伊豆半島ジオパーク
IZU PENINSULA GEOPARK

APPLICATION
to be a UNESCO Global Geopark

Izu Peninsula Geopark Promotion Council , Japan

Contents

A. Identification of the Area

A.1 Name of the Proposed Geopark

The name of the proposed Geopark is the “Izu Peninsula Geopark”.

The Izu peninsula is blessed with a rich natural environment, where history, culture, and cuisine have grown and flourished. As one of the most famous regions in Japan for hot springs, it has long welcomed many visitors. Much of this natural and social environment is closely entwined with the creation of the peninsula and its current geology.

A.2 Location of the Proposed Geopark

fig. 1 shows the location of the Izu Peninsula Geopark. It extends from 34°32′42.4″ to 35°13′16.3″ North, and from 138°42′18″ to 139°12′32.4″ East. It is 100 km WSW of Tokyo, the capital of Japan, and by train is about 40 minutes from Tokyo, and 1 hour from Tokyo International Airport. In order to make area including all terrestrial areas where resident exists, Geopark area is set also in the sea area (3km from the coastline). And, the boundary on the north side is in agreement with the administrative boundaries.

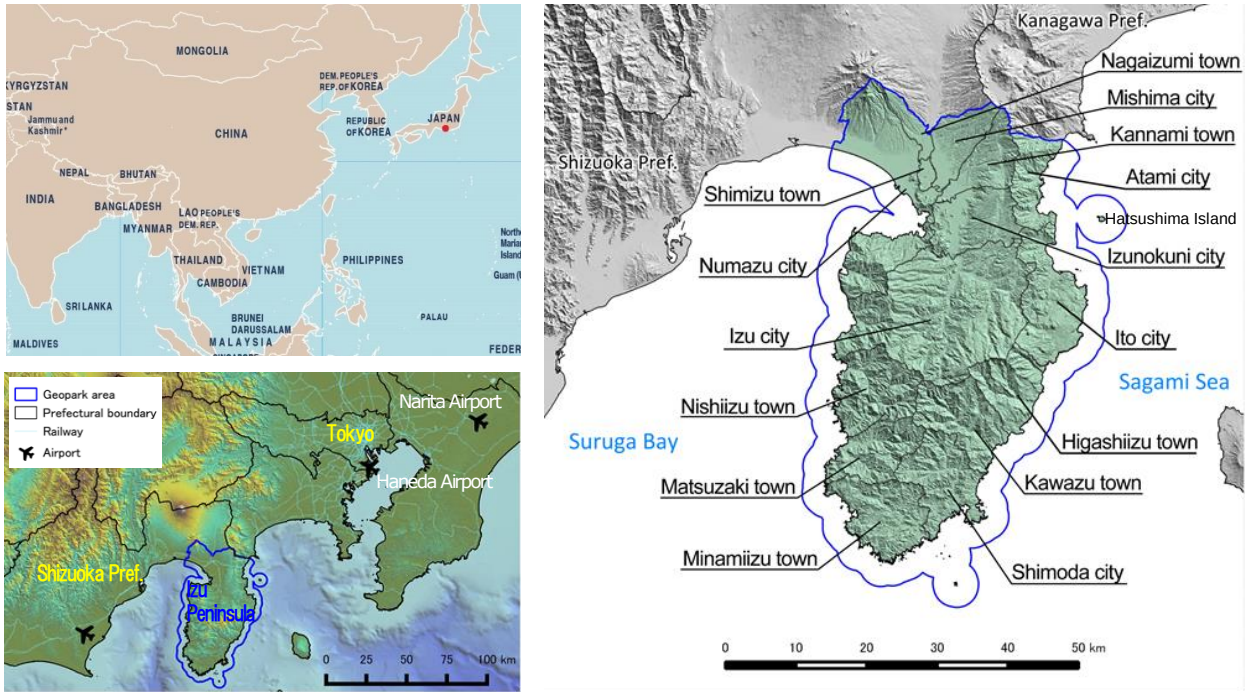


fig. 1 Location of the Proposed Geopark

A.3 Surface Area, Physical and Human Geographical Characteristics

The proposed Geopark covers the whole area of the Izu Peninsula, 2,027 km^2 (land area: 1585 km^2). This covers the area in common between the geophysical “Izu”, which was carried from the south by the motion of Philippine Sea plate and collided with Honshu(Japan main island) , and the cultural and tourist “Izu”, the old “Izu-no-Kuni”.

There are 15 administrative units within the Geopark : Numazu City, Atami City, Mishima City, Ito City, Shimoda City, Izu City, Izunokuni City, Higashiizu Town, Kawazu Town, Minamiizu Town, Matsuzaki Town, Nishiizu Town, Kannami Town, Shimizu Town, and Nagaizumi Town.

A.3.1 Physical Geographical Characteristics

[Topography/Relief]

The Izu peninsula is a peninsular landmass that extends about 60 km southward at the eastern edge of Shizuoka Prefecture: it has a maximum east-west width of 40 km, and a total coastal length of 318 km. Most of the area, apart from the Tagata plain

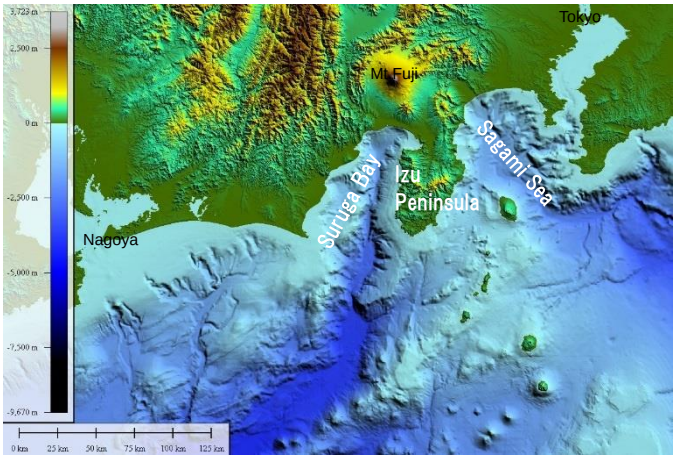


fig. 2 Topography

in the north, is covered by mountains of low to moderate elevations. The highest point of the peninsula is Mt. Banzaburo (1405 m asl) in the Amagi Range. The protrusion of these mountains over the sea causes heavy rain to fall in some regions of the peninsula, and also creates a diverse coastal topography. This complex landscape also forms natural barriers between localities within the peninsula, and creates scenic diversity between and within areas.

Sagami bay, located to the east of the peninsula, has a depth of 1000m off the shore of Hatsushima Island and 1500m in the bay off the south shore of Ōshima Island. Suruga bay in the west is still deeper, 2500m in the baymouth between Irozaki and Omaezaki. These deep bays are influenced by water coming in from outlying oceanic systems. The Kuroshio current, flowing along the south of the Japanese archipelago, is impeded by the volcanic rise to the south of the Izu peninsula and changes its path to flow into the bays. Cold seawater originating from large scale circulation off Greenland flows beneath the warmer Kuroshio. Fig. 2 shows the topographical characteristics of and around the Geopark.

The Kanogawa river (length 46 km) is the longest river of the peninsula. It is one of the few rivers that flows northward into the Pacific Ocean (Suruga bay). In the lower parts of the Kano plain, the width of the river narrows due to the inflow of volcanic ejecta and debris flow, and it tends to flood during heavy rain and typhoons. The peninsula has no large river systems apart from the Kanogawa river, and therefore sediment inflow into the surrounding sea is negligible. The deep waters near the coast and different temperature ranges and water qualities in the bays make these water bodies rich fishing grounds.

[Climate]

According to the Köppen-Geiger classification, the Izu peninsula is located in the temperate humid climate zone, as with most locations in Japan. However, the climate within the peninsula varies appreciably between the coastal and interior parts. The coastal regions are influenced by the warm Kuroshio current and have a mean annual temperature of 15–17 ºC; the southern tip of Irozaki Cape does not receive any snowfall even in the winter. In contrast the northern Tagata plain has a wide difference between day and night temperatures, and winter in this area is noticeably colder. The central Amagi highland receives a flow of humid air from the Pacific, resulting in high levels of precipitation (over 4000 mm/year at Mt Amagi) and frequent snowfall during winter. On the other hand the western part of the peninsula is relatively dry due to the prevailing winds depositing their moisture content over the central highlands. Compared to the Tokyo metropolitan area, the coastal areas are warm in winter and cool in summer.

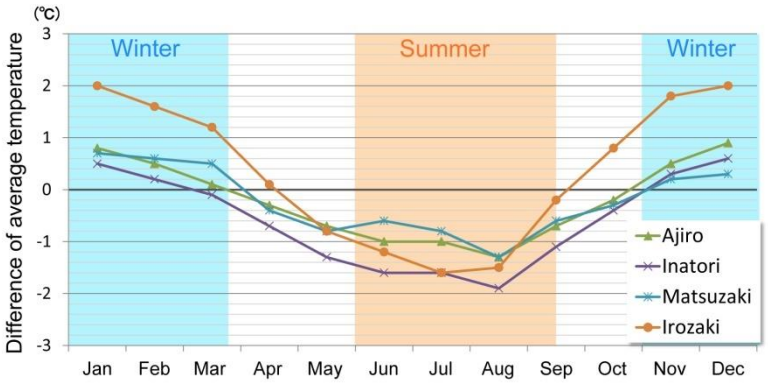


fig. 3 Annual Temperature Source: Japan Meteorological Agency

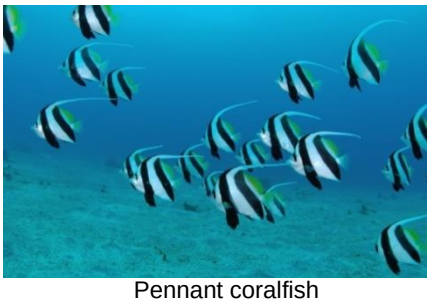
[Ecosystems and Biodiversity]

The climatic diversity of the peninsula directly contributes to its biodiversity. The Amagi highlands, with multiple prominent peaks such as Banjiro and Banzaburo-dake, is known for its forests of deciduous broadleaf trees: Fagus crenata (Buna or Japanese Beech), Stia monadelpha (Himeshara) and Aceraceae family. In particular, it is unusual to find a Fagus crenata forest on the Pacific coast. A 2.2 km^2 tract of old-growth forest is located in Kannami Town, on the slopes of the Quaternary volcanic mountains (500–850 m asl of elevation) that rise at the east of the Tagata plain. Broadleaf trees such as 700 year old giant Fagus crenata, as well as gigantic Quercus acuta (Akagashi), and Stewartia monadelpha are found there. This tract of forest is known for its contribution to the watershed, and has been preserved for this purpose since the Edo Period (1603–1868).

In the northwestern part of the peninsula, a curious sand spit formation in the Osezaki area allows a large group of very old juniper trees to thrive. These junipers mark the northernmost extension of the natural range of juniper in the Japanese archipelago, and some of the giant trees are estimated to be nearly a thousand years old. The Osezaki Juniper Colony is registered as a National Natural Monument.

Osezaki Juniper

Amagi beech



Pennant coralfish

A diverse range of marine organisms, mostly native to a warm marine environment, can be found in the sea around the peninsula. In the past, new marine species like Bodianus masudai (Shimakitsunebera) were discovered off the coast of the Izu peninsula, and marine species previously unknown in Japan continue to be discovered from the depths of the seas around this proposed Geopark. In addition some marine species such as Pseudanthias leucozonus (Shiroobihanadai) and Pseudotrichonotus altivelis (Hotate'eso) are only found off the coasts of Izu, and they are therefore endemic to the region. The Uchiura bay is home to the Acropora reef building coral family (Acropora tumida, Japanese name Edamidoriishi), and this location is the northernmost limit of Acropora's range around the Japanese archipelago. Several deep sea species such as Regalecus russelii (Ryūgūnotsukai), Diaphus watasei (Hadakaiwashi lanternfish), Chiroteuthis imperator (Yūreiika or phantom squid), Paralomis dofleini (Tsubuezoibaragani) as well as the Japanese Spider Crab (Macrocheira kaempferi) have their habitats in the deep waters around the peninsula. The Japanese Spider Crab, or Takaashigani, is the largest crab species in the world, and it lives in the deep Suruga bay to the west of Izu. Seaweed beds are widespread along most coastal areas: the rocky coastal areas are known for Sargassum and Gelidium seaweed, while sandy beaches are known for Zostera (sea grass). Vegetation such as Ecklonia is the food for the Abalone (Awabi), Turban shell (Sazae) and Sea Urchin (Uni).

A.3.2 Human Geographical Charactersitics

【Population】

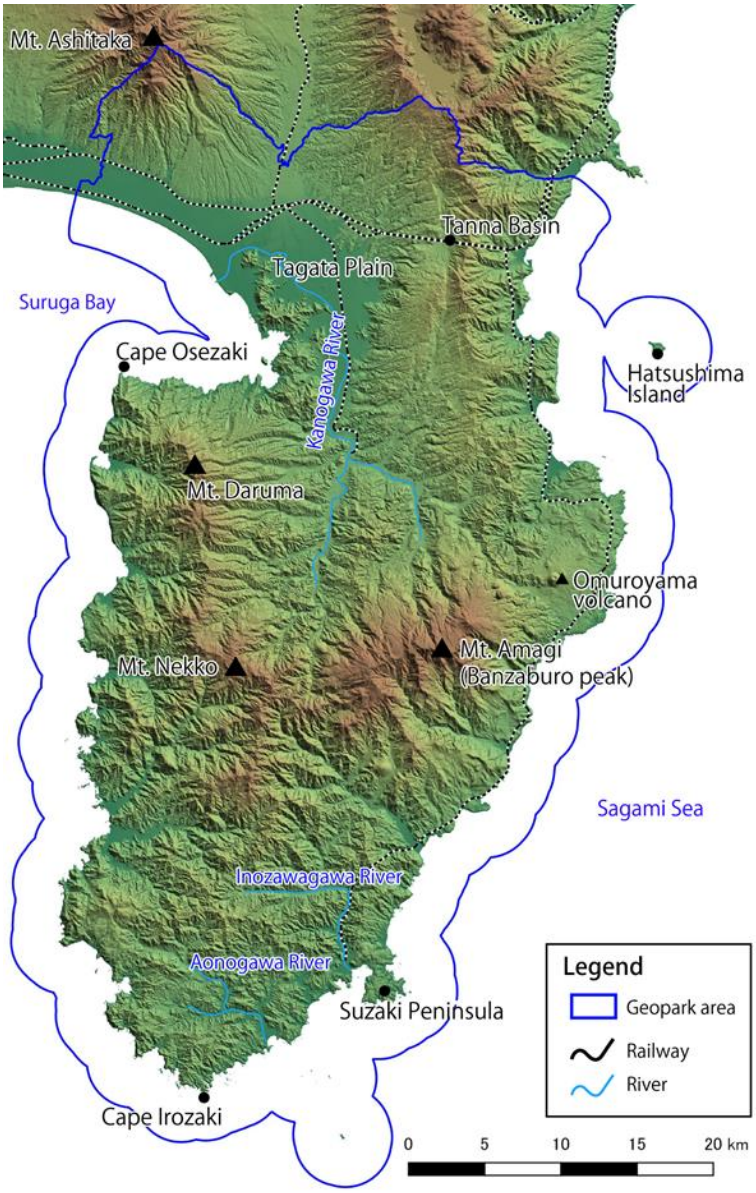
The total population of the proposed Geopark area is 669,585 (2015 census), comprising 278,158 households. Because mountains and highlands predominate, the population is mostly concentrated in the coastal and narrow plain regions. 62% of the total population is concentrated in the 5 administrative units (Numazu City, Mishima City, Kannami Town, Shimizu Town and Nagaizumi Town) around the Tagata plain.

【Historical and Cultural Backgrounds】

Human occuptaion of the peninsula goes back around 30,000 years. This was the latter part of the Paleolithic era in Japan. The discovery of varied remains in the Ashitaka mountains and western parts of the lower Hakone mountain area testifies to the existence of sizable populations at this period. Later, Izu became a strategic location for marine traffic. The evidence comes from the discovery of obsidian from Kozushima island in the Mitakadanma ruins in Kawazu Town; this shows that this place was a storage point for obsidian that entered Izu from outside.

Artifacts from the Yayoi Era (300 BC–250 AD), when wet rice cultivation became widespread throughout Japan, are found in the southern part of the peninsula. The Hizume ruins of Minamiizu Town, Himemiya ruins of Kawazu Town, and Ebisujima ruins of Shimoda City are valuable evidence for the history of this period, when the coastal areas in the south of the peninsula were developed due to the lack of flat land.

Notable ruins of the Kofun Era (250 AD–600AD) include the Mukaiyama, Kashiya, and Ema burial mounds. The Mukaiyama mounds are the first keyhole Kofun burial mounds found in Izu, while the mounds in Kashiya park are accessible to tourists. The Jo-ri-sei



Topography of the Izu Peninsula

primitive land grid system was developed in the Asuka Period (592–710 AD) and this formed the basis of the development of cropland and roadways in the Tagata plain.

Izu has been the site of important turning points in history. Minamoto no Yoritomo (A.D. 1147 – 1199. The founder and the first shogun of the Kamakura Shogunate of Japan.) was exiled to Izu after the Heiji Rebellion of 1160, and raised the banner of

Kashiya tunnel-tombs

Ebisujima Ritual Ruins

Nirayama Reverberatory Furnaces
（Part of World Heritage）

rebellion there in the battles that led to the creation of the Kamakura bakufu. In the mid-19th century, Shimoda was the site of the agreement of treaties to open Japan to trade. Designated National Historic Sites include Hirugakojima, where Minamoto no Yoritomo is said to have spent 20 years of exile, Ganjojuin, where his wife Hojo Masako was born, the Nirayama Reverberatory Furnaces, which was built by Hidetatsu Egawa in the mid-19th century in an attempt to construct large guns, and which survives almost intact, and Gyokusenji, which was the first US consulate in Japan. The Nirayama Reverberatory Furnaces is part of the "Sites of Japan's Meiji Industrial Revolution: Iron and Steel, Shipbuilding and Coal Mining" World Heritage Site.

[Use of Stone and Minerals]

The old stone quarries of Izu peninsula are a major cultural attraction of the area. 'Izu Stone' is a special stone quarried in Izu, and it was prized as a building material in pre-modern Japan. There are two types of Izu Stone: 'hard' and 'soft.' The hard stones are generally andesitic stones that have excellent heat and trauma resistance properties; these were used as materials for castle walls in Edo castle and Sunpu castle. The soft stones are generally softer and lighter volcanic ash, and were perfect materials to build kilns or storehouses. These stones were also prized for their ornamental value.

The Usami Quarry in Ito, which supplied hard Izu Stone in the past, was registered as a historic site in 2011.

Izu Soft Stone was used throughout the Kanto region of Japan (the area around Tokyo in east central Japan), due to both the fact that these stones are easy to process, and to the historical importance of Izu as a marine trade point. Later, after the Kanto earthquake (1923) and the development of overland routes, Oya stone from Tochigi replaced soft Izu Stone as the dominant quarried stone in Japan. Soft stone from Izu can still be seen in the baths and floors of many Japanese households, and in the walls of many historical buildings and storehouses in Shimoda City.

In addition, minerals such as gold were extracted in large quantities from Izu's mines in premodern times. Gold mining in Izu rivaled the Tohoku region in the middle ages, and mines such as the Toi and Gantsuki Tensho goldmines were prominent. These two goldmines are registered as historic sites by their local authorities.

Quarry Used for Edo Castle

Shimoda Streetscape

Gantsuki Tensho goldmine

[Beliefs and Festivals]

92 shrines from Izu are registered in the 10th-century Engishiki register of shrines. This number is higher than other regions of Shizuoka Prefecture. Izu has witnessed frequent natural disasters such as earthquakes, volcanism and tsunami since ancient times. These events directly contributed to local beliefs, as local communities began to worship the deities who were supposed to rule over natural forces. Many shrines were thus built in this region as places for worshipping such deities.

Mishima Taisha Shrine

Mishima Taisha Shrine is the most important Shinto shrine in the Izu peninsula. The presiding deity, or kami, is Mishima Daimyojin, a kami of fire. Whenever there was an eruption on the Miyakejima or Kozushima volcanic islands off Izu, the rank of Mishima Daimyojin was raised. The main sanctuary is a National Important Cultural Property. The legend of Mishima Daimyojin says that the deity arrived in Mishima after initially lodging at Shirahama Jinja Shrine in Shimoda. Shirahama Jinja is the oldest shrine in the Izu peninsula, and the shrine continues to worship the kami of the turbulent Izu islands through a fire ritual known as the Hitachisai festival.

In addition there are many shrines such as Iro Jinja Shrine at the tip of southern Izu where people worship the kami of the seas and pray for safe voyages.

Iro Jinja Shrine

Kawakanjo (Prayer for the safety of Kanogawa River)

[Writers and Izu]

Izu is a famous hot spring destination, and many famous writers frequented this area. Yasunari Kawabata, who received the Nobel Prize in Literature in 1968, set his novel The Dancing Girl of Izu in the Izu peninsula. Another famous novel is Shirobamba, written by Yasushi Inoue, set in the Amagi Yugashima area. Other notable authors who wrote stories set in the area include Osamu Dazai and Banana Yoshimoto. There are many inns, spring baths and other buildings in Izu that were visited by literary luminaries.

A.4 Organization in charge and Management Structure

A.4.1 Izu Peninsula Geopark Promotion Council

The Izu Peninsula Geopark Promotion Council is the body responsible for managing the Geopark. It is composed of 72 bodies, including local authorities, transport companies, and local media organizations. The members are listed following table.

【Local Government】Shizuoka Prefecture, Numazu City, Atami City, Mishima City, Ito City, Shimoda City, Izu City, Izunokuni City, Higashiizu Town, Kawazu Town, Minamiizu Town, Matsuzaki Town, Nishiizu Town, Kannami Town, Nagaizumi Town, Shimizu Town

【Regular Members】16 Tourist Associations (Numazu, Heda, Atami, Mishima, Ito, Shimoda, Izu, Izunokuni, Higashiizu town, Kawazu town, Minamiizu town, Matsuzaki town, Nishiizu town, Kannami town, Shimizu town, Nagaizumi town),
5 Chambers of Commerce and Industry (Numazu, Atami, Mishima, Ito, Shimoda)
11 Societies of Commerce and Industry (Numazu, Izu, Izunokuni, Higashiizu town, Kawazu town, Minamiizu town, Matsuzaki town, Nishiizu town, Kannami town, Shimizu town, Nagaizumi town)
3 Guide Clubs (Amagi Nature Guide Club, Izu Peninsula Geoguide Association, Ito Geo marine Club)
NPO Machikon ITO, Shizuoka Prefectural Izu Sogo High School, Mishima Building Contractors Society, Shimoda Building Contractors Society,
Izukyu Holdings Co.Ltd., Izuhakone Railway Co.Ltd., Izuhakone Bus Co.Ltd., Tokai Jidosha Co.Ltd., Shizuoka Taxi Association Izu Section, Izubus Co.Ltd., S-pulse Dream Ferry Co.Ltd., Shizuoka Road Public Corp.,
Shizuoka Bank Ltd., Mishima Shinkin Bank, Numazu Shinkin Bank, Izukyu Cable Network Co.Ltd.,
【Research Institution】Shizuoka University Center for Integrated Research and Education of Natural Hazards
【National Ministries and Offices】MLIT. Numazu Office of River and National Highway, MLIT. JMA. Shizuoka Meteorological Office, MAFF. Forestry Agency Izu Office, MoE. Hakone Environmental Office

MoE: Ministry of the Environment, MLIT: Ministry of Land, Infrastructure, Transport and Tourism JMA: Japan Meteorological Agency, MAFF: The Ministry of Agriculture, Forestry and Fisheries of Japan

A.4.2 Structure of the Management Organization

The Izu Peninsula Geopark Promotion Council is composed of a General Assembly, an Executive Committee, the Promotion Council Bureau, and a number of Working committees. The General Assembly is made up of representatives of all the member organizations, and meets once a year to set regulations, strategy, and budget, and to discuss other important issues. The Executive Committee investigates issues to be submitted to the General Assembly, and is responsible for putting plans into effect. The Promotion Council Bureau carries out day-to-day work on the ground and serves as a contact point for the Geopark. The Working committees provide specialist support, and at present there are four: Geoconservation, Geotourism, Education, and Academic Research.

The Promotion Council Bureau is located in the Shuzenji area of Izu City, near the entrance to the peninsula, and currently has 11 staff. The Bureau employs a specialist geologist, in earth sciences and disaster mitigation. His responsibilities include carrying out research within the park, preparing scientific interpretations and explanatory panels for the geosites, and educational and promotional activities. The Bureau has a budget to hire two specialists (geologists or relevant specialists), but at the time of writing one post is vacant, and the Bureau is advertising to fill it.

