

Outreach activities in geology under the SDGs scheme

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Outreach activities

Extra works of the major geological activities in previous time

Nowadays, becoming one of main subjects

For example, geotourism and geoeducation

Human-driven global change (Schmeisser and Doss, 2014)

All geology students need an understanding of the global-scale processes.

Those students should communicate that information to the public.

The Sustainable Development Goals (SDGs)

Adopted by United Nations (2015).

The aims are to

Eradicate global poverty,

End unsustainable consumption patterns, and

Facilitate sustained economic growth and environmental protection
by 2030.



SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

1 NO POVERTY 	2 ZERO HUNGER 	3 GOOD HEALTH AND WELL-BEING 	4 QUALITY EDUCATION 	5 GENDER EQUALITY 	6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY 	8 DECENT WORK AND ECONOMIC GROWTH 	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 	10 REDUCED INEQUALITIES 	11 SUSTAINABLE CITIES AND COMMUNITIES 	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION 	14 LIFE BELOW WATER 	15 LIFE ON LAND 	16 PEACE, JUSTICE AND STRONG INSTITUTIONS 	17 PARTNERSHIPS FOR THE GOALS 	

Gill (2017) states that all of the geological sciences help to achieve the SDGs, ensuring sustainable and equitable foundations for future global development. The 11 key aspects of geology are noted to understand in SDGs scheme.

Eight aspects in group of 'Earth Materials, Processes and Management'

1. Agrogeology, 2. Climate change, 3. Energy, 4. Engineering geology, 5. Geohazards, 6. Geoheritage and Geotourism, 7. Hydrogeology and Contaminant geology, and 8. Mineral rock resources.

Three aspects in group of 'Skills and Practice'

1. Education, 2. Capacity building and 3. a Broad miscellaneous category.

The outreach programs may be related to 'geoheritage and geotourism' and 'education' in the above geological aspects.

Geological Sciences	Description	Example Job Title
Agrogeology	Using rock and mineral resources to improve soil fertility and water retention	Environmental Consultant, Geochemist
Climate Change	Understanding past the climate changes and applying to know how the climate change in the future	Engineering Geologist, Geochemist, Geophysist, Mining Geologist
Energy	Identifying energy sources and raw material for energy supply and infrastructure	Engineering Geologist, Geochemist, Geophysist, Mining Geologist
Engineering Geology	Supporting the design and construction of infrastructure at all scales (e.g., dams, roads, tunnels, airstrips, ports, pipelines)	Engineering Geologist, Geomorphologist
Geohazards	Understanding the generation of landslides, earthquakes, tsunamis and volcanic eruptions and producing hazard maps	Engineering Geologist, Sedimentologist, Seismologist, Volcanologist
Geoheritage and Geotourism	Using geology and landscapes within tourism and aiding the conservation of geodiversity	Geoscience Communicator, Geoscience Educator
Hydrogeology and Contaminant Geology	Managing groundwater resources and assessing and monitoring contamination	Hydrogeology, Environmental Consultant, Geochemistry
Minerals and Rock Materials	Using geological sciences to identify and develop mineral and rock resources, for a variety of uses	Economic Geologist, Exploration Geologist, Geochemist

A description of eight key aspects of Geological Science

	Geological Sciences											
	Earth Materials, Processes and Management								Skills and Practice			
Sustainable Development Goals (SDGs)	Agrogeology	Climate Change	Energy	Engineering Geology	Geohazards	Geoheritage and Geotourism	Hydrogeology and Contaminant Geology	Minerals and Rock Materials	Education	Capacity Building	Miscellaneous	
No Poverty	○	○	○	○	○	○	○	○	○	○		
No Hunger	○	○		○	○		○	○				
Good Health	○						○					
Quality Education									○			
Gender Equality											o(a)	
Clean Water and Sanitation							○					
Clean Energy			○	○				○				
Good Jobs and Economic Growth			○			○		○				
Innovation and Infrastructure				○						○	o(b)	
Reduced Inequalities											o(c)	
Sustainable Cities and Communities		○		○	○	○	○	○				
Responsible Consumption			○			○	○	○	○	○	o(d)	
Protect the Planet		○		○	○		○		○			
Life Below Water		○					○				o(e)	
Life on Land	○						○					
Peace and Justice											o(f)	
Partnerships for the Goals										○		

A matrix to visualize of the role of geologists. Modified from Figure 2 of Gill (2017) with permission of IUGS

Gill (2017) gives detail wordings for the short phrases.

‘Geoheritage and Geotourism’ and ‘Education’ promote or give

- *Conservation of geodiversity,

- *Understanding geological sciences by tourists and communities,

- *Life-long learning opportunities,

- *Sustainable economic growth,

- *Productive employment, and

- *Sustainable consumption and production patterns.

These are expected from outreach activities.

