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

REGULAR TRAINING COURSE ON
Fundamental on Geological Survey

The **International School for Geoscience Resources** of KIGAM presents an regular training course on **"Fundamentals on Geological Survey"**. The course takes place at the Ara room of International School for Geoscience Resources (IS-Geo) of KIGAM in Daejeon (Korea) in **June 2 through 27, 2014** and includes the following modules.

Modules	Date	Representative Lecturers
Module 1. Petrology and Petrogenesis	6.2.-5.	Moonsup Cho (Seoul Nat'l Univ., Korea) Kye-Hun Park (Pukyong Nat'l Univ., Korea)
Module 2. GIS/RS Theory and Data Processing	6.9.-13.	Saro Lee (KIGAM, Korea)
Module 3. Some Recent Trends in Modern Structural Geology and Tectonics	6.16.-20.	Olivier Lacombe (UPMC-Paris VI, France)
Module 4. Quaternary, Urban and Anthropogenic Geology	6.23.-27.	Jonathan Lee/ Jonathan Ford (BGS, the UK)

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Ministry of Science, ICT and Future Planning

COURSE INFORMATION

• Agenda

This course consists of four parts, “Petrology and Petrogenesis”, “GIS/RS Theory and Data Processing”, “Structural Geology and Tectonics”, and “Quaternary, Urban and Anthropogenic Geology”. The first part, petrology and petrogenesis, provides general introduction to basic principles and theories essential for understanding the origin and evolution of igneous and metamorphic rocks, and a comprehensive introduction to geochemical and isotopic characteristics of Mid-Ocean Ridge Basalts (MORB) and Oceanic Island Basalts (OIB) for the understanding of their petrogenesis and geochemical evolution of their source reservoirs. The second part gives learning the application of suitability analysis using GIS/RS technique and social networking between practicians and researchers in geological field. The third part course aims at illustrating some recent trends in modern structural geology and tectonics that it demonstrates and discusses the need for an accurate characterization and quantification of physical parameters (e.g., stress, strain, fluid flow, …) and tectonic mechanisms. The last part provides a basic and intermediate introduction to global, regional and local-scale quaternary, urban and anthropogenic geology with focus on understanding earth systems and levels of human-landscape interaction from the perspective of process, application and strategic relevance.

• Course Covered

- Petrology and Petrogenesis
- Introduction to GIS, GIS Data Processing using ArcGIS and GIS Application
- Introduction of Remote Sensing and Image Processing
- Introduction and application of SAR and Hyperspectral Remote Sensing
- Some Recent Trends in Modern Structural Geology and Tectonics
  - Quantification of orientations and magnitudes of past crustal stresses
  - Stress, strain, deformation mechanisms, fluid pressure and fluid flow in deforming sedimentary rocks
  - Initiation, geometry and mechanics of brittle faulting in sedimentary rocks and exhuming metamorphic rocks
  - Geometry, kinematics and mechanics of foreland fold-thrust belts
- Strategic demand for understanding quaternary, urban and anthropogenic geology
- Systems approach to understanding quaternary landscape change focussing upon surface responses to climate, sea-level and neo-tectonic change and human influence
- Application of office and field-based approaches to mapping and

modelling of Quaternary and Anthropogenic terrains

- **Course Requirements: Prerequisite**
  - Have some basic knowledge of geology and geoscience
  - Have a background in geology, stress and strain analysis, rock mechanics, and rheology
  - Have a background and basic knowledge of basic geomorphology or sedimentology
  - Experience with computer using will help but is not necessary

- **Who should Attend?**
  - Geologists interested in learning basic concepts and recent developments of igneous and metamorphic petrology.
  - Scientists or engineers interested in petrogenesis of the mantle-derived rocks such as mid-ocean ridge basalts or ocean island basalts and geodynamic models for the evolution of their mantle source reservoirs
  - Scientists, researchers and graduate students working on and/or interested in modern structural geology and tectonics, especially those interested in bridging the gap between scales of investigation and in the quantification of natural observations and processes for a better understanding of tectonic mechanisms.
  - Geological and environmental scientists, engineers, curators, involved in quaternary sciences
  - National or local government officials, preferably middle manager, researchers and engineers engaged in the field of geology, GIS, remote sensing, and geological hazard