The Academic Research Working Group supports these scholarly activities, and has 17 members drawn from the natural sciences, including the geosciences and ecology, social sciences, archaeology, and conservation. The Education Working Group is primarily a contact body with local schools, and both shares information and holds meetings to present the results of educational activities.

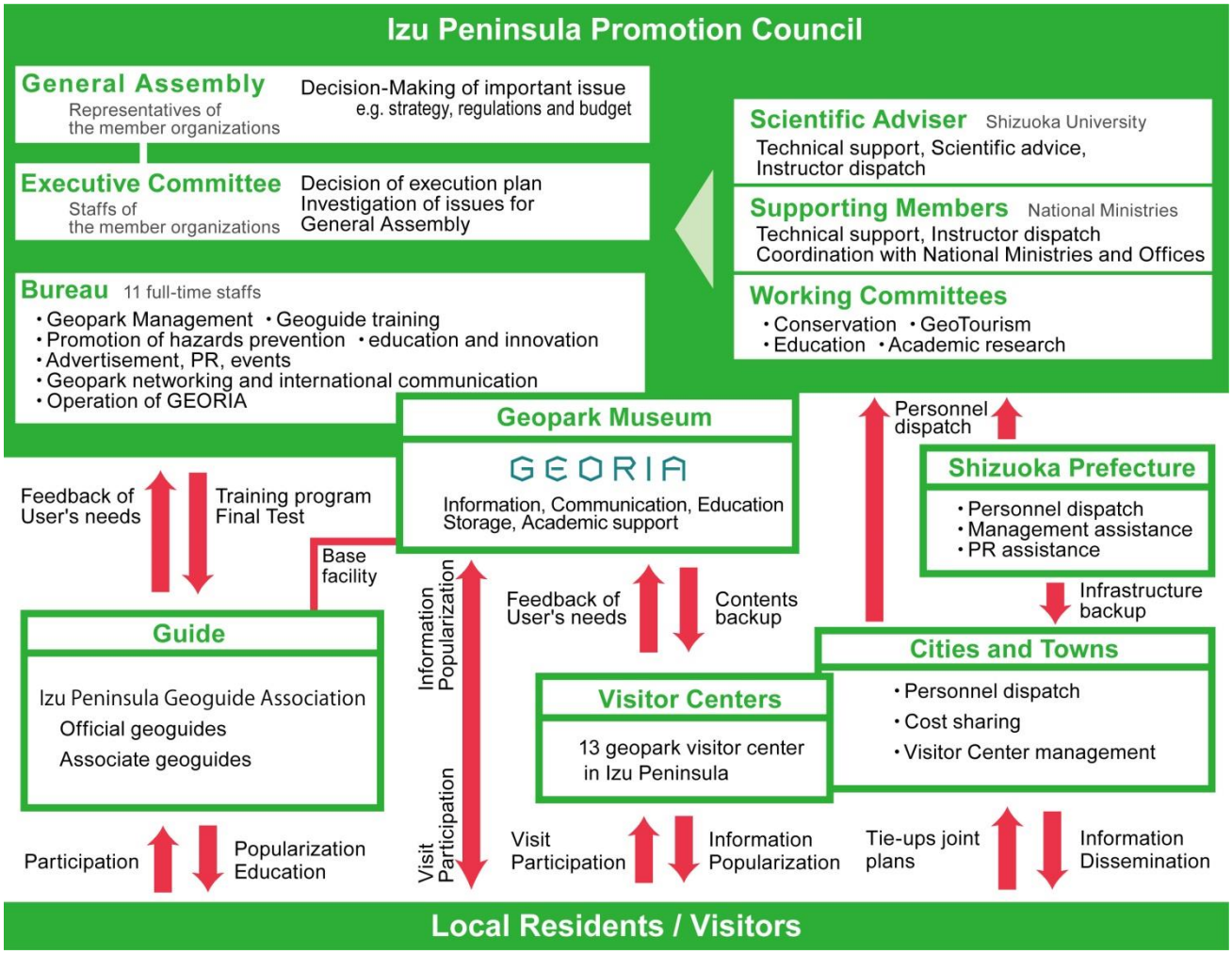


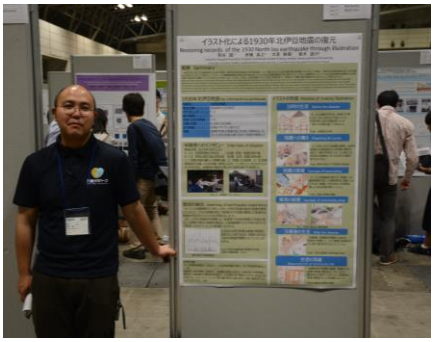
fig. 4 Organization structure

A.4.3 Supporting Units/ Members

The Geopark receives a range of academic, research and capacity-building advice, as well as joint-research, geoguide education and geoscience lecture support from Shizuoka University (one of the National Universities of Japan). Efforts are ongoing to expand academic outreach and involve other universities and think-tanks.

Professor Masato Koyama of the Center for Integrated Research and Education of Natural Hazards at Shizuoka University is the main academic advisor. Dr. Koyama is a well-known volcanologist in Japan, and he has made extensive contributions to the Geopark in the form of lectures, advisory support and publications on the Geopark from before the establishment of the Promotion Council, and continuing today. In addition, the Center for Integrated Research and Education of Natural Hazards supports joint research with the Geopark.

Further, the Council has a system of support for research, with the goal of building up scientific knowledge of the area, and it is building contacts with and supporting researchers in a variety of fields.



Poster presentation of the research that was supported by the councill

A.4.4 Finances

The Promotion Council has independent funding exclusively for Geopark promotion and management. The main income sources are financial commitments from each of the 15 administrative units, the special tourism promotion body for the Izu peninsula, and funds allocated to the Geopark by Shizuoka Prefecture Government. The structural costs, such as visitor center management, explanation panel construction, managing trails, parking spaces and toilet facilities, are met from the common funds of the 15 administrative units, as subsidized by Shizuoka Prefecture. The chart below gives a summary of the available budget.
Table 1 shows the management budget, and Table 2 the budget for hard infrastructure.

Table 1 Izu Peninsula Geopark Promotion Council maintains its own budget

(Units: ¥1,000)

	2011	2012	2013	2014	2015	2016
Council Budget	33,759	30,000	38,048	39,440	45,240	40,240

Table 2 Expenditure on Geopark Facilities by local authorities, subsidized by Shizuoka Prefecture

(Units: ¥1,000)

	2011	2012	2013	2014	2015	2016
Total Expenditure	140,034	329,919	465,061	384,528	374,313	486,300
Prefectural Subsidy	70,000	197,700	286,900	196,400	199,300	296,700

A.5 Application contact person

Izu Peninsula Geopark Promotion Council
President: Yutaka Kikuchi
838-1 Shuzenji, Izu-shi, Shizuoka-ken, Japan. 410-2416
Tel: +81-558-72-0520 Fax: +81-558-72-1355
E-mail: info@izugeopark.org

Yutaka Kikuchi
President of Izu Peninsula Geopark Promotion Councill

Dr. Masato Koyama
The main academic advisor

B. Geological Heritage

B.1 General geological description of the proposed Geopark

The Izu peninsula is located at the northern edge of the Philippine Sea plate, at the far northern end of the Izu-Bonin arc. The Izu-Bonin arc was born where the Pacific plate, an oceanic plate, subducts under the Philippine Sea plate, another oceanic plate. This subduction continues today, and an arc of volcanism and an archipelago of volcanic islands have been formed along with it. The Izu peninsula and its adjacent seas form the northern extremity of this active volcanic arc (fig. 5, fig. 6).

The Philippine Sea plate, carrying the Izu-Bonin arc on its eastern edge, is moving northwest relative to the Japanese archipelago (Honshū Arc), which straddles the boundary between the Eurasian and North American (Okhotsk) plates. In the area of the Izu peninsula, it moves about 3cm/year relative to the North American plate. To absorb this motion, the Philippine Sea plate is subducting beneath the Eurasian plate at the Suruga-Nankai trough and Ryūkyū trench, and beneath the North American plate at the Sagami trough. However, the Izu-Bonin arc, an active volcanic arc with a thick, buoyant crust, cannot easily be subducted, and is colliding with the Honshu arc. The Izu peninsula is located at the very point of collision.

Due to this tectonic pattern, the Izu peninsula is sandwiched between two plate subduction boundaries: the Suruga trough in the west, and the Sagami trough to the east. As a result, within 20km of the east and west coasts of the peninsula there are deep seas of 1500–2500m, and plate boundary earthquakes of magnitude 8 or more arise there every 100 to 300 years. The shaking and tsunamis caused by these earthquakes have repeatedly inflicted great damage on the Izu peninsula.

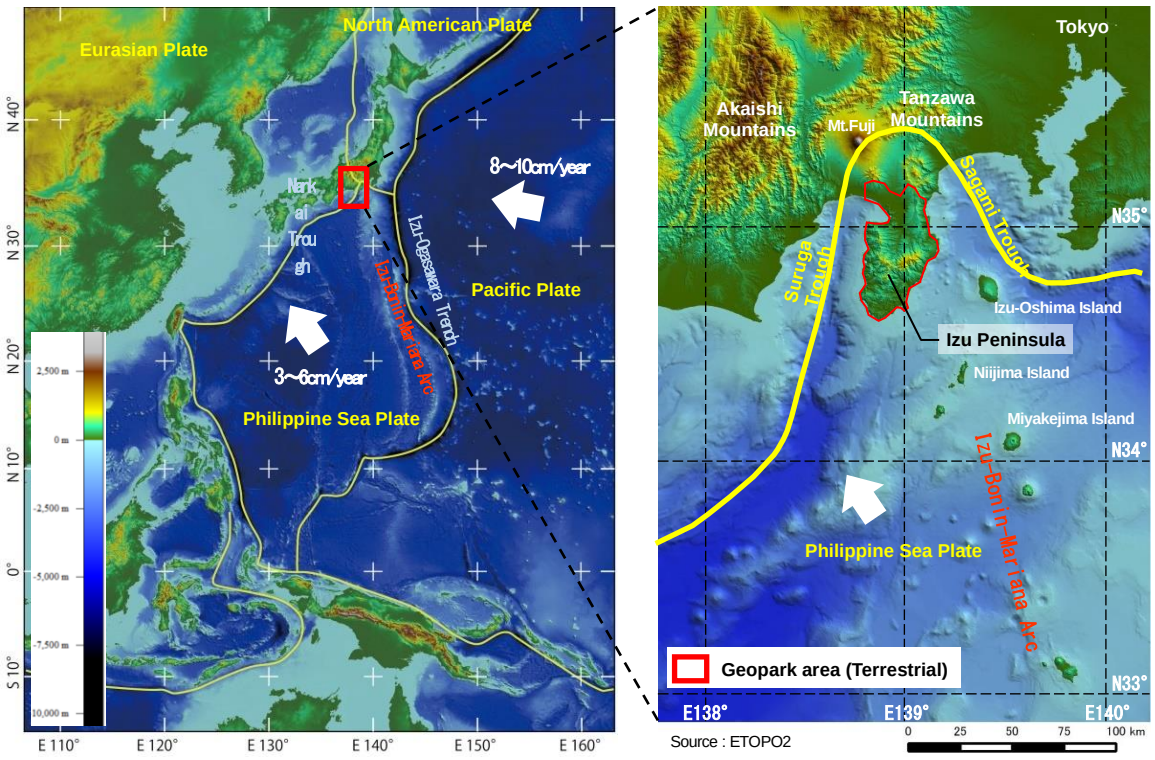


fig. 5 Tectonic situation of the Izu Peninsula and adjacent areas

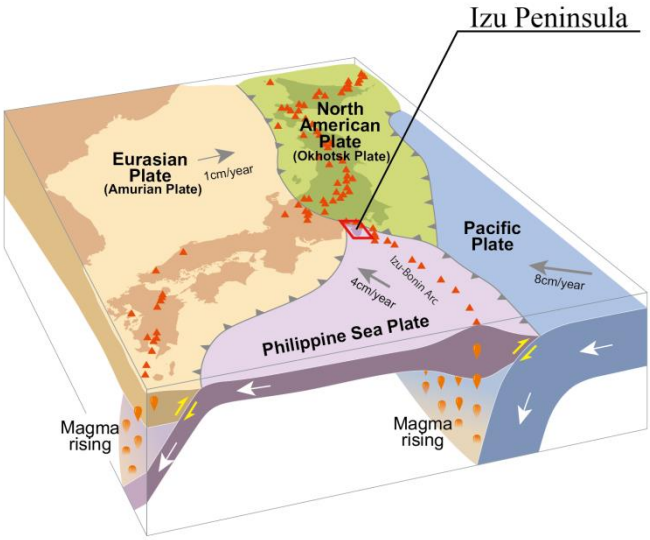


fig. 6 Izu Peninsula at plate junction

On the other hand, as the ridge of the Izu-Bonin arc extends south from the southern end of the peninsula, this area is occupied by a large area of shallow ocean, under 500m in depth, studded with many islands. These islands, the Izu islands, are almost all volcanic islands, and many submarine volcanoes have also been identified in the surrounding area. Many of these terrestrial and submarine volcanoes are active. These active volcanoes have erupted many times in the historical period, and the eruption of Izu Ōshima in 1986 and of Miyakejima in 2000 led to the evacuation of the entire population of those islands.

Further, where the north and northwestern edges of the peninsula form the collision zone with the Honshu arc, the Ashigara, Tanzawa, Misaka, Tenshu, and Akaishi fold mountains rise up to 1000 to 3000 m, and the compression and uplift continue today. This area also includes the Fuji River Mouth and Kannawa-Kozu-Matsuda fault zones. Further, continental Quaternary volcanoes such as the Fuji volcano and Hakone volcano have erupted to cover the area, and some of them are still active. Fuji volcano had a large scale eruption in 1707, and even Hakone volcano saw a small scale eruption in 2015.

The interior of the Izu peninsula, that is, the region within the Izu Peninsula Geopark, is mostly occupied by eroded mountains with a height of under 1400 m, such as Amagi volcano and Daruma volcano, and there are no large rivers or plains. The only significant river is the Kanogawa river, which flows north from the region around Amagi volcano, and the largest plain in the Izu peninsula, the Tagata plain, is found in its downstream region. As the peaks of the Izu peninsula are surrounded by water on three sides, the moist air from the sea brings annual rainfall of as much as 4000 mm. This means that landslides and similar disasters often occur, and the Kanogawa river and Tagata plain are both notorious for flooding. In addition, lava and mud flows from Fuji volcano in the north, and pyroclastic and mud flows from Hakone volcano in the northeast, sometimes reach the plain.

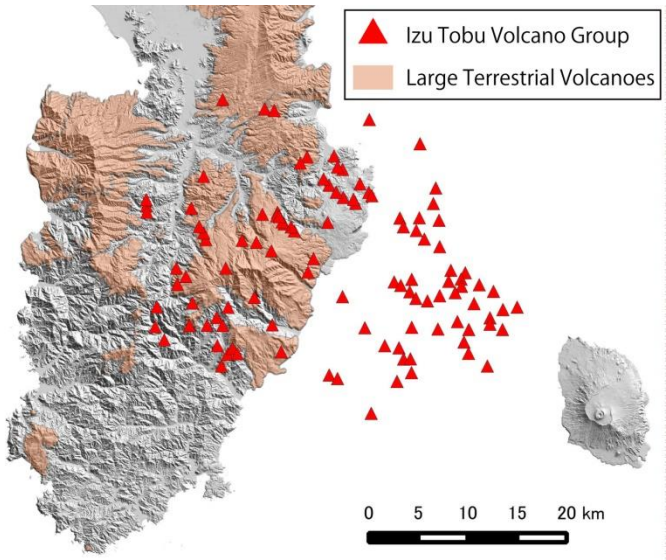


fig. 7 Distribution of terrestrial volcanoes

The basement of the mountain range that makes up the Izu Peninsula Geopark is composed of Neogene submarine volcanic rock, and Quaternary volcanoes such as Amagi volcano are distributed on top (Fig. 5). However, in the last 150,000 years the Izu Tobu volcano group, an independent monogenetic volcano group of a type that is rare in the Japanese archipelago, has become active, and over 100 small volcanoes are scattered across the eastern Izu peninsula and the adjoining sea bed (fig. 7). The only currently active volcanoes in the Izu peninsula are in this Izu Tobu volcano group. The magma reservoir for the Izu Tobu volcano groups gives rise to earthquake swarms from time to time, damaging the surrounding area and leaving people unsettled. In July 1989, the first small-scale eruption on the Izu peninsula or within its surrounding waters in 2700 years occurred, on the sea bed off the coast of Ito.

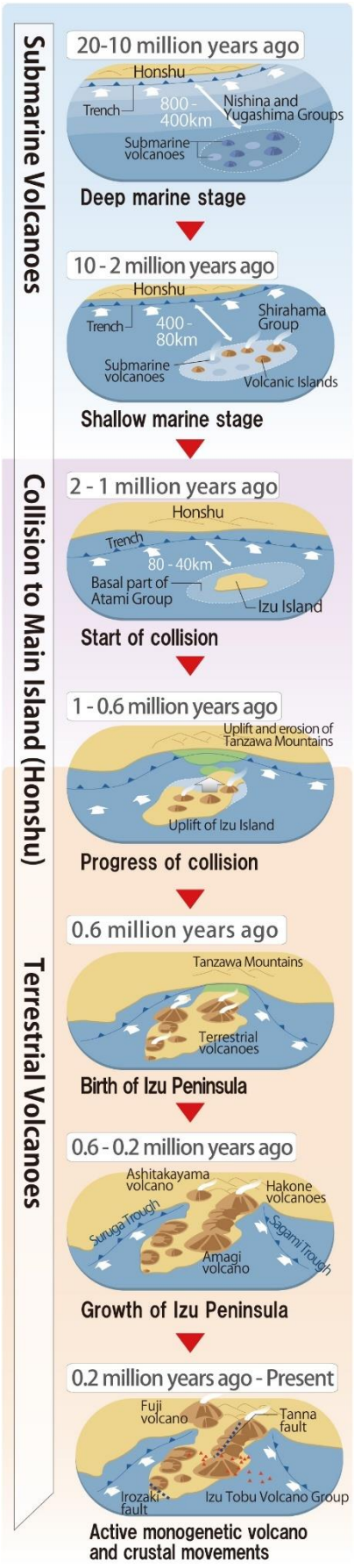


fig. 8 Geological history of Izu Peninsula since 20 million years ago

The influence of the collision between the Izu-Bonin and Honshū arcs can be seen in the crustal movements of the Izu peninsula, where the east coast is undergoing uplift while the west coast subsides. The evidence for this can be seen in wave-eroded platforms, and the other geomorphology of the coasts. Further, many active faults, most prominently the Tanna fault, lie in the region, and have repeatedly given rise to magnitude 6 to 7 earthquakes over the course of history, such as the magnitude 7.3 North Izu Earthquake in 1930, and the magnitude 6.9 Izu Peninsula Oki Earthquake in 1974. These earthquakes have done a lot of damage to the peninsula.

This completes the summary of the present geological situation of the Izu peninsula and its surrounding region, but it is worth noting that many research findings also directly support the assumption that the Izu peninsula was located further to the south in the past. In other words, the Izu peninsula is an allochthonous crustal block that was brought into collision with Honshū by the northwards movement of the Philippine Sea plate. Strata and rocks from almost the whole of the past 20 million years are found at the surface across the peninsula, and it is possible to follow a faithful geological record from before the collision with the Honshū arc, that is, from when the peninsula was located to the south (Figs 6 & 7).

The strata and rocks found in the Izu peninsula can be broadly divided into two groups. The lower (20 to 2 Ma) are pre-collisional submarine volcanics (Nishina group, Yugashima group, Shirahama group), and the upper (from 2 Ma) are post-collisional terrestrial volcanoes (the Atami group). The former are strata from the long pre-collisional period of submarine volcanism, while the latter are strata dating from after collision and continental uplift. Further, at the base of the latter are syn-collisional trough-filling sedimentary rocks, which built up in the trough that formed between the Izu peninsula and Honshū during the collision.

Most of the submarine volcanics in the lower strata are made up of volcanic rocks from submarine eruptions and the associated secondary sediments and intrusive rocks. These strata and rocks, which were originally on the sea bed, have been widely exposed on the surface as a result of uplift and emergence caused by the collision. When compared to the older Nishina and Yugashima groups (from 20 Ma to 10 Ma), the younger Shirahama group (from 10 Ma to 2 Ma) contains many shallow-water fossils and terrigenous volcanic rocks. This shows that, over time, the island arc developed, and shallow seas and volcanic islands appeared. Further, the low dip of the paleomagnetic traces in these rocks and strata, along with the marine fossils, show that the Izu region was, at the time of eruption or deposition, located at a lower latitude than at present, in the tropical or sub-tropical zones.

Later, between 2 Ma and 1 Ma, concomitant with the collision with Honshū and uplift, sea floor sediments disappear from the strata, and by around 1 Ma the whole of the Izu peninsula became terrestrial. The strait between Izu and Honshū, joining the Suruga and Sagami troughs, disappeared due to sedimentation and uplift, and by about 600,000 years ago, the present form of the peninsula was established.

Volcanic eruptions continued across almost the whole of the peninsula after it became a landmass, and by about 200,000 BP the large scale terrestrial volcanoes such as Amagi volcano had formed, and the mountainous scenery that we see in the peninsula today had taken shape. From about 150,000 years ago, the independent monogenetic volcanoes of the Izu Tobu volcano group have erupted until the present.

