A LEGAL REGIME FOR DEEP SEA MINING

*John L. Mero**

During the past few years an incredible number of conferences have been held, articles written, proposals made and resolutions passed concerning a legal regime to control development of the resources of the world ocean. Much of the debate generated on this subject stems from diplomatic sources and in those circles a great emphasis is placed on verbal activities or negotiations rather than action. Another source of endless conversation concerning the law of the sea is legal groups; since talk is the stock in trade of these groups, they can hardly be criticized. Rarely are the activitists, in this case the fishermen or miners, asked for their opinions concerning what kind of law they would like to have covering their activities in the ocean. And the general attitude of these operators of ocean-oriented enterprises is to ignore the legalists until trouble develops or some government decides to enforce a decree concerning activities in a certain area of the ocean.

In the case of mineral resources of the ocean, it is well to have some idea of the magnitude of the potential resource and its expected effect on world social or economic welfare if exploited on a substantial scale. There is no doubt whatsoever that supplies of raw materials vitally affect relationships between nations. Adequate supplies of raw materials for expanding populations or economies have been a prime cause of wars between nations from the beginning of human civilization. The great oil discoveries in northern Alaska[1] will greatly affect the relations between the United States and the nations of northern Europe on the one hand and the nations of the Middle East on the other if the Alaskan oil can be produced and delivered to markets at a price economically competitive with oil from the Middle East.

All highly industrialized societies depend to a very high degree on adequate supplies of a host of mineral commodities. In

* B.S., University of No. Dakota, M.S. and Ph.D., University of California, Berkeley; President of Ocean Resources, Inc., La Jolla, California.

1. In 1968 the Atlantic Richfield Co. and Humble Oil & Refining made a discovery of an oil field near Prudhoe Bay in northern Alaska which is expected to produce in excess of 10 billion barrels of oil. Late in 1969, lease sales in this area yielded over $900 million to the state of Alaska. *North American Attention Shifts to Alaska's Prudhoe Bay Region*, 169 WORLD OIL No. 3, 64, 66 (1969).

one way this dependence is a force for peace and stabilization as it makes all nations more dependent on one another. Mineral deposits, however, are not uniformly distributed throughout the earth's crust. Economic sources of some mineral commodities occur sometimes in a single nation or a small group of nations, generally to the detriment of the have-not nations. Mineral deposits, in fact, are very inadequately distributed throughout the surface of the continents of the earth. Thus the nations of southern Africa control over 90 percent of the diamond raw materials of the earth, the Congo and Canada are the world's major suppliers of cobalt, Canadian companies control the bulk of the world's supply of nickel, the United States is the world's major supplier of molybdenum, the Soviet Union holds over 70 percent of the economic reserves of manganese in the world, a group of five or so nations produce the bulk of the world's primary copper, and so on.[2] Highly industrialized nations try to develop as many alternate sources of mineral commodities as possible so as not to be too dependent on any one source or nation. A primary underlying cause of the American intervention in Vietnam must be to prevent that portion of the world and, thus, Indonesia, and possibly Australia, from falling into the control of unfriendly nations, for Indonesia and Australia have been long recognized as two of the great untapped sources of raw materials of the world. The great investments of American corporations in mining ventures in Australia and Indonesia in recent years only emphasize this observation.

When the metal-rich deposits of the ocean are developed on a substantial scale, it will greatly affect the economies of various nations, especially of those nations that are highly dependent on such commodities as nickel, cobalt, copper or manganese. That development we can foresee. Other situations which may develop with large scale production of minerals from the sea can only be speculated about at this time. In any case it is proper for those concerned with international legal regimes to consider the resources of the sea, not as a bottomless pit of funds for financing international welfare programs (for, as we shall see, it is doubtful that the resources of the sea will ever provide much monetary wealth unless the entire economics of the world mining industry are juggled) but in regard to the effects that this source of raw

2. *E/MJ Annual Survey and Outlook*, 170 ENG. & MIN. J. No. 3 (1969).

materials will have on populations around the world. Advances in technology almost always hurt some small group economically for a time, but almost always benefit a much larger group. Thus, when production of copper from the ocean floor deposits shuts down mines in such nations as Chile or Zambia, which nations' economies are highly dependent on production of this metal from mines located therein, the copper miners of those nations will be momentarily hurt. But a much larger segment of the world population will be immeasurably helped by the development of an essentially unlimited source of a vital industrial metal at a price much less than that for which this metal can now be produced from continental deposits. Populations in underdeveloped nations of the world which cannot afford to use copper at $0.70 per pound[3] or nickel at $1.30 per pound[4] will be able to afford to use these metals when the price is only $0.20 per pound.

