Deep Seabed Mining

A Report to Congress

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
December 1995

UNITED STATES DEPARTMENT OF COMMERCE
The Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

MAR 13 1986

The Honorable Albert L. Gore, Jr.
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

I am pleased to submit the National Oceanic and Atmospheric Administration's (NOAA) Deep Seabed Mining Report. The report is in compliance with Section 309 of the Deep Seabed Hard Mineral Resources Act, 30 U.S.C. § 1401 *et seq.*

Because of the low level of industrial and NOAA activity under the Act, NOAA proposes to defer further issuances of this Report until such time as the level of activity increases. In the meantime, NOAA will keep the Congress informed of any important developments that affect the development of the industry.

Sincerely,

D. James Baker

Enclosure

THE ADMINISTRATOR

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The Honorable Newt Gingrich
Speaker of the House of Representatives
Washington, D.C. 20515

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DEEP SEABED MINING

Report to Congress

Prepared by:

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December 1995

U. S. Department of Commerce
Ronald H. Brown, Secretary

National Oceanic and Atmospheric Administration
D. James Baker, Under Secretary for Oceans and Atmosphere

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EXECUTIVE SUMMARY

The National Oceanic and Atmospheric Administration (NOAA) activities related to the implementation of the Deep Seabed Hard Mineral Resources Act ("the Act"), 30 U.S.C. § 1401 et seq., in fiscal years 1994 and 1995 are described in this eighth biennial report to the Congress. The Act establishes an interim domestic legal regime under which U.S. citizens may conduct exploration for and commercial recovery of manganese nodules pending ratification by and entry into force of an acceptable Law of the Sea Treaty with respect to the United States. On October 7, 1994, the President transmitted to the Senate, for its advice and consent, the United Nations Convention on the Law of the Sea of 1982 (UNCLOS) and the Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea ("the Agreement").

The authorization for appropriations under the Act expired on September 30, 1994, and was not renewed. While the authorization for appropriations has expired, the Act remains in force. No funds were appropriated for the program in Fiscal Year 1995.

Licenses and Permits

Four exploration licenses were issued during 1984. On May 21, 1993, the Kennecott Consortium surrendered its license for Site USA-4. On June 17, 1993, NOAA received an application from Ocean Minerals Company (OMCO) for an exploration license for the surrendered license area. The license was issued on December 22, 1994.

On February 1, and April 22, 1994, Ocean Mining Associates (OMA) and Ocean Management, Inc. (OMI), respectively, submitted applications to NOAA to revise the schedule of expenditures contained in the exploration plans for Deep Seabed Mining Exploration Licenses USA-2 and USA-3. The revision to OMA's license was approved on October 17, 1994, and the revision to OMI's license was approved on November 2, 1994.

In two letters dated September 29, 1995, OMCO informed NOAA that Cyprus Minerals Company was withdrawing from the consortium, that the deep seabed mining activities of the remaining partners was being consolidated in Lockheed Martin Missiles & Space (LMMS), that OMCO was being abolished and that it wants to reduce the schedules of expenditures for licenses USA-1 and USA-4. NOAA has requested information from LMMS to complete an application to revise its licenses.

There were no other licensing or permitting activities.

Exploration and Commercial Recovery Activities

During the two years covered by this report, licensees have continued to monitor legal, technical, scientific, market and economic factors affecting the feasibility of engaging in commercial deep seabed mining. Data analyses and equipment development studies were also performed.

Environmental Assessments and Impacts

There were no licensee at-sea activities during the period covered by this report. NOAA's efforts during these years continued to be directed toward research in support of future regulatory decisions, focussing on international cooperative at sea environmental studies; however, activities were virtually terminated when no funds were appropriated for the program in Fiscal Year 1995.

NOAA's principal environmental research effort has been the Benthic Impact Experiment (BIE), designed to assess the recovery of the benthic (bottom dwelling) ecosystem from exposure to the near bottom plume which will be generated by the collector used to recover manganese nodules from the sea floor. Previous NOAA research has adequately addressed other potential environmental effects until larger, at-sea mining system tests are performed. The BIE has been a cooperative effort with the Yuzhmorgeologiya Association of the Russian Ministry of Geology. During 1994, a Russian research ship, with both U.S. and Russian scientists, revisited the Pacific Ocean area where a plume was generated during 1993 using NOAA's Deep Sea Sediment Resuspension System (DSSRS) from the Russian ship. After a camera survey, box corer and multicorer samples were randomly collected in the control area and the area of heaviest sediment deposition. Meiofauna and species analyses are expected to be completed during April 1996. A statistical evaluation of the sediment redeposition impact will be conducted to two taxonomic levels (to the functional group and species level) for both meio- and macrofauna.

NOAA has continued to consult and cooperate with other mining nations on at-sea environmental research and to establish a network for exchange of information on research efforts and regulatory measures to protect the environment. During 1994, the Metal Mining Agency of Japan (MMAJ) conducted a BIE in its western mining claim area using NOAA's DSSRS. InterOceanMetal (IOM), an eastern European mining consortium, performed a similar BIE study using NOAA's DSSRS and ancillary equipment during 1994 and 1995. NOAA, MMAJ and IOM will share all information from these research efforts. A comparison of results will further predictive capabilities in evaluating the benthic impacts of deep seabed mining.

