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COMMITTEE ON THE PEACEFUL USES OF THE
SEA-BED AND OCEAN FLOOR BEYOND THE
LIMITS OF NATIONAL JURISDICTION
Economic and Technical Sub-Committee

INTERIM REPORT OF THE ECONOMIC AND TECHNICAL
SUB-COMMITTEE

1. The Economic and Technical Sub-Committee, established by the Committee on the Peaceful Uses of the Sea-Bed and Ocean Floor Beyond the Limits of National Jurisdiction, was entrusted with the consideration of the following topics:

- (i) Economic and technical requirements which such a régime as is referred to in operative paragraph 2 (a) of resolution 2467 A (XXIII) should satisfy in order to meet the interest of humanity as a whole.
- (ii) Operative paragraph 2 (b) of resolution 2467 A (XXIII) - to study the ways and means of promoting the exploitation and use of the resources of this area, and of international co-operation to that end, taking into account the foreseeable development of technology and the economic implications of such exploitation and bearing in mind the fact that such exploitation should benefit mankind as a whole.
- (iii) Economic and technical implications of
 - (a) all other questions mentioned in the terms of reference of the Committee as contained in resolution 2467 A (XXIII); and
 - (b) the reports submitted by the Secretary-General pursuant to resolutions 2467 B, C and D (XXIII) and 2414 (XXIII).

It was, furthermore, requested to prepare and adopt its report, containing its recommendations, for submission to the Main Committee.

2. The Bureau of the Economic and Technical Sub-Committee was composed of the following members:

Chairman: Mr. Roger Denorme (Belgium)

Vice-Chairman: Mr. Ramesh Arora (India)

Rapporteur: Mr. Anton Prohaska (Austria)

3. The Economic and Technical Sub-Committee held its meetings in New York from 11 to 27 March 1969. The meetings were attended by the representatives of the forty-two member countries of the Committee. Also present were the observers of the following countries: Barbados, Burma, Denmark, Jamaica, Netherlands, New Zealand, Nicaragua, Portugal, South Africa, Spain, Sweden, Turkey, Ukrainian SSR, Venezuela, and the representatives of UNESCO-ICC, WMO, IMCO and FAO.

4. At the end of its 14th meeting held on 27 March 1969 the Sub-Committee adopted its interim report to the Committee.

5. As a background for discussion, the Economic and Technical Sub-Committee had at its disposal the report of the Economic and Technical Working Group of the Ad Hoc Committee to Study the Peaceful Uses of the Sea-Bed and Ocean Floor Beyond the Limits of National Jurisdiction, and the preliminary note by the Secretariat entitled "Economic Considerations conducive to promoting the Development of the Resources of the Sea-Bed and Ocean Floor Beyond the Limits of National Jurisdiction in the Interests of Mankind" (document A/AC.138/6 and Corr.1). The introductory remarks made by the Chairman on 11 March were also circulated as an official document (A/AC.138/SC.2/3).

6. In accordance with its programme of work (A/AC.138/SC.2/2) the Economic and Technical Sub-Committee gave consideration to the following items:

- (i) Consideration of progress achieved in the exploration and exploitation of the resources of the sea-bed and the ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction and in the techniques used for their development.
 - (a) Hydrocarbons and soluble minerals; drilling;
 - (b) Surficial deposits and deposits within bedrock; dredging and mineral extraction.

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- (ii) Preliminary study of the ways and means of promoting the exploitation and use of the resources of this area, and of international co-operation to that end, bearing in mind the fact that such exploitation should benefit mankind as a whole.
- (a) General considerations;
 - (b) Establishment of basic documents;
 - (c) Exploration of mineral concentrations;
 - (d) Evaluation of mineral concentrations or deposits which have been ascertained: technical feasibility and economic exploitability;
 - (e) Exploitation of mineral deposits.

PART I

Consideration of progress achieved in the exploration and exploitation of marine hydrocarbons 1/ and in the techniques used for their development

7. During its meetings of 12 and 13 March 1969, the Economic and Technical Sub-Committee gave consideration to this item. It based its deliberations on national experiences in this field and on various sources of relevant information, and had particular regard to the technical and economic facts of work at sea and on the ocean floor. Taking into account the conclusions reached in paragraphs 11-29 of the Economic and Technical Working Group's report, it reviewed the advances of the past year in the exploration and exploitation of marine hydrocarbons.
8. The study and analysis of activities presently carried out in off-shore areas was considered particularly useful with respect to projections and forecasts regarding the eventual development of marine mineral resources beyond the limits of national jurisdiction.
9. The limited extent of our knowledge in the field of exploration and exploitation of marine mineral resources was again emphasized. Even though considerable progress has been achieved - the Glomar Challenger was able to core samples at depths below 5,000 metres of water - most of the geological and
- 1/ The term "marine minerals" used throughout this report includes all minerals on or under the sea-bed but excludes minerals in solution in sea water. The terms "hydro-carbons" and "petroleum" will be used interchangeably in this report to include crude oil, natural gas and gas condensate.

topographical structure of the sea-bed and ocean floor beyond national jurisdiction is still unknown in sufficient detail to permit full appraisal of its resource potential. For example, although it appears that sediments thick enough to contain large quantities of petroleum are mainly confined to the continental margin and the small ocean basins, the occurrence of thick layers of sediment containing appreciable accumulations of petroleum in some parts of the abyssal plain cannot be excluded.

10. In connexion with the task undertaken by the Glomar Challenger, it was noted with appreciation that the results of this programme are being made available to the world scientific community.

11. Progress achieved in petroleum exploration and exploitation has been significant during the last year in almost every respect: in the development of exploration methods, in extending the capability for drilling to greater depths, in adding new producing areas, in increasing production and in improving facilities for storage and transfer of petroleum at sea and on shore.

12. Although technological advances were regarded satisfactory and justifying the conclusion of the Ad Hoc Committee "that a cautious optimism is appropriate as to the technical achievements that may be expected" reference was made to serious accidents which occurred in the process of off-shore drilling.