Considered in this light, the development of the resources of the sea will be a great boon to the developing nations of the world. Of course, if controlled by some international agency, the price of ocean-obtained metals can be held artificially high with the profits being drained off as royalties to the international agency. The international agency would then, presumably, redistribute these funds throughout the world in the form of land development projects designed to improve the material life of local inhabitants. But in the process this international agency would build a great bureaucracy to administer the collection and redistribution of these funds, and, while the bureaucrats will undoubtedly live much better, the producers and consumers of the material produced will not gain as much as if they were left to work the deposits and consume them on their own.

Another aspect of developing the resources of the sea is that the level of technology required is not indicated to be of a level unattainable by most nations of the world. Since the deposits tend to be vast in size, all nations can exploit them to any degree they wish without affecting the exploitation of the deposits by any other nation. In one sense this situation would be disadvantageous for the peace of the world, for it would lead to a greater degree of national independence. If all nations were totally dependent on all other nations for some vital raw material, there would be a

3. *Id.* at 29-30.
4. *Id.*

tendency for all nations to attempt to live with each other on a more peaceful, trade-inducing basis. On the other hand, as all nations and groups within individual nations might choose to mine in the ocean in exactly the same location (an almost inconceivably but remotely possible circumstance) with the ensuing difficulties that that situation would incur, it is probably well to have some legal regime governing exploitation of mineral deposits of the sea. But there are other more pressing reasons.

All mineral deposits of the earth vary in composition and value from place to place and time to time. The mineral deposits of the sea are no different in this regard; however, the recognized mineral deposits of the sea tend to be spread out over much greater lateral areas of the earth's surface than are continental mineral deposits. In any case it will require much effort on the part of the potential miner to find a deposit he considers of acceptable grade, depth of water, location in reference to weather, distance to port, etc.; thus, there is some reason for allowing such a prospector to lay claim to a deposit that he may have found after great expense. Also, changes in the environment that might be caused in the mining of any oceanic deposit, while expected to be negligible in most cases, must be considered and, if occurring, must be controlled. Deposits must be made available to all comers if competition in pricing is to be attained with the consumers ultimately benefitting. Conservation must be practiced so that the deposits are not wasted by using highly profitable but inefficient recovery systems.

So all of us, internationalists, diplomats, lawyers and even miners, would prefer to see a legal regime adopted covering exploitation of the mineral deposits of the sea. There is, however, a considerable difference of opinion between the miners and the other groups on the design of this legal regime and what it should work to accomplish. For the miners will want a legal system which works to promote development of these deposits while preserving as much freedom of action as possible in determining exploration and exploitation systems. "Getting the rock in the box," or production of the mineral, has always been the prime concern of the miner, many times to the detriment of the environment, which in past times was not always of much consideration to anyone. Diplomats, lawyers, trade protectionists, bureaucrats, etc. sometimes have very different motives in

designing the legal regime. If such individuals play the major role, it could doom ocean mining forever. The formulation of the law is much too important to be left to the lawyers or diplomats. There are a myriad of reasons why persons from these professions should not play a major role in the formation of this regime, a major one being that lawyers and diplomats tend to be traditionalists. The extrapolation of existing land laws to the deposits of the sea would be fatal to the ocean deposits, for they vary in many important characteristics from any mineral deposit ever found on land. The legal regime must take into account the known characteristics of the deposits to have any tangible association with reality. If reality is ignored, and it has largely been ignored in past proposals for oceanic resource legal regimes, then it will work a great hardship on the workers. If the needs of the workers are disregarded in the design of this regime, they might choose not to work at all. And, in the end, it will be the needs of the workers, i.e., the mining companies, that will be important in establishing this ocean mining industry. In the past, on land, it generally has been the miners themselves who established their code of ethics concerning mining operations. This system has worked very well; at least, it did until pollution of the environment became a major problem. We should give it a try in the ocean, for while the miners of the past have been almost totally negligent in their concern about pollution of the earth's natural environments, the present day managers of the world mining industry are very much aware of this problem and will be the group that eventually solves these problems with, of course, proper pressure being applied by the rest of society.

