September 15-19, 2003

Tsukuba, Japan

The Fifth (2003) ISOPE

Ocean Mining Symposium

ISOPE OMS-2003

AIST Auditorium
Tsukuba, Japan
September 15–19, 2003

Technical Program

Invited and Peer-reviewed Papers

Environment	**Mining Systems & Technology**
Gas Hydrates	**Deep-Ocean Water Upwelling**
Exploration & Survey	**Processing Technology**

Organized by:
International Organizing Committee

Sponsored by:
International Society of Offshore and Polar Engineers (ISOPE)
with cooperating organizations (list inside)
Mining and Materials Processing Institute of Japan (MMIJ)

ISOPE OMS-2003 Secretariat
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MMIJ

Welcome to ISOPE OMS-2003

We greatly appreciate the excellent responses and help we have received from colleagues around the world in the successful organization of the 5th ISOPE Ocean Mining Symposium (ISOPE OMS-2003), Tsukuba, Japan, September 15–19, 2003. The symposium features **9 sessions of peer-reviewed papers** from 13 countries. This year the symposium introduces gas hydrates and upwelling and utilization of deep-ocean water in addition to deep-ocean exploration and survey, 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 desired to have a close international cooperation and more exchange of the individuals' progress, and agreed to establish a non-governmental body, OMWG, which can also act as an informal channel among the governments: The OMWG concept got blessing from director generals of the participating governments: The U.S., Germany, Japan, IOM, Korea, India, France (joined later), 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 or the members to interact with their governments. The International Society of Offshore and Polar Engineers (ISOPE) facilitates the OMWG activities.

The 2nd OMS-97, 3rd OMS-99 and 4th OMS-2001 were successfully held in Seoul, Korea, Goa, India and Szczecin, Poland, respectively, with participation from 13 countries.

On behalf of the International Organizing Committee, it is our pleasure to welcome all participants to the ISOPE OMS-2003 Symposium in Tsukuba.

Co-chairmen of the ISOPE OMS-2003 Symposium	
Jin S. Chung, USA	Tetsuo Yamazaki, Japan
Ryszard Kotlinski, Poland	

MONDAY September 15

15:00
OMS-2003 Executive Committee Meeting — Okura Frontier Hotel

17:00
Ocean Mining Working Group (OMWG) Meeting — Okura Frontier Hotel

For Tour Information — (see the Bulletin board at Foyer)

TUESDAY September 16

08.30 -14.00
Symposium Registration — AIST Auditorium

09:00
Opening Address — AIST Auditorium

09.15 -10.30
1. OPENING SESSION — AIST Auditorium

11.00-12.40
2. EXPLORATION AND SURVEY — AIST Auditorium

13.00-14.00
OMS Lunch — AIST Cafeteria Restaurant

14.00-16.30
3. DEEP-OCEAN WATER UPWELLING — AIST Auditorium

18.00-20.00
OMS SYMPOSIUM BANQUET — Okura Frontier Hotel

WEDNESDAY September 17

08:30 –10:30
4. MINING SYSTEMS & TECHNOLOGY I — AIST Auditorium

11.00-13:00
5. MINING SYSTEMS & TECHNOLOGY II — AIST Auditorium

13.00-14.00
OMS Lunch — AIST Cafeteria Restaurant

14.00-15.30
6. GAS HYDRATES I — AIST Auditorium

16.00-18.00
7. GAS HYDRATES II — AIST Auditorium

Tuesday - Wednesday
Author Practice — Session Room No. 2
On-site Registration — AIST Auditorium

THURSDAY September 18

08:30-10:30
8. ENVIRONMENT — AIST Auditorium

11.00-13:00

9. PROCESSING TECHNOLOGY AIST Auditorium

13.00-14.00
OMS Lunch AIST Cafeteria Restaurant

14.00-15.30
10. CLOSING SESSION AIST Auditorium

FRIDAY, September 19

06.00 – 20.00
TECHNICAL TOUR: "TAKUMI" Deep-ocean Water Upwelling Plant, Sagami Bay and **JAMSTEC,** Yokosuka

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***Cosponsored by*:**
International Society of Offshore and Polar Engineers (ISOPE)
Marine Mining Division, Mining and Materials Processing Institute of Japan (MMIJ)

***Cooperated by*:**
International Society of Offshore and Polar Engineers (ISOPE)
U.S. National Science Foundation (NSF)
Mining and Materials Processing Institute of Japan (MMIJ)
Korea Association for Deep Ocean Minerals Development (KADOM)
Korea Committee for Ocean and Resources Engineering (KCORE)
National Institute of Oceanography (NIO, India)
Interoceanmetal Joint Organization (IOM, Poland)
Ifremer (France)
Kansai Society of Naval Architects of Japan (KSNAJ)
China Ocean Mineral Resources R&D Association (COMRA)

