

INTERNATIONAL SCHOOL FOR GEOSCIENCE RESOURCES  
KOREA INSTITUTE OF GEOSCIENCE AND MINERAL RESOURCES (KIGAM)

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## TRAINING COURSE ON Gas Hydrate Exploration & Development

The **International School for Geoscience Resources** of KIGAM presents an intensive training course on Gas Hydrate Exploration & Development. The course will take place at the Ara room of International School for Geoscience Resources of KIGAM in Daejeon (Korea) in Nov. 1 to 11, 2010 and will include the following topics:

- **Topic 1. Gas Hydrate R&D in KIGAM** *by Dr. Byong-Jae Ryu*  
Nov. 1<sup>st</sup> (Mon.)     Gas Hydrate R&D in KIGAM
- **Topic 2. Geophysical Aspects of Gas Hydrate** *by Prof. Gwang Lee*  
Nov. 2<sup>nd</sup> (Tue.)     Geophysical Aspects I of gas hydrate  
Nov. 3<sup>rd</sup> (Wed.)     Geophysical Aspects II of gas hydrate
- **Topic 3. Natural Gas Hydrates** *by Dr. Alexei V. Milkov*  
Nov. 4<sup>th</sup> (Thu.)     What is a Natural Gas Hydrate  
Nov. 5<sup>th</sup> (Fri.)     Examples of Natural Gas Hydrate occurrences  
Nov. 6<sup>th</sup> (Sat.)     How much Gas occurs in Natural Gas Hydrates
- **Topic 4. Characterization of Hydrate-Bearing Sediments** *by Prof. Tae Sup Yun*  
Nov. 7<sup>th</sup> (Sun.)     Characterization of HBS – Part I  
Nov. 8<sup>th</sup> (Mon.)     Characterization of HBS – Part II
- **Topic 5. Laboratory Studies of Gas Hydrate** *by Drs. Jang-Jun Bahk & Joo Yong Lee*  
Nov. 9<sup>th</sup> (Tue.)     Geological & geochemical analyses  
Experimental studies for development of gas hydrate production technologies
- **Topic 6. Gas Hydrate Survey using R/V Tamhae-II** *by Drs. Byong-Jae Ryu & Dong-Geun Yoo*  
Nov. 10<sup>th</sup> (Wed.)     Gas hydrate indicators  
Nov. 11<sup>th</sup> (Thu.)     Equipments for marine gas hydrate survey

## Content of session

### Topic 1. Gas Hydrate R&D in KIGAM *by Dr.Byong-Jae Ryu*

#### **Overview**

The purpose of this topic is to introduce the gas hydrate R&D activities in Korea. In Korea, gas hydrate researches were initiated by the the Korea Institute of Geoscience and Mineral Resources (KIGAM) in 1996. To determine the potential of gas hydrate accumulation in the East Sea of Korea, KIGAM have performed the regional geophysical surveys and geological studies of gas hydrates by using the R/V Tamhae-2 during the period of 2000 - 2004. From 2005, National Gas Hydrate Development Program has been carried out. The ultimate goals of this national program are to confirm the gas hydrate occurrence in the East Sea, and to develop the technologies for production of gas hydrate.

- **Session I: Gas Hydrate R&D Activities in KIGAM**
  - Gas Hydrate R&D during the period of 1996-1999
  - Gas hydrate R&D during the period of 2000-2004
  - Gas hydrate R&D from 2005

### Topic 2. Geophysical Aspects of Gas Hydrate *by Prof. Gwang Lee*

#### **Overview**

The purpose of this topic is to provide the participants with an introduction to the geophysical aspects of gas hydrate and key geophysical tools to explore and appraise gas hydrate accumulations. On the first day, we will review the geophysical properties of gas hydrate and discuss various exploration methods including seismic reflection, the amplitude-variation-with-offset (AVO) technique, and well logging. On the second day, we will learn how to estimate heat flows from the depths of the bottom-simulating reflector. Case studies for different geological settings will also be covered. In the afternoon of the second day, the participants will have hands-on

exercises to interpret seismic data, map various seismic indicators of gas hydrate and associate gas, and estimate heat flows.

