

## **IMPORTANCE OF HYDROGRAPHY IN RESOURCE EXPLORATION**

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### **Abstract**

Ever since man first ventured into the sea environment, hydrography has played a vital role in promoting marine scientific activities. This paper specifically deals with the importance of hydrography in resource exploration, highlighting the responsibilities of coastal States bordering the Indian Ocean to ensure availability of reliable and up-to-date nautical charts in order to derive maximum benefits from the regime created by the new United Nations Convention on the Law of the Sea. A brief summary is given of the approximate extent of the areas over which some of the States of the Indian Ocean will gain sovereign rights as soon as the new Convention, which is awaiting ratification, comes into force. A comparison of the EEZs with the land masses of a few countries reveals that they have gained control over areas much larger than the land. The status of hydrography and nautical charting of the countries concerned shows the enormous tasks that lie ahead for most of them to chart their waters as a matter of priority. The necessity for regional co-operation in hydrography and, finally, a brief on the IHO is included for the benefit of those who are not well aware of the activities of this unique and important intergovernmental organization serving the cause of hydrography since 1921.

### **INTRODUCTION**

The science of hydrography originated in the need for the production of

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charts for the use of the mariner. The activity involves and includes many branches of the science of hydrology, geology, oceanography and is of constant interest. The information gathered by hydrographers has made major contributions in furthering marine scientific activities. The work of hydrographers depicted on charts and other nautical publications has become increasingly important for all coastal States, after the adoption of the new United Nations Convention on the Law of the Sea, which establishes a comprehensive framework for the regulation of all ocean space. Before taking up a few of the relevant provisions of the new Law of the Sea Convention, and the impact on developing countries bordering the Indian Ocean, it is imperative to define hydrography so as to fully appreciate the leading role which it plays to effectively plan exploratory activities of non-living resources within the Exclusive Economic Zones (EEZs).

### WHAT IS HYDROGRAPHY?

A document entitled 'Report of the United Nations Group of Experts in Hydrographic Surveying and Nautical Charting' was presented to the 2nd U.N. Regional Cartographic Conference for the Americas in Mexico City, 5 to 16 September 1979. This excellent document comes from an independent expert group and therefore carries more weight, and your governments should be persuaded to read it carefully, if they have not already done so. This report not only explains the need for hydrographic expertise in every country, but also gives guidelines as to what action should be taken and how to obtain assistance. It defines Hydrography as 'the science of measuring and depicting those parameters that are necessary to describe the precise nature and configuration of the sea-bed, its geographical relationship to the adjacent land masses and the characteristics and dynamics of the sea'. The parameters measured comprise bathymetry (vertical measurement of depths), geology, geodesy and geophysics, as also the measurement of horizontal and vertical movement of the water column (tidal streams, currents and tidal heights), studies of waves and swell and certain other physical parameters of sea water and the composition of the sea or ocean floor. Most of the data collected is compiled into a chart which shows, by means of appropriate symbols, the depth of water, the low and high water lines, offshore features such as islands, isolated rocks, the nature and extent of sea bottom elevations, navigable channels and routes as well as aids to navigation and other pertinent information required for safe navigation.

### UNCLOS 1982

Bearing the definition of hydrography and the contents of a nautical chart in mind, it is now appropriate to discuss some of the provisions of UNCLOS without dwelling on the history of the development of this new Law and its provisions, a document which is at present awaiting ratification. However, a few of the articles that have direct bearing on hydrography and resource exploration will be

dealt with in some detail. Prior to signing of the new Law of the Sea Convention, in December 1982, the 1958 Geneva Conventions provided a definition of Territorial Waters without specifying a limit and a Contiguous Zone as extending not beyond 12 nautical miles from the low water line. The advancement in technology increased and the diversified nature of activities in the ocean necessitated urgent reconsideration of various zones of jurisdiction so as to make them compatible with the new realities. The coastal States can now exercise extended control over areas, defined in the UNCLOS as under:

*Territorial Waters*

Every State has the right to establish the breadth of its territorial sea up to a limit not exceeding 12 nautical miles, measured from base lines.

*Contiguous Zone*

The Contiguous Zone may not extend beyond 24 nautical miles from the base lines from which the breadth of the territorial sea is measured.

