Deep Seabed Mining

Marine Environmental Research Plan 1981 - 85

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Ocean Minerals and Energy
June 1982

WEIGHT

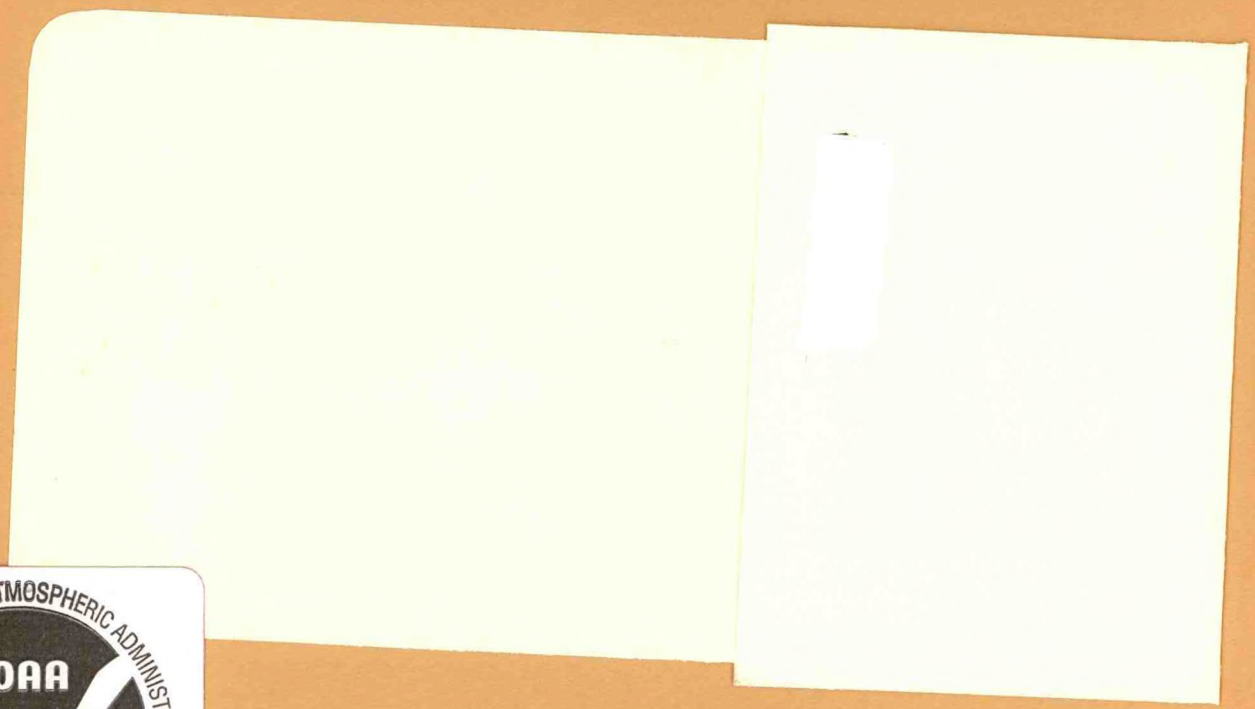
1000 g =	1 milligram (mg) = 0.000035 ounces	1 ounce = 31,103 mg
	1 gram (g) = 0.035 ounces	1 ounce = 31.1 g
	1 kilogram (kg) = 2.68 pounds	1 pound = 0.37 kg
1000 kg =	1 tonne (t) = 2679 pounds	1 pound = 0.0003 t

LENGTH

1 micron (um) = 0.000039 inches	1 inch = 25.4 mm
1 millimeter (mm) = 0.039 inches	1 inch = 2.54 cm
1 centimeter (cm) = 0.39 inches	1 foot = 0.30 m
1 meter (m) = 3.28 feet	1 mile = 1.61 km
1 kilometer (km) = 0.62 (statute) miles	

AREA

1 hectare = 2.47 acres	1 acre = 0.4 hectares



Deep Seabed Mining

Marine Environmental Research Plan 1981-85

Prepared by:
Office of Ocean Minerals and Energy
2001 Wisconsin Avenue, N.W.
Washington,D.C. 20235

June 1982

U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and Atmospheric Administration
John V. Byrne, Administrator

Office of Ocean Minerals and Energy
James P. Lawless, Acting Director

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

THE ADMINISTRATOR

JUN 30 1982

Honorable George H. Bush
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

It is my honor to transmit the Deep Seabed Mining Environmental Research Plan 1981 - 1985 of the National Oceanic and Atmospheric Administration pursuant to Section 109 of the Deep Seabed Hard Mineral Resources Act (P.L. 96-283). This plan describes the program of ocean research for FY 1981-1985 that is necessary to support environmental assessment activity during exploration and commercial recovery of hard mineral resources from the deep seabed.

Sincerely yours,

John V. Byrne

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

THE ADMINISTRATOR

JUN 30 1982

Honorable Thomas P. O'Neill
Speaker of the House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

It is my honor to transmit the Deep Seabed Mining Environmental Research Plan 1981-1985 of the National Oceanic and Atmospheric Administration pursuant to Section 109 of the Deep Seabed Hard Mineral Resources Act (P.L. 96-283). This plan describes the program of ocean research for FY 1981-1985 that is necessary to support environmental assessment activity during exploration and commercial recovery of hard mineral resources from the deep seabed.

Sincerely yours,

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PREFACE

The passage of Public Law 96-283, the Deep Seabed Hard Mineral Resources Act, on June 28, 1980, represents a novel, Congressionally mandated charge for the National Oceanic and Atmospheric Administration (NOAA) - the development and implementation of a policy and regulatory framework to foster the growth of a new marine-dependent industry in an environmentally sound manner. This responsibility entails not only the development and enforcement of regulations and the issuance of permits and licenses, but also the concomitant preparation of environmental impact statements, and the conduct of marine research to support the regulatory decisions.

When Public Law 96-283 was passed, as well as the new Ocean Thermal Energy Conversion (OTEC), Act (P.L. 96-320) (another regulatory responsibility), NOAA management established the Office of Ocean Minerals and Energy, a new organizational element reporting directly to the Administrator of NOAA, to encompass both programs. Regulatory and research responsibilities were assigned to that office to ensure that scientific results would be properly integrated into the decision-making process.

This first Five-Year Research Plan on deep seabed mining is based on the results of previous research (i.e. the Deep Ocean Mining Environmental Study and numerous related studies); the results of many workshops; and the comments and recommendations from academia, industry, the public sector, other Federal agencies, and State governments. The Plan was written by an interagency team to take advantage of the wide range of expertise that exists within the Federal Government and to ensure that the interests of other agencies are appropriately represented. Participation from representatives both inside and outside the Federal Government will be continued in an effort to maintain the relevance and scientific validity of the program. This Plan will be updated

biannually to reflect increases in scientific knowledge from this program and other oceanographic programs, advances in industry's technologies and plans,* budget fluctuations and the more refined requirements of the regulatory framework.

*this plan does not include information from mining license applications.

EXECUTIVE SUMMARY

In response to a growing awareness of the United States' need for new domestic supplies of minerals to reduce its dependence on foreign supplies, the Deep Seabed Hard Mineral Resources Act (Public Law 96-283) was signed into law on June 28, 1980. This law directs the National Oceanic and Atmospheric Administration (NOAA) to develop a regulatory framework in which, ultimately, commercial recovery of manganese nodules can proceed in an environmentally sound manner, beginning as early as 1988. The law also requires the implementation of a marine research program to support the regulation of mining activities, seabased nodule processing, and ocean disposal of processing wastes in consonance with protection of the quality of the marine environment. This research program is to provide the basis for making the environmental findings required by law, including the determination, on a continuing basis, that resulting environmental effects do not preclude the continuation of mining activities.

Manganese nodules, which are fist-sized mineral concretions found at or just below the surface of the seafloor, can contain relatively high concentrations of at least four nationally strategic metals: manganese, copper, cobalt, and nickel. At present, the area of greatest industrial interest is between Hawaii and Central America, in water depths of 4000-6000 meters where nodule abundance and metal content appear high enough to support profitable commercial operations.

Although the specific technologies and methods to be used in deep seabed mining are still under development, a generalized scheme for the mining operations can be predicted. A typical mining operation will employ a surface vessel to which is attached a nodule "collector" that is towed or propelled along the ocean floor beneath the mother ship. A collector will skim the nodules and

surface sediments from the seabed with the majority of sediments being winnowed out before the nodules are transported to the surface vessel by a connecting pipeline. At the surface, additional sediment will be removed and the relatively "clean" nodules transferred to another vessel to be taken to a processing plant. Because of technical and economic uncertainties, nodule processing will occur onshore during first-generation mining. The processing methods to be used are uncertain at present since this is a new industry that will require the modification of existing processes or the development of new ones. The locations of processing plants and modes of waste disposal have not yet been decided.

This Five Year Research Plan, prepared in response to the Congressional mandate, addresses scientific needs for Fiscal Years 1981-85 relating to the potential environmental effects from mining and at-sea disposal of processing wastes. Studies of potential land impacts from onshore nodule processing and waste disposal are considered beyond the scope of this document and will be discussed in other planning documents.

During mining, two general types of environmental disturbances will occur--one at the seafloor, and the other at the ocean surface. At the seafloor, benthic biota will be removed and probably killed with the passage of the nodule collector. Benthic organisms outside the collector path also will be affected by a plume of sediments, abraded nodules, and animal fragments created in the wake of the collector. At the water surface, a plume of similar composition will be created by the discharge of reject materials from the vessel after shipboard nodule separation.

Initial environmental concerns focused on the potential impact that increased concentrations of suspended particulates would have on the biota, and on changes that might result from the introduction of bottom water, sediments, and abraded nodule fragments to the surface water. The short-term effects of these perturbations have been studied by NOAA under the Deep Ocean Mining Environmental Study (DOMES) and summarized in the Programmatic Environmental Impact Statement (PEIS). These results are presented in Table A. Many environmental concerns raised when the possibility of mining of manganese nodules was first suggested appear now to be insignificant; however, several questions are still unresolved and many tentative conclusions need to be verified under more realistic mining conditions. Many of the conclusions from the DOMES and PEIS are based on limited data collected during a few days of pilot mining equipment tests. Such data may not be representative of those associated with actual commercial recovery. Additional data need to be collected over a longer period to verify conclusions and refine these predictions. This will be possible when the mining industry conducts its equipment endurance tests, expected to begin in 1984. An effective monitoring strategy also must be developed and implemented to ensure that no significant adverse effects occur during exploration and commercial recovery. In addition, the significance to the benthic environment of the collector impact and the resulting plume needs to be examined. More information on the benthic ecosystem will enable better predictions to be made on the rate of benthic recovery following sediment removal and the effect on benthic organisms of increased concentrations of suspended matter and rates of sedimentation due to the passage of the collector. Another question needing investigation is the possibility of behavior modification in adult and larvae fish due to increased particulate concentrations.

TABLE A.
Summary of Initial Environmental Concerns and Potential Significant Impacts of Mining

INITIAL CONDITIONS[1] / DISTURBANCE	PHYSICO-CHEMICAL EFFECTS	POTENTIAL BIOLOGICAL IMPACTS (REMAINING CONCERNS IN CAPITALS)	POTENTIAL SIGNIFICANCE OF BIOLOGICAL IMPACT			
			PROBABILITY OF OCCURRENCE	RECOVERY RATE	CONSEQUENCE	OVERALL SIGNIFICANCE
COLLECTOR	o Scour and compact sediments	DESTROY BENTHIC FAUNA IN AND NEAR COLLECTOR TRACK	Certain	Unknown[3] (Probably Slow)	Adverse	Unavoidable * (Uncertain Sig.)
	o Light and Sound	Attraction to new food supply; possible temporary blindness	Unlikely	Unknown (Probably Rapid)	Uncertain	None
BENTHIC PLUME	o Increased sedimentation rate and increased suspended matter ("rain of fines")	o EFFECT ON BENTHOS - Covering of food supply	Likely	Unknown[3] (Probably Slow)	Adverse	Unknown *
		- Clogging of respiratory surfaces of filter feeders	Likely	Unknown[3] (Probably Slow)	Adverse	Unknown *
		- Blanketing	Certain	Unknown[3] (Probably Slow)	Adverse	Unknown *
		o Increased food supply for benthos	Unlikely	Rapid[4]	Possibly Beneficial	None
	o Nutrient/Trace Metal increase	o Trace metals uptake by zooplankton	Unlikely	Rapid	No detectable effect	None
	o Oxygen demand	o Lower dissolved oxygen for organisms to utilize; mortality from anaerobic conditions	Unlikely	Rapid	No detectable effect	None
SURFACE DISCHARGE Particulates	o Increased suspended particulate matter (sediments, nodule fragments and biota debris)	o Effect on Zooplankton - Mortality	Unlikely	Rapid[4]	No detectable effect[2]	None
		- Change in abundance and/ or species composition	Unlikely	Rapid[4]	No detectable effect[2]	None
		- Trace metal uptake	Unlikely	Rapid[4]	Locally Adverse	Low*
		- Increased food supply due to introduction of benthic biotic debris and elevated microbial activity due to increased substrate	Unlikely	Rapid[4]	Possibly Beneficial	None
		o Effect on adult fish	Unlikely	Rapid[4]	No detectable effect[2]	None
		o EFFECT ON FISH LARVAE	Uncertain (Low)	Uncertain (Probably Rapid)	Uncertain	Low*
	o Oxygen Demand	o Lower dissolved oxygen for organisms to utilize	Unlikely	Rapid	No detectable effect	None
	o Pynocline accumulation	o Effect on primary productivity	Unlikely	Uncertain (Probably Rapid)	Unknown (Prob. Undetect)	Low
	o Decreased light due to increased turbidity	o Decrease in primary productivity	Certain	Rapid[4]	Locally Adverse	Low
SURFACE DISCHARGE Dissolved Substances	o Increased nutrients	o Increase in primary productivity	Very Low	Rapid[4]	No detectable effect[2]	None
		o Change in phytoplankton species composition or introduce deep-sea microbes or spores to surface	Very Low	Rapid[4]	No detectable effect[2]	None
	o Increase in dissolved trace metals	o Inhibition of primary productivity	Very Low	Rapid[4]	No detectable effect[2]	None
	o Supersaturation in dissolved gas content	o Embolism	Very Low	Rapid	No detectable effect[2]	None

1. Includes characteristics of the discharge and the mining system.
2. Based on experiments/measurements conducted under DOMES.
3. Years to tens of years, or longer.
4. Days to weeks.

Uncertain = Some knowledge exists; however the validity of extrapolations is tenuous.

Unknown = Very little or no knowledge exists on the subjects; predictions mostly based on conjecture.

*Areas of future research
SPM = Suspended Particulate Matter

Studies are also needed to support U.S. efforts toward international designation of stable reference areas, scientific "control areas" provided for under the Act.

Wastes from onshore nodule processing may be disposed of at sea. Disposal may occur through a pipe extending from the shore or from a vessel or barge that may discharge wastes over the continental shelf or seaward of the shelf break. Biological impacts that could result from such disposal depend on the character and the volume of the wastes and on the mode and location of disposal. Other studies of ocean disposal of wastes suggest several areas requiring research including: physical and chemical characterization of processing wastes, physical dispersion and chemical alteration of wastes upon disposal, biological effects on resident biota in the area of discharge, and site characterization studies required for ocean dumping.

The selection and timing of research projects are dictated by the requirements of Government, anticipated industry development, and the status of scientific knowledge. Using these guidelines, a schedule of research tasks with estimated costs for the Fiscal Years 1981-1983 has been prepared and is presented as Table B: programmatic needs for Fiscal Years 1984 and 1985 are discussed in Chapter 5. It should not be presumed that NOAA will fund all identified tasks in their entirety. NOAA will be exploring the possibility of cost-sharing with industry and developing cooperative arrangements with academia and other nations to more effectively meet the identified programmatic needs, especially those beyond FY 1983.

RESEARCH ACTIVITY	Fiscal Year Funding Requirements ($K)[1] (1980 Dollars) 81	82	83
Analysis & Characterization of Potential Reject Wastes	180	285	185
At-Sea Disposal Technologies and Concerns	70	---	---
Biological Impacts - Mining	10	75	155
Stable Reference Areas	10	40	20
PROGRAMMATIC TOTAL	270	400	360

[1] Includes management costs.

TABLE B. Projected Budget Breakdown, FY 1981-83

1. INTRODUCTION

In 1975, in anticipation of domestic legislation providing the framework for mining of manganese nodules found in the deep ocean, NOAA began a research program, entitled the Deep Ocean Mining Environmental Study (DOMES), to evaluate potential at-sea environmental effects from this new industrial activity. The initiation of this program marked the first time that the technology of a new resource recovery industry was to be developed totally under the National Environmental Policy Act. In addition, at the request of Congress, NOAA initiated studies on the potential onshore coastal zone effects of this new industry.

The DOMES Program focused on studies relating to short-term (one week), near-field (<5-10 km from the point of operations), physico-chemical and biological effects, of deep ocean mining. The program also broadly characterized the region of potential mining, since so little is known of the deep-sea ecosystem where mining is expected to occur. The DOMES program produced a collection of five years of data that provided: 1) a broad overview of the environmental conditions existing in the area of expected development; 2) a first-order predictive capability for determining environmental effects; and 3) a basic guide for impact assessment and future monitoring efforts. Many of the original concerns relating to immediate marine environmental impacts were adequately addressed during DOMES, as documented in NOAA's Programmatic Environmental Impact Statement (PEIS). Questions of long-term impact remain, however, as does the need to implement an effective monitoring strategy.[1]

The onshore coastal zone effects studies focused on manganese nodule processing and related activities, such as marine and onshore transportation and ocean and onshore disposal of processing wastes. Other studies assessed the near-term likelihood of processing nodules at sea. Further studies of

geographical areas of potential interest to industry for onshore processing plants identified locations in Hawaii, and along the West and Gulf Coasts. These studies highlighted the critical need for information on waste disposal, whether at sea or on land.

Thus, when the Deep Seabed Hard Mineral Resources Act (Public Law 96-283), passed on June 28, 1980, there was already in existence a sizeable data base on deep seabed mining and associated activities. This law designates the National Oceanic and Atmospheric Administration as the agency responsible for promulgating and enforcing regulations relating to mining and its associated activities. Section 109(a) of the Act also directs the Administrator of NOAA to "... expand and accelerate the program assessing the effects on the environment from exploration and commercial recovery activities, including seabased processing and the disposal at sea of processing wastes, so as to provide an assessment, as accurate as practicable, of environmental impacts of such activities for the implementation of subsections (b), (c), and (d)" (i.e., terms, conditions, and restrictions pertaining to licenses and permits, programmatic and site-specific environmental impact statements). This program of marine research is to be presented to the Congress as a Five-Year Research Plan that outlines the areas to be studied and the estimated costs associated with the program.

To carry out the mandated environmental responsibilities, two objectives have been identified as being critical to the research program:

1) To develop the capability to <u>assess</u> environmental impacts related to deep seabed mining and at-sea processing and disposal; and
2) To develop the capability to <u>predict</u> and determine the significance of potential impacts so that, if significant, mitigating strategies can be developed.

The program focuses on the unresolved issues identified by the DOMES reports and the PEIS, on verifying tentative conclusions stated in these documents, and on determining the feasibility and acceptability of at-sea disposal of processing wastes. This Plan is intended to give a broad overview of the research proposed for the next five years, FY 1981-85, to meet these objectives. It addresses all marine research needs likely to be important in the determination of environmental impacts from seabed mining and at-sea waste disposal, regardless of agency jurisdiction. The Plan is written primarily for a general audience. More detailed, scientific planning documents will be prepared to meet the needs of NOAA management, project managers whose programs closely interact with the deep seabed mining program, and the specific project personnel participating in the program.

Several constraints have been placed on the scope of this document. NOAA has interpreted Public Law 96-283, subsections 109(a) and (b), to limit the Plan to only those issues that are marine-related, and to those that may directly affect the ocean ecosystem. Impacts from at-sea processing, although required to be considered by the Act, are not included in this Five-Year Research Plan since they result from second-generation technology, and so are not relevant to the period covered by this document. Impacts to terrestrial environments from land-based operations are not considered within the scope of this document. Studies of onshore impacts (both environmental and socio-economic) have been conducted in cooperation with other agencies, and further studies are being planned which will be discussed in other program documents. The issues of assessment and conservation of resources are also considered beyond the scope of this document. All of these issues, however, are discussed in the PEIS.

The research program set out in this Plan is driven to a major extent by the timing and requirements of regulatory decisions of the Federal Government,

and by the timing and plans of industry. This is to be expected, since research results must support Government's regulatory decisions. Owing to the inherent linkage between research, the regulatory framework, and industry's progress, a chapter in the Plan covers each of these latter topics. Chapter 2, Legal and Regulatory Framework, outlines the generic information needs, both under Public Law 96-283 and other related laws, which must be met before a decision can be made. Chapter 3, Industry Plans, provides the reader with an overview of industry's plans and estimated timing. Since such plans can be delayed or altered because of unforeseen problems or shifts in strategies, information provided in this section is only a best estimate at the time of this writing. Chapter 4, Environmental Research Needs, addresses the scientific concerns associated with environmentally sound management decisions on deep seabed mining and at-sea disposal of processing wastes. Potential environmental effects are evaluated in terms of present scientific knowledge, with those issues still unresolved being defined and discussed in terms of importance to assessment and prediction of environmental impacts. The final chapter, Implementation, integrates the scientific needs identified in the preceding discussion with timing and other constraints imposed by regulatory needs and industry progress. Each task is justified in terms of specific factors used to establish priority, yielding a schedule of tasks to be performed over the next five years.

Figure 1 illustrates in schematic form the philosophy used in formulating this Research Plan. Step 1, Initial Conditions or Disturbance, refers to the specifications governing the regulated activities. This includes such factors as location of mining and disposal sites, volume and composition of the mining or waste discharge, and equipment design. Step 2, Physico-Chemical Effects, is the definition of those changes in the physical and chemical environment

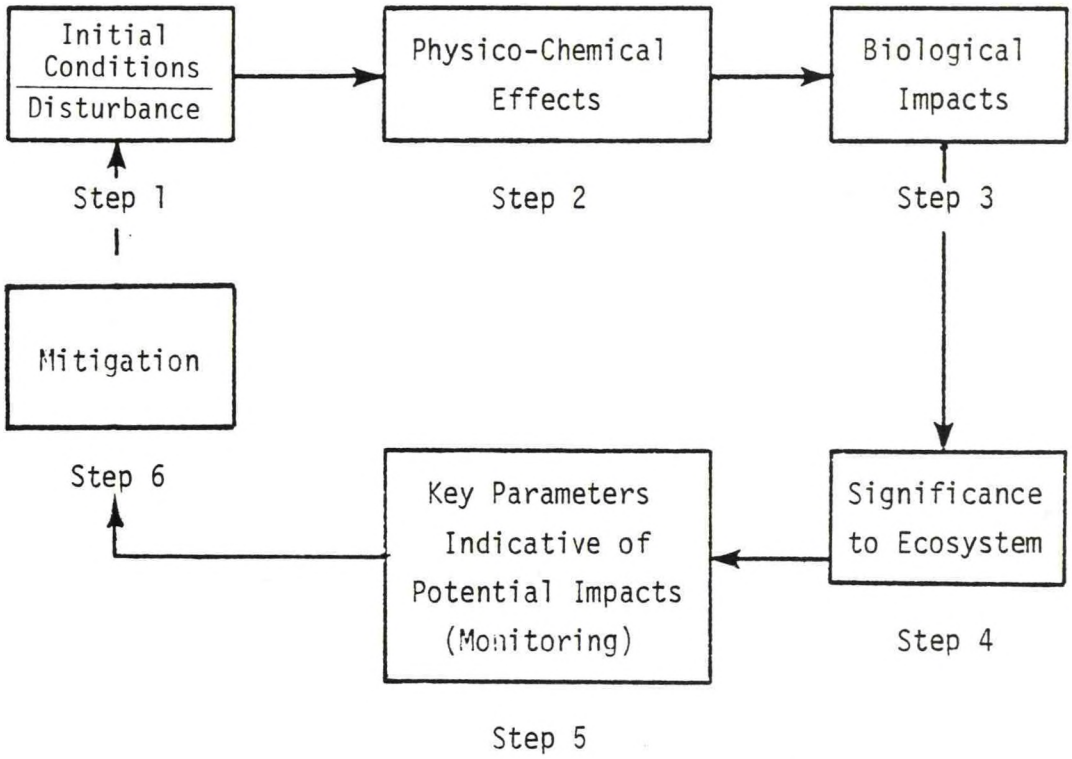

FIGURE 1. Research Strategy

that result from the Initial Conditions. Such changes would include an increased concentration of particulates in the water column, increased concentration of specific chemical compounds, and decreased light penetration due to increased particulate concentrations. Step 3, Biological Impacts, is the definition of the biological consequences due to changes in the physico-chemical environment. This would include benthic mortality due to blanketing or starvation from sedimentation of the plume from the mining collector and decreases in primary productivity due to the surface plume. Step 4, Significance to Ecosystem, is the essential element to the determination of subsequent managerial actions. This involves an analysis of the consequences to the rest of the marine ecosystem of measured or predicted environmental change. Scientific information presently provides only a limited understanding of the functioning of marine ecosystems; however, predictions based on best available knowledge and modeling can frequently help evaluate the importance of any change in adversely affecting the ecosystem. The content of Step 5, Monitoring, is based on the results from all the previous steps. For instance, high-priority measurements for a monitoring program are those physico-chemical parameters which appear to effect biological changes that could pose a threat to the ecosystem. Depending on the results of the monitoring program as well as the evaluation of the significance of potential biological impacts, strategies can be identified to obviate or mitigate possible adverse effects, i.e., Step 6. Actions might then be taken to change the Initial Conditions or type of disturbance through amending the terms, conditions, and restrictions of a license or permit in order to minimize or eliminate any potential adverse impacts.

It should be emphasized that this research approach, as depicted in Fig. 1, only represents a framework for guiding the research program and not a formula which will provide answers with total accuracy. Knowledge of the deep sea

environment is scant and difficult to obtain, and the ecosystem is extremely complex. Consequently, establishing cause - effect relationships (Steps 1-3) and evaluating potential significance to the ecosystem of environmental changes (Step 4) are exceedingly difficult. Because of those constraints, this research program must be viewed as a means to increase the accuracy of predictions through better understanding, but not a mechanism for providing clearly defined conclusions with no assumptions or caveats.

2. LEGAL AND REGULATORY FRAMEWORK

2.1 DEEP SEABED HARD MINERAL RESOURCES ACT (Public Law 96-283)

The Deep Seabed Hard Mineral Resources Act, the governing domestic law for manganese nodule mining, was signed on June 28, 1980, after almost a decade of Congressional debate. The final form of the legislation represents the consideration of an array of viewpoints, a balance between national and international interests, and a statement of strong concern for facilitating ocean mining and environmental protection. The primary justification for this law was the critical U.S. need for new and alternative sources of strategic metals (manganese, cobalt, and nickel) that are now obtained from foreign land sources.[2] Manganese nodules would provide a stable new mineral source of these elements. A Law of the Sea treaty, if one it enters into force, would provide for a regulatory regime to exploit these resources. Congress passed this interim domestic legislation to allow ongoing exploration and development activities to continue, to encourage further investment and continued technology development, and to ensure that the marine environment is protected during these activities. If a treaty enters into force with respect to the United States, the domestic legislation will remain in effect for U.S. citizens only to the extent that it is not inconsistent with the treaty.

2.1.1 Regulatory Regime

Licenses and Permits. In the legislation, exploration and commercial recovery by U.S. citizens are prohibited unless performed under a license (for exploration) or permit (for commercial recovery) issued by the Administrator of the National Oceanic and Atmospheric Administration (NOAA) in accordance with the requirements of the Act, and in consultation and cooperation with the affected departments and agencies. The issuance of a license

is prohibited before July 1, 1981; commercial recovery pursuant to a permit may not begin before January 1, 1988. Commercial recovery is defined in the legislation, in part, as "... any activity engaged in at-sea to recover any hard mineral resource at a substantial rate for the primary purpose of marketing or commercially using such resources to earn a net profit." Exploratory operations in progress prior to the enactment of the legislation are allowed to continue without a license, provided that a timely license application is made after regulations are promulgated.

In the issuance or transfer of a license or permit, the Administrator incorporates terms, conditions, and restrictions (TCR) to be followed by the licensee or permittee. These must be consistent with the provisions of this law and are created for such purposes as the promotion of resource conservation and waste prevention, the protection of the environment, the safety of life and property at sea, and the assurance of diligent operations under the work plan.

The time set forth in the Act for the license or permit application process should not normally exceed 460 days. In the process, the applications must first be certified to the maximum extent possible within 100 days, to be certain that preliminary eligibility requirements are met. After certification, an environmental impact statement (EIS) must be completed and the TCR must be formulated prior to permit or license issuance. A draft EIS and the proposed TCR are required within 180 days after certification and must be finalized within an additional 180 days.

The licenses for exploration are issued for a period of 10 years with possible 5-year extensions. The permits for commercial recovery are issued for a period of 20 years and as long thereafter as commercial quantities of nodule minerals are recoverable. If there has been no commercial

recovery under a permit within 10 years, the permit is terminated unless good cause can be shown involving circumstances beyond the control of the permittee.

Regulations. In the implementation of the Act, the Administrator must formulate the operational regulations necessary and appropriate to implement the legislation, including the licensing and permitting procedures. The Administrator, in consultation with various other agencies, is required to formulate a set of proposed regulations within 270 days of the enactment of the legislation, with the final set being issued 180 days later. The Administrator may amend the regulations for reasons of resource conservation, or the protection of the environment or of life and property at sea, except that amendments relating to conservation of resources will not apply to previously issued licenses and permits if serious or irreparable economic hardship would be caused.

Vessel Requirements and Eligibility. The legislation requires that all vessels used in the commercial recovery and processing of hard mineral resources from the deep seabed must be documented under the laws of the United States. In addition, at least one vessel used in the transportation of mineral resources from the mining sites must be U.S.-documented. All such U.S.-documented vessels used in commercial recovery and processing are subjected to National Pollutant Discharge Elimination System (NPDES) permits under the Federal Water Pollution Control Act, as amended. Discharges subject to these permits include the mining discharge from the mining vessel and may include the benthic plume if a "discharge" is involved in the collector's method of operation.

Processing Plant Location. In general, the location of the processing plants under U.S.-issued permits is required to be in the United States. However, variances may be granted if the President determines that an overriding

national interest is involved necessitating foreign placement. Also, the Administrator may allow foreign placement of processing facilities if a determination is made that the economic viability of the permittee is jeopardized by the requirement, and that the U.S. will receive an appropriate share of foreign processed minerals under that permit, if the national interest necessitates such return.

2.1.2 Environmental Provisions of the Act

The Deep Seabed Hard Mineral Resources Act provides for environmental protection during all phases of ocean mining development, including exploration, commercial recovery, and disposal of processing wastes. It is a declared purpose of the Act "... to accelerate the program of environmental assessment of exploration for and commercial recovery of hard mineral resources of the deep seabed and assure that such exploration and recovery activities are conducted in a manner which will encourage the conservation of such resources, protect the quality of the environment, and promote the safety of life and property at sea."

Specific environmental provisions under the Act include:

- the conduct of environmental studies;
- preparation of environmental impact statements for a) the general areas of mining (PEIS's), and b) the issuance of each license or permit (site-specific EIS's); and
- the promulgation of regulations and terms, conditions and restrictions to govern licenses or permits that are consonant with environmental protection, including required monitoring and enforcement.

