

Development and Testing of Remotely Operated Artificial Nodule Laying System at 500-m water depth

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ABSTRACT

The Indian Pioneer Area having resources of poly metallic nodules is about 2000 km from the nearest Indian seaport. Development of technology for long term deep sea mining is a very complex task considering the depth and the distance of the mining site. So, the development work is attempted in different stages with the initial attempts for development being focused at 500 meters depth at about 40- 100 km from the nearest Indian port. However, as nodules are not available at 500 m depth, an artificial nodule carpeted site with a nodule abundance of 5-10 kg/m² has to be created for proving the performance of any underwater mining system in shallow waters. A remotely operated artificial nodule laying system with a hopper and a rotary vane feeder was developed for this purpose. Thrusters are provided in the hopper to control its movement while the nodules are laid on the sea bed. Artificial nodules were developed having properties like density and aggregate impact index similar to that of manganese nodules using clay and sawdust and baked in a kiln. The hopper and feeder system was deployed at 520-m depth (Latitude 13.3N and Longitude 80.7E) with 1.5 tonnes of nodules in June 2007 and a nodule carpeted site was successfully created. An underwater mining system with a crawler based machine having a nodule collector and crusher and a flexible riser system are being developed. The vehicle will be tested on such a seafloor created using the remotely operated artificial nodule system.

KEY WORDS: Poly metallic Nodules, Remotely operated underwater mining systems, Manganese Nodules.

INTRODUCTION

Deep sea bed has potentially rewarding frontier resources and mining these resources will be challenging. The current interests are in Manganese nodules and cobalt rich crust. The demand for manganese nodules will be high in future. On 26th January, 1981 the Indian oceanographic vessel "ORV *Gaveshni*" collected the first sample of polymetallic nodule from Indian Ocean. Extensive exploration surveys have been done in an area of more than 4 million square kilometers and one mine site of 150, 000 sq km has been allotted to

India in the Central Indian Ocean Basin (CIOB). As per the condition of the International Seabed Authority, 50 % of the area has been relinquished to this body. Efforts towards development of technology are in progress and India is working on a mining system using the flexible riser concept. The concept was demonstrated for pumping fine sea floor material in the Indian seas at 451 m for short term operations in 2000 (Deepak et al, 2001). Demonstration of the concept for long term operations required major changes in the mother ship Sagar Kanya for dynamic positioning and launch and recovery operations. These changes were done and the mining system was tested again for mining fine sea floor material for long term operations in 2006 (Deepak et al, 2007). At present the mining machine is being modified for manganese nodule mining by addition of manganese nodule collector, crusher and an S-transfer tube positive displacement pump. The machine will have to be tested at 500 m depth. As manganese nodules are not available at 500 m depth, it is planned to create a mining site similar to that of the CIOB using artificial nodules to qualify the modified mining system. A remotely operated artificial nodule laying system has been developed for the same and tested at 500 m depth. The system is a suspended self propelled remotely operated vehicle with a rotary vane feeder for laying nodules. This paper discusses in detail about the subsystems of the nodule laying system and the tests done.

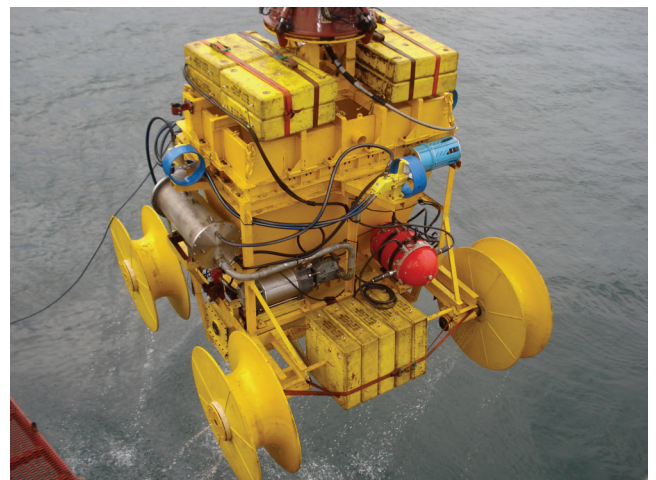


Fig. 1 Remotely Operated Artificial Nodule laying system