- ***Session I: Geophysical Aspects I of Gas Hydrate***
  - Introduction
  - Gas hydrate exploration
  - Seismic indicators of gas hydrate and associated gas
  - Application of amplitude-variation-with-offset (AVO) technique to gas hydrate prediction
  
- ***Session II: Geophysical Aspects II of Gas Hydrate***
  - Heat flow estimation from the depth of the bottom-simulating reflector
  - Case studies
  - Exercise

### **Topic 3. Natural Gas Hydrates** *by Dr. Alexei V. Milkov*

#### **Overview**

This 3-day lecture will discuss the occurrences of gas hydrates in natural environments both onshore and offshore. We will discuss how to locate gas hydrates using geological, geophysical and geochemical techniques. Then, several examples of gas hydrate occurrence will be discussed in relation to the main controlling factors of gas hydrate concentration in sediments. The lecture will focus in details on geochemistry of gas hydrates and on gas hydrate resources, both on local and on global scales. Economic geology and recovery of natural gas hydrates will be briefly discussed at the end of the lecture.

- ***Session I: What is a Natural Gas Hydrate***
  - What is a natural gas hydrate

- Where natural gas hydrates occur
- Geological, geochemical and geophysical techniques to locate natural gas hydrates
- **Session II: Examples of Natural Gas Hydrate Occurrences**
  - Marine high gas flux environments (seeps, mud volcanoes): Haakon Mosby Mud Volcano, Gulf of Mexico, Hydrate Ridge Where natural gas hydrates occur
  - Marine low gas flux environments: Blake Ridge, Hydrate Ridge
  - Hydrated gas accumulations onshore: Russia, Alaska, Canada - Geochemistry of natural gas hydrates
- **Session III: How much Gas occurs in Natural Gas Hydrates**
  - Accumulations and provinces Marine low gas flux environments: Blake Ridge, Hydrate Ridge
  - Worldwide - Economic geology of natural gas hydrates

## **Topic 4. Characterization of Hydrate-Bearing Sediments** *by Prof. Tae Sup Yun*

### **Overview**

This topic covers the characterization methods of hydrate-bearing sediments (HBS) using a range of experimental and numerical analyses. The fundamental investigation of synthetic and natural HBS helps understand the formation of hydrates in sediments and relevant geophysical and geomechanical properties. The lecture includes the introduction of varying characterization methods that are readily usable, the interpretation of properties and their implications. Laboratory and field examples are presented as supplementary materials. It is expected that the participants understand the significance of HBS characterization and its applicability to scientific and engineering aspects.

- ***Session I: Characterization of HBS – Part I***
  - Geophysical and Geomechanical characterization of synthetic HBS: elastic wave velocities, mechanical behaviors, thermal and electrical properties
  - Characterization of HBS recovered by pressure coring and scaled-production testing
- ***Session II: Characterization of HBS – Part II***
  - Image analysis of HBS and geomaterials: X-ray and 3D micro-CT
  - Sediment characterization and its implication
  - Relevant experimental and numerical methods applicable to HBS

## **Topic 5. Laboratory Studies of Gas Hydrates** *by Drs. Jang-Jun Bahk & Joo Yong Lee*

### **Overview**

The lecture will introduce the laboratory studies of gas hydrates for geological and geochemical analyses, followed by the experimental studies of gas hydrate production technologies. Some experiment exercises with natural gas hydrate samples will be demonstrated to the participants.

- ***Session I: Geological and geochemical analyses***
  - Overview on board and onshore experiments for characterization of gas hydrate occurrence
  - Demonstration of experiments with natural gas hydrate samples
- ***Session II: Experimental studies for development of gas hydrate production technologies***

- Overview on gas hydrate production technologies and related physical properties
- Experimental studies on the physical properties of hydrate-bearing sediments
- Experimental studies on the production behaviour of hydrate-bearing sediments

## **Topic 6. Gas Hydrate Survey using R/V Tamhae -II** *by Drs. Byong-Jae Ryu & Dong-Geun Yoo*

### **Overview**

The course will introduce the seismic indicators for the occurrence of gas hydrate in the Ulleung Basin. We will also show the equipments for marine gas hydrate survey including gravity meter, multibeam echosounder and 2D/3D seismic systems. Especially, 2D/3D seismic system consists of data acquisition system (TRIACQ), integrated navigation system (TRINAV), quality control system (TRILOGY QC), air-gun array, and streamer hydrophone.

