

September 20–24, 2009
Chennai, India

**The Eighth (2009) ISOPE
Ocean Mining (& Gas
Hydrates) Symposium**



Final Program

Invited and Peer-reviewed Papers

Nodules, Crusts, Sulphide Exploration & Environment Deep-Ocean Mining Programs Mineral Processing Ocean Energy	Gas Hydrates and Engineering Deep-Ocean Water Utilization Mining and Economics Mining Systems and Technology Underwater and Subsea Systems
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Organized by:
International Organizing Committee

Sponsored by:
International Society of Offshore and Polar Engineers (ISOPE)
National Institute of Ocean Technology (NIOT)
with cooperating organizations (listed inside)

ISOPE OMS-2009 Local Secretariat
Attn.: Dr. Atmanand, National Institute of Ocean Technology
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meetings@isope.org : www.isope.org



Welcome to ISOPE OMS-2009

We greatly appreciate the excellent responses and help we have received from colleagues around the world in the successful organization of the 8th ISOPE Ocean Mining Symposium (ISOPE OMS-2009), NIOT, Chennai, India, September 20–24, 2009. The symposium features **13 sessions of 52 peer-reviewed papers** and **6 additional oral** presentations from **11** countries. This year the symposium continues to introduce gas hydrates and upwelling of deep-ocean water in addition to deep-ocean exploration, environment, mining systems, and processing systems.

The 1st (1995) ISOPE Ocean Mining Symposium (ISOPE OMS-95) was held in Tsukuba. An informal organizational meeting of **Ocean Mining Working Group (OMWG)** was held in Tsukuba, Japan, on November 22, 1995. At the meeting, representatives from 7 countries agreed to establish the group for a close international cooperation and more exchange of the individuals' progress, which can also act as an informal channel among the governments. The group concept got blessing from director generals of the participating governments. The U.S., Germany, Japan, IOM, Korea, India, and China (joined later).

The primary objectives of the OMWG are:

- to advance, at an international level, technological progress in the interdisciplinary field of ocean resources, environment and mining and related technologies, through international cooperation and participation;
- to disseminate scientific knowledge and provide timely exchange of technical knowledge and information;
- to provide opportunities through its programs for interested individuals to maintain and expand their knowledge in these fields for the benefit of engineering and scientific profession.
- to facilitate opportunities for the members to interact with their governments. The International Society of Offshore and Polar Engineers (ISOPE) facilitates the group activities.

The 2nd OMS-97, 3rd OMS-99, 4th OMS-2001, 5th OMS-2003, 6th OMS-2005 and 7th OMS-2007 were successfully held in Seoul, Korea, Goa, India, Szczecin, Poland and Tsukuba, Japan, Changsha, China and Lisbon, Portugal, respectively, with participation from **17** countries.

On behalf of the International Organizing Committee, it is our pleasure to welcome all participants to the ISOPE OMS-2009 Symposium in Chennai.

<i>Co-chairmen of the ISOPE OMS-2009 Symposium</i>	
Prof. Jin S. Chung, USA	Dr. M.A. Atmanand, India

SUNDAY September 20

14:00
OMS-2009 Participants Registration Sagar Sangamam, NIOT

17:00
OMS-2009 IOC Rajendra Chola Hall, NIOT

For Tour Information (see the bulletin board in the foyer to
confirm participation on or before
21 September)

MONDAY September 21

Bus departs 08:30 from Hotel Savera and GRT Grand to NIOT

07:30–08:30
Symposium Registration Sagar Sangamam, NIOT

09:00
Inauguration Panikar Hall

09:35
1. OPENING SESSION Panikar Hall

10:35
2. EXPLORATION Panikar Hall

13.00-14.00
OMS Lunch Manthan Hall

14:00
3. OCEAN ENERGY Panikar Hall

15.30
4. ENVIRONMENT Panikar Hall

18:00 Bus departs from NIOT to
DAKSHINACHITRA Auditorium Lobby

19:00 – 21.00
Banquet Dinner Dakshinachitra

21:35 Bus departs from Dakshinachitra to Hotels

TUESDAY September 22

Bus departs 08:30 from Hotel Savera and GRT Grand to NIOT

07:30–08:30
Symposium Registration Sagar Sangamam, NIOT

09:00
5. GAS HYDRATES I Panikar Hall

10:20
6. GAS HYDRATES II Panikar Hall

13.00-14.00 OMS Lunch	Manthan Hall
14:00 7. MINERAL PROCESSING: SCIENCE AND ENGINEERING I	Panikar Hall
16.00 8. MINERAL PROCESSING : SCIENCE AND ENGINEERING II	Panikar Hall
18:00 Bus departs from NIOT to Kalakshetra	SagarSangamam Lobby
18:30 -20:00 Indian cultural evening at KALAKSHETRA – Cultural Programme	Kalakshetra
20.00 – 21.00 Dinner	Kalakshetra
21.05 Bus departs from Kalakshetra Hotel	

