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4.
Ocean Science: Its Place in the New Order of the Oceans

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THE OCEANS, which comprise over 70 percent of our planet, are still a relatively unknown environment. Nevertheless they offer exciting potential for mineral and biological resources, a potentially safe disposal site for some human and industrial wastes, new sources of energy, control or modification of climate, a medium for transport of much of the world's trade, a military playground, and other potential not yet even considered. The study of the ocean necessary to achieve this potential is visualized by some countries as a form of power, by others as an opportunity, and by still others as a frustration because of their lack of marine science expertise. In any case, marine scientific research will be critical to those countries that wish to develop their new 200-nautical-mile Exclusive Economic Zone (EEZ) and other marine areas having potential. Those countries without marine science expertise will be at a disadvantage unless they develop such capabilities and/or develop cooperative efforts in scientific research and training with those countries that have such skills. The achievement of a country's marine objectives may often be more a function of national policy and politics than the ability to pose and solve the appropriate scientific or technical question.

Many scientists feel that marine research is approaching a very

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important crossroad. On one path are recent exciting scientific discoveries such as the deep-sea vents along oceanic spreading centers and their associated polymetallic sulfide deposits and exotic lifeforms or similarly our increasing understanding of air–sea interactions, and thus ultimately better climate prediction and even modification. These discoveries hold considerable promise for major advances in our use and exploitation of the ocean, that can also eventually impact on many other human endeavors. On the other path, however, are some aspects of the Law of the Sea (LOS) treaty that could severely reduce or restrict marine scientific research in large and important areas of the ocean. The challenge is to find an intermediate or new path that allows the continuation of important marine research, without scientists or countries becoming frustrated or diverted by the LOS treaty and other entanglements. Indeed, it may even be possible that the LOS treaty could yield positive benefits, but to achieve them and capitalize fully on present and new scientific discoveries will require innovative approaches toward marine research. *It is to everyone's advantage that the ocean is used properly.*

In this paper I would like to comment on various aspects of the LOS treaty for marine scientific research, their implications for scientists and developing countries, and then conclude with some suggestions for improving marine science opportunities for all. As a marine scientist, from a developed country, my views may well be biased. However, I have worked during much of my career with developing countries and hopefully have and can express a feeling as to some of their marine scientific expectations.

Background

During most of the early history of marine scientific research, essentially all of the ocean was free for exploration; restrictions, even after the first LOS Convention in 1958, were limited to the territorial sea and some types of continental shelf research. During these times the main restrictions on scientific research were technology, an occasional inability to formulate an appropriate hypothesis for testing, and infrequent financial constraints; political restraints were rare. Marine technology and science then clearly was not captive to national or international rules.[1] Unfortunately, some aspects of marine science may

have been too successful, in particular the promotion of certain ocean mineral resources, especially manganese nodules and hydrocarbons. Anticipation of potential riches from the sea floor helped to encourage an international movement toward increasing ocean enclosure that culminated in the Third United Nations Conference on the Law of the Sea (UNCLOS III). At this conference ocean science was not generally visualized as a natural freedom of the sea or even a benefit, but rather as a threat toward resource development or as having important military implications. Scientific information, and the ability to use it, has an economic value which often cannot be fully used by developing countries. Thus often the case for science was lost in the north-south dialogue. Much could be written to show how poorly the presentation for science was made, but that is another story.

The present marine science conditions, resulting from the LOS negotiations and treaty, include coastal state permission for research as well as several very specific requirements (described in more detail in following sections) covering all portions of the coastal ocean. Individually none of these requirements have to be limiting; collectively, however, they will present a difficult path for a marine scientist to follow if he or she wishes to develop a marine scientific program with a foreign country. It may well be that the perceptions of these difficulties could do more to discourage scientists from working in foreign waters than the treaty itself. The EEZs of the world, it should be noted, include about 28 million square nautical miles or around 32 percent of the total ocean area. If all regions of the ocean that will have controls for marine science are considered, about 42 percent of the ocean is involved.[2] This region obviously includes many important areas of oceanographic study and most of the ocean's biological and mineral resources.

UNCLOS III and Marine Scientific Research

Formal negotiations concerning marine scientific research and other issues at UNCLOS III began in 1974, and eventually on April 30, 1982, a Law of the Sea Treaty was approved by a vote of 130 to 4.[3] The United States, Venezuela, Turkey, and Israel voted against it, and 17 other countries abstained; 60 nations must ratify the treaty for it to enter into force, 20 have done so by mid-1985.

