Aso is alive!

A journey across time and space, experiencing the land of Aso and the lives of those who live in the Gigantic Caldera.

ASO GeoPARK

Application for membership in the Global Geoparks Network

Aso Geopark Promotion Council
JAPAN

A member of Japanese Geopark Network

ASO GeoPARK

CONTENTS

IDENTIFICATION OF THE AREA

1-1 Name of the proposed geopark

Aso Global Geopark

The name ‘Aso’ is derived from the park’s symbolic attraction, Aso Volcano.
The Geopark has been a member of the Japan Geopark Network since 2009.

1-2 Surface area, physical and human geography characteristics of the proposed Geopark

1-2-1 Geomorphology

The Geopark is situated on the Japanese archipelago, which is part of an arc-shaped archipelago off the eastern coast of the Eurasian continent. Viewed from a global perspective, the Japanese archipelago sits on a continental margin, at the junction between continental plates and oceanic plates. The entire Japanese archipelago is located on a mobile belt from the Quaternary period. Situated mid-latitude in the Northern Hemisphere, the islands belong to a temperate monsoon zone, with relatively mild weather and four clear seasons.

As is visible in Fig.1-1, the core areas of the world’s continents consist of stabilized continents and orogenic zones predating the Paleozoic eras, while the peripheral areas, including the Japan Islands, consist of newer orogenic zones. Moreover, distribution of land and sea and major landforms is estimated by plate tectonics. The Japanese archipelago is located in a subduction zone, where the Pacific and Philippine Plates slide beneath the Eurasian and North American Plates; this is clearly illustrated by the presence of features such as the Japan Trench. Such mobile belts are known to be sites of frequent earthquake activity as well as active zones of Quaternary volcanism.

The Geopark is situated in the center of Kyushu, the westernmost of Japan’s four main islands. The park covers a total land area of 1,198 square kilometres and encompasses one city, four towns, and three villages (the city of Aso, the towns of Minami-Oguni, Oguni, and Yamato [formerly Soyo], and the villages of Ubuyama, Takamori, Minami Aso, and Nishihara)

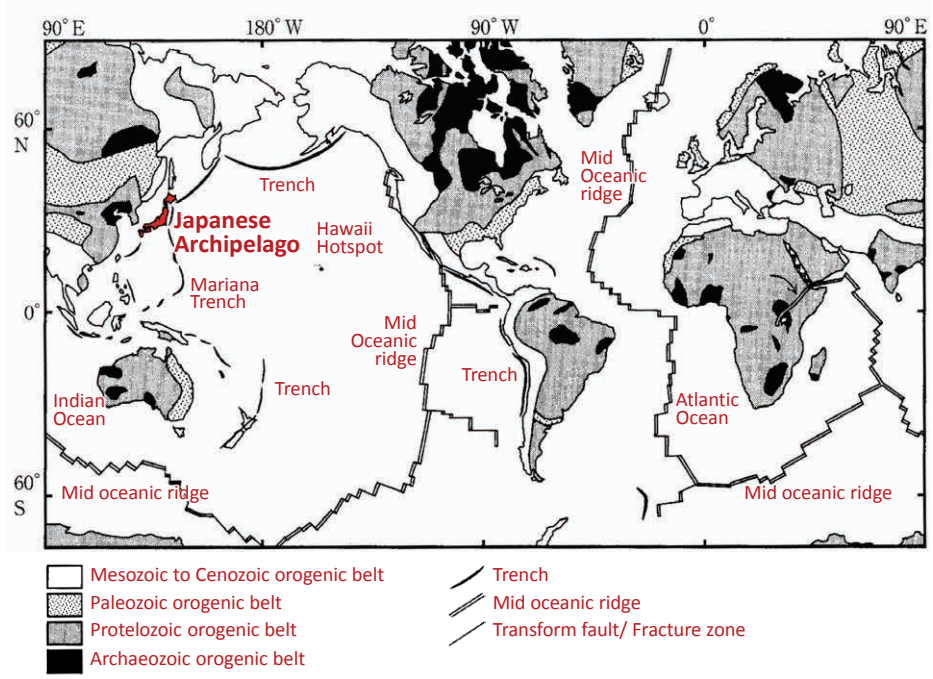


Fig. 1-1 Location of Japan among the world (Nishimura, 2006)

Fig. 1-2 Location of Aso Geopark

The eight municipalities are the most effective administrative district to control Aso Geopark. and provided endowment to Aso Geopark's operational body, Aso Local Development Design Centre Foundation (ASODC), which develop the entire area of Aso Caldera.

The district is located about 900 kilometres from Tokyo and can be reached from there by airplane in approximately one-and-a-half hours. It is about 150 kilometres from Fukuoka, Kyushu's biggest city, and takes about two and a half hours by car from there. The Aso Caldera comprises the core of Aso Geopark.

1-2-2 Aso Geopark's Unique Features

The central features of the proposed Geopark are its giantic caldera (18 km x 25 km) and the craters inside it, which include one of the most active volcanoes in Japan.

Global Geoparks with calderas include Batur Geopark in Indonesia and Toya Caldera and Usu Volcano Geopark in Japan. However, while lakes cover the inside of the calderas in these Geoparks, Aso Caldera's floor is largely dry. For that reason people are able to live in and explore the caldera, observing close-up its volcanic formations and diversity of geological features. The caldera has a good transportation network, with two railway lines and many roads. Visitors can view the caldera from any angle and easily observe its geological features and history. The active crater is accessible by buses, ropeways and cars, allowing visitors to look inside the crater basin. Aso Geopark is further differentiated from Unzen Volcanic Area Geopark and other Geoparks with active volcanoes by its main themes: the giant caldera formed by super eruptions, the active crater, and the coexistence of humans with the volcano.

Fig. 1-3 Bird's eye view of Aso Caldera

1-2-3 Topography and climate

Aso Geopark's most outstanding feature is the gigantic caldera and vast pyroclastic plateau formed by a super eruption that occurred about 90,000 years ago. The slopes of the central cones inside the caldera are extremely precipitous, and for this reason climbing in the area of Mt.Takadake, the highest peak, requires special equipment. On the other hand, the gently hilly region surrounding the caldera is well suited to tourism and various types of production activities, as is the caldera floor. The somma is made up of precipitous cliffs, which form the inner walls of the caldera, and the outer slopes of the caldera, formed by an almost flat pyroclastic plateau.

Humans have long lived both inside and outside the caldera. Today 70,000 residents carry out their daily lives and unique culture within Aso Geopark. However, the still-active crater and periodic collapse of the caldera walls due to heavy rainfall continue to bring disaster to these human communities.

Aso is located 400 meters above sea level and has an average temperature of 13 degrees Celsius, with annual rainfall of 3,000 mm. Compared to neighboring areas the region is relatively cool and wet (Fig.1-4).

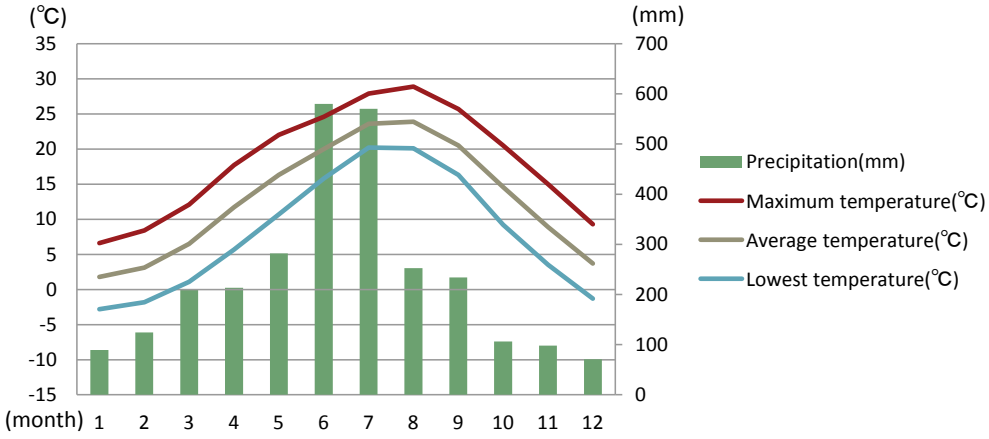


Fig. 1-4 Temperature and rainfall distribution of Aso City

1-2-4 Ecological characteristics of relic vegetation

The yearly cycle of seasons at Aso begins with the spring burning of the grasslands, called "noyaki," which takes place in March. Soon after, Kyushu Azaleas (Fig.1-5 *Miyama Kirishima*) and lilies of the valley (*Suzuran*) burst into bloom. In summer the grasslands are vibrant green, and in fall a sea of clouds formed by fog that accumulates inside the caldera rolls over the shimmering Japanese silver grass. In winter, hoarfrost can be seen in the central cones zone. Even for Japan, the progression of the four seasons is particularly dramatic in Aso.

Relic vegetation from the Asian mainland, vegetation from regions further north, and vegetation belonging to the ancient Sohayaki element can all be widely observed in Aso Geopark. Some of this vegetation does not exist anywhere else in Japan. Many of the plants are adapted to a cool climate and grassland environment, which disappeared from most other parts of Japan when the climate changed following the last ice age. This relic vegetation has survived in Aso until the present day due to the area's cold upland climate, the effect of the active volcano, and agricultural activities such as burning, grazing, and grass harvesting that have preserved the grasslands.

Vast grasslands

Aso's grasslands have long been maintained by humans through regular burning, grazing and harvesting of meadow plants, which prevented succession to forest. The resulting 22,000-hectare semi-natural grassland is the largest in Japan.

The grasslands and their livestock have a long history. They are mentioned in a historic document from 967, which indicates they have been managed for at least 1,000 years. The cattle grazed in the area are mainly indigenous Japanese Brown Cattle, rather than the more common Japanese Black Cattle. Each spring farmers work together to burn the entire caldera area as a single unit, turning the landscape black. This important agricultural practice protects the land from diseases and pests, as well as from succession to forest. Aso's grasslands and their management are registered as a Globally Important Agricultural Heritage System (GIAHS), which is an initiative of the Food and Agriculture Organization of the United Nation (FAO).

Volcanic wildlands and broadleaf native forest

In the area around the Nakadake Crater in the central cone, only vegetation that can tolerate volcanic gasses, such as Japanese knotweed (*Itadori*) and Japanese sedge (*koiwakansuge*), is found. The landscape is desert-like and wild. Because of the rough, difficult-to-access topography, parts of the area are untouched and covered in native plants.

Fig. 1-5 Miyama kirishima

Fig. 1-6 Sea of clouds fills up Aso Caldera!

1-2-5 History and culture

Ninety thousand years ago, a super eruption destroyed the natural ecosystems around Aso Volcano. However, they slowly recovered. Remains of Stone Age settlements dating back at least 30,000 years have been found on the peaks surrounding the caldera. Gradually, humans moved down to the caldera floor. However, arable land is believed to have been limited due to the rugged natural conditions in the caldera and the presence of a vast marsh.

As a result, primitive industries such as metal forging and paint production using local materials such as limonite developed in the caldera floor communities before agriculture.

Full-scale development of the caldera floor started after the third century AD. In the early seventh century, Aso Volcano was mentioned in the Book of Sui, a Chinese historiography – the first instance of a Japanese volcano being mentioned in a foreign document. The people of Aso traditionally worshipped the volcano and developed a variety of folk events related to Takeiwatasu-no-mikoto, the pioneer deity of Aso. Those events and rituals are still carried on today. Aso has also attracted many literary figures, who created works inspired by the magnificent volcanic topography and vast grasslands.

In 1934 the area centering around the Aso caldera was certified as Japan's first National Park. The park will celebrate its 80th anniversary in 2014.

Fig. 1-7 Nakadori burial mounds, the fifth Century AD.

Fig. 1-8 Unique agricultural rituals in Aso Shrine

1-2-6 Population, economy, transport

The population of the proposed area is about 70,000, which represents about 3.8% of the population of Kumamoto prefecture, where the park is located. According to past census data, population peaked at 115,000 in 1955 and has been declining since.

