

September 22–26, 2013
Szczecin, Poland

The Tenth (2013) ISOPE
**Ocean Mining & Gas
Hydrates Symposium**



Final Program

Invited and Peer-reviewed Papers

**Nodules, Crusts, Sulphide
Exploration & Environment
Mineral Processing**

**Gas Hydrates and Engineering
Mining Systems and Technology
Underwater and Subsea Systems**

Organized by:
International Organizing Committee

Sponsored by:
International Society of Offshore and Polar Engineers (ISOPE)
InterOceanMetal Joint Organization (IOM)
with cooperating organizations (listed inside)

ISOPE OMS-2013 Local Secretariat
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IOM

Welcome to 10th ISOPE OMS-2013

We greatly appreciate the excellent responses and help we have received from colleagues around the world in the successful organization of the 10th ISOPE Ocean Mining & Gas Hydrates Symposium (ISOPE OMS-2013), Szczecin, Poland, September 22–26, 2013. The symposium features **14 sessions of 53 peer-reviewed papers** and **5** additional oral presentations from **16** countries. This year the symposium continues to introduce gas hydrates in ocean and permafrost in addition to deep-ocean exploration, environment, mining systems, and processing systems.

The 1st (1995) ISOPE Ocean Mining Symposium (ISOPE OMS-95) was held on November 22, 1995 in Tsukuba, Japan as an informal organizational meeting of the **Ocean Mining Working Group (OMWG)**. At the meeting, representatives from 7 countries agreed to establish the group for close international cooperation and continued exchange of the individuals' progress, which could also act as an informal channel between governments. The group concept received the blessing of directors general of the participating governments: U.S., Germany, IOM, Japan, 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 professions.
- 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 Seoul, 3rd OMS-99 Goa, 4th OMS-2001 Szczecin, 5th OMS-2003 Tsukuba, 6th OMS-2005 Changsha, 7th OMS-2007 Lisbon, 8th OMS-2009 Chennai, and 9th OMS-2011 Maui were successfully held.

On behalf of the International Organizing Committee, it is our pleasure to welcome all participants to the ISOPE OMS-2013 Symposium in Szczecin.

<i>Co-chairmen of the ISOPE OMS-2013 Symposium</i>	
Prof. Jin S. Chung, USA	Dr. T Abramowski, Poland

SUNDAY September 22

14:00
OMS-2013 Registration and badge pickup Foyer, 11 Fl
17:00 Copernicus 2, 11 F
OMS-2013 IOC
For Tour Information (see the bulletin board in the foyer)

**All sessions will be held in Copernicus 2, 11th Floor
of Radisson Blu Hotel**

MONDAY September 23

07:30–08:30
Symposium Registration Foyer, 11 Fl
Copernicus 2
09:00
1. OPENING SESSION
10.35
2. EXPLORATION & ENVIRONMENT I Copernicus 2
13.00–14.00
OMS Lunch Europa, Ground Fl
14:00
3. EXPLORATION & ENVIRONMENT II Copernicus 2
15.30
4. GAS HYDRATES I: Fundamentals Copernicus 2
19:00 – 21.00
Banquet Dinner and Polish Cultural Evening Hall Vivaldi's, Ground Fl

TUESDAY September 24

07:30–08:30
Symposium Registration Foyer, 11 Fl
09:00
5. GAS HYDRATES II: Properties 1 Copernicus 2
10:30
6. GAS HYDRATES III: Properties 2 Copernicus 2
13.00–14.00
OMS Lunch Europa, Ground Fl
14:00
7. GAS HYDRATES IV: Development Copernicus 2
16.30
8. MINERAL PROCESSING Copernicus 2
20.00 – 21.00
Dinner Restaurant Europa, Ground FL

Monday – Wednesday

Author Practice Copernicus Bar, 11 F 1
On-site Registration Foyer, 11 Fl

WEDNESDAY September 25

09:00		
9. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY I: Mining System		Copernicus 2
10:30		
10. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY II: Pipe & Lift I		Copernicus 2
13:00-14:00		
OMS Lunch		Europa, Ground Fl
14:00		
11. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY III: Pipe & Lift 2		Copernicus 2
15:20		
12. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY V: Miner 1		Copernicus 2
17:20		
13. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY V: Miner 2		Copernicus 2
18:00		
14. Closing Session		Copernicus 2

