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**A GLOBAL APPROACH FOR THE
MANAGEMENT OF THE OCEAN**

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Overview of Ocean Resources

In 1945 President Truman issued a proclamation that claimed sovereign sea floor rights for coastal states. After this, the oceans, and especially the continental shelves, became attractive as a new frontier for sources of petroleum and minerals. A great deal of money has been invested in discovering non-living resources in the oceans. From this investment, our knowledge of the oceans has increased and we understand better the potential of the oceans. This article will begin by reviewing some of the ocean's non-living resources, discuss the need for ocean management and the concerns about marine pollution, and conclude with a discussion of various research methodologies which might be undertaken in joint collaboration.

Oil is one of the most important energy resources in the world. However, reportedly the oil supply will be fully exhausted within approximately 43 years. Therefore, more successful exploration and production of oil is required if we are to supply the quantity necessary for society.

At present, only 27 percent of sedimentary petroleum basins in the world produce commercial hydrocarbons. Another 40 percent of the basins have been partially and moderately explored and tested but have not yielded commercial quantities of petroleum. The remaining 33 percent of the world's basins have had little or essentially no exploration activity. The majority of the moderately explored and unexplored basins, which mostly are located in the oceans, are the next frontier.

Consumption of gas, which is another important energy resource, has increased dramatically in recent years because it is cleaner to use than oil. Recent research indicates that gas resources are limited to 70 years.

Gas hydrates, therefore, are an attractive potential energy resource. Gas hydrates have the following characteristics. First, an enormous amount of methane is apparently sequestered within clathrate structures at shallow sediment depths within 2000 meters of the Earth's surface. Second, methane is widely distributed in the world. In addition, its density is ten times greater than that of other unconventional gases—such as those found in coal beds, tight sands, black shales, and deep aquifers—and is two to five times greater than that of conventional natural gas.

Also, larger quantities of ferromanganese nodules, which are rich in nickel, copper, and cobalt, are known to be present on the sea floor, and the Pacific Ocean is one of the most favorable sources. Recovery of the cobalt-rich manganese crust, which is located on irregular steep-sided volcanic islands and sea mounts, poses, as yet, unresolved engineering and mining problems.

The crust thickness of more than two centimeters may yield accessible concentrations of about 16 kilograms of ore per square meter of crustal surface. Therefore, the economic return in cobalt, nickel, manganese, copper, and molybdenum from these crusts could be much greater than from manganese nodules at deep water sites. It has been estimated that a single sea mount could yield up to four million tons of ore. Ferromanganese crust and nodules probably could be mined fairly easily. When such mining will begin depends on economic factors as well as development of additional uses for the nodules.

Studies using the submersible Alvin found active hydrothermal vents with a fluid temperature exceeding 350 degrees celsius. These vents are commonly called "black smokers" because the plumes contain enough sulfide to be black in color. On coming in contact with cold water, the metals and sulfur precipitate, producing deposits containing iron, copper, zinc sulfides, silver, and hydrates (calcium sulfide). These polymetallic sulfides, discovered in the last decades at sea floor spreading centers, may ultimately be exploitable resources of zinc, silver, and copper.

Trends toward controlling land use near cities that limit extraction of sand and gravel almost certainly will force such mining to offshore areas. Phosphorate is well known in the offshore area and

its exploitation will be dictated when onshore resources become inadequate. Significant concentrations of heavy minerals of economic value are present in continental shelf sands. Whether these are present in economic quantities is only just becoming known, but preliminary data suggests that they are.

Need for Ocean Management

Over the next 50 years, the population of the world will become two times its present size and consumption of energy will increase two to three times that of the present day. In addition, the volume of the world's economy will grow three to five times greater. Therefore, large quantities of energy resources and heavy minerals will be needed, and the ocean provides a good source of many such resources.

The oceans are a great source of living-resources such as fish stock and food acquired through marine aquaculture and as byproducts of biotechnology. The ocean energies such as tide, wave, and thermal gradients could be converted into electronic power. The oceans can also be used to enlarge life space through reclaimed land, onshore and offshore man-made islands, as well as recreational or waste disposal areas and roads for sea transport. The oceans also are a controlling factor in weather and climate change.