Thus, the ideas for a legal regime for deep sea mining that will be outlined in this article will be ones that favor the workers. Much of it is opinion based on my belief that such legal conditions would encourage development of the mineral resources of the ocean without hindering other uses of the ocean to any measurable degree and without noticeable changes to the natural environment. This legal regime will deal only with those parts of the ocean outside present limits of national jurisdiction. Once the deep sea mining industry is established, we will know better what regulations we can live with and the rules can be modified by internationalists who might see ends that the miners do not see in the mineral deposits of the sea. Until usable commodities are being produced from the deep sea deposits, all discussions

concerning deep sea mining legal regimes are really only academic. There are some groups with a considerable constitutency who believe that many financial problems of the world can be solved by the profits to be generated by mining the deposits of the ocean. Some groups even believe that these funds could finance a new world government which, hopefully, would be somewhat more effective at governing the world populations than past or present international associations have been. While effective world government is a goal highly to be desired, it should be established because it is needed. If the control and distribution of the profits to be gained by mining the mineral resources of the deep sea are a necessary object by which to form this government, then I, for one, am perfectly willing to assign the deposits to this new world government. If, however, the government depends for its financial support on such profits, which are largely illusory, then it will rapidly collapse unless such funds are forthcoming. A much better scheme would be to internationalize all resources of the world and assign ownership of these resources to a world government. Artificial prices for minerals could be established which would, however, have some economic basis, and the world government could thereby generate funds for its operations. Such a system would penalize the poorer people of the world by raising the prices of commodities they need, but sometimes it is easier and less traumatic for a government to raise its funds that way than via the much more equitable and honest graduated income tax method. In any case, it is generally conceded by almost everyone who has studied this field that some kind of a regime should be established to regulate development and production of minerals from the sea.

Before outlining the proposed legal regime, it might be well to describe the deposits of the deep sea and their apparent potential worth to society.

THE MINERAL DEPOSITS OF THE DEEP SEA

A strict definition of the deep ocean, or those parts of the ocean not now under national jurisdiction, is rather hard to come by. The only convention which would seem to apply is the Convention on the Continental Shelf[5] formulated at Geneva in

5. Convention on the Continental Shelf, Sept. 15, 1958 [1964] 15 U.S.T. 471, T.I.A.S. No. 5578, 449 U.N.T.S. 311.

1958 and now ratified by about 40 member nations of the U.N. Basically that convention states that a nation may lay claim to the ocean floor adjacent to its shores for purposes of mineral exploitation out to a water depth of 200 meters or to that depth which admits of the exploitation of minerals.[6] This "exploitability clause" has become a matter of much debate among ocean lawyers. Presumably a nation could move its boundaries out over the ocean floor to any distance from its land, provided it could exploit the minerals therein. In the extreme, this convention would lead to a division of the ocean floor by the median line concept. It was certainly not the intention of the framers of this convention that such a division of the deep ocean floor should take place and this situation is not likely to occur, as it would work to the disadvantage of many major nations such as China, the U.S.S.R., Germany, Italy, etc. The maximum depth at which national jurisdiction has thus far been claimed under the 1958 Geneva convention is about 7,000 feet in the Red Sea, where Sudan has laid claim to that portion of the Red Sea floor adjacent its coast out to the median line of that body of water. The exploitability clause was used to justify this proclamation.

Other nations such as Chile, Ecuador and Peru define their continental shelves as extending to a distance of 200 miles from their shores.[7] While the proclamations of these nations were made mainly to control fishing in the superjacent waters, they would presumably also apply to minerals underlying these waters, as the proclamations describe this 200-mile outer limit as the continental shelves of these nations. Water depths of 20,000 feet or more are found in these areas.

