



Harnessing offshore mineral resources of EEZ of India: Advances in exploration, assessment and sustainable mining technologies

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Abstract: Exclusive Economic Zone of India (EEZ) holds immense potential for the mineral requirements of the country especially construction sand, heavy minerals, phosphorite, lime mud and polymetallic crust and nodules. Offshore exploration within EEZ of India has systematically advanced under the Geological Survey of India (GSI), identifying 5,89,160 sq km as Offshore Prospective Areas (OPA). Focused studies on construction-grade sand, heavy mineral placers, lime mud, phosphorites, and polymetallic crusts and nodules employ a multi-disciplinary framework, integrating high-resolution bathymetric mapping, seismic surveys, sediment sampling, and geochemical analyses. Key findings include a delineation of 511 sq km off the coast Kerala, holding 992 million tonnes of silica-rich construction sand, and a 18,767 sq km area with lime mud reserves of 1,53,996 million tonnes (>40% CaO). Heavy mineral resources, distributed across 1,317 sq km, include economically vital minerals like ilmenite, rutile, zircon, monazite and vanadiferous titanomagnetite. Polymetallic nodules from the Andaman and Lakshadweep Seas, rich in Co (0.21%), Ni (0.76%), and Rare Earth Elements (REE) (average 1,499 ppm), are significant for strategic metal reserves. These results demonstrate the viability of marine mineral extraction technologies, such as trailing suction hopper dredgers and advanced robotic systems, in sustainable resource development. The compilation underscores India's potential to harness offshore mineral wealth, reducing import dependence and supporting industrial and technological growth.

Key Words: Offshore minerals, construction-grade sand, heavy mineral placers, lime mud, phosphorites, polymetallic crusts and nodules

Introduction

The significant growth in the construction sector has resulted in an increasing demand for fine aggregate, particularly river sand, which has become a limited resource in India due to extensive over-exploitation since the 1990s (Padmalal and

Maya, 2014). This excessive extraction has precipitated detrimental environmental impacts, highlighting the urgent need for alternatives such as offshore sand to alleviate these concerns. Dunes and beaches of India are rich in strategic heavy minerals, including thorium (Th), uranium (U), and

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EEZ Resources Commission of the European Communities, National Science Foundation, 1989 *Proceedings* National Science Foundation (U.S.), International Ocean Technology Congress, 1989* **Ocean Resources** D.A. Ardu, M.A. Champ, 1990-10-31 Today western nations consume annually only a small percentage of their resources from the sea despite the proclamation of Exclusive Economic Zones EEZ by many In contrast most Pacific Basin Countries obtain more than a quarter of their annual needs from the ocean Determination of greater rewards from the development of marine resources is markedly inhibited by the limited technical abilities available to locate and assess them Knowledge of Exclusive Economic Zone resources is schematic and generalised and a detailed understanding of the geology and processes relating to the economic use of the seafloor is both fragmentary and very basic Technology for mapping the mineral resources of continental shelves and ocean areas except in active offshore hydrocarbon provinces has been largely developed in pursuit of scientific objectives and competence to rapidly appraise economic potential is limited Similarly the capability to characterise and evaluate the other resources of the seas is rudimentary The development of ocean resources will become increasingly urgent as the growth of the world population and the depletion of land reserves combine to enhance demand Also increasing environmental constraints will limit the availability of traditional land based resources nevertheless new offshore development must proceed in a manner whereby the marine environment is not plundered but protected and conserved The challenge to develop ocean resources with responsible environmental stewardship will require greater leadership than the development of the technologies of exploitation Proceedings of the 1987 Exclusive Economic Zone Symposium on Mapping and Research Geological Survey (U.S.), 1988 **Proceedings EEZ Resources** ,1989 *Proceedings of the 1987 Exclusive Economic Zone Symposium on Mapping and Research* John F. Elder, Lawrence H. Smith, Richard W. Will, Ronald Charles Severson, Hansford T. Shacklette, William B. Krohn, 1988 1988 Annual Report on Alaska's Mineral Resources ,1988 **EEZ Resources: Technology Assessment Conference** ,1989 *Resource Use and Use Conflicts in the Exclusive Economic Zone* Lynne Carter Hanson, Lewis M. Alexander, 1984 Policy and Science of Exclusive Economic Zone Mapping ,1989 **Intervention ... Conference and Exposition** ,1990 *Underwater Technology* ,1990 **Geologie en Mijnbouw** ,1991 **WTEC Panel on Research Submersibles and Undersea Technologies** Richard J. Seymour, 1994 Proceedings ,1989 Ocean resources. Vol. 1. Assessment and utilisation. Derived from papers presented at the 1st International Ocean Technology Congress on EEZ resources. Technology assessment held in Honolulu, Hawaii, 22-26 jan. 1989 ,1990 **Index of Conference Proceedings** British Library. Document Supply Centre, 1991 **Calendar of Scientific Meetings and Events** American Association for the Advancement of Science. Office of Communications, 1988 **Maritime Information Review** ,1999 International Workshop on Very Large Floating Structures Yoshiyasu Watanabe, 1996

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Table of Contents Eez Resources Technology Assessment

1. Understanding the eBook Eez Resources Technology Assessment
 - The Rise of Digital Reading Eez Resources Technology Assessment
 - Advantages of eBooks Over Traditional Books
2. Identifying Eez Resources Technology Assessment
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Eez Resources Technology Assessment
 - User-Friendly Interface
4. Exploring eBook Recommendations from Eez Resources Technology Assessment
 - Personalized Recommendations
 - Eez Resources Technology Assessment User Reviews and Ratings
 - Eez Resources Technology Assessment and Bestseller Lists

5. Accessing Eez Resources Technology Assessment Free and Paid eBooks
 - Eez Resources Technology Assessment Public Domain eBooks
 - Eez Resources Technology Assessment eBook Subscription Services
 - Eez Resources Technology Assessment Budget-Friendly Options
6. Navigating Eez Resources Technology Assessment eBook Formats
 - ePub, PDF, MOBI, and More
 - Eez Resources Technology Assessment Compatibility with Devices
 - Eez Resources Technology Assessment Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Eez Resources Technology Assessment
 - Highlighting and Note-Taking Eez Resources Technology Assessment
 - Interactive Elements Eez Resources Technology Assessment
8. Staying Engaged with Eez Resources Technology Assessment
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Eez Resources Technology Assessment
9. Balancing eBooks and Physical Books Eez Resources Technology Assessment
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Eez Resources Technology Assessment
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Eez Resources Technology Assessment
 - Setting Reading Goals Eez Resources Technology Assessment
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Eez Resources Technology Assessment
 - Fact-Checking eBook Content of Eez Resources Technology Assessment
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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