Civil and Criminal Proceedings

No civil nor criminal proceedings were instituted under provisions of the Act.

International Conflict Resolution

No international conflict resolution efforts were required during 1994 and 1995. During 1994, the Republic of Korea registered minesites with the United Nations' Preparatory Commission for UNCLOS, but it was determined that there were no conflicts with the U.S. licensed sites.

Recommendations

There are no recommendations regarding amending this Act.

CHAPTER I
INTRODUCTION

Purpose and Scope

This eighth biennial report to the Congress, submitted pursuant to section 309 of the Deep Seabed Hard Mineral Resources Act ("the Act"), 30 U.S.C. § 1401 *et seq.*, describes deep seabed mining activities conducted by the National Oceanic and Atmospheric Administration (NOAA) during fiscal years 1994 and 1995. The Act establishes a domestic legal regime under which U.S. citizens may conduct exploration for and commercial recovery of manganese nodules from the deep seabed beyond national jurisdiction pending entry into force of an acceptable Law of the Sea Treaty with respect to the United States.

The authorization for appropriations under the Act expired on September 30, 1994, and was not renewed. While the authorization for appropriations has expired, the Act remain in force. NOAA has been using existing resources to continue its licensing functions and to conclude environmental research in an orderly manner.

The report has two chapters. Chapter I provides: an overview of the nature of the resource; a description of the national interest in the development of ocean minerals resources and related technologies; an identification of the members of the mining consortia who hold exploration licenses issued pursuant to the Act; a description of the status of industrial activities; and a brief description of the deep seabed mining technology. Chapter II describes: NOAA activities associated with the four exploration licenses issued under provisions of the Act, including the issuance of a license for an area surrendered during 1993; the activities of each of the licensees; and NOAA's environmental research activities in support of future regulatory decisions.

Activities reportable under the Act but not yet having occurred include: commercial recovery permit issuance or denial, environmental damage from mining activities, and civil and criminal proceedings.

The Resource

Manganese nodules were first discovered during the 1873-76 oceanographic voyage of the *HMS CHALLENGER*, but remained scientific curiosities until their value as a potential mineral resource was realized in the late 1950's. The nodules are concretions which are found on the bottom the world's oceans and of some lakes and inland seas. Most of them range from peas to potatoes in size and shape. They are composed chiefly of metal oxides, usually occurring as a crust which has slowly accumulated layer by layer on some nucleating object such as a small rock or shark's tooth. Current interest in nodules focuses on their nickel, copper, cobalt and manganese content, although other metals, such as molybdenum, may be of interest by the time an industry develops.

While nodules occur on a world-wide basis, their population density on the sea floor and the concentrations of the value metals are highly variable. Main commercial interest has focussed on an area

in the east-central Pacific Ocean (Figure 1) that contains a higher population of high-grade nodules than other areas. The nodules in this area have a high average percentage of the value metals, especially nickel (approximately 1.4 percent nickel, 1.2 percent copper, 0.2 percent cobalt, 28 percent manganese). This 13 million km^2 area is commonly known as the Clarion-Clipperton Fracture Zone (CCFZ) and is where all of the U.S. license sites and most of the foreign sites are located. This area has been estimated to contain from 3.6 to 13.5 billion metric tons (dry weight) of nodules--an apparently very large resource for the future.

The National Interest

The United States is dependent on imports for its supply of primary nickel, cobalt and manganese. Nickel, used mainly in stainless steel and other high temperature steel alloys, is supplied by Australia and Canada. Cobalt, which is imported primarily from Zaire and Zambia, is used for the high-temperature alloys necessary in the aerospace industry. Manganese, imported primarily from the Republic of South Africa, France, Gabon and Australia, is required in the steel industry. Copper, in which the United States is nearly self-sufficient, is used mainly in electrical equipment. Development of deep seabed resources would provide the United States with a stable supply of these imported metals at competitive prices.

While political instability has decreased in recent years, dependence on foreign sources of metals can lead to uncertainties in supply ranging from cost instability to supply disruption. In addition, to further develop their economies, foreign producers may retain more of their domestic output as they acquire their own capability to manufacture finished products.

The U.S.-based consortia are the world's leaders in the development of the technology needed to recover and process manganese nodules. There is a significant opportunity for the technological leaders to develop export markets. However, national efforts in China, India, Japan, Korea and Eastern Europe are beginning to erode this leadership.

The establishment of a domestic deep seabed manganese nodule mining industry would provide the United States with: (a) a stable supply of strategic metals important to the economy at competitive prices, (b) a reduced annual balance of payments deficit, (c)increased investment in a basic industry, (d) regional employment benefits, and (e) continued leadership in new ocean technologies.

