

Ten Big News Items 2006 from the Institute for Geo-Resources and Environment



Ten Big News Items **2006**

**from the Institute for Geo-Resources
and Environment**



Ten Big News Items 2006 from 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.

December, 2006

Dr. Yusaku Yano, Director

Institute for Geo-Resources and Environment

National Institute of Advanced Industrial Science and Technology

Ten Big News Items 2006 from the Institute for Geo-Resources and Environment

Title	Research Group	
Development of large-scale groundwater modeling of the Yellow River basin, China	Water Environment Research Group	Photo1
Development of a system using GIS for managing and analyzing environmental noise in cities	Geo-analysis Research Group (Hiroyuki Imaizumi)	Photo2
Study of the seawater/freshwater interface in Tokai-mura, Japan	Geo-barrier Research Group	Photo3
Development of vibration probe penetration test for liquefaction analysis	Exploration Geophysics Research Group (Motoharu Jinguuji)	
Development of a method for making induced polarization measurements on a base rock	Reservoir Dynamics Research Group (Shinichi Takakura)	Photo4
Discovery of flood-generated deposits from the deep-sea floor in the Japan Sea	Fuel Resource Geology Research Group (Takeshi Nakajima)	Photo5
Development and application of a method for evaluating the biomass of living methanogens in sediment	Organic Geochemistry Research Group	Photo6
Achievement of nationwide mapping of permeability in Japan	Geothermal Resources Research Group (Muraoka, H., Sakaguchi, K., Nakao, S. and Kimbara, K.)	Photo7
Evaluation of potential of stratabound manganese deposits to supply heavy rare earths	Mineral Resources Research Group	Photo8
Mineral resource dataset and mineral resource map of Asia	Mineral Resources Research Group	Photo8



Photo1



Photo3



Photo4



Photo5



Photo2



Photo6



Photo7



Photo8

Development of large-scale groundwater modeling of the Yellow River basin, China

Water Environment Research Group



【Outline】

In collaboration with the China Geological Survey, we developed a large-scale groundwater circulation model covering the entire Yellow River basin, China. The model is coupled with a surface water model, and the total number of grids in the model exceeds 1.4 million.

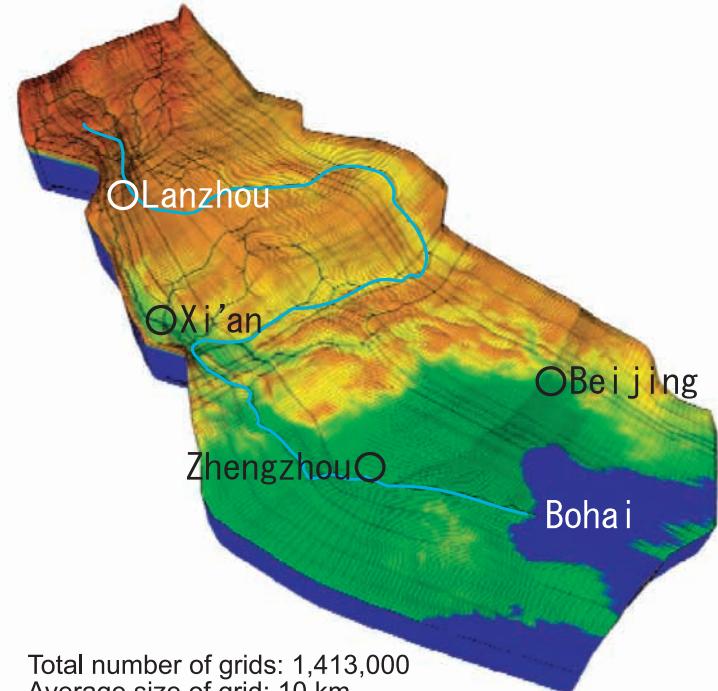
【Activities】

We collected data on groundwater levels, the distribution of permafrost, water chemistry, and oxygen and hydrogen isotopes through field and laboratory studies. These data and cooperative discussion with Chinese institutions have aided in improving the model. We have already obtained good simulation results for the past groundwater flow in the area. We are now trying to simulate future groundwater flow systems based on several scenarios.

Ishii, T. (2006) Groundwater project in the Yellow River basin. SAT (The Science Academy of Tsukuba), No. 12.

【In future】

The final report of this project will be translated into Chinese, submitted to the Chinese government, and hopefully reflected in their policy for management of groundwater resources in the Yellow River basin.



Total number of grids: 1,413,000

Average size of grid: 10 km

Three-dimensional groundwater model of the Yellow River basin.

By courtesy of Geosphere Environmental Technology Corp.

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

Development of a system using GIS for managing and analyzing environmental noise in cities

Hiroyuki Imaizumi



【Abstract】

We have been developing a prototype computer system for managing and analyzing environmental noise in cities. The system combines a noise propagation calculation model with a geographic information system (GIS) in which various kinds of numerical maps (spatial information) and attribute data relating to environmental noise are used to identify the noise field.

【Description of study】

We have been focusing on the following topics:

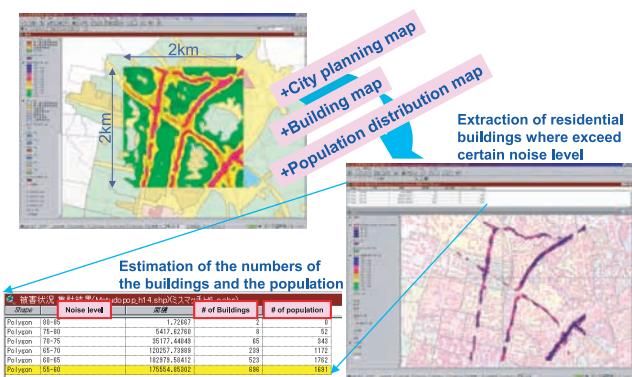
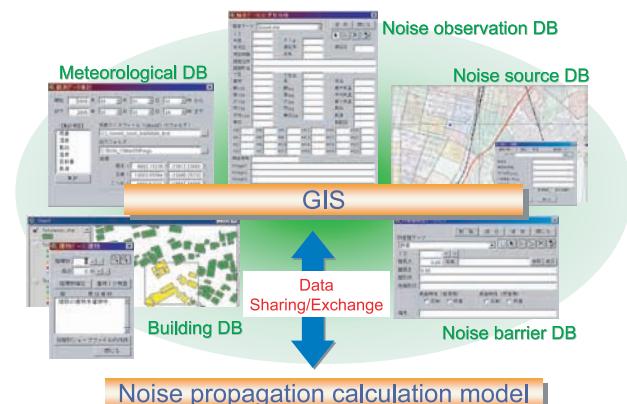
1. Constructing an attribute database relating to environmental noise control
2. Arranging various kinds of numerical maps essential for management and analysis of environmental noise
3. Developing functional extensions of GIS
4. Developing a noise propagation calculation model that can work together with GIS
5. Case studies using the prototype computer system

H. Imaizumi et al. (2006), Application of road traffic census to environmental noise mapping in cities, Proceedings of the 6th European Conference on Noise Control.

【Application】

We are expecting the following applications of the prototype computer system:

1. Long-term management and control of environmental noise in cities by local administrative organizations
2. Support for city planning aimed at minimizing the impact of environmental noise on the surrounding environment
3. Dissemination of information to the public regarding environmental noise



Contact information: Hiroyuki Imaizumi, e-mail: hiroyuki.imaizumi@aist.go.jp tel: +81-29-861-8775

Study of the seawater/freshwater interface in Tokai-mura, Japan

Geo-barrier Research Group

【Outline】

A long-term groundwater study has been carried out both within the test area of the Tokai Research and Development Center of the Japan Atomic Energy Agency and in a village situated to its west. Analysis of data from the study revealed the shape and mechanism of variation of the seawater/freshwater interface.

【Description of study】

Within the study area, construction of the Japan Proton Accelerator Research Complex is underway. To evaluate the effect of the construction and facility, a system was established for long-term monitoring of groundwater. Analysis of groundwater data has clearly revealed changes in groundwater flow due to severe pumping and a landward shift of the seawater/freshwater interface. No large-scale shift of a seawater/freshwater interface has ever been previously detected by direct observation. Therefore, this report gives the first good example of such a shift and change in groundwater flow.

【Application】

We expect this study will be helpful (1) in evaluating the deep groundwater flow velocity and shape of the seawater/freshwater interface and (2) in determining the relationship between changes in groundwater flow and seawater/freshwater interface affected by seawater-level changes caused by topography and climate change.

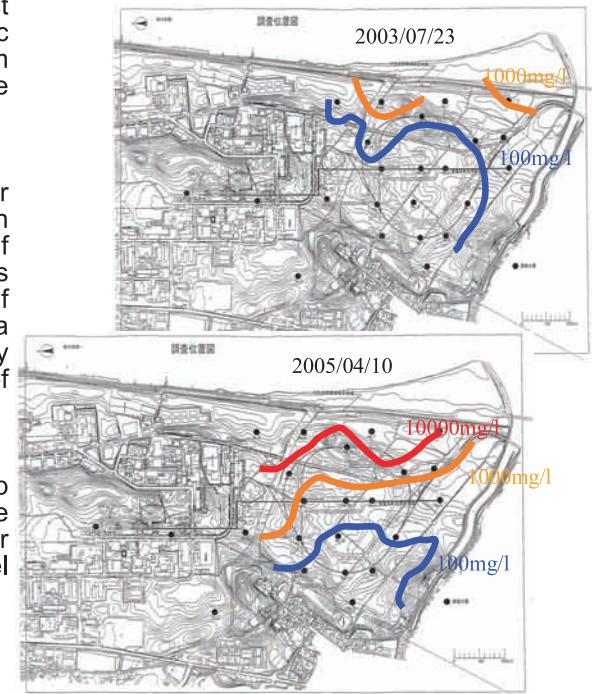


Fig. Change of salinity (mg/L)

Contact information: Kinichirou Kusunose, e-mail: k.kusunose@aist.go.jp, tel +81-29-861-3595

Development of vibration probe penetration test for liquefaction analysis Motoharu Jinguuji, Exploration Geophysics Research Group

【Outline】

We have developed a new test — the vibration probe penetration test (VPT) — for determining and evaluating liquefiable soils. VPT, unlike other tests such as CPT, directly uses the dynamic response of soils.

【Activities】

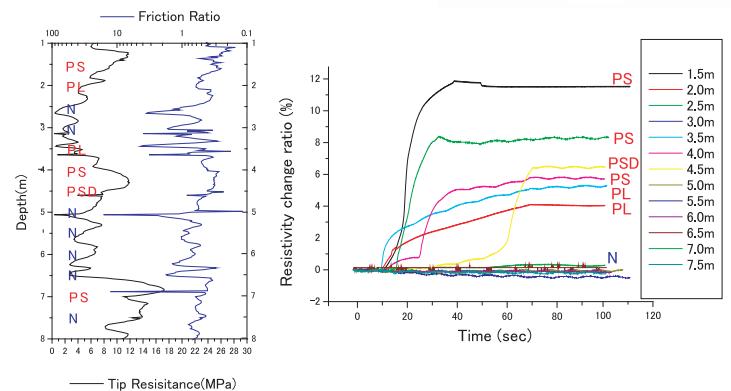
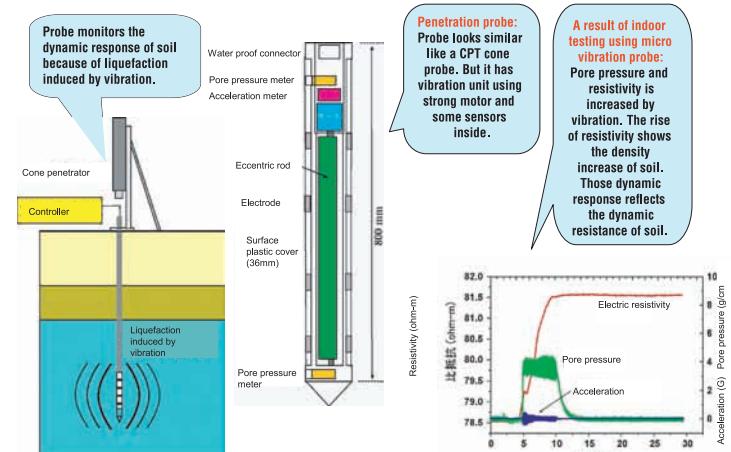
To confirm the effectiveness of the test, we conducted both laboratory experiments and field tests. We found that soil resistivity was strongly related to soil density and that VPT patterns reflect soil properties such as permeability of sand and liquefaction resistance.

Jinguuji, M. et al. (2006) Development of vibration penetration test (VPT) and results of laboratory and field experiments, Proceedings of First European Conference on Earthquake Engineering and Seismology, pp. 1–7.

【In future】

Our results have shown that VPT may have some additional merit in some soils such as sands with high silt content. VPT can also be used to evaluate ground improvement after liquefaction by comparing test results before and after treatment.

The bottom figures show the result of in situ testing in the field (Antalya, Turkey). Resistivity is strongly related to the density of soil. N (negative) means no density increase in the soil and indicates a high liquefaction resistance. P (positive) means that liquefaction resistance is low at the indicated depth because of a large change in soil density. Further analysis of the patterns is required to determine whether the resistivity patterns can also reveal other soil characteristics such as permeability.



Contact information: Motoharu Jinguuji, e-mail: m.jinguuji@aist.go.jp, tel +81-29-861-8293

Development of a method for making induced polarization measurements on a base rock

Shinichi Takakura, Reservoir Dynamics Research Group



【Abstract】

A method for attaching nonpolarizable electrodes on a hard base rock was devised, and induced polarization (IP) measurements were made on the tunnel walls of a sericite deposit. The resistivity and chargeability sections were analyzed along the walls, and the sericite veins were clearly detected by normalized chargeability (i.e., chargeability normalized by resistivity).

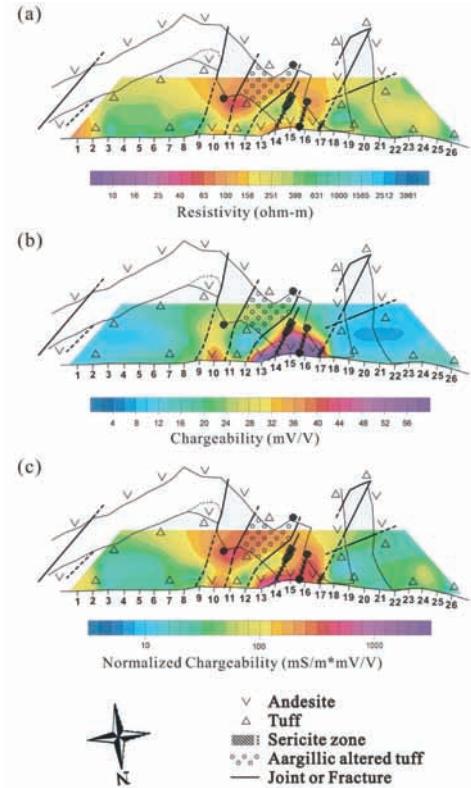
【Description of study】

One of the most difficult problems in making IP measurements inside a tunnel involves attaching the nonpolarizable electrodes for potential measurements to the hard base rock of the tunnel wall. We solved this problem by pasting the nonpolarizable electrodes on the base rock with plaster mixed with the same salts as those used for the electrodes. Using this method for attaching the electrodes, we made two-dimensional IP measurements on the tunnel walls of a high-quality sericite deposit. The geological distribution of sericite veins and altered rocks was clearly detected by normalized chargeability (i.e., chargeability normalized by resistivity).

Takakura, S. and Nakada, K. (2006) IP measurements on tunnel walls of a sericite deposit — A contact method of nonpolarizable electrodes on a base rock and detection of clay minerals by normalized chargeability. *Butsuri-Tansa (Geophysical Exploration)*, 59 (in press).

【Application】

Our IP measurement technique can be used to evaluate and monitor degradation of rock mass structures and concrete structures as well as to investigate metal and clay resources in mine tunnels.



Comparison of (a) the resistivity section, (b) the chargeability section, and (c) the normalized chargeability section with geology confirmed by digging of new tunnels.

Contact information: Shinichi Takakura, e-mail: takakura-s@aist.go.jp, tel +81-29-861-3927

Discovery of flood-generated deposits from the deep-sea floor in the Japan Sea

Takeshi Nakajima, Fuel Resource Geology Research Group



【Outline】

In sediment cores collected from the deep-sea floor (3400 m deep) in the central Japan Sea, I discovered sedimentary layers with structures that have characteristics of flood-generated deposits. These layers were interpreted as flood-generated deposits derived from rivers draining into Toyama Bay.

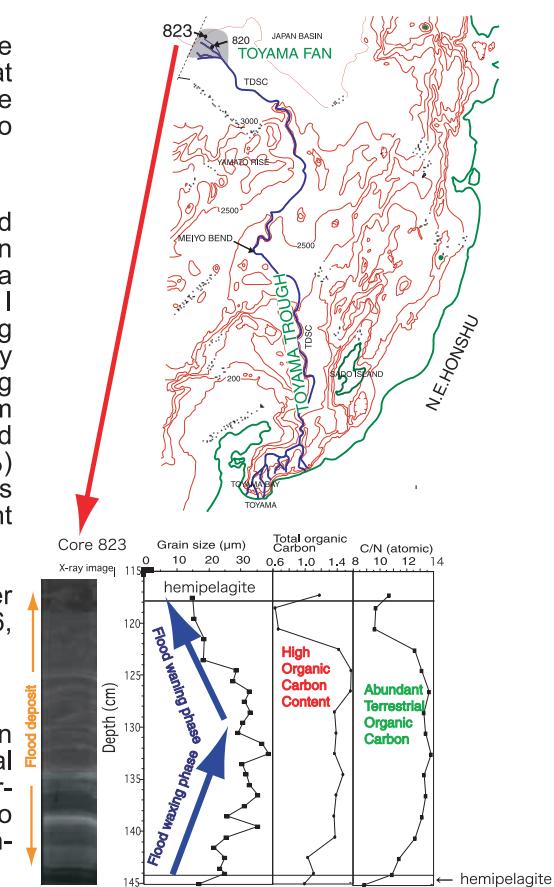
【Activities】

Characteristic sedimentary layers of up to 30 cm thick showing upward coarsening followed by upward fining structures were identified in sediment cores collected from the deep-sea fan at the terminal Toyama Deep-Sea Channel (blue line on the map) in the central Japan Sea. I interpreted these sedimentary structures to have been formed by waxing and waning flows of flood-generated turbidity currents. These turbidity currents may have been generated by river floods with waxing and waning flow phases in Toyama Bay, and may have traveled more than 700 km away from river mouths through the channel. These flood-generated sedimentary layers have a higher organic carbon content (up to 1.6 wt %) and higher organic carbon/nitrogen ratio than do hemipelagic mud layers deposited during normal periods. The deposits may thus contain abundant organic carbon derived from land plants transported by flood flows.

Nakajima, T. (2006) Hyperpycnites deposited 700 km away from river mouths in the central Japan Sea. *Journal of Sedimentary Research*, 76, 60–73.

【In future】

Historical studies of past flood disasters and climate changes based on marine sediment cores will aid in assessing future increases in natural disasters caused by global warming. Because of the inferred high hydrocarbon potential of flood-generated deposits, this study should also lead to new frontiers in developing hydrocarbon resources in deep-water environments.



Contact information: Takeshi Nakajima, e-mail: takeshi.nakajima@aist.go.jp, tel: +81-29-861-3695

Development and application of a method for evaluating the biomass of living methanogens in sediment

Organic Geochemistry Research Group

**【Abstract】**

We have developed a new analytical method for evaluating the biomass of living methanogens in sediment. We applied the method to marine core samples from the eastern Nankai Trough and found an unexpected distribution of methanogens.

【Description of study】

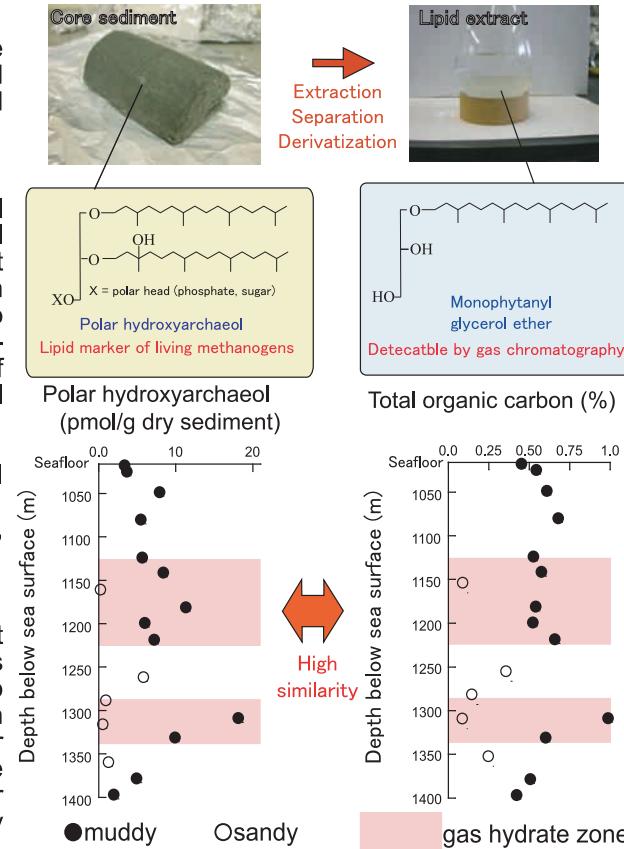
We have developed a method for extracting polar hydroxyarchaeol from sediment, converting the compound to monophytanyl glycerol ether, and quantitating the product by gas chromatography. As part of the research activities of Japan's Methane Hydrate Exploitation Program (MH21), we applied the method to METI Tokai-oki to Kumano-nada core sediments and successfully detected hydroxyarchaeol in most samples. The data showed that the distribution of methanogens is controlled more strongly by the amount of total organic matter than by depth.

Oba, M., Sakata, S., and Tsunogai, U. (2006) Polar and neutral isopranyl glycerol ether lipids as biomarkers of archaea in near-surface sediments from the Nankai Trough. *Organic Geochemistry*, 37 (in press)

【Application】

Our method shows how methanogens are distributed in sediment near natural gas accumulations of microbial origin, such as water-dissolved natural gases and gas hydrates, which should help identify the area of methane generation. Such information will aid in modeling natural gas systems, and thus contribute to improving our assessment of natural resources and enhancing successful resource exploration. Our method may also be utilized as a basis for developing new technologies for enhancing gas production by stimulating the activity of geomicrobes.

Contact information: Susumu Sakata, e-mail: su-sakata@aist.go.jp, tel: +81-29-861-3898



Analytical results for METI "Tokai-oki to Kumano-nada" core sediments

Achievement of nationwide mapping of permeability in Japan

Muraoka, H., Sakaguchi, K., Nakao, S. and Kimbara, K., Geothermal Resources Research Group

**【Abstract】**

Using hot spring discharge data, we have accomplished a nationwide mapping of permeability in Japan. To the best of our knowledge, this is the first time that permeability mapping has been accomplished on such a large regional scale.

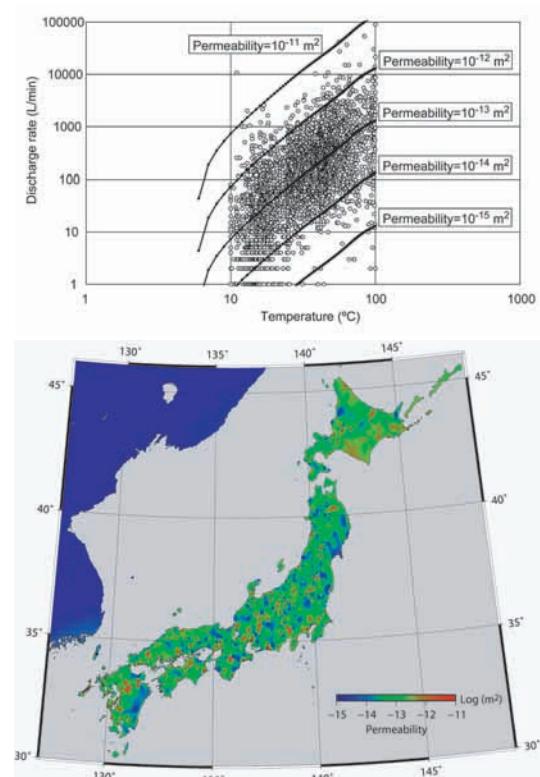
【Description of study】

Permeability, the measure of ease with which a fluid flows through a porous medium, is the most important parameter controlling fluid circulation in the earth's crust. The parameter is, however, difficult to estimate on a regional scale because of its strong site dependency. Because permeability is normally determined by drilling into a particular site, regional permeability mapping has seldom been performed. We have accomplished a nationwide mapping of permeability at a 1-km skin depth, using the correlation between the discharge rate and the discharge temperature for hot springs in Japan. Our method can be applied to a variety of fields and will be further developed by refining the model and acquiring additional data.

Muraoka, H., Sakaguchi, K., Nakao, S., and Kimbara K. (2006) Discharge temperature–discharge rate correlation of Japanese hot springs driven by buoyancy and its application to permeability mapping. *Geophysical Research Letters*, 33, L10405, doi : 10.1029/2006GL026078.

【Application】

Because permeability is the most important parameter in controlling fluid circulation in the earth's crust, our results are relevant not only for development of geothermal resources but also for groundwater utilization, subsurface space utilization, and geological waste disposal.



Graph for estimating permeability (top) and permeability map of Japan (bottom)

Contact information: Hirofumi Muraoka, e-mail: hiro-muraoka@aist.go.jp, tel: +81-29-861-2403

Evaluation of potential of stratabound manganese deposits to supply heavy rare earths

Mineral Resources Research Group

**【Outline】**

Japanese stratabound manganese deposits and ores enriched with heavy rare earths were evaluated as potential sources of heavy rare earths (Dy, Tb).

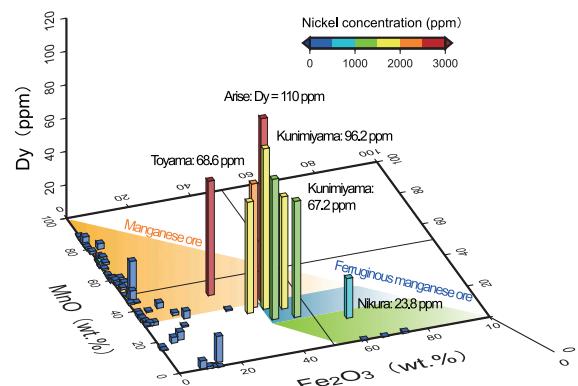
【Description of study】

- The newly evaluated enriched deposits are Kunimiyama, Arise, and Toyama from Shikoku Island. The rare earth concentrations in these enriched deposits are higher than those in the ion absorption type deposits in south China.
- These enriched deposits are inevitably associated with basaltic rocks and chert beds, indicating that the ores were formed by hydrothermal activity associated with submarine basaltic volcanism.
- The ores contain abundant hematite and are enriched in Ni and Zr.

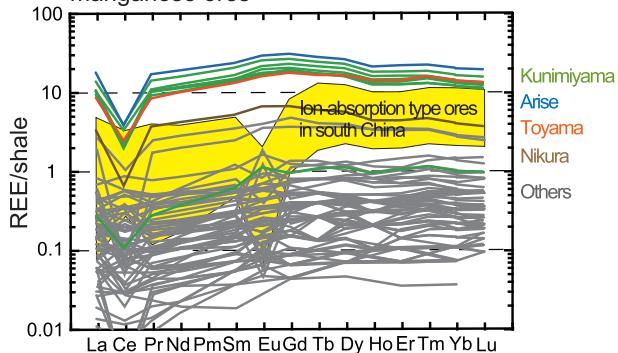
【Application】

Stratabound manganese deposits have the potential to supply heavy rare earths, which are expected to be exhausted soon due to increasing demand. Our results provide a strategy for exploring stratabound manganese ores enriched in heavy rare earths.

Relationship among dysprosium, manganese and iron contents



Rare earth concentration in stratabound manganese ores



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

Mineral resource dataset and mineral resource map of Asia



Mineral Resources Research Group

【Outline】

We compiled a mineral resource dataset for East Asia and plotted the data on a 1:3,000,000 mineral resource map.

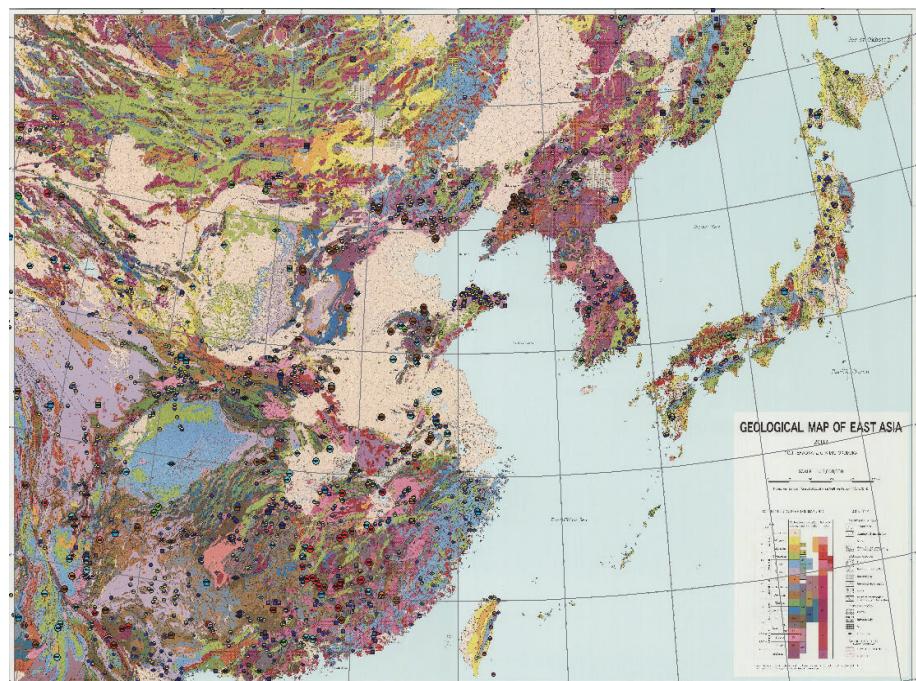
【Description of study】

- The dataset contains data for more than 3,000 metallic and non-metallic mineral deposits, including location, commodity, deposit type, age, size, reserves, ore minerals, and status of mining in East Asia.
- The mineral resource dataset is plotted on a 1:3,000,000 geological map.

【Application】

- The dataset and map can be used to
- (1) locate major metallic and non-metallic mineral deposits
 - (2) estimate the mineral potential of countries in East Asia
 - (3) select mineral exploration targets

1:3,000,000 mineral resource map of East Asia



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

Ten Big News Items 2006 from the Institute for Geo-Resources and Environment



Date of issue : December, 2006

Dr. Yusaku Yano, Director

Institute for Geo-Resources and Environment

National Institute of Advanced Industrial Science and Technology

AIST Tsukuba Central 7, Tsukuba, Ibaraki 305-8567, Japan

tel:+81-29-861-3633

AIST Tsukuba West, Tsukuba, Ibaraki 305-8569, Japan

web: <http://unit.aist.go.jp/georesenv/>



Water Environment

Geo-Analysis

CO₂ Geological Storage

Geo-Barrier

Exploration Geophysics

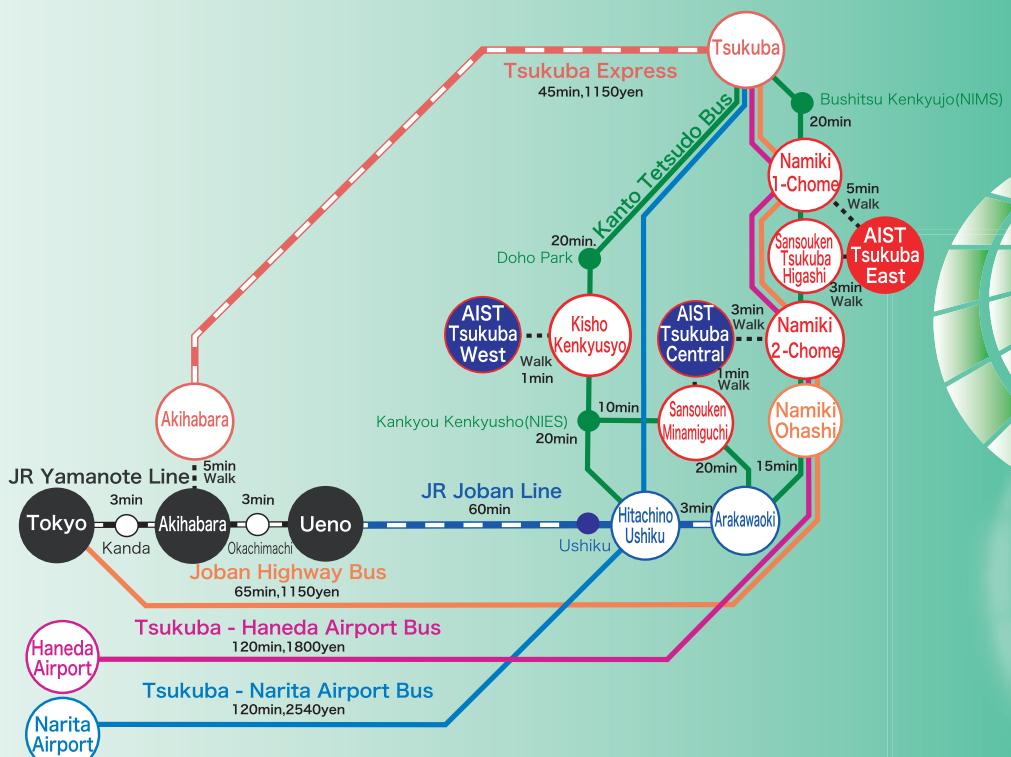
Reservoir Dynamics

Organic Geochemistry

Fuel Resource Geology

Geothermal Resources

Mineral Resources



Research at the Institute for Geo-Resources and Environment is carried out at two locations, Tsukuba Central 7 and Tsukuba West.

Ten Big News Items 2006 from the Institute for Geo-Resources and Environment