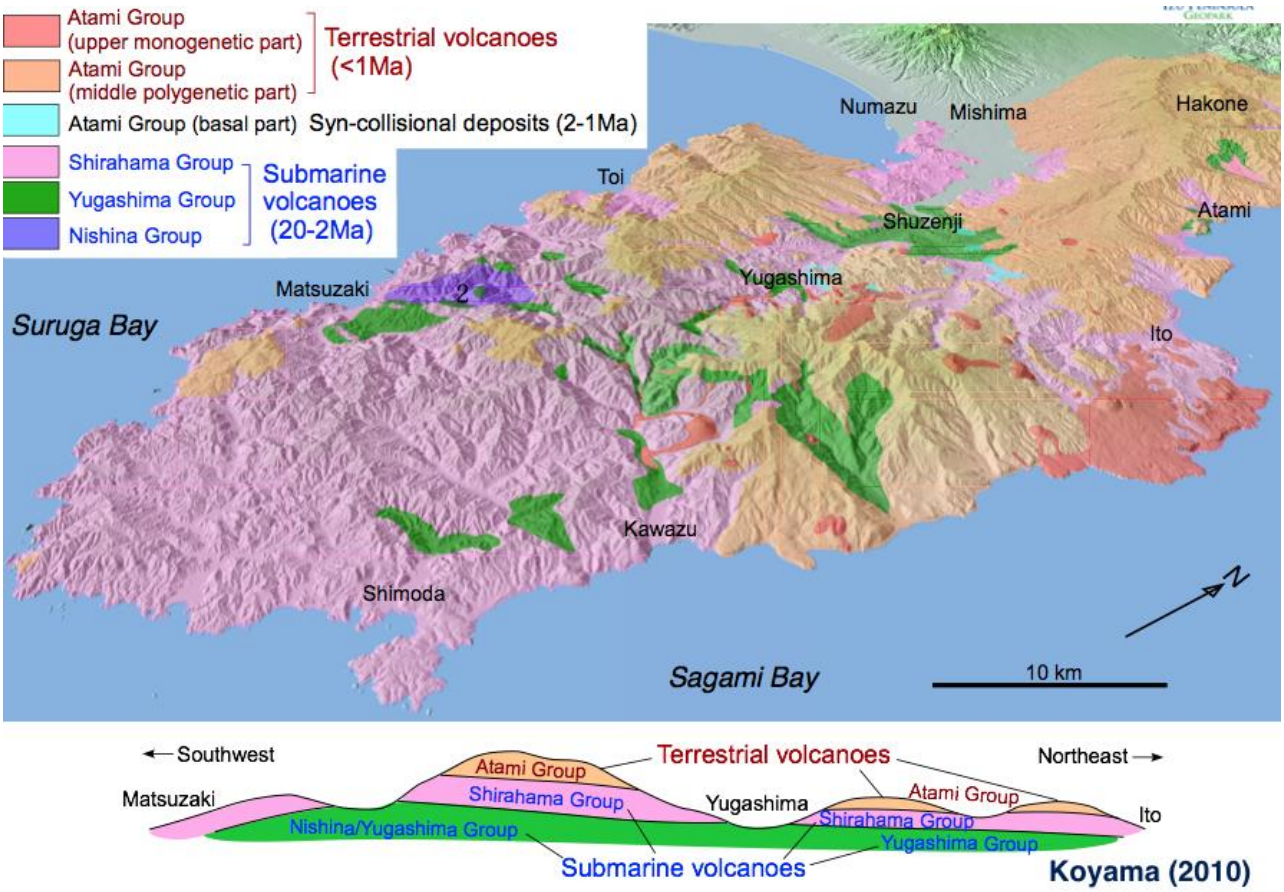


fig. 9 Simplified geological map and structure of Izu Peninsula

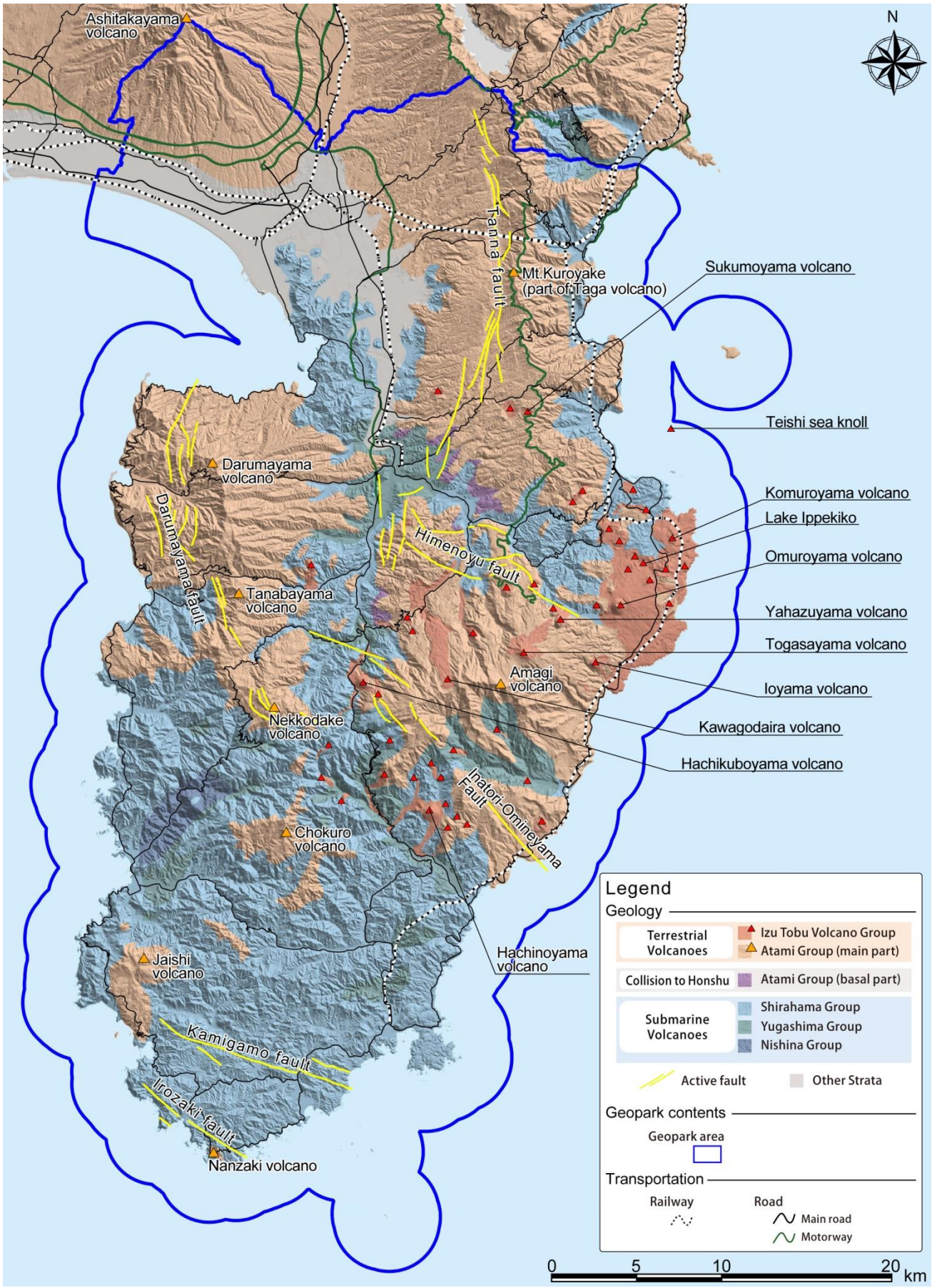


fig. 10 Geological map of the Izu Peninsula Geopark

B.2 Listing and description of geological sites within the proposed Geopark

ID	Site Name	Description	Value	geological	cultural	biological	disaster
1	Momozawagawa River	Lava flows from Ashitaka volcano and its structure, Beech forest					
2	Surugadaira	The Graded Slopes at the Foot of Ashitaka Volcano					
3	Southern foot of Ashitakayama Volcano	The Graded Slopes at the Foot of Ashitaka Volcano and land use					
4	Nagakubo	The Graded Slopes at the Foot of Ashitaka Volcano, Historic battlefield					
5	Southwest foot of Hakone Volcano	The Graded Slopes at the Foot of Ashitaka Volcano and land use					
6	Ayutsubo Falls	Lava flows from Fuji volcano, Lava tree molds, Local folklore					
7	Mishima	Top section of Mishima lava and springwater, Gotenba mudflow					
8	Kubo waterspring	Spring water from the lavas by Fuji volcano, Lahar deposit, Ecosystem					
9	Kiyozumi Green Area, Maruike Pond	Spring water from the lavas and its use					
10	Gekko Astronomical Observatory	Astronomical observatory					
11	Tashiro Basin	1930 Kitaizu earthquake fault slip, Tashiro basin landscape	National				
12	Jikkokutoge Pass	Viewing spot ; Tanna fault, Tanna and Tashiro basin, Fuji volcano, Amagi volcano					
13	Izusan	Source of hot spring					
14	Kakitagawa River	Spring water from the lavas by Fuji volcano, Ecosystem, Environmental reconstruction	National				
15	Tanna Basin	Lateral slip during 1939 Kitaizu earthquake, underground preservation of fault structure, Tanna fault model	International				
16	Atami	Landscape of hot spring town					
17	Mt. Kanukiyama	Volcanic necks, Viewing spot of large terrain					
18	Senbonhama, Ushibuseyama	Submarine lava dome at seaside cliff, tsunami related local belief at Oasa shrine					
19	Ohira	Lock gate against Kanogawa river flood					
20	Kashiya	Pyroclastic deposit of Hakone volcano and tunnnel tombs					
21	Mt.Kurotake	Viewing spot ; Tanna fault, Tanna and Tashiro basin	International				
22	Ikenoyamatoge Pass	Fault valley landscape					
23	Cape Uomizaki	Early phase submarine volcanic deposits from Taga volcano					
24	South Nirayama Pass	Cross section of Taga volcano(Strato volcano)					
25	Izunagaoka	Submarine volcanic deposits, Kitaema tunnnek tombs, Kanogawa drainage canal and repository					
26	Sizuura, Uchiura	Submarine volcanic necks and other deoisits, Outlet of Kanogawa drainage canal					
27	Osezaki	Osezaki volcano lavas and vent, Sand spit and freshwater lans, Juniper forest					
28	Ita	Ita volcano lavas, Sand spit and Myojin pond, Sungo ancient tombs					
29	Nishiura	Submarine volcano deposit, Kanogawa drainage canal					
30	Ukihashi	Fault valley landscape					
31	Ajiro	Volcanic ejecta of Taga volcano					
32	Hatsushima Island	Terraced terrain and uplift					
33	Mt. Joyama, Mt. Katsuragiyama	Volcanic neck, Tuff stone quarry ruin					
34	Takatsukayama Volcano, Sukumoyama Volcano	Scoria cone and maar of Izu Tobu Volcano Group					
35	Usami, Oishigasawa	Lava flow from Usami volcano, Stone quarry ruin					
36	Heda	Good harbor formed from sand spit, Deep-sea organisms, Tsunami related forest					
37	Sanagiyama, Kinkanzan	Landscape of large terrestrial volcanoes					
38	Darumayama Volcano	Landscape associated with the collision between Izu and Honshu	International				
39	Shuzenji Spa	Submarine volcano deposit and Hot spa					
40	Ohito, Shuzenji	Gold mine ruin, Kanogawa river and life of local resident					
41	Shimoshiraiwa, Kadono	Calcareous sandstone cliff, Lepidocyclina fossil	International				
42	Hinata	Outcrop of Turbidite					
43	Kitaomi	Usami volcano lava flow landscape and its land use					
44	Yokoyama, Umegi	Sandstone/mudstone and gravel from the last sea od Izu block					
45	Hiekawa, Kashiwatoge Pass	Lava dome, Obsidian that was used in ancient times					
46	Ito Spa	Townscape of historical hot spa, Disaster(Tsunami) remains					
47	Teishi Sea-Knoll	Latest eruption of Izu Tobu Volcano Group, Volcano disaster	National				
48	Okuno, Kadono	Lava from Kadono and Omuroyama volcanoes, Dam and society, surrounding landscape					
49	Joboshi	Tuff Ring of Izu Tobu Volcano Group					
50	Cape Shiofukizaki, Kawana	Surf benches and wave-cut notches resulting from coseismic uplift					
51	Komuroyama Volcano	Scoria cone of Izu Tobu Volcano Group					
52	Lake Ippekiko, Umenokidaira Volcano	Maar of Izu Tobu Volcano Group, Vegetation of wetlands	National				
53	Funayama	Cross section of Darumayama volcano(Strato volcano)					
54	Odoi	Cross section of Darumayama volcano(Strato volcano), Terraced rice fields					
55	Funabara	Lava flows of Izu Tobu Volcano Group and land use					
56	Kawagodaira Volcano	Pumice lava layer and pyroclastic flow, Spring water from lava, Japanese horseradish field	National				
57	Kokushigoe Pass	Maar of Izu Tobu Volcano Group and its land use					
58	Maruno Highland	Scoria cone of Izu Tobu Volcano Group and lava flow landscape					
59	Omuroyama Volcano	Largest scoria cone of Izu Tobu Volcano Group, Ecosystem maintained by mountain firing	International				
60	Futo Coast, North Jogasaki Coast	Lavas flowing into the sea and related ecosystem	National				
61	South Jogasaki Coast	Lavas flowing into the sea and related ecosystem	National				
62	Ioyama Volcano, Akakubo Volcano	Scoria cone of Izu Tobu Volcano Group					
63	Ike	Damming of the river by the lava from Omuroyama volcano, Rice paddy fields created by the land reclamation					
64	Toi Gold Mine	Gold mine ruin					
65	Seigoshi Mine	Gold mine ruin					
66	Mochikoshi mine	Gold mine ruin					
67	Yugashima	Submarine volcano deposits, Gold mine ruin, related Novels					
68	Togasayama Volcano	Scoria cone of Izu Tobu Volcano Group					
69	Yahazuyama Volcano	Lava dome of Izu Tobu Volcano Group					
70	Koshimoda	Lava flows og Tanaba volcano ,Shrine associated with the tsunami					
71	Ugusu mine	Silica mine ruin	National				
72	Nishina Pass, Nekkodake Volcano	Landscape Of Nekko volcano, land use					
73	Hachikuboyama Volcano	Scoria cone and lava flow of Izu Tobu Volcano Group, Waterfalls, land use, related novels					
74	Namesawa	Lava flow of Izu Tobu Volcano Group, related novels					
75	Cape Koganezaki	Hydrothermal alteration	National				
76	Ojiro, Miyagahara	Damned lake formes by landslide					
77	Amagitoge Pass	Landscape of large terrestrial volcano, fault lake and its ecosystem,					
78	Source of Shiratagawa river	Sulfur mine ruin					
79	Shiranutanoike Pond	Freshwater pond formed by land slide, ecosystem around the pond					
80	Dogashima, Nishina Port	World-famous reserch field of submarine volcanoes	International				
81	Nishinagawa River, Hozoin Temple	Oldest strata in Izu Penunsula, Pillow lavas	International				
82	Numanokawa River	Lava flows of Izu Tobu Volcano Group					
83	Kawazu Seven Falls	Lava flows and waterfalls of Izu Tobu Volcano Group, Columnar joint, Colony of fern	National				
84	Mt. Kannonyama	Submarine volcano deposits and Stone Buddha made by tuff stone					
85	Okusagano	Lava flows of Izu Tobu Volcano Group and its structure					
86	Sekiguchi, Kawakubogawa River	Scoria cone of Izu Tobu Volcano Group					
87	Atagawa, Hokkawa	Cross section of stratovolcano, Hot spring, Geothermal utilization					
88	Hosono Plateau	Southeastern slope of Amagi volcano and surrounding panorama, Wetlands formed by lahar and its ecosystem					
89	Ikeshiro, Chokuroyama Volcano	Landscape of Chokuro volcano, mine ruin					
90	Hachinoyama Volcano	Scoria cone of Izu Tobu Volcano Group, Scoria deposit					
91	Nashimoto, Yugano	Lepidocyclina fossil					
92	Oike, Koike	Maar of Izu Tobu Volcano Group, Scoria deposit					
93	Inatori	Scoria cone of Izu Tobu Volcano Group and its cross section, Hot spring					
94	Hachigakubo, Ogawasawa	Scoria cone of Izu Tobu Volcano Group, Folktales related to landslide disasters					
95	Mine, Sawada	Fountain of hot spring					
96	Kadono	Fossils in submarine volcano deposits					
97	Matsuzaki, Sakurada	Cross section of submarine volcanoes					
98	Iwachi, Ishibu, Kumomi	Volcanic neck, Tuff stone quarry ruin, faith associated with volcano eruption	International				
99	Cape Hagachizaki	Hydrothermal alteration					
100	Tenjinbara, Jaishi	Landscape of Jaishi volcano					
101	Nawaji	Gold mine ruin					
102	Rendaiji	Gold mine ruin, Townscape of hot spa					
103	Shirahama Coast	Calcareous sandstone include fossil, faith associated with volcano eruption					
104	Mera, Koura	Magmatic dike, Folklore associated with the dike					
105	Shimoda Port	Volcanic necks, Tsunami					
106	Shimogamo Spa	Hot spring, Geothermal utilization, Stone quarry ruin					
107	Kisami, Toji	Sea cave and sand bank, Uplifted fossils	International				
108	Yumigahama Beach	Cross section of Submarine volcanoes, Sand spit, Tsunami disaster prevention facility					
109	Suzaki	Submarine volnoca deposits, Subaqueous debris flow deposit, Ritual ruins					
110	Cape Tsumekizaki	Columnar joints of intrusive bodies, hydrothermal alteration					
111	Okuiro Coast	Large outcrop of submarine volcano	International				
112	Irozaki Fault	Active fault and 1974 Izu hanto oki earthquake	National				
113	Irozaki, Ikenohara	Outcrop of submarine and terrestrial volcano, Active fault	International				
114	Karuizawa	Fault valley and stream capture landscape					

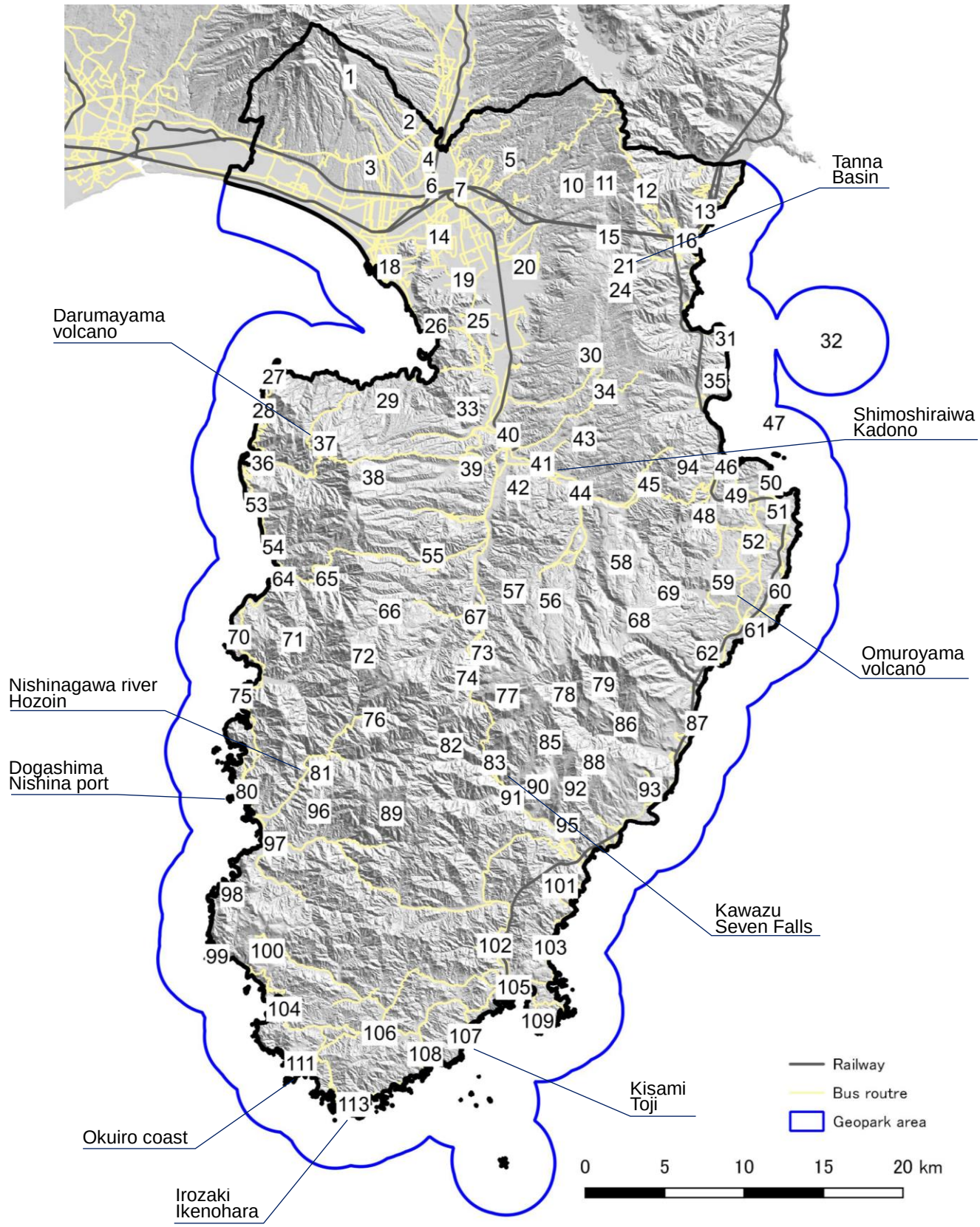


fig. 11 Distribution of the sites of Izu Peninsula Geopark

(The numbers in this map corresponds to the ID of the previous page.)

This section describes geosites that allow the characteristic and varied geological history of the Izu peninsula, as described in section B.1, to be clearly grasped. Here and in section B.3 we will describe ten geosites of high value in detail, and the other geosites are listed and briefly described in the appendix.

Site 1: Darumayama volcano - Southern Volcanic Islands in Collision with Honshū – →(fig. 11 Site ID: 37)

The ideal place to experience the collision of the Izu-Bonin and Honshū arcs is in the north of the Izu peninsula.

This location is on the ridge of the Daruma volcano, at an elevation of 630m. The ridge was formed during the terrestrial volcanism that followed the collision, and looks down on Suruga bay, with Fuji volcano and Hakone volcano beyond. Further in the distance, one can see the fold mountain ranges created by the collision: the Tanzawa mountains. The strata and rocks making up the Tanzawa mountains are also part of the Izu-Bonin arc, which collided with and were absorbed by Honshū before the collision of the Izu peninsula.

3D topographic map of northern Izu Peninsula and Izu-Honshu collision zone

The Suruga trough, which forms the current plate boundary between Honshū and the Izu peninsula, is found on the bed of Suruga bay. This plate boundary runs east to connect to the Sagami trough, passing under Fuji volcano and Hakone volcano e and the Tanzawa mountains.

Panoramic view of the Izu-Honshu collision zone from Darumayama

Site 2: Shimoshiraiwa, Kadono - Southern Volcanic Islands in Collision with Honshū - →(fig. 11 Site ID: 41)

A strata of calcareous sandstone bearing an unusual number of fossils is sandwiched between the turbidite strata of the Yugashima group, laid down by the submarine volcanoes of the central Miocene period.

In the Shimoshiraiwa region of Izu City, many marine fossils from the southern seas of 11 Ma, such as foraminifera, coral, sea urchin spines, and shell fragments, have been found in the calcareous sandstone that dips towards the east at an angle of 30º to 40º. These fossils include large, tropical to sub-tropical foraminifera such as Lepidocyclina and Miogypsina. At this period, the warm period had finished in the rest of Japan, which was influenced by cold currents, and so the occurrence of these fossils in the Izu peninsula alone is evidence showing that, at that time, the peninsula was located far to the south of the rest of Japan. Further, the paleomagnetism of the calcareous sandstone shows a low dip, meaning that this region used to be at a low latitude (20º to 30º north).

The large foraminifera fossils at this location are a Prefectural Natural Monument. They can be seen with the naked eye, making this an important geosite for understanding the geohistory and plate movements of the Izu peninsula.


Fossil-bearing calcareous sandstone at Shimoshiraiwa, Izu City

Fossils from the calcareous sandstone at Shimoshiraiwa, Izu City

Site 3: Nishinagawa River, Hozoin - Oldest Strata of the Izu Peninsula - →(fig. 11 Site ID: 81)

The basin of the Nishina river, which flows through western Izu, is the site of the oldest strata in Izu, the pillow lavas of the Nishina group, and thus vital to an understanding of the roots of the peninsula.

The pillow lavas exposed at this location are water-modified grey-green phenocryst-free basalt, in tubular forms of 30 to 80 cm in diameter. There are many almond-shaped inclusions of minerals such as chlorite, packed with air bubbles, within the basalt, and the stone has been used to line baths and wash basins in hot spring resorts due to this distinctive pattern. In addition, a double dike can be seen passing through the pillow lavas at this point. This strata has been dated to the early Miocene on the basis of calcareous nanofossils found in the fine-grained tuff in the same area.

Pillow lava at Ishiki, Nishi-Izu Town

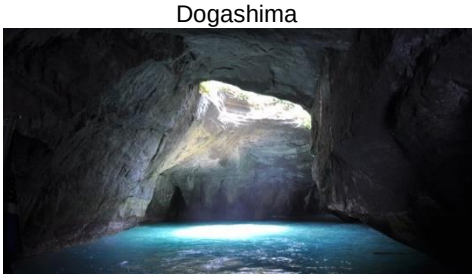
Site 4: Dogashima, Nishina Port – Submarine volcanoes- →(fig. 11 Site ID: 80)

The Shirahama group (late Miocene to Pliocene), which overlies the Yugashima group, was built up by submarine eruptions in the shallow seas around the volcanic island arc, and is made distinctive by various rock formations derived from this origin.

In the area around Dogashima in NishiIzu Town, submarine volcaniclastic flows, pumice and volcanic ash that fell and built up on top of them, and water-fractured lava that flowed along the seabed are widely distributed, and continuously exposed along the coast. Further, through studies of fossils, the dates of eruptions and order of layers, and the deposition environment, have been constrained. As a result, a great deal of research has been carried out here into submarine volcanoes.

Along the southern Dogashima coast, submarine volcaniclastic flows and pumice and ash strata covering them can be observed. From thermal history measurements on gravel incorporated in the volcaniclastic flows, it is estimated that they were embedded at a temperature of 450 to 500 ºC. The upper levels of the volcaniclastic flow gradually transition to thoroughly cross-bedded tuff while retaining their dominant trough shape, indicating that this was part of the same activity. Further, these strata contain volcanic bombs with a history of sudden cooling.

Photp4-1 : Submarine volcaniclastic flow underlies the cross-laminated tuff at Dogashima



Photp4-2 : Sea cave with a beautiful skylight at Dogashima

These favorable conditions for research contributed to the construction of early theories of explosive sea-floor eruptions (see, for example, Cashman and Fiske 1991).

Sea erosion has created caves in the cliffs of exposed volcanic material, and it is possible to enter the caves in boats and enjoy the numinous atmosphere created by the “skylights” in the cave.

Western coast of Izu peninsula and location of Dogashima, Nishi-Izu Town

Site 5: Okuiro Coast – Submarine volcanoes-

→(fig. 11 Site ID: 111)

There are many intrusive bodies in the Shirahama group. Some larger intrusive bodies have been exposed by erosion, and rise up here and there across the peninsula as volcanic necks. Smaller ones decorate cliffs as dikes and sills with columnar joints. Together, they create a distinctive landscape.