A more logical approach to defining the continental shelves of maritime nations would be to fix the outer boundary in space, defining it as so many miles from the present coastline or to a depth of so many meters, whichever is greater. The measurements suggested by a number of authors (Brooks, Mero) are a distance of 100 miles or a depth of 2,500 meters. The 2,500-meter depth has a basis in geologic fact, since an outer boundary at this depth would include all geologic continental shelf areas, while the 200-

6. Official Records of the United Nations Conference on The Law of the Sea, A/Conf. 13/38.

7. Chapman, *Legal Problems in Harvesting Minerals of the Deep Sea Bed, Symposia on Economic Importance of Chemicals from the Sea*, AM. CHEM. SOC. 177-86 (1963).

meter depth contour does not.[8] Because of the geologic nature of the continental shelves and slopes, with the drop-off to the deep sea floor being rather rapid once it starts, the moving of the outer boundary of national jurisdiction from 200 meters to a depth of 2,500 meters would not add more than about ten percent to the present areal extent of the continental shelves of the world's nations as defined at the 200-meter depth contour. Everything outside this depth contour or the 100-mile distance line then would be considered open ocean, free to all comers and awaiting some future meeting of the nations of the world to formulate a legal regime. The 2,500-meter depth contour or 100-mile distance line appears to be quite practical from a geologic standpoint and politically is fair to all nations bordering the sea. It should be adopted as soon as is practical to forestall any uncertainty about whose property an ocean miner is working on when he is working in the deep ocean outside these limits.

While the recognized mineral deposit potential of the continental shelf and slope area within the 2,500-meter depth contour is large and highly varied, containing such deposits as oil and gas, limestone, sand and gravels, iron ore, coal, sulphur, barite, bauxite, phosphorite and placer deposits of diamonds, gold, platinum, titanium minerals, tin, chromite, zircon, etc.,[9] the mineral deposit potential of the deep ocean floor appears, at the present time, to be quite limited.[10] The presently recognized mineral deposits of the deep sea, that area outside the 2,500-meter depth contour, is limited to the cobalt-copper-nickel-manganese rich nodules.[11] Siliceous and calcereous oozes may hold some economic potential; however, there is no shortage of these commodities on continental areas[12] and such deposits would likely be mined only after the manganese nodules are being mined. The JOIDES[13] deep sea drilling project has uncovered what appears to

8. Brooks, *Deep Sea Manganese Nodules: From Scientific Phenomenon to World Resource*, PROC. SECOND ANN. CONF. LAW OF THE SEA INSTITUTE, UNIV. OF R.I. 96 (1967).

9. J. MERO, THE MINERAL RESOURCES OF THE SEA, 53-80 (1965).

10. *Id.* at 120-27.

11. *Id.*

12. *Id.* at 111-17.

13. JOIDES is an acronym for Joint Oceanographic Institutes Deep Sea Drilling Project. In this program the National Science Foundation is financing drilling of about 100 holes to depths of 1,000 to 2,500 feet into the ocean floor in the pelagic areas of the ocean (water in excess of 10,000 feet depth in general). The initial phase of this project is

be petroleum deposits in certain deep sea areas in the Gulf of Mexico at a depth of about 12,500 feet; however, it will be many years before anyone has the capability of producing oil from such a depth. While we can speculate on the occurrence of a variety of mineral deposits in the deep ocean, thus far the only known deposits in this area of the sea which show great economic potential are the manganese nodules.

This situation, however, is not without substantial merit, as the seafloor nodules (generally called manganese nodules as manganese tends to be the dominant metal found therein) contain about 15 industrially useful metals, most of which would be produced in any operation to recover elements from the nodules. Thus, the sea floor nodules are a potential economic source of manganese, nickel, cobalt, copper, zinc, molybdenum, zirconium, cerium, lead, titanium, iron, vanadium and several rare earth elements. Of these metals, only manganese, nickel, cobalt, copper, molybdenum and zirconium would be produced in quantities which would upset present world sources of these metals. The present free world value of these metals produced is about $8 billion and a number of nations' economies are highly dependent on production and sale of several of these metals. To cite an example of how upsetting production of these metals from the ocean might be: A single operation in the ocean, mining 15 million tons of the nodules per year (which is the size of operation under consideration by one major world mining company), which nodules would contain 2.5 percent of copper, 2.0 percent of nickel, 0.2 percent of cobalt, 36 percent of manganese, 0.2 percent of zinc, 0.06 percent of molybdenum, 0.06 percent of zirconium and 0.06 percent of lead, would produce the following percentages of the present free world production of these metals: manganese, 150 percent; copper, 7.5 percent; nickel, 73 percent; cobalt, 160 percent; zinc, one percent; molybdenum, 15 percent; zirconium, 350 percent; and lead, 0.4 percent. Such production rates would completely upset the cobalt, nickel, manganese and zirconium markets. Considering that this would be only one operation by one company tends to compound the upset. As several companies from the United States alone will enter this field, practically all