Module 1. Petrology and Petrogenesis - Dr. Moonsup Cho and Dr. Kye-Hun Park

- **Summary of topic contents and learning objectives**

Petrology is one of the major fields of geology, and provides the basic knowledge and research tools for any geologic investigation or mineral exploration. This module provides general introduction to basic principles and theories essential for understanding the origin and evolution of igneous and metamorphic rocks. At the end of the module the participants will be able to understand current status of chemical geodynamics of the mantle. Because MORB and OIB are products of partial melting processes of oceanic mantle in places where crustal contamination is unimportant and provide incomparable evidence to the nature of the mantle, following question will be addressed during the module; how do we use radiogenic isotope ratios and trace element ratios in basalts to make such inferences about the mantle?

- **Day 1. Rock-forming minerals and igneous petrology - Dr. Moonsup Cho**

The opening day lecture starts with general introduction to minerals and rocks, and the importance of petrology in understanding large-scale tectonic issues. Crystal structures and chemistries of rock-forming minerals are then discussed, followed by brief introductions to igneous rock classification schemes and petrologic phase equilibria. Each lecture starts with the Q and A session on various themes relevant to lecture topic.

  - Introduction – minerals, rocks and tectonics
  - Rock-forming minerals and rock classifications
  - Petrologic phase equilibria

- **Day 2. Igneous and metamorphic petrology - Dr. Moonsup Cho**

The second day lecture covers the fundamental concepts of igneous and metamorphic petrology. It starts with the review of the Day 1 lecture, and then discusses the application of and petrologic phase equilibria to crystallization and melting processes. Fundamental concepts of metamorphism are briefly summarized, followed by the review on the P-T-time path and its orogenic implications.

  - Crystallization and melting processes
  - Fundamentals of metamorphism
  - P-T-time path and orogeny

- **Day 3. Petrogenesis of MORB and OIB - Dr. Kye-Hun Park**

The third day is devoted to learn the basic principles of petrogenesis of MORB (Mid-ocean Ridge Basalts) and OIB (Ocean-Island Basalts), including igneous activity along the diverging plate boundary, intraplate hotspot activity, adiabatic rise of mantle material and depressive melting, fractional crystallization,

geochemical variations (major elements, trace elements, and isotopic characteristics), and oceanic crust and upper mantle structure.

- Plate tectonics and generation of oceanic igneous rocks
- Geochemical characteristics of MORB and OIB
- Petrogenesis of MORB and OIB

- **Day 4. Mantle components and chemical geodynamics - Dr. Kye-Hun Park**

The fourth day is allocated for the topics of mantle heterogeneities and geochemical evolution of the mantle, including comprehensive discussions about along-ridge heterogeneity, geochemical comparison between MORB and OIB, isotopic mantle components, possible mantle reservoirs, and geodynamic models such as plumes and mantle convection.

- Mantle heterogeneities
- Isotopic multispace and mantle components
- Mantle reservoirs and dynamic models

Module 2. GIS/RS Theory and Data Processing

- **Summary of topic contents and learning objectives**

The opening day of the module is an introductory course in GIS-based spatial analysis for geological event mapping and a part of geological GIS application. Firstly the module talks about the GIS and GIS software. The module is designed to provide a basic understanding of fundamental concepts and principles that is essential for GIS, method for managing GIS data for analysis geological phenomenon, practical exercises of ArcGIS software, and geological GIS application according to groundwater productivity. The objective of this module is to provide basic concepts, methodologies and to learn GIS software for analysis and predictive modelling of geo-objects. The analysis of spatial association between geo-objects and evidence factors is discussed and demonstrated. This module involves an introductory topic in remote sensing and image processing. It covers the introduction of Remote Sensing, and basic digital image processing. Also, based on a few examples, participants learn how to apply remote sensing technique for the description of spatial patterns and identification of spatial properties. This module also involves an advanced topic in remote sensing for geological phenomena and geospatial statistics in geology. It covers the introduction of SAR, remote sensing, hyperspectral remote sensing, and geological remote sensing.