The Southwestern Izu Coast, a National Site of Scenic Beauty, is an impressive coastline where many eroded intrusive masses take on remarkable shapes. Large numbers of intrusive bodies are exposed at Cape Mitsuishi, a part of this coast. Submarine volcano deposits are cross-cut by many andesitic intrusive bodies which range in size from less than a meter to several hundred meters at this cape. Relationships between the beds and the intrusive bodies are assumed to have originated mostly by interaction between hot magma and poorly consolidated wet sediments at a shallow depth beneath the sea floor.

These are a good example for understanding the realities of submarine volcanic activity in the back-arc and shallow waters of the rift zone of volcanic island arc.

The intrusive bodies which appeared on cross section in the submarine volcano

Okuiro coast of Izu peninsula, Minami-Izu Town

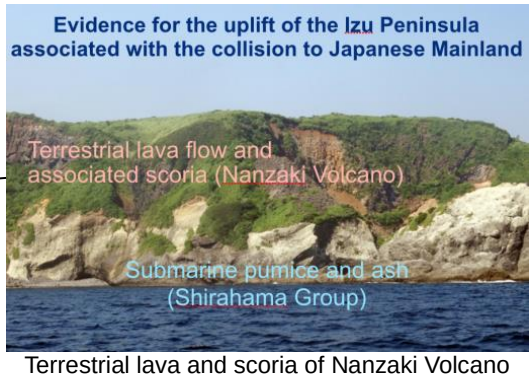
Site 6: Irozaki, Ikenohara – The uplift of the whole Izu peninsula and subsequent terrestrial volcanism –

→(fig. 11 Site ID: 113)

When, one million years ago, the Izu peninsula became a continental land mass due to the collision between the Izu-Bonin and Honshū arcs, the volcanoes continued to erupt despite changing from submarine to terrestrial. In other words, the end of the long period of submarine volcanism was the beginning of the period of terrestrial volcanism. The evidence of this can be seen around Irozaki, at the southern tip of the Izu peninsula.

At this point, lava and scoria from the Nanzaki volcano (K-Ar date of 430,000 BP), in the Atami group, directly overlie the white submarine tuff of the Shirahama group. A brown weathered layer has formed on the upper surface of the Shirahama group.

Southern coast of Izu peninsula and location of Yusuge park, Minami-Izu Town



Terrestrial lava and scoria of Nanzaki Volcano overlie submarine tuff of the Shirahama Group

Site 7: Omuroyama Volcano – The Active Monogenetic Volcano Group - →(fig. 11 Site ID: 59)

After the collision with the Honshū arc, eruptions of large-scale terrestrial volcanoes continued, but about 150,000 BP a group of independent monogenetic volcanoes (Izu Tobu volcano group), which are unusual in the Japanese archipelago, became active. The activity continues today.

Omuroyama volcano is the largest scoria cone in the Izu Tobu volcano group, and was formed in an eruption about 4000 years ago. From the peak, one can see the many volcanoes scattered throughout Ito City, and landscape produced by their eruptions. The spread of the volcano group is visible.

Aeral view of a part of the Izu Tobu Volcano Group and location of Omuroyama, Ito CIty

The eruption of Omuroyama produced a great amount of lava, which filled in the uneven topography that existed before the eruption, creating the gentle Izu plateau. Further, the lava that reached Sagami bay created the scenic Jogasaki coast. The lava flows from the scoria cone arose from the base of the mountain. In the final stages of the eruption the viscosity of the lava rose, creating a plug dome (Iwamuroyama) over the lava mouth.

Thanks to the annual burning of the mountain, the beautiful shape of Omuroyama, like an upturned bowl, has been preserved, and the whole mountain is a Nationally Designated Natural Monument.

Beautiful bowl-like shape of Ōmuroyama Scoria Cone, Ito City

Panoramic view from the summit of Omuroyama, Ito City

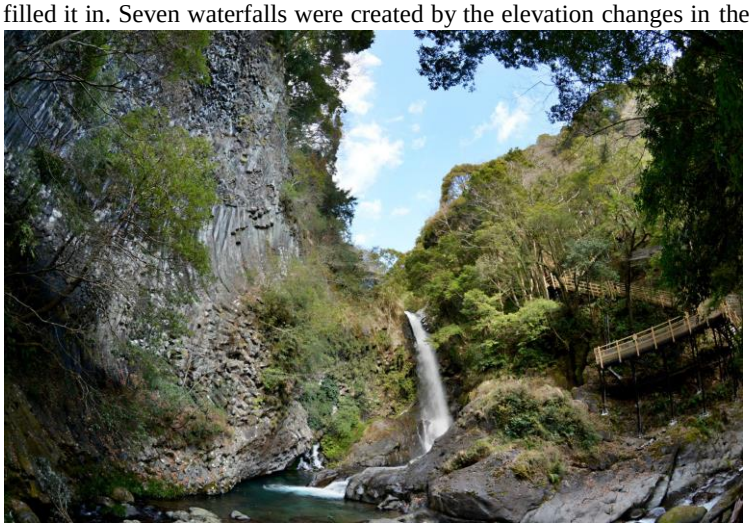
Site 8: Kawazu Seven Falls – The Active Monogenetic Volcano Group - →(fig. 11 Site ID: 83)

Lava flows from the Izu Tobu volcano group have created beautiful waterfalls in many locations. The Nanadaru falls in Kawazu Town are one example.

Around 25,000 years ago, lava from the Noboriominami volcano that appeared on the southern slope of Amagi volcano flowed about 2 km down the valley of the Kawazu river as it filled it in. Seven waterfalls were created by the elevation changes in the lava, and these are the famous Kawazu Seven falls. The basal rocks of the waterfalls are carved into beautiful columnar joints formed when the lava contracted as it cooled and hardened, and the different forms of the columnar joints at each waterfall create a dynamic landscape.

The Kawazu Seven falls and the nearby Amagi Pass, a difficult pass linking north and south Izu, are the setting for "The Dancing Girl of Izu", a famous novel by the Nobel laureate Yasunari Kawabata, who loved Izu. The area is visited by many hikers tracing the dancing girl's journey.

The Kawazu Seven falls, are far from the only waterfalls created by lava from the Izu Tobu volcano group, and others include Joren Falls and Namesawa Gorge. These scenic locations are often the setting for novels or films.



Lava flow with beautiful columnar joints at Kamadaru waterfall, Kawazu Town

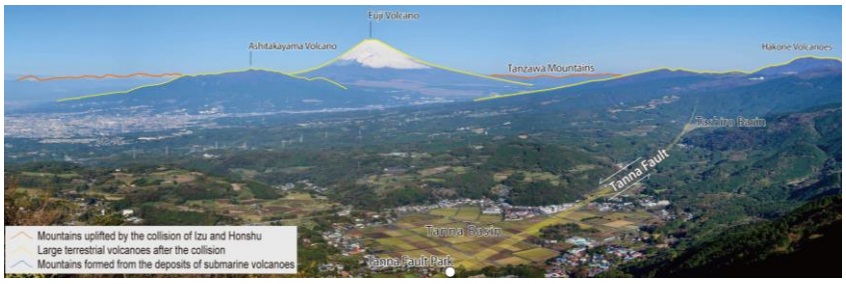
Site 9: Tanna Basin – Continuing Crustal Deformation and Active Faults - →(fig. 11 Site ID: 21)

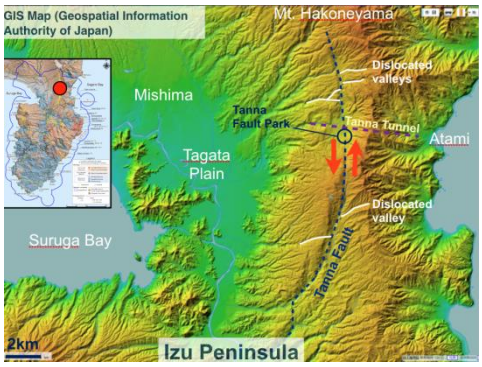
Due to the collision between the Izu-Bonin and Honshū arcs, the whole of the Izu peninsula is the site of active crustal deformation, and is criss-crossed with active faults. Some of those have repeatedly caused magnitude 6 to 7 earthquakes in the historical period.

In the early hours of November 26th 1930, a strong (magnitude 7.3) earthquake struck northern Izu. During this North Izu Earthquake, the Tanna fault and its southwest extension, and further the Himenoyu Fault on its southeastern side, slipped by up to 2 metres. The horizontal slip preserved in Tanna Fault Park is a Nationally Designated Natural Monument.

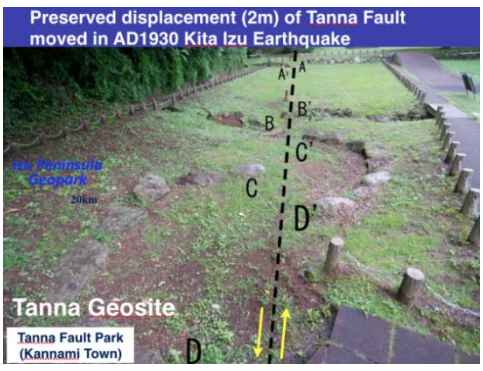
The past slippage on the Tanna fault adds up to over 1 km horizontally and about 100 m vertically. The investigations of the topography generated by this left-slip fault were globally pioneering, making it a world-famous site.

he slippage generated by the North Izu Earthquake directly struck the construction site of the Tanna Tunnel, being dug beneath the Tanna Basin at that time. Due to the construction of this tunnel, the Tanna region, which had been a prosperous wasabi farming area thanks to its many springs, saw those springs dry up. With the help of the Railways Ministry of the time, it changed to a dairy farming region.





Geomorphology of Tanna fault, Kannami Town



Historical left-lateral displacement along the Tanna fault, preserved at the Tanna fault

Site 10: Kisami, Toji – Continuing Crustal Deformation and Active Faults –
→(fig. 11 Site ID: 107)

The collision has made the whole Izu peninsula a site of active crustal deformation. In particular, over the last few hundred thousand years, the eastern side of the peninsula has been uplifted, while the western side has subsided. Due to this, marine terraces, wave-cut platforms, and wave-cut notches are found mainly on the east coast.

In particular, such marine terraces and wave-cut platforms extend over several levels in the Shimoda region. There are many examples of sea caves in the wave-cut terraces, and layers of uplifted fossils are often preserved on the surfaces of the caves. Detailed investigation of these fossils has shown that the area has been uplifted several times, including three in the last few thousand years.

There are large sea caves with beautiful skylights, such as Ryugukutsu, which, together with the nearby Sand Ski Run, has become a popular geospot. Rocks deposited by the tsunami caused by the 1854 Ansei Earthquake have been found on the adjacent coast.

Layers of uplifted fossils in sea cave, Shimoda city

Skylight of an uplifted sea cave "Ryūgūkutsu", Shimoda City

B.3 Details on the interest of these sites in terms of their international, national, regional or local value

As explained in section B.1, the distinctive features of the Izu Peninsula Geopark arise from the northward motion of submarine volcanoes on the Philippine Sea plate, their collision with Honshū, and the associated diverse volcanism and crustal deformation. The Izu peninsula is globally unique as the site of a collision between two active volcanic arcs. In addition to the geological heritage of this distinctive origin, the natural landscape, ecosystems, and culture arising from it are "Gifts of Volcanoes from the South". This section will discuss the importance of the geological heritage under three headings, linked to the 10 important geosites introduced in section B.2.

1. A Unique Point on Earth — The Meeting of Two Active Volcanic Arcs (Section B.2 Sites 1 & 2)

The Izu peninsula is the location where two active volcanic arcs, the Izu-Bonin arc and the Honshū arc, meet (fig. 12). Let us consider whether there are any other such places. Active volcanic arcs arise in subduction zones where plate subduction has continued for some time, and the tip of the subducted slab has reached a depth of around 100 km. As the collision of two active volcanic arcs must indicate that two subduction zones meet, let us first look for such places. The only three candidates are the region around the Izu peninsula, around Halmahera, and in the area around the Solomon Islands.

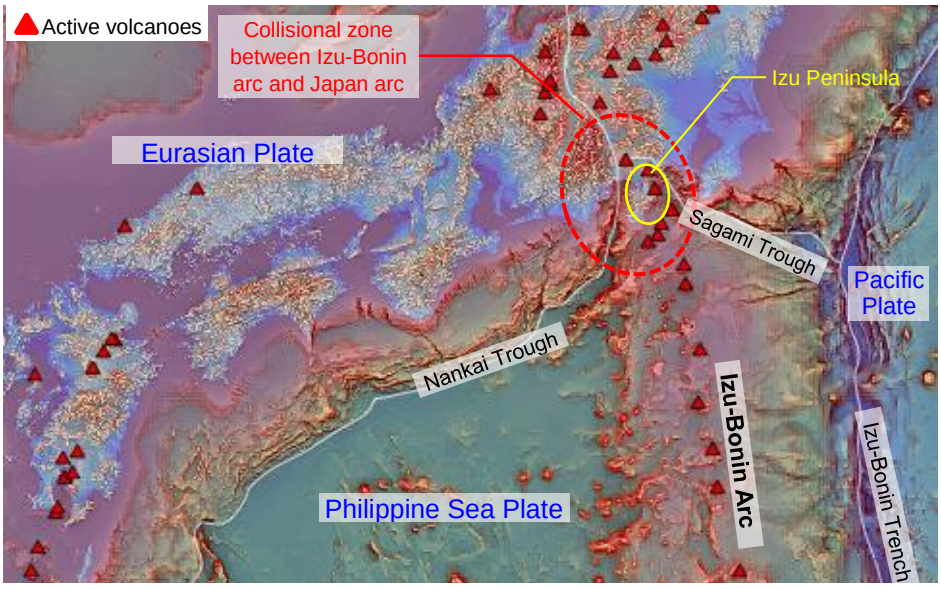


fig. 12 Pseudo-3D topographic map around the Izu Peninsula (base map is by JCG)

However, if we look carefully at the other two candidates, we see that as one of the two subduction zones has no clear volcanic chain, two active volcanic arcs do not meet there (fig. 13). In other words, the area around the Izu peninsula is the only place in the world where two active volcanic arcs meet clearly, and both the

collision and the various phenomena that arise from it are in progress even now. No other Geoparks comprise a place with this sort of unique geoscientific theme.

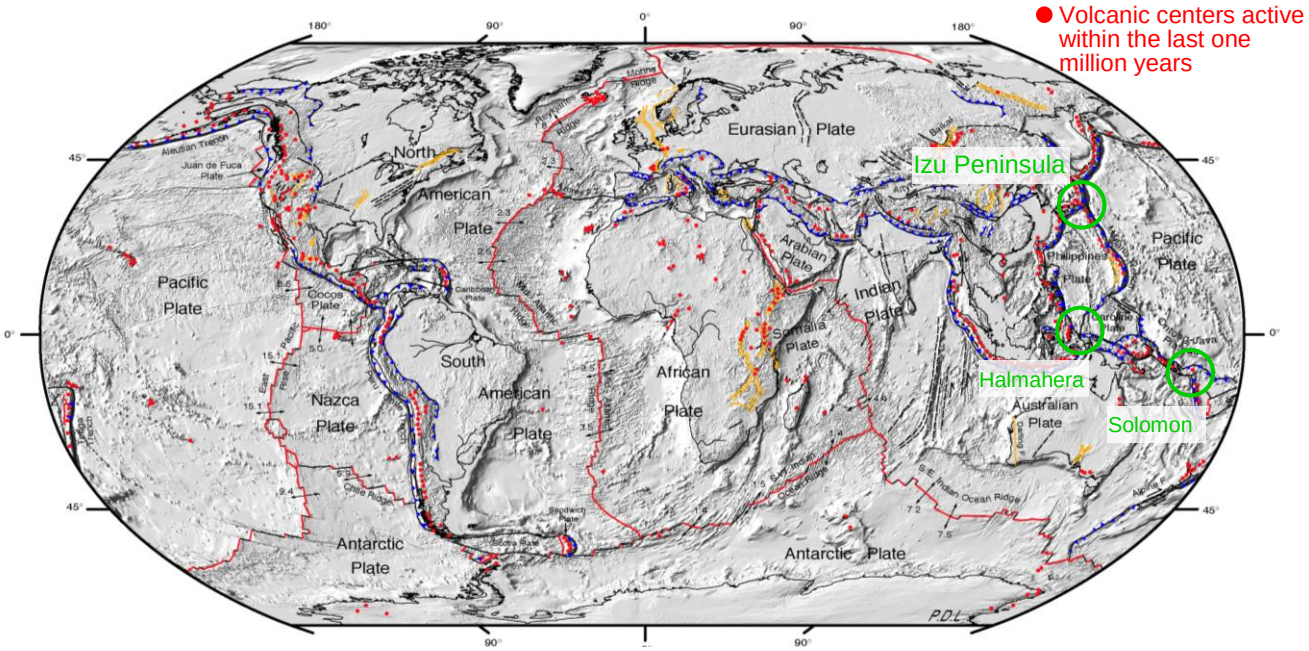


fig. 13 Distribution of active volcanoes and Plate boundary (after NASA, 2002)

The collision of the two active volcanic arcs is reflected in the topography, geological structure, and development history of the Izu peninsula and surrounding region, and a great deal of research has been carried out there. The theory that the Izu peninsula, unlike the rest of Japan, is on the Philippine Sea plate (Sugimura, 1972), and that it is colliding with Honshu (Matsuda, 1978) was proposed soon after the establishment of the theory of plate tectonics in the late 1960s, and in that sense we can say that this region was identified as a collision between island chains very early, and the site of pioneering research.

After that, it was determined that, before the beginning of the collision with the Izu crustal block about 1 Ma, the Tanzawa crustal block had collided with Honshu, about 5 to 6 Ma. It is also thought that another crustal block (the Misaka-Kushigatayama block) had collided even earlier (Amano et al., 2007). The collisions between island arcs in this area are thus associated with discontinuous and multiple collisions, and the resulting subterranean structure has been carefully investigated (Arai and Iwasaki, 2014). It is thought that the bending, rotation, and uplift of the geological band structure that gives central Honshu its distinctive features has had a major influence on geological structure and topography (Tamura et al., 2010, Site 1,fig. 14, fig. 15).

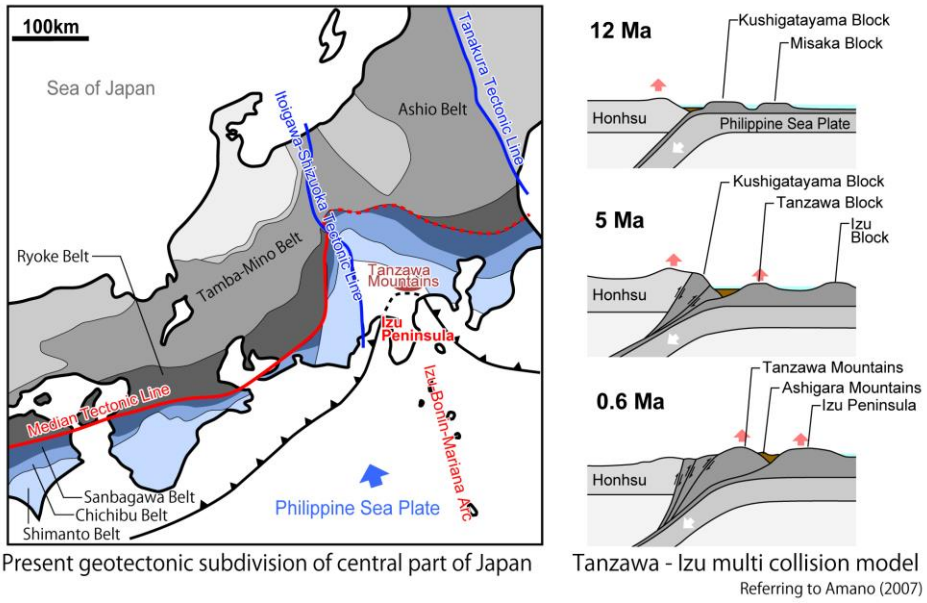


fig. 14 Geotectonic structure of central Japan (left), collision of island arcs (right)
（after Amano et al., 2007）

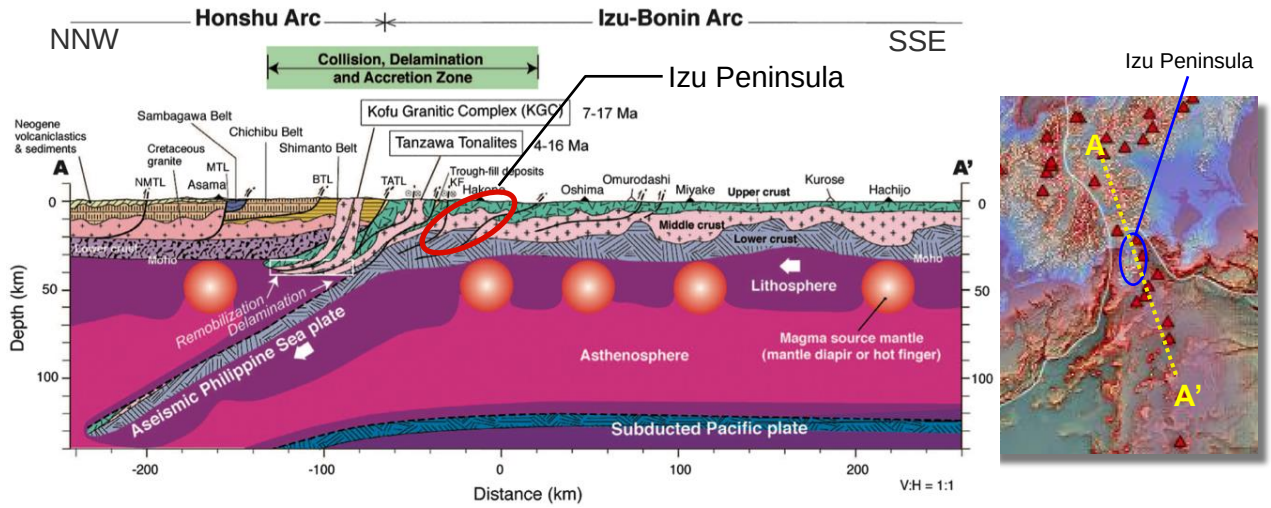


fig. 15 Tanzawa–Izu collision zone cross-section (Tamura et al., 2010)

Further, the region around Izu, as the site of multiple collisions between island arcs, has not just been valuable for research on plate movement and collisions, but has also given rise to the working hypothesis that continental crust itself arises from the development of island arcs and their mutual collisions. A great deal of work to substantiate this hypothesis is in progress (Tatsumi and Stern, 2006; Tatsumi et al., 2008; Tamura et al. 2010).