Monday – Wednesday

Author Practice	Varuna Hall
On-site Registration	Sagar Sangamam Lobby

WEDNESDAY September 23

Bus departs 08:30 from Hotel Savera and GRT Grand to NIOT

09:00 9. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY I	Panikkar Hall
10:30 10. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY II	Panikkar Hall
13:00-14:00 OMS Lunch	Manthan Hall
14:00 11. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY III	Panikkar Hall
15:30 12. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY IV	Panikkar Hall
17:00 13. . CLOSING SESSION	Panikkar Hall
18:30 Bus departs from NIOT to Hotel	

Co-sponsored by:
International Society of Offshore and Polar Engineers (ISOPE)
National Institute of Ocean Technology (NIOT)
Ministry of Earth Sciences, Govt. of India (MoES)

Financial sponsors

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Institut für Konstruktion (IKS), University of Siegen, Siegen, Germany

Co-operated by:

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Mining and Materials Processing Institute of Japan (MMIJ)
Korea Association for Deep Ocean Minerals Development (KADOM)
Korea Society of Ocean Engineers (KSOE, formerly KCORE)
National Institute of Oceanography (NIO, India)
Interoceanmetal Joint Organization (IOM, Poland)
Japan Society of Naval Architects and Ocean Engineers (JSNAOE)
China Ocean Mineral Resources R&D Association (COMRA)

Supported by:

National Institute of Ocean Technology (NIOT)
Ministry of Earth Sciences, Govt. of India (MoES)

Local Secretariat:

Dr. M.A. Atmanand, National Institute of Ocean Technology, India
Dr. G.A. Ramadass, National Institute of Ocean technology, India

Technical Executive Committee:

Prof. Jin S. Chung, ISOPE, Cupertino, California, USA
Dr. M.A. Atmanand, National Institute of Ocean Technology, India

International Organizing Committee

Prof. Jin S. Chung (**Chairman**), ISOPE, Cupertino, California, USA
Dr. M.A. Atmanand, National Institute of Ocean Technology, Chennai,
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Changsha, China
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Daejeon, Korea

Symposium Co-chairmen

Prof. Jin S. Chung, ISOPE, Cupertino, California, USA
Dr. M.A. Atmanand, National Institute of Ocean Technology, Chennai,
India

ISOPE OMS-2009 Chennai

NIOT, Chennai, India

September 20–24, 2009

TECHNICAL PROGRAM

MONDAY 09:00

INAUGURATION

Monday 09:00 Panikkar Hall

OPENING ADDRESS

Monday 09:30 Panikkar Hall

Prof. Jin S Chung, Chair, ISOPE OMS-2009 Symposium, ISOPE, Cupertino, California, USA

1. OPENING SESSION

Monday 09:35 Panikar Hall

Chair: Prof. M. Ravindran, Former Director, NIOT, India

Co-Chair: R Kotlinski, Interoceanmetal Joining Organization, Szczecin, Poland

Deep Sea Mining - Indian Scenario (Invited)

Dr. S. K. Das, Advisor, MoES, India

Gas Hydrates Research in India (Invited, Oral Presentation)

Harsh K. Gupta, Former Secretary (MoES), India

Deep-Ocean Mining Technology III: Developments (Invited)

Jin S Chung, ISOPE, Cupertino, California, USA

2. EXPLORATION

Monday 10:35 Panikar Hall

Chair: G S Roonwal, Inter-University Accelerator Centre, India

Exploration for Polymetallic Nodules in the German License Area

Carsten Rühlemann, Udo Barckhausen, Stefan Ladage, Lutz Reinhardt, and Michael Wiedicke, Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, Germany

Exploration for Movable Nodule Sites: Some Methodological Aspects

Ryszard Kotlinski, Interoceanmetal Joint Organization & Univ. of Szczecin; Valcana Stoyanova, Interoceanmetal Joint Organization, Szczecin, Poland

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

Abhishek Tyagi, Maruthadu Sudhakar, and Ganesh Chandvale,
National Centre for Antarctic and Ocean Research, Goa, India

**Possible «Polygenetic» Hydrocarbon Fields in Eastern Indian
Ocean Triggering by Hydrothermal Activity along Deep Faults**

Oleg V. Levchenko and Vladimir V. Matveenkov, P.P. Shirshov Inst.
of Oceanology, RAS, Moscow, Russia

**Preliminary Feasibility Study for the Commercial Development of
Seafloor Hydrothermal Deposits in the EEZ of the Kingdom of
Tonga**

