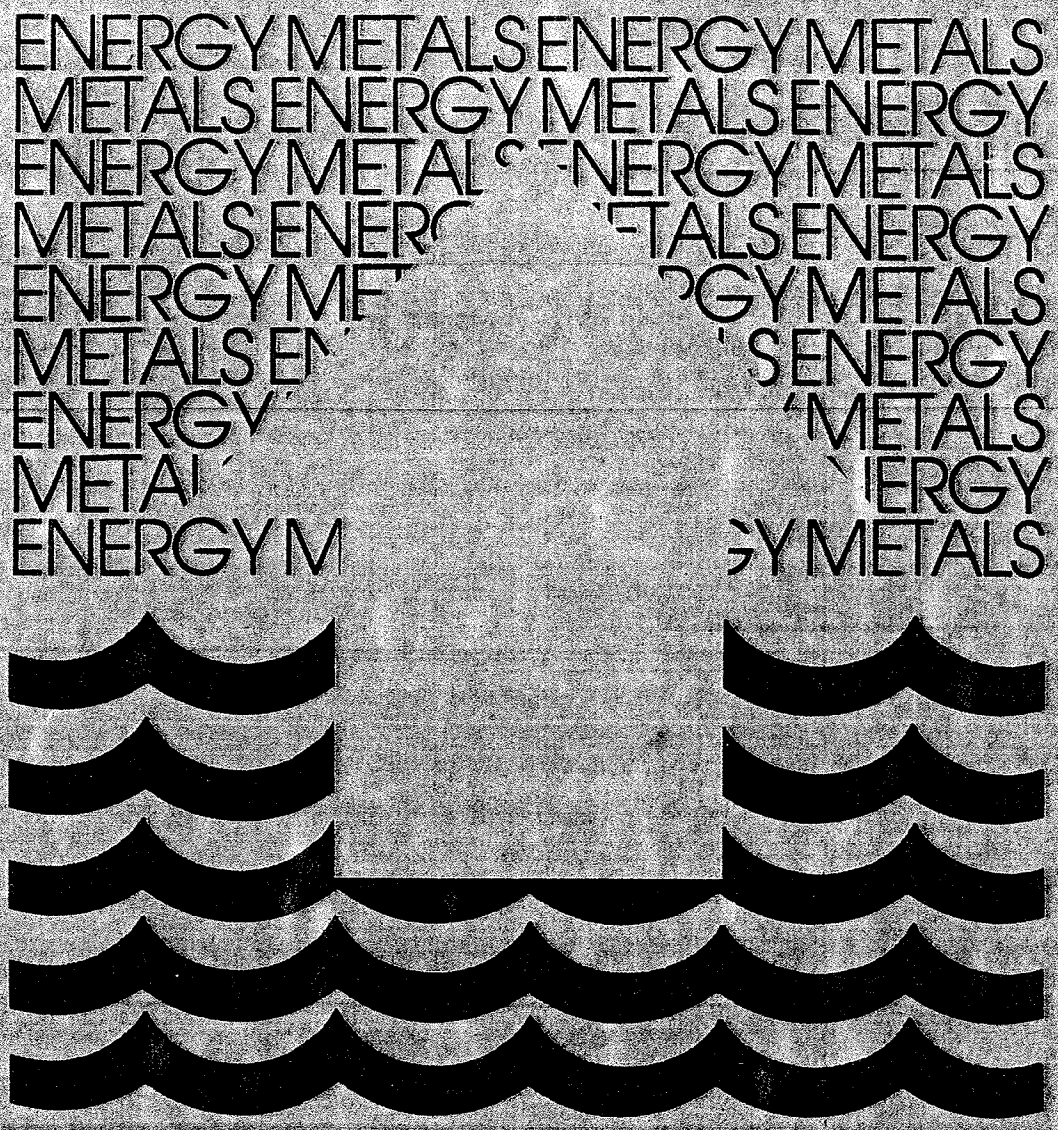

Deep Seabed Mining

Report To Congress

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
December 1993

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

JAN - 3 1994

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

Dear Mr. President:

I am pleased to submit the Deep Seabed Mining Report of the National Oceanic and Atmospheric Administration to the Congress in compliance with Section 309 of the Deep Seabed Hard Mineral Resources Act, Public Law 96-283.