The new regime for marine scientific research in much of the ocean

will change the present way marine scientific research programs are developed and implemented. It should be stressed that it is irrelevant whether the treaty is eventually ratified by the necessary 60 countries or not, since most coastal countries have already adopted rules concerning marine scientific research in their EEZ.

Some of the history of the marine science negotiations during UNCLOS III has been published.[4] Many countries, including most coastal states, favored or even encouraged restrictions on marine research. The few supporters of marine science were the United States, the Soviet Union (until 1976), West Germany, the Netherlands, and sometimes Japan.[5] By supporters of marine science I mean those countries that supported relatively few, minor or no restrictions on marine science in the exclusive economic zone and further seaward regions. During UNCLOS III there was essentially a consensus concerning coastal state control over research in internal waters and the 12-nautical-mile territorial sea.

The LOS treaty has produced several distinct juridical regions for the ocean; these include: internal waters, territorial seas, straits used for international navigation, archipelagic waters, exclusive economic zones, the continental shelf beyond 200 miles, a region called "the area," and high seas. The treaty establishes boundaries between these juridical regions (or in some instances defines the method by which such boundaries are to be determined), the mixture of coastal state and flag state jurisdiction within each region, and the rules of conduct within each region. Several of these jurisdictions, such as the exclusive economic zone, archipelagic waters, and "the area" (figure 4.1) are new. Broadly speaking there is more restriction for essentially all uses of the ocean as one moves from the open ocean toward the coast; for science from essentially complete freedom on the high seas to absolute coastal state jurisdiction over foreign research in a coastal nation's internal waters.[6]

The treaty itself does not define the term marine scientific research; it does, however, say that "marine scientific research shall be conducted exclusively for peaceful purposes;. . . shall be conducted with appropriate scientific methods . . . , [and] shall not unjustifiably interfere with other legitimate uses of the sea" (article 240). A further comment is that coastal states "shall endeavour to adopt reasonable rules, regulations and procedures to promote and facilitate marine scientific research. . . beyond their territorial sea and to facilitate. . . access to

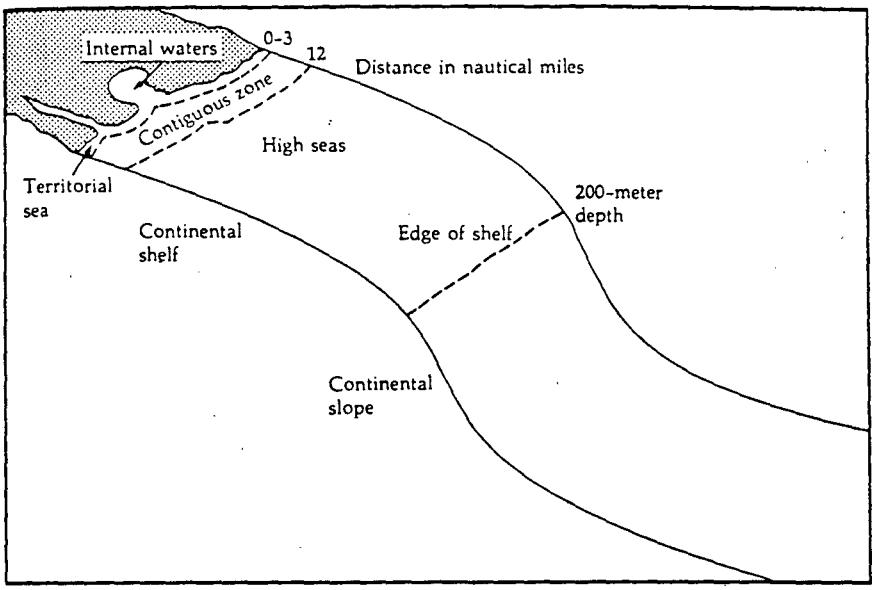

Figure 4.1. The major divisions of the ocean under the various 1958 conventions.

their harbours and promote assistance for marine scientific research, vessels" (article 255). It also says that "states and competent international organizations shall promote and facilitate the development and conduct of marine scientific research in accordance with this Convention" (article 239). As positive as these articles may seem, all except 240 are nonbinding. What follows is a brief discussion of scientific conditions within each juridical region.[7]

Internal Waters

Internal waters include rivers, bays, lakes, and other marine areas landward of the base line from which the territorial sea is delineated. Within internal waters the coastal state exercises complete jurisdiction over who shall enter and conduct marine scientific research and under what conditions. These rules are similar to those in the 1958 convention on the territorial sea and continguous zone.

