

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  
Attn.: Dr. Jozef Franzen, InterOceanmetal Joint Organization,  
Ul. Cyryla i Metodego 9, 71-541 Szczecin, Poland  
Fax: 48 +91-4539399 Telephone: +48-91-4256813 ; E-mail:  
[j.franzen@iom.gov.pl](mailto:j.franzen@iom.gov.pl)



**ISOPE**  
P.O. Box 189  
Cupertino, Calif. 95015-0189, USA  
Fax 1-650-254-2038: [www.isopec.org](http://www.isopec.org)  
[info@isopec.org](mailto:info@isopec.org) ;

**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  
OMS-2013 IOC Copernicus 2, 11 F  
For Tour Information (see the bulletin board in the foyer)

**All sessions will be held in Copernicus 2, 11<sup>th</sup> 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		
<b>9. DEEP-OCEAN MINING SYSTEMS &amp; TECHNOLOGY I: Mining System</b>		Copernicus 2
10:30		
<b>10. DEEP-OCEAN MINING SYSTEMS &amp; TECHNOLOGY II: Pipe &amp; Lift I</b>		Copernicus 2
13:00-14:00		
OMS Lunch		Europa, Ground Fl
14:00		
<b>11. DEEP-OCEAN MINING SYSTEMS &amp; TECHNOLOGY III: Pipe &amp; Lift 2</b>		Copernicus 2
15:20		
<b>12. DEEP-OCEAN MINING SYSTEMS &amp; TECHNOLOGY V: Miner 1</b>		Copernicus 2
17:20		
<b>13. DEEP-OCEAN MINING SYSTEMS &amp; TECHNOLOGY V: Miner 2</b>		Copernicus 2
18:00		
<b>14. Closing Session</b>		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  
ISOPE

***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

***International Organizing Committee***

Prof. Jin S. Chung (**Chairman**), ISOPE, Cupertino, California, USA  
Dr. T Abramowski (**Co-chairman**), IOM, Szczecin, Poland  
Dr. M.A. Atmanand, National Institute of Ocean Technology, Chennai,  
India  
Dr. Sup Hong, Korea Research Institute of Ship and Ocean Engineering,  
Daejeon, Korea  
Dr. Takeshi Komai, Tohoku University, Sendai, Japan

Prof. S. Liu, Central South University, China  
Dr. G. Schriever, BIOLAB Forschungsstitut, Hohenwestedt, Germany  
Dr. Valcana Stoyanova, Interoceanmetal Joint Organization, Szczecin,  
Poland  
Dr. Ning Yang, Changsha Research Institute of Mining and Metallurgy,  
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](http://www.isopec.org) and submit online**  
or Email an abstract to [meetings@isopec.org](mailto:meetings@isopec.org)

**11th PACOMS-2014 Shanghai Symposium**

Shanghai Jiao Tong University, China  
October 12-16, 2014  
[www.isopec.org](http://www.isopec.org) >PACOMS-2014 Shanghai

**25th ISOPE-2015 Kona Conference, Hawaii, USA**

Big Island, Hawaii, USA, **June 21-26, 2015**  
[www.isopec.org](http://www.isopec.org) or [www.isopec2015.org](http://www.isopec2015.org)

**Submit abstracts online or to [meetings@isopec.org](mailto:meetings@isopec.org)**



**International Society of  
Offshore and Polar Engineers (ISOPE)**  
P.O. Box 189  
Cupertino, California 95015-0189, USA  
[info@isopec.org](mailto:info@isopec.org) ; [www.isopec.org](http://www.isopec.org)

# ISOPE OMS-2013 Szczecin

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

## TECHNICAL PROGRAM

All sessions will be held in Copernicus 2, 11<sup>th</sup> 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-Błaszczyk, AGH Univ of Science and Tech; Ryszard Andrzej Kotliński, Lukasz Maciag, 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 Paleocceanographic 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 Seul, 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 CO<sub>2</sub> 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 N<sub>2</sub>**

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:** Kyoung Ho H 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 Hubinský, 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 Szelangiewicz, 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](mailto: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](http://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](mailto:reservations.szczecin@radissonblu.com)  
or contact local secretariat [j.franzen@iom.gov.pl](mailto: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.isopec.org](http://www.isopec.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 [isopec-5@isopec.org](mailto:isopec-5@isopec.org) before August 20.

**Polish** participants: Ask for another form from Local Secretariat [oms@iom.gov.pl](mailto: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: [isopec-5@isopec.org](mailto:isopec-5@isopec.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.isopec.org](http://www.isopec.org) > deep ocean mining to reach [isopec-5@isopec.org](mailto:isopec-5@isopec.org). Registration fees (note: US\$100 surcharge after September 1 for on-site registration) are as follows:

Category	Fee (US \$)*	
	received before <b>August 5</b>	
<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.

#### **ISOPE PUBLICATION ORDER**

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:

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

All **ISOPE PUBLICATIONS (listed on [www.isope.org](http://www.isope.org))** can be ordered from **ISOPE, 1674 North Shoreline Blvd, Suite 146, Mountain View, California 94043, 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 **pavable to ISOPE** will be accepted. Shipping (surface-mail) and handling charges are included (also see the ISOPE Publication Order Information).

#### **PUBLICATION ORDER INFORMATION**

All ISOPE publications are indexed by EI, EI Compendex and more. All ISOPE conference and symposium papers are peer-reviewed.

*Journal of Offshore and Polar Engineering*

Proceedings:

*Annual ISOPE Conference (1991-present)*

*ISOPE Ocean Mining and Gas Hydrates Symposium (1995-present)*

*ISOPE Pacific Asia Offshore Mechanics Symposium (1990-present)*

*ISOPE European Offshore Mechanics Symposium (1990, 1999)*

Email order of individual papers

Individual papers in PDF file can be emailed upon payment by credit card: Use the order form providing the paper title, first author's name and publication year.

#### How to Order

Download the publication order form from [www.isope.org](http://www.isope.org) > orders, [www.isope.org](http://www.isope.org) > publications, or e-mail to [orders@isope.org](mailto:orders@isope.org) asking for the order form, and enclose the correct amount of payment or purchase order, and mail to:

#### **ISOPE Order Department**

**495 North Whisman Road, Suite 300  
Mountain View, California 94043-5711 USA  
[orders@isope.org](mailto:orders@isope.org): Fax 1-650-254-2038**

Advance payment is required. MasterCard, VISA, or AMEX; international money order or U.S. bank checks in US Dollars *payable to ISOPE* will be accepted. Shipping and handling charges will be added

**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](mailto: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](mailto:cit.szczecin@wp.pl); [cikit@zamek.szczecin.pl](mailto:cikit@zamek.szczecin.pl); [www.zamek.szczecin.pl/tourism](http://www.zamek.szczecin.pl/tourism); [cit@mosrir.szczecin.pl](mailto:cit@mosrir.szczecin.pl);

Page: [szczecin.eu](http://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](mailto:cit.szczecin@wp.pl); [cikit@zamek.szczecin.pl](mailto:cikit@zamek.szczecin.pl).

**HOTEL RESERVATION FORM (download the form)**

Download the form from [www.isopec.org](http://www.isopec.org) > *deep ocean mining* on menu page, or ask from [isopec-5@isopec.org](mailto:isopec-5@isopec.org) .