Supported by:
Foundation for Advancement of Science and Technology, Japan
National Institute of Advanced Industrial Science and Technology, Japan

***Secretariat*:**
Dr. Tetsuo Yamazaki, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan

***Technical Executive Committee*:**
Prof. Jin S. Chung, ISOPE, Cupertino, California, USA
Dr. Tetsuo Yamazaki, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan
Dr. Ryszard Kotlinski, IOM, Szczecin, Poland

International Organizing Committee
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Dr. Takeshi Komai, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan
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Dr. G. Schriever, BIOLAB Forschungsistitut, Hohenwestedt, Germany
Dr. R. Sharma, National Institute of Oceanography, Goa, India

Dr. A. Usui, Kochi University, Kochi, Japan
Dr. Valcana Stoyanova, ISBA, Kingston, Jamaica
Dr. T. Yamazaki (**Co-chair**), National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan
Dr. Ning Yang, Changsha Research Institute of Mining and Metallurgy, Changsha, China

Symposium Co-chairmen
Jin S. Chung, ISOPE, Cupertino, California, USA
Tetsuo Yamazaki, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan
R. Kotlinski, IOM, Szczecin, Poland

TECHNICAL PROGRAM

Opening Address

Tuesday 09:00 AIST Auditorium

Deep-ocean Mining Technology: A Learning Curve
Jin S Chung, Ocean Mining Working Group (OMWG), ISOPE, Cupertino, California, USA

Welcome Address

Tuesday 09:10 AIST Auditorium
Teruo Kumagai, Tokyo University of Science, Tokyo, Japan

1. OPENING SESSION

Tuesday 09:15 AIST Auditorium
Chair: T. Yamazaki, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan
Co-Chair: G. Schriever, BIOLAB Forschungsistitut, Hohenwestedt, Germany

Deep-sea Resources as the Heritage for the Future
Ryszard Kotlinski, Technical University of Szczecin and Interoceanmetal Joint Organization, Szczecin, Poland

Introduction of MH21 (Research Consortium for Methane Hydrate Resources in Japan) and Current Topics in Production Method and Modeling of Methane Hydrate
Hideo Narita, National Institute of Advanced Industrial Science and Technology, Sapporo, Japan

Past and Current Challenges of Deep Ocean Water Utilization for Marine Nutrition
Masayuki Mac Takahashi and Tohru Ikeya, University of Tokyo, Tokyo, Japan

2. EXPLORATION AND SURVEY

Tuesday 11:00 AIST Auditorium
Chair: R. Kotlinski, IOM, Szczecin, Poland

Co-chair: Kokichi Iizasa, National Inst of Advanced Industrial Science and Technology, Tsukuba, Japan

Geological Survey of Cobalt-rich Manganese Crusts Using a Camera-Monitored Drill Machine (BMS): Hakurei-maru II Cruise SOPAC2002 in the Marshall Islands Area.
A Usui, Kochi Univ, Kochi, Japan; K Matsumoto, Deep Ocean Resources Development Co, Ltd, Tokyo; M Sekimoto, Metal Mining Agency of Japan, Tokyo; N Okamoto, South Pacific Applied Geoscience Committee, Suva, Fiji

Metallogenic Region in the Izu-Ogasawara (Bonin) Arc, Northwestern Pacific
K Iizasa, Natl Inst of AIST, Tsukuba, Japan

Effect of Marine Phosphatization on Element Concentration of Cobalt-Rich Crusts
J Pan, Inst of Mineral Resources, CAGS, Beijing, China; E Decarlo, Univ of Hawaii, Honolulu, USA; S Liu, Inst of Mineral Resources, CAGS, Beijing, China

PGM and Other Accessory Minerals in Fm Hydrogenous Crusts-Placer Mechanism of Accumulation [Proceedings Only]
Mikhail P. Torokhov, Lidya I. Anikeeva, Department of mineral resources of the Ocean, VNIIOkeangeologia, Russia

3. DEEP-OCEAN WATER UPWELLING

Tuesday 14.00 AIST Auditorium
Chair: Koji Otsuka, Osaka Prefecture University, Sakai, Japan
Co-chair: Nai-Kuang Liang, National Taiwan University, Taipei, Taiwan

A Preliminary Study on Air-Lift Artificial Upwelling Induced by Air-Bubble Screen
Nai-Kuang Liang and Hai-Kuen Peng, National Taiwan University, Taipei, TAIWAN, China