Territorial Sea

The treaty establishes a territorial sea of up to 12 nautical miles in width. Within the territorial sea the coastal state has "the exclusive

right to regulate, authorize and conduct marine scientific research, . . . [which] shall be conducted only with the express consent of and under the conditions set forth by the coastal State" (article 245). These provisions are also similar to those of the 1958 Convention on the Territorial Sea and the Contiguous Zone; a new aspect is the clear definition of a 12-mile width to the territorial sea. The treaty does not mention the mechanisms to get permission for research in a country's territorial sea or the conditions that a coastal state can impose. There is a right of innocent passage through the territorial seas; however, article 19, paragraph 2(j), eliminates "the carrying out of research or survey activities" as an accepted activity under innocent passage. On a positive side those countries signing the treaty will be restricted to no more than a 12-mile width for their territorial sea.

Straits Used for International Navigation

The establishment of 12-nautical-mile-wide territorial seas will have an important effect on 116 straits that are more than 6 but less than 24 miles wide, and that now will be included within the territorial seas of the adjacent states.[8] Examples include Bab el Mandeb (Red Sea) and the Strait of Gibraltar. Article 40 states that "foreign ships, including marine scientific research and hydrographic survey ships, may not carry out any research or survey activities without prior authorization of the States bordering straits." This, in effect, means that international straits less than 24 miles wide will be treated as territorial seas, as far as marine scientific research is concerned.

Archipelagic Waters

Several treaty articles will allow archipelagic states to define base lines for archipelagic waters, although the actual extent of these waters is not clear. An archipelagic state is one formed by one or more archipelagos, such as Indonesia and the Philippines; Hawaii and the Galapagos Islands are not candidates. An archipelagic state can exercise a similar jurisdiction over marine scientific research in its archipelagic waters as it does over such research in its territorial sea, i.e., essentially complete control.

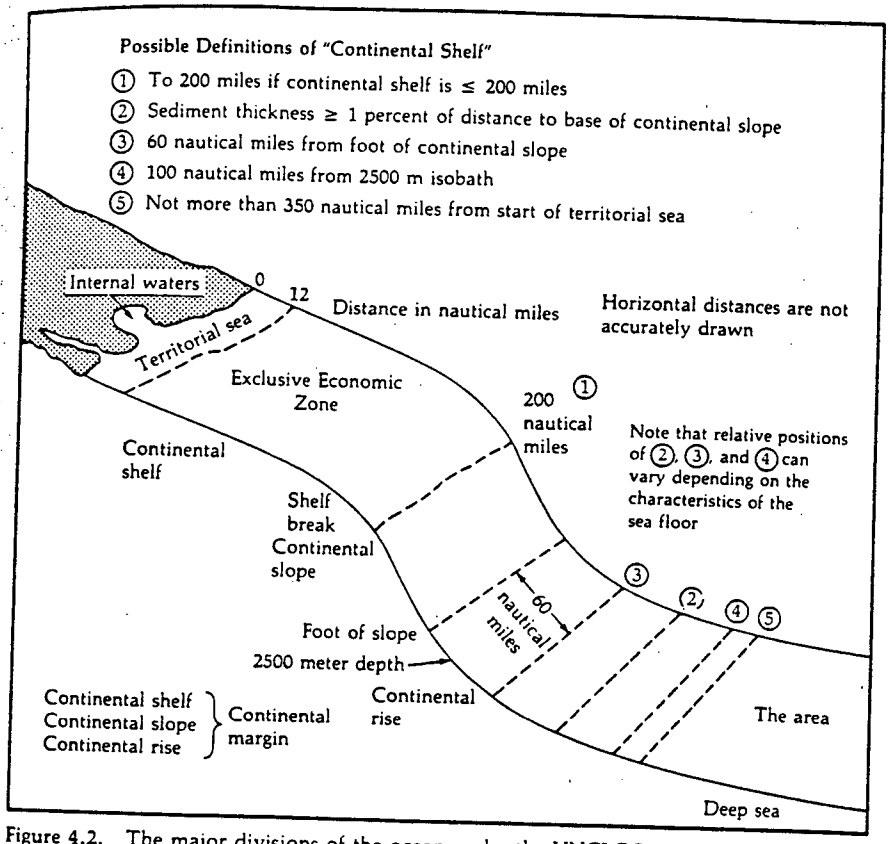

Figure 4.2. The major divisions of the ocean under the UNCLOS III treaty. The numbers in (b) refer to possible definitions of the continental shelf: 1) to 200 miles if the continental shelf is < 200 miles; 2) sediment thickness ≥ 1 percent of the distance to the foot of the continental slope; 3) 60 nautical miles from the foot of the continental slope; 4) 100 nautical miles from the 2500-meter isobath; and 5) not more than 350 nautical miles from the inner boundary of the territorial sea. Note that the relative position of 2, 3, and 4 can vary depending on the characteristics of the sea floor. (Horizontal distances are not accurately drawn.)