Co-sponsored by:

**International Society of Offshore and Polar Engineers (ISOPE)
InterOceanMetal Joint Organization (IOM)**

Co-operated 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 Society of Ocean Engineers (KSOE, formerly KCORE)
National Institute of Ocean Technology (NIOT)
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:

IOM
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Local Secretariat:

Dr. Jozef Franzen, InterOceanmetal Joint Organization, Szczecin, Poland

Technical Executive Committee:

Prof. Jin S. Chung, ISOPE, Cupertino, California, USA
Dr. T Abramowski, IOM, Szczecin, Poland
Dr. Takeshi Komai, Tohoku University, Sendai, Japan

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Dr. T Abramowski (**Co-chairman**), IOM, Szczecin, Poland
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Changsha, China
Dr. C. H. Yoon, Korea Institute for Geosciences & Mineral Resources,
Daejeon, Korea

Symposium Co-chairmen
Prof. Jin S. Chung, ISOPE, Cupertino, California, USA
Dr. T. Abramowski, IOM, Szczecin, Poland



Plan to Attend Coming ISOPE Meetings

24th ISOPE–2014 Busan Conference, Korea
at BEXCO , Busan, June 15–20, 2014

Ocean and Arctic
including
Ocean Mining, Gas Hydrates, Shale Gas, Clean Coal
and Clean Energy

Abstract Deadline: October 12, 2013

For Call For Papers, visit www.isopec.org and submit
online or Email an abstract to meetings@isopec.org

11th PACOMS-2014 Shanghai Symposium
Shanghai Jiao Tong University, China
October 12-16, 2014
www.isopec.org >PACOMS-2014 Shanghai

25th ISOPE-2015 Kona Conference, Hawaii, USA
Big Island, Hawaii, USA, June 21-26, 2015
www.isopec.org or www.isopec2015.org

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ISOPE OMS-2013 Szczecin

Radisson Blu Hotel, Szczecin, Poland
September 22–26, 2013

TECHNICAL PROGRAM

All sessions will be held in Copernicus 2, 11th Floor.

MONDAY 09:00

1. OPENING SESSION

Monday 09:00 Copernicus 2, 11 Floor

Chair: T Abramowski, Interoceanmetal Joining Organization (IOM),
Szczecin, Poland

Co-Chair: T Komai, Tohoku University, Sendai, Japan

Welcome to InterOceanMetal and Szczecin

Tomasz Abramowski, Co-chair, ISOPE OMS-2013 Symposium,
Interoceanmetal Joining Organization, Szczecin, Poland

Symposium Opening Address

Jin S Chung, Chair, ISOPE OMS-2013 Symposium, ISOPE, Cupertino,
California, USA

**Commercial Mining System Development for Manganese Nodules:
Take Direct-to- or Incremental-to-5,000-m Approach? (Invited)**

Jin S Chung, ISOPE, Cupertino, California, USA

Tailings and their Disposal in Deep-Sea Mining (Invited)

Gerd Schriever, Hjalmar Thiel, BIOLAB Forschungsinstitut, Germany

**Baselines Data Support for Developing of Environmentally Sound
Nodule Mining Systems**

Valcana Stoyanova, Interoceanmetal Joint Organization, Poland

2. EXPLORATION & ENVIRONMENT 1

Monday 10:35 Copernicus 2

Chair: R Kotlinski, Szczecin University, Poland

Co-Chair: Thomas Kuhn, Federal Institute for Geosciences and Natural
Resources (BGR), Germany

**Cook Islands Nodules Revisited: An Updated Resource Assessment
[Oral Presentation]**

David S. Cronan, Imperial College, UK

**Seamount and Cobalt-Platinum rich Fe-Mn Crust Resources in the
Indian Ocean**

G S Roonwal, AMS Group, Inter Univ. Accelerator Center, India

**Variability and Accuracy of Polymetallic Nodules Abundance
Estimations in the IOM Area – Statistical and Geostatistical Approach**