The depressed level of world metal markets and a recent discovery of a major, high grade nickel deposit in Canada has dimmed prospects for commercial deep seabed mining in the near future; the new discovery is also important because it could lead to additional discoveries on land. Nevertheless, because of its future benefits to the economy, nodule mining should remain an option for United States industry in the years ahead.

Mining Consortia

The three domestic deep seabed mining licensees include one domestic partnership and two

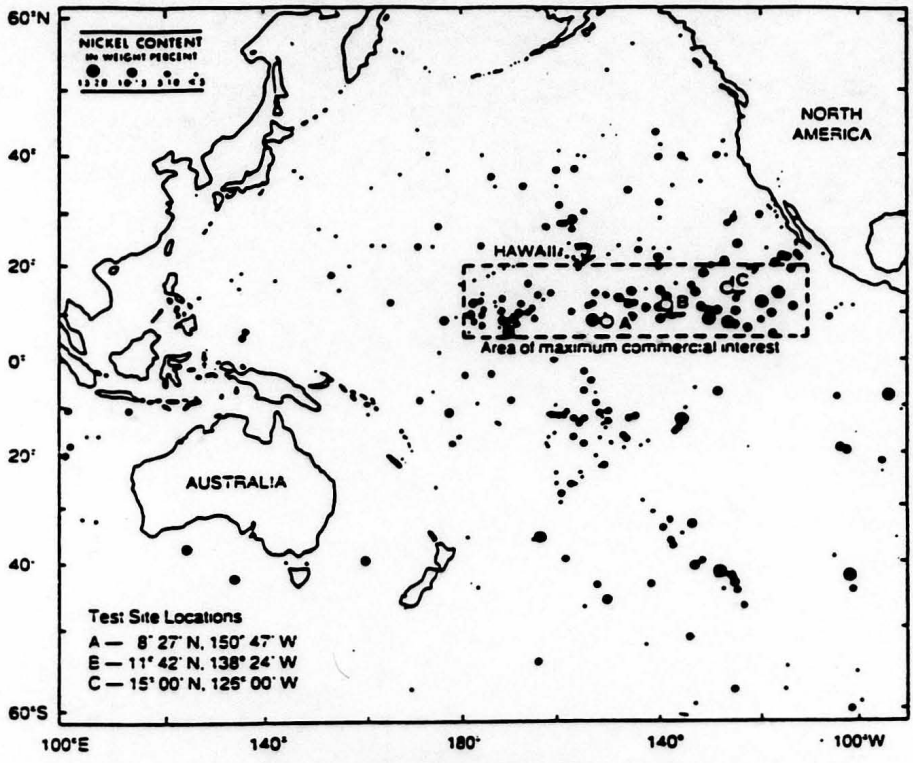


Figure 1 - **High Nickel Concentration in Managese Nodules in th Pacific Ocean and Area of Greatest Commercial Intersest for Deep Seabed Mining, including test sites used during NOAA's Deep Ocean Mining Environmental Studies (DOMES) Project (Horn, Horn and DeLach, 1972)**

multinational private sector consortia with U.S. members (Figure 2). They, along with the Kennecott Consortium (KCON) were issued exploration licenses by NOAA in 1984. KCON surrendered its license(USA-4) to NOAA on May 21, 1993, and the site was applied for by another of the licensees, Ocean Minerals Company (OMCO), on June 17, 1993. The license to USA-4 was issued to OMCO on December 22, 1994. As can be seen from Figure 2, foreign participation in the consortia now consists of entities in Canada, Belgium, Germany and Japan.

Figure 2 - Holders of U.S. Deep Seabed Mining Exploration Licenses, including dates of consortia formation and parent companies, as set forth in applications filed with NOAA in February 1982 and subsequently amended.

Nation	USA-1 & USA-4 Ocean Minerals Company* (OMCO) (11/77)	USA-2 Ocean Management, Inc. (OMI) (5/75)	USA-3 Ocean Mining Associates (OMA) (10/74)
United States	Cyprus Minerals Co. (Cyprus Mining Co.) - 50 % Lockheed Martin Missiles & Space (Lockheed Martin Corp.) - 37.528 % Lockheed Martin Systems Co., Inc. (Lockheed Martin Corp.) - 12.472 %	Schlumberger Technology Corp. - 24.67 %	Essex Minerals Co. (USX Corp.) - 33.333 % Sun Ocean Ventures, Inc. (Sun Co.) - 33.333 %
Belgium			Union Seas, Inc. [a U.S. corporation] (Union Miniere) - 33.333 %
Canada		INCO, Ltd. - 25.11 %	
Germany		AMR (Preussag A.G. & Metallgesellschft A.G.) - 25.11 %	
Japan		Deep Ocean Mining Co., Ltd. (19 Japanese companies) - 25.11 %	

* - OMCO informed NOAA in a letter dated September 29, 1995, that: Cyprus Minerals Co. is withdrawing from the consortium; remaining ownership interests are being consolidated in Lockheed Martin Missiles & Space; and OMCO is to be abolished.