Ocean Nutrient Enhancer "TAKUMI" for the Experiment of Fishing Ground Creation
Kazuyuki Ouchi, Ouchi Ocean Consultant, Inc., Karuizawa, Japan

Concept for a Wave Driven Mechanical Artificial Upwelling Device
Roger Handschuh, Gerald Schneider, Enno Sebastian Schulte, Universität Siegen, Siegen, Germany

Research Plan for Assessment of the Effectiveness of Fertilizing Sea Area by Utilizing Deep Ocean Water - A Trial in the Project for the Development of Fishing Grounds by Applying Deep Ocean Water
Seiichi Kanamaki, Yasuharu Uemura, Hisaaki Ohmura, Fuyo Ocean Development and Engineering Co.,Ltd., Tokyo; Tatsuo Suzuki, Ashcrete Corporation, Tokyo; Yoichi Honda, Hazama Corporation, Tokyo; Yuko Oshima, PASCO Environmental Science Institute, Tokyo; Ichiro Yasuda, University of Tokyo, Tokyo, Japan

MF 21 ONE Project - Long Compliant Steel Riser Pipe Installation and Model Basin Studies (Oral Presentation Only)
Satoshi Masuda, JFE SOLDEC Corporation, Yokohama; Masayuki Yonezawa, JFE Engineering Corporation, Tokyo; Masao Morikawa, Universal Shipbuilding Corporation, Tsu, Japan

Development of an Evaluation Technique for Detecting the Pumped-Up Deep-Ocean Water at Subsurface Layer - A Preliminary Experiment to Trace the Behavior of the Artificially Upwelled Deep-Ocean Water Using SF_6 (Oral Presentation Only)
Hisaaki Ohmura, Seiichi Kanamaki, Yasuharu Uemura, Fuyo Ocean Development and Engineering Co. Ltd., Tokyo; Kazuo Iseki, National Research Inst of Fisheries and Environment of Inland Sea, Saeki; Ken Furuya, University of Tokyo, Tokyo; Yuko Oshima, PASCO Environmental Science Inst, Tokyo, Japan

Tuesday 18.30-20.30
OMS SYMPOSIUM BANQUET Okura Frontier Hotel

4. MINING SYSTEMS & TECHNOLOGY I

Wednesday 08:30 AIST Auditorium
Chair: Sup Hong, Korea Research Inst. of Ship and Ocean Engineering, Daejeon, Korea
Co-chair: Ning Yang, Changsha Research Institute of Mining and Metallurgy, Changsha, China

The Path to Commercialisation Mining Seafloor Massive Sulphides
C. J. Rees, B. K. Hebblewhite, D. Laurence, University of New South Wales, Sydney, NSW, Australia

A Case Study of Mining Seafloor Massive Sulfides in Japanese EEZ
Tetsuo Yamazaki and Kokichi Iizasa, Natl. Inst. of Advanced Industrial Science and Technology, Tsukuba, Ibaraki, Japan; Se-Hun Park and Souhei Shimada, University of Tokyo, Tokyo; Satoshi Shiokawa, Metal Mining Agency of Japan, Tokyo, Japan

Economic Simulations of a Small Scale Manganese Nodule Mining System Taking into Account New Technologies
E Schulte, R Handschuh, W Schwarz, Univ of Siegen, Siegen, Germany

Extraction of Thick Coal Seams and Seams with Rear-Earth Elements on the Shelf Applying Bore-Hole Economic and Ecologically Effective Hydraulic Mining
Yuriy N. Niskovskiy, N. A.Nikolaichuk, M.A.Zvonariov, Elena V. Niskovskaya, Far Eastern State Technical University, Vladivostok, Russia

The Technologies and The Means for Industrial Development of Solid Mineral Resources of the Far-Eastern Seas Shelf
Anatoliy V. Zhukov, Michail I. Zvonarev and Alexander N. Tyurin, Far-Eastern State Technical University, Vladivostok, Russia

Behavior of Deep Sea Mining Pipe and its Effect on Internal Flow

Chi Ho Yoon, Yong Chan Park, Dong Kil Lee, Kwang Soo Kwon and Seok Ki Kwon, Korea Inst of Geoscience and Mineral Resources, Daejeon; Won Mo Sung, Hanyang University, Seoul, Korea

A New Method Using Euler Parameters for 3D Nonlinear Analysis of Marine Risers/Pipelines
S Hong, H-Y Kim, J-S Choi, Korea Research Inst of Ships and Ocean Eng, KORDI, Daejeon, Korea

Effects of pipe flow on dynamics of underwater flexible pipes
S Hong, Korea Research Inst of Ships and Ocean Eng, KORDI, Daejeon, Korea