---

described in *Initial Reports of the Deep Sea Drilling Project*, 1 ORANGE, TEXAS TO HOBOKEN, N.J. (Aug.-Sept., 1968). On the second hole drilled in this program in the Gulf of Mexico, oil was discovered in the Sigsbee Knolls area at a water depth of 12,500 feet.

markets for these metals will be greatly affected. Incidentally, the product value produced by one of these operations would be about $1.8 billion if all the products could be sold at present market quoted prices. The capital investment to build the facilities to mine and handle 50,000 tons of the nodules per day can be expected to be about $200 million; however, the net profit on this operation, assuming continental production prices control the pricing of the offshore obtained metals, would probably be about $800 million per year after U.S. taxes are paid.[14]

Therefore, it is obvious that metal prices of the metals that can be produced from the sea floor nodules will drop rather rapidly once a competitive situation develops in the offshore. It is now expected that the production price for copper, nickel and cobalt from deep sea mines will eventually be about $0.15 per pound or from 25 percent for copper to ten percent for nickel of the present (1970) selling price of these metals.[15] World consumption of these metals will greatly increase as those populations in Africa, Latin America and Asia, which do not now consume these metals in large quantities because they cannot afford them, start to consume at these prices. Once consumption of these metals is initiated, most nations will want to have their own mining operations in the ocean to save on foreign exchange. The stage will be set for 50 or more deep sea mining operations where ten large operations would easily supply the entire present world needs at any reasonable prediction of future consumption. Competition for the deposits most economic to mine will become intense under such circumstances and there will be no end of claim jumping, piracy and trouble unless some legal regime is initiated to forestall such happenings.

The time table to be reached for the above stages in deep sea mining is approximately as follows: Within the next ten years the first operator will be mining and processing the nodules on an economic, large-scale basis—at a rate of at least three million tons per year; within 15 years at least five operators will be mining and processing about 50 million tons of the nodules per year; within about 30 years at least 50 operators will want to produce about 200 million tons of the nodules per year. As technology and communications develop, the time span required for such

14. Author's calculations.
15. *Id.*

developments to spread throughout the world is considerably shortened the estimated time span for deep ocean mining developments might be contracted over the above estimates so that within the next 20 years problems will develop without a rational legal regime to govern exploitation of minerals from the deep sea. Thus, the goal of the international legal experts should be to have the deep ocean mining law formulated some time within the next ten years and enacted and in force within the next 15 years, or by 1985.

A Proposed Legal Regime for Deep Sea Mining

Any rationale and effective legal regime to control leasing of mineral deposits in the deep ocean must take cognizance of the character of the deposits being leased. In the case of the sea floor nodules, these deposits are presently recognized as being constituted of only a monolayer of roughly spherical nodules, averaging about two to three inches in diameter.[16] The areal concentration of these deposits ranges from about 15,000 to 150,000 tons per square mile of ocean floor.[17] On land, mineral deposits are generally three dimensional in shape; thus rather small surface areal claims can cover a large tonnage of ore. In the deep sea, a rather large areal coverage is needed if the miner is to control sufficient tonnage to repay his investment and operation costs and to allow an adequate profit. Although there are a number of mechanical characteristics involved which make the sea floor nodules substantially different in character from land deposits,[18] the essentially two dimensional character is the one which will have the greatest bearing on the formulation of a legal system governing their exploitation.