The southern origin and northward movement of the Izu crustal block are mainly confirmed by two types of evidence: paleomagnetism and paleontology (Geosite 2). Paleomagnetic data has been obtained from several locations on the Philippine Sea plate (Koyama et al., 1992; Yamazaki et al., 2010,fig. 16), and using these data and geological data as constraints, the history of the structural development of the Philippine Sea Plate has been reconstructed (Wu et al., 2016, fig. 17). It has become clear that the Izu crustal block rotated clockwise in the course of its northward motion

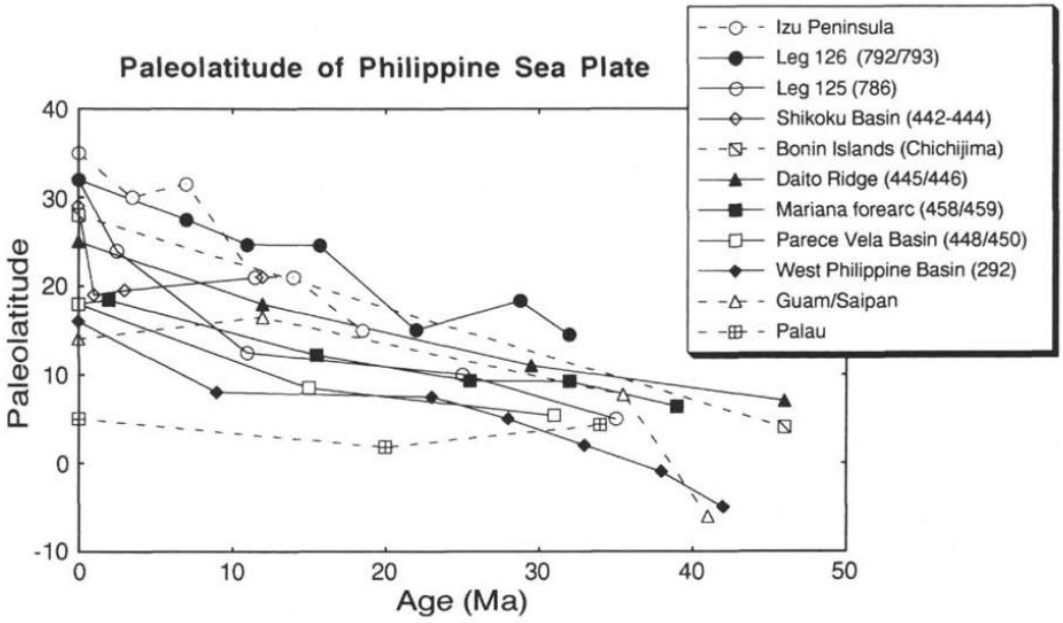


fig. 16 Northward drift of Izu Peninsula and Philippine Sea Plate revealed by paleomagnetic measurements (Koyama et al., 1992)

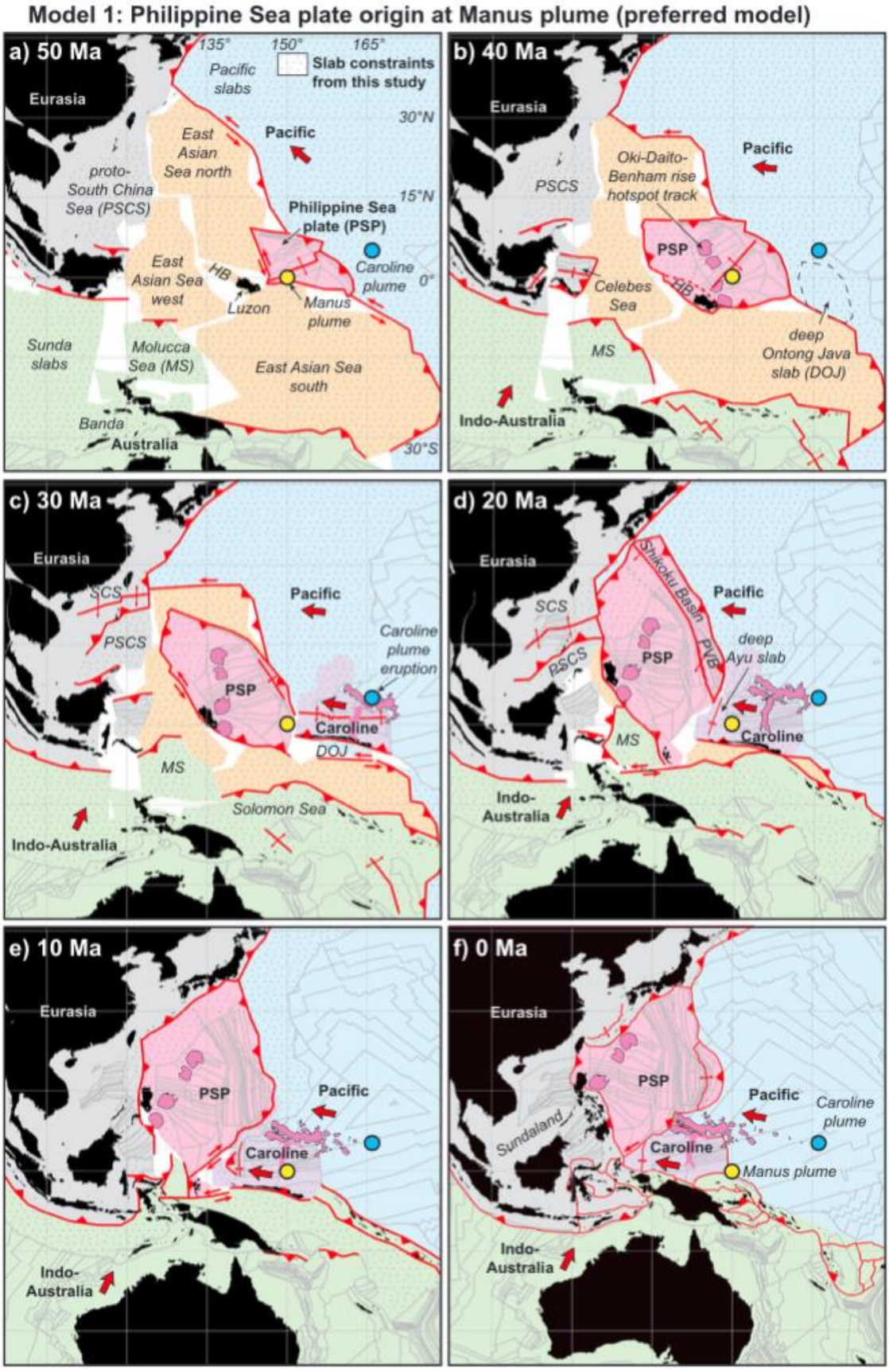


fig. 17 Tectonic Evolution of the Philippine Sea Plate (Wu et al., 2016)

The paleontological data is primarily based on Lepidocyclina foraminifera. These species flourished throughout the tropical and subtropical regions of the world from the Eocene to Miocene (Matsumaru, 1971,fig. 18).

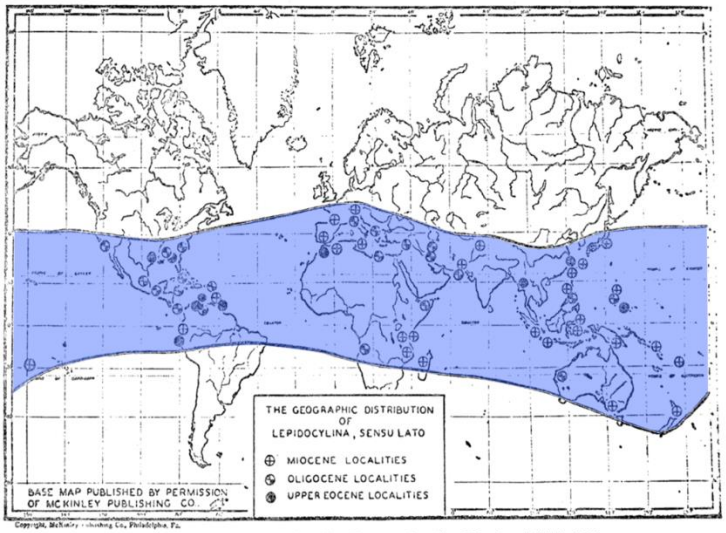
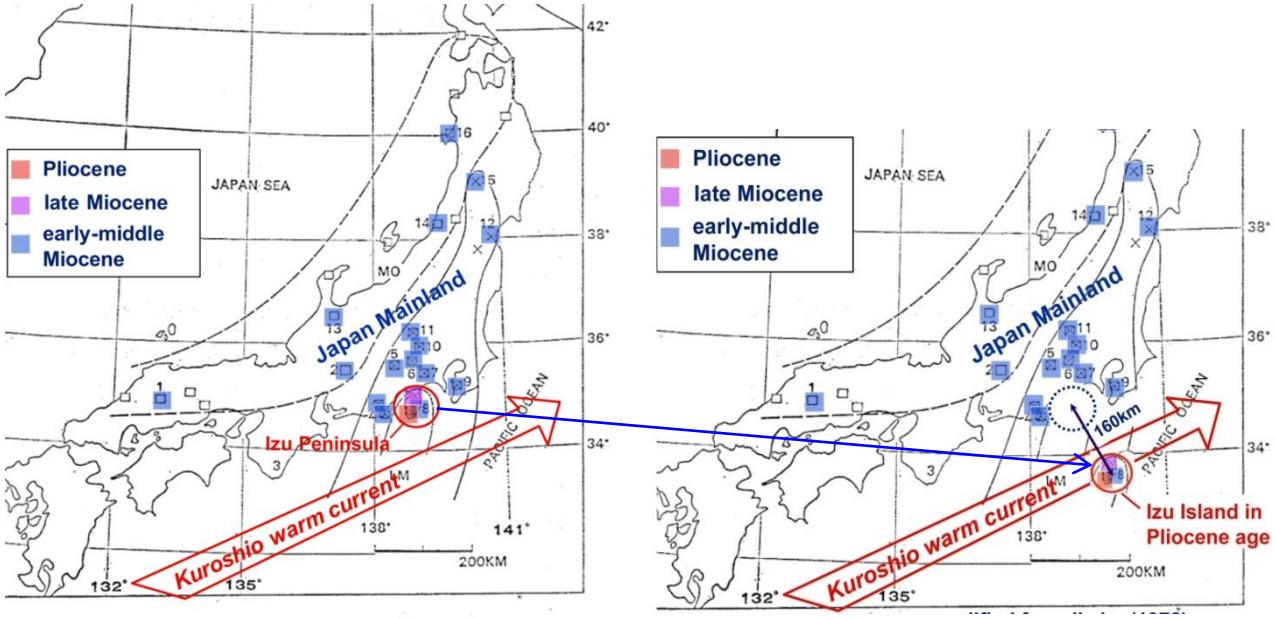


Fig. 26. Geographic distribution of *Lepidocyclina, sensu lato* (after Schenck and Childs, 1942).

fig. 18 Geological distribution of larger foraminifera Lepidocyclina and its family (Eocene to Miocene) (Matsumaru, 1971)

Lepidocyclina Spp. were found in various areas of Honshū from the early to mid Miocene, but for some reason fossils from the late Miocene and early Pleistocene are found only in the Izu peninsula (Ikebe 1972, fig. 19, left). This puzzling spatio-temporal distribution is explained by the fact that in the late Miocene and early Pleistocene, when the various regions of Honshū were already under the influence of cold currents, the Izu crustal block alone was still located further south, where Lepidocyclina continued to flourish under the influence of warm currents (Tsuchi, 1984, fig. 19 right)



第2図 日本の *Lepidocyclina* および *Miogypsina* の産地
× *Lepidocyclina* □ *Miogypsina*
LM *Lepidocyclina* 分布地域（実線）
MO *Miogypsina—Operculina* 分布地域（破線）
鎖線は *Lepidoclina* の再出現地域
番号は第3図と共通（Ikebe and Chiji, 1971）

fig. 19 Distribution of larger foraminifera Lepidocyclina/Miogypsina modified from Ikebe (1972)

2. The Varied History of the Land of Volcanoes (Section B.2, Sites 3 to 6)

In the last section we covered the dynamic origin and history of the Philippine Sea plate and the Izu-Bonin arc, but for almost that whole period it seems that the Izu crustal block was at the edge of the Philippine Sea plate, where there was continuous volcanic activity due to the subduction of the Pacific plate. As strata and rocks recording the last 20 million years of this history are exposed at the surface of the Izu peninsula, a great deal of research has already been carried out. Further, recent deep ocean drilling expeditions, such as ODP Leg 126 and IODP Expedition 350, have recovered cores from the seas around the Izu peninsula, giving the geological and volcanological research on the Izu peninsula additional importance as a source of comparative data.

As already explained in section B.1, the history of volcanic activity in the Izu peninsula can be split into three periods: Neogene submarine volcanism; Quaternary terrestrial volcanism on a large scale, after the collision with the Honshū and conversion to land mass; and the scattered activity of the independent monogenetic volcanic group, continuing from 150,000 years ago until the present day. This volcanic activity, occurring at different times and in different environments, has left visible many different aspects of volcanoes. These range from the subterranean structure of old submarine volcanoes, exposed as volcanic necks and rock structures (Sites 3 to 5), to the newly-minted volcanic forms and eruption products of the active Izu Tobu volcano group. At some locations, you can even see the transition from submarine to terrestrial layers of volcanic ejecta (Site 6).

In the Izu Peninsula Geopark, you can enjoy these volcanoes and the landforms and rocks they have produced as an organic whole (Koyama 2009, 2010, 2012, 2013, 2014, 2015a, 2015b). There are already a significant number of Geoparks, both in Japan and in the rest of the world*, that take volcanoes as their theme, but the Izu peninsula stands out. Nowhere else is it possible to trace the multifarious and dramatic changes of volcanism over such a long period of time, as the environment changes from deep sea, to shallow sea, to terrestrial, and as the change in stress field caused by a collision transforms the volcanism from large scale to monogenetic.

In particular, it should be noted that the collision between the Izu peninsula and the Honshū arc, resulting in rapid conversion to continental crust followed by erosion, means that submarine volcanoes, which cannot normally be viewed, are exposed all along the coast, creating an ideal research environment. As result, a great deal of work has been carried out, particularly on the west and south coasts (Ito et al., 1984, Matsumoto et al., 1985, Kano, 1989, Tamura et al., 1991, Cashman and Fiske, 1991, Jutzeler et al., 2014, 2015, 2016), and the Izu penisula can be described as a driving force behind global research on submarine volcanoes.

*The following Geoparks take active volcanoes as their theme. Global: Katla, Reykjanes (Iceland); Jeju Island (South Korea); Toya Caldera and Usu Volcano, Unzen Volcanic, Aso (Japan). Japanese: Mt Bandai, North Slopes of Mt Asama, Hakone, Izu Ōshima, Kirishima, Sakurajima/Kinkowan.

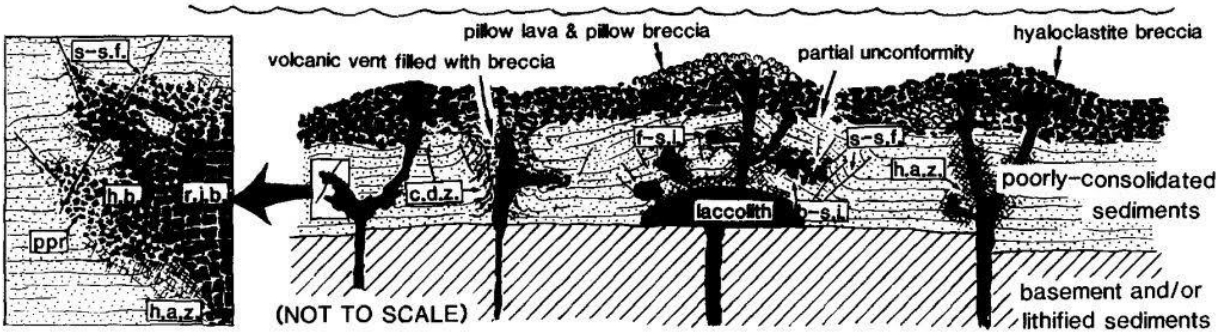


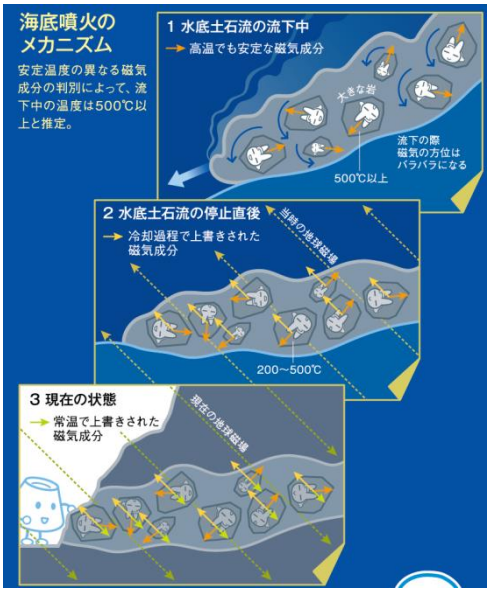
Fig. 19. Schematic figure indicating several interactive phenomena between hot magma and poorly consolidated wet sediments in a shallow level to the ocean bottom. *b-s.i.* = bulbous-shaped intrusion; *c.d.z.* = chaotically disturbed zone; *f-s.i.* = finger-shaped intrusion; *h.a.z.* = hydrothermally altered zone; *h.b.* = hyaloclastite breccia; *ppr* = peperite; *r.j.b.* = regularly jointed body; *s-s.f.* = synsedimentary fault.

fig. 20 Mode of emplacement of intrusive bodies in the southern coast of Izu Peninsula, estimated by method of structural geology (Kano, 1989)

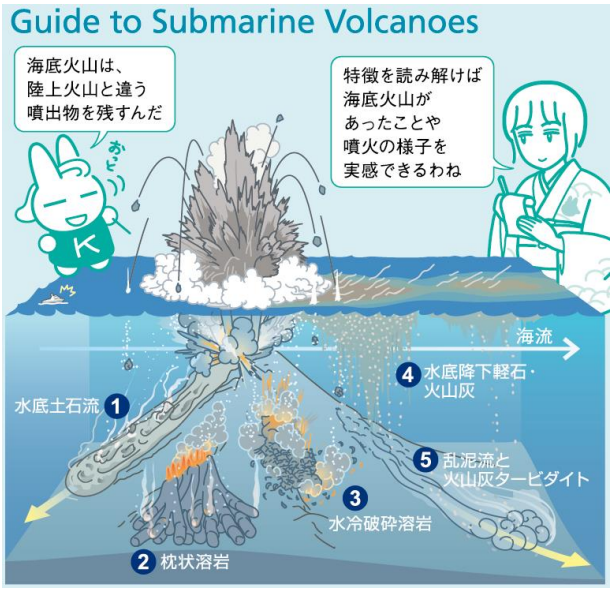
For example, Kano (1989) used principles of structural geology to explain the complex intrusive bodies found across south and west Izu (Site 5) in terms of the penetration of magma into unhardened sediment. Tamura et al. (1991) showed that submarine

volcaniclastic sediments (Site 4) were the product of gravitational flow concomitant on an eruption, by using magnetic petrology to investigate the thermal history of included gravel, and showing that its fixing temperature was 450 to 500 ºC. Cashman and Fiske (1991) carried out detailed analysis of the terminal velocity of pumice and volcanic rock particles in the same sediments, and by comparison with particle size showed that they had fallen underwater. These results are internationally important and pioneering in the fields of intrusion, eruption, and deposition by submarine volcanoes.

At the Izu Geopark, materials are made available explaining the varieties of submarine volcanic ejecta and what to look for on the ground by summarizing this research in an easily-understood way (Koyama 2012, fig. 21). The research on the monogenetic volcanoes also deserves special mention, but as it concerns active volcanoes it will be covered in the next section.



Mode of emplacement of volcaniclastic flows at Dogashima, estimated from thermo-petromagnetic analysis (after Tamura et al., 1991)



Guide to submarine volcanic products (Koyama, 2012)

fig. 21 The material to explain an earth science phenomenon

3. Dynamic Scenery Born of Ongoing Collision and Volcanism (Section B.2 Sites 7 to 10)

The biggest difference between the Izu peninsula and other Geoparks is that the collision between two active volcanic arcs and the accompanying changes are still ongoing. As a result, the Izu peninsula is undergoing continuing crustal deformation and many faults are active even now. Further, the Izu peninsula is sandwiched between two plate subduction boundaries, in the Suruga-Nankai trough to the west and the Sagami trough to the east. The Suruga-Nankai trough generates plate boundary earthquakes every 100 to 200 years on average, while the Sagami trough does so every 250 years or so.

The active terrestrial faults generate plate interior earthquakes in the magnitude 6 to 7 range every few hundred to few thousand years, while the adjoining seabed generates plate boundary earthquakes of around magnitude 8. The peninsula has been repeatedly assaulted by these tremors and, in the latter case, tsunamis. There are relatively recent examples of earthquakes that caused significant damage to the peninsula: for plate interior earthquakes, the magnitude 7.3 Tanna earthquake in 1930, and the 1974 Izu Peninsula Oki earthquake, and for plate boundary earthquakes, the magnitude 8.4 Ansei earthquake of 1854 and the magnitude 7.9 Great Kanto Earthquake of 1923 (Usami et al., 2013). The tsunami caused by the 1854 Ansei earthquake struck the port of Shimoda, and its destruction of the Russian battleship Diana, anchored in Shimoda bay while negotiations to open Japan took place, is well known (fig. 22).

fig. 22 Contemporary paintings recorded the tsunami caused by the 1854 Ansei Earthquake

On the other hand, as the Izu peninsula is directly above the active volcanic arc generated by the subduction of the Pacific plate, it is densely populated with Quaternary volcanoes, including active volcanoes. The magmatic activity of the monogenetic volcano group found in the peninsula and adjoining seas, the Izu Tobu group, continues sporadically. In July 1989 there was a small seafloor eruption about 3 km offshore of the town of Ito in northeastern Izu, and although it was the first in about 2700 years, it scared the local residents (Koyama 2015).

In addition, the continuing collision and uplift have given the Izu peninsula a rugged topography, which leads to high rainfall. That, in turn, means that landslides, floods, and similar disasters are historically common, including those caused by the Kanogawa typhoon of September 1958 (MLITT Numazukawa Roads Office).

As we can see, the Izu peninsula has been assaulted by the forces of nature over both geological and historical time, but if we take the long view these same phenomena are also responsible for creating the dynamic and beautiful scenery of the peninsula. The active monogenetic volcanoes of the Izu Tobu volcano group have, over the geologically extremely short period of 150,000 years, created a veritable outdoor museum of volcanoes: a landscape studded with over a hundred scoria cones, tuff rings, maars, and lava domes, and overlaid with the lava, pyroclastic flows, and ejecta from those volcanoes' eruptions (Koyama, 2010, 2015a, 2015b). Furthermore, these beautiful volcanoes and ejecta landforms have suffered almost no erosion, and are all but perfectly preserved (Sites 7 and 8).

Beyond that, by carefully analysing the order of deposition of the ejecta from these volcanoes and their periods, changes in the location and type of eruption, the existence of simultaneously erupting fissures, and the relationship with the crustal stress field have all been determined (Hayakawa and Koyama 1992, Koyama et al., 1995, Koyama 2015, Koyama and Suzuki 2016, fig. 23). This knowledge is used together with geophysical monitoring data in the construction of hazard maps and eruption scenarios, and is being used in the prediction of eruptions in the Izu Tobu Volcano group and in disaster mitigation strategies (Shizuoka Prefecture, 2011; Japanese Meteorological Agency 2011,fig. 24, fig. 25). Monogenetic volcano groups for which the eruption history is known in such detail and used in eruption scenarios and disaster mitigation plans, are very few*.

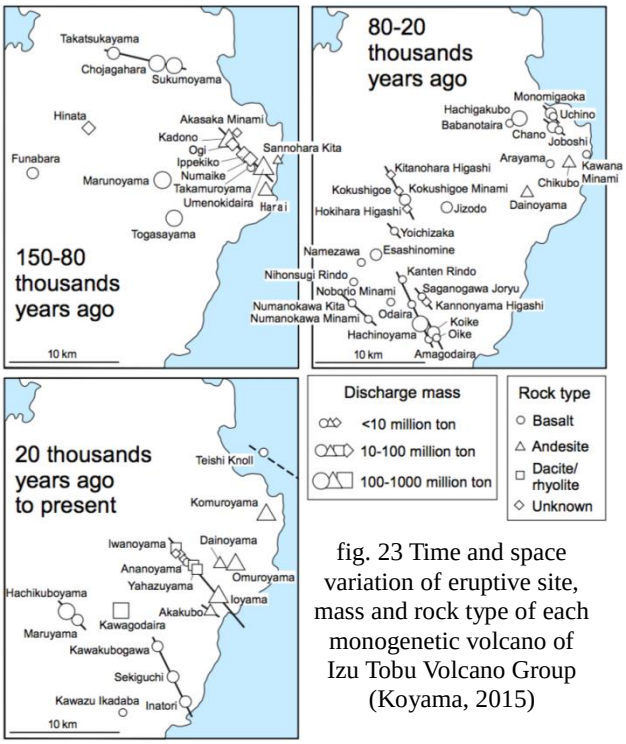


fig. 23 Time and space variation of eruptive site, mass and rock type of each monogenetic volcano of Izu Tobu Volcano Group (Koyama, 2015)

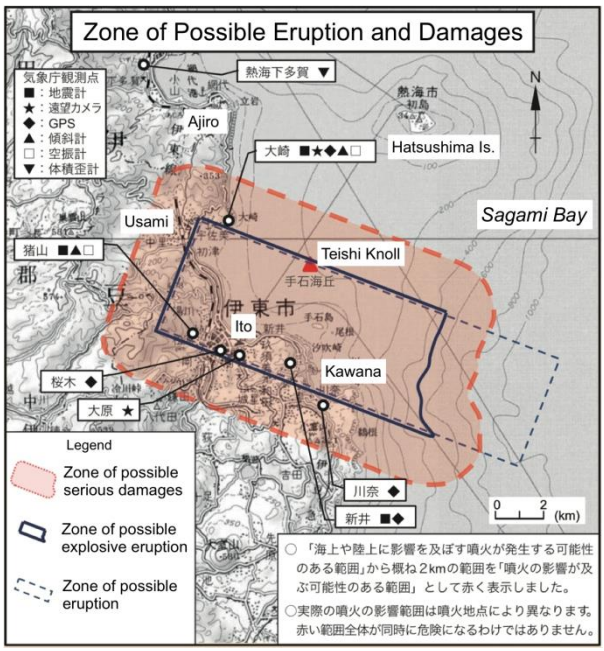


fig. 24 Hazard map of Izu Tobu Volcano Group (Shizuoka Prefecture, 2011)

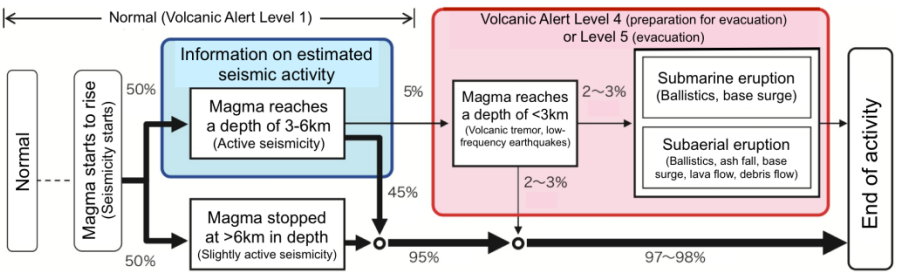


fig. 25 Eruption scenario of Izu Tobu Volcano Group (Shizuoka Prefecture, 2011)

* The Izu Tobu volcano group is an independent volcano group with no parent volcano, which is rare in the Japanese archipelago. There are two UNESCO Global Geoparks including independent monogenetic volcano groups, Vulkaneifel (Germany) and Wudalianchi (China), but in neither case is the eruption history as clear as it is for the Izu Tobu Volcano group, and there is no evidence of contemporary subterranean magma activity. As the long-term eruption frequency is low, there is no disaster mitigation strategy in either place. In areas that are not Geoparks, the eruption history of the Aukland monogenetic volcano group (New Zealand) is understood to some extent, and there is a disaster mitigation plan in place.