*Exclusive Economic Zone*

The EEZ extends up to 200 nautical miles from the base line. In this zone, the coastal State has sovereign rights for the purpose of exploring and exploiting the living and non-living resources of the sea-bed, sub-soil and superjacent waters.

The priority for all coastal States is, therefore, to establish various zones of jurisdiction so as to commence exploration and exploitation of living as well as non-living resources, with confidence and authority. It is simple and easier to mark the limits on land by pillars or any other physical means, but humanly impossible to do so at sea. A careful study of the articles relating to various zones of jurisdiction indicates that the Law of the Sea Convention addressed this question by incorporating provisions on Base Lines which are the starting points for drawing the limits at sea. These starting points, referred to as Normal Base Lines and Straight Base Lines, have been defined in Article 5 and Article 7 of the new Law of the Sea Convention. It is pertinent to consider these two articles at this stage. Article 5 reads as follows:

‘Except where otherwise provided in this Convention, the normal base line for measuring the breadth of the territorial sea is the low-water line along the coast as marked on large scale charts officially recognized by the coastal State.’

Article 7, inter alia, makes the following provisions concerning Straight Base Line:

‘1. Localities where the coastline is deeply indented and cut into, or if there is a fringe of islands along the coasts in its immediate vicinity, the method of straight base lines joining appropriate points may be employed in drawing the base line from which the breadth of the territorial sea is measured.

2. Where because of the presence of a delta and other natural conditions the coastline is highly unstable, the appropriate points may be selected along the furthest seaward extent of the low-water line.

3. Straight base lines shall not be drawn to and from low tide elevations, unless lighthouses or similar installations which are permanently above

sea level have been built on them.'

It is evident from the above that, in order to establish various zones of jurisdiction, the first step for a coastal State is to determine its low-water line along the coast and depict it on an officially recognized chart. Low-water line is an identifiable feature shown on nautical charts at medium and large scales. However, on small-scale charts, it becomes impractical to distinguish the low-water line from the high-water line. The determination of the low-water line, particularly in areas with a fairly large tidal range, is normally accomplished by means of sounding operations. Occasionally, the low-water line is surveyed directly at low tide and remote sensing techniques are also now being used.

The Convention gives a special treatment to low tide elevations, which must be determined with precision as these are going to affect the seaward limits. While Article 7 lays down restrictions on including low tide elevations as base points for a straight base line, it may be noticed that Article 13 provides for these features to generate a base line for measuring the breadth of the territorial sea, provided they are situated within 12 miles of the coast or an island. The existing charts held by most of the coastal States of the Indian Ocean and adjacent seas do not show the precise delineation of many of these features since the hydrographers charting the waters at that time were only concerned about the safety of navigation. In many areas, in order to save time, they encircled some shallow areas with a 'danger line' within which it is normally not possible to distinguish individual features.

The most significant hydrographic and geological consideration in the new Law of the Sea Convention has been the development of Article 76 which defines the continental shelf. It is important to discuss some of its provisions and their impact on national Hydrographic Offices. This article, *inter alia*, makes the following provisions:

*a.* The continental shelf of a coastal State comprises the sea-bed and sub-soil of the submarine areas that extend beyond the territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines, where the outer edge of the continental shelf does not extend up to that distance.

*b.* The continental margin comprises the submerged prolongation of the land mass of the coastal State, and consists of the sea-bed and sub-soil of the shelf, the slope and the rise. It does not include the deep ocean floor with its oceanic ridges or the sub-soil thereof.

*c.* The coastal State shall establish the outer edge of the continental margin wherever the margin extends beyond 200 nautical miles by either:

(i) a straight line not exceeding 60 nautical miles in length, connecting fixed points, defined by co-ordinates of latitude and longitude, referring to the outermost fixed points at each of which the thickness of sedimentary rocks is at least one per cent of the shortest distance from such point to the foot of the continental slope, or

(ii) by reference to fixed point not more than 60 nautical miles from

the foot of the slope.

d. The fixed points comprising the line of the outer limits of the continental shelf on the sea-bed either shall not exceed 350 nautical miles from the baselines from which the breadth of the territorial sea is measured or shall not exceed 100 nautical miles from the 2,500 metre isobath.

e. Information on the limits of the continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured shall be submitted by the coastal State to the Commission on the Limits of the Continental Shelf set up on the basis of equitable geographical representation. The Commission shall make recommendations to coastal States on matters related to the establishment of the outer limits of their continental shelf.

f. The coastal State shall deposit with the Secretary General of the United Nations charts and relevant information, including geodetic data, permanently describing the outer limits of its continental shelf.'