Tertiary industry dominates the region's economy, as is common throughout Japan. However, compared to the national average, agriculture and forestry comprise a comparatively high percentage of the local economy, with 20% of the work force employed in primary industry. Livestock raised on the grasslands and cool-climate vegetables are the main agricultural products. Gross agricultural output is 29 billion Japanese yen. About half of this, 13 billion Japanese yen, is from the grasslands-based livestock business.

Mt. Aso and its somma are designated by the Japan Travel Bureau as a special A-level tourism resource, the only such area in Kyushu. Approximately 17 million tourists visit annually, the highest rate in Kumamoto Prefecture. 1 million visitors stay in local accommodations and about 200,000 visitors are from abroad. Tourists are increasing yearly.

Kumamoto airport, located near Aso Geopark, offers excellent flight routes, including 21 roundtrips per day to Tokyo and 10 to Osaka. There is also a regular flight to Seoul used by three million people each year.

Fig. 1-9 Nangodani Valley of Aso Caldera

Roads and railways

Route 57, which traverses the caldera floor from east to west, is the region's main road, with other roads branching out from it. Access is good from Kumamoto, the prefectural capital (approximately one hour by car), and Fukuoka, the biggest city in Kyushu (two hours by car). The public transport network is made up of two railways, which run parallel to national roads in the north and south. Local residents and tourists can also take loop line local buses.

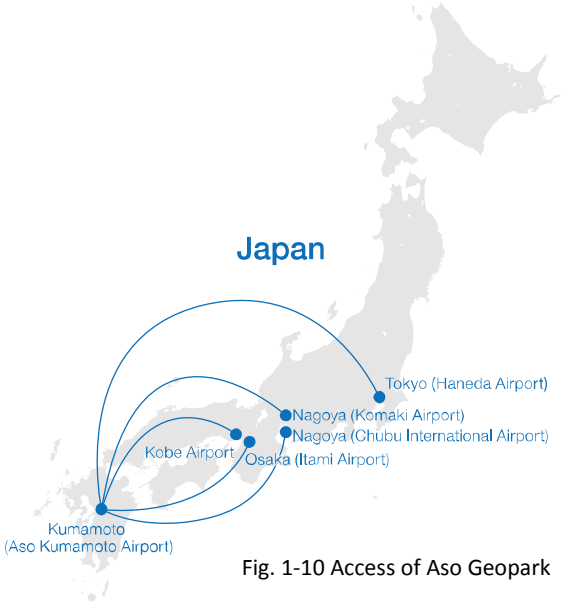


Fig. 1-10 Access of Aso Geopark

Access to Aso Geopark from outside of Kyushu, Japan

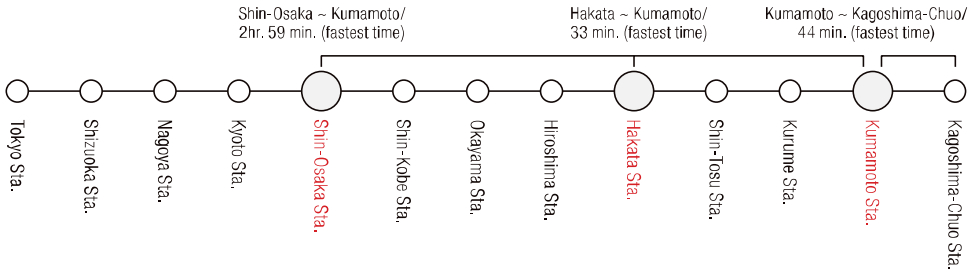
By air

Tokyo (Haneda Airport)	← 1hr. 30 min.~2hr. →	Aso Kumamoto Airport
Nagoya (Komaki Airport)	← 1hr. 15 min.~1hr 25 min. →	
Nagoya (Chubu International Airport)	← 1hr. 10 min.~1hr 25 min. →	
Osaka (Itami Airport)	← 1hr.~1hr 10 min. →	
Kobe Airport	← 1hr.~1hr 5 min. →	

Highway express bus

The Sunrise Kyoto Station Hachijo Exit	← 11hr. 49 min./ 1 round trip a day. →	Kumamoto Bus Terminal
The Sunrise Osaka Station (Higashi-umeda)	← 9hr. 57 min./ 1 round trip a day. →	
The Shiranui Meitetsu Bus Terminal	← 11hr. 9 min./ 1 round trip a day. →	

Shinkansen



Access to Aso Geopark from each prefecture in Kyushu

Railway

From Fukuoka City

Hakata Sta. — Kumamoto Sta. — Tateno Sta. — Aso Sta.
(Kyushu Shinkansen 33 min. or more; Hohi Line/ limited express approx. 43 min.; Hohi Line/ limited express approx. 24 min.)
Tateno Sta. — Takamori Sta. (Minamiaso Railway - approx. 30 min.)

From Saga City

Saga Sta. — Shin-Tosu Sta. — Kumamoto Sta. — Tateno Sta. — Aso Sta.
(Nagasaki Line/ limited express approx. 14 min.; Kyushu Shinkansen approx.25 min.; Hohi Line/ limited express approx. 43 min.; Hohi Line/ limited express approx. 24 min.)
Tateno Sta. — Takamori Sta. (Minamiaso Railway - approx. 30 min.)

From Nagasaki City

Nagasaki Sta. — Shin-Tosu Sta. — Kumamoto Sta. — Tateno Sta. — Aso Sta.
(Nagasaki Line/ limited express 1 hr. 32 min.; Kyushu Shinkansen approx. 25 min.; Hohi Line/ limited express 43 min.; Hohi Line/ limited express 24 min.)
Tateno Sta. — Takamori Sta. (Minamiaso Railway - approx. 30 min.)

From Oita City

Oita Sta. — Bungo-Takeda Sta. — Aso Sta.
(Hohi Line/ limited express 1 hr. 3 min.; Hohi Line/ limited express 42 min.)

From Miyazaki City

Miyazaki Sta. — Shin-Yatsushiro Sta. — Kumamoto Sta. — Tateno Sta. — Aso Sta.
(Highway Express Bus"B&S Miyazaki" approx. 2 hr. 10 min.; Kyushu Shinkansen 11 min. or more; Hohi Line/ limited express approx. 43 min.; Hohi Line/ limited express approx. 24 min.)
Tateno Sta. — Takamori Sta. (Minamiaso Railway - approx. 30 min.)

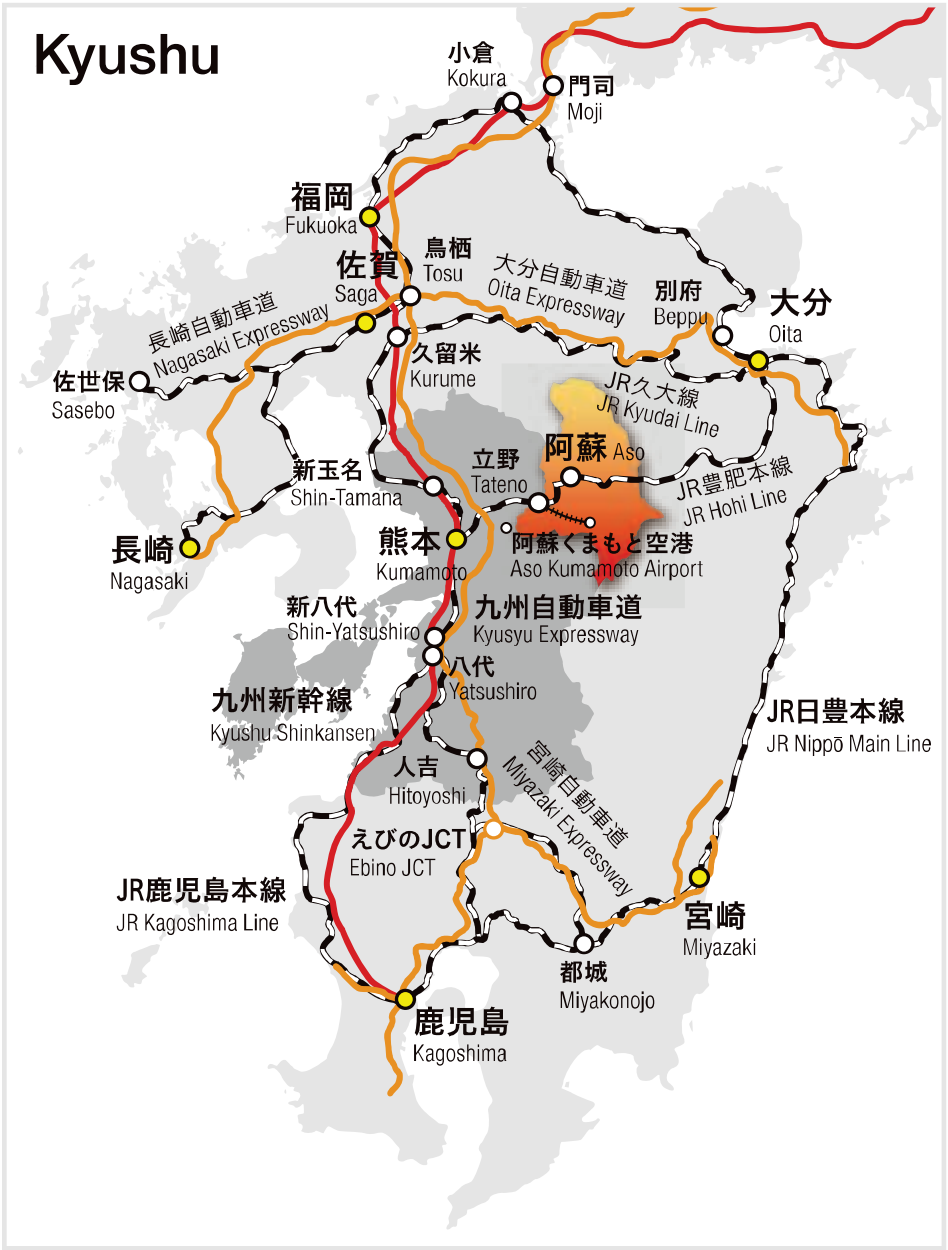
From Kagoshima City

Kagoshima-Chuo Sta. — Kumamoto Sta. — Tateno Sta. — Aso Sta.
(Kyushu Shinkansen 43 min. or more; Hohi Line/ limited express approx. 43 min; Hohi Line/ limited express approx. 24 min.)
Tateno Sta. — Takamori Sta. (Minamiaso Railway - approx. 30 min.)

Highway Express Bus

From Fukuoka City	approx. 1 hr. 44 min./ 100 round trips a day	Kumamoto City	Approx. 1 hr. 40 min. → Aso Sta.
From Kitakyushu City	approx. 3 hr./ 6 round trips a day	Kumamoto City	
From Nagasaki City	approx. 3 hr. 22 min./ 8 round trips a day	Kumamoto City	
From Miyazaki City	approx. 3 hr. 14 min./ 14 round trips a day	Kumamoto City	
From Oita City	approx. 2 hr./ 10 round trips a day	Aso Sta.	

※Access by regular route bus.



1-3 Oversight organization and management structure of the proposed Geopark

1-3-1 Organization and Management

The Aso Geopark Promotion Council was established in May 2009. Its aims are to preserve and research the region's valuable topography and geology by working together with public and private entities, as well as to contribute to the local community by developing an appropriate environment for education and geo-tourism.

Council members

The Council is made up of representatives from local municipalities (Fig.1-11), as well as educational, research, tourism, environment and economic organizations that share our aims and support our activities and projects. Council members deliberate important issues at general meetings.

Administration

Administrative meetings to deliberate measures and policies are organized by representatives from the local municipality or from other groups centrally involved with various council activities. .

Advisers

The council commissions experts in volcanology, as well as members of the Environment Ministry, Ministry of Land, Infrastructure, Transport and Tourism and national and prefectural governments, to give advice on Aso Geopark's strategies and activities. Curators at the Aso Volcano Museum contribute actively to related academic fields.

Expert Committee

Fully understanding the value and potential of Aso Geopark requires input from experts in a broad range of fields, not only volcanic geology. The Expert Committee is made up of scholars from various fields doing research in the Aso region, as well as disaster prevention experts and a representative from the Japan Geopark Committee. The Committee offers advice on Aso Geopark's activities and strategies.

