Proceedings of The Eighth (2009) ISOPE Ocean Mining Symposium
Chennai, India, September 20-24, 2009
Copyright © 2009 by The International Society of Offshore and Polar Engineers (ISOPE)
ISBN 978-1-880653-75-3; ISSN 1946-0066

Bulk Polymetallic Nodule Collection in Central Indian Basin- Implications of Acoustic Survey Technologies for Site Selection and Innovations to Maximize Nodule Recovery

Abhishek Tyagi, M. Sudhakar and Ganesh Chandvale
National Centre for Antarctic and Ocean Research,
Headland Sada, Goa, India

ABSTRACT

The task of collecting polymetallic nodules in bulk quantities for metallurgical process studies has been assigned to National Centre for Antarctic and Ocean Research (NCAOR), Goa. NCAOR is normally given a target to collect 20 to 40 tonnes of nodules every year for metallurgical studies. For achieving this task, using minimum ship time, acoustic geophysical techniques have been used for identifying areas of high nodule concentration and safe areas for deepsea dredging operations by using a nodule mining dredge. The acoustic geophysical techniques such as Multibeam Swath Bathymetric Echosounding (MBES) "Hydrosweep-DS2" and Shallow Acoustic Seismic Sub-Bottom Profiling (SBP) "Parasound", have been used for identifying the areas of high and low nodule concentrations and thereby maximizing the opportunities of recovery of nodules with each dredge-haul. Mapping using MBES provided realistic imaging of the bottom topography for selection of suitable dredging locations and SBP provided fairly good estimates of nodule concentration on the seafloor. Also various mechanical and design improvisations in the dredges, based on past experience of operations, have been made to maximize recovery of polymetallic nodules.

KEY WORDS: Polymetallic Nodules; Acoustics; Dredging; Mining.

INTRODUCTION

The exploration for polymetallic nodules deposits in Indian Ocean Basin was launched in 1981 and India was recognized as a Pioneer Investor in 1982 as per UNCLOS-III. India carried out exploration activities extensively between 1982 and 1987, and made her claim to the Preparatory Commission (PrepCom) for the International Seabed Authority and International Tribunal for the Law of the Sea for a Pioneer Area in the Central Indian Ocean Basin (CIOB) that was allocated on 17 August 1987. The exploration efforts encompassing nearly 4 million km^2 resulted in demarcating two Pioneer Areas of 150,000 km^2 each having equal resource potential. The Pioneer Area allocated to India was subsequently taken up for phase-wise relinquishment in three stages and India relinquished 50% of the allocated area, as per the UNCLOS resolutions and by the year 2002 India was licensed with 75,000 km^2 of nodule-rich area in CIOB by the International Seabed Authority (ISA), Jamaica to carryout development activities short of commercial production . Indian efforts are continuing for identifying a First Generation Mine Sites (FGMS) for nodules within the retained area. An area measuring 18,400 km^2 was earmarked for this purpose, in this area systematic close grid sampling, detailed chemical analysis for resource evaluation and topographic surveys have been carried out. In CIOB, the polymetallic nodules are found at an average depth of 5130 m and the bathymetry plays a vital role in their distribution (Pattan and Kodagali, 1988). The estimated reserves of nodules in this area are of the order of 380 million metric tons having high grades. While fairly good estimates of abundance of nodules and grades are now known in all the allocated areas of the world, future exploration necessitates a closer view at the seafloor and the sub-bottom using technologically advanced systems available in the current world scenario such as high resolution acoustic systems. As a part of the PMN programme, NCAOR is given the task of collection of 20 to 40 tonnes of polymetallic nodules every year for metallurgical process studies. In order to achieve the task using minimum ship time, acoustic geophysical techniques have been used for identifying areas of high nodule concentrations as well as safe areas for deepsea dredging operations by employing nodule mining dredge. The present study deals with the details of acoustic survey technologies and discuss about their usefulness for site selection and maximizing recovery in dredging operations.

MATERIAL AND METHODS

The CIOB hosts the world's second largest and economically viable seafloor ferromanganese deposits after Clarion and Clipperton Zone (CCZ). The FGMS is located around 11°S latitude and 76°E longitude at a distance of about 2000 km from the southern tip of India (Fig.1) and the present studies were carried out in a part of this area. A research vessel "RV Akademik Boris Petrov" (ABP) having a Multibeam Swath Bathymetric Echosounding System (MBES) "ATLAS Hydrosweep DS2" (AHD) with 240 beams was used to carry out surveys of the dredging sites. The input for the system in this vessel is obtained from 240 beams from the insonified area of the seafloor, resulting in better accuracy and resolution. This system is an improvement over the mapping systems used in the early nineties in the Indian Pioneer Area. Topographic information based on the surveys carried out by this vessel was processed to generate an accurate map of the dredging sites.