coastline is then plotted on each of these screens, and if any coastline appears on that screen a flood of red color is initiated at 90° to the right of it, on the land. Any screens entirely on land are also flooded red. The screen matrix is then used to prepare a second binary file for each sheet which will contain the depths for the marine areas. Sequentially reading off the color contents of the screens, the binary file is prepared, with the red areas set to +1, the coastline set to 0, and the marine areas set to -32767, meaning no data (yet).

This method can also be used for defining extensive shoal areas such as those found off Tunisia, or in the Red Sea. The outlines of the areas are digitized from the colored areas on the navigational charts, plotted on the screen matrix, and filled with the appropriate color. When read off to make the binary file, an appropriate depth is assigned to the shoal area, and the black borders associated with the shoal color are not reported as 0 but as the value of the shoal. These interactive-graphical methods for large images are very simplistic and easy to programme.

Preparation of digital depth data from various sources:

For gridding, the data must be available digitally as *x,y,z* triads or position and depth. If it is not, then it must be digitized using a variety of techniques. All soundings obtained by measuring two-way travel time are converted to meters by using the appropriate corrections in Matthews' (1939) or Carter's (1980) tables.

1) Sounding records or echograms are digitized from projected microfilm or from the original records on a digitizer tablet. The depth is digitized against time or event number, and the navigational tracks is digitized against time or event number. The position of the soundings is then determined by eliminating the parametric time/events, under the assumption of constant speed and course between fixes.

2) Spot soundings on charts or fair sheets are digitized by scanning the charts at 200 or 300 dpi, and using PC 'heads-up' digitizing techniques to digitize the soundings, again from a matrix of EGA screens. This we have done (Hall, 1997) for more than 800 charts at scales of 1:4,000 to 1:500,000, with up to 75,000 soundings on a single sheet (Abu Qir Bay). The positions of the overprinted map graticule are digitized and used to generate equations which describe an affine transformation with a rubber sheeting component (Doytsher and Hall, 1997a), thus allowing the digitized pixel locations to be transformed to geographic position. Sediment information related to anchor-holding quality of the bottom are also extracted. For charts in the WGS-84 datum, it is possible to digitize the coast directly from the scans. If the charts are for a different datum, then the digital WGS-84 coastline can be overplotted on the screen matrix so as to measure the positional offsets in pixels to be applied to the digitized data.

3) For survey areas represented only by closely spaced contours (such as those of the early Seabeam swath surveys), a DTM can be produced by using the methods described by Hall et al. (1990). The contour map is scanned, the image resized and fitted into a known map co-ordinate set, and then ten colors are used to fill the intervals between contours. W-E and N-S profiles on the required grid are then built up of the topography by using a seed height at one corner and then identifying the contour values through their bounding colors. This is an extremely easy method to use, and has been used to build 25 m DTMs of about 150,000 km² from 1:50,000 scale mapping of 10-20 m contours in Israel, Cyprus, and the neighboring countries. This is also very useful for converting uncorrected contours into corrected DTMs.

Production of the marine DTM:

1) For detailed swath mapping survey areas which can readily be gridded to 0.1', the final DTM will be simply dropped into place. This will probably be the case with the new l'Atalante data when it becomes available. The same will apply for any areas with dense contours which were directly converted to DTMs on a 0.1' grid.

2) For isolated soundings, the DTM gridding process used is based upon the multiquadric equations of topography of Hardy (1971). These equations use irregular data to generate an analytic surface fitting all the data points. The method is seldom used in practice, since it is computationally very intensive. It consists of taking *n* data points, and using the distances between them to solve *n* equations in *n* unknowns. The surface is then calculated at each node by computing the distances to the *n* datapoints and summing these distances times the vector components of the diagonal terms of the solved determinant of the distance coefficients. In practice, on a Pentium II PC up to 300 points can be treated in a few seconds, and used to interpolate a surface over the interior of the area covered by the points. Sufficient overlap is required so that the interior area interpolated will fit with its neighbours.

3) For the inshore areas with relatively dense hydrographic data, the DTM is calculated by just automatically stepping through areas of 1-4 square minutes, depending upon the data density. The DTM is calculated using data for a much larger area, with sufficient overlap to produce an smooth surface overall.

4) For areas in which only sparse soundings are available, primarily in the deep sea with its passage soundings, significant holes with no data exist. These can be up to several hundreds of square minutes. In these areas the gridding process needs some sort of general data to guide it. Several possibilities exist for providing this guide data.

a) One possibility is the use of gridded datasets, such as those made by the U.S. Navy for the Mediterranean. The one at 1' is now apparently available, but I consider it unlikely that its basis in the eastern Mediterranean is better than what is already available to IBCM. Apparently another dataset also exists at 0.5' spacing. It was to have been released around 1995 but unfortunately this never happened.

b) The second possibility, which is what has been used in tests on Sheet 10, is the calculation of a 0.5' dataset based upon a high speed gridding of all the available data (tens of thousands up to millions of points) using a nonexact interpolator such as minimum curvature splines or kriging. This was done using the minimum curvature option in Surfer® for Windows (Keckler, 1995). For a single IBCM sheet this requires an array of 1021 by 1021 points which is not excessive. These data points are only used if no data exists for the 1' square box centered on the guide datapoint.

5) Gridding of the sparsely sounded areas can also be carried out more or less automatically. Relatively larger areas are taken into consideration, the equations set up and solved, and then the interior areas gridded.

6) In the tests carried out on Sheet 10, a graphical interface was developed using FORTRAN programming and EGA color graphics (16 colors, 640 by 350 pixels). The upper left corner of an area was defined, and then a grey area of 64 by 35 minutes was displayed, each pixel representing a 0.1' node. The data for that area, plus a bordering strip was then extracted from the main file with all data, and plotted as white dots at the nearest grid node. The guide grid was then plotted out as pink dots. Those guide datapoints to be used can be graphically determined by seeing if they fall into a grey area 10 by 10 pixels in size (this is easier than going back through the data). The land and marine binary files can then be written onto the screen. If already gridded data exists, then it is plotted as color dots according to a chosen depth/elevation interval using a 10 color spectral palette.

On the shelf areas a color interval of 1-2 m was chosen, while for slope and deeper areas the interval might be 10-50 m depending upon complexity. This 'layercake effect' of repeated spectral colors shows what has been done, and how the different areas match. The contacts between colors basically define contours. At this point further gridding can be carried out. Instructions are given via a 16 button cursor on a digitizing tablet. Areas are defined using a rubber rectangle, and if 290 or less points exist within it, then the equations are set up and solved. Then sub-areas can be defined for which the gridding is done, with the spectral colors being plotted out, except where white data dots exist. The method shows how the gridding will go, and was useful in defining how a more automated method could be programmed. The colors immediately show where datapoints are bad. These bad datapoints can be identified and removed from the gridding process. As previously mentioned, an array of only 8 by 15 EGA screens can cover the entire area of an IBCM sheet. Thus, the interpolation for a single sheet can be carried out in a relatively short period of time with a $2000 PC system with digitizer.

g) Areas with extensive small islands, or port facilities, can be gridded in a different way. Instead of relying on the land data, which will be applied only to those areas where marine data doesn't exist, it is possible to digitize the shoreline as a number of 0 depths, together with the local maximal heights which generally appear on the charts, as well as formlines if they exist. Using this data, the Hardy multiquadric surface gridding will do a sufficiently good job of representing the land and sea topography.