Se-Hun Park, Hee-Cheol Yang, Kyeong-Yong Lee, and Jai-Woon
Moon, Korea Ocean Research & Development Inst., Ansan, Korea

**Detailed Seabed Survey and High Precision Subsea Navigation in
Deepwater Environment (Oral Presentation)**

Roar Martiniussen, Kongsberg Maritime AS, Norway

**Rock Physics Modeling of Shallow Marine Sediments in Eastern
Continental Margins of India**

P. Dewangan, G. Sriram, and T. Ramprasad, National Inst. of
Oceanography, Goa, India

**Response of Os Isotope to Paleooceanographic Changes in West
Pacific as Recorded in a Ferromanganese Crust**

Jiangshan Li and Xiangwen Ren, First Inst. of Oceanography, SOA &
Inst. of Oceanology, CAS; Xuefa Shi and Jihua Liu, First Inst. of
Oceanography, SOA, Qingdao, China

3. OCEAN ENERGY

Monday 14:00 Panikar Hall

Chair: Dr. S. K. Das, MoES, India

**Techno-Commercial Study of Twin Unidirectional Turbine Based
Wave Energy Plants**

Krishnamoorthi Mala, Joseph Jayaraj, Job K. Ninoy, and Venkatraman
Jayashankar, Indian Inst. of Technology Madras, Chennai, India

**Performance Comparison of Power Modules in the Indian Wave
Energy Plant**

Krishnamoorthi Mala, Joseph Jayaraj, and Venkatraman Jayashankar,
Indian Inst. of Technology Madras; Malayath A. Atmanand, NIOT,
Chennai, India; T. Setoguchi, Saga Univ., Saga; M. Takao, Matsue
National College of Technology, Matsue, Japan

**Effect of Taut and Catenary Mooring on Spar Platform with 5
MW Wind Turbine**

T. Seebai and R. Sundaravadivelu, Indian Inst. of Technology Madras,
Chennai, India

Low Temperature Thermal Desalination Plants

Phanikumar VS Sistla, Venkatesan Govindarajulu, Purnima Jalihal, and Kathirolu Subramanian, National Inst. of Ocean Technology, Chennai, India

4. ENVIRONMENT

Monday 15:30 Panikar Hall

Chair: V.V. Stoyanov, SEATECHRIM, EDB OE, Russian Academy of Sciences, Russia

Co-Chair: Koji Otsuka, Osaka Prefecture Univ., Japan

System for Monitoring of Underwater Radioactive and Chemical Waste Objects: Information Control System on Basis of Autonomous Devices

Vladimir V. Stoyanov, SEATECHRIM, EDB OE, Russian Academy of Sciences; O.V. Stepanets and A.N. Plishkin, GEOKHI, Russian Academy of Sciences, Moscow, Russia

Deepwater and Thru Ice (Oral Presentation)

Henrik Bang-Andreasen, Seaproof Solutions, Nesttun, Norway

Biomass Quantification of Ecosystems around Seafloor Massive Sulfide Deposit with Image Analysis

Naoki Nakatani, Masahito Ikemoto, Rei Arai, and Tetsuo Yamazaki, Osaka Prefecture Univ., Sakai, Japan

Combined Analysis of Ecology and Economy of Manganese Nodule Mining

Amon Yamada, Tetsuo Yamazaki, Rei Arai, Naoki Nakatani, Osaka Prefecture Univ., Sakai, Japan

Inclusive Environmental Impact Assessment for Ocean Nutrient Enhancer (Oral Presentation)

Koji Otsuka, Osaka Prefecture Univ., Japan

18:00 – 21:00

Banquet Dinner

Dakshinachitra

TUESDAY 09:00

5. GAS HYDRATES I

Tuesday 09:00 Panikar Hall

Chair: Takeshi Komai, AIST, Japan

Co-Chair: M. Subbaiah, Inst of Minerals and Materials Tech, India

Field Scale Simulation on Gas Production Behavior during Depressurization Process in Methane Hydrate Sediments located at Nankai Trough Area in the Adjacent Sea of Japan

Yasuhide Sakamoto, Takeshi Komai, Kuniyuki Miyazaki, and Norio Tenma, National Inst. of Advanced Industrial Science and Technology (AIST), Tsukuba; Tsutomu Yamaguchi, Toho Univ., Funabashi, Japan

Carbonatite Emplacement and Localization of Gas Hydrates in the Ocean Floors of Eastern Hemisphere

Ramachandran Ramasamy, Subramanian Subramanian, and Ranganathan Sundaravadivelu, Indian Inst. of Technology Madras, Chennai, India

Seabed Sulphides, Gas Hydrates, and Hydrocarbon Resources in the Andaman Sea, North-East Indian Ocean