Environmental Studies. The Act directs the Administrator of NOAA to expand and accelerate the program assessing the effects on the environment from ocean mining exploration, commercial recovery, seabased nodule processing, and disposal of such processing wastes at sea. It is the Congressional intent (Senate Report 96-307) that every effort be made to ensure that such study is

concluded in time to employ the results in the development of the programmatic and individual environmental impact statements; the regulations developed for administration of the Act; and the establishment of license and permit terms, conditions, and restrictions.

The Administrator is directed to "...conduct a continuing program of ocean research to support environmental assessment activity through the period of exploration and commercial recovery...," and within 160 days of the enactment of this Act, prepare a five-year plan to carry out the program. The program is directed to include, as appropriate, "...studies of the ecological, geological, and physical aspects of the deep seabed in general areas of the ocean..." to be involved in ocean mining. The Act specifically directs the study to include, but does not limit the study to, the

"(a) natural diversity of the deep seabed biota;

(b) life histories of major benthic, midwater, and surface organisms most likely to be affected by commercial recovery activities;

(c) long- and short-term effects of commercial recovery on the deep seabed biota; and

(d) assessment of the effects of seabased processing activities."

The monitoring of ocean mining activities under a license or permit is specifically required by the law. The Administrator may place appropriate Federal officers or employees as observers aboard vessels used by the licensee or permittee to monitor ocean mining activities; assess the effectiveness of license or permit terms, conditions, and restrictions; and report failure to comply with such license or permit provisions. The licensee or permittee is required to cooperate with such observers, provide their own monitoring of environmental effects of mining activities, and submit such information as the Administrator may require.

Environmental Impact Statements. NOAA is required to prepare a

programmatic environmental impact statement (PEIS) "...with respect to the area of the oceans in which exploration and commercial recovery by any United States citizen will likely first occur." This "area of the ocean" is considered to be the area between Hawaii and Central America. A draft PEIS is required within 270 days of the date of passage of this Act (March 25, 1981), and the final PEIS is required 180 days later (September 21, 1981). This subsection of the law also provides for the discretionary preparation by NOAA of other PEIS's on "...the areas of the oceans in which any United States citizen is expected to undertake exploration and commercial recovery ...", if deemed necessary.

The issuance under this Act of a license or permit is deemed a major Federal action under the National Environmental Policy Act of 1969 and, as such, requires preparation of an environmental impact statement (EIS) for each certified license or permit application within the 360-day schedule referenced earlier. The EIS's are to make use of information from any applicable studies or any other EIS prepared pursuant to this Act and are to include terms, conditions, and restrictions for the license or permit.

Licenses and Permits. Provisions are made in all phases of the license and permit application process for the incorporation of environmental considerations. Applications are required to contain such environmental information as the Administrator of NOAA finds necessary and appropriate for carrying out relevant responsibilities under the Act. The work plans of the applicant for exploration or commercial recovery are required to contain plans for environmental safeguards and monitoring systems.

The size and location of the mining area are determined by the applicant and approved by the Administrator unless there is an expectation that there might be a "significant adverse impact on the quality of the environment which cannot be avoided by the imposition of reasonable restrictions," or the area is

determined not to be a "logical mining unit." The latter is defined, in part, to be an area which can be explored or mined with due regard for the protection of the environment.

Eligibility for issuance or transfer of a license or permit also requires that the Administrator find in writing, after consultation with interested departments and agencies, that the work proposed will not likely result in "significant adverse effect on the quality of the environment." License or permit terms, conditions, and restrictions are to be generally specified in the regulations developed under the Act, but may vary for the protection of the environment as required by differing physical and environmental conditions. Terms, conditions, and restrictions may be modified if relevant data and other information indicate that such modification is required to protect the quality of the environment. Terms, conditions, and restrictions are also to be developed for the purpose of conserving natural resources; and in their development, the Administrator must consider the environmental effects of exploration and commercial recovery activities.

The Administrator is also directed to require in all permit activities the use of the best available technologies for the protection of the environment, wherever such activities have a significant effect on the environment, except where it is determined by the Administrator that "the incremental benefits are clearly insufficient to justify the incremental cost of using such technologies." As stated in Senate Report 96-307, the word "technologies" was carefully chosen and used in the plural form "to make certain that experimentation with various mining technologies is not inhibited by a bureaucratic edict that a single best technology is followed. In short, this language is not intended. . . to mandate the basic technology chosen by the licensee or permittee for exploration or commercial recovery."

Activities under licenses and permits can be denied, suspended, or modified. The Administrator may, of course, deny certification or issuance if the applicant is held ineligible, and a license or permit may also be revoked or suspended for reasons of substantial failure to comply with the Act or with the regulations or TCR issued thereunder. The Administrator, in consultation with other agencies, may modify the TCR for reasons of international interference, or to protect the environment and safety of life and property at sea. The Administrator may also suspend or modify particular activities if the President determines that action is necessary to avoid conflict with an international treaty or a breach of international peace; or the President may order by executive order an immediate suspension of a license or permit, or suspension or modification of particular activities under a license or permit, for the same reasons. An immediate suspension of a license or permit, or suspension or modification of activities under a license or permit, may be ordered by the Administrator for reasons of a significant adverse effect on the environment, or to preserve the safety of life and property at sea. These powers of the President and Administrator extend to activities in operation prior to the establishment by NOAA of licensing and permitting procedures. Except in these cases of immediate suspension orders, all such instances of denial, revocation, modification, or suspension must allow reasonable time for the licensee or permittee to correct, if possible, any deficiency.

2.1.3 International Environmental Considerations

Several provisions in the Act specifically refer to environmental considerations at the international level. The Secretary of State is encouraged to successfully negotiate a comprehensive Law of the Sea Treaty which, among other things, "provides for the establishment of requirements for the protection of the quality of the environment as stringent as those promulgated pursuant to the Act." Further, the Secretary of State is encouraged to promote any inter-

national actions necessary to adequately protect the environment from adverse impacts due to seabed mining operations not subject to this Act.

Furthermore, the Act provided for, prior to the entry into force of a Law of the Sea Treaty, consultation between NOAA and other nations with seabed mining laws, in consultation with the State Department, to establish a network of reciprocating states, in order to assure mutual recognition and prevent conflict among ocean mining projects. However, NOAA's designation of a reciprocating state is contingent upon the Secretary of State finding that the foreign nation regulates seabed mining "in a manner compatible" with that provided by this Act and implementing regulations, including "adequate measures for the protection of the environment" and effective enforcement provisions. Negotiations on the content and timing of such reciprocal arrangements have begun.

The Act also requires the Secretary of State to seek, in cooperation with the Administrator, the establishment of stable reference areas by negotiation with reciprocating states. Stable reference areas are to be specifically designated sections of the seabed in which no mining activities will occur, and which would be established "...as a reference zone or zones for the purposes of resource evaluation and environmental assessment of deep seabed mining," thus providing a similar, though non-impacted, seabed environment against which the environmental effects of seabed mining can be assessed. Discussions with reciprocating states on establishment of stable reference areas, which by law must be initiated prior to June 28, 1981, have already begun.

2.2 RELATED LAWS AND COORDINATION REQUIREMENTS

Although the Deep Seabed Hard Mineral Resources Act is the basic legislation for the marine research in this Plan, two other major pieces of environmental legislation will affect industry's plans relating to the marine environment and thus the content of the research program: the Clean Water

Act and the Marine Protection, Research, and Sanctuaries Act. If industry elects to dispose of wastes from land-based processing plants in the ocean, they must meet the requirements of the Clean Water Act (for discharge through outfall pipes) or the Marine Protection, Research, and Sanctuaries Act (for ocean dumping). In addition, discharges from seabed mining vessels (excluding support vessels) are subject to the requirements of the Clean Water Act.

2.2.1 Marine Protection, Research and Sanctuaries Act (the "Ocean Dumping Act")

The Marine Protection, Research and Sanctuaries Act (Public Law 92-532) was passed in 1972 after several studies and a report by the Council on Environmental Quality revealed the magnitude and nature of ocean dumping and potential adverse environmental effects resulting from it. Title I of the Act regulates the dumping of waste materials into any ocean waters by U.S. flag vessels or ships leaving U.S. ports. Under this Act, the Administrator of the Environmental Protection Agency (EPA) is authorized to issue permits to regulate ocean dumping of waste materials, excluding chemical, biological, or radiological warfare agents or high-level radioactive wastes which are prohibited, and dredged material which is regulated by the Corps of Engineers with EPA concurrence. The Act covers only those actions involving transportation of materials for the purpose of ocean dumping. Wastes discharged on-site from at-sea processing or mining ships are not covered by the Ocean Dumping Act since no transportation is involved; therefore, a permit under the Federal Water Pollution Control Act is required for these activities.

Regulations and criteria to implement the Ocean Dumping Act were issued in 1973 and updated in 1977. They are currently being considered for another revision in view of advances in scientific knowledge and increased operating experience.

The Ocean Dumping Act sets out nine factors that must be considered by

the Administrator of EPA in the establishment and application of criteria to be used in the evaluation of permit applications for ocean dumping. They are:

1) the need for the proposed dumping;
2) the effect of dumping on human health and welfare;
3) the effect on fish and shellfish, plankton, wildlife, shorelines and beaches;
4) the effect on marine ecosystems;
5) the persistence and permanence of the effects;
6) the effect from varying volumes and concentrations of dumped material;
7) alternatives;
8) the effect on alternative ocean uses; and
9) preferential use of sites beyond the edge of the continental shelf.

The Ocean Dumping Act allows the Administrator of EPA to designate recommended sites for dumping, considering the above criteria. It has been EPA policy to designate separate dumpsites to receive specific types of wastes or wastes from particular industries. This allows monitoring at the sites to determine what effects, if any, result from the disposal of specific wastes. No sites have been studied for the effects of dumping processing wastes. The only existing sites which have been designated to receive wastes similar to those from ocean mining and processing activities would be dredged material sites. For economic reasons, these are usually located near the dredge sites on the continental shelf and are not expected to be adequate for the expected volumes of processing wastes. In addition, no baseline studies have been performed to determine their acceptability as disposal sites for manganese nodule processing wastes. Therefore, it is expected that new sites will need to be designated if the decision is made to dump processing wastes in the ocean.

Once a site has been designated and a permit is issued to ocean dump, the regulations require monitoring to assure that the use of the site does not produce any unacceptable adverse effects. The Coast Guard maintains surveillance of the actual dumping operations.

In addition to domestic legislation, an international agreement, the

International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, has also been ratified by the U.S. and other nations to control ocean dumping. This document provides minimum standards for signatory nations in the evaluation of applications for ocean dumping.

2.2.2 Federal Water Pollution Control Act (Clean Water Act)

Any discharge into the marine environment must be in compliance with guidelines established under Section 403(c) of the Clean Water Act. The permit, called a National Pollutant Discharge Elimination System (NPDES) permit, which allows the discharge of any pollutant from a point source, is issued by EPA under authority conferred in Sec. 402 of the Clean Water Act, or by a state, if such authority is delegated by EPA.

In the case of marine mining and processing, an NPDES permit would be required (1) during mining operations for the discharge from the mining vessel, since it is specifically provided for in the Deep Seabed Hard Mineral Resources Act and may include the "discharge" from the collector, depending on the method of operation; (2) during land processing activities for the at-sea disposal of wastes from an outfall; and (3) for disposal of wastes from at-sea processing if disposal occurs on-site and wastes are not transported. The possibility of a general NPDES permit during exploration is also being explored by EPA.

The factors to be considered by the Administrator of EPA in developing 403(c) guidelines are clearly stated in the law and are similar to those in the Ocean Dumping Act. Guidelines implementing this section were issued on October 3, 1980 (40 CFR Part 125), and became effective 30 days later. These guidelines state that an NPDES permit may not be issued if the EPA Director of the Regional Enforcement Division "on the basis of available information" determines "prior to permit issuance that the discharge will cause unreasonable degradation of the marine environment." If the Director has "insufficient information" to make this determination "there shall be no discharge of pollutants

... unless the Director determines" that: (1) such discharge will not cause "irreparable harm to the marine environment during the period in which monitoring is undertaken," (2) there are no reasonable alternatives, and (3) the discharge complies with minimum permit conditions. An "unreasonable degradation of the marine environment" means:

1) significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge surrounding biological communities;

2) threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms; or

3) loss of aesthetic, recreational, scientific, or economic values which is unreasonable in relation to the benefit derived from the discharge.

In addition to the requirements under Section 403(c) of the Clean Water Act, several other sections of this law are relevant to obtaining a NPDES permit. These include use of Best Practicable Control Technology Currently Available (BPT) and Best Available Technology Economically Achievable (BAT), and application of New Source Performance Standards (NSPS). At present, however, no guidelines and standards exist for this industry addressing the requirements of these sections. Although it is unlikely that any of these guidelines would be promulgated prior to issuance of the first exploration licenses (expected to be in early 1983), there is a possibility of producing a guidance document that would recommend treatment and/or operational procedure; however, these would not be requirements. In the absence of any of the above guidelines, a permit would be based on the Ocean Discharge Criteria in Section 403(c) and Best Engineering Judgment. This may involve reviewing guidelines and standards promulgated for other similar industrial categories, or transfer of treatment technologies.

2.2.3 Coordination Requirements

Under the Deep Seabed Hard Mineral Resources Act, the Administrator of NOAA must consult with the Administrator of the Environmental Protection Agency,

the Secretary of State, and the Secretary of the department in which the Coast Guard is operating before establishing terms, conditions, and restrictions on licenses and permits for the purpose of protecting the environment. The views of the above agencies, and any other interested persons must also be solicited during the regulation formation process. The Administrator is also required to consult with 1) all interested agencies and departments before issuing a license or permit, or modifying the terms, conditions, and restrictions thereof, and 2) any Regional Fishery Management Council (RFMC), established by the Magnuson Fishery Conservation and Management Act, prior to the issuance, transfer, modification, or renewal of a license or permit, if the license or permit activities could adversely affect any fishery within the jurisdiction of the appropriate RFMC. In general, the Administrator is required by regulation to provide for full consultation and cooperation with other Federal agencies or departments which have statutory responsibilities affected by activities under any license or permit.

In addition to Public Law 96-283, there are other laws that mandate consultation with specific agencies to foster protection of the marine environment. These include the Fish and Wildlife Coordination Act and the Endangered Species Act. Also, the National Ocean Pollution Planning Act of 1978 (Public Law 95-273) requires coordination both within NOAA and among other Federal agencies involved in marine pollution research to ensure efficient use of limited Federal resources. All of these legislative mandates must be considered in the planning and implementation of the research program.

3. INDUSTRY PLANS

3.1 RESOURCES

Manganese nodules are small, fist-sized concretions of a complex mixture of materials, including minerals of detrital and authigenic origin, colloidal matter, and igneous and metamorphic rocks in varying degrees of degradation. Many, but not all, nodules contain an observable nucleus such as a foreign object, pumice or basaltic fragments, or an older nodule fragment. The complex oxide ore of the nodule contains a number of value metals including manganese, copper, nickel, and cobalt.

High concentrations of manganese nodules occur primarily in the abyssal plains of the deep sea, generally where sedimentation rates are low (1-3 mm/1000 years). The deposits of current commercial interest are found at water depths between 4,000 and 6,000 meters. Nodules occur in patches and can vary over short distances, both in metal content and in abundance. Even where nodule occurrence is considered high, abundance can vary greatly within a few hundred yards. Studies[3] have shown that the outer rind of nodules differs from the interior rind: Nickel and copper are concentrated in that portion of the rind in contact with the sediment and are depleted where the rind contacts seawater. These observations may account for a significant part of the compositional variation found in nodules from the same location, since nodules of different sizes and shapes have varying fractions of their total bulk embedded in the sediment.[4]

Maps recently published by the U.S. Geological Survey (USGS), prepared at scales of 1:10 million and utilizing publicly available data, have outlined

the area of primary nodule deposition in the Clarion-Clipperton Fracture Zone (Fig. 2). This area extends from about 7°N to 15°N and 120°W to 155°W and covers approximately 2.5 million km^2. It is one of the richest sectors explored and constitutes a "prime area," that is, an area which contains deposits of relatively abundant nodules having significantly higher grades than those found elsewhere.

3.2 MINING

3.2.1 Technology

Four international mining consortia, each of which includes one or more U.S. corporations, have been formed in recent years to share the cost of exploration as well as the development of mining and processing systems. Table 1 shows the present membership, including percentages of ownership, where known, and dates of consortium announcement. A fifth consortium, AFERNOD, consisting solely of French organizations, has been similarly active since 1971.

Two main types of mining systems have been considered for use by industry to mine deep seabed manganese nodules: hydraulic, and the Continuous Line Bucket (CLB) system. The hydraulic systems are currently favored by the international consortia, and so are emphasized in the following discussion. Undoubtedly, the ocean mining technology will change as the developing new industry expands to maturity and so may require a consequent shift in research emphasis to the new technologies as they are developed. However, this Five-Year Research Plan focuses on the environmental issues associated with the technology likely to be used in the early years of mining.

Mining systems will collect nodules and some bottom sediments, pump the resulting slurry by a pipeline to a surface mining vessel, separate nodule

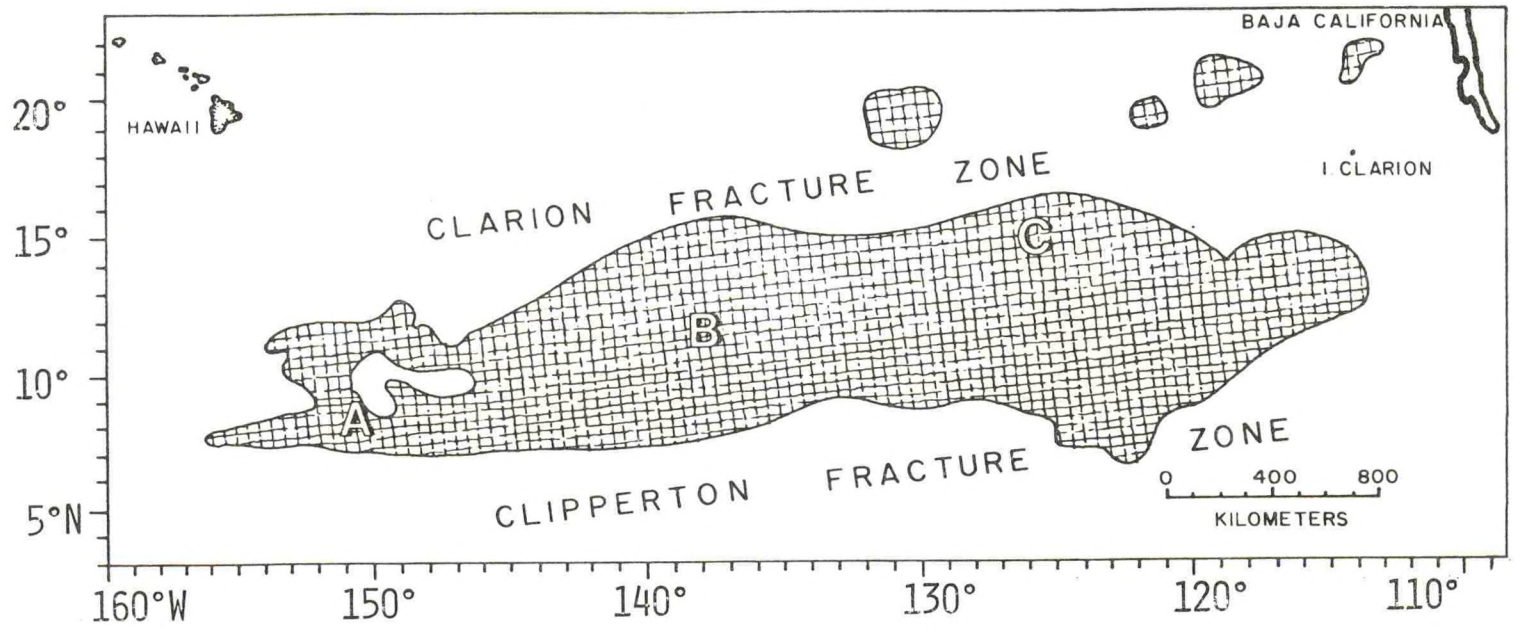

FIGURE 2. High Density Nodule Areas in the Equatorial Pacific

Areas in the northeastern equatorial Pacific where manganese nodules contain more than 1.8 percent nickel plus copper (modified from McKelvey et al, 1979). Sites A, B, and C were the focal points of Deep Ocean Mining Environmental Study (DOMES) program. The pilot-scale mining tests, subject of DOMES II program, took place near sites A and C.[5]

TABLE 1. Deep Seabed Ocean Mining International Consortia

Deep seabed mining consortia involving United States firms and (parent companies), including dates of consortia formation, as set forth in applications filed with NOAA in February, 1982.

Nation	Kennecott Consortium (KCON) (1/74)	Ocean Mining Associates (OMA) (10/74)	Ocean Management Inc. (OMI) (5/75)	Ocean Minerals Company (OMCO) (11/77)
United States		Essex Minerals Co. (U.S. Steel) 25% Sun Ocean Ventures Inc. (Sun Co.) 25%	Sedco, Inc. 25%	AMOCO Ocean Minerals Co., (Standard Oil Co. (Indiana)) 30.669% Lockheed Systems, Co., Inc. (Lockheed Corp.) 6.329% Lockheed Missiles & Space Co., Inc., (Lockheed Corp.) 38.64% of OMInc.
Belgium		Union Seas, Inc. a U.S. corporation (Union Miniere) 25%		
Canada	Noranda Exploration, Inc., a U.S. corporation 12% (Noranda Mines Ltd.)		INCO, Ltd. 25%	
Italy		Samim Ocean Inc., U.S. corporation (ENI/Italy) 25%		
Japan	Mitsubishi Corp. 12%		Deep Ocean Mining Co., Ltd. (DOMCO-19 Japanese Companies) 25%	
Netherlands				Ocean Minerals, Inc. (OMInc., a U.S. corp.) 63.002% -Billiton B.V. 48.68% of OMInc. (Royal Dutch/Shell Group) -BKW Ocean Minerals 12.68% of OMInc., (Royal Boskalis Westminister N.V.)
United Kingdom	Kennecott Corp., a U.S. corporation (Sohio/BP) 40% R.T.Z. Deep Sea Mining Enterprises, Ltd. (Rio Tinto-Zinc) 12% Consolidated Gold Fields, PLC 12% BP Petroleum Dev., Ltd. 12% (The British Petroleum Co., p.l.c.)			
West Germany			AMR 25% (Preussag A.G., Salzgitter A.G., Metallgesellschaft A.G.)	

materials and sediments onboard, store the nodule materials, and then discharge the sediments and bottom water into the surface waters. Figure 3 illustrates a representative mining system and identifies its major components, which are described in the following text.

During commercial mining, a mining vessel, which may approach 350 m in length, is expected to mine 24 hours a day on an average of 300 days a year. An additional 30 days will be devoted to overhaul, with approximately 35 days to be used for transit and "down-time" for weather.

As the ship proceeds, the collector is either towed or propels itself along the seabed, gathering nodule material and sediments from the top few centimeters of the sea bottom along a path 10-20 meters wide. Under commercial conditions, the collector is expected to cover about 100 km daily in closely spaced tracks, thus potentially recovering an estimated 5000 tonnes (dry weight) of nodules daily.[6] To recover this tonnage, an area of 1.9 km^2 will be "mined" daily, approximately 60 percent or 1.1 km^2 will be contacted by the collector. Annually, this will require a minesite subarea of 900 km^2 (assuming 30% of the site is unmineable due to topographic features) to recover 1.5 million tonnes of nodules. Therefore, two mining ships are likely to service a 3-million-tonnes-a-year processing plant.

Preliminary separation of nodule material may take place at the collector: oversize materials may be rejected via a protective grill, while fines and sediments pass through the wire-cage hoppers or are rejected hydraulically. The remaining nodules and sediments are drawn by a pipeline to the mining vessel. Nodules also may be crushed to a relatively uniform size at the lower end of the pipeline to increase the efficiency of the lift system. The nodules and sediment are passed into a chute, and the slurry is pumped by pipeline to the mining vessel, using either very special slurry pumps or airlift

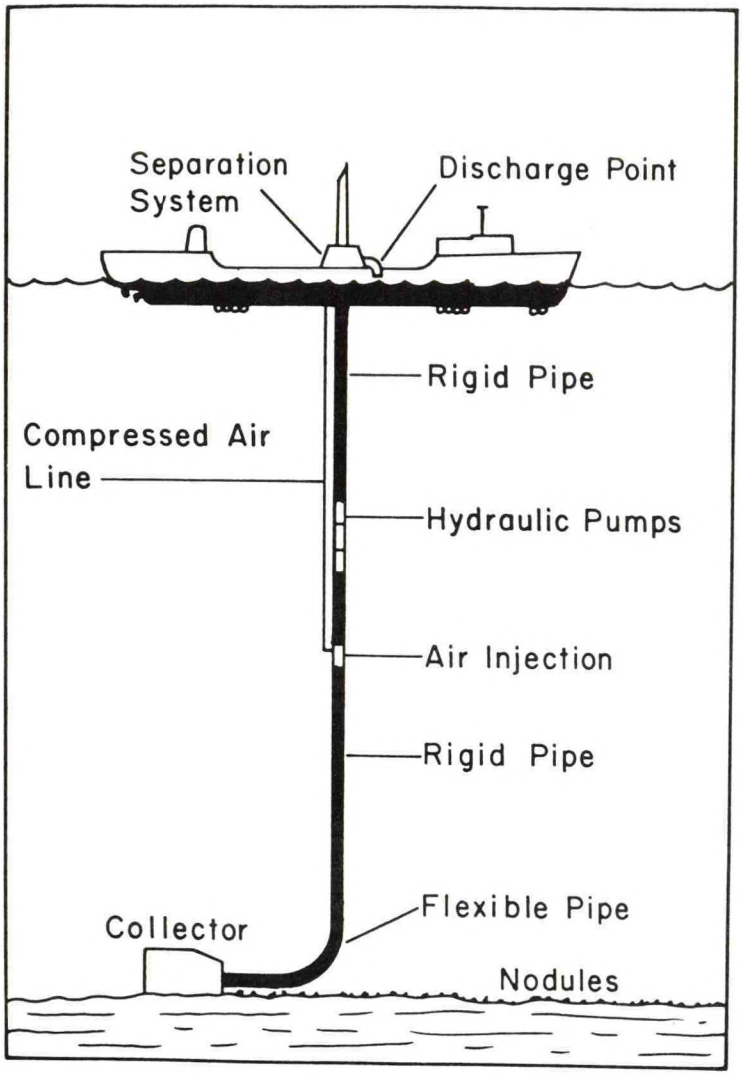

FIGURE 3. Diagram of a Representative Mining System and Identification of its Major Components

systems. A benthic plume that will be formed following the passage of the collector is due to disturbance and resuspension of sediments upon initial contact and due to sediments that are rejected prior to ascent in the lift pipe.

The lift system propelling nodules and sediments to the surface consists of a rigid pipeline using either in-line pumps, air injection, or a combination of both. Normally, the in-line pumps will be placed several thousand meters below the surface. Collector intake rates from pilot-scale mining tests are discussed in more detail in Chapter 4. Exploration technology, procedures, timing, and constraints have been described in greater detail by others.[7]

Once aboard ship, the nodule materials and sediments pass through a separator, where the nodule materials are removed from the water, sediment fines, and entrained air. Rejected materials are passed through a shaker screen or other means of separation, where additional smaller nodule materials are separated out and retained. The remaining sediments, fines, and bottom waters are then discharged to the sea, forming a surface plume.

While the mining ship(s) are operating, one exploration vessel may be used to delineate important characteristics of the site, such as nodule abundance and grade, and seafloor topography. A small, fast auxiliary ship probably will be used to provide crew and service personnel transportation, as well as to transport mail, spare parts, food and other supplies to and from the logistics base onshore. Therefore, a commercial scale mine-site "fleet" will probably include one or two mining ships, one exploration/mapping vessel, one fast service vessel, and at least two bulk-ore carriers to transport the nodules to shore for metallurgical processing.

The unusual feature of the transportation step will be the transfer of nodules from mining ship to the ore carrier, probably using a slurry pipeline.

The ore carriers will carry fuel and supplies to the mining ship on return trips.[8]

3.2.2 Timing

Under Public Law 96-283, commercial recovery of nodules cannot begin until 1988; however, exploration and testing initiated prior to the Act's passage may continue before the licensing procedure is established by NOAA, and thereafter such activities may occur under a NOAA license. The consortia applying for a U.S. license are expected to submit their applications as soon as possible in order to protect their priority of right to a minesite area under both a system of reciprocating states and a Law of the Sea Treaty. It is anticipated that a licensing system for exploration and testing operations will be operable in October 1981, and the licensing process will take approximately 15 months. Applications for permits for commercial recovery will be made after industry has made its final determination regarding the feasibility of seabed mining, probably no earlier than 1985.

While the licensing of operations is expected to occur as soon as possible, the rate of development by consortia in their work plans will probably vary considerably because of differing economic assessments and goals. Large-scale resource assessment activities by the major consortia may be expected to begin within the next year at the earliest, in preparation for the specification of a mine site in the license application. Further surveys in these areas will continue in increasingly finer detail. At-sea tests of mining equipment are projected to begin in 1984 and gradually become more intensive toward 1985, evolving into large "shakedown" tests. These tests are critical to the determination of whether to proceed toward full-scale development and commercial recovery. It should be emphasized, however, that these timing projections may be affected by the nature of the Law of the Sea negotiations.

If the investment climate is favorable, the engineering designs for the chosen mining system could be finalized in 1985 when construction of the mining vessels and equipment may begin. Fine-scale mine site mapping and surveying would probably begin shortly after 1985 at the earliest and continue up to and after the start of full-scale commercial recovery sometime after January 1, 1988.

3.3 PROCESSING

3.3.1 Characteristics of Processing Systems

From a process-metallurgical point of view, manganese nodules may be described as a complex oxide ore containing a number of value metals, the most important of which are manganese, nickel, copper, and cobalt. The nodules contain a large number of other elements as well, which would not be processed for sale as commercial products but would be rejected from a nodules processing plant as waste material in the tailings.

The value metals, which are dispersed throughout the nodules, have a widely varying composition and show a complex mineralogy in which relatively pure phases of each metal cannot be isolated. The impact of the latter finding is most significant, because it is not possible to upgrade the concentration of a desired metal by simple, inexpensive physical means, i.e., the entire nodule must be processed to extract the metal(s) of interest. Since nodules typically contain about 25% manganese on a dry weight basis and a total of about 3.0% of all other value metals, the amount of wastes produced will exceed the amount of product sold by a considerable margin.

The value metals occurring in the nodules usually are produced commercially from terrestrial ores as pure metals, i.e., electrolytic copper, or alloys of stipulated composition such as ferromanganese. Therefore, the oxides

of the various metals will have to be chemically reduced to allow their isolation and purification. Many suggested nodule processing techniques selectively reduce manganic oxide to manganous oxide, since that process apparently disrupts the structure of the nodules and permits the majority of the other value metals to be extracted by techniques adapted from the processing of other terrestrial ores. The manganous oxide may be reduced further if the production of manganese metal is required.

A key factor in determining the structure of a nodule processing scheme is whether manganese will be recovered as a primary product, in addition to nickel, copper, and cobalt. If recovery of only the latter three value metals is desired, the reduction of manganese will probably be carefully controlled, since it would be desirable not to further complicate the required nickel/copper/cobalt separation steps with the presence of dissolved manganese if it could be maintained as the relatively inert, benign oxide. A "Three-Metal Process" can provide for the recovery of some manganese as a secondary product which could be produced as the metals market permits.

If, however, four metals are desired as the primary products, the processing approach adopted depends primarily on the form of manganese to be produced, either pure metal or alloy, and the required purity. Manganese may be recovered either early in the sequence of reduction and purification steps, or from the partially processed nodule residue after the nickel, copper, and cobalt have been extracted. In any case, a four-metal plant produces a smaller amount of waste than a three-metal plant per unit of nodule treated since the manganese will have been recovered for sale, instead of being rejected.