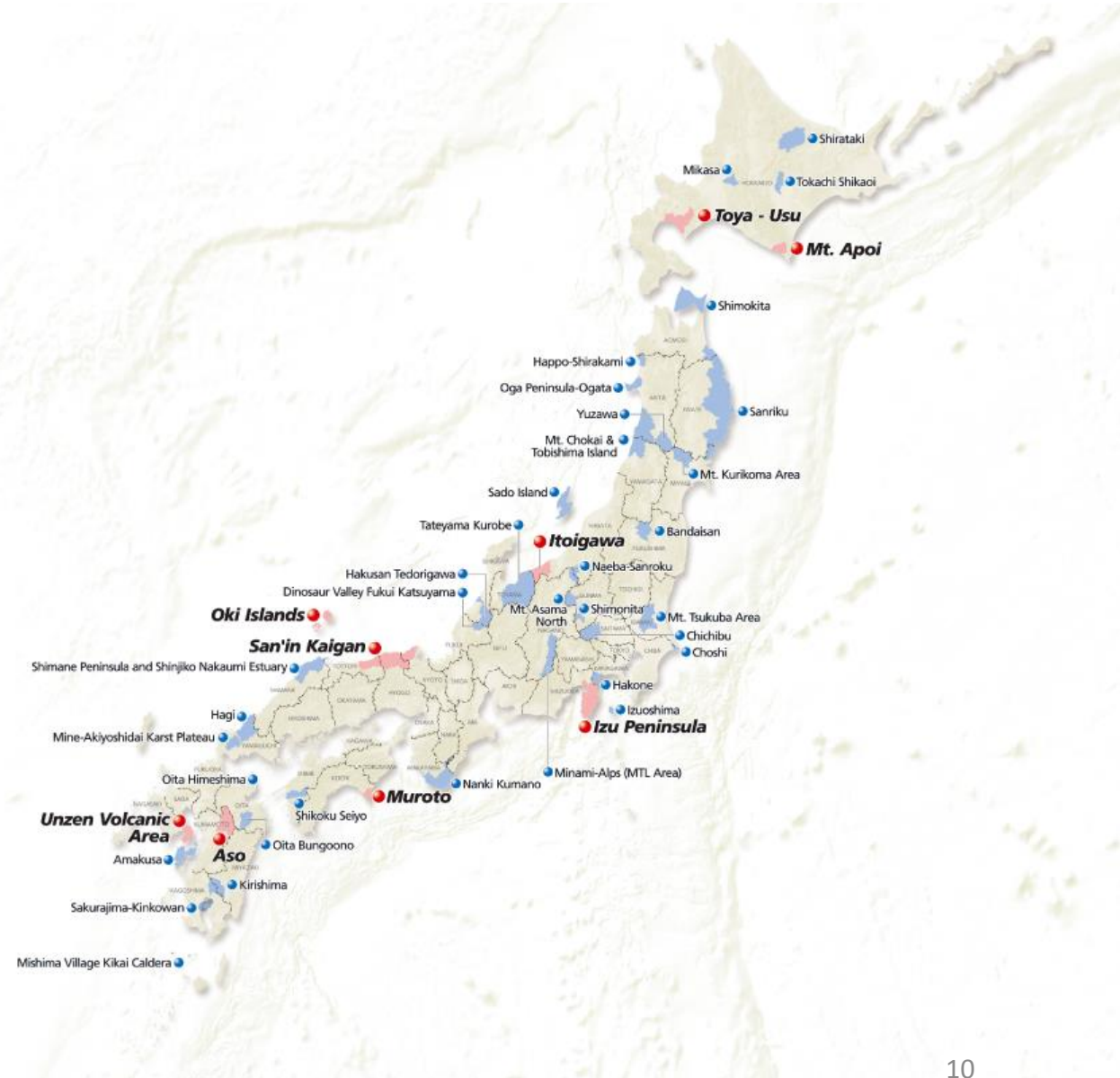
Outreach activities in Japan

- Geopark in Japan
- Geological Exhibition
- Field training for high-school students
- Geological guide maps

Geoparks in Japan

Japanese Geoparks Network (JGN)

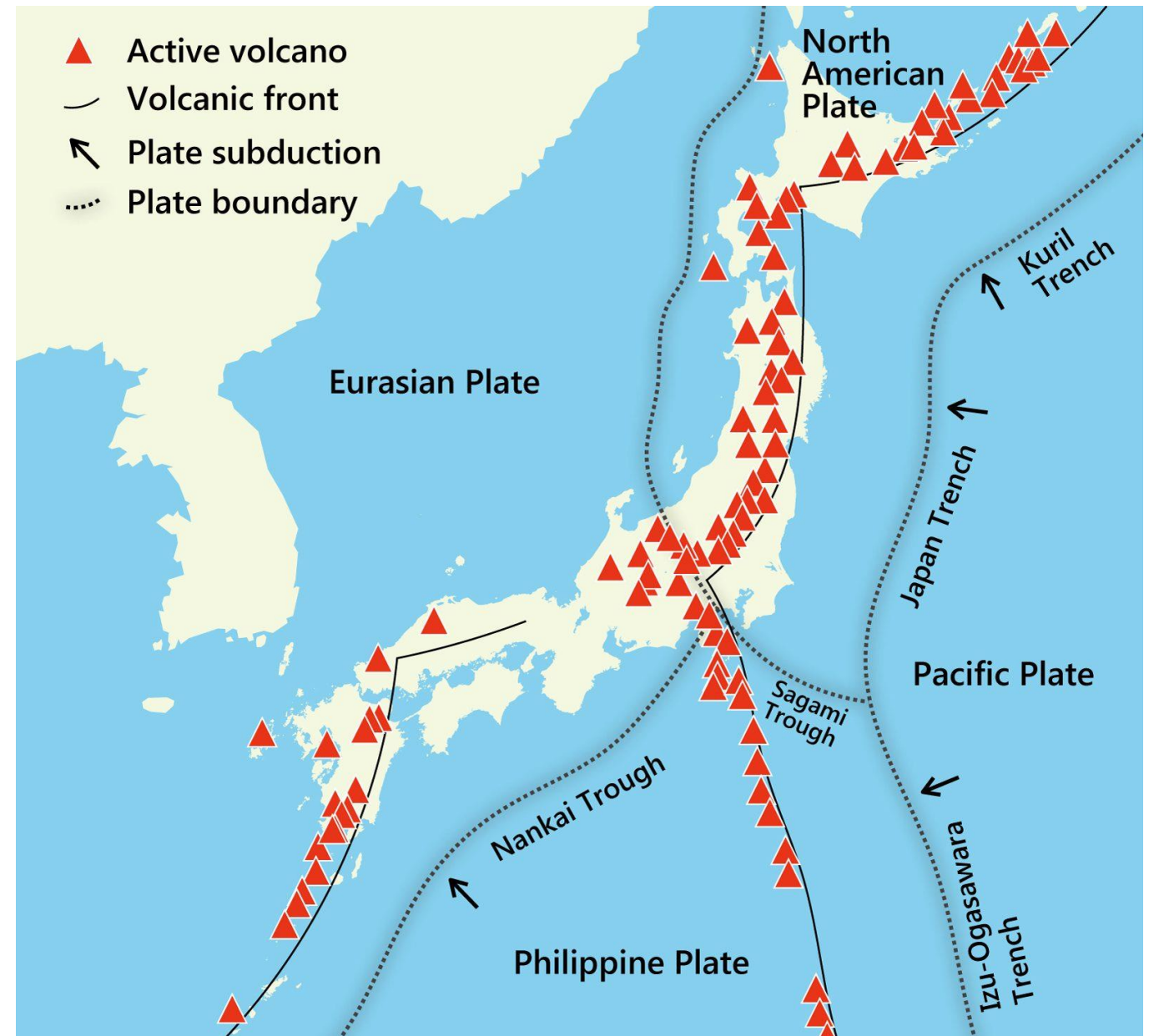
- A Geopark is a geographical area where sites and landscapes of geological significance are managed with concepts of protection, education and sustainable development.
- As of April 2019, the JGN regular membership consists of 9 UNESCO Global Geoparks in Japan and 35 Japanese National Geoparks.



