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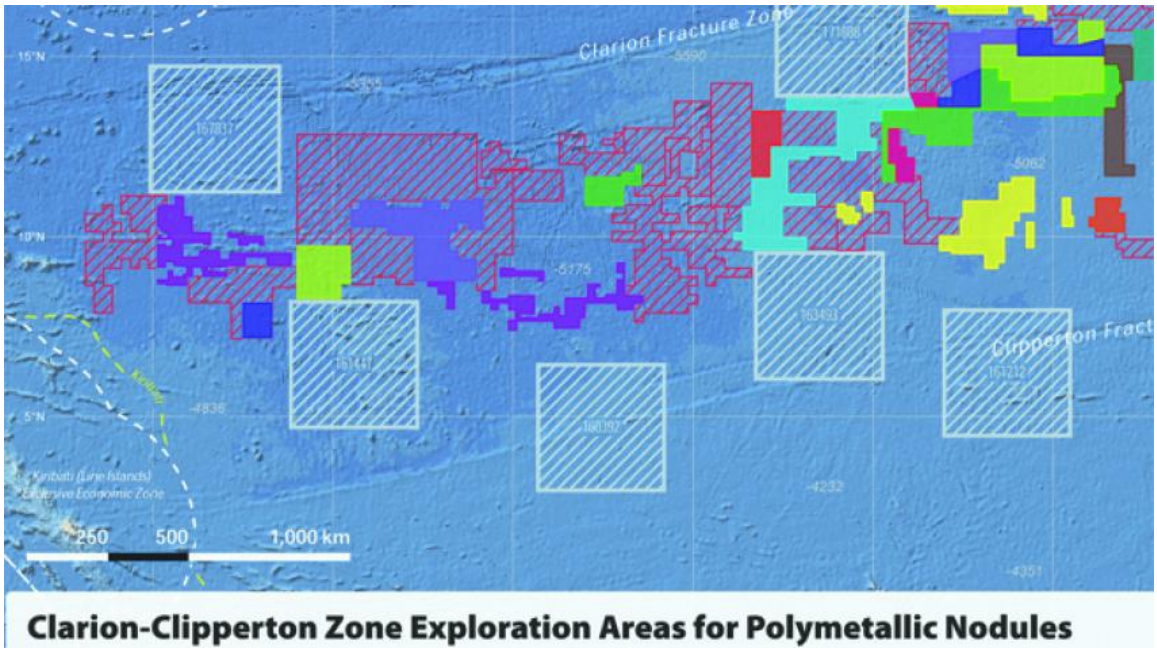

Clarion-Clipperton Zone Exploration Areas for Polymetallic Nodules

Marine Regions (Ostend, Belgium, Flanders Marine Institute, 2016) © Simon Claus and others. Available from https://www.isa.org.jm/contractors/exploration-areas.

The International Seabed Authority and Deep Seabed Mining

The deep ocean below 200 metres is the largest habitat for life on Earth and the most difficult to access. The sea floor, just like the terrestrial environment, is made up of mountain ranges, plateaus, volcanic peaks, canyons and vast abyssal plains. It contains most of the same minerals that we find on land, often in enriched forms, as well as minerals that are unique to the deep ocean, such as ferromanganese crusts and polymetallic nodules.

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The existence of mineral deposits in the deepest parts of the ocean has been known since the 1860s. In Jules Verne's *20,000 Leagues Under the Sea*, Captain Nemo announced that "in the depths of the ocean, there are mines of zinc, iron, silver and gold that would be quite easy to exploit", predicting that the abundance of marine resources could satisfy human need. Although he was right about the abundance of the resources, he was most certainly wrong about how easy it would be to exploit them.

Serious attention was focused on deep seabed minerals in the 1960s, when American geologist John L. Mero published a book entitled *The Mineral Resources of the Sea*, in which he made the case that the seabed could become a major source of supply for meeting the world's mineral needs. This in turn led Ambassador Arvid Pardo of Malta to deliver a speech to the First Committee of the United Nations General Assembly, in which he called for the resources of the deep seabed to be designated as the "common heritage of mankind" and urged the creation of a system of international regulation to prevent technologically advanced countries from colonizing the seabed and monopolizing these resources to the detriment of developing States.