The United Kingdom and Germany each have also issued licenses for additional areas under their own respective domestic seabed mining legislation. The license issued by the United Kingdom to the Kennecott Consortium was also surrendered in 1993. The German license is held by Arbeitsgemeinschaft meerestechnisch gewinnbare Rohstoffe (AMR), a deep seabed mining consortium of two German firms, which is a partner in the U.S.-based Ocean Management, Inc. (OMI), consortium.

There are also seven national consortia and state-sponsored organizations presently developing deep seabed mining capabilities. These are: Association Francaise pour l'Etude et la Recherche des Nodules (AFERNOD), a French consortium of government and industry; the Deep Ocean Resource Development Company (DORDCO), a Japanese consortium of government and industry; the Southern Production Association for Marine Geological Operations (Yuzhmorgeologiya) of Russia's Ministry of Geology; the Polymetallic Nodules Project of India's National Institute of Oceanography; the InterOceanMetal (IOM) Group, a consortium consisting of the governments of Russia, Poland, the Czech and Slovak Federal Republic, Bulgaria and Cuba; the China Ocean Mineral Resources Research and Development Association (COMRA) of the People's Republic of China; and Korean Ocean Research and Development Institute (KORDI) of the Republic of Korea. All have registered sites as "Pioneer Investors" with the Preparatory Commission established in connection with the United Nations Convention on the Law of the Sea (UNCLOS). Figure 3 shows the U.S. licensed areas in relation to all the foreign areas, except India's. The site registered by India is in the Indian Ocean. Multilateral agreements have been executed by all parties with sites in the CCFZ to respect each other's boundaries.