In this context two points were being stressed: (a) that improvements and refinements to present technology are still needed; (b) that a high degree of technical competence is required not only by the off-shore operator but also by the responsible authority.

13. Interest in the essential services and equipment which are necessary to increase the scale and extent of off-shore exploration and production has considerably increased during the last year. Such equipment includes underwater navigation equipment, acoustic and seismic penetration survey devices, measuring and recording devices for use under water, acoustic telemetry, command and release systems, diving and underwater living equipment, submersibles, underwater cameras and television, etc. Developments during the past year in reflection seismic devices using non-explosive energy sources and in continuous recording and computerized analysis of the data have been of an incremental rather than a revolutionary nature but have helped to bring these methods to a higher level of effectiveness.

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Several submersibles, some of new design and construction with greater depths capability and endurance, allowing access to larger areas of the ocean floor were completed during the last year. The technology for undersea habitats and work units has also been advanced.

14. Hydrocarbons may be the most valuable economic resources of the subsoil of the ocean. Many of the most promising regions for oil and gas are related to off-shore zones of the continental margin and small ocean basins adjoining to oil or gas-bearing regions on the continent.

15. New ground for off-shore oil production has been gained both in new areas of the shelves now shown to be productive or promising and in deeper waters made accessible by advancing technology.

16. At present commercial exploratory drilling of hydrocarbons in water depths up to 300-400 metres has been achieved in one area.

Significant in this connexion is that work towards the development of a system with re-entry capability in deep water is at the problem definition stage. Such a system could conceivably be operational by the end of this year.

17. During the last twenty years world consumption of energy in all its forms has doubled. It was estimated that in the next fifteen years world energy consumption will double again. Nevertheless, the vastness of the continental, shelf areas, which for their greatest part have not yet been explored, suggest that for the next decade or so world supply of petroleum appears to be sufficient even if for economic and technical reasons exploration and exploitation of marine hydrocarbons remain confined to these areas.

18. How much of the anticipated increase in world demand for hydrocarbons will be met in the future by off-shore petroleum sources will depend inter alia:

(i) On the availability and cost of synthetic fuels.

Synthetic hydrocarbons (derived from tar sands, oil shales and coal) are not expected to have a significant influence on the market for petroleum during the next decade; the costs of extracting hydrocarbons from these sources are not much above those of natural petroleum, which on the one hand means that there is some incentive for the research and

development that may make them competitive in the future and on the other means that they provide a ceiling on petroleum prices, which would prevent them from rising to the high level that might be required at first to support petroleum production from the deep ocean floor.

(ii) On future discoveries of oil on land.

Off-shore costs are higher than on-shore costs under comparable conditions of drilling depth and field size. Virgin off-shore ground offers, however, a better opportunity to find giant fields producible at costs low enough to offset the difference in development expenses, but large on-shore discoveries such as those recently made in Alaska could retard growth in off-shore production.

(iii) On policies affecting the supply of energy.

Since economic policies on a national and international level are subject to change they also appear likely to affect the competitive position of various sources of energy.

Recognizing that such uncertainties may invalidate any forecasts made now, present trends suggest (i) that off-shore production might supply approximately 30-35 per cent of the world market by 1980 as compared to 16 per cent at the present time; (ii) that, until such time, off-shore production will not exceed depths of 600 metres below sea level (a) because it will take time to develop appropriate deep sea drilling systems and (b) because less expensive on-shore and shallower off-shore sources appear ample enough to meet the demand until 1980 and somewhat beyond.

19. Expenditure related to oceanography has sizably increased in many countries in recent years, in particular in some highly developed countries. Ten years ago only five countries carried out off-shore exploration programmes, but at present these activities are in progress in more than sixty-six countries. Every year increasingly large sums are spent by Governments and private companies on projects in this field. This trend and its beneficial effects on marine petroleum development may decrease if future regulations of oil exploitation in deeper water do not take into account the appropriate requirements.

20. At the end of the discussion of this item, the following observations were made:

(a) To a large extent the geological structure of the sea-bed, prerequisite to further exploration and exploitation, remains unknown. Accordingly, at the present moment, the existence of thick sediments even at great depths which might contain accumulations of petroleum and gas cannot be excluded.

(b) The technical progress achieved during the past months does not to any appreciable extent change the conclusions of the reports of the Ad Hoc Committee but has justified the prospects which were envisaged and the cautious optimism voiced in this report. The present available data generally confirm the figures put forward last year.

(c) Technical improvements should be coupled with greater efforts to prevent accidents such as those which have recently occurred. Such accidents illustrate the difficulties inherent in off-shore developments and the necessity of a very high degree of scientific and technical competence of those concerned with such operations.

(d) Several factors have a bearing on the further development of off-shore drilling and related research, inter alia: the over-all demand for hydrocarbons; the possibility of new oil discoveries on land; the possibility of greater development of synthetic hydrocarbons; the possibility of harnessing other sources of energy competing with hydrocarbons, the hazards connected with under-sea exploitation; finally, economic policies which may have a delaying effect.

(e) Large investments in oceanographic research programmes are being made in several countries, mostly highly developed. This fact might warrant continued efforts to expand the international co-operation in this field.

(f) Hydrocarbons appear to constitute the most promising resources of the ocean floor. It would not be surprising, therefore, if their exploitation would be the first successful mining operation at great depths.

(g) While from a technical standpoint, exploration and exploitation of petroleum and gas may soon be possible at great depths, such operations may not be economical for some time. Regulations in this field should be realistic so as not to hinder continued investment and progress.

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Consideration of progress achieved in the exploration and exploitation of marine surficial and sub-surface deposits and in the techniques used for their development

21. During its meetings of 13 and 14 March 1969, the Economic and Technical Sub-Committee gave consideration to this item. It took into account the conclusions reached in paragraphs 11-29 of the report of the Ad Hoc Committee's Economic and Technical Working Group as well as the most recent developments in the exploration and exploitation of surficial and sub-surface hard mineral deposits of the ocean floor.

