

The Proceedings of The Third (1999) ISOPE OCEAN MINING SYMPOSIUM

Goa, India

November 1999

ENVIRONMENT, EXPLORATION AND SURVEY,
MINING SYSTEMS AND TECHNOLOGY, AND MATERILAS AND PROCESSING

How to Use This Table of Contents

Click on a *blue paper title* you would like to view.

This contents was created by scanning the papers from the conference proceedings.

Copyright © 1999 by International Society of Offshore and Polar Engineers,
Cupertino, California, USA. All Rights Reserved.

ISBN 978-1-880653-45-6

ISSN 1946-0074

Indexed by Engineering Index, Compendex and Others

www.isopec.org; orders@isopec.org

Edited by:

Jin S. Chung, International Society of Offshore and Polar Engineers, Cupertino, California, USA

Rahul Sharma, National Institute of Oceanography, Goa, India

presented at:

The Third (1999) ISOPE Ocean Mining Symposium, Goa, India, November 8-11, 1999

organized by:

International Society of Offshore and Polar Engineers

National Institute of Oceanography, Goa, India

Cosponsored by:

International Society of Offshore and Polar Engineers (ISOPE)

Department of Ocean Development, Government of India

National Institute of Oceanography, India

Cooperated by:

International Society of Offshore and Polar Engineers (ISOPE)

U.S. National Science Foundation (NSF)

Mining and Materials Processing Institute of Japan (MMIJ)

Korea Association for Deep Ocean Minerals Development (KADOM)

Korea Committee for Ocean Resources Engineering (KCORE)

National Institute of Oceanography (NIO, India)

Interoceanmetal Joint Organization (IOM, Poland)

Ifremer (France)

Kansai Society of Naval Architects of Japan (KSNAJ)

China Ocean Mineral Resources R&D Association (COMRA)

The publisher and the editors of its publications assume no responsibility for the statements or opinions expressed in papers or presentations by the contributors to this symposium or proceedings.

International Society of Offshore and Polar Engineers (ISOPE)
P.O. Box 189, Cupertino, California 95015-0189 U.S.A.

The Proceedings of The Third (1999) ISOPE OCEAN MINING SYMPOSIUM

Goa, India, November 8-11, 1999

Copyright © 1999 by International Society of Offshore and Polar Engineers,
Cupertino, California, USA. All Rights Reserved.

ISBN 978-1-880653-45-6

ISSN 1946-0074

Indexed by Engineering Index, Compendex and Others

www.isopec.org; orders@isopec.org

CONTENTS

DEEP-OCEAN MINING - General and Review

<u>Indian Poly metallic Nodule Program</u>	I
<i>A.E. Muthunayagam and S.K. Das</i>	
<u>Opportunities for Offshore Minerals Exploration in Indian Ocean</u> <i>E. Desa</i>	6
<u>Deep-Ocean Mining issues and Ocean Mining Working Group (OMWG)</u> <i>Jin S. Chung</i>	14

MINING TECHNOLOGY AND SYSTEMS

<u>Non-Linear Dynamic Response of Ocean Mining Pipe</u> <i>P.R. Babu and Suhail Ahmad</i>	21
<u>Effects of Internal Flow on Dynamics of Deep Seawater Risers</u> <i>Koji Otsuka, Akiyoshi Bando and Yoshiho Ikeda</i>	30
<u>A Proposal of the Deep Ocean Water Upwelling Machine Using Density Current</u> <i>Kazuyuki Ouchi and Hiroyuki Nakahara</i>	36
<u>An Experimental Study on the Flow Characteristics of Solid-Liquid Two Phase Mixture in a Vertical Tube</u> <i>Chi Ho Yoon, In Kee Kim, Kwang Soo Kwon, Seok Ki Kwon, Jung Seock Kang, Ou Kwang Kwon and Chi Won Seo</i>	43
<u>Deepsea Core Boring by BMS in Northern Mariana Area</u> <i>Shigeru Sarata and Katsutoki Matsumoto</i>	49
<u>Tracing Collector Passes and Preliminary Analysis of Collector Operation</u> <i>Tetsuo Yamazaki, E. Kuboki and H. Yoshida</i>	55
<u>Track-Keeping Control of Seafloor Miner by Successive Learning of Unknown Velocity and Soil Properties</u> <i>Jin S. Chung</i>	63
<u>Experimental Study on Hydraulic Performance of Hybrid Pickup Device of Manganese Nodule Collector</u> <i>Sup Hong, Jong-Su Choi, Jin-Ha Kim and Chan-Kyu Yyang</i>	69

Underwater Sand Mining System for Shallow Waters

C.R. Deepak, M. Pugazhaandi, S. Paul, M.A. Shajahan, G. Janakiraman, M.A. Atmanand,
K. Annamalai, K. Jeyamani, M. Ravindran, E. Schulte, J. Panthel, H. Grebe and W. Schwarz..... 78

EXPLORATION AND SURVEY

The First Phase of the IOM Survey Program According to Plan of Work for Exploration in the Area
K. Kotlinski and V. Stoyanova 87

Mode of Occurrence of Iron-Manganese Crusts on Inactive Seamounts in the Northwestern Pacific
Back-Arc Setting
Akira Usui, Qsamu Ishizuka and Makoto Yuasa 91