Sincerely,

D. James Baker

Enclosure

THE ADMINISTRATOR

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The Under Secretary for
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The Honorable Thomas S. Foley
Speaker of the House of Representatives
Washington, D.C. 20515

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Deep Seabed Mining

Report To Congress

Prepared by:
Office of Ocean and Coastal Resource Management
Ocean Minerals and Energy Division
1305 East-West Highway
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December 1993

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 1992 and 1993 are described in this seventh biennial report to the Congress. The Act establishes a domestic legal regime, pending the ratification and entry into force of an acceptable Law of the Sea Treaty with respect to the United States, under which U.S. citizens may conduct exploration for and commercial recovery of manganese nodules.

Licenses and Permits

Four exploration licenses were issued during 1984. During 1993, NOAA received notification from Kennecott Consortium that it was surrendering its license and received an application from Ocean Minerals Company for an exploration license for the surrendered license area. There were no other licensing or permitting activities.

Exploration and Commercial Recovery Activities

During the two years covered by this report, licensees' activities have continued to be directed toward studies of equipment development, relevant technological advances, and economic factors, as well as data analysis and integration. In addition to these efforts the consortia have actively continued to monitor legal and political developments affecting mining, including the United Nations Secretary-General's informal consultation on potential changes to the United Nations Convention on the Law of the Sea.

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.

NOAA continued studies begun in 1989 to characterize the environment within the area designated by NOAA as a potential Provisional Interim Preservational Reference Area (PIPRA). Subsidiary agreements to implement the cooperative agreement made between NOAA and the Yuzmorgeologiya Association of the Russian Ministry of Geology during 1989, for cooperative deep seabed mining environmental research were signed. Under the agreements a Russian research ship, with scientists from Russia, the United States, and other nations onboard, is

being used to operate NOAA's Deep Sea Sediment Resuspension System (DSSRS) as part of NOAA's Benthic Impact Experiment (BIE). Cooperative research cruises were conducted in the PIPRA during both 1992 and 1993.

NOAA has continued to consult with other mining nations to cooperate on at-sea environmental research and to establish a network for exchange of information on research efforts and regulatory measures to protect the environment. An agreement was signed with the Metal Mining Agency of Japan to cooperate in environmental research. Japan will conduct a Benthic Impact Experiment in its western mining claim area using NOAA's Deep Sea Sediment Resuspension System.

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 1992 and 1993.

Recommendations

There are no recommendations regarding amending this Act.

CHAPTER I
INTRODUCTION

Purpose and Scope

This seventh biennial report to the Congress, submitted pursuant to section 309 of the Deep Seabed Hard Mineral Resources 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 1992 and 1993.

This chapter provides an overview of the nature of the resource, reasons for the national interest in the development of ocean minerals resources and related technologies, the members of the mining consortia, the status of industrial activities, and a description of the mining technology. NOAA's activities in implementation of the Act are addressed in Chapter II.

Activities included in Chapter II relate to: NOAA's environmental research activities in support of future regulatory decisions, and activities under four exploration licenses, including the surrender of one license and an application for the surrendered site.

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 are small, irregular, fist-sized concretions of manganese and iron minerals that are found on the bottom of many of the world's oceans and some lakes. They 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. Although 79 elements have been identified in Pacific Ocean nodules, only four are of strategic and economic importance: manganese, copper, nickel, and cobalt. While nodules occur on a world-wide basis, their population density on the seafloor and the concentrations of the value metals are highly variable. Main commercial interest therefore focussed on an area in the east-central Pacific Ocean (Figure I) that contains a higher population of high-grade nodules than other surveyed areas. The nodules in this area have a high average percentage of the value metals, especially nickel (approximately I.3 percent nickel, I.I percent copper, 0.2 percent cobalt, 25 percent manganese). This 13 million km^2 area--commonly known as the Clarion-Clipperton Fracture Zone--was the subject of NOAA's five-year Deep Ocean Mining Environmental Study (DOMES) and so is also referred to as the DOMES area. The DOMES study formed the basis for many of the scientific findings in NOAA's Deep Seabed Mining Final Programmatic Environmental Impact Statement (September 1981). The DOMES area is also 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 enormous resource for the future.