Japan islands is located at a few plate boundary.

Therefore, active volcanos are common in Japan.

Some volcanos are designated UNESCO Geoparks, e.g. Toya-Utsu, Shimabara, Aso and Izu.



The Toya-Usu UNESCO Global Geopark

The Toya-Usu UNESCO Global Geopark is a geopark with Lake Toya at its center. Look for the donut shape on a map of Hokkaido. You'll find a donut-shaped lake (10 km in diameter) in southwestern Hokkaido. This is Lake Toya.

Showa-shinzan volcano was suddenly uplifted and produced about 70 years ago.



This outreach activity results in Understanding geological sciences by tourists and communities

Geological Exhibition

- Geological Survey of Japan (GSJ) has been communicating geology for citizens and students through some events and products.
- For example, GSJ is organizing the Geological Exhibition every year as one program of the annual meeting in the Geological Society of Japan.
- This exhibition is composed of
 - Special lecture,
 - Regional geology,
 - Geological experiment and
 - Current works in GSJ.



Geological Map on the floor

- This is useful for habitant to understand geology of the area.
- This map gives not only general geology but also active fault and other geo-hazard information.



Experiment is popular in the young generation

Program includes making fossil replica, crushing rocks and reproducing liquefaction phenomena.



Current research work corner

- Various geological maps are presented with easy interpretation.
- GSJ develops digital geological maps and revises the harmonious digital geological map in Japan territory every year.



This outreach activity results in Understanding geological sciences by communities

Field training for high-school students

- This program is sponsored by the Japan Science Foundation.
- Study program is planned and implemented by GSJ.
- Geologists and students stay in same hotel three days and they do geological survey in the mountain area.



Each student experiences the way of geological mapping and draws an original geologic map and cross section.



- Some students have interest in geology and enter the geology course of the university.
- One student is now engaged in the oil company as a geologist and may contribute to global economics.

This outreach activity results in Economic Growth.

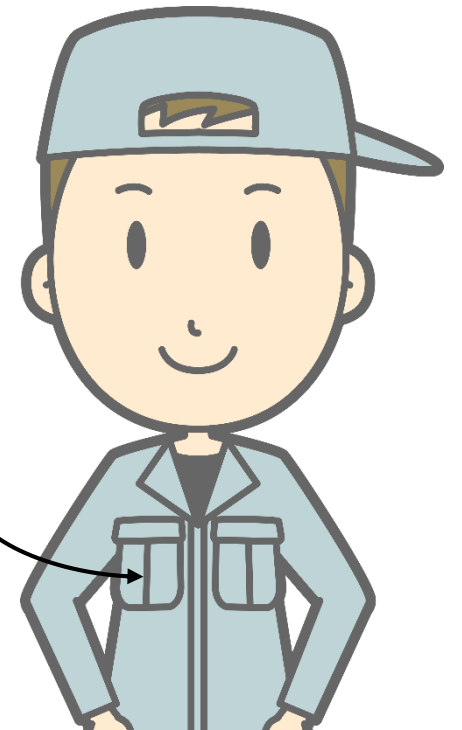
Geological Guide Maps

- A field excursion for non-geologists is often planned by geologists in universities, museums and institutes. However, some of non-geologists want to have an excursion by themselves.
- Detailed geological guide maps are useful for citizens and students for their own field trips. If a guide map is prepared as digital information, it is more convenient, especially for young generation who are familiar to digital tool.



The guidance for editing a guide map

- (1) One-day or half-day walking courses are prepared.
- (2) Geological map and explanatory text must be included in the guide.
- (3) Supplemental mapping must be done in field to check geology.
- (4) The map may be folded to convenient size. It may put in a pocket of clothes.
- (5) Transportation method should be introduced, e.g. train and bus, for students.
- (6) Digital information is distributed in addition to the paper map.



Geologic guide maps

(Takahashi ed.)