If these and other possibilities are to be realized, a great deal of research is necessary. Research will help delineate and quantify the resources, recover known resources, assess the potential of the oceans for disposal of municipal and industrial wastes, and maintain environmental quality in the face of greater use. Additionally, increased research on ocean dynamics and air-sea interactions will improve both meteorological forecasting and our understanding of atmospheric phenomena. In short, research and information needs in a wide variety of fields are the major hurdles facing our exploration of the seas.

Many oceanic phenomena are global or regional in nature and cannot be fully understood by research in just one part of the ocean. Therefore, programs in which many nations participate will be required to conduct efficient and effective studies. The Ocean Drilling Program (ODP) in which the United States, Japan, Canada, and others participate, is a good example of a global approach to ocean study. Korea will join ODP by the end of 1996.

Marine Pollution

The oceans have been considered the ultimate appropriate dumping ground for wastes of human society. In the same way that fishery stocks were once considered inexhaustible, so we have felt, until recently, that the immense volume of the world's oceans had an infinite capacity for absorbing all of our waste materials. The discharge of human sewage and garbage into coastal waters is practiced throughout the world. Dilution, in other words, was considered the solution to pollution.

In addition to sewage, large amounts of garbage are dumped into the sea each year from shore and ships. These wastes add large amounts of small particles, heavy metals, and nutrients which give rise to "red tide." More insidious than sewage, though less obvious, are the various invisible toxic chemicals produced by the industrialized nations. These chemicals are often transferred through the food chain in the sea and affect animals and places removed in time and in space from the source.

In recent years, we have come to realize that, however large, the oceans are not infinite in their capacity to absorb wastes and that some of our wastes in very small amounts may have significant effects on communities and species.

Oil and gas spills are especially notable when a large ship goes aground or a drilling platform has an accident. These types of spills obviously can cause severe environmental damage, but the small unnoticed accident can also have a considerable impact. Hydrocarbons are toxic to most forms of marine life. Their effects can persist for many years, especially if they get into the bottom sediment and are slowly released over time. There are several environmental problems that can occur

in the mining of marine minerals and these will vary depending on coastal circulation, wave conditions and other factors. The damage of dumping nuclear wastes is not in polluting the ocean, but rather in introducing a large amount into a small restricted area where it cannot be dispersed and diluted.

Probably the most critical aspect of marine pollution is the large quantity of pollutants that enter the coastal zone, semiclosed bays, and estuaries. In many instances, this quantity exceeds the capacity of these waters to cleanse themselves. Even with proper treatment and management, large amounts of potentially damaging pollutants can remain in the bottom sediment of coastal zones, semiclosed bays, and estuaries.

Research Methodology

For too long, the seas of the world have been considered an inexhaustible source of food, as having an infinite capacity to absorb and purify our wastes, and as a source of all the raw materials needed to maintain an industrial society. It is now apparent that none of these assumptions is true and that the human population at the current level of technological development has the ability to inflict massive destruction on the seas. At present, the seas remain in good condition relative to the land. We cannot afford to permit them to be degraded, however, if we wish to extend our tenure as a species on this planet.

In order to curtail or reduce many forms of pollution, international cooperation and large-scale financing are required. Research and development for marine science should be actively undertaken in the international arena, with each country taking the role which is best suited to its circumstance. Countries adjoining semi-enclosed or nearly closed seas must, for example, cooperate urgently for effective control of marine pollution.

Ocean technology, which until now has been mobilized toward exploitation of the ocean, belongs by and large to advanced nations. Now, however, it is necessary to share the technology with

developing or newly developing economies in order to safeguard the fragile ocean in the wake of significant human pollution.

Research dealing with the oceans has two features; one extracting resources from the ocean and the other devoted to the protection of the ocean environment. Ocean science and technology has thus become highly diversified. It is necessary, therefore, for sustainable research and development to be pursued jointly by many nations.

If the ocean is to remain an infinite well of resources nurturing human creatures, all nations, whether poor or rich, must closely cooperate to make the best use of the ocean. Therefore, all of us should share the common commitment to set up a viable means to preserve the ocean. I hope bilateral cooperation between Korea and the United States will further enhance our understanding and global commitment to sustain the ocean.