Since no "optimum" nodule processing technology appears to exist, industry will have to select a processing scheme based on an evaluation of a large number of technical, economic, and marketing considerations. While

numerous variations in processing routes are possible, the routes may be organized according to their fundamental extractive metallurgy, either as a smelting operation, or according to the leaching solution used to reduce and/or leach the nodules in the hydrometallurgical process. Leaching solutions used in hydrometallurgical processes can be classified into three major types: those producing acid sulfate solutions, chloride (halide) solutions, or ammoniacal solutions. The types of extractive metallurgical processes available to industry for manganese nodule processing are presented in Table 2.

Most of the technology presented in this table is based on elements of the extractive metallurgy used in the processing of certain terrestrial ores. For instance, reduction/ammonia leach and high temperature sulfuric acid leach are adopted from technology used to process nickeliferous laterites. The smelting route also is used for certain types of laterites, as well as for copper and nickel sulfide ores. The cuprion process is an adaptation of the reduction/ammonia leach route, using a low-temperature reduction step.

An integral part of the hydrochloric acid route, which was developed specifically for nodule processing, appears to be the recovery of manganese, probably in a pure metal form. Although other hydrometallurgical processes appear to be adapted mostly to copper, nickel, and cobalt removal, an "add-on" is included to recover selected amounts of manganese. The smelting or pyrometallurgical process produces a slag from which a manganese alloy should be readily producible, and a copper-nickel-cobalt-rich matte from which these metals can be extracted by hydrometallurgical means.

The generalized structure of a nodule processing plant is presented schematically in Fig. 4. All major operations for both three- and four-metal processing plants can be characterized according to one of the key functions presented in this figure.

TABLE 2. Classification of Extractive Metallurgical Process Systems

System Type	Process Descriptions
Sulfate Systems	*High Temperature Sulfuric Acid Leach
	*Smelting
	Sulfuric Acid Reduction Leach
	Reduction Roast/Sulfuric Acid Leach
	Sulfation Roast
Ammoniacal Systems	*Reduction/Ammonia Leach
	*Cuprion/Ammonia Leach
	High Temperature Ammonia Leach
Chloride Systems	*Hydrochloric Acid Reduction Leach
	Hydrogen Chloride Reduction Roast/Acid Leach
	Segregation Roast
	Molten Salt Chloridation

*Most likely processes to be adopted for first-generation, onshore processing plants.

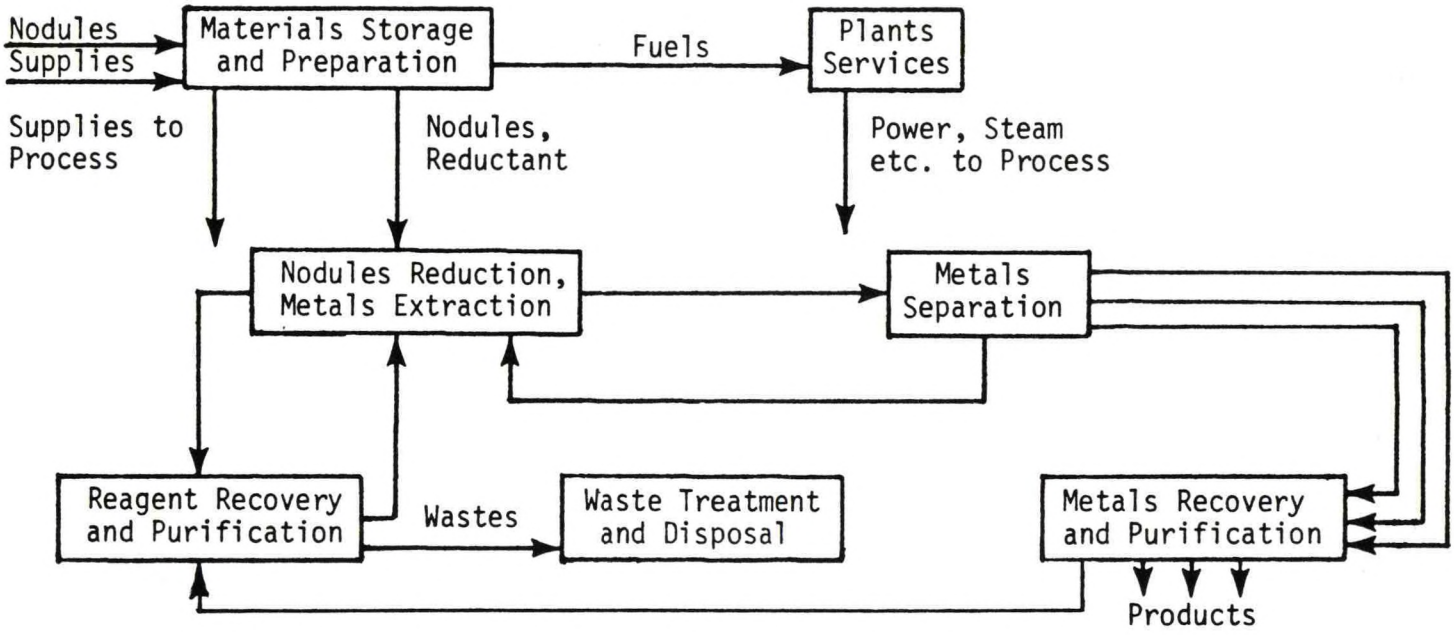

FIGURE 4. Generic Processing System

In general, the bulk of the material-flow through a processing plant is from materials preparation to reduction/extraction and reagent recovery prior to waste treatment and disposal. The metals separation step(s) serve to produce solutions or compounds in a form capable of being reduced and purified further, if necessary, to produce commercially acceptable products.

Studies have identified geographical areas on the West and Gulf Coasts and in Hawaii which are representative of those locations of potential interest to industry for onshore processing plants[9,10,11,12]. To a great extent, site selection will be determined by transportation--availability of a port with a suitable channel depth for nodule transport ships, and an economical bulk transport system, e.g., railroads from the contiguous states, for bringing in fuel and reagents and shipping products. The plant itself, however, can be located at some distance inland from the port.

3.3.2 Likely Production Rates

Nodule processing plants producing only three metals will be considerably larger than those producing manganese as well, because of the need to balance economies of scale of larger plants with the ability of the metals market to accept without disruption the manganese from a four-metal plant. Various estimates have placed the probable size of a first-generation, three-metal nodule processing plant in the range of three million tonnes per year of nodules (dry weight basis), which would result in the production of fifty to seventy-five thousand tonnes per year of total product. This appears to be the smallest-sized plant for which an acceptable return on investment is possible. The impact of this size plant on the nickel and copper markets would be negligible, although the cobalt production could be significant relative to current consumption.[13] However, a plant of this size that produced manganese metal or ferromanganese alloy would have a significant effect on current and near-future manganese

markets. Hence, various estimates place the probable size of four-metal plants in the range of one million tonnes of nodules per year, with total metal production on the order of two hundred to two-hundred-fifty thousand tonnes per year. This appears to be a reasonable economic size, given the value of the metals produced and construction and operating costs. Costs for a four-metal plant on a per tonne nodule basis are higher than for a three-metal plant.

The differing plant sizes and the question of manganese removal result in the production of widely varying amounts of waste material. Four-metal process plants will generate about one-half to one million tonnes per year of solid wastes per plant, while three-metal process plants will generate approximately three to four-and-one-half million tonnes per year. The characteristics of these wastes will be summarized in Section 3.3.4.

3.3.3 Timing

Previous efforts to develop processing technologies for extracting value metals from manganese nodules have been restricted to laboratory-sized facilities. Expansion into a larger demonstration operation is dependent upon several factors, such as the availability of adequate volumes of nodules to sustain the operation of a pilot plant capable of continuous processing with a nodule through-put of up to several hundred tonnes per day. Obtaining such volumes hinges on the success of the reliability and endurance field tests scheduled to begin as early as 1984. Assuming successful testing in 1984, a pilot plant might be operable as early as 1985. Sustained processing tests could be expected for at least six months to a year. Wastes in adequate quantities for evaluating environmental impact would be available as early as mid-1985. If, based on the tests at the demonstration plant, a decision is made to initiate commercial recovery, actions will be initiated to obtain required

licenses and permits from Federal, state, and local governments. Depending on geographic location, this procedure could take from three to seven years. Consequently, given the time required for obtaining necessary licenses and permits and for plant construction, a commercial processing plant probably will not be in operation much before the end of the decade.

3.3.4 Processing Waste Disposal

Section 3.3.2 pointed out that the amount of waste produced varies greatly among the processing technologies and, particularly, between the three- and four-metal processes. The chemical and physical properties of the wastes also vary greatly, since their nature is determined by the sequence of processing steps to which they have been subjected. In addition to nodule waste or "rejects," each type of plant will produce various amounts of other wastes, such as combustion ash, scrubber solids, and tank house purges.

Most wastes from the three-metal hydrometallurgical processes will consist of solid residues from the nodule which have been chemically and physically altered and from which the value metals have been extracted. In addition, a liquid waste will be produced, which contains dissolved materials, including sea salts, unrecovered value metals, unrecovered reagents, and traces of other compounds. These trace compounds are widely dispersed during the processing and are of importance because some have toxic compounds. These compounds, as found in nodules "as mined", are not toxic. Their chemical form following processing, however, is uncertain. Some of these substances may exit in the waste stream in the same chemical and physical state in which they entered the process, while others may be altered and exit in the waste stream; still others may exit as impurities in the products.

Since no processing plants for manganese nodules are in operation, estimates of waste characteristics are based on experience from other similar

metallurgical operations. The physical form of the tailings from all three-metal hydrometallurgical processing plants may be similar to wastes currently produced in processing nickeliferous laterites. However, the bulk chemical composition would be different because of nodule chemistry and probably would consist mainly of manganese oxides and carbonates.

The bulk of the residues from a three- or four-metal smelting process will be quite different because granular slags are the primary component. Similar materials, produced in large volume in the production of nickel and copper from terrestrial ores, are known to be inert and stable for a long time and are essentially free-draining. The small portion of waste from the leaching of the matte would be disposed of like wastes from a three-metal plant.

The reduction/hydrochloric acid leach process produces wastes which are more difficult to characterize, since there is no directly analogous terrestrial process. The wastes would consist of nearly equal amounts of leached tailings accompanied by other processing wastes and fused salts. The leached tailings would have properties analogous to those from three-metal plants. The second waste, the fused salts, would be subject to dissolution on standing by contact with water and, therefore, would need to be contained to prevent chemical migration.

The variety of options available for treating processing wastes ranges from relatively simple chemical steps, such as treatment with lime, to much more complex operations such as washing, drying, or chemical fixations by pozzolanic materials. Treatment with lime stabilizes the wastes by adjusting the pH and by precipitating potentially toxic materials. More complex alternatives, which are all much more costly and not practiced in the extractive metallurgy of terrestrial ores, would have to be demonstrated before adoption to show that

they mitigate a problem encountered by the more conventional disposal techniques. Such a demonstration would require the production of a significant amount of "real" nodule wastes so that their properties could be determined experimentally, rather than by analogy.

The most common way of disposing of tailings and other process wastes from the land-based processing operations for terrestrial ores is in slurry form in containment areas or "tailing ponds." If necessary, the containment area can be lined with natural or man-made material to prevent contamination of groundwater. The slurry liquids are either allowed to evaporate, or are decanted and recycled, or both.

Alternative processing waste disposal methods used by the mining industry depend upon the physical and chemical characteristics of the wastes. That is, waste slurry, because of its fluid character, can be placed only in a containment area or discharged by ocean dumping or ocean outfall. However, if wastes are produced in a dry solid form and are innocuous, a landfill disposal scheme may be implemented or the wastes may be sold for subsequent use. For example, granulated slag from smelting may make suitable fill or ballast, and sometimes gypsum and lime wastes are sold and used as soil additives.

The amount of land required for onshore disposal, particularly in coastal states, could be a problem for industry and land users. Over a twenty-year operating period, and assuming a containment area of 12 meters depth, a four-metal plant may require approximately 150-175 hectares, and a three-metal plant 800-1000 hectares, depending on climatic conditions. In very wet climates, containment areas may be difficult to stabilize and revegetate. Dusting and leaching would have to be controlled and the safety of tailings dams assured. If the wastes contain any toxic compounds, rather extensive measures may be required, depending on concentrations, to prevent surface and groundwater

contamination and dusting. Whether wastes are innocuous or not, onshore waste disposal is regulated by state and Federal agencies.

Ocean disposal may be accomplished by the use of "conventional" dump barges, nodule transport vessels supplemented by dump barges, or an ocean outfall (a pipe extending offshore). These modes of waste disposal also are regulated.

Both methods involving barge transport require the return of slurried wastes to the marine terminal, temporary storage of wastes at the terminal, a barge/vessel loading operation, and the delivery of the material to a designated dumpsite. The size of the marine terminal can be expected to increase because of waste handling and storage requirements and the space required to berth tugs and barges. Dusting may have to be controlled if the wastes partially dry while awaiting loading.

In analogous ocean dumping operations, the dump barges are loaded through weather deck hatches and dewatered by overflowing the liquid fraction. Since in nodule processing the liquid fraction is also part of the water, it is not known if this practice could be followed for nodule processing wastes. In a purely barge-based system, about two barge loads per week would be dumped, assuming reasonably sized barges, i.e., 6000-8000 DWT. At the dumpsite, a hatch opens in the bottom of the barge and the wastes slide out. These actions create a near-surface turbidity plume as well as a short-term change in water chemistry.

The number and size of dump barges could be reduced by using the nodule transport vessels for waste disposal. Slurried waste would be pumped aboard outbound transports and discharged by pumping at a designated site. A pipe extending to a depth below the surface could be used, which would be expected to reduce near-surface effects. The volume of waste material involved, would be greater than the original volume of mixed nodules and so would necessitate a

"conventional" dump barge system to supplement the transports. The additional shipboard equipment required as well as the delays created by the discharge operation may make the use of transports for disposal unattractive.

Another ocean disposal alternative is an ocean outfall, i.e., a pipe extending from a shore facility. This method also could be applicable for the disposal of decantants from tailings ponds since the decantants are expected to be high in sea salts. For those areas of the coastline having a narrow continental shelf, such a pipe could be relatively short to reach waters in excess of 1000 meters. This method has been used for the disposal of effluents from municipal sewage treatment facilities on all coasts of the United States and for sewage sludge disposal off southern California.

Although these alternatives assume that the wastes could meet required environmental regulations, a discussion of these options should not be presumed as an endorsement of acceptability by the appropriate Federal and state agencies.

3.3.5 Seabased Processing and Associated Waste Disposal

Since the majority of the nodule becomes a waste even after manganese recovery, transportation savings would accrue if finished metals could be produced at sea, or if only a "concentrate" could be shipped to shore. Moreover, this would either eliminate or reduce waste disposal considerations associated with onshore processing plants. A recent NOAA-sponsored study[14] examined the feasibility of full (finished metal) and partial (concentrations or more properly "beneficiation") at-sea processing, and determined that neither method would likely be implemented during first-generation systems, a prediction recently confirmed by industry.[15] The reasons for this are many, as shown in the following discussion.

The installation of a processing plant, or any element of that plant, in a seagoing vessel will subject the equipment to some motion, which is the

principal difference from a land-based plant. Operations or equipment that would be most affected by vessel motions are smelting, electrowinning, decanting, rake classification, leach thickeners, stripping and scrubbing tanks, furnaces and converters, extraction tanks, and possibly fluidized-bed reactors, since these processes or equipment are dependent upon gravity and need a stable environment for their effectiveness.

Complete at-sea processing of nodules would require the development of new technology in metal separation and reduction, which is not likely to be considered in first-generation processing plants. Such developments are thought to be beyond the state-of-the-art and, if developed, would introduce further uncertainties and complexities into systems that have not yet been commercially demonstrated.

As an alternative to complete processing of nodules at-sea, beneficiation can be considered for concentrating value metals. Unfortunately, repeated demonstrations have shown that nodules are not amenable to physical beneficiation used for land ores, and thus chemical processing is required. One option is to ship reductants to sea, perform a separation, generate an impure precipitate with concentrated value metals, and ship the precipitate to shore. Another similar option, is to ship the metal-bearing solution to shore, rather than generating the precipitate at sea. The economic feasibility of these alternatives must be explored and the technical uncertainties resolved. Either approach would eliminate the generation of the solid fraction of processing wastes onshore and reduce the size of the onshore plant.

The wastes produced by the complete or partial sea-based plant would be disposed of in the same general area as the mining operation. These wastes would be similar, but probably not identical, to the wastes generated by a completely shore-based plant.

4. ENVIRONMENTAL RESEARCH NEEDS

Protection of the marine environment from adverse impacts of mining and disposal activities requires the capability to assess changes due to these activities and the capability to predict and determine the significance of such changes. This knowledge is necessary for the implementation of effective mitigation measures, and forms the basis of an effective monitoring program to be implemented to provide assurance that mining and ocean waste disposal are not causing significant adverse environmental effects. The development of this knowledge and the implementation of effective monitoring programs are the focus of this research plan.

This chapter examines the status of scientific knowledge in terms of the research strategy discussed in Chapter 1 and identifies areas where further research is needed to support sound management decisions that protect the marine environment while allowing the mining industry to develop. Table 3 summarizes the concerns raised when the prospect of deep seabed mining was originally proposed and presents current thinking, based primarily on the results of DOMES, and on the significance of these issues. As is apparent, many of the problems anticipated several years ago do not now appear to be major concerns; however, several important questions remain, especially those relating to long-term environmental consequences. A parallel table dealing with processing has not been developed, since research in this area is still in the preliminary stage and insufficient data exist on the initial conditions that effect the environmental consequences of ocean disposal of processing waste.

The discussion in the following sections presents the scientific information used to develop Table 3 and identifies areas where further research is needed to evaluate potential mining impacts. A similar discussion on potential

TABLE 3.
Summary of Initial Environmental Concerns and Potential Significant Impacts of Mining

INITIAL CONDITIONS[1] / DISTURBANCE	PHYSICO-CHEMICAL EFFECTS	POTENTIAL BIOLOGICAL IMPACTS (REMAINING CONCERNS IN CAPITALS)	POTENTIAL SIGNIFICANCE OF BIOLOGICAL IMPACT			
			PROBABILITY OF OCCURRENCE	RECOVERY RATE	CONSEQUENCE	OVERALL SIGNIFICANCE
COLLECTOR	o Scour and compact sediments	DESTROY BENTHIC FAUNA IN AND NEAR COLLECTOR TRACK	Certain	Unknown[3] (Probably Slow)	Adverse	Unavoidable * (Uncertain Sig.)
	o Light and Sound	Attraction to new food supply; possible temporary blindness	Unlikely	Unknown (Probably Rapid)	Uncertain	None
BENTHIC PLUME	o Increased sedimentation rate and increased suspended matter ("rain of fines")	o EFFECT ON BENTHOS - Covering of food supply	Likely	Unknown[3] (Probably Slow)	Adverse	Unknown *
		- Clogging of respiratory surfaces of filter feeders	Likely	Unknown[3] (Probably Slow)	Adverse	Unknown *
		- Blanketing	Certain	Unknown[3] (Probably Slow)	Adverse	Unknown *
		o Increased food supply for benthos	Unlikely	Rapid[4]	Possibly Beneficial	None
	o Nutrient/Trace Metal increase	o Trace metals uptake by zooplankton	Unlikely	Rapid	No detectable effect	None
	o Oxygen demand	o Lower dissolved oxygen for organisms to utilize; mortality from anaerobic conditions	Unlikely	Rapid	No detectable effect	None
SURFACE DISCHARGE Particulates	o Increased suspended particulate matter (sediments, nodule fragments and biota debris)	o Effect on Zooplankton - Mortality	Unlikely	Rapid[4]	No detectable effect[2]	None
		- Change in abundance and/ or species composition	Unlikely	Rapid[4]	No detectable effect[2]	None
		- Trace metal uptake	Unlikely	Rapid[4]	Locally Adverse	Low*
		- Increased food supply due to introduction of benthic biotic debris and elevated microbial activity due to increased substrate	Unlikely	Rapid[4]	Possibly Beneficial	None
		o Effect on adult fish	Unlikely	Rapid[4]	No detectable effect[2]	None
		o EFFECT ON FISH LARVAE	Uncertain (Low)	Uncertain (Probably Rapid)	Uncertain	Low*
	o Oxygen Demand	o Lower dissolved oxygen for organisms to utilize	Unlikely	Rapid	No detectable effect	None
	o Pynocline accumulation	o Effect on primary productivity	Unlikely	Uncertain (Probably Rapid)	Unknown (Prob. Undetect)	Low
	o Decreased light due to increased turbidity	o Decrease in primary productivity	Certain	Rapid[4]	Locally Adverse	Low
SURFACE DISCHARGE Dissolved Substances	o Increased nutrients	o Increase in primary productivity	Very Low	Rapid[4]	No detectable effect[2]	None
		o Change in phytoplankton species composition or introduce deep-sea microbes or spores to surface	Very Low	Rapid[4]	No detectable effect[2]	None
	o Increase in dissolved trace metals	o Inhibition of primary productivity	Very Low	Rapid[4]	No detectable effect[2]	None
	o Supersaturation in dissolved gas content	o Embolism	Very Low	Rapid	No detectable effect[2]	None

1. Includes characteristics of the discharge and the mining system.
2. Based on experiments/measurements conducted under DOMES.
3. Years to tens of years, or longer.
4. Days to weeks.

Uncertain = Some knowledge exists; however the validity of extrapolations is tenuous.

Unknown = Very little or no knowledge exists on the subjects; predictions mostly based on conjecture.

*Areas of future research
SPM = Suspended Particulate Matter

impacts from ocean disposal of processing wastes follows. An evaluation is then made of the monitoring needs and possible mitigation strategies that might be required.

It should be noted that this chapter discusses what is considered to be a reasonable research program necessary to carry out the intent of the law; it does not identify the organization who will carry out elements of the program. In Chapter 5, however, tasks that the industry will be responsible for conducting as part of their license and permit requirements (e.g. site-specific monitoring, ocean disposal site designation) are not discussed further; only that work which remains after these tasks are omitted is addressed in terms of timing and costs.

4.1 MINING

The Deep Ocean Mining Environmental Study (DOMES) was a comprehensive five-year research program designed to identify and estimate the severity of environmental impacts of at-sea manganese nodule recovery operations. Industry, government, academia, and the public endorsed the need for this type of program as early as 1972. While preliminary DOMES research was initiated at that time, sufficient funding for the full program was not appropriated until 1975.

DOMES consisted of two phases. The specific objectives of the first phase, referred to as DOMES I, were: 1) to establish environmental baselines at three sites in the North Pacific chosen to provide a range of environmental parameters to be expected under actual mining; 2) to develop a first-order predictive capability for determining environmental effects from mining, and 3) to develop an information base for the development of environmental guidelines for industry and government. The objectives of DOMES II were to refine and

modify the predictive capabilities established in DOMES I through the analysis of data acquired by observation and monitoring of pilot-scale mining system tests.

During the first phase of DOMES, the broad environmental conditions in the manganese nodule province of the Pacific Ocean (i.e., the DOMES area) were determined in order to provide a background against which mining-produced perturbations could later be compared. These studies were carried out at three sites (Fig. 2, Chapter 3, page 33), which covered the range of environmental parameters expected to be encountered during mining. Field work associated with the studies included upper water layer measurements of currents, light penetration, plant pigments, primary productivity, abundance and species composition of zooplankton and nekton. Temperature, salinity, suspended particulate matter, nutrients, and dissolved oxygen were measured throughout the water column. Current measurements were made in the benthic boundary layer. Abundance and distribution of benthic populations, and characteristics of the sediments and pore water were determined. In addition, the seasonal and spatial variability of chemical and biological parameters at four oceanographic depth zones (the surface mixed layer, the pycnocline, the bottom of the pycnocline to 400 m, and 400 to 1000 m) were characterized statistically in order to facilitate comparison with observations to be taken in conjunction with actual mining activities. Summaries of the results of DOMES I, pre-mining environmental conditions and predictions of mining impacts, are presented in several technical reports.[16,17]

The second phase of the DOMES project focused on refining and modifying predictive capabilities through analysis of data acquired during pilot-scale tests of mining systems. Two successful pilot-scale mining tests were monitored in 1978, both using hydraulic mining systems. Each test saw hundreds of tonnes

of manganese nodules brought from water depths of 4,000 to 5,000 m to the surface. These tests established the engineering feasibility of deep sea mining, provided the first opportunity to observe actual effects of operations such as those envisioned for the next decade, and allowed comparisons of those effects with earlier estimates of mining perturbations. During these tests, discharge volumes, particulate concentrations, and temperature were measured from each mining vessel, limited studies were made of the surface and benthic plumes; and biological impact assessments were made. The analyses have been reported, including the results from both tests, on the environmental effects. [18,19]

4.1.1 Initial Conditions - Disturbance

During actual operations, the generic mining system described in Section 3.2 will pump up a slurry consisting of bottom water (from within a few meters of the sea floor), interstitial water and bottom sediments (from the first few centimeters of the ocean floor), benthic biota, and manganese nodules. In some cases, the pumping systems may use injected compressed air to provide the lifting force necessary for the vertical transport of the slurry. After the nodules, are removed, sediments, bottom and interstitial waters, abraded nodule material, and macerated benthic biota will be discharged over the side of the mining vessel.

The recovery and separation of the nodules will directly affect both the upper water column and the benthic environment. Specifically, the benthic effects will be: 1) the removal of surface sediments and biota and 2) the creation of a benthic plume emanating from the collector, consisting of bottom and interstitial water, bottom sediments, some nodule material, and benthic biota. Surface effects will result from the discharge of materials from the vessel that create a surface plume having the same components as the benthic plume.

Nodule recovery rates and bulk properties of the discharge from the mining tests during DOMES II are presented in Table 4. Although the industry test sequences may not have been comparable efforts, they are considered equally representative to arrive at reasonable values to estimate the effects of commercial-scale mining, the mean values being used in estimating the discharge characteristics of a commercial miner.[21] The results of the mining tests showed that the discharge was composed principally of bottom water and pelagic silts and clays, although nodule fragments were also discharged at widely varying rates. The separation system employed on the mining vessel substantially affected the size and character of the discharge. On the average, for every 4 kg of nodules recovered, 1 kg of solids (mostly sediments and some nodule fragments) were discharged. The bulk density of the discharge was one percent greater than the density of the ambient surface waters, with the discharged solids settling more rapidly than predicted for clay-sized particles.[22]

Estimates of those quantities and discharge characteristics to be expected from commercial-scale mining operations were made by extrapolating the discharge data obtained during pilot-scale mining tests and by using the information provided by the mining industry on future commercial mining systems. In these estimates, it was assumed that during a commercial mining operation the daily nodule recovery rate would be 5000 tonnes and that the ratio of nodules recovered to solids discharged at the surface would be the same as the mean values given in Table 4 i.e., 4 to 1.

During a commercial mining operation, it is estimated that the solid fraction of the mining effluent, consisting mainly of bottom sediments and some abraded nodule material, will be discharged at rates of 1.4×10^4 g/s at the surface and at 5.5×10^5 g/s near the seafloor. The liquid fraction of the surface discharge will be bottom water with a salinity of 34.7 o/oo and a temperature of 7°C; the bulk density of the surface discharge will be

TABLE 4. Discharge Characteristics Resulting from Mining Tests [20]

	OMI		OMA	MEAN OF TESTS
	PUMP	AIR LIFT	AIR LIFT	BOTH SYSTEMS
Average flow rate of discharge (ℓ/s)[1]	160	100	95	120
Total particulate concentration (g/ℓ)	12.7 ± 9.56	6.8 ± 5.61	5.8 ± 3.91	8.4 ± 7.67
Solid discharge rate (g/s)	2030	680	550	1.0×10^3
Solids in the discharge by volume (%)	0.55	0.30	0.25	0.4
Temperature of discharge (°C)	8.5	7-10	4.4-5.2	7
Bulk density of discharge[2] (g/cm^3)	1.034	1.030	1.031	1.032
Nodules collected (mt/hr)[1] (g/s)	11 (3.1×10^3)	5 (1.4×10^3)	27 (7.5×10^3)	14.3 (4.0×10^3)
Solids in the pipeline by volume (%)	1.9	1.3	6	2.8

[1]Data supplied by the mining companies.

[2]Bulk densities calculated using a salinity value of 34.70 $^0/_{00}$.

approximately 1.06 g/cm^3. As suggested by data from the pilot-scale mining tests, the ratio of nodule material to sediments in the mining discharge will be dependent upon the nodule-sediment separation system employed on the mining ship.

In view of the uncertainties involved in these computations and especially in the absence of monitoring results from long-sustained mining operations, the dispersion models given in the next section are based on the rates of 2.8×10^4 g/s and 9.6×10^5 g/s for surface and benthic solid discharges, respectively. These estimates, although within the same order of magnitude, have been slightly increased to allow for the range of variability observed during the mining tests.[23]

4.1.2 Physico-Chemical Effects

The extrapolated discharge volumes, together with other information gained during the monitoring of mining tests, such as the settling velocity of mining particulates, were used in the dispersion models of the mining particulates. However, because these extrapolations are based on limited data, the predictions of plume time and length scales must be verified during more prolonged tests. The distribution of mining particulates in the upper water column and in the benthic layer, and redeposition thicknesses on the sea floor predicted by these models, provide the basis for estimates of the mining impacts.

Benthic - Physico-Chemical Effects. In the deep-sea environment, most of the benthic fauna inhabit the uppermost centimeters of the seafloor sediments. As the collector passes over the seabed, it will remove the top few centimeters of the bottom in a track 10-20 meters wide, destroying the habitat and most probably any resident biota. On either side and immediately adjacent to the collector track, bottom materials will be disturbed and pushed aside by the action of the collector. Although industry plans call for abutting

collector tracks, it should be noted that various factors, such as unfavorable topography, sweep efficiency of the collector, and the random distribution of nodules, will preclude this pattern. In fact, it has been estimated that approximately 30% of a given mining area will remain undisturbed by the collector during first-generation mining.[24]

The benthic discharge or plume consists primarily of those bottom sediments which are thrown up by the collector or which sift through the collector hopper and do not immediately resettle. The rate of this solid discharge, given a furrow depth of 10 cm and collector speed of 1 m/s, is 9.6×10^5 g/s. The height of the top of the plume can be expected to be several times the height of the collector and may extend horizontally more than 100 km during continuous mining operations.[25] The plume will also contain fragements of benthic biota disturbed by the collector, 400 kg estimated as being displaced daily.[26]

All of the solid materials will likely be moved laterally by bottom currents and may eventually be redeposited at some distance from the collector track. Large benthic areas may be subjected to elevated suspended particulate loads up to a year after a particular area has been mined.

Observations of industry tests of pilot-scale equipment showed that the mining system was efficient in separating the unwanted sediment from the nodules, an estimated 97 percent of the sediment being removed at the seafloor. Most of the sediment (90 percent) resuspended by the collector appeared to resettle within about 70 m of either side of the collector track, judging from photographic records and mass balance calculations, indicating that the effective benthic settling velocity of solids was relatively large (approximately 0.1 cm/s). However, at stations 17 km downstream, an increase in suspended particulate load was still detectable 5 to 8 days after mining, suggesting that a portion of the plume consisted of very fine particles that settle out very slowly.[27]

During commercial mining operations, it is envisioned that a mining vessel will annually mine an area 30 km by 30 km, using a collector 20 m wide and moving at a speed of 1 m/s. The dispersion models for commercial mining operations predict that the bulk of the suspended material from the collector disturbance will be deposited within a few hundred meters of the collector; however, there will be an increased suspended load, consisting mostly of fine particles with settling velocities of 0.01 cm/s or less, extending to distances beyond 100 km from the mining (Figure 5). As a result, benthic areas of 3,000 to 5,000 km^2 may have elevated suspended loads for up to a year after the mining from a single ship.[28]

Surface - Physical-Chemical Effects. The major components of the surface mining discharge will be resuspended bottom sediments, nodule fragments, bottom and interstitial water, and benthic and near-bottom biota. In all mining tests to date, effluent pipes have discharged over the side of the mining vessel onto the sea surface. It is expected that future commercial mining vessels will discharge in the same way. As the discharge materials enter the water column, they sink and disperse. The dispersion models for commercial mining operations predict length scales of 100 km and widths of 20 to 30 km for the surface plume. Along the plume axis, at the average mixed layer depth of 50 m, particulate concentrations are expected to be less than 1000 micrograms per liter; at a depth of 100 m, concentrations are not expected to exceed 300 micrograms per liter (Figure 6).