22. At present, off-shore mining operations are carried out in water depths of less than sixty metres by several countries. The exploratory activities now under way may eventually lead to the development of off-shore mining in new areas. None of the recent developments however point to break-throughs that may substantially enlarge the scope of marine mining in the near future.

23. Advances in off-shore mining of hard minerals have not been as rapid as those relating to hydrocarbons. However, in line with the increasing emphasis being placed on off-shore mining by both Government and industry throughout the world, the present limited stage of development of off-shore mining technology may be expected to change in the years to come.

24. Mining in deeper water appears to advance on a slow pace. This might be explained, inter alia, by the following:

(a) knowledge of the regional geology necessary to guide prospecting is still fragmentary;

(b) exploration techniques are poorly developed especially for sub-surface minerals;

(c) evaluation technology for most of the minerals considered is both weak and expensive;

(d) low-cost mining and dredging systems at greater depths have not yet been developed;

(e) the development of some surficial deposits may be delayed by the need to develop beneficiation processes;

(f) finally, low-cost on-shore sources of most sea-bed minerals are ample for the foreseeable future.

25. Nevertheless, there is much interest in economic recovery and production of manganese nodules, particularly for their content of nickel and copper, and a recent

announcement of progress in this field suggests that production of metals from them may begin by the early 1970s.

26. Industry continues to investigate the potential of the ocean floor as a source of a variety of minerals on account of the large quantities which might be found to be economically exploitable, although the costs of exploitation, except in the long term, may be generally higher than on land.

27. At the end of the discussion of this item, the following observations were made:

(a) Progress has been made in the field of dredging and mining of surficial and sub-surface hard minerals. However, no breakthroughs have occurred which would change the conclusions reached by the Ad Hoc Committee last year.

(b) This somewhat slow development is mainly due to the technical problems involved in prospecting and recovery under water of surficial and sub-surface deposits and to the economic inadequacy of the processes for upgrading surficial deposits.

(c) At this stage industry is becoming increasingly aware of the vast mineral deposits contained in the ocean floor which could in the future become technically recoverable and economically exploitable.

PART II

28. During the discussion of item (ii) on the programme of work, several examples were given of national experience in regulation of the mineral resources of the continental shelves and suggestions were made concerning the requirements to be met by any régime devised to promote the development of sea-bed resources beyond the limits of national jurisdiction. Many of the suggestions are alternatives which the Sub-Committee considered relevant to the item, and no attempts were made to recommend which examples were most relevant to the sea-bed beyond the limits of national jurisdiction. Thus many of the following paragraphs consist of expert opinions which were not fully debated or agreed upon.

General considerations with respect to the ways and means of promoting the exploitation and use of sea-bed resources

29. During its meetings of 17, 18 and 21 March 1969, the Economic and Technical Sub-Committee gave consideration to this item. It had before it the report of the Ad Hoc Committee's Economic and Technical Working Group (paragraphs 18-29 and 39-61),

and the preliminary note prepared by the Secretariat on "Economic Considerations Conducive to Promoting the Development of the Resources of the Sea-Bed and Ocean Floor Beyond the Limits of National Jurisdiction in the Interests of Mankind" (document A/AC.138/6 and Corr.1). It based its deliberations, inter alia, on national experiences as reported by various delegations.

30. The report of the Ad Hoc Committee's Economic and Technical Working Group (paragraphs 49-61) has established that the conditions which should be met by any régime of sea-bed resources management can be studied without prejudging the subsequent legal considerations. Drawing upon the experience of the Ad Hoc Committee, the Economic and Technical Sub-Committee based its deliberations on economic and technical requirements and in no way dealt with legal aspects of this question which should be properly considered in the Legal Sub-Committee and in the Main Committee. It was pointed out that the problems raised during the discussion of item 2 on the programme of work would have to be considered further in the light of the forthcoming report of the Secretary-General pursuant to resolution 2467 C (XXIII) and subsequently in the devising of an international régime.

31. In the past ten years man's knowledge of the sea-bed and its environment has considerably increased, but must still be considered inadequate and of an approximate nature. Basic data or documents relating to some regions of the ocean floor are practically non-existent or are sparse. Hence, substantial improvement of our knowledge of the sea-bed and ocean floor is an urgent necessity. In this context, reference was made to the usefulness of the long-term programme of oceanographic research which is to be based on national programmes prepared by Governments and to the efforts of the IOC of UNESCO in the preparation of the comprehensive outline of the scope of the programme.

32. The importance of scientific co-operation on a regional and international level was stressed. An important element of such co-operation would consist in training national experts, in particular of developing countries, and in providing them with basic equipment to carry out research and investigation in this field. Such measures would lay the ground for the future direct participation of the countries concerned in the exploration and exploitation of the sea-bed and ocean floor beyond the limits of national jurisdiction.

33. It was stressed that for the development of the resources of the ocean floor new forms of international co-operation should not reflect present inequalities and differences between developed and developing countries. They should provide not only for equality of opportunity, but also for equality in the actual enjoyment and equitable sharing of benefits derived from exploitation of the resources of the ocean floor. A primary goal should be to ensure maximum benefits for mankind as a whole compatible with minimum impairment of marine floors and fauna.
34. It was noted that benefits derived from any such co-operation should, furthermore, contribute to closing the existing gap between developing and developed countries. In this regard it was pointed out that many ways were possible to realize the common endeavour of exploitation for the benefit of all mankind and that all avenues which might lead to that end should be carefully explored.
35. Any study of ways and means which are to ensure that the resources of the sea-bed beyond national jurisdiction be developed without conflict in an orderly manner and in a way not interfering unjustifiably with the other traditional uses of the sea must take into account that eventual arrangements would be applicable to a vast area, encompassing the larger part of the world's surface.
36. Unless the resources of the sea-bed and ocean floor and subsoil thereof are extracted and brought to the market places of the world on a basis competitive with minerals from land, there is no prospect of any tangible benefit to mankind as a whole.
37. There is no difference in principle between the factors which determine the economic viability of mineral exploitation on land or beneath the sea. Therefore, experience gained on land is generally relevant and should be studied.
38. It was noted that the Secretary-General would, pursuant to resolution 2467 C (XXIII) submit a study on the question of establishing in due time, approximate international machinery for the promotion of the exploration and exploitation of the resources of the sea-bed and ocean floor beyond national jurisdiction. Pending the opportunity to study this paper the Sub-Committee reserved its position on the nature and form of any arrangements for a régime which might eventually be agreed upon.
39. It was pointed out that agreement on arrangements which meet the criteria of effectiveness, credibility and impartiality is one of the first vital steps in creating an economic environment that will encourage and promote the use of the

sea-bed resources; they must instill confidence in the minds of potential operators that rights granted will be, and can be, upheld. They must command the support and respect of all the nations of the world - developing and developed, socialist and capitalist, large and small, coastal and landlocked.

