Potential Marine Geological Resources of Bangladesh: The Future Prospects of Blue Economy

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The resources found in oceans, encompassing physical, geological, and biological elements, are collectively known as "marine resources" and hold immense value for human wellbeing. The term gained prominence through Sustainable Development Goal 14, one of the United Nations' 17 goals established in 2015, focusing on "Life below water." Generally, marine resources are grouped into three categories: biotic resources, abiotic resources (minerals and energy), and commercial resources (navigation, aviation, trade, transport, etc.). Additionally, they are commonly classified as living resources and non-living resources. Alternatively, marine resources can be categorized as minerals, energy, and food. Marine mineral resources refer to the deposits of minerals beneath or at the seabed, containing metals, minerals, components, or aggregates that can be extracted. For a nation, marine mineral resources within its continental shelf and Exclusive Economic Zone (EEZ) area bears significant implications for its economy and resource management.

Types of Marine Mineral Resources and their Locations

Minerals of the Continental Shelf Deposits. These are shallow regions extending from the coastline into the ocean and contain various valuable minerals, including oil and gas, sand and gravel, and phosphates.

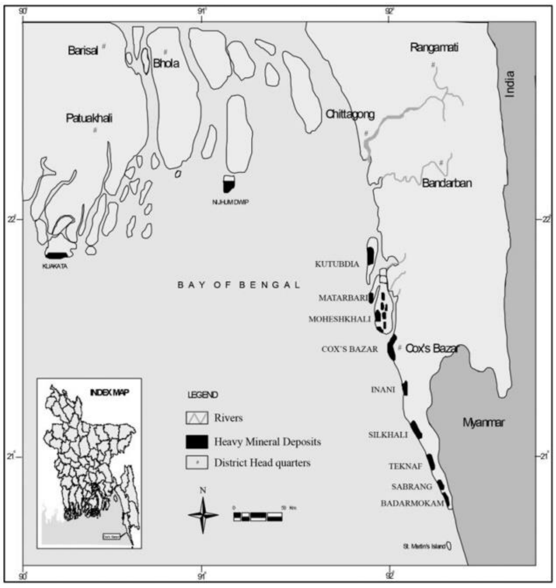
Minerals of the Continental Slope Deposits. The continental slope is the steep transition between the continental shelf and the deep ocean. Essential mineral resources found here include gas hydrates and cobalt-rich crusts.

Minerals of the Deep Sea Bottom Deposits refer to mineral resources found in the abyssal plains and areas beyond the continental slope. Notable examples include manganese nodules, polymetallic sulfides, and ferromanganese crusts.

Provable Potential Minerals in the Bangladesh Maritime Area

Heavy Mineral Deposit. Bangladesh Atomic Energy Commission (BAEC) has found valuable economic minerals of placer deposits along the coastal area of Bangladesh through the last three decades-long exploration activities. According to Akon (2019), the percentage of heavy minerals in different deposits varies, ranging from 7.30% to 42.20%. On average, these deposits contain about 23% of heavy minerals. The heavy mineral deposits are primarily composed of fine to very fine-grained particles, ranging from 0.075 mm to 0.15 mm. Overall, these mineral sand deposits contain 4.35 million tonnes of heavy minerals.

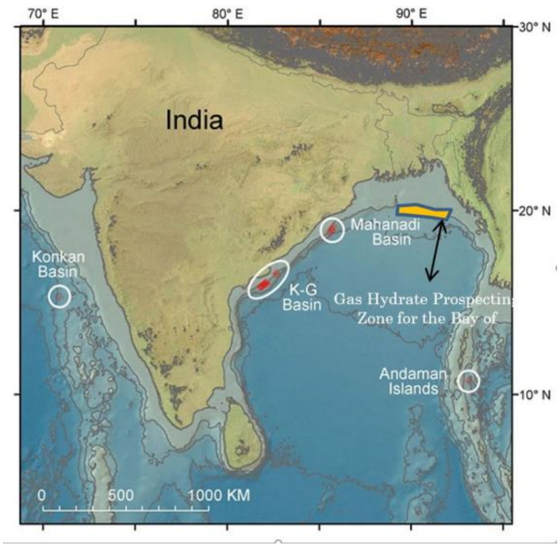
Bangladesh Oceanographic Research Institute (BORI) conducted a study to map the heavy mineral deposits in the coastal and nearshore marine regions. The study area spanned from the coastline to a distance of 25 km into the inner sea, covering the region from Saint Martin's Island to Feni (Eastern Coastal Marine Area). During the study, they found that the surface sediment of this area had a concentration of heavy minerals ranging from 8% to 18%. This discovery suggests that there is potential for future heavy mineral deposits in the maritime area of Bangladesh.