Indication of Data Density:

The original concept of how to indicate data density was to keep a second binary file with extension DDD (for instance SHEET10M.DDD where the M indicates Marine). This type of data would naturally fall out of the multiquadric surface calculation. This binary file would be half the size of the DTM file, since a single byte would be used to indicate the distance from each grid node to the nearest sounding, in grid spacings. With the 0.1' grid spacing, a value of 0 would indicate data within less than 100 m, while a value of 255 would be 25.5' (up to 25.5 nm) away. As noted above, these files would take too much space to be included on the single IBCM-II CD-ROM. Hence, the alternate suggestion above of using a single byte to indicate the number of data points per square minute, or about 260 Kbytes per map sheet.

VII. WHAT CAN THE VHOs PROVIDE?:

For a seamless DTM of land and sea, the future VHO contribution lies primarily in providing quality controlled data for the coastal and shelf/slope areas within their territorial or EEZ waters. Deep water swath mapping and the establishment of the NGDC and IHO Digital Bathymetry Databases has reduced the role once played in the maintenance of the Quarter Million Plotting Sheets. A listing of the potential contributions is as follows:

1) Digitized coastlines as ASCII strings of latitude/longitudes to appropriate precision (better than 50-100 m). A useful digitizing convention to simplify spatial calculations/manipulations is to always proceed along the coast so that the high side (land) is on the right.

2) Quarter Million Plotting Sheets with analog soundings for historical data up to 1992 (the generally agreed time at which VHOs began digitizing their data). Most, if not all, of these have been digitized.

3) Digital soundings from tracks obtained post 1992 or whenever digital data collection began. It is important that VHOs exchange data obtained in areas of responsibility other than their own.

4) Hydrographic fair sheets in analog form for reconnaissance surveys along less navigated shores.

5) Within the Mediterranean and Black Seas the original IBCM Zones of Responsibility were taken on by the VHOs of France (10), Greece (interest in up to 12), Italy (21), Russia (26), Spain (10) and Turkey (interest in up to 18). However, there are now over twenty littoral states and other political entities with hydrographic interests in the Mediterranean, and another five in the Black Sea. It goes without saying that each of these has reached a different level of coverage for their areas, and a different degree of success in digitizing past holdings and obtaining new digital data. It is presumed that unless the Mediterranean Black Sea Hydrographic Commission is able to reach a fantastic level of consensus, the procedure of obtaining data for each of these areas will be somewhat different. Hence, a variety of possibilities exist.

These are:

a) Provide analog data (contours, spot soundings, echograms, etc.) for digitizing, from which grids will be interpolated by IBCM (*e.g.,* Turkey, HDNO - Russia, and the UKHO).

b) Provide digital data (*x,y,z*) which could be gridded by IBCM (*e.g.,* HDNO - Russia).

c) Provide gridded data (*z* only) at 0.1' spacing from internally digitized datasets (*e.g.,* the preference of the Italian Instituto Idrigrafico della Marina).

d) Provide no data, in which case published charts would be used to provide coastlines and soundings to fill gaps (*e.g.,* much of the Levant).

I maintain that the VHOs should go out of their way to actively gather data at sea for IBCM-II. The limit of any extra effort might consist of encouraging the inclusion of proprietary or sensitive data in the in-house generation of DTMs.

VIII. USES FOR THE DTM:

Numerous computations to be carried out on gridded topographic data. Looking into the future, it is likely that in 10 years time the computing power of the PC will be ~100 times what it is today. It is also likely that by that time ships will be able to receive in real-time vast quantities of synoptic oceanographic and meteorological data. This raises interesting possibilities about the use of local land and seafloor topography to calculate in real time the various factors influencing the safe handling of ships. Among these factors, and others are:

1) tides,
2) current streams of whatever origin,
3) wave climate,
4) wind interaction with the coasts
5) land radar signatures
6) HF/VHF/UHF and microwave propagation inshore
7) tsunami runup
9) flushing of pollutants
10) coastal zone planning
11) ocean dumping
12) fisheries
13) dredging
14) continental margin definition for UNCLOS
15) calibration/validation of automated echo-sounding
16) ASW in the deep ocean and littoral zones
17) oceanographic modelling, water exchange
18) pipeline and cable survey planning

IX. REFERENCES CITED:

Carter, D. J. T., 1980. Echo-sounding correction tables (formerly Matthews' Tables). Hydrographic Department, Ministry of Defense, Taunton, United Kingdom, Publication NP-139, 3rd Edition, 150 p. (also available on computer magnetic media).

Doytsher, Y., and Hall, J. K., 1997a. Gridded affine transformation and rubber-sheeting algorithm with FORTRAN program for calibrating scanned hydrographic survey maps. *Computers & Geosciences*, 23(7), p. 785-791.

Doytsher, Y., and Hall, J. K., 1997b. Interpolation of DTM using bi-directional third-degree parabolic equations, with FORTRAN subroutines. *Comp. & Geosci.*, 23(9), p. 1013-1020.

Hall, J. K., 1996. Historical bathymetric surveys of the inner continental shelf of the southeastern Levant. In: R. Bogoch and T. Weissbrod (eds.), *Geol. Surv. Isr. Current Research*, v. 10, Jerusalem, p. 40-45, 1996.

Hall, J. K., Schwartz, E. and Cleave, R. L. W., 1990. The Israeli DTM (Digital Terrain Map) Project. In: *Microcomputer Applications in Geology*, Volume II. (J. Thomas Hanley and Daniel F. Merriam eds.), pp. 111-118. Pergamon Press. Includes FORTRAN-77 DTM program on diskette as part of the COGS (Computer Oriented Geological Society) public-domain library.

Hardy, R. L:, 1971. Multiquadric equations of topography and other irregular surfaces. *J. Geophys. Res.*, 76(8), p. 1905-1915.

Keckler, D., 1995. Surfer® for Windows, Version 6. User's Guide. Golden Software, Inc., Golden, CO, 528 p.

Matthews, D. J., 1939. Tables of the velocity of sound in pure water and sea water for use in echo sounding and sound ranging (Second edition). British Admiralty Hydrographic Department, Publ. H.D. 282, London, 52 p.

ANNEX IV

APPENDIX FOR THE EXPLANATORY NOTE TO THE NEW EDITION OF THE 'MAGNETIC FIELD ANOMALIES (T_A) OF THE BLACK SEA'

by
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1. During the compilation of this map, the methodological goal of this activity was the most complete and detailed data coverage of the seabed and the shoreline of the Black Sea. To avoid a presence of the "white spots" on the map the use of magnetometric materials varying in precision, method of measurement, and epoch of measurement was allowed. Some of these materials were partially processed and compiled into a single massive while there were some discrepancies between other components regarding the magnetic level. For the areas that were related to the shoreline of the Black Sea, the main task was to follow structural relationships of local specific features of anomalies related to the seabed and land surface.

Geological goals of this work (that were not addressed yet) will be directed towards the identification of new side-fault magnetically-active linear elements of the crust and the refining elements that were identified earlier. To address these goals it is planned to identify a more detailed structure of magnetic anomalies of the seabed, conduct the regionalisation of the territory on the basis of the original field and using materials related the correct and incorrect transformation. The use of profile (KMPV-GSZ) and areal (MOV) seismic materials would allow one to estimate 3D models of magnetization of the consolidated basement.