Direct Current Power Supply for Deep-sea Mining Machine
Josef Janoušek, Petr Tušla, Petr Voženilek, Karel Buhr, Czech Technical University in Prague, Prague, Czech Republic

5. MINING SYSTEMS & TECHNOLOGY II

Wednesday 11.00 AIST Auditorium
Chair: Roger Handschuh, Universität Siegen, Siegen, Germany
Co-chair: Chi Ho Yoon, Korea Inst of Geoscience and Mineral Resources, Daejeon, Korea

Virtual Reality Research of Ocean Poly-metallic Nodule Mining Based on the COMRA's Mining System
Shaojun Liu, Gang Wang, Li Li, Zhenyu Wang, Yu Xu, Central South University, Changsha, Hunan, China

Dynamic Simulation of COMRA's Self-Propelled Vehicle for Deep Ocean Mining System
Zhenyu Wang, Shaojun Liu, Li Li, Bihua Yuan, Gang Wang, Central South University, Changsha, China

Several Considerations of the Design of the Hydraulic Pick-Up Device
Ning Yang and Hongping Tang, Changsha Research Inst of Mining & Metallurgy, Changsha, Hunan, China

Transferability of Soil Mechanical Parameters to the Traction Potential Calculation of a Tracked Vehicle
E. Schulte, R. Handschuh, W. Schwarz, Institut für Konstruktions- und Fördertechnik, Universität Siegen, Siegen, Germany

Comparative Study on Tracked Vehicle Dynamics on Soft Soil: Single-Body Dynamics vs. Multi-Body Dynamics
H-W Kim, S Hong, J-S Choi, Korea Research Inst of Ships and Ocean Eng, KORDI, Daejeon, Korea

An Experimental Study on Tractive Performance of Tracked Vehicle on Cohesive Soft Soil
J-S Choi, S Hong, H-K Kim, Korea Research Inst of Ships and Ocean Eng, KORDI, Daejeon; T-H Lee, Hanyang Univ, Seoul, Korea

Prediction of the Motion of Tracked Vehicle on Soft Soil Using Kriging Metamodel

T-H Lee, C-S Lee, J Jung, Hanyang Univ, Seoul; H-W Kim, S Hong, J-S Choi, Korea Research Inst of Ships and Ocean Eng, KORDI, Daejeon, Korea

6. GAS HYDRATES I

Wednesday 14.00 AIST Auditorium
Chair: Takeshi Komai, National Inst of Advanced Industrial Science and Technology, Tsukuba, Japan
Co-chair: Kotaro Ohga, Hokkaido University, Sapporo, Japan

Macro and Micro Approach: Hydrate Phase Equilibria
Huen Lee, Korean Advanced Inst for Science and Technology, Daejeon, Korea

Static Shear Behaviors of Methane Hydrate and Ice
Yasuyuki Nabeshima, Yusuke Takai, Tamotsu Matsui, Osaka University, Suita, Osaka, Japan

Applicability of Cubic Equations of State and Their Mixing Rules to the Prediction of Decomposition Condition of Methane-ethane Mixture Hydrates
Fumio Kiyono, Akihiro Yamazaki, National Inst of Advanced Industrial Science and Technology, Tsukuba; Tajima Hideo, Wu-Yang Sean, Toru Sato: University of Tokyo, Tokyo, Japan

Numerical Prediction of Decomposition of Methane Hydrate in Water Flow
Wu-Yang Sean, Toru Sato: University of Tokyo, Tokyo; Akihiro Yamazaki, Fumio Kiyono, National Inst of Advanced Industrial Science and Technology, Tsukuba, Japan

7. GAS HYDRATES II

Wednesday 16.00 AIST Auditorium
Chair Yasuyuki Nabeshima, Osaka University, Suita, Japan
Co-chair Wu-Yang Sean, University of Tokyo, Tokyo, Japan

Properties of Multiphase Flow in Marine Sediments with Gas Hydrate
Authors: Yasuhide Sakamoto, Takeshi Komai, Yoshishige Kawabe, Tsutomu Yamaguchi, National Inst of Advanced Industrial Science and Technology, Tsukuba, Japan

Numerical Study on Recovery System of Methane-Hydrate
Ryoukichi Hamaguchi, Hiroki Yahashi, Minemoto Masaki, Yousuke Matsukuma; Kyushu University, Fukuoka; Naoyuki Kamishima, Kiwamu Arikawa, Masaharu Watabe, Mitsubishi Heavy Industries, Ltd, Takasago, Japan