#### **Delimitation of boundaries between adjacent and opposite coastal States**

Having established the baselines and outer limits of jurisdictional zones, it will be important to delimit the territorial sea, EEZ, and continental shelf between States with opposite or adjacent coasts. Articles 15, 74 and 83 provide the necessary guidelines requiring coastal States to make agreements and strive to achieve an equitable solution in accordance with Article 38 of the Statutes of the International Court of Justice.

#### **IMPACT OF PROVISIONS OF THE NEW LAW OF THE SEA CONVENTION ON COASTAL STATES**

All the above events, leading to the availability of vast areas over which States could exercise jurisdiction and exploit living as well as non-living resources, need the provision of accurate and up-to-date nautical charts prepared from data collected by hydrographers. It might be suggested that charts of the Indian Ocean are already available which could be used for drawing baselines, various zones of jurisdiction and delimitation of boundaries between States. Indeed, several articles of the Convention use the expression 'charts officially recognized by the coastal State' and thus a State which has no charting capability may, as an interim measure, grant official recognition to charts of their coasts produced by other countries. However, using such charts could entail surrendering certain critically important areas, because many of the existing charts of the Indian Ocean are based upon very old surveys, some dating back over 100 years. The studies made by the U.N. Group of Experts in 1978 indicated that the existing chart coverage of developing countries with limited or no hydrographic capability is based, by and large, on inadequate and outdated surveys, many of which were made by lead-line sounding and using geodetic control, long since overtaken by more modern

methods. In many parts of the Indian Ocean, the sea-bed configuration is subject to fairly rapid changes due to siltation, coastline erosion and other natural phenomena. Consequently, the low-water line, as depicted on older charts, may easily be displaced by a considerable distance. Moreover, the older charts were not designed to provide the data required for claiming continental shelves up to 350 nautical miles, as defined in Article 76 which requires a coastal State to deposit data on the foot of the slope, thickness of the sedimentary rock and 2,500-metre isometric contours with the U.N. Commission on the Limits of the Continental Shelf within ten years of coming into force of the Convention.

### **Status of Hydrography and Nautical Charting**

A preliminary review of the present status of hydrography and nautical charting of the Indian Ocean and its adjacent seas reveals that most of the countries are in dire need of either creating facilities or strengthening the existing hydrographic infrastructure in order to derive maximum benefits from exploitation of non-living marine resources such as hydrocarbons, aggregates, placers, precious corals, metalliferous sediments, polymetallic sulphides, manganese nodules and cobalt-rich manganese incrustations, expected to be available within the EEZ. The existing charts of many of the States, based on data collected by obsolete and conventional techniques of spot lead line sounding and positional control, are not suitable for delimitation of boundaries, particularly in situations involving cross-boundary hydrocarbon deposits and for the establishment of various zones of jurisdiction. The U.N. Group of Experts very rightly pointed out that inadequate hydrographic services could lead to costly delays in resource exploitation, further cautioning Administrations that 'in the marine environment, there can be no exploitation of resources without exploration and there can be no exploration without hydrography'.

It will therefore be appreciated by the experts participating in this IOMAC meeting on non-living resource exploration that the basic document required by any contracting agency for resource exploration, be it metals or hydrocarbon, must be a nautical chart. It will also be logical for commercial agencies intending to make investments at sea to demand tidal and meteorological data from the concerned State so as to plan their exploratory activities in a cost-effective manner. There is an urgent need for most of the Indian Ocean States to obtain a detailed topographic and geological picture of the sea-bed, otherwise the possible numerous uncharted seamounts and other unknown obstructions could cause serious damage to the equipment used for exploration and exploitation of the resources. In fact, foreign firms, which are often invited for exploratory activities, can only be persuaded to make the heavy investment involved if such basic prospection data on hydrography and geology is made available with assurances of non-interference from neighbouring coastal States through conclusion of bilateral agreements on maritime boundaries. These tasks require close co-ordination of efforts by hydrographers, oceanographers, geologists and geophysicists of the nations concerned, seeking the assistance of international agencies and entering into regional or sub-regional arrangements of co-operation. This brings us to consider the role played by the International Hydrographic Organization in exten-

ding assistance and co-operation to promote marine scientific activities relating to hydrography on a global basis.

## **IHO — Technical Assistance and Regional Co-operation**

### **A. Brief History and Functions of IHO**

The developed maritime nations, being well aware of the importance of charts and navigational publications, had initiated efforts to co-operate in the field of hydrography as early as 1835. In 1921, the International Hydrographic Bureau was established to promote and encourage the free exchange of ideas and information between national hydrographic offices and to introduce standardization in surveying and charting. Its membership has since grown from 22 to 57, which includes only 11 States bordering the Indian Ocean. The headquarters of the Organization were provided in Monte-Carlo by H.S.H. Prince Albert I of Monaco and, in 1970, the implementation of its international Convention gave the IHB an enhanced intergovernmental status. Conferences are held at the Bureau every five years and the Member States freely exchange their charts and publications. Their products are the foundation of almost all offshore mineral exploration activities and the techniques developed by them are generally adopted by industry for their own use. Many of the IHO Member States have properly equipped hydrographic survey vessels manned by well-qualified personnel, trained to IHO standards, to provide bathymetric, gravity and magnetic data, physical data of the water column and sea-bed samples; some also collect seismic reflection profiles to determine the thickness of sedimentary layers beneath the sea floor. These surveys are now specifically aimed at providing all the basic information needed to plan the exploration for and development of oceanic mineral resources. In 1971, the IHO agreed upon the limits and contents of two series of small-scale charts of the world's oceans at 1:3.5M and 1:10M scales to avoid duplication of effort by Member States. All the charts of these two INT series have now been published. Each sheet has been produced by a volunteer Member State and reproduction material of all sheets is available to all other IHO Member States who can reproduce these charts, incorporating minimal changes to meet their own national requirements. In 1982, a six-volume series of IHO standardized specifications for charts on medium and large scales was adopted by the IHO Member States; these have since been promulgated and are being used for publication of INT chart series at medium and large scales. The co-operative efforts of IHO and IOC through the joint IOC/IHO Guiding Committee for the General Bathymetric Charts of the Ocean have resulted into production of the Fifth Edition of GEBCO charts — a series which was first established by H.S.H. Prince Albert I in 1903. This Fifth Edition, covering all the oceans of the world in 18 sheets, reliably depicts the relief features of the ocean floor at accuracy standards commensurate with the modern state of knowledge. With a view to keeping an eye to the future, a 'GEBCO Sub-committee on Digital Bathymetry' has been formed to study and advise on the desirability, ways and means of digitizing the contours of the GEBCO Fifth Edition as well as achieving an international system of storage and retrieval. At present, IHO is actively involved, in close association with IMO and

INMARSAT, in developing standards for Electronic Chart Display and Information Systems (ECDIS) (\*) and the Global Maritime Distress and Safety System (GMDSS). A working group is drafting an IHO special publication on the technical aspects of the Law of the Sea, covering determination of baselines, geodetic datums, geographical co-ordinates related to a world datum (WGS), continental slope and measurements therefrom, determination of seaward limits of national jurisdiction, computation of equidistance lines by reducing effects of base points, etc. This publication will serve as a very useful guide for hydrographic offices to assist their Governments in the delimitation of maritime boundaries.

### **B. Technical Assistance for Developing Countries**

One of the functions of the IHO is to offer technical assistance and advice to developing nations on matters relating to hydrography and the creation of a Hydrographic Office. To achieve this objective, at the I.H. Conference in 1982 and then in 1987, the Member States approved an increase in funds to enable IHB staff to visit countries, at their request, to advise on how to set up a Hydrographic Office. The visiting expert assesses the Government Department under which the Office should be established, evaluates requirements of resources, equipment and personnel, recommends training requirements and possible venues, and provides guidance on acquisition of funds from various international agencies. Once a country decides to go ahead and start a new Hydrographic Office, or to build up its present arrangements for hydrography, the IHB acts as an intermediary with a developed State willing and able to enter into a bilateral agreement for this purpose. The developing Indian Ocean States are strongly advised to consider availing themselves of this facility, offered free to both IHO Member and non-Member States, and to consider applying for membership of the IHO in order to avail themselves of all the advantages which could accrue from their membership and in line with the membership of other international bodies such as IMO.