2. The following materials were used for the compilation of the map:

- computer files of profile hydromagnetic surveys conducted in 1967-1994 by the geophysical survey company "Yuzhmorgeo". These surveys were conducted by B. D. Uglov, V. A. Lygin and others at different times. These materials were partially used by V. V. Soloviev in 1983. These materials were not processed in their integrity and no maps were published. Profile lines are shown on the scheme of actual materials;

- computer files of a detailed areal hydromagnetic survey, 1 :250,000 scale, conducted on the shelf zone of the Bulgarian sector of the Black Sea in 1990. The faculty of the Moscow State University V. P. Melikhov, A. M. Shamaro, and P. N. Kuprin conducted this work. Results of this survey were never published before;

- maps of the results of the detailed areal hydromagnetic surveys were conducted by the Trust "Dneprogeophysika" in 1968 and 1972- 1974, to the west to the Crimea Peninsula. The authors are A. Ya. Krasnoschek, V. I. Samsonov, and A. N. Vikhritskyi. The results obtained were published in 1988 and were included in the compilation Sheet L-36 of the *Map of Anomalies of Magnetic Field of the USSR*;

- schematic map of the results of the hydromagnetic survey of 1969, 1975, and 1976 conducted near the Bulgarian shoreline. The authors are B. V. Osipov, B. D. Uglov, and Ya. P. Malovitskyi. Materials, together with the land-related data by Grigorov, were published in 1979 in the *Monograph of the Bulgarian Academy of Sciences*;

- schematic map of the results of the hydromagnetic survey (D. V. Romanescu et al., 1975) along the Romanian shoreline published together with the land data in 1979 in the *Monograph of the Bulgarian Academy of Science*;

- maps of the results of the areal magnetic survey, 1:200,000 scale, related to the northwestern part of the Black Sea, the North Crimea, and the west part of the Azov Sea. The survey was conducted from 1957 to 1983. The results were revised based on the standard methodology and tied to the system of the State registration magnetic survey points. The results were published in 1988 (*Map of Anomalies of Magnefic Field of the USSR*, Sheet L-36); - map of results of area magnetic survey related to the East part of the Azov Sea and the Black Sea shores of the Caucasus. The map (1:2,500,000 scale) was published in 1974 (*Map of Anomalies of the Magnetic Field of the USSR*, Sheet 7);

- map of the field Z_a of the land surface magnetic survey of the mountain part of the Crimea. The map was published in 1988 (1:200,000 and 1:100,000 scales) as an insert to the *Map of Anomalies of the Magnetic Field of the USSR*.

3. The methodology of the processing of materials and the compilation of the summary map related to the Black Sea and its shoreline were mainly oriented towards hydromagnetic surveys. At the first stage, profile measurements were corrected in relation to the normal magnetic fields considering the year of a survey. An attempt to tie surveys to the normal fields of the 1996 period failed, *i.e.*, the level of magnetic field on the seabed began to differ sharply from the level of the field in sheets of the State Survey of the USSR published and tied together. Because of this problem it was decided not to make additional mistakes on the regional level and the trend, but to revise processed hydromagnetic surveys on the basis of a normal field of 1965 period. Thus, it was decided to tie the anomaly magnetic field of the seabed to the level of the Main State Survey conducted in the northern and eastern parts of the region.

Based on the results of approval of maps on magnetic anomalies (1:100,000 scale) by the State Commission, a mean square error related to their compilation was estimated at 0.22 mOe. In hydromagnetic materials, the error in anomalies of the seabed estimated based on the points of intersection of the overall selection of the profiles was 0.37 mOe. Such a high error may be explained by the differences in the quality of the original material. Based on the catalogues of surveys (especially of old surveys), it is difficult to understand how and to what extent the corrections to deviation, *i.e.*, qualitative corrections in respect to the variations in geomagnetic field, were made. The information related to these issues was lost in parts or was inaccessible. The analysis of errors that was conducted indicated that surveys in the East Depression of the Black Sea characterized by the high amplitudes and higher rate of differentiation have the highest errors in their intersections. In several cases, the linear anomalies were observed that looked like the "profile" anomalies, but of varying amplitude (0-2 mOe). They did not have a systematic dependency from the survey year. Considering their correspondence to the large linear positive zone of the northwestern lineation their genesis and geological nature is possible. Considering this fact we did not feel that there is a basis for their complete exclusion from the future compilations. Nevertheless, the levelling of the data was made by a re-estimation of the matrix of the original data in respect to the upper subsurface at the depth of 0.5 km that corresponded to the lowering of the field to the level of the original mean square error of 0.37 mOe. The important fact is that linear (or "profile") anomalies identified in the seabed of the northwestern extent correlated with the anomalies peculiarities of the magnetic field of the Caucasian shore.

A satisfactory correlation of the field isolines based on the hydromagnetic and aerial magnetic data in the northwestern part of the Black Sea and to the west of the Crimea Peninsula represents an additional indicator of the optimum selection of parameters during the compilation of the new map.

A justified isoline "step" is 1 mOe. But considering an interprofile correlation of the anomaly effects (and for the best visual demonstration) we decided that it will be possible to present a resulting map of magnetic field anomalies of the seabed using the isoline "step" of 0.5 mOe.

4. The new edition of the map of the anomalies of the *Magnetic Field of the Black Sea* differs of the map compiled earlier by V. V. Soloviev (1983) in terms of the larger volume of the original data that were used in the map compilation. The greatest differences in the character of the field were noticed in:

1. the central part of the seabed, *i.e.*, in the zone that divides Western and Eastern Depressions;
2. the area to the south and to the southeast of the Crimea-Kerch shore, *i.e.*, in the zone of the connection of the structures of the Crimea and the Black Sea Depression;
3. the southwestern seabed, in the area of connection of the East Staraya Planina mountains, structures of the West Pont mountains, and structures of the Black Sea Depression.

Overall, the appearance of the isolines of the magnetic field related to the entire seabed is more differential and less levelled compared to the old edition of the map by V. V. Soloviev; in several cases, the extent of the local zone of the field were more clearly identified.

At the present time, for the purpose of saving resources and time it would be desirable to supply this map with the additional data on the magnetic field of the Turkish shore. Addition of these materials would enhance greatly the informational value of the new edition of the map and the reliability of the subsequent geological conclusion related not only to the side-fault structure of the marine crystalline basement, but would also specifically contribute to the goal of the paleo-reconstruction of the tectonic sphere of the region.

ANNEX V

MAPPING THE CONTINENTAL SHELF
Geology, geophysics and geo-ecology

Prof. Nicolae Panin
General Director, National Institute of Marine Geology and Geo-ecology
Bucharest, Romania

Continental shelves of the Black Sea have been studied from different points of view, including geologic structure and evolution, mineral resources, environmental state, hazards, etc. by each riparian country in their own section. Thematic mapping of shelf area was carried out by specialised institutions in different countries. For gathering the entire existing information, the obtained maps have been included in the Black Sea GIS, created in 1995-1997 period by a consortium of riparian countries research institutes under the co-ordination of the Black Sea Environmental Programme PCU.