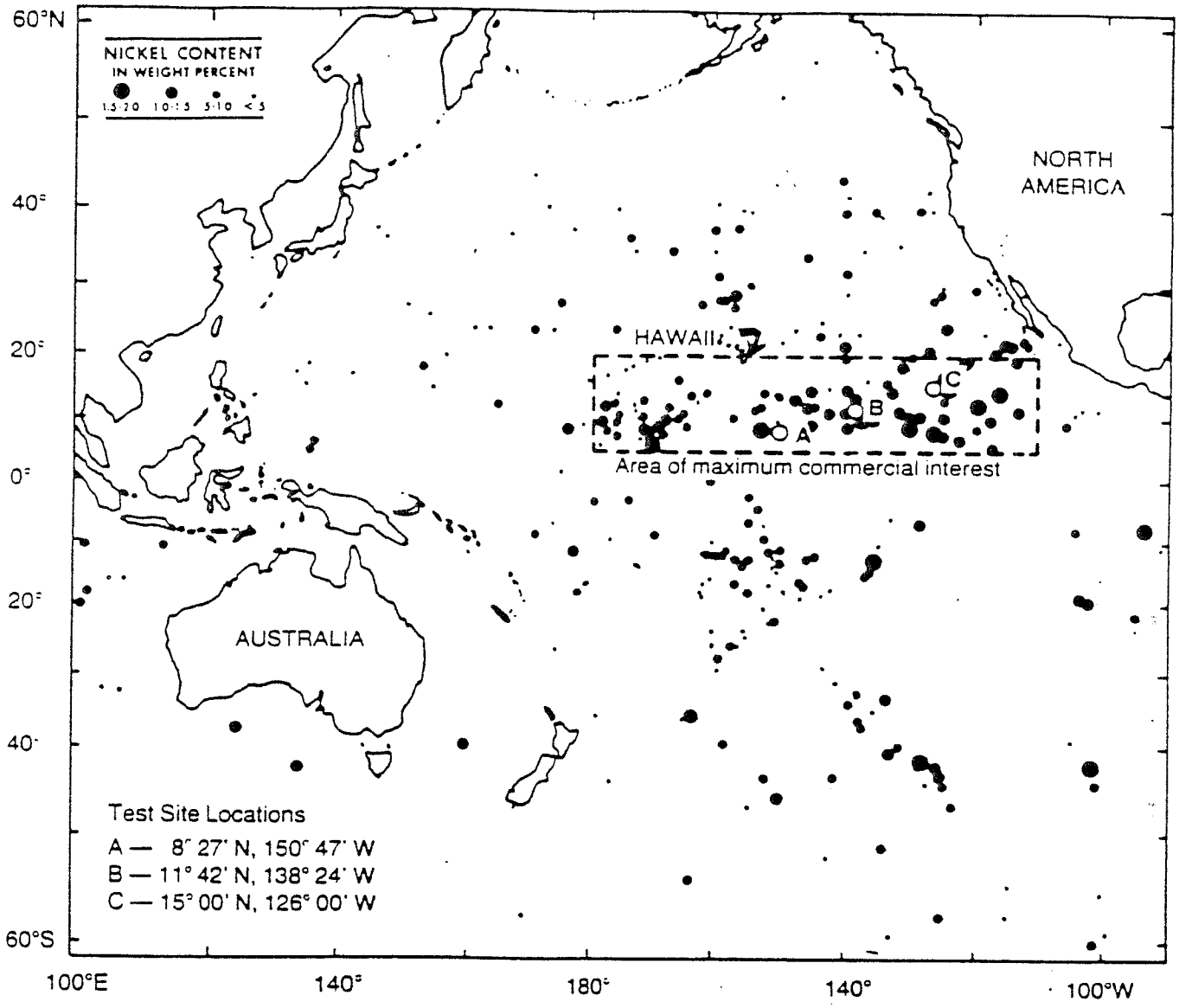

Figure 1 --Area of manganese nodule maximum commercial interest and high nickel concentration in nodules with DOMES test site locations (Horn, Horn, and DeLach, 1972).