Ganpat S Roonwal, Inter- Univ. Accelerator Centre, Aruna Asaf Ali Marg, New Delhi, India

6. GAS HYDRATES II

Tuesday 10:20 Panikar Hall

Chair: Harsh K. Gupta, Former Secretary (MoES), India

Co-Chair: Ram Prasad, NIO, India

Investigation of Deformation Mechanism for Methane Hydrate Sediment based upon Mechanical Properties in Unloading and Reloading Process under Triaxial Compression

Kuniyuki Miyazaki and Akira Masui, National Inst. of Advanced Industrial Science and Technology (AIST), Tsukuba; Tsutomu Yamaguchi, Toho Univ., Funabashi; Yasuhide Sakamoto, Yuji Ogata, and Kazuo Aoki, National Inst. of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan

NMR Measurement and Analysis of Porosity and Permeability for Hydrate-bearing Sediments

Takeshi Komai, Yasuhide Sakamoto, and Yoshito Nakashima, National Inst. of Advanced Industrial Science and Technology (AIST), Ibaraki; Naoyo Takahara, Akishima Laboratories, MITSUIZOSSEN Inc., Akishima; Hideki Minagawa and Norio Tenma, National Inst. of Advanced Industrial Science and Technology (AIST), Sapporo, Japan

Electrical Heating of Hydrate Sediment for Gas Production

Hideki Minagawa, Yasunori Nishikawa, Yoshie Takahashi, and Hideo Narita, National Inst. of Advanced Industrial Science and Technology (AIST), Sapporo, Japan

Investigation for High Concentration Inhibitor Injection into Artificial Methane Hydrate Bearing Sediment

Taro Kawamura, Michika Ohtake, Yoshitaka Yamamoto, Hironori Haneda, Yasuhide Sakamoto and Takeshi Komai, National Inst. of Advanced Industrial Science and Technology (AIST); Satoru Higuchi, Nihon Axis Company Ltd., Tsukuba, Japan

7. MINERAL PROCESSING I

Tuesday 14:00 Panikar Hall

Chair: Yanqing Fan, Beijing General Research Inst. of Mining and Metallurgy, China

Co-Chair: Vladislava P. Stefanova, Univ. of Chemical Technology and Metallurgy, Sofia, Bulgaria

Use of Process Optimization and Cost Model for Metal Recovery from Manganese Nodules: The Role of Manganese Recovery

Arijit Biswas, Nirupam Chakraborti, and Prodip Kumar Sen, Indian Inst. of Technology, Kharagpur, India

Recovery of Cu, Ni, Co and Mn from Sea Nodules by Direct Reduction Smelting

Sanjay Agarwal, Kamalakanta Sahu, Ranjit Kumar Jana, and Surya Pratap Mehrotra, National Metallurgical Laboratory, Jamshedpur, India

Precipitation of Manganese from Manganese Nodule SO₂-Roast Ammoniacal Ammonium Leach Liquor

Kailash Chandra Nathasarma, Inst. of Minerals & Materials Technology (CSIR), Bhubaneswar, India

Production of Silicomanganese Alloy from Low Manganese Containing Leached Sea Nodules Residue

Ranjit Kumar Jana and Navneet Singh Randhaw, National Metallurgical Laboratory, Jamshedpur, India

Electrolytic Manganese Dioxide (EMD) from Manganese Cake - A Byproduct of Nodule Process

Jyoti Prakasha Panda, Kali Sanjay, Malay Kumar Ghosh, and Tondepu Subbaiah, Inst. of Minerals and Materials Technology, Bhubaneswar, India

Potentiality of Indian Ocean Manganese Nodule and its Leached Residue as Oxidation Catalyst and Adsorbent

K.M. Parida, Saswati S Dash, and Amaresh Pradhan, Inst. of Minerals and Materials Technology, Orissa, India

8. MINERAL PROCESSING II

Tuesday 16:00 Panikar Hall

Chair: G. A. Ramadass, NIOT, India

Co-Chair: Ranjit Kumar Jana, National Metallurgical Laboratory, Jamshedpur, India

Lithium Ion Sieve Preparation from Reduction-Ammoniacal Leaching Residue of Polymetallic Nodules

Lei Zhao, Kaixi Jiang, Xunxiong Jiang, Yanqing Fan, and Shengdong Wang, Beijing General Research Inst. of Mining and Metallurgy, Beijing, China

Preparation of Lithium Ion Sieve from Polymetallic Nodules

Yanqing Fan, Xunxiong Jiang, Shengdong Wang, Lei Zhao, Kaixi Jiang, and Linyong Feng, Beijing General Research Inst. of Mining and Metallurgy, Beijing, China

Study on Continuous Leaching Hydrometallurgical Processes about Cobalt-rich Crust