Jacek Mucha, Monika Wasilewska-Błaszczak, AGH Univ of Science and
Tech; Ryszard Andrzej Kotliński, Łukasz Maciąg, Univ of Szczecin, Poland

**Application of Hydro-Acoustic and Video Data for the Exploration of
Manganese Nodule Fields [Oral Presentation]**

Thomas Kuhn, Carsten Rühlemann, Michael Wiedicke-Hombach, Federal
Institute for Geosciences and Natural Resources (BGR); Timm
Schöning(2), Tim Nattkemper, Bielefeld University, Germany

Exploration of Polymetallic Nodule Using AUV in the Central Equatorial Pacific
Masatsugu Okazaki, Akira Tsune, Deep Ocean Resources Development, Japan

3. EXPLORATION & ENVIRONMENT 2

Monday 14:00 Copernicus 2

Chair: David S. Cronan, Imperial College, UK
Co-Chair: Masatsugu Okazaki, Deep Ocean Resources Development, Japan

Deep Sea Exploration and Exploitation of Minerals in PNG – An Update [Oral Presentation]

Mohan Singh, Mineral Resources Authority, Papua New Guinea

Geochemistry of Molybdenum Element in Co-rich Crusts from the Magellan Seamounts and Tracing of Paleocyanographic Environment
Guoqing You, Jiahua Pan, Wenhong Sun, Shuqin Liu, Chinese Academy of Geological Sciences, China

Grain Size of the Seabed Sediments Underlying Polymetallic Nodules in the Exploration Area of Interoceanmetal

Ivo Dreiseitl, Interoceanmetal Joint Organization; Roman Bednarek, Cyprian Seoul, West Pomeranian Univ of Tech, Poland

The Contouring Accuracy of Polymetallic Nodules Ore Fields in the Interoceanmetal (IOM) Area, East Pacific Ocean

Jacek Mucha, Monika Wasilewska-Błaszczuk, AGH Univ of Science and Tech, Poland

4. GAS HYDRATES I: Fundamentals

Monday 15:30 Copernicus 2

Chair: Werner F Kuhs, Universität Göttingen, Germany
Co-Chair: Zhengquan Lu, Chinese Academy of Geological Sciences; China

Influence of Cation for Cage Occupancy from Small Cage Competition with Methane at Natural Gas Hydrates in Real sediments

Juwoon Park, KAIST; Sun-Hwa Yeon, Korea Inst of Energy Research; Jiwoong Seol, Dong-Yeun Koh, KAIST; Young-ju Seo, Keun-Pil Park, Dae-Gee Huh, Jaehyoung Lee, KIGAM; Huen Lee, KAIST, Korea

Axial Symmetrical Thermal Conduction and Phase Transformations in THF Hydrate-Bearing Sediments

Xu Hui Zhang, Xiao Bing Lu, Chinese Academy of Sciences; Shi Yao Hong, Xia Zhen, Guangzhou Marine Geological Survey, China

Origin of Gases from Gas Hydrate in the Qilian Mountain Permafrost, Qinghai: Comparison of Gas Composition and Carbon Isotopes

Zhengquan Lu, Xiaohua Xue, Chinese Academy of Geological Sciences; Zewen Liao, Chinese Academy of Sciences; Hui Liu, China Geological Survey, China

Spectroscopic Explanation of Metastability in Gas Hydrate Formation

Dongwook Lim, Woongchul Shin, Seongmin Park, Hyeyoon Ro, Dong-Yeun Koh, Jiwoong Seol, KAIST; Se-Joon Kim, Jaehyoung Lee, KIGAM; Huen Lee, KAIST, Korea

18:00 – 21.00

Banquet Dinner

Hall Vivaldi's, Ground Fl

TUESDAY 09:00

5. GAS HYDRATES II: Properties 1

Tuesday 09:00 Copernicus 2

Chair: Takeshi Komai, Tohoku Univ, Japan
Co-Chair:

Development of Ring Shear Apparatus with Permeability Measurement System for Hydrate Bearing Sediments

Hideki Minagawa, Hiroaki Kaneko, Sho Kimura, Takuma Ito, Hideo Narita, National Inst of Advanced Industrial Science and Tech, Japan

Basic Study on the Permeability of Sand during Direct Shear Test

Masayo Kakumoto, Jun Yoneda, Jun Katagiri, Kuniyuki Miyazaki, Norio Tenma, Kazuo Aoki, National Institute of Advance Industrial Science and Technology (AIST), Japan

Geotechnical Properties of Soil Samples Recovered from Eastern Nankai Trough Offshore Japan

Shin'ya Nishio, Eiji Ogisako, Atsushi Denda, Shimizu Corp; Hiroyuki Tanaka, Hokkaido Univ; Hiroyuki Hirakawa, Oyo Corp, Japan

Geochemical Characteristics of the Soil above Muli Gas Hydrate Reservoir

Zhongjun Sun, Mingcai Xu, Zhibin Yang, Aihua Qin, Chinese Academy of Geological Sciences, China

An Experimental Study of Natural Gas Hydrate in Permafrost by the Electromagnetic Method

Meixing He, Hui Fang, Qing Zhong, Chinese Academy of Geological Sciences; Yao Zhang, Guangzhou Marine Geological Survey; Yongzhen Yuan, Genggeng Qiu, Chinese Academy of Geological Sciences; Yixin Ye, East China Inst of Tech, China

6. GAS HYDRATES III: Properties 2

Tuesday 10:30 Copernicus 2

Chair: Hideki Minagawa, National Inst of Advanced Industrial Science and Tech, Japan

Co-Chair: Taewoong Ahn, Korea Inst of Geoscience and Mineral Resources, Korea

Using Alcohol Vapor as Catalyst for Synthesizing Methane Hydrate

Po-Chun Chen, MOEA; Wu-Liang Huang, National Taiwan Univ; San-Hsiung Chung, MOEA; Li-Jen Chen, National Taiwan Univ, Taiwan, China

Gas replacement in clathrate hydrates during CO₂ injection – kinetics and micro-structural mechanism

Andrzej Falenty, M. Mangir Murshed, Universität Göttingen, Germany; Andrey N. Salamatina, Kazan State Univ, Russia; Werner F. Kuhs, Universität Göttingen, Germany

Quantitative Raman Scattering of Guest Molecules in Gas Hydrates and Its Relevance to Gas Exchange Processes Involving N₂

Junfeng Qin, Werner F. Kuhs, Universität Göttingen, Germany

Validation of Seismic Methods to Detect Natural Gas Hydrates in Permafrost

Mingcai Xu, Zhongjun Sun, Jianxun Liu, Baowei Zhang, Xiaojiang Wang, Guangke Wang, Chinese Academy of Geological Sciences, China

Triaxial Behaviour of Methane Hydrate Bearing Sand

Masayuki Hyodo, Shintaro Kajiyama, Norimasa Yoshimoto, Yukio Nakata, Yamaguchi Univ, Japan

7. GAS HYDRATES IV: Development

Tuesday 14:00 Copernicus 2

Chair: Huen Lee, KAIST, Korea

Co-Chair: Ganpat S.Roonwal, AMS Group, Inter Univ. Accelerator Center, India

Monitoring System for Seafloor Deformation during Methane Hydrate Production Test

Tatsuya Yokoyama, Mio Shimoyama, Shinji Matsuda, Koichi Tago, Junya Takeshima, OYO Corp, Japan

Research on Marine Gas Hydrate Drilling Sampler of China

Hong Ren, Laiju Han, Junliang Xu, Zhonghua Wu, Sinopec, China

Development of Large Scale Production System for Methane Hydrates

Jiro Nagao, Yoshihiro Konno, National Inst of Advanced Science and Tech, Japan

Experimental Investigation on Controlling the Depressurization-Induced Production Behavior from Hydrate-Bearing Sediments in 10-Meter-Scale

