Current Issue Outline 80-1

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Washington, D.C.
January 1980

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Environmental Data and Information Service

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Philip M. Klutznick, Secretary

National Oceanic and Atmospheric Administration
Richard A. Frank, Administrator

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Thomas D. Potter, Acting Director

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MANGANESE NODULES

Issue Definition

Ferromanganese nodules, small potato-shaped, reddish-brown or black objects that litter the bottom of the world's oceans, have precipitated a political and technological nightmare and a multi-billion dollar dream. They were first collected by HMS Challenger in 1872, but over the last two decades have become a potentially valuable resource whose ownership is in dispute. The nodules contain copper, nickel, and cobalt as well as iron and manganese, plus traces of more than 20 other metals, all of which have great value for American industry.

Manganese Nodule Characteristics

The stones range in texture from hard to crumbly, in form from spherical or disc-shaped to lumpy, and in size from 0.5 inch to 6 inches in diameter. The mineral content of the nodules and their concentration in different ocean regions have been found to vary as a function of sediment conditions, plant and animal life, the composition of the waters, the presence of bacteria that may precipitate the metals, and the geological characteristics of the seabed.

Cobalt-rich deposits seem to lie in the north Pacific ocean southwest of Hawaii and north of the Equator. Nodules rich in copper and nickel are found a few hundred miles southeast of Hawaii. These sites are thought to provide the most suitable conditions for large-scale mining operations--a relatively smooth terrain averaging 2 pounds of nodules per square foot over a considerable portion of an area of at least 20,000 square miles.

Researchers are investigating several questions about the presence of manganese nodules on the ocean floor.

(1) How are manganese nodules formed? Do the metals come from the seawater, from the biological activity of marine organisms, or from some other source? Why do the nodules form around a nucleus such as a bit of coral?

(2) Why are nodules more common in some waters than in others?

(3) What factors account for varying concentrations of metals within the nodules and for the arrangement of the metals within the nodules?

(4) What factors account for the variable growth rates of the nodules?

(5) Why are nodules found resting on the sea floor or only shallowly buried in the sediment and not at greater depths?

Technological Issues

Technology for sampling, harvesting, transporting, and extracting or processing minerals from marine manganese nodules is complicated, expensive, and currently in the process of being tested and refined. Sampling mechanisms, needed to help locate high-yield mine sites, include the free-fall grab sampler and the underwater television camera. Promising mining methods include the dredge head system, which uses a hydraulic lift mechanism to rake or suck up nodules, and the continuous line bucket system, which consists of a loop of cable with buckets attached at intervals. There are problems, however, with the mechanical efficiency of the gear and the means of ejecting sediment brought up from the ocean bottom along with the nodules. Overall cost effectiveness, in terms of the expected yield of valuable minerals, will be the determining factor.

Social Issues

The possibility of large-scale harvesting of manganese nodules from the sea has raised economic, political, legal, and environmental issues. Stated briefly, the major question is: "Who owns the ocean's resources beyond a nation's territorial waters?"

The industrialized nations, those with the greatest need for the minerals and the better able to afford the costs of developing and managing a marine mining industry, expect to reap the benefits of their investment. The United Nations has affirmed that the ocean is "the common heritage of all mankind," and thus the nonindustrialized developing nations expect that the profits of ocean resource use be shared, especially with those who cannot afford to invest heavily in ocean mining at this time.

This conflict, debated since 1973 by the United Nations Conference on the Law of the Sea, has spawned secondary issues such as the sharing of mining and extraction technology with other nations through an international enterprise and the approval of mine sites by an International Seabed Authority.

Economic issues relate not only to the costs of technological development and mining operations--and it is estimated that corporations and national governments have already invested $150 million--but also to the relative amounts of public and private funds that should be

committed to manganese nodule mining. A third issue involves the effect on world markets should large amounts of these minerals suddenly become available. Countries in Latin America, Africa, and Asia, major suppliers of copper, nickel, cobalt, and other minerals, and which do not have sufficient industry to use them, could be adversely affected by a flood of these commodities on the world market.

Environmental issues include the effects of mining operations on the ocean bottom and the possible pollution caused by ocean-based and land-based processing facilities, such as disturbance of the sediment, changes in oxygen content and temperature of the water, effects on marine organisms, and possible damage to fisheries.

Various U.S. government agencies and research laboratories are studying these issues, and the U.S. Congress is considering legislation with regard to the development of the hard mineral resources of the deep seabed. The place of ocean mining within the framework of U.S. ocean policy for the development, management, and conservation of ocean resources is also a matter of concern, as are the possible consequences of any such legislation for the outcome of the Law of the Sea Conference.

Information Sources

A wealth of material is available on various issues in the use of manganese nodules. The references provided here are intended as an introduction to the literature.

For the latest developments with regard to U.S. ocean mining policy or the U.N. Conference on the Law of the Sea, the reader should consult the appropriate offices listed below or the professional newsletters in ocean resources, for example, OCEAN SCIENCE NEWS (Nautilus Press).

UNITED NATIONS INFORMATION CENTER. (202) 296-5370. The next session of the Law of the Sea Conference will be held July 16-August 24, 1979, in New York City. The Hon. Elliot L. Richardson is chairman of the U.S. delegation.

UNITED STATES CONGRESS. BILL STATUS OFFICE. This telephone service provides information on pending legislation. House: (202) 225-1772; Senate: (202) 224-2971. HR.2759 and HR.3268 have been referred to subcommittees under Merchant Marine and Fisheries, Foreign Affairs, and Interior. S.493 has been referred to committees on Energy and Natural Resources, Commerce, and Foreign Relations. (Information as of June 1, 1979)

International Decade of Ocean Exploration Office, National Science Foundation, Washington, DC 20550. (202) 632-7356.
IDOE supports a series of international symposia and MANOP (Manganese Nodule Project), a research program begun in 1977.

Marine Minerals Office, National Oceanic and Atmospheric Administration, Rockville, MD 20852. (301) 443-8323.
NOAA sponsors a long-range environmental assessment program for deep ocean mining, the DOMES (Deep Ocean Mining Environmental Study) project, and programs on costs, nodule transport, and waste disposal. (See bibliography below.)

Ocean Mining Administration, Department of the Interior, Washington, DC 20240. (202) 343-2125.
This agency shares responsibility for seabed mineral resources.

Ocean Programs Branch, Office of Water and Hazardous Materials, Environmental Protection Agency, Washington, DC 20460
(202) 245-3054.
This agency will share responsibility for ocean programs relating to deepsea mining of manganese nodules once legislation has been enacted.

Lamont-Doherty Geological Observatory, Columbia University, Palisades, NY 10964.
Among the marine mining research supported by Lamont-Doherty is an investigation of the possible connection between manganese nodules and volcanic formations.

Scripps Institution of Oceanography, University of California, La Jolla, CA 92093.
Scripps supports the Sediment Data Bank and a manganese nodule dating program.

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NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

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