

Exploration for nodules in the Central Indian Ocean Basin : past, present and the future

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Introduction

The Polymetallic Nodules Project has a long (>2 decades) history. Initially, the Surveys and Exploration aspect was the driving force for this project. The project was initiated with the recovery of manganese nodules onboard RV Gaveshani on 26th January, 1981. Subsequently, a large project was launched to explore for nodule deposits in the Central Indian Basin (CIOB) in 1982. This was also responsible for our country to be recognized as a Pioneer Investor by the U.N. in 1982. The CIOB was chosen out of the other basins in the Indian Ocean due to its accessibility, proximity and more importantly, the existing data bank showed this is to be the most prolific of all Indian Ocean basins for nodule occurrence.

Some facts

Polymetallic Nodules lie outside the Exclusive Economic Zone Area covered by the nodules in the Indian Ocean is – 10-18 mil. Sq.km Total Estimated reserves in the Indian Ocean—0.15 trillion tones. Successful exploitation depends on : Technological Development, Geological and Environmental Factors, Metallurgical factors, Legal and political factors

While the project attained national importance with around eight national laboratories and other large organizations participating (eg. IBM, GSI, etc). One such organization being the Geological Survey of India which had its geologists receive valuable seagoing experience which in turn has been of immense use in developing its Marine Wing. There have been other spin offs as well : such as generation of capability for exploring our EEZ, the Indian Ocean Ridge systems, exploring the EEZs of other nations bordering the Indian Ocean. Above all, this project gave the country an undisputed international presence. Table 1 shows some of the events in the history and evolution of the project.

Table 1 : Important events in the evolution of the PMN Project.

<i>Date</i>	<i>Event</i>
January, 1981	First nodule collected
July, 1981	Formation of the Department of Ocean Development
April, 1982	India recognized as a Pioneer Investor
December, 1982	India signed UNCLOS III
August, 1983	First metals from nodules
August, 1983	Completed 3 million km ² exploration
August, 1987	150,000 km ² Pioneer Area allocated to India by the ISBA
July, 1994	20% of allocated area relinquished (Phase I)
June, 1995	India ratified UNCLOS III
October, 1996	10% of allocated area relinquished (Phase II)
March, 2002	Final 20% area relinquished (Phase III) to ISBA
Current activity	Identification of a 1st Generation Mine Site

Initial surveys and current status

The surveys initially involved grid sampling at the space of one degree interval (~100 km), because a large area of the CIOB needed to be surveyed. By August 1983 we had covered an area of 3 million km² in the CIOB by sampling. Based on the initial results, the sampling grid was progressively reduced to 50, 25, 12.5 km and so on. Initially the depths were also obtained using a single beam echosounder. The acquisition of a multibeam swath bathymetry has brought about a sea change in the way we look at the seafloor. The entire seafloor in the Pioneer Area was mapped using this system, which gave us a very clear idea of the features such as abyssal hills, large seamounts, fractures and lineations, and also the continuation of the abyssal plains etc. This went a long way in understanding, identifying a Pioneer Area and also for subsequent relinquishment of a part of the allocated area as per the stipulations of the International Seabed Authority.

Initially, we identified two areas each of 150,000 km², registered our claim with the ISBA. One of these application areas was allocated to us in 1987. Since then, in accordance with the obligation envisaged in resolution II, Para 1 (e) of the UNCLOS III (United Nations Law of the Sea) we needed to relinquish the 50% in three instalments : 20, 10 and 20%. This was accomplished in March 1993, September, 1996 and March, 2002 respectively. After the final 20%

relinquishment, the retained area contained 382 million tons of nodules with the typical grades as given in Table 2.

Table 2 : The Typical Grade of our mine site area

Manganese 22-30%
Iron 5-11%
Nickel 1-1.7%
Copper 0.9-1.5%
Cobalt 0.08-0.12%
Ni+Cu+Co 2.2-3.3%

While this exercise was being carried out, the team also collected about 250 tons of nodules during the nineties for metallurgical studies.

The next objective was to identify the richest possible area in the Central Indian Ocean Basin to be the possible Ist Generation Mine Site for nodules. Keeping the above considerations the following activities were then planned for the next five years (2002-2007):

An area having contiguous blocks rich in grade and of high abundance and endowed with reasonably flat topography was identified. This area measured 17,500 km². It was envisioned that this would form the nucleus for the Ist generation mine site and intensive investigations were planned in this localized area . The following activities were initiated for this purpose :

- Carrying out detailed sampling (At a grid of ~ 6.25 km spacing)...
- Comprehensive resource evaluation including other elements (35 elements in all) than the traditional Mn, Ni, Co, Cu
- Slow scan multibeam and backscatter studies from Hydrosweep swath bathymetry data to get high resolution data on the seafloor.
- R & D on different aspects of nodules other associated material and their environment of occurrence

At this moment of time, the project team is on its way to achieve the targets set for 2007 : i.e., identification of a potential Ist Generation Mine Site for nodules.

Future

The future envisages that exploration intensity would reduce and mining activity would play an increasing role during field operations. Therefore it is felt here that there would be greater synergy between the two teams (exploration team and the mining team) in this endeavour for smooth overlaps between the activities.

The seafloor needs to be looked at much closer proximity accompanied by higher resolution in the area designated for mining with more sophisticated instrumentation as payloads in remotely operated vehicles.

Over the years, active research has given us depth in understanding the environment of nodule occurrence, its formation, distribution etc. However, it is time that we go one step ahead and generate a model of nodule genesis in the CIOB. The CIOB has its peculiar inputs from all its four sides in contrast to the nodules in the Clarion-Clipperton fracture zones in the Pacific. This would be achieved with long cores spread transecting the application area and spreading spatially beyond in this part of the Indian Ocean.