Taewoong Ahn, Jaehyoung Lee, Joo Yong Lee, Se Joon Kim, Korea Inst of Geoscience and Mineral Resources, Korea

Laboratory Test to Evaluate the Performance of Sand Control Screens during Hydrate Dissociation Process by Depressurization

Jaehyoung Lee, Taewoong Ahn, Joo Yong Lee, Se Joon Kim, Korea Inst of Geoscience and Mineral Resources, Korea

The Lab-Scale Evaluation of Geomechanical Safety during the Production from Marine Gas Hydrate Deposits

Joo Yong Lee, Jaehyung Lee, Se Joon Kim, Taewoong Ahn, Korea Inst of Geoscience and Mineral Resources, Korea

8. MINERAL PROCESSING

Tuesday 16:30 Copernicus 2

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

Co-Chair: Kyoun Ho Park, KIGAM

Recovery of Total Rare Earth Metal from The Deep Sea Nodule Leach Liquor by Solvent Extraction Process

Chul Woo Nam, Pankaj Ku Parhi, Kyung Ho Park, Smruti Pra Barik, Jean Tae Park, Korea Inst of Geosciences & Mineral Resources, Korea

Leaching of Rare Earth Metals from Deepsea Nodule by Dilute Sulfuric Acid Solution

Kyung Ho Park, Pankaj Ku Parhi, Chul Woo Nam, Smruti Pra Barik, Jean Tae Park, Korea Inst of Geosciences & Mineral Resources, Korea

Study on Self-Catalysis Reduction Leaching of Ocean Co-Mn Polymetallic Ores in Ammonia Solution

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

Optimization of the Existing Methods for Recovery of Basic Metals from Polymetallic Nodules

M. Pelegrin Rodriguez, CEDINIQ; Ruben Aja, CIPIMM, Cuba; R. Causse Miyares, Interoceanmetal Joint Organization, Poland

Copper, Nickel and Cobalt Extraction from FeCuNiCoMn Alloy Obtained after Pyrometallurgical Processing of Deep Sea Nodules

Vladislava Przebinda Stefanova, Peter Kostadinov Iliev, Boris Stoilov Stefanov, Univ of Chemical Tech and Metallurgy, Bulgaria

Study on the Ammonia-Nitrogen Wastewater Treatment by Ocean Manganese Nodules

Denggao Zhang, Yanqing Fan, Rengjian Wang, Xunxiong Jiang, Beijing General Research Inst of Mining & Metallurgy, China

WEDNESDAY 09:00

9. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY I: Mining System

Wednesday 09:00 Copernicus 2

Chair: Tomasz Abramowski, Interoceanmetal Joint Organization, Poland

Co-Chair: M Singh, Mineral Resources Authority, Papua New Guinea

In-Situ Soil testing in the Central Indian Ocean Basin at 5462-m Water Depth

S. Muthukrishna Babu, N.R. Ramesh, P. Muthuvel, R. Ramesh, C.R. Deepak, M.A. Atmanand, National Inst of Ocean Tech, India

Preliminary Design Considerations for a Ship to Mine Polymetallic Nodules in the Clarion-Clipperton Zone

Tomasz Abramowski, Interoceanmetal Joint Organization; Tomasz Cepowski, Maritime Academy of Szczecin, Poland

Suspension Principle of Deep-Sea Miner and Drag Tests

Hao Zheng, Qiong Hu, Ning Yang, Yangrui Chen, Bing Yang, Changsha Research Inst of Mining and Metallurgy, China

A Study on Dynamic Behaviors of Pilot Mining Robot According to Extremely Cohesive Soft Soil Properties

Chang-Ho Lee, Hyung-Woo Kim, Sup Hong, MOERI/KIOST, Korea

Design Analysis of a Deep-sea Manganese Nodule Mining System using Axiomatic Design [Oral Presentation]

Minuk Lee, Sup Hong, Jong-Su Choi, Hyung-Woo Kim, Tae-Kyeong Yeu, KIOST; Su-gil Cho, Tae Hee Lee, Hanyang Univ, Korea

10. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY II: Pipe & Nodule Lift I