- **Day 1. Introduction of GIS and ArcGIS - Dr. Saro Lee**

This topic introduces Geographic Information Systems (GIS) and how to use GIS Software for GIS data processing. You can learn the basic concept, principles and applications. Then, GIS software is introduced, focused on the GIS data processing for geo-environmental analysis.

  - Concept of GIS
  - Principles of GIS
  - GIS and Data
  - Applications of GIS
  - Introduction of ArcGIS/GIS software

- **Day 2. GIS data processing using ArcGIS - Dr. Moung Jin Lee**

This topic involves basics of data processing, data analysis technique using ArcGIS, GIS data processing and some examples applied to supported data using ArcGIS. The module consists of main topics as below. All topics have an example data and practice time.

  - Data Display using ArcGIS
  - Database Query
  - Spatial Database Format
  - Exercises of ArcGIS

- **Day 3. GIS application in geoscience - Dr. Yongsung Kim**

This topic involves overview of potential mapping, groundwater system, GIS data processing and some examples applied to groundwater potential mapping, using likelihood ratio, weight of evidence and logistic regression models and, verifies the accuracy for well locations in GIS Environment. The model is based on the relationship between groundwater productivity data, including specific capacity (SPC) and its related hydrogeological factors. Related factors, including topography, lineament, geology, forest and soil data are collected and inputted into a spatial database.

- Introduction to predictive modeling using GIS
- Construction of spatial data for potential analysis
- Analysis of relationships and potential using GIS
- Practical exercise: potential mapping based on GIS
- Practical exercise: validation of potential mapping based on GIS

- **Day 4. Introduction of remote sensing - Dr. Changwook Lee**

This topic is an introduction to remote sensing of the earth as a system and explores the fundamental principles of remote sensing. And you can learn how to collect and display the remote sensing data. We will have lab time to hands-on work with field spectroadiometer for mineral detection. The topic introduces some applications using remote sensing data.

- Overview of remote sensing
- Collecting remotely sensed data
- Displaying remotely sensed data
- Image processing of remote sensing image
- Applications of remote sensing in Geoscience area

- **Day 5. Application of remote sensing - Dr. Changwook Lee**

This topic covers include energy interactions, reflectance, scanning systems, satellite sensors, digital image process, and image classification. Integral to the course is an introduction to the handling of large image data sets using computers. Students will work with image processing software.

- Geological Interpretation using remote sensing
- Collecting remotely sensed data
- Introduction of SAR remote sensing
- Introduction of hyperspectral remote sensing
- Application of SAR remote sensing
- Application of hyperspectral remote sensing

Module 3. Some Recent Trends in Modern Structural Geology and Tectonics – Dr. Olivier Lacombe

- **Summary of topic contents and learning objectives**

This module aims at illustrating some recent trends in modern structural geology. Its aims are to demonstrate and to discuss the need for an accurate characterization and quantification of physical parameters and tectonic mechanisms. Examples are taken in different fields in structural geology and at various scales, from crystalline deformation to the scale of entire foreland fold-thrust belts. Many of them are based on field examples the instructor has worked on and it illustrates the changes in scale and the use of a multisource approach needed for a better understanding and integration of tectonic mechanisms acting in the earth crust. For this purpose, the topics of the module have been chosen on one hand to cover a certain range of scales of investigations (microscale, day 1; micro-mesoscale, days 2-3 and macroscale, days 4-5), and on the other hand, to illustrate both the combination of techniques of micro (meso) structural investigations and regional case studies.

- **Day 1: Toward a better quantification of orientations and magnitudes of past crustal stresses: insights from calcite twinning paleopiezometry and comparison with present-day stresses**

The concept of stress is of primary importance when dealing with the mechanics of materials. However, our knowledge of the stress levels sustained by natural rocks remains poor. This is especially true for past crustal stresses. Also, a remaining matter of debate is the real significance of so-called paleostresses compared to modern stresses. The Day 1 lecture aims at illustrating the recent improvements to the classical calcite twinning paleopiezometer, which now allows to simultaneously compute (paleo) stress orientations and differential stress magnitudes, and even principal stress magnitudes when combined with fracture analysis and rock mechanics data. Some results gained in various settings worldwide are discussed and put in perspective of the underlying tectonic processes and crustal behavior, together with a comparison of paleo- and modern stresses in terms of physical meaning and patterns.