Exclusive Economic Zone

The exclusive economic zone is a new concept, it extends 200 nautical miles (370 kilometers) from the baseline from which the territorial sea is measured (figure 4.2). As such it includes all of the world's coastal waters and most of the geological continental shelves. The treaty, however, does not seem to apply to the Antarctic continent. Requirements

for marine scientific research in a foreign country's exclusive economic zone (or on the continental shelf within its zone) include consent and an imposing set of requirements. There are six important conditions.

1. Consent is necessary and shall "in normal circumstances" be granted (article 246, paragraph 3). Consent can be denied if the project (i) "is of direct significance for the exploration and exploitation of natural resources, whether living or non-living"; (ii) "involves drilling into the continental shelf, the use of explosives or the introduction of harmful substances into the marine environment"; (iii) "involves the construction, operation or use of artificial islands . . . ;" or (iv) if the request of consent contains inaccurate information "or if the researching State or competent international organization has outstanding obligations to the coastal State from a prior research project" (article 246, paragraph 5). A coastal state's decision based on these four provisions is not reviewable by a third party (article 297, paragraph 2).

2. Specific information concerning the research must be supplied not less than 6 months before the start of the project. Research states or international organizations must provide descriptions of (i) "the nature and objectives of the project"; (ii) "the method and means to be used, including name, tonnage, type and class of vessels and a description of scientific equipment"; (iii) "the precise geographical areas in which the project is to be conducted"; (iv) "the expected date of first appearance and final departure of the research vessels, or deployment of the equipment and its removal, as appropriate"; (v) "the name of the sponsoring institution, its director, and the person in charge of the project"; and (vi) "the extent to which it is considered that the coastal state should be able to participate or to be represented in the project" (article 248).

3. Applicants for consent to conduct research must (i) "ensure the right of the coastal state, if it so desires, to participate or be represented in the marine scientific research project, especially on board research vessels . . . ;" (ii) provide preliminary and final reports, if the coastal state so requests; (iii) provide access for the coastal state to all data and samples for the project and "furnish it with data which may be copied and samples which may be divided without detriment to their scientific value"; (iv) provide, if requested, "an assessment of such data, samples and research results or provide assistance in their assessment or interpretation"; (v) ensure "that research results are made internationally available through appropriate national or international channels"; and (vi) "inform the

coastal state immediately of any major change in the research programme" (article 249).

4. "Communications concerning the marine scientific research projects shall be made through appropriate official channels unless otherwise agreed" (article 250). These official channels will probably be foreign ministries or in the case of the United States its Department of State. The requirement of using "official channels" will lessen the role of a scientist-to-scientist contact that so often has been successful in developing projects. On the positive side, using official channels should reduce ambiguity concerning responsibility for granting the permission, an item which has caused troubles in the past.

5. Coastal states can suspend research activities (i) if they are "not being conducted in accordance with the information communicated" (that is, the information requested in article 248), or if the conditions specified in article 249 are not met; or (ii) if there is a major change in the research project or activities (article 253). Coastal states can stop the marine scientific research activities if such problems or changes "are not rectified within a reasonable period of time" (article 253).

6. After permission to conduct research is granted, "land-locked and geographically disadvantaged states" can request to receive the information provided under articles 248 and 249. Land-locked or geographically disadvantaged states may also participate when feasible in the project through qualified experts, although the coastal state can object to their choice of experts (article 254). The potential for a three-party conflict could be high, especially concerning states having poor relationships (Pakistan and Afghanistan, for example).

The net effect of these and other conditions fall into three broad categories. First and perhaps most important, concerns the *predictability* of whether the actual expedition occurs and if the program will be modified or changed during the sea-going part or afterwards. Without adequate predictability scientists could well tend to avoid areas or regions where expectations of success are relatively low. The second concern is that of *flexibility* in the actual research. Quite often discoveries are made at sea that should be followed up. However, these may require changes in the ship's course or in the research protocol. In some instances these may require permission which, in turn, will require time and delay perhaps leading to lost or missed scientific opportunities. The last concern is that of the increasing *politicalization*

of the ocean. Decisions concerning scientific access may often be made on a political basis rather than on its scientific merits. Soviet scientists have indicated up to 100 refusals of entry to foreign parts in the past year and similar, though less frequent, refusals have been received by U.S. scientists.