This Black Sea GIS contains, for demonstrating the principle of complex mapping of the marine bottom, the geological and geophysical maps of the Romanian continental shelf, carried out by the National Institute of Marine Geology and Geo-ecology of Romania (former Romanian Centre of Marine Geology and Geo-ecology).

Maps at two scales are presented: 1:200,000 and 1:50,000. The Romanian continental shelf of the Black Sea is already entirely mapped at 1:200,000 scale: 7 sheets covering an area of almost 22,000 Km². The mapping at 1:50,000 is underway, being carried out for approximately 35% of the mentioned area (the survey have started with the inner shelf zone).

The original maps are thematic ones: they cover geology-sedimentology, bathymetry, geophysics - gravimetry and magnetic fields, geo-ecology. The Black Sea GIS includes, at present, only the geological-sedimentological maps, which are presented by meaning of different main layers:

- sedimentology (grain size) of the bottom sediments;
- clay minerals distribution in the bottom sediments;
- heavy minerals distribution in the bottom sediments;
- micropaleontological and benthos distribution (molluscs assemblages) on the bottom sediments.

The original maps have all these layers superposed and contain additional information about sporo-polenic spectrum in the sediments, characteristic assemblages of foraminifera and ostracoda, main physico-mechanical characteristics of the sediments (density and humidity), some geochemical information (CaCO3 content), the distribution of present day and fossil characteristic benthic assemblages, etc.

The maps have also three or four vignettes for showing the sheet position as well as samples and sub-bottom profiler lines location.

Information about the map projection system and the precision of the sample and sub-bottom profiling line positioning is also supplied.

Sedimentological map of bottom sediments

The area represented by one sheet of sedimentological map at 1 :200,000 scale is of 1,600 Km². This area is covered by a dense network of sampling stations for having a satisfactory image on the distribution of sediments within the considered area.

The samples have been analysed from grain size point of view by combined classical methods (sieving for the coarse fraction >63 µm and sedimentation for fine material <63 µm). The resulted data were statistically processed and the sediments were classified using the Shepard's triangular diagram into 10 grain size classes. All these classes are represented on the original maps. For the Black Sea GIS simplification of grain size classes has been made. The sediments have been grouped into only four classes:

- mainly sandy sediments containing sands, clayey sands and silty sands;
- mainly silty sediments regrouping silts, sandy silts and clayey silts;
- mainly clayey sediments containing clays, silty clays and sandy clays.
- the last category is sand-silt-clay mixture, representing the sediments formed of sand, silt and clay in almost equal quantity.

The GIS maps present the distribution of these four grain size categories of sediments on the continental shelf within the area represented by the considered sheet of sedimentological map. In addition information about bathymetry is presented on the same map. For the continental shelf the contour lines are spaced at 2.5 m.

Analysing the sedimentological maps of the Romanian continental shelf one could easily recognize the different main depositional zones encountered on the shelf:

- Danube Delta Front with delta front platform and slope;
- Danube Prodelta;
- littoral zone;
- inner continental shelf under the influence of the Danube born sediment drift;
- outer shelf, sediment starving zone.

Maps of clay minerals distribution

X-ray analyses for determining specifically the clay minerals have been carried out on sediment samples collected in the same network of sampling stations as for the sedimentological (grain size) layer of the map. The results have been processed and interpreted and, finally, areas of predominance of different clay minerals evidenced. Mainly three categories are presented: areas where montmorillonite is dominant, areas with illite as dominant clay mineral and areas where chlorite + kaolinite represent at least 30 % of clay minerals amount.

The clay minerals distribution maps could help in highlighting the different sources of sediments responsible for supplying the Black Sea continental shelf zone as major river sediment discharge, coastal area erosion, other local sources, etc.

Maps of heavy minerals distribution

Heavy minerals quantitative analyses have been carried out on the sandy fraction (0.250-0.0063 mm) of sediment samples taken in the same network of sampling stations as for the sedimentological (grain size) layer of the map. The results have been processed and interpreted and areas of different assemblages of heavy minerals occurrence evidenced.

One could separate on the base of different mineral species participation within the heavy fraction composition the following assemblages (the order of citation indicates the relative predominance of each mineral species):

a) garnets-amphiboles-epidote-opacites-pyroxenes;
b) amphiboWes-garnets-opacites-epidote;
c) garnets-opacites-amphiboles-epidote-pyroxenes;
d) garnets-epidote-opacites-amphiboles.

The heavy minerals distribution maps are a very good tool for determining the sources of supplies with terrigenous material of the continental shelf. On the Romanian shelf the main source is the River Danube, more specifically its bed-load. The sediments brought by the Danube are redistributed along the coasts by the littoral sediment drift system, which in the western part of the Black Sea is oriented from North to South.

The heavy minerals distribution maps give also information about the hydrodynamic characteristics and erosional processes of the bottom sediments in the considered area.

Present day Molluscs assemblages distribution maps

Benthos fauna determinations have been carried out on sediment samples taken in the same network of sampling stations as for the sedimentological layer of the map. The resulted data have been statistically processed and different biocenosis with characteristic benthal organisms assemblages were represented on the map. The benthic assemblages develop in very characteristic bathymetrical, sedimentological and ecological conditions.

Beginning with the coastal area towards the continental shelf edge one could evidence the following main biocenosis:

- *Mya arenana*
- *Spisula subtruncata*
- *Mytilus galloprovincialis*
- *Mytilus - Modiolus* phaseolinus ecotonal transitional zone
- *Modiolus phaseolinus*

Within the shelf edge zone, at water depth more than 120 m, the fossil assemblage with *Dreissena* is represented on the bottom. On the continental shelf at different water depth intervals other fossil assemblages are evidenced.

Geo-ecological maps

The geo-ecological mapping refers at pollution state of bottom sediments, at the state of different benthic eco-systems and biogeochemical processes and at fluxes of sediments, nutrients and pollutants as well as greenhouse gases releases. Mapping of natural hazards could be also performed.

The pollution state of the bottom sediments is given on maps of anomalous content of different chemical elements in the sediments. The state of benthic eco- systems is represented also on maps showing the tendency of development/regression of characteristic benthic organisms assemblages. The maps for nutrients and pollutant fluxes at the sediment/water interface are based on in-situ measures of such fluxes with "landers". The fluxes of greenhouse gases are mapped by special echo sounding and measured with gas analysers.

The eco-geological maps represent a very useful tool in studying and preventing the environmental degradation of the studied marine area.

Maps of gravity and magnetic fields

The first results of surveying the marine gravity and magnetic fields on the continental shelf were presented in 1985 on maps of 1:500,000 scale. Then the Romanian shelf area was mapped systematically at 1:200,000 scale. Seven sheets covering the entire shelf area were completed and published. At this scale, the gravity field has been represented by iso-lines at 2.5 mGal intervals, while the magnetic field is pictured by contours at 50 nT.

Since 1990, more detailed geophysical mapping at 1:50,000 scale of the inner shelf has started. On these maps the contours lines for the gravity field are spaced at 1.0 mGal and for the magnetic field at 10 nT. About 35% of the Romanian continental shelf area is already mapped and the corresponding sheets published.

