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A Study of Exploitation of Minerals from Ocean Floor and Related Environmental Issues

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Abstract – Modern society is in growing need for food, energy, water and minerals. Economic growth and increase in world population are driving demand to the very limits of what the earth can provide for us. People's basic needs have a marked effect on every level of the world's supply chains. The increasing wealth of emerging economies has evolved into new standards of living, which demand evermore from our planet's land, rivers and forests. We must have an open discussion about our individual roles in the sustainability of our societies. To tackle our short-term needs, we must look at all opportunities, on land as well as offshore. However, addressing the long-term problems would require a broad view of technology, human behaviour and innovation. Consumer's attitudes and behaviours in selecting products and facilities also needs guidance, influenced by the more healthy, renewable and recyclable solutions. The seabed holds vast and diverse resources capable of sustaining human demands for centuries ahead. Key among these resources is solid minerals, biogenic and energy resources. Here in this research paper we are going to confine our study to solid minerals only.

Keywords: Minerals. Economic Growth, Consumer's Attitudes, Renewable and Recyclable.

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INTRODUCTION

Modern society is in growing need of natural resources. Energy security remains one of the greatest challenges that we face. We need increasing amounts of energy, but it is no longer acceptable to supply it at the expense of the environment. In the coming years we will continue our struggle to innovate and discover new sources of clean, cheap and reliable energy. The ocean has vast resources that could contribute to solving our energy needs. The evolution of the energy market in the coming fifty years requires innovation, strong international cooperation and moderation from consumers. This research paper is going to explore some opportunities of meeting these challenges.

SEABED/SEAFLOOR:

The seabed is often termed as the seafloor, sea floor, or ocean floor. It is the bottom of the ocean. The seabed, defined here as the bottom of the ocean, has rich natural reserves including energy, solid minerals, and biogenic resources. Most of the oceans have a common structure, created by common physical phenomena, mainly from tectonic movement, and sediment from various sources. Sediments in the seabed vary diversely in their origin, from eroded land materials carried into the ocean by rivers or wind flow, waste and decompositions of sea animals, and precipitation of chemicals within the sea water itself, including some from outer space.

The seabed has been explored by submersibles such as Alvin and, to some extent, scuba divers with special equipment. The process that continually adds new material to the ocean floor is seafloor spreading and the continental slope. In recent years satellite images show a very clear mapping of the seabed, and are used extensively in the study and exploration of the ocean floor.

EXPLOITATION:

It is the act of using resources for profit. Resources are a means of supporting society and creating wealth. They can be minerals, land, or other natural properties of a country such as water, energy or biological diversity. Any exploitation activity for seabed resources requires the transformation of the resource into a reserve. In contrast to onshore resources, a very small part of the seabed resources has been mapped using high-resolution devices.

ENERGY, SOLID MINERALS AND BIOGENIC RESOURCES:

This paper tries to explore the possibilities of seabed exploitation, hydrocarbons excluded. The oil industry was the first to embark in seabed exploitation activities within the Exclusive

Economic Zone of many nations, and many hydrocarbon resources are already part of national reserves. There are mainly three types of seabed resources: energy, solid minerals and biogenic resources. Firstly, energy in the seabed can be extracted from a wealth of sources: hydrothermal and hydrodynamic energy from hydrothermal vents, hydrostatic pressure from the deep water. Secondly, solid mineral resources include poly-metallic nodules, poly-metallic crusts, poly-metallic massive sulphide deposits, poly-metallic sediments, and marine diamond deposits. Finally, the third type of resource is biogenic, which consists of genetic resources, fisheries and biofuels. Here in this paper we will confine our study to solid minerals only.

SOLID MINERAL RESOURCES:

Some major sources of hard minerals on the seabed are discussed under.

1. **Polymetallic Nodules**: Polymetallic nodules are small potato-sized rocks that contain minerals precipitated from seawater and sediment pore water. The metal accumulation rates are very slow, and it takes millions of years to form a manganese nodule. Polymetallic nodules can contain up to 40 different metals, including manganese, iron, nickel, copper, aluminum, iron and cobalt. The average concentrations of these metals vary depending of the local characteristics of where they are formed. Some estimations place the total nodule deposits at 500 billion tons (Archer 1981). In some areas studies assessed the readily recoverable quantities of copper and cobalt to 2.4 billion tons of each element, 3.6 billion tons of nickel, and 96 billion tons of manganese (R. Stein & Walter 1977). The highest metal concentrations in nodules occur in equatorial regions of oceans where the remains of tiny plants and animals sink to the seafloor, dissolve, and release the metals into the pore water of seafloor sediments. Areas of commercial interest include the eastern equatorial Pacific, between the Clarion and Clipperton fracture zones, and the central equatorial Indian Ocean.

2. **Polymetallic Crusts:** Polymetallic crusts are also known as cobalt crusts. Minerals form pavements up to 250 mm thick on rock outcrops in water depths of 400 to 4,000 m at the seafloor on the flanks and summits of seamounts, ridges, plateaus, and abyssal hills, where the rocks have been swept clean of sediments at least intermittently for millions of years. The composition of polymetallic crusts is high in manganese from 13.5 to 26.3 wt. percentage. In addition, crusts can also contain significant amounts of iron, nickel, copper, cobalt, zinc, barium, cerium and other minor metals. Some of the important areas where rich manganese crusts have been found in the Pacific include the north-west Hawaiian Ridge, Johnston Island, Huwlarid-Baker Islands, Marianas Island, Guam, Marshall Islands, Central Seamounts, Palmyra-Kingman, Micronesia and Wake Island.