Ambassador Pardo's grand vision captured the zeitgeist of the 1960s and was to become a major driving factor in United Nations efforts to elaborate a comprehensive regime for ocean governance between 1967 and 1982. In 1970, the General Assembly, in resolution 2749 (XXV), adopted the Declaration of Principles Governing the Sea-Bed and the Ocean Floor, and the Subsoil Thereof: beyond the Limits of National Jurisdiction, which reserved the seabed exclusively for peaceful uses. Following Pardo's advice, the Assembly also declared the mineral resources of the seabed as the "common heritage of mankind", to be developed for the benefit of mankind as a whole through international machinery to be established for that purpose.

After the initial euphoria of the 1970s, a collapse in world metal prices, combined with relatively easy access to minerals in the developing world, dampened interest in seabed mining.

It would take another 24 years for the machinery proposed by the General Assembly to come into existence in the form of the International Seabed Authority, an autonomous organization within the United Nations common system, with headquarters located in Kingston, Jamaica. All States parties to the 1982 United Nations Convention on the Law of the Sea (UNCLOS) are members of the Authority, amounting to 168 members, including the European Union. The Authority is one of the three international institutions established by UNCLOS; the other two are the Commission on the Limits of the Continental Shelf and the International Tribunal for the Law of the Sea. Its primary function is to regulate exploration for and exploitation of deep seabed minerals found in 'the Area', which is defined by the Convention as the seabed and subsoil beyond the limits of national jurisdiction, that is, beyond the outer limits of the continental shelf. The Area comprises just over 50 per cent of the entire seabed on Earth.

Today, after decades 'on hold', there is renewed interest from the private sector and Governments alike in the potential for commercial exploitation of marine minerals. The principal drivers of this new interest are a combination of technological advances in marine mining and processing, and an increase in the long-term demand for minerals, which is attributable to globalization and industrialization in the developing world. Terrestrial mineral deposits are coming under increasing pressure because of the need to serve a continuously growing global population, an expanding middle class that is driving urbanization and the need for renewable, low-carbon infrastructure. Easily mined, high-grade ore deposits are quickly declining. Although new resources are likely to exist in the deep subsurface or in remote locations, mining these terrestrial deposits will require large amounts of energy and have significant social and environmental consequences. Increased recycling of metals will provide some relief but will never be sufficient to satisfy the anticipated long-term growth in demand. Deep seabed minerals are therefore increasingly likely to make an important contribution to sustainable development, particularly for those countries that lack secure sources of supply on land, as well as small island developing States that lack opportunities for economic development.

Commercial interest is currently focused on three types of marine mineral deposits. **Polymetallic nodules** occur throughout the ocean and are found lying on the sea floor in the abyssal plains, often partially buried in fine grain sediments. Nodules contain a wide variety of metals, including manganese, iron, copper, nickel, cobalt, lead and zinc, with important but minor concentrations of molybdenum, lithium, titanium, and niobium, among others. The most studied area of commercial interest is the Clarion-Clipperton Zone (CCZ) in the eastern Pacific, at water depths between 3,500 and 5,500 metres. This single deposit contains more nickel, manganese and cobalt than all terrestrial resources combined. Other areas of potential interest are the Central Indian Ocean basin and the exclusive economic zones of the Cook Islands, Kiribati and French Polynesia.

Polymetallic sulphides (sometimes called sea floor massive sulphides or SMS) are rich in copper, iron, zinc, silver and gold. Deposits are found at tectonic plate boundaries along the mid-ocean ridges, back-arc ridges and active volcanic arcs, typically at water depths of around 2,000 metres for mid-ocean ridges. These deposits formed over thousands of years through hydrothermal activity, when metals precipitated from water discharged from the Earth's crust through hot springs at temperatures of up to 400'C. Because of the black plumes formed by the activity, these hydrothermal vents are often referred to as 'black smokers'. Active hydrothermal vents form unique ecosystems. Chemosynthetic bacteria, which use hydrogen sulphide as their energy source, form the basis of the vent food web, which is comprised of a variety of giant tube worms, crustaceans, molluscs and other species. Many vent species are considered endemic to vent sites, and hydrothermal vent habitats are thus considered to hold intrinsic scientific value.