Shengdong Wang, Xunxiong Jiang, Kaixi Jiang, Yanqing Fan, and Lei Zhao, Beijing General Research Inst. of Mining and Metallurgy, Beijing, China

Separation of Metal Ions from Manganese Nodule Bulk Sulphide Leach Liquor Using Hollow Fiber Membrane Module

Pankaj K. Parhi and Kadambini Sarangi, Inst. of Minerals and Materials Technology (CSIR), Bhubaneswar, India

**Selective Dissolution of FeCuNiCoMn Alloy Obtained after
Pyrometallurgical Processing of Polymetallic Nodules**

Vladislava P. Stefanova, Peter K. Iliev, Boris S. Stefanov, and Avram
G. Avramov, Univ. of Chemical Technology and Metallurgy, Sofia,
Bulgaria

18:30 – 21.00

Indian cultural evening with Dinner

Kalakshetra

WEDNESDAY 09:00

9. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY I

Wednesday 09:00 Panikar Hall

Chair: M. S. Nagar, Ex-CMD, Indian Rare Earths, India

Co-Chair: Enno Schulte, University of Seigen, Germany

**Future of Deep Seabed Mining and Demand-Supply Trends in
Indian Scenario**

Maruthadu Sudhakar, National Centre for Antarctic and Ocean
Research, Headland Sada, Goa; Syamal K. Das, Ministry of Earth
Sciences, New Delhi, India

**A Hardware-in-the-loop Simulation System of Heave
Compensation of Deepsea Mining**

Qiong Hu and Shaojun Liu, Central South Univ. and Changsha
Research Inst. of Mining and Metallurgy, Changsha, China

**Research on Physical Simulation Test Installation of Heave
Compensation System of Deepsea Mining**

Qiong Hu, Central South Univ. and Changsha Research Inst. of Mining
and Metallurgy; Hao Zheng, Changsha Research Inst. of Mining and
Metallurgy, Shaojun Liu, Central South Univ. and Changsha Research
Inst. of Mining and Metallurgy; Ning Yang, Changsha Research Inst.
of Mining and Metallurgy, Changsha, China

**Modelling and Simulation of 6 DOF Motion Simulator for
Underwater Research Applications**

Thangavel Periasamy, Thondiyath Asokan, and Makaram
Singaperumal, Indian Inst. of Technology Madras, Chennai, India

**Self-Propelled Miner and Integrated Mining Test at Inshore Site
(Oral Presentation)**

Sup Hong, Hyung-Woo Kim, Jong-Su Choi, Tae-kyeong Yeu, Soung-
Jea Park, and Suk Min Yoon, MOERI/KORDI; Chi-Ho Yoon,
Jongmyung Park, Jung-Seok Kang, Young-Ju Kim, Sang-Bae Kim, and
Wantae Kim, KIGAM, Daejeon, Korea

10. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY II

Wednesday 10:30 Panikar Hall

Chair: Chi-Ho Yoon, Korea Inst. of Geoscience & Mineral Resources,
Daejeon, Korea

Co-Chair: Shaojun Liu, Central South Univ., Changsha, China

Conception of Nodules Feeder to Vertical Transport Pipeline

Jerzy Sobota, Wroclaw Univ. of Environmental and Life Science, Wroclaw, Poland; Willibald Kolarcik and Pavel Marek, HYDROSYSTEM project a.s., Olomouc; Pavel Vlasak, Inst. of Hydrodynamics ASCR, Prague, Czech Republic

Vertical Distribution of Concentration in Horizontal Pipeline – Density and Particle Size Influence

Jerzy Sobota, Wroclaw Univ. of Environmental and Life Science, Wroclaw, Poland; Pavel Vlasak, The Czech Academy of Sciences, Prague, Czech Republic; Grzegorz Strozik and Franciszek Plewa, Silesian Univ. of Technology, Gliwice, Poland

Flow Analysis by CFD Model of Lifting System for Shallow Sea Test

Chi-Ho Yoon, Jung-Seok Kang, Jong-Myung Park, Yong-Chan Park, Young-Ju Kim, and Seok-Ki Kwon, Korea Inst. of Geoscience & Mineral Resources, Daejeon, Korea

Numerical Prediction of a Lifting Pump for Deep-Sea Mining

Jongmyung Park, Chi-Ho Yoon, and Jung Seok Kang, Korea Inst. of Geoscience and Mineral Resources, KIGAM, Daejeon, Korea

Development and Testing of Remotely Operated Artificial Nodule Laying System at 500 m Water Depth

K Amudha, S Rajesh, NR Ramesh, MuthukrishnanBabu, Raju Abraham, CR Deepak, and Malayath A. Atmanand, National Inst. of Ocean Technology, Chennai, India

11. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY III

Wednesday 14:00 Panikar Hall

Chair: Jerzy Sobota, Wroclaw Univ. of Environmental and Life Science, Wroclaw, Poland

Co-Chair: Sup. Hong, MOERI/KORDI, Daejeon, Korea

Effects of Microtopography on Mining Possibility of Cobalt-rich Manganese Crusts

Koji Goto, Tetsuo Yamazaki, Rei Arai, and Naoki Nakatani, Osaka Prefecture Univ., Sakai, Japan

Development of Dynamics Model of Seafloor Mining System and Analysis of Influence Factors in the Deploying Process

Xiaozhou Hu, Shaojun Liu, and Bin Du, Central South Univ. and The State Key Laboratory of Deep Sea Mineral Resources Development and Utilization Technology, Changsha, China

Fluid-solid Coupled Dynamical Analysis of Deep-ocean Mining System

Qihua Rao, Zhi Wang, Shaojun Liu, and Min Fang, Central South Univ., Changsha, China

Interaction of Fluid-solid Coupled Flexible Hose and Mining Machine in Deep-ocean Mining System

Zhi Wang, Qiuhua Rao, Shaojun Liu, and Min Fang, Central South Univ., Changsha, China

12. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY IV

Wednesday 15:30 Panikar Hall
Chair: W. Schwarz, Univ. of Siegen, Siegen, Germany
Co-Chair: Deepak, NIOT, India

Method of Metamodel-based Multidisciplinary Design Optimization for Development of a Test Miner

Tae Hee Lee and Min Uk Lee, Hanyang Univ., Seoul; Jong-Su Choi, Hyung Woo Kim and Sup Hong, Maritime & Ocean Engineering Research Inst., KORDI, Daejeon, Korea

Simulation of Tracked Vehicle Performance on Deep Sea Soil Based on Soil Mechanical Laboratory Measurements in Bentonite Soil

Enno Schulte and W. Schwarz, Univ. of Siegen, Siegen, Germany

Application of Robust Design Techniques for Underwater Vehicle Control

Mohan Santhakumar and Thondiyath Asokan, Indian Inst. of Technology Madras, Chennai, India

Design of Interactive Simulation System and Graphical User Interface for Underwater Vehicle Control and Navigation

Mohan Santhakumar, Subramanian Saravanakumar, Thangaratu Thiruppathi, and Thondiyath Asokan, Indian Inst. of Technology Madras, Chennai, India

Research on the Path Planning for Deep-seabed Mining Vehicle

Sui-ping Wang, Wei-hua Gui, and Xiao-ling Ning, Central South Univ., Changsha, China

A Study on Steering Performance of Four-Column Tracked Vehicle on Extremely Cohesive Soft Soil (Oral Presentation)

Hyung-Woo Kim, Sup Hong, Chang-Ho Lee, Jong-Su Choi, and Tae-kyeong Yeu, MOERI/KORDI, Daejeon, Korea

13. CLOSING SESSION

Wednesday 17:00 Panikar Hall
Chair: Jin S Chung, ISOPE, USA
Co-Chair: Ramadass, NIOT, India

GENERAL INFORMATION

PLACE AND DATE: NIOT, Pallikaranai, India; September 20-24, 2009

All sessions of ISOPE OMS-2009 symposium will take place at:

National Institute of Ocean Technology
Sagar Sangamam
Pallikaranai
Chennai, Tamil Nadu 600100, India
Phone: +91-44-66783366

ACCOMMODATION

Savera (use Reservation Form)
146, Dr. Radakrishnan Road, Chennai 600 004 - India
Phone: +91-44-2811-4700 Fax: +91-44-2811-3475
E-mail: hotsave@mds.vsnl.net.in; <http://www.saverahotels.com>

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T. Nagar, Chennai - 600 017
Tamil Nadu, India
Phone: +91-44 -2815- 0500 / 5500
Fax: +91-44 -2815 -0778.
E-mail: reservations@ertgrand.com; <http://www.ertgrand.com>

ACCESS TO NIOT

Chennai International Airport is the closest to Hotels. Many fleets of Metropolitan coaches and pre-paid taxi are available round the clock to reach the Hotels. OMS 2009 Local Secretariat has arranged transport from Hotels to NIOT.

PARKING

Hotel parking is free for guests.

LANGUAGE

The language for the symposium is English. No translation service will be arranged.

CURRENCY EXCHANGE

Currency can be exchanged either at the airport, banks or hotel for the most favorable rates. Exchange rate as of June, 2009 is: 1 USD = Rs 48.

HOTEL ACCOMMODATION:

To get the OMS-2009 discount rate, **use the Reservation Form** in this program or posted on www.isopec.org. You can also ask for a copy of the form from isopec-riot@riot.res.in ; Write ISOPE OMS-2009 on Subject line. Only a limited number of rooms at ISOPE OMS-2009 rates are available.

