Member Country Report of JAPAN

Submitted by

Japan Delegation

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1. OUTREACH

1.1. Summary

This chapter describes the major outreach activities of the Geological Survey of Japan (GSJ), National Institute of Advanced Industrial Science and Technology (AIST) on their research outputs on geoscience. The first section below reviews the general outreach activity of GSJ mostly targeting the people in Japan. The second section introduces the International Training Course that GSJ has launched in 2018.

1.1.1. Outreach activity of GSJ

GSJ gives priority to outreach activity as an important opportunity to provide its research results to the public, particularly to young students, industry people, and policy makers. The Geological Museum, the most important outreach facility of GSJ, exhibits GSJ’s research outcomes both by its permanent exhibition, which is regularly updated, and by short-term special exhibits held several times a year. In addition to the outreach activities through the Museum, GSJ conducts the following activities.

For the general public:
- Geological Information Exhibition at the annual meeting of the Geological Society of Japan.
- “Geo Salon,” a seminar series on geological science to the public in Tsukuba and other places. GSJ newly started “Geo Salon in Tokyo” series.
- Open Laboratory Day for the public.
- Geological exhibition for the “Geology Day (10th of May),” a special day set by academic societies to promote the understanding of geology in Japan.

For industry and academics:
- One or two-day exhibit for industry in Tsukuba and regional offices of AIST,
- Training course on geological mapping for junior employees of geology-related companies.
- “GSJ Symposium” on specific geoscience topics. Some symposia are open to the general public.

GSJ website (https://www.gsj.jp/en/) is GSJ’s another important measure of outreach. GSJ provides various kinds of geological information including recent research results, online geologic maps, geological databases, etc. through its website.
1.1.2. GSJ International Training Course

In 2018, GSJ has launched a regular training course for young geological researchers and engineers from the CCOP member countries. This is the first international training course funded by GeoBank, our own foundation launched in 2017 that is supported by companies and individuals interested in geoscience. Entitled as “GSJ International Training Course on Practical Geological Survey Techniques 2018 - application to geological disaster mitigation -”, the training course was held from June 26 to July 13, 2018 with nine trainees from nine countries nominated by their permanent representative to CCOP.

It aims to offer the participants an opportunity to improve their practical geological survey techniques and to construct international human networking. The program was comprehensively organized to learn about:

- field survey techniques
- various techniques to acquire and analyze geological data
- visualization of geological information
- application in social demands such as disaster prediction and mitigation.

The trainees joined field excursions, received intensive lectures on practical geological survey skills, and experienced many hands-on works based on geological maps and databases and experiments with the latest laboratory equipment. The schedule was a little tight, but the post-training remarks from the trainees are favorable particularly in regard to the comprehensive and practical program. The training contents will be improved based on the feedbacks to make the course more informative and beneficial to the participants. Details of the second training course will be announced in early 2019.
Fig. 1.2. Group photo at the Hanazono Valley, northern Ibaraki during the field excursion to the Abukuma Mountains.

Fig. 1.3. Practical work on U-Pb dating of zircon.

Fig. 1.4. Demonstration of microtremor survey.

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2. COOPERATION AND PARTNERSHIP

2.1. Summary

GSJ conducts international cooperation activities either on a bi-lateral basis or under an international project. The major international collaborative researches that are related to Southeast Asian countries are:

- Geological information (OneGeology, ASEAN Harmonized Geology, and CCOP Geoinformation Sharing Infrastructure Project)
- Geological hazards (Asia-Pacific region geohazards risk)
- Geological environment (Coastal geology)

International cooperation activity conducted by Kanazawa University in Cambodia and by the University of Tokyo are also reported in this chapter.

2.2. Geological Information

2.2.1. OneGeology

GSJ is continuously implementing the OneGeology project covering East and Southeast Asia in cooperation with the Coordinating Committee for the Geoscience Programmes in East and Southeast Asia (CCOP) and its member countries. The GSJ server host the MWSs of the geological maps of Indonesia, Malaysia, Vietnam, Myanmar, the Philippines and Papua New Guinea. The WMSs of Lao PDR, Thailand and the Republic of Korea are hosted on their own servers. GSJ will soon register relevant maps like the 200k Seamless Geological Map of Japan with the OneGeology portal.

The CCOP Geoinformation Sharing Infrastructure for East and Southeast Asia (GSi) project is presently working on the registration of some maps in the GSi system to the OneGeology portal. Written permission is being obtained from data owners. The OneGeology portal covering East and Southeast Asia (Fig. 2.1) is linked to the GSi system at https://ccop-gsi.org/gsi/onegeologyasia/index.php.

Fig. 2.1. The OneGeology portal covering East and Southeast Asia.

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2.2.2. ASEAN Harmonized Geological Map

GSJ has been supporting the ASEAN Harmonized Geological Map (1:1,000,000) project since 2014. In 2017, a field workshop was held in northern Lao PDR from September 30 to October 4 (Fig. 2.2), following the in-house workshop in Vientiane from September 25 to 29. The result of the survey during the field workshop was reported at the project meeting held in conjunction with the 53rd CCOP Annual Session in the Philippines on October 17, 2017. The Harmonized Geological Map (scale 1:1,000,000) of the Indochina Peninsula (including Thailand, Vietnam, Myanmar, Lao PDR and Cambodia) will be completed in the project, and it will be used as the base geological map of the ASEAN Mineral Resources Database.

![Fig. 2.2. Participants of the field workshop at the Myanmar-Lao PDR Friendship Bridge over the Mekong River, which forms the border between the countries.](image)

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2.2.3. CCOP Geoinformation Sharing Infrastructure for East and Southeast Asia (GSi)

The main objective of the CCOP Geoinformation Sharing Infrastructure for East and Southeast Asia (GSi) Project is to develop a web-based system for the sharing of geoscience information among the CCOP countries. The information system will also make geoscience information in the region easily accessible. The GSi main portal site (Fig. 2.3) provides web-based functions for spatial data rendering and analysis in the forms of Web Map Service (WMS) and Web Processing Service (WPS), respectively. It can also be used to download data in several formats. The system follows the Spatial Data Infrastructure (SDI) model. The system also provides the interface for the creation of a customized WebGIS portal for spatial data viewing and processing.

The 2nd GSi International Workshop was held in Luang Prabang, Lao PDR, from December 5 to 7, 2017 with valuable support from the Department of Geology and Minerals, Ministry of Mines and Energy of Lao PDR and CCOP Technical Secretariat (Fig. 2.4). Twenty-two (22) participants from the CCOP member countries (Cambodia, Japan, Korea, Lao PDR, Malaysia, Myanmar, Papua New Guinea, the Philippines,
Thailand and Vietnam) attended the meeting. The system development and project future plan were discussed and a training on how to use the system and mobile application was conducted. More than 420 data including geological maps, earthquake and volcanic maps, groundwater, mineral resources and topographic maps from 11 countries (Cambodia, Indonesia, Japan, Korea, Lao PDR, Malaysia, Myanmar, Papua New Guinea, the Philippines, Thailand and Vietnam) are currently available on the GSi system. More than 20 portal sites from the participating countries and organization are also created (e.g. https://ccop-gsi.org/gsi/thailand/). The portal sites from the CCOP projects such as the “East and Southeast Asia Groundwater Information System” are also available. The 3rd GSi International Workshop will be held in Langkawi, Malaysia, from September 18 to 20, 2018. The GSi main portal site will be officially opened to the public on the first day of the workshop.

![Fig. 2.3. The CCOP GSi main portal site (https://ccop-gsi.org/main/).](image1)

![Fig. 2.4. The 2nd GSi International Workshop in Luang Prabang, Lao PDR](image2)

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2.3. Geological Hazards

2.3.1. Asia-Pacific Region Global Earthquake and Volcanic Eruption Risk Management (G-EVER)

The Asia-Pacific Region Earthquake and Volcanic Hazards Mapping Project aims to develop an advanced web-based hazard information system that provides the information about past and recent earthquake and volcanic hazards online. The system shows the distribution of earthquake hypocenters and source areas, tsunami inundation areas, active faults, and fatalities due to earthquake events, as well as the distribution of Holocene volcanoes, calderas, large-scale ignimbrites, tephra falls, and fatalities in major volcanic events in an interactive and user-friendly interface (Fig. 2.5). The fatalities in earthquakes and volcanic events are classified by the main cause of the death and graphically illustrated. The digitized GIS data of the Eastern Asia Earthquake and Volcanic Hazards Information Map (Takarada et al., 2016) can be displayed and downloaded using the system. This project is implemented with the cooperation of major research institutes and organizations in the Asia-Pacific region.

The G-EVER Volcanic Hazard Assessment Support System (VHASS; http://volcano.g-ever1.org/) aims to provide a user-friendly, WebGIS-based, open-access online system for potential hazards assessment and risk-mitigation of Quaternary volcanoes in the world (Takarada, 2017). VHASS currently provides three deterministic modeling simulation codes of volcanic processes, which are the Energy Cone, Titan2D and Tephra2. By using the system, the area that would be affected by volcanic eruptions in any location near the volcano can be estimated using numerical simulations. VHASS is being implemented using the ASTER Global DEM covering 2,790 Quaternary volcanoes in the world. The simulation results using Energy Cone and Titan2D are displayed directly on the Google Maps and the data can be downloaded (Fig. 2.6). VHASS can be used to determine volcanic hazard risks by overlaying the distributions of volcanic deposits on major roads, houses and evacuation areas.

Fig. 2.5. G-EVER Eastern Asia Earthquake and Volcanic Hazard Information System (http://ccop-geoinfo.org/G-EVER) showing the fatality data of Pinatubo Volcano, the Philippines.
Fig. 2.6. The Titan2D simulation result at Sinabung Volcano, Indonesia, using VHASS (http://volcano.g-ever1.org).

References:

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2.4. Geological Environment

2.4.1. Coastal Geology in Asia

Collaborative researches on deltas, coastal geology and coastal environment in East and Southeast Asia were carried out between GSJ and organizations in these countries. Joint field surveys were conducted in natural levees and point bars of the Mekong River, Cambodia with the General Department of Mineral Resources, Cambodia in February and March 2018, and in CanGiao mangroves, Vietnam with the HCMC Institute of Resources Geography, VAST in March 2018. The purpose of these surveys is to understand the sedimentary facies of levees and point bars of the Mekong, and the Holocene evolution of the CanGiao lowland, respectively. The results of collaborative activities are published as follows.


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2.4.2. International activity of Kanazawa University

Kanazawa University carried out research and educational activities mostly in Cambodia in partnership with the National Authority for Protection and Management of Angkor and the Region of Siem Reap (APSARA National Authority), the Institute of Technology of Cambodia (ITC), and the Department of Geology, the Ministry of Mines and Energy of Cambodia (DGMME) from the second half of 2017 to the first half of 2018.

Kanazawa University and Komatsu College sent ten undergraduate students of various departments to the APSARA National Authority from August to September 2017 as a part of capacity building programmes related with research activities in the Angkor World Heritage site and the Tonle Sap Biosphere Reserve site of UNESCO in Cambodia. The students were engaged in routine work of the authority to learn environmental management such as monitoring of groundwater level, water quality survey in local rivers and afforestation in the world heritage site (Fig. 2.7).

Serious environmental problems such as water pollution, changes of the freshwater ecosystem and coastal erosion have emerged in the Lake Tonle Sap and its environs due to the recent rapid growth of the Cambodian economy and notable development of tourism in the Angkor World Heritage site. In order to conserve its great biodiversity and unique sedimentological and hydrological settings, a three-year research programme named “Evaluation of Mechanisms Sustaining the Biodiversity in Lake Tonle Sap, Cambodia (EMSB)” Phase 2 started, led by Kanazawa University in cooperation with the APSARA National Authority, ITC and DGMME in April 2016. On the basis of the results of EMSB Phase 1 (2000 - 2007) and surveys from 2016 to 2017, bottom sediment sampling, hydrological monitoring, plant ecological investigation, underwater light condition and primary production measurements, DNA analyses of the lake water, and invertebrate and vertebrate samplings were carried out over the entire lake area in August (flooding period), October (high water period) 2017, and March (falling period) 2018. The progress of the research activities will be presented at the international symposia which will be held in both Cambodia and Japan at the beginning of 2019.
2.4.3. Geophysical research at the University of Tokyo

The Graduate School of Engineering, the University of Tokyo (UTokyo), has been engaged in the development of seismic data analysis methods, especially for seismic attenuation estimation. Its targets include geothermal energy, active faults, conventional oil and gas, and methane hydrate.

A novel method for separating intrinsic and scattering attenuation for zero-offset vertical seismic profiling (VSP) data has been developed. Intrinsic attenuation, which transforms seismic energy into heat, has the potential to clarify the physical properties of earth materials because composite materials with pore spaces or fractures fully or partially saturated with fluids exhibit viscoelastic properties that depend on the effective stress or fluid type. Although other possible intrinsic attenuation mechanisms, such as the effects of wetting on grain boundaries or viscous shear relaxation, have been proposed, many researchers believe that the fluid flow induced by the seismic wave propagation is the most influential mechanism that can account for observed seismic attenuation over a broadband frequency range. In contrast, scattering attenuation caused by acoustic impedance heterogeneities is a function of the wavelength of the seismic wave and the characteristic size of the heterogeneities. Scattered seismic events have the potential to provide information about the orientation, spacing, and density of a fracture.

The zero-offset VSP survey is recognized to be ideal for attenuation estimation because the VSP survey observes direct waveforms propagating through subsurface formations. The most popular method of separating intrinsic and scattering attenuation generates numerical zero-offset VSP data from known velocity data, such as sonic velocity logs, and isolates the intrinsic attenuation by subtracting the synthetic scattering attenuation from the total attenuation. Numerical experiments have demonstrated the limitation of this conventional method due to its assumption that the intrinsic and scattering attenuation are independent each other. Actually, the mutual interactions between the
intrinsic and scattering attenuation should be taken into account. In order to overcome this limitation, a novel method is proposed to separate intrinsic and scattering attenuation for zero-offset VSP data by reforming the modified median frequency shift (MMFS) method with seismic interferometry (SI), assuming that intrinsic attenuation is frequency independent while scattering attenuation is frequency dependent. The proposed method can simultaneously derive both intrinsic and scattering attenuation estimates from only VSP data without sonic and density well-log data. The numerical experiments of the present study also investigate the importance of parameter optimization in applying preprocessing filters in order to balance the resolving power and noise reduction effect. The method is applied to zero-offset VSP data acquired in an onshore oil field in order to demonstrate its applicability in investigating heterogeneities of subsurface formations (Fig. 2.8).

![Fig. 2.8.](image)

(a) Seismic time section across the VSP survey well with geological formation and lithology information. The tops of several key formations are indicated by the red line with depth information. (b) Categorization based on three characteristics: seismic facies inferred from the seismic section in (a), intrinsic attenuation and scattering attenuation from VSP data (after Matsushima et al., 2017).

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3. KNOWLEDGE ENHANCEMENT AND SHARING

3.1. Summary

Systematic geological surveys and researches have been conducted by GSJ and other geoscience organizations in Japan for the development of geological resources, mitigation of geological hazards, geological mapping in coastal areas, and environmental conservation and underground utilization in the past year. The chapter summarizes those research activities.
3.2. Geological Resources

3.2.1. Mineral Resources

3.2.1.1. Introduction

The slump in price of metals for the recent several years has ended in 2017. The price of metals has generally risen against the background of the economic recovery of China and the movement of environmental protection in developing countries. The price rise of Cu, Zn, Ni, and Au was more significant than that of other elements mainly due to strikes at mines in Chile and Peru. Under the circumstances, the Ministry of Economy, Trade and Industry (METI) has continued to budget for the securement of base and critical metals, mainly through Japan Oil, Gas and Metals National Corporation (JOGMEC) and AIST.

3.2.1.2. Research Activities at AIST and GSJ

(1) Mineral Resources on land

The activity of the Strategic Urban Mining Research Base (SURE) in AIST is continuously active, and they have conducted large-scale collaborative researches on material recycling technologies with major mining and metallurgical industries and local governments in Japan. The Geological Survey of Japan (Research Institute for Geo-Resources and Environment: GREEN) has been in charge of mineral exploration, and are conducting the following three programs: 1) study on the concentration mechanism of critical metals, resource evaluation, and the beneficiation of ore minerals, 2) geological and technical studies on industrial minerals and their processing, and 3) international cooperation and consulting on mineral resources.

For the program of metal elements, GREEN has been continuing a five-year joint project (2012-2017) studying the rare-earths potential in South Africa with the cooperation of the Council for Geoscience, South Africa (CGS). GREEN has also conducted joint projects on mineral resources with the Department of Geological Survey and Mineral Explorer, Myanmar (DGSE) and the Argentine Mining and Geological Service (SEGEMAR) (Fig. 3.1). GSJ has also conducted following projects on industrial minerals: 1) the standardization of performance evaluation technique on bentonite, 2) the geological studies on kaolin and silica resources in Japan.

![Field Survey of a Chromite deposit in Myanmar (left), and a granite massif in Argentina (right).](image)

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(2) Deep-Sea Mineral Resources

To establish a convenient and efficient survey method for deep-sea hydrothermal deposits, GSJ conducted a research program using a deep-tow package which consists of three major instruments of swath bathymetry system, side-scan sonar, and CTD, together with a magnetometer. With the package, clear images of hydrothermal plumes and surface structures can be obtained. Based on the results, ROV (remotely operated vehicle) dives were conducted in FY 2017, and new hydrothermal fields were found.

To understand the formation processes of the deep-sea hydrothermal deposits, GSJ conducted a geological, geochemical and geophysical studies of volcanic rocks obtained from the central Okinawa Trough as a part of a SIP (Cross-ministerial Strategic Innovation Promotion Program) program under close cooperation with the other institutes and universities. The model of magma genesis in a hydrothermal field was modified based on the petrographic and geochemical data obtained from three hydrothermal sites. The modified model suggests the importance of bimodal magmatism in seafloor massive sulfide ore-forming systems. Furthermore, a new geochemical exploration method for hydrothermal mineralization was proposed. Another cooperative study of the deep-sea manganese crusts was also conducted under the SIP program.

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3.2.1.3. Mineral Resource Development by Japan Oil, Gas and Metals National Corporation (JOGMEC)

(1) Introduction

In order to ensure a stable supply of mineral resources for industries and people of Japan, JOGMEC supports Japanese companies in securing the interests of resources overseas at the development stages ranging widely from formation of exploration projects to assistance in development and production. The brief introduction of the JOGMEC’s activities and achievements in Asia from July 2017 to June 2018 is given below. The departments in parentheses are the ones in charge.

(2) Overseas exploration (Metals Exploration Department)

To reduce early-stage risks in exploration for Japanese companies and facilitate their overseas mineral exploration activities, JOGMEC carries out mineral exploration jointly with various organizations abroad such as state mineral enterprises, regional governmental organizations, geological survey organizations, local mining companies, and major or junior mining companies that hold mineral properties (“Joint Venture Survey”). If the exploration results are positive, the equity interest is transferred to Japanese companies from JOGMEC. When a Japanese company owns or has assurances of ownership of exploration rights in an area with mineral potential, JOGMEC conducts projects and shares the costs with the corporation (“Overseas Geological Surveys”). In the past year, JOGMEC executed projects in two countries in Southeast Asia, namely Cambodia and Myanmar. In Cambodia, JOGMEC and the General Department of Mineral Resources (GDMR) jointly conducted soil geochemical exploration and drilling.
(3) Technology development and technical support (Metals Exploration Department and Metals Mining Technology Department)

For the purpose of more efficient exploration, JOGMEC develops technologies for exploration (remote sensing and high-resolution geophysical technologies), production (extraction of metals from mineral ores and their enrichment) and recycling. JOGMEC also provides technical support to mining operation sites in developing countries.

(4) Mine pollution control (Metals Environment Management Department and Metals Finance Department)

JOGMEC provides technical and financial support to local governments and companies in Japan so that they can implement efficient and reliable measures to prevent mine pollution. JOGMEC also provides the latest technological information and know-how of environmental conservation on mine site to the engineers of the countries rich in mineral resources to support their sustainable development of mining. In 2017, in response to a request from the Philippines, JOGMEC invited Philippine officials to Japan and provided an opportunity for technical transfer of environmental conservation at mine sites.

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3.2.2. Energy Resources

3.2.2.1. Oil and Gas

Major oil and gas fields are located in the Niigata Basin and Akita-Yamagata Basin, both in the Japan Sea side of northeastern Honshu. Several other oil and gas fields are located in the central zone of Hokkaido and in the offshore basins of northeastern and southwestern Japan.

In FY2017 and 2018, exploration, development and production have been conducted in several oil and gas fields. Domestic oil and natural gas are explored and produced by JAPEX, INPEX and JX Nippon Oil & Gas Exploration. Water soluble gas with iodine rich waters is produced by the Kanto Natural Gas Development Co., Ltd. and other companies in the south Kanto Basin, east of Tokyo.

JOGMEC has continued 3D seismic survey projects in the offshore of Japan since 2008, with the seismic survey vessel “Shigen”, processing the data at its research center. In 2017, the “Shigen” had 3D data acquisition in the offshore of Tottori, Hyogo, Joban, eastern Boso, and Nagasaki. INPEX drilled an exploratory well at about 140 km north of Yamaguchi Prefecture under the commission of METI in 2016. It reached 2900 m below the sea floor. JOGMEC has published the final report on this well in 2018.

JAPEX has been conducting the initiative program on the tight oil of the Onnagawa formation at the Ayukawa Oil-field in the Akita-Yamagata sedimentary basin. The production rate has increased more than five-fold after the acidic jobs to open micro-fractures filled with carbonate or silicate. Tight oil (10 kl/day at first) and shale gas (2,000 Nm³/day at first) had been produced since December 2016. The tight oil reserve in the Ayukawa area is estimated to be 2 million bbl, using the Downey et al. (2011) method. JOGMEC started the study on rock properties of the Onnagawa siliceous shale that has good potential of shale oil since 2018. They also plan to start the study for the Teradomari formation in the Niigata basin.
Domestic production is shown below:

- Annual crude oil production in 2017: 561,522 kl (condensate: 350,566 kl) (= 9,677 bbl/day)
- Annual natural gas production in 2017: 3,008 mil Nm³ (water soluble gas: 490 mil Nm³) (= 308 mil. cf/day = 53,300 BOE/day)

Oil development companies in Japan have been exploring and developing oil and natural gas resources all over the world, particularly interested in Southeast Asia, Papua New Guinea, Western Australia, Middle East, Africa, Norway, United Kingdom, Caspian Sea, Russia, North America, Venezuela and Brazil.

INPEX has started to produce LNG and gas-condensate in the INPEX-operated Ichthys Area, offshore Western Australia in 2018. This project aims to produce approximately 8.9 million tons of liquefied natural gas (LNG) and approximately 1.65 million tons of liquefied petroleum gas (LPG) per year, along with approximately 100,000 barrels of condensate per day at peak; the area is expected to be operational over 40 years.

Their recent activities in the CCOP region are available in their websites.
- JX Nippon Oil & Gas Exploration: http://www.nex.jx-group.co.jp/english/index.html
- Idemitsu Kosan Co., Ltd.: http://www.idemitsu.com/
- Itochu Oil Exploration (CIECO): http://www.ITOCHUoil.co.jp/e/index.html
- Petro Summit E&P Corporation: http://www.psep.tokyo.jp/ (Japanese version only)

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3.2.2.2. Gas Hydrate
The Research Consortium for Methane Hydrate Resources in Japan (MH21), established in 2001 and organized by the Agency of Natural Resources and Energy (ANRE) of the Ministry of Economy, Trade and Industry (METI), is composed of JOGMEC, AIST and some other organizations from industries and universities. The MH21 program has two targets for methane hydrates: sand bed type and shallow type ones. The recent activities regarding the research and development of natural gas hydrate are shown on its website:

http://www.mh21japan.gr.jp/english/

The main research objective of the sand bed type methane hydrates is the R&D for the gas production in offshore methane hydrate fields in Japan. The second production test of offshore methane hydrate was carried out on the Dai-ni Atsumi Knoll in the Nankai Trough area from April to June 2017 in order to establish gas production technologies. The results are currently under evaluation. The outline of the test is available at the MH21 website.

The Methane Hydrate Project Unit in the Research Institute of Energy Frontier of AIST (MHPU, https://unit.aist.go.jp/rief/mhpu/) has been developing safe and efficient methods for producing natural gas from methane gas hydrate on a project of the MH21 consortium. MHPU has carried out in-situ analysis and characterization of pressurized
core samples of hydrate-concentrated layers, and physicochemical behavior analysis during gas production from gas hydrate deposit using simulation and history matching.

ANRE has started the research on recovery technologies for shallow methane hydrate. Preliminary reports of these researches were presented at the 9th Comprehensive Symposium on Methane Hydrate (CSMH-9) held at AIST on October 26 and 27, 2017.

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### 3.2.2.3. Coal

Major coal fields are located in central and eastern Hokkaido and northern Kyushu in Japan. Most of them were deposited in Paleogene time. Several seams are distributed deep underground about 1,000 m below the surface or even running under the sea bottom. The Ishikari Coal-field, distributed in central Hokkaido, is the most important coal field that produced high volatile bituminous coking coal.

Domestic coal production decreased to 1.21 million metric ton (MMt) in 2016 from over 50 MMt in 1960. Nearly half of it, 539,000 Mt, is from the Kushiro Coal Mine, the only underground coal mine in Japan. The rest, 683,000 Mt, comes from seven open-pit coal mines in Hokkaido. The amount of imported coal in Japan is 189 MMt in 2016.

Details of the coal reserves in Japan were surveyed in 1950’s and has been revised up to now. The result of coal reserves survey by the Japan Coal Center (J-Coal) in 2008 is as follows:

- Proven reserves: 4,899 MMt
- Probable reserves: 3,422 MMt
- Possible reserves: 11,824 MMt

JOGMEC supports the oversea activities of Japanese companies and hold the mining safety training course for foreign mining engineers from China, Indonesia and Vietnam. Idemitsu Kosan Co. Ltd. operates several coal mines in Australia.

- Japan Coal Energy Center (J-Coal): http://www.jcoal.or.jp/eng/
- Idemitsu Kosan Co., Ltd.: see Oil & Gas section

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### 3.2.2.4. Geothermal Resources

(1) Overview

Japan has approximately 23 GWe of estimated theoretical potential of geothermal energy down to the depth of basement rock (~3 km deep). After a long stagnation period of geothermal development from the beginning of this century, new activities have started after the nuclear accident in Fukushima in March 2011. The Ministry of Economy, Trade and Industry (METI) gives fiscal incentives for geothermal developments such as subsidies for exploration and drilling, and the Feed-in Tariff (FiT) scheme. These measures have encouraged geothermal development by private sectors. As of March 2017, 32 new geothermal power plants with total power capacity of 16 MWe have
opened since the enactment of geothermal FiT in July 2012, making the total national geothermal capacity as 538 MWe (Kamenosono, 2018). Although all these new plants are rather small in scale, two full-size plants of 10 MWe or larger, for which 3-year-long environmental assessment is required, will be in operation in 2019 in Hachimantai, Iwate and Wasabizawa, Akita. A topical thing is that Japan Oil, Gas and Metals National Corporation (JOGMEC), the current operating agent to give fiscal supports to private sectors, has begun a service to give technical advises to local authorities on issuing permission for geothermal developments. For this purpose, JOGMEC holds periodic advisory committee meetings consisting of geothermal experts in the nation.

As to ground source heat pump (GSHP) system, the number of installation has recently been increasing by 20% each year. About 2,230 systems were installed by the end of 2015, while there were 1,500 at the end of 2013 (MOE, 2016). The Geo-Heat Promotion Association of Japan, an NPO mainly consist of company members, promotes the installation.

(2) Research Activities

The hottest project on geothermal research is a national project on the subduction-origin supercritical geothermal resources, which is led by Geothermal Energy Team (GET) in the Renewable Energy Research Center (RENRC), AIST, and funded by New Energy and Industrial Technology Development Organization (NEDO), a funding agency of the Ministry of Economy, Trade and Industry (METI) (Fig. 3.2). The project was launched in 2017 after a two-year-prefeasibility study. The Cabinet Office of Japan considers subduction-origin supercritical geothermal resources as one of the most promising technology for green-house gas reduction toward 2050.

![Fig.3.2. Conceptual model of subduction-origin supercritical geothermal resources.](image)
As a funding agent of METI, JOGMEC also supports technology development by private sectors and/or research institutes. Besides, JOGMEC conducts its own geothermal R&D such as regional airborne geophysical survey, heat-hole survey, and drilling technology development.

In AIST, the Shallow Geothermal and Hydrogeology Team (SGHT), RENRC is conducting suitability mapping and developing the system optimization technologies for GSHP application, based on hydrogeological data, with consideration of the advection effect, for both closed and open loop systems. SGHT is collaborating with universities and institutes in Thailand, Vietnam and Indonesia on demonstration projects of GSHP in Southeast Asia.

A three-year project “Assessment on Necessary Innovations for Sustainable Use of Conventional and New-Type Geothermal Resources and their Benefit in East Asia” conducted by RENRC was over in the end of June 2018. It was a cooperation project with researchers from China, Indonesia, Korea, Malaysia, New Zealand, the Philippines, Thailand and Vietnam. The final report, giving new insights in the value of geothermal energy use and recommendation to policymakers, will be posted at the web page of the sponsor, the Economic Research Institute for ASEAN and East Asia (ERIA). RENRC has been organizing geothermal sessions in the Grand Renewable Energy 2018 (GRE2018), an international conference held in Yokohama, Japan in June 2018. Quite a few numbers of presentations were given from GET and SGHT teams.

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3.2.3. Groundwater Resources

(1) Summary
GSJ is implementing groundwater research on the following five topics: 1) publication of hydro-environment maps, 2) basic study for groundwater hydrology, 3) study of coastal deep groundwater, 4) technical cooperation with Southeast Asian countries, and 5) study of ground source heat pump systems.

(2) Scientific Research Activities for Groundwater
GSJ has published a series of digital hydrogeological maps, the “Water Environmental Map” for several basins and plains in Japan (Fig. 3.3). They are composed of geological and geomorphological maps and hydrological information such as water quality and groundwater table. A total of nine maps had been published by 2017. In 2018, two Water Environmental Maps of “Osaka Plain” and “Yufutsu Plain” will be released. Groundwater sampling has been done for future publication in the Niigata Plain, northern Kyushu and the Wakayama Plain.

GSJ has also conducted a study for a high-level nuclear waste program, developed an evaluation method for the stability of deep groundwater in coastal areas, and determined the zones where the groundwater is scarcely affected by long-term sea level change. In
2018, deep groundwater sampling is planned from a depth of 300 m to determine the groundwater age in northern Hokkaido.

(3) Activity in CCOP

The CCOP-GSJ-MME Groundwater Project Phase III Meeting was held in Siem Reap, Cambodia from 5 to 7 March 2018. In accordance with the 2017 Project workplan, Indonesia, Japan, Korea, Malaysia, the Philippines and Thailand have submitted their data respectively, with some modifications to the original workplan for the Philippines and Korea. The submitted groundwater data are accessible from the GSi Groundwater Portal, https://ccop-gsi.org/gsi/ccop_water/index.php. The data recently received from Indonesia, Malaysia and the Philippines are to be uploaded to the portal. China and Vietnam have still to contribute data to the Project as agreed in the previous meetings.

In the Sub-Project of the Development of Ground-Source Heat Pump (GSHP) System in CCOP Regions, a borehole heat exchanger was installed at the National Laboratory for Energy Conversion Technology (B2TKE), Agency for the Assessment and Application of Technology (BPPT), Indonesia in October 2017. A thermal response test (TRT) was conducted for the GSHP system installed at the Chulalongkorn University, Thailand to evaluate the apparent thermal conductivity of the ground (Fig. 3.4). Circulating heat medium (water) in the well with a fixed heat load, the temperatures at inlet and outlet of the well were measured. The thermal conductivity of the ground at the Chulalongkorn University was proved to be high enough for the cooling application of GSHP.

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3.3. Geological Hazards

3.3.1. Earthquake Related Studies

3.3.1.1. Studies of Active Faults

Onshore and offshore active faults were surveyed to determine their distributions and past earthquake activities with financial support from the Ministry of Education, Culture, Sports, Science and Technology (MEXT): The Ota Fault, the Kamogawa-teichi Fault, the Itoigawa-Shizuoka Tectonic Line Onshore Fault Zones, and the Ishikari-teichi-touen Offshore Fault Zone. In addition, paleoseismic investigation of the Futagawa Fault Zone (Fig. 3.5), one of the source faults of the 2016 Kumamoto earthquake, was also conducted. The cores drilled from the sea bottom of offshore segment of the Hinagu Fault Zone were also analyzed. These results were used by the Headquarters for Earthquake Research Promotion (HERP) of the Japanese Government for long-term evaluation of active faults.

HERP website: http://www.jishin.go.jp/main/index-e.html

![Fig. 3.5. Trenching survey on the east extension of the Futagawa Fault Zone (Sawazuno site), Kumamoto Prefecture.](image)

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3.3.1.2. Studies of seismotectonics

The local stress map in the Kanto district has been constructed on the basis of focal mechanism solutions of earthquakes within the earth's crust, which is currently being compiled into a technical paper. In this fiscal year, another study targeting the Chugoku district, where shallow large earthquakes occasionally occur (e.g., 1943 M7.2 Tottori earthquake, 2000 M7.3 Western Tottori earthquake), has started. More than 1,300 well-determined focal mechanism solutions have been obtained for the microearthquakes shallower than 25 km that occurred over approximately the past 13 years (Fig. 3.6). Most of the earthquakes show a strike-slip faulting mechanism with E-W compression, which
conforms to the general tectonic trend in this area. The local distribution of reverse-faulting earthquakes found in the study suggests the existence of stress heterogeneity in the area. These focal mechanism solutions are used as the primary information for constructing the stress map in the area.

![Stress map in the Kanto district (top right) and focal mechanism solutions in the Chugoku district (bottom left).](image)

**Fig. 3.6.** Stress map in the Kanto district (top right) (Imanishi et al., in preparation) and focal mechanism solutions in the Chugoku district (bottom left). The focal mechanisms are color-coded following the definition of Flohlich (1992), which classifies them as reverse (green), strike-slip (red), and normal (blue) faulting earthquakes.

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### 3.3.1.3. Study of subduction zone paleoearthquakes

Coastal paleoseismological study is important to evaluate seismic and tsunami hazards of offshore large earthquakes. GSJ has been conducting field surveys in coastal areas to clarify the source fault of past giant earthquakes generated from the subduction zone and offshore active faults, and its rupture history. The study basically deals with tsunami deposits, features of raised coastal landforms and historical documents in the areas along the Pacific coasts, which face the subduction zones (Kuril-Japan Trench, Sagami Trough, and Nankai Trough), and the Japan Sea coasts. Based on the obtained field data, a source fault model is built by simulating tsunami inundation or coseismic crustal movement. Our activity and results of the surveys in 2017 are as follows.

**Kuril-Japan Trench:** Imminent occurrence of a giant earthquake is anticipated along the southern part of the Kuril Trench. In order to evaluate the actual scale of tsunami inundation in the eastern coast of Hokkaido, a field survey to determine the ancient coastline positions and the inundation limit of the historic large tsunamis in the 13th and the 17th century was conducted.
**Sagami Trough**: To detect the geomorphological uplift caused by past subduction zone earthquakes, an objective method to detect the paleoshorelines of marine terrace was developed based on high-resolution DEM analysis and applied in the southern part of the Boso Peninsula. The results will contribute to the long-term forecast of a large earthquake in the Tokyo metropolitan area, which will cause a considerable damage.

**Nankai Trough**: The study is being carried out under the project entrusted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), “Disaster mitigation research project on Mega thrust earthquakes around Nankai/Ryukyu subduction zones”. To reconstruct the faulting history of the Fujikawa-kako Fault Zone, which is located at the eastern end of the trough, drilling core samples were obtained along the fault trace in both sides of uplift and subsidence and analyzed. Reconnaissance survey for tsunami deposit in the Miyazaki Plain, located in the western end of the trough, was also conducted in this project. In the Kikai Island, located on the southern extension of the trough, microatoll corals are found to have emerged in recent several hundred years, which may suggest their coseismic uplift (Fig. 3.7).

**Japan Sea**: In southwestern Hokkaido, a large tsunami was generated by an offshore active fault near Okushiri Island in 1993. GSJ found the geological evidence of the predecessor in the 13th century and proposed its fault model. These geological data including those of tsunami deposit in each site is being compiled and will be published on the website of the tsunami deposit database (https://gbank.gsj.jp/tsunami_deposit_db/) established by GSJ.

![Fig. 3.7. Survey of coral microatoll in the Kikai Island facing the Ryukyu Trench, southern extension of the Nankai Trough. Emerged coral microatoll of 270 cm in radius, developed during 14-17th century, indicates intermittent uplift probably due to past earthquakes.](image)

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### 3.3.1.4. Precise monitoring system for the Tokai, Tonankai and Nankai Earthquakes

GSJ has been constructing observatories to monitor groundwater and borehole strain in and around the expected focal zones of the Nankai and Tonankai earthquakes since 2006. Wells of 30, 200 and 600 meters deep were constructed in each of the observatories. Groundwater level and groundwater temperature are observed in each well, and a multi-component borehole strainmeter and a borehole tiltmeter are installed at the bottom
of either the 600 or 200 meters deep well. Sixteen observatories are in operation as of June 2018.

In order to estimate a fault-model of short-term slow slip events (S-SSEs) occurring at the plate boundary of the Nankai Trough, we proposed a method that estimates the spatio-temporal distribution and the duration of the S-SSE simultaneously by introducing a switching model. The switching model represents three forms in three periods. In the first and third periods, the fault is fixed, and in the second period, the fault is moving slowly. The time points at which the model changes as well as the parameters of the switching model are estimated by the maximum likelihood method using the Expectation-Maximization algorithm. Applying appropriate models depending on situation changes, the method improved the estimation accuracy of the slip distribution and the duration of the S-SSE. The method is also compared to the conventional ones through their application to the synthetic and real strain data.

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3.3.2. Volcanic Hazards

GSJ is studying volcanic and magmatic activities from a multi-disciplinary viewpoint. Eruptive histories of active volcanoes are studied with geological mapping and radiometric dating techniques. Assessment of volcanic activity is carried out by the analyses of eruptive materials and volcanic gas.

The geological map of Hachijojima Volcano, Izu Islands, was published in May 2018 (Fig. 3.8). The volcano had remained inactive for 400 years, but magma intrusion caused an earthquake swarm in August 2002. The map clarifies the eruption history in both land and sea areas of Hachijojima Volcano.


![Fig. 3.8. Geological map of Hachijojima Volcano (GSJ, AIST).](image-url)
Small phreatic eruptions took place on Kusatsu-Shirane Volcano, 150 km northwest of Tokyo, on 23 January 2018. One person was killed and eleven were injured including ski resort visitors. GSJ promptly surveyed the distribution of volcanic ash to estimate the eruptive volume and analyzed the volcanic ash (Fig. 3.9).

In the 2017-2018 eruption of Shinmoedake Volcano, southern Kyushu, a new lava flow filled the summit crater and flowed slightly across the crater rim (Fig. 3.10). Ejecta and volcanic gas were studied for the investigation of the eruption.


**Fig. 3.9.** Volcanic ash layer sandwiched between the snow that fell before and after the eruption, 2.8 km northeast from the new craters in Kusatsu-Shirane Volcano. Photo by Y. Ishizuka on 24 January 2018.

**Fig. 3.10.** The 2018 lava overflowing from the summit crater of Shinmoedake Volcano (dark area on the near side of the crater; view from northwest). Photo by T. Oikawa (GSJ) on 14 March 2018.

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3.4. Coastal Zone Geology

3.4.1. Seamless geological map in coastal area

In 2008, GSJ started the "Geology and Active Fault Survey of the Coastal Area" project. This project aims to contribute to the reduction of the earthquake risk in coastal zones where active faults and soft ground are distributed. GSJ conducts various surveys such as borehole drilling and high-resolution seismic and gravity profiling continuously from land to sea and makes seamless geological maps in coastal areas.

From 2014 to 2016, surveys of coastal geology were conducted in the eastern coast of the Boso Peninsula (Kujukuri Plain), Chiba Prefecture (Fig. 3.11) and northern coast of Sagami Bay (Sagami and Ashigara plains), Kanagawa Prefecture. In the Kujukuri area, the basement structure of the alluvium was revealed in the plain and the sea area and an anticline structure which affects the geological and geomorphological structures was found to present from the sea to land. In the Ashigara Plain, two subsidence events due to the activity of the Kozu-Matsuda Fault were found to have occurred after 8,000 years ago. These results are being compiled and will be published in 2018/2019.

From 2017, the survey around the Ise and Mikawa bays has started as a three-year project to estimate the active fault and marine terrace activities from Pleistocene to Holocene. Seismic reflection survey has been carried out on the seafloor of the Ise and Mikawa bays, and two borehole drilling in the Miyakawa Plain, western coast of the Ise Bay and in the Nishi-mikawa Plain, northern coast of the Mikawa Bay.

Fig. 3.11. Seamless geological map of the eastern coast of the Boso Peninsula.

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3.4.2. Three-Dimensional Geological Model in Coastal Urban Area

The 3D geological map covering the northern Chiba Prefecture, east of Tokyo Metropolis, was released on the website of the “Urban Geological Map”
The 3D mapping project of this area was carried out as a cooperative work with the Chiba Prefectural Environmental Research Center (CERC).

The map was created from a 3D geological model, which was constructed based on high-quality stratigraphic data and a vast number of borehole logs. The first step of the 3D mapping project was to establish the standard stratigraphic framework on the basis of the drilling survey data including detailed core description (sedimentary facies, marker tephra layers, and fossils), age measurement, and PS velocity and density logging. Next, borehole logs in the past public construction work accumulated by CERC were correlated with each other by adopting the stratigraphic framework stated above. Then the Digital Elevation Models (DEMs) of the geological boundary surfaces were generated on the basis of the correlated borehole data by using spline fitting technique. Finally, a 3D model is virtually constructed from the DEMs of the geological boundary surfaces and the logical model of geological structure. On the website, users can visualize subsurface geological structure in 3D to a depth of several tens of meters and generate cross-section images along arbitrary lines.

The next stage of the project is to construct the 3D geological map of Tokyo. We aim to publish the map in a few years in cooperation with the Civil Engineering and Training Center of Tokyo Metropolitan Government.

**Fig. 3.12.** 3D geological model of the Funabashi-Narashino area, Chiba Prefecture.

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### 3.4.3. Coastal Environment of Okinawa Islands

One of the projects implemented by GSJ is the study of the coastal environment of the subtropical Okinawa/Ryukyu Islands and the adjacent regions. The objective of this research is to better understand the relationship between marine coastal ecosystems and climate change both at regional and global scales.

The project includes researches based on coral skeletal climatology, where a unique method for accurately reconstructing marine environments over the past several hundred years with high temporal resolution (ca. 2 weeks) has been offered based on chemical and isotope analysis of long-lived coral skeletons. The reconstruction of the changes in past seawater pH using the long-lived coral samples and fossil corals is one of the major
topics of the research. Recently, boron isotope ratios (ratio of $^{11}$B and $^{10}$B; $\delta^{11}$B) in the coral skeleton has received much attention as a new proxy of past marine environments, because it is the excellent index of seawater pH. The ratio is measured using the thermal ionization mass spectrometry (TIMS) or the multi-collector inductively coupled plasma mass spectrometry (MC-ICP-MS).

The one-hundred-year history of ocean acidification recorded in the skeleton has been successfully deciphered with the results of high-precision analyses of boron and carbon isotopes in the skeleton of massive *Porites* corals collected from Kikai Island (Ryukyu Islands) and Chichijima Island (Ogasawara Islands). Interestingly, in both locations, the rate of decline in seawater pH has increased in the latter half of the 20th century. The data recorded in the corals confirm the fact of acidification trend in the western Pacific Ocean. It is indicated that the decreasing seawater pH may have lowered the pH of coral calcification fluid and that the ocean acidification may have negatively influenced the calcification of corals. The finding is crucial in estimating the future of coral ecosystem.

The study was conducted by the research group consisting of the University of Tokyo, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), the Meteorological Research Institute, and the Geological Survey of Japan, AIST and the result was published in *Scientific Reports* (Kubota et al., 2017, v. 7, 7694, doi: 10.1038/s41598-017-07680-0).

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### 3.5. Environmental Geology

#### 3.5.1. Soil Contamination

Soil contamination is a “negative legacy” of economic development and can be induced by almost all human activities. While the situation has become more and more serious in rapidly developing countries, remediation of contaminated soil still remains a big challenge in developed countries. A systematic study on characterization, remediation and risk assessment of different kinds of contaminants including chloroethylene (vinyl chloride: VC), a substance recently regulated in Japan, has been strategically performed at GSJ. Representative research topics in 2017 are as follows:

1) Examination of reliability associated with soil leaching tests: The effects of centrifugal intensity and filtration volume per filter were examined. The results demonstrated that the metal concentrations in the filtrate significantly varied depending on the centrifugal intensity when the intensity was 3000g for 2 hours or less. Increased filtration volume per filter significantly decreased the filtrate metal concentration when filter cake formed during the filtration. Cautions should be exercised when performing batch leaching tests. Detailed information is available at: [https://doi.org/10.1016/j.scitotenv.2017.12.048](https://doi.org/10.1016/j.scitotenv.2017.12.048).

2) Bioremediation of multiple volatile organic contaminants (VOCs): Stable Isotope Probing (SIP) technology was used to identify appropriate bacterial degraders for individual VOCs. *Hyphomicrobium* and *Propioniferax* were the main dichloromethane (DCM) and benzene degraders, respectively, under the coexistence of DCM, benzene and toluene. The known benzene degrader *Pseudomonas sp.* was not actively involved in the degradation. Detailed information is accessible at: [https://doi.org/10.1007/s11270-017-3604-1](https://doi.org/10.1007/s11270-017-3604-1).
3) Characterization of biodegradation properties of newly regulated substance VC: Field investigation (Fig. 3.13) and laboratory experiments have been performed to understand the biodegradation properties of VC. The factors are divided into three categories of biological, chemical and physical, and will be systematically examined in the ongoing project.

Detailed information on other research subjects are available from the following website: https://unit.aist.go.jp/georesenv/georisk/english/home/index.html

![Fig. 3.13. Field investigation at a site contaminated with chlorinated ethylene.](image)

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### 3.5.2. CO₂ Storage (CCS)

The Geological Carbon Dioxide Storage Technology Research Association, which is composed of four companies (OYO Corporation, INPEX Corporation, Japan Petroleum Exploration Co., Ltd., and Taisei Corporation) and two organizations (Research Institute of Innovative Technology for the Earth, and Geological Survey of Japan, AIST), was established in April 2016, to work on the project “Research and development of safety technology for geological CO₂ storage”. Its mission is to promote the development of technology for large-scale geological storage (1 million-ton CO₂/year) suitable for the geological conditions in Japan, and for improvement of social acceptance. The project is funded by the New Energy and Industrial Technology Development Organization (NEDO), which has taken over the role from the Ministry of Economy, Trade and Industry (METI) at the start of this fiscal year.

The project has three major objectives: (1) Establishment of safety management technology for large-scale geological storage of CO₂, (2) Establishment of technology for effective injection into and utilization of a large-scale storage site, and (3) Development of criteria and standards favorable for promoting CCS. Among these schemes, AIST works on the development of unique and superior core technology for low-cost monitoring, coupled-analysis of hydraulics and dynamics, and measurement of geochemical reaction rate. As to geophysical monitoring, the changes in gravity have successfully been measured at high resolution using a superconducting gravimeter at the CCS demonstration test site in Tomakomai, Hokkaido for more than three years. The separation of each gravity component, derived from various geophysical phenomena, from observed gravity data revealed a good correlation between the extracted gravity
changes (trend component) and rainfall data. Therefore, the next step is to numerically simulate the gravity change caused by the rainfall and to remove this noise component from the trend component to highlight the signal derived from injected CO2.

Technology exchanges and the dissemination of our research and development results are actively promoted taking every opportunity such as Japan-US cooperation on CCS research, international conferences of AOGS2018 (15th Annual Meeting of Asia Oceania Geosciences Society), and the 9th joint workshop on CO2 geological storage, groundwater, and geological disposal of radioactive waste, which was organized with the Korea Institute of Geoscience and Mineral Resources (KIGAM) at Horonobe, Japan, in September 2017.

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4. DATA AND INFORMATION

4.1. Summary
This chapter describes the publication and distribution of geo-information done by GSJ from July 2017 to June 2018.

4.2. Publication
(1) Maps
GSJ has published seven map sheets and one CD-ROM during the period of this report.
Map sheets
- 1:50,000 Geological Map (4)
- Miscellaneous Map Series (1)
- Volcano Map (1)
CD/DVD ROM
- Marine Geological Map (1)
Web
- Gravity Map (1)
- Miscellaneous Map Series (1)
(2) Others
Monthly newsletters “GSJ Chishitsu News” have been published both in print and on the web. Geoscientific reports newly published are:
- Bulletin of the Geological Survey of Japan (Vol.68, No. 4 - Vol. 69, No. 1) (4)
- Annual Report on Active Fault and Paleoeearthquake Researches (No. 17) (1)
- GSJ Interim Report (Nos. 74, 75) (2)
- GSJ Open-File Report (Nos. 644-653) (10)
- GSJ Technical Report (Nos. 8, 9) (2)

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4.3. Data Services

GSJ continues to develop download data and web service data.

Downloadable vector data (Shapefile and kml file)
- The geological maps of volcanoes (19)
- 1:50,000 Geological Map (25)

WMS/WMTS service
- The geological maps of volcanoes (19)

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4.4. Data Archive

GSJ has provided 1,663 records of the metadata of its maps to the geospatial information clearing house of the government, in Japan Metadata Profile (JMP) ver. 2.0 formats.

GSJ has also been operating a bibliographic database GEOLIS (Geological Literature Search System) since 1986, in which about 496,000 metadata are currently registered.

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4.5. ASTER Value-Added product open to the public

GSJ has provided ASTER Value-Added (hereafter ASTER-VA) product free of charge since 2016. ASTER, Advanced Spaceborne Thermal Emission and Reflection Radiometer is an advanced optical sensor onboard NASA’s TERRA satellite. GSJ has been involved in the sensor development originally for the earth resource exploration. Its data of over 3.2 million images collected from 2000 to 2018 cover the entire globe and have great potential for use in variety of businesses (Fig. 4.1). Aiming to promote their use, GSJ has distributed them for free with added value to meet not only for the exploration but the industry needs.

Fig. 4.1. Number of processed ASTER L1A scene.
MADAS (https://gbank.gsj.jp/madas/) is a system which can search for the ASTER-VA data without registration (Fig 4.2). ASTER-VA can be browsed and downloaded as KML and GeoTIFF format. ASTER-VA data as KML can be browsed on Google Earth and other web maps.

The user can also download ortho-rectified ASTER-VA by pushing the Tar button. This ASTER-VA contains all the ASTER ortho-rectified bands plus generated scene-based DEM, except for the band3B data (some bands may not be included depending on the observation mode). Atmospheric correction is not applied to the image. GeoTIFF format, which is easy to use with GIS software, is applied. Data is compiled as a single tar.gz file, which can be uncompressed by using free software (Fig 4.3).

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