

TEN BIG NEWS ITEMS 2014

Institute for Geo-Resources and Environment



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 a stable supply of natural resources for industrial activities and society at large. In order to disseminate the research results, Ten Big News Items of 2014 were selected from various activities carried out at our institute over the past year as having the most potential to contribute to the achievement of sustainable development, based on the following factors:



In 2014, as the last fiscal year of the third term of AIST's medium-term plan, we energetically mapped out research results related to our strategic research issue, "Creation of important intellectual infrastructures".

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

February 2015 Dr. Shinsuke Nakao, Director

– Ten Big News Items 2014 –



– Ten Big News Items 2014 –





Earning the Encouragement and Best Paper Awards from the Mining and Materials Processing Institute of Japan

Kuniyuki Miyazaki and Yasuki Oikawa (Geo-Environmental Systems RG)





Awards received for geoenvironmental risk studies Environmental Award winners and participants



Takeshi Komai (Tohoku U.), Yoshishige Kawabe and Yasuhide Sakamoto (Geo-Environmental Risk RG) Awards received for geoenvironmental risk studies Receiving Best Poster Award at 20th WCSS

Junko Hara (Geo-Environmental Risk RG), Susumu Norota, Yasuyuki Kakihara (Hokkaido Research Organization), Yoshishige Kawabe and Ming Zhang (Geo-Environmental Risk RG)



Awards received for geoenvironmental risk studies

2014 JSIDRE Awards ceremony

Shizuka Hashimoto (Kyoto U.), Hiroyuki Arita (Niigata U.), Tetsuo Yasutaka (Geo-Environmental Risk RG) and Yumi Iwasaki (Kyoto U.) Publication of "Geochemical and Risk Assessment Map of Subsurface Soils -Ibaraki Prefecture"



Junko Hara, Yoshishige Kawabe and Ming Zhang (Geo-Environmental Risk RG)

Publication of the "Mineral Resouces Map of Asia"

Outline

A 1:5,000,000 "Mineral Resources Map of Asia" with explanatory notes was published by the Geological Survey of Japan, AIST in Dec. 2014. This map provides data about mineral deposits in the Asian region.

Detail

Our group previously issued the following mineral resources maps:

- Mineral Resources Map of East Asia (1:3,000,000), GSJ, 2007

- Mineral Resources Map of Central Asia (1:3,000,000), GSJ, 2012 Approximately 8,000 metallic and non-metallic deposits are included in the mineral resources map.

[URL] https://www.gsj.jp/Map/EN/asia-area-geoscience.html

Application of research results

Demand for mineral resources has increased from year to year associated with industrial development. It is, therefore, expected that this map will contribute to fundamental mineral potential analysis and large-scale exploration programs.

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Fig. 1 Mineral Resources Map of Asia (GSJ, 2014)



Fig. 2 Enlarged view of the map in the vicinity of Uzbekistan.

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Takeshi Nakajima

Formation of pockmarks and submarine canyons associated with the dissociation of methane hydrate

Outline

We proposed a model in which pockmarks and submarine canyons on the Joetsu Knoll in the Sea of Japan could have been formed by dissociation of methane hydrate induced by hydrostatic pressure release during low sea level stands in glacial times.

Detail

By analyzing sediment cores and 3D seismic data on the Joetsu Knoll, we surmised that pockmark and submarine canyon formation occurred while the sea level was falling. The drop in hydrostatic pressure raised the base level of methane hydrate stability, promoting dissociation of methane hydrate. The consequent generation and upward migration of methane gas with sand could lead to the collapse of mounds and to explosions, which in turn could form turbidity currents and submarine canyons.

•Nakajima, T., et al. (2014) J. Asian Earth Sciences, 90, 228-242.

Application of research results

This study implies the possibility that the long-term history of shallow methane hydrate activity can be reconstructed using the history of submarine canyon development. If this is the case, the proposed model can be applied to regional evaluation of shallow methane hydrate resources.

collaborators

Takuya Itaki, Hajime Katayama (IGG, AIST), Yoshitaka Kakuwa, Ryo Matsumoto (Meiji Univ.), Yukihito Yasudomi (Univ. Tsukuba), Isao Motoyama (Yamagata Univ.), Takayuki Tomiyama, Hideaki Machiyama (JAMSTEC) and Osamu Okitsu (JX)



- A: Methane hydrate mounds during high sea level stands
- B: Formation of pockmarks and submarine canyons during sea level drops
- Modified from Nakajima et al. (2014)

Methanogenesis in a dissolved-in-water-type natural gas field

Outline

To address the development of enhanced natural gas recovery using microorganisms, a methanogenic pathway and activity were elucidated from deep gas-bearing aquifers in the Minami-Kanto gas field (Fig.1).

Detail

Formation water samples collected from the Minami-Kanto gas field were subjected to methanogenic culture (Fig. 2), genetic analysis and methanogenic activity measurement. We found diverse, living methanogens in formation water and a predominance of hydrogenotrophic methanogenesis. In situ methane production was limited by the availability of substrates and potentially affected by physicochemical impacts associated with natural gas development.

• Katayama, T., et al. (2014) Int.J.Syst.Evol.Microbiol., **64**, 2089-2093. • Katayama, T., et al. (2014) ISME J. (in press).

Application of research results

The biogeochemical data obtained by this investigation are used in developing microbial enhanced gas recovery in the Minami-Kanto gas field.

Sponsors/Collaboration

· Japan Oil, Gas and Metals National Corporation (JOGMEC)

· Kanto Natural Gas Development Co., Ltd.

Contributing to the national water problem solution

Outline

Research work to on recovering from the East Japan Great Earthquake, work on high-level radio isotope wastes, and a hydroenvironment map study were evaluated highly and members of the group were invited to join national councils on water problems.

Detail

Our researchers (Marui, Ikawa, Ono and Machida) are being sent to the following national councils as well-informed persons and/or specialists:

- Committee on Countermeasures for Contaminated Water from the Fukushima Daiichi Nuclear Power Station
- \bigcirc Technical Committee on High-level Radio Isotope Wastes
- Well-informed Committee about Fundamental Plans for Water Cycle Laws
- O Councils in local governments (e.g. Ibaraki Pref.)

Application of research results

Our opinions and the results of our studies have contributed greatly to policies adopted for national and local groundwater management, including countermeasures for. contaminated water in the decomissionning of the Fukushima Daiichi NPS.

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Fig. 1 Minami-Kanto gas field Natural gases are dissolved in formation water in deep aquifers situated below 100 m underground.



Fig. 2 Cultivation of methanogenic microorganisms Methane production (lower left) and methanogen cells (microscopy: upper right) from the formation water culture. Isolation of novel methylotrophic methanogen (electron microscopy: lower right).

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The new Groundwater Research Group, although established in April 2014, carries a history of achievements

Fuel Resource Map "Kanto Region"

Outline

A fuel resource map of the Kanto Region has been edited through compilation of various geological data and geochemical analyses on dissolved-in-water-type natural gas.

Detail

The geological features of dissolved-in-water-type natural gas had not been studied in detail in the Kanto Region since 1976, except for in the Minami-Kanto gas field. A succession of hot spring gas explosions in the region suggested that geoinformation on the gas needed to be updated. Therefore, the Fuel Resource Map "Kanto Region" was created by compiling geoinformation and geochemical analyses on the natural gas and hot water in the region. The map shows that gas is widely distributed in the region, accompanied by deep geothermal water, and that gas compositions and origins vary across the region.

Application of research results

The map provides basic data for the efficient use of fuel and hot spring resources, and may contribute to formulation of guidelines on hot spring drilling in the Kanto Region for local governments and developers.

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Takayuki Sawaki



Fuel Resource Map "Kanto Region" (upper) and gas compositions in prefectures in the region (lower)

Estimation of a regional geothermal system around the Toyoha geothermal area, Hokkaido, by electromagnetic exploration

Outline

We collected and analyzed data from MT surveys conducted in and around the Toyoha geothermal area to estimate the regional geothermal system and evaluate whether geothermal development in the Toyoha area would affect the Jozankei hot springs.

Detail

Analysis of the regional resistivity model showed that a large conductive zone, interpreted as a geothermal reservoir, is present below Mt. Muine and the Toyoha area, and that there is another conductive zone, interpreted as a hot-spring reservoir, below the Jozankei area. The possibility that they will interfere with each other is thought to be low because they are separated by a resistive zone corresponding to a pre-Neogene basement (Usubetsu formation).

• Takakura, S. (2014) Butsuri-Tansa (Geophys. Explor.), 67, 195-203

Application of research results

Electromagnetic methods will play an important role in evaluation of geothermal reservoirs or a hot springs because the analyzed resistivity structure facilitates estimation of the regional structure of a geothermal system including the geothermal reservoirs, heat sources, and hot springs.

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A 2-D resistivity section of the Toyoha geothermal area, including Mt. Muine and the Jozankei hot springs as analyzed and interpreted for the 2D profile.

Promotion of research on geological storage of CO₂ through international cooperation

Outline

We have promoted research work on monitoring and modeling technologies related to evaluating the safety of geological CO_2 storage through international and domestic cooperation. The world's first monitoring of CO_2 using a superconducting gravimeter has carried out at a US test site.

Detail

We participated in a US demonstration project and carried out gravity, SP, and AE monitoring at the FWU test site to monitor CO_2 injection starting in May 2014. This is the world's first trial using a superconducting gravimeter to monitor geological CO_2 storage. Our monitoring study is a part of an R&D project commissioned by METI. Funding for this demonstration project was provided by the US DOE NETL through the Southwest Partnership on Carbon Sequestration (SWP).

We have promoted dissemination of our geological CO_2 storage research results by presenting 6 research papers at the GHGT-12 in the US, one of the biggest CCS-related international meetings, and by organizing the 7th joint workshop with the Korea Institute of Geosciences and Mineral Resources.

Application of research results

Development of effective geophysical monitoring technologies and assessment of the safety of geologically stored CO₂.



Outline

Having evaluated the great originality and possibilities of his work, the Mining and Materials Processing Institute of Japan (MMIJ) bestowed its Encouragement Award on Dr. Kuniyuki Miyazaki for his research on the mechanical properties of methane-hydrate-bearing sand. MMIJ also gave its award for Best Paper to Yasuki Oikawa for his research on evaluating rock damage after coring.

Detail

The time dependency of artificial methane-hydrate-bearing sand was experimentally investigated and found to be significantly strong for a geomaterial.

• Miyazaki, K., et al. (2009) J. of MMIJ, 125, 156-164

Rock damage induced by stress relief was simulated using FEM. Relationships between crack density and relieved stress show that the basic assumptions about DSCA stress measurement are not always valid. However, the results showed that measured stress states can generally match the relieved stresses for some stress state.

Matsuki, K., Oikawa, Y., et al. (2012) J. of MMIJ, 128, 121-133

Application of research results

The mechanical properties of the sand studied are expected to be used to develop or improve numerical simulation of the geomechanical response of seabed layers to gas extraction from reservoirs. Relationships between crack density and relieved stress will be used in the measurement/analysis of field rock cores as basic damage data.

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Gravity monitoring at the US test site



The 7th AIST-KIGAM Joint Workshop

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Award certificates from the Mining and Materials Processing Institute of Japan

Awards received for geo-environmental risk studies

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Outline

Research scientists of the Geo-Environmental Risk Research group together with their collaborators won 3 awards from different organizations/societies.

Detail

An Environmental Award was granted for over 10 years of development and promotion of the application of the Geo-Environmental Risk Assessment System (GERAS).

• Komai, T., Kawabe, Y. and Sakamoto, Y. (2014.6) Development of Geo-Environmental Risk Assessment System, 41th Environmental Award.

A presentation on identifying arsenic speciation and accumulated organic species in different organic sedimentation environments won the Best Poster Award at the 20th World Congress of Soil Science. • Hara, J., Norota, S., Kakihara, Y., Kawabe, Y. and Zhang, M. (2014.6) 20th World Congress of Soil Science, Best Poster Award.

A paper entitled "Potential Impacts of Prolonged Evacuation due to Radioactive Contamination on the Reconstruction of Rural Fukushima" (In Japanese) won the best paper award from the Japan Society of Irrigation, Drainage and Rural Engineering (JSIDRE).

· Hashimoto, S., Arita, H., Yasutaka, T. and Iwasaki, Y. (2014.8) 2014 JSIDRE Best Paper Award.

Application of research results

The results can be widely used in risk assessment and management and can contribute to reconstruction.



Environmental Award winners and participants



Receiving Best Poster Award at 20th WCSS



2014 JSIDRE awards ceremony



Publication of "Geochemical and Risk Assessment Map of Subsurface Soils – Ibaraki Prefecture"

Outline

Following the publication of geochemical and risk assessment maps of subsurface soils for Miyagi, Tottori and Toyama prefectures, the map for Ibaraki prefecture was published as the 4th in the map series.

Detail

Based on geological and geo-environmental surveys, subsurface soils across Ibaraki prefecture were sampled. The chemical compositions and bulk and leaching concentrations of various toxic heavy metals such as Pb, Cr, and As in subsurface soils were characterized and analyzed. In addition, quantitative assessment of human risk potentially induced by heavy metals was also performed taking both land use and regional life style into consideration.

• Hara, J., Kawabe, Y. and Zhang, M. (2014) Geochemical and risk assessment map of subsurface soils – Ibaraki Prefecture. Soil Assessment Map E-6, Geological Survey of Japan, AIST.

Application of research results

Fundamental information published in this map series is useful for reviewing new land uses, determining the origin of soil contamination, and for communicating information on risks.

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Example: Human risk map of As



Sandstone/mudstone alternation of the Nambayama Formation (Niigata)



Ripple mark in the Nambayama Formation (Niigata)



Outcrop of the Kuji Group (Iwate)



Gushing dissovled-in-water-type natural gas (methane) on a river in the Minami-Kanto gas field (Chiba)



Survey of a carbonatite deposit in South Africa.



[Articles]

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- <u>Funatsu, T.</u>, et al. (2014) International Journal of Rock Mechanics and Mining Sciences, **67**, 1-8.
- <u>Horiuchi, Y.</u>, et al. (2014) Mineralium Deposita, **49**, 1013-1023.
- <u>Ikawa, R.</u>, et al. (2014) Hydrogeology Journal, **22**, 987-1002.

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- <u>Katayama, T.</u>, et al. (2014) International Journal of Systematic and Evolutionary Microbiology, doi: 10.1099/ijs.0.063677-0.
- <u>Katayama, T.</u>, et al. (2014) The ISME Journal, doi:10.1038/ismej.2014.140.
- <u>Katayama, T.</u>, et al. (2014) Applied and Environmental Microbiology, **80**, 1126-1131.
- Maekawa, T. (2014) Fluid Phase Equilibria, 384, 95-99.
- <u>Mitsuhata, Y.</u>, et al. (2014) Near Surface Geophysics, **12**, 613-621.
- <u>Miyazaki, K.</u>, et al. (2014) International Journal of Offshore and Polar Engineering, **24**, 75-80.

<u>Morimoto, S. and Seo, Y.</u> (2014) Journal of MMIJ, **130**, 219-224. (in Japanese)

- <u>Nakajima, T.</u>, et al. (2014) Journal of Asian Earth Sciences, **90**, 228-242.
- <u>Nakashima, Y.</u> and Nakano, T. (2014) Journal of X-ray Science and Technology, **22**, 91-103.
- <u>Ohno, T.</u>, et al. (2014) Journal of MMIJ, **130**, 465-472. (in Japanese)
- <u>Ono, M.</u>, et al. (2014) Radioisotopes, **63**, 471-479. (in Japanese)

<u>Ono, M.</u>, et al. (2014) Journal of Groundwater Hydrology, **56**, 189-208. (in Japanese)

Sorai, M., et al. (2014) Journal of Geophysical Research, DOI:10.1002/2014JB011177.

- The underlined authors are members of this Institute.
 The full list of the research results including list in this page will be in the Annual Report of the Institute (FYs 2013 and.2014).
- Takakura, S. (2014) BUTSURI-TANSA (Geophysical Exploration), **67**, 195-203. (in Japanese)
- Takakura, S. (2014) Journal of the Geothermal Research Society of Japan, **36**, 21-31. (in Japanese)
- Takakura, S., et al. (2014) BUTSURI-TANSA (Geophysical Exploration), **67**, 267-275. (in Japanese)
- Takeuchi, M., et al. (2014) International Journal of Systematic and Evolutionary Microbiology, **64**, 462-468.
- Takeuchi, M., et al. (2014) International Journal of Systematic and Evolutionary Microbiology, **64**, 3240-3246.
- <u>Ueda, T.</u>, et al. (2014) Earth Planets and Space, **66**, 31, doi:10.1186/1880-5981-66-31.
- <u>Ueda, T.</u>, et al. (2014) Journal of Applied Geophysics, **100**, 23-31.
- <u>Yasutaka, T.</u>, et al. (2014) Soil Science and Plant Nutrition, **60**, 818-823.

[Geological Maps]

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- Kamitani, M., Ohno, T., Okumura, K., Teraoka, Y. and Watanabe, Y. (2014) Mineral Resources Map of Asia 1:5,000,000, GSJ, AIST.

[Book]

Sudo, S. (2014) Sand from around the World. Seibundo-Shinkosha, Tokyo, pp. 223. (in Japanese)





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