- Tsukuba

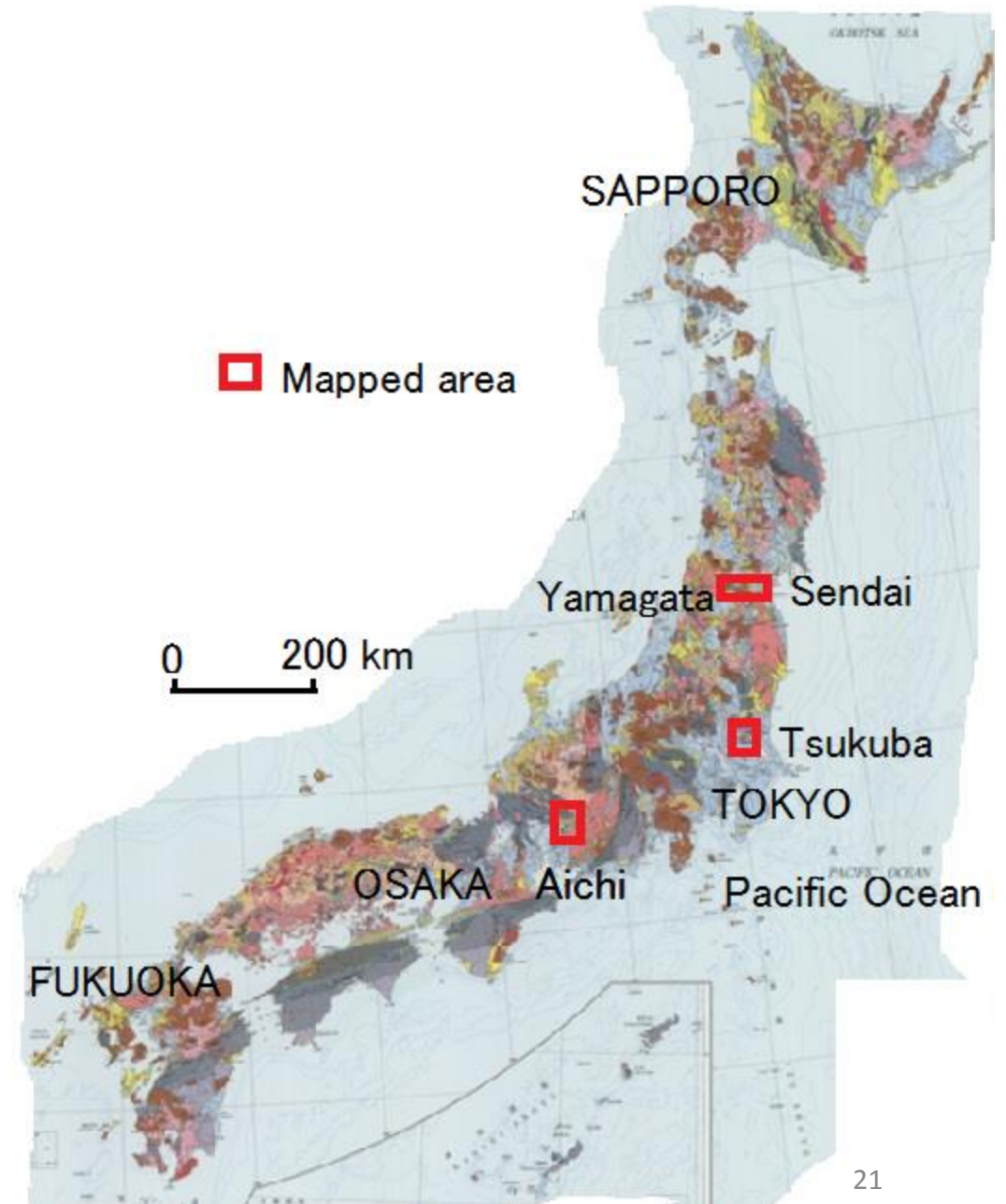
High temperature type metamorphic rocks, gabbro and granitic rocks

- Sendai-Yamagata

Neogen to Quaternary volcanic rocks and abandoned copper mines

- Aichi

Jurassic accretionary complex, granitic rocks and Cenozoic sediments.

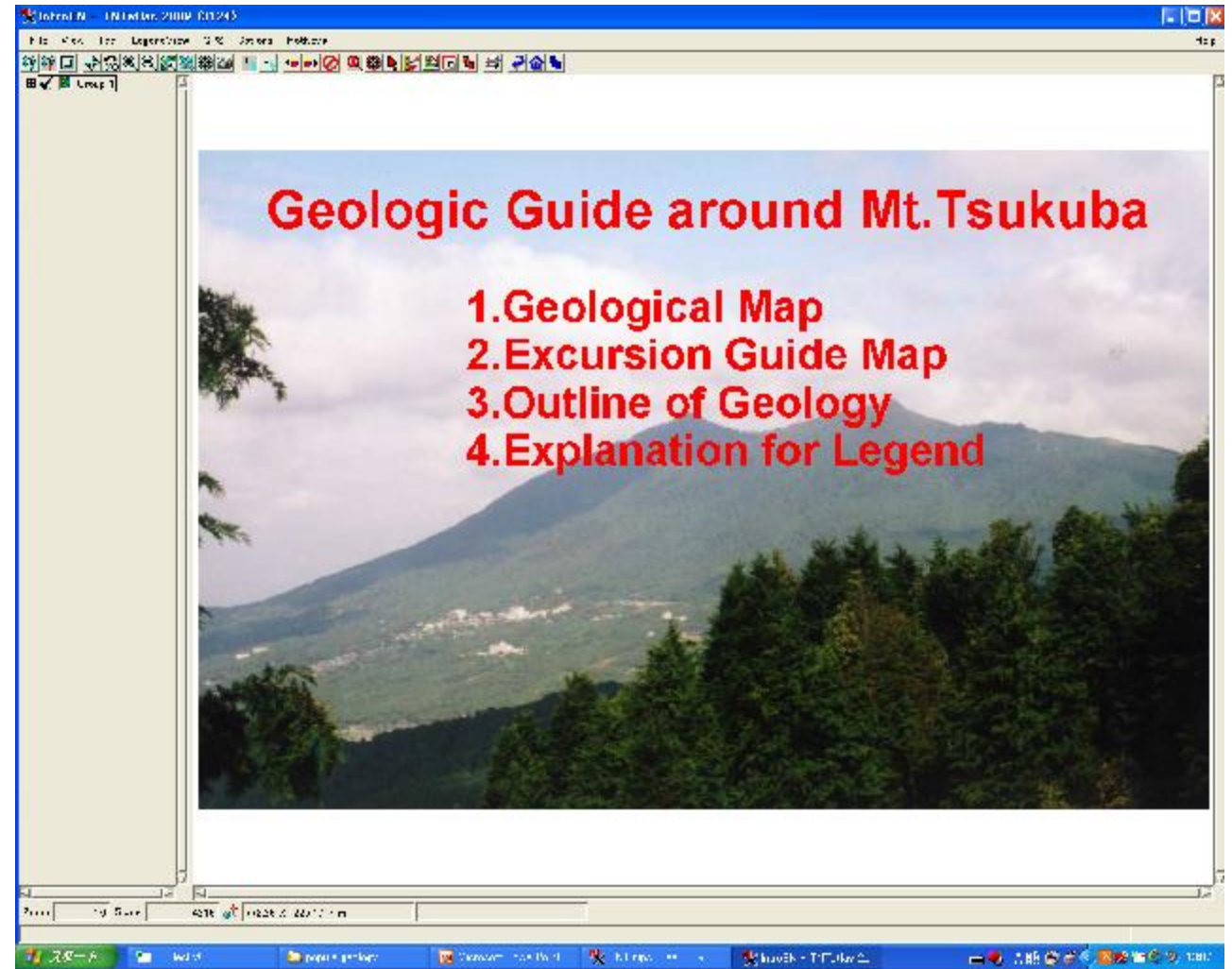


Geologic guide around Mt. Tsukuba

In addition to the paper (hard) map, a digital map is edited on GIS soft wear (TNT mips).

This is top page of the digital map.