On the other hand, the collision with the Honshū arc has created many active faults and much uplifted topography in the Izu peninsula. The most famous and notable of these faults is the Tanna fault.
The Tanna fault is running north-south in the northern part of the Izu peninsula, showing left-lateral slip. Its most recent activity was in 1930, and caused a magnitude 7.3 earthquake. In the wake of this earthquake, topographical and geological research was carried out, and discovered left slip of 1 km along the fault (Kuno 1936). This was the first time that slip of such distance had been discovered. After that, detailed topodynamical research was carried out (Matsuda 1972), and from the early eighties the history of the fault's activity was investigated through trenches (Tanna Fault Excavation Research Group, 1983; Earthquake Research Institute, 1988; Kondo et al., 2003). As a result, its detailed activity history (on average, once in a thousand years) has been determined (fig. 26). The discovery of nine slip events in a single trench was unprecedented in the early 1980s, and this research demonstrated the value of this research method. In other words, we can say that, along with the discovery of the large-scale lateral slip in the 1930s, the research on the Tanna fault has led global research on faults, and it is raised in a standard textbook on paleoseismology (McCalpin and Nelson, 1996). Recently, it has also been discovered, based on paleomagnetic studies, that the block defined by the Tanna fault and the fault group to its east is undergoing large-scale structural anti-clockwise rotation (Koyama 1982, 1992, Kimura et al., 2011).

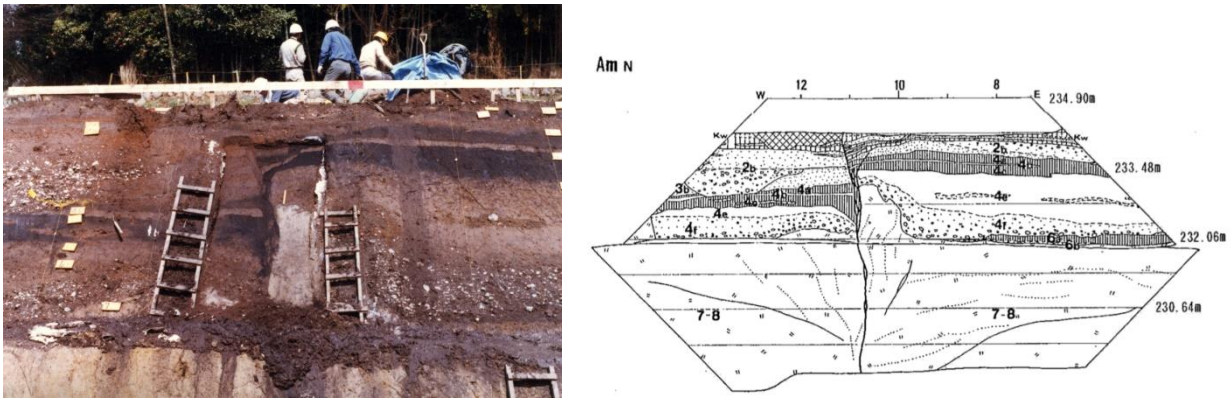


fig. 26 Trench excavation survey on Tanna Fault. Left photo shows the upper part of the fault sketch on the right (Earthquake Research Institute, 1988)

The 1 meter of lateral slip arising from the 1930 North Izu earthquake is preserved in two locations as a nationally designated Natural Monument. One of these locations is now a park, with a facility allowing the subterranean structure to be viewed from a trench, and this is one of the core sites of the Geopark (Site 9).
Based on the fact that, in broad terms, marine terraces and uplifted wave-cut platforms and notches are only found on the eastern coast, it is believed that, over the last few hundred thousand years, crustal deformation has been proceeding with uplift in the east and subsidence in the west. In recent years, research on the fossil uplift layers in sea caves bored into the wave-cut platforms has advanced, showing that there have been several episodes of uplift over the past few thousand years, including three in the historical period. The relationship with plate boundary and off-shore fault earthquakes is debated, and along with the investigation of

fig. 27 Uplifted sea cave and fossil beds on the cave wall at Shimoda and Ito

tsunami deposits, the implications of this research for disaster mitigation are drawing a lot of attention (Kitamura and Kobayashi 2014; Kitamura et al. 2014; Kitamura and Kawade 2015, Kitamura et al., 2014, 2015, 2016,fig. 28).

These uplifted fossil layers are valuable sites, so they are not listed as public sites, but rather classified as research sites and managed appropriately to preserve them. However, a nearby large sea cave and skylight, along wth the adjacent sand deposit, are are popular geosite (Site 10).

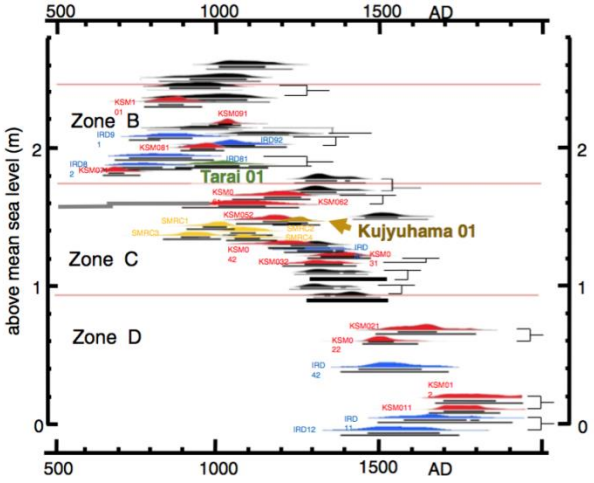


fig. 28 Elevation and chronology of fossil beds on the wall of a sea cave at Shimoda (Kitamura et al., 2015)

B.4 Listing and description of other sites of natural, cultural and intangible heritage interest and how they are related to the geological sites and how they are integrated into the proposed Geopark

As described in sections B.1 and B.3, the crustal deformation arising from the collision with the Honshu arc has created a steep, mountainous landscape in the Izu peninsula and the region to its north. As this collision zone is also sandwiched between two plate subduction troughs, both the land and the sea have exceptionally steep and varied topography. The shallow seas and flow of the Kuroshio current along the coast of the peninsula are responsible for a rich marine environment and a warm climate. Further, the uplifted mountains of the peninsula receive a lot of rain, which generates many springs at the boundary between the permeable terrestrial volcanic rock and impermeable submarine volcanic rock layers.

As a result, many natural environments and ecosystems have arisen both on the Izu peninsula and in the surrounding seas. This rich environment, together with the geology described in section B.1, has given birth to a varied natural landscape and distinctive local products. The local products deserving of special mention are gold deposits, silicastone deposits, various kinds of stone, hot springs, fish, tengusa seaweed, wasabi, rice, and dairy products. Local industries and society have developed on the basis of these resources.

The steep topography of land and sea created by the crustal deformation attendant on collision meant that the peninsula was a barrier to travel between east and west Japan, but for that very reason it came to play an important role in such communication. In particular, when sea travel was at its height, ports like Shimoda and Mera flourished. A prime example of a key transport point on land is Nirayama, the administrative capital of the old Izu region. The number of surviving religious artifacts, particularly Heian period (794–1192) Buddhist images, show that this region was also a spiritual center.

This geographical nexus became both a meeting point for the cultures of east and west Japan, and a strategic base for the rulers of every period. The Kamakura Bakufu (13th century), established by the Nirayama-based Minamoto and Hojo families, and the World Heritage-listed Nirayama reverberatory furnaces built by the Nirayama magistrate Egawa Hidetatsu were born in this environment.

Thanks to this situation, the products, ideas, and culture born in Izu did not remain there, but rather created a wide cultural area and had a strong impact on the history and culture of Japan as a whole. As ancient examples, we can see the trade in obsidian tools, and the religious rituals performed as a high political matter by the Heian court in response to volcanic eruptions in the region. More recently, Izu's hot springs and seafood were treated as treasures as far away as Edo, the present Tokyo. In the modern period, many literati and artists, drawn by the spectacular scenery and local products, stayed in Izu, and produced many works of art and literature. In particular, the Nobel laureate Yasunari Kawabata's novel The Dancing Girl of Izu has been filmed many times, and is widely popular in Japan.

Further, as Izu has been exposed to the fury of nature throughout geological and historical time, not only are the scars of past disasters preserved as lessons for the future, but the avoidance and mitigation of disasters is an integral part of the traditions, wisdom, skills, religion, social structure, and culture of the region. As concrete examples, we can look to the Tsunami Stones, Wave-Breaking Jizo images, the legend of the red cow, the Tanna Fault Park, the Kanogawa River Drainage Canal, and the

Byūo Tsunami Gate in Numazu port.

Within the Izu Geopark, beyond the specifically geological sites, there are many places worth seeing that depend on the history, culture, and natural scenery that are so closely tied to the geological background of the region. In this section, we provide a list in Table 2.

Table 3 Non-Geological Sites and Relationship to Geopark

Category	Site Name	Description
Water and Forests	Kannami Virgin Forest	This watershed protection forest has been preserved since the Edo period (1603–1868), and occupies the slopes of a Quaternary volcano. It includes 500-year-old Japanese evergreen oak. Close to geosites such as the Tanna Basin and Jukkoku Pass, it shows the gently-sloping topography of the volcano and its characteristic vegetation.
	Osesaki	Sacred spring, juniper, connected to tsunamis and vegetation
	Amagi Virgin Forest	National park special protection area, high altitude, related to precipitation
	Mishima Springs	Mt Fuji springs
	Kakitagawa Springs	Mt Fuji springs
	Suidoyama, Ito	Scoria cone, related to landslides
	Miyagahara Deep Water	Related to landslides and landslide dams
Natural Disasters	Earthquake Slip Scars	North Izu Earthquake, Nationally Designated Natural Monument
	Koshimoda Mishima Jinja Shrine	Shrine reached down a slope (very unusual), tsunami legends
	Senbonhama-Ushibuseyama	Legend of Nichiren's tsunami-averting prayer, Ansei Earthquake tsunami pool, Byūo (Large tsunami water gate)
	Kanogawa River Drainage Canal	Loss of the Kanogawa River's mouth, Kanogawa Typhoon
	Collapse of Jabamiyama	Pyroclastic plateau, Divine era cypress, Kanogawa Typhoon
	Collapse of Kajiyama	North Izu Earthquake
	Tsunami-Stones, Wave-Breaking Jizo images, tsunami flood marks	Records of tsunami due to Meio, Keicho, Genroku Kanto, Ansei, and Taisho Kanto earthquakes
History	Nirayama Reverberatory Furnaces	World Heritage Site. Iron-making furnaces built at the end of the Edo period for the manufacture of large guns. Izu stone is used for part of the structure. The bricks were made from Kawazu hot spring clay. The skills of construction and mining workers from the Izu area were also put to use in the construction and operation of the reverberatory furnaces. It is part of the Sites of Japan's Meiji Industrial Revolution: Iron and Steel, Shipbuilding and Coal Mining World Heritage Site.
	Izu Administrative Capital	Important figures from many eras were exiled to Izu, a place far from the capital in Kyoto. One such was Minamoto Yoritomo, the founder of the Kamakura Bakufu. Hirugakojima, to which Yoritomo is said to have been exiled, is now surrounded by rice fields, but the Kanogawa river used to flow through the area, before its course changed. Tours telling the story of Yoritomo and the Hojo, and the influence of geography, are already happening.
	Shuzenji	Legend of Kobo Daishi, stories of Yoritomo and the Hojo, hot springs with literary connections
	Old Amagi Tunnel	Difficult point on the Shimoda Road, appears in novels, including *The Dancing Girl of Izu*, and the famous enka song "Crossing Amagi".
	Shimoda Port	Large port city on the maritime route, Perry's Black Ships and smuggling incident, Ansei Earthquake and tsunami and the story of the *Diana*, buildings in Izu stone and black-and-white namako walls
	Matsuzaki	Chohachi Irie's Kote'e arts, San'yo Tsuchiya's San'yo Juku (School), buildings in Izu stone and namako walls
Resources and Industry	Obsidian	Kashiwa Pass (stone tools found across central Japan), Ikadaba (Kokaseki)
	Izu Stone	Nirayama Reverberatory Furnaces, Edo Castle, Odaiba, Shimoda streetscape

	Gold deposits	Toi gold mine etc. Second-most productive in Japan after the Sado gold mines
	Silica stone deposits	Ugusu silica stone (had the largest share of industrial glass production), Koganezaki, Crystal Park
	Amagi Wasabi	Top share for domestic production, relation to geological structure and water springs
	Pool rice culture	Creation of rice fields by forced drainage of lakes dammed by lava flows
	Ishibu Terraced Rice Fields	Related to Jaishi volcano and springs
	Vegetables from SE slopes of Hakone	Related to Hakone, Yugawara, and Taga volcanoes
	Tanna Dairy	Related to Tanna Tunnel and North Izu Earthquake
	Amagi Tengusa	Kanten made from Tengusa seaweed using the cool and dry climate of Mt Amagi.
	Deep Sea Creatures	Japanese Spider Crab, related to Suruga Trough
	Fish, marine products	Rich fish and marine products of the Kuroshio current, related to topography and marine currents
	Tago Salted Tuna Factory	Traditional preserved food of the Tago area of Nishi-Izu City. Tago prospered from its skipjack tuna fishery, in which high-quality fish were landed, and used to offer salted tuna when praying for safe voyages, rich catches, and prosperous descendants. As an auspicious fish, it was also offered as "New Year Fish". It is possible to visit the factory, and it is included in tours.
Religion	Shirahama Jinja Shrine	Volcano deities cult
	Mishima Taisha Shrine	Volcano deities cult
	Naranda no Sato (Nazenji) Hotoke no Sato Museum	The Izu peninsula boasts a surprisingly high number of Buddhist images at the level of National Treasure or Important Cultural Property. This is believed to be because the images were shipped from Kyoto or Nara to Izu, which was a key point on the maritime routes. As it was a common site of exile, the exiles could easily bring the culture of the capital with them. The connection between people and the sea, including transport, and the flow of culture in from the outside are often raised on geotours, and as an extension of that these museums are sometimes included.
Hot Springs	Hashiriyu at Izusan Minë Geyser	All the hot springs are gifts of the colliding volcanic arcs, but only those where the source can be seen or the character of hot spring country can be seen particularly clearly are registered as geosites. Even the hot springs that are not registered are good places to relax after a walking tour.
Literature	Izu Modern Literature Museum (Showa Forest Hall) Yasushi Inoue Literature Museum (Nagaizumi Town) Yugashima Hot Springs	Many authors loved the scenery and hot springs of Izuand included them in their works, either directly described as setting, or as metaphors for the state of mind of characters. Many geotours also follow in the footsteps of authors and trace the course of their works, and visit literary monuments and places associated with the authors. Yasunari Kawabata's Nobel Prize for Literature, *The Dancing Girl of Izu Shirobamba, Natsukusa fuyunami, Chronicle of My Mother* Setting of *Shirobamba,* Yugashima Elementary School, Yasushi Inoue's grave, Place where Yasunari Kawabata wrote and setting of many essays and works of fiction
Intangible Heritage	Kawakanjo Burning of Ōmuroyama Red Cow Legend Enka songs	A traditional repose of souls ceremony connected with Kanogawa river flood Preservation of the form of the scoria cone Legend of the Ogawasawa mudslide "Crossing Amagi (Amagi goe)", "Jogasaki Blues"

C. GEOCONSERVATION

C.1 Current and Potential Pressure on the proposed Geopark

Due to the Geopark's proximity to the Tokyo metropolitan area, urban and tourism development are putting pressure on some geosites and some of the geological heritage. Population and development related pressure have affected the mountains, seas, ecosystems, and landscapes of the region in the past. Also, as Izu is a prominent tourist destination near the capital city of Tokyo, ongoing mass tourism trends remain a worry; the Geopark must strive to make travel more environmentally friendly and reduce anthropogenic impact on the natural environment.

In addition, the geological and natural heritage face damage from people who do not understand them, such as through the removal of fossils or plants, or destruction of geological heritage during works to recover from disasters.

C.2 Curent status in terms of protection of geological sites wothin the proposed Geopark

The concept of geological heritage is a holistic one: it unifies all cultural, landscape, and ecological heritage systems as parts of the planet's heritage. This concept allows us to understand that the earth itself, with its land formation and various geodynamic processes, provides the basis for all the diversity we see in living and non-living nature. Therefore, it is important to understand and evaluate the interrelationships between land, ecosystems and culture, in order to effectively address the issue of geoconservation. It is also important to evaluate the various traditional knowledge systems, and tangible and intangible cultural heritage components, along with the scientific evaluation of natural processes. The interrelationship between ecological and social systems has been explored through 'Social-Ecological System' (SES) research (Berkes et al. 2012). A newer, more comprehensive 'Geosystem' (Gray 2004) concept is now being discussed by many scholars to unify living nature and non-living nature as an interrelated system. The key component of the Geosystem approach is 'geodiversity'—the idea that all the diversity we encounter in life is interrelated as parts of the same planet.

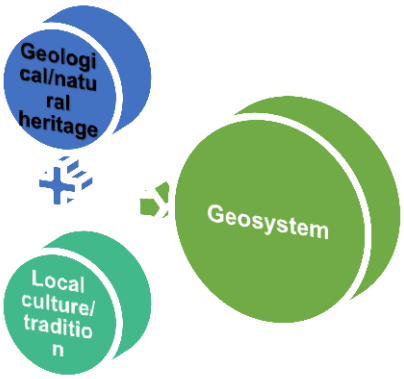


fig. 29 Image of geosystem

At Izu Peninsula Geopark, there is an ongoing effort to understand the interrelationship between geological heritage and local society, which is reflected in the research on and evaluation of the geological heritage that the Geopark has undertaken. The 2013 Survey of Conservation and Utilization of Natural and Cultural Resources, conducted in coordination with the Ministry of the Environment, created a database of all types of natural and cultural resources around the geosites of the Izu peninsula. This database includes information on intangible heritage and local beliefs.

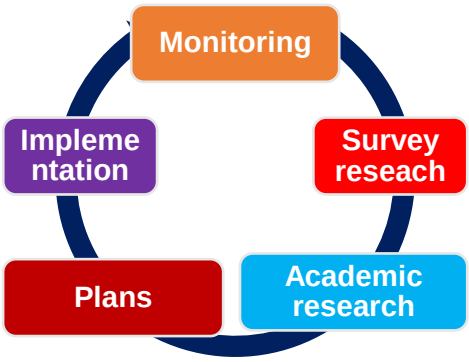


fig. 30 Adaptive governance cycle

Based on this documentation, the Geopark is currently drafting a Conservation Manual. Efforts are being made to make this manual flexible, so that it can incorporate new research findings and feedback. The idea is to create an 'Adaptive Management' platform for conservation of geological heritage.

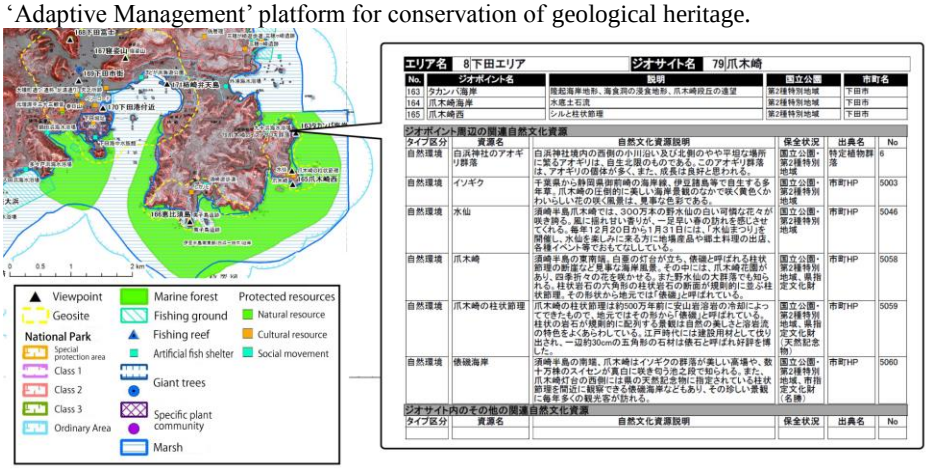


fig. 31 Image of geosite and adjacent nature/culture heritage (left) and database screenshot (right)

C.3 Data on the management and maintenance of all heritage sites

C.3.1 The Management of heritage sites

The geosites of the Izu Peninsula Geopark tell a single story, of an area defined by a group of closely connected phenomena. Several viewpoints have been established within each geosite, with each viewpoint representing one thing to see.

At present, 114 geosites, including those introduced in the previous section, and 313 viewpoints have been defined within the Geopark. These viewpoints include some that cannot be viewed safely, and others to which access is restricted. Such viewpoints would not generally be appropriate for inclusion in geotours, but they have been included on the list to support the monitoring and management of the scientifically important locations within the Geopark. In light of this, the viewpoints have been divided into the four categories given in the table below, based on intended use.

Table 4 Viewpoint categories and details

Viewpoint Type	Details	Number
General access	These sites can be visited by anyone: tourists, residents or researchers. They pose little or no difficulty of access, and visitors can get a sense of the geostory of the peninsula. Website or pamphlet based guidance is available, and explanation panels are also present in many of these sites.	159
Limited access	These sites can be visited by anyone: tourists, residents or researchers. However, some of them are difficult to access or raise some safety concerns. While these sites can contribute to geotourism, visitors should access these sites accompanied by geoguides or tour operators.	27
Educational purposes	These sites have particular value for geoscience researchers. There are no or few access issues, but the significance of the site cannot be easily explained to all levels of visitors. Information about these sites can be provided by the Geopark if requested, and is included in the viewpoint manual.	105
Research purposes	Mainly for research purposes. They have geoscientific value but access is generally difficult. The Geopark provides special guidance about these sites on a case-by-case basis.	22
		Total 313

These geosites and viewpoints have been recorded as GIS data in order to facilitate management of the many locations. This database is not fully public, out of concern for the safety of visitors and conservation, but the data is made available to public bodies that are commissioning construction or conservation projects, to ensure that development does not destroy any of the geosites or viewpoints.