Multibeam Echosounder Pseudo Sidescan Images as a Tool for Manganese Nodule Exploration
V.N. Kodagali and B. Chakmborty 97

The Implementation Agreement and Indian Interests
B. Vijay Kumar 105

ENVIRONMENT

Summary of the Japanese Environmental Study for Deep-sea Mining
Satoru Okubo 111

Indian Deepsea Environment Experiment (INDEX): Achievements and Applications
Rahul Sharma 118

Vertical Distribution of Meiobenthos in Relation to Geotechnical Properties of Deep-Sea Sediment
in the IOM Pioneer Area (Clarion-Clipperton Fracture Zone, NE Pacific)
Teresa Radziejewska and Igor Modlitba 126

Sedimentological Impacts of INDEX Experiment
A,B. Valsangkar, N.V. Ambre and Maria Rodrigues 131

Effect of Benthic Disturbance on Geotechnical Characteristics of Sediments from Nodule Mining
Area in the Central Indian Basin
N,H. Khadge 138

Baseline Studies and Evaluation of Effects of Surface Discharge of Deepsea Mining -INDEX Area
S.N. de Souza and S.D. Sardesai 145

Environmental Impact of Suspended Tailings Discharge During Mining Nodules
Jianxin Xia and Ning Yang 152

Large-Scale Impact of Manganese Nodule Mining in the Pacific Numerical Simulations of the
Dispersion of Tailings
S. Rolinski 156

Environmental Study on the Deepsea Mining of Manganese Nodules in the Northeastern Tropical
Pacific: Modeling the Sediment-Laden Negative Buoyant Flow
T. Doi, K. Nakata, M. Kubota and S. Aoki 163

Inter - comparison Between Aanderaa and Potok Current Meters Deployed During INDEX Programme,
A.A. Fernandes, S. Pednekar and P. Vethamony 169

Holothurians as Indicators for Recolonisation Processes in Environmental Assessments
Hartmut
Bluhm 177.

Biological Results of JET Project: An Overview
Yoshihisa Shirayama 185

Immediate Response of Meio and Macrobenthos to Disturbance Caused by Benthic Disturber,
B.S. Ingole,, Z.A. Ansari, S.G.P. Matondkar and N. Rodrigues 191

Validation of EIA Sampling Methods — Bacterial and Biochemical Analyses
Sheelu G.,P,A, Loka Bharati, Shanta Nair, C. Raghukumar and C. Mohandass..... 198

<u>Surface Meteorological Conditions at Benthic Disturbance Site - INDEX Area During Austral Winter 1997</u>	
<i>A. Suryanarayana,, V.S.N. Murty, V. Ramesh Babu and B.S, Beena</i>	203
<u>Watermass Structure at Benthic Disturbance Site (INDEX Area) and Anticipated Mining Effects On Hydrophysical Properties</u>	
<i>V.Ratnesh Baku, V.S.N. Murty, A. Suryanurayana and B.S. Beena</i>	208
<u>Current Structure and Kinetic Energy of The Abyssal Waters in the Central Indian Basin</u>	
<i>V.S.N Murty, V. Ramesh Babu, A. Suryanarayana and B.S, Beena</i>	216

PROCESSING TECHNOLOGY

<u>The Smelting-Rusting-Solvent Extracting Process to Recover Valuable Metals from Polymetallic Nodules</u>	
<i>Zhong Xiang, He Zequan, Shen Yujun, Mao Yongjun, Qu Shuguang and Li Xianbai</i>	227
<u>An Evaluation of Mineral Processing Experimental Data for Cobalt-Rich Crust Development</u>	
<i>Se Han Park, Sohei Shimada and Yasuhiko Okano</i>	232
<u>Processing of Polymetallic Sea Nodules: An Overview</u>	
<i>Premchand and R.K, Jana</i>	237
<u>Manganese Recovery from Leach Liquors / Residues Generated during Hydro metallurgical Processing of Manganese Nodules</u>	
<i>K. Sanjay, T, Subbaiah, S, Anand and R.P. Das</i>	246
<u>Design of Flexible Configuration Nodule Processing Pilot Plants in The Contest Of Evolving Metal Markets</u>	
<i>P.K, Sen and T.R.P. Singh</i>	253
<u>Studies on Removal of Impurities from Ocean Nodules Leach Liquor by Solvent Extraction</u>	
<i>K. Bhattacharya, M.F. Fonseca, R. Sadanandam, S.K. Tangri and A,K. Suri</i>	260
<u>Simultaneous Spectrophotometric Estimation of Iron, Copper, Cobalt and Nickel in Ocean Nodule Leach Liquor</u>	
<i>K. Srikant, N.K. Menon, R. Sadanandam, S.K. Tangri and A,K. Suri</i>	265
<u>Recovery of Nickel and Cobalt Values from Various Sources</u>	
<i>I.G. Sharma, A.C. Bidaye, P.R. Menon, P.P. Shukla and A.K. Suri</i>	268

VERBAL PRESENTATIONS

<u>Mining System with Free Swimming Pick-Up Device and Dose Test of Environment Assessment</u>	
<i>Ning Yang</i>	

.....