The bottom water introduced to the surface layer with the mining discharge is richer in nutrients than the near-surface layer. If an air-lift mining system is used, the discharged bottom water may also differ in the dissolved gas content from the near-surface water because of the injection of compressed

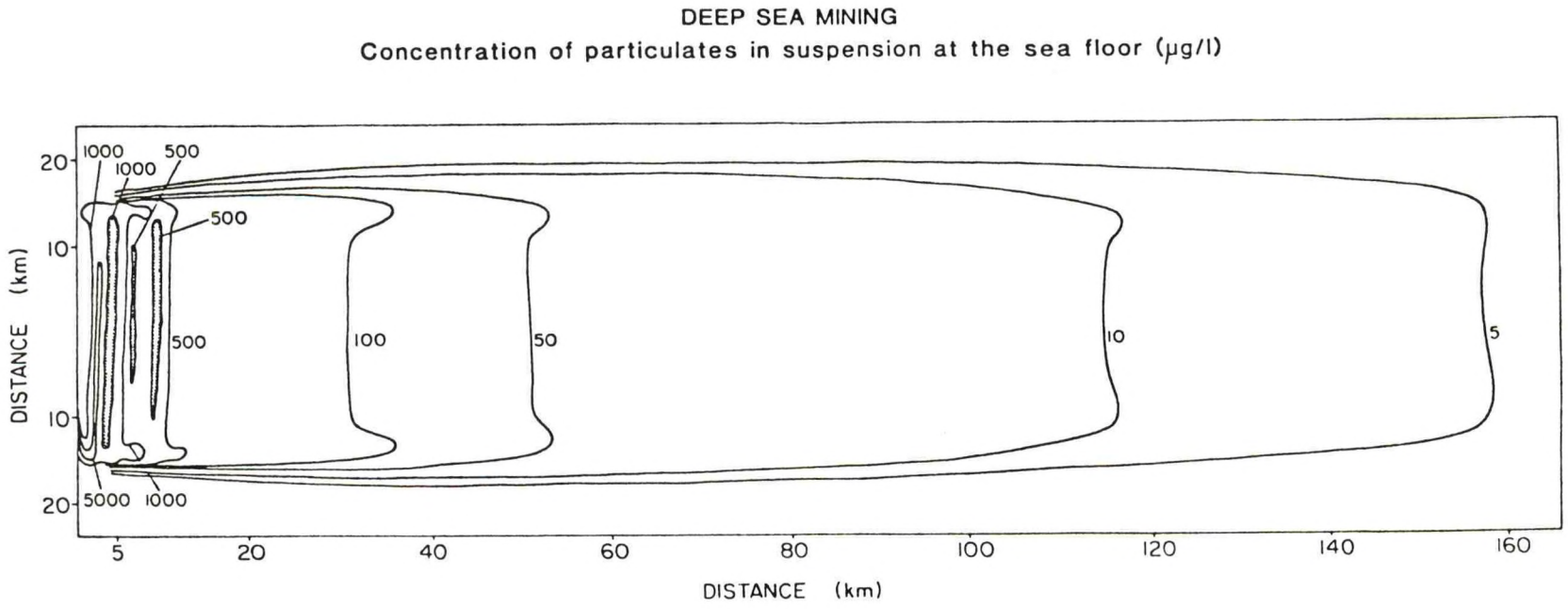

FIGURE 5. Benthic Plume Particulate Concentrations Above Ambient (6 µg/l)[29] (Assumption: bottom current 4 cm/s, perpendicular to movement of collector, collector velocity of 1 m/s)

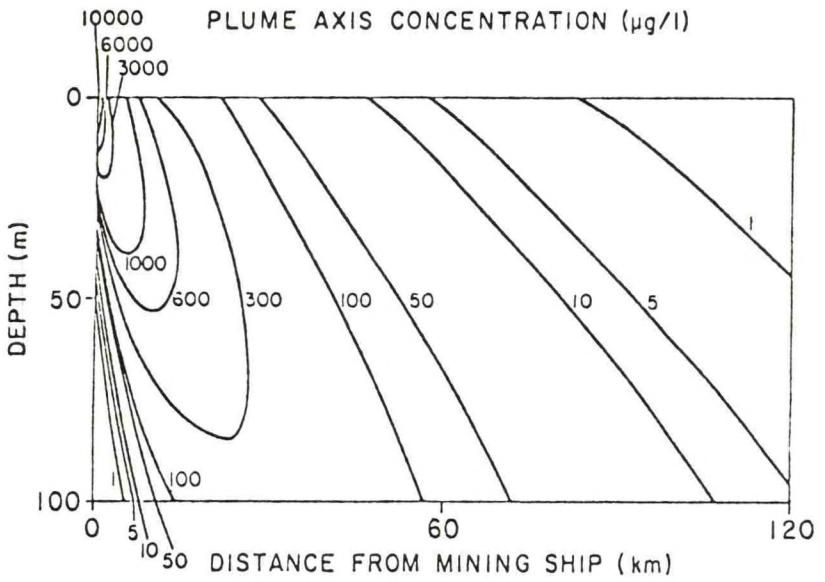

FIGURE 6. Surface Plume Particulate Concentrations Above Ambient ($\sim$ 40 µg/l)[32]

air. Predictions verified during the pilot-scale mining tests indicated that these changes would be undetectable owing to low discharge rates and high mixing in the immediate vicinity of the mining vessel. Measurements of dissolved oxygen and nutrients in the mining plume during these tests indicated no discernible differences in the nutrient and dissolved oxygen content between the samples from the plume water and the ambient samples.[31]

There has been a concern that trace metals could be introduced to the upper water column as dissolved constituents from bottom water or via release from particulates (sediments and nodule fragments) in the discharge. The DOMES results indicate that the dissolved metal content of the bottom water and the surface layer were similar; therefore, there is expected to be no detectable change in dissolved metals due to the discharge of bottom water.[32] Also, experiments conducted with sediments and repeated separately with crushed nodules indicate that the mining discharge does not result in increased concentrations of dissolved trace metals.[33]

Another particulate component of the surface discharge is the benthic biota debris displaced by the collector. It is predicted that some 10 kg per day will be discharged at the surface.[34] Organic matter is also introduced into the water column with the organic matter associated with the sediments (average content of organic carbon is 0.15 percent). The discharge of material containing oxidizable organic carbon would be expe ted to increase the biological oxygen demand of the receiving waters. However, the DOMES results indicate that, because the organic carbon in the sediment is essentially refractory and because both the upper and lower layers of the water column in the DOMES area are usually well oxygenated, the introduction of additional organic matter is not expected to have any detectable effect on the ecosystem.[35]

The introduction of mining particulates into the upper water layers will increase the attenuation of solar radiation in the water column with subsequent

effects on primary production. Mining tests have shown that such reduction in light intensity does occur.[36] Predictions for a commercial mining operation show that some light reduction is likely to occur up to distances of 100 km from the mining ship; however, this shading effect on the phytoplankton is expected to be temporary and to resemble the effect from a cloudy day.[37]

4.1.3 Potential Biological Impacts

Based on the mining test observations and forecasts of plume dimensions, potential environmental impacts have been identified and evaluated. Since the mining tests monitored were intermittent and of short duration, only short-term effects have been observed. Some of the impacts are expected to be deleterious; however, the majority appear to be undetectable and insignificant, as shown in Table 3 (page 4-2). A few of the impacts, especially potential long-term impacts, have yet to be examined, and several conclusions need verification. These will be addressed in future research.

Benthic - Biological Impacts. The impact to the benthos from deep sea mining will result from 1) sediment removal by the collector and consequent destruction of resident biota and 2) sediment put into suspension in the lower water column from passage of the collector, and consequently, a) smothering of organisms who are unable to burrow out or whose filtration apparatus are clogged and b) starvation of animals who live off the thin layer of organic material deposited on the surface of the seafloor, which will become covered by material lower in food value. The collector will remove sediment along its track to a depth of several centimeters and, since most of the benthic organisms live in the upper few centimeters of the sea floor, the benthic populations living in this track and on the nodules are expected to be destroyed. During commercial mining operations, a collector 20 m wide will daily contact an area of 1.3 km^2.[38] Assuming a benthic biomass of approximately 0.3 g/m^2 (wet weight), the total biomass destroyed daily will be about 400 kg. Benthic

mortality will be unavoidable.

The significance of this loss rate to the benthic community as well as the size and significance of impacts from the benthic plume under full-scale commercial operations is difficult to evaluate because of the extremely limited existing knowledge of the deep sea ecosystem.[39] The majority of the individuals of the deep sea benthos live in the upper centimeter of the sediment and pass through a screen with 1.0 mm openings. Because of these animals' small size and frailty, as well as the difficulty in sampling in such water depths, a very small amount of work has been done on the numerically dominant animals inhabiting this region. It is known that there is a high species diversity in the deep sea, although frequently there is a small number of individuals per species.[40] Box cores from the DOMES area contained 381 species of animals larger than 0.3 mm. Nearly three-fourths of these species were represented by fewer than five individuals.[41] This scarcity of individuals per species presents a severe problem in adequately sampling the benthos and the problem is compounded by the dominance of extremely small animals (Table 5). These characteristics explain the difficulty in using photographs alone to characterize the benthic community, as shown in Table 5 if a comparison of results from box cores is made with those from photographs.

The lack of knowledge of all the species present in the deep sea is matched by the extremely limited scientific understanding of the life cycles of the known organisms in this environment. In most cases, it is unknown at what rate organisms of the deep sea reproduce and disperse, what their origin and response to artificial and natural changes might be, or how they interact to form the energetic pathways of deep sea food webs. Thus, the impact to the benthic community of surface sediment removal and habitat alteration is unknown. The fauna of the manganese nodule zone generally appear to have very long

TABLE 5. Abundance of Deep Sea Benthos in the DOMES Area

DOMES Sites	A	B	C
From 0.25 m^2 cores [42*]			
Average biomass (grams per m^2)	0.14	0.19	0.64
Average density of macrofauna (no. individuals per m^2)	99	114	152
Average density of meiofauna (no. individuals per m^2)	258	378	110
Percent macrofauna as suspension feeders	14	18	22
From bottom photos[43]			
Average density of visible fauna (no. individuals per m^2)	0.01	0.03	0.03

*Note that Hecker and Paul lost approximately 45 percent of the polychaetes that were actually in the sample. Correcting for this loss would increase macrofauna density to 116, 138, and 179 individuals per m^2 at sites A, B, and C respectively. Hecker and Paul (1979) also note that their methods allowed most of the meiofauna to escape uncounted; the extent of the meiofauna underestimate is unknown.

maturation periods, low reproductive rates, and very low recruitment rates. As a result, they may be extremely susceptible to major habitat alterations.[44] The impact may be lessened, however, since the mining system is not expected to strip the entire mine site; the collector will probably sweep less than 75 percent of the sea floor, 25 to 30 percent being unmineable because of unfavorable bathymetric features.[45] Thus, areas left unmined might serve as sources for recolonization of the mined sites; however, resedimentation from the benthic plume is expected to blanket and/or smother much of the resident benthic biota in the unmined area, thus potentially inhibiting recolonization from these areas. For those individuals that are affected, survival may be dependent on species mobility and feeding habits. Repopulation by a species will be affected by its general abundance and reproductive patterns.

The disturbances created by the mining collector during exploration, such as the sound waves created by the mining equipment and the light associated with a television camera, has led to speculation that some species of deep living fish which communicate through sound might be attracted to the collector and that others might be "blinded" as observed during submersible dives. Such effects are expected to be temporary and insignificant.

The increase in organic matter due to benthic mortality from the mining collector, has also been suggested as having an effect on the deep-sea environment by providing a new food source. Any detectable increase in organic matter, however, is expected to be beneficial because of the extreme scarcity of food in this environment.

Surface - Biological Impacts. At the outset of the DOMES program, concern was expressed that potential surface impacts resulting from mining activities would include the following perturbations: decrease in phytoplankton photosynthesis and primary production from increased suspended matter and

decreased light; changes in phytoplankton species composition from nutrient alterations, decreased light, and chemical inhibition; zooplankton mortality in the plume; changes in abundance and taxonomic composition of zooplankton from phytoplankton alterations and particulates ingestion; and clogging of the gills of fish in the plume. Each of these potential impacts is discussed in the following text.

Phytoplankton photosynthesis--the assimilation of inorganic carbon into plant biomass using sunlight as the energy source--forms the base of the marine food chain. The rate of photosynthesis is affected by light quality, intensity, and duration. Mining particulates will increase light attenuation and thereby directly affect the primary production in the mining area. Measurements of solar radiation and light penetration, in-situ primary production experiments, and on-deck incubations were conducted during the mining tests to provide a quantitative estimate of this impact. These studies suggest that, in a commercial operation, primary production will be reduced by 50 percent in the water column over an area approximately 20 km long and 2 km wide.[46] Phytoplankton populations found in the areas affected by the surface plume are expected to receive diminished, although temporary, light levels over a three- to four-day period. Based on an along-plume advection velocity of 24 cm/sec, half-light will be restored within approximately 40 hours and full-light within 80-100 hours.[47] Aside from measurements of the effect of particulates on the quality of light and routine monitoring of total light penetration, no further phytoplankton studies appear to be required.

The surface waters of much of the DOMES region are characterized by low nutrient concentrations. Among major plant nutrients, the combined nitrogen is believed to be the rate-limiting factor of phytoplankton growth and of primary production. Since the bottom water is higher in nutrients than near-surface water, its discharge at the sea surface during mining would increase

the local supply of nitrate, thereby causing an increase in primary production. However, any increase would be expected to be extremely small and probably not detectable. Assuming that all the nitrate is incorporated into plant biomass, it is estimated that the increase in primary production would be six orders of magnitude below the ambient level of primary productivity of the DOMES region.[48]

Concern had also been expressed at the outset of the DOMES program that the addition of bottom water would affect the species composition of the surface phytoplankton populations by changing the nutrient or trace metal content of the water. As mentioned previously, increases in nutrient or trace metal concentrations from the mining discharge were not detected in DOMES II studies. Incubation experiments conducted with bottom sediments and interstitial water from DOMES Sites A, B, and C at nutrient concentrations estimated at the discharge point in pilot mining tests, showed the species composition after 72 hours to be similar to the initial and control samples.[49] Experiments conducted during both mining tests to determine combined stimulatory-inhibitory effects possibly attributable to the release of dissolved trace metals or other toxic substances with the mining discharge, indicated no significant difference between experimental and control samples.[50] Thus, in commercial mining operations, no significant changes in species composition of phytoplankton in the mining area are anticipated due to these dissolved components.

Mining activities will introduce into the water column fine particles which have a high surface area. Consequently, another concern was that these particles would stimulate bacterial growth by providing sites for attachment and by accumulating dissolved organic matter on the surface, providing nourishment for the bacteria. Since bacteria are digested by zooplankton, increased bacterial growth could add nutritive value to some mining particles ingested by filter-feeding

zooplankton; however, the effect would be expected to be extremely small.[51] Likewise, any increased oxygen demand by an increased bacterial population would be expected to be extremely small and have no effect on other oxygen requiring organisms because of the high oxygen content in the upper water layers.

It also was suggested[52] that due to the high adsorption of cobalt, a required plant trace nutrient, onto nodule fragments, a cobalt deficiency might occur in the surface layers. This is not expected to be a significant effect since experiments that demonstrated the high cobalt adsorptive capacity of nodule fragments were conducted at concentrations four times that of the surface plume from the mining ship. Consequently, any effect, if it occurs, would be expected to be very local (i.e., directly behind the ship) and short-lived because of the rapid dispersion of the discharge.

Direct mortality during the one or two days zooplankton might reside in the plume was also considered a possibility. This would result from the ingestion of the higher concentrations of particulate matter. This could lead to a modified metabolic activity, interference with respiratory surfaces and feeding appendages, and an increase in the energy needed by the zooplankton to capture and assimilate food necessary for basic metabolic requirements. Extensive laboratory experiments were carried out to evaluate the effects of mining particulates on macrozooplankton mortality. No major increase in mortality above control levels was observed over a range of particulate matter concentrations during short-term incubations (24 to 48 hours).[53] However, no experiments were carried out over a longer period to evaluate any alterations in growth patterns due to behavior modification, such as feeding.

In addition to laboratory experiments, field observations were made to determine the occurrence of macrozooplankton mortality in the surface plume.

Estimates of the abundance and taxonomic composition of surface-living (upper 1 m) macrozooplankton were obtained from ambient, pre-mining conditions at DOMES Site A and also in the discharge plume during mining tests near the same site. Statistical analysis of selected species in plume and control samples suggested that no major changes in macrozooplankton composition or abundance had occurred during exposure to the plume.[54]

Zooplankton are also considered the most likely organisms to ingest trace metals associated with particulate fractions of the mining effluent. The concern has been raised[55] that trace metal entry at this low level of the pelagic food web might lead to biomagnification in higher carnivores such as commercially harvested tuna species. Although copepods have been shown to consume discharged particles[56], the degree of actual trace metal absorption through the gut wall is uncertain. The concentration of trace metals in zooplankton fecal material, for example, can greatly exceed that measured in either the zooplankton themselves or their planktonic food[57].

It is clear that levels of accumulation in individual species depend on a range of environmental factors, including chemical form and availability of the metal, rate and mechanism of biological uptake, and ability of organisms to store, excrete, or detoxify contaminants[58]. It is not expected that this effect is a cause for concern since the potential for trace metal accumulation from abraded nodule fragments should be mitigated by short exposure periods (1-3 days), low bioavailability of metals associated with inorganic matter, the capacity of fish to regulate certain metals and a dilution effect caused by relatively rapid reproductive rates of oceanic zooplankton. Even if substantial accumulation did occur locally via zooplankton ingestion, biomagnification on an ecosystem scale is unlikely given that 1) trace metals associated with abraded nodule fragments (e.g. Fe, Mn, Ni, Cu, Co, and Zn) tend not to be mangified in food

webs[59], 2) metals tend to be excreted by normal biological processes once organisms leave the discharge plume, and 3) higher carnivores are motile and spend only a limited portion of their lifespan in the affected area.[60]

Another environmental concern was that the mining discharge from an air-lift mining system could cause direct mortalities to fish resulting from the supersaturation of dissolved gases. This is not expected to occur, however, because of the small discharge rates and subsequent mixing, preventing the attainment of high concentrations of dissolved gases. Measurements of oxygen profiles made during both industry field tests support this hypothesis: oxygen profiles in the plume were not different from the profiles made in ambient water.[61]

Increased particulate concentrations have been suggested as potentially causing the clogging of gills of fish in the area of mining. Laboratory experiments with several species of tuna[62] have demonstrated an avoidance of turbid areas. Furthermore, no ill effects were detected in tuna when exposed for short periods to particulate concentrations of 1,200 - 10,500 ug/l. Estimates of particulate concentrations in the wake of the mining ship fall well below these values, except where the discharge enters the water. Consequently, the immediate dilution of the discharge and the tendency of some fish to avoid turbid areas are expected to prevent any adverse effects to fish due to clogging of the gills.

As is evident from the previous discussion, the results from the DOMES program, although based on limited field observations of mining, indicate that there will probably be few short-term environmental effects from deep seabed mining. It should be reiterated, however, that DOMES did not investigate potential long-term effects from mining. Studies needed to evaluate these effects, as well as to validate previous predictions, are defined in Section 4.3, Future Research.

4.2 OCEAN WASTE DISPOSAL

As noted in Chapter 3, ocean disposal of manganese nodule processing wastes may be a viable alternative to onshore waste disposal provided that regulatory requirements can be met. Ocean disposal could be accomplished by ocean dumping on or beyond the continental shelf or by means of ocean outfalls, i.e., pipes extending from the shore. No clear industrial preference for onshore or ocean waste disposal has been expressed. A significant influence on industry's approach will be the types of restrictions the Government may impose. This creates somewhat of a dilemma for both industry and Government: for planning purposes industry would like an early indication of potential Government requirements, while before commenting on potential ocean disposal, the Government would like further information on the characteristics of the wastes planned for disposal and on the areas to be used.

4.2.1 Initial Conditions - Disturbance

In approving funding during 1975 for the Deep Ocean Mining Environmental Study (DOMES), the Congress requested that the Government consider as well the possible environmental onshore and coastal zone, social, and economic effects of deep seabed mining. During August, 1977, the National Oceanic and Atmospheric Administration (NOAA) published a three-volume, contractor-prepared report entitled a "Description of Manganese Nodule Processing Activities for Environmental Studies."[63] NOAA was assisted by the Environmental Protection Agency (EPA) and the Department of the Interior's Bureau of Mines (BOM) in awarding the contract and reviewing the contractor's findings. Deep seabed mining consortia and affected and concerned interests, such as environmental interest groups and state agencies, also assisted in reviewing the contractor's findings. The study was designed to provide information needed for subsequent assessment of potential environmental, social, and economic effects, although not actually

to assess potential impacts. It considered various types of processing techniques and plants, alternative methods for disposing of nodule processing wastes, marine transportation of nodules, and marine terminals for unloading nodule transport vessels. The study also assessed the potential of full or partial at-sea processing and postulated technological approaches for making wastes "more disposable" if any of the constituents were of environmental concern. The results of this study provide the basis for present estimates of probable processing technologies and expected waste volumes and disposal strategies.

The importance and complexity of the waste disposal problem was recognized by several Federal agencies (FWS, EPA, NOAA, and BOM) who have initiated an interagency effort to examine this issue. Three studies have been undertaken to evaluate this problem: 1) characterization of reject processing waste (funded by NOAA and implemented by Bureau of Mines); 2) evaluation of the viability of at-sea disposal for processing waste (contractor jointly funded by NOAA and EPA); and 3) evaluation of the viability of land disposal (contractor funded by Bureau of Mines). The first two studies, because they provide information for the evaluation of potential marine-related impacts, are discussed in this Plan.

The major problem in evaluating the acceptability of ocean waste disposal is that the chemical and physical characteristics of the wastes from various processes are unknown. In most analyses of nodule constituents, the contents are reported by elemental name rather than by the compounds present. A number of the elements exist in chemical forms that are considered hazardous or toxic; however, the constituents of possible concern total less than one-half of one percent by weight. It is currently believed, based on analyses, that these constituents are not accessible to the environment as they exist in the

complex matrix of a nodule. However, to recover the value metals from nodules, it is necessary to disrupt the nodule's matrix. Hence, it is possible that some constituents may no longer be inert and non-toxic after the nodules are processed. Some of the trace constituents of concern may appear in the products as impurities, while others will appear in the waste stream. Furthermore, neither metal nor reagent recovery is complete, so compounds of value metals and reagents will probably also appear as traces in the waste stream.

The quantity of nodules processed, the number of metals extracted, and the processing technique used will alter the quantity and the physical and chemical characteristics of the wastes produced. For example, a so-called three-metal hydrometallurgical process will produce a large volume of a solid-liquid mixture as waste, while a four-metal pyrometallurgical process will produce a smaller total volume of waste, with most of it existing as a granulated slag and only a small part existing as a solid-liquid mixture.

To provide an improved assessment of the physical and chemical characteristics of the nodule wastes, the Bureau of Mines (BOM), under NOAA sponsorship, has begun a three-year study of the extractive processes described in the 1977 report on processing waste disposal. The study is to be completed in 1983. The first step is to determine the mineralogy of nodules, using data from the literature and from the laboratory analysis of nodule samples that industry has agreed to furnish. The next step is to update the processing routes described in the earlier report on processing using more recent, industry-supplied data. BOM will then attempt to trace the constituents of interest through each processing route by an analysis of chemical reactions. BOM also plans to design laboratory-scale processing units to produce samples of processing wastes from their process development and testing efforts. These will be compared with industry-supplied, laboratory-generated wastes.

While wastes generated by laboratory-scale units and furnished by

industry may not be truly "representative" of wastes from a full-scale plant, the work is expected to provide an early indication of the potential toxicity of the wastes. This will form the basis for either narrowing the scope of future studies or determining other areaas for further environmental research. Both Government and industry need some data at an early date on the characteristics of the expected wastes to develop preliminary assessments of the feasibility of disposal alternatives either onshore or at sea and, if necessary, to allow industry to refine the processing waste disposal alternatives.

The technology for ocean dumping and ocean outfalls is available; present systems need only to be adapted to handle the particular types and quantities of wastes that will be produced. At-sea disposal of the processing wastes is expected to be considered in areas where obtaining large tracts of land for containment areas would be difficult or expensive, or in areas where climatic conditions would make eventual stabilization and revegetation of the disposed waste difficult or impossible. However, as noted earlier, if ocean disposal is preferred by industry, evidence must be presented that there would be no deleterious impact on the marine environment from the waste disposal. Generic information for this determination has been defined, in part, through regulation; however, since this is a new industry, the applicability of these requirements needs to be examined.

The location of ocean disposal sites will be dictated in great part by that of the processing plants and the associated port facilities. Separate studies have been conducted to identify geographical areas suitable for industry facilities. These will assist in evaluating possible offshore disposal locations. Subsequent studies have also identified applicable Federal and state laws. These studies identified waste disposal as one of the most significant aspects of deep ocean mining.

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4.2.2 Physico-Chemical Effects

When waste materials are introduced into the ocean, either by being discharged through a pipe from shore or by dumping or discharge from a barge or other vessel, a number of physical and chemical processes occur which determine the fate and behavior of different fractions of the waste material. These processes include physical fractionation and dispersion that affect the waste material when it is discharged or dumped. The net effect of these processes is strongly dependent upon the nature of the waste material, the mode of introduction into the marine environment, and the characteristics of the receiving environment.

Some insight into the expected behavior of processing waste can be gained from studies of ocean disposal of other wastes, such as the Corps of Engineers' Dredged Material Research Program, the acid-waste disposal studies off the coast of New York and New Jersey, and the studies of the tailings outfall from a copper processing plant off Vancouver Island, Canada.[64] Then processing wastes are discharged from a dumping vessel at sea, the physical processes occurring are quite different from those that occur when the discharge takes place through a pipe. The dynamics of high volume, particulate discharge has been studied by the U.S. Army Corps of Engineers for ocean dumping of dredged material. The bulk density and large volume of dredged material discharged (and most likely that of the processing waste material) cause it to sink through the water column as a density plume and be diluted through mixing with the surrounding water. The solid fraction will settle out, depending on the spectrum of particle sizes and their characteristic settling velocities, and local current regimes. The liquid fraction of the waste material will disperse and be diluted by the ambient water, depending upon its density. The shallower the water depth, the less fractionation will occur before the dumped material impacts the bottom sediments.

For discharge through a pipeline, the liquid fraction of the discharge--depending upon density, local currents, and expulsion pressure--would be expected to rise and be diluted and dispersed in the disposal site water. The solid fraction of the processing waste would be expected to be transported varying distances--depending on particulate size, turbulent diffusivity, and the strength of the local currents--before ultimately reaching the sea floor. Heaviest concentrations of rejected solids are usually concentrated around the point of discharge.[65]

4.2.3 Potential Biological Impacts

Although there is a sizeable body of knowledge on the effects of wastes and other discharges in the marine environment,[66] extrapolation of effects to processing wastes must be done with caution, since the chemical and physical characteristics of processing wastes are expected to differ from previously studied substances, and environmental conditions and resident biota will vary depending on the discharge location. For this reason, representative processing waste material should be used to measure the responses of species characteristic of areas that may be used for disposal.

The physical effect of the waste material on the benthos may be similar to the effect of the benthic mining discharge depending on the discharge method, water depth, and dispersion patterns: biota may be buried and small size particulates that are carried downstream by currents may settle out, covering the food supply of detritus feeders on the seafloor or clogging the filtering apparatus of filter-feeding benthos. The chemical effect is dependent on the nature of the wastes, its reaction in seawater, and the bioavailability of specific chemical constituents. Estimates of these effects might be made initially through information gained by the DOMES, the Corps' Dredged Material Research Program, and other ocean disposal programs. However, additional

studies will need to be undertaken to adapt these results to the specific wastes from nodule processing and the affected biota and environment where disposal is to occur.

4.3 FUTURE ENVIRONMENTAL RESEARCH

4.3.1 Mining

The mining tests monitored during DOMES II were designed by industry to test equipment and techniques and so were scaled down from the production volumes estimated for full-scale commercial mining. Because these were the first deep ocean manganese nodule mining engineering tests, they can not be considered to be typical scaled-down tests. The actual mining that took place was intermittent and of short duration (i.e., 15 to 54 hours), as would be expected for testing a new technology, with a fairly wide range of nodule production rates. Although analysis of data from these tests indicated reasonable agreement with the predictions made during Phase I of the DOMES Project, some conclusions need further validation based upon more realistic mining conditions.

The short duration and intermittence of the mining tests resulted in a small, transitory plume, which did not allow sufficient additional data to be collected to validate the DOMES II predictions. More detailed measurements are needed to provide a better description of an actual plume and its temporal evolution, as well as the physical parameters controlling plume dispersion. Among the dynamic properties which are still poorly documented are the coefficients of diffusion, in-situ settling velocity of mining particulates, processes controlling settling velocity particularly in the benthic environment, and the state of particle aggregation. The results from pilot-scale mining tests suggested that processes other than simple, two-dimensional models of advection, diffusion, and settling were active. Additional data points are needed for the calibration of existing models or development of new models, if

necessary. It is important that these models be continually refined and updated, since they form the basis for the impact predictions and monitoring programs.

If mining fines accumulate along the pycnocline, this could cause a reduction in light levels below the pycnocline. Since the maximum level of chlorophyll a--a measure of phytoplankton standing crop--is located at the top or the middle of the pycnocline, such a reduction in light levels could shift the optimum light level into the nutrient-poor waters above and potentially reduce primary production. Significant pycnocline accumulation might also influence vertical migration, a phenomenon affected by ambient light levels and a mechanism for food transfer to the deep ocean. Although this effect is expected to be insignificant, since mining tests showed particulates to settle fairly rapidly, this prediction should be verified during future mining tests.

Of particular importance to the support of regulatory requirements, is the development of a data base to answer questions relating to possible mitigation of the benthic plume effects. During the mining tests, the impact of mining on benthos outside of the collector track due to the benthic plume could not be assessed. Since benthic fauna live in nearly uniform environmental conditions, they can be susceptible to even relatively minor alterations in their environment. Most deep-sea animals living near the sediment-water interface of nodule fields may have limited burrowing abilities, because sedimentation naturally occurs at rates of a millimeter per thousand years. Deep-sea suspension feeders are likely to be especially sensitive to clogging of their filtration apparatus, which has evolved to operate at ambient particulate concentration levels of a few micrograms per liter. In some instances, organisms may not be directly affected by sediment redeposition, but may find that their food supply is inaccessible or diluted. Since the food supply of benthic organisms in the deep sea exists in minute quantities and is spread over large areas, even a

slight redeposition of materials may be detrimental to an individual organism. Accordingly, the zone of disturbance associated with the benthic discharge may be detected well beyond the immediate area of the collector--perhaps to distances of some 100 km, where increased particulate concentrations are predicted to still be detectable.