Another interesting characteristic of the nodules is the marked change in composition over large lateral distances in the Pacific Ocean. Along the continents, they are rich in iron while in the central part of the ocean and on certain topographic highs, the nodules tend to be enriched in cobalt.[19] In several areas of the Pacific, nodules which are almost pure manganese dioxide are

16. J. Mero, *supra* note 9, at 127-32.
17. *Id.* at 165-75.
18. *Id.* at 129-35.
19. Mero, *Minerals on the Ocean Floor*, 203 Scientific American 64, 66 (Dec. 1960).

found.[20] In the areas of the ocean far removed from islands or continents, the nodules are rich in nickel and copper.[21] As the equatorial regions are approached, the percentage of copper in the nodules increases markedly.[22]

From present indications there appear to be about 1.5 trillion tons of the nodules now exposed at the surface of the sediments of the Pacific Ocean.[23] If only ten percent of these deposits prove economical to exploit, using average percentages of such metals as manganese, nickel, cobalt and copper, it can be calculated that the reserves of these metals in the nodules are measured in terms of thousands of years on the basis of present day world consumption. Thus, for all practical purposes, the reserves of the nodules can be considered to be unlimited. In general, where there is an unlimited amount of a resource, no one gets too excited about anyone else exploiting it. Certainly this is true in the case of oxygen and nitrogen which are taken from the atmosphere or in the taking of minerals from seawater. Although there are hundreds of such operations throughout the world, no one pays a royalty to anyone for exploitation of such resources and no one answers to anyone else in exercising his right of exploitation. A major difference in such resources and the sea floor nodules is that the atmosphere and seawater are generally considered as having a very uniform composition throughout the world; sea floor nodules are not uniform in their composition, concentration, size or other aspects which greatly affects the economics of mining. Also the nodules do not shift their position in space from time to time as do the minerals in the atmosphere or in seawater. Thus, the nodules fall into a mineral deposit category in which leasing of various deposits can be beneficial to the mining operators and, of course, beneficial to the leasing agency.

Leasing Agency

The leasing agency could probably best be a function of the United Nations. Its functions would be largely administrative: a clearing-house for claim registrations and policing of the work requirements and a collection agency for fees and royalties paid

20. *Id.* at 65.
21. *Id.* at 66.
22. *Id.*
23. J. MERO, *supra* note 9, at 165-79.

for the privilege of having claims registered and worked. A small staff of less than 25 persons would be required for these functions, as it is not anticipated that there will be many claims registered or worked. A prime requisite for securing a lease would be financial and technical competence in working the claim, which would rule out speculation in the deposits of the deep sea. Thus, it is not anticipated that too many claims would be registered, certainly not more than 100 or so over the next 30 years.

After the agency is established, a code of laws would be formulated which would allow the technically and financially competent nationals of any nation to stake claims on any area of the deep ocean floor they wished. The size of these claims for individuals, partnerships, or corporate entities should be limited, probably to a maximum of 5,000 square miles and a minimum of 1,000 square miles. The claim boundaries would be defined in terms of lines of latitude and longitude. Five thousand square miles would contain at least 100 million tons of the nodules, which should be an amortization tonnage for any capital investment necessary to put that property in production. The aggregate claims of any given nation should be limited so that the total area claimed would not contain more than 100 years' reserves of one of the major economic minerals in the nodules—manganese, nickel, cobalt and copper. Thus, nationals of the United States would be limited to a total claimed area of about three million square miles of the ocean floor, which area would normally contain 100 years' reserves of copper for the United States at her present rate of consumption.[24] These areas allowed would, of course, be adjusted as consumption rates change. Three million square miles would be only about five percent of the total area of the Pacific Ocean suspected to contain deposits of the nodules. If all the three million square miles were taken up, it would require some 600 separate claims, assuming an average claim area of 5,000 square miles. Since only about 40 of these operations, assuming an average production rate per unit of five million tons of nodules per year containing an average of one percent copper, could produce the total United States consumption in copper annually, not to mention the tremendous over-production of manganese, nickel, cobalt, zircon, molybdenum, etc. that would be produced as a by-product, only a small fraction of the

24. *E/MJ Annual Survey and Outlook*, supra note 2.

allowable areas would actually be taken up and worked unless the operators wished to court bankruptcy.