3. **Seabed Massive Sulphides:** Deposits Polymetallic sulphides, also known as massive sulphides, are found at vent fields. These formations have high contents of copper, iron, zinc and silver combined as sulphide minerals. They are referred to as massive sulphides, and the term massive pertains to metal content rather than to size or shape of the deposit. Gold and other metals may also be present in lower concentrations. Massive sulphide bodies are principally found along the earth's major tectonic belts, as indicated in Figure 1-8. Up to 40% of the known deposits occur at shallower depths in backarc basins and on submarine volcanic ridges within 200 nautical miles of the coast and within the jurisdiction of national exclusive economic zones.

4. **Polymetallic Sediments**: There are many places in the ocean where the processes described above have given rise to metalliferous sediment formation. Most of these are associated with mid-ocean ridge spreading centres, but some have also been found in island arcs. The best examples of metalliferous sediments discovered to date are in the Red Sea where metal rich hydrothermal brines discharge into a number of deeps along the axial rift to give rise, on fractional precipitation, to sulphide deposits containing high grade Cu and Zn, and to metal rich silicates and oxides precipitated at increasing distances from the sulphides. The metalliferous sediments of the Atlantis II Deep in the northern Red Sea constitute the first hydrothermal deposit found at a divergent plate boundary in the ocean and remain the most efficient ore-forming system and the largest such deposit found to date.

5. **Marine Diamonds**: Marine diamond mining takes place primarily along the 1,400 km stretch of coastline of southern Namibia and north-west South Africa. Namibia has the richest known marine diamond deposits in the world, estimated at over 100 million carats. The diamond content of the deposits varies from 0.15 carat per square metre (ct/m2) to 2.45

ct/m2 for corresponding sediment thicknesses of 1-6m. Corresponding grades by weight are approximately 0.07 to 0.28 carat per metric ton (ct/t). Richer deposits have been reported with 1.00 ct/t. The diamonds are of 95 per cent gem quality, with the stones weighing 0.3 to 0.7 ct on average.

ENVIRONMENTAL CONSIDERATIONS:

Protecting the Marine Environment There are three scientific reasons for deferring commercial exploitation of mineral resources in deep-sea hydrothermal vents: firstly, we still have much to learn about the ocean; secondly, there is a lack of strategies for environmental impact assessment in the deep seas; and thirdly, mitigation strategies do not exist. These reasons could well apply to any exploitation activity in other areas of the sea. Scientists suggest that we still need to place the proper regulations and control mechanisms to guarantee an environmentally conscious and sustainable use of ocean resources. It is difficult to build up a strategy to assess the environmental impact of any seabed exploitation activity, mainly because operation technologies are different. They remain on a conceptual stage. Even for resources that are closer to our daily life, such as food from fisheries of sea-farming activities, have suffered from a lack of an integrated framework for environmental impact assessment and mitigation.

Ecological Issue Conservation of the marine environment is important. The ocean supports a wealth of creatures that are only beginning to be understood, as is evident in the rate of discovery of these so-called biogeographic provinces. The issue for ecology is the impact of seabed exploitation on the ecosystem and biodiversity. It is still unknown to what extend exploitation will destroy and lead to the 13 reduction of species. In some area of the seabed, the habitants are unique and local.

Resource Issue The definition and discovery of a resource sometimes depends on people's recognition on the use of that particular resource. People in the future may very well need a resource of no value or use today. Therefore, all of the resources in the seabed are potentially necessary for society. From food to hydrocarbon fuels, we are already dependant in offshore resources for a good deal of our economies and livelihoods. Preservation is important, and sustainable resource exploitation should be a top priority.

Legal Issue In order to minimize environmental effects from seabed exploitation, many international organizations have made the first steps in the direction of environmental laws or guidelines. The United Nations Convention on the Law of the Sea (UNCLOS) is an example of a legal framework of international scope that regulates exploitation activities. The International Seabed Authority (ISA) was instituted, which duty is "to ensure effective protection of the marine environment from harmful effects which may arise from mining-related activities in the Area" (UN 1982). In addition, the ISA has already developed regulations to govern prospecting and exploration for polymetallic nodules and is in the process of developing a regulatory regime for exploration for new types of resources, including polymetallic sulphides and cobalt-rich crusts.

CONCLUSION:

The exploitation of mineral commodities from the seabed presents similar challenges. Political support, due to the financial risks of these ventures, can be a driving force for the industry. However, as long as new mining ventures show a limited success, the risks will outweigh the benefits for private or public support. The seabed mining industry lags behind onshore projects and recycling. Several technical challenges, including the transport of ores and the logistics of the mining operation would limit any short-term ventures to the Exclusive Economic Zone. Scientists expose three scientific reasons for deferring commercial exploitation of mineral resources in deep-sea hydrothermal vents: firstly, we still have much to learn about the ocean; secondly, there is a lack of strategies for environmental impact assessment in the deep seas; and thirdly, mitigation strategies do not exist. These reasons could well apply to any exploitation activity in other areas of the sea. Scientists suggest that we still need to place the proper regulations and control mechanisms to guarantee an environmentally conscious and sustainable use of ocean resources. It is difficult to build up a strategy to assess the environmental impact of any seabed exploitation activity, mainly because operation technologies are different. They remain on a conceptual stage. Even for resources that are closer to our daily life, such as food from fisheries of sea-farming activities, have suffered from a lack of an integrated framework for environmental impact assessment and mitigation.

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