Phosphorites. Phosphate rocks, commonly known as phosphorites, are sedimentary formations rich in phosphorus (P). The majority of the world's phosphate production is derived from marine phosphorites. The richest and greatest of these emerge at low latitudes in areas of upwelling associated with divergence (Sheldon, 1964). Generally, cherty carbonate rock and light-colored sandstone or shale are connected with phosphorites produced on neighboring platforms or stable areas. In India's offshore area, areas of obvious geological potential (OGP) for phosphorites have been delineated. Phosphorites are being searched for in favorable geomorphic locations such as seamounts, terraces, wave-cut notches, spurs, and so on along India's eastern continental edge (Bay of Bengal) (Wadhawan et al., 2013). As per geological conditions, the continental shelf breaks and slope area of the Bangladesh maritime zone may have potential phosphorite deposits.

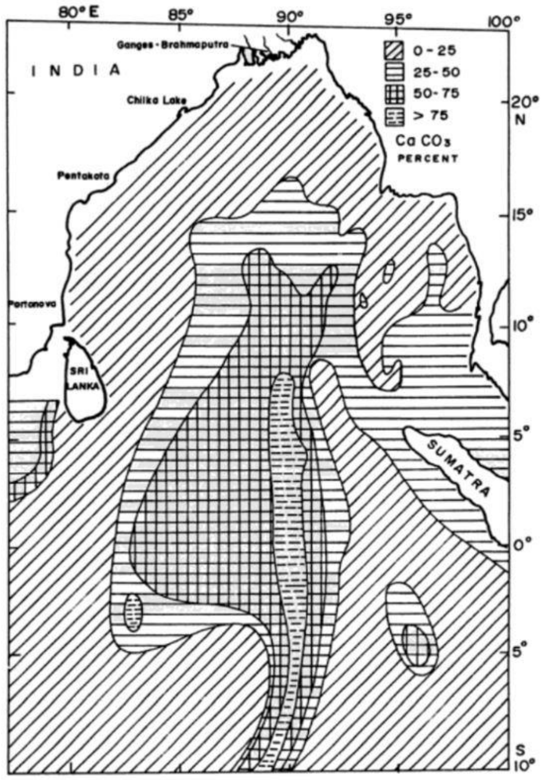
Gas Hydrate. The world's Gas hydrate resources are estimated at 7100 TCM of gas hydrates under standard temperature and pressure conditions. SAARC Energy Center (2010) reports that among the SAARC countries, one or more sides of India, Pakistan, Sri Lanka, Bangladesh, and the Maldives are surrounded by oceans like the Indian Ocean, the Bay of Bengal, and the Arabian Sea. There is a great likelihood that oceanic sediments adjacent to these countries shall contain a substantial amount of gas hydrates. Parameters like sedimentary thickness, sedimentation rate, total organic carbon content, seabed temperature, and geothermal gradients indicate good gas hydrates prospects in the vast Indian offshore (Sain & Gupta, 2008). In India, the prognosticated resources for Gas Hydrates are calculated to be 1894 TCM. As per findings of ONGC of India, the Krishna-Godavari Basin estimated reserves of about 134 trillion cubic feet (TCF). They also show the potentiality of Gas Hydrate in the Mahanadi Basin (205 m sub-surface) (SAARC Energy Center, 2010).

As per geological conditions and deposition process similarities, also Bangladesh has such prospecting on Gas Hydrate deposits. According to the Daily Star (5 January 2022), the Ministry of Foreign Affairs of Bangladesh declared the possible discovery of 0.11 to 0.63 TCF Gas Hydrate in the maritime area of Bangladesh, which is equivalent to 17-103 TCF methane gas where they studied about 6500 km of seismic lines. In the case of India, national institutes such as National Institute of Oceanography (NIO), National Geophysical Research Institute (NGRI), National Institute of Ocean Technology (NIOT), Indian Institutes of Technology (IIT), Oil and Natural Gas Corporation (ONGC), etc. has frequent interactions with the scientists working in this area of research of Gas Hydrate. Bangladesh can continue of study with the interaction of different institutes working in this field, such as Petrobangla, Geological Survey of Bangladesh, Blue Economy Cell, Bangladesh Oceanographic Research Institute, Maritime Affairs Unit of the Ministry of Foreign Affairs for further progress of the discovery of Gas Hydrate in the EEZ of Bangladesh. Although technology is not adequately supported yet for gas production from Gas Hydrate, it has potential to meet energy scarcity in the future.



