

NEWS

2013

TEN
BIG
NEWS
ITEMS
2013

Institute for
Geo-**R**esources and **E**nvironment

Ten Big News Items from the Institute for Geo-Resources and Environment

Our research focuses on three major areas to ensure the sustainable development of society: (1) utilization of the geosphere to establish a sustainable and stable energy cycle, (2) protection of the geosphere for the safety and health of the nation, and (3) security of stable supply of natural resources for industrial activities and society at large. Ten Big News Items of 2013 were selected from various activities carried out at our institute over the past year, and have the most potential to contribute to the achievement of sustainable development, based on the following factors:

- Noteworthy research results
- Launch, promotion, or completion of important projects or joint researches
- Contribution to society through publication of research results or through technology transfer
- Creation of important intellectual infrastructures or results of fundamental researches
- Events, awards, and others that bring honor to the institute
- Important initiatives that lead to advances in researches of the institute

In 2013, our institute was reformed on geothermal and geo-heat research sections. Development of renewable energies has been greatly expected after the Great East Japan Earthquake. For its promotion, the Fukushima Renewable Energy Institute, AIST (FREA) was established at Tsukuba in October 2013, preceding the official opening of the institute at Koriyama, Fukushima Prefecture in April 2014. Leading researchers on the studies were moved from our institute to FREA and started to make geothermal and geo-heat studies a featured research theme of FREA. This Ten Big News 2013 includes news items related to the geothermal and geo-heat studies, in addition to other important results of research and development.

I hope that this brochure will help you in understanding the activities and contributions of our institute.

May 2014

Dr. Shinsuke Nakao, Director

Ten Big News Items 2013

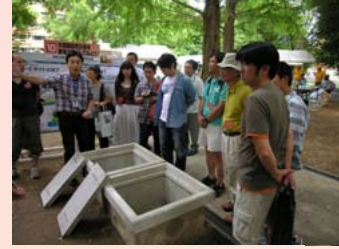
Title	Researchers (Affiliation or position)	
● Next step of geothermal and geo-heat studies, and outreach activities		
Contribution to establishment of the renewable energy institute -Opening of the Fukushima Renewable Energy Institute, AIST (FREA)-	Geothermal Energy Team and Shallow Geothermal and Hydrogeology Team (Renewable Energy Research Center)	A
Research on use of ground-source heat: GSHP system installed in the Geological Museum	Y. Uchida, M. Yoshioka, G. Shrestha (Renewable Energy Research Center), and Geological Museum	B
Summer Special Exhibition at the Geological Museum for research and outreach on geothermal energy and Ground-Source Heat Pump (GSHP) systems	N. Yanagisawa, T. Sawaki, K. Mizugaki (Resource Geochemistry RG), M. Sugihara, T. Ishido (CO ₂ Geological Storage RG), S. Takakura, H. Karasawa (Geo-Environmental Systems RG), K. Sakaguchi, K. Yasukawa, Y. Uchida, M. Yoshioka (Renewable Energy Research Center), S. Okuma (Institute of Geology and Geoinformation), and S. Yoshida (Geological Museum)	C
● Science and Technology Week poster “Minerals in Every Home”	Y. Okuyama (Chief Senior Researcher)	D
● Improvement of hydrogeological X-ray CT experiments using K absorption edges	Y. Nakashima (Exploration Geophysics RG) and T. Nakano (Institute of Geology and Geoinformation)	E
● Impact of CO ₂ geological storage on microbial ecosystems in deep subsurface	D. Mayumi, M. Takeuchi and S. Sakata (Geomicrobiology RG)	F
● Winning of the Organic Geochemistry Award (Research Award)	S. Sakata (Geomicrobiology RG)	G
● Winning the Best Paper Award from the Japan Society of Civil Engineers –Risk assessment of heavy metals in tsunami sediment induced by the Great East Japan Earthquake–	Y. Kawabe, J. Hara, T. Yasutaka, Y. Sakamoto, M. Zhang (Geo-Environmental Risk RG), and T. Komai (Tohoku University)	H
● Development of the safety management techniques for decontamination of waste materials containing radioactive cesium	Y. Sakamoto, T. Yasutaka, Y. Imoto, H. Sugita (Geo-Environmental Risk RG), K. Miyazaki (Geo-Environmental System RG), Y. Mitsuhashi (Deputy Director), H. Higashino and Y. Ishikawa (Research Institute of Science for Safety and Sustainability)	I
● Initiation of the joint study of critical metal resources between AIST and Brazil	T. Takagi, S. Kodama, Y. Kon, T. Ejima and other 11 group members (Mineral Resources RG)	J
● The Geological Society of Japan “Koto Bunjiro” Award in 2013	S. Morita and T. Nakajima (Fuel Resource RG)	K
● Intensive geological surveys commenced in 2013: three year shallow subsurface methane gas hydrate prospecting in the Sea of Japan	S. Morita, M. Sato, T. Nakajima, S. Goto (Fuel Resource RG), and M. Tanahashi (Principal Research Manager)	L



A



B



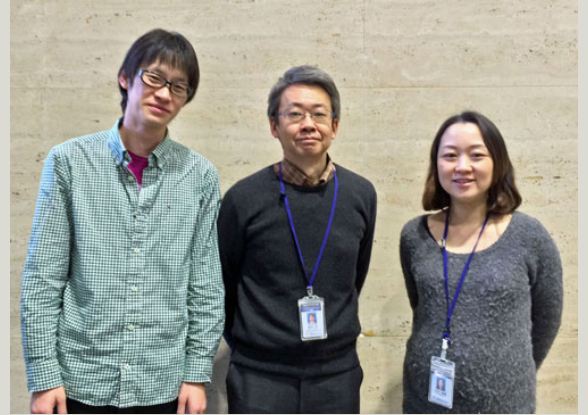
C



D



E



F



G



I



J



H



K



L

Geothermal Energy Team and Shallow Geothermal and Hydrogeology Team
(Renewable Energy Research Center)

To make geothermal and geo-heat studies a featured research theme of the Fukushima Renewable Energy Institute, AIST (FREI), we have transferred leading researchers from GREEN, contributing to the establishment of FREI.

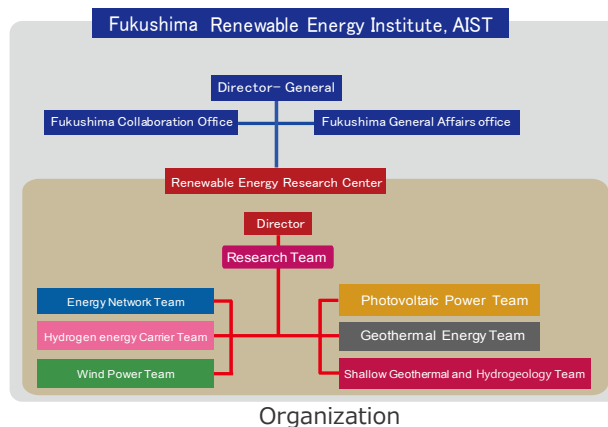
Following the federal government's "Basic Policy of Reconstruction after the Great East Japan Earthquake" issued in July 2011, AIST established FREA, which will be opened officially in April 2014. GREEN has transferred to FREA our featured research themes "Geothermal and Hydrogeology Studies", which are technology for the effective and sustainable use of geothermal power generation, and for potential assessment of ground-source heat pump systems and system optimization. The transferred researchers are:

- Innovation Coordinator: Keiichi Sakaguchi
- Principal Research Manager: Kasumi Yasukawa
- Geothermal Energy Team (GET): Hiroshi Asanuma (Leader), Nobukazu Soma
- Shallow Geothermal and Hydrogeology Team (SGHT): Yohei Uchida (Leader), Yasumori Takahashi, Mayumi Yoshioka

Promotion and diffusion of geothermal and hydrogeology related technologies will be attained through collaboration between Fukushima GET & SGHT and GREEN's research members as well as by collaboration with industry, academia, and overseas organizations.



Fukushima Renewable Energy Institute: Main building



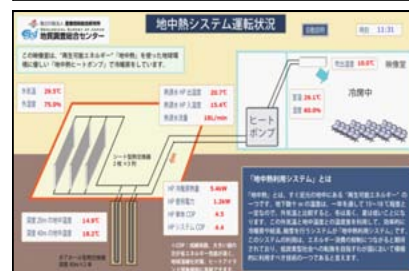
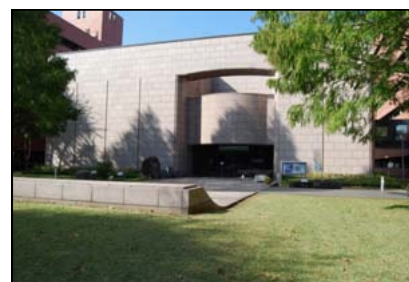
Research on use of ground-source heat: GSHP system installed in the Geological Museum

Since the Great East Japan Earthquake, ground-source heat (GSH) has been advocated as renewable energy resource. In Japan, geology and groundwater flow must be considered to use the GSH efficiently. Therefore, for practical tests and outreach activities, a ground-source heat pump (GSHP) system was installed in the Geological Museum in July 2013.

In practical tests of GSHP system being conducted in the Geological Museum, the following three issues have been considered.

- 1) Perform tests in the auditorium and make the visitors understand that energy saving in air-conditioning is possible.
- 2) Compare typical systems (vertical type) and the latest system (sheet type), and aid in industrial development through new technology.
- 3) Display outdoor heat exchangers, and an indoor heat pump and fan coil. Set up a monitor to show the system operation status of the, so that visitors can readily grasp system details, which usually cannot be demonstrated.

Along with exhibits related to geological structure and the system's potential maps inside the museum, the relation of GSH use with geology and groundwater can be understood. From 2014, test results will be compared with those of the system installed at the Fukushima Renewable Energy Research Institute. The influence of the geological difference will be perceived.



Contact: Youhei Uchida, E-mail: y-uchida@aist.go.jp, Phone: +81-29-861-3841

Summer Special Exhibition at the Geological Museum for research and outreach on geothermal energy and Ground-Source Heat Pump (GSHP) systems

N. Yanagisawa et al. (GREEN), K. Sakaguchi et al. (Renewable Energy Research Center), S. Okuma (Institute of Geology and Geoinformation), and S. Yoshida (Geological Museum)

【Outline】

We held a special exhibition on technology to use geothermal energy and Ground-Source Heat Pump(GSHP) systems at the Geological Museum, where a GSHP system has been newly installed.

【Details】

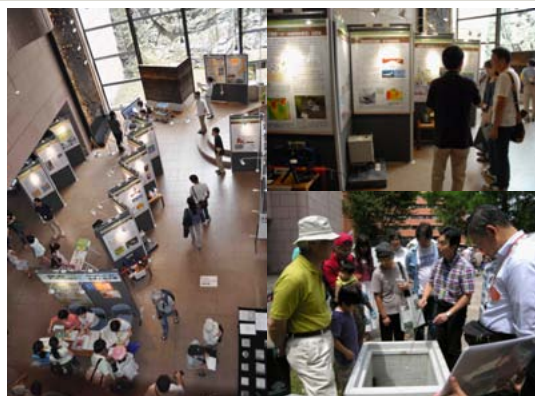
During July–September 2013, panel exhibitions on geothermal energy and GSHP systems were held in the Geological Museum. With panels, brochures, and apparatus, we exhibit various technologies for geothermal energy use such as exploration (geology, geophysics), drilling, material, and reservoir engineering mainly in our institute and power plants including small binary systems. Special focus is devoted to issues associated with geothermal development such as their relation with hot spring resorts and national parks.

Along with new installation of a GSHP system in the Geological Museums, we gave lectures and lab tours to promote the GSHP system. Approximately 17,000 guests visited the exhibition. This represents a new step for outreach for geothermal energy and our activities.

【Application of research results】

Our institute and the Renewable Energy Center at Fukushima, AIST are continuing research for geothermal energy and GSHP systems. To support our research, we continue to conduct outreach activities using the installed GSHP system, in addition to brochures explaining the exhibition.

Contact: Norio Yanagisawa, E-mail: n-yanagisawa@aist.go.jp, Phone: +81-29-861-2410



Several photographs of the Geothermal and GSHP exhibition at the AIST Open House on July 20, 2013.



GSHP system installed at the Geological Museum: Left side, Heat exchanger and header; Right side, System inside the media room including heat pump and monitor(after GSJ Open File No.584, p.25).

Science and Technology Week poster “Minerals in Every Home”

Y. Okuyama (Chief Senior Researcher)

【Outline】

A poster entitled “Minerals in Every Home” was made and issued on the occasion of the 2013FY Science and Technology Week. The poster is the first of the “Every Home” series having a theme of earth sciences.

【Details】

“Every Home” series posters have been issued every Science and Technology Week (STW) since 2005FY. The 2013FY’s poster was made having “minerals” as its theme. The theme was proposed by the Japan Association of Mineralogical Sciences. The Society organized a working group to produce the poster, gathering 13 society members from the fields of scientific research, and museum and educational activities. The activity producing the poster was supported by AIST. The poster beautifully illustrates what minerals are, what mineralogical sciences are, and how minerals are related to our everyday life. Detailed explanations of the posters are obtainable from the STW website.

【Application of research results】

A poster, with 245,000 printed copies, was distributed during STW. The poster is also used in schools as an educational material for science study.



Poster “Minerals in Every Home”



Home page of Science and Technology Week (<https://stw.mext.go.jp/>). The website provides explanations on the contents of the poster.

Contact: Yasuko Okuyama, E-mail: okuyama-gsj@aist.go.jp, Phone: +81-29-861-3883

Improvement of hydrogeological X-ray CT experiments using K absorption edges

Y. Nakashima (Exploration Geophysics RG),
and T. Nakano (Institute of Geology and Geoinformation)

[Outline]

We performed computer simulations and experiments of the X-ray computed tomography (CT) using polychromatic X-ray sources. Effects of the K absorption edges of heavy elements on the beam hardening artifact were analyzed quantitatively to obtain the following two results: (a) and (b).

[Details]

(a) A CeCl_3 aqueous solution (0.55 mol/L) sample was imaged by medical CT. The atomic number and molar concentration were estimated by reproducing the degree of the beam hardening (the sample center is darker than the sample rim) of the experimentally obtained CT image by systematic computer simulations (Fig. 1).

(b) Two homogeneous sand pack samples (56 mm diameter) saturated with an iodine-bearing or tungsten-bearing contrast agent were imaged by medical CT. The obtained images demonstrated that the latter significantly suppressed undesirable beam hardening compared with the former, which is conventionally used in hydrogeological experiments (Fig. 2).

- Y. Nakashima and T. Nakano (2012) Japanese Patent (Appl. No. 2012-267612).
- Y. Nakashima and T. Nakano (2013) Presentation at the 69th annual scientific congress of Japanese Society of Radiological Technology (awarded the CyPos prize (bronze)).
- Y. Nakashima (2013) J. Hydrol. Hydromech. Vol.61, pp.347-351.

[Application of research results]

Item (a) is applicable to the nondestructive screening of hazardous geomaterials such as soil cores contaminated with heavy elements. Item (b) is useful for the more accurate determination of relative permeability curves that are necessary for CO_2 underground storage and for enhanced oil recovery.

Contact: Yoshito Nakashima, E-mail: nakashima.yoshito@aist.go.jp, Phone: +81-29-861-3960

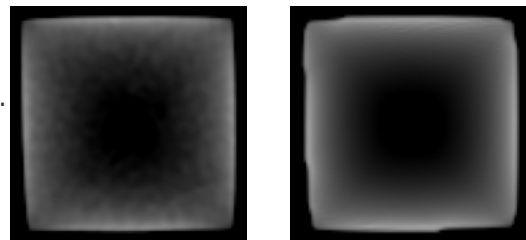


Fig. 1 CT images of a CeCl_3 solution in a plastic container (28 mm inside diameter) exhibiting beam hardening: (left) experimental and (right) simulated.

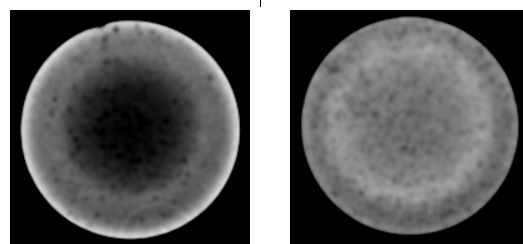


Fig. 2 CT images of sand pack samples with a different contrast agent: (left) KI 9.16 wt.%; (right) $\text{Na}_6\text{H}_2\text{W}_{12}\text{O}_{40}$ 8.80 wt.%.

Impact of CO_2 geological storage on microbial ecosystems in deep subsurface

D. Mayumi, M. Takeuchi and S. Sakata (Geomicrobiology RG)

[Outline]

We investigated that the effect of CO_2 geological storage on the microbial ecosystems in depleted oil reservoirs known as a candidate sites for sequestration of emitted CO_2 .

[Details]

We conducted high-temperature and high-pressure incubation experiments mimicking the *in situ* oil reservoir conditions using production water and crude oil collected from Yabase oil field, Japan (Fig. 1). We observed methane production from acetate under the condition of high CO_2 concentration as well as the *in situ* reservoir condition (Fig. 2). However, the microbial community involved in methane production changed dramatically in the high CO_2 condition. We demonstrated that the methane production process was completely different in *in situ* reservoir and high CO_2 conditions (Fig. 3)

- D. Mayumi et al. (2013) Nature Communications

[Application of research results]

This paper presents the possibility of carbon capture and storage (CCS) for enhanced microbial energy production in depleted oil reservoirs.

[Collaborators]

S. Tamaki, Y. Kamagata (Bioproduction Research Institute), H. Maeda, Y. Miyagawa and M. Igarashi (INPEX)

Contact: Daisuke Mayumi, E-mail: mayumi-daisuke@aist.go.jp, Phone: +81-29-861-3800

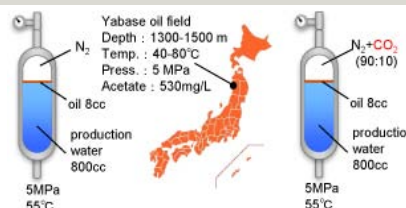


Fig.1 High-temperature and high-pressure incubation experiments mimicking the *in-situ* oil reservoir (left) and the conditions after CO_2 geological storage (right).

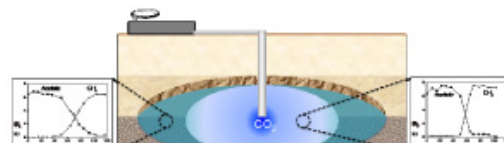


Fig.2 Methane production from acetate under the *in situ* oil reservoir (left) and the conditions after CO_2 geological storage (right).

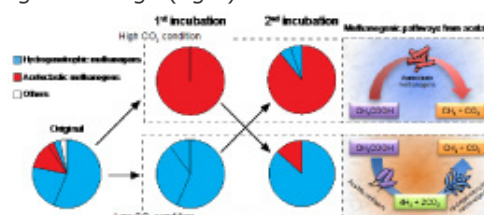


Fig. 3 Transition of microbial communities depending on CO_2 concentrations and the associated methane production processes.

Winning of the Organic Geochemistry Award (Research Award)

S. Sakata (Geomicrobiology RG)

【Outline】

Having evaluated its great contribution to the progress of organic geochemistry, the Japanese Society of Organic Geochemistry has given the Organic Geochemistry Award (Research Award) to Dr. Susumu Sakata for his research on the origin of natural gas and oils and the contribution of microbes.

【Details】

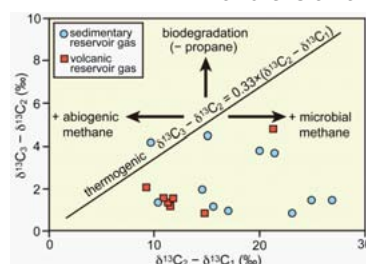
Dr. Sakata of Geomicrobiology R.G. has reported the diversity of the origins of natural gases produced from domestic gas and oil fields. Particularly, the contribution of microbial methane is found to be important not only in dissolved-in-water type natural gases but also in natural gases associated with oils or condensates. He has also shown that microbes living in oil and gas reservoirs have methanogenic activity, and that the methanogenic pathway might change along with the change of CO₂ concentration. He further determined the composition and carbon isotopic ratio of lipids that are characteristic of autotrophic bacteria (cyanobacterium and ammonia-oxidizing bacterium), and argued for their importance as producers of hopanes in oils and rocks.

【Application of research results】

Results of natural gas origin and methanogenic activity help us use subsurface microbes for the efficient development of fuel resources. Results of lipids in autotrophic bacteria are used to estimate the origin of hydrocarbons in oils and the depositional environment of source rocks.



Awards ceremony in the Meeting of Organic Geochemistry 2013, and the award certificate.



Carbon isotopic relations among methane, ethane, and propane in natural gases. (after Sakata et al. (1997) *Geochim. Cosmochim. Acta*, 55, 1395-1405.)

Compounds	ϵ_p (‰) ^a
Hexadecanoic acid	-7.6
Heptadecane	-8.4
Heptadecene	-9.2
Phytol	-6.4
Bishomohopanol ^b	-8.5
Diplopterol	-6.9
Chlorophyllide	+2.7

^a $\epsilon_p = 10^3 \times (R_{\text{lipid}}/R_{\text{cell}} - 1)$, where $R = {}^{13}\text{C}/{}^{12}\text{C}$

^b Degradation product of bacteriohopanepolyol

Carbon isotopic fractionation associated with lipid biosynthesis by a cyanobacterium. (after Sakata et al. (1997) *Geochim. Cosmochim. Acta*, 61, 5379-5389.)

Contact: Susumu Sakata, E-mail: su-sakata@aist.go.jp, Phone: +81-29-861-3898

Winning the Best Paper Award from the Japan Society of Civil Engineers

– Risk assessment of heavy metals in tsunami sediment induced by the Great East Japan Earthquake –

Y. Kawabe, J. Hara, T. Yasutaka, Y. Sakamoto, M. Zhang (Geo-Environmental Risk RG), and T. Komai (Tohoku University)

【Outline】

Systematic investigation and assessment were conducted of the potential risk posed by heavy metals in tsunami sediments related to the Great East Japan Earthquake. The results were presented in an original paper, which won the best paper award from the Japan Society of Civil Engineers.

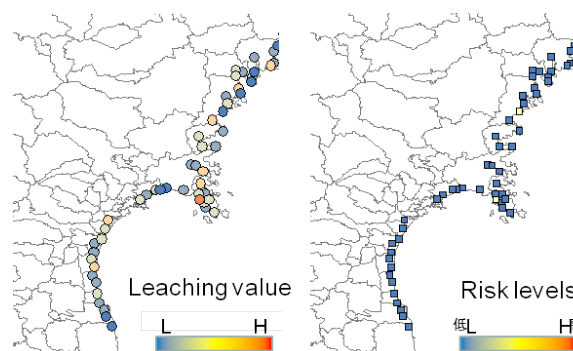
【Details】

An urgent survey was conducted of tsunami sediments deposited along the coastal areas in six prefectures that suffered massive damage from the giant tsunami. Along with the survey, a quantitative assessment was made of the risk of heavy metals within tsunami sediments. Although leaching values of arsenic and lead exceeded environmental criteria at a few points, their risk levels to human health were not high. The results were presented widely at international conferences and published in an original paper by the Journal of JSCE.

- Y. Kawabe et al. (2012) Heavy Metals in Tsunami Sediment by the Great East Japan Earthquake and Their Risks to Human, J. JSCE, Div. G, Environmental Systems and Engineering, Vol.68, No.3, pp.195-202.

【Application of research results】

Developing strategies for risk mitigation and risk reduction associated with the treatment of tsunami sediments.



Leaching values of arsenic (left) and risk levels (right) for the tsunami sediments in the Miyagi coastal area as an example.



Best paper award from the Japan Society of Civil Engineers.

Contact: Yoshisige Kawabe, E-mail: y-kawabe@aist.go.jp, Phone: +81-29-861-3102

Development of the safety management techniques for decontamination of waste materials containing radioactive cesium

Y. Sakamoto, T. Yasutaka, Y. Imoto, H. Sugita (Geo-Environmental Risk RG),
K. Miyazaki (Geo-Environmental System RG), Y. Mitsuhashi (Deputy Director),
H. Higashino and Y. Ishikawa (Research Institute of Science for Safety and Sustainability)

【Outline】

We developed a comprehensive technique consisting of environmental monitoring and safety management for storage sites and the surrounding area, in association with decontamination for waste materials containing radioactive cesium (Cs) derived from Fukushima Daiichi nuclear disaster. Through publication of fundamental information from the public and neutral viewpoint, we contributed to the recovery of Fukushima prefecture.

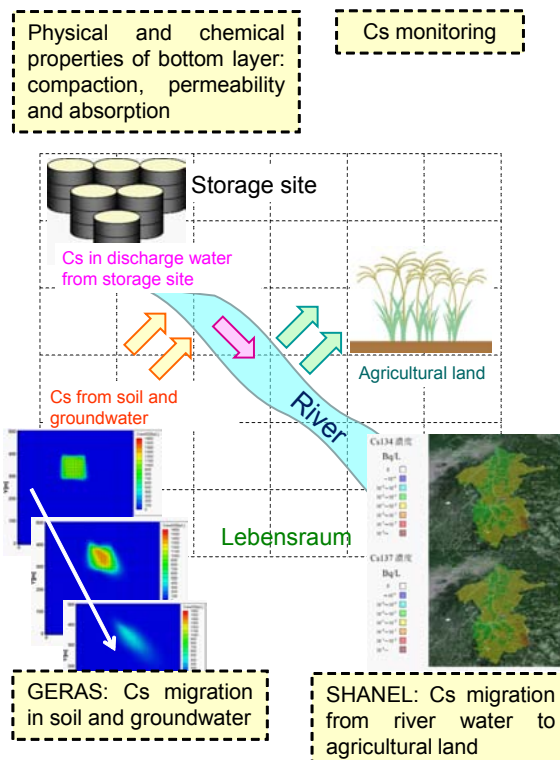
【Details】

In this study, physical and chemical properties of the bottom layer of a storage site were experimentally evaluated in terms of compaction, permeability, and absorption of Cs. Then environmental monitoring of radioactive Cs contained in discharged water from storage site and river water was also conducted. By unifying GERAS* and AIST-SHANEL**, we developed a comprehensive safety assessment system based on the prediction of Cs distribution striding multimedia, such as soil, groundwater, rivers, agricultural land, and crops.

*Geo-Environment Risk Assessment System, **Standardized Hydrology-based Assessment tool for chemical Exposure Load

【Application of research results】

For safety management of decontamination waste material, extensive utilization of the results is expected as tools for policy making and risk communication.



Outline of safety management technique for decontamination waste material

Contact: Yasuhide Sakamoto, E-mail: sakamoto-yasuhide@aist.go.jp, Phone: +81-29-861-3101

Initiation of the joint study of critical metal resources between AIST and Brazil

T. Takagi, S. Kodama, Y. Kon, T. Ejima and other 11 group members (Mineral Resources RG)

【Outline】

Brazil, a large country having huge potential of mineral resources, has amicable relations with Japan, largely based on its 1.5 million citizens of Japanese ancestry. AIST has concluded MOU with the Departamento Nacional de Produção Mineral (DNPM) in December 2012, and has initiated a joint study of critical metal resources.

【Details】

In 2013FY, we conducted a joint survey of rare-earth deposits in central to southern Brazil, and independently assessed their resource potential, based on our mineralogical study and mineral processing tests. In the future, we expect to expand the targets to silica stone deposits for metallic silicon manufacturing.

【Application of research results】

We will analyze geological and mineralogical data on critical metal resources in Brazil in cooperation with DNPM, and will contribute to the stable import of critical metals including rare-earths for Japanese industrial use.



Field surveys at Araxa mine (left) and Morro do Ferro prospect (right), Minas Gerais in June 2013.



Visit of DNPM staff to a rock aggregate mine (left) and a stone manufacturing factory (right) in Ibaraki, Japan in December, 2013.

Contact: Tetsuichi Takagi, E-mail: takagi-t@aist.go.jp, Phone: +81-29-861-3926

The Geological Society of Japan "Koto Bunjiro" Award in 2013

S. Morita and T. Nakajima (Fuel Resource RG)

【Outline】

Drs. Morita and Nakajima received The Geological Society of Japan "Koto Bunjiro" Award in 2013 for their study, which found typical submarine landslide deposits using seismic analysis in Sanrikuoki Basin.

【Details】

As a result of geological structure analysis conducted with data of the METI seismic survey "Sanrikuoki 3D", numerous large submarine landslide (slump) deposits were found in the Sanrikuoki Basin off Shimokita Peninsula. The slumps are characterized by their great scale and typical imbrication and dewatering structures. Their volume is readily apparent in the basin. The structures are related to hydrocarbon migration

- S. Morita, T. Nakajima and Y. Hanamura (2011)
Submarine slump sediments and related dewatering structures: Observations of 3D seismic data obtained for the continental slope off Shimokita Peninsula, NE Japan, J. Geol. Soc. Japan, Vol.117, pp.95-98.

【Application of research results】

Results are marked as new formation patterns of submarine landslides and sedimentary basins in gentle continental slope of high methane flux.



Award certificate and memorial medal

Contact: Sumito Morita, E-mail: morita-s@aist.go.jp, Phone: +81-29-861-2490

Intensive geological surveys commenced in 2013: three year shallow subsurface methane gas hydrate prospecting in the Sea of Japan

S. Morita, M. Sato, T. Nakajima, S. Goto (Fuel Resource RG),
and M. Tanahashi (Principal Research Manager)*

【Outline】

Intensive geological surveys were conducted as the first of a three-year intensive prospecting program of shallow subsurface methane gas hydrate deposits in the Sea of Japan, in cooperation with Meiji University under the contract with METI. There, a 1) Regional geological survey, 2) detailed the bathymetric and subbottom survey, and 3) Environmental survey were conducted.

【Details】

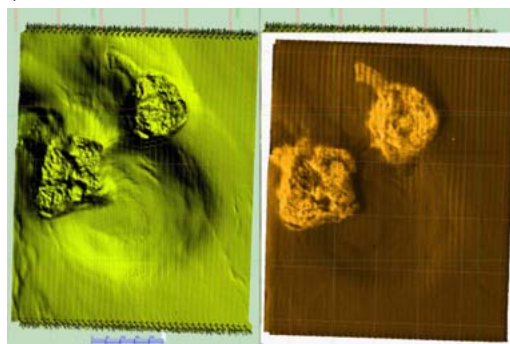
Eleven dive surveys of an Autonomous Underwater Vehicle (AUV, upper right image) for Detailed bathymetric and subbottom survey were performed in Joetsu Area in the Sea of Japan with Multi Beam Echo Sounder (MBES), Side Scan Sonar (SSS), and Sub-Bottom Profiler (SBP) to investigate the detailed sea bottom features (lower right image) and unique subbottom acoustically wiped columnar geological structures, called "gas chimneys", which may suggest the existence of methane gas hydrate within the structures.

【Application of research results】

Data and analyzed results will be used to plan and carry out further geological surveys for the prospecting of shallow subsurface methane gas hydrates in the Sea of Japan.



AUV Deep1 of Fukada Salvage and Marine Works Co., Ltd.



Examples of AUV derived MBES topographic and SSS images over the pockmark and mounds (From abstracts of the Forum for Shallow Methane Hydrate).

*retired on March 2014

Contact: Sumito Morita, E-mail: morita-s@aist.go.jp, Phone: +81-29-861-2490

Photo snap



Scenes of field excursion at Nichinan Submarine Landslide Meeting



Deck operation of gravity coring off Shimokita Peninsula



Sampling of natural gas dissolved-in-water at a drilling site for a hot spring (after AIST Open Lab Catalog 2012)



Folded alternating beds of sandstone and mudstone of the Kayo Formation, Okinawa (after GREEN Report 2012)



Survey of a closed iron-fluorite mine in South Africa.

Photo snap



Deployment of the new electromagnetic measurement system at a coastal area.



A seismic reflection survey of Fujikawa-kako fault zone, Shizuoka Pref. A photograph of the seismic energy excitation by two vibroseis trucks.



Three scenes of gravity measurement



Demonstration equipment of CO₂ supply system for protected horticulture



Geoscience Exhibition in Miyagi 2013: Presentation of geothermal and geo-heat studies



Ibaraki Stone Festival

Published in May 2014 by Dr. Shinsuke Nakao, Director,
Institute for Geo-Resources and Environment
National Institute of Advanced Industrial Science and Technology (AIST)
Tsukuba Central 7, Tsukuba, Ibaraki 305-8567, Japan
<https://unit.aist.go.jp/georesenv/>