The arrangements should also be effective. For example, the economics of an operation can be drastically changed, or even destroyed, if there are delays in taking decisions which result in excessive dead time for an operating rig. On the other hand, risks of blow-outs, pollution and waste or destruction of resources exist if the wrong decisions are taken.

Thus the skills of many experts (geologists, geophysicists, geochemists, petroleum engineers, mining engineers, safety experts, marine biologists, lawyers, administrators, etc.) will be needed if exploration and exploitation of ocean floor resources are to be both encouraged and effectively controlled. Any international arrangements must therefore provide for a high degree of technical and professional expertise. Such arrangements must provide the necessary competence to cope with new and complex situations, and the sensitivity to react quickly and decisively.

40. It was pointed out that adequate and reasonable economic incentives must be provided by such arrangements if sea-bed resources are to be exploited. At the same time the interests of the world community must be safeguarded.

41. Stability of the basic rules is also important. To assess the economics of a project the potential operator has to be assured that the conditions under which he will work are clearly set out, and that they will not be subject to arbitrary changes during the life of his title.

42. It was suggested that it would be advisable to keep fees and other payments required from operators at a modest, or low level at the exploration stage, and then, looking to mankind as a whole, to provide for a sharing in the benefits through appropriate provisions at the time of production. In any event, due allowance should be made in devising any scheme to take into account the difficulties and therefore the high costs and risks inherent in the marine environment.

43. The view was expressed that from the point of view of operators, the size of the areas should allow for efficient and economic exploration. Equally, it is

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important that areas be effectively and energetically worked and not allowed to lie fallow. In this connexion, it was also noted that this objective might be achieved in various ways; for example, by a sliding scale of fees and/or work requirements which increase over time, by requiring the surrender of portions of the area after stipulated periods, or by stipulating that a concession will lapse if the mineral is not exploited within a defined period, or by a combination of all three.

44. Drilling and mining activities carried out on land present hazards requiring strict and adequate safety measures. This is all the more true for all phases of marine mineral resources development, due to the hostile environment in which it takes place. Mineral exploration and extraction may interfere with fishing, while the use of dynamite in seismic exploration may kill fish locally. One single blow-out may pollute vast expanses of the ocean, and even spread to neighbouring countries, significantly upset the ecological balance and damage the traditional maritime activities. Since only a few countries have so far adopted national safety codes for oil drilling within their continental shelf area, the necessity of adopting such appropriate legislation in the interest of the world community was urgently stressed. It was also pointed out that, although the establishment of sea lanes and use of modern aids to navigation have largely eliminated hazards to navigation, the increase in the number of fixed or stationary installations multiplies the number of obstacles shipping must face and calls for appropriate safeguards to prevent such hazards as well as specific measures to solve conflicts arising from different uses of the sea and to protect the interests of coastal States.

45. Pollution stemming from sub-sea mineral exploitation is essentially of two types, namely (a) oil, gas, brines or fluids released directly from the well, from production or storage facilities, and from pipelines and (b) particulate matter stirred up from the sea bottom in mining or discharged as waste in the course of on-site beneficiation. The potential ill effects of mineral exploitation in waters beyond the limits of national jurisdiction are little understood at this stage, and will require both further study and caution in undertaking exploitation.

46. With regard to the problem of safety of personnel, sub-sea mineral development combines some of the hazards related to shipping and fishing and other hazards associated with dredging or on-shore drilling. Even though experience seems to be sufficient to form the basis for adequate safety regulations and practices, this aspect deserves continued review and improvement.

47. The opinion was expressed that in the foreseeable future only a limited number of countries will be in a position to actively participate on the basis of their own technologic capability in the exploitation of the sea-bed and ocean floor beyond the limits of national jurisdiction. This should, however, not preclude the others from benefiting from this development. In view of this consideration and pending the establishment of appropriate international arrangements it was suggested that it would be timely and appropriate to focus on interim steps to facilitate development of sea-bed resources: these should be simple and pragmatic in nature and not prejudice the eventual régime which may be established. They might include the registry of activities carried out beyond the limits of national jurisdiction, as well as scientific technical co-operation, training of personnel, safety measures, etc. The opinion was also expressed, on the other hand, that such interim steps are unnecessary, since no activities should be permitted prior to the establishment of an international régime and that efforts should be concentrated on the establishment of such a régime.

48. The importance of international co-operation with regard to submarine archaeology dealing with sunken cities and wrecks on the bottom of the sea was also mentioned. Apart from increasing historical knowledge, progress in that field will also provide appreciable information on sea-level changes having occurred thousands of years ago, thus establishing a link between archaeological and geological evidence.

49. At the end of the discussion of this item, the following observations were made:

(a) Once again, it was emphasized that our knowledge of the ocean is still fragmentary and perhaps too scant to provide a basis for economic exploitation of the sea-bed and its resources beyond the geophysical continental shelf.

(b) New forms of international co-operation should be considered to ensure the rational and equitable exploitation of the resources of the sea-bed.

(c) The fact that the exploitation of marine mineral resources is only in its very early stage provides a good opportunity to draw up, in good time, an international régime for operations on and under the sea-bed.

(d) A main objective of an international régime in this respect should be that all countries, whether coastal or land-locked, benefit from such a development and that the special interests and needs of developing countries be taken into account.