Promotion Office

Aso Geopark Promotion office is part of the Aso Local Development Design Centre Foundation (ASODC), a public interest incorporated foundation. ASODC was jointly established by eight municipalities with an endowment of three billion Japanese yen, with the mission of integrally promoting the entire Aso Caldera. The foundation is a joint public-private venture that funds its operations with income from investments such as government bonds.
ASODC staff work on a wide range of projects related to Aso Geopark. One ASODC staff and two specialised staff are fully focused on these projects, with other ASODC staff also supporting Geopark operations.

In order to most effectively build and carry out the park's strategic plan, a branch office housing the Aso Geopark Promotion Council was established in October 2011 inside the Aso Volcano Museum, located in the central cone area. The two full-time specialised staffs divide their time between this office and at the ASODC main office as necessary. Please refer to Fig.1-12

1-3-2 Sponsours

Aeon Group, one of Japan's largest retail companies, has made an arrangement with ASODC to donate a portion of income from purchases made with electronic money cards to a fund used for grassland regeneration projects in the Aso area. Suntory Beverage Service Limited also donates income from its vending machines. While these funds are currently limited, they are gradually increasing.

Aso City has created the 'ASO Environmental Symbiosis Fund' for maintenance and conservation of the regional natural environment for future generations. The fund focuses on children's education, protection of rare wild plants, and nature regeneration projects on Mt. Aso, and is financed with donations from individuals, businesses, and other organizations. Over 1,422 donors have contributed a total of more than 35 million Japanese yen. These activities contribute to the sustainable conservation of regional resources.

1-3-3 Budget

Breakdown of income of Aso Geopark Promotion Council is management gains and income from other sources. This income is separate from that provided by annual municipal budgets and is a sustainable source of funding. The council also receives subsidies and other financial contributions from the national and prefectural governments. Total annual income for 2013 was 32.5 million Japanese yen ($325,000).
Its detail can be found in Annex.

The council collaborates on physical infrastructure projects including signboards with Kumamoto's prefectural government, the Environment Ministry, which oversees Japan's national parks, and the Ministry of Land, Infrastructure, Transport and Tourism, which promotes tourism strategies.

1-4 Application contact person (name, position, address, tel/fax, e-mail)

Name: Mr. Akinobu Ishimatsu
Position: chief staff
Address: 1F Aso Volcano Museum, 1930-1 Akamizu, Aso City, Kumamoto, Japan
Tel: +967-34-2089
Fax: +967-34-2090
E-mail: info@aso-geopark.jp

Aso Geopark Promotion Council

Chair Advisory Body

Expert Committee

Chair

Established in 2009

Mr. Yoshioki Sato,

Mayor of Aso City

Advisers

- Dr.Kazunori Watanabe, Emeritus Professor, Kumamoto University
- Chief of Aso Natural Environment Office, Kyushu Regional Environment Bureau, Ministry of the Environment
- Head of Cultural World Heritage Promotion Office, Regional Cultural Promotion Bureau, Kumamoto Prefecture Promotion Department
- Head of Tourism Section, Tourism Environment Intercommunication Bureau, Kumamoto Prefecture Commerce Department
- Deputy Director of the Kumamoto Local Meteorological Observatory

Administration

Research

- Aso Volcano Museum
- Kumamoto University
- Aso Volcanological Laboratory Institute for Geothermal Sciences Graduate School of Science, Kyoto University
- Kumamoto Geosciences Association
- Kumamoto Geotechnical Consultants Association

Education

- Aso Eco Tourism Association National Aso Youth Friendship Centre
- Aso Den'en Kukan Eco Museum office
- Aso Museum
- Namino Plateau Yasuragi
- Recreation and Rest Centre Aso Nature Guide Association
- Aso Tanibito Eco Museum
- Aso Park Volunteers Association

Tourism

- Aso City Tourism Association
- Minami-Oguni Town Tourism Association
- Oguni Tourism Association
- Ubuyama Village Tourism Association
- Takamori Town Tourism Association
- Minami-Aso Village Tourism Association
- Yamato Town Tourism Association

Environment

- Aso Nature Conservation Group
- Natural Parks Foundation Aso Branch
- Aso Green-Stock Foundation
- Aso Local Development Design Centre Foundation (ASODC)

Economy

- Aso Junior Chamber of Commerce
- Kumamoto 21
- Japan Limonite Co., Ltd

Government

- Kumamoto Prefecture Aso Regional Promotion Bureau
- Aso City
- Minami-Oguni Town
- Oguni Town
- Ubuyama Village
- Takamori Town
- Minami-Aso Village
- Nishihara Village
- Yamato Town

Operation

Aso Local Development Design Centre Foundation (ASODC)

Fig. 1-11 Member of Aso Geopark Promotion Council

Aso Geopark Promotion Council Operational Structure

Operational Body
Aso Local Development Design Centre Foundation (ASODC)
Public Interest Incorporated Foundation

Manager Mr. Keita Kunitani

Regional Development Project

Tourism Promotion Projects

Environment and Landscape Preservation Project

Communications Project

ASO DC Staff

Mr. Seiki Eto
Mr. Kazuaki Korogi
Mr. Akinobu Ishimatsu
Mr. Sou Setsuda
Ms. Mie Tsue

Aso Geopark Promotion Office
Full-Time Specialized Staff
Mr. Akira Katayama
Ms. Mariko Yamauchi

Aso Geopark Operation

Manager Mr. Keita Kunitani
Role: General Management

Mr. Akinobu Ishimatsu
Role : Government, Municipal Collaboration, Marketing

Aso Geopark Promotion Office
（Branch in Aso Volcano Museum）

Mr. Akira Katayama
Role : Education, Tourism, Administration

Ms. Mariko Yamauchi
Role : Press , Networking, Geoguides Management

Aso Geopark Guides Association Office

Aso Volcano Museum
（Volcanology Research Department）

・Director : Mr. Shin'ichiro Ikebe(Doctorate of Science)
・Three Academic Advisers（Doctorate of Science）
・Three Curators
（Doctorate of Science x2, Master of Agriculture x1 ）

Aso Geopark Research Organization

Aso Geopark Expert Committee
（Academic Research Body）

Animals: Mr. Toshiki Oka
Board Member, Aso Nature Guide Association
History /Folklore: Ms. Seiko Sato
Committee Member, Council for the Protection of Cultural Properties
Archeology : Mr. Yoshiaki Shimazu
Lecturer, Art Department, Sojo University
Plants : Mr. Sumio Sei
Board member, Aso Wildflower Association / Former Principal, Nakahara Elementary School, Minami-Oguni Town
Water : Mr. Nobuhiro Tanaka
Special Advisor on Groundwater Conservation, Kumamoto Prefecture
Disaster Prevention : Mr. Noriyuki Minami
Specially Appointed Professor, Research Faculty of Agriculture, Hokkaido University / Former Sediment Control Department Manager
Geopark : Mr. Setsuya Nakada
Professor, Earthquake Research Institute , the University of Tokyo/ Committee Member, Japan Geopark Network Committee(JGC)

Kumamoto University
Member of Aso Geopark Promotion Council
(Academic Field)

Fig. 1-12 Operational structure of Aso Geopark Promotion Council

GEOLOGICAL HERITAGE

2-1 Location of the proposed Geopark

Aso Geopark is situated at 32°N, 131°E, on the island of Kyushu in the Japanese archipelago, which is located in the Circum-Pacific orogenic belt. The park is home to Aso Caldera, the most notable landform of its type in Japan. In the center of the caldera is a cone group of 18 mountains, including the active Nakadake crater, which erupts once every few years to few dozen years. The caldera measures 25 kilometres from north to south and 18 kilometres from east to west. The circumference of the somma is more than 100 kilometres, and the caldera walls have a relative elevation of between 300 and 600 meters.

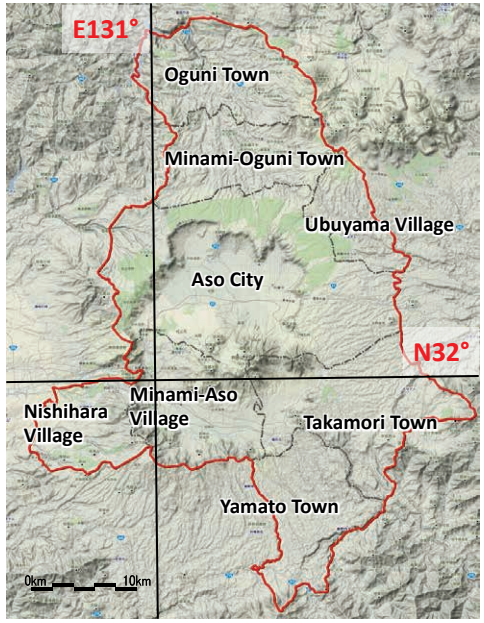


Fig. 2-1 location of Aso geopark

This gigantic collapse caldera was formed by four super pyroclastic eruptions that took place approximately 270,000 to 90,000 years ago. The fourth super eruption, 90,000 years ago, was Japan's largest in the past 100,000 years. Its eruption volume totaled 600 cubic kilometres. The volcanic ash spewed into the air and rained down over the entire Japanese archipelago. Fifteeen-centimeter-deep deposits can be observed in eastern Hokkaido, 1,700 kilometers from Aso Caldera.

Today, the region's beautiful, clearly formed caldera topography and its central cone group are important elements of Japan's geological heritage. The easily accessible Geopark offers a unique opportunity for visitors to observe the topography of a typical caldera formed by a super eruption.

2-1-1 Aso's unique location with the volcanic Japanese Islands

The Japanese archipelago is situated on mobile belt encircling the Pacific Ocean, west of the Ring of Fire.

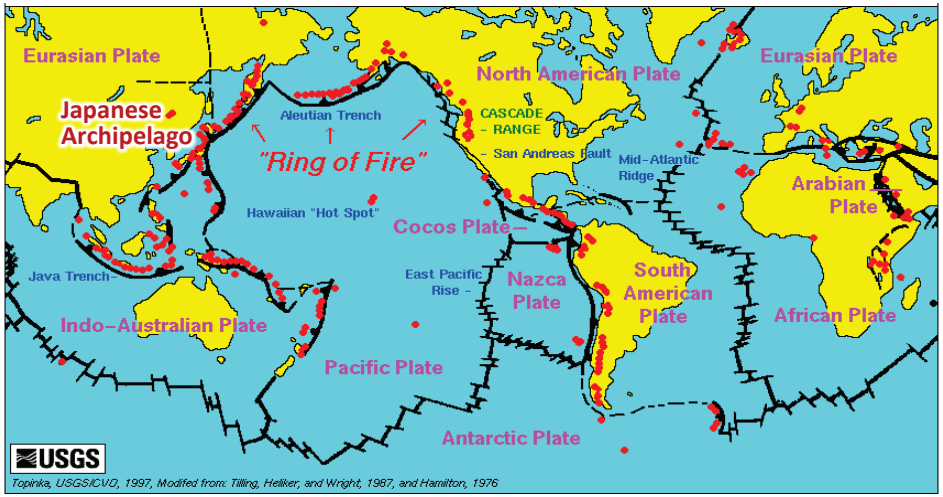


Fig. 2-2 Active Volcanoes, Plate Tectonics, and the "Ring of Fire" (USGS)

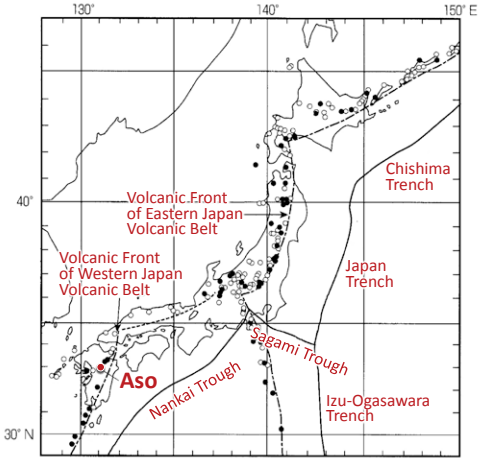


Fig. 2-3 Distribution of volcanoes in Japan (Takagi, 2012)

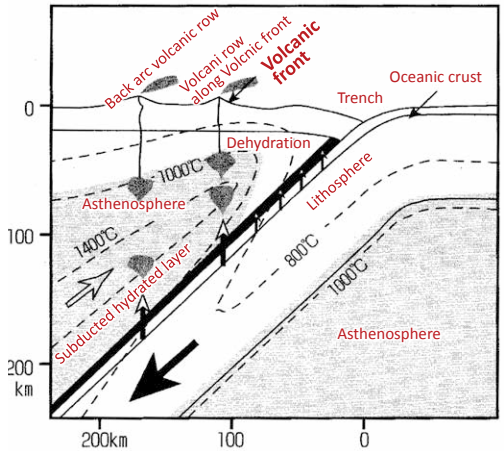


Fig. 2-4 Conceptual diagram of magma formation in Japan (Takagi, 2012)

2-1-2 Plate boundaries and motion in Japan

The Japanese archipelago consists of four main islands aligned north-to-south and surrounded by smaller islands. Kyushu, where Aso Geopark is situated, is the southernmost of the four islands. It is located on the Eurasian Plate, which is bordered to the southeast by the Philippine Sea Plate. Magma is believed to form when the Philippine Sea Plate is subducted beneath the Eurasian Plate. Fig. 2-5 shows the regional stress field, related to plate subduction, that exists between the Kii Peninsula, in the Kinki region, and Kyushu. Between the Kinki and Chugoku regions is a compressive field aligned from northwest to southeast, whereas Kyushu is situated in an extensional region coming from the north-south direction. For that reason, a rift zone related to the collapse structure and running from east to west has developed there. Most of the Japanese archipelago is believed to sit in a compression field from the Pacific, but Kyushu is an exception.