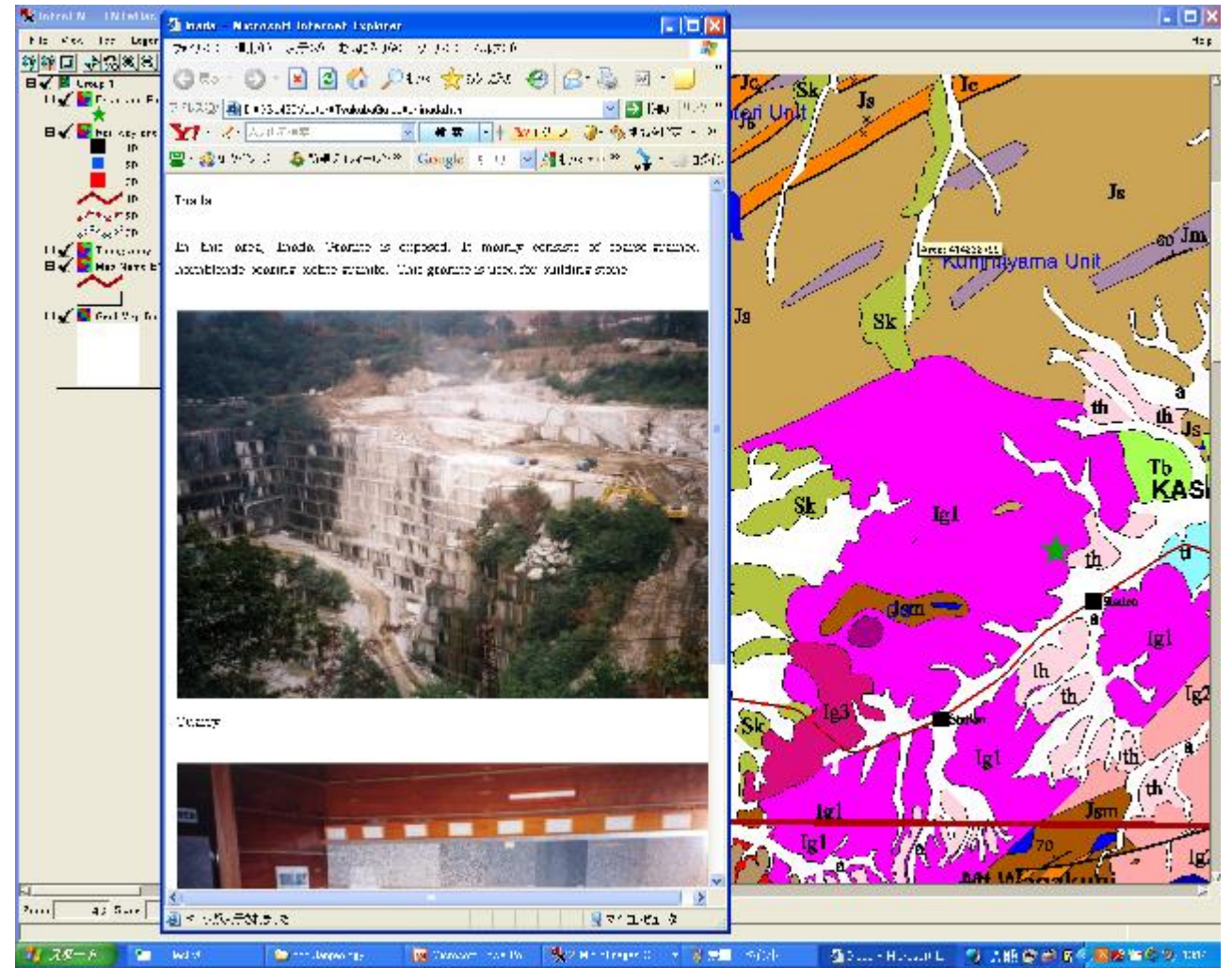
Mt. Tsukuba is located near Tokyo. Many tourists come every weekend. The tourists who are interested in geology were very few. The persons who has interest in geology is increasing.



Getting geologic information of the point in the map

Inada, north of the area, is famous in quarrying granitic rocks (Inada Granite).

The Inada Granite has been used in many buildings and memories, e.g. the Diet Building in Japan.



Geologic guide along Sen-Zan railway

- This railway is popular in the railway fans for railway engineering history such as the long-distance tunnel, the trestle type bridge, turntables for steam locomotives and the test route for AC type trains.
- The guide includes not only geology along the railway but also building stone in Sendai City.

仙山線沿線 地質ガイド



仙山線沿線
地質ガイド
仙台市地質学会編 2010年



写真10 仙台市大森地区の黒曜石。黒曜石は、溶岩が急冷して固化したもので、転石としてよく見られる。



写真11 仙台市大森地区の仙台駅。仙台駅は、東北新幹線と仙山線の主要駅である。

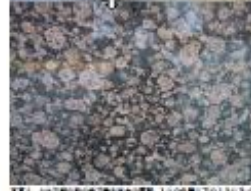


写真12 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真13 仙台市大森地区の丸石。丸石は、溶岩が流れて固化したもので、転石としてよく見られる。



写真14 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真15 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真16 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真17 仙台市大森地区の滝。滝は、溶岩が流れて固化したもので、転石としてよく見られる。



写真18 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真19 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真20 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真21 仙台市大森地区の丸石。丸石は、溶岩が流れて固化したもので、転石としてよく見られる。



写真22 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真23 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真24 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真25 仙台市大森地区の丸石。丸石は、溶岩が流れて固化したもので、転石としてよく見られる。



写真26 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真27 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。