There is no precedent for studying the impacts of deep-sea mining on benthic organisms. The level of increase in sedimentation rates or in suspended loads that can be tolerated in the deep sea is not known.[67] Thus, studies are needed on the recolonization rates of the deep sea benthos following such a disturbance and on the impact of various rates of resedimentation so that the significance of mining activities on the benthic community can be evaluated. This information will assist in determining the importance of factors such as minesite spacing, minesite shape and plume dispersion in affecting benthic impact and recovery and the need and effectiveness of controlling these factors to minimize benthic impact. These concepts are discussed in more detail in the draft PEIS for deep seabed mining.[68]

Although DOMES experimental studies indicate that large increases in concentrations of dissolved trace metals should not result from the discharge of bottom sediments and nodule fragments into surface waters, recent research suggests that even natural levels of certain trace metals can influence or control the productivity and species composition and succession of oceanic phytoplankton communities[69, 70]. Thus relatively small changes in dissolved trace metal concentrations (particularly copper) and/or in ratios among certain metals (e.g., copper, zinc, manganese and iron) could alter food web structure or productivity. NOAA will continue to evaluate this concern as techniques and knowledge increase regarding phytoplankton interactions with their environment.

Another concern has been expressed regarding the effect of the mining discharge on the survival and growth rate of fish larvae which are highly

dependent on their visual environment (e.g., tuna). Tuna are known to be attracted to disturbances and that disturbances increase the gonad maturation rate. It has thus been suggested that tuna will be attracted to the mining area and release their eggs, resulting in a higher concentration of eggs and consequently larvae, than occurs naturally. The concern is that the higher concentration of particulates from the mining discharge will coincide with the higher concentration of larvae, potentially resulting in an adverse effect on tuna year-class. There is a need to determine the existence of this effect and its potential significance to year-class strength.[71]

4.3.2 Processing

It is an assumption of this Plan that at-sea disposal of processing wastes is an option being considered by industry, specifically through outfall pipes or ocean dumping and that this would occur in designated disposal areas located over the continental shelf, or seaward of the continental shelf. Ideally, environmental assessments associated with issuing required permits should be based on the chemical and physical characteristics of processing wastes from commercial-scale processing plants. Unfortunately, commercial-scale plants are not expected to begin operations until the late 1980's at the earliest; in fact, their construction in the U.S. may be dependent upon resolving waste disposal concerns. Demonstration processing plants are expected to be operative by the mid-1980's with consequent availability of reject material more representative of commercial-scale wastes than material from small-scale processing units operated to date. It is important that waste characterization and effects studies begin early in order to give industry and Federal and state agencies a preliminary indication, for planning purposes, of the potential acceptability of ocean disposal. Chemically, there is a need to know if compounds present in the liquid and solid wastes are inert, or if they will

react with seawater to produce undesirable compounds that could affect marine life. It is also important to know the general physical characteristics since the particle size will affect the rapidity with which the waste will settle and the extent to which it is dispersed. Hence, there is a need to determine its pre-disposal chemical and physical characteristics so that its immediate interaction with the environment can be predicted and, to the extent possible, its long-term physical and chemical behavior estimated. These studies, as mentioned earlier, were initiated in 1980 as an interagency effort and are expected to be completed in FY 1983.

A one-year study of at-sea disposal technologies and environmental considerations associated with each technology has also been initiated as an interagency effort. As the work progresses and as the results of the Bureau of Mines (BOM) waste characterization studies become available, it is expected that information gaps will become evident. Although it is impossible at this time to predict exactly what all of these gaps will be, several generic studies can be defined regarding the wastes and the specific physical and chemical effects that occur when the waste is discharged into the seawater. Existing physical models will have to be adapted to specifically reflect the waste behavior upon discharge or dumping into specific environments. As representative wastes become available, biological assessments and bioassays should be initiated to estimate impacts that may result from ocean disposal. In addition, methodologies for testing potential biological effects need to be evaluated and refined for applicability to processing wastes. As studies are completed, uncertainties related to ocean disposal will be reduced, and the Government will be better able to define monitoring requirements and, as appropriate, mitigation measures if this option is found to remain a viable alternative.

4.3.3 Site Studies

Disposal Site Studies. A permit to dump materials in the ocean must indicate the site where the material is to be dumped, and all the terms, conditions, and restrictions applicable to such an activity in order to provide adequate environmental protection and non-interference with other uses of the ocean. Baseline surveys or trend assessment surveys will be needed to evaluate the suitability of an ocean site to receive processing wastes. Such data also provide a base against which post-dumping conditions can be compared.

Likewise, if industry elects to discharge wastes through an outfall pipe, a similar data base must be in existence prior to the initiation of waste discharge.

Site-Specific Studies. As industry continues its exploratory activities and areas to be mined become better defined, a limited amount of additional site-specific environmental information may be required to meet the requirements of a Site-Specific EIS. The need for this information will be determined on a site by site basis.

Stable Reference Areas. (SRA) Under the Deep Seabed Hard Mineral Resources Act, as part of reciprocating state international negotiations "stable reference areas" are to be established in the manganese nodule mining regions. These areas are to be similar to those covered by permits and are to serve as reference areas or "controls" against which the environmental effects of seabed mining can be measured. Mining and major equipment testing are to be prohibited in these areas. Because these areas are to serve as scientific control areas, it is essential that the important scientific issues associated with this concept be analyzed prior to implementing actions to designate these areas. Such an analysis would be based on existing information about the DOMES area, knowledge

of the deep sea ecosystem, and environmental data submitted by the industry. Once this has been accomplished, a cost-effective program can be developed that addresses the concern expressed in the SRA concept.

4.3.4 Monitoring

As stated in the beginning of this Plan, a major emphasis in the deep seabed mining program is the implementation of an effective monitoring program. This is necessary to ensure that unpredicted environmental changes are detected and mitigated prior to the occurrence of adverse and irreversible effects. This requires the identification of the appropriate parameters to monitor, the sampling strategy to be used and the technology that can effectively monitor these parameters without incurring enormous costs.

As mentioned at the beginning of this chapter, DOMES results have dispelled many of the initial environmental concerns raised when the question was first asked as to what environmental effects might result from deep ocean mining. DOMES also provided a data base of ambient values of environmental parameters in the area to be initially mined, an identification of the parameters to be measured, and a range of predicted values to be expected during commercial mining. This information will form the basis of any monitoring program. Dispersion modeling will be used to identify locations where sampling should be conducted and to predict concentrations over time of parameters that affect the biota (e.g., suspended particulates). In addition, ecological modelling will provide insight into the significance of the variation of specific parameters, so that monitoring efforts can be focused on those measurements whose variation could have the most significant effect.

Monitoring data will be provided by industry. Proposed regulations for deep seabed exploration and equipment testing require industry to submit environmental "baseline" information during the license phase and to carry out monitoring

within the guidelines issued by NOAA ("Technical Guidance Document"). Information to be provided can be grouped into three categories: 1) location of site and exploration and monitoring plans submitted at the time of application; 2) descriptive information characterizing the site environmentally, to be submitted either with the application or at least one year prior to equipment tests; and 3) specific environmental data sets collected during demonstration-scale mining tests (i.e., monitoring data). Similar data requirements are expected to be included in regulations governing commercial recovery. The Government's role will be to evaluate the effectiveness of the industry-submitted monitoring plans and negotiate an acceptable plan for incorporation into terms, conditions, and restrictions; to monitor industry's performance during testing and commercial mining through the use of industry reports and Federal observers; and to evaluate data taken during equipment tests to improve estimates of environmental impact from commercial-scale mining.

If ocean dumping for disposal of processing wastes is used by industry, it is expected that there will be similar data requirements i.e., pre-disposal environmental information, discharge or dumping plans, and monitoring of environmental effects.

4.3.5 Mitigation

The major unresolved environmental concerns that remain as a result of the DOMES program are those relating to long-term effects. As shown in Table 6, few identifiable issues remain to be addressed: the significance of the adverse impact on the benthic biota due to the mining collector and resulting plume and the effect of the surface plume on fish larvae. Although the importance of these potential effects is unknown or uncertain, mitigation measures should be examined. Options to minimize surface and benthic discharge effects, if

such becomes necessary, have already been evaluated to a limited extent,[72, 73] possible alternatives being shown in Table 6. It should never be assumed, however, that technology is to be dictated by the Government so as to hinder the development of new and innovative ideas to accomplish the same end result.

Identifying the key parameter(s) that should be modified will be a central objective in examining mitigation strategies. The effectiveness--predicted and measured--of optional mitigation strategies and the cost-benefit relationship must also be examined. Experiments can be conducted during industry's field tests to evaluate the effects of various mining system designs and onboard treatment of the suspended particulate load at the surface and benthic boundary layer. Such observations will suggest the potential effectiveness of various technologies and alternatives that should be examined. Similarly, if ocean disposal of processing wastes is used by industry, field tests with representative wastes will help to identify potential areas of concern and possible means to mitigate adverse effects.

The determination of possible mitigation strategies, like monitoring, is an iterative process, closely linked to industry's developing technology and the continuous accrual of scientific knowledge. Thus, it is expected that the need for mitigation will, in time, become better defined, resulting in more effective mitigation strategies.

4.4 SUMMARY OF ENVIRONMENTAL RESEARCH NEEDS

While many early environmental concerns about deep-sea manganese nodule mining have essentially been answered by the DOMES program, some remain. Also, because of the short duration of the pilot-scale mining tests monitored in 1978 and the accompanying wide variations in production and discharge rates, conclusions based on the extrapolation of results from these tests to commercial

Potential biological impacts	Potential significance*	Examples of possible mitigation strategies	Supporting research
Fish larvae feeding	Uncertain	Premature	o Determine occurrence o Determine potential year class effect
Destruction of benthic biota in collector track	Unavoidable	Premature	o Evaluate effect on benthic community
Smothering and starvation of benthos	Unknown	Varying mining pattern Control dispersion of benthic plume ("Rain of Fines")	o Monitor recolonization following disturbance o Identify factors important in recolonization o Evaluate effectiveness of various mining strategies in minimizing impact o Develop capability for long-term monitoring of suspended particulate matter concentrations at mine site boundaries

*Uncertain is used when prediction is based on some knowledge, although insufficient. Unknown is used when prediction is primarily conjecture, based on minimal knowledge.

TABLE 6. Potential Biological Impacts and Supporting Research to Evaluate Possible Mitigation Strategies.

mining conditions must be validated. Thus, data from the monitoring of longer duration mining tests are essential to improve the current ability to predict the impact of commercial-scale mining.

Various processing techniques have been identified, and initial estimates have been made on the nature and quantities of potential wastes. These and subsequent studies have shown that more detailed information is required on waste disposal alternatives, the chemical and physical characteristics of the wastes themselves, and potential biological impacts. Results from NOAA's DOMES and the Corps of Engineers' Dredged Material Research Program are applicable to many of the environmental concerns raised by the ocean disposal of processing wastes; however, because this new technology will create a "new" waste, the transfer of results regarding potential effects from processing wastes can be done only to a limited extent. Research has just been initiated on the characteristics of these particular wastes; these results will form the basis for the evaluation of potential biological impacts from the ocean disposal of these wastes.

Research needs proposed in this Plan have been categorized into five areas as shown in Fig. 1. Within each category, remaining research needs are summarized below, based on the previous discussion.

1) Determination of characteristics and the modes of introduction of effluent (mining or processing) into the marine environment (Initial Conditions-Disturbance). This information, which is essential to the development of an adequate model, includes data on the concentrations, discharge rates and characteristics, and the mode of discharge, whether from mining or processing. In mining, the first considerations in impact predictions are the mining system configuration and the depth of discharge. These are needed for interpreting the studies with respect to specific mining system parameters and performance.

The factors that determine the characteristics and the volume of the processing wastes are: (1) whether three or four value metals are recovered; (2) the processing technique used; (3) the waste treatment prior to disposal; (4) the ratio of solids to liquids in the reject waste material; and (5) what other plant wastes are combined with reject wastes for disposal. These factors, as well as the mode and rate of discharge are the initial conditions that effect waste disposal impacts, and, as such, are essential in the determination of mitigating measures. Some of this information on waste characteristics is expected to be provided by the mining consortia, while data on the mining discharge will be provided by both industry and Federal observers on mining vessels.

2) Physico-Chemical Effects. After sufficient data are available on the characteristics of the mining discharges, carefully chosen measurements of physical and chemical effects from field studies are required for the calibration of the existing models of the dispersion of mining particulates. Similarly, field data will be needed to refine existing dispersion models to be applicable to processing wastes. In some cases, laboratory studies will be necessary to better define processes affecting physico-chemical behavior of mining discharges or reject wastes in the ocean. This information contributes to the improvement of model predictions on which estimates of biological impacts are based and helps define parameters to be measured for monitoring the effects.

3) Biological Impacts. In parallel with the physico-chemical measurements, studies need to be conducted to improve the capability to assess and predict the impact on biota from mining (i.e., benthos and fish larvae) and processing waste disposal (i.e., phytoplankton, zooplankton and benthos). Both field and laboratory studies should be conducted. Information is particularly lacking on the deep-sea ecosystem and should be developed so that better predictions can be made on the recovery rate of the benthos following mining and the potential

significance of this disturbance to the deep-sea ecosystem.

4) Monitoring. All available information must be analyzed in determining the significance of impacts, particularly on the deep-sea ecosystem. Ecological models can be used to better define significant processes and key environmental parameters and to predict ecosystem stress should a significant change be effected in one component of the environment. These results, as well as other field data, will be evaluated to identify environmental measurements that should be made in an effective monitoring program to detect both long- and short-term effects.

5) Mitigation. Based on model predictions, field measurements, and monitoring data, the need for mitigation measures should be continually evaluated. Alternative mitigating strategies need to be examined in terms of their effectiveness, environmental impact, and relative costs to industry.

6) Site Designation Studies.

It should be noted that the additional tasks, designation of stable reference areas and ocean dumpsites, although not specifically within the research strategy previously discussed, are required by law. The integrated research results developed from previous studies will focus these site characterization studies on critical parameters indicative of environmental change.

Table 7 summarizes proposed research tasks as outlined in the preceding text.

TABLE 7. Research Tasks by Category

INITIAL CONDITIONS - DISTURBANCE

- o Mining system configuration
- o Mining surface discharge characteristics
- o Characterization of manganese nodule processing wastes
- o At-sea waste disposal technologies and concerns

DETERMINATION OF PHYSICO-CHEMICAL EFFECTS OF MINING AND PROCESSING DISCHARGE

- o Surface and benthic mining plume measurements
- o Development and measurement of in-situ settling velocity and state of aggregation of mining particulates
- o Effects of mining particulates on the attenuation and quality of light
- o Refinement and calibration of dispersion models for mining discharge (surface and benthic) for processing waste disposal (near-shore and offshore)
- o Physico-chemical behavior of reject wastes after discharge or dumping

BIOLOGICAL IMPACTS FROM DISCHARGE

- o Examination of the effects of burial and increased suspended load and the rate of recolonization of the deep-sea benthos
- o Evaluation of the effects of mining on tuna larvae
- o Evaluation of the effects of reject wastes on biota

MONITORING AND EVALUATION OF SIGNIFICANCE

- o Refinement of existing ecosystem models to evaluate significance of detectable impacts
- o Development of strategy and technology for monitoring

MITIGATION

- o Identify potential mitigation strategies
- o Evaluate effectiveness of various mining strategies in minimizing potential impact
- o Verify predicted effectiveness through field tests

SITE DESIGNATION

- o Identify and designate ocean disposal areas and conduct required studies
- o Identify potential sites for stable reference areas

5. IMPLEMENTATION

5.1 MANAGEMENT

5.1.1 Planning

The development of this Five-Year Marine Environmental Research Plan has involved the participation of numerous representatives from academia, Federal and state governments, industry, and the public sector through workshops and other public meetings, as well as broad external review of draft documents concerning programmatic research needs. This procedure has been valuable as a means of information exchange and evaluation of relevance of programmatic plans and results. Such procedures will be continued in order to maintain this dialogue and to ensure a thorough evaluation of the research program.

As mentioned in the Introduction, other planning documents relating to both land and at-sea issues will be prepared to support program implementation. This Plan on marine research will be updated every two years and will be accompanied by annual technical development plans that specifically outline each year's activities. These annual documents will summarize the previous year's results, define the upcoming year's program and evaluate the progress toward reaching the stated objectives.

5.1.2 Program Conduct

The program will be implemented through a combination of methods, using the capabilities of Federal agencies, the private sector, and academia under specific grants and contracts. The mix of strategies is expected to vary, depending upon annual research needs, capabilities of different institutions (including industry and government laboratories), and budgetary restrictions. Where appropriate, research efforts will be

coordinated with those of other programs addressing related scientific problems.

Research program management will reside within NOAA's Office of Ocean Minerals and Energy, which will be responsible for planning, timely implementation of the program, development of research products relevant to management's needs, and effective use of available resources. This office will also be responsible for developing and enforcing regulations, and for writing the necessary environmental impact statements. Merging these three functions into a single office is expected to facilitate coordination and improve the effectiveness of the office in implementing the Deep Seabed Hard Mineral Resources Act.

5.1.3 Review and Evaluation

As the program progresses, NOAA intends to invite appropriate prominent scientists and engineers from both inside and outside Government to review and comment on the program in terms of 1) its relevance and timeliness in supporting the legal and regulatory requirements, and 2) its scientific and engineering validity. The composition of these review groups is expected to vary according to the expertise required and the objectives of the review. In addition, periodic workshops will be held to gain a broader-based evaluation of the relevance and validity of the program and to disseminate research results.

Investigators will be required to submit periodic written reports on the technical progress of their projects and to participate in review and evaluation meetings. To allow peer review and better dissemination of research results to the scientific community, investigators will be strongly encouraged to publish in the open literature.

5.1.4 International Participation

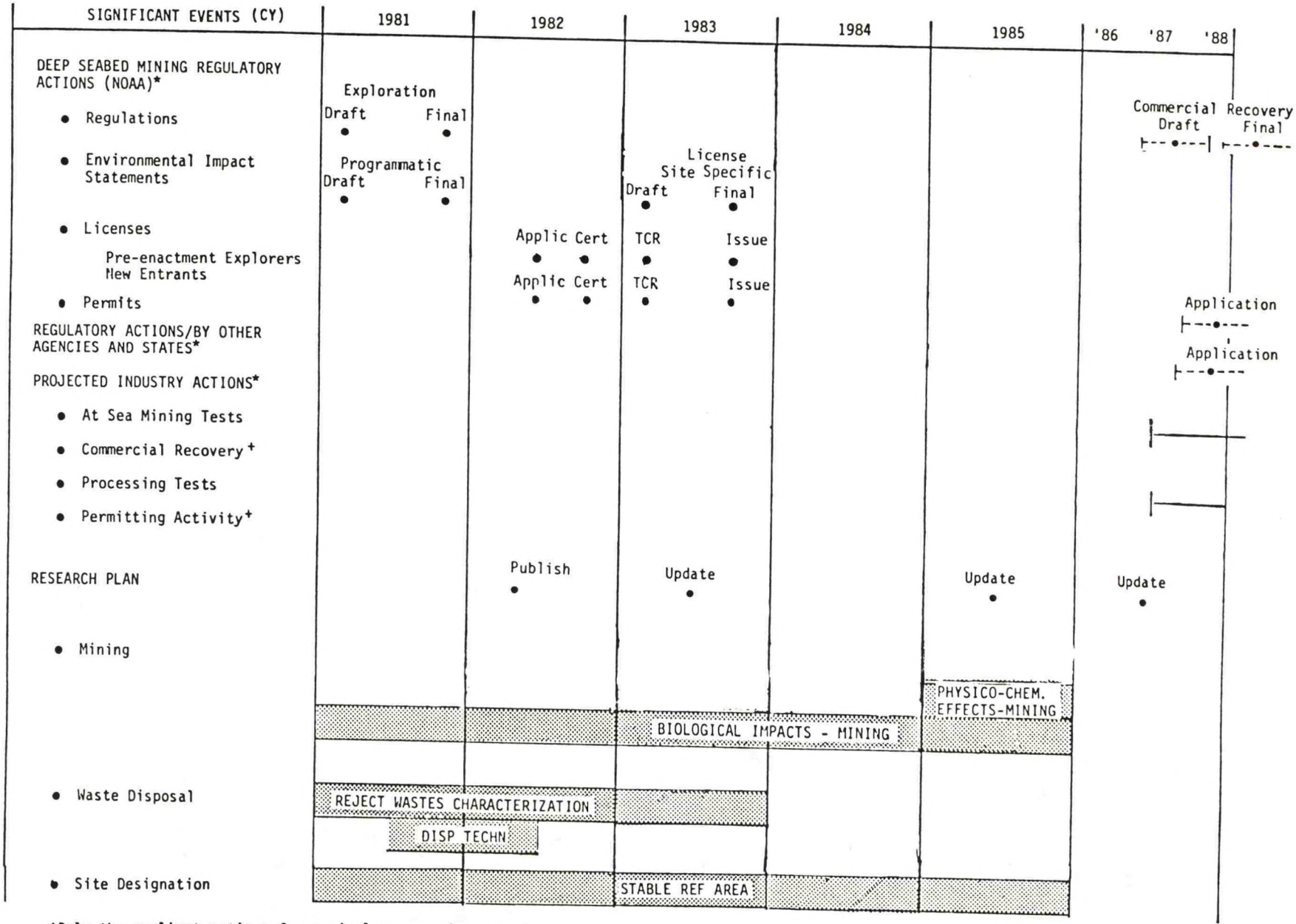
In addition to supporting domestic regulatory needs, the United States must also evaluate the environmental programs of potential reciprocating states involved in seabed mining. Consequently, technical representatives from appropriate Federal agencies and academia will be convened, as required, to discuss other nations' environmental programs relating to deep seabed mining and associated activities.

Efforts are in progress to establish a mechanism with reciprocating states for the exchange of scientific information and, if possible, the implementation of cooperative scientific programs.

5.2 LIMITATIONS AND ASSUMPTIONS

The development of any plan is dependent upon certain assumptions and expectations. This is particularly true for this research program, since it is contingent upon the plans and progress of a new industry with new technologies. Thus, as mentioned earlier, predictions regarding industry's plans for timing, mining system configurations, rate of production, reject disposal strategies, processing facility location, preferred processing techniques that affect reject characteristics, initiation of reliability and endurance (R&E) tests, and many other factors, are the best available estimates at the time of writing. Consequently, research plans that depend upon the outcome of these industry decisions will be modified as mining activities progress.

The present schedule of Federal regulatory actions, anticipated industry plans, and corresponding research emphasis is summarized in Fig. 7. As is evident from this figure, and based on other information from industry, the following assumptions have been made regarding industry's plans.



*Only the earliest actions for a single consortium are shown.
+Beyond 1988

FIGURE 7. Projected Industry-Government Schedule

1. R&E tests will begin in the late eighties.
2. At-sea disposal of processing rejects is an option being considered by industry. Any of the following strategies may be used: outfall pipes or barge dumping, over the continental shelf or seaward of the shelf break; or deep water injection by suspended pipe from a barge or ship.
3. Both three- and four-metal processing plants are considered by industry as possible alternatives.
4. License applications may be received as early as the beginning of 1982.
5. Permit applications may be submitted toward the end of the decade.
6. Demonstration-scale processing plants will be operative in the late-1980's with consequent availability of reject material more representative of that from commercial-scale plants.
7. Mining activities will occur in the DOMES areas and will employ technology and methodology of the type described in Chapter 3 of this text.
8. Although the Act requires the consideration of impacts from at-sea processing, this is likely to be a "second-generation" technology and therefore not of significant importance for a research plan for fiscal years 1981-1985.
9. Although the text emphasizes the importance of monitoring, cost estimates do not reflect a major monitoring program by the Government since industry will be responsible for the conduct of the majority of the monitoring of field tests and of commercial mining activities within NOAA issued guidelines.[74]

10. Different mechanisms are being explored to share other program costs with industry. In addition, it may be possible to conduct joint programs with other Federal agencies or reciprocating states. Consequently, program or ship costs may lessen.

5.3 FACTORS CONSIDERED IN PRIORITY SETTING

Unresolved issues associated with deep seabed mining and at-sea waste disposal have been discussed in previous chapters. To meld these research needs into a plan, priorities were placed on the identified research tasks, considering the following factors: importance of information in supporting management's needs; timing, in terms of decision-making needs, industry's schedules, and amount of time required to develop "adequate" data base; feasibility; and cost-effectiveness.

The importance of providing relevant information to the decision-making process has been the major emphasis in the previous discussions. Determining the critical information needs includes the preparation of decision documents, where information needs are identified (e.g., the environmental impact statements), and technical program planning and review where the scientific validity of conclusions and recommendations are discussed and areas identified where further research is required. This is a continuing process, since scientific results, industry's plans and technologies, and other factors frequently require a reassessment of the value of proposed research.

Careful timing of the research tasks is paramount to the usefulness of scientific results. The timing of research depends on both the managerial and technical requirements. Key regulatory decision points are shown in Fig. 7 (i.e., preparation of environmental impact statements and issuance of licenses and permits). The figure indicates only when the earliest

actions may begin since similar decisions for each consortium for each geographical area are expected to occur intermittently after the date shown. After a license or permit is issued, decisions may be required by the Government modifying the terms, conditions, and restrictions of the license or permit based on monitoring data submitted by industry and/or collected by the Government.

The amount of time required to develop the technical information to the necessary degree of accuracy is also essential in determining the timing of research. However, it should never be presumed that a decision must await the collection of scientific information that supports predictions having 100% accuracy. Adequate resources, time, and frequently technology are usually prohibitive to obtaining such results. Thus, a best estimate of the time required to develop an "adequate" data base must be combined with the date when the information is needed to identify the project initiation date. If the research is dependent upon completion of other tasks before being initiated, or if its completion is critical to the initiation of other research, the start-up of specific tasks must be varied to accommodate these dependencies. Additionally, if industry's performance (e.g., the conduct of at-sea tests or availability of representative processing wastes), is critical to specific research, plans must be altered accordingly.

Feasibility analysis of each project is inherent in evaluating the priority of a research task. Several projects require the development of new methodologies or instrumentation for proper data collection. Consequently, the additional time required to develop such technology

must be factored into the planning so that data results are still available when needed. Other factors, such as specific sampling platform availability and technical feasibility, also must be considered in establishing the timing of projects and their priority relative to other research needs.

Obtaining maximum research effort from the resources expended is an obvious aim of research program management. Many projects, because of such factors as inordinately large data set requirements, expensive logistical demands, or dependency on several other low-priority tasks, may result in a low value of the research dollar and a consequent lower priority. Conversely, there are circumstances in which the value of the research monies can be "increased" through such mechanisms as cooperative programs with other agencies, or other countries. Such factors are also considered in the establishment of programmatic priorities and timing of research projects.

5.4 ANNUAL RESEARCH PLANS

The following section presents the research needs identified in the previous chapter according to fiscal year, considering the factors discussed in the previous section. As mentioned earlier, the driving forces behind the timing of research in this program are the Government decision points and industry's activities. Key dates associated with Federal actions that affect this research program are the preparation of site-specific environmental impact statements (EIS), beginning in early 1982 with a concomitant determination of terms, conditions and restrictions (TCR) for a license for exploration. Other license applications are expected to follow intermittently with similar EIS and TCR preparations.

Another important governmental decision concerns the disposal of processing wastes. Since this Plan addresses only marine-related

environmental impacts, only two modes of disposal, dumping and ocean outfalls, are considered. The probability of industry's using the ocean for disposal is obviously an interactive process between industry and Government. Industry is concerned about economics and the environmental acceptability of ocean disposal, while the Government is concerned about evaluation of this option prior to its selection by industry as the preferred alternative. As stated earlier, it has been assumed that this mode is a viable option that must be evaluated by Government and that a decision as to acceptability may be required during the late eighties when permit applications may be submitted.

Industry plans affecting the timing of research tasks include the at-sea reliability and endurance (R&E) tests of mining equipment over sustained periods and the operation of prototype processing plants. Another major industry activity, although beyond the period covered by this Plan, is the initiation of commercial operations, which might begin, at the earliest, during the late 1980's.

These Government and industry activities form the timing framework which constrains the proposed research program. Any changes in the timing of these activities will most likely have an effect on the research timing. The following discussion sets out, in order of priority and by fiscal year, research listed in Table 7 (excluding that to be conducted by industry in association with licenses and permits) for the next five years (Table 8).

TABLE 8. Cost Estimates of Research Activities by Fiscal Year, in Order of Decreasing Priority

FISCAL YEAR	RESEARCH ACTIVITY	FUNDING ($K)[1,2] (1980 Dollars) Program Costs
1981	Analysis & Characterization of Potential Reject Wastes	180
	At-Sea Disposal Technologies & Concerns	70
	Biological Impacts--Mining o Evaluate Potential of Trace Metal Uptake	10
	Stable Reference Areas	10
	Total	270
1982	Analysis & Characterization of Potential Reject Wastes	285
	Biological Impacts - Mining o Evaluate Potential of Adverse Effects on Fish	75
	Stable Reference Areas	40
	Total	400
1983	Analysis & Characterization of Potential Reject Wastes	185
	Biological Impacts - Mining o Benthic Studies - Preparation	155
	Total	360

[1] Costs include management expenses

[2] It is expected that some information gaps will be filled by academia and industry's programs, thus diminishing these costs estimates.

5.4.1 Fiscal Year 1981

Analysis and Characterization of Potential Reject Wastes

Highest priority has been assigned to the continued analysis and characterization of processing reject wastes, owing to the dependence of most of the processing tasks on a knowledge of the waste constituents and the expected behavior of the waste material. Processing research studies to develop agency guidelines for disposal, whether offshore or on land, cannot be started until a better understanding of the waste material is reached. These wastes are expected to be a combination of the nodule rejects, combustion by-products, scrubber solids and tank-house purges. Since nodule rejects are not common industrial wastes, initial efforts are directed toward characterizing these wastes. The results of this three-year study, which began at the end of Fiscal Year 1980, will be the "best" estimate of reject characteristics. These results will be confirmed in future work, using more representative wastes as they become available. This preliminary information, however, will allow a priority of concerns to be established early, thereby guiding experimental design for the future evaluation of potential biological impacts. By FY 1983, limited quantities of experimental reject material using different processing technologies are expected to be generated by, and available in limited quantities from, the Bureau of Mines (who is performing this study for NOAA), thus permitting the initiation of the development of guidelines for ocean disposal.

At-Sea Disposal Technologies and Concerns

In the past, at-sea disposal has been discussed only in general terms, as an option available to industry. No evaluation has been made, however, as to the legal, economic, operating, and environmental constraints that will affect this option. Early analysis of this alternative will assist the Government in evaluating industrial plans for at-sea disposal and highlight areas that require further analysis prior to the receipt of permit applications. A study of this option, like the waste characterization study, has already been initiated, since its results strongly influence the direction of subsequent waste disposal studies. It is a one-year contract study that is being funded by both NOAA and EPA.

Biological Impacts-Mining

The potential for trace metal uptake through zooplankton ingestion of nodule fragments has been raised as a possible environmental problem. A preliminary analysis of this issue will be initiated in FY 1981 to determine the need and direction of future research.

Stable Reference Areas

The Deep Seabed Hard Mineral Resources Act requires the Secretary of State, in cooperation with the Administrator of NOAA, to include in the reciprocating states negotiations discussions on the establishment of stable reference areas. These areas are essentially to serve as "control" areas wherein mining does not take place. Discussions on this topic are to begin within one year after enactment of the Act. To meet this requirement, an analysis of various options that might be pursued will be conducted to provide the basis of initial discussions in summer, 1981.