Continental Shelf Beyond 200 Miles

The juridical continental shelf has a complex, essentially nonscientific definition (figure 4.2), and its outer edge occasionally may correspond to the outer part of the geological continental margin. In the treaty the juridical continental shelf can extend to at least 200 nautical miles or to the edge of the exclusive economic zone. When the continental shelf falls entirely within the exclusive economic zone the rules for marine scientific research are the same. Considerable confusion can (and will) occur in defining the outer edge of the juridical continental shelf when the continental margin (shelf, slope, and rise in the geological sense) extends beyond 200 nautical miles. The outer edge can be defined "by the foot" (a very poorly defined term) "of the continental slope" or the thickness of the sedimentary rocks (how this thickness is determined is not stated) (article 76, paragraph 4); in any case, the outer edge of the shelf shall not exceed 350 nautical miles from the territorial sea base line or 100 nautical miles from the 2500-meter isobath (article 76, paragraph 5) unless a plateau, rise, cap, bank, or spur extends beyond 350 miles (article 76, paragraph 6). The actual extent of the continental shelf beyond 200 miles cannot be determined at this time, but some estimates put it as high as 8 to 10 percent of the ocean.[9] The provision concerning sediment thickness is bound to cause confusion and allow for excessive claims.

The conditions for marine scientific research on the continental shelf beyond 200 nautical miles are the same as described for the exclusive economic zone *except* that a coastal state may withhold consent *only* in areas it has publicly designated as subject to exploitation or detailed exploratory operations within a reasonable period of time (article 246, paragraph 6). Scientific studies in the water column above the continental shelf and beyond the limits of the exclusive economic zone are not considered marine research on the continental shelf, and conditions are similar to the high seas.

"The Area"

The seabed beyond coastal state jurisdiction (that is, beyond the continental shelf when it extends past the EEZ) is defined as "the area." At present the treaty has no significant restrictions concerning marine scientific research in "the area" and "States' parties may carry out marine scientific research in the area" (articles 87, 143, and 256). The treaty also says that states "shall promote international cooperation in marine scientific research" (article 143). A Deep Seabed Authority will be established by the treaty and it may carry out research either directly or through contract and is charged with promoting and encouraging marine research as well as disseminating scientific knowledge.

High Seas

Freedom of scientific research is one of six "freedoms" explicitly listed for the high seas (article 87). High seas are defined as that part of the ocean water column that excludes internal waters, territorial seas, archipelagic waters, and exclusive economic zones. It should be mentioned that freedom of research was not an explicit freedom of the seas in the 1958 Convention on the High Seas.

Other Aspects of UNCLOS III

The treaty introduced a new concept whereby consent is *implied*, and a researching state or competent international organization could start a research program six months after submitting a request, if the coastal state has not denied consent within four months after receiving the request and the information specified in articles 248 and 249. It should be appreciated, however, that the coastal state could just ask for additional information within the four months after receiving the request and effectively postpone a decision by restarting the clock for the four month period. In addition, it is not clear if implied consent is applicable to nonratifiers of the treaty.

Publication of scientific results can be an important issue. Although the treaty in one place encourages publication and the flow of scientific

data (article 244, paragraphs 1 and 2), elsewhere (article 249 paragraph 2), it requires "prior agreement for making internationally available the research results of a project of direct significance for the exploration and exploitation of natural resources." If, therefore, a coastal state concludes that the research program for which it already approved is "of direct significance for the exploration and exploitation of natural resources, whether living or non-living" (article 246, paragraph 5a), it can then control or prohibit publication of such results.

The treaty does offer specific mechanisms for the compulsory settlement of disputes, although there are three important exceptions for marine scientific research problems. Dispute settlement, in any case, will be of more importance for lawyers than scientists who generally do not have the will, desire, time or resources to pursue disputes through the courts. In addition, for a project to be successful the goodwill of both the research and foreign state is required. Therefore, pursuing or even initiating a dispute will not auger well for a cooperative scientific venture. The three exceptions to dispute settlement are the right of the coastal state to withhold consent for marine scientific research in the exclusive economic zone, on the continental shelf beyond 200 miles, and to order suspension or cessation of such research. In other words, those parts of the treaty that are most likely to generate disagreement are not subject to compulsory dispute settlement. One might hope, however, that the specter of dispute settlement possibilities could minimize arbitrary or capricious actions by coastal states and that for those instances where there are honest differences of opinion the dispute settlement provisions could eventually provide some interpretative flesh to what are often ambiguously worded articles.