The National Interest

The United States is dependent on potentially unreliable foreign sources for two of the strategic metals found in manganese nodules: cobalt and manganese. Cobalt, which we import primarily from Zaire and Zambia, is used for the high-temperature alloys necessary in the aerospace industry. Manganese, imported primarily from Australia, Brazil, and South Africa (which has been projected as our major source in 10 to 20 years), is required in the steel industry. Nickel, used mainly in stainless steel and other high temperature steel alloys, is supplied by Australia and Canada. Copper, in which the United States is nearly self-sufficient, is used mainly in electrical equipment.

Dependence on foreign sources of metals can lead to uncertainties in supply ranging from cost instability to supply disruption. In addition to the possibility of political instability, foreign producers may retain more of their domestic output as they acquire their own capability to manufacture finished products. Also, as the sources of supply become more restricted, the ability of the mines to meet world demand can become a factor in determining both supply and price.

The U.S.-based consortia are the world's leaders in the development of the technology needed to recover and process manganese nodules. However, national efforts in India, Japan and Korea are beginning to erode this leadership. The leader in technology has the potential for developing export markets for these.

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 presently depressed level of world metal markets has dimmed prospects for commercial mining in the near term. Nevertheless, nodule mining appears to be competitive with new sources of these metals and so must remain an option for United States industry in the years ahead.

Mining Consortia

The domestic deep seabed mining industry presently includes three multinational private sector consortia with U.S. members (Figure 2) which were issued exploration licenses by NOAA in 1984. Kennecott Consortium (KCON) was also issued a license in 1984 but notified NOAA that it was surrendering its site (USA-4) on May 21, 1993. 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, which was also issued to the Kennecott Consortium, was also surrendered in 1993. There are also five national consortia presently developing their own deep seabed mining capabilities: the French consortium, AFERNOD; the Japanese consortium, Deep Ocean

Fig. 2 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, and subsequently amended, showing NOAA license identification.

Nation	USA-1 Ocean Minerals Company (OMCO) (11/77)	USA-2 Ocean Management Inc. (OMI) (5/75)	USA-3 Ocean Mining Associates (OMA) (10/74)	USA-4 *Kennecott Consortium (KCON) (1/74)
United States	Cyprus Minerals Co. (Cyprus Mining Co.) 50% Lockheed Missiles & Space Co., Inc. (Lockheed Corp.) 37.528% Lockheed Systems, Co., Inc. (Lockheed Corp.) 12.472%	Schlumberger Technology Corp. 24.67%	Essex Minerals Co. (USX Corp.) 25% Sun Ocean Ventures Inc. (Sun Co.) 25%	Kennecott Utah Copper Corp. (a U.S. Corporation owned by R.T.Z.) 52%
Belgium			Union Seas, Inc. a U.S. Corporation (Union Miniere) 25%	
Canada		INCO, Ltd. 25.11%		Noranda Exploration, Inc., a U.S. Corporation 12% (Noranda Mines Ltd.)
Italy			Deep Sea Systems, Inc. U.S. Corporation (ENI/Italy) 25%	
Japan		Deep Ocean Mining Co., Ltd. (DOMCO-19 Japanese Companies) 25.11%		Mitsubishi Corp. 12%
United Kingdom				R.T.Z. Deep Sea Mining Enterprises, Ltd. (Rio Tinto-Zinc) 12% Consolidated Gold Fields, PC 12%
West Germany		AMR 25.11% (Preussag A.G., Salzgitter A.G., Metallgesellschaft A.G.)		

*License Surrendered May 21, 1993

December 1993

Resource Development Company (DORDCO); Russia's Yuzhmorgeologiya; the Interoceanmetal (IOM) consortium, consisting of the governments of the Russia, Poland, Czechoslovakia, Bulgaria and Cuba; and the People's Republic of China consortium, COMRA (China Ocean Mineral Resources Research and Development Association). Germany also issued one license to the wholly-German consortium AMR. Figure 3 shows the U.S. areas in relation to all the foreign areas. In addition to these eight consortia, each of which has been involved in nodule mining research and development activities, exploration has been conducted in the Indian Ocean by India and in the Clarion-Clipperton Zone by the Republic of Korea.