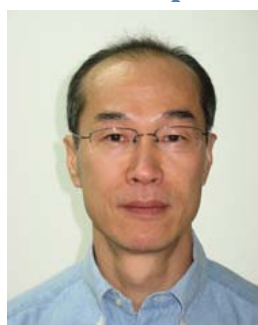
- **Session I: Gas hydrate indicators**
  - Overview on gas hydrate indicators for the presence of gas hydrate (geological, geochemical and geophysical indicators)
- **Session II: Equipments for marine gas hydrate survey**
  - Overview on R/V Tamhae-2
  - Introduction and overview of equipments for marine gas hydrate survey
  - 2D/3D seismic system

**About the presenter – Dr. Byong-Jae Ryu**



Dr. Byong-Jae Ryu is currently working in Petroleum & Marine Resources Research Division, Korea Institute of Geoscience and Mineral Resources as a principal researcher & the director of Gas Hydrate Department. He received his Ph.D. from Stuttgart University, Germany in 1990. His research is mainly related to Gas Hydrate exploration and development fields.

**About the presenter – Prof. Gwang Lee**



Gwang Lee is a professor in the department of energy resources engineering at Pukyong National University, Busan, Korea. He received his Ph.D. in geological/geophysical oceanography from Texas A&M University in 1990. From 1991 to 1994, he worked as an exploration geologist for Shell Offshore Inc. His research interests include the application of seismic reflection to oil/gas/hydrate exploration and geological CO<sub>2</sub> sequestration.

**About the presenter – Dr. Alexei V. Milkov**



Alexei Milkov holds degrees in Geology from Saint-Petersburg State University, Russia (BSc, 1996; MSc, 1998) and Texas A&M University (PhD, 2001). He has been studying geology and geochemistry of natural gas hydrates since 1995. Alexei participated in several gas hydrate expeditions in the Western Siberia, Norwegian Sea, Gulf of Mexico and offshore Oregon. He has 110 publications (including 40 peer-reviewed papers) on gas hydrates, mud volcanoes, geological emissions of methane, reservoir geochemistry and methanogenic biodegradation. Alexei currently works as a Petroleum Systems Analyst with BP in Russia.

**About the presenter – Prof. Tae Sup Yun**



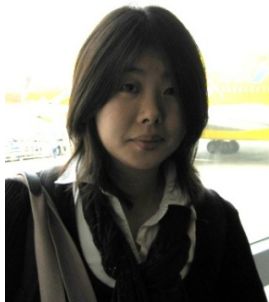
Tae Sup Yun is an assistant professor in the Department of Civil and Environmental Engineering at Yonsei University, Seoul, Korea. His educational background includes B.S. in geology and Ph.D. in Geotechnical engineering from Georgia Institute of Technology. His expertise includes sensor and energy application to geo-engineering, sustainable and engineered geomaterials at particle-scale, and non-destructive testing.

**About the presenter – *Dr. Jang-Jun Bahk***



Bahk Jang Jun is a senior researcher in the department of petroleum and marine research division. He received his Ph.D. in marine geology from Seoul National University in 2001. His research interests include the geologic interpretation of marine gas hydrate occurrence.

**About the presenter – *Dr. Joo Yong Lee***



Joo Yong Lee is currently working in Korea Institute of Geoscience and Mineral Resources as a senior researcher. She received Ph.D. in Civil Engineering from Georgia Institute of Technology in 2007. Her research interests include laboratory characterization of physical properties and production behaviour of hydrate-bearing sediments.

**About the presenter – *Dr. Dong-Geun Yoo***



Dong-Geun Yoo is currently working in Korea Institute of Geoscience and Mineral Resources as a senior researcher. He received his Ph.D. in marine geology from Chungnam National University in 1997. His research interests include the application of seismic interpretation to gas hydrate exploration.