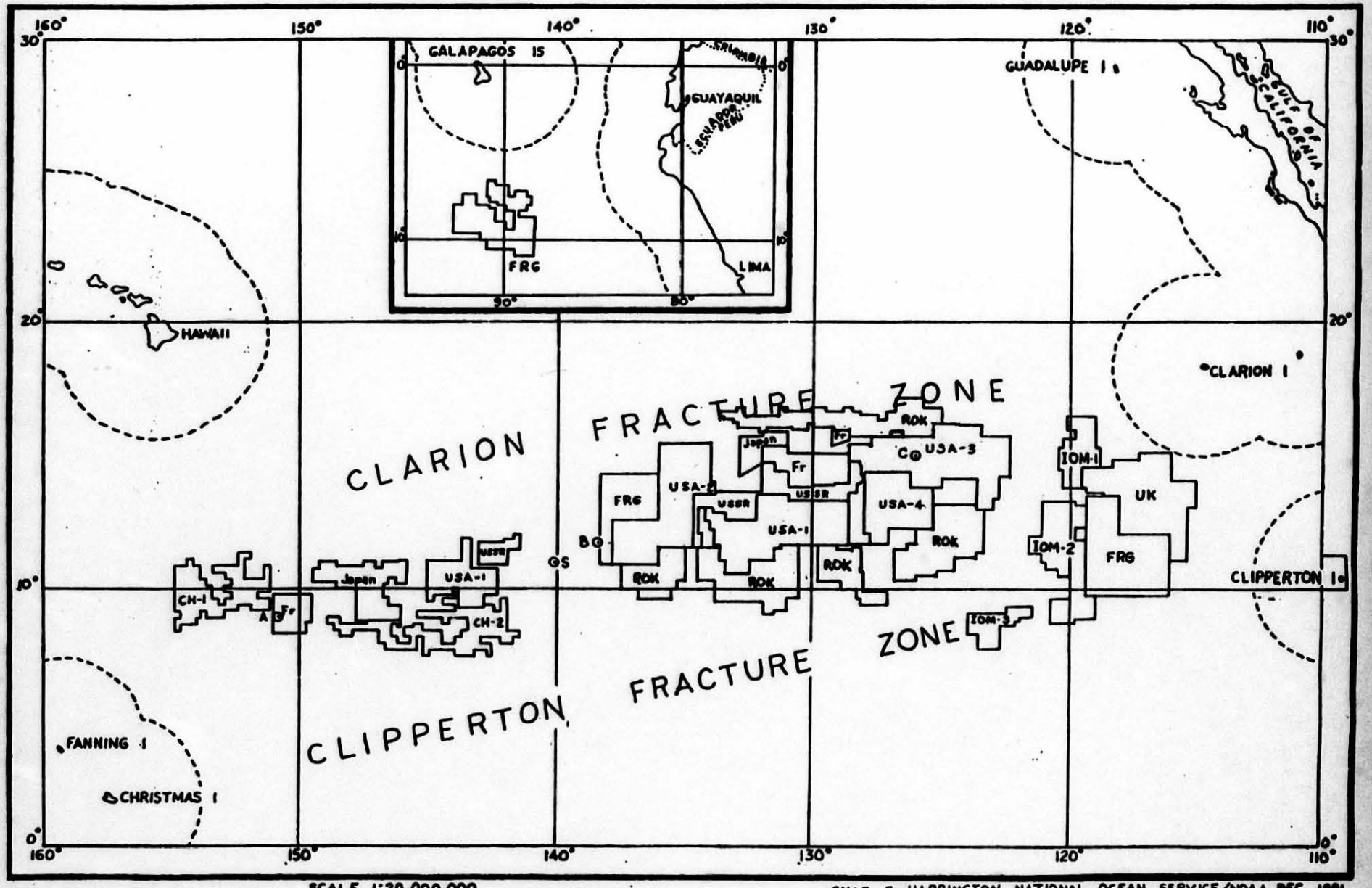
Overview of Industrial Activity

All of the NOAA licensees had conducted extensive sea floor studies and technology development, including at-sea testing of integrated mining systems, prior to enactment of the Act. After domestic and international resolution of conflicting claims and issuance of the exploration licenses, activities consisted primarily of the analysis and integration of exploration data received from other consortia and monitoring technological, legal and economic developments affecting their ability to engage in commercial recovery. Although further at-sea surveys and mining system tests, which would be authorized under the license, will be necessary in some cases, no additional at-sea data collection and tests are presently scheduled by the licensees. The specific activities conducted by each licensee over the last two years are described in Chapter II.

The major impediment to an increased level of industrial activity has been the badly depressed markets for the metals to be obtained from nodules, coupled with supply and demand factors. Until the previously mentioned large nickel discovery in Canada, it was generally assumed that commercial deep seabed mining would not be economically feasible until between the Years 2005 and 2010, at the earliest. However, the new discovery, and additional discoveries onshore it may lead to, will probably delay this at least another decade or so.

The licensees are also cautious about committing major new funds to their ventures because of concerns regarding the UNCLOS and the agreement on implementation of its Part XI ("the Agreement") which was reached during the Summer of 1994. UNCLOS and the Agreement were transmitted to the Senate by the President for its advice and consent on October 7, 1994. While the specific concerns of the licensees differ somewhat, the licensees essentially view the new regime as presenting economic and political risks that they do not face under the Act. Both OMA and OMI stated in their annual reports to NOAA that the changes made are not sufficient in terms of being able to attract private sector investment in deep seabed mining.

DEEP SEABED MINING OPERATING AREAS



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CHAS. E. HARRINGTON, NATIONAL OCEAN SERVICE/NOAA, DEC. 1991

Technology Presently Contemplated for Mining

A first generation deep seabed mining system will likely consist of: one or two mineships; four to six nodule transport ships; a dedicated marine terminal; an onshore nodule transportation system (probably a slurry pipeline if within the continental United States); an onshore processing plant; a processing reject disposal facility; and various supporting facilities and operations, such as an exploration ship, a high speed crew and supply ship and an exploration data analysis center. While one licensee will not rule out at-sea processing, at-sea processing is considered unlikely in first generation systems. U.S. licensees have tested at-sea, at a small scale, the nodule recovery system which will be operated from the mineship(s) and have developed nodule processing systems at a "larger than bench scale," but smaller than pilot plant scale. The nodule recovery system consists of a sea floor nodule collector, pipestring and lift system.

The nodule collector will sweep the sea floor in nearly adjacent swaths, with each swath being approximately twenty meters (65 feet) wide. The collector will be either towed or self-propelled; both types have been tested by licensees. One licensee states that it intends to use a self-propelled collector. Bottom water, sediment and some benthic fauna will be drawn into the collector in addition to nodules. The collector will attempt to discharge as much of the sediment as possible near the sea floor while feeding the nodules into a 4,000 to 5,000 meter (12,000 to 15,000 foot) pipe leading to the surface. There is a possibility that the collector will grind nodules before feeding them into the pipe and it may also have onboard buffer storage to account for the variable distribution of nodules on the sea floor. The upward flow of water and nodules in the pipe will be created by submerged pumps, an air lift or a combination of the two. Both pumps and air lift systems have been tested by the licensees. While advances made in technology since the tests in the late-1970's should significantly improve efficiency and reliability, the overall approach to nodule recovery is expected to remain the same. This type of nodule recovery system is commonly referred to as a hydraulic system.

The licensees have each developed methods to recover the value metals from the nodules. The processing technique selected depends on whether the operator wants to produce nickel, copper and cobalt as the primary products, a so-called "3-metal" operation, or to produce manganese as a primary product as well, a so-called "4-metal" operation. Many 3-metal processes have the production of some, to all of the manganese as an option. The Act requires processing to be performed within the United States unless the President determines such a requirement contravenes overriding national interests of the United States or the NOAA Administrator finds that processing outside of the United States is necessary for the economic viability of the venture (metals must be returned to the United States to the extent of the permittee's ownership if the Administrator finds this necessitated by the national interest).

As will be discussed in Chapter II, NOAA's environmental research has addressed both potential at-sea and potential onshore effects of deep seabed mining. Research results to date suggest that commercial deep seabed mining is likely to be environmentally compatible.