Dissociation Behavior of Methane Gas Hydrate in Ethylene Glycol and Silicone Oil
Taro Kawamura, Yoshitaka Yamamoto, Ji-Ho Yoon, Hironori Haneda; National Inst of Advanced Industrial Science and Technology, Tsukuba; Kotaro Ohga, Kiyoshi Higuchi, Hokkaido University, Sapporo, Japan

Experimental Research on the Formation and Storage of the Methane Gas Hydrate
Yoshihiro Kobayashi, Sojo University, Kumamoto, Japan

8. ENVIRONMENT

Thursday 08:30 AIST Auditorium
Chair: T Fukushima, Ship and Ocean Foundation, Tokyo, Japan
Co-chair: R Sharma, Natl Inst of Oceanography, Goa, India

Collection of Marine Data for Visualisation of Seafloor Mining Sites.
Jayne Holden, Philip Stothard, David Laurence, University of New South Wales, Sydney, Australia

Summary of "Environmental Impact Research on Marine Ecosystem for Deep-sea Mining" Conducted by Metal Mining Agency of Japan
S Ohkubo, Metal Mining Agency of Japan, Tokyo; T Yamazaki, Natl Inst of AIST, Tsukuba, Japan

Examination of Environmental Assessment Methods of Deep Sea Development (Oral Presentation Only)
T Fukushima, Ship and Ocean Foundation, Tokyo; Y Shirayama, Kyoto Univ, Shirahama, Japan; T, Yamazaki, Natl Inst of AIST, Tsukuba, Japan

Monitoring the Effects of Simulated Disturbance on Benthic Conditions and Its Implications to Deep Seabed Mining
R Sharma, B Nagender Nath, A B Valsangkar, N H Khadge, B S Ingole, G Parthiban, S Jai Sankarn, Natl Inst of Oceanography, Goa, India

The Benefit Of A Multidisciplinary Cooparation And Exchange Of Data In The Evaluation Of Environmental Data According To The International Seabed Authorties Guiedlines For Future Polymetallic Nodule Mining (Oral Presentation Only)
Gerd Schriever, BIOLAB Forschungsistitut, Hohenwestedt, Germany

Marine Environment in the IOM Area (Clarion-Clipperton Region, Subtropical North-East Pacific): Current Knowledge and Future Needs [Proceedings Only]
T.Radziejewska, University of Szczecin, Szczecin, Poland; K.Szama□ek, University of Szczecin; R.Kotli□ski, Technical University of Szczecin and Interoceanmetal Joint Organization, Szczecin, Poland

Calculation Of Suspended Solids Dispersion In The Sea Environment [Proceedings Only]
Boris Arkhipov, Vladimir Koterov, Gayane Khublaryan, Anna Kocherova, Viacheslav Solbakov, Dorodnicyn Computing Centre of the Russian Academy of Sciences, Moscow; Galina Belousova., Victor Evdokimov, The Scientific and Production Company Environmental Centre IFPA, Moscow, Russia

9. PROCESSING TECHNOLOGY

Thursday 11:00 AIST Auditorium
Chair: Frantisek Vranka, Interoceanmetal Joint Organization, Szczecin, Poland
Co-chair: Shaojun Liu, Central South University, Changsha, Hunan, China

An Integration with Non-Metallurgical Industries — New Challenge for Polymetallic Nodules Processing?
František Vranka, Interoceanmetal Joint Organization, Szczecin, Poland

Dissolution Studies on Cu-Ni-Co-Fe Matte Obtained from Manganese Nodules
S Si, S Anand, Regional Research Lab, Bhubaneswar, India; K-H Park, C W Nam, Korea Inst of Geo-Sciences and Mineral Resources, Daejeon, Korea; R P Das, Regional Research Lab, Bhubaneswar, India

Iron Precipitation by Jarosite Method from the Marine Nodules Acid Solutions
Ariel Mosqueda Martínez,Ciro Manuel Sam Palanco, P. Miguel Pelegrín Rodríguez, Centro de Investigaciones del Níquel. Moa, Cuba

Chemical Roast Reduction of Marine Nodules Blended with Laterite Overburden
Ariel Mosqueda Martínez, P. Miguel Pelegrín Rodríguez , Centro de Investigaciones del Níquel. Moa, Cuba

10. CLOSING SESSION

Thursday 14:00 AIST Auditorium
Chair: Jin S. Chung**,** ISOPE, Cupertino, California, USA
Co-chair: A. Usui, Kochi University, Kochi, Japan

Summary reports from individual session chairs

Closing Notes

GENERAL INFORMATION

PLACE AND DATE: **Tsukuba, Japan**; September 15–19, 2003
All sessions of **ISOPE OMS-2003** symposium will take place at:

AIST Auditorium
1-1-1 Higashi, Tsukuba, Ibaraki 305-8561, Japan
Phone: +81-29-861-2095