The law would have provisions concerning multiple use of the areas so that mining does not interfere with fishing, shipping, communication cables, and vice versa. The law would require performance on the part of the claimant and the spending of some nominal sum, such as $100 per square mile of claim per year, to hold this claim. The length of time that an individual can hold a claim before he puts it into production should be limited, probably to ten years. If the operator fails to spend his performance funds in exploration or development of his claim, he may pay an equivalent sum to the registry agency at the end of each annual period. All funds spent in developing the claim or in exploration in it would be applicable against the annual performance payment. Failure to do the work or pay the performance fee would result in the lapse of the claim. Affidavits would be filed annually, briefly describing the nature of the work and the amount of money spent up to the minimum sum necessary to hold the claim. Registry agents should, of course, be allowed access to vessels of the claimant to confirm work requirements.

When production is initiated on any given property or claim, a nominal royalty of perhaps $1 per ton of nodules mined and processed would be paid to the registry agency. The funds received for claim registry, in lieu of work requirements, or as royalty payments, would be used to support the administrative costs of the registry agency and that function alone. The deep sea nodules should not be viewed as an independent source of income for the United Nations or any other political agency.

In registering a claim with this agency, the claimant would thus gain exclusive rights to mine in his claimed area. Free and open access to the property would be allowed for scientific purposes; however, permission from the claim holder would have to be obtained to avoid damage to equipment, such as data-gathering buoys, etc., that the claimant may have placed in the area. After a ten-year period has lapsed, or when a claim is forfeited, all exploration data that has been gathered on a specific claim must be placed on file with the registry agency, which files would be open to the public. Operating statistics, such as recovery efficiency, production rates, and nodule size, would also be placed

in these files within one year after an operator has ceased mining operations in any specific property.

If any group chooses to operate without a lease or permit, it should be allowed to do so, but nevertheless that operator must observe the conservation and multiple use regulations governing the exploitation of the resources of the sea. Admiralty laws concerning piracy should prevent anyone from interfering with its operation. If a company is operating in an area, then it may register this information with the agency and no one else may register a claim within 20 miles of its point of operation dating from the day that this information is registered and extending to the cessation of its operations. The area of operations must be defined as the intersection of a line of latitude and longitude. There would be a nominal $1,000 fee for registering such information.

A representative of the registry agency would be allowed on any mining vessel at all times to ascertain that the operator is observing multiple use and conservation regulations. Enforcement of these regulations would be through the national government under which flag the operator is operating.

General exploration and sampling of deposits in the ocean would be allowed to anyone at no cost in terms of fees paid to the registry agency and no notification need be given to any agency of such exploration. Sampling of the deposits by any individual group would be limited to one million tons of the nodules in aggregate throughout the ocean, which tonnage should be sufficient for pilot plant tests or other testing or experimental purposes, including mining system design studies.

A deep ocean mining legal regime incorporating these regulations would do much to encourage an orderly development of one of the great untapped natural resources of the earth. The tapping of this resource is important for many reasons: in addition to supplying a growing world population with adequate supplies of vital raw materials, it would allow the mining companies to stop despoilation of certain areas of the earth which could be used for other purposes. Since no ground is being disturbed or destroyed and only a thin superficial layer of material will be removed from the ocean floor, no pollution of any kind is anticipated in sea floor nodule mining operations. No animal or plant life will be destroyed since few animals and no plants live

on the deep ocean floor. No human populations will be affected in any way because no one will live within hundreds of miles of any deep ocean mining operation. The processing of the nodules to salable products will not create environmental changes, as the indicated processing techniques would not involve the releasing to the atmosphere of any noxious gasses or materials. In fact, it has been found that the sea floor nodules are excellent oxidation-reduction catalysts and might be used in converting unburned hydrocarbons in internal combustion engines to harmless carbon dioxide.[25] Such exhausts are now recognized as a major pollutant of the atmosphere. Also the nodules have been found to be excellent scavengers of sulphur dioxide from stack or other gasses.[26] Sulphur dioxide is a major pollutant in cities and in areas near power plants which must burn high sulphur coals or oils.

The sea floor nodules would appear to be one of the most useful objects yet found in nature to aid man to live a decent material life on this planet without destroying or changing the natural environment, and in fact might also help to better that environment.

---

25. Weisz, *Deep Sea Manganese Nodules as Oxidation Catalysts*, 10 J. CATALYSIS 7 (1968).

26. S. Zimmerley, Use of Deep-Sea Nodules for Removing Sulfur Compounds from Gases, U.S. Patent 3,330,096, at 1 (1967).