写真28 仙台市大森地区の溶岩流跡地。溶岩流跡地は、溶岩が流れて固化したもので、転石としてよく見られる。

Geologic guide map in Aichi along Tokai Nature Trail

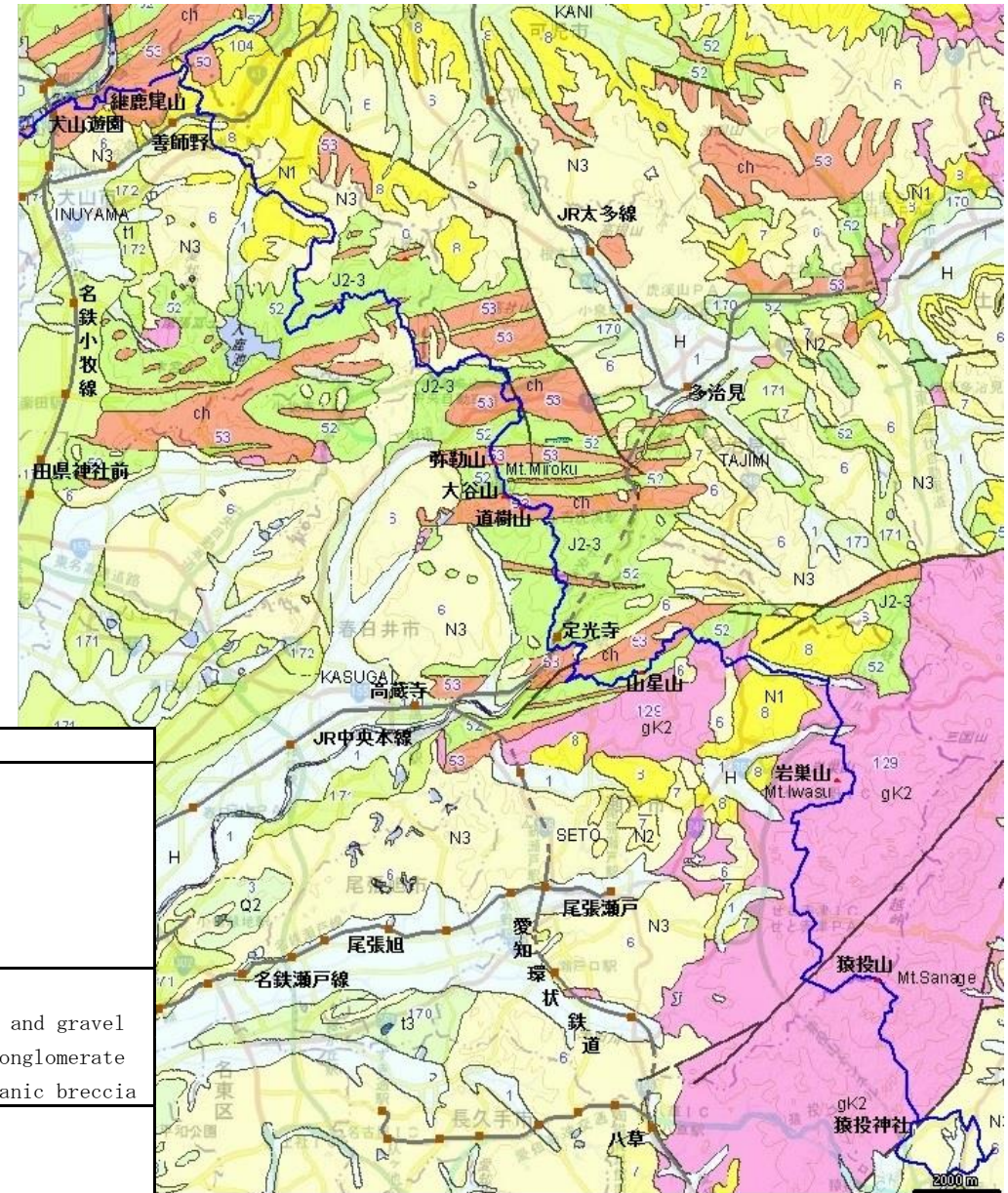
- The Tokai Nature Trail is prepared in about 1697 km from Tokyo to Osaka.
- This guide map introduced geology in northern Aichi area, 70 km of the trail.



(HP of Tokai Natural Trail Association)

Geological map

- Blue line is trail.
- Geology along the trail is Jurassic accretionary complex, i.e. chert (brown) and sandstone and mudstone (yellowish green), Cretaceous granite (pink) and Miocene sediment (yellow).
- Geological information is based on GSJ digital seamless geological map.



Geologic age		no.	symbol	Geology	Lithology	
Cenozoic	Quaternary	Holocene	1	H	Alluvium, Fan deposits	Gravel, sand and mud
		Pleistocene	170	t3	Lower terrace deposits	Gravel, sand and mud
			2	Q3	Mud flow deposits	Rubble and mud
			171	t2	Middle terrace deposits	Gravel, sand and mud
			172	t1	Higher terrace deposits	Gravel, sand and mud
	Neogene	Pliocene	3	Q2	Karayama and Yagoto Formations	Gravel, sand and mud
		Miocene	6	N3	Seto Group (upper)	Gravel, sand and mud
7	N2		Seto Group (lower)	Porcelain clay, mud, sand and gravel		
8	N1		Mizunami Group (main part)	Sandstone, mudstone and conglomerate		
Mesozoic	Cretaceous	Late Cretaceous	104	N1	Mizunami Group (Hachiya F.)	Andesite, basalt and volcanic breccia
		Jurassic	Middle to Late	52	J2-3	Matrix of accretionary complex
	Jurassi		53	ch	Blocks of accretionary complex (Triassic to Middle Jurassic)	Chert

Examples in text



Sandstone and mudstone in Shonai River near Jokoji Station

Jokoji to Mt. Yamaboshi: At Jokoji Station, you cross over Shonai River. Sandstone, mudstone and chert are cropped out in this river. Just after the bridge over Shonai R., you cross signal road. You trace a mountain path along a small valley. This path is suitable to practice a mapping based on foot measuring.



Weathered granite around Mt. Iwasu

Mt. Iwasu: You use a bus bound for Kami-Shinano from Owari-Seto Station for accessing Mt. Iwase. You walk for a while along a paved road from bus terminal Kami-Shinano, then find an entrance of Tokai Nature Trail. Granitic rocks are exposed along the path. Parallel joints run with NNE-SSW strike. At ridge way, you can access peak of Mt. Iwasu. Around here, weathered granite is cropped.