5.4.2 Fiscal Year 1982

Analysis and Characterization of Potential Processing Reject Wastes

This is a continuation of the three-year task begun in late FY 1980 to develop a first-order prediction of the characteristics of processing rejects based on 1) mineralogy and processing technologies, 2) an analysis of industry-supplied reject material and 3) an analysis of laboratory-generated processing rejects. This task will produce a standard methodology for analysis of processing rejects.

Biological Impacts - Mining

One biological study will be conducted in 1982 on the growth and survival of commerially-important fish larvae exposed to the mining discharge. An analysis of existing literature will be made to determine the potential for behavioral and growth effects in fish larvae (e.g., tuna, billfish) resulting from the increased suspended particulates from the mining discharge, since the visual environment is a governing parameter in the successful development of recently hatched larvae. The study will also evaluate the probability of higher larvae concentrations in the area of mining due to the attraction of tuna to disturbances and the consequent acceleration of gonad development under stress. Based on the results of this study, extrapolations will be made to determine if there is any potential for a significant effect on fish year classes of the region due to commercial-scale mining.

Stable Reference Areas

Discussions with reciprocating states on the general approach to the establishment of stable reference areas will be initiated in

FY 1981. Based on these discussions, efforts in FY 1982 will focus on evaluating the scientific issues associated with the establishment of "control" areas.

5.4.3 Fiscal Year 1983

Analysis and Characterization of Potential Reject Wastes

This will be the final year of this study. The major effort will be the generation of rejects from bench-scale processing systems in order to estimate potential reject characteristics from various processing methodologies. The results of this study will provide the basis for further Government actions on processing waste disposal.

Biological Impacts - Mining

Planning for a benthic project will be initiated in 1983 to examine benthic recovery patterns following a severe physical disturbance. Efforts during the first year will address the experimental design for field studies to begin in 1984. Evidence to date indicates high, unavoidable mortality of the deep-sea benthos in the area mined by the collector. The areal distribution and degree of impact, the significance of this impact to the ecosystem, and the rate of recovery following mining are questions that have not been sufficiently examined. Since inadequate scientific information is available to make reliable predictions, a multi-year study is planned to examine these questions. Experiments will address the rates of recolonization following physical disruption of the bottom and the effect of various rates and depths of resedimentation on benthic mortality and community recovery. Observations will be made on the different life stages and species of benthos that reappear as the disturbed area is repopulated and the changes in community structure

(e.g., natural diversity) that occur over time. These experiments will provide information on the potential significance of mining disturbances on the deep sea benthos and possibly suggest mining strategies to lessen benthic impact and facilitate more rapid recolonization. It is recognized, however, that in view of the paucity of data and the expense of sampling platforms, development of an understanding of the deep sea ecosystem could be an extremely expensive research effort. Consequently, experiments are to be carefully selected to make maximum use of limited resources.

In addition, the advisability of subsurface discharge from mining ships will be evaluated. Issues such as the potential environmental consequences from discharge at various depths below the surface, advantages and disadvantages of this disposal method as compared to surface discharge, and monitoring strategies will be examined.

Physico-Chemical Effects - Mining

Refinement of the plume model will continue based on new information from other agencies' programs conducted in FY 1982. Industry submitted data will be used in the model to predict potential plume distribution during demonstration-scale mining tests and to evaluate industry-submitted monitoring plans.

Stable Reference Areas

Discussions will continue with reciprocating states on the general approach to the establishment of stable reference areas. More detailed technical plans based on the scientific analyses conducted in FY 1982 will be developed.

5.4.4 Fiscal Year 1984

Biological Impacts - Mining

In 1984, field studies will be initiated at depths greater than 3500 meters to examine benthic recolonization patterns following a physical disturbance. This information will be important to the identification and development of mitigation strategies, the implementation of effective benthic monitoring programs, and the predictions of the significance of the benthic impact resulting from mining.

Stable Reference Areas

Field surveys of areas identified as potential stable reference areas may be conducted, depending upon discussions with reciprocating states and the availability of adequate resources.

5.4.5 Fiscal Year 1985

Biological Impacts - Mining

Observations on the patterns and rapidity of benthic recolonization will continue.

Physico-Chemical Effects - Mining

Also in FY 1985, technology developed for measuring particulate behavior under the Navy's High Energy Benthic Boundary Layer Experiment (HEBBLE) program will be evaluated in terms of its applicability for evaluating plume dispersion characteristics from mining. Depending on the results of this analysis, such technology may be tested during equipment tests in 1987 as a potential monitoring tool during commercial-scale mining.

Stable Reference Areas

Characterization of areas designated as stable reference areas may continue.

5.4.6 Summary

A summary of the proposed budget breakdown for the Fiscal Years 1981-83 is presented as Table 9. NOAA will seek further support from industry and development of cooperative arrangements with the academic sector and other nations in carrying out research beyond 1983.

RESEARCH ACTIVITY	Fiscal Year Funding Requirements ($K)[1] (1980 Dollars) 81	82	83
Analysis & Characterization of Potential Reject Wastes	180	285	185
At-Sea Disposal Technologies and Concerns	70	---	---
Biological Impacts - Mining	10	75	155
Stable Reference Areas	10	40	20
PROGRAMMATIC TOTAL	270	400	360

[1] Includes management costs.

TABLE 9. Projected Budget Breakdown, FY 1981-83

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7. GLOSSARY

Abyssal - Pertaining to the great depths of the ocean, generally between 4000 meters and 6000 meters.

Authigenic - Products of chemical and biochemical action that originated in sediments at the time of or after deposition, and before burial and consolidation.

Beneficiation - Treatment of a raw material so as to improve its properties, such as preparing for smelting.

Benthic - Pertaining to all submarine bottom terrain, regardless of terrain.

Benthic Plume - A stream of water containing in suspension particles of seafloor sediment, abraded manganese nodules, and macerated benthic biota, that emanates from the mining collector as a result of collector disturbance of the seafloor and subsequent rejection of seafloor sediment from the mining system. The far-field component of the benthic plume is termed the "rain of fines".

Benthos - Bottom-dwelling forms of marine life.

Biomass - The amount of living matter per unit of water surface or volume, expressed in weight units.

Biota - All living organisms living in a region - phytoplankton, zooplankton, benthos, and fish.

Chlorophyll - A group of green pigments active in photosynthesis, used as an index of the standing crop of plant forms, or as a means of estimating the rate of photosynthesis.

Colloid - As a size term, refers to particles smaller than 0.00024 millimeters; smaller than clay size.

Copepod - Minute shrimp-like crustaceans, most species ranging between 0.5 and 1.0 mm in length.

Electrowinning - Reductions of metal from a solution by means of electrochemical processes.

Epipelagic - The upper portion of the water column, extending from the surface to a depth of 200 m.

First-Generation Technology - Hydraulic mining of deep seabed manganese nodules in the DOMES area by four or five international consortia, coming into production between 1988 and 1995 at a rate determined by the world demand for nickel.

Flocculation - Aggregating into lumps, as when fine or colloidal clay particles in suspension in fresh water clump together upon contact with salt water and settle out of suspension.

Hydrometallurgical - Pertaining to hydrometallurgy; the treatment of ores, concentrates, and other metal-bearing materials by wet processes, usually involving the solution of some component, and its subsequent recovery from the solution.

Igneous Rock - Rock formed by solidification of molten material or magma.

Interstitial - Contained in the pore spaces betrween the grains in rocks and sediments.

Laterite - Red residual soil developed in humid, tropical, and subtropical regions of good drainage.

Leaching - Extracting a soluble metallic compound from an ore by selectively dissolving it in a suitable solvent, such as water, sulfuric acid, hydrochloric acid, etc. The solvent is usually recovered by precipitation of the metal or by other methods.

License - Authorization granted for exploratory mining activities.

Macrofauna - Animals retained on a sieve of 0.3 to 1.0 mm.

Macrozooplankton - Zooplankton within the size range of 1 millimeter to 1 centimeter in length.

Meiofauna - Animals adapted for living between individual grains of sediment, usually considered to be benthic animals that will pass through a 300 micron or 1.0 mm sieve, but are retained on a 50 micron sieve.

Metamorphic Rock - Rock which has undergone structural and minerological changes, such as crystallization, in response to marked changes of temperature, pressure, and chemical environment.

Nephelometer - An instrument for determining the concentration of particles in suspension.

Pelagic - Having to do with the water column.

Pelagic sediments - Deep ocean sediments that have accumulated by the settling out of the ocean on a particle-by-particle basis.

Permit - Authorization granted for commercial mining activities.

Phytoplankton - Drifting forms of plants which are the basic synthesizers of organic matter in marine and fresh waters.

Primary Productivity - The amount of organic matter synthesized by marine plants from inorganic substances in a unit volume of water per time period, or in a column of water expressed as a unit area cross-section, extending from surface to bottom, per unit time.

Pycnocline - The zone where the water density increases quite rapidly with depth. It separates the well-mixed surface layers from the denser bottom waters.

Pyrometallurgical - Referring to pyrometallurgy involved in winning and refining metals where heat is used, as in roasting and smelting, to remove metals from ores. It is the most important and oldest of the extractive processes.

Reduction - A chemical reaction in which electrons are added to the chemical structure of the reactant. A reaction which takes place at the cathode in electrolysis.

Refractory - Difficult to oxidize. Organic matter that is refractory is composed of high-molecular-weight organic molecules that tend to be resistant to bacterial attack and hence non-biodegradable.

Reject Wastes - The solid and liquid wastes resulting from the processing of manganese nodules. Other wastes that will be produced, although not included in the category of "reject wastes," include combustion ash, scrubber solids, and tank-house purges. Whether these wastes will be combined with reject wastes for disposal is uncertain.

Slurry - Pulp not thick enough to consolidate as a sludge, but sufficiently dewatered to flow viscously.

Smelting - The chemical reduction of a metal from its ore by a process usually involving fusion, so that the earth and other impurities, separated as lighter and more fusible slags, can readily be removed from the reduced metal. Thermal processing wherein chemical reactions take place to produce liquid metal from a beneficiated ore.

Standing Stock - The biomass or abundance of living material per unit volume or area of water or sediment.

Zooplankton - Drifting or weakly swimming animal forms in marine and fresh waters. They are the principal consumers of the phytoplankton.

Public Law 96-283
96th Congress

An Act

To establish an interim procedure for the orderly development of hard mineral resources in the deep seabed, pending adoption of an international regime relating thereto, and for other purposes.

June 28, 1980
[H.R. 2759]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Deep Seabed Hard Mineral Resources Act.
30 USC 1401 note.

SECTION 1. SHORT TITLE.

This Act may be cited as the "Deep Seabed Hard Mineral Resources Act".

30 USC 1401.

SEC. 2. FINDINGS AND PURPOSES.

(a) FINDINGS.—The Congress finds that—

(1) the United States' requirements for hard minerals to satisfy national industrial needs will continue to expand and the demand for such minerals will increasingly exceed the available domestic sources of supply;

(2) in the case of certain hard minerals, the United States is dependent upon foreign sources of supply and the acquisition of such minerals from foreign sources is a significant factor in the national balance-of-payments position;

(3) the present and future national interest of the United States requires the availability of hard mineral resources which is independent of the export policies of foreign nations;

(4) there is an alternate source of supply, which is significant in relation to national needs, of certain hard minerals, including nickel, copper, cobalt, and manganese, contained in the nodules existing in great abundance on the deep seabed;

(5) the nations of the world, including the United States, will benefit if the hard mineral resources of the deep seabed beyond limits of national jurisdiction can be developed and made available for their use;

(6) in particular, future access to the nickel, copper, cobalt, and manganese resources of the deep seabed will be important to the industrial needs of the nations of the world, both developed and developing;

(7) on December 17, 1970, the United States supported (by affirmative vote) the United Nations General Assembly Resolution 2749 (XXV) declaring inter alia the principle that the mineral resources of the deep seabed are the common heritage of mankind, with the expectation that this principle would be legally defined under the terms of a comprehensive international Law of the Sea Treaty yet to be agreed upon;

(8) it is in the national interest of the United States and other nations to encourage a widely acceptable Law of the Sea Treaty, which will provide a new legal order for the oceans covering a broad range of ocean interests, including exploration for and commercial recovery of hard mineral resources of the deep seabed;

(9) the negotiations to conclude such a Treaty and establish the international regime governing the exercise of rights over, and exploration of, the resources of the deep seabed, referred to in General Assembly Resolution 2749 (XXV) are in progress but may not be concluded in the near future;

(10) even if such negotiations are completed promptly, much time will elapse before such an international regime is established and in operation;

(11) development of technology required for the exploration and recovery of hard mineral resources of the deep seabed will require substantial investment for many years before commercial production can occur, and must proceed at this time if deep seabed minerals are to be available when needed;

(12) it is the legal opinion of the United States that exploration for and commercial recovery of hard mineral resources of the deep seabed are freedoms of the high seas subject to a duty of reasonable regard to the interests of other states in their exercise of those and other freedoms recognized by general principles of international law;

(13) pending a Law of the Sea Treaty, and in the absence of agreement among states on applicable principles of international law, the uncertainty among potential investors as to the future legal regime is likely to discourage or prevent the investments necessary to develop deep seabed mining technology;

(14) pending a Law of the Sea Treaty, the protection of the marine environment from damage caused by exploration or recovery of hard mineral resources of the deep seabed depends upon the enactment of suitable interim national legislation;

(15) a Law of the Sea Treaty is likely to establish financial arrangements which obligate the United States or United States citizens to make payments to an international organization with respect to exploration or recovery of the hard mineral resources of the deep seabed; and

(16) legislation is required to establish an interim legal regime under which technology can be developed and the exploration and recovery of the hard mineral resources of the deep seabed can take place until such time as a Law of the Sea Treaty enters into force with respect to the United States.

(b) PURPOSES.—The Congress declares that the purposes of this Act are—

(1) to encourage the successful conclusion of a comprehensive Law of the Sea Treaty, which will give legal definition to the principle that the hard mineral resources of the deep seabed are the common heritage of mankind and which will assure, among other things, nondiscriminatory access to such resources for all nations;

(2) pending the ratification by, and entering into force with respect to, the United States of such a Treaty, to provide for the establishment of an international revenue-sharing fund the proceeds of which shall be used for sharing with the international community pursuant to such Treaty;

(3) to establish, pending the ratification by, and entering into force with respect to, the United States of such a Treaty, an interim program to regulate the exploration for and commercial recovery of hard mineral resources of the deep seabed by United States citizens;

(4) to accelerate the program of environmental assessment of exploration for and commercial recovery of hard mineral resources of the deep seabed and assure that such exploration and recovery activities are conducted in a manner which will encourage the conservation of such resources, protect the quality of the environment, and promote the safety of life and property at sea; and

(5) to encourage the continued development of technology necessary to recover the hard mineral resources of the deep seabed.

SEC. 3. INTERNATIONAL OBJECTIVES OF THIS ACT. 30 USC 1402

(a) DISCLAIMER OF EXTRATERRITORIAL SOVEREIGNTY.—By the enactment of this Act, the United States—

(1) exercises its jurisdiction over United States citizens and vessels, and foreign persons and vessels otherwise subject to its jurisdiction, in the exercise of the high seas freedom to engage in exploration for, and commercial recovery of, hard mineral resources of the deep seabed in accordance with generally accepted principles of international law recognized by the United States; but

(2) does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any areas or resources in the deep seabed.

(b) SECRETARY OF STATE.—(1) The Secretary of State is encouraged to negotiate successfully a comprehensive Law of the Sea Treaty which, among other things, provides assured and nondiscriminatory access to the hard mineral resources of the deep seabed for all nations, gives legal definition to the principle that the resources of the deep seabed are the common heritage of mankind, and provides for the establishment of requirements for the protection of the quality of the environment as stringent as those promulgated pursuant to this Act.

(2) Until such a Treaty is concluded, the Secretary of State is encouraged to promote any international actions necessary to adequately protect the environment from adverse impacts which may result from any exploration for and commercial recovery of hard mineral resources of the deep seabed carried out by persons not subject to this Act.

SEC. 4. DEFINITIONS. 30 USC 1403

For purposes of this Act, the term—

(1) "commercial recovery" means—

(A) any activity engaged in at sea to recover any hard mineral resource at a substantial rate for the primary purpose of marketing or commercially using such resource to earn a net profit, whether or not such net profit is actually earned;

(B) if such recovered hard mineral resource will be processed at sea, such processing; and

(C) if the waste of such activity to recover any hard mineral resource, or of such processing at sea, will be disposed of at sea, such disposal;

(2) "Continental Shelf" means—

(A) the seabed and subsoil of the submarine areas adjacent to the coast, but outside the area of the territorial sea, to a depth of 200 meters or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of such submarine area; and

(B) the seabed and subsoil of similar submarine areas adjacent to the coast of islands;

(3) "controlling interest", for purposes of paragraph 14(C) of this section, means a direct or indirect legal or beneficial interest in or influence over another person arising through ownership of capital stock, interlocking directorates or officers, contractual relations, or other similar means, which substantially affect the independent business behavior of such person;

(4) "deep seabed" means the seabed, and the subsoil thereof to a depth of ten meters, lying seaward of and outside—

(A) the Continental Shelf of any nation; and

(B) any area of national resource jurisdiction of any foreign nation, if such area extends beyond the Continental Shelf of such nation and such jurisdiction is recognized by the United States;

(5) "exploration" means—

(A) any at-sea observation and evaluation activity which has, as its objective, the establishment and documentation of—

(i) the nature, shape, concentration, location, and tenor of a hard mineral resource; and

(ii) the environmental, technical, and other appropriate factors which must be taken into account to achieve commercial recovery; and

(B) the taking from the deep seabed of such quantities of any hard mineral resource as are necessary for the design, fabrication, and testing of equipment which is intended to be used in the commercial recovery and processing of such resource;

(6) "hard mineral resource" means any deposit or accretion on, or just below, the surface of the deep seabed of nodules which include one or more minerals, at least one of which contains manganese, nickel, cobalt, or copper;

(7) "international agreement" means a comprehensive agreement concluded through negotiations at the Third United Nations Conference on the Law of the Sea, relating to (among other matters) the exploration for and commercial recovery of hard mineral resources and the establishment of an international regime for the regulation thereof;

(8) "licensee" means the holder of a license issued under title I of this Act to engage in exploration;

(9) "permittee" means the holder of a permit issued under title I of this Act to engage in commercial recovery;

(10) "person" means any United States citizen, any individual, and any corporation, partnership, joint venture, association, or other entity organized or existing under the laws of any nation;

(11) "reciprocating state" means any foreign nation designated as such by the Administrator under section 118;

Post, p. 574.

(12) "Administrator" means the Administrator of the National Oceanic and Atmospheric Administration;

(13) "United States" means the several States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, the United States Virgin Islands, Guam, and any other Commonwealth, territory, or possession of the United States; and

(14) "United States citizen" means—

(A) any individual who is a citizen of the United States;

(B) any corporation, partnership, joint venture, association, or other entity organized or existing under the laws of any of the United States; and

(C) any corporation, partnership, joint venture, association, or other entity (whether organized or existing under the laws of any of the United States or a foreign nation) if the controlling interest in such entity is held by an individual or entity described in subparagraph (A) or (B).

TITLE I—REGULATION OF EXPLORATION AND COMMERCIAL RECOVERY BY UNITED STATES CITIZENS

SEC. 101. PROHIBITED ACTIVITIES BY UNITED STATES CITIZENS.

30 USC 1411.

(a) PROHIBITED ACTIVITIES AND EXCEPTIONS.—(1) No United States citizen may engage in any exploration or commercial recovery unless authorized to do so under—

(A) a license or a permit issued under this title;

(B) a license, permit, or equivalent authorization issued by a reciprocating state; or

(C) an international agreement which is in force with respect to the United States.

(2) The prohibitions of this subsection shall not apply to any of the following activities:

(A) Scientific research, including that concerning hard mineral resources.

(B) Mapping, or the taking of any geophysical, geochemical, oceanographic, or atmospheric measurements or random bottom samplings of the deep seabed, if such taking does not significantly alter the surface or subsurface of the deep seabed or significantly affect the environment.

(C) The design, construction, or testing of equipment and facilities which will or may be used for exploration or commercial recovery, if such design, construction, or testing is conducted on shore, or does not involve the recovery of any but incidental hard mineral resources.

(D) The furnishing of machinery, products, supplies, services, or materials for any exploration or commercial recovery conducted under a license or permit issued under this title, a license or permit or equivalent authorization issued by a reciprocating state, or under an international agreement.

(E) Activities, other than exploration or commercial recovery activities, of the Federal Government.

(b) EXISTING EXPLORATION.—(1) Subsection (a)(1)(A) shall not be deemed to prohibit any United States citizen who is engaged in exploration before the effective date of this Act from continuing to engage in such exploration—

(A) if such citizen applies for a license under section 103(a) with respect to such exploration within such reasonable period of time, after the date on which initial regulations to implement section 103(a) are issued, as the Administrator shall prescribe; and

(B) until such license is issued to such citizen or a final administrative or judicial determination is made affirming the denial of certification of the application for, or issuance of, such license.

Suspension of exploration.

(2) Notwithstanding paragraph (1), if the President by Executive order determines that immediate suspension of exploration activities

is necessary for the reasons set forth in section 106(a)(2)(B) or the Administrator determines that immediate suspension of activities is necessary to prevent a significant adverse effect on the environment or to preserve the safety of life and property at sea, the Administrator is authorized, notwithstanding any other requirement of this Act, to issue an emergency order requiring any United States citizen who is engaged in exploration before the effective date of this Act to immediately suspend exploration activities. The issuance of such emergency order is subject to judicial review as provided in chapter 7 of title 5, United States Code.

Judicial review

5 USC 701 *et seq*

(3) The timely filing of any application for a license under paragraph (1)(A) shall entitle the applicant to priority of right for the issuance of such license under section 103(b). In any case in which more than one application referred to in paragraph (1) is filed based on exploration plans required by section 103(a)(2) which refer to all or part of the same deep seabed area, the Administrator shall, in taking action on such applications, apply principles of equity which take into consideration, among other things, the date on which the applicants or predecessors in interest, or component organizations thereof, commenced exploration activities and the continuity and extent of such exploration and amount of funds expended with respect to such exploration.

Action on applications, principles of equity

(c) INTERFERENCE.—No United States citizen may interfere or participate in interference with any activity conducted by any licensee or permittee which is authorized to be undertaken under a license or permit issued by the United States to the licensee or permittee under this Act or with any activity conducted by the holder of, and authorized to be undertaken under, a license or permit or equivalent authorization issued by a reciprocating state for the exploration or commercial recovery of hard mineral resources. United States citizens shall exercise their rights on the high seas with reasonable regard for the interests of other states in their exercise of the freedoms of the high seas.

30 USC 1412

SEC. 102. LICENSES FOR EXPLORATION AND PERMITS FOR COMMERCIAL RECOVERY.

(a) AUTHORITY TO ISSUE.—Subject to the provisions of this Act, the Administrator shall issue to applicants who are eligible therefor licenses for exploration and permits for commercial recovery.

(b) NATURE OF LICENSES AND PERMITS.—(1) A license or permit issued under this title shall authorize the holder thereof to engage in exploration or commercial recovery, as the case may be, consistent with the provisions of this Act, the regulations issued by the Administrator to implement the provisions of this Act, and the specific terms, conditions, and restrictions applied to the license or permit by the Administrator.

(2) Any license or permit issued under this title shall be exclusive with respect to the holder thereof as against any other United States citizen or any citizen, national or governmental agency of, or any legal entity organized or existing under the laws of, any reciprocating state.

(3) A valid existing license shall entitle the holder, if otherwise eligible under the provisions of this Act and regulations issued under this Act, to a permit for commercial recovery. Such a permit recognizes the right of the holder to recover hard mineral resources, and to own, transport, use, and sell hard mineral resources recovered, under the permit and in accordance with the requirements of this Act.

(4) In the event of interference with the exploration or commercial recovery activities of a licensee or permittee by nationals of other states, the Secretary of State shall use all peaceful means to resolve the controversy by negotiation, conciliation, arbitration, or resort to agreed tribunals.

Interference by nationals of other states

(c) RESTRICTIONS.—(1) The Administrator may not issue—

(A) any license or permit after the date on which an international agreement is ratified by and enters into force with respect to the United States, except to the extent that issuance of such license or permit is not inconsistent with such agreement;

(B) any license or permit the exploration plan or recovery plan of which, submitted pursuant to section 103(a)(2), would apply to an area to which applies, or would conflict with, (i) any exploration plan or recovery plan submitted with any pending application to which priority of right for issuance applies under section 103(b), (ii) any exploration plan or recovery plan associated with any existing license or permit, or (iii) any equivalent authorization which has been issued, or for which formal notice of application has been submitted, by a reciprocating state prior to the filing date of any relevant application for licenses or permits pursuant to this title;

(C) a permit authorizing commercial recovery within any area of the deep seabed in which exploration is authorized under a valid existing license if such permit is issued to other than the licensee for such area;

(D) any exploration license before July 1, 1981, or any permit which authorizes commercial recovery to commence before January 1, 1988;

(E) any license or permit the exploration plan or recovery plan for which applies to any area of the deep seabed if, within the 3-year period before the date of application for such license or permit, (i) the applicant therefor surrendered or relinquished such area under an exploration plan or recovery plan associated with a previous license or permit issued to such applicant, or (ii) a license or permit previously issued to the applicant had an exploration plan or recovery plan which applied to such area and such license or permit was revoked under section 106; or

(F) a license or permit, or approve the transfer of a license or permit, except to a United States citizen.

(2) No permittee may use any vessel for the commercial recovery of hard mineral resources or for the processing at sea of hard mineral resources recovered under the permit issued to the permittee unless the vessel is documented under the laws of the United States.

Vessel documentation

(3) Each permittee shall use at least one vessel documented under the laws of the United States for the transportation from each mining site of hard mineral resources recovered under the permit issued to the permittee.

Transportation of minerals from mining sites

(4) For purposes of the shipping laws of the United States, any vessel documented under the laws of the United States and used in the commercial recovery, processing, or transportation from any mining site of hard mineral resources recovered under a permit issued under this title shall be deemed to be used in, and used in an essential service in, the foreign commerce or foreign trade of the United States, as defined in section 905(a) of the Merchant Marine Act, 1936, and shall be deemed to be a vessel as defined in section 1101(b) of that Act.

46 USC 1244.
46 USC 1271.

(5) Except as otherwise provided in this paragraph, the processing on land of hard mineral resources recovered pursuant to a permit

Processing on land within U.S.

shall be conducted within the United States: *Provided*, That the President does not determine that such restrictions contravene the overriding national interests of the United States. The Administrator may allow the processing of hard mineral resources at a place other than within the United States if he finds, after opportunity for an agency hearing, that—

Processing outside U.S.

(A) the processing of the quantity concerned of such resource at a place other than within the United States is necessary for the economic viability of the commerical recovery activities of a permittee; and

(B) satisfactory assurances have been given by the permittee that such resource, after processing, to the extent of the permittee's ownership therein, will be returned to the United States for domestic use, if the Administrator so requires after determining that the national interest necessitates such return.

30 USC 1413

SEC. 103. LICENSE AND PERMIT APPLICATIONS, REVIEW, AND CERTIFICATION.

(a) APPLICATIONS.—(1) Any United States citizen may apply to the Administrator for the issuance or transfer of a license for exploration or a permit for commercial recovery.

(2)(A) Applications for issuance or transfer of licenses for exploration and permits for commercial recovery shall be made in such form and manner as the Administrator shall prescribe in general and uniform regulations and shall contain such relevant financial, technical, and environmental information as the Administrator may by regulations require as being necessary and appropriate for carrying out the provisions of this title. In accordance with such regulations, each applicant for the issuance of a license shall submit an exploration plan as described in subparagraph (B), and each applicant for a permit shall submit a recovery plan as described in subparagraph (C).

Exploration plan

(B) The exploration plan for a license shall set forth the activities proposed to be carried out during the period of the license, describe the area to be explored, and include the intended exploration schedule and methods to be used, the development and testing of systems for commercial recovery to take place under the terms of the license, an estimated schedule of expenditures, measures to protect the environment and to monitor the effectiveness of environmental safeguards and monitoring systems for commercial recovery, and such other information as is necessary and appropriate to carry out the provisions of this title. The area set forth in an exploration plan shall be of sufficient size to allow for intensive exploration.

Recovery plan

(C) The recovery plan for a permit shall set forth the activities proposed to be carried out during the period of the permit, and shall include the intended schedule of commercial recovery, environmental safeguards and monitoring systems, details of the area or areas proposed for commercial recovery, a resource assessment thereof, the methods and technology to be used for commercial recovery and processing, the methods to be used for disposal of wastes from recovery and processing, and such other information as is necessary and appropriate to carry out the provisions of this title.

Size and location selection

(D) The applicant shall select the size and location of the area of the exploration plan or recovery plan, which area shall be approved unless the Administrator finds that—

(i) the area is not a logical mining unit; or

(ii) commercial recovery activities in the proposed location would result in a significant adverse impact on the quality of the environment which cannot be avoided by the imposition of reasonable restrictions.

"Logical mining unit."

(E) For purposes of subparagraph (D), "logical mining unit" means—

(i) in the case of a license for exploration, an area of the deep seabed which can be explored under the license in an efficient, economical, and orderly manner with due regard for conservation and protection of the environment, taking into consideration the resource data, other relevant physical and environmental characteristics, and the state of the technology of the applicant as set forth in the exploration plan; or

(ii) in the case of a permit, an area of the deep seabed—

(I) in which hard mineral resources can be recovered in sufficient quantities to satisfy the permittee's estimated production requirements over the initial 20-year term of the permit in an efficient, economical, and orderly manner with due regard for conservation and protection of the environment, taking into consideration the resource data, other relevant physical and environmental characteristics, and the state of the technology of the applicant set out in the recovery plan;

(II) which is not larger than is necessary to satisfy the permittee's estimated production requirements over the initial 20-year term of the permit; and

(III) in relation to which the permittee's estimated production requirements are not found by the Administrator to be unreasonable.

(b) PRIORITY OF RIGHT FOR ISSUANCE.—Subject to section 101(b), priority of right for the issuance of licenses to applicants shall be established on the basis of the chronological order in which license applications which are in substantial compliance with the requirements established under subsection (a)(2) of this section are filed with the Administrator. Priority of right shall not be lost in the case of any application filed which is in substantial but not full compliance with such requirements if the applicant thereafter brings the application into conformity with such requirements within such reasonable period of time as the Administrator shall prescribe in regulations.

(c) ELIGIBILITY FOR CERTIFICATION.—Before the Administrator may certify any application for issuance or transfer of a license for exploration or permit for commercial recovery, the Administrator must find in writing, after consultation with other departments and agencies pursuant to subsection (e) of this section, that—

(1) the applicant has demonstrated that, upon issuance or transfer of the license or permit, the applicant will be financially responsible to meet all obligations which may be required of a licensee or permittee to engage in the exploration or commercial recovery proposed in the application;

(2) the applicant has demonstrated that, upon issuance or transfer of the license or permit, the applicant will have the technological capability to engage in such exploration or commercial recovery;

(3) the applicant has satisfactorily fulfilled all obligations under any license or permit previously issued or transferred to the applicant under this Act; and

(4) the proposed exploration plan or recovery plan of the applicant meets the requirements of this Act and the regulations issued under this Act.

Applications, transmittal to Attorney General and FTC.

(d) ANTITRUST REVIEW.—(1) Whenever the Administrator receives any application for issuance or transfer of a license for exploration or permit for commercial recovery, the Administrator shall transmit promptly a complete copy of such application to the Attorney General of the United States and the Federal Trade Commission.

(2) The Attorney General and the Federal Trade Commission shall conduct such antitrust review of the application as they deem appropriate and shall, if they deem appropriate, advise the Administrator of the likely effects of such issuance or transfer on competition.