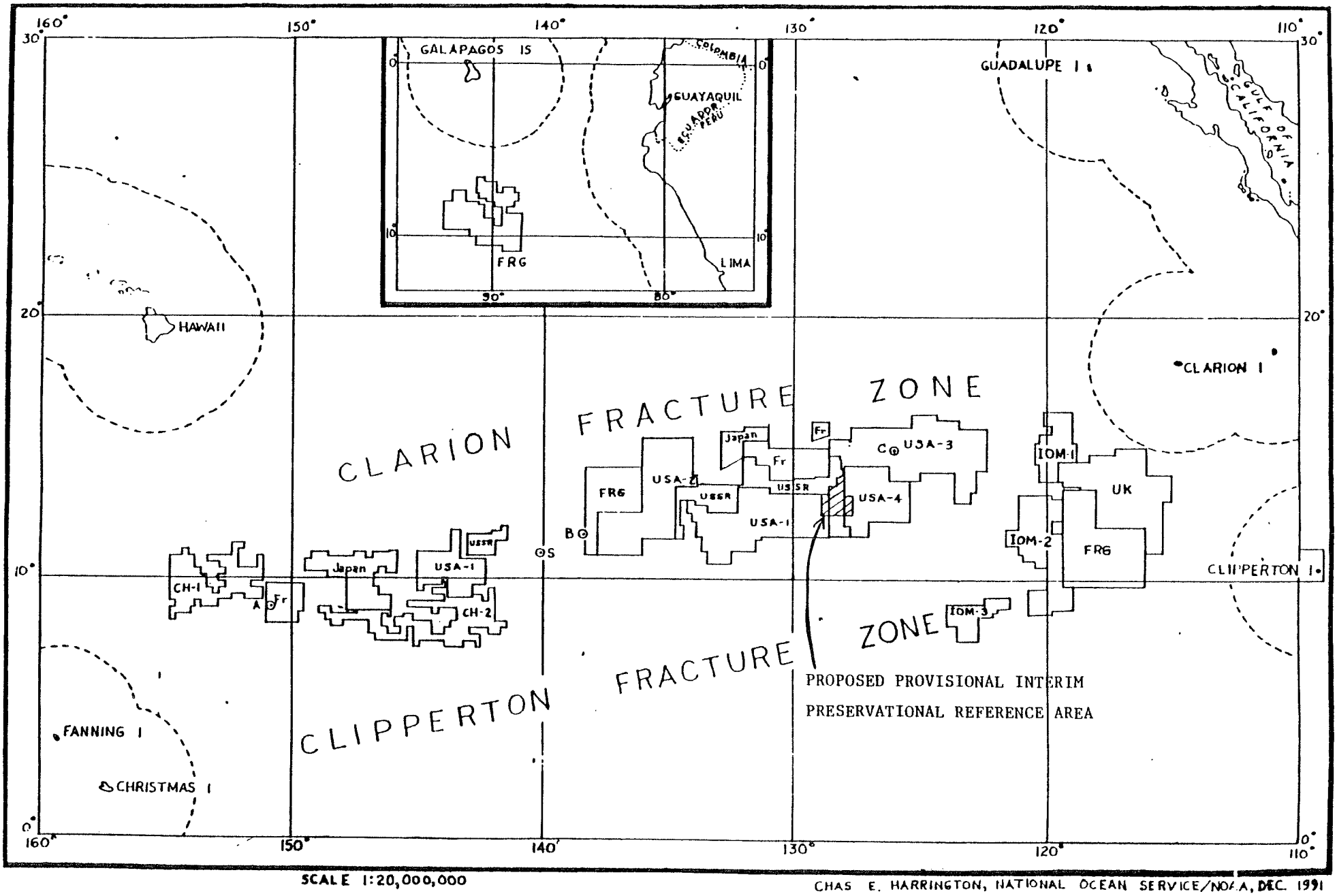

Figure 3. U.S. and Foreign Operating Areas and Proposed Provisional Interim Preservational Reference Area
(USA-4 and UK areas surrendered May 21, 1993)

Overview of Industrial Activity

All of the NOAA-licensed consortia, prior to enactment of the Act, had already conducted extensive seafloor studies and technology development, including at-sea testing of mining systems. License activities presently consist primarily of the analysis and integration of exploration data collected by each consortium or received from other consortia as a result of conflict resolution of overlapping claims. Activities also include the continued monitoring of technological developments, economic assessments and other planning activities for future development of the operators' respective sites. Although further mining system tests may be authorized under the license, no additional tests are presently planned by the licensees.