Wednesday 10:30 Copernicus 2

Chair: Pavel Vlasak, Inst of Hydrodynamics, Czech Republic

Co-Chair: Josef Franzen, IOM, Poland

Conveying of Coarse-Grained Particles in Pipes

Pavel Vlasak, Zdenek Chara, Jiri Konfrst, Inst of Hydrodynamics, Czech Republic; Jerzy Sobota, Wroclaw Univ of Environmental and Life Sciences, Poland; Bohus Kysela, Inst of Hydrodynamics, Czech Republic

Slip Velocities in Mixture Vertical Pipe Flow

Jerzy Sobota, Wroclaw University of Environmental and Life Sciences, Poland; Pavel Vlasak, Institute of Hydrodynamics AS CR, Czech Republic; Leszek Petryka, Marcin Zych, AGH University of Science and Technology, Poland

Consideration of Seafloor Ore Separation by Slurry Flushing for Seafloor Massive Sulfide Mining

T. Yamazaki, Y. Yamamoto, R. Arai, N. Nakatani, Osaka Prefecture Univ, Japan

Application of the Cross-Correlation Method to Determine Solid and Liquid Velocities during Flow in a Vertical Pipeline

Leszek Petryka, Marcin Zych, AGH Univ of Science & Tech; Robert Hanus, Rzeszow Univ of Tech; Jerzy Sobota, Wroclaw Univ of Environmental and Life Sciences, Poland; Pavel Vlasak, Inst of Hydrodynamics, Czech Republic

11. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY III: Pipe & Nodule Lift 2

Wednesday 14:00 Copernicus 2

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

Co-Chair: Qingjue Han, Central South Univ, China

Identification of Vertical Deep-Ocean Pipe End-Point Position

Peter Hubinsky, Jozef Rodina, Jaroslav Hanzel, Boris Rudolf, Slovak Univ of Tech, Slovakia

Computer simulations of the water flow around the ocean mining pipe

Tomasz Abramowski, Interoceanmetal Joint Organization; Tadeusz Szlangiewicz, Katarzyna Żelazny, West Pomeranian Univ of Tech, Poland

Structural Health Monitoring for Top-tensioned Riser with Response Data of Damaged Model

Cheon-Hong Min, Sup Hong, Hyung-Woo Kim, Jong-Su Choi, Tae-Kyeong Yeu, MOERI/KIOST, Korea

Experimental and Computational Investigation of Turbulent Pulsatile Flow through a Flexible Hose

N.R. Ramesh, K. Thirumurugan, S. Rajesh, C.R. Deepak, M.A. Atmanand, National Inst of Ocean Tech, India

**12. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY IV:
Miner1**

Wednesday 15:20 Copernicus 2

Chair: Valcana Stoyanova, Interoceanmetal Joint Organization, Poland
Co-Chair: Enno Schulte, Germany

Multi-objective Design Optimization for Manganese Nodule Pilot Miner Considering Collecting Performance and Manoeuver of Vehicle
Su-gil Cho, Sanghyun Park, Sungsik Choi, Tae Hee Lee, Hanyang Univ;
Minuk Lee, Jong-Su Choi, Hyung Woo Kim, Chang-Ho Lee, Sup Hong,
Korea Inst of Ocean Science and Tech, Korea

Performance Tests of a Manganese Nodule Crusher
Cheon-Hong Min, Sup Hong, Hyung-Woo Kim, Chang-Ho Lee, Min-Uk
Lee, Jong-Su Choi, Tae-Kyeong Yeu, Ki-Young Sung, MOERI/KIOST,
Korea

Operating System of KIOST Pilot Mining Robot in Inshore Test
Tae-Kyeong Yeu, Suk-Min Yoon, Sup Hong, Jin-Ho Kim, Hyung-Woo
Kim, Jong-Su Choi, Cheon-Hong Min, Korea Inst of Ocean Science and
Tech, Korea