Aso Caldera is located in an area known to have a rift structure with a collapsed base that runs in an east-west direction (Matsumoto, 1974; Okada, 1993). This structure has impacted the formation of a volcanic array in the region. A number of active volcanoes on the island of Northern Kyushu are located within the rift.

Aso Caldera is situated on a geotectonic line that runs from Oita to Kumamoto and marks the southern border of the rift (Takagi et al., 2007). It has been observed that when the southern portion of Kyushu slides to the west, pull forces act in the north-south direction at the same time, creating a right-lateral fault that opens from north to south.

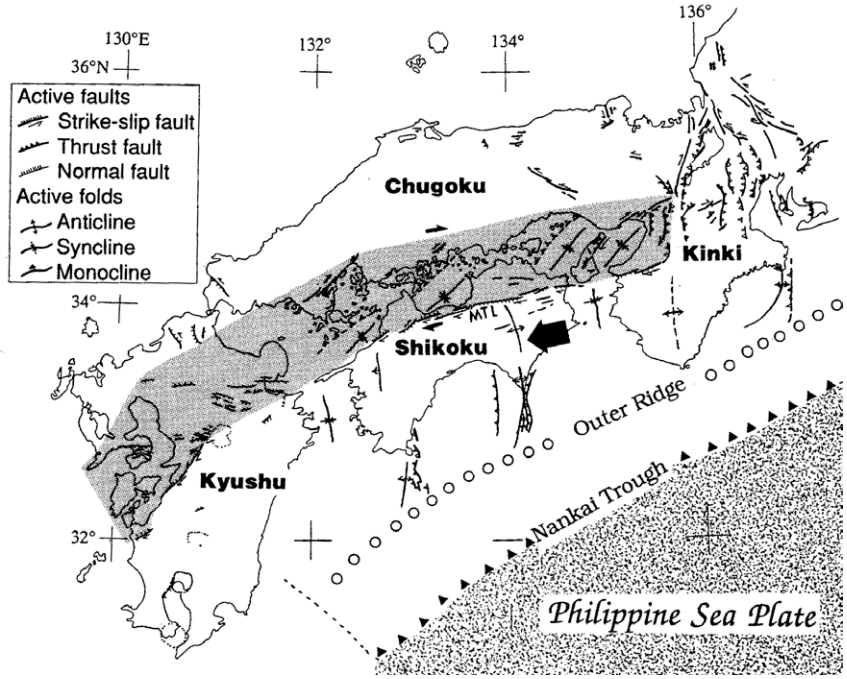


Fig. 2-5 Regional stress field between the Kii Peninsula and Kyushu (Tsukuda, 1993)

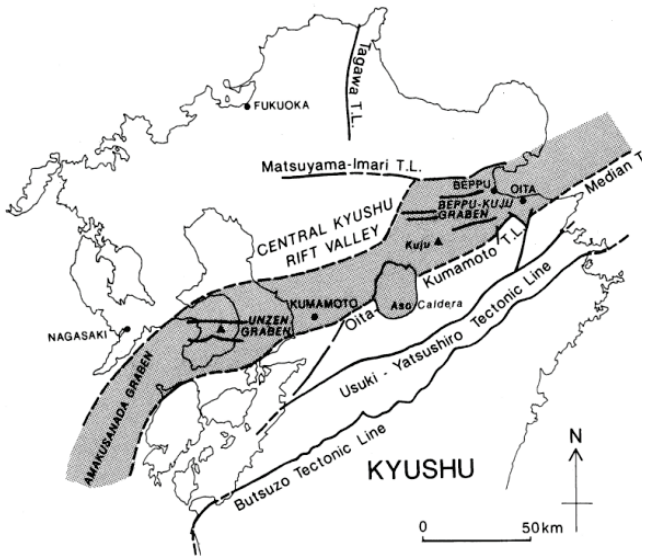


Fig.2-6 Central Kyushu Rift Valley and main geotectonic lines (Okada, 1993)

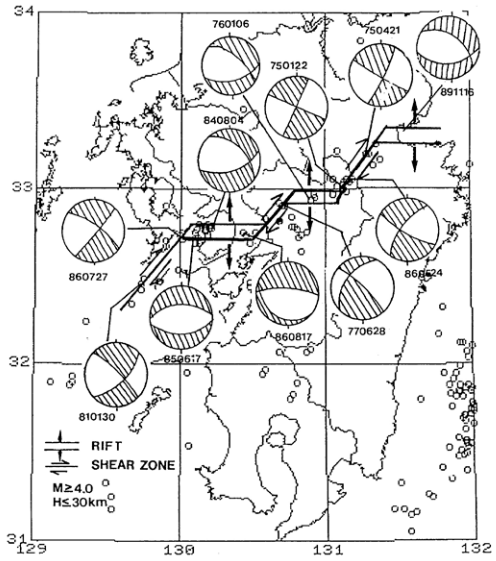


Fig.2-7 Rift structure between Beppu and Shimabara, and earthquake focal mechanism (Tada, 1993)

2-1-3 Unique location of Aso caldera

Aso Caldera is situated along a volcanic front in the western Japan volcanic zone. There are two active volcanic lines in Kyushu. One runs from Yufudake, in Oita Prefecture, through the Kuju volcanoes and Aso Caldera, and on to Fugendake in the Mt. Unzen volcanic group, which is part of the Unzen Volcanic Area Global Geopark. The second active volcanic line runs from Aso Caldera to Sakurajima in the Kirishima volcanic group, and then on to the Ryukyu Islands.

Fig.2-8 Distribution of volcanoes in Kyushu

The former is characterized by dome-shaped volcanoes made of hornblende andesite, while the latter is characterized by andesite volcanoes and large calderas of felsic magma, which have very different shapes from the former. Aso Caldera sits at the intersection of the two volcanic lines, directly on top of the Oita-Kumamoto tectonic line, which is thought to be an extension of Kyushu's median tectonic line.

2-2 General geological description

Aso Volcano is one of the world's few great calderas, containing a volcanic group that consists of a diverse variety of volcanic topography and geology. People have been living in this volcanic area and developing a unique culture and landscape there for tens of thousands of years.

Aso Volcano is divided into four main zones based on geographical and topographical differences. The first consists of the central cones of the caldera. The second is the caldera floor. The third is the caldera wall. The fourth is the outer slope of the somma surrounding the cone group and plains.