All of the NOAA-licensed consortia retain a strong interest in the attempt, led by the Secretary-General of the United Nations, to modify the United Nations Convention on the Law of the Sea in order to make the Convention acceptable to the United States and other industrialized countries. The licensees are monitoring the activities and providing comments on various documents resulting from the consultations.

As mentioned above, a discussion of specific activities conducted by each licensee over the last two years is presented in Chapter II.

Technology Presently Contemplated for Mining

The first generation mining technologies under consideration by the United States consortia are all hydraulic type lift systems. Hydraulic systems, using either submerged centrifugal pumps or air lift systems, will recover nodules in a seawater slurry and pump them through a pipeline from a seafloor collector to a mining ship on the ocean surface. The nodule collector likely will sweep the bottom in nearly adjacent swaths; each swath may be up to 20 meters (65 feet) wide. The collectors will be either towed or self-propelled. Both types of systems have been tested by the consortia. One consortium states that it intends to use a self-propelled collector.

In addition to the nodules, bottom water, sediment, and some benthic fauna will be drawn into the collector. Most of this extraneous material will be ejected at the seafloor; however, some of this material will be transported up the pipeline and, after separation from the nodules, discharged at the sea surface. The two activities, ejection near the seafloor and sea surface discharge, are the two perturbations toward which NOAA has directed most of its environmental effects research. Direct collector contact, while having an environmental impact, will affect a relatively small area and is unavoidable if nodules are to be mined.

It is expected that nodules will be transported to shore for processing in at least first generation commercial systems, although one consortium wants to keep the at-sea processing option open.

CHAPTER II

IMPLEMENTATION OF THE

DEEP SEABED HARD MINERAL RESOURCES ACT

Licenses and Permits

In 1984 NOAA issued exploration licenses to four mining consortia:

USA-I - 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)

These actions followed the resolution of originally overlapping site applications by the above consortia and the French and Japanese consortia. Part of their overlap settlement agreement led to the exchange of extensive exploration data pertaining to relinquished areas. All four consortia were authorized to conduct exploration activities in their respective areas for the original 10-year duration of the license.

In 1991, NOAA approved extensions of the original licenses of OMA, OMI, and OMCO for five years from 1994 to 1999.

The terms, conditions and restrictions (TCRs) issued with each license require the licensee to pursue exploration activities in accordance with its approved exploration plan. In order to show that it is following its exploration plan and achieving the major objective of exploration--the ability to apply for a commercial recovery permit by the end of the 10-year license period--each licensee must submit an annual report to NOAA within 90 days of each anniversary date of the license. Annual reports have been received each year from the four consortia.

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.

On May 21, 1993, Kennecott Consortium notified NOAA that it was surrendering its deep seabed mining license USA-4 (58 FR 33933, June 22, 1993).

On June 17, 1993, Ocean Minerals Company (OMCO) submitted to NOAA an exploration license application for the former KCON license area USA-4 (58 FR 34782, June 29, 1993).

Exploration and Commercial Recovery Activities

USA-I - Ocean Minerals Company (OMCO)

OMCO's license activities during the two reporting periods between September 1, 1991 and August 31, 1993 consisted of equipment development studies, data analysis and integration, and commercial re-evaluation.

The equipment development effort continues to be limited to paper studies that involved review of available relevant technical information pertaining to emerging technologies that would improve the basic design of OMCO's mining system. Technologies reviewed included fiber optics for improved data transmission; new polymers for lower cost, lighter weight pipe; and advanced sonar and navigation systems for obtaining high resolution bathymetry and more accurate positioning.

Data analysis and integration activities included continuing the examination of the OMCO environmental data set which has been archived at the University of Hawaii Marine Minerals Technology Center. Free-fall grab samples were examined for midwater fish identification and distribution; plankton collected in neuston tows were sorted and identified; and seafloor photographs were further examined for megafauna observations.

OMCO participated in U.S. and international consultations regarding reform of Part XI of the Law of the Sea Treaty.

Since the world price of nickel dictates the economics of deep ocean mining, OMCO continued to monitor the trends in the nickel market.