The obtained data on the gravity field on the continental shelf area offer the possibility to model its deep geologic structure and to evidence the continuation into the marine domain of the main land geological units and fractures. The data referring to the magnetic field could allow a more precise determination of diverse geological bodies with differentiated magnetic properties. For instance on the Romanian continental shelf the presence of igneous rocks and of the salt have been confirmed by marine magnetometric studies and mapping. The continuation of a metamorphic iron rich complex, from the land into the shelf has been also very clearly pointed out by magnetometric measurements.

Conclusions

A complex approach of geological, geophysical and geo-ecological study of the continental shelf unit, as well as of the slope and apron areas could provide us a large amount of very important information of scientific and economic interest. The geological structure of the continental shelf area is the base for appreciating the mineral resources potential of the area, for studying the geological evolution and the impacts of past and present-day climate and sea-level changes and the possible measures for preventing their negative effects; the complex study of the bottom sediments, as well as the investigation of the benthic biogeochemical processes at the water/sediment interface and inside the sediment column is the only way for knowing the exact environmental state of the marine domain and for trying to undertake the appropriate actions to rehabilitate the damaged ecosystems.

The most useful and complete way to demonstrate the results of the studies is to summarise them into thematic maps of the studied regions. The mapping activity must be standardised, with a very close quality control. All the data obtained could be afterwards used for establishing complex GIS for the considered areas. For closed seas as Mediterranean and Black Seas, the complex mapping of at least continental shelf areas could be tackled in the framework of a large intemational programme under the co-ordination of the IOC and national authorities. If such decision is approved, the mapping of the shelf areas could be undertaken by each riparian country for its own section of the shelf by using national specialised institutions as well as the international co-operation. An important governmental and international support is needed. We must also keep in mind the necessity of co-ordination and correlation of the obtained at national level maps.

ANNEX VI

IBCM-II TERMS OF REFERENCE AND DRAFT TECHNICAL SPECIFICATIONS
Extract of letter of Dr. John K. Hall to Prof. Carlo Morelli dated 29 June 1997

'Dear Carlo:

I am in receipt of your fax of yesterday to the Geological Survey. I enclose herewith the text of what we worked out *[during the afternoon of the first day of the MBSHC meeting in Istanbul, June 16, 1997]* with R.Adm. Aléxandros Maratos and Ing. Gen. François Milard, the fellow from SHOM.

Terms of Reference for VHOs for the Second Edition of the IBCM (IBCM-II)

The IBCM Second Edition is a scientific initiative to build a seamless digital terrain model (DTM) on a 0.1' (~180 m) grid of all the area (land and sea) of the ten sheets of the IBCM. This DTM will be based upon all the data available to the compilers. This data will be from all sources and time periods. It is sure that most of the areal coverage for the sea will not be of hydrographic standard, but it will be the best available at this time, and will be continuously evaluated during compilation as to its geological reality.

The areas of actual importance to the VHOs cover about 30% of the Mediterranean, even though the original IBCM was completely divided between eight countries. Within this other 70%, the bulk of the new available data is from scientific swath surveys and transit tracks.

Taking into account the above it is clear that while the data clearinghouse activities of the IHO through the IHO's Digital Bathymetry Data Centre in Boulder, Colorado, USA are very useful, they are not sufficient to fulfill the needs of the IBCM-II because the VHOs as well as the scientific community have hesitated to contribute the truly large swath datasets.

It is also evident that the VHOs are not entering the digital age at the same speed or level of performance. Because of this, and because of differences in treating the propriety of the digital data, we suggest that a very flexible attitude be taken regarding how the VHOs will participate. There will certainly be those who would prefer that IBCM use their raw data to generate the DTM in their areas, while others will be adamant in wanting to generate the DTM while concealing their data sources.

In accordance with the above the terms of reference for the VHOs they could be summarized as follows:

1. Beginning in the eastern Mediterranean with Sheet 10 and progressing outwards, Dr. John K. Hall, a member of the IBCM Editorial Board and the new IBCM-II Chief Editor, will undertake to compile the IBCM-II with specifications as attached to this resolution, using

a) Data digitized from the original 92 1:250,000 Admiralty Quarter Million plotting Sheets,
b) Any other data in analog or digital form which can be made available to him by the VHOs,
c) Data that exists in the Boulder Colorado IHO-DBDC.

2. The IHB and the IOC in cooperation with the VHOs will identify national research institutions that may have data which could be included in the IBCM-II.

DRAFT - Technical Specifications

1. The DTM grid will have a horizontal spacing of one tenth arc minute (0.1'), or 6 arc seconds. The vertical resolution will be according to the limits and ranges laid out in Hall (1993), where the requirement to digitally pack elevation and bathymetric data into a two byte integer within the DTM allows 0.1 m resolution between -2,000 m and +2,500 m, and 1 m resolution for depths below 2000 m, or elevations above 2,500 m.

2. The datum will be the WGS84 (World Geodetic System 1984) geoid which is the basis of GPS navigation.
3. Shorelines will be derived from the most detailed charts or maps available for the coasts.
4. Marine interpolation will be through the use of multiquadric surfaces (Hardy, 1971), a computationally intensive method honouring all data points. For holes in the available data larger than 2' square, artificial control points on a 0.5' grid derived from minimum curvature (Briggs, 1974) or similar high speed generalized techniques (Smith and Wessel, 1990) using all the data, will be employed in the multiquadric surface computation.

5. The land DTM will be based upon the NOAA GLOBE (Global Land One-km Base Elevation) 30" dataset derived from topographic data of the US National Imagery and Mapping Agency (formerly the Defence Mapping Agency). This dataset consists of both Maximum and Minimum 30-Second Elevation Grids and Average 30-Second Elevation Grids for one degree squares, above sea-level. In test trials only the second grid has been used, interpolated using bi-directional third-degree parabolic blending functions (Doytsher and Hall, 1997) which produce a 0.05' grid, whose every other node is taken.

6. A separate digital file with one byte per grid node will be constructed for each IBCM sheet giving an estimate of the possible interpolation accuracy. The multiquadric surface interpolation requires for each grid node a knowledge of the distance to all the (up to 300) data points used. By saving the minimum distance in this file, expressed as 0.1' grid nodes in byte format (256 levels), one can see the distance to the nearest available data point (a figure between 0.0' -within 0.05' or about 90 m - and up to 25.5' - 47 km).

7. Publication by the IBCM Editorial Board of the IBCM-II 0.1' gridded DTM will probably take several forms. The gridded digital data will be available on CD-ROMs. This data will probably also be printed as ten new 1:1,000,000 scale sheets using a hypsometrically coloured shaded relief representation, such as that already freely available from the GMT (Generic Mapping Tools) software (Wessel and Smith, 1991).

8. Track and isolated depth sounding location plots of the generally available data will probably be printed on reverse of the published maps. For high density areas of hydrographic quality coverage, or areas of deep-water swath bathymetry, the limits of detailed coverage will be indicated. This detailed data will not be passed onto third parties by the compilers.