Guaranteed reservation must be received by August 15.

Electric Voltage: The electrical power supply voltage is 220 V, 50 Hz, for each room of the Hotel.

BUS TRANSPORTATION BETWEEN HOTEL AND NIOT

During the symposium, the OMS local secretariat will provide bus services in the morning and evening between the hotels and NIOT.

CITY TRANSPORTATION

City bus service and taxi service are also available.

ADVANCE SYMPOSIUM REGISTRATION BY MAIL OR FAX (use the Registration Form)

All persons attending the symposium are required to register, pay the appropriate fee, and get a symposium badge. Remember to send via airmail or Fax the Advance Registration (*and Invoice*) Form in this Program or a copy to reach before:

May 15 for one author per paper, and August 20 for non-authors from outside India:

ISOPE OMS-2009 Secretariat, 495 North Whisman Road, Suite 300, Mountain View, California 94043, USA: Fax+1-650-254-2038.

In case one charges to a credit card via **FAX**, the card number should be typed in bold face or written clearly to be readable in the transmitted fax copy. Use the Advance Registration Form in this program or a copy. Registration fees (note: US\$50 surcharge after September 1 for on-site registration) are as follows:

Category	Fee (US \$)*	
<input type="checkbox"/> Author, Co-authors	400	_____
<input type="checkbox"/> Session or Symposium Chair, Co-Chair	400	_____
<input type="checkbox"/> ISOPE Member	400	_____
<input type="checkbox"/> ISOPE member with new application (incl. 2009 membership fee and 1-year journal issues)	490	_____
<input type="checkbox"/> Non-Member	470	_____
<input type="checkbox"/> Full-time Student with 2005 student ID Card	300	_____
<input type="checkbox"/> OMS Banquet	Free	
<input type="checkbox"/> Reserve a seat for Symposium Tour	Free	
<u>TOTAL AMOUNT DUE</u>		_____

* The *registration fee* includes a symposium proceeding CD-ROM, NIOT Reception, OMS Banquet, lunches, Dinners and coffee/tea breaks.

** **One author per paper is required to advance-register by August 5.**

REGISTRATION CANCELLATIONS

Request for cancellation of registration must be received in writing by **September 05, 2009** to be granted a refund minus US\$50 processing charge. No refunds for the author whose paper is already included in the proceedings.

REGISTRATION BADGE

Registration badges are required for admittance to all the symposium activities, including the banquet and lunch.

ON-SITE SYMPOSIUM REGISTRATION

Participants who miss the advance registration may register at the Symposium Registration Desk, but there is a US\$50 surcharge. The registration desk will be open from 08:30-16:00 hrs.

ISOPE PUBLICATION ORDER

The **ISOPE OMS-2009 Symposium Proceedings (ISBN 978-1-880653-75-3)** is included in the symposium registration fees: CD-ROM and Hard Copy. The proceedings volumes (300 pp. est.) can be ordered by mail at the rates of:

Mail order at \$100 (ISOPE Member \$80) including shipping charge.

All ISOPE PUBLICATIONS (listed on www.isopec.org) can be ordered from ISOPE, P.O. Box 189, Cupertino, California 95015-0189, USA: Fax 1-650-254-2038. Advance payment is required. MasterCard or VISA card, international money order or U.S. bank checks in US dollars *payable to ISOPE* will be accepted. Shipping (surface-mail) and handling charges are included (also see the ISOPE Publication Order Information.)

SYMPOSIUM HEADQUARTERS
SYMPOSIUM BANQUET
September 21, 18:30–20:30

Registration Desk
Dakshinachitra, Chennai

LCD Test ROOM Session Room
LCD projector, PC and screen (and an overhead projector,) will be set up in the session room.

INTERNATIONAL PARTICIPANTS AND VISA APPLICATION

International authors, participants or attendees who need help (except financial), especially invitation, can contact: Dr. M. A. Atmanand, OMS-2009 Local Secretariat.

Dr. M A Atmanand, **OMS-2009 Local Secretariat**,
E-mail: atmanandma@hotmail.com; Fax: +91-44-2246-2038

Entry Visa: Most non-Indian participants may be required to apply for an entry visa. Please get an application form at the Consulate of Republic of INDIA in your country.

ABOUT CHENNAI

Chennai, formerly known as Madras, is the capital of the southern state of Tamil Nadu in India, and is the country's fourth-largest city. It is located on the Coromandel Coast of the Bay of Bengal. With an estimated population of 7.45 million (2005), the 367 year old city is the 34th largest metropolitan area in the world. It has the 2nd longest seashore (Marina Beach) in the world.