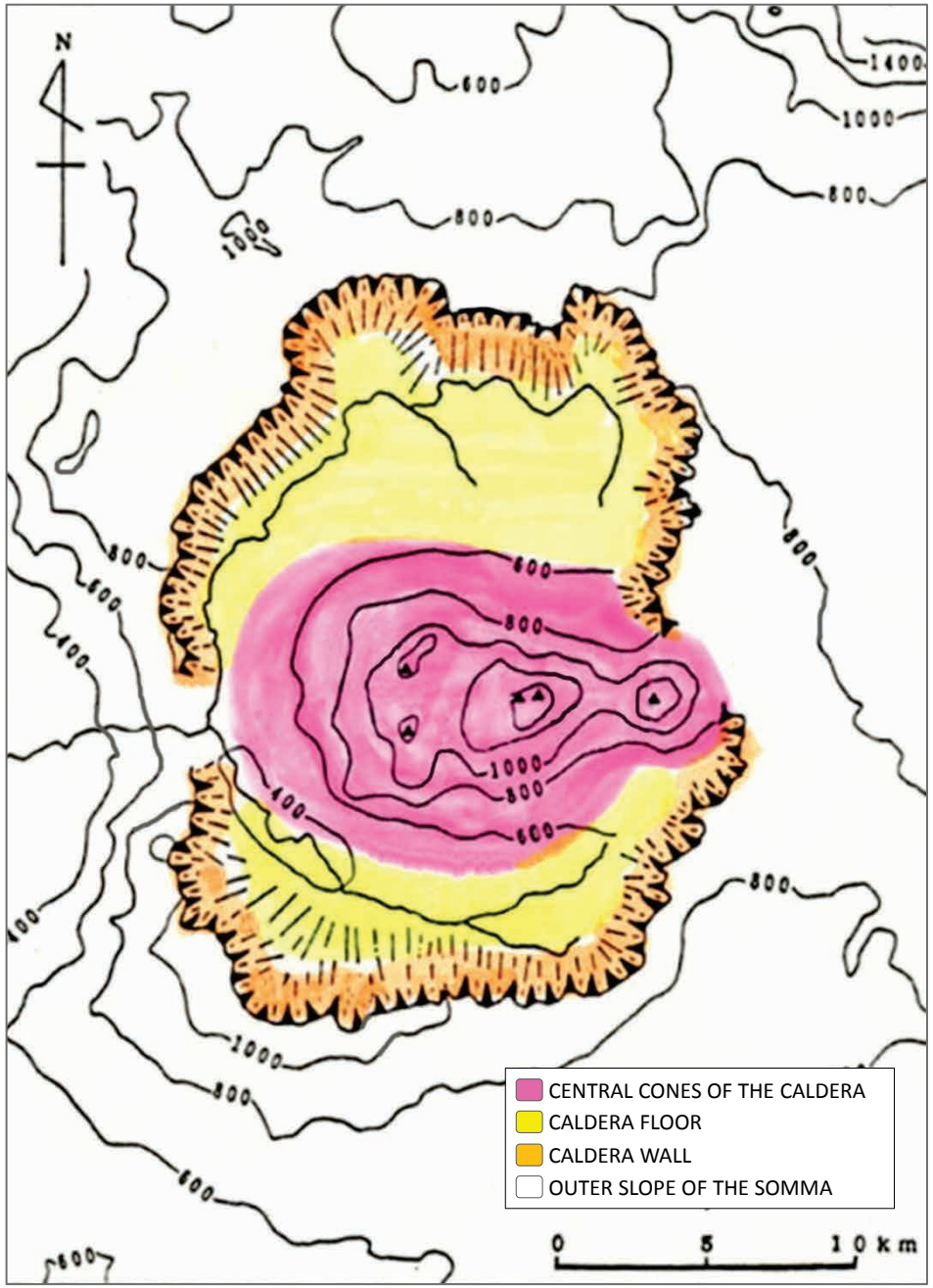


Fig.2-9 Four geographical and geological zones of Aso volcano

Aso's volcanic history

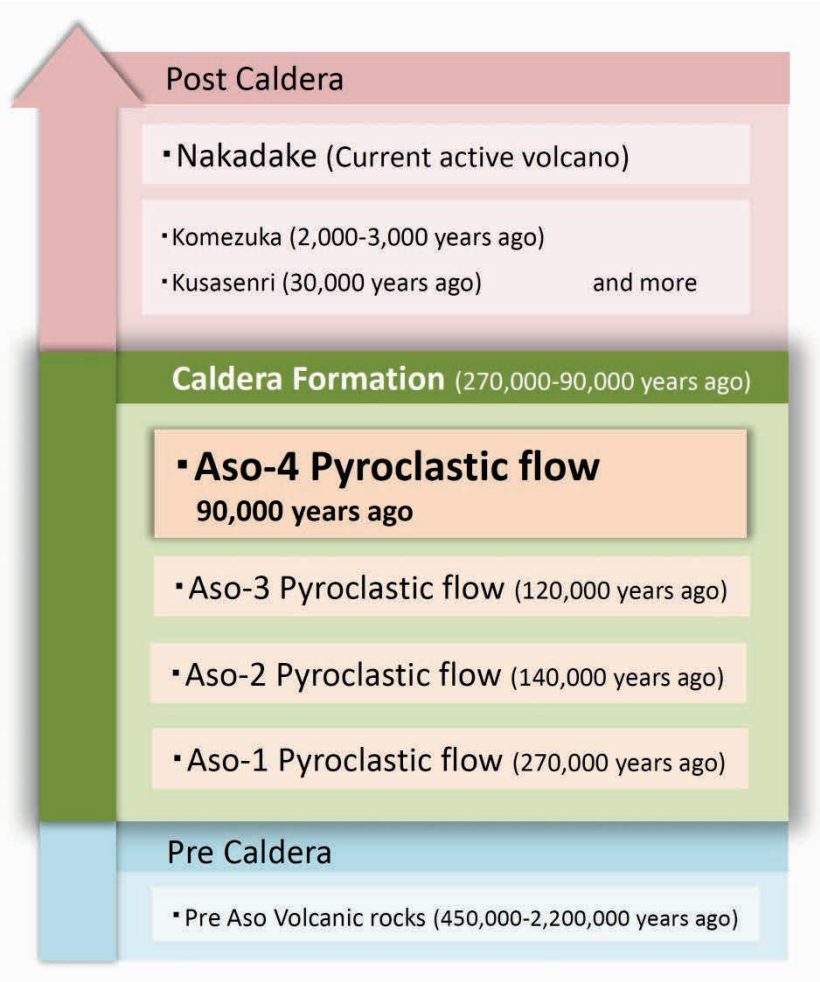


Fig.2-10 Brief history of Aso volcano

Fig.2-10 shows the brief history of Aso Volcano. Four gigantic pyroclastic flow eruptions occurred repeatedly between 270,000 and 90,000 years ago. The current caldera was formed by the fourth super eruption 90,000 years ago. Next a caldera lake formed, and after that a complex series of volcanic events inside the caldera created the current cone group. Nakadake crater remains active and is one of the most dynamic volcanoes in Japan.

2-2-1 Central cones of the caldera

The central volcanic cone group is made up of many mountains. The five main peaks are referred to as 'Aso Gogaku': Mt. Takadake (1,592 m), Mt. Nekodake (1,433 m), Mt. Nakadake (1,506 m), Mt. Kijimadake (1,321 m) and Mt. Eboshidake (1,337 m). These mountains are varied in both shape and formation period. They include stratovolcanoes (Mt. Takadake, Mt. Nekodake, Mt. Nakadake and Mt. Eboshidake), scoria cones (Komezuka), a tuff ring (Ikenokubo marr), a lava dome (Takanoobane peak) and mud volcanoes and fumarolic areas (Yoshioka, Yunotani and Jigoku). The volcanic topography, component materials and interior structures are diverse. Mt. Nekodake is older than the other volcano groups and sits outside the gravitationally collapse structure of the caldera.

The central volcanic cones have historically been among the most active in Japan, and continue to have periodic eruptions. Fumarolic activity at the Nakadake crater has occurred repeatedly, not always in conjunction with eruption periods. This has effected the vegetation within a several kilometer radius. Only certain types of shrubs and herbaceous plants are able to grow there, creating a wild volcanic landscape. Apart from the active craters, a variety of volcanic deposits, volcanic topography, unique vegetation, and aeolian landforms can be seen at the central cones. The area is an ideal place to gain a comprehensive understanding of these volcanic features.

2-2-2 Caldera floor

The caldera floor extends to the north and south of the central cone group. The northern portion of the caldera floor is called Asodani Valley, and the southern portion is called Nangodani Valley. Both are alluvial plains formed by river basins. This flat topography is believed to have formed at the same time as the caldera lake.

The caldera floor is the centre of human life in the Aso region. Many towns and villages dot the plains, and most of the land has been converted to paddies and fields. Bountiful natural springs and hot springs flow from the floor, supporting human life and providing places for relaxation and enjoyment. Peatlands and yellow soil, called Limonite, that tell of past environmental change, lacustrine deposits that reveal the story of the ancient caldera lake, and falls over the Shirakawa and Kurokawa Rivers are among the many geological sites related to water that can be observed on the caldera floor.

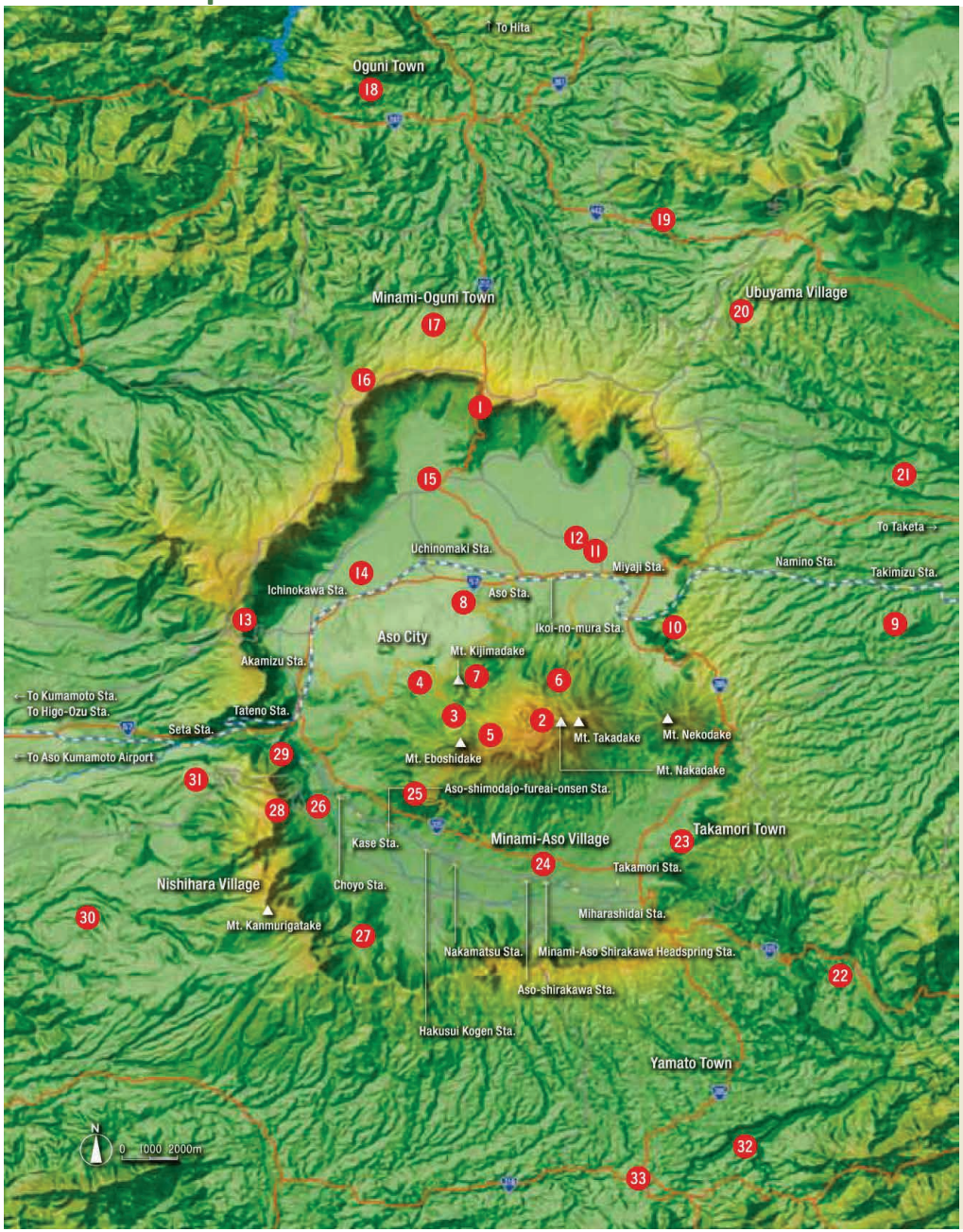
2-2-3 Caldera wall

The somma is divided into the inner caldera wall and the gentle outer slopes of the caldera, which differ in terms of their topography. The walls also differ in the north and south in terms of height, slope, diss ected levels, fun, talus, and alluvial cones. The north wall is believed to be a newer formation than the south wall. Pre-Aso volcanic rocks and pyroclastic deposits are exposed in many places on the caldera walls. They are very important geological features before the caldera formation, process of caldera formation and its period or geological changes after the caldera formation. Talus, alluvial cones and fans, which develop on the bottom of steeply- inclined caldera wall. Moreover natural springs inside the caldera wall are important geological sites for understanding topography and geological structure.

2-2-4 Outer slope of the somma

The somma is composed of gentle highlands that expand outwards from the caldera rim and include pyroclastic plateaus, hills, and undulating topography that arose primarily as a result of the formation of the caldera. The area sits in the upper reaches of the watershed of a nationally designated Class A river that runs through central Kyushu. Many exposed pyroclastic deposits can be seen in canyon walls, valley floors and riverbeds throughout the watershed. These are important sites for understanding the character of pyroclastic flows and deposits, and for studying the geological changes that took place beginning after the pyroclastic depositions and continuing up to the present day. The area also has a number of hot springs, including the so-called Jigoku or “hell” Onsen, as well as rock towers consisting of pre-Aso volcanic rocks; some of these geological sites have played an important role in people’s lives for many generations.

2-3 Aso Geopark Geosite



1. Daikambo Caldera Geosite
2. Nakadake Geosite
3. Kusasenri Geosite
4. Komezuka Geosite
5. Furubochu Geosite
6. Sensuikyo Gorge Geosite
7. Mt. Kijimadake Geosite
8. Fumotobochu Geosite
9. Mt. Ogidake Geosite
10. Koganotaki Fall Geosite
11. The Deity of the Volcano Geosite
12. Cluster of springs in Aso Valley District Geosite
13. Futaenotouge Mountain Pass Geosite
14. Aso Yellow Ocher (Aso Odo) Geosite
15. Uchinomaki Hot Spring Geosite
16. Milk Road Grassland Geosite
17. Oshito-ishi Geosite,
18. North Outer Rim Pyroclastic Flow Geosite
19. Oguni-go Area Hot Spring Geosite
20. Ikeyama and Yamabuki Geosite
21. The Sankin-kotai Road Geosite
22. Kusakabe Geosite
23. Camel mountain (Rakuda-yama) Geosite
24. Cluster of springs in Minami-Aso District Geosite
25. Jigoku and Tarutama Hot Springs Geosite
26. Nango valley Geosite
27. Mt.Rakanyama Geosite
28. Tawarayama Mountain Pass Caldera geosite
29. Tateno Gorge Geosite
30. Shiraitonotaki Falls Geosite
31. Omine Volcano Geosite
32. Soyokyo Gorge Geosite
33. Heitate Shrine Geosite