Rear Earth Element and Yttrium (REY). There are countless uses for REY in healthcare, business, energy, space technology, etc. REY is the foundation of the clean, green technology of the future. Monazite, one of the primary ores for Light Rare Earth Elements (LREE), has an estimated resource of 12 Metric Million Tons (MMT) in India (Wadhawan et al., 2013). The offshore REY is comparatively enriched in deep sea muds (metalliferous sediments, zeolitic clay, and pelagic red clay), nearshore carbonaceous clay with high metal content, and cobalt-rich Fe-Mn crusts and nodules that were deposited on volcanic seamounts/ridges and abyssal plains, respectively (German et al., 1990; Byrne & Kim, 1990; Kato et al., 2011). In the Bay of Bengal, there are probable potential REY resources as per the geological conditions of the maritime area of Bangladesh.

Carbonated sand and Lime Mud. Rich in carbonate, carbonated sand is produced by the deterioration of coral reefs and the addition of calcareous rocks brought about by wave action and other shallow-water processes. These sands are excellent for the cement, glass, bleaching powder, fertilizer, soda ash, calcium carbonate, iron, and steel industries based on their composition (CaO: 50.16%, MgO: 1.63%, SiO2: 0.03%). The Lime Mud is also amorphous, homogenous, creamy white, and comprises mud aggregates, detrital grains, ooids, and skeletal materials. Aragonite and calcite comprise most of the clay components of lime mud (Wadhawan et al., 2013). The continental shelf, which extends onto an area of the continental slope with a low sedimentation rate during the late Pleistocene, is the most plausible location for lime mud (Vaz et al., 1993; Rao et al., 2012). Considering geological conditions and the Bay of Bengal's depositional process, there may be potential resources of Lime Mud and Carbonated Sand in the EEZ area of Bangladesh.



Manganese Nodules, Polymetallic Sulfides, and Co-rich Ferromanganese Crusts are deep-sea bottom deposits found in the abyssal plains and areas beyond the continental slope. All these are valuable metal-bearing mineral resources. There is no possibility of finding these minerals in the EEZ of Bangladesh. Those minerals are primarily found in Area Beyond National jurisdiction (ABNJ) and International water areas (54% of the world's oceans). However, the demand for metals for future industries is increasing. These minerals are currently being explored and exploited under the supervision of the International Seabed Authority (ISA), of which Bangladesh is an active member. ISA has 169 Members, including 168 Member States and the European Union. Bangladesh can take the initiative to become a contractor for exploring deep-sea mineral deposits to meet the future demands of industrial development.

Potential Challenges

Extracting marine mineral resources presents several technical and logistical challenges for Bangladesh. These include operating at extreme depths, dealing with harsh environmental conditions, developing suitable extraction technologies, and establishing cost-effective methods for transportation and processing. The challenges include:

Technological Advancements. Extracting marine mineral resources within the continental shelf and EEZ often requires advanced technologies. Seismic surveys, drilling rigs, underwater robotics, and Remotely Operated Vehicles (ROVs) are commonly used to explore and extract resources. Continuous advancements in technology enable more efficient and environmentally responsible resource extraction.

Environmental Considerations. Sustainable management of marine mineral resources within the continental shelf and EEZ requires careful consideration of environmental impacts. Extraction activities can disrupt marine ecosystems, damage habitats, and contribute to pollution. Environmental impact assessments, mitigation measures, and monitoring systems are crucial to minimize these effects and ensure the protection of marine biodiversity.

Balancing Economic and Environmental Interests. Coastal states must balance exploiting marine mineral resources for economic development and ensuring sustainable resource management. Robust legal frameworks, effective governance structures, and stakeholder engagement are essential for achieving this balance and maximizing the long-term benefits of marine mineral resources.

Harnessing marine mineral resources comes with challenges. Technical complexities, environmental considerations, and the delicate balance between economic and environmental interests are significant hurdles that Bangladesh must navigate. Advanced technologies, environmental impact assessments, and robust governance structures are essential for sustainable and responsible resource extraction. Bangladesh's maritime area holds immense potential for marine geological resources, presenting a promising pathway for the country to embrace the Blue Economy and foster sustainable development. With proper planning, technological advancements, and responsible resource management, Bangladesh can capitalize on these resources while safeguarding the marine ecosystem for future generations.

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