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

OMI's license activities during the two reporting periods between August 30, 1991 and August 29, 1993 consisted of continuing to monitor developments in the legal, scientific, and economic areas for impact on the prospects for commercial mining.

OMI has continued to monitor ongoing technical developments relating to deepsea mining by attending conferences and meetings with experts from industry and academia. OMI has also followed developments pertaining to the Law of the Sea regime by participating in consultations among representatives of NOAA, Department of State and representatives of other countries regarding the possibility of U.S. entry into the Law of the Sea Treaty.

OMI continued its cooperation with German government-funded research programs conducted by the University of Hamburg and other research institutes. This environmental research, which has been conducted in cooperation with other governments, including France and Japan, involved activity in AMR's license site.

OMI also maintained its close watch on the world nickel market, both as to demand and price. INCO specifically monitored the effect on the price of nickel of Russian-origin exports.

OMI also completed an exchange of data with Russia and is integrating the data obtained into its database.

USA-3 - Ocean Mining Associates (OMA)

OMA's license activities during the two reporting periods between September 1, 1991 and August 31, 1993 involved continued analysis of the overall OMA ocean mining effort and the monitoring of world mineral markets and environmental activities.

OMA delivered to NOAA at the Marine Minerals Technology Center approximately 600 pounds of Atlantic Ocean manganese nodules and a similar weight of manganese "slabs" for use in governmental and multinational environmental research activities associated with marine mining.

OMA continued 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 "roadmap" to all paper and electronic supporting documents cross-referenced to records storage manifests and locations.

OMA encouraged and participated in cooperative international programs in deep seabed mining environmental research. OMA personnel participated in the shallow-water test phase of NOAA's international research program in the U.S. license areas.

Further, 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: 1) participating in U.S. and international consultations regarding reform of Part XI of the Law of the Sea Treaty; and 2) monitoring mineral markets and associated economic, technical, legal and political developments and other factors influencing changes in the OMA Venture Analysis.

USA-4 - Kennecott Consortium (KCON)

On May 21, 1993, KCON notified NOAA that it was surrendering its deep seabed mining license USA-4. KCON's reporting requirement therefore consists of the

period from November 1, 1991 to October 31, 1992. During this period KCON's activities consisted of monitoring legal, economic and political developments for prospective commercial mining; keeping abreast of technological and metal market trends; and continuing discussions with NOAA and the Department of State concerning Part XI of the United Nations Convention on the Law of the Sea.

The Safford, Arizona storage site for nodules and other sample materials was also maintained as were all technical files.

During 1992, KCON conducted studies to evaluate the long-term viability of ocean mining and explored financial alternatives to relinquishment of the license. In consideration of the economic and political climate that presently exists for commercialization of seabed mining, KCON concluded that there is no justification for continuing investment in manganese nodule development.

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. The following is a brief description of the environmental research conducted since 1991 or currently in progress.

NOAA continues to evaluate the suitability of a site, originally contributed by OMA, OMCO, and KCON from their license areas, to be designated as a Preservational Reference Area (PRA) (Figure 3). This site was designated by NOAA in 1988 as a Provisional Interim Preservational Reference Area (PIPRA). A preservational reference area is a stable reference area unaffected by mining activities and environmentally similar to the mining sites. The PRA will serve as a control area for measuring environmental impacts. The available data on the variability of deep-sea fauna in this area of the Pacific Ocean suggest that the site being considered by NOAA as a PRA will be biologically similar to the mining sites. Additional research is currently being conducted to determine the composition of the benthic fauna at this site, to determine its similarity to the fauna of the mining areas, and to further describe the benthic environment. NOAA also designated an area within the Ocean Mining Associates mine site as a proposed provisional impact reference area (PIRA) to be used for monitoring benthic impact during commercial operations.

NOAA has been seeking and has achieved international cooperation for efficient use of our resources to address environmental issues associated with deep seabed mining. Prime examples of this international cooperation are NOAA's agreements with the Yuzhmorgeologiya Association of Russia's Ministry of Geology for coordinated at-sea research and exchange of scientists. Agreements were signed in September 1989, November 1990, and August 1991. Plans for a cooperative

Benthic Impact Experiment (BIE) to be conducted in the U.S. Preservational Reference Area were agreed to at a meeting held in November 1990 in Gelendzhik, Russia. Meetings were also held in Washington, D.C. in August 1991 and in Seattle in December 1992 to review results of the research already in progress and to discuss cooperative research planned for the following years.