An indirect issue for marine science is military activities in the ocean. A key LOS point for countries with powerful navies was passage through and over international straits and archipelagic waters. Military ships in normal operations often make routine oceanographic measurements. However, it is not clear how such activities will be considered within the treaty. Warships are defined (article 29) as, among other things, being "manned by a crew which is under regular armed forces discipline." Military ships (as well as other ships) may transit territorial seas and archipelagic waters under innocent passage. However, "research and survey activities" are not considered as part of innocent passage (article 19, paragraph 2J). It also appears that warships will be

free to collect some oceanographic data from foreign EEZs whereas nonmilitary research vessels (or military vessels with civilians) will require permission.

Implications of the LOS Treaty for Marine Scientists

In my opinion there are two critical negative things that can result from the above-mentioned and other conditions in the treaty. The first concerns the *unpredictability* as to whether permission will actually or eventually be granted. This, of course, will cause problems in ship-scheduling (usually at least one year of lead time is required) and in the consideration and evaluation of grant or requests for funding the program. One mechanism that could reduce this unpredictability is the so-called "implied consent" article (article 252). Its principal point, as previously mentioned, is that if a coastal state does not respond to a permission request within four months, then a research organization may proceed with the work six months after the date that the initial request was made. However, it is dubious that this rule would be officially tested by an institution director (or even a ship captain) who would have to be willing to risk seizure of a research vessel without some very strong assurances and support from his or her government. The treaty also offers a coastal state, if it wishes (either innocently or maliciously), to continuously delay an official response to a permission request, by asking for additional information; in effect, denying the research without actually officially doing so. It should be noted that denial of permission for marine scientific research or delaying the permission process is a relatively painless act, often with little or no political consequences for the foreign country.

The possibility of foreign states denying or delaying scientific permission may be more serious than anticipated since there seems to be increasing nationalistic feelings by foreign countries toward their offshore ocean areas and their real or imagined resources. An indication of this is that several countries have recently implemented restrictions against passage of military vessels in their territorial sea without giving prior notice or getting permission—conditions contrary to the treaty. Whether these nationalistic actions are just posturing due to LOS negotiations or whether they are long-term effects remains to be seen. The second critical negative thing that could affect marine science,

concerns the *spontaneity* of the research. Consent requires six months -advance notificaton and relatively precise plans concerning the actual program before permission is granted. The opportunity to change the research protocol is thus very limited. This, in turn, could limit a rapid response to a major oceanographic event or opportunity (El Niño, for example) as well as changes at sea based on acquired data. A third issue, concerning publication, has been discussed on previous pages.

On the positive side, having a specific set of marine science articles is probably better than the other principle scenario, which is, each coastal country having specific (and different) rules and regulations in their waters, as many countries presently do. The treaty articles, although difficult, are at least consistent and probably will make it easier for governments and institutions to deal with their counterparts elsewhere. For U.S. scientists or others from countries who have not ratified the treaty it is not clear if they will have the few benefits and protection in the treaty.[10]

Implications of the LOS Treaty for Less Developed States

It is evident that expertise in marine scientific research is available to only a few developed countries. It is an expensive science requiring highly trained scientists, research vessels, support personnel and laboratory facilities. Expertise is generally needed in several fields, including biological oceanography, chemical oceanography, marine geology, marine geophysics, physical oceanography, and ocean engineering. Experienced electronic technicians are required to maintain even elementary equipment. The seagoing operation requires additional skills and experience as well as specifically designed and equipped ships. Many countries have bought equipment and ships well beyond their needs and their ability to maintain them. If marine resource questions are high on a country's priorities the skills of lawyers, economists, and other types of scientists will also be required.

It is often not a simple matter for a developing country to allow scientists from a developed state access to its waters for research, especially if the research can affect its marine resource development. The technological and economic differences between the countries may often cause suspicions even with the best intentions. In addition there

are other factors including pride and concern about how the information will or could be used. One of the motivations of UNCLOS III was to reduce the marine differences between states. An earlier agreement, the 1974 UN Charter of Economic Rights and Duties of States, also considered a similar point, i.e., that states should benefit from science and technology regardless of their level of development.[11] Resource development, its study and protection are very common themes in UNCLOS III. The granting of control to the coastal state over the marine resources in its waters should alleviate much of its concern as to being exploited by marine research by a foreign state. In addition the coastal state will have opportunity to fully participate in the research and share the data. These rights, however, can be of limited value if the coastal state does not have sufficient expertise to use these opportunities. Likewise, it is often the developed state that will pose the research questions, and it is not clear as to how much the coastal state may intervene in the research project so as to make the program more in line with its needs and interests.[12]

The question of publication can be a two-sided issue for the coastal state. The wide dissemination of some information, especially concerning resources, might not be in the best interests of a coastal state. Alternatively basic scientific information might not be reported in an adequate manner for use by the coastal state (for example, published in a different language, or not a full assessment or presentation of all data).