- **Day 2: Stress, strain, deformation mechanisms, fluid pressure and fluid flow in deforming sedimentary rocks : what can we learn from integrated studies of folded strata ?**

The Day 2 lecture is devoted to giving an overview of how microstructural (internal strain, fracture development, paleostress pattern) and fluid flow evolution can be reliably linked to macrostructural evolution and regional tectonic history. We will examine how the combination of various techniques (analysis of anisotropy of rock

physical properties, of calcite twinning paleopiezometry, strain analysis, geochemistry and microthermometry of vein cement/rock matrix, estimates of fluid pressure,…) helps decipher microscale deformation mechanisms and folded rock history and bridge the gap with macroscale kinematic evolution of folds, to further serve as complementary inputs to forthcoming geomechanical modeling of folding.

- **Day 3 : How brittle deformation localizes in the upper crust ? Initiation, geometry and mechanics of brittle faulting in sedimentary rocks and exhuming metamorphic rocks : insights from field studies**

The Day 3 lecture will be devoted to examine our current knowledge on the way deformation localizes, a key question in modern structural geology. This question will be addressed on the basis of field studies, by examining various natural cases illustrating the birth then the growth of brittle mesoscale features and at deciphering the underlying mechanisms and mechanics that may lead to major tectonic features in the brittle crust.

- **Day 4 : Geometry, kinematics and mechanics of foreland fold-thrust belts (1) : insights from multisource study in the active Zagros fold-thrust belt (Iran)**

The Day 4 lecture is devoted to the study of the morphology, anatomy and development of a famous fold-thrust belt, the Zagros belt (Iran). The geometry, kinematics and mechanics of cover folding and basement faulting will be linked and discussed in terms of superimposed thick-skinned and thin-skinned deformation. This lecture briefly addresses some techniques used for fold dating and exhumation. This example also leads to discuss the critically tapered wedge model. The structural evolution is replaced in the regional tectonic framework.

- **Day 5 : Geometry, kinematics and mechanics of foreland fold-thrust belts (2) : how the basement (and deeper lithospheric levels) may control the structural evolution**

The Day 5 lecture aims at illustrating how basement tectonics may have controlled the geometry and the kinematics of foreland fold-thrust belts, even in classical 'thin-skinned' thrust belts. It provides an overview of the control by the basement of the structural evolution of some fold-thrust belts worldwide, with additional considerations on the rheology of the crust/lithosphere and its control on the shortening in thrust belts. Again, emphasis is put on the necessary change in scale and multisource data/techniques integration to better understand crustal deformation and underlying dynamics.

Module 4. Quaternary, Urban and Anthropogenics Geology – Dr. Jonathan Lee and Mr. Jonathan Ford

- **Summary of topic contents and learning objectives**

The aim of the module is to provide a modern and state-of-the-art training on Quaternary, Urban and Anthropogenic Geology – its global context and relevance to scientific and applied drivers. At the end of the module, students should have:

- An appreciation of the context and application of Quaternary, Urban and Anthropogenic geology to science, resource and geohazards management;
- A multi-scaled basic understanding of geological and human processes that operate within the landscape during the recent geological time;
- A knowledge and insight into geological processes operating within eastern and south-east Asia during the Quaternary – especially the influence of climate change, changing base-level and sea-level and human interaction with the shallow sub-surface.
- A basic knowledge of the range of office and field-based techniques that can be used to map and model Quaternary, Urban and Anthropogenic geology.
- An insight into the differences between Quaternary and bedrock mapping and approaches to stratigraphy and the range of different methodologies and approaches that can be employed and utilised in mapping and modelling;
- Field experience examining the Quaternary and Anthropogenic geology within urban and rural terranes.

- **Day 1. Quaternary and anthropogenic geology**

The opening day of this module comprises an introduction to the Module and three lectures that will provide a theoretic background to the scientific and applied context of Quaternary, Urban and Anthropogenic geology. These lectures focuses on defining the Quaternary and Anthropocene, outlining the strategic need and value of understanding these geological systems, methods of capturing and visualising geological data, basic principles of stratigraphy and geochronology.