Place for Accommodation and Symposium Banquet:

Okura Frontier Hotel Tsukuba (Use Reservation Form or Follow Online reservation instruction.)
1-1364-1, Azuma, Tsukuba, Ibaraki 305-0031, Japan
Phone: +81-29-852-1112 Fax: +81-29-852-5623
E-mail:yoyaku@okura-tsukuba.co.jp

ACCESS TO TSUKUBA

By Air: Tokyo International Airport (**Narita** Airport) is the closest to Tsukuba. Limousine **bus service** with 9 departures per day is available from the Narita Airport to Tsukuba. It takes about 1.5 hours. The fare is 2,540 Yen (about US$21) for one way. The ticket needs to be purchased at the Keisei Airport Bus Counter at the airport before boarding. Bus pickup points are Bus Stop **No. 15 of Terminal 1**, and at **No. 12 of Terminal 2**. The timetable of the limousine service is as provided below.
Okura Frontier Hotel Tsukuba is 1-minute walk from **Tsukuba Center Bus Terminal**. **AIST Auditorium** is about 4 km from Tsukuba Center Bus Terminal: Catch a taxi to go to AIST Auditorium (Sansoken Kyoyokodo in Japanese). The fare is about 2,000 Yen (about US$17).

Hotel access map in English:
http://www.okura-tsukuba.co.jp/english/access.html
Hotel access map in Japanese:
http://www.okura-tsukuba.co.jp/info/access.html
AIST Auditorium access map in English:
http://www.aist.go.jp/index_en.html
Select "Guide Map" then "AIST Tsukuba."
AIST Apuditorium access map in Japanese:
htt://www.aist.go.jp/aist_j/guidemap/tsukuba/tsukuba.html
Detailed campus map is available by selecting "Central No.1."

Airport Bus Timetable

Narita Airport		**Tsukuba Center**
Terminal 1	**Terminal 2**	
07:20	07:25	09:00
09:05	09:10	10:45
10:35	10:40	12:15
12:50	12:55	14:30
14:35	14:40	16:15
16:15	16:20	17:55
17:20	17:25	19:00
18:40	18:45	20:20
20:00	20:05	21:40

Tsukuba Center	**Narita Airport**
06:20	08:00
07:20	09:00
08:50	10:30
10:20	12:00
11:55	13:35
13:25	15:05
14:35	16:15
15:50	17:30
17:35	19:15

By Express Bus: From Tokyo Station, at Yaesu South Exit (Yaesu Minami-guchi in Japanese), highway bus service to Tsukuba is available. At bus stop No. 2, take the bus for ***Tsukuba Center***. *Do not* take the bus to Tsukuba-san: It goes to Mt. Tsukuba. Both leave from the same bus stop. At this bus stop, there are five destinations, each marked by a different colored line on the pavement. The bus for Tsukuba Center is the **light green line** that is middle line or the third line from the left. Destination signs are displaced on the front and right side of the bus door in Japanese and English. Busses to Tsukuba Center run every 10-15 minutes. It takes 60-70 minutes from Tokyo Station to Tsukuba. A one-way ticket costs 1,250 Yen (about 11USD). The express bus goes straight to Tsukuba City then stops at the following five places.
1. **Namiki Oohashi**
2. Namiki Ichi chome

3. Sengen Ichi chome
4. Takezono Ni chome
5. **Tsukuba Center** (Terminal).
AIST auditorium is the first stop, Namiki Oohashi. Shortly after the bus exits the highway, an audio-tape guide will make an announcement in Japanese and English. Please push the button above your seat to notify the bus driver that you would like the bus to stop. When you get off the bus, turn right, walk to the first traffic light and turn left. It takes about 10 minutes. This is the main gate of the AIST campus. On the left side, there is a small guard booth. Please ask the guard for directions to the auditorium.

PARKING
Okura Hotel parking is free for guests. AIST parking is also free, but you need to get an entrance license card at the guard booth.

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 30, 2003 is: 1 USD = 119.96 Yen, 1 EURO = 137.22 Yen.

HOTEL ACCOMMODATION:
Reservation Form inside back cover must be used. ISOPE rate is arranged at Okura Frontier Hotel Tsukuba: For **online reservation**, click on www.okura-tsukuba.co.jp/index_e.html and write ISOPE OMS-2003. Only a limited number of rooms at ISOPE OMS-2003 rates are available at the symposium venue. **Guaranteed reservation by AUGUST 20.**

Voltage: The voltage for electrical power supply is 100 V, 50 Hz.