(e) The international régime should be effective, equitable and trustworthy. It should provide economic incentives for the development of marine mineral resources, particularly at the exploratory phase.

(f) Operations beyond the limits of national jurisdiction should be conducted in such a way as to reduce to a minimum the danger to human life, pollution and interference with the traditional maritime activities.

Particular problems related to the first phase of marine mineral resources development: the establishment of basic documents

50. During its meeting of 19 March 1969, the Economic and Technical Sub-Committee gave consideration to this item. It had before it the preliminary note by the Secretariat on "Economic considerations conducive to promoting the development of resources of the sea-bed and ocean floor beyond the limits of national jurisdiction in the interests of mankind". It based its deliberations also on the letter dated 27 February 1969 addressed by the Chairman of the IOC to the Secretary-General (A/AC.138/10).

51. In the Report of the Ad Hoc Committee's Economic and Technical Working Group (paragraph 19) four phases were distinguished in the process of mineral development, the first of which deals with the acquisition of the basic knowledge through systematic area surveys and research, necessary to understand the character, distribution and variation of the mineral resources.

52. Basic documents, especially bathymetric, geophysical and geologic maps are needed to help identify areas favourable for the occurrence of various

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minerals and to appraise their potential resources, and as such are a prerequisite for the development of marine mineral resources. Such data also help to define properties of the sea bottom that need to be known to predict the hazards to mining operations and the effects of mining on other uses. Due to the vastness of the area - approximately 360 million square kilometres are covered by water - the systematic mapping and charting of the ocean floor is a long-term and costly endeavour. Although widely spaced geophysical and sampling traverses and special purpose mapping provide some information on the geology of the ocean floor, systematic geological mapping of the oceanic basins has not yet begun. Geophysical mapping is in its early stage.

53. Practical considerations suggest that parts of this enormous task be undertaken by means of co-operative planning. Such a procedure would avoid overlapping and duplication of national efforts, lead to results in the shortest possible time and allow for a pooling of facilities and qualified personnel.

54. In order to achieve effective and rational co-operation there must be agreement on co-ordinated planning of scientific research, on standardized measuring techniques and data processing as well as common understanding on the areas which would deserve priority investigation.

55. In the context of co-operative planning the co-ordinating role played by the IOC of UNESCO in the past was mentioned and the hope was expressed that it will continue and strengthen its activity in this field.

56. The need to standardize and calibrate instruments used at sea and in the laboratory was especially stressed; repeated slight errors in measurements could give rise to large-scale erroneous conclusions and seriously hamper progress. It was also pointed out that the reliability of bathymetric and geological maps of the ocean floor depend on the accuracy of navigation systems with which they were recorded. In the last thirty years the development of electronic navigation has contributed to considerable progress. Today this is enhanced by the precision attained on the high seas with the artificial satellite navigation system. Additionally, the VLF continuous wave system promises vast coverage, range, and precise navigational resolution capacity. The need to support marine exploration surveying by means of precise navigation is world wide.

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57. In the field of international co-operation, reference was also made to the regional economic commissions of the United Nations and the valuable assistance they could provide in particular with regard to the selection of appropriate areas for the purpose of such oceanographic expeditions.

58. At the scientific level of investigation where research consists of an enquiry by scientists into the basic nature of the sea and the sea floor with no economic goal in mind, it was pointed out that there should be the least possible restriction on the movement of oceanographic vessels, and no unnecessary hindrance placed in their way. The idea was put forward that if coastal States limit excessively the freedom of research they may undermine the scientific basis upon which future progress will depend for all countries.

59. The question was raised of how the basic documents resulting from expeditions at sea were to be made accessible to the world community. The results of research in the areas of the sea-bed beyond national jurisdiction should be freely accessible to all.

It was also pointed out that if a system of concessions is adopted, it appears feasible to reconcile this principle with the proposition that prospectors be given exclusive rights to explore an area for a specified period. In return for granting exclusive exploration rights, operators might be required to make the basic data obtained in the course of the operation freely accessible after the lapse of a suitable period of time. This could be considered in the framework of the arrangement to be agreed upon for granting of exploration rights.

60. Existing international exchange of information and data is limited to scientific data. There is a need for an international exchange of applied technological data. A fundamental problem with such information is the task of interpreting and processing the data for publication and retrieval. Standardizing the methods of storing oceanographic data so that they are permanently and swiftly available to scientists everywhere is of primary importance. It was mentioned in this context that World Oceanographic Data Centres operate in Moscow and Washington. It was further suggested that a register of existing publications, maps and relevant documents be established and that new publications could be registered.

61. Systematic mapping as indicated before will eventually provide the broad base of understanding needed for full use of the ocean floor and efficient development of its resources. The view was however expressed that the prospector and developer may precede the topographer and survey geologist at sea as they may have on land. It was also pointed out that the development of ocean floor mineral deposits will therefore not have to await completion of the enormous and comprehensive task of a relatively detailed basic survey.
62. The question arises whether priority could or should be given to certain areas for which the establishment of basic documents might be promoted. In this respect, it might be better to pursue the systematic gathering of basic knowledge of areas which show signs of potential mineralization in preference to areas where preliminary surveys offer no encouragement.
63. Similarly, technical possibilities and economic prospects of such undertakings should be kept in mind: for some minerals it would seem prudent to proceed progressively oceanwards from the shelf towards greater water depths. Other criteria might be, inter alia, the availability of markets for given minerals and prevailing weather conditions. The importance of certain areas or resources for developing countries should also be taken into account.
64. At the same time, however, it is desirable to pursue purely scientific sea-bed exploration, for large areas of this vast domain are not well enough known to understand its potential even qualitatively. It is also desirable to continue research on crustal and oceanologic processes of the deep ocean, for an understanding of these processes is fundamental to science and to learning what mineral concentrations are likely to exist in this environment.
65. The scientific results of the co-operative programmes prepared and co-ordinated regionally and internationally by Governments and/or governmental and non-governmental organizations and by the UNESCO Intergovernmental Oceanographic Commission could prove a useful guide in determining these priorities.
66. The need was stressed to associate developing countries more fully and without delay in this new venture. It is of primary importance to make the Governments and people of those countries aware of the vast possibilities inherent in the development of the ocean floor and to provide for necessary means and for the training of national experts.

