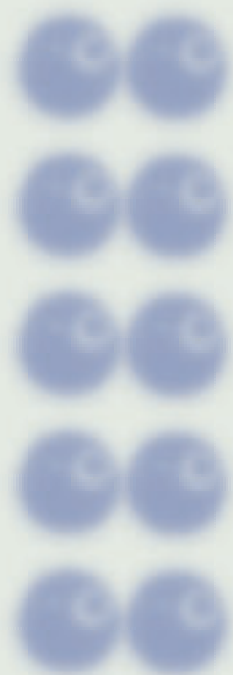




GREEN

INSTITUTE FOR GEO-RESOURCES AND ENVIRONMENT

Institute for Geo-Resources and Environment
National Institute of Advanced Industrial Science
and Technology
November, 2005
<http://unit.aist.go.jp/georesenv/>



Ten Big News Items

TEN BIG NEWS ITEMS

of the Institute for Geo-Resources and
Environment



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

Our research focuses on three major areas central to ensuring the sustainable development of society: (1) Utilization of the geo-environment to establish a sustainable and stable energy cycle, (2) protection of the geo-environment for the safety and health of all, and (3) procurement of a stable supply of natural resources for industrial and social activities. This brochure describes ten noteworthy projects carried out at our institute over the past year. The items selected for this brochure were chosen because of their

- Scientific and technological promise
- High standards of technological transfer through collaboration
- Initiatives to build the foundation of a geologic knowledge base

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

November, 2005

Dr. Masahiro Seto, Director
Institute for Geo-Resources and Environment
National Institute of Advanced Industrial
Science and Technology



Photo1



Photo2



Photo3



Photo4



Photo5



Photo6



Photo7



Photo8



Photo9



Photo10



Discovery of arsenic-accumulating bacteria

Geo-analysis Research Group Mio Takeuchi



【Abstract】

Arsenic is a major source of soil and groundwater pollution in Japan and has been associated with serious health problems in many parts of Asia. The possible use of microorganisms to remove arsenic from the environment would be both cost-effective and environmentally friendly. We have discovered, for the first time, that the marine bacterium *Marinomonas communis* can accumulate and tolerate large amounts of arsenic.

【Description of study】

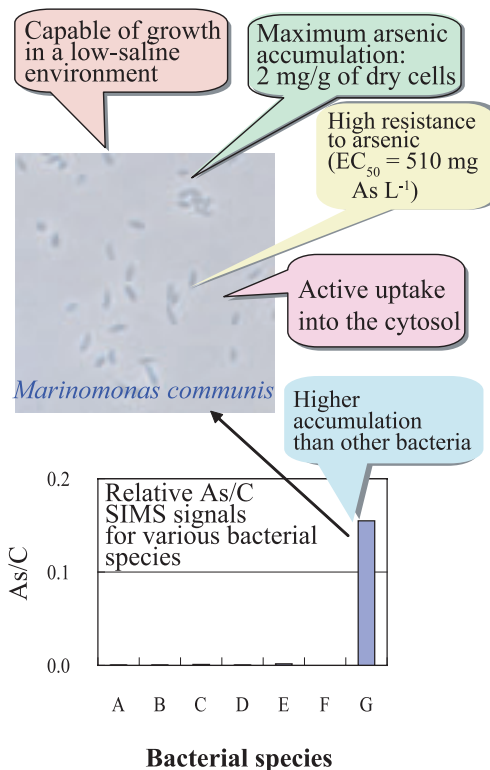
Although many microorganisms capable of accumulating various metals are known, no arsenic-accumulating microorganisms have been reported, and clean up of arsenic using microorganisms has been presumed to be impossible. However, because other marine organisms such as algae and fish are known to accumulate arsenic, we examined several pure cultures of marine bacteria. We discovered that the marine bacterium *Marinomonas communis* is capable of removing arsenic from solution and that this ability is not a simple adsorption but related to the active uptake into the cytosol.

Reference

Takeuchi, M., et al. (2004) Response of marine and terrestrial bacteria to arsenic. The Fourth International Symposium on Advanced Science Research.

【Application】

Elucidation of the detailed mechanism of, and conditions for, arsenic accumulation in the bacterium *Marinomonas communis* may lead to a cost-effective and environmentally friendly means of removing arsenic from contaminated water. Our research may also lead to other important discoveries such as why arsenic accumulates in marine organisms.



Contact information: Mio Takeuchi, takeuchi-mio@aist.go.jp, phone +81-29-861-2478



Anomalously high number of methanogens in the low-density layer in Holocene marine mud under the Nakagawa Lowland, central Japan

Hideyoshi Yoshioka, Mio Takeuchi, Susumu Tanabe, Shun-ichiro Igari



【Abstract】

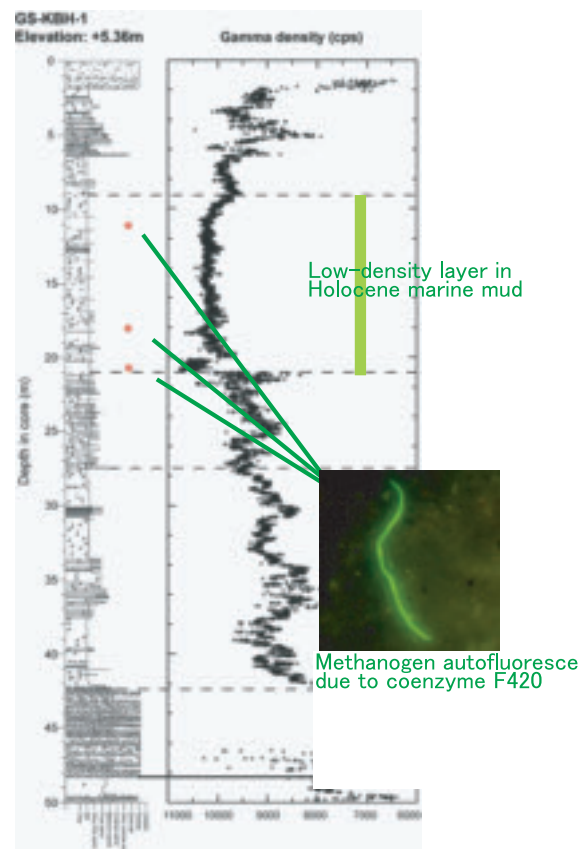
We discovered an anomalously high number of methane-producing methanogens in the low-density layer in Holocene marine mud under the Nakagawa Lowland, northeast of Tokyo. This might be the first evidence indicating that natural gas deposits are forming in the mud sediment of the terrestrial subsurface.

【Finding】

An anomalously high number of methanogens and a relatively high concentration of biologically produced methane were discovered in a sediment core sample obtained from the Nakagawa Lowland, northeast of Tokyo. The Holocene marine mud (6000–4000 cal BP) in the core contained 4×10^5 methanogen cells per gram of dry sediment and methane gas at a $\delta^{13}\text{C}_{\text{CH}_4}$ of -60‰ in the pore water. The number of methanogens in the sediment core sample was anomalously high compared with that in modern deep sea floor and Pliocene–Holocene sediments.

【Implication of the discovery】

Our discovery implies a relationship between methanogenesis and the low-density layer in Holocene marine mud. This relationship hints at the origin and mechanism of formation of natural gas deposits.



Contact information: Hideyoshi Yoshioka, hi-yoshioka@aist.go.jp, phone +81-29-861-3810

Use of electromagnetic exploration methods to identify high-salinity groundwater zones

Exploration Geophysics Research Group Yuji Mitsuhashi



【Abstract】

Three different electromagnetic methods were used in combination to identify high-salinity groundwater zones in the Kujukuri coastal plain. Zones of high conductivity due to the presence of high-salinity groundwater were revealed at three scales.

【Description of study】

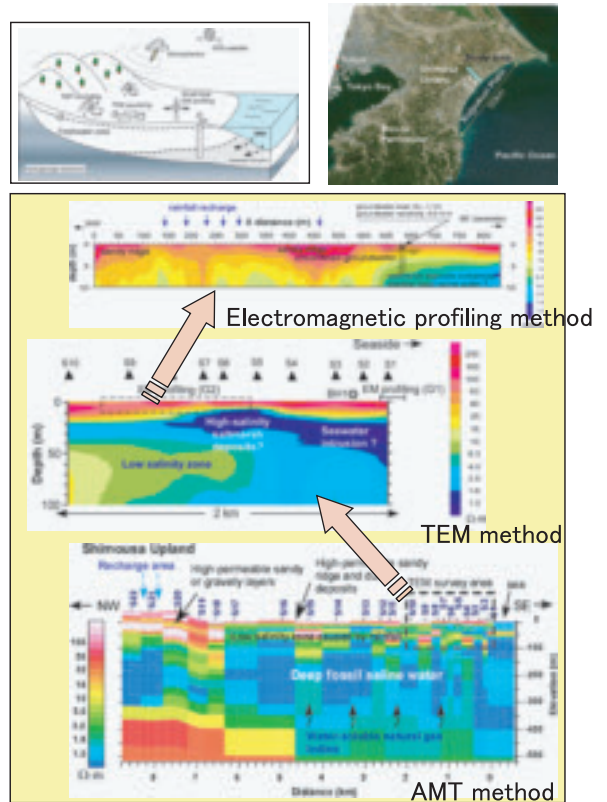
The three electromagnetic methods employed were the AMT (audio-frequency magnetotellurics) method, for large-scale exploration; the TEM (transient EM) method, for exploration of medium-sized areas; and the electromagnetic profiling method, for shallow depths. The AMT, TEM, and electromagnetic profiling data were used to estimate the distributions of conductive zones due to deep fossil sea water, present sea water invasion, and high-salinity salt marsh deposits. Studies involving combined application of AMT, TEM, and electromagnetic profiling to the same area are rare, and our results prove that our procedure is effective in verifying the existence of conductive zones and identifying their origins.

Reference

Mitsuhashi, Y., et al. (2005) An investigation of saline water distribution in a coastal plain by various electromagnetic methods. Poster presentation at Near Surface 2005, European Geophysical Exploration Meeting.

【Application】

Combined application of AMT, TEM, and electromagnetic profiling could be used in efforts to preserve the groundwater environment in coastal plains and in investigations of the groundwater environment near geological disposal sites.



Contact information: Yuji Mitsuhashi, y.mitsuhashi@aist.go.jp, phone +81-29-861-2387

Development of Geosphere Environmental Risk Assessment System

Geo-analysis Research Group



【Abstract】

GERAS-1, the screening model component of the Geosphere Environmental Risk Assessment System (GERAS), was completed and released. GERAS is an analytical software tool for objectively evaluating the risk of human exposure to soil pollution. The site model component of GERAS, GERAS-2, was also completed and will be released in 2006.

【Description of study】

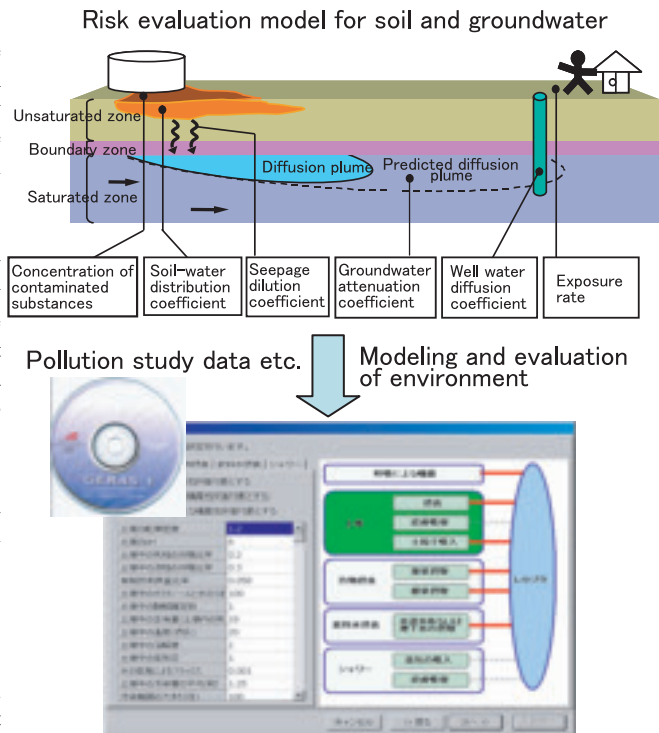
A mathematical model and database were developed to quantitatively evaluate the risk and amount of human exposure to soil polluted by heavy metals and organic compounds. For the first time in Japan, the model can be used to evaluate the level of soil contamination at industrial sites. GERAS-1 is intended to be used mostly as a self-management tool for risk evaluation and is readily available to companies.

Reference

Kawabe, Y., Komai, T., and Sakamoto, Y. (2005) Exposure estimation of organic compounds in Japan -Risk analysis by Geo-environmental risk assessment model-. Shigen to Sozai (Resources and Materials), Vol. 121, pp. 19-27.

【Applications】

As the first software for environmental risk assessment in Japan, GERAS will likely be widely used at industrial sites to evaluate soil pollution. GERAS can be used as an environmental management system and site assessment tool.



Soil pollution evaluation system for Windows

Contact information: Yoshishige Kawabe, y-kawabe@aist.go.jp, phone +81-29-861-8795



Downhole percussion drill

Environmental Technology Research Group



【Abstract】

A new downhole percussion drill capable of drilling wells at penetration rates higher than those of conventional rotary drills has been developed.

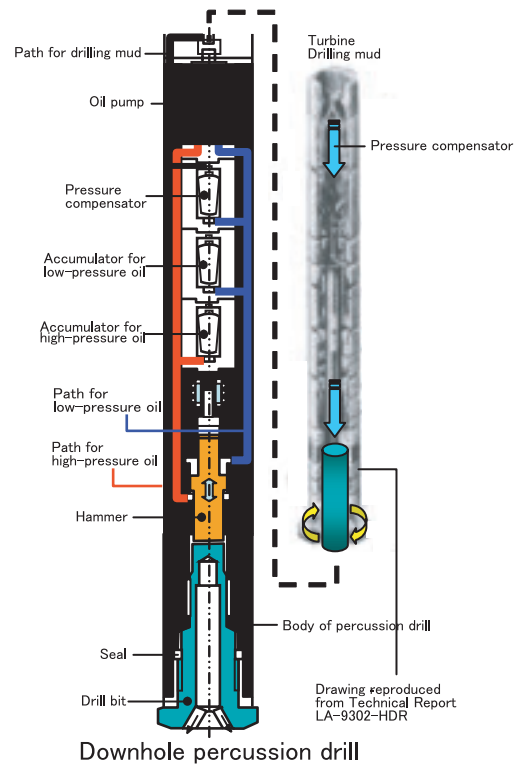
【Description of study】

A new percussion drill with a high reliability and durability has been developed. The drill provides percussive blows to a drill bit at the bottomhole. Conventional downhole percussion drills encounter rapid wear due to direct reciprocation of the hammer by drilling mud, which contains abrasive cuttings. In the new percussion drill, the hammer is reciprocated by oil with a high lubricating ability, resulting in a greatly improved performance over conventional downhole percussion drills.

US Patent 6,752,222 B2; UK Patent GB 2383059 B

【Application】

The new drill dramatically decreases drilling time and drilling cost, since it easily drills hard rock formations. Because of its high efficiency and low cost, the new drill will be especially useful in the exploration and development of oil, gas, and geothermal energy resources as well as in mining and civil engineering.



Contact information: Hirokazu Karasawa, karasawa.h@aist.go.jp, phone +81-29-861-8815



Collaborative research in evaluation of heavy rare earth element resources

Mineral Resources Research Group



【Abstract】

A research effort, in collaboration with a private company, has been initiated to evaluate the resource potential of heavy rare earth elements.

【Goals】

- To establish a reliable database containing information on the world's rare earth element ore deposits and reserves.
- To evaluate the resource potential of rare earth elements in promising areas and deposits by geological survey.
- To collaborate with geological surveys in Korea, Thailand, Vietnam, and other Asian countries.

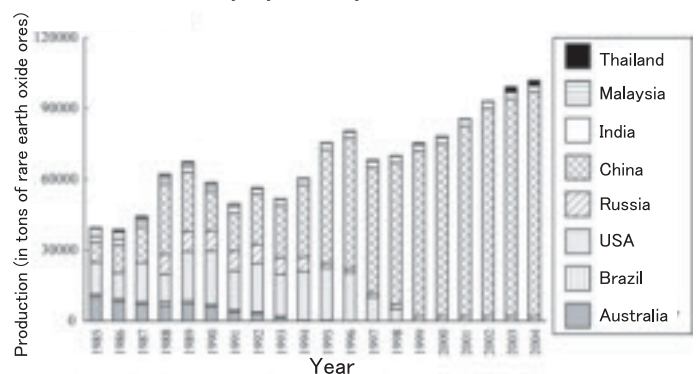
Reference

Ishihara, S., and Murakami, H. (2005) An attractive mineral resource: heavy rare earth — Are the ion-absorption-type deposits enough to support the modern high-technology industry? Chishitsu News, No. 609, pp. 4-18.

【Potential applications】

- Forecast world's supply of heavy rare earth elements.
- Determine the feasibility of developing rare earth deposits in countries other than China, where most rare earth ore deposits are known to occur (cf. figure at top right).
- Identify potential exploration areas for heavy rare earth deposits.

Amount of production of rare earth oxides shown on a country-by-country basis (USGS, 2003)



Bayan Obo rare earth ore deposit, the world's largest mine



Contact information: Yasushi Watanabe, y-watanabe@aist.go.jp, phone +81-29-861-3811



Development of geothermal reservoir management techniques

Reservoir Dynamics Research Group



【Abstract】

Improved modeling techniques for management of geothermal reservoirs were developed by using data from a combination of new geophysical monitoring techniques.

【Description of study】

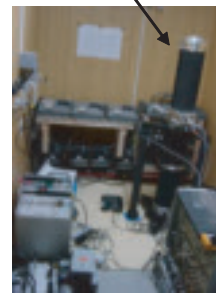
New geophysical monitoring techniques involving repeated, highly accurate hybrid microgravity measurements and continuous electrical measurement were developed. Data from a combination of the newly developed geophysical monitoring techniques were effectively used to create an improved, history-matching model for management of geothermal reservoirs. Collaborative studies with six private companies were carried out.

Presented at WGC2005: “System Integration of Various Geophysical Measurements for Reservoir Monitoring”.

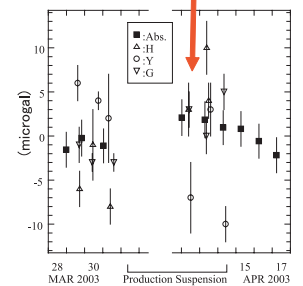
【Application】

The techniques are applicable not only for geothermal resources but also for carbon dioxide storage in aquifers, etc. A “User Society” consisting of 20 companies and universities was organized to disseminate the geothermal reservoir simulation technique.

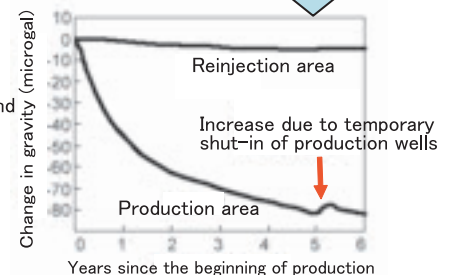
Hybrid microgravity measurement using an absolute gravity meter as a reference



Increase of gravity due to temporary field-wide shut-in of production wells



History matching



Calculation of gravity change from underground conditions computed by reservoir simulation

Contact information: Tsuneo Ishido, ishido-t@aist.go.jp, phone +81-29-861-3829



Completion and publication of water environment maps for urban areas

Water Environment Research Group



【Abstract】

Fundamental hydrologic data such as groundwater level, general hydrology, oxygen/hydrogen isotope ratio, underground temperature profile data, and other data were unified into a database to analyze the regional flow of groundwater. Water environment maps showing an overview of the hydrologic environment for catchment areas were published.

【Description of study】

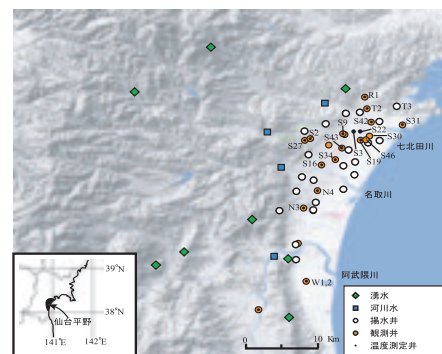
Previous hydrogeological maps of Japan were reviewed and revised, emphasizing hydrological environment, flow pattern, and groundwater quality. The revised maps were published and are readily available. A database containing underground temperature profile data for the Akita, Sendai, Kanto, and Nobi Plains, together with chemical analyses of groundwater, spring water, and river water in these plains, was created. Published maps were offered to local governments and educational institutions.

【Utilization of data】

The maps are the first complete hydrography data collection sets for Japan, and are expected to be widely utilized in efforts to preserve groundwater resources and prevent groundwater pollution. The maps should also be useful for analysis of geosphere environmental problems and in the development and utilization of geothermal energy resources.

Reference

Uchida, Y., Yasukawa, K., Tenma, N., Otani, T., and Mori, K. (2005) Study of underground temperature distribution in Sendai Plain. 1. Regional modeling of three dimensional groundwater flowage and heat transfer. J. Geotherm.Res. Soc.Jpn., Vol. 27, pp. 115-130.



On-site survey

Water quality analysis, and compilation of data



Water environment map

Contact information: Takemasa Ishii, take-ishii@aist.go.jp, phone +81-29-861-3827



Completion and publication of a series of 1:500,000 scale mineral resources maps

Mineral Resources Research Group



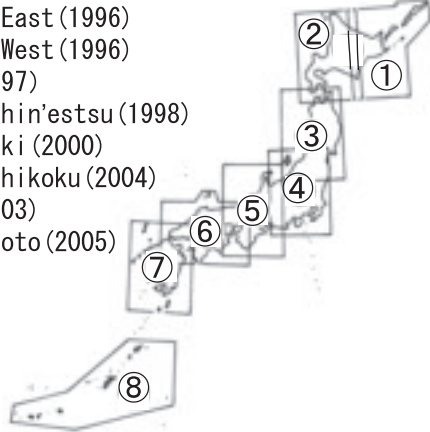
【Abstract】

A series of 1:500,000 scale mineral resources maps covering all of Japan has been completed and published.

【Description of the project】

Newly compiled mineral resources maps covering whole Japan in eight sheets were published from Geological Survey of Japan.

- ①Hokkaido, East (1996)
- ②Hokkaido, West (1996)
- ③Tohoku (1997)
- ④Kanto Koshin'etsu (1998)
- ⑤Chubu Kinki (2000)
- ⑥Chugoku Shikoku (2004)
- ⑦Kyushu (2003)
- ⑧Nansei Shoto (2005)



The map contains data of 2,300 metallic or nonmetallic ore deposits, and shows their types, sizes, and formation ages and geologic relationships with surrounding rocks.

【Utilization of map】

For understanding mineral resources of Japan.

For further on-site survey and exploration for mineral resources.

For prevention of pollution from past and present mining and for environmental protection.

Contact information: Sadahisa Sudo: sudo-gsj@aist.go.jp, phone +81-29-861-3647

Mineral resources map 'Kyushu'



Completion and publication of "Off Sanriku Fuel Resource Geology Map"

Fuel Resource Geology Research Group



【Abstract】

The hydrocarbon resource potential of Cretaceous to Paleogene coal seams within the area from the axial zone of Hokkaido to offshore Sanriku was reexamined. In collaboration with Japan Energy Oil Exploration Co. Ltd., a CD-ROM version "Off Sanriku Fuel Resource Geology Map" was released in February 2005.

【Description of the map】

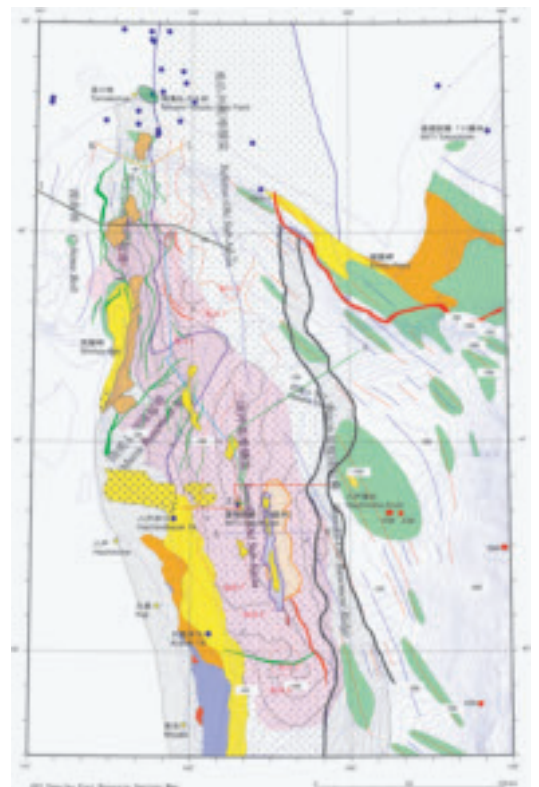
Under the working hypothesis that coal is a potential source of natural gas, reservoir structures and source rocks characteristic of the area from the axial zone of Hokkaido to offshore Sanriku were studied. Coal layers distributed in this area and their hydrocarbon maturity were examined to evaluate their potential as a natural gas resource. The geology, geophysical exploration results, and drilling data were compiled into a 1:750,000 scale thematic map.

Reference

Osawa, M., Nakanishi, S., Tanahashi, M., and Oda, H. (2002) Structure, tectonic evolution, and gas exploration potential of offshore Sanriku and Hidaka Provinces, Pacific Ocean, off northern Honshu and Hokkaido, Japan. J. Jpn. Assoc. Petrol. Technol., Vol. 67, pp. 38-51.

【Application of study results】

The reservoir structure and source rock information obtained in this study is useful for exploration in the area from offshore Hokkaido to offshore Iwate Prefecture.



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

Title	Research Group	
Discovery of arsenic-accumulating bacteria	Geo-analysis Research Group (Mio Takeuchi)	photo1
Anomalously high number of methanogens in the low-density layer in Holocene marine mud under the Nakagawa Lowland, central Japan	Organic Geochemistry RG(Hideyoshi Yoshioka, Shun-ichiro Igari), Geo-analysis RG (Mio Takeuchi), Susumu Tanabe (Institute of Geology and Geoinformation)	photo2
Use of electromagnetic exploration methods to identify high-salinity groundwater zones	Exploratuon Geophysics Research Group (Yuji Mitsuata)	photo3
Development of Geosphere Environmental Risk Assessment System	Geo-analysis Research Group	photo4
Downhole percussion drill	Environmental Technology Research Group	photo5
Collaborative research in evaluation of heavy rare earth element resources	Mineral Resources Research Group	photo6
Development of geothermal reservoir management techniques	Reservoir Dynamics Research Group	photo7
Completion and publication of water environment maps for urban areas	Water Environment Research Group	photo8
Completion and publication of a series of 1:500,000 scale mineral resources maps	Mineral Resources Research Group	photo9
Completion and publication of “Off Sanriku Fuel Resource Geology Map ”	Fuel Resource Geology Research Group	photo10