Geologic guide around Ulaanbaatar

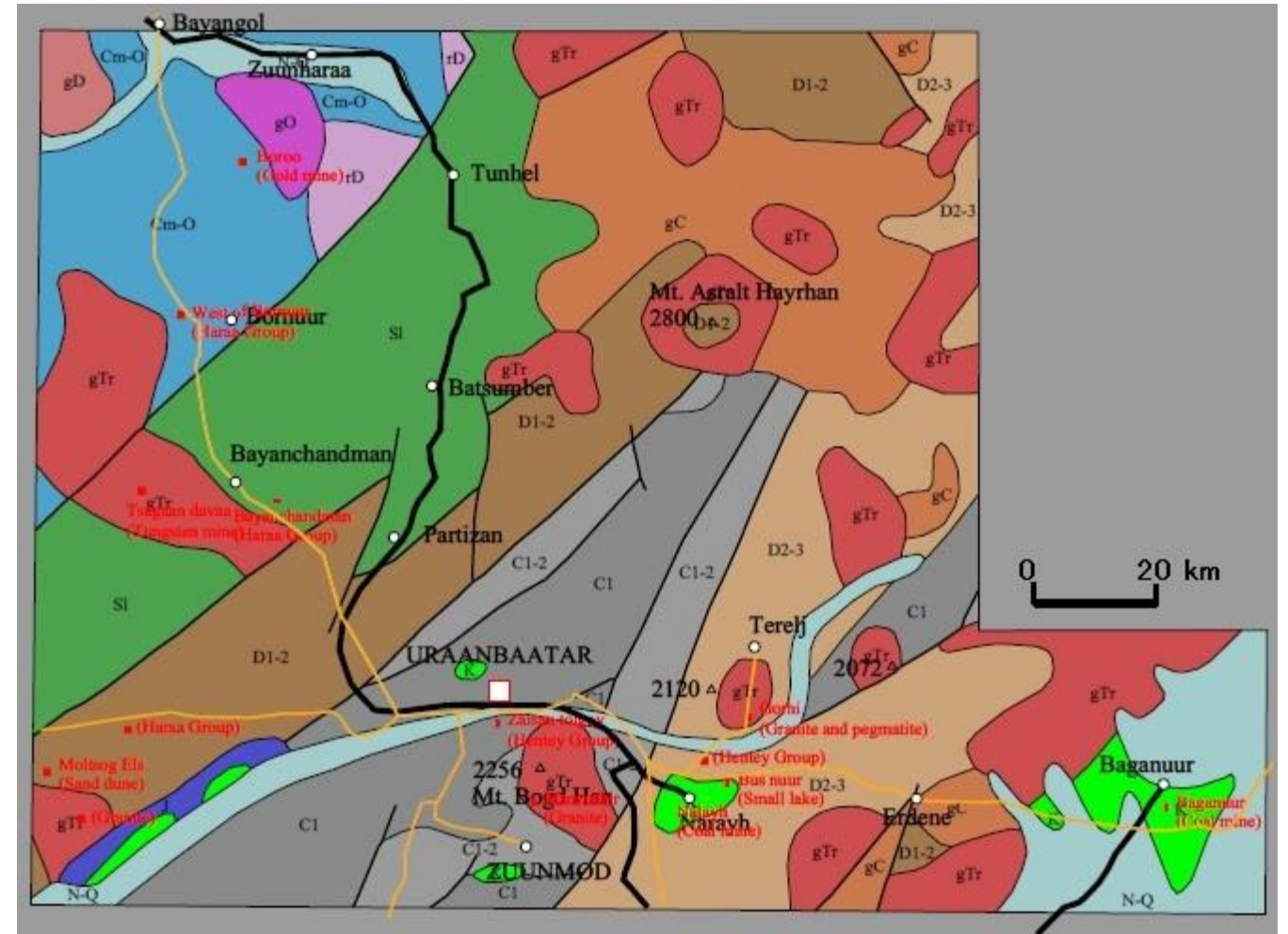
- The field excursion guide was prepared in the East Eurasia Geological Seminar 2003, and it was revised as the digital guide map (Takahashi, 2004).



Geological Map

The area around Ulaanbaatar is geologically included in the northern domain of Badarch et al. (2002).

The area can be divided into the following units in younging order; the Haraa Group, Hentey Group, Granitic rocks, Cretaceous lake deposits and Cenozoic sediments (Magic Project, 1998).





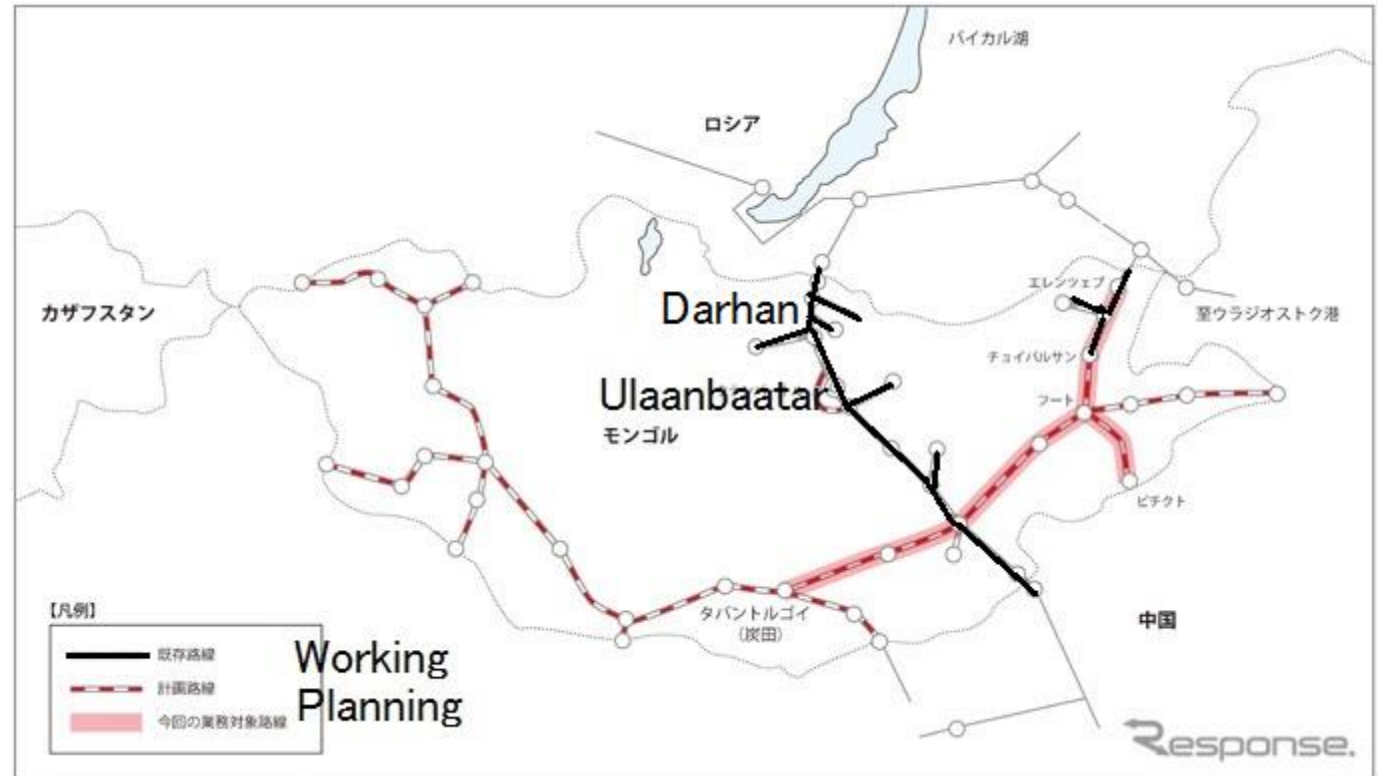
Baga-nuur coal mine:
Baga-nuur coal deposit is situated at 110 km east of Ulaanbaatar. In this area Cretaceous Zuunbayan Formation is distributed. This Formation is divided into 3 members.