General Comments

The marine science articles in the LOS treaty will clearly affect the style and operation of marine scientific research in and by many countries. It will require changes in the approach of scientists, institutions, and funding organizations for work in foreign waters. A considerable amount of additional planning will be necessary prior to the actual development of a program and the request for funding, and this could discourage some researchers. On the other hand, successful planning could make for a much more congenial and scientifically successful program. It is easy to come up with pessimistic viewpoints toward the treaty. However, one might hope, that the numerous requirements in

the treaty may, in the long term, just be administrative tasks and the details of the treaty could be very beneficial in reducing misunderstandings.

An additional outcome of the treaty may be an increase in the development of bilateral or multinational programs. The treaty itself (article 243) strongly encourages the development of bilateral or multilateral agreements "to create favorable conditions for the conduct of marine scientific research." Cooperative science and technology agreements between states is not an uncommon practice, however this has not been fully exploited in the marine sciences.

The role of many intergovernmental organizations, at least from a developed country viewpoint, has often been less than successful in marine science ventures. The major marine organization is the Intergovernmental Oceanographic Commission (IOC), which is part of UNESCO. The LOS treaty has a specific article (article 247) concerning international organizations, that describes a new mechanism for obtaining permission for research in foreign waters. Unfortunately, in the case of IOC it has become more political in orientation in recent years than scientific and this trend may well continue. The United States, at the time of this writing, has withdrawn from UNESCO, however, this action does not have to affect participation in IOC. Development of programs within international forums and organizations can be a successful mechanism for scientific research but will require considerable time and involvement.

Future Opportunities

There is an important underlying aspect of the LOS treaty that may help to ultimately overcome many of its potential negative marine science aspects. Simply said, many, if not all, coastal countries are going to be, or already are anxious to ascertain and exploit their marine potential. This, especially with developing countries, will mean that they will turn to developed countries for help in marine science and policy questions. It is in the interest of the developed and developing world, and of marine science in general, to see a rational development of marine science capabilities and resource development. Unfortunately, however, there can be considerable potential for disappointment, especially among developing countries since the distribution of

ocean resources and ocean space will be quite unequitable and only a few countries, mostly developed, will receive the major portion of the world's EEZs. Landlocked states (over 30 of them) will not even have an offshore zone. Most marine resources occur either within the EEZ or the continental shelf (legal sense). Essentially upwards of 90 percent of all present fish catch and most, if not all, oil and gas resources will fall in these regions. A "backlash" toward the countries who will receive most of these benefits may result. The manganese nodule "treasure" of the deep sea will never become a major resource.

Nevertheless there clearly is an obvious need to develop good working cooperative marine science efforts between developed and developing countries. The style of how these programs eventually occur will obviously vary within different countries and organizations. Regarding this I will talk mainly from the viewpoint of the United States, where in spite of the apparent need for cooperative efforts there exists no single contact point for foreign interests that can represent the complete spectrum of U.S. marine interests and activities. Various government agencies may have international marine offices, in particular the National Oceanic and Atmospheric Administration, the National Science Foundation, the Department of State and, in addition, several oceanographic institutions have active international operations. However, for a foreign country or scientist their visibility is often limited and these offices generally serve, and correctly so, just the organizations they represent. A foreign country looking for a cooperative program with U.S. scientists could find this array of organizations a labyrinth.

The U.S. marine community has developed extensive expertise in programs that would be especially valuable for developing countries. For example, specific coastal zone management programs have been developed by NOAA's Coastal Zone Management Office; marine resource expertise has been developed through Sea Grant and U.S. industry; and basic scientific and marine policy skills have been produced by academia and others. The question is then, within the United States, are we most sufficiently and successfully making our skills and abilities available for foreign cooperative ventures? My personal feeling is that although the United States has several outstanding programs with individual institutions in foreign countries, we could be doing better and to do better would lead to increased scientific research opportunities and other benefits to the U.S. marine community, the

nation in general, and to other countries. In this regard, I propose that the United States establish an Office of International Marine Science Cooperation that could be a focal point for foreign contacts seeking to develop cooperative programs with the U.S. marine scientific community and vice versa. Such an office could be located within the federal government, at an oceanographic institution, or at a neutral site such as the National Academy of Sciences (see reference 12 for further discussion of relative benefits of each possibility). Such a concept could also be adopted on an international scale, for example, by the Scientific Committee on Oceanic Research (SCOR) within the International Council of Unions, IOC or some similar UN body; this concept could also be of interest to other developed countries. For this reason I will elucidate further on this concept.[13] The main objectives of such an office (remember I am using the United States as an example) would be as follows:

—To improve opportunities and efficiencies for those in the U.S. marine community wishing to work with foreign countries (and in foreign waters)
—To improve access for foreign countries and institutions to marine scientific research and training opportunities with U.S. organizations
—To collect and circulate information to the U.S. marine scientific community concerning opportunities, mechanisms and funding sources for foreign programs
—To identify problem countries or areas for the U.S. marine community and advise on mechanisms for dealing with such problems (in particular, from scientific experience in such countries)
—To identify potential U.S. scientists interested in working in specific foreign countries
—To assist in the development of multidisciplinary teams
—To serve as a spokesperson for the U.S. marine scientific interests in working with foreign countries.

One of the rationales for recommending an Office for International Marine Science Cooperation is a 1981 Ocean Policy Committee study, conducted by its marine technical assistance group,[14] that made an assessment of U.S. capabilities to fulfill the needs of developing countries as well as providing recommendations, policies, and mechanisms for future U.S. programs in marine technical assistance and coopera-

tion. A workshop was held in La Jolla, California, involving approximately 60 participants including 20 representatives from developing countries. A key recommendation of that meeting was that an office be established as a central point of contact for U.S. or foreign investigators seeking information on U.S. support for marine-related projects. The meeting also recommended that economists and social scientists be involved in planning, management, and evaluation of marine-related projects to ensure adequate consideration of the socio-political and economic framework of the host country. This is an important point often neglected by developing countries in the establishment of cooperative programs.

In summary the LOS treaty problems facing marine scientists may be even more complex than the research they are trying to perform. It may be no less easy for developing countries. Close cooperation through cooperative programs may offer the opportunity for both to meet their objectives.

NOTES

1. J. A. Knauss, "Marine Technology Drives Marine Policy," *Proceedings OCEANS* (1983), 3:1128–1132—a compelling paper on how the U.S. response to the ocean is influenced by technology rather than by an orderly development of ocean policy.

2. L. M. Alexander, "The Disadvantaged States in the Law of the Sea," *Marine Policy* (1981), 5:196.

3. Third United Nations Conference on the Law of the Sea, Draft Convention on the Law of the Sea (U.N. Document A/Conf. 62/L-78/Rev., August 3, 1981).

4. W. S. Scholz, *Marine Policy* (1980), 4:91; Ocean Policy Committee, *Science* (1977), 197:230.

5. E. Miles, "United States Distant-Water Oceanography in the New Ocean Regime," in P. G. Brewer, ed., *Oceanography: The Present and Future* (Woods Hole, Mass.: Springer, 1983), pp. 283–301.

6. See D. A. Ross and J. A. Knauss, "How the Law of the Sea Treaty Will Affect U.S. Marine Science," *Science* (1982), 217:1003–1008.

7. Much of the following material comes from Ross and Knauss.

8. U.S. Department of State, *Bulletin* 70:389, Washington, D.C.: GPO, 1974.

9. L. Alexander, personal communication.

10. Although the United States has not accepted the LOS treaty, President Reagan, in his March 1983 statement, did acknowledge the right of other countries to exercise jurisdiction over marine research in their EEZs (if exercised reasonably and in a manner consistent with international law). He did

not, at the present time, exercise jurisdiction by the United States over marine scientific research in its own EEZ.

11. Charter of the Economic Rights and Duties of States Adopted by Resolution 3281 (XXIX) of the General Assembly of the United Nations, December 12, 1974.

12. Maria Edwarda Gonsalves, "Science, Technology, and the New Convention of the Law of the Sea," *Impact of Science on Society* (1983), 3(4):344–347.

13. D. A. Ross, "Effective Use of the Sea, Overcoming the Law of the Sea Problems," *Proceedings OCEANS* (1983), 1:1–3.

14. Ocean Policy Committee, *International Cooperation in Marine Technology, Science and Fisheries: The Future U.S. Role in Development*. Proceedings of a Workshop, January 18–22, 1981, Scripps Institution on Oceanography, La Jolla, Calif. (Washington, D.C.: National Academy Press, 1981).