References cited:

Briggs, I. C., 1974. Machine contouring using minimum curvature. *Geophysics*, 39(1), p. 39-48.
Doytsher, Y., and Hall, J. K., 1997. Interpolation of DTM using bi-directional third-degree parabolic equations, with FORTRAN subroutines. *Comp. & Geosci.*, 23(9), p. 1013-1020.
Hall, J. K., 1993. DEMPACK: DEM data storage in a two-byte integer. *Comp. & Geosci.*, 19(10), p. 1567-1569
Hardy, R. L., 1971. Multiquadric equations of topography and other irregular surfaces. *J. Geophys. Res.*, 76(8), p. 1905-1915.
Smith, W. H. F., and Wessel, P., 1990. Gridding with continuous curvature splines in tension. *Geophysics*, 55(3), p. 293-305.
Wessel, P. and W. H. F. Smith, 1991. Free software helps map, display data. *EOS Trans, Am. Geophys. Un.*, 72, p. 441, 446.

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It was as usual a great pleasure to see you in Istanbul, if only for a day. With best regards, I remain

Sincerely yours,

Dr. John K. Hall
Marine Geophysicist'

ANNEX VII

FAXES IN SUPPORT OF THE NOMINATION OF ING. GEN. PATRICK SOUQUIERE AS VICE-CHAIRMAN OF THE IBCM EDITORIAL BOARD

Fax dated 27 May 1998 sent via Prof. Brian, CIESM on 2 June 1998 IHB Ref. S1/5015

Subject: **Seventh Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean, 2-4 June, Dubrovnik, Croatia.**

Reference: **IHB fax S1/5015 dated 14 May 1998**

'Dear Sirs:

This message is to inform you that, regretfully, the IHB will not be able to send a representative to the meeting of the Editorial Board of the IBCM, as was previously announced.

The Chairman of the Mediterranean and Black Seas Hydrographic Commission, Captain Yüce, attending the Conference, is kindly requested to represent the IHO.

The IHB has not at present received any response to the reference message in which IHB proposed the nomination of a Vice-Chairman (Ing. gen. Patrick SOUQUIERE, SHOM, France) to the Editorial Board. The Bureau shall inform the Secretariat of CIESM in Dubrovnik if any responses are received before 2 June 1998.

We apologize for any inconvenience.

On behalf of the Directing Committee

Yours sincerely,

Rear Admiral Giuseppe ANGRISANO
President'

Fax from the Instituto Hidrografico de la Marina, Cadiz, Spain, to Rear Admiral Giuseppe Angrisano

Subject: **Seventh Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean, 2-4 June, Dubrovnik, Croatia.**

Reference: **BHI S1/0505 dated 14 May 1998**

'Dear Admiral:

Answering to your fax of the "reference", I have honour in informing you that we support the nomination by France of Ing. Gen. SOUQUIERE as IBCM Editorial Board Vice-Chairman.

On the other hand, I regret informing you that we are unable to attend to the meeting of the "subject".

Yours sincerely,

Capt. Juan M. NODAR CRIADO
COMANDANTE-DIRECTOR'

ANNEX VIII

TURKISH NOTE ON THE ALLOCATION OF RESPONSIBILITY FOR IBCM PLOTTING SHEETS IN THE EASTERN AEGEAN SEA

IHB, in its letter file N°. S3/2704 of 25 February 1986 asked to have all the plotting sheets at 1:250.000 of the Mediterranean placed under the responsibility of the IHO. Meanwhile, IHB informed the relevant Hydrographic Offices (HOs) that the enclosed index of the mentioned letter show the description of the new areas of responsibility accepted by France, Germany, Spain and UK, as well as the description of the previous IBCM areas of responsibility already accepted by Greece, Italy, Turkey, USSR and UK, and asked the HOs to confirm the limits of their areas of responsibility and plotting sheet numbers covering these areas.

The Hydrographic Office (HO) of Turkey, in its letter serial n° Pl.KO:3600-64-86 of 17 March 1986, informed the IHB that it definitely did not agree with the limits of the areas of responsibility due to the fact that in 1972, the responsibility for the preparation of the bathymetric plotting sheets numbers 45A, 45B, 63E part and 64 of the IHO aét 1:1 million of the Mediterranean had been transferred to the HO of Turkey.

IHB, in its letter N° S3/2704 of 4 April 1986 informed the HO of Turkey that the index had been prepared by the Bureau using the information received from the IBCM concerning the areas of the responsibility for the bathymetric plotting sheets at 1:1 million of the Mediterranean and therefore they had considered that the areas of responsibility described in the IBCM index had been accepted by all the participants in this programme and requested any pertinent information and comments regarding the areas of responsibility for the plotting sheets of the IBCM in order to clarify the matter and reach a suitable solution on this issue.

Due to the above-mentioned previous allocations, the HO of Turkey, in its letter serial N° PLKO:3600-93-86 dated 17 April 1986, objected to this situation. It also informed the IHB that, at the last meeting of the *ad hoc* Group of Experts on the IBCM held in Leningrad on 12-15 June 1978, the IBCM index - which was previously accepted by the *ad hoc* Group - had not been accepted by Turkey due to the reason that responsibility of the 1:250, 000 scaled plotting sheets covering the same area with the 63E part allocated to Turkey, must be given to the same country. For this reason the HO of Turkey insisted again that the limits of the Turkish area of responsibility and the plotting sheets must be discussed until reaching an acceptable solution.

After those letters a lot of correspondence have been made and the positions on the subject have been raised at appropriate meetings but the disagreement has not been settled. IHO and other international bodies have no right to allocate the ICM plotting sheet responsibilities without the consent of related parties. In this subject, the IHB has played a consultative role and not decided anything without getting the approval of involved parties. They just made proposals and tried to find the best compromise solution acceptable to both sides. They never acted according to the one-sided proposals. A well documented summary of their existing situation can be found in IHB Letter File N° 2704 of 21 April 1993 (attached).

The Department of Navigation, Hydrography and Oceanography of Turkish Navy (DNHO-TN) has always been willing to co-operate with regard to IHO, IOC matters. Therefore, DHNO-TN supports the joint allocation of sheets between Greece and Turkey for the Aegean Sea, but the disagreement continues.

In view of the continuing disagreement concerning even joint allocation of sheets between Greece and Turkey, IHB, in its letter S3/2704 of 30 June 1994, informed both parties that it drew its proposal that sheets 6303, 6307, 6311, 6315 and 6316 be a joint responsibility, in the IHO-IOC Catalogue of Bathymetric plotting sheets, Pub N° B-2 index 6 would continue to be shown in the present 4th Edition, March 1991. The subject letter is given in the enclosure.

DNHO-TN will continue to provide sounding data for those sheets namely 6303, 6307, 6311, 6315 and 6316.

DNHO-TN has always been in a position to support proposals of international, intergovernmental, technical, scientific competent organizations as IHO and IOC, for all aspects of chart-related matters within the region.

Incidentally it is worth mentioning again the DNHO willingness for co-operative, collaborative works with all its neighboring countries in all aspects of oceanographic, hydrographic research and studies in the Eastern Mediterranean in general, and in the Aegean Sea in particular.