The BIE is a project designed to assess the environmental impact of deep seabed mining on the organisms living in and on the seafloor. 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 will be indicative of the impacts to be associated with commercial mining. The results of this research effort will be used by NOAA in establishing the terms, conditions, and restrictions that will be issued with a commercial recovery permit.

The multi-year BIE began in June 1991 utilizing the Russian research vessel YUZHMORGEOLOGIYA. In this first part of the BIE project, NOAA tested the Deep Sea Sediment Resuspension System (DSSRS) at a depth of 4000 meters off the California coast. The DSSRS was designed to the specifications of NOAA scientists and is a critical piece of equipment for simulating a mining disturbance. The success of DSSRS on this test cruise demonstrated that large scale mining disturbances could be simulated allowing the direct measurement of mining impacts on benthic community structure.

During July 1991 the next phase of the BIE project took place in the near-equatorial North Pacific Ocean (approximately 13° N and 128°W). Scientists from Japan and Germany participated in these cruises. During this part of the experiment, current meters were recovered and deployed, a transponder net was deployed and calibrated, information about the topography in the BIE area was collected using sidescan sonar, and TV/camera transects were made across the BIE site to assess manganese nodule coverage and the abundance of large, surface-dwelling deep-sea animals.

During August 1991 pre-impact benthic sampling was conducted using 7 box core and 10 multicore samples to characterize the benthic community structure. Samples were also collected to assess sediment porewater chemistry and radionuclide inventories. In order to map the extent of sediment deposition during the experiment, sediment traps and current meters were also deployed. The DSSRS was then towed to blanket the BIE study area with sediment. Due to winch problems on the ship only one DSSRS tow was completed.

In April 1992, NOAA again attempted the next phase of the BIE project with a cruise on the YUZHMORGEOLOGIYA to the study site. The main goal of this cruise was to finish blanketing the experimental area with varying thicknesses of sediment using the DSSRS. Enroute to the area, the DSSRS was tested off Long Beach, California. Additional baseline box cores were taken and two current meters and a sediment trap were then deployed within the study area. Forty-four

tows were completed with the DSSRS to blanket the area with sediment. The resedimentation plume was sampled with CTD casts, sediment traps, and multicore samples. A multicorer was used to collect short-term post-disturbance seafloor samples to assess microbiological and meiofaunal impacts. Finally, eight current meter moorings were deployed to obtain more detailed information about the benthic currents in the BIE area.

Following radionuclide analysis of the sediment trap and multicore samples, the conclusion was reached that the first generation DSSRS did not work properly due to design problems. In December 1992, NOAA conducted a thorough review of the original DSSRS design using Japanese and U.S. engineers. The design review questioned a number of the conceptual ideas used to build the DSSRS and recommended that a second generation Deep Sea Sediment Resuspension System (DSSRS-II) be designed and built. NOAA followed this advice, building the DSSRS-II in March and April 1993, wet-testing the system in both shallow-water (May 1993) and deep-water (June and July 1993).

From August to September 1993, NOAA initiated the BIE-II with another research cruise on the YUZHMORGEOLOGIYA. Prior to initiating the BIE-II 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 second generation DSSRS-II blanketing the study area with sediment. CTD casts, sediment traps and radionuclide 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.

Additional benthic impact experiments similar to the BIE are under discussion for the Russian mining claim area. NOAA has reached an agreement with the Metal Mining Agency of Japan, on further cooperation in environmental research studies related to deep seabed mining in the western DOMES area. A BIE will be conducted by Japan in 1994 in its western mining claim area using NOAA's DSSRS-II. Because of the different environmental conditions found in the western part of the DOMES area, this research will be especially valuable and directly applicable to OMCO's western U.S. license site which is adjacent to Japan's site. NOAA will share all information resulting from this research.

In another example of international cooperation, a U.S. scientist participated in the 1992 cruise of the German research ship SONNE during its investigation of the environmental effects of mining in the eastern South Pacific. The objectives of this study were to create a large scale disturbance on the seabed and then observe its recolonization over several years.

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.

Recommendations

There are no recommendations regarding amending this Act.