Workshop and External Review

NOAA's National Ocean Service (NOS) conducted a Deep Seabed Mining Workshop on January 19, 1994 in Washington D.C.. The purpose of the workshop was to assist NOAA and the Department of Commerce (DOC) develop a position on reauthorization of the Act by assembling a comprehensive base of information pertinent to the future of nodule mining. Representatives from other Federal agencies, the licensees, academia, environmental interest groups, the legal community and Congressional staffs were invited to ensure all aspects of the issues were addressed. A report on the workshop was published in March 1994 with the recommendations generally endorsing the program's continuation and current direction.

NOAA and DOC ultimately decided not to request funds specifically for the Deep Seabed Mining Program for FY 95. This was based upon the low level of near term industrial activity, there being other, higher priority programs requiring funds and the anticipation of severe budget cuts. NOAA did commit to using base funding to continue the license activities and to an orderly conclusion of the program's primary environmental research effort, the Benthic Impact Experiment (BIE).

Based on discussions of the research at the workshop, NOS decided to conduct a scientific peer review of the BIE. This was done on August 10-11, 1994, in Seattle, WA. The purposes of the review were to obtain external scientific opinion on the project's scope and effectiveness and to evaluate future research directions, so that in the event Congress did restore funding, NOS would have a clear strategy to follow. The results of the review are described in Chapter II. A final report on the review was published in December 1994.

CHAPTER II
IMPLEMENTATION OF THE DEEP SEABED HARD MINERAL RESOURCES ACT

Licenses and Permits

In 1984 the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) issued exploration licenses to four U.S.-based deep seabed mining consortia pursuant to provisions of the Deep Seabed Hard Mineral Resources Act ("the Act"), 30 U.S.C. § 1401 *et. seq*, and NOAA's implementing regulations, 15 CFR Part 970 :

USA-1 - to Ocean Minerals Company (OMCO)
USA-2 - to Ocean Management, Inc. (OMI)
USA-3 - to Ocean Mining Associates (OMA)
USA-4 - to Kennecott Consortium (KCON)

The four licensees were authorized to conduct exploration activities in their respective areas for the 10-year duration of the licenses established by the Act. In 1991, NOAA approved five-year extensions (until 1999), as provided for in the Act, of the licenses of OMA, OMI, and OMCO and revisions of their exploration plans. OMA, OMI and OMCO each cited adverse market conditions as the reason to delay applying for a permit for commercial recovery and for reducing expenditures. On February 1 and April 22, 1994, OMA and OMI respectively, submitted applications to NOAA to further revise, downward, the schedules of expenditures in the exploration plans for their licenses. The revision of OMA's license was approved on October 17, 1994, and the revision of OMI's license was approved on November 2, 1994. With the recent discovery of the large, high-grade nickel deposit in Canada, the potential for this discovery leading to others and the resultant effects on markets, it is likely that the licenses may have to be revised again to show a further delay in preparations for commercial recovery.

On May 21, 1993, KCON notified NOAA that it was surrendering exploration license USA-4 (58 FR 33933, June 22, 1993) and on June 17, 1993, OMCO submitted an exploration license application for the area to NOAA (58 FR 34782, June 29, 1993). On December 22, 1994, NOAA issued the exploration license for USA-4 to OMCO (59 FR 66942, December 28, 1994).

In two letters dated September 29, 1995, OMCO informed NOAA that Cyprus Minerals Company was withdrawing from the consortium, that the deep seabed mining activities of the remaining partners was being consolidated in Lockheed Martin Missiles & Space (LMMS), that OMCO was being abolished and that it wants to reduce the schedules of expenditures. From information received thus far, NOAA believes that these are significant, but not major changes to the licenses and can be processed as revisions to licenses USA-1 and USA-4. NOAA has requested information from LMMS to complete an application to revise its licenses.

The terms, conditions and restrictions (TCRs) issued with each license require the licensee to pursue exploration activities in accordance with its approved exploration plan; the objective of the plan is to be able to apply for a permit for commercial recovery by the end of the license period. In order to show that it is following its exploration plan and achieving the major objective of exploration each licensee must submit an annual report to NOAA within 90 days of each anniversary date of the license. Annual reports for 1994 and 1995 have been received each year from the three licensees; however, NOAA has requested clarifications from OMCO on its 1995 report for USA-1 and USA-4.

The information included in the annual reports indicates that in spite of the continued depressed mineral markets and a general reduction in all staff levels, the NOAA licensees have been diligent in each license year in pursuing the activities that are appropriate and are authorized under NOAA licenses and the accompanying TCRs.

Exploration and Commercial Recovery Activities

USA-1 & USA-4 - Ocean Minerals Company (OMCO)

OMCO's license activities were performed during the two reporting periods, between September 1, 1993 and August 31, 1995, for USA-1 and for approximately eight months of a reporting period, December 22, 1994 to August 31, 1995, for USA-4. While there are slight differences in the terminology used in the exploration plans for the two licenses, OMCO's activities consisted of: monitoring legal, technical and political developments affecting future commercial recovery; equipment development studies; deposit data analysis and integration; environmental analyses; and commercial re-evaluation. There were no at-sea tests nor at-sea data collection efforts during the reporting periods. NOAA has requested clarifications and additional information needed to complete the evaluation of OMCO's diligence for the second reporting period and partial reporting period.