BUS TRANSPORTATION BETWEEN HOTEL AND AIST AUDITORIUM
During the symposium (Sep. 16 ~ 18), Okura Hotel bus services are available in the morning and evening between the hotel and AIST auditorium. Pick up a bus time table at the hotel front, when you check in.

CITY TRANSPORTATION
City bus service in Tsukuba is inconvenient. Taxi ride is recommended.

SYMPOSIUM TECHNICAL TOUR, September 19, 06:00-20:00; 6,000 Yen (about USD50):
Symposium technical tour is organized for 19 September: **Takumi Deep-Ocean Water Upwelling Plant** in the Sagami Bay and **Japan Marine Science and Technology Center** (JAMSTEC).
Ocean Water Upwelling Plant lifts nutrient-rich water from 200-m deep and mixes it with surface water, then flushes the mixture at 20-m deep. The nutrient-rich water is expected to increase the primary production of the surface layer. A small boat will carry the participants to the plant moored at the center of the bay.
JAMSTEC is well known as a core research institution for marine development in Japan. Its technological development journey for reaching the depths of the ocean with research into the diving technology necessary for underwater work will be introduced.
The final highlight of the technical tour is **Kamakura** City. Kamakura is an old historical and cultural place where Japan's first shogun-controlled military government was established about 800 years ago. Many old historic temples and shrines are there in the city area.
An optional visit to the **Port and Airport Research Institute** (PARI) is available for the people who are afraid of sea sickness. PARI has hydraulic models and basins to test port and harbor structures and their functions. When the sea condition is not good, all the participants will visit PARI.
The technical tour starts at 6.a.m. Breakfast sandwiches is served in the bus and lunch in a restaurant is included. The bus will return to the hotel at 20:00. You may skip visits in the middle of the trip. For example, if you take a train from Yokosuka Station at 15:30, you can reach Tokyo International Airport

(Narita Airport) at 18:00. Please ask further information to ISOPE OMS-2003 Secretariat.

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:**

July 31 for one author per paper and August 31 for non-authors:

ISOPE OMS-2003 Secretariat, Attn.: Dr. Tetsuo Yamazaki, AIST Tsukuba West, 16-1 Onogawa, Tsukuba 305-8569, Japan, Fax:+81-29-861-8709.

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	Registration Fee* (JPYen)	
	Before August 31**	After August 31
Author, Co-authors, Panelist	29,999**	36,000
Session or Symposium Chair, Co-Chair	29,999	36,000
New ISOPE member application (incl. Yr. 2004 membership fee and one year journal issues)	40,799	46,800
Spouses (no proceedings/no luncheon ticket)	N/C	N/C
Full-time Student with 2003 ID Card	12,000	18,000

* The Symposium registration fee includes the symposium banquet, 3 group lunches, tea breaks, and a symposium proceedings.

**** One author per paper is required to advance-register by the end of July.**

REGISTRATION CANCELLATIONS

Request for cancellation of registration must be received in writing by **September 5, 2003** to be granted a refund minus US$50 processing charge. No refund for an author after 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 during the following hours:

Tue., Sept. 16	08:30-16:00	Wed, Thu. Sept. 17 & 18	08:00-14:00

ISOPE PUBLICATION ORDER

A copy of ISOPE OMS-2003 Symposium Proceedings (ISBN 1-880653-61-3) 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 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.)

PRESS - The press is invited to register at: Registration Desk

SYMPOSIUM HEADQUARTERS Registration Desk

SYMPOSIUM BANQUET
18:00–19:30 **Okura Frontier Hotel Tsukuba**
Banquet Hall Subaru

AUDIO VISUAL PRACTICE ROOM Session Room No. 2
An overhead projector, LCD projector and screen will be set up from 08:00-17:00, Tuesday–Thursday in Session Rooms No. 1 and No. 2. Session Room No. 2 is used as the practice room, when no session is scheduled. For any specific requirements for presentations, participants may contact: Dr. Tetsuo Yamazaki, AIST Tsukuba West, 16-1 Onogawa, Tsukuba 305-8569, Japan (Fax: +81-29-861-8709, E-mail: tetsuo-yamazaki@aist.go.jp).

INTERNATIONAL PARTICIPANTS AND VISA APPLICATION
International authors, participants or attendees who need help (except financial) can contact: Dr. Tetsuo Yamazaki, AIST Tsukuba West, 16-1 Onogawa, Tsukuba 305-8569, Japan (Fax:+81-29-861-8709, E-mail: tetsuo-yamazaki@aist.go.jp).