Fig.2-11 Location of geosite

Table 2-1 Geosite List

No.	Name of Geosite	Theme of Geosite	Brief Overview	Major Resources	Classify	Points
1	**Daikanbo Caldera Geosite**	Experience a world-class caldera (view from the north)	Observe and experience a world-class caldera. Appreciate the scale and impact of the eruption that formed the caldera.	caldera topography of Aso Gorge, central volcanic cone group, grasslands, kuroboku soil, pyroclastic plateau	caldera formataion	Aso Caldera
					caldera formataion	Daikanbo
					post caldera	Outcrop of Akahoya ash layer
2	**Nakadake Geosite**	Sense the activity of the earth through an active volcano.	Directly experience the workings of the earth through a still-active volcano. Learn about the region's unique topography and criffs, as well as the traditional practice of worshipping the volcano. The area features both beautiful grasslands and desolate volcanic topography, as well as various volcanic formations.	crater wall, volcanic gas, wasteland flora, surge deposits, agglutinate, intrusive rocks	post caldera	Nakadake crater
					post caldera	Sunasenri-ga-hama
3	**Kusasenri Geosite**	Grazing land and volcanic activity.	Observe unique topography formed about 30,000years ago and marsh vegetation growing on the periphery of the crater pond.	Mt. Komatate, marsh vegetation	post caldera	Kusasenri-ga-hama Mt.Eboshidake
					facilities	Aso Volcano Museum
					post caldera	Kusasenri-ga-hama lookout
4	**Komezuka Geosite**	Topography and geological features formed by a relatively new volcanic group.	Komezuka is a typical scoria cone formed about 3,000 years ago, making it one of Aso's most recent volcanoes. Observe a tunnel formed by a lava flow.	Scoria, lava tunnel	post caldera	Komezuka
					post caldera	Kami-Komezuka
5	**Furubochu Geosite**	Volcanic activity and mountain religion.	See the remains of a center of mountain religion and reflect on the way Mt. Nakadake's volcanic activity shaped human culture.	Saigandenji Temple, Mt. Aso Shrine, profile of geological strata, various remains	Non-geological	Furubochu
6	**Sensuikyo Gorge Geosite**	Rocky peak and alpine plants.	Learn about the relationship between Kyushu azalea, an alpine species, and the desolate, rocky landscape of volcanic mountains such as Mt. Nakadake, Mt. Takadake and Mt. Washigamine.	Kyushu azalea	pre/post caldera	Sensuikyo gorge Mt. Takadake, Mt.Nekodake
7	**Mt. Kijimadake Geosite**	Recent volcanic activity dating to several thousand years ago.	Like Komezuka Geosite, this is a relatively new volcano that was active 3,000～4,000 years ago. Its topographic features have not been eroded and therefore can be clearly seen.	Agglutinate, scoria, lava	post caldera	Mt. Kijimadake Mt. Ojyodake
8	**Fumotobochu Geosite**	One town's history and culture .	This town was revived by Kato Kiyomasa after Furubochu declined. Visit the many remaining temples, shrines and statues of Jizo, the guardian deitiy of children.	Jizo statues, townscape of Fumotobochu	Non-geological	Saigandenji temple
					facilities	Aso Den'en Kukan Eco museum
9	**Mt. Ogidake Geosite**	Isolated peak on the pyroclastic flow plateau.	When pyroclastic flow covered this area in ninety thousands years ago, the top part of this mountain was left exposed. Enjoy excellent views of the pyroclastic plateau.	Rhyolite, isolated peak	pre caldera/caldera formataion	Mt. Ogidake Pyroclastic plateau, Kuju volcanos
10	**Koganotaki Fall Geosite**	Falls on the outer rim of the caldera.	See a waterfall flowing over Sakanashi rhyolite, which forms a part of the outer rim, and its famous ice pillar in winter.	Sakanashi rhyolite	pre caldera	Koganotaki waterfall
11	**The Deity of the Volcano Geosite**	Seek the roots of the culture centered on Aso Volcano.	Dedicated to Takeiwatatsuno-mikoto, the pioneer deity of Aso, Aso Shrine is a spiritual center for residents of the area, as are nearby Kokuzo Shrine and the Nakadori burial mound of the Aso Family. Shimomiya Shrine, where the Hitaki shrine rituals (a sacred rite involving fire) are carried out, is also located in this site.	Myths, the pioneer deity of Aso, natural drinking water fountain, Zougahana point	Non-geological	Aso Shrine
						Kokuzo Shrine
						Kaminokokura and Shimonokokura burial mounds
						Nakadori burial mounds

No.	Name of Geosite	Theme of Geosite	Brief Overview	Major Resources	Classify	Points
12	**Cluster of springs in Aso Valley District Geosite**	Alluvial fan and artesian aquifer.	An unusual area with artesian springs an alluvial fan formed by a river originating in the central volcanic cones.	Alluvial fan, natural drinking water fountain, and Teno spring water	post caldera	Miyaji and Yakuinbaru destrict springs
13	**Futaenotouge Mountain Pass Geosite**	Myths and history.	Learn about the formation of Aso Volcano by observing the topography of the caldera, central volcanic cone group, Kurokawa River on the caldera floor, and oxbow lake. Hear myths and folk stories related to large and unusual stones in the Aso area.	Views of the caldera, central volcanic cone group, oxbow lake, myths, stone paths made from welded tuff	post caldera	Futaenotouge mountain pass.
					post caldera	Matoishi(Matoishi ochaya, remain of garden pond)
14	**Aso Yellow Ocher (Aso Odo) Geosite**	Environmental and cultural gifts from the great volcano .	See Aso Yellow Ocher (Limonite), distributed around Aso Gorge, and understand the related role of geothermal water following the formation of the caldera. Ocher has been used since ancient times to make red iron oxide paint and to produce iron ore and cattle feed.	Limonite, red iron oxide, Shimoyamanishi Burial Mound, rust-colored stream, Onobaru Burial Mound, oxbow lake	post caldera	Aso Yellow Ocher (Limonite)
15	**Uchinomaki Hot Spring Geosite**	Historic hot spring town.	Visit historic hot springs once frequented by writers and artists. Located in an embayment of the caldera, some believe this site was once a crater.	lacustrine deposits	post caldera	Uchinomaki hot spring
16	**Milk Road Grassland Geosite**	Vast grasslands cover the north somma.	Learn about the origins of Aso's grasslands by observing the grasslands in the north somma and the volcanic ash soil (kuroboku, akaboku, akahoya) visible along the road.	Kuroboku, akaboku, akahoya volcanic ash soil and Milk Road	post caldera	Grassland scenery
17	**Oshito-ishi Geosite**	Fusion of nature and culture.	View a group of megalithic andesite stones located on a hill 845 m above sea level. The biggest stone has a pyramid shape with a height of 5.5 m and a circumference of 15.3 m. It is said to have been a sacred place for rituals and festivals since ancient times.	Isolated peak, andesite	pre caldera/caldera formataion	Oshito-ishi
18	**North Outer Rim Pyroclastic Flow Geosite**	Understanding the vast pyroclastic flow.	Observe the characteristics of Aso's pyroclastic flow, such as the structure of welded tuff and the unique scenery formed by erosion of the pyroclastic flow deposits.	Pyroclastic flow, welded tuff, recession of waterfall, Shiromurataki Falls	caldera formataion	Nabegataki fall
					caldera formataion	Yusuikyo gorge
					caldera formataion	Nanataki fall
					caldera formataion	Aso pyroclastic flow deposits (on Yamanami highway)
19	**Oguni-go Area Hot Spring Geosite**	Hot spring village formed by volcano.	Visit the abundant hot springs (onsen) in this village, believed to be heated by Kuju Volcano	Kuju volcano, Kurokawa Onsen	post caldera	Minami Oguni onsen village
					post caldera	Tuetate onsen
					post caldera	Suzume Jigoku (Sparrow Hell)
					post caldera	Waita onsen village
20	**Ikeyama and Yamabuki Geosite**	Sources of spring water.	Groundwater filtered through the Aso and Kuju pyroclastic flow deposits gushes from springs at this site.	Pyroclastic flow	post caldera	Ikeyama spring
					post caldera	Yamabuki spring
21	**The Sankin-kotai Road Geosite**	Road utilized natural topographic features.	Bungo Highway was used by the local lord when he traveled to his alternate residence in Tokyo. The road avoids damp ground, illustrating the detailed topographic knowledge of the local people. The stone pavement along the caldera wall was made with rocks mined nearby.	Futaenotouge Mountain Pass, stone pavement, Sakanashi post town, Tenjin Bridge, Takimuro Hill, pyroclastic flow	Non-geological	Sankin-kotai road
					Non-geological	Matoishi ocyaya, remain of garden pond
22	**Kusakabe Geosite**	Kudarimiya Shrine, dedicated to the God of Aso.	Hikoyaimiminomikoto, the son of Emporer Jinmu, is enshrined here. The layout, which requires visitors to descend stone stairs to reach the shrine, is extremely unusual.	Myths,The pioneer god of Aso .	Non-geological	Kusakabeyoshimi shrine

No.	Name of Geosite	Theme of Geosite	Brief Overview	Major Resources	Classify	Points
23	**Camel mountain (Rakuda-yama) Geosite**	Scenery featuring intrusive rocks.	Observe the structure and joints of intrusive rocks to understand their development. Minami-Aso Visitor Center and wildflower garden are situated nearby. View regional vegetation.	Columnar joints, intrusive rocks	pre caldera	Camel mountain(Rakuda-yama)
					facilities	Minami-Aso visitor center Aso wild flower garden
24	**Cluster of springs in Minami-Aso District Geosite**	Springs created by the volcano and the daily life of local people.	Visit the well-known and abundant natural springs in the southern part of the Aso Caldera. The high quality water originates in the central volcanic cones and southern somma.	Shirakawa spring, Terasaka spring and others, different water quality and amount of discharge	post caldera	Minamiaso village spring group
					post caldera	Takamori spring tunnel
25	**Jigoku and Tarutama Hot Springs Geosite**	Geothermal area and hot springs, explosion crater.	See the hot springs at the explosion crater and eroded area on Mt. Yomine. The entire region is one of the few fumarolic areas in the central volcanic cone group. View a drawing of the Yunotani Disaster, a hydrovolcanic explosion at the hot springs in 1816.	Landslide topography, crater, maar, Mt. Yomine, hydrogen sulfide, Kinryuunotaki Falls, Suzume Jigoku (Sparrow Hell), Yoshioka fumarole, Yoshioka Onsen, Yunotani Disaster, crater remains	post caldera	Jigoku and Tarutama onsens
					post caldera	Ikenokubo
26	**Nango valley Geosite**	Characteristic topography related to the formation of Nango Valley .	Observe terraces in Nangodani Valley, in the south caldera, and learn about the formation of lakes and rivers after the caldera was formed.	2～3 steps of terrace	post caldera	Terraced topography in Nangodani valley
27	**Mt.Rakanyama Geosite**	Understand unusual formations .	View eroded or collapsed tuff breccia and, mainly at Mt. Kanmuridake, andesite consisting of huge crystals such as pyroxene and amphibole.	Tuff breccia, Osoroshiga-fuchi, Mennoishi, pyroxene at Go-Toge Peak, huge tuff breccia crystals, 16 Rakan Caves	pre caldera	Mt. Rakanyama strange spectacle
					pre caldera	Zizo-toge pass dike swarm
28	**Tawarayama Mountain Pass Caldera geosite**	Experience the grand scale of the caldera.(view from the south)	Observe the expansive caldera topography and understand the impact of the eruptions that formed the caldera.	Nangodani Valley, south somma	caldera formation	Aso Caldera Tawarayama lookout
29	**Tateno Gorge Geosite**	Intersection of fault activity and volcanic activity.	Due to fault activity, a caldera lake is believed to have repeatedly formed and disappeared at this site. Learn about the site history and hear a related myth about Aso's pioneer deity.	Tateno lava columnar joints, confluence of Shirakawa and Kurokawa Rivers, Kitamukouyama forest, Kugino stratum, Kitamukouyama faults, river erosion	post caldera	Tateno gorge
					post caldera	Ayugaerinotaki fall
					post caldera	Sugarugataki fall
30	**Shiraitonotaki Falls Geosite**	Waterfall formed by lava on the somma.	Visit a 20-meter-high waterfall located on rock believed to predate Aso volcanic rock. Observe clear columnar joints.	Rocks predating Aso Volcano, columnar joints	pre caldera	Shiraitonotaki fall
31	**Omine Volcano Geosite**	Visit an active fault.	Omine Volcano was formed ust before the formation of the current caldera, and lava flows from this volcano created a vast lava plateau. Observe evidence of past movements of the plateau caused by fault activity.	Takayubaru pyroclastic flow, Aso Kumamoto airport, Futagawa faults, Futadaki Falls	pre caldera	Omine volcano, Takayubaru lava plateau
32	**Soyokyo Gorge Geosite**	A beautiful valley created by a volcano and springs .	View this beautiful of gorge formed by eroded Aso pyroclastic flow deposits	Pyroclastic flow, columnar joints, Funanokuchi Spring	caldera formataion	Soyokyo Gorge
33	**Heitate Shrine Geosite**	Connect with the world of the gods.	Surrounded by a rich natural environment, this shrine is said to be the birthplace of Takama–ga-hara mythology.	Myths	Non-geological	Heitate Shrine

2-4 Characteristics of Aso

2-4-1 Characteristics of Aso caldera

Aso Caldera measures about 25 kilometres north-south and about 18 kilometres east-west, with a perimeter of over 100 kilometres. The total inner area is about 380 square kilometres. Two caldera floors, Asodani Valley and Nangodani Valley, occupy the north and south portions of the caldera interior. Nangodani Valley is 300 to 600 meters above sea level; the outer rim is 600 to 1,200 meters above sea level. Between the caldera rim and the caldera floor stand steep caldera walls. The central cones are aligned from east to west in the center of the caldera. Giant calderas like Aso are formed when a super eruption is followed by a collapse. The present giant caldera was formed mainly by a super eruption about 90,000years ago (Aso-4), but three other super eruptions also took place starting 270,000 years ago.