OMCO's monitoring of technological developments efforts and its equipment development studies largely involve assessing new technologies which could improve the efficiency, reliability and economy of the deep seabed mining system. Thus, OMCO has looked into such things as fiber optics to improve the transmission of data and commands for the collector, fiber optic flow sensors, and permanent magnet brushless direct current motors. During the last reporting period OMCO re-examined the desirability of self-propelled collectors over towed collectors.

OMCO is continuing to conduct deposit data analysis and integration efforts. This involves re-examining exploration data collected by OMCO and data received from others, as part of site conflict resolution agreements, in order to determine which parts of the minesite should be explored first in greater detail when at-sea operations resume. The potential application of Geographical Information Systems (GIS) to sea floor exploration and environmental data is of particular interest. In its latest environmental assessment, OMCO has been evaluating the natural

disturbance and redeposition of sea floor sediments to determine their significance compared to the plume which will be generated by the collector. As part of commercial re-evaluation, OMCO has continued to monitor factors affecting metal markets, particularly the market for nickel.

USA-2 - Ocean Management, Inc. (OMI)

OMI's license activities during the two reporting periods between August 30, 1993 and August 29, 1995 consisted of continuing to monitor developments in the legal, scientific, and economic areas for impact on the prospects for commercial mining. There were no at-sea tests nor at-sea data collection efforts during the reporting periods. The activities were consistent with OMI's approved exploration plan, whose revision was approved on November 2, 1994.

OMI has continued to monitor ongoing technical developments relating to deep seabed mining by attending conferences and meetings with experts from industry and academia. OMI has also followed developments pertaining to the United Nations Convention on the Law of the Sea (UNCLOS) and the agreement relating to the implementation of its Part XI by participating in consultations among representatives of NOAA, Department of State and representatives of other countries.

OMI also maintained its close watch on the world nickel market, both as to demand and price. INCO, a partner in OMI, specifically monitored the effect on the price of nickel of Russian-origin exports. INCO also provided valuable information to NOAA and the Department of State concerning a major, high-grade nickel deposit discovery which was made, on land, in Voisey Bay, Labrador, Canada.

USA-3 - Ocean Mining Associates (OMA)

OMA's license activities during the two reporting periods between September 1, 1993 and August 31, 1995 involved continued analysis of the overall OMA ocean mining effort and the monitoring of world mineral markets and environmental activities. There were no at-sea tests nor at-sea data collection efforts during the reporting periods. Activities were consistent with OMA's approved exploration plan, whose revision was approved on October 17, 1994.

OMA completed the compilation of an overall OMA Program Consolidation Report to provide documentation for the total OMA Ocean Mining R&D effort. This effort includes: 1) a summary of the current status of the OMA program; 2) executive summaries of the consolidation reports previously issued by each OMA Department (Marine Sciences, Mining Systems, Process Systems, Venture Analysis, and Legal); and 3) a "road map" to all paper and electronic supporting documents cross referenced to records storage manifests and locations.

OMA continued to monitor legal and political events involving the legal rights acquired by, and the obligations imposed upon, them under international law, the NOAA license, various intergovernmental agreements, and the private overlap settlement agreements to which OMA is a

signatory.

Additional activities conducted during the reporting period include participating in U.S. and international consultations regarding reform of Part XI of UNCLOS and monitoring mineral markets and associated economic, technical, legal and political developments and other factors influencing changes in the OMA Venture Analysis.

Environmental Assessments and Impacts

The major area of NOAA's efforts under the Deep Seabed Hard Mineral Resources Act has been the continuation of environmental studies to support future regulatory decisions. NOAA's environmental research efforts have focussed on determining the biological effects of the increased sedimentation on the seafloor that would result from deep seabed mining operations. NOAA's 1975-80 Deep Ocean Mining Environmental Studies (DOMES) Project has basically eliminated, pending verification during monitoring of further at-sea mining system tests, virtually all other environmental concerns which were raised about deep seabed mining. During the late 1970's and early 1980's, NOAA did extensive research on the potential onshore effects of manganese nodule processing and associated activities. The U.S. Bureau of Mines, the Environmental Protection Agency and the Fish and Wildlife Service as well as the State of Hawaii and other components of NOAA, such as the National Marine Fisheries Service, participated. A major concern was that the remains of nodules after processing would contain a variety of trace metals, such as arsenic and barium. Analyses of laboratory generated and industry provided samples by the Bureau of Mines showed that these were in a chemical form which would not harm the environment.

The primary recent environmental research effort has been the Benthic Impact Experiment (BIE), which has been conducted in cooperation with the Yuzhmorgeologiya Association of Russia's Ministry of Geology. Cooperative BIE efforts have also been conducted with the Metal Mining Agency of Japan (MMAJ) and the eastern European consortium InterOceanMetal (IOM). The experiment is designed to assess the impact of deep seabed mining on the organisms living in and on the seafloor; technological and cost considerations limited the extent to which these could be investigated during the DOMES Project. The experiment consists of blanketing an area of the seafloor with sediments in a manner simulating the mining of manganese nodules. The response of the benthic organisms to different levels of sediment burial and the time frames for population recovery will be indicative of the seafloor impacts to be associated with commercial mining. Available data on the variability of deep-sea fauna for the selected control and experiment sites in the Clarion-Clipperton Fracture Zone (CCFZ) suggest that the sites are biologically similar to potential commercial mining sites in the eastern CCFZ.