Electric-Electronic System of Pilot Mining Robot, MineRo-II
Jin-Ho Kim, Tae-Kyeong Yeu, Suk-Min Yoon, Hyung-Woo Kim, Jong-Su
Choi, Cheon-Hong Min, Sup Hong, Korea Institute of Ocean Science and
Technology (KIOST), Korea

A Study on Dynamic Behaviors of Pilot Mining Robot According to Extremely Cohesive Soft Soil Properties
Chang-Ho Lee, Hyung-Woo Kim, Sup Hong, MOERI/KIOST, Korea

13. DEEP-OCEAN MINING SYSTEMS & TECHNOLOGY V: Miner2

Wednesday 17:20 Copernicus 2

Chair: S Hong, Korea Institute of Ocean Science and Technology (KIOST),
Korea

Co-Chair: N R Ramesh, National Inst of Ocean Tech, India

A New Path Tracking Control Algorithm of Deepsea Tracked Miner
Qingjue Han, Shaojun Liu, Central South Univ, China

Dynamic Analysis of a Tracked Vehicle Based on a Subsystem Synthesis Method
Hyung-Woo Kim, Chang-Ho Lee, Sup Hong, KIOST; Jae-Won Oh,
Hanyang Univ; Cheon-Hong Min, Tae-Kyeong Yeu, Jongsu Choi, KIOST,
Korea

Study on Geometric Path Tracking Algorithm for Tracked Vehicle Model
Suk-Min Yoon, Tae-Kyeong Yeu, Sup Hong, Hyung-Woo Kim, Jong-Su
Choi, Cheon-Hong Min, Korea Inst of Ocean Science and Tech; Sang-Bong
Kim, Pukyong National Univ, Korea

14. CLOSING SESSION

Wednesday 18:00 Copernicus 2, FL 11

Chair: Jin S Chung, ISOPE, USA

Co-Chair: Takeshi Komai, Tohoku Univ, Japan



GENERAL INFORMATION

PLACE AND DATE:

Radisson Blu hotel, Szczecin, Poland
September 22-26, 2013

All sessions of ISOPE OMS-2013 symposium will take place at:

Radisson Blu Hotel
Plac Rodla 10, PL
70-419 Szczecin, Poland
Phone: +48 -91-3595595

HOW TO REACH SZCZECIN? Click Google for flights, transportation, and tours

1. Flights to International Airport Szczecin (Poland) via International Airport Warszawa (Poland), or

2. Flights to Berlin-Tegel or Berlin-Schoenefeld (Germany).
For the participants arriving on September 22, Sunday at Berlin airports above, a special shuttle is being organized:
Contact j.franzen@iom.gov.pl

Otherwise:

From Berlin -Tegel Airport or Berlin-Schoenefeld Airport to Szczecin we recommend a [shuttle](#).

For more information see: <http://www.berlinia.net/en/> or: <http://www.interglobus.pl/>. Get off from a shuttle at Szczecin-Główny (Main Railway Station) and take a taxi from Main Railway Station to Radisson Blu hotel (5 – 10 min., cca 3 USD,

From Airport Szczecin to hotel a shuttle, see <http://www.berlinia.net/en/> or <http://www.interglobus.pl/>.

3. Ryanair operates daily flights between Szczecin and London (Stansted), Two flights per week between Szczecin and both Trondheim and Oslo.

ACCOMMODATIONS: SYMPOSIUM VENUE

Download hotel reservation form www.isopec.org > **Deep Ocean Mining**

Radisson Blu Hotel,
Plac Rodla 10, PL 70-419
Szczecin, Poland
Phone: +48-91-3595595 Fax: +48-91-3594594
E-mail: reservations.szczecin@radissonblu.com
or contact local secretariat j.franzen@iom.gov.pl

ACCESS TO Radisson Blu Hotel

Take a taxi from train station or bus station to the hotel (5-10 min., cca 10 PLN = 3 USD. Taxi can take credit card.

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 banks or hotel for the most favorable rates. Exchange rate as of June, 2013 is: 1 USD = 3.1 PLN.