Recommendations

(3) The Attorney General and the Federal Trade Commission may make any recommendations they deem advisable to avoid any action upon such application by the Administrator which would create or maintain a situation inconsistent with the antitrust laws. Such recommendations may include, without limitation, the denial of issuance or transfer of the license or permit or issuance or transfer upon such terms and conditions as may be appropriate.

(4) Any advice or recommendation submitted by the Attorney General or the Federal Trade Commission pursuant to this subsection shall be submitted within 90 days after receipt by them of the application. The Administrator shall not issue or transfer the license or permit during that 90-day period, except upon written confirmation by the Attorney General and the Federal Trade Commission that neither intends to submit any further advice or recommendation with respect to the application.

Attorney General and FTC, notification.

(5) If the Administrator decides to issue or transfer the license or permit with respect to which denial of the issuance or transfer of the license or permit has been recommended by the Attorney General or the Federal Trade Commission, or to issue or transfer the license or permit without imposing those terms and conditions recommended by the Attorney General or the Federal Trade Commission as appropriate to prevent any situation inconsistent with the antitrust laws, the Administrator shall, prior to or upon issuance or transfer of the license or permit, notify the Attorney General and the Federal Trade Commission of the reasons for such decision.

Violation.

(6) The issuance or transfer of a license or permit under this title shall not be admissible in any way as a defense to any civil or criminal action for violation of the antitrust laws of the United States, nor shall it in any way modify or abridge any private right of action under such laws.

"Antitrust laws."

(7) As used in this subsection, the term "antitrust laws" means the Act of July 2, 1890 (commonly known as the Sherman Act; 15 U.S.C. 1-7); sections 73 through 77 of the Act of August 27, 1894 (commonly known as the Wilson Tariff Act; 15 U.S.C. 8-11); the Clayton Act (15 U.S.C. 12 et seq.); the Act of June 19, 1936 (commonly known as the Robinson-Patman Price Discrimination Act; 15 U.S.C. 13-13b and 21a); and the Federal Trade Commission Act (15 U.S.C. 41 et seq.).

(e) OTHER FEDERAL AGENCIES.—The Administrator shall provide by regulation for full consultation and cooperation, prior to certification of an application for the issuance or transfer of any license for exploration or permit for commercial recovery and prior to the issuance or transfer of such a license or permit, with other Federal agencies or departments which have programs or activities within their statutory responsibilities which would be affected by the activities proposed in the application for the issuance or transfer of a license or permit. Not later than 30 days after the date of enactment of this Act, the heads of any Federal departments or agencies having expertise concerning, or jurisdiction over, any aspect of the recovery or processing of hard mineral resources shall transmit to the Administrator written comments as to their expertise or statutory responsibilities pursuant to this Act or any other Federal law. To the extent possible, such agencies shall cooperate to reduce the number of separate actions required to satisfy the statutory responsibilities of these agencies. The Administrator shall transmit to each such agency or department a complete copy of each application and each such agency or department, based on its legal responsibilities and authorities, may, not later than 60 days after receipt of the application, recommend certification of the application, issuance or transfer of the license or permit, or denial of such certification, issuance, or transfer. In any case in which an agency or department recommends such a denial, it shall set forth in detail the manner in which the application does not comply with any law or regulation within its area of responsibility and shall indicate how the application may be amended, or how terms, conditions, or restrictions might be added to the license or permit, to assure compliance with such law or regulation.

Written comments, transmittal to Administrator.

Transmittal of applications, recommendations.

(f) REVIEW PERIOD.—All time periods for the review of an application for issuance or transfer of a license or permit established pursuant to this section shall, to the maximum extent practicable, run concurrently from the date on which the application is received by the Administrator.

(g) APPLICATION CERTIFICATION.—Upon making the applicable determinations and findings required in sections 101, 102, and this section with respect to any applicant for the issuance or transfer of a license or a permit and the exploration or commercial recovery proposed by such applicant, after completion of procedures for receiving the application required by this Act, and upon payment by the applicant of the fee required under section 104, the Administrator shall certify the application for the issuance or transfer of the license or permit. The Administrator, to the maximum extent possible, shall endeavor to complete certification action on the application within 100 days after its submission. If final certification or denial of certification has not occurred within 100 days after submission of the application, the Administrator shall inform the applicant in writing of the then pending unresolved issues, the Administrator's efforts to resolve them, and an estimate of the time required to do so.

30 USC 1414

SEC. 104. LICENSE AND PERMIT FEES.

No application for the issuance or transfer of a license for exploration or permit for commercial recovery shall be certified unless the applicant pays to the Administrator a reasonable administrative fee which shall be deposited into miscellaneous receipts of the Treasury. The amount of the administrative fee imposed by the Administrator on any applicant shall reflect the reasonable administrative costs incurred in reviewing and processing the application.

30 USC 1415

SEC. 105. LICENSE AND PERMIT TERMS, CONDITIONS, AND RESTRICTIONS; ISSUANCE AND TRANSFER OF LICENSES AND PERMITS.

Public comments.

(a) ELIGIBILITY FOR ISSUANCE OR TRANSFER OF LICENSE OR PERMIT.—Before issuing or transferring a license for exploration or permit for commercial recovery, the Administrator must find in writing, after consultation with interested departments and agencies pursuant to section 103(e), and upon considering public comments received with respect to the license or permit, that the exploration or commercial recovery proposed in the application—

(1) will not unreasonably interfere with the exercise of the freedoms of the high seas by other states, as recognized under general principles of international law;

(2) will not conflict with any international obligation of the United States established by any treaty or international convention in force with respect to the United States;

(3) will not create a situation which may reasonably be expected to lead to a breach of international peace and security involving armed conflict;

(4) cannot reasonably be expected to result in a significant adverse effect on the quality of the environment, taking into account the analyses and information in any applicable environmental impact statement prepared pursuant to section 109(c) or 109(d); and

(5) will not pose an inordinate threat to the safety of life and property at sea.

(b) ISSUANCE AND TRANSFER OF LICENSES AND PERMITS WITH TERMS, CONDITIONS, AND RESTRICTIONS.—(1) Within 180 days after certification of any application for the issuance or transfer of a license or permit under section 103(g), the Administrator shall propose terms and conditions for, and restrictions on, the exploration or commercial recovery proposed in the application which are consistent with the provisions of this Act and regulations issued under this Act. If additional time is needed, the Administrator shall notify the applicant in writing of the reasons for the delay and indicate the approximate date on which the proposed terms, conditions, and restrictions will be completed. The Administrator shall provide to each applicant a written statement of the proposed terms, conditions, and restrictions. Such terms, conditions, and restrictions shall be generally specified in regulations with general criteria and standards to be used in establishing such terms, conditions, and restrictions for a license or permit and shall be uniform in all licenses or permits, except to the extent that differing physical and environmental conditions require the establishment of special terms, conditions, and restrictions for the conservation of natural resources, protection of the environment, or the safety of life and property at sea.

Written statements.

(2) After preparation and consideration of the final environmental impact statement pursuant to section 109(d) on the proposed issuance of a license or permit and subject to the other provisions of this Act, the Administrator shall issue to the applicant the license or permit with the terms, conditions, and restrictions incorporated therein.

Final environmental impact statements.

(3) The licensee or permittee to whom a license or permit is issued or transferred shall be deemed to have accepted the terms, conditions, and restrictions in the license or permit if the licensee or permittee does not notify the Administrator within 60 days after receipt of the license or permit of each term, condition, or restriction with which the licensee or permittee takes exception. The licensee or permittee may, in addition to such objections as may be raised under applicable provisions of law, object to any term, condition, or restriction on the ground that the term, condition, or restriction is inconsistent with this Act or the regulations promulgated thereunder. If, after the Administrator takes final action on these objections, the licensee or permittee demonstrates that a dispute remains on a material issue of fact, the licensee or permittee is entitled to a decision on the record after the opportunity for an agency hearing pursuant to sections 556 and 557 of title 5, United States Code. Any such decision made by the Administrator shall be subject to judicial review as provided in chapter 7 of title 5, United States Code.

Objection to terms, notification to Administrator.

Hearing.

Judicial review.

5 USC 701 *et seq.*

(c) MODIFICATION AND REVISION OF TERMS, CONDITIONS, AND RESTRICTIONS.—(1) After the issuance or transfer of any license or permit under subsection (b), the Administrator, after consultation with interested agencies and the licensee or permittee, may modify any term, condition, or restriction in such license or permit—

(A) to avoid unreasonable interference with the interests of other states in their exercise of the freedoms of the high seas, as recognized under general principles of international law;

(B) if relevant data and other information (including, but not limited to, data resulting from exploration or commercial recovery activities under the license or permit) indicate that modification is required to protect the quality of the environment or to promote the safety of life and property at sea and if such modification is consistent with the regulations issued to carry out section 109(b);

(C) to avoid a conflict with any international obligation of the United States, established by any treaty or convention in force with respect to the United States, as determined in writing by the President; or

(D) to avoid any situation which may reasonably be expected to lead to a breach of international peace and security involving armed conflict, as determined in writing by the President.

(2) During the term of a license or a permit, the licensee or permittee may submit to the Administrator an application for a revision of the license or permit or the exploration plan or recovery plan associated with the license or permit. The Administrator shall approve such application upon a finding in writing that the revision will comply with the requirements of this Act and the regulations issued under this Act.

License or permit revision, application.

(3) The Administrator shall establish, by regulation, guidelines for a determination of the scale or extent of a proposed modification or revision for which any or all license or permit application requirements and procedures, including a public hearing, shall apply. Any increase in the size of the area, or any change in the location of an area, to which an exploration plan or a recovery plan applies, except an incidental increase or change, must be made by application for another license or permit.

Modification or revision determination.

(4) The procedures set forth in subsection (b)(3) of this section shall apply with respect to any modification under this subsection in the same manner, and to the same extent, as if such modification were an initial term, condition, or restriction proposed by the Administrator.

(d) PRIOR CONSULTATIONS.—Prior to making a determination to issue, transfer, modify, or renew a license or permit under this section, the Administrator shall consult with any affected Regional Fishery Management Council established pursuant to section 302 of the Fishery Conservation and Management Act of 1976 (16 U.S.C. 1852), if the activities undertaken pursuant to such license or permit could adversely affect any fishery within the Fishery Conservation Zone, or any anadromous species or Continental Shelf fishery resource subject to the exclusive management authority of the United States beyond such zone.

Regional Fishery Management Councils.

SEC. 106. DENIAL OF CERTIFICATION OF APPLICATIONS AND OF ISSUANCE, TRANSFER, SUSPENSION, AND REVOCATION OF LICENSES AND PERMITS; SUSPENSION AND MODIFICATION OF ACTIVITIES.

30 USC 1416.

(a) DENIAL, SUSPENSION, MODIFICATION, AND REVOCATION.—(1) The Administrator may deny certification of an application for the

issuance or transfer of, and may deny the issuance or transfer of, a license for exploration or permit for commercial recovery if the Administrator finds that the applicant, or the activities proposed to be undertaken by the applicant, do not meet the requirements set forth in section 103(c), section 105(a), or in any other provision of this Act, or any regulation issued under this Act, for the issuance or transfer of a license or permit.

(2) The Administrator may—

(A) in addition to, or in lieu of, the imposition of any civil penalty under section 302(a), or in addition to the imposition of any fine under section 303, suspend or revoke any license or permit issued under this Act, or suspend or modify any particular activities under such a license or permit, if the licensee or permittee, as the case may be, substantially fails to comply with any provision of this Act, any regulation issued under this Act, or any term, condition, or restriction of the license or permit; and

(B) suspend or modify particular activities under any license or permit, if the President determines that such suspension or modification is necessary (i) to avoid any conflict with any international obligation of the United States established by any treaty or convention in force with respect to the United States, or (ii) to avoid any situation which may reasonably be expected to lead to a breach of international peace and security involving armed conflict.

(3) No action may be taken by the Administrator to deny issuance or transfer of or to revoke any license or permit or, except as provided in subsection (c), to suspend any license or permit or suspend or modify particular activities under a license or permit, unless the Administrator—

Publication in Federal Register

(A) publishes in the Federal Register and gives the applicant, licensee, or permittee, as the case may be, written notice of the intention of the Administrator to deny the issuance or transfer of or to suspend, modify, or revoke the license or permit and the reason therefor; and

Correction of deficiency

(B) if the reason for the proposed denial, suspension, modification, or revocation is a deficiency which the applicant, licensee, or permittee can correct, affords the applicant, licensee, or permittee a reasonable time, but not more than 180 days from the date of the notice or such longer period as the Administrator may establish for good cause shown, to correct such deficiency.

(4) The Administrator shall deny issuance or transfer of, or suspend or revoke, any license or permit or order the suspension or modification of particular activities under a license or permit—

(A) on the thirtieth day after the date of the notice given to the applicant, licensee, or permittee under paragraph (3)(A) unless before such day the applicant, licensee, or permittee requests a review of the proposed denial, suspension, modification, or revocation; or

(B) on the last day of the period established under paragraph (3)(B) in which the applicant, licensee, or permittee must correct a deficiency, if such correction has not been made before such day.

Hearing

(b) ADMINISTRATIVE REVIEW OF PROPOSED DENIAL, SUSPENSION, MODIFICATION, OR REVOCATION.—Any applicant, licensee, or permittee, as the case may be, who makes a timely request under subsection (a) for review of a denial of issuance or transfer, or a suspension or revocation, of a license for exploration or permit for commercial recovery, or a suspension or modification of particular activities under such a license or permit, is entitled to an adjudication on the record after an opportunity for an agency hearing with respect to such denial or suspension, revocation, or modification.

(c) EFFECT ON ACTIVITIES; EMERGENCY ORDERS.—The issuance of any notice of proposed suspension or revocation of a license for exploration or permit for commercial recovery or proposed suspension or modification of particular activities under such a license or permit shall not affect the continuation of exploration or commercial recovery activities by the licensee or permittee. The provisions of paragraphs (3) and (4) of subsection (a) and the first sentence of this subsection shall not apply when the President determines by Executive order that an immediate suspension of a license for exploration or permit for commercial recovery, or immediate suspension or modification of particular activities under such a license or permit, is necessary for the reasons set forth in subsection (a)(2)(B), or the Administrator determines that an immediate suspension of such a license or permit, or immediate suspension or modification of particular activities under such a license or permit, is necessary to prevent a significant adverse effect on the environment or to preserve the safety of life and property at sea, and the Administrator issues an emergency order requiring such immediate suspension.

(d) JUDICIAL REVIEW.—Any determination of the Administrator, after any appropriate administrative review under subsection (b), to certify or deny certification of an application for the issuance or transfer of, or to issue, deny issuance of, transfer, deny the transfer of, modify, renew, suspend, or revoke any license for exploration or permit for commercial recovery, or suspend or modify particular activities under such a license or permit, or any immediate suspension of such a license or permit, or immediate suspension or modification of particular activities under such a license or permit, pursuant to subsection (c), is subject to judicial review as provided in chapter 7 of title 5, United States Code.

5 USC 701 *et seq*

SEC. 107. DURATION OF LICENSES AND PERMITS.

30 USC 1417

(a) DURATION OF A LICENSE.—Each license for exploration shall be issued for a period of 10 years. If the licensee has substantially complied with the license and the exploration plan associated therewith and has requested extensions of the license, the Administrator shall extend the license on terms, conditions, and restrictions consistent with this Act and the regulations issued under this Act for periods of not more than 5 years each.

Extensions

(b) DURATION OF A PERMIT.—Each permit for commercial recovery shall be issued for a term of 20 years and for so long thereafter as hard mineral resources are recovered annually in commercial quantities from the area to which the recovery plan associated with the permit applies. The permit of any permittee who is not recovering hard mineral resources in commercial quantities at the end of 10 years shall be terminated; except that the Administrator shall for good cause shown, including force majeure, adverse economic conditions, unavoidable delays in construction, major unanticipated vessel repairs that prevent the permittee from conducting commercial recovery activities during an annual period, or other circumstances beyond the control of the permittee, extend the 10-year period, but not beyond the initial 20-year term of the permit.

Termination and extensions

SEC. 108. DILIGENCE REQUIREMENTS.

30 USC 1418

(a) IN GENERAL.—The exploration plan or recovery plan and the terms, conditions, and restrictions of each license and permit issued

under this title shall be designed to assure diligent development. Each licensee shall pursue diligently the activities described in the exploration plan of the licensee, and each permittee shall pursue diligently the activities described in the recovery plan of the permittee.

(b) EXPENDITURES.—Each license shall require such periodic reasonable expenditures for exploration by the licensee as the Administrator shall establish, taking into account the size of the area of the deep seabed to which the exploration plan associated with the license applies and the amount of funds which is estimated by the Administrator to be required for commercial recovery of hard mineral resources to begin within the time limit established by the Administrator. Such required expenditures shall not be established at a level which would discourage exploration by persons with less costly technology than is prevalently in use.

Less costly technology

(c) COMMERCIAL RECOVERY.—Once commercial recovery is achieved, the Administrator shall, within reasonable limits and taking into consideration all relevant factors, require the permittee to maintain commercial recovery throughout the period of the permit; except that the Administrator shall for good cause shown, including force majeure, adverse economic conditions, or other circumstances beyond the control of the permittee, authorize the temporary suspension of commercial recovery activities. The duration of such a suspension shall not exceed one year at any one time, unless the Administrator determines that conditions justify an extension of the suspension.

Temporary suspension

30 USC 1419

SEC. 109. PROTECTION OF THE ENVIRONMENT.

(a) ENVIRONMENTAL ASSESSMENT.—(1) DEEP OCEAN MINING ENVIRONMENTAL STUDY (DOMES).—The Administrator shall expand and accelerate the program assessing the effects on the environment from exploration and commercial recovery activities, including seabased processing and the disposal at sea of processing wastes, so as to provide an assessment, as accurate as practicable, of environmental impacts of such activities for the implementation of subsections (b), (c), and (d).

(2) SUPPORTING OCEAN RESEARCH.—The Administrator also shall conduct a continuing program of ocean research to support environmental assessment activity through the period of exploration and commercial recovery authorized by this Act. The program shall include the development, acceleration, and expansion, as appropriate, of studies of the ecological, geological, and physical aspects of the deep seabed in general areas of the ocean where exploration and commercial development under the authority of this Act are likely to occur, including, but not limited to—

(A) natural diversity of the deep seabed biota;

(B) life histories of major benthic, midwater, and surface organisms most likely to be affected by commercial recovery activities;

(C) long- and short-term effects of commercial recovery on the deep seabed biota; and

(D) assessment of the effects of seabased processing activities.

Plan, submittal to Congress

Within 160 days after the date of enactment of this Act, the Administrator shall prepare a plan to carry out the program described in this subsection, including necessary funding levels for the next five fiscal years, and shall submit the plan to the Congress.

(b) TERMS, CONDITIONS, AND RESTRICTIONS.—Each license and permit issued under this title shall contain such terms, conditions, and restrictions, established by the Administrator, which prescribe the actions the licensee or permittee shall take in the conduct of exploration and commercial recovery activities to assure protection of the environment. The Administrator shall require in all activities under new permits, and wherever practicable in activities under existing permits, the use of the best available technologies for the protection of safety, health, and the environment wherever such activities would have a significant effect on safety, health, or the environment, except where the Administrator determines that the incremental benefits are clearly insufficient to justify the incremental costs of using such technologies. Before establishing such terms, conditions, and restrictions, the Administrator shall consult with the Administrator of the Environmental Protection Agency, the Secretary of State, and the Secretary of the department in which the Coast Guard is operating, concerning such terms, conditions, and restrictions, and the Administrator shall take into account and give due consideration to the information contained in each final environmental impact statement prepared with respect to such license or permit pursuant to subsection (d).

Best available technologies, use

Consultation

(c) PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT.—(1) If the Administrator, in consultation with the Administrator of the Environmental Protection Agency and with the assistance of other appropriate Federal agencies, determines that a programmatic environmental impact statement is required, the Administrator shall, as soon as practicable after the enactment of this Act, with respect to the areas of the oceans in which any United States citizen is expected to undertake exploration and commercial recovery under the authority of this Act—

(A) prepare and publish draft programmatic environmental impact statements which assess the environmental impacts of exploration and commercial recovery in such areas;

(B) afford all interested parties a reasonable time after such dates of publication to submit comments to the Administrator on such draft statements; and

Comments

(C) thereafter prepare (giving full consideration to all comments submitted under subparagraph (B)) and publish final programmatic environmental impact statements regarding such areas.

(2) With respect to the area of the oceans in which exploration and commercial recovery by any United States citizen will likely first occur under the authority of this Act, the Administrator shall prepare a draft and final programmatic environmental impact statement as required under paragraph (1), except that—

(A) the draft programmatic environmental impact statement shall be prepared and published as soon as practicable but not later than 270 days (or such longer period as the Administrator may establish for good cause shown) after the date of enactment of this Act; and

(B) the final programmatic environmental impact statement shall be prepared and published within 180 days (or such longer period as the Administrator may establish for good cause shown) after the date on which the draft statement is published.

(d) ENVIRONMENTAL IMPACT STATEMENTS ON ISSUANCE OF LICENSES AND PERMITS.—The issuance of, but not the certification of an application for, any license or permit under this title shall be deemed to be a major Federal action significantly affecting the quality of the human environment for purposes of section 102 of the National Environmental Policy Act of 1969. In preparing an environmental

42 USC 4332 Consultation

impact statement pursuant to this subsection, the Administrator shall consult with the agency heads referred to in subsection (b) and shall take into account, and give due consideration to, the relevant information contained in any applicable studies and any other environmental impact statement prepared pursuant to this section. Each draft environmental impact statement prepared pursuant to this subsection shall be published, with the terms, conditions, and restrictions proposed pursuant to section 105(b), within 180 days (or such longer period as the Administrator may establish for good cause shown in writing) following the date on which the application for the license or permit concerned is certified by the Administrator. Each final environmental impact statement shall be published 180 days (or such longer period as the Administrator may establish for good cause shown in writing) following the date on which the draft environmental impact statement is published.

Publication

Publication

(e) EFFECT ON OTHER LAW.—For the purposes of this Act, any vessel or other floating craft engaged in commercial recovery or exploration shall not be deemed to be "a vessel or other floating craft" under section 502(12)(B) of the Clean Water Act and any discharge of a pollutant from such vessel or other floating craft shall be subject to the Clean Water Act.

"A vessel or other floating craft."

33 USC 1362

(f) STABLE REFERENCE AREAS.—

International negotiations.

(1) Within one year after the enactment of this Act the Secretary of State shall, in cooperation with the Administrator and as part of the international consultations pursuant to subsection 118(f), negotiate with all nations that are identified in such subsection for the purpose of establishing international stable reference areas in which no mining shall take place: *Provided, however,* That this subsection shall not be construed as requiring any substantial withdrawal of deep seabed areas from deep seabed mining authorized by this Act.

(2) Nothing in this Act shall be construed as authorizing the United States to unilaterally establish such reference area or areas nor shall the United States recognize the unilateral claim to such reference area or areas by any State.

Report to Congress.

(3) Within four years after the enactment of this Act, the Secretary of State shall submit a report to Congress on the progress of establishing such stable reference areas, including the designation of appropriate zones to insure a representative and stable biota of the deep seabed.

"Stable reference areas."

(4) For purposes of this section "stable reference areas" shall mean an area or areas of the deep seabed to be used as a reference zone or zones for purposes of resource evaluation and environmental assessment of deep seabed mining in which no mining will occur.

30 USC 1420.

SEC. 110. CONSERVATION OF NATURAL RESOURCES.

For the purpose of conservation of natural resources, each license and permit issued under this title shall contain, as needed, terms, conditions, and restrictions which have due regard for the prevention of waste and the future opportunity for the commercial recovery of the unrecovered balance of the hard mineral resources in the area to which the license or permit applies. In establishing these terms, conditions, and restrictions, the Administrator shall consider the state of the technology, the processing system utilized and the value and potential use of any waste, the environmental effects of the exploration or commercial recovery activities, economic and resource data, and the national need for hard mineral resources. As used in this Act, the term "conservation of natural resources" is not intended to grant, imply, or create any inference of production controls or price regulation, in particular those which would affect the volume of production, prices, profits, markets, or the decision of which minerals or metals are to be recovered, except as such effects may be incidental to actions taken pursuant to this section.

"Conservation of natural resources."

SEC. 111. PREVENTION OF INTERFERENCE WITH OTHER USES OF THE HIGH SEAS. 30 USC 1421

Each license and permit issued under this title shall include such restrictions as may be necessary and appropriate to ensure that exploration or commercial recovery activities conducted by the licensee or permittee do not unreasonably interfere with the interests of other states in their exercise of the freedoms of the high seas, as recognized under general principles of international law.

SEC. 112. SAFETY OF LIFE AND PROPERTY AT SEA. 30 USC 1422

(a) CONDITIONS REGARDING VESSELS.—The Secretary of the department in which the Coast Guard is operating, in consultation with the Administrator, shall require in any license or permit issued under this title, in conformity with principles of international law, that vessels documented under the laws of the United States and used in activities authorized under the license or permit comply with conditions regarding the design, construction, alteration, repair, equipment, operation, manning, and maintenance relating to vessel and crew safety and the promotion of safety of life and property at sea.

(b) APPLICABILITY OF OTHER LAWS.—Notwithstanding any other provision of law, any vessel described in subsection (a) shall be subject to the provisions of the International Voyage Load Line Act of 1973, and to the provisions of titles 52 and 53 of the Revised Statutes and all Acts amendatory thereof or supplementary thereto.

46 USC 86 note.

46 USC 362 note, 543 note.

SEC. 113. RECORDS, AUDITS, AND PUBLIC DISCLOSURE. 30 USC 1423

(a) RECORDS AND AUDITS.—(1) Each licensee and permittee shall keep such records, consistent with standard accounting principles, as the Administrator shall by regulation prescribe. Such records shall include information which will fully disclose expenditures for exploration and commercial recovery, including processing, of hard mineral resources, and such other information as will facilitate an effective audit of such expenditures.

(2) The Administrator and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access, for purposes of audit and examination, to any books, documents, papers, and records of licensees and permittees which are necessary and directly pertinent to verify the expenditures referred to in paragraph (1).

Accessibility.

(b) SUBMISSION OF DATA AND INFORMATION.—Each licensee and permittee shall be required to submit to the Administrator such data or other information as the Administrator may reasonably need for purposes of making determinations with respect to the issuance, revocation, modification, or suspension of any license or permit; compliance with the reporting requirement contained in section 309; and evaluation of the exploration or commercial recovery activities conducted by the licensee or permittee.

(c) PUBLIC DISCLOSURE.—Copies of any document, report, communication, or other record maintained or received by the Administrator containing data or information required under this title shall be made available to any person upon any request which (1) reasonably

describes such record and (2) is made in accordance with rules adopted by the Administrator stating the time, place, fees (if any, not to exceed the direct cost of the services rendered), and procedures to be followed, except that neither the Administrator nor any other officer or employee of the United States may disclose any data or information knowingly and willingly required under this title the disclosure of which is prohibited by section 1905 of title 18, United States Code. Any officer or employee of the United States who discloses data or information in violation of this subsection shall be subject to the penalties set forth in section 303(b) of this Act.

Penalties

30 USC 1424

SEC. 114. MONITORING OF ACTIVITIES OF LICENSEES AND PERMITTEES.

Each license and permit issued under this title shall require the licensee or permittee—

Federal observers

(1) to allow the Administrator to place appropriate Federal officers or employees as observers aboard vessels used by the licensee or permittee in exploration or commercial recovery activities (A) to monitor such activities at such time, and to such extent, as the Administrator deems reasonable and necessary to assess the effectiveness of the terms, conditions, and restrictions of the license or permit, and (B) to report to the Administrator whenever such officers or employees have reason to believe there is a failure to comply with such terms, conditions, and restrictions;

(2) to cooperate with such officers and employees in the performance of monitoring functions; and

(3) to monitor the environmental effects of the exploration and commercial recovery activities in accordance with guidelines issued by the Administrator and to submit such information as the Administrator finds to be necessary and appropriate to assess environmental impacts and to develop and evaluate possible methods of mitigating adverse environmental effects.

30 USC 1425

SEC. 115. RELINQUISHMENT, SURRENDER, AND TRANSFER OF LICENSES AND PERMITS.

(a) RELINQUISHMENT AND SURRENDER.—Any licensee or permittee may at any time, without penalty—

(1) surrender to the Administrator a license or a permit issued to the licensee or permittee; or

(2) relinquish to the Administrator, in whole or in part, any right to conduct any exploration or commercial recovery activities authorized by the license or permit.

Liability

Any licensee or permittee who surrenders a license or permit, or relinquishes any such right, shall remain liable with respect to all violations and penalties incurred, and damage to persons or property caused, by the licensee or permittee as a result of activities engaged in by the licensee or permittee under such license or permit.

(b) TRANSFER.—Any license or permit, upon written request of the licensee or permittee, may be transferred by the Administrator; except that no such transfer may occur unless the proposed transferee is a United States citizen and until the Administrator determines that (1) the proposed transfer is in the public interest, and (2) the proposed transferee and the exploration or commercial recovery activities the transferee proposes to conduct meet the requirements of this Act and regulations issued under this Act.

SEC. 116. PUBLIC NOTICE AND HEARINGS.

30 USC 1426

(a) REQUIRED PROCEDURES.—The Administrator may issue regulations to carry out this Act, establish and significantly modify terms, conditions, and restrictions in licenses and permits issued under this title, and issue or transfer licenses and permits under this title, only after public notice and opportunity for comment and hearings in accordance with the following:

Publication in Federal Register

(1) The Administrator shall publish in the Federal Register notice of all applications for licenses and permits, all proposals to issue or transfer licenses and permits, all regulations implementing this Act, all terms, conditions, and restrictions on licenses and permits, and all proposals to significantly modify licenses and permits. Interested persons shall be permitted to examine the materials relevant to any of these actions, and shall have at least 60 days after publication of such notice to submit written comments to the Administrator.

Comments

(2) The Administrator shall hold a public hearing in an appropriate location and may employ such additional methods as the Administrator deems appropriate to inform interested persons about each action specified in paragraph (1) and to invite their comments thereon.

(b) ADJUDICATORY HEARING.—If the Administrator determines that there exists one or more specific and material factual issues which require resolution by formal processes, at least one adjudicatory hearing shall be held in the District of Columbia in accordance with the provisions of section 554 of title 5, United States Code. The record developed in any such adjudicatory hearing shall be part of the basis for the Administrator's decision to take any action referred to in subsection (a). Hearings held pursuant to this section shall be consolidated insofar as practicable with hearings held by other agencies.

Consolidation of hearings

SEC. 117. CIVIL ACTIONS.

30 USC 1427

(a) EQUITABLE RELIEF.—Except as provided in subsection (b) of this section, any person may commence a civil action for equitable relief on that person's behalf in the United States District Court for the District of Columbia—

(1) against any person who is alleged to be in violation of any provision of this Act or any condition of a license or permit issued under this title; or

(2) against the Administrator when there is alleged a failure of the Administrator to perform any act or duty under this Act which is not discretionary,

if the person bringing the action has a valid legal interest which is or may be adversely affected by such alleged violation or failure to perform. In suits brought under this subsection, the district court shall have jurisdiction, without regard to the amount in controversy or the citizenship of the parties, to enforce the provisions of this Act, or any term, condition, or restriction of a license or permit issued under this title, or to order the Administrator to perform such act or duty.

(b) NOTICE.—No civil action may be commenced—

(1) under subsection (a)(1) of this section—

(A) prior to 60 days after the plaintiff has given notice of the alleged violation to the Administrator and to any alleged violator; or

(B) if the Administrator or the Attorney General has commenced and is diligently prosecuting a civil or criminal

action with respect to the alleged violation in a court of the United States; except that in any such civil action, any person having a valid legal interest which is or may be adversely affected by the alleged violation may intervene; or

(2) under subsection (a)(2) of this section, prior to 60 days after the plaintiff has given notice of such action to the Administrator. Notice under this subsection shall be given in such a manner as the Administrator shall prescribe by regulation.