67. At the end of the discussion of this item, the following observations were made:

(a) Before us is the task of conducting a systematic geological survey of the sea-bed and the ocean floor. It is an enormous task, very expensive and will involve many years of work.

(b) The object of such a survey is not confined to the search for economically valuable mineral deposits, but is broader in scope.

(c) It requires international co-operation in the planning of research programmes, in the standardization of the methods used for survey and analysis, etc. The active participation of all countries should be sought in bringing about such co-operation.

(d) It should be governed by the principle of freedom of scientific research, in accordance with the relevant provisions of International Law and the results obtained should be freely accessible to all.

(e) However, development of some of the mineral resources of the ocean floor does not have to await complete topographic and geologic knowledge of the whole of the area.

(f) The question arises whether or not certain priorities could be devised in the selection of areas for which the establishment of basic documents should be promoted. In this regard attention could be focused on areas which seem to offer an economic potential for exploitation and where development techniques would be available in the near future, such as the continental margin.

(g) The need to support marine exploration surveying by means of precise navigation is worldwide.

(h) In the interests of effective dissemination of all available information, prospectors who are granted exclusive exploration rights might also be required to make accessible freely, after the lapse of a suitable period, the basic data they have gathered.

(i) It is important to make the Governments and people of developing countries aware of the opportunities of this new venture so that they may participate in it without delay.

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Particular problems related to the second and third phase of marine mineral resources development: the exploration of mineralization zones and the evaluation of their exploitability

68. During its meeting of 20 March 1969, the Economic and Technical Sub-Committee considered jointly the second and third phase of marine mineral resources development: the exploration of mineralization zones and the determination of the economic value of the mineral concentrations or deposits which have been discovered. It had before it the preliminary note by the Secretariat on "Economic Considerations Conducive to Promoting the Development of the Resources of the Sea-Bed and Ocean Floor Beyond the Limits of National Jurisdiction in the Interests of Mankind" (document A/AC.138/6).

69. It was suggested that experience gained in various countries in relation to the development of mineral resources under national jurisdiction should be taken into account when considering the measures which might be conducive to promoting the development of the resources of the ocean floor beyond the limits of national jurisdiction. An appropriate adaptation of the existing practices might be envisaged with a view to ensuring the optimum efficiency. The identification of common denominators amongst these practices might facilitate the acceptance by the international community of an agreed procedure. But it should also be recognized that the terms appropriate for mineral resource allocation and development vary from place to place and time to time. Various views were expressed with regard to promoting the development of marine mineral resources beyond the limits of national jurisdiction.

(a) According to one, the operator would be called upon to make a declaration of intent to undertake exploration in a certain area. The registration of such a declaration would be made subject to certain conditions such as respect of international law, reasonable regard for the marine environment, etc. No exclusive exploratory rights would, however, be granted.

(b) A more formal system would entail the issuance of an exploration permit. Such a permit would be granted for a given area and for a relatively short period of time. It would give no exclusivity to the operator nor rights to exploitation. The operator might, however, enjoy preferential treatment when applying for an ensuing exploitation permit and would receive some compensation if his application is rejected.

(c) Under a third system, an exclusive exploration licence would be granted for a more limited area and a longer period of time. Such a licence would entail exclusivity in the search for specified minerals and would carry the right to future exploitation of the deposits discovered. It might be awarded on one of several alternative bases, including the first to file, a lottery, or a judgement of the operator's financial and technical capabilities and his proposed programme. Competitive bidding is another possible basis for awarding title, although it may be less applicable to the totally unexplored resources of the deep ocean floor than it is in already producing provinces.

70. It was suggested that individual Governments are in the best position to judge the suitability of their own nationals as potential operators applying for permits and leases, and it is advisable that they be directly involved in such arrangements.

71. It was further suggested that any such lease-system would also have to contain provisions which would ensure that the interests of all countries were equitably respected.

72. Reference was made to the importance of preventing oil and gas blow-outs and storm breaks which may endanger human safety and result in pollution and other damage as well. Fortunately, such accidents have been rare because of the general effectiveness of prevention equipment. Thus, out of 7,642 wells drilled for oil and gas on the outer continental shelf of the United States until the beginning of February 1969, only twenty-three resulted in blow-outs and only one of these - the recent Santa Barbara Channel blow-out - resulted in an oil spill that led to significant environmental damage. The study of the origin, effects and means of prevention and control of such accidents, however, deserves high priority due to their potential danger to human life and the marine environment. Nevertheless, it was recognized that it may not be possible to completely eliminate such accidents because of the difficulty of overcoming once and for all the possibility of human error and/or equipment failure.

73. It was urged that without prejudice to the establishment of an international régime for the exploitation of the sea-bed resources, measures which would further international co-operation, in the interests of mankind as a whole might be strengthened. It was suggested that such measures would include technical

assistance to developing countries comprising the training of qualified personnel, the establishment of reference services which could provide easier access to basic data, the provision of capital needed to undertake sea-bed resources development operations, etc.

74. Further description of the different structural units underlying the seas and oceans was advocated, inter alia, the continental shelf, the continental slope, margin and continental terrace, the abyssal plain and other important features.

75. The importance was also stressed of taking into account the characteristic differences between the oceans and internal and marginal seas.

76. At the end of the discussion of this item, the following observations were made:

(a) It would seem appropriate to study procedures and practices at present used on a national level in order to assess their suitability to concessions granted beyond the limits of national jurisdiction.

(b) Various types of arrangements are feasible. These should provide that the obligations assumed by an operator are matched by appropriate opportunity for reward.

(c) A régime should serve the interests of mankind as a whole, and should take into account the special interests and needs of developing countries.