Fig2-13 shows the Volcanic Explosive Index based on volume of volcanic products. Volcanic products from Aso-4 comprised over 80 cubic kilometres of pyroclastic flow and 600 cubic kilometres of total deposits, including tephra blown across a wide area. Aso-4 is believed to have been a super eruption bigger than VEI 7.

VEI	Ejected magma	Examples
8 (mega-colossal)	3000km³	The youngest Toba-Tuff (74,000 years ago) Yellowstone Huckleberry Ridge Tuff (2,000,000 years ago)
	2000km³	
7 (super-colossal)	1000km³	Yellowstone Lava Creek Tuff (600,000 years ago) **Aso-4(90,000 years ago)**
6 (colossal)	100km³	
5 (paroxysmal)	10km³	Tambora (1815) Pinatubo (1991)
4 (cataclysmic)	1km³	
3 (severe)	0.1km³	Mount. Unzen (1990-95)
2 (explosive)	0.01km³	
1 (gentle)	0.001km³	
0 (non-explosive)	0.00001km³	

Fig.2-13 Volume of volcanic products based on Volcanic Explosive Index (VEI)

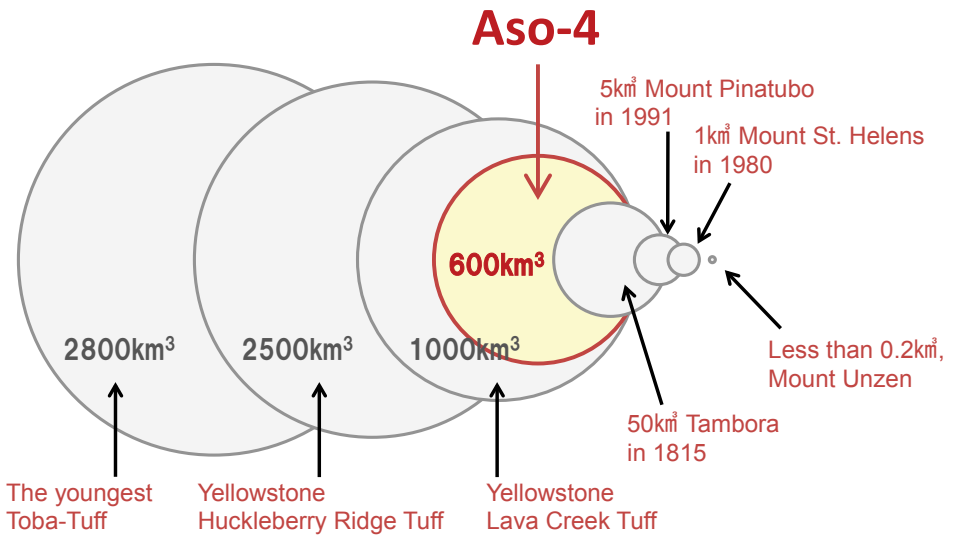


Fig.2-12 Amount of volcanic products of super-eruption (modified from Takahashi, 2008)

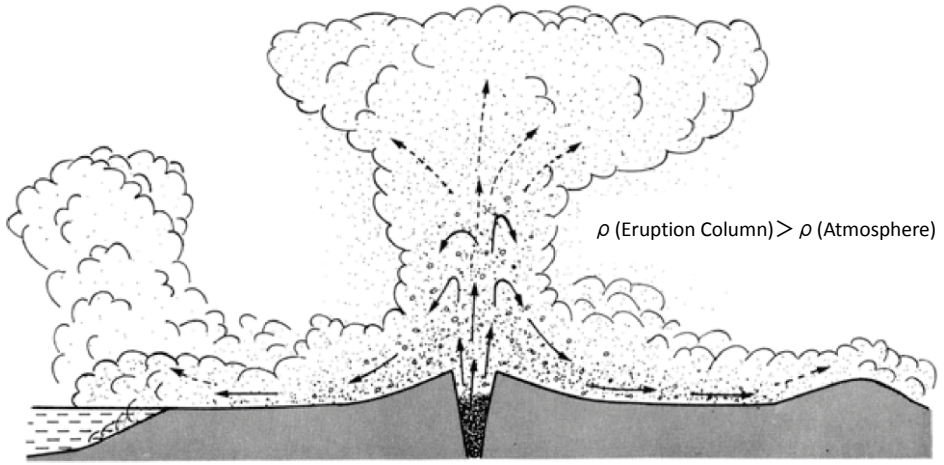


Fig.2-14 Schematic diagram of pyroclastic flow (Machida and Arai, 1992)

The biggest caldera in the world is Toba Caldera in the north of the Indonesian island of Sumatra. It is 100 kilometers long and about 30 kilometers wide, with a water depth of up to 530 meters and a total area of 1,000 square kilometres. The caldera has become a lake, and is the largest of its type in the world today. It was formed by the biggest super eruption in the past two million years, on the same level as the Huckleberry Ridge eruption, which had an erupted magma volume of 2,500 cubic kilometres and created a tuff in Yellowstone. The Aso-4 eruption was just one level below these two events.

The difference between these calderas and Aso is their present condition. Other calderas are either so huge that viewing their topography as a whole is impossible, their walls have dissected out, or they have becomes caldera lakes. What's unique about Aso Caldera is that despite its enormous scale, it remains a nearly intact circle and can be seen clearly with the naked eye. Due to earthquakes and the erosive action of rivers, part of the caldera wall has collapsed, drying out the floor and allowing easy observation of the central cone group. An excellent network of roads means that visitors can view the caldera's beautiful form from many different angles. In addition, the region's 70,000 residents have evolved a unique culture that takes advantage of the geographical conditions, making the caldera an excellent site for learning about how humans live in volcanic areas.

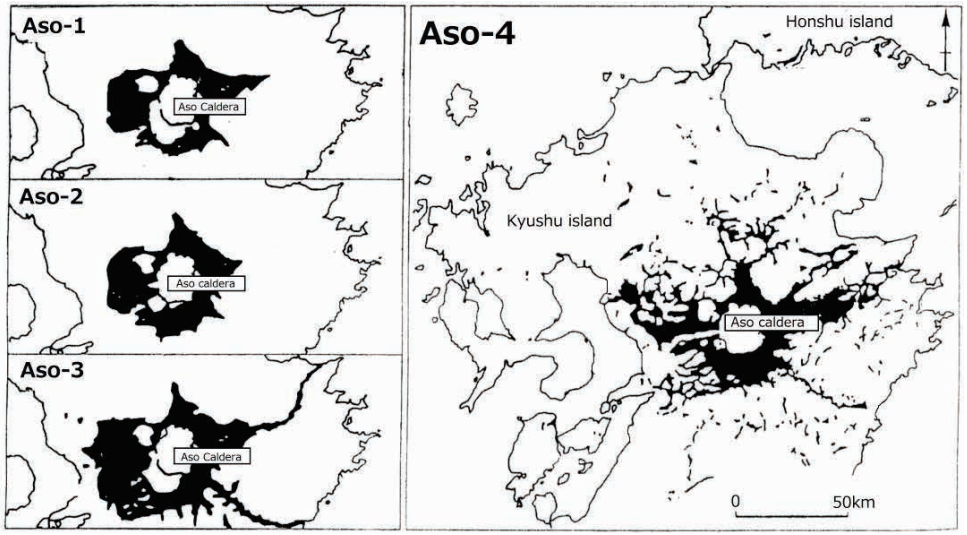


Fig.2-15 Distributions of Aso1-4 pyroclastic flow depositions (Ono and Watanabe, 1983)

2-4-2 Impact of super eruptions

Impact of pyroclastic flow

Following the super eruptions that formed Aso Caldera, pyroclastic flow spread over the surrounding land. Depositions from Aso-4 pyroclastic flows covered an area with a 160-kilometre radius to the north and a 100-kilometre radius to the south. A portion of the materials extended across the sea to Honshu, the main island in the Japanese archipelago. The area around Aso was completely covered by the pyroclastic flow, and nearly all the plants and animals there are believed to have died. If the total eruption volume of 600 cubic kilometres had settled evenly over Kyushu, it would have covered the entire island with a layer 17 meters thick.

Many geological sites on the somma offer an opportunity for visitors to sense the enormity and impact of the ancient super eruption. The magnificent caldera landscape, the central volcanic cones, and the rim of the caldera can be viewed in their entirety from numerous points on the surrounding peaks. Looking in the other direction, a gentle pyroclastic plateau and hills formed by volcanic deposits are visible. A diversity of unique landscapes, structures, and rock faces formed by the pyroclastic flow may also be observed.

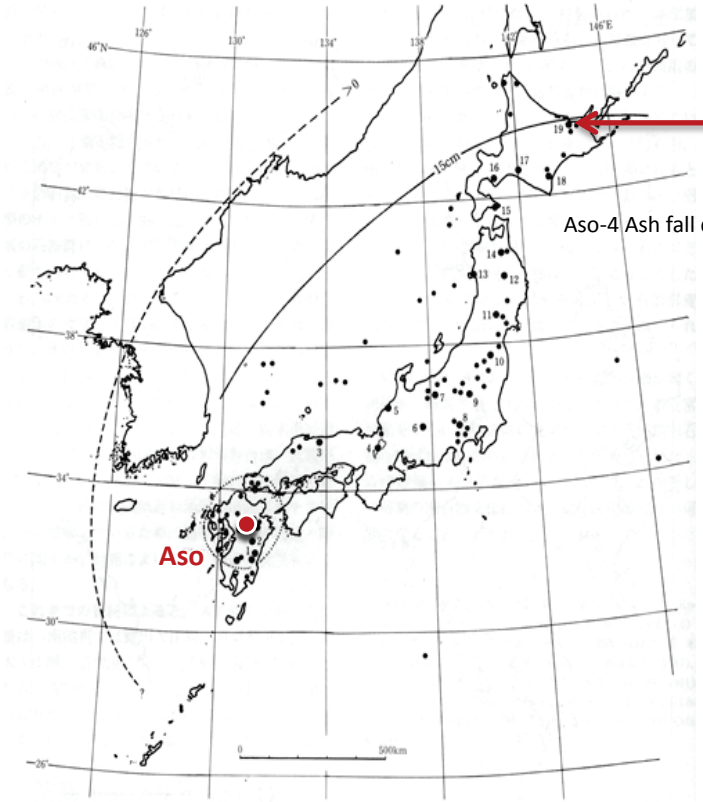
Fig.2-15 shows the current distribution of depositions on all sides of the caldera. The deposits are especially well preserved and easy to see on the north and southeast sides of the caldera. These sites offer an excellent opportunity to study the deposition process as well as the subsequent processes of cooling and erosion.

Widespread impact of volcanic ash

During super eruptions such as Aso-4, volcanic ash consisting of light-weight volcanic glass separates from ash columns and pyroclastic flows. These clouds of ash are spread by the eruption as well as by wind, leading to fallout and deposition of volcanic ash over a wide area.