- Introduction to the module
  - Module overview and introductions
  - Logistics
- The quaternary-anthropocene System I – significance, drivers and systems
  - Strategic drivers for mapping and modelling
  - Applications of map and model data

- Data sources, manual and digital data capture systems.

- The auaternary-anthropocene System II
  - What is the quaternary - definition, drivers of global change
  - Defining the anthropocene
  - Principles of quaternary stratigraphy: establishing a quaternary succession, geochronology, calibrating and correlating
  - Quaternary domains: principles and practice
- Derived products from quaternary spatial data
  - Development of products from quaternary spatial data
  - Examples including mineral resources, flooding, ground conditions

- **Day 2. Quaternary systems**

The aim of Day 2 is to examine the various Quaternary Systems that are and have been significant drivers of landscape change in eastern and south-east Asia. We provide a state of the art introduction to geological processes relating to Soils and Weathering, Fluvial and Hillslope systems, Marine and Coastal systems and Cryogenic systems.

- Oils & weathering processes
  - Introduction to soils and weathering processes
- Fluvial and slope systems
  - Slope processes
  - Fluvial processes, base-level and catchment change
  - Models of river terrace development and correlation
- Marine and coastal systems
  - Coastal processes and landforms
  - Patterns and drivers of sea-level change
- Cryogenic systems
  - Principles, processes and products of periglaciation and permafrost
  - Principles, processes and products of mountain glaciations

- **Day 3. Anthropogenic and urban systems**

This day focuses on exploring Anthropogenic and Urban geological systems. It provides guidance on how geology and landforms may be classified and then using case studies, outline the challenges and techniques of urban mapping and modelling. Applications of with respect to aggregate resources, drainage etc will be discussed.

- The Anthropocene
  - An introduction to the concept of the anthropocene and anthropogenic (Human) geology – the geological zone of human interaction
- Urban geology
  - Classification of anthropogenic deposits and landforms
  - Challenges and techniques of urban mapping and modelling
  - Case studies of urban geological models

- Applications of anthropogenic geology
  - Applications of urban modelling for: drainage, land-use, mineral aggregates.
- Practical
  - Applications to resources and urban geology

- **Day 4. Mapping quaternary, urban and anthropogenic terrains**

During Day 4, participants receive a basic introduction to planning and executing a Mapping Project within Quaternary and Anthropogenic Terrains. Particular focus is placed on outlining the various laboratory and field-based methodologies that may be employed by the geologists. Participants are also in small groups undertake a practical aimed at developing analytical and interpretational skills relating to reconstructing landscape histories.

- In the laboratory: designing the mapping project
  - Planning your quaternary mapping project
  - Standards and scale
  - Remote mapping techniques
- In the field: mapping techniques
- Practical: quaternary history reconstruction
  - Practical exercise: evaluating different forms of geological evidence to reconstruct the landscape history of an area

- **Day 5. Field trip**

The purpose of the final day of the module is to visit several localities near to KIGAM to examine field examples of Quaternary and Anthropogenic geology – to discuss form, genesis and methodologies for mapping and modelling.

- Mapping training: basic techniques in field mapping

About the instructor – (Module 1) Dr. Moonsup Cho

Prof. Cho is a professor of geology at the School of Earth and Environmental Sciences, Seoul National University. He has earned his Ph.D. degree at Stanford University in 1986, after completing M.Sc. degree at University of Toronto and B.Sc. at Seoul National University. He is currently a member of the Korean Academy of Science and Technology (since 2006), and a fellow at the Mineralogical Society of America (since 2003) and the Geological Society of America (since 2011). He has served many years as editorial board members of various international journals including Lithos (2004-2013) and the Geological Society of America Bulletin (2010-2012), and is currently serving as subject editor of the Journal of Geological Society London and associate editor of Geochemical Journal.

About the instructor – (Module 1) Dr. Kye-Hun Park

Dr. Kye-Hun Park is the professor in the Department of Earth Environmental Sciences of Pukyong National University. He obtained his MSc in Geology from the Seoul National University (1982) and his PhD in Geochemistry/Petrology from the Columbia University (1990).