Cobalt crusts accumulate at water depths of between 400 and 7,000 metres on the flanks and tops of seamounts. They are formed through the precipitation of minerals from seawater and contain iron, manganese, nickel, cobalt, copper and various rare metals, including rare earth elements. Globally, it is estimated that there may be as many as 100,000 seamounts higher than 1,000 metres, although relatively few of these will he found suitable for cobalt crust extraction. The most prospective area for cobalt crusts is located in the Magellan Seamounts in the Pacific Ocean, east of Japan and the Mariana Islands.

Under UNCLOS, exploration for and exploitation of seabed minerals in the Area may only be carried out under a contract with the International Seabed Authority and subject to its rules, regulations and procedures. Contracts may be issued to both public and private mining enterprises, provided they are sponsored by a State party to UNCLOS and meet certain standards of technological and financial capacity. Ultimately, the economic advantages of deep seabed mining, most likely in the form of royalties paid to the Authority, are to be shared for the "benefit of mankind as a whole", with particular emphasis on the developing countries that lack the technology and capital to carry out seabed mining for themselves.

The Authority has developed regulations, including provisions relating to environmental protection, to govern exploration. It has so far approved 28 exploration contracts in the Pacific, Indian and Atlantic Oceans, covering more than 1.3 million square kilometres of ocean floor. In January 2017, Poland applied for the twenty-ninth exploration contract. Such contracts are held by States parties to UNCLOS and by companies sponsored by those parties. National Government participants include those from China, France, Germany, India, Japan, the Republic of Korea, the Russian Federation and the Interoceanmetal Joint Organization (a consortium of Bulgaria, Cuba, the Czech Republic, Poland, the Russian Federation and Slovakia). Contracts have also been granted to an increasing cohort of private entities sponsored by both developed and developing States parties, including small island developing States such as the Cook Islands, Kiribati, Nauru, Singapore and Tonga.

The Authority is now focused on the development of a regulatory regime for exploitation of these resources. This involves consideration of a range of technological, financial and environmental issues. Although there will be technological variations in the mining equipment required for each type of mineral deposit, the basic concept and methodology for recovery is similar. In each case, a collector vehicle will make contact with the sea floor and collect the mineral deposits. In the case of SMS and cobalt crusts, this will require cutting or breaking the mineral deposits from the substrate. Nodules may be harvested directly from the seabed. In all cases, the mined materials, combined with seawater, will be brought to the surface by a riser system and transported to a surface support vessel. There the ore will be separated from the seawater and transported to processing plants on land.

Perhaps the primary concern for the Authority as a regulator is how to balance the societal benefits of deep seabed mining, including access to essential minerals, the non-displacement of communities) extensive deep sea research and technological development, against the need to protect the marine environment. Of course, the fact that no part of the Area may be exploited without permission from the Authority ensures that the environmental impacts of deep seabed mining will be monitored and controlled by an international body. This in itself reflects a precautionary approach to seabed development. It is evident, nevertheless, that mining will impact the marine environment to some extent, especially in the immediate vicinity of mining operations. Impacts may include the crushing of living organisms, the removal of substrate habitat and the creation of sediment plumes. There is also the possibility of other environmental damage through malfunctions in the riser and transportation system, hydraulic leaks, and noise and light pollution. Much of the Authority's work to date has focused on requiring exploration contractors to collect baseline data, especially on the composition and distribution of deep sea species, and conduct scientific research to better understand the potential long-term impacts of deep sea mining.

The adoption of UNCLOS in 1982 was one of the greatest achievements of the United Nations. One of the Convention's most important contributions is that it placed more than 50 per cent of the seabed under international jurisdiction, beyond the reach of any single State. Although it has taken more than 50 years of multilateral effort to begin to realize the promise of the "common heritage of mankind" envisioned by Ambassador Pardo and enshrined in UNCLOS, the prospects for sustainable exploitation of seabed mineral resources are better now than at almost any other time in the last 30 years. If managed effectively, in accordance with the rule of law as set out in the Convention, deep sea mining has the potential to contribute to the realization of Sustainable Development Goal 14, particularly for landlocked and geographically disadvantaged States, and small island developing States that are heavily reliant on the ocean and its resources for economic development.