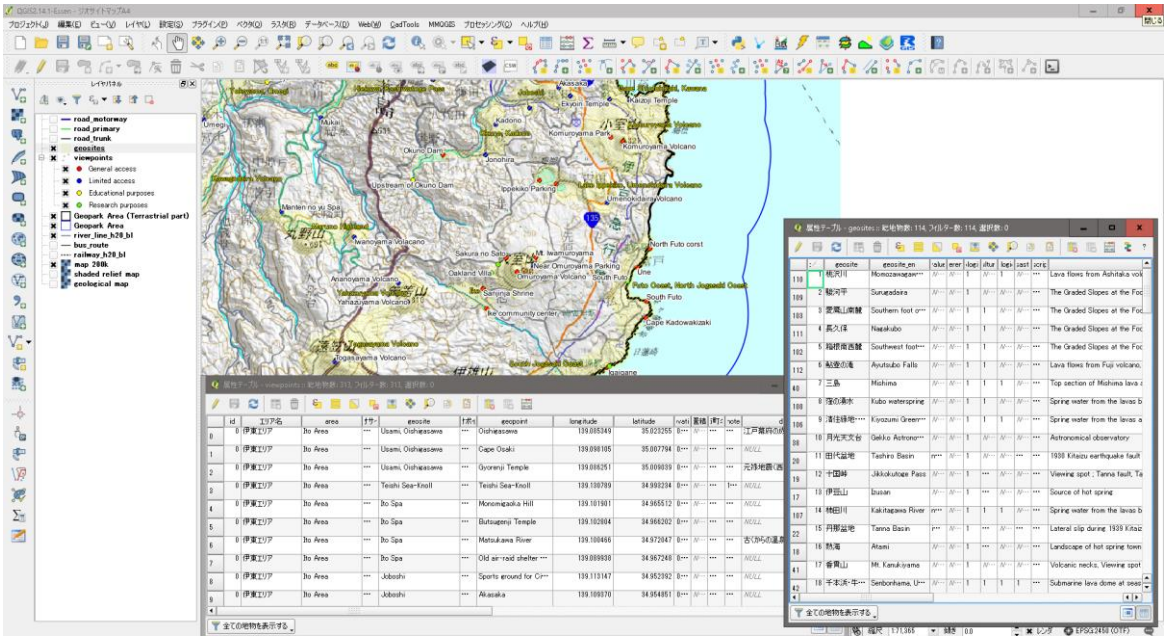


fig. 32 Geosite/Viewpoint Management Database

C.3.2 The Conservation and Preservation Management of Geosites

In this section, we will explain the management status of geosites and geological heritage as governed by the following three factors:

i. Legal protection of geological heritage
ii. De-facto protection as result of nature restoration and traditional management
iii. Geopark initiatives and related schemes.

i. Legal Protection — National Parks Law, Cultural Properties Protection Law, Local Ordinances

The Izu Peninsula Geopark includes a 224 km2 area of the Fuji-Hakone-Izu National Park. This area is protected under the National Park Conservation law (national level). The Fagus crenata forests of the central Amagi highlands, some of the most valuable indigenous ecosystems, and coastlines are the main parts of this protected area. 132 viewpoints (of 313) are protected under this law. Among these, 110 viewpoints are subject to 'Special Zone' status, while the Haccho-Ike Pond viewpoint has the 'Specially Protected Land Feature' status. Stringent legal stipulations safeguard these sites from pressures such as development, construction or logging.

In addition there are 750 'Cultural Properties' designated by the 'Cultural Property Protection Act', and 40 are designated as viewpoints. Apart from these, there are a number of locations where unique plant colonies or ecosystem features are subject to special protection status. There are many instances of historical town landscapes (parts of Shimoda, Atami, Mishima, and Izunokuni cities) and environment-related features (Nagaizumi town) that are protected as cultural properties. Finally, coastal management plans and forestry plans effectively protect natural features located in these areas.

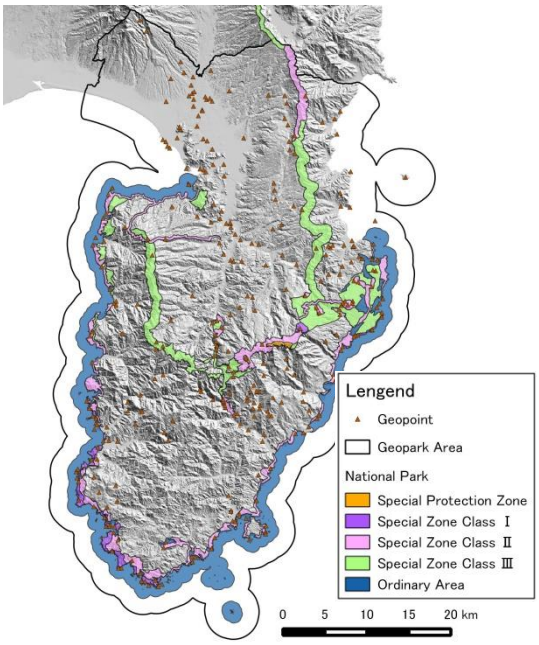


fig. 33 National park and viewpoints

ii.De-facto protection as result of nature restoration and traditional management

A number of conservation efforts predate the Geopark activity in the area: some of these are nature restoration projects run by local residents, and there are cases where parts of the natural environment have been traditionally managed as a form of 'commons'—effecting their protection and renewal.

(a) Nature restoration

This type of protection stems from efforts to 'restore' natural environments or landscapes that suffered serious deterioration in the past. While most of these efforts are oriented towards the living aspects of the environment, the overall effect is the protection of the geological diversity (as ecosystems are important part of geological diversity). A table listing some major initiatives is given below.

Table 5 Examples of Nature Conservation and Restoration

Kakita River (Shimizu Town)	1.2 km river entirely generated by springwater from Mount Fuji, important habitat. The freshwater environment had deteriorated during the years of post-war economic growth, but 40 years of restoration activity have improved it. Kakitagawa Midori-no Trust, one of the first National Trusts for the environment in Japan, played a key part. In 2011, the Ministry of Land, Infrastructure, Transport and Tourism drew up a plan for restoring the Kakitagawa environment. The site continues to be a focal point for nature conservation today.
Mishima Springwater (Mishima City)	Mishima City has a unique environment: natural springs form little rivers all over the city. Citizens of Mishima, led by the NPOs Groundwork Mishima and Mishima Yūsuikai, have led an ongoing effort to clean up industrial pollution and restore the freshwater environment.
Ishibu Rice Terrace (Matsuzaki Town)	This series of rice terraces, 370 in total covering an area of 42,000 m^2, is unusual for east Japan. The region is affected by the aging of society, but locals have made efforts to preserve this landscape, and restore some damaged paddies. A 'paddy owner system' allows urban residents to own and invest in these rice paddies. Agri-product development, and collaboration with industry and schools are other features. The area's way of managing natural resources through agriculture has been recognized as 'good practice' by the Ministry of the Environment.

Ishibu Rice Terraces

Springs in Shirataki Park

Kakita River

(b) Management as a Local Commons

Traditional landscape management by local societies over generations is another important part of the conservation of the heritage of the Geopark. Some of these practices are geared to securing 'ecosystem services' and the renewal of resources (for example, periodic grassland burning and regeneration), while other practices have philosophical or religious significance. The result in both cases is the effective protection and renewal of parts of the natural ecosystems, which can be seen as form of 'local commons.' A number of geosites and viewpoints are associated with this type of protection, and a list of some prominent examples is given below. This type of traditional management of natural resources also has profound lessons for sustainability.

Table 6 Examples of Traditionally Managed Landscapes

Omuroyama (Ito City)	Ōmuroyama (581 m asl) is one of the largest scoria cones in Japan. Created through a monogenetic eruption 4000 years ago, the mountain retains a beautiful pudding-like shape due to a long tradition (700 years) of vegetation burning. This prevents large trees from growing; the pampas grass on the mountain was once used for compost and roofing houses.
Mt Misuji (Hosono Plateau, Higashi izu Town)	Mt Misuji is a gentle highland, a part of the former large volcanic system of Amagi. This plateau was created by the collapse of the southeastern slope, and the area is covered in pampas grass. Like Ōmuroyama, periodic cutting and burning of vegetation allow a good look at the landscape features.
Marine Commons	The Izu peninsula is bracketed by the two deep bays of Sagami and Suruga. These seas provide habitats for a very large number of marine organisms. The regional fishing cooperatives have devised traditional informal resource management techniques such as stipulation of catch amount and no-fishing seasons, in order to preserve coastal fisheries.
Sacred Groves	There are many gigantic and old trees in Izu. Most of these were preserved as parts of sacred groves or shrine forests. This is a very good example of how local beliefs and traditions can help preserve valuable ecosystem features.
Shiranuta-no-Ike Pond (Higashiizu Town)	Shiranuta-no-Ikë pond is a rainwater pond in a naturally hollowed cavity (landslide induced) in the Kawakubo river basin. The area is within the Amagi volcanoes, which were active 800,000 to 200,000 years ago. The site is surrounded by natural forests and the pond itself is the habitat of the green tree frog. As the area is hard to access, the environment is effectively secure from human impact.

iii.Geopark Initiatives and Related Schemes

The Geopark has provided an opportunity to re-evaluate the geological heritage of the region. Programs run by the Geopark have succeeded in creating impetus for the conservation of outcrops and preservation of strata specimens. In addition, the geopark provides training programs for construction personnel, forestry workers and farmers in the Shizuoka Prefecture. A short list is given below.

Table 7 Examples of Geopark Initiatives

Ishiki Pillow Lava conservation (Nishiizu Town)	An outcrop of an old submarine lava formation (pillow lava) in the Ishiki region of Nishiizu Town is the oldest land outcrop in the peninsula. This outcrop became a focus for conservation after the Geopark was established. A committee for preserving this outcrop was established in 2012.
Surface peel of outcrop at Komuroyama (Ito City)	This surface peel was created by Geopark researchers, and the NPOs Machikon Ito and the Ito Historical Guide Group in March 2012. The original outcrop was discovered during a road construction project, and is now exhibited on the Komuroyama in a space provided by the Tokai Automobiles group. This surface peel provides a record of 40,000 years of monogenetic volcanism in the area, and is therefore a very valuable geological specimen.
Training program for civil engineering, agriculture-forestry, and technical workers	Many geosites are located in steep terrain, and these are vulnerable to the construction of roadways and check weirs. The Geopark Promotion Council provides training for civil engineers, and construction and agroforestry workers in Shizuoka Prefecture in order to minimize construction impact and prevent damage from lack of knowledge. New construction activities are expected to address these concerns. The training program has continued for three years now, and has succeeded in expanding the awareness of geological heritage among these workers.

Other

In addition, there are various maintenance, trail management and garbage removal programs that help the Geopark to maintain its heritage.

Table 8 Other Notable Conservation Activities

Cleaning of seabed (Minamiizu Town)	The NPO Izu Mirai Juku is engaged in seabed cleaning with the support of divers and locals. Efforts are ongoing to evaluate marine landscapes.
Nature research by citizens	There are many citizen groups that engage in informal research on the natural environment. A good example is the Atami Shizen Gakko, an NPO in Atami City that undertakes various observation, survey, and experience based activities to evaluate the local natural environment. Snorkeling, marine classrooms, and observation cruises are notable activities.
Sociocultural landscapes	Many historical artifacts and cultural landscapes are preserved in Izu. Some of these are registered as cultural monuments under the relevant laws. Many such artifacts are related to the geological heritage. Mishima Taisha Shrine (Mishima Daimyojin, a fire deity) and Kakisaki Bentenjima Shrine (Ryūjin, a sea deity) are examples from local beliefs. There are many literary reliefs and plaques commemorating famous writers who visited Izu in or around geosites. There are also examples of preservation of historic buildings or objects.

D. Economic Activity and Business Plan

D.1 Economic activity in the proposed Geopark

D.1.1 Characteristics of Local Industries

Industries in the peninsula can be divided into two broad zones: the northern part enjoys good traffic infrastructure, while the southern part is relatively rural and scenic. The Tokaido Shinkansen (Bullet Train Line), and the Tomei and Shin-Tomei Expressways (Highways) are major traffic arteries that connect the northern region to urban hubs like Tokyo, Yokohama and Nagoya. The area is only 1 hour by train from Tokyo, and due to the presence of abundant water, manufacturing industries have flourished in the region. The area has also been developed as a suburban commuter hub for people working in the Tokyo metropolitan region.

The central and southern parts of the peninsula are famous as tourist destinations, and attract a lot of tourists throughout the year. For this reason, tourism is also the biggest industry in the peninsula. Services industries account for 69.4% of employment, higher than the national average of 66.5%. If the northern region is excluded, service industries account for over 70% of employment, with tourism providing a particularly high proportion.

Table 9 Industrial workers and employment rate

City/Town	Total working population	Primary industry workers	Secondary industry workers	Tertiary industry workers	Tertiary sector employment percentage
		population	population	population	population
Numazu City	100,487	2,818	30,943	64,589	64.3
Atami City	18,047	286	2159	15,102	83.7
Mishima City	54,802	1,230	15,173	37,181	67.8
Ito City	32,277	810	4,312	26,207	81.2
Shimoda City	11,863	566	1,519	9,630	81.2
Izu City	17,079	1,129	3,928	11,848	69.4
Izunokuni City	24,569	1,361	6,347	16,562	67.4
Higashiizu Town	6,961	595	849	5,503	79.1
Kawazu Town	3,927	517	535	2,862	72.9
Minamiizu Town	4,330	499	560	3,204	74.0
Matsuzaki Town	3,578	256	626	2,691	75.2
Nishiizu Town	4,280	249	919	3,102	72.5
Kannami Town	18,554	705	5,294	12,404	66.9
Shimizu Town	16,072	191	5,084	10,536	65.6
Nagaizumi Town	20,323	455	7,261	12,495	61.5
Total	337,149	11,667	85,509	233,916	69.4

D.1.2 Tourism

Tourism to the Izu peninsula is primarily supported by its hot springs. In Japan, with its many volcanoes, people have made use of hot springs since ancient times to refresh their bodies and minds, and bring themselves back to full health and vigor. Nevertheless, the number of tourists staying at hot spring resorts has shown a long-term decline, and Izu is no exception.

Despite this, over 10 million people stay in the candidate area every year. We aim to increase consciousness of environment preservation of local residents and tourists by Geopark and to preserve from destruction of heritages due to overuse.

In 2009, inspired by the changing needs of increasingly diverse tourists, the people of the Izu peninsula started to formulate and develop the Geopark, aiming to take pride in what was truly good in the area, and, while preserving it, share it with visitors in a sustainable way. As this process advanced, the Izu Geopark Promotion Council was established in 2011. The 2014 Tourism Basic Plan of Shizuoka Prefecture includes the Geopark as a major focus for the future development of tourism.

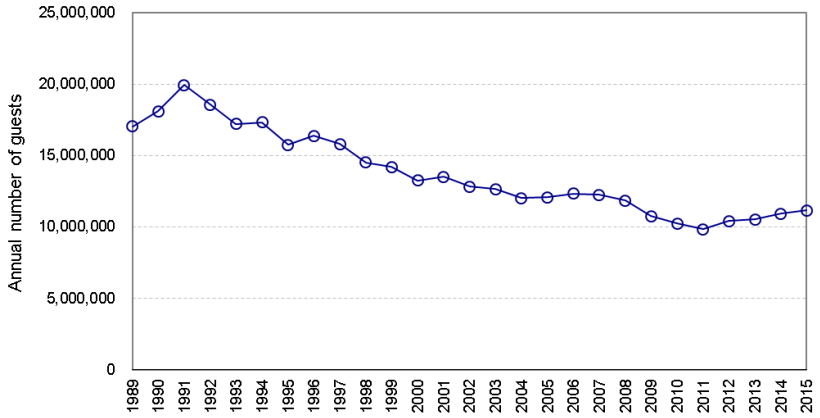


fig. 35 Changes of the number of staying guests

D.1.3 Agriculture, Forestry, and Animal Husbandry

The Izu peninsula is mostly mountainous. As a result, apart from the Tagata plain in the north and narrow strips of land in the valleys, land suitable for rice agriculture is limited. Many local farm products make use of the soil conditions of the gentle slopes of quaternary volcanoes. Notable products from the eastern part of the Tagata Plain, and southern and western extensions of the Hakone volcanic area, include potato, radish, watermelon, and shiitake mushroom. Kannami watermelon and Mishima vegetables are among the well-known local brands from these areas.

Satsumas (tangerines) are cultivated on the mountainsides facing the sea. Dairy farming is popular in the Tanna and West Amagi areas. Horseradish (wasabi) cultivation is practiced on the areas of quaternary volcanoes that are cleft and partially eroded by natural agents. The wasabi plantations cover full streams at places, and intensively use the spring water to cultivate the crop.

Flower cultivation with the help of the warm climate and ‘hot-spring melon’ farming with the use of geothermal heat are some other notable farming activities. Daisies and carnations are notable among the cultivated flower varieties. The Agriculture Research Institute of Shizuoka Prefecture has recently started a program of cultivating 11 traditional vegetables of the peninsula as local alternatives to imported vegetables.

Sunlight dried radish at Hakone flank

Horseradish farm in Ikadaba

West Amagi Plateau

Flier of traditional vegetables

D.1.4 Fisheries

The deep Suruga and Sagami troughs and the overlying bay waters are rich fishing grounds, yielding catch of a very large variety of shallow marine and deep marine fish. The spider crab, the largest crab species in the world, is caught off the coast of Heda cape in Numazu on the west coast. Off the east coast, the Kinmedai (Beryx splendens) is caught widely and products such as canned Kinmedai are popular. The Geo-don (Geopark seafood dish) is a specialty of the Ito City Fishing Cooperative: a variety of fish are caught by lowering a fixed net, and served fresh on a rice bowl. This type of catch involves anticipation of tidal patterns and understanding of geological properties of the coast.

Fisheries are managed sustainably through two main mechanisms. The first is legal, in which the country carries out regular scientific surveys of stocks to assess sustainability, and the country and prefecture issue licenses and quotas. The second is through voluntary management by local fishing cooperatives.

D.2 Existing and Planned Facilities in the proposed Geopark

D.2.1 Central Facility

In April 2016 the Izu Peninsula Geopark Museum “GEORIA” was opened as the based of operations for the Geopark. It is used to provide information to visitors, as a base for educational activities, and to support researchers.

GEORIA serves as a hub, providing information and the results of academic research to all the visitor centers, and gathering information about each region within the park from those visitor centers in turn. It also gathers information about other Geoparks, both within Japan and across the world.

A researcher is permanently based here, and in addition to the display space, it also houses a library and other educational facilities, the Bureau offices, and a base for guides. It also has the facilities to collect and manage specimens (stone cutters etc), and the displays are under constant revision as it supports both internal and external researchers.

The aim is make GEORIA a place where people interested in the Geopark can become involved in its management and build links with one another, so that they can build the Geopark together.

Elementary School Students at GEORIA

Tour Design Workshop

Exhibition Room

This facility is also used for contact between students. The picture to the left shows local high school students using GEORIA to introduce the region to visiting high school students from the USA.

D.2.2 Provision of Visitor Centers

This Geopark covers a wide area, and visitors can enter from many directions. Further, geosites and accommodation are widely scattered within the Geopark. In such a situation, GEORIA would not suffice to distribute information by itself. Thus, the Geopark aims to establish one visitor center in each of the administrative regions (the 15 towns and cities) within the Geopark, each of which will provide information on the surrounding area. At present, 13 of the centers have opened.

While the visitor centers and GEORIA serve different functions, they also form a network of information exchange, ensuring that visitors to any region of the Geopark can be offered somewhere to enjoyably learn about the area. Further, the Geopark aims at a system that allows visitor feedback to be shared between all the centers.

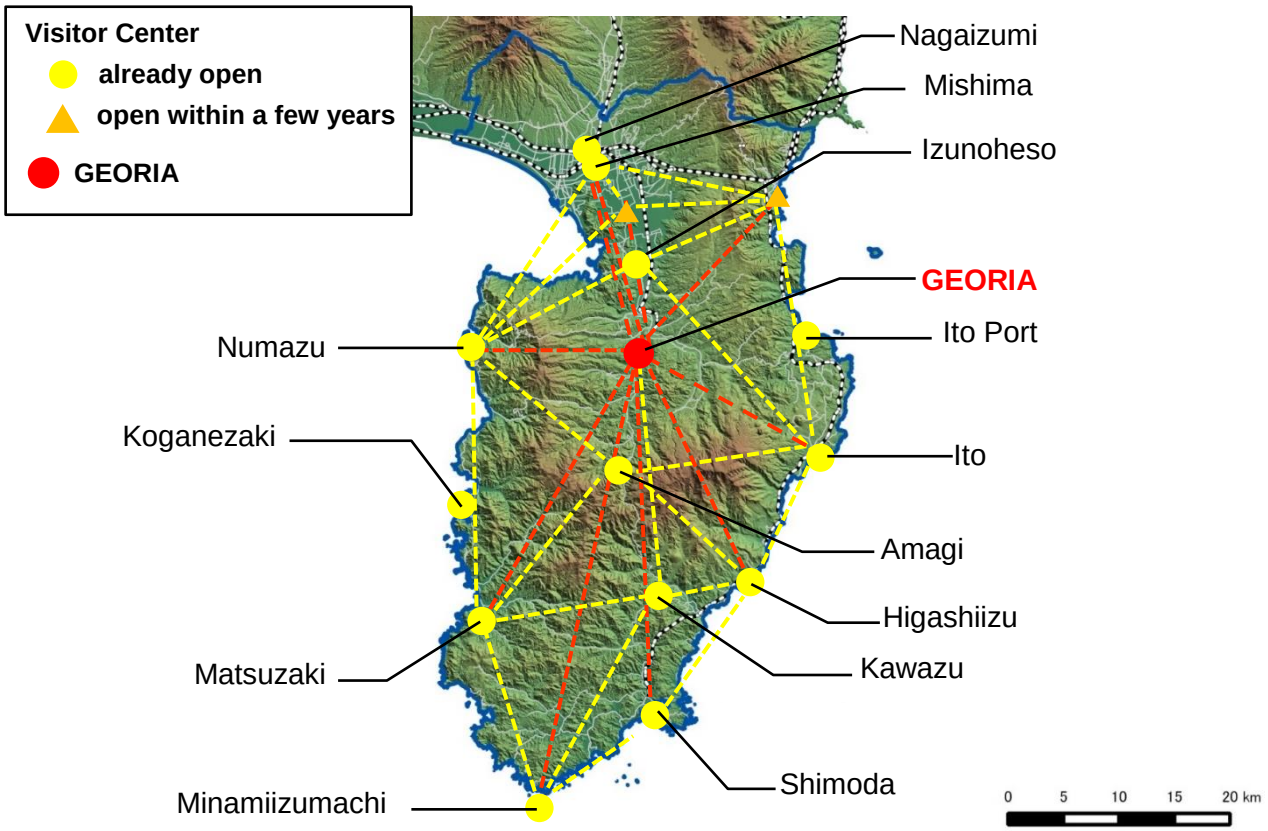


fig. 34 Location of visitor centers

D.2.3 Guidance and Interpretation Panels

Bilingual (Japanese and English) geo-interpretation panels bearing simple explanations of the origin of geosites have been set up throughout the park for visitors and to support geotours. These panels have been set up while working with local authorities, companies and NPOs to ensure that they work well with existing tourist information panels. By the end of March 2014, 100 panels had been set up in 85 locations. The content and design of the panels is decided under the supervision of the Promotion Council's researchers, taking account of local historical records and the opinions of guides. The interpretation panels are made to have a common and easy-to-understand design throughout the area, and have QR Codes linking back to the Promotion Council's website, encouraging access to further information.

Example of interpretation panel at Asahidaki viewpoint. The panels provide information not only on geology but also on history and culture.

D.3 Analysis of geotourism potential of proposed Geopark

Geotourism in the Izu peninsula can perhaps be said to have begun in the 1990s, when NPOs and the local Education Committee in Ito City in the east of the peninsula invited Professor Masato Koyama of Shizuoka University to lead educational activities about volcanoes. However, at that time the activities were almost entirely confined to Ito City.

During the process of the establishment of the Izu Peninsula Geopark Promotion Council and of training geoguides with a view to being recognized as a Japanese Geopark, a wide variety of geotours came to be carried out across the peninsula.

In 2014, the Promotion Council set its Basic Plan, and now operates the Geopark in accordance with that plan. In constructing the plan, a web-based questionnaire was implemented among 350 local residents and responses about the awareness of and hopes for Geopark activities were analyzed. A workshop was subsequently conducted to exchange information between Geopark personnel and local people. 100 people participated in this workshop, including local residents, administrative workers, traffic system employees, guides and high school students. The results of the questionnaire and the workshop are discussed below.

D.3.1 Geotourism Strengths

- It is possible to witness different types of volcanism — submarine volcanoes, terrestrial volcanoes, and monogenetic volcanoes — resulting from the tectonic motion of three plates around the peninsula. Izu's position at the boundary of three plates makes it a unique location on the planet.
- Due to its relatively warm climate, the Geopark can be visited throughout the year. Geotours take place all over the peninsula, across the four seasons.
- Izu was a favorite among writers of modern times due to its hot springs. The area is one of the most well-known hot-spring destinations of Japan, attracting 37 million visits (including day trips) per year. Walking trails and toilets are well-managed, and touring the peninsula is possible with minimal trouble.
- There are a number of ecotourism activities, as well as interesting local varieties of tourism combining the geological heritage with such things as hot springs, literary tours, local cuisine, and marine sports.
- 70% of the respondents were hopeful that the Geopark would have a positive effect on tourism promotion and 80% were hopeful that the Geopark would have positive effects on nature conservation.
- The establishment of GEORIA has created a general natural history museum.