About the instructor – (Module 2) Dr. Saro Lee

Dr. Saro Lee got his B.Sc. degree in geology (Yonsei University, Seoul, Korea) in 1991, M.Sc. in GIS-based geological hazard mapping (Yonsei University, Seoul, Korea) in 1993, and Ph.D. in landslide susceptibility mapping using GIS (Yonsei University, Seoul, Korea) in 2000.

He is currently a director at the department of geosciences information, KIGAM where he involved in GIS/RS application on geological hazard studies. He started his professional career in 1995 as a researcher in the KIGAM. He spent many years as a part time lecturer in the department of earth system sciences, geology and military affairs at the Yonsei Univ., Kyungpook National Univ. and Daejeon Univ., respectively, Korea from 2004-2005. Since 2006 to the 2010, he was an adjunct professor in the department of geology & earth environmental sciences at the Chungnam National Univ. He is now the Professor of the University of Science & Technology.

He carried out several International Cooperative Research Projects in the field of geological hazard in Cambodia, China, Indonesia, Malaysia, Philippines, Thailand and Vietnam. Also He managed and had lectures KOICA International Training Program six times (Mineral Exploration and GIS/RS) for participants from more than 20 Countries (Afghanistan, Cambodia, Cameroon, Colombia, DR Congo, East-timor, Fiji, Indonesia, Kazakhstan, Kyrgyz Republic, LAO PDR, Madagascar, Malaysia, Mongolia, Myanmar, Nigeria, Nepal, Peru, Philippines, Turkmenistan, Uzbekistan, Vietnam, and so on).
His research interest includes geospatial predictive mapping with GIS and RS such as landslide susceptibility, ground subsidence hazard, groundwater potential, mineral potential, as well as habitat potential. He has published over 70 papers a citation h-index of 33 in Scopus.

About the instructor – (Module 2) Dr. Moung Jin Lee

Dr. Moung Jin Lee is currently working as Research Specialist at Korea Environment Institute. He received the B.Sc. degree in Environment in 2000, and the M.Sc. in Remote sensing and GIS from Yonsei University in 2004, and the Ph.D. in GIS and Geological hazard from Yonsei University, Seoul, Korea, in 2012.

He worked in the image processing of remote sensing and GIS application on natural disaster in Yonsei Natural Science Institute (YNSI) from 2001 to 2004. He spent one years as research in the department of groundwater development at the Korea Rural Community Corporation, Korea from 2004-2005. During the period, 2005-2006, he was worked Korea Telecomm Network(KTN) 2005 to 2006, and work in Urban Information System(UIS) and Ubiquitous city. He has more than 10 years of research and industrial experience and has published over 20 research and reviewed articles in referred technical journals and books. He specializes in remote sensing and GIS application and soft computing techniques in natural hazard and environmental problems. He is also the associate of The Korea Society of Remote Sensing.

About the instructor – (Module 2) Dr. Yongsung Kim

Dr. Yongsung Kim got his B.Sc. degree in geology (Yonsei University, Seoul, Korea) in 1998, M.Sc. in discrimination between earthquake and artificial blast by using seismic and infrasound waves (Yonsei University, Seoul, Korea) in 2000, and Ph.D. in groundwater productivity potential mapping with probability models (Kyungpook University, Daegu, Korea) in 2010. He got P.E. in geology and geotechnics in 2006.

He is currently a vice-president of GeoGreen 21, groundwater and soil specialty company where he involved in groundwater survey and planning.
His works includes geospatial predictive mapping with GIS and RS such as groundwater equipotential distribution, groundwater productivity and groundwater vulnerability. He has done numerous projects such as national groundwater survey(13 areas), national groundwater inventory, national groundwater management plan, national groundwater information strategy planning, basic groundwater survey for RBF, and related deign project.