(c) COSTS AND FEES.—The court, in issuing any final order in any action brought under subsection (a) of this section, may award costs of litigation, including reasonable attorney and expert witness fees, to any party whenever the court determines that such an award is appropriate.

(d) RELATIONSHIP TO OTHER LAW.—Nothing in this section shall restrict the rights which any person or class of persons may have under other law to seek enforcement or to seek any other relief. All vessel safety and environmental requirements of or under this Act shall be in addition to other requirements of law.

30 USC 1428

SEC. 118. RECIPROCATING STATES.

(a) DESIGNATION.—The Administrator, in consultation with the Secretary of State and the heads of other appropriate departments and agencies, may designate any foreign nation as a reciprocating state if the Secretary of State finds that such foreign nation—

(1) regulates the conduct of its citizens and other persons subject to its jurisdiction engaged in exploration for, and commercial recovery of, hard mineral resources of the deep seabed in a manner compatible with that provided in this Act and the regulations issued under this Act, which includes adequate measures for the protection of the environment, the conservation of natural resources, and the safety of life and property at sea, and includes effective enforcement provisions;

(2) recognizes licenses and permits issued under this title to the extent that such nation, under its laws, (A) prohibits any person from engaging in exploration or commercial recovery which conflicts with that authorized under any such license or permit and (B) complies with the date for issuance of licenses and the effective date for permits provided in section 102(c)(1)(D) of this Act;

(3) recognizes, under its procedures, priorities of right, consistent with those provided in this Act and the regulations issued under this Act, for applications for licenses for exploration or permits for commercial recovery, which applications are made either under its procedures or under this Act; and

(4) provides an interim legal framework for exploration and commercial recovery which does not unreasonably interfere with the interests of other states in their exercise of the freedoms of the high seas, as recognized under general principles of international law.

(b) EFFECT OF DESIGNATION.—No license or permit shall be issued under this title permitting any exploration or commercial recovery which will conflict with any license, permit, or equivalent authorization issued by any foreign nation which is designated as a reciprocating state under subsection (a).

(c) NOTIFICATION.—Upon receipt of any application for a license or permit under this title, the Administrator shall immediately notify all reciprocating states of such application. The notification shall include those portions of the exploration plan or recovery plan

submitted with respect to the application, or a summary thereof, and any other appropriate information not required to be withheld from public disclosure by section 113(c).

(d) REVOCATION OF RECIPROCATING STATE STATUS.—The Administrator, in consultation with the Secretary of State and the heads of other appropriate departments and agencies, shall revoke the designation of a foreign nation as a reciprocating state if the Secretary of State finds that such foreign nation no longer complies with the requirements of subsection (a). At the request of any holder of a license, permit, or equivalent authorization of such foreign nation, who obtained the license, permit, or equivalent authorization while such foreign nation was a reciprocating state, the Administrator, in consultation with the Secretary of State, may decide to recognize the license, permit, or equivalent authorization for purposes of subsection (b). Consultation

(e) AUTHORIZATION.—The President is authorized to negotiate agreements with foreign nations necessary to implement this section. Presidential negotiation

(f) INTERNATIONAL CONSULTATIONS.—The Administrator, in consultation with the Secretary of State and the heads of other appropriate departments and agencies, shall consult with foreign nations which enact, or are preparing to enact, domestic legislation establishing an interim legal framework for exploration and commercial recovery of hard mineral resources. Such consultations shall be carried out with a view to facilitating the designation of such nations as reciprocating states and, as necessary, the negotiation of agreements with foreign nations authorized by subsection (e). In addition, the Administrator shall provide such foreign nations with information on environmental impacts of exploration and commercial recovery activities, and shall provide any technical assistance requested in designing regulatory measures to protect the environment. Assistance on environmental protection

TITLE II—TRANSITION TO INTERNATIONAL AGREEMENT

SEC. 201. DECLARATION OF CONGRESSIONAL INTENT. 30 USC 1441

It is the intent of Congress—

(1) that any international agreement to which the United States becomes a party should, in addition to promoting other national oceans objectives—

(A) provide assured and nondiscriminatory access, under reasonable terms and conditions, to the hard mineral resources of the deep seabed for United States citizens, and

(B) provide security of tenure by recognizing the rights of United States citizens who have undertaken exploration or commercial recovery under title I before such agreement enters into force with respect to the United States to continue their operations under terms, conditions, and restrictions which do not impose significant new economic burdens upon such citizens with respect to such operations with the effect of preventing the continuation of such operations on a viable economic basis; *Ante*, p. 557.

(2) that the extent to which any such international agreement conforms to the provisions of paragraph (1) should be determined by the totality of the provisions of such agreement, including, but not limited to, the practical implications for the security of investments of any discretionary powers granted to an international regulatory body, the structures and decisionmaking procedures of such body, the availability of impartial and effective procedures for the settlement of disputes, and any features that

tend to discriminate against exploration and commercial recovery activities undertaken by United States citizens; and

(3) that this Act should be transitional pending—

(A) the adoption of an international agreement at the Third United Nations Conference on the Law of the Sea, and the entering into force of such agreement, or portions thereof, with respect to the United States, or

(B) if such adoption is not forthcoming, the negotiation of a multilateral or other treaty concerning the deep seabed, and the entering into force of such treaty with respect to the United States.

30 USC 1412

SEC. 202. EFFECT OF INTERNATIONAL AGREEMENT.

If an international agreement enters into force with respect to the United States, any provision of title I, this title, or title III, and any regulation issued under any such provision, which is not inconsistent with such international agreement shall continue in effect with respect to United States citizens. In the implementation of such international agreement the Administrator, in consultation with the Secretary of State, shall make every effort, to the maximum extent practicable consistent with the provisions of that agreement, to provide for the continued operation of exploration and commercial recovery activities undertaken by United States citizens prior to entry into force of the agreement. The Administrator shall submit to the Congress, within one year after the date of such entry into force, a report on the actions taken by the Administrator under this section, which report shall include, but not be limited to—

Ante, p. 557

Report to Congress

(1) a description of the status of deep seabed mining operations of United States citizens under the international agreement; and

(2) an assessment of whether United States citizens who were engaged in exploration or commercial recovery on the date such agreement entered into force have been permitted to continue their operations.

30 USC 1413

SEC. 203. PROTECTION OF INTERIM INVESTMENTS.

In order to further the objectives set forth in section 201, the Administrator, not more than one year after the date of enactment of this Act—

Proposed legislation, submittal to Congress

(1) shall submit to the Congress proposed legislation necessary for the United States to implement a system for the protection of interim investments that has been adopted as part of an international agreement and any resolution relating to such international agreement; or

Status of negotiations, report to Congress

(2) if a system for the protection of interim investments has not been so adopted, shall report to the Congress on the status of negotiations relating to the establishment of such a system.

30 USC 1414

SEC. 204. DISCLAIMER OF OBLIGATION TO PAY COMPENSATION.

Sections 201 and 202 of this Act do not create or express any legal or moral obligation on the part of the United States Government to compensate any person for any impairment of the value of that person's investment in any operation for exploration or commercial recovery under title I which might occur in connection with the entering into force of an international agreement with respect to the United States.

TITLE III—ENFORCEMENT AND MISCELLANEOUS PROVISIONS

SEC. 301. PROHIBITED ACTS.

30 USC 1461.

It is unlawful for any person who is a United States citizen, or a foreign national on board a vessel documented or numbered under the laws of the United States, or subject to the jurisdiction of the United States under a reciprocating state agreement negotiated under section 118(e)—

(1) to violate any provision of this Act, any regulation issued under this Act, or any term, condition, or restriction of any license or permit issued to such person under this Act;

(2) to engage in exploration or commercial recovery after the revocation, or during the period of suspension, of an applicable license or permit issued under this Act, to engage in a particular exploration or commercial recovery activity during the period such activity has been suspended under this Act, or to fail to modify a particular exploration or commercial recovery activity for which modification was required under this Act;

(3) to refuse to permit any Federal officer or employee authorized to monitor or enforce the provisions of this Act, as provided in sections 114 and 304, to board a vessel documented or numbered under the laws of the United States, or any vessel for which such boarding is authorized by a treaty or executive agreement, for purposes of conducting any search or inspection in connection with the monitoring or enforcement of this Act or any regulation, term, condition, or restriction referred to in paragraph (1);

(4) to forcibly assault, resist, oppose, impede, intimidate, or interfere with any such authorized officer or employee in the conduct of any search or inspection described in paragraph (3);

(5) to resist a lawful arrest for any act prohibited by this section;

(6) to ship, transport, offer for sale, sell, purchase, import, export, or have custody, control, or possession of any hard mineral resource recovered, processed, or retained in violation of this Act or any regulation, term, condition, or restriction referred to in paragraph (1); or

(7) to interfere with, delay, or prevent, by any means, the apprehension or arrest of any other person subject to this section knowing that such other person has committed any act prohibited by this section.

SEC. 302. CIVIL PENALTIES.

30 USC 1462

(a) ASSESSMENT OF PENALTY.—Any person subject to section 301 who is found by the Administrator, after notice and an opportunity for a hearing in accordance with section 554 of title 5, United States Code, to have committed any act prohibited by section 301 shall be liable to the United States for a civil penalty. The amount of the civil penalty shall not exceed $25,000 for each violation. Each day of a continuing violation shall constitute a separate offense. The amount of such civil penalty shall be assessed by the Administrator by written notice. In determining the amount of such penalty, the Administrator shall take into account the nature, circumstances, extent, and gravity of the prohibited act committed and, with respect to the violator, any history of prior offenses, good faith demonstrated in attempting to achieve timely compliance after being cited for the violation, and such other matters as justice may require.

Written notice

Appeal filing, copy to Administrator

(b) REVIEW OF CIVIL PENALTY.—Any person subject to section 301 against whom a civil penalty is assessed under subsection (a) may obtain review thereof in an appropriate district court of the United States by filing a notice of appeal in such court within 30 days from the date of such order and by simultaneously sending a copy of such notice by certified mail to the Administrator. The Administrator shall promptly file in such court a certified copy of the record upon which the particular violation was found and such penalty was imposed, as provided in section 2112 of title 28, United States Code. The findings and order of the Administrator shall be set aside by such court if they are not found to be supported by substantial evidence, as provided in section 706(2)(E) of title 5, United States Code.

Referral to Attorney General

(c) ACTION UPON FAILURE TO PAY ASSESSMENT.—If any person subject to section 301 fails to pay a civil penalty assessed against such person after the penalty has become final, or after the appropriate court has entered final judgment in favor of the Administrator, the Administrator shall refer the matter to the Attorney General of the United States, who shall recover the civil penalty assessed in any appropriate district court of the United States. In such action, the validity and appropriateness of the final order imposing the civil penalty shall not be subject to review.

(d) COMPROMISE OR OTHER ACTION BY THE ADMINISTRATOR.—The Administrator may compromise, modify, or remit, with or without conditions, any civil penalty which is subject to imposition or which has been imposed under this section unless an action brought under subsection (b) or (c) is pending in a court of the United States.

30 USC 1463

SEC. 303. CRIMINAL OFFENSES.

(a) OFFENSE.—A person subject to section 301 is guilty of an offense if such person willfully and knowingly commits any act prohibited by section 301.

(b) PUNISHMENT.—Any offense described in paragraphs (1), (2), and (6) of section 301 is punishable by a fine of not more than $75,000 for each day during which the violation continues. Any offense described in paragraphs (3), (4), (5), and (7) of section 301 is punishable by a fine of not more than $75,000 or imprisonment for not more than six months, or both. If, in the commission of any offense, the person subject to the jurisdiction of the United States uses a dangerous weapon, engages in conduct that causes bodily injury to any Federal officer or employee, or places any such Federal officer or employee in fear of imminent bodily injury, the offense is punishable by a fine of not more than $100,000 or imprisonment for not more than ten years, or both.

30 USC 1464

SEC. 304. ENFORCEMENT.

Coast Guard, assistance

(a) RESPONSIBILITY.—Subject to the other provisions of this subsection, the Administrator shall enforce the provisions of this Act. The Secretary of the department in which the Coast Guard is operating shall exercise such other enforcement responsibilities with respect to vessels subject to the provisions of this Act as are authorized under other provisions of law and may, upon the specific request of the Administrator, assist the Administrator in the enforcement of the provisions of this Act. The Secretary of the department in which the Coast Guard is operating shall have the exclusive responsibility for enforcement measures which affect the safety of life and property at sea. The Administrator and the Secretary of the department in which the Coast Guard is operating may, by agreement, on a reimbursable basis or otherwise, utilize the personnel, services, equipment, including aircraft and vessels, and facilities of any other Federal agency or department, and may authorize officers or employees of other departments or agencies to provide assistance as necessary in carrying out subsection (b). While providing such assistance, these officers and employees shall be under the control, authority, and supervision of the Coast Guard. The Administrator and the Secretary of the department in which the Coast Guard is operating may issue regulations jointly or severally as may be necessary and appropriate to carry out their duties under this section.

Other Federal agencies, assistance

(b) POWERS OF AUTHORIZED OFFICERS.—To enforce this Act on board any vessel subject to the provisions of this Act, any officer who is authorized by the Administrator or by the Secretary of the department in which the Coast Guard is operating may—

(1) board and inspect any vessel which is subject to the provisions of this Act;

(2) search any such vessel if the officer has reasonable cause to believe that the vessel has been used or employed in the violation of any provision of this Act;

(3) arrest any person subject to section 301 if the officer has reasonable cause to believe that the person has committed a criminal offense under section 303;

(4) seize any such vessel together with its gear, furniture, appurtenances, stores, and cargo, used or employed in, or with respect to which it reasonably appears that such vessel was used or employed in, the violation of any provision of this Act if such seizure is necessary to prevent evasion of the enforcement of this Act;

(5) seize any hard mineral resource recovered or processed in violation of any provision of this Act;

(6) seize any other evidence related to any violation of any provision of this Act;

(7) execute any warrant or other process issued by any court of competent jurisdiction; and

(8) exercise any other lawful authority.

(c) DEFINITION.—For purposes of this section, the term "provisions of this Act" or "provision of this Act" means (1) any provision of title I or II of this title, (2) any regulation issued under title I, title II, or this title, and (3) any term, condition, or restriction of any license or permit issued under title I.

Ante, pp. 557, 575, 577

(d) PROPRIETARY INFORMATION.—Proprietary and privileged information seized or maintained under this title concerning a person or vessel engaged in exploration or commercial recovery shall not be made available for general or public use or inspection. The Administrator and the Secretary of the department in which the Coast Guard is operating shall issue regulations to insure the confidentiality of privileged and proprietary information.

Regulations

30 USC 1465

SEC. 305. LIABILITY OF VESSELS.

Any vessel documented or numbered under the laws of the United States (except a public vessel engaged in noncommercial activities) which is used in any violation of this Act, any regulation issued under this Act, or any term, condition, or restriction of any license or permit issued under title I shall be liable in rem for any civil penalty assessed or criminal fine imposed and may be proceeded against in any district court of the United States having jurisdiction thereof.

30 USC 1466

SEC. 306. CIVIL FORFEITURES.

(a) IN GENERAL.—Any vessel subject to the provisions of sections 304 and 305, including its gear, furniture, appurtenances, stores, and cargo, which is used, in any manner, in connection with or as a result of the commission of any act prohibited by section 301 and any hard mineral resource which is recovered, processed, or retained, in any manner, in connection with or as a result of the commission of any such act, shall be subject to forfeiture to the United States. All or part of such vessel, and all such hard mineral resources, may be forfeited to the United States pursuant to a civil proceeding under this section. All provisions of law relating to the seizure, judicial forfeiture, and condemnation of a vessel or cargo for violation of the customs laws, and the disposition of the vessel, cargo, or proceeds from the sale thereof and the remission or mitigation of such forfeitures shall apply to seizures and forfeitures incurred or alleged to have been incurred under the provisions of this section insofar as such provisions of law are applicable and not inconsistent with this Act.

(b) JURISDICTION OF COURTS.—Any district court of the United States which has jurisdiction under section 307 shall have jurisdiction, upon application by the Attorney General on behalf of the United States, to order any forfeiture authorized under subsection (a) and any action provided for under subsection (d).

Seizure of property by Attorney General.

(c) JUDGMENT.—If a judgment is entered for the United States in a civil forfeiture proceeding under this section, the Attorney General may seize any property or other interest declared forfeited to the United States which has not previously been seized pursuant to this Act or for which security has not previously been obtained under subsection (d).

Bond or other security

(d) PROCEDURE.—Any officer authorized to serve any process in rem which is issued by a court having jurisdiction under section 307 shall stay the execution of such process, or discharge any property seized pursuant to such process, upon the receipt of a satisfactory bond or other security from any person subject to section 301 claiming such property. Such bond or other security shall be conditioned upon such person (1) delivering such property to the appropriate court upon order thereof, without any impairment of its value; or (2) paying the monetary value of such property pursuant to any order of such court. Judgment shall be recoverable on such bond or other security against both the principal and any sureties in the event that any condition thereof is breached, as determined by such court.

(e) REBUTTABLE PRESUMPTION.—For purposes of this section, it shall be a rebuttable presumption that all hard mineral resources found on board a vessel subject to the provisions of sections 304 and 305 which is seized in connection with an act prohibited by section 301 were recovered, processed, or retained in violation of this Act.

30 USC 1467

SEC. 307. JURISDICTION OF COURTS.

The district courts of the United States shall have exclusive jurisdiction over any case or controversy arising under the provisions of this Act. These courts may, at any time—

(1) enter restraining orders or prohibitions;

(2) issue warrants, process in rem, or other process;

(3) prescribe and accept satisfactory bonds or other security; and

(4) take such other actions as are in the interest of justice.

SEC. 308. REGULATIONS.

30 USC 1468
Solicitation of views

(a) PROPOSED REGULATIONS.—Not later than 270 days after the date of enactment of this Act, the Administrator shall solicit the views of the agency heads referred to in section 109(b) and of interested persons, and issue, in accordance with section 553 of title 5, United States Code, such proposed regulations as are required by or are necessary and appropriate to implement titles I and II and this title. The Administrator shall hold at least one public hearing on such proposed regulations.

Ante, pp. 557, 575.
Public hearing

Views and comments, solicitation and consideration

(b) FINAL REGULATIONS.—Not later than 180 days after the date on which proposed regulations are issued pursuant to subsection (a), the Administrator shall solicit the views of the agency heads referred to in section 109(b) and of interested persons, consider the comments received during the public hearing required in subsection (a) and any written comments on the proposed regulations received by the Administrator, and issue, in accordance with section 553 of title 5, United States Code, such regulations as are required by or are necessary and appropriate to implement titles I and II and this title.

(c) AMENDMENTS.—The Administrator may at any time amend regulations issued pursuant to subsection (b) as the Administrator determines to be necessary and appropriate in order to provide for the conservation of natural resources within the meaning of section 110, protection of the environment, and the safety of life and property at sea. Such amended regulations shall apply to all exploration or commercial recovery activities conducted under any license or permit issued or maintained pursuant to this Act, except that any such amended regulations which provide for conservation of natural resources shall apply to exploration or commercial recovery conducted under an existing license or permit during the present term of such license or permit only if the Administrator determines that such amended regulations providing for conservation of natural resources will not impose serious or irreparable economic hardship on the licensee or permittee. Any amendment to regulations under this subsection shall be made on the record after an opportunity for an agency hearing.

Hearing

(d) CONSISTENCY.—This Act and the regulations issued under this Act shall not be deemed to supersede any other Federal laws or treaties or regulations issued thereunder.

SEC. 309. BIENNIAL REPORT.

30 USC 1469

(a) SUBMISSION OF REPORTS.—The Administrator shall submit to the Congress—

(1) not later than December 31, 1981, a report on the administration of this Act during the period beginning on the date of enactment of this Act and ending September 30, 1981; and

(2) not later than December 31 of each second year thereafter, a report on the administration of this Act during the two fiscal years preceding the date on which the report is required to be filed.

(b) CONTENTS.—Each report filed pursuant to subsection (a) shall include, but not be limited to, the following information with respect to the reporting period.

(1) Licenses and permits issued, modified, revised, suspended, revoked, relinquished, surrendered, or transferred; denials of certifications of applications for the issuance or transfer of licenses and permits; denials of issuance or transfer of licenses and permits; and required suspensions and modifications of activities under licenses and permits.

(2) A description and evaluation of the exploration and commercial recovery activities undertaken, including, but not limited to, information setting forth the quantities of hard mineral resources recovered and the disposition of such resources.

(3) An assessment of the environmental impacts, including a description and estimate of any damage caused by any adverse effects on the quality of the environment resulting from such activities.

(4) The number and description of all civil and criminal proceedings, including citations, instituted under this title, and the current status of such proceedings.

(5) Such recommendations as the Administrator deems appropriate for amending this Act to further fulfill its purposes.

30 USC 1470

SEC. 310. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Administrator, for purposes of carrying out the provisions of titles I and II and this title, such sums as may be necessary for the fiscal years ending September 30, 1981, and September 30, 1982.

30 USC 1471

SEC. 311. SEVERABILITY.

If any provision of this Act or any application thereof is held invalid, the validity of the remainder of the Act, or any other application, shall not be affected thereby.

TITLE IV—TAX

Deep Seabed Hard Mineral Removal Tax Act of 1979.
26 USC 1 note.

SEC. 401. SHORT TITLE.

This title may be cited as the "Deep Seabed Hard Mineral Removal Tax Act of 1979"

SEC. 402. IMPOSITION OF TAX ON REMOVAL OF HARD MINERAL RESOURCES FROM DEEP SEABED.

(a) GENERAL RULE.—Chapter 36 of the Internal Revenue Code of 1954 (relating to certain other excise taxes) is amended by adding at the end thereof the following new subchapter:

"Subchapter F—Tax on Removal of Hard Mineral Resources From Deep Seabed

26 USC 4995

"SEC. 4495. IMPOSITION OF TAX.

"(a) GENERAL RULE.—There is hereby imposed a tax on any removal of a hard mineral resource from the deep seabed pursuant to a deep seabed permit.

"(b) AMOUNT OF TAX.—The amount of the tax imposed by subsection (a) on any removal shall be 3.75 percent of the imputed value of the resource so removed.

"(c) LIABILITY FOR TAX.—The tax imposed by subsection (a) shall be paid by the person to whom the deep seabed permit is issued.

"(d) TIME FOR PAYING TAX.—The time for paying the tax imposed by subsection (a) shall be the time prescribed by the Secretary by regulations. The time so prescribed with respect to any removal shall be not earlier than the earlier of—

"(1) the commercial use of, or the sale or disposition of, any portion of the resource so removed, or

"(2) the day which is 12 months after the date of the removal of the resource.

"SEC. 4496. DEFINITIONS. 26 USC 4996

"(a) DEEP SEABED PERMIT.—For purposes of this subchapter, the term 'deep seabed permit' means a permit issued under title I of the Deep Seabed Hard Minerals Resources Act.

"(b) HARD MINERAL RESOURCE.—For purposes of this subchapter, the term 'hard mineral resource' means any deposit or accretion on, or just below, the surface of the deep seabed of nodules which contain one or more minerals, at least one of which is manganese, nickel, cobalt, or copper.

"(c) DEEP SEABED.—For purposes of this subchapter, the term 'deep seabed' means the seabed, and the subsoil thereof to a depth of 10 meters, lying seaward of, and outside—

"(1) the Continental Shelf of any nation; and

"(2) any area of national resource jurisdiction of any foreign nation, if such area extends beyond the Continental Shelf of such nation and such jurisdiction is recognized by the United States.

"(d) CONTINENTAL SHELF.—For purposes of this subchapter, the term 'Continental Shelf' means—

"(1) the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 meters or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of such areas; and

"(2) the seabed and subsoil of similar submarine areas adjacent to the coasts of islands.

"SEC. 4497. IMPUTED VALUE. 26 USC 4997

"(a) IN GENERAL.—For purposes of this subchapter, the term 'imputed value' means, with respect to any hard mineral resource, 20 percent of the fair market value of the commercially recoverable metals and minerals contained in such resource. Such fair market value shall be determined—

"(1) as of the date of the removal of the hard mineral resource from the deep seabed; and

"(2) as if the metals and minerals contained in such resource were separated from such resource and were in the most basic form for which there is a readily ascertainable market price.

"(b) COMMERCIAL RECOVERABILITY.—

"(1) MANGANESE, NICKEL, COBALT, AND COPPER.—For purposes of subsection (a), manganese, nickel, cobalt, and copper shall be treated as commercially recoverable.

"(2) MINIMUM QUANTITIES AND PERCENTAGES.—The Secretary may by regulations prescribe for each metal or mineral quantities or percentages below which the metal or mineral shall be treated as not commercially recoverable.

"(c) SUSPENSION OF TAX WITH RESPECT TO CERTAIN METALS AND MINERALS HELD FOR LATER PROCESSING.—

"(1) ELECTION.—The permittee may, in such manner and at such time as may be prescribed by regulations, elect to have the application of the tax suspended with respect to one or more commercially recoverable metals or minerals in the resource which the permittee does not intend to process within one year of the date of extraction. Any metal or mineral affected by such

election shall not be taken into account in determining the imputed value of the resource at the time of its removal from the deep seabed. Any suspension under this paragraph with respect to a metal or mineral shall be permanent unless there is a redetermination affecting such metal or mineral under paragraph (2).

"(2) LATER COMPUTATION OF TAX.—If the permittee processes any metal or mineral affected by the election under paragraph (1), or if he sells any portion of the resource containing such a metal or mineral, then the amount of the tax under section 4495 shall be redetermined as if there had been no suspension under paragraph (1) with respect to such metal or mineral. In any such case there shall be added to the increase in tax determined under the preceding sentence an amount equal to the interest (at rates determined under section 6621) on such increase for the period from the date prescribed for paying the tax on the resources (determined under section 4495(d)) to the date of the processing or sale.

26 USC 6621

Ante, p. 582

"(d) DETERMINATIONS OF VALUE.—All determinations of value necessary for the application of this subchapter shall be made by the Secretary (after consultation with other appropriate Federal officials) on the basis of the best available information. Such determinations shall be made under procedures established by the Secretary by regulations.

26 USC 4498

"SEC. 4498. TERMINATION.

Ante, p. 582

"(a) GENERAL RULE.—The tax imposed by section 4495 shall not apply to any removal from the deep seabed after the earlier of—

"(1) the date on which an international deep seabed treaty takes effect with respect to the United States, or

"(2) the date 10 years after the date of the enactment of this subchapter.

"(b) INTERNATIONAL DEEP SEABED TREATY.—For purposes of subsection (a), the term 'international deep seabed treaty' means any treaty which—

"(1) is adopted by a United Nations Conference on the Law of the Sea, and

"(2) requires contributions to an international fund for the sharing of revenues from deep seabed mining.".

(b) CLERICAL AMENDMENT.—The table of subchapters for chapter 36 of such Code is amended by adding at the end thereof the following new item:

"SUBCHAPTER F. Tax on removal of hard mineral resources from deep seabed."

26 USC 4495 note

(c) EFFECTIVE DATE.—The amendments made by this section shall take effect on January 1, 1980.

30 USC 1472

SEC. 103. ESTABLISHMENT OF DEEP SEABED REVENUE SHARING TRUST FUND.

(a) CREATION OF TRUST FUND.—There is established in the Treasury of the United States a trust fund to be known as the "Deep Seabed Revenue Sharing Trust Fund" (hereinafter in this section referred to as the "Trust Fund"), consisting of such amounts as may be appropriated or credited to the Trust Fund as provided in this section.

(b) TRANSFER TO TRUST FUND OF AMOUNTS EQUIVALENT TO CERTAIN TAXES.—

(1) IN GENERAL.—There are hereby appropriated to the Trust Fund amounts determined by the Secretary of the Treasury to be equivalent to the amounts of the taxes received in the Treasury under section 4495 of the Internal Revenue Code of 1954.

Ante, p. 582

(2) METHOD OF TRANSFER.—The amounts appropriated by paragraph (1) shall be transferred at least quarterly from the general fund of the Treasury to the Trust Fund on the basis of estimates made by the Secretary of the Treasury of the amounts referred to in paragraph (1) received in the Treasury. Proper adjustments shall be made in the amounts subsequently transferred to the extent prior estimates were in excess of or less than the amount required to be transferred.

(c) MANAGEMENT OF TRUST FUND.—

(1) REPORT.—It shall be the duty of the Secretary of the Treasury to hold the Trust Fund, and to report to the Congress for the fiscal year ending September 30, 1980, and each fiscal year thereafter on the financial condition and the results of the operations of the Trust Fund during the preceding year and on its expected condition and operations during the fiscal year and the next five fiscal years after the fiscal year. Such report shall be printed as a House document of the session of the Congress to which the report is made.

Printing as House document.

(2) INVESTMENT.—

(A) IN GENERAL.—It shall be the duty of the Secretary of the Treasury to invest such portion of the Trust Fund as is not, in his judgment, required to meet current withdrawals. Such investments may be made only in interest bearing obligations of the United States. For such purpose, such obligations may be acquired (i) on original issue at the issue price, or (ii) by purchase of outstanding obligations at the market price.

(B) SALE OF OBLIGATIONS.—Any obligation acquired by the Trust Fund may be sold by the Secretary at the market price.

(C) INTEREST ON CERTAIN PROCEEDS.—The interest on, and the proceeds from the sale or redemption of, any obligations held in the Trust Fund shall be credited to and form a part of the Trust Fund.

(d) EXPENDITURES FROM TRUST FUND.—If an international deep seabed treaty is ratified by and in effect with respect to the United States on or before the date ten years after the date of the enactment of this Act, amounts in the Trust Fund shall be available, as provided by appropriations Acts, for making contributions required under such treaty for purposes of the sharing among nations of the revenues from deep seabed mining. Nothing in this subsection shall be deemed to authorize any program or other activity not otherwise authorized by law.

(e) USE OF FUNDS.—If an international deep seabed treaty is not in effect with respect to the United States on or before the date ten years after the date of the enactment of this Act, amounts in the Trust Fund shall be available for such purposes as Congress may hereafter provide by law.

(f) INTERNATIONAL DEEP SEABED TREATY.—For purposes of this section, the term "international deep seabed treaty" has the meaning given to such term by section 4498(b) of the Internal Revenue Code of 1954.

Ante, p. 584

30 USC 1473.

SEC. 404. ACT NOT TO AFFECT TAX OR CUSTOMS OR TARIFF TREATMENT OF DEEP SEABED MINING.

Except as otherwise provided in section 402, nothing in this Act shall affect the application of the Internal Revenue Code of 1954. Nothing in this Act shall affect the application of the customs or tariff laws of the United States.

Approved June 28, 1980.

LEGISLATIVE HISTORY:

HOUSE REPORTS: No. 96-411, Pt. 1 (Comm. on Interior and Insular Affairs), Pt. 2 (Comm. on Merchant Marine and Fisheries), Pt. 3 (Comm. on Ways and Means), and Pt. IV (Comm. on Foreign Affairs).

SENATE REPORTS: No. 96-307 (Comm. on Energy and Natural Resources; Comm. on Commerce, Science, and Transportation; and Comm. on Foreign Relations), No. 96-357 (Comm. on Finance), and No. 96-360 (Comm. on Environment and Public Works), all accompanying S. 493.

CONGRESSIONAL RECORD
Vol. 125 (1979): Dec. 14, S. 493 considered and passed Senate.
Vol. 126 (1980): June 9, H.R. 2759 considered and passed House.
June 23, considered and passed Senate, amended.
June 25, House concurred in Senate amendments.

WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS:
Vol. 16, No. 27 (1980): July 3, Presidential statement.

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