Terelj Park (Hentey Group and Gorkhi Granite):
The Terelj Park is located in about 40 km east of the Ulaanbaatar. The granitic pluton, Gorkhi Granite, is well cropped out at the Gorkhi in the Terelji Park.

Plan (Idea): Geological guide in UB-Darhan

- From UB to Darkhan, transportation is convenient, e.g. by train and/or by bus.
- Vendian limestone, Paleozoic strata, Mesozoic granite and volcanics, and Mesozoic strata are distributed.



(Based on HP of Nihon Koei engineering)

Preliminary survey



- At Zuunharaa (Mandal)
- Rhyolite covers Paleozoic strata.
- Rapid train is convenient.



- At Bayanchandmani
- Porphyritic granite is cropped. K-feldspar phenocryst has weak preferred orientation.
- Many long distance buses pass this town.

Input



Targets



Actions



Results



Effect in Society

Mapping and
Compiling
↓
Integrating
information
↓
User friendly
map, a guide
map

A guide
map

Habitants

Tourists

Students

Understanding
geology

Life-long learning

Geo-tourism

Geological survey
experience

Understanding
community

Healthful life

Tour guide
Geo-goods

School of Geology

Protecting Geo-hazard

Powerful aging society

New local industry
Employment chance

New program in education
industry

Contribution to global
economics, e.g. big deposits



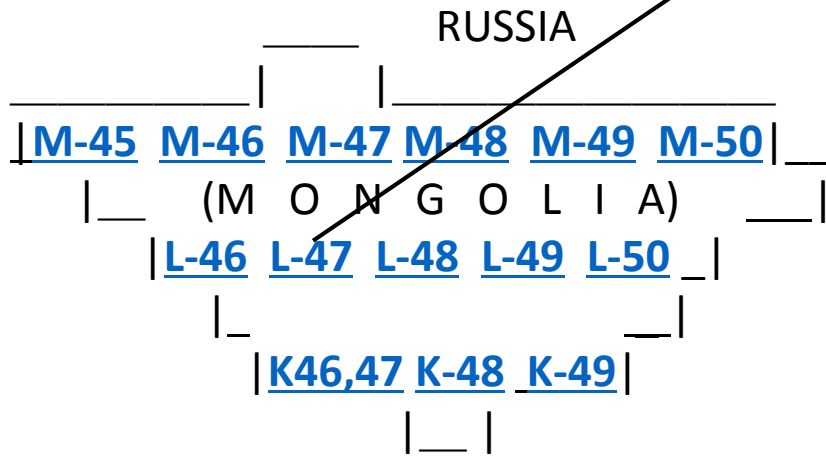
▪ Knowing importance of geology and biology
▪ Sustainable economic growth
Approach to final SDGs

Other my interest: Easy access site on “Geological Information of Mongolia”.

Anyone gets data for compiling a geological map in the target area. This is my trial.

<http://y95480.g1.xrea.com/mapdatamongolia.htm>

Geological map data service in Mongolia



Credit for one million scale geological map;

Referring one million scale geological map (MRAM, 1998) has been permitted by Director of Mineral Resources Information Technology Center on May 19, 2017.

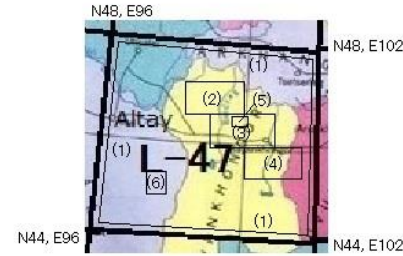
Appendix

Very simplified geology of Mongolia

Brief geologic map of Mongolia ([to brief geologic map](#))

Text simplified geology of Mongolia ([to simplified text](#))

L-47



(1) Geological map of Mongolia (1:1,000,000 in scale)
MRAM Geological Survey and MAS Institute of Geology and Mineral Resources (1998)
Long., Lat.: (96 00, 44 00), (102 00, 44 00), (96 00, 48 00), (102 00, 48 00)

--- [L-47 map](#) (png)

--- [Legend](#) (png)

Please use two windows; one is for geological map, the other is for legend. New window can be opened by “Ctrl” + “N”.

(2) (3) (4) Geology of the Bayankhongol area, Mongolia (Scale 1:200,000)

Explanation Text

--- [GSJ Open File 344, 1999](#)

(2) Geologic map (L47-9) (98 00-99 00 E, N 46 40-47 20 N)

--- [GSJ Open File 350, 1999](#)

(2) Geologic map (L-47-10) (99 00-100 00 E, 46 40-47 20 N)

--- [GSJ Open File 346, 1999](#)

(3) Geologic map (L-47-16) (99 00-100 00 E, 46 00-46 40 N)

--- [GSJ Open File 347, 1999](#)

(3) Geologic map (L-47-17) (100 00-101 00 E, 46 00-46 40 N)

--- [GSJ Open File 345, 1999](#)

More products should be informed. The product may be desirable free access one.