Chennai's economy has a broad industrial base in the automobile, technology, hardware manufacturing, and healthcare industries. The city is India's second largest exporter of software, information technology (IT) and information-technology-enabled services (ITES). A major portion of India's automobile manufacturing industry is based in and around the city. Chennai Zone contributes 39% of the State's GDP. Chennai accounts for 60% of the country's automotive exports and is sometimes referred to as "the Detroit of India".

Shopping Spots

The Thegaraya Nagar, know as "T Nagar" is a great place to shop, especially at Pandy Bazaar and bustling markets around Pangal Park. Nalli, Chennai silks, RMKV, Kumaran silks, etc., at Usman Road offers a wide range of silks, cottons, saris, and more. Here you will also find huge, multi-story shops like Lalitha Jewelry, GRT Thangamaligai, and Prince Jewelry selling an astonishing range of gold, silver and diamond jewelry.

Climate and Clothes

Weather in Chennai during September is warm: 30°C–34°C.
For further more Information , <http://www.chennaihub.com>

Plan to Attend Other ISOPE Meetings

ISOPE–2010 Beijing, China

June 20–26, 2010

Abstract Deadline: October 15, 2009

For *Online abstract submission*, visit www.isopec.org



**International Society of
Offshore and Polar Engineers (ISOPE)**
495 North Whisman Road, Suite 300
Mountain View, California 94043, USA
meetings@isope.org : www.isope.org

HOTEL RESERVATION FORM (must use this form)

ISOPE OMS-2009 Symposium, September 20–24, 2009

Savera /GRT Grand are the official hotel for the Symposium. For **guaranteed reservation and discount room rate**, (1) this form must be directly mail/Faxed to respective Hotel with “NIOT – CORPORATE” as a reference for booking , no later than **August 20:**

Surname: _____ First (Fore) & Middle: _____

Circle: Male Female; Title Mr. Ms. Mrs. Prof. Dr.

Company: _____

Address _____

Country _____ Postal (ZIP) Code _____

Fax _____ : E-mail _____

Arrival: September __ Time _____;

Depart.: September __, Time _____

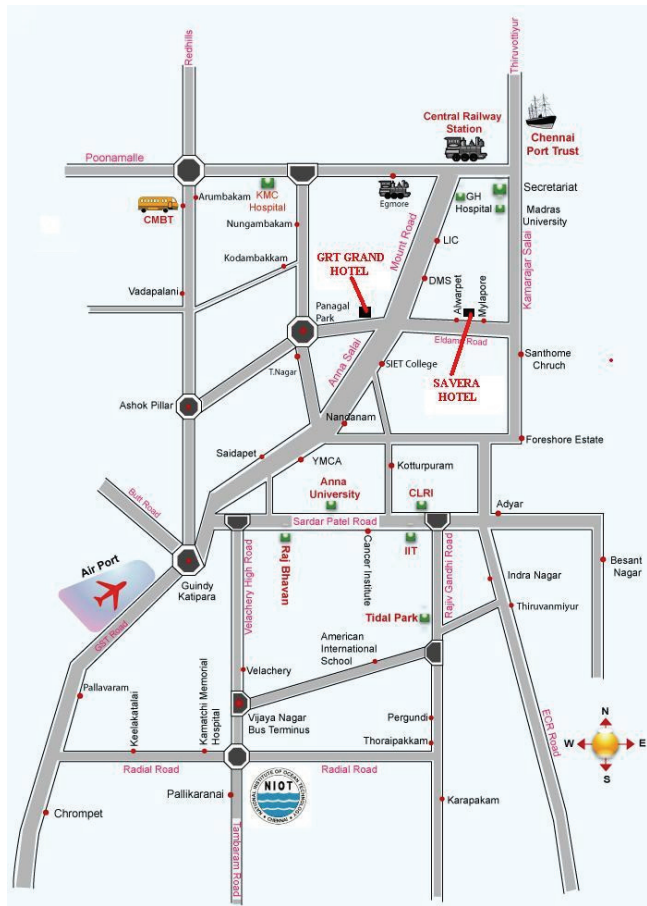
Please, circle or mark [X] for the room you wish to reserve:

Hotel	Room Rates (Rs)
Savera	[2500] 1-person room
	[3500] 2-person room
GRT Grand	[5500] 1-person room
	[6500] 2-person room

Note: Room rate + 12.5 % tax. Breakfast buffet is included.

Local Symposium Secretariat has already reserved the necessary number of rooms at Hotel Savera and Hotel GRT Grand at special OMS-discount-rate for all the participants and guests.

CANCELLATION: Email or fax room cancellation to Local OMS-2009 Secretariat, **15 days or earlier** before your arrival date in the reservation.



NIOT Campus Route map from Airport (map not to scale)



Rajendra Chola Hall and Panikar Hall