HOTEL ACCOMMODATION:

To get the OMS-2013 discount room rate, **use the Reservation Form** in this program or posted on www.iso-pe.org >Hotel >Ocean Mining. Write ISOPE OMS-2013 on Email Subject line. Only a limited number of rooms at ISOPE OMS-2013 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. Adaptor to European 3-prong electric outlet may be needed.

CITY TRANSPORTATION

City bus service and taxi service are also available.

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

All persons from **outside Poland** 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 iso-pe-5@iso-pe.org before August 20.

Polish participants: Ask for another form from Local Secretariat oms@iom.gov.pl.

Deadline: May 21 for one author per paper, and August 20 for non-authors from outside Poland.

ISOPE OMS-2013 Secretariat, 1674 North Shoreline Blvd, Suite 146, Mountain View, California 94043, USA: iso-pe-5@iso-pe.org.

In case one charges to a credit card via **EMAIL** or **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 [download from www.iso-pe.org > deep ocean mining to reach iso-pe-5@iso-pe.org. Registration fees (note: US\$100 surcharge after September 1 for on-site registration) are as follows:

Category	Fee (US \$)*	
	received before August 5	
<input type="checkbox"/> Author, Co-authors	450	_____
<input type="checkbox"/> Session or Symposium Chair, Co-Chair	450	_____
<input type="checkbox"/> ISOPE Member	450	_____
<input type="checkbox"/> ISOPE member with new application (incl. 2009 membership fee and 1-year journal issues)	540	_____
<input type="checkbox"/> Non-Member	540	_____
<input type="checkbox"/> Spouses (no proceedings, incl. lunch)	100	_____
<input type="checkbox"/> Full-time Student with 2005 student ID Card	350	_____
<input type="checkbox"/> OMS Banquet	Free	_____
<input checked="" type="checkbox"/> Symposium Tour: pending		

TOTAL AMOUNT DUE _____

* 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.**

REGISTRATION CANCELLATIONS

Request for cancellation of registration must be received in writing by **September 05, 2013** 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\$100 surcharge. The registration desk will be open from 08:30-16:00 hrs.

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The **ISOPE OMS-2013 Symposium Proceedings (ISBN 978-1-880653-92-0)** are included in the symposium registration fees: CD-ROM. The proceedings volumes (300 pp. est.) can be ordered by mail at the rates of:

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PRESS - The press is invited to register at: Registration Desk,
Corridor, Floor 11

SYMPOSIUM HEADQUARTERS Registration Desk,
Corridor, Floor 11

SYMPOSIUM BANQUET
September 23 , 18:30–20:30

Hall Vivaldi's, Ground Floor

LCD Projector Test Room

Session Room
LCD projector, PC and screen (and an overhead projector,) will be set up in the session room. For any other specific requirements, the participants should contact:

Dr. Jozef Franzen, **OMS-2013 Local Secretariat**
E-mail: j.franzen@iom.gov.pl; Fax: +48-91-4256813, Tel.: +48-91-4256813

INTERNATIONAL PARTICIPANTS AND VISA APPLICATION

International authors, participants or attendees who need help (except financial), especially invitation, can contact: Dr. Jozef Franzen, OMS-2013 Local Secretariat.

Entry Visa: Participants from a few countries may be required to apply for an entry visa. Please get an application form at the Consulate of Poland in your country.

ABOUT SZCZECIN

Szczecin, is the capital city of the West Pomeranian Voivodeship in Poland. In the vicinity of the Baltic Sea, it is the country's seventh-largest city and a major seaport in Poland.

City tourist bureaus: cit.szczecin@wp.pl; cikit@zamek.szczecin.pl;
www.zamek.szczecin.pl/tourism; cit@mosrir.szczecin.pl;

Page: szczecin.eu – select a language on a front page right above (Polish, English, German)

CLIMATE AND CLOTHES

Weather in Szczecin during September is moderate: 10~24°C.
A moderate rain is possible, an umbrella probably not necessary.

For further more Information:

cit.szczecin@wp.pl; cikit@zamek.szczecin.pl.

HOTEL RESERVATION FORM (download the form)

Download the form from www.isopec.org > *deep ocean mining* on menu page, or ask from isopec-5@isopec.org .