INTERNATIONAL HYDROGRAPHIC BUREAU

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IB File N° S3/2704

30 June 1994

Rear Admiral A. MARATOS
Hellenic Navy Hydrographic Service
TGN 1040
ATHINAI
Greece

and

Captain H. YÜCE
Seyir Hidrografi ve Osinografi
Dairesi Baskanligi
Çubuklu 81647
ISTANBUL
Turkey

ALLOCATION OF RESPONSIBILITY FOR IBCM PLOTTING SHEETS IN THE AEGEAN SEA

References:

a) Letter 171.S/2/93 of 5 January 1994 from the Hellenic Navy Hydrographic Service

b) IHB letter S3/2704 dated 21 April 1993.

c) Letter 3600-151-94/HID dated 14 May 1993 (not sent to Greece) from the Department of Navigation Hydrography and Oceanography of Turkey.

d) Letter TEK 3600-14-94/HID dated 7 February 1994 from the Department of Navigation Hydrography and Oceanography of Turkey.

e) Letter 171.5/7/AS128/84 dated 12 April 1994 (not sent to Turkey) from the Hellenic Navy Hydrographic Service.

Dear Admiral Maratos,
Dear Captain Yuce,

In his letter, reference a), the Director of the HNHS, although regretting the 1991 decision of the IBCM Editorial Board (EB) to omit the "area allocated limit" for sheets 6303, 6307, 6311, 6315 and 6316 proposed the joint participation of Greece and Turkey in collecting sounding data for the plotting sheets 6303, 6307, 6311 and 6316. The letter included a proposed line of separation to the east of which Turkey would be responsible and to the west Greece would be responsible. For plotting sheet 6315, Greece indicated their reasons for retaining the responsibility of collecting soundings for the entire area of the plotting sheet.

In the letter, reference b), the IHB responded that it could not endorse a demarcation line in that the IHO is a non-political organization and, as such, does not have authority to act as an arbitrator in any Political matters. In that same letter, the IHB noted that Greece was claiming sole responsibility for plotting sheet 6315 and sought the Turkish opinion in that respect.

Consequently, IHB proposed to both countries a redraft of the IBCM Index.

In their letter, reference c), the Turkish Department of Navigation, Hydrography and Oceanography responded to the Bureau supporting a joint allocation to the two countries (GR and TU) of plotting sheets 6303, 6307, 6311 and 6316.

For plotting sheet 6315, Turkey said that "it should be treated the same way as the others because this area falls into an area which is not delineated."

In their letter, reference d), Turkey responded to Greece that whilst appreciating the proposal (ref. d) about the maintenance of the plotting sheets that proposal was not technically acceptable because it was "putting forward unacceptable conditions".

In their letter, reference e), Greece asked the IHB to revert to the allocation of responsibilities for IBCM plotting sheets which appeared in the diagrammatic index of the report of the 4th session of the EB Paris 11-13 December 1989).

The IHB comments on the overall situation are as follows:-

1. Both countries have a willingness to technically cooperate with regard to IHO matters in the Aegean Sea; this is clearly demonstrated by the content of the letters in references a), c) and d) and by the fact that the Chief Editor is being provided with a very satisfactory amount of sounding data from both countries.

2. There is disagreement on both sides about proposals to define the respective limits of responsibility for collecting sounding data. The IHB appreciates that disagreements concerning the delimitation of boundaries can only be solved at government level and is beyond the authority of the IHO/IHB. However, the delineation of areas of responsibility for collecting data is not necessarily bound by limits of national jurisdiction as may be observed elsewhere in the world and, consequently, the IHO's concern must be only to achieve the most effective system of data collection. Ideally, but not necessarily, this system will assign one country to one geographic area.

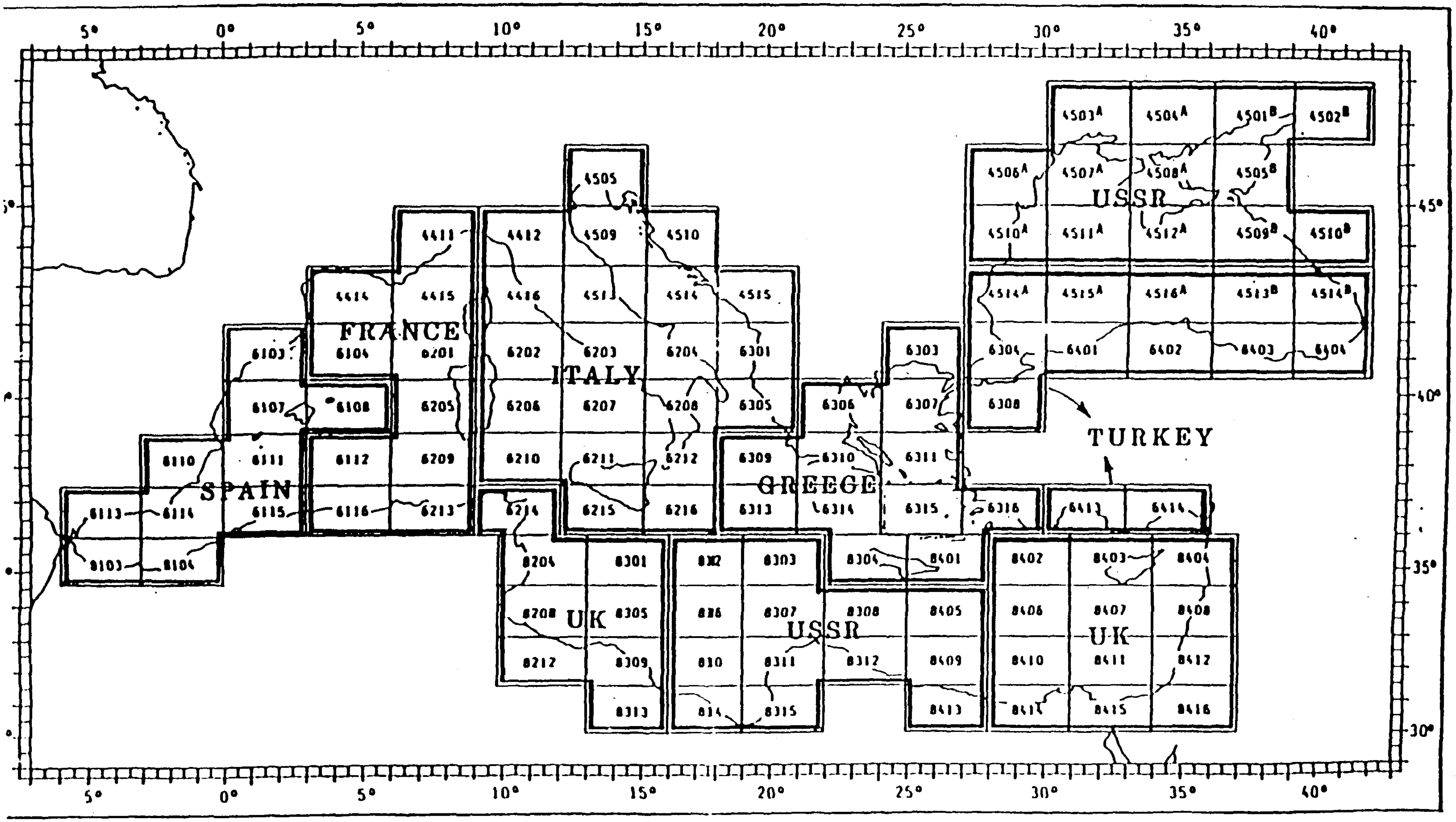
3. In view of the continuing disagreement concerning even joint allocation of sheets between Greece and Turkey for the Agean Sea, the IHB finds that the best solution is to adopt the least controversial position. Therefore, IHB withdraws its proposal (reference b) that sheets 6303, 6307, 6311, 6315 and 6316 be a joint responsibility. In the IHO-IOC Catalogue of Bathymetric Plotting Sheets, Publication BP-002 (now called B-2), Index 6 will continue to be shown without a limit between Greece and Turkey, as is shown in the present 4th Edition, March 1991.

In conclusion, at this point the IHB is not in a position to put forward any other proposal for solving this problem. It is hoped that the two countries will continue to work together to eventually find a mutually agreeable solution for all aspects of chart-related allocations within the region. We thank both parties for their consideration of our proposal.

On behalf of the Directing Committee
Yours sincerely,

Christian Andreasen

Rear Admiral Christian ANDREASEN
President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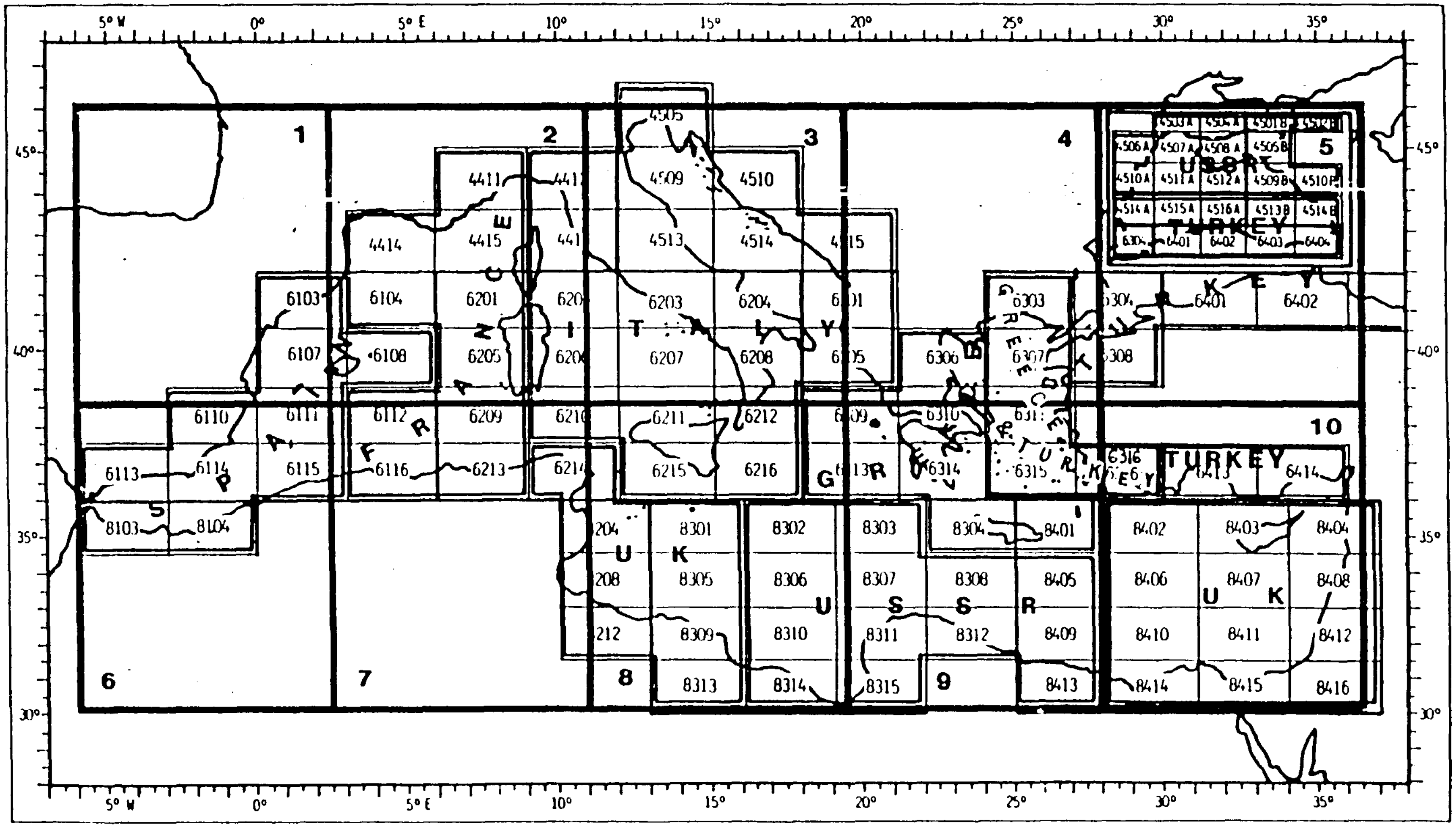
INTERNATIONAL BATHYMETRIC CHART OF THE MEDITERRANEAN (IBCM)

CARTE BATHYMETRIQUE INTERNATIONALE DE LA MEDITERRANEE (CBIM)

Index of bathymetric plotting sheets at scale 1:250 000	4510	Index des minutes de rédaction bathymétriques à l'échelle de 1:250 000
Limits of IBCM sheets (scale 1:1M — 1:2M for Black sea — at lat 38°).		Limites des feuilles de la CBIM (échelle 1:1M — 1:2M pour la mer Noire — à la lat. 38°)
Limits of areas allocated.		Limites des zones allouées.
Chairman of the Editorial Board.	Prof C. Morelli (Italy)	Président du Comité d'édition.



ANNEX IX

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ANNEX X

LIST OF ACRONYMS

AGI	Année géophysique internationale
BGI	Bureau gravimétrique international
BODC	British Oceanographic Data Center (UK)
CGOM	Consultative Group on Ocean Mapping (IOC)
CIESM	Commission internationale pour l'exploration scientifique de la mer Méditerranée
DAC	Data Assembly Center
DMA	Defense Mapping Agency (USA)
DTM	Digital Terrain Model
EB	Editorial Board
EEZ	Exclusive Economic Zone
EOS	Earth Observing System
ESA	European Space Agency
GEBCO	General Bathymetric Chart of the Oceans (IOC/IHO)
GEODAS	Geophysical Data System
GIS	Geographic Information System
GMT	Generic Mapping Tools (P. Wessel and W.H.F. Smith)
GPS	Global Positioning System
HDNO	Head Department of Navigation and Oceanography (Russia)
HNHS	Hellenic Navy Hydrographic Service
IBCM	International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series (IOC)
IBC	International Bathymetric Chart (IOC)
IBCWIO	International Bathymetric Chart of the Western Indian Ocean (IOC)
ICM	Instituto de Ciencias del Mar (Spain)
IFREMER	Institut français de recherche pour l'exploitation de la mer
IHB	International Hydrographic Bureau

IHO	International Hydrographic Organization
IOC	Intergovernmental Oceanographic Commission (UNESCO)
JPL	Jet Propulsion Laboratory (USA)
NGDC	National Geophysical Data Center (USA)
NIMA	National Imagery and Mapping Agency (USA)
NIWA	National Institute of Water and Atmospheric Research (NZ)
NOAA	National Oceanic and Atmospheric Administration (USA)
SHOM	Service hydrographique et océanographique de la marine (France)
UNCLOS	United Nations Convention on the Law of the Sea (Montego Bay, 1982)
UNESCO	United Nations Educational, Scientific and Cultural Organization
VHO	Volunteering Hydrographic Office
WVS	World Vector Shoreline (NIMA)