About the instructor – (Module 2) Dr. Changwook Lee

Dr. Changwook Lee got his B.Sc. degree in geology (Kangwon National University, Chuncheon, Korea) in 1999, M.Sc. in Remote sensing using SAR interferometry (Yonsei University, Seoul, Korea) in 2002, Researcher & Visiting Scientist for U.S. Geological Survey (USGS) National Center for Earth Resources Observation and Science (EROS), USA in 2006, and Ph.D. in Time-series surface deformation by SBAS InSAR technique (Yonsei University, Seoul, Korea) in 2009. He had fill the Postdoctoral position in InSAR for the ARTS contract with the US Geological Survey EROS data center, and all work was to be performed as determined by the USGS project Manager working in coordination with SSSC Management. The work was performed at the USGS Cascades Volcano Observatory in Vancouver, Washington by National Aeronautics and Space Administration (NASA) project supports until August 2011. He was research professor at the Department of Geoinformatics, The University of Seoul where he involved in Remote Sensing applications using SAR and Optic images for geological natural hazard until August 2012. He is currently a research scientist at National Institution of Meteorological Research (NIMR) where he involved in Global Environment System Research lab using SAR and Optic images for geological natural hazard. He supported an awarded NASA grant to develop and apply advanced satellite interferometric synthetic aperture radar (InSAR) image technique to study Aleutian volcanoes. Especially, Small BAse Subsets (SBAS) and Persistent Scatterer InSAR (PSInSAR) using multi-interferogram InSAR processing methods were applied to approximately a dozen active Aleutian volcanoes by identifying point-like, persistently-scattering and time-series surface deformation patterns on the volcanoes to analyze the temporal history of ground movement with an accuracy of a few millimeters

About the instructor – (Module 3) Prof. Dr. Olivier Lacombe

Prof. Lacombe holds a PhD in Earth Sciences from UPMC (1992). In 1994, he obtained a permanent research position as assistant professor in UPMC, and got his 'Habilitation à Diriger des Recherches' in 2000. Since 2002, he has a full professor position in the Department of Tectonics, then in ISTeP. He is the head of the 'Déformations, Sismo-tectonique, Imagerie, Relief' ('DESIR') research team.

Prof. Lacombe is a specialist in tectonics. His research focuses on various topics: Paleostress orientations and magnitudes in orogenic settings (from the fold scale to the entire fold belt scale) using combined analysis of calcite twins, faults and fractures;

- Structure and kinematic evolution of fold-thrust belts of Tertiary orogens (Taiwan, Alps, Pyrenees, Zagros, Rockies), with emphasis on regional tectonic evolution, fracture pattern, geometry and kinematics of thrust/fold structures, timing of deformation and exhumation, transverse structures and along-strike belt segmentation, involvement of the basement in shortening;
- Ductile to brittle transition during exhumation of HP metamorphic rocks in orogens (Alps, Cyclades-Aegean); kinematics and mechanics of low-angle normal faults ('detachments');
- Mechanisms of deformation, paleostress patterns and evolution of pore fluid (over)pressures in folded sedimentary strata, and fluid-rock-tectonics interactions in basins and orogens; case studies in Albania, Iran, USA and in the external western Alps.

To date, Prof. Lacombe has authored about 80 papers in tectonics and geodynamics published in peer-reviewed ISI journals as well as 3 book chapters. He has supervised 13 PhD theses and 16 Master theses. He has given many invited conferences, especially in Europe and in Taiwan. He has been convener of two international meetings held in France in 2005 (*'Thrust belts and foreland basins')* and 2011 (*'Faults : Why ? Where ? How ?')* and of several sessions in European Geoscience Union meetings. He has been leading editor of a book of the series Frontiers in Earth Sciences (Springer) in 2007 : *'Thrust belts and foreland basins : from fold kinematics to hydrocarbon systems'*. He has also been leading Guest Editor for several special issues : '*Geodynamic evolution of the Zagros*' (Geological Magazine, 2011), '*Into the deformation history of folded rocks*' (Tectonophysics, 2012), '*Faults, stresses and mechanics of the upper crust : a tribute to Jacques Angelier*' (Bulletin de la Société Géologique de France, 2013), '*Fluid-rock-tectonics interactions in basins and orogens*' (Marine and Petroleum Geology, 2014). Prof. Lacombe is a member of the editorial board of Geological Magazine and Editor-in-Chief

of the Bulletin de la Société Géologique de France; he is reviewer for many international scientific journals.
In addition to numerous administrative tasks in UPMC, Prof. Lacombe is member of the section 18 of the Comité National de la Recherche Scientifique (CoNRS) and is an expert for the Agence Nationale de la Recherche (ANR), the Agence d'Evaluation de la Recherche et de l'Enseignement Supérieur (AERES) and the Institut National des Sciences de l'Univers (INSU). He is the french representative of the International Lithosphere Program (ILP).

About the instructors – (Module 4) Dr. Jonathan Lee

Dr Jonathan Lee is a Senior Geologist at the British Geological Survey (BGS), Nottingham, UK where he leads the programme of Quaternary Research for Southern Britain and the development of a National Geological Model for superficial deposits. He obtained his BSc Hons degree in Geology and Physical Geography (1996) from Kingston University (UK), and subsequently an MSc in Quaternary Science (1998) and a PhD in Quaternary Geology (2003) from Royal Holloway University of London (UK). He joined BGS following the completion of his PhD and has worked on Quaternary and bedrock sequences throughout the Southern UK and on international projects in Europe and the Arabian Peninsula.
His main research interests and specialism are in glacial geology and glacial processes, river terrace archives, desert environments and long-term glacial histories. He has published over 80 scientific publications including 40 papers in ISI journals and numerous book chapters and papers within conference proceedings, and in 2004 received the Lewis Penny Medal from the Quaternary Research Association for his contributions to enhancing the understanding of the UK Quaternary. He is currently Quaternary Editor for the journal Proceedings of the Geologists' Association and is a regular reviewer of peer-reviewed papers for most of the main journals relating to Quaternary stratigraphy and glacial geology.

About the instructors – Jonathan Ford

Jon Ford joined the BGS as a survey geologist in 2001 and now holds the position of Chief Geologist for England. He has developed considerable knowledge and experience of the Quaternary and Mesozoic evolution of the Southern UK, the geology of the Anthropocene and the shallow sub-surface. This knowledge has been gained through extensive field mapping campaigns, borehole studies, 3D geological modelling work and related research.

Jon's published outputs include geological maps, peer-reviewed papers, book chapters and 3D models. With an MSc in Computing Science, a dominant theme in his career is the innovative use of digital systems, including 3D modelling, to address geological challenges and enable the used of geological data in decision making. Prior to obtaining his BSc in Applied Geology from the University of Leicester, Jon worked in the UK coal industry in northern England. The early parts of his graduate career were spent working as an exploration geologist in various parts of Latin America. Jon has continued to work internationally on a variety of geological surveys and training initiative in Africa and Brazil. He is a Chartered Geologist and European Geologist.

KIGAM Korea Institute of Geoscience and Mineral Resources

GENERAL INFORMATION

STARTING/END DATE AND LOCATION

- **June 2 through 27 (4 weeks) at KIGAM in Daejeon, Korea**.

LANGUAGE OF STUDY

- The language of instruction is English and the courseware is in English.

ASSESSMENT AND CERTIFICATION

- A participant will receive the certificate upon completion of the course.

REGISTRATION

- **Deadline – By May 2 for a nominee**
  Before 7 days in starting date of each module for someone else except for a nominee
- **How to Register**
  - Complete and return the attached form, "Nomination form" for a nominee and "Registration form" for someone else except for a nominee to Mr. Seung-Ryeol Hwang (hwang3816@kigam.re.kr) by email
  - Visit at http://isgeo.kigam.re.kr, IS-Geo URL. You can learn more about all training courses in IS-Geo website.

COURSE FEE

- The fee for each module contains the access to electronic course notes, the certificate of attendance and the Pre-Course e-Learning.
- **The fee for a nominee is free.**
- The fee to someone else except for a nominee in each module is 500 US dollars /500,000 KRW per module (100 US dollars/100,000 KRW per module for only students).

CONTACT

- For more inquires about training courses of IS-Geo, please contact at any time
- **Mr. Seung-Ryeol Hwang**, Assistant Coordinator by phone at +82-42-868-3816 or by email at Hwang3816@kigam.re.kr

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Ministry of Science, ICT and Future Planning