Entry Visa. Some authors may be required to apply early for an entry visa. Please get an application form at the Embassy/Consulate of Japan in your country. If the Consulate requires you to submit an official letter of invitation, please e-mail to Dr. Tetsuo Yamazaki, AIST Tsukuba West, 16-1 Onogawa, Tsukuba 305-8569, Japan (Fax:+81-29-861-8709, E-mail: tetsuo-yamazaki@aist.go.jp). Visitors from most of European countries and USA do not require a visa. However it is recommended that the participants inquire at Embassy/Consulate of Japan. For further information, click on the Ministry of Foreign Affairs, Japan (http://www.mofa.go.jp/j_info/visit/visa/index.html).

ABOUT TSUKUBA
Tsukuba is located in the southwestern part of Ibaraki Prefecture. It is situated approximately 50 km in southwest of Mito City, the capital of the prefecture, approximately 50 km in northeast of Tokyo and approximately 40 km in northwest of Tokyo International Airport (**Narita** Airport). The city has an extended shape in north-south direction that measures 25.4 km in width and 14.9 km in length. Its area being 259.59km^2, this is the second largest city in the prefecture.
Tsukuba is a city where the two elements of abundant nature and Tsukuba Science City's technology can coexist. Tsukuba Science City is the realization of a plan that began in the 1960s. After 40 years and an expenditure of about US$14 billion, Tsukuba has developed into a premier science city in the world. It now boasts about 40 national institutes (a half of all national institutes in Japan), several academic organizations, nearly 150 high-tech companies (including about 20 from abroad), and a total researcher population of about 13,000, with a total population of about 190,000. Tsukuba's strength lies in the balance and breadth of the researchers, research fields, and facilities that can be found there.

Climate and Clothes
Weather in Tsukuba during September is warm: 20°C~30°C. It may rain a few days a week. It is recommended tocarry an umbrella or raincoat.

Tokyo International Airport (**Narita Airport**) and Tsukuba

AIST Auditorium is located in AIST Central. Okura Frontier Hotel Tsukuba is next to Tsukuba Center Bus Terminal (See details in General Information.).

HOTEL RESERVATION FORM (must use this form)

Okura Frontier Hotel Tsukuba, Tsukuba, Japan

ISOPE OMS-2003 Symposium, September 15–19, 2003

Okura Frontier Hotel Tsukuba is the official hotel for the Symposium. For **guaranteed reservation and room rate**, (1) this form must be received **via either fax or airmail** only and no later than **AUGUST 20:**

Group Reservation ISOPE OMS-2003
Okura Frontier Hotel Tsukuba
1-1364-1, Azuma, Tsukuba, Ibaraki 305-0031, Japan
Phone +81-29-852-1112; Fax +81-29-852-5623
E-mail: yoyaku@okura-tsukuba.co.jp

Or (2) you can make online reservation: www.okura-tsukuba.co.jp/index_e.html. Don't forget to write **ISOPE OMS-2003** in the question and comment box.

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.: _____ __, Time ____

Hotel room rates per night* (all rates in Yen):

Room Choice	Single	Twin
Standard room	9,800	9,500 per person

Name of the person to share: _____

* Rates include breakfast, tax and service charge.

Methods of Payment. No advance deposit is required. Pay directly to the Hotel as you check in. All common credit cards or cash payments are accepted. Cancellation must be notified in advance in writing directly to the hotel so that the room can be released to others on the waiting list.

Signature: _____ Date: _____, 2003

Photocopy, Complete, and Send/Fax This Form

Reservation after **AUGUST 20** is subject to room availability.

TECHNICAL PROGRAM

ISOPE OMS-2003 Tsukuba
Tsukuba, Japan
September 15-19, 2003

Find Forms for the Hotel Reservation and Advance Registration inside this program.

ISOPE OMS-2003 ***Venue Address:***
AIST Auditorium
1-1-1 Higashi, Tsukuba, Ibaraki 305-8561, Japan
Tel: +81-29-861-2095 or +81-29-861-8210 (cell Yamazaki)

Okura Frontier Hotel Tsukuba
1-1364-1, Azuma, Tsukuba, Ibaraki 305-0031, Japan
Phone: +81-29-852-1112 Fax: +81-29-852-5623
E-mail:yoyaku@okura-tsukuba.co.jp

Plan to Attend Other ISOPE Meetings

ISOPE–2004 Toulon, France
May 23–28, 2004
Abstract Deadline: September 30, 2003
For Call For Papers, **visit** www.isope.org and submit online or fax an abstract to Fax +1–650–254–2038 USA

ISOPE PACOMS-2004 Vladivostok, Russia, September: Update on www.isope.org and submit an abstract to PACOMS-2004, **Fax +1–650–254–2038** USA

ISOPE–2005 Seoul, COEX, Seoul, Korea, June 19–24

ISOPE OMS–2005: Venue and date to be announced on www.isope.

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