In Japan, westerly winds typically blow over the archipelago at a speed of 25 to 50 m/s and a height of 5,000 to 10,000 m. For that reason, when a super eruption in the region sends ash columns high into the air, volcanic ash is carried east. In the case of large eruptions from Aso Volcano, volcanic ash spreads northeast from Aso's location in the southwest of the Japanese archipelago. Fifteen-centimetre-thick ash sediment from the

Aso-4 super eruption has been found in eastern Hokkaido, 1,700 kilometres north, attesting to the massive scale of the event. Assuming an average wind speed of 30 m/s, ash likely began to fall over Hokkaido a mere 16 hours after the eruption began. Ash from Aso-4 also turned into aerosol and covered the entire globe, causing climate change. This is believed to have happened in a relatively short period of time.



Aso-4 Ash fall deposit in Eastern Hokkaido

Fig.2-16 Isopach map of Aso-4 ash (Machida and Arai, 1992)

Examples of volcanic impact in other areas, And the significance of Aso geopark

Super eruptions have a huge impact on both environments and people's lives. Volcanic ash from the Akahoya super eruption of the Kikai Caldera, which took place about 7,300 years ago in southern Kyushu and formed a 20-by-17-kilometer submarine caldera, had a total eruptive volume of 170 cubic kilometres. The twenty-centimetre-thick deposits at the Daikanbo Caldera Geological Site in Aso Geopark originate from this eruption. The Takeshima pyroclastic flow produced by the Akahoya eruption is also believed to have had a massive impact on the surrounding area. Laurel forests in the flow area died and were replaced by Japanese silver grass (*susuki*) and other grassland vegetation. The impact of the flow has also been observed in the region's earthenware culture, with the eruption marking a clear disconnect in the style of pottery produced.

Ex.1) Impact of 1628 BC Minoan Eruption

In 1628 BC, a caldera was formed by the Minoan Eruption, a huge eruption of a submarine volcano. The explosive event caused disasters all over the Aegean Sea.

EX.2) Impact of 535 eruption of Krakatoa

A volcanic winter was caused by the destructive eruption in 535. Trees around the world stopped growing for several years after the eruption.

EX.3) Impact of 1815 eruption of Tambora

The 1815 eruption was the largest recorded in the past two centuries. Abnormal sunsets were observed globally for several years following the event. This led to global cooling known as the 'year without a summer' that caused 10,000 deaths. In total 50,000~90,000 people died as a result of the eruption, including deaths caused by famine and plague.

The eruption that formed the Aso caldera was bigger than these eruptions, and its impact is believed to have been massive and widespread. However, its exact impacts remain unclear.

As noted above, the world's most recent super eruption occurred at Mt. Tambora in 1815. However, no super eruptions have occurred in Japan since the Kikai Caldera eruption 7,300 years ago. As a result most people today spend little time thinking about such events. Yet without a doubt future caldera eruptions will occur on the world's tectonic belts. One of Aso Geopark's most important and meaningful roles is to communicate the processes and impacts of super eruptions to visitors from Japan and the world.

2-4-3 Central volcanic cone group

The active Nakadake Volcano has erupted on average once every 10 years for the past 1,500 years, which is as far back as records exist. The present characteristics of the volcano's magma have been studied through its deposits. The magma is primarily basaltic andesite, with a high volume of potassium relative to other volcanoes. This differentiates Aso from other active volcanoes on Kyushu, and has characterized it since the Aso-1 super eruption occurred about 270,000 years ago.

Many sites in Aso Geopark provide opportunities to understand volcanic activity after the formation of the caldera. At the Nakadake Geological Site, layers of volcanic ash, volcanic bombs, agglutinate and other materials formed from magma can be seen. At other sites, visitors can experience the activity of the Earth through hot springs, geothermal areas, and other features unique to active volcanic regions.

Nakadake Crater

Aso's Nakadake Crater is distinguished by its well-maintained access routes. Visitors can reach the crater by car, ropeway or footpath and peer inside. For Japanese tourists, a trip to Aso is synonymous with a visit to the mouth of the active Nakadake Crater. Nakadake is composed of multiple craters aligned from north to south in an area measuring 400 meters east-to-west and 900 meters north-to-south. The four clearest craters are numbered 1-4.

Volcanic activity at Nakadake has been frequent and has shifted between craters. The regular cycle of activity is as follows: a crater lake or "yudamari" is formed in the basin during the inactive period → gravel spouts from the basin, drying it out →red heat phenomenon occurs → volcanic ash erupts → rumbling and eruption of volcanic rock occurs (Stromboli eruptions). After the Stromboli eruptions have continued for a period, a phreatomagmatic eruption suddenly takes place. When activity subsides, a "yudamari" lake once again forms in the crater bottom.

Fig.2-17 Strombolian Eruption at Nakadake Crater

Even during its calm periods, Nakadake Crater emits several hundred tons of volcanic gas daily on average. The strongly acidic water in the yudamari remains at about 50 to 60 degrees Celsius, and is colored a beautiful emerald green by iron ions.

Fig.2-18 Nakadake geosite

Fig.2-19 crater lake "yudamari"

Fig.2-20 red heat phenomenon

Volcanic cone group and surroundings

The central volcanic cone group consists of many mountains in addition to Mt. Nakadake. The five main mountains (Aso Gogaku) are Mt. Takadake (1,592 m), Mt. Nekodake (1,433 m), Mt. Nakadake (1,506 m), Mt. Kijimadake (1,321 m) and Mt. Eboshidake (1,337 m). These mountains vary both in shape and formation period. They include stratovolcanoes (Mt. Takadake, Mt. Nekodake, Mt. Nakadake and Mt. Eboshidake), scoria hills (Komezuka), a tuff ring (Ikenokubo), a lava dome (on the crater floor of eastern Mt. Kijimadake) and mud volcanoes and fumarolic areas (Yoshioka, Yunotani and Jigoku). The volcanic topography, component materials and interior structures are widely varied.

Although, All the mountains in the group except Mt. Nekodake were formed after the caldera.

Each mountain provides insight into how geographical features vary according to formation period, as well as a sense of the Earth's dynamic activity. Komezuka is a very well balanced scoria hill, whose faults can be observed at Kamikomezuka. Kusasenri-ga-hama crater is the remains of a 30,000-year-old crater, measuring about 1,000 across and now covered with low grass. The site is representative of many landscapes at Aso Geopark. To the north of Kusasenri-ga-hama crater lie Mt Kijima and Mt.Ojodake, scoria dating back several thousand years. The grassy landscapes here contrast with the wild and rocky scenery of Mt. Takadake and Mt. Nekodake, which consist of intrusive rocks, agglutinate and lava.

Fig.2-21 Komezuka

Fig.2-22 Kusasenri-ga-hama

Aso Volcano Museum is located near Kusasenri-ga-hama crater. The museum functions as a visitor centre and an optional site for geo tours when the weather is bad.

CENTRAL VOLCANIC CONE GROUP FOOTHILLS AND CALDERA FLOOR

The foothills of the central volcanic cone group and the caldera lowlands are divided into two main areas, Asodani Valley in the north and Nangodani Valley in the south. These valleys are made up of alluvial fans and plains. A number of geological sites here are ideal for observing volcanic formations, lava flows and other features formed by sedimentation.

The main geological sites in these areas are the Jigoku-Tarutama Onsen (hot springs), Ayugaerinotaki Falls, Sugarugataki Falls, Kugino Geological Layers, Tateno Lava Columnar Joint, Aso Yellow Ochre and Nangodani Valley River Terrace.

Each of these sites consists of various geological elements, making them essential places for learning about the diversity and complexity of Aso Volcano.

Geological sites around the somma

Many geological sites around the somma illustrate the repeated dynamic volcanic activity that occurred before the caldera formed, not only in the central volcanic cone group, but also at Tateno Gorge, Omine Volcano, Futagawa Faults and Rakuda (camel) Mountain.

Tateno Gorge is the only gap in the somma, and was formed by an active fault group that fans out from it. After formation of the original V-shaped gorge, the area was repeatedly reshaped by lava from Tateno, Akase and other volcanoes in the central cone group, which dammed the river. Fault activity and further changes followed; the river is currently in the process of deepening once again.

2-4-4 Preserved grassland

Aso Geopark's grasslands are the largest in Japan and a magnificent symbol of the park. In the somma, they cover a landscape formed by pyroclastic plateaus and volcanic ash, and are composed of unique plant communities of miscanthus (*susuki*) and dwarf bamboo (*nezasa*). A similar landscape can be seen near the central cone group.

Although the details of the grassland's formation are not entirely clear, researchers have confirmed that sasa grasslands (primarily miyako zaza dwarf bamboo) existed in the area between 32,000 and 30,000 years ago by studying phytoliths in the volcanic ash layers east of Aso Volcano. However, the grasslands deteriorated during the most recent glacial cooling period between about 30,000 and 13,500 years ago, in part due to volcanic activity. About 13,500 years ago, miscanthus-dominated grasslands began to spread, and

Fig.2-23 Grassland burning

continue to thrive today. It is unlikely that the miscanthus grasslands would have existed for such a long period without some form of human interference to forestall succession; researchers believe humans have been maintaining them from the time of their formation.

The 10th century Chronicles of Japan includes a description of “grassy fields extending far and wide” in the region, indicating that grasslands have without doubt existed for at least a millennia. The space remained open and treeless not only because of repeated volcanic activity and ash fallout, but also most likely because of grazing, grass harvesting, and burning carried out by humans.
The annual burning takes place to clear out dead plant matter and suppress the growth of bushes and trees. The ultimate goals of this activity are to encourage the growth of plants suitable for feeding to livestock, prevent flooding and landslides caused by the accumulation of dead grass in rivers, and prevent wildfires. Grassland management has been crucial to maintaining healthy animal and plant communities, water resources, and land, as well as ensuring the livelihood of cattle farmers and the health of the regional economy.

This system of land maintenance and cattle farming was registered as a Globally Important Agriculture Heritage System (GIAHS) by FAO in 2013. An important role of GIAHS in developed countries is to advance global agricultural technology. In Aso, the agricultural system is deeply related to the volcanic geography, and has potential for application in other volcanic regions. Aso Geopark would be the first site in the world to be registered as both a Global Geopark and a GIAHS.

Fig.2-24 GIAHS Logo

2-4-5 Aso yellow ocher ”LIMONITE”

Aso Geopark contains iron and lacustrine deposits that yield limonite, called ‘Aso odo’ or Aso yellow ochre because of its colour. These ochers are believed to have been formed by the accumulation of geothermal water and organic matter during the caldera lake period. According to current research, limonite continues to be produced by gushing geothermal water.

The yellow ochre is an ancient regional resource that scholars believe was the foundation of a local trading culture. It was likely used to produce a type of red oxide baked paint used in ancient burial mounds, and as a raw material for making iron tools. Today the soil is valued for its usefulness in desulfurization, odour absorption, and water purification, as well as for its high mineral content. It is used as a desulfurizing agent and an animal feed stock. Pioneering projects in resource circulation that focus on reusing desulfurizing agents are currently being implemented, and represent an important field of sustainable technology.

Fig.2-25 Aso yellow ocher”LIMONITE”

2-4-6 Natural springs and onsen (hot springs)

Aso Geopark has many magma-heated onsen (hot springs) and natural springs fed by catchments in the somma and central cones. These are attractive elements for many visitors. Over 1,500 springs exist, but their complex structure means that some are not fully understood. Many springs gush from the northern part of the caldera floor. They supply abundant water for domestic and agricultural use, and are recharged mainly in the slopes of the eastern central cones. The southern portion of the caldera also has abundant water resources, located mainly near the bottom edges and erosion valleys of the central cone group's alluvial fans. These are believed to be recharged mainly on the southern slopes of the central cone group. One of the most important springs is Shirakawa Spring, which gushes 60 tons of water per minute and was selected as one of Japan's 100 Best Water Environments by the Environment Ministry.

Springs in the somma are believed to be related both to the nature of the soil and to pyroclastic deposits. The sloped lower portions the caldera walls are comprised of pre-Aso volcanic rocks, alluvial cones and talus. Thick pyroclastic sediments can also be observed at the top of the caldera walls and all around the plateau on the outer slope of the caldera. Some springs gush from the cracks in welded tuffs or from non-welded sediments.

Onsens in Aