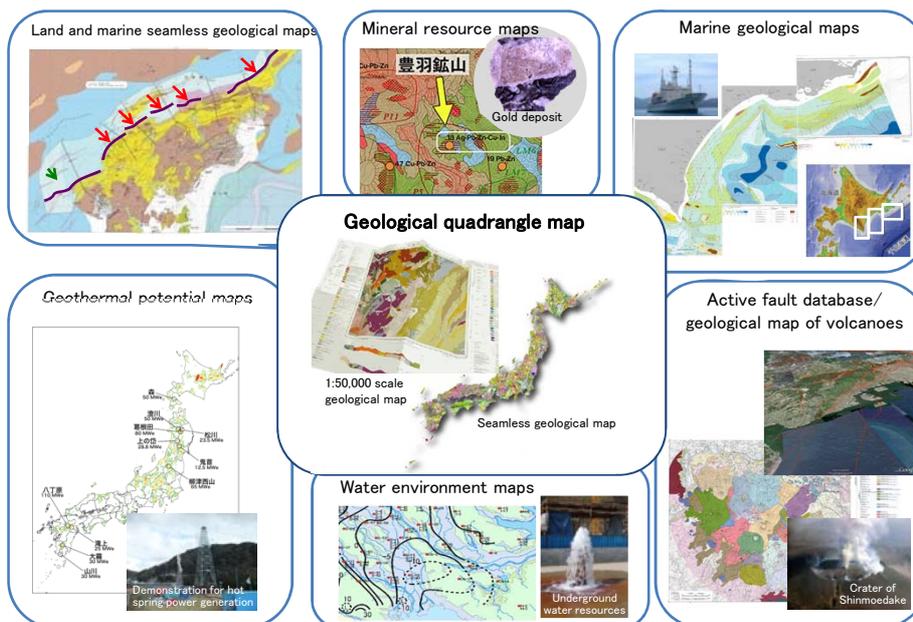


### III. Geological information

Category of use and application Type of geological information	Disaster prevention/reduction	People's lives	Supporting business operators	Environment/energy	Regulatory compliance
Geological quadrangle map, Seamless Digital Geological Map of Japan, etc.	<u>103-106</u> <u>109, 112</u>	<u>108, 134,</u> <u>135</u>	<u>100, 102</u> <u>106, 107</u> <u>110, 123</u> <u>134</u>	<u>101, 102</u> <u>108</u>	
Marine geological maps, etc.	<u>120, 121</u>	<u>122</u>		<u>120, 121</u> <u>122, 124</u>	
Active fault database, geological map of volcanoes, etc.	<u>113</u> <u>115-118</u>		<u>114</u>		
Mineral resource maps, geothermal potential maps, etc.	<u>128</u>		<u>125</u>	<u>125-130</u>	
Water environment maps, etc.	<u>119</u>	<u>119</u>		<u>119</u>	
Others	<u>111</u>	<u>133, 136</u> <u>137</u>	<u>131, 136</u> <u>137</u>	<u>131, 132</u>	



# Geological Information

## **1. What is geological information?**

Geological information refers to geological maps, database, etc. which express features of strata and rocks distributed underground and geological structures such as geological age and distribution.

Since the land of Japan is unique even throughout the world with complex geological structure consisting of steep mountains and plains, geological data collection and organization considering these features are necessary to fulfill responsibilities such as land maintenance and management, environmental conservation, and ensuring stable supply of resources and energy. And it is important to prepare these geological information as national basic information to be widely used by the people.

As geological information, there are basic and fundamental geological information such as 1:50,000 scale geological maps and 1:200,000 scale geological maps which are created for the same section as the topographical map of the Geospatial Information Authority of Japan and marine geological maps, and geological information for a particular purpose such as active fault database, geological map of volcanoes, mineral resource map, geothermal potential map, and water environment map, and have been organized by the government.

These geological information is used in a wide variety of fields. For example, in municipalities, geological maps, active fault database, geological map of volcanoes, etc. are used to create disaster prevention plans, realizing more realistic and detail disaster prevention activities. Furthermore, private enterprises can conduct safe and economical construction by understanding the geological information around the construction area through geological quadrangle map before the construction. In recent years, the information is also applied to evaluation of real estates, etc.

From the view point of securing stable supply of resources and energy, marine geological maps, mineral resource maps, etc. are used to understand the presence of reserved seabed mineral deposit including rare-earth elements and rare metals, and geothermal potential maps are used to investigate the possibility of introducing geothermal power generation, a renewable energy which has been gaining attention since the Great East Japan Earthquake.

## **2. Organizing geological information in Japan**

Geological information in Japan has been organized by the National Institute of Advanced Industrial Science and Technology (former Geological Survey of Japan, Agency of Industrial Science and Technology, Ministry of International Trade and Industry, hereinafter referred to as "AIST") which is the core organization for 130 years since its establishment.

AIST, as the national center for organizing geological information, has been working to organize basic information such as geological maps, to develop evaluation technique related to geospherical environment and resources, and to research on prediction of

geological disasters such as earthquakes and volcanoes.

Furthermore, to realize an economic society which allows safe, secure and fulfilling lives, AIST has also been promoting activities to improve maintenance and management of land in terms of natural resources, environment and disaster prevention. In particular, by organizing geological information based on the Basic Act on the Advancement of Utilizing Geospatial Information, integration of geographic information and other geospatial information can be facilitated.

Organization of geological information is a continuation of persistent works which includes walking through woods and such, and it was an extended 53-year work to create 1:200,000 scale geological maps of the entire nation. However, it is important to continue the work to prepare basic information of the nation.

### **3. Request for organizing geological information for a new era**

Taking into account the change in situation since the Great East Japan Earthquake and following the reconstruction basic guideline, AIST has been organizing survey of tsunami-related sediments, survey of active faults, etc. which help to prevent and reduce disaster.

Since the Great East Japan Earthquake, the number of access made by the people to the active fault database has been increasing rapidly, and the people are getting more interested in prevention and reduction of disasters.

Hereafter, to evaluate the geological risks of urban and plain areas, standard boring will be conducted primarily by AIST, and organization of geological information will be reinforced by centralizing the boring data.

In particular, by discussing centralization of the boring data scattered in individual municipalities and providing comprehensive geological ground information, a system which allows every person to understand the geological risks at his/her foot will be created and a geological information database which is easy to understand and easy to use will be organized.

Until now, geological information has been organized to target academic and construction experts, with focus on securing more professional and higher quality information. From now on, in addition to enrichment of high quality geological information, easy-to-understand and easy-to-use geological information will be organized and provided.



### III. Geological information

100. "Geological quadrangle map (1)"  
- Effective in reducing costs and making basic documentation for large scale civil engineering work -
101. "Geological quadrangle map (2)"  
- Basic data for developing domestic fuel resources -
102. "Geological quadrangle map (3)"  
- Used for environmental conservation and tourist promotion by the municipality -
103. "Seamless digital geological maps of Japan (1)"  
- Basic data for forecasting deep-seated landslide -
104. "Seamless digital geological maps of Japan (2)"  
- Used as information to predict earthquake motion -
105. "Seamless digital geological maps of Japan (3)"  
- Geological map to determine causes of landslides -
106. "Seamless digital geological maps of Japan (4)"  
- Geological map that deepens understanding for various disaster prevention and tourist information -
107. "Seamless digital geological maps of Japan (5)"  
- Basic information to introduce the region -
108. "Seamless digital geological maps of Japan (6)"  
- A clue to determine the source and cause of groundwater pollution -
109. "Urban geological ground maps (1)"  
- Map showing the seismic ground motion predicted from ground characteristics -
110. "Urban geological ground maps (2)"  
- Contributes to designing effective urban planning -
111. "3D ground structure models"  
- Contributes to information for predicting building damage and liquefaction risks due to earthquakes -
112. "Land and marine seamless geological maps"  
- Earthquake disaster prediction information for coastal areas -
113. "An active fault database (1)"  
- Provides information to promote repairs that resist earthquakes and earthquake disaster prevention -
114. "An active fault database (2)"  
- Information on on active faults to be used as indicators for real estate value -
115. "Tsunami inundation history maps"  
- Used for earthquake and tsunami disaster prevention -
116. "An underground water observation database relating to earthquakes"  
- Used for emergency alert announcements from underground water observation relating to earthquakes -
117. "Geological maps of volcanoes (1)"  
- Basic data to hand down volcanic disaster information -
118. "Geological maps of volcanoes (2)"  
- Information for predicting volcanic eruption disasters -

119. "Water environment maps"  
- For effective use of water resources and geothermal energy -
120. "Marine geological maps"  
- Contributes to exploration of marine resource and assessment of geological disaster risks -
121. "Sedimentological maps"  
- Contributes to geological disaster risk and assessing the presence of resources -
122. "Contributing to establish the outer limits of continental shelf"  
- Contributes to establish the outer limits of the continental shelf by providing geological evidence -
123. "Geochemical & risk assessment maps of subsurface soils"  
- Contributes to evaluating the geoenvironment for land utilization -
124. "Fine seabed aggregate resource maps"  
- Used for mining areas on the seabed with aggregate resources by local governments -
125. "Geothermal potential maps (1)"  
- Contributes to establishing a new energy introduction vision from local government -
126. "Geothermal potential maps (2)"  
- Basic information for introducing renewable energy -
127. "Geothermal potential maps (3)"  
- Utilizing for feasibility surveys for the introduction of small-scale geothermal power generation -
128. "Fuel resource maps"  
- To use natural gas safely -
129. "Mineral resource maps"  
- Basic information for the stable supply of mineral resources -
130. "Marine mineral resource distribution maps"  
- Used to develop seabed mineral resources -
131. "Aggregate resource survey reports"  
- Used as basic data for various development and environmental conservation measures and aggregate resource control measures -
132. "Gravity maps"  
- Used for resource exploration -
133. "Geochemical maps"  
- Provides information to respond to the needs of society to alleviate concern -
134. "JIS for geological maps"  
- Used to draft electronic delivery procedures for national geological and soil survey results -
135. "Earth science education for Japanese nation"  
- Geological maps used to educate the people about earth science -
136. "The geological museum, GSJ, AIST"  
- Geological museum used for educational purposes -
137. "Geological sample database"  
- Contributes to educational use of rock samples -

## 100. Examples of utilizing geological quadrangle map (1) – 1:50,000 scale geological maps –

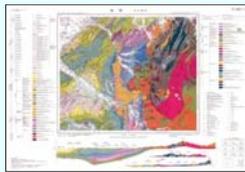
### What is 1:50,000 scale geological quadrangle maps?

They are geological maps that show geological structure, geological age and features of geological units distributed under the top soil and vegetation in an area of a 1:50,000 scale topographic quadrangle map issued by the Geospatial Information Authority of Japan.



### Creating and supplying geological quadrangle maps

- Created as basic intellectual information for the country.
- Plays a role as a standard for various geological surveys.



With a detailed investigation:

- Establishes standard stratigraphy
- Categorizes geological units

Geologic information standards for the region and its surrounding area

Geological information including locations of faults and deformed are of strata and rocks is described in maps and research report along with features, age, and type of strata and rocks.

### – Effective in reducing costs and making basic documentations for large scale civil engineering work –

This has proven effective for such as “cost reduction” and “shortening investigation period” for operators by having an overview of the geological features, and knowing the geological situation in order to select the work and construction site, etc., from geological information on the geological quadrangle maps.

Examples of use for region investigation to construct railways and roads



Independent contractor (Geological survey)

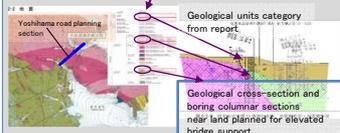
1:50,000 scale geological quadrangle maps are directly used for the investigation work.

• Uses “wide area survey” and “geological overview” for the **Investigation report**



Order (Japan Railway Construction, Transport and Technology Agency)  
Kyushu Shinkansen between Shin-Yatsushiro and Nishi-Kagoshima geological map, March 2004  
Japan Railway Construction, Transport and Technology Agency, Railway Construction Headquarters, Kyushu Shinkansen construction office

• “Legends” for geological quadrangle maps in geological units category for civil engineering work specialized geological survey are used for **reference**.



Order (Tohoku Regional Bureau Ministry of Land, Infrastructure and Transport)

FY 2009, Value ground survey outside Takada district, Report (Yoshihama road compilation)

## 101. Examples of utilizing geological quadrangle maps (2) – 1:50,000 scale geological maps –

### What are 1:50,000 scale geological quadrangle maps?

They are geological maps that show geological structure, geological age and features of geological units distributed under the top soil and vegetation in an area of a 1:50,000 scale topographic quadrangle map issued by the Geospatial Information Authority of Japan.



### Creating and supplying geological quadrangle maps

- Created as basic intellectual information for the country.
- Plays a role as a standard for various geological surveys.



1:50,000 scale geological map of “Kamo”

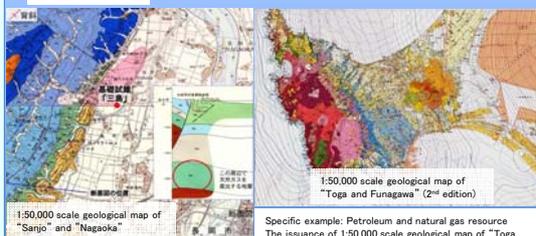
Geological information including fault and geological deformation points along with features, age, and type of subterranean strata and rocks is described in maps and instruction booklets.

### – Basic data for developing domestic fuel resources –

“Possibility of new mineral exploration” and “shortening investigation period” is expected through understanding geological structure (whether it is a deformation that potentially stores natural gas) and features (whether it will bear natural gas) of strata on the geological map.

Data such as strata classification (age, rock type) and geological structure (faults, etc.) on geological quadrangle map are used as basic data in addition to own information, and become materials for investigation for possible mining.

#### Natural gas



1:50,000 scale geological map of “Sanjo” and “Nagaoka”

Provides detail information on geological structure and classification of strata bearing natural gas.

Specific example: Petroleum and natural gas resource  
The issuance of 1:50,000 scale geological map of “Toga and Funagawa” (2nd edition) clarified the accurate stratigraphy of the region and it was confirmed that it would be worth exploring minerals at Oga Peninsula, which was previously determined to have no value for mineral exploration. A ground surface geological survey and geophysical mineral exploration on the scale of several hundred million to 1 billion yen is being conducted. Also, this information is used in other regions as exploration reference data for fuel resources. Japan Petroleum Exploration Co., Ltd.

Highly reliable geological information is used as basic data for resource exploration.

## 102. Examples of utilizing geological quadrangle maps (3) – 1:200,000 scale geological maps

### ■ What are 1:200,000 scale geological quadrangle maps?

They are geological maps that show geological structure, geological age and features of geological units distributed under the top soil and vegetation in an area of a 1:200,000 scale topographic quadrangle map issued by the Geospatial Information Authority of Japan.



### ■ Creating and supplying geological quadrangle maps

- 1:200,000 scale geological quadrangle maps have been completed for 124 quadrangles in the entire country.
- Created as basic intellectual information for the country.
- Plays a role as a standard for various geological surveys.



A geological survey and existing geological information has currently been compiled to create a 1:200,000 scale geological quadrangle map of "Yakushima", and along with the geological map, items such as the formational ages and chemical analysis data of rocks are included.

### - Used for environmental conservation and tourist promotion by the municipality -

Used as basic data for when introducing things such as the natural landscape of an area to show the location on geological maps and as means to popularize the area.

Example of utilizing as basic maps and information to introduce the natural landscape of an area

The municipality is starting to emphasize the following items:

- Nature is treated as a tourist attraction and used with the aim of stimulating the local economy.
- Effort is put into conservation activities to protect the natural environment.
- Academic knowledge is acquired and popularized to support these activities.

Environmental training projects of the Yakushima Environmental and Cultural Foundation

Aichi Environmental Research Center  
"Cultural history of water from the Toyokawa basin"  
<http://www.pref.aichi.jp/kankyo-c/nature/toyogawa/geo.html>



Poster  
"The Geology of Yakushima"  
published by the Geological Museum  
Guidebook created



Photo provided by: Yakushima Environmental and Cultural Foundation

○ Geological map is included in the Yakushima nature guidebook as a base map, and places of note in the region are introduced in the geological map.

○ Photos of spring water, etc., in the region are also introduced along with geological information for the location.

## 103. Examples of utilizing Seamless Digital Geological Map of Japan (1)

### ■ What is Seamless Digital Geological Map of Japan (1:200,000)?

The Seamless Digital Geological Map of Japan (1:200,000), which was made using the general legend shown by the age and the kind of strata or rocks (ex. sedimentary rock, igneous rock, metamorphic rock).



### ■ Creating and providing Seamless Digital Geological Map of Japan

- AIST has completed the publication of 1:200,000 geological maps of Japan.



➢ They are distributed via international standards Web Map Service (WMS).

➢ Users can extract rocks and ages from the map according to their needs (e.g. extract accretionary complex that are prone to collapsing).

\*Note: Accretionary complex: A group of complex strata created by subduction of an ocean plate at a continental margin.

### - Basic data for forecasting deep-seated landslide -

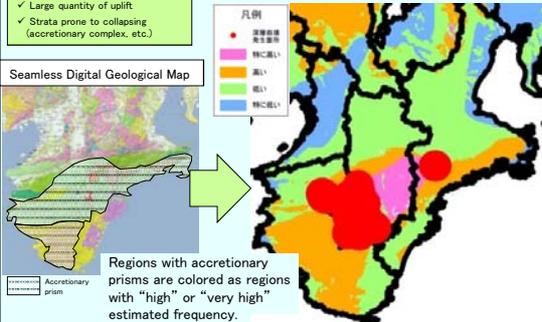
Uses Seamless Geological Map of Japan (1:200,000) to understand the distribution of accretionary complexes that are prone to collapsing.

Seamless geological map show the accretionary prism as one of the geological classifications. Accretionary prisms are considered as one of the causes of deep-seated landslides.

Causes of deep-seated landslides:  
✓ Large amounts of rainfall and snowfall  
✓ Large quantity of uplift  
✓ Strata prone to collapsing (accretionary complex, etc.)

- Example of using seamless geological maps to estimate the frequency of deep-seated landslides -

Deep-seated landslide estimated frequency map (MLIT)



Regions with accretionary prisms are colored as regions with "high" or "very high" estimated frequency.

Areas prone to collapsing are estimated from data for weather conditions and plateau projection along with information for accretionary complex in the seamless geological map.

Deep-seated landslide is a landslide in which the sliding surface is deeper than shallow landslide, and a comparatively large scale.

## 104. Examples of utilizing Seamless Digital Geological Map of Japan (2)

### What is Seamless Digital Geological Map of Japan (1:200,000) ?

The Seamless Digital Geological Map of Japan (1:200,000), which was made using the general legend shown by the age and the kind of strata or rocks (ex. sedimentary rock, igneous rock, metamorphic rock).



### Creating and providing Seamless Digital Geological Map of Japan

- AIST has completed the publication of 1:200,000 geological maps of Japan.



➢ They are distributed via international standards Web Map Service (WMS).

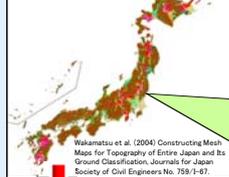
➢ Users can extract rocks and the age from the map according to their needs (e.g. extract strata distribution from the Cenozoic era; Cenozoic era stratum is a layer of rock that is generally soft).

### - Used as information to predict earthquake motion -

The Seamless Digital Geological Map of Japan (1:200,000) is used to understand the distribution of Cenozoic strata prone to trembling.

Examples of using geological information on the Seamless Digital Geological Map of Japan to predict earthquake motion by converting the information to stratum hardness for each strata classification.

#### Surface geology mesh map



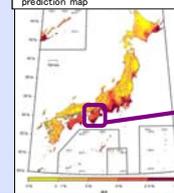
The type of earth tremor is determined by the hardness of the ground. Terrain classification maps with high accuracy are required for position accuracy, and a high level of position accuracy is required to prevent disasters.

Surface geology mesh maps are created as ground classification maps with a high level of position accuracy for entire Japan by applying the geological information to terrain classification maps.

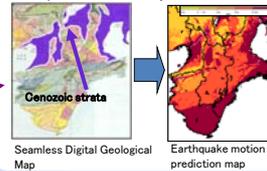
#### Adapting geologic classification to geographic classification

Soft stratum: Green: Lowland, yellow: Diluvial plateau  
 = Cenozoic strata distribution  
 Hard stratum: Red: Volcano, brown: Hard rock  
 = Volcanoes and hard geological rocks

#### "Stochastic earthquake motion prediction map"



Cenozoic strata is soft  
 → There is a tendency for the earthquake motion to be amplified and the intensity to increase



This provides a graphic display of the probability to experience tremors at seismic intensity of 6 (lower) or above within the next 30 years. The darker the color, the greater the probability. (The Headquarters for Earthquake Research Promotion)

## 105. Examples of utilizing Seamless Digital Geological Map of Japan (3)

### What is Seamless Digital Geological Map of Japan (1:200,000) ?

The Seamless Digital Geological Map of Japan (1:200,000), which was made using the general legend shown by the age and the kind of strata or rocks (ex. sedimentary rock, igneous rock, metamorphic rock).



### Creating and providing Seamless Digital Geological Map of Japan

- AIST has completed the publication of 1:200,000 geological maps of Japan.



➢ They are distributed via international standards Web Map Service (WMS) (It is easy to investigate the correlation by overlay with other geospatial information).

➢ Users can extract rocks and the age from the map according to their needs.

### - Geological map to determine causes of landslides -

Seamless Digital Geological Map is highly utilized due to their feature of being transmitted in an international standard service and able to overlay to other geological information (for example, landslide maps, NIED) to clarify the correlation.

An example of overlay of NIED landslide map on Seamless Digital Geological Map  
 WMS distribution over the government gateway for geographical information

#### Causes of landslides:

- ✓ Sliding surface: Stratum prone to sliding
- ✓ Terrain: Land slopes such as mountains and hills
- ✓ Stratum prone to collapsing
- ✓ Rise in underground water level

Geology of landslide can be recognized as Neogene mudstone, metamorphic rocks and altered volcanic rocks.



<http://mapgateway.gis.go.jp/WMSGateway/jsp/main.jsp>

Since **Seamless Digital Geological Map of Japan** (1:200,000) is distributed by WMS, it can be used as base maps for various data.

The government gateway for geographical information is a GIS portal site to promote the popularization of the interface commonly equipped by each government department in order to work towards the use and application of geographical information across all government departments for the GIS Action Program 2010 (decided by the promotion council for positioning and geographical information system, etc.)

## 106. Examples of utilizing Seamless Digital Geological Map of Japan (4)

### What is Seamless Digital Geological Map of Japan (1:200,000) ?

The Seamless Digital Geological Map of Japan (1:200,000), which was made using the general legend shown by the age and the kind of strata or rocks (ex. sedimentary rock, igneous rock, metamorphic rock).



### Creating and providing Seamless Digital Geological Map of Japan

• AIST has completed the publication of 1:200,000 geological maps of Japan.



➢ They are distributed via international standards Web Map Service (WMS).

➢ Users can extract rocks and the age from the map according to their needs (e.g. extract ejecta information on the specific volcano).

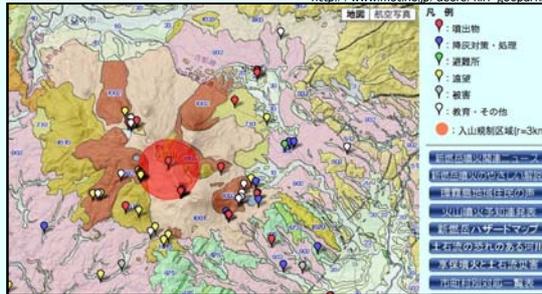
### - Geological map that deepens understanding for various disaster prevention and tourist information -

Geological maps are used for securing of safety and increase of understanding for local residents concerning disaster prevention and securing safe evacuation routes by overlaid information such as current eruption information and evacuation points and volcanic geological information (distributions of pyroclastic flow and lava of past eruptions) shown on Seamless Digital Geological Map of Japan.

Example of overlay of various data by the user on **Seamless Digital Geological Map of Japan** and releasing it on the internet

Shinmoedake eruption related information (Kirishima Geopark)

<http://www.mct.ne.jp/users/kiri-geopark2/>



As a response to the Kirishima volcanic eruption, AIST plotted various vital information (controlled entry zone to the mountain, location of evacuation points, far observation sites, observation sites to view falling volcanic ash, locations where damages occurred) on a seamless geological map, and updated this information in real time to provide it to the people in the area.

## 107. Examples of utilizing Seamless Digital Geological Map of Japan (5)

### What is Seamless Digital Geological Map of Japan (1:200,000) ?

The Seamless Digital Geological Map of Japan (1:200,000), which was made using the general legend shown by the age and the kind of strata or rocks (ex. sedimentary rock, igneous rock, metamorphic rock).



### Creating and providing Seamless Digital Geological Map of Japan

• AIST has completed the publication of 1:200,000 geological maps of Japan.



➢ They are distributed via international standards Web Map Service (WMS). (It is being distributed in a format that is easy to use by professional and general users on Web-GIS and Google Maps, etc.)

➢ Users can extract rocks and the age from the map according to their needs. (Investigate the geological background of nearby natural landscapes in the area).

### - Basic information to introduce the region -

Geological maps are used as basic data that introduce the region by associating with landscapes and waterfalls in the area with geological background which includes distribution of rocks shown on seamless geological maps.

Route setting for waterfall-tour and photos and explanations of waterfalls in the area are introduced on the homepages.

The geological background of natural landscape such as waterfalls, etc., increases interests of tourists and can fulfill their intellectual curiosity.

#### Explanation for waterfall and river development with geological information

• Users Group for Natural History Museum and Institute, Chiba:  
Waterfall tour  
<http://chibataki.moo.jp/tomonokaial/2007taki/071103album/abukumatakialbum.html>



Seamless Digital Geological Map of Japan is distributed on several GIS services such as Google Maps and Google Earth. Therefore, general users find them easy to use. Many users use the geological map because the Google Maps/Google Earth versions is easy to add information onto.

## 108. Examples of utilizing Seamless Digital Geological Map of Japan (6)

### What is Seamless Digital Geological Map of Japan (1:200,000) ?

The Seamless Digital Geological Map of Japan (1:200,000), which was made using the general legend shown by the age and the kind of strata or rocks (ex. sedimentary rock, igneous rock, metamorphic rock).



### Creating and providing Seamless Digital Geological Map of Japan

• AIST has completed the publication of 1:200,000 geological maps of Japan.



- They are distributed via international standards Web Map Service (WMS).
- Users can extract rocks and the age from the map according to their needs (show the geological condition of earth's surface).

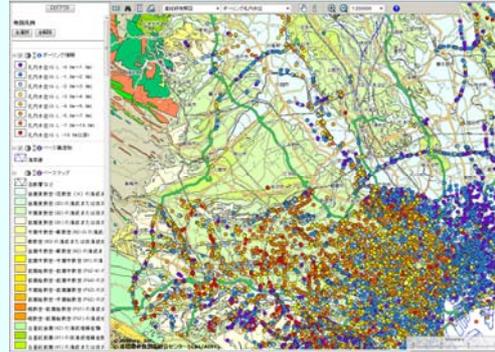
### - A clue to determine the source and cause of groundwater pollution -

Contaminants in drinking groundwater are one of the threats against sustainable human's life. For example, a heavy metal pollution is often influenced by local geological and hydrogeological conditions. The layered seamless map give us a clue to determine the source and cause of the pollution.

Example of plotting deep well information and boring data held by a company on the Seamless Digital Geological Map of the Kanto Plain

G-Space II: Asahi Geo Survey Co., Ltd.

<http://www.asahigs.co.jp/gspace/dataservice.html> (Permission granted to use seamless geological map)

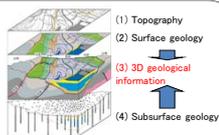


Display of the seamless geological map, showing the surface geology, borehole locations and groundwater levels overlaying a map. The seamless geological map is useful when designing the survey of groundwater pollution, and evaluating the vulnerability of the land against the artificial pollution.

## 109. Examples of utilizing urban geological maps (1) - Seismic hazard map -

### What are urban geological maps?

Geological maps that show the distribution of strata based on surface geology and borehole logs in urban areas.



### Urban geological maps

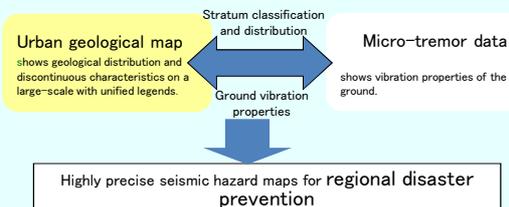
Urban geological maps are drawn based on the existing documentation and additional survey results around the urban area.



Subsurface geological information shows the 3D distribution of soft layers, bedrocks and the physical properties of each stratum.

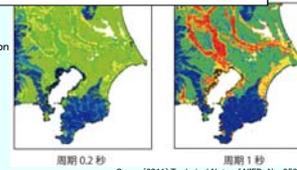
### - Map showing the seismic ground motion predicted from ground characteristics -

The amplification of seismic ground motion can be predicted to a high degree of accuracy by using subsurface geological maps based on borehole logs.



Assumed utilization examples

Detailed mapping of amplification by period.  
Calculate amplification by each vibration property over long and short periods.  
[Application]  
Maximum seismic ground motion prediction  
Liquefaction prediction  
Earthquake-proof design  
Industry site evaluation

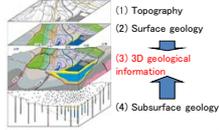


Seismic ground motion shows the degree of the amplification due to the effect from ground. In general, long-period vibration is amplified where soft sediments are thickly deposited, which causes substantial damage to high-rise buildings, oil tanks and wooden houses. Knowing these features allows plans to be optimized for disaster prevention and industrial site design by incorporating earthquake countermeasures.

## 110. Examples of utilizing urban geological maps (2)

### What are urban geological maps?

Geological maps that show the distribution of strata based on surface geology and borehole logs in urban areas.

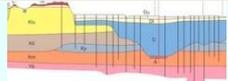


### Urban geological maps

Urban geological maps are drawn based on the existing documentation and additional survey results in urban areas.



#### Enhancement of subsurface geological information



Subsurface geological information shows the 3D distribution of soft layers, bedrocks and the physical properties of each stratum.

### Contributes to designing effective urban planning

The depth of the engineering base and the thickness of a soft sediments shown in Urban geological maps are expected to be used as basic information for effective infrastructure development, urban planning, industrial site planning, real estate value assessment, etc.

### Assumed utilization examples

#### Urban geological map in an urban area



Provides with geological and ground information on a large-scale with unified legends

Reclaimed land? Natural ground? Any soft layers? How thick?



Residential land selection, buying and selling (individuals and companies)

What is the depth of the base to support the foundations for constructions?



Urban infrastructure development (National, local governments and companies)



Industrial site planning (National, local governments and companies)

## 111. Examples of utilizing 3D ground structure models

### What is a 3D ground structure model?

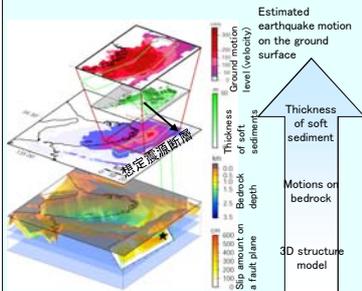
A 3D ground structure model shows the bedrock, sedimentary thickness and earthquake faults.



Subterranean structure of the Ishikari plain

### Maintaining 3D ground structure models

It shows the estimated results such as the predominant period and level of the ground shaking that travels across soft sediments and near-fault earthquake motion based on the shape of an embedded fault and the 3D spread of stratum.

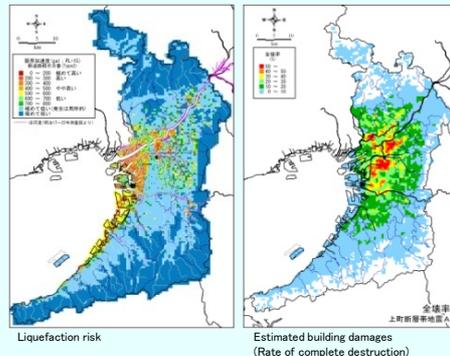


### Contribution to information on building damage and liquefaction risks due to earthquakes

The national and local governments estimate damages such as fire outbreaks, casualties and building damages from population and building characteristics (timber-built, steel reinforced, high-rise, etc.) using characteristics of strong motions on the ground surface due to hypothetical earthquakes and subterranean structure shown in the 3D ground structure models.

Example of utilizing estimated building damages and liquefaction risks from ground motion predictions from 3D ground structure models

#### Estimated damages in Osaka (e.g. From Osaka Prefecture natural disaster comprehensive disaster prevention measures investigation (March, 2007))



Liquefaction risk

Estimated building damages (Rate of complete destruction)

## 112. Examples of utilizing land and marine seamless geological maps - Geological and active fault information

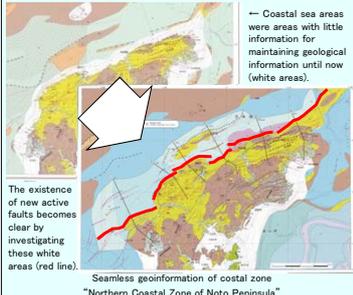
### ■ What are land and marine seamless geological maps?

They are geological maps developed as comprehensive geological information on regions of sea and land by performing surveys that focus on places where the sea and land meet, for which little geological information was known until now. The connection of stratum from faults at coastal areas and areas of the ocean surrounded by coastline to areas of land are shown.



### ■ Maintaining and supplying land and marine seamless geological maps

- Maintain geological information without interruption between land and sea for the Niigata plain and the northern part of the Noto Peninsula as a collection of land and marine seamless geological information.
- Select regions of importance for priority infrastructure and disaster risk and maintain the maps in the near future.



### - Earthquake disaster prediction information for coastal areas -

Contributes to re-evaluation of earthquake disaster risk by clarifying whether active faults exist in regions with little information (sea and land boundary zone) by investigating these coastal areas where little geological information is known.

#### Assumed utilization examples

##### Mitigating large disaster risks for priority infrastructure

Conducts measures to reduce specific disaster risks for industrial locations and constructions for such as harbors, factories and bridges based on reviews of strong vibration and liquefaction predictions due to ground characteristics and earthquake risks.



##### Developing waterfronts that is resistant to disasters

Preserves landscape and develops reclaimed land, shipping lanes and harbor facilities that are resistant to disasters based on accurate ground characteristic evaluation and disaster risk assessment with anticipation of reconstructing production, distribution and tourist sites that are essential for strategic growth.



##### Coastal erosion control based on medium and long-term predictions

Coastal erosion measures based on medium and long-term coastal erosion and deposition predictions based on sedimentology analysis for deposition and erosion according to sea level changes that extend to about 100 m over approximately 10,000 to 20,000 years in the past along the coastal plain.



## 113. Examples of utilizing an active fault database (1) - municipality use -

### ■ What is an active fault database?

This is a compilation of data for active faults in Japan that are known to be 10 km or more in length. The locations of the active faults and the characteristics of each type of active faults can be searched in this database.



### ■ Maintaining and supplying an active fault database

This compiled information comprised of 4 data types was edited and interpreted by AIST from data recorded in existing documentation.

- Distribution of active faults (behavioral segments) throughout Japan and their parameters
- Bibliographic data from documentation relating to active faults in Japan
- Survey result data for each site recorded, edited and interpreted from existing documentation
- Subterranean structure data for up to several dozen meters underground

Versions for HTML, Google Map, GSI Maps, etc. are available

Example of simplified display of individual fault

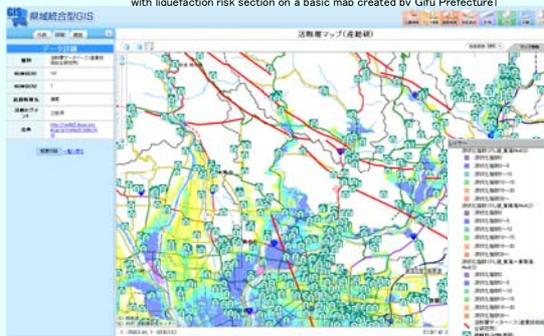


### - Provides information to promote repairs that resist earthquakes and earthquake disaster prevention -

Used for basic information for regional disaster prevention plans and for plans to promote repairs that resist earthquakes by combining regional disaster prevention information with activity history and locations of active faults obtained from the active fault database.

Example of utilizing the active fault database by combining it with regional disaster prevention information for regional disaster prevention

[A map that includes active faults and locations for evacuation points, and a map with liquefaction risk section on a basic map created by Gifu Prefecture]



Region integrated GIS Gifu (Construction Research Center of Gifu Prefecture)

- Integrated browsing of various regional information is possible over the internet as an integrated type GIS. The active fault database is used as part of the content of this service.

## 114. Examples of utilizing an active fault database (2) – private real estate company use –

### What is an active fault database?

This is a compilation of data for active faults in Japan that are known to be 10 km or more in length. The locations of the active faults and the characteristics of each type of active faults can be searched in this database.



### Maintaining and supplying an active fault database

This compiled information comprised of 4 data types was edited and interpreted by AIST from data recorded in existing documentation.

- Distribution of active faults (behavioral segments) throughout Japan and their parameters
- Bibliographic data from documentation relating to active faults in Japan
- Survey result data for each site recorded, edited and interpreted from existing documentation
- Subterranean structure data for up to several dozen meters underground

Versions for HTML, Google Map, GSI Maps, etc. are available

Example of simplified display of individual fault



### Information on active faults to be used as indicators for real estate value –

Locations and other information for active faults obtained using the active fault database are understood and used for planning facility sites for companies, valuing real estate, etc.

An example of using the active fault database as a service that provides an explanation to companies and residents after assessing the activity level/ground information and active fault locations for points specified by private companies.



A fault location map from the active fault database is used.

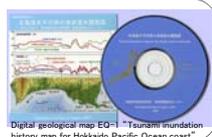
A comprehensive assessment service company for compiling information searches (Geonet Online Co., Ltd.)

- The active fault database is used as part of the content for "Geonet Online".

## 115. Examples of utilizing tsunami inundation history maps

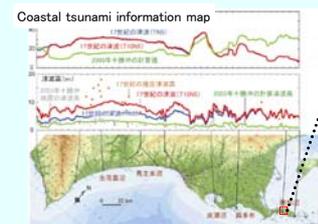
### What are tsunami inundation history maps?

They are maps that show inundation areas due to large tsunamis that occurred from past earthquakes on a topographical map based on tsunami simulation results using geological field survey data.



### Maintaining and supplying tsunami inundation history maps

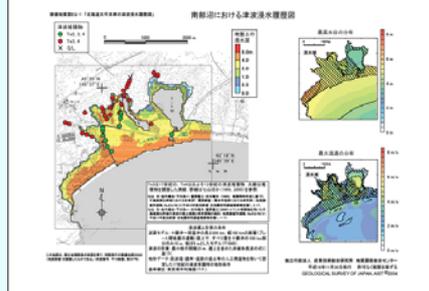
- A graphic display of the tsunami inundation history due to large earthquakes generated from plate interface along the Pacific Ocean coast of eastern Hokkaido from Nemuro to Urakawa, the arrival time and tsunami height.
- Shows the distribution of tsunami deposit, maximum tsunami height and flow velocity for marshy lowlands at five areas between Nemuro and Urakawa.



### Used for earthquake and tsunami disaster prevention –

The arrival time and height of tsunamis that will occur in the near future can be evaluated, and based on the information, earthquake and tsunami disasters can be prevented by using results of a simulated earthquake model assumed from past tsunami inundation and its history shown on a tsunami inundation history map.

Example of tsunami inundation history map for each area



➢ Central and local governments have established regional disaster prevention plans, using the tsunami inundation history maps as the basic data.

➢ It is possible to estimate the hazard of large tsunamis that are likely to occur in the near future including those of the maximum scale, based on empirical data from past large tsunamis.

⇒ Prepare a more effective disaster prevention plan

Laws for regional development to prevent tsunami disaster (enforced from December 2011)

<Implementation of measures relating to tsunami disaster prevention>

## 116. Examples of utilizing an underground water observation database relating to earthquakes

### What is underground water observation relating to earthquakes?

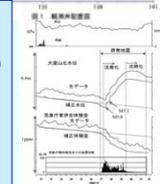
It is known that underground water levels and distortions change due to precursors that occur prior to earthquakes. This observation supplements these data for large earthquakes from a perspective of short and medium-term forecast.



### Providing underground water observation data relating to earthquakes



Observes seismic waves, water temperature, distortions, underground water level, etc. at about 60 observation points with aims of predicting and researching earthquake in the Tokai, Tonankai and Nankai regions. Graphs for observed data are updated daily and are available on the AIST homepage.



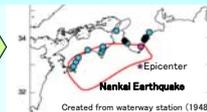
### - Used for emergency alert announcements from underground water observation relating to earthquakes -

Data acquired by observing underground water is forwarded to the Japan Meteorological Agency in real time and then used to monitoring for earthquake predictions for the Tokai region.

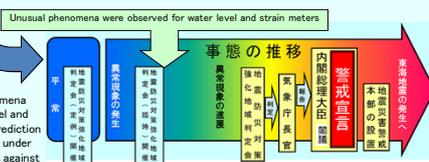
Example of utilizing in evacuation advice by predicting earthquakes from changes in underground water level, etc.

Background: Example of water level changes prior to earthquake (Nankai Earthquake in 1946)

There were several signs such as well water level dropping prior to the Nankai Earthquake in 1946.



At the time, waterway stations data showed underground water level drops and hot spring water level drops prior to the earthquake.



When unusual phenomena occurs for water level and strain meters, the Prediction Council for the Area under Intensified Measures against Earthquake Disaster will be held (on a temporary basis) and prediction information will be announced from the Japan Meteorological Agency.

気象庁発表の「東海地震に関する情報」

東海地震に関する緊急情報  
東海地震注意情報  
東海地震予知情報

「カラーレベル Ⅲ」  
「カラーレベル Ⅱ」  
「カラーレベル Ⅰ」

防犯機関等の対応  
情報収集  
準備行動  
東海地震に関する最新情報  
最新情報に関するお問い合わせ

## 117. Examples of utilizing geological map of volcanoes (1) - Geological Map of Volcanoes-

### What are geological map of volcanoes?

Geological maps of volcanoes are those made to show eruption history for active volcanoes. They show the eruption ages distribution in which lava flows and volcanic ashes, and pyroclastic flow deposits spewed out of an active volcano.



### Maintaining and supplying geological map of volcanoes

A geological map of volcanoes can be used as a past volcanic disaster map. By understanding the eruption history of an active volcano, it is possible to predict volcanic activity in the near future from the perspective of disaster prevention.



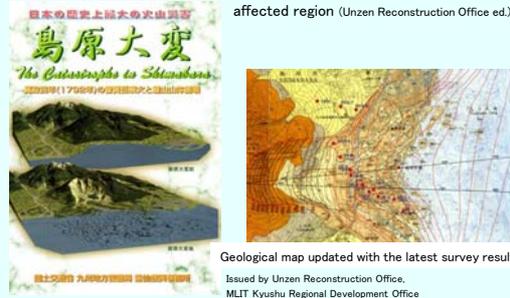
An active volcano is a volcano that erupted around ten thousand years ago or sooner. AIST has completed maintenance of data for 16 volcanoes that are highly active. Maintenance of geological information for volcanoes is in progress along with 1:50,000 scale geological maps.

### - Basic data to hand down volcanic disaster information -

In volcanic disaster prevention, geological maps of volcanoes are used as basic data to hand down volcanic disaster information based on the eruption history for the ages and distribution of pyroclastic flow deposits shown on the maps.

An example that easily explains eruption styles and sequences using a geological map of volcanoes as well as several old documents and illustrations of the eruption.

Documents for handing down volcanic disaster information in the affected region (Unzen Reconstruction Office ed.)



The eruption of Unzen in 1792 was the worst volcanic disaster in Japan. A tsunami occurred due to the large-scale collapse of the volcano. Approximately 15,000 people were killed around the Shimabara Bay. The event was called "the Catastrophe in Shimabara" and remained on record in old documents, etc. The Shimabara Reconstruction Office has compiled information to hand down to future generations on its homepage and within pamphlets.

## 118. Examples of utilizing geological map of volcanoes (2) –Geological maps /Active volcano database –

### ■ What is an active volcano?

An active volcano is one that has erupted in the past 10,000 years.



### ■ Maintaining and supplying a geological map of volcanoes/active volcano database

○ A geological map of volcanoes is one that shows geology from the perspective of eruption history.

○ Eruption history, scale and style for each active volcano throughout Japanese Islands have been collected into a database by AIST for use as an active volcano database.



Geological Map of Sakurajima Volcano

○ The history of lava flows and volcanic ashes that spewed out of an active volcano can be recognized using the geological maps of volcanoes. Knowing the eruption history means predicting future activity from the perspective of preventing a volcanic disaster.

○ Maintenance of geological information for volcanoes is in progress not just for geological maps of volcanoes but also for 1:50,000 scale geological maps.

16 geological maps of volcanoes have published for highly active volcanoes.

### – Information for predicting volcanic eruption disasters –

Utilized as data to predict future volcanic activity from past eruption history displayed in geological maps of volcanoes.

#### Hazard map for Sakurajima Volcano

Showing dangerous regions for lava flows and volcanic ash based on the past large scale lava flows and pyroclastic flow deposits drawn by the Geological Map of Sakurajima Volcano.

In addition, precursor phenomena and an overview of past eruption activities are shown (top map). Knowing in advance the dangers of future volcanic disasters from past disasters is expected to be useful for daily preparation and for evacuation during emergencies.



過去の4大噴火の概要と近年の主な噴火活動



Hazard map for Sakurajima Volcano (Kagoshima)



In addition, volcano disaster maps have been distributed by municipalities for many active volcanoes such as Tokachidake, Hokkaido-Komagatake, Chokai, Kusatsu-Shirane, Asama, Miyakejima, Yufu and Unzen volcanoes, which anticipates current and future activity from the volcanoes using geological maps of volcanoes as basic data.

## 119. Examples of utilizing water environment maps

### ■ What are water environment maps?

Digital map edited with the purpose of helping to understand the local hydrogeology. It records various groundwater data such as water table, temperature, water quality and oxygen/hydrogen isotope ratios.



### ■ Published and publishing schedule of water environmental map

Published regions (2004 to 2010)  
"Sendai Plain", "Akita Plain",  
"Kanto Plain", "Nobi Plain",  
"Chikushi Plain", "Yamagata Basin"

Publishing schedule (up to 2015)  
"Ishikari Plain", "Kumamoto Area"

Red: Published or publishing  
Blue: under the plan



### – For effective use of groundwater and geothermal energy –

Hydrogeological information such as groundwater level and distribution of temperature and water chemistry shown as maps are used to understand groundwater regime and to evaluate the geothermal potential for groundwater source heat pump.

#### Examples of Application

##### Basic data to understand local hydrogeology

Data are taken from rivers, springs and private and observation wells  
→ Can lead to manage groundwater resource on the basin scale, considering the groundwater flow system from the recharge to the discharge areas.

##### Location of water resource in emergency

Provides information of the locations of wells and springs on the maps.

##### Basic data to evaluate geothermal potential for groundwater source heat pump

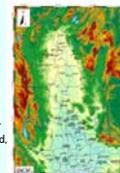
Provides data such as water table and temperature distribution of groundwater.  
→ Can become vital basic data to assess future geothermal energy.

##### Water environment map in Asia

We are planning to edit water environment maps on the Hong River Delta region, Vietnam and Chao Phraya Plain, Thailand.

→ It is vital information to develop the industrial water for promoting the infrastructure and/or for the expansion into Asia of Japanese companies.

Water environment map for Chao Phraya Plain, Thailand, editing in the framework of COOP project.



## 120. Examples of utilizing marine geological maps – 1:200,000 marine geological maps –

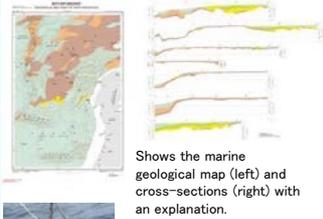
### ■ What is marine geological map?

Marine geological map shows distribution and characteristics of submarine faults, stratigraphy, geological age and features of rock and strata distributed beneath the surface sediments.



### ■ Creating marine geological maps

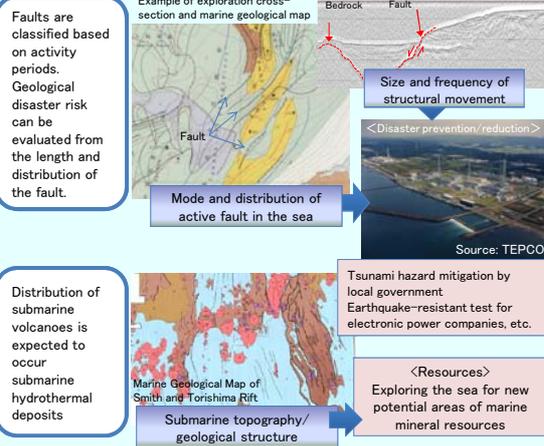
- AIST has completed a survey of a marine geological map for the ocean surround Japan's main four islands at a scale of 1:200,000.
- A survey focusing on the ocean surrounding Okinawa is being conducted from 2008.



Marine geological map 61 "Marine Geological Map West of Noto Peninsula (CD)"

### - Contributes to exploration of marine resources and assessment of geological disaster risk -

By creating marine geological maps, (1) it is possible to understand the existence, mode and activity of faults under the seabed, which contributes to assessment of geological disaster risks, and (2) it can be used to search for new potential areas of marine mineral resources related to submarine volcanoes.



## 121. Examples of utilizing sedimentological maps – 1:200,000 sedimentological maps –

### ■ What is surface sediment map?

Sedimentological map shows distribution of surface sediments and rock bed based on their grain size and sand composition.



### ■ Creating sedimentological maps

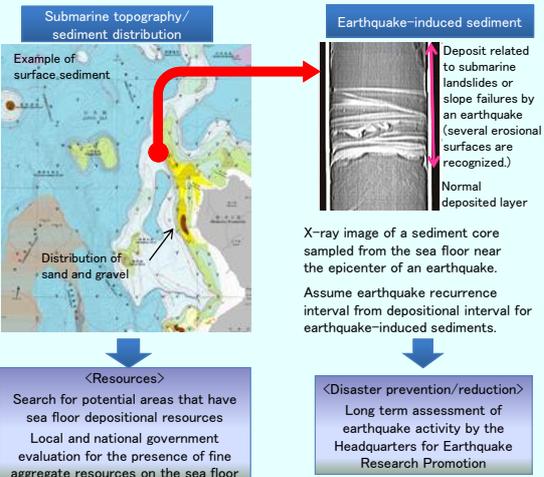
- AIST has completed a survey of a marine geological map for the ocean surround Japan's main four islands at a scale of 1:200,000.
- A survey focusing on the ocean surrounding Okinawa is being conducted from 2008.



Marine Geological Map 57 "Sedimentological Map West of Noto Peninsula"

### - Contributes to geological disaster risk and assessing the presence of resources -

By analyzing the grain size and composition of surface sediments, (1) the distribution of fine aggregate resources such as sand and gravel can be understood, and potential areas that have these resources can be searched, and (2) the information on past earthquake history from submarine landslides and their related deposits can be used and applied to disaster mitigation.



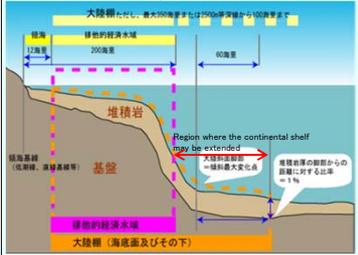
## 122. Contributing to establish the outer limits of the continental shelf

### What is the continental shelf?

"The United Nations Convention on the Law of the Sea" which came into effect in 1994 (ratified in 1996 in Japan) states that a "coastal state has the sovereign right to develop natural resources of the seabed and subsoil".

### Maintaining geological information for the continental shelf

The UN Convention on the Law of the Sea states that:  
 ✓ The seabed at up to 200 nautical miles from the territorial sea baselines can be taken as the "continental shelf".  
 ✓ For sea area that exceeds 200 nautical miles:  
 1. The continental shelf is measured to fixed points of 60 nautical miles from the foot of the continental slope  
 2. The continental shelf boundary can be extended to a point where the thickness of the sedimentary rock is 1% of the distance from the foot of the continental slope. However, this must not exceed the furthest point of either 350 nautical miles from the coastal state or 100 nautical miles from the 2,500 m isobath.



Continental shelf defined in the UN Convention on the Law of the Sea  
 (Figure from the web site of the Hydrographic and Oceanographic Department)

### - Contributes to establish the outer limits of the continental shelf by providing geological evidence - Progression

Example showing how AIST used geological knowledge and know-how from marine geology surveys it has accumulated to grasp a spatial stretch of the continental shelf and continental shelf extension was approved.

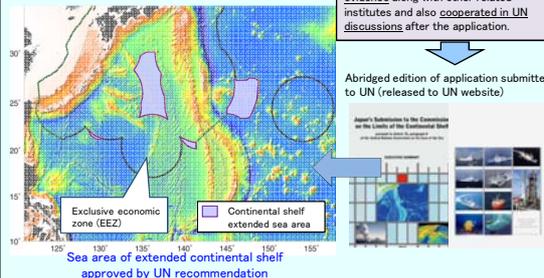
Application for the establishment of the outer limits of the continental shelf was submitted by Japan in November 2008. A recommendation was issued based on the result from the UN Commission on the Limits of the Continental Shelf. This resulted in a decision to extend the continental shelf by approximately 310,000 square kilometers which equals to approximately 80% of Japan's territory.

Among the governmental continental shelf demarcation survey system,  
 ✓ Surveys of the sea area to harvest bedrock and analysis of these samples  
 ✓ Submarine topography survey, geological structure survey and crust structural analysis by related institutes

Provides geological evidence for establishment of the outer limits of the continental shelf

Contributed to the submission of UN application based on detailed geological evidence along with other related institutes and also cooperated in UN discussions after the application.

Abridged edition of application submitted to UN (released to UN website)



## 123. Examples of utilizing geochemical & risk assessment maps of subsurface soils

### What are geochemical & risk assessment maps of subsurface soils?

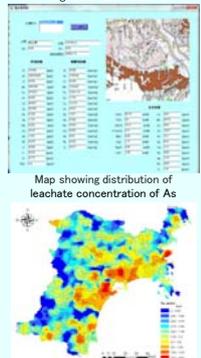
They are intellectual fundamental information including distribution maps and database of major geochemical components, concentrations and potential human exposure risk of hazardous heavy metals in subsurface soils in compliance with the Soil Contamination Countermeasures Act.



### Maintaining geochemical & risk assessment maps of subsurface soils

Soil type distribution and soil geochemical data

- ✓ Maintained and published for Miyagi, Tottori and Toyama prefectural regions.
- ✓ In general, when a geological consulting company performs a soil contamination assessment in compliance with the Soil Contamination Countermeasures Act, the information provided in the maps can be utilized.
- ✓ Potential risk associated with 12 hazardous elements are available in the risk assessment maps.



### - Contributes to evaluating the goenvironment for land utilization -

In combination with the use of existing spatial information on resources and geo-environments, the distribution of hazardous substances obtained from the geochemical & risk assessment maps of subsurface soils can contribute to effective land utilization.

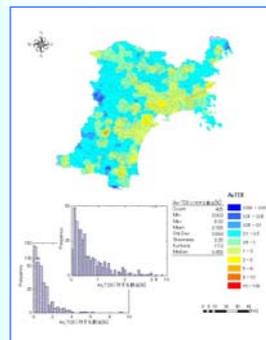
Possible utilization examples

- **Assessment of the origin of hazardous substances that are related to soil and groundwater contamination**
- **Selection of sites for civil engineering works that can avoid pollution**

They are expected to be used as basic information for smooth utilization of land by private companies that deal with soil and groundwater contamination in addition to local governments.

The behavior of hazardous substances over a wide area such as the movement and accumulation of heavy metals from their supply source can be understood and analyzed by performing a diverse investigation after combining existing resource and environmental spatial information such as ore deposit information, farm crops, water distribution maps, land use maps and information recorded in the geochemical & risk assessment map of subsurface soils.

"Geochemical & risk assessment map of subsurface soils - Miyagi Prefecture region -" Human exposure risk distribution map for As



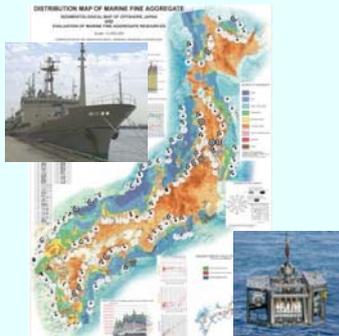
## 124. Examples of utilizing fine seabed aggregate resource maps

### What is fine seabed aggregate resource map?

They are maps compiling information concerning the presence and potential of fine aggregate resources in sediment at water depths shallower than 200 m.

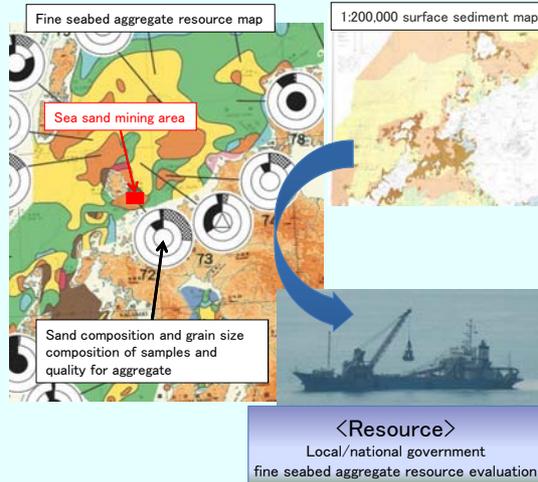
### Creating seabed aggregate resource maps

AIST has completed the evaluation for aggregate resources at total 22 areas for a part of Hokkaido and the entire continental shelf around Honshu, Shikoku and Kyushu.



### Used for mining areas on the seabed with aggregate resources by local governments –

Understanding the quality of sediment at water depths shallower than 200 m that can be explored using fine seabed aggregate resource maps in terms of the sediment grain size, composition and aggregate allows these maps to be used as data for potential mining areas of seabed aggregate.



## 125. Examples of utilizing geothermal potential maps (1)

### What are geothermal potential maps?

They are maps with geothermal resource information that are a collection of various fundamental information relating to potential and characteristics of geothermal resources throughout Japan (especially hydrothermal resources). They are published as geothermal resource maps and database.

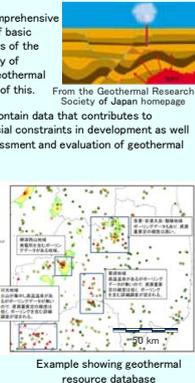


### Maintaining and supplying geothermal potential maps

Geothermal potential is a comprehensive evaluation of various types of basic information that are indicators of the characteristics and the quality of geothermal resources, and geothermal resource amounts are a part of this.

Geothermal potential maps contain data that contributes to investigations on such as social constraints in development as well as fundamental data for assessment and evaluation of geothermal resources.

- > Distribution of possible power generation amount in the five levels of reservoir temperature class
- > Well distribution (depth, maximum temperature, etc.)
- > Hot spring distribution (temperature, outflow rate, typical chemical analytical value, etc.)
- > Gravity basement depth distribution
- > Quaternary volcano distribution
- > Natural park range



### Contributes to establishing a new energy introduction vision from local government –

Geothermal potential maps are used as basic information to evaluate the potential of introducing geothermal power generation (the potential geothermal energy amount that can be calculated theoretically) when establishing a new energy introduction vision by the local government.

Examples of investigating the introduction of geothermal power generation while establishing new energy introduction visions

#### Fukushima Prefecture renewable energy promotion vision

[http://www.cms.pref.fukushima.jp/pcp\\_portal/PortalServlet?DISPLAY\\_ID=DIRECT&NEXT\\_DISPLAY\\_ID=U000004&CONTENTS\\_ID=28428](http://www.cms.pref.fukushima.jp/pcp_portal/PortalServlet?DISPLAY_ID=DIRECT&NEXT_DISPLAY_ID=U000004&CONTENTS_ID=28428)

"Creating a new society by rapidly promoting renewable energy" has been raised as one of the major policies towards recovery in Fukushima Prefecture and among future promotion visions it was shown that

"geothermal binary-cycle power generation is also expected to be introduced in the future as well as conventional types of geothermal power generation because there are many hot springs and abundant geothermal resources".

#### Kagoshima Prefecture new energy introduction vision

<http://www.pref.kagoshima.jp/ad02/kurashi-kankyo/kankyo/ondanka/biyon/ontaishinene.html>

In the "new energy introduction vision" of Kagoshima Prefecture, the introduction of geothermal power generation (binary-cycle system) is being investigated because binary-cycle system is advantageous on issues such as sustainability of resources and the effects on existing hot spring facilities.



## 126. Examples of utilizing geothermal potential maps (2)

### What are geothermal potential maps?

They are maps with geothermal resource information that are a collection of various fundamental information relating to potential and characteristics of geothermal resources throughout Japan (especially hydrothermal resources). They are published as geothermal resource maps and database.



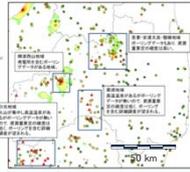
### Maintaining and supplying geothermal potential maps

Geothermal potential is a comprehensive evaluation of various types of basic information that are indicators of the characteristics and the quality of geothermal resources, and geothermal resource amounts are a part of this.

From the Geothermal Research Society of Japan homepage

Geothermal potential maps contain data that contributes to investigations on such as social constraints in development as well as fundamental data for assessment and evaluation of geothermal resources

- > Distribution of possible power generation amount in the five levels of reservoir temperature class
- > Well distribution (depth, maximum temperature, etc.)
- > Hot spring distribution (temperature, outflow rate, typical chemical analytical value, etc.)
- > Gravity basement depth distribution
- > Quaternary volcano distribution
- > Natural park range



Example showing geothermal resource database

### - Basic information for introducing renewable energy -

Geothermal potential maps are being used to survey renewable energy introduction potential by the Ministry of the Environment and are used for policy guidelines and resource assessment investigations by the government.



Creating a hot spring classification sorted by geothermal and hot spring resources in the entire country based on geothermal potential maps.



## 127. Examples of utilizing geothermal potential maps (3)

### What are geothermal potential maps?

They are maps with geothermal resource information that are a collection of various fundamental information relating to potential and characteristics of geothermal resources throughout Japan (especially hydrothermal resources). They are published as geothermal resource maps and database.



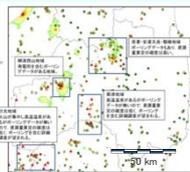
### Maintaining and supplying geothermal potential maps

Geothermal potential is a comprehensive evaluation of various types of basic information that are indicators of the characteristics and the quality of geothermal resources, and geothermal resource amounts are a part of this.

From the Geothermal Research Society of Japan homepage

Geothermal potential maps contain data that contributes to investigations on such as social constraints in development as well as fundamental data for assessment and evaluation of geothermal resources

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- > Well distribution (depth, maximum temperature, etc.)
- > Hot spring distribution (temperature, outflow rate, typical chemical analytical value, etc.)
- > Gravity basement depth distribution
- > Quaternary volcano distribution
- > Natural park range



Example showing geothermal resource database

### - Utilizing for feasibility surveys for the introduction of small-scale geothermal power generation -

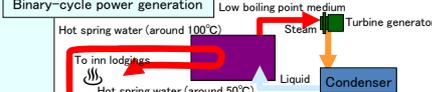
Using the potential map data such as the outflow rate and temperature of nearby hot springs to a planned area of small-scale geothermal power generation, it is possible to find where sustainable hot springs exist and this information is utilized for feasibility surveys for introducing small-scale geothermal power generation.

Examples of use for "Feasibility survey for the introduction of small-scale geothermal power generation (binary-cycle method)" in Niigata Prefecture

<http://www.pref.niigata.lg.jp/sangyoshinko/1271196038532.html>



Example of use as basic data for Matsunoyama hot spring binary-cycle power generation project (April 2010)



Binary-cycle power generation uses geothermal energy at a low temperature of around 100°C to heat and evaporate a low boiling point (easy to boil) medium (such as pentane). The steam of low boiling temperature medium turns turbines to generate electricity.

## 128. Examples of utilizing fuel resource maps

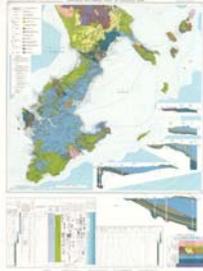
### ■ What are fuel resource maps?

Fuel resource maps show basic geological data and the distribution of fuel resources such as petroleum, natural gas and coal in Japan.



### ■ Service fuel resource maps

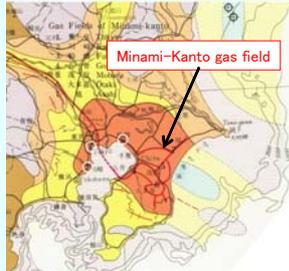
AIST published fuel resource maps of oil and gas fields and coal fields, that show the potential data of petroleum, natural gas and coal in places such as Hokkaido, Akita, Niigata, Kanto (Chiba, Kanagawa) and Okinawa.



Geological map series of oil and gas fields of Japan "Central-southern part of Okinawa Jima" (1:50,000)

### - To use natural gas safely -

Understanding the distribution of natural gas shown in fuel resource maps is useful for safety measures to prevent explosion accidents when developing hot springs and performing underground constructions.



Minami-Kanto gas field

Enlarged map of the Kanto region from Distribution map of oil and gas fields in Japan (2nd ed., 1976), 1:2,000,000 map series

- Minami-Kanto gas field is the largest natural gas deposit dissolved-in-water type in Japan.
- Brine that contains microbial methane is also rich in iodine and Japan is the second rank of iodine production in the world.
- The brine is also used as hot springs (deep geothermal water resources).

### ● Accidents due to natural gas

- An explosion caused by natural gas degassing from hot spring water occurred at Shibuya-ku, Tokyo, in 2007, while hot springs in the Kanto plain are developing.
- These points are included in the "Minami-Kanto gas field".

### ● Contribution to government

- The "Distribution map of oil and gas fields in Japan (2nd ed.)" was used as a basic map for emergency surveying of natural gas at hot springs throughout Japan.
- The map is also used as basic data for licensing councils for hot spring drilling and development.

## 129. Examples of utilizing mineral resource maps

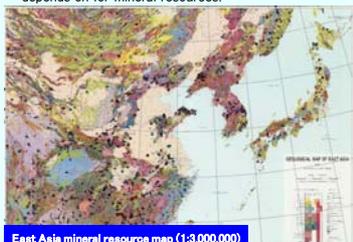
### ■ What are mineral resource maps?

They are maps that show metal/non-metal resource distribution, mineral resource types and geological relevance on geological maps. It is possible to see the geological overview and distribution of mineral resources at a glance.



### ■ Maintaining and supplying mineral resource maps

- Domestic mineral resource maps (1:500,000) are prepared to understand the presence of mineral resources throughout the country as basic information for the government.
- Overseas mineral resource maps are prepared focusing on the Asia region to which Japan greatly depends on for mineral resources.



East Asia mineral resource map (1:3,000,000)

### - Basic information for the stable supply of mineral resources -

The spread of mineral deposits can be estimated from the geological distribution shown in mineral resource maps which allows strategic exploration for specific resources.

Provides basic data for strategic resource planning by domestic private companies and the government.

- Domestic mineral resource maps are used for wide area geological structure surveys conducted by JOGMEC (Japan Oil, Gas and Metals National Corporation).
- For "southern regions of Hokkaido", "central regions of Tohoku", etc.

Provides basic information to maintain a resource database (overseas contribution)

Maintains the data for the existence of critical metal resources that are increasing in importance in terms of economics and guaranteeing resource security for the nation from existing information and field surveys.

- Used in East Asia mineral resource database which is being created jointly by Asian countries in a project to reinforce analysis for global remote sensing resources (Agency for Natural Resources and Energy).

- A database is being prepared to re-evaluate rare earth resource amounts in the world which is being promoted by a joint research with the US Geological Survey.



MOU contract concluded between GSJ-AIST and USGS (December 2011)

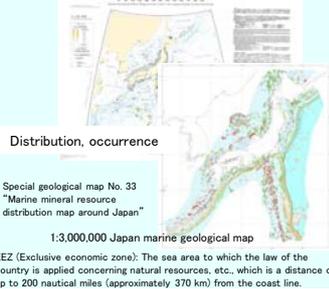
## 130. Examples of utilizing marine mineral resource distribution map

### What is marine mineral resource distribution map?

The map shows the distribution of marine mineral resources such as hydrothermal sulfide and manganese oxide (manganese nodule and crust), and their chemical composition.

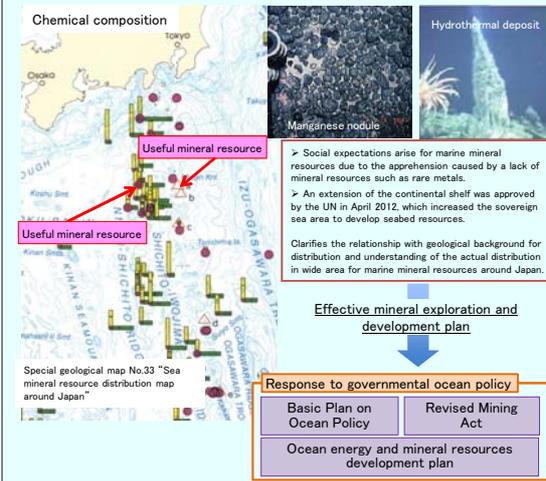
### Maintaining marine mineral resource distribution maps

- ✓ Shows the distribution and chemical composition of marine mineral resources over a range that includes Japan's EEZ.
- ✓ Collects information including those from research cruises by AIST and other research institutes to construct a database.
- ✓ Clarifies the relationship with geological background based on the integration of marine geological map data and understanding of the actual distribution of mineral resource



### - Used to develop marine mineral resources -

Marine mineral resource distribution map shows the distribution and chemical composition of useful minerals at the sea bottom from samples taken within Japan's EEZ and it can be used as indicator for minerals targeted for exploration to develop marine mineral resources.



## 131. Examples of utilizing aggregate resource survey reports

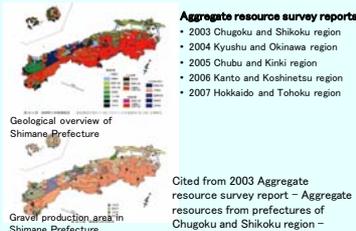
### What are aggregate resource survey reports?

They are reports that summarize the presence of regional aggregate (rubble and gravel used as base material for roads and raw material for concrete) resources for each prefecture.



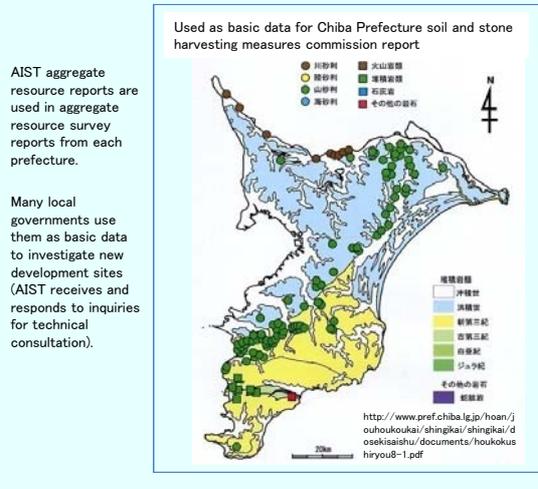
### Maintaining aggregate resource survey information

- AIST has collected information concerning the presence of aggregate resources in each prefecture of Japan from the late 20th century.
- A report summarizing this information for each region was published between FY 2003 and 2007.
- It also includes lithology with chemical compositions and grain size of sand and gravel within layers.



### - Used as basic data for various development and environmental conservation measures and aggregate resource control measures -

By knowing the grain size and lithology of sand and gravel shown in aggregate resource survey reports, the value and usage of resources as aggregate can be determined and this information can be used as basic data for various development and environmental conservation measures and aggregate resource control measures.



## 132. Examples of utilizing gravity maps

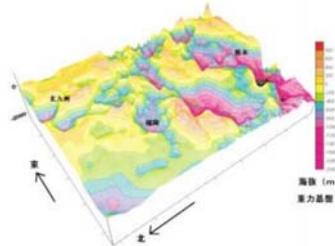
### What are gravity maps?

Gravity changes depending on the geology (density of rocks and unevenness of the stratum boundary surface) of the region. Factors such as the distribution of magma and underground geological structure are made clear from gravity maps (Bouguer anomaly).

### Maintaining gravity maps

By analyzing gravity maps (Bouguer anomaly), subterranean undulations of a plain that do not appear in geological maps of the terrain and ground surface can be seen.

For example, soft layers generally have a low density, therefore, the gravity is low where soft layers are thick.



Maintained as a gravity database from 2009 and onwards.  
Can be used as numerical data by selecting an area, etc., and extracting the gravity map.

### - Used for resource exploration -

Gravity maps are utilized as data for mineral resource and fuel resource exploration by showing locations with high gravity among underground rocks from the level of gravity shown on gravity maps.

Remote sensing  
Document survey

In general, metal ore deposits are relative to high density intrusive rock, a location with high gravity. Furthermore, geothermal reservoir structures are relative to such as fracture structures that provide flow pathways for hot water so locations, indicated by low gravity.

Terrain, geology, gravity,  
and magnetism survey in  
a wide area

Conduct sequential detailed  
survey to achieve goals

Geological, geochemistry,  
electrical/electromagnetic  
precision survey and  
drilling exploration

Estimate resource amount  
Economical assessment

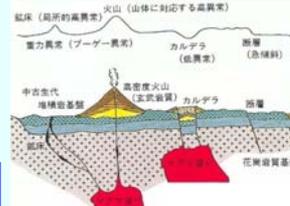


Illustration of geophysical exploration  
(The Society of Exploration Geophysicists of Japan)

Since gravity is generally high at high density and low at low density, gravity is high at bedrock with a high distribution of ore deposit such as volcanoes and low at regions with fuel resources that accumulate in sedimentary rock such as petroleum.

## 133. Examples of utilizing geochemical maps - geochemical maps for the sea and land -

### What are geochemical maps?

They are distribution maps of elemental concentrations that show how elements, which are influenced by the urban environment and industrial activities, are distributed as the natural background.

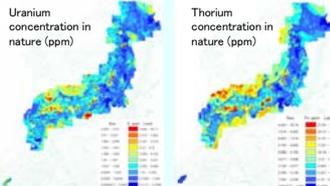


### Maintaining and supplying geochemical maps

• Database for nationwide geochemical maps for land and sea of Japan is available over the internet.  
[https://gbank.gsj.jp/geochemmap/index\\_e.htm](https://gbank.gsj.jp/geochemmap/index_e.htm)

• The concentrations of elements that exist in nature are measured for each element and geological maps and data for the concentration distribution are provided.

It is possible to calculate the radiation dose from uranium, thorium and potassium (radio-active K40) contents in nature.

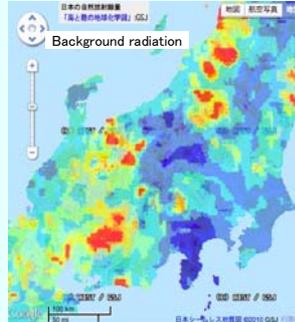


From geochemical maps of the sea and land  
• Awarded the environmental prize for excellence in FY 2005 (Hitachi Environment Foundation) for evaluating the natural element level (background) which is referenced when evaluating environmental pollution.

### - Provides information to respond to the needs of society to alleviate concern -

It is possible to distinguish anthropogenic pollution level from the background radiation calculated using elemental concentrations in nature.

An example that shows background radiation dose at a height of 1 m from the ground surface which was calculated from the concentrations of uranium, thorium and potassium (radioactive K40) shown in land and sea geochemical maps.



### Geochemical features of regions with high background radiation

Granite regions have high concentrations of uranium, thorium and potassium. Therefore, regions underlain by granite on a 1:200,000 seamless geological map of Japan overlap with regions with high background radiation.

<http://www.geosociety.jp/hazard/content0058.html>  
(The Geological Society of Japan)

These maps provide an increase in understanding of the distribution of radioactive elements and natural radiation, and be utilized for assessment of anthropogenic pollution.

## 134. Examples of utilizing JIS for geological maps

### What are JIS for geological maps?

They are Japanese Industrial Standards (JIS) for geological maps. These are standards of sign, design, color, term and definition, classification and display of legend, which are necessary for making geological maps. That the creator of the geologic map makes a geologic map based on these standards promotes that the user of the geologic map uses a geologic map and its attribute data exactly. This contributes to high level use, facilitate data processing and unify interpretation of geological maps and their associated data.

### Maintaining JIS for geological maps

JISA0204 determines geologic expression method, sign, color and design to use for a geologic map. This is based on knowledge of AIST.

JISA0205 coded kinds of rocks and strata, ages and symbols shown in the geologic map systematically.



表4-1 工学地質図に用いる

たい地質符号名	コード	たい地質符号名	コード
れき岩 (礫岩)	111101002	角れき岩	03
砕れき岩	111111002	大れき岩	111121002
砂れき岩	111131002	極れき岩	111141002
砂岩	111200002	極粗粒砂岩	111210002
粗粒砂岩	111220002	中粒砂岩	111230002
細粒砂岩	111240002	極細粒砂岩	111250002
砂岩	111260002	付マ岩	111300112
シルト岩	111400002	粘土岩	111500002
れき質砂岩	112190002	砂質泥岩	112200002
泥質砂岩	112230002	砂質シルト岩	113170002
シルト岩	114200002	砂質頁岩	121000002
石灰岩	121100002	頁岩	121900002
チャート	131000002	凝灰岩	171120002
石灰	172300002		

### Used to electronic delivery procedures for national geological and soil survey results

The geologic classification regulated by JIS for geological maps is adopted to geology and soil survey specifications by MLIT. This promotes unification of geologic maps in the whole country.

Application example to geological and soil survey results electronic delivery procedures (December 2008, MLIT) ([http://www.mlit.go.jp/report/press/kanbo08\\_hh\\_000030.html](http://www.mlit.go.jp/report/press/kanbo08_hh_000030.html))

When result of geology and soil survey is submitted, JIS for geological maps (JIS A 0204, 0205, 0206) is required for codes to classify rock and soil for boring cross-section.

○ Spread to MLIT boring database (KuniJiban).

○ Spread to local governments Reflected in specification documents for orders.

Promotes the unification of an electronic delivery format

Advances the popularization and awareness campaign to promote secondary uses of the database.

## 135. Examples of utilizing earth science education for the Japanese nation - educational use of geological maps -

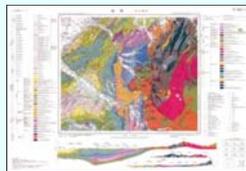
### What are geological maps?

They are geological maps that show geological structures, geological age and features of rocks and strata distributed under the top soil and vegetation in a topographic quadrangle map area of a scale issued by the Geospatial Information Authority of Japan.



### Maintaining and supplying geological quadrangle maps

- Maintained as basic intellectual information for the country.
- Plays a role as a standard for various geological surveys.



With a detailed investigation:

- Establishes standard stratigraphy
- Categorizes formations and rocks

Standards of geologic information for the region and its surrounding area

Geological information including points of fault and beds' deformation along with features, age, and type of subterranean strata and rocks is described in maps and explanatory texts.

### Geological maps used to educate the people about earth science

Geological maps created by AIST are selected and used for textbooks and supplementary teaching material.

Geological information about Japan published by AIST is used as reliable information.

Example of use in textbooks

Example of use in supplementary teaching material

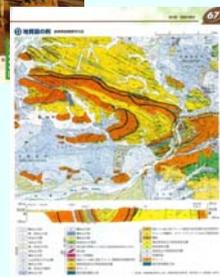


High School Earth Science 2 Textbook (Keirinkan)  
1:2,000,000 Japan geological map is printed as "Japan geological map" at the end of the book.



Earth Science Chart (Hamajima Shoten)

1:50,000 scale geological quadrangle map of "Gifu" (1999) is used as an example of a geological map.



Used as model teaching material to improve understanding and to teach how to read geological maps such as stratum dip and geological structure (geological fold).

## 136. Examples of utilizing the Geological Museum, GSJ, AIST

### What is the Geological Museum?

The Geological Museum is an exhibition facility at AIST that collects, manages and maintains samples as a national center for geological specimens while spreading and publicizing results from "geological surveys".



### Maintaining the Geological Museum

The Geological Museum aims to contribute to the construction of a safe and sustainable society by effectively utilizing research results from "geological surveys" and provide understanding of the changes that take place on earth to all people in Japan.

Therefore, the museum has permanent exhibitions and commentary, specially planned exhibitions, movement exhibitions, experimental learning events, popular lectures and geological consultations.



### Geological Museum used for educational purposes

The Geological Museum is used for school education and re-education by holding exhibitions that help the general population to easily understand research results.

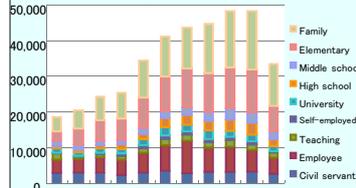
✓ Over 40,000 people visit the geological museum each year and many of the visitors are groups of friends or family.

✓ Explanatory guidance in the museum was provided for 376 groups in FY 2011.

✓ As well as museum training, etc., various services are supplied to correspond to needs for training given to high school students from the SSH (Super Science High school) system, experiments and observation given to elementary and middle school students, and training for teachers.

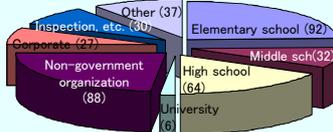
✓ Original teaching material such as posters are provided when their use is requested by schools, etc.

Changes in number of visitors to the Geological Museum



The number of visitors decreased because the museum was closed often due to power saving over the summer holidays from earthquake disaster in 2011.

Number of explanatory guidance by group type in FY 2011



## 137. Examples of utilizing a geological sample database

### What is a database on Geological Museum samples?

AIST has published information on the internet for samples registered at the Geological Museum that were submitted for geological research. It is possible to look up these samples online.



### Maintaining a geological sample database

The database on Geological Museum samples is managed by dividing the collected samples into six **sample classifications**, namely, fossils, minerals, rocks, ore minerals, boring cores and living creatures.

When searching through the registered samples, it is possible to view photos of rocks while reading information about such as their name, age and localities.

### Contributes to educational use of rock samples

By putting these geological samples in a database, users can easily search for the best rock sample they require to use as a teaching material, which contributes to educational use.

Examples of use and application such as being introduced in publications and lending of geological samples such as registered rock samples to museums of the whole country.



Rock samples were loaned for a special science museum event that showed the history of the earth through a time tunnel. (Achievement in FY 2009)

Number of samples loaned and published

	Museums, etc.	Publications, etc.
FY 2009	3	20
FY 2010	7	20
FY 2011	8	13

- ❖ Samples used by museums  
Exhibits loaned to the National Museum of Emerging Science and Innovation, the National Museum of Nature and Science, Tsukuba Science Information Center and Ibaraki Nature Museum.
- ❖ Samples in publications  
Images of geological samples were used in reference books, textbooks and encyclopedias.
- ❖ Samples used for educational programs and broadcasting  
Samples and material were used on NHK education programs and natural science information programs.
- ❖ Earth Science Olympiad  
Samples from the Geological Museum were used in tests.