(d) Although accidents in offshore drilling cannot be completely eliminated, their number can be reduced by means of improved safety measures and practices.

Particular problems related to the fourth phase of marine resources development:
the exploitation of mineral deposits

77. During its meetings of 21 and 24 March 1969, the Economic and Technical Sub-Committee considered this item. It based its deliberations on the report of the Ad Hoc Committee's Economic and Technical Working Group (paragraphs 30-38), on the preliminary note by the Secretariat "Economic Considerations Conducive to Promoting the Development of the Resources of the Sea-Bed and Ocean Floor Beyond the Limits of National Jurisdiction in the Interests of Mankind" (document A/AC.138/6 and Corr.1). The Sub-Committee was also informed on methods applied by various Governments at the national level.

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78. Attention was called to the fact that the geologic characteristics of minerals that may be exploited from the sea-bed differ from one mineral or group of minerals to another, and influence the size of the area required for viable operation and the time required to achieve production. For nearly all minerals a far larger area may need to be explored to find a deposit suitable for mining than is finally selected for exploitation.

Exploration of concealed deposits and the evaluation of the precise amount and quality of both exposed and unexposed deposits can only be determined by extensive and expensive forms of sampling and may even require some production experience. At the stage when such expensive forms of exploration are reached, the operator needs an exclusive right to explore and to produce if workable deposits are found. Because the value of such deposits cannot be determined in advance, particularly in wholly unexplored areas, the basis for payment for such rights should be one that is related to actual production rather than a pre-determined estimate of the value of an unexplored area.

79. It was mentioned that the high investment risks characteristically associated with mining should be compensated for by the opportunity for higher profits than are acceptable in many other enterprises. The risks stem from uncertainty of discovery, uncertainties concerning the feasibility of mining and recovery systems, possibility of loss from mining accidents, storms, and so on, and from uncertainties concerning future prices, demand, and other external circumstances. Although the high risk in mining cannot be eliminated altogether, it tends to diminish with increasing knowledge about the occurrence of recoverable minerals in a given area and with increasing experience in producing them. Net resource value - the surplus remaining when the mineral has been sold and after production costs and profits on risk investment have been paid - is the amount which would be received from granting of a concession for the production and sale of these resources. Limited as it is on one side by production costs and endangered by the risk involved and on the other by a price that is fixed externally, net resource value varies considerably from place to place and time to time. At the outset of sea-bed exploitation it may be nearly zero, but if exploration shows the existence of workable deposits, if production costs can be reduced, if environmental hazards can be controlled, and if prices do not decrease, net resource value may increase over time.

Direct revenue from the production of minerals is welcome to all governments, and to developing countries it may be the principal benefit to be derived from production of sea-bed resources initially. An important consequence of the availability of minerals, however, is in the chain of economic activities that surround their production and follow on their use, and in the future these benefits should come to be shared by all the people of the world.

It was suggested, therefore, that, in the long run, the goal should be not only the direct revenue that may come from the sale of the sea-bed resources, but also to encourage sub-sea production of the raw materials as will make them available.

80. The Economic and Technical Sub-Committee was informed of various methods applied nationally to regulate mineral exploration and exploitation with a view to examining whether common denominators could be arrived at which could serve as examples for similar regulations when such an international régime is envisaged.

81. The view was expressed that any exclusive rights that might be granted should be over areas large enough and for periods long enough to enable the operator to carry out exploration and exploitation with the benefit of economies deriving from the scale of activities. According to this view, these rights should only be given over such an area and for such a period as will ensure that the area is effectively and energetically worked during the life of the title.

82. It was also suggested that production titles should specify the minerals which they cover: as a general rule, all embracing titles should not be contemplated. Subdivision into hydro-carbons and other minerals should be considered at the least. The possibility was mentioned, however, that hydro-carbon titles might be extended to cover other substances which may be recovered by drilling: e.g., sulphur in some forms of its occurrence and helium. Consideration should be given to whether hard minerals might also be grouped in ways corresponding to the mode of occurrence: e.g., it is impossible in the case of typical lead and zinc occurrences to extract the one without the other. Also nickel and copper occur with manganese, as all may be present in the same nodules.

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83. It was pointed out that the need for stability in the basic rules would not imply that conditions should be immutable and that production rights should be granted for an adequate specified period of time, at the end of which the title holder should have the opportunity to renew his title, subject however to review the conditions for the renewed title. Such a way of proceeding would allow for long-term planning on the part of the operator and induce him to apply sound exploitation methods. Since sea-bed mineral resources were non-renewable, responsible development was imperative. On the other hand it would permit a review of the portion of the benefit from production which should accrue to mankind as a whole - that is to say, the renewed title could carry a higher rate of royalty or tax, or a lower rate could be imposed to ensure more complete mining of the resource.

84. It was emphasized that promotion and success of international co-operation in the development of marine mineral resources will be dependent on the régime which will be devised.

85. It was pointed out that operators exploiting ocean floor resources within the framework of an international régime should do so (a) in a way which conforms with good mining practices and makes the best use of these resources, (b) without unjustifiable interference with other activities on the sea-bed or on the superjacent high seas, (c) with constant vigilance to guard against marine pollution and the disturbance of the ecological balance. Ways would have to be devised, therefore, by which the quantities and grade of minerals mined or extracted could be measured and their value assessed in order that mankind, as a whole, may receive its just and equitable due. It was pointed out as well, that the requirements of competence and efficiency be balanced with the need to keep costs and personnel within manageable proportions so that a bureaucracy not be created which would absorb the financial benefits which might accrue from ocean floor production.

86. It was pointed out that, under any régime, operators should be required to:

- (i) submit advance notices of proposed programmes;
- (ii) provide information and appropriate materials on a current basis as well as to furnish comprehensive technical reports;
- (iii) assist in the carrying out of appropriate inspections by authorized officials.

87. With particular regard to the technical aspects, reference was made to arrangements which should be designed so as to adequately reflect such requirements and factors arising from the exploratory techniques necessary to find the various types of deposits, the evaluation procedures required to justify their development and the equipment and methods for their extraction.

88. With particular regard to the economic aspects it was also noted that allowance should be made for the economic realities and provide adequate economic incentives to attract the necessary investment capital, protecting at the same time the interests of the international community as a whole. Rights should be granted in a manner devoid of political or other discrimination, for specified periods of time and oblige the holder either to pursue resource development actively or to relinquish the rights granted.

89. Mankind as a whole should benefit from the production of sea-bed resources: once discovered and produced they will add to the existing inventory of minerals which are a wasting and non-replaceable asset as distinct from other natural resources available for use by mankind.

In this connexion the view was expressed that the international community would benefit from sharing financially with the operator, be it a private company or a State-owned enterprise, in the proceeds from the sale of his product.

The special interests and needs of developing countries would thereby have to be taken into account.

90. It was pointed out that if royalties are imposed they should not be so high as to discourage exploitation or to promote irresponsible methods of exploitation. They should be modest at the initial stages of exploitation, since the returns will then also be small, and they could vary with the difficulties and costs of the exploitation.

91. It was suggested that in providing exploitation rights for particular minerals an account would need to be taken of the availability on the world markets of the same minerals produced from land, the demand position and the other relevant factors.

The promotion of an exploitation of specific sea-bed minerals which could entail a drop in price of corresponding land minerals on the export of which some or many developing countries rely is a matter for careful consideration by the world.

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community. In this context, it was considered over-optimistic to expect, as was suggested in paragraph 36 (b) of the report of the Ad Hoc Committee's Economic and Technical Working Group, that "the economies of the developing countries will be more diversified and consequently less dependent on raw materials exports" by the time sizable exploitation of marine mineral resources will be achieved.

92. Reference was made to marine mineral deposits in particular hydro-carbons, located partly within the zone of national jurisdiction and partly outside this area. Two ways were suggested to reconcile the interests of the coastal State and the interests of the world community in exploiting these deposits:

- (i) to establish an intermediate buffer zone contiguous to the outer limits of national jurisdiction where the coastal State would enjoy priority of rights or exclusive rights of exploitation, depending on the extent of the overlapping of the deposit;
- (ii) to consider a joint exploitation of such resources by the coastal State and the entrepreneur operating within the envisaged international arrangement.

93. It was noted that international co-operation in the field of sea-bed resources development would benefit from the participation of all States, developed as well as developing. One form of promoting the participation of developing countries which lack the necessary capital and technological skill would be in the training of their nationals. It was therefore advocated that the existing training programmes in this area be enlarged, more widely publicized, and that new programmes be created at the national, regional and international levels, so as to attract and encourage the potential scientists and research students from developing countries.

94. In this context, it was further suggested that operators should accept among their personnel, trainees from developing countries in order to assist them in the training of national experts, and that nationals of developing countries, where similar types of deposits as are looked for by the operator are identified, should thereby enjoy priority,

95. At the national level measures are taken for the protection of installations used for exploration and exploitation on the continental shelf, as well as measures to avoid that such installations constitute a danger to the environment or an impediment to other activities.

In this context, the view was expressed that these measures could be carried over into an international agreement which, inter alia, might provide for the establishment of "safety zones" around such installations, without giving the installations the status of islands.

96. Personnel engaged in off-shore operations should be given guarantees commensurate with the risks they take. In addition, safety codes should be adopted to ensure best possible protection of this personnel.

97. Safeguards against potential hazards inherent in exploitation activities and provisions for the prevention of marine pollution and damage to coastal States should also be considered in this context.

98. The activities of the Intergovernmental Maritime Consultative Organization were mentioned. It was proposed that the International Conventions under its auspices, i.e., the International Convention for the Prevention of Pollution of the Sea by Oil (1954) as amended and the International Convention for the Safety of Life at Sea (1960) be complemented so as to take into account problems relating to:

- (i) the safety of construction, equipment and operation of drilling rigs, production platforms, submersibles, and other devices used for the exploitation and transportation of sea-bed resources;
- (ii) the safety of the people working on them;
- (iii) the danger arising from ships navigating in the area where underwater operations take place;
- (iv) the spillage of oil and other noxious or hazardous substances into the sea due to the exploitation of sea-bed resources.

99. Any international arrangement for the exploitation of marine mineral resources might also include provisions relating to the liability for accidents occurring during the operation of off-shore ventures. In particular the necessity of considering a régime of compensation for damages to third parties was stressed.

100. At the end of the discussion of this item, the following observations were made:

- (a) In order to promote the exploitation of the resources of the sea-bed beyond the limits of national jurisdiction, it will be necessary to encourage the capital investment and to further and protect the interests of the international community.

(b) The necessary scientific, technical and economic expertise must be available if the task is to be accomplished efficiently.

(c) Various formulas regarding the granting of exploitation titles on a national level have been discussed. It will be useful to determine the common denominators of these national formulas, and to examine their respective advantages and drawbacks.

(d) Mankind as a whole stands to benefit from the development of sea-bed resources in two ways: from the increase of world inventory of mineral resources; and by financial sharing in the benefits resulting from their exploitation.

(e) There was common understanding that all countries should participate to the extent possible in the exploration and exploitation of the resources of the ocean floor and share equitably from their exploitation.

(f) It was therefore considered important (i) to promote international co-operation providing for the training of nationals of developing countries with a view to enabling developing countries to participate directly in such undertaking and (ii) to provide for international arrangements which will benefit all mankind, taking into account the special needs and interests of developing countries.

(g) Since the economy of certain developing countries is very much dependent upon the export of certain primary commodities it will be necessary to study in detail the economic impact of exploitation of marine mineral resources on the world market.

101. Following a proposal by the delegation of India the Sub-Committee decided that the Secretariat be requested to prepare, as a follow-up of the preliminary note A/AC.138/6 and in the light of the deliberations held in the Economic and Technical Sub-Committee during its session of March 1969, a study which would include a review of the measures taken by various Governments with regard to the development of their continental shelf mineral resources, in particular oil and gas, and the denominators which are common to these measures.