To create the sediment plume for the BIE, a Deep Sea Sediment Resuspension System (DSSRS) was designed and constructed to the specifications of NOAA scientists during 1990-91. After DSSRS testing and extensive baseline data collection at the control and experiment sites, an attempt was made to blanket the experiment area during August 1991 by towing the DSSRS

from the Russian research vessel the *R/V YUZMORGEOLOGIYA*. A key gear on the winch being used broke and the operation had to be terminated after one tow. During April 1992, the DSSRS was again towed from the Russian ship, but analyses of sediment trap and multicorer samples indicated that the DSSRS was not resuspending enough sediment. During December 1992, NOAA conducted a design review with U. S. and Japanese engineers and it was decided that a second generation DSSRS - the DSSRS-II - should be built.

From August to September 1993, the BIE resumed with another research cruise on the *YUZHMORGEOLOGIYA* towing the DSSRS-II. Prior to initiating the experiment, bottom photography, side-scan sonar and box cores were used to collect baseline data on nodule coverage, and mega-, macro- and meiofaunal abundances. Additionally, two current meters deployed in 1992 were recovered and redeployed along with 18 sediment traps. Forty-nine successful tows were then made with the DSSRS-II blanketing the study area with sediment. CTD casts, sediment traps and radio nuclide analysis of sediment cores were used to map the extent of the far-field sediment redeposition. Sediment trap data indicates that sufficient sediment was dispersed this time into the study area to generate a far-field impact similar to what is expected to occur during commercial mining. Post-disturbance box cores were taken to assess short-term impacts on the meio- and macrofauna. Four additional current meter moorings were also deployed to obtain additional long-term bottom current data.

In July 1994, the BIE site was revisited. After camera survey, box corer and multicorer samples were randomly collected in the control area and in the disturbed area of heaviest sediment deposition. The taxonomy of the macrofauna samples to family level have just been completed. Meiofauna and species analyses are expected to be completed during April 1996. The statistical evaluation of the sediment redeposition impact will be conducted to two taxonomic levels (to the functional group and species levels) for both meio- and macrofauna. NOAA intends to use existing base resources to complete data analyses and to complete an orderly conclusion of the research program.

On August 10, 1994, in Seattle, WA, NOAA assembled a review panel of six distinguished marine scientists and non-government organization representatives with scientific backgrounds to perform a scientific review of the BIE. As stated in the invitation letter, "The purpose of the review is to obtain external scientific opinion on the scope and effectiveness of the current BIE and to evaluate the proposed future research directions." The panel made several recommendations, including: critically assess faunal information already collected before performing additional field work; designing future experiments to measure faunal responses as a function of sediment dose; designing better methods to track and map the sediment plume; and having the sampling plan take into account local depositional microenvironments.

As previously noted, NOAA has engaged in cooperative BIE studies with MMAJ and IOM. NOAA provided advice and loaned equipment, such as the DSSRS-II and current meters, to them in exchange for sharing the data and information acquired during the research. Comparisons of the results of the BIEs will further predictive capabilities and the data provides

information for U.S. licensed areas remote from the NOAA BIE site. MMAJ conducted baseline studies and simulated mining impact with the NOAA's DSSRS-II in 1994 and revisited the disturbed area and collected samples one year after the disturbance in October 1995. Similarly, after the baseline cruise, IOM conducted BIE studies in July 1995 and plans to revisit the disturbed site during 1996.

The Korean Ocean Research and Development Institute (KORDI) of the Republic of Korea and the China Ocean Mineral Resource and Development Association (COMRA) of the People's Republic of China have also expressed interest in conducting similar BIE studies in their areas. Representatives of KORDI and COMRA have visited and conferred with NOAA on future BIE studies and potential cooperation. KORDI plans to start BIE studies with the selection of the BIE site and baseline studies in 1996.

Cooperative environmental studies with these countries provide the mining nations with the opportunity to collect unparalleled environmental information on the effects of deep ocean mining from diverse locations within the CCFZ, allowing the mining nations to efficiently utilize their limited financial resources while addressing the key environmental uncertainties facing deep ocean mining.

Civil and Criminal Proceedings

No civil nor criminal proceedings were instituted under provisions of the Act.

International Conflict Resolution

In accordance with the Act, in previous years the United States had concluded four agreements, with a total of thirteen other countries, resolving mine site overlaps and assuring against future conflicts.

During this reporting period, no international conflict resolution efforts were required. During 1994, the Republic of Korea registered minesites in the CCFZ area with the United Nation's Preparatory Commission. It was determined that there were no conflicts with the U.S. licensed sites.

Recommendations

There are no recommendations regarding amending this Act.