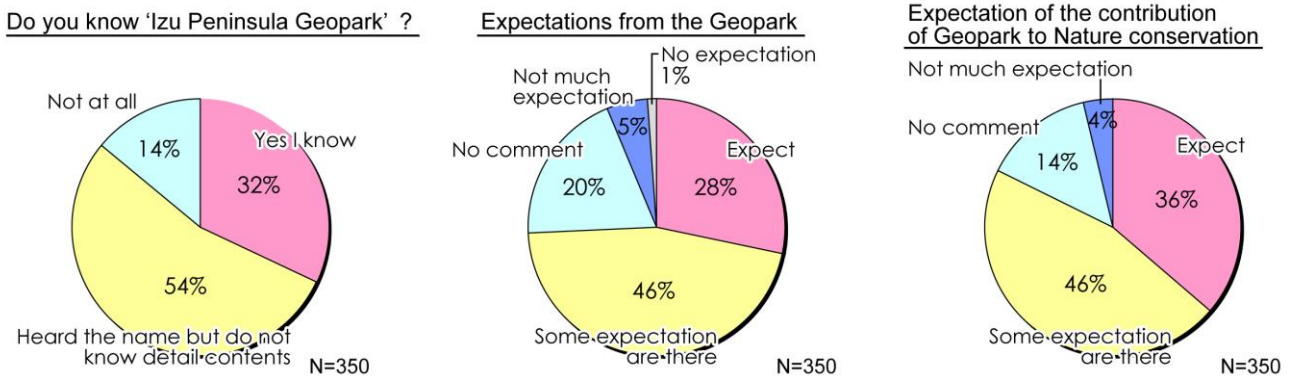


fig. 35 Web questionnaire results

D.3.2 Geotourism Weaknesses

- Only 30% of the respondents were aware of the Geopark's various activities, though 50% responded that they had heard about the Geopark in some manner. This leaves ample room for further popularizing the Geopark among locals.
- Lack of geoguides who can communicate in foreign languages.

D.3.3 Ongoing Activities and Future Vision

Based on the findings of the survey and the discussion at the workshop, the following three areas of activity are seen to be necessary.

a. Attracting Visitors to Geotours

Workshop for master plan

In addition to creating Geopark fans who visit the Geopark as their main destination, it is necessary to attract other types of visitors to the Geopark using a diverse range of strategies.

With regard to Geopark fans, the Promotion Council currently collects information about geotours and Geopark events from the member local authorities, companies, and geoguides, and distributes this information through its website and monthly email newletter, classified by the month of the event. A system of registered supporters has also been established. If a registered supported attends multiple tours or events, they may receive a special bonus, and this scheme has increased the number of repeat visitors. In addition, the NPO Machikon Ito runs a series of tours over the course of a year. This event has a membership system, and is aimed at people who are interested in geoscience, with a particular focus on the Izu peninsula. There are 10 events over the course of a year, of which one is a bus tour to another Geopark in Japan. Through learning about other regions, participants gain a renewed appreciation of their home area, and this event is not only preparing the ground for receiving new fans, but also energizing the Geopark network within Japan.

In order to draw in people who have visited the area for other regions, guidance panels are being set up at places that draw many people, such as the “Michi no Eki” (local centers for people arriving by car) or other tourist spots. Further, training courses for accommodation staff are conducted at GEORIA, and many articles are published in travel magazines.

b. Improving Residents’ Readiness to Welcome Tourists

In order for geotourism to expand in an area, local residents must have a good understanding of geotourism. Many lecturers and demonstrations are organized by the Promotion Council, cities/towns, and geoguides to popularize the Geopark among residents. The number of such lectures, explanation meetings, demonstrations and study-meets reached 538 as of March 2016. A total of about 22,500 people have participated in these events.

Publications (left),

Bilingual「Geo IZU」application(right)

Local media, such as newspapers, have also helped to drive the spread of understanding of the Geopark. The Shizuoka Shimbun and Izu Shimbun newspapers have been particularly helpful. The official guidebook to the Geopark, “Boken Hanto Izu e Yokoso!” (“Welcome to Izu, Peninsula of Adventure!”), was published in cooperation with Shizuoka Shimbun, as was the “Izu Peninsula Geopark Trekking Guidebook”. The newspaper is introducing examples of how the geological environment of the area impacts people’s lives and work in its continuing “Living with the Earth” series. Similarly, Izu Shimbun has run a continuing series on the Geopark over the last few years, and introduced the attractions of the Izu Peninsula Geopark from a variety of angles.

c. Multilingual Support

As tourism diversifies, group tours from Asia form a high proportion of general foreign tourists in the Izu peninsula. On the other hand, the number of individual Western tourists is also increasing, particularly in southern areas of the peninsula around Shimoda. Geotourism, from the perspective of the preservation of geological heritage, landforms, and ecosystems, is primarily targeted at individuals, rather than groups.

The Geopark has Japanese, English, Chinese, and Korean websites. Geopark maps and DVDs have been available in Japanese, English, Chinese (mainland Putonghua and Taiwanese versions) and Korean since 2013. In March 2014, the Geo-Izu smartphone application was released. This application targets individual tourists, and is available in Japanese and English. The application features 12 videos running simultaneously on the screen, and it directs the user to the routes to geosites. The Geopark will strive to implement special walking tours for foreigners that introduce aspects of geology as well as Japanese culture, by collaborating with travel agencies that specialize in conducting international tours.

In March 2016, the park made a video targeting individual foreign tourists, and introducing activities such as kayaking, trekking, and diving, by which they could experience the beautiful geological heritage and natural environment of the peninsula. This video was extremely well received, and the Promotion Council is now working with local businesses and tour companies to ensure that people can easily participate in such geoactivities.

D.4 Overview and policies for the sustainable development

D.4.1 Geotourism and Economy

a. Geotours

Many geotours are conducted by various organizations across the peninsula. These tours have different objectives. Since the establishment of the Geopark Promotion Council, and up to the end of March 2016, a total of 779 geotours were conducted by the Promotion Council and officially recognized geoguides. These tours attracted total of around 30,000 participants. Geoguides also conduct tours on their own, or collaborate with other organizations to design tours. The sightseeing cruise company Dogashima Marine operates geosite cruise tours of 50 minute duration every Saturday; geoguides provide explanations of sites on this tour. More specialized tours include photo-tours of geosites, hiking tours from visitor centers, bicycle and sea-kayak tours, and walking tours.

If sustainable tourism is to be realized, it is necessary to train geoguides, develop souvenirs and foods that can be made in the local area, and conserve the geosites. Goods and guide training will be covered later, but steps are also being taken to conserve popular geosites. For example, at Ōmuroyama, it is only possible to ascend the mountain by a chair lift, and signs have been erected to stress the importance of preserving the form of the scoria cone. The Promotion Council will continue to work closely with guides and local residents to ensure that conservation and tourism reinforce one another.

b. Product Development

One of the major attractions of the geopark is a variety of products developed by the locals. The ideas behind these products and their unique sales strategies reflect the innovativeness of the local people. The most famous product is the Geo-gashi (Geological sweets), and detailed information about these is provided in a later section. Others include Geopark bread, and ‘Lava Georock’ candy, all of which are inspired by geosites or landscapes. Pottery modeled on geological landforms is another notable local product.

The Geopark visitor centers are actively involved in promoting and selling geo-gashi and other Geopark related products as souvenirs. Attractive geosites, geotours or Geopark related products are also frequently featured in the programs aired on local cable television channels.

The Geopark is also positively committed to promoting local agriculture, fisheries or processed food products such as spring-fed wasabi horseradish and eel, seafood from the deep trenches, and vegetables grown in the volcanic soils. In addition to items that are directly related to the geology of the land, we are committed to promoting traditionally famous food products like the seaweed of Matsuzaki or Shio-katsuo (salted bonito) as attractions of the Geopark, and incorporating them into tours.

Geopark related pamphlets


Geopark bread

Sand-spit plate (left)
Actual sand-spit (right)

c. Geoguides

The training of geoguides is a key part of Geopark development because these guides show the attractions of the land to visitors and promote education and geotourism. A geoguide training program has been run by the Geopark every year since 2011 (since 2013, the training program has required an enrollment fee), and every year around 50 people take the training. The current system trains potential geoguides through a series of lectures and field demonstrations and conducts a test that includes simulation of field guiding after 2 months. In the five years to March 2016, 179 geoguides successfully completed this training.

In 2012, the Izu Peninsula Geoguide Organization was established by certified geoguides. This is a voluntary organization and it helps geoguides to cooperate among themselves. The organization provides a platform for geoguides with knowledge about different areas to communicate and develop guiding skills that can be used across the peninsula, conduct emergency rescue drills, and develop other related guiding skills. Further information about their activities is given later.

A program to develop 'Geoguide-associates' began in 2013. This is mainly aimed at nature guides who also want to introduce some aspects of the Geopark. It is currently not possible to organize lectures or training trips for these guiding associates, but the program will have the effect of expanding the use of the Geopark to other areas of nature tourism. A notable development has been the establishment of the 'Ito Geomarine Club,' which conducts geo-snorkeling and geo-diving for diving enthusiasts.

Geoguides played a major part in the 11 geotours held after the "7th All-Japan Geopark Conference", held in the Izu peninsula in October 2016. The guides led various types of tour, including hiking, cruising, and kayaking, while Ito Geomarine Club organized snorkeling expeditions. Elementary school geoguides also helped, and in all 380 people participated in the 11 geotours.

D.4.2 Geo-education

In order to achieve long term sustainable economic development, it is important to educate the next generation about the Geopark. Along with this children's education, adult education about natural disasters such as earthquakes, volcanoes, storms, and flooding is important. Moreover, such knowledge must be transmitted effectively and disaster response measures must be developed. The section below introduces some important education and natural disaster response efforts of the Geopark.

a. Geoscience Education

Izu Sogo High School has incorporated the Geopark into its educational activities since the very first days of the park, starting even before the Geopark was admitted to the Japanese Geoparks Network. It was the first prefecture administered school to gain UNESCO School status, and was recognized for its active curriculum of geopark-related activity. The Sogo High School science division prepares geosite leaflets and fliers, and provides special lecturers for elementary school students. The school children are also involved in guiding geosites with local support. Geopark education is mandatory for the 2nd year students enrolling for general education, and in October 2016 around 240 pupils visited the park for study. The opening of GEORIA had a strong positive effect on the Geopark's educational activities.

Matsuzaki High School runs collaborative learning programs with Izu Sogo High School. Geosite trips and conservation activities are undertaken by students at this school. They have already started collaboration with locals to help in conservation activities and foster Geopark related products. Further, they participated in the APGN2015 Symposium, in September 2015, giving presentations on their activities.

The Ito High School Arts Section developed a birds-eye view representation of the land created by the lava flow from the Izu Tobu Volcano Group. Panels of this view were made and distributed to elementary and middle schools in the area. This project

was the result of a collaboration between the school and the local Rotary Club, and there is evidence that initiatives such as this are helpful in deepening the interaction between schools and local residents.

It is also important that teachers also have a good understanding of the Geopark and the geology of the land. The Geopark Promotion Council Bureau provides expert support for a volcano experiment toolkit and data about past disasters. Guidance is provided to school teachers who are interested in geological science and natural disaster prevention. In this way the geopark is conducting various educational outreach activities. Further, when an educational contact meeting was held in May 2016, many schools expressed a strong interest in the Geopark, and at the All-Japan Geopark Conference in October, many high schools gave poster presentations about their activities.

Recently, study of the Geopark has started to develop in elementary schools, some of which visit GEORIA, and the Promotion Council is responding by sending its researchers to give classes in schools.

In addition, the Geopark runs booths and exhibitions at various local events with the support of geoguides. Simple experiments and quizzes are arranged for children and their parents who visit the booths. In this way, the Geopark aims to popularize geoscience among visitors. In August 2013, the 'Earthquake-Volcano Summer School for Children' was organized in Shimoda and Minamiizu (the southern part of the peninsula). A total of 33 children from different parts of Japan participated.

Tour by Izu Sogo High School

Birds eye view of landscape

Children summer school

b. Disaster Mitigation Education

Geoparks are places to enjoy the earth's heritage, but they are also places where visitors can learn about past natural disasters. Education about such disasters allow us to assimilate knowledge gained from the past and prepare ourselves to respond effectively in the case of any future disaster. Thus, this type of education helps to develop local level disaster-preparedness.

The Izu Peninsula is a land of active volcanoes (the Izu Tobu Volcano Group), steep mountains, and heavy rainfall, so the risk of a natural disaster striking the region is high. The Geopark runs a variety of disaster preparation programs as a key part of its activity. We make efforts to teach people to see the evidence of past natural disasters in the geological structure of the land through the interpretation panels and geotour contents. Remains from past natural disasters and disaster mitigation infrastructure are also featured in our geosites. Such measures are helpful for spreading natural disaster awareness more directly. While adults are also very interested in disaster mitigation, the Geopark is utilized in disaster mitigation education for elementary school children in Minanmiizu Town, and geoguides serve as teachers.

D.4.3 Geo-heritage

Geoparks are places to conserve geological heritage, but they are also places where local societies can use that heritage for sustainable development. We have provided detailed information about conservation in Section C, and here we talk about sustainable utilization of the geological heritage.

As geological heritage is a matter of local pride, it is utilized in the various tours and learning activities in the Geopark area. Natural landscapes and ecosystems provide the basis for the livelihood of many people, especially for those in the coastal areas.

The Geopark promotion council runs many types of programs such as awareness programs for the general public, human resource development (geoguide training and collaboration with schools), surveys, and research programs. In addition, the Geopark is committed to promoting sustainable resource use by local communities. Such conservation and usage must be based on academic studies.

In 2012, a survey of volcanic gas release at Teishi Sea Knoll off the Ito coast was conducted in collaboration with the Center for Integrated Research and Education of Natural Hazards, Shizuoka University. In 2013, Dr. Nemesio Perez from the Canary Islands visited the area. We hosted a joint lecture by Dr. Perez and Dr. Motoo Ukawa of Nihon University about continuing

undersea volcanism. At that time, we provided support for Dr. Perez's field survey. Further, as described earlier, the Geopark provides support for young researchers conducting studies connected with the peninsula. In the future, the Geopark will provide research results for public use through its academic activities.

D.5 Policies for community empowerment in the proposed Geopark

The local governments of the Izu peninsula came together in April 2013 to create the "Izu Peninsula Grand Design", and now follow common policies in certain fields. This Grand Design included a SWOT analysis of the peninsula, where tourism is the main industry, and a collective pledge was made to make the Geopark a 'leading project' for regional development. The pledge called for increased collaboration between different areas of the peninsula, based on the concept of a common heritage of a beautiful yet at times dangerous nature. Planning documents from different administrative units feature Geopark related aspects, and this raises the hope that the Geopark will be a key to tool for local development in the future. Within that, there are particular hopes for the Geopark's role in responding to natu
ral disasters, and in disaster mitigation education.

	Internal origin	External origin
Helpful	**Strength** ●Short distance from Tokyo ●Warm and comfortable climate ●Natural resources are abundant ●Tourism and lodging facilities ●History and literature influence ●Local brands with long history	**Opportunity** ●Traffic infrastructure development ●World heritage designation (Nirayama Reverberatory Furnaces) ●Haneda International Airport, Shizuoka Airport development ●Development of Asia and increase of tourists
Harmful	**Weakness** ●Internal communications not ideal ●Traffic network issues ●Natural disasters ●Depopulation and aging	**Threat** ●Natural disasters ●Decline of tourism industry ●Transport network change (Access improvement to other tourist spots) ●Large scale tourist facilities near Tokyo

fig. 36 analysis from Izu Peninsula Grand Design

In 2012, the Volcanic Disaster Prevention Council was set up to monitor the Izu Tobu Volcano Group and design effective responses in the case of an emergency. This council is currently preparing evacuation plans and other related emergency responses. The disaster management plans of Shizuoka Prefecture, Ito City and Izu City clearly mention that the relevant administrative units will liaise with the Izu Peninsula Geopark Promotion Council and disseminate information about volcanism to tourists and concerned parties. The Promotion Council is a member of the Volcanic Hazard Prevention Council and various programs to involve the Geopark in disaster prevention are currently being designed and implemented.

The involvement of women in the Geopark is also moving forward. There are 179 people who have taken and passed the guide training courses run by the Geopark Promotion Council, and about 40% of them are women. The Izu Geoguide Association is currently led by a woman, and the geoguides responsible for the Geogashi and Geo-Ikebana described later are all women. The flexible and distinctive ideas of these women are a cornerstone of the Geopark.

D.6 Policies for public and stakeholder awareness in the proposed Geopark

As the Geopark is about local people, geoguides who know about the geological heritage of the land are a most valuable asset for the Geopark. They take a central role in promoting the Geopark within and outside its immediate locality. Several innovative efforts by our geoguides to promote the Geopark have attracted widespread attention.

The Geogashi Ryokodan (Geological sweets travel group), a guide group consisting of two local women, has developed novel sweets that replicate landforms and landscapes of the Geopark. The sweets are made with local ingredients and each package includes a Japanese and English description of the landform or landscape. This brand is now famous, and the activities of Geogashi Ryokodan are often featured in the media. They were also a big hit with visitors from Asia at the APGN international meeting. The Geogashi Ryokodan is involved in designing geogashi tours, joint product development with local schools, and

assisting with the development of products at other Geoparks, and has a stand at regional science events across the country. Their involvement in activities that capture the ideals of the Geopark is continuing to develop.

A geoguide based in Mishima designed a unique Ikebana flower arrangement style that depicts geosites. Ikebana is a traditional Japanese flower art, and is also an intangible heritage. An exhibition of this Ikebana in Mishima in December 2013 attracted 347 visitors in one day. This Geo-Ikebana was also displayed to the 1,000 participants in the 7th All-Japan Geopark Conference held in Izu in October 2016.

The All-Japan Conference is the largest Geopark-related event in Japan. The aims of holding the conference in Izu were, naturally, to support Geoparks across Japan, and also to increase the interest of people living in this region in Geoparks. The conference encouraged interest inGgeoparks from many angles, including the appeal of geology and landforms, research presentations that involved children, experience events, and food, the blessings of the earth. In cooperation with the Japan Geopark Network, we also welcomed 10 people representing UNESCO and three southeast Asian countries seeking to register and develop Geoparks, and as well as holding meetings with Japanese Geopark representatives, we provided tours with geoguides, and further raised the interest in Geoparks of both the visitors and local residents through an appreciation of our differences and unique features.

Local businesses are becoming increasingly attached to the Geopark. The Izukyū Cable Network and Izukyūko group (cable car and railway) have started to run ‘geo-trains’ with the Geopark logo and geosite photographs. Further, Tokai Automobile, which runs the local scheduled buses, is helping to raise local awareness of the Geopark by including its logo in buses and on bus stops.

The Promotion Council Bureau is directly responsible for several initiatives, such as special lectures for residents and local schools, the Geopark Aptitude Test (2,147 people have taken this simple web-based test over 5 years), demonstration booths in various programs, and providing lectures or demonstrations upon request.

Geogashi

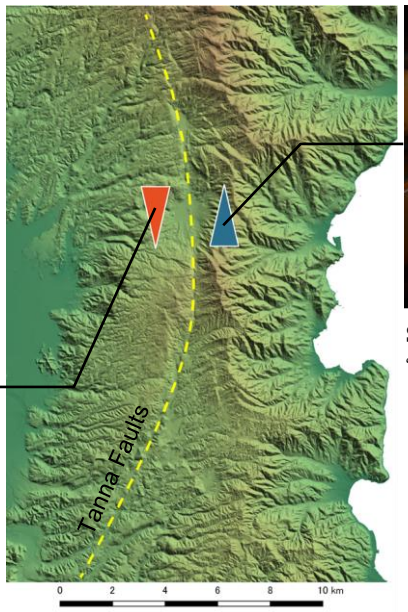
Geoikebana
Traditional flower arrangement

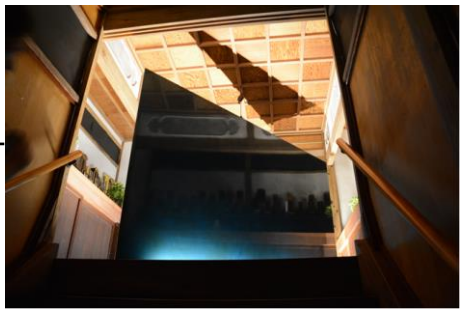
Geotrain guidance
in local train

Cliff Edge Project

Art project by local artists.
Two arrow shaped objects located on both sides of the fault show the direction of the movement of Tanna fault.

North-pointing arrow in
“KURUBUSHI-BASE” art gallery





South-pointing arrow in
“Chokoji” temple

E. Reasons for Seeking Recognition as a UNESCO Global Geopark

The Izu Peninsula Geopark is committed to the ideals of a Geopark, to contributing to the conservation of the nature, history and culture of the area, and to promoting tourism, local development, education, and the mitigation of natural hazards. The Geopark is engaged with other Japanese and international Geoparks, and we aim to bring benefits to our area as well as to enrich Geoparks in general in the process. As the peninsula is located close to Tokyo and is popular as a tourist destination, Izu Peninsula Geopark has a unique opportunity to spread Geopark awareness among a large number of people, and to develop a new value system for the Japanese people, who live on a geologically active and dynamic land.

We are motivated to reach new goals of research, education, disaster mitigation, and conservation of geological heritage by implementing global-level Geopark activities and communicating the activities of geoguides and local residents to the world.

We have the following three contributions in mind as a UNESCO Global Geopark.

The first contribution is to bring the heritage of the Izu peninsula, a land of globally important geological heritage, to the network.

The Izu peninsula originated as a submarine volcanic massif in the southern ocean. It collided with Honshū and created new landforms through volcanism and crustal motion due to the tectonic motion of the Philippine Sea plate. Izu's geological history and ongoing volcanism and crustal motion allow us to gain insight into the planetary processes of land formation and evolution. The Izu peninsula in this sense is a unique place in the world, with many features not otherwise represented in the Geopark network. In all areas of the peninsula evidence of this geological heritage can be found. The geological story of the peninsula can be followed in the following order: ancient submarine volcanism in a deep marine environment followed by transition to submarine volcanism in a shallow marine environment, collision with Honshū, assimilation to continental crust and terrestrial volcanism, and finally the ongoing monogenetic volcanism (itself rare in Japan). The foremost aim of our Geopark is to provide knowledge about the process of evolution of the earth's crust through our geological heritage.

The second contribution is the value system of living in a geologically active location, the utilization of geological heritage, and advanced disaster mitigation initiatives.

The people of Izu have used volcanic gifts such as hot springs, horseradish plantations that use the abundant springwater of the central Amagi mountains, and the spectacular natural scenery of seaside cliffs as an economic base for local society. But on the other hand, Izu has suffered from serious natural disasters. Earthquakes and volcanic eruptions due to ongoing crustal motion, flooding and landslides due to heavy rainfall and steep terrain—these are some typical examples of natural disasters in this region. A Geopark in this area is therefore a tool for raising natural hazard awareness among locals, by extending understanding of nature and the cause of natural hazards. Several structures such as a flood bypass channel in a flood-prone river, a massive tidal surge lock-gate with an observation facility, and volcanic activity observation apparatus, are all used in Izu geotours.

We believe that by promoting our region as a Geopark, and by communicating local efforts to use the benefits of nature and respond to natural hazards we can reach out to people who suffer from similar disasters and share useful information.

The third contribution is that at our geopark there are ongoing efforts for sustainable development driven by local society.

Whatever landscape appears before our eyes has a special meaning, and the world appears a different place when we are able to understand the deeper significance of our everyday experiences. The local people of the Izu peninsula have started to feel a sense of wonder through knowing more about their Geopark, and learning about the earth in the process. The Geopark allows local inhabitants to re-evaluate the landscapes they are naturally familiar with, and Geopark activities have begun to communicate the heritage of Izu to visitors and future generations. The Geopark contributes to a deeper sense of pride among local people, and Geopark activities are successfully cultivating a common resolve to develop Izu in a sustainable way, paying close attention to the characteristics of the land and preserving cultural traditions that stretch back generations.

Yasunari Kawabata, the Nobel Prize winning author, described Izu as 'a huge park in itself'. We, as Izu Peninsula Geopark, will continually strive to develop this 'huge park' in a sustainable manner.

Then, we will share the experiences and knowledge gained through the above efforts to the Geopark network and aim to further increase the value of Geopark.

Opening lines from "Introduction to Izu" by Yasunari Kawabata

People say Izu is a land of poets.

Historians say Izu is a miniature of Japan.

I add: Izu is a land resembling the south.

Izu is an art gallery that has every possible landscape of mountains and sea in its possession.

The whole Izu Peninsula is one large park...

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