### **C. Regional Co-operation**

For reasons of economy, the IHO holds regular Conferences only once every five years, which are attended by all its Member States. However, the rapid technological advancement, frequent changes in trade patterns and increased offshore exploratory activities necessitate more contacts between individual Hydrographic Offices. Such frequent contacts could best be arranged between neighbouring maritime nations, and many of the IHO Member States have, therefore, formed Regional Hydrographic Commissions. At present, the following IHO Regional Commissions are functioning:

- Northern Hydrographic Group
- North Sea Hydrographic Commission
- Baltic Sea Hydrographic Commission
- Mediterranean and Black Seas Hydrographic Commission

(\*) Author's note: Since presentation of this paper, SP 52: Draft Specification for Electronic Chart Display and Information Systems (Third Draft) was published, in October 1988.



- Eastern Atlantic Hydrographic Commission
- East Asia Hydrographic Commission
- US/Canada Hydrographic Commission.

The members of the Regional Commissions hold regular meetings, mostly on an annual basis, to discuss matters of mutual, regional and international concern. The reports of such meetings are presented to the IHO during the Conference as well as in the monthly I.H. Bulletin and the annual IHO Report. The Member States of each Commission co-operate with each other on programmes or joint actions, studies and exchange of information pertaining to the field of hydrography. They also participate in hydrographic programmes which require concerted action and exchange information regarding surveys, research, new developments, technical details as well as organizational questions relating to hydrography in its widest sense. They review the existing regional status of nautical surveying and charting and plan re-surveys of the areas critical for merchant shipping and resource exploration. It may be pointed out that even well established hydrographic organizations of developed industrialized States have felt it necessary to enter into regional co-operation in hydrography, since even they are faced with large areas of their EEZs which are not adequately surveyed to meet modern requirements. It is unfortunate that many of the Indian Ocean States are neither Members of the IHO nor is there an active Regional Commission, except for the East Asia Hydrographic Commission. There is thus a very urgent need for the States bordering the Indian Ocean and adjacent seas to seriously consider the benefits of becoming Members of the IHO and the formation of a Regional Hydrographic Commission.

### CONCLUSION

It is evident and abundantly clear that inadequate charts could lead, not only to serious pollution resulting from strandings of vessels in inadequately surveyed waters (which has not been addressed in this paper), but also to costly delays in resource exploration and exploitation and that the successful exploratory activities within the EEZs of the countries around the Indian Ocean would require:

1. Establishment of base lines by conducting detailed surveys involving tidal observations, comprehensive hydrographic surveys and aerial surveys, as appropriate.
2. Availability of updated charts based on the data collected by modern and accurate techniques of surveying, showing detailed bottom topography and including data on the continental shelf as well as geophysical and geological data.
3. Knowledge of the currents and prevailing meteorological conditions to facilitate the planning and execution of exploratory activities with safety, avoiding periods predominantly hostile.
4. Formation of a Regional Hydrographic Commission so as to plan and implement publication of an INT chart series of the Indian Ocean as early as possible and to assist all the coastal States in the region in establishing or strengthening their national hydrographic capability.

5. Consider applying for membership of IHO and establishing a Hydrographic Office with an effort to achieve self-reliance through the technical assistance and advice of concerned international agencies.
6. Integrate marine activities within the national plans for economic development and ensure co-ordination of efforts by all marine oriented agencies.
7. Negotiate agreements on delimitation of maritime boundaries, where applicable.

### References

- [1] United Nations Convention on the Law of the Sea (1982).
- [2] D.C. KAPOOR and Adam J. KERR (1986): A Guide to Maritime Boundary Delimitation. Carswell Legal Publications, 2330 Midland Ave., Agincourt, Ontario, Canada M1S 1P7.
- [3] D.W. HASLAM (1985): Why a Hydrographic Office? *Int. Hydrog. Review*, Vol. LXII(1), January.
- [4] D.W. HASLAM (1985): Present State of Hydrographic Surveying in the North Sea and English Channel. *Int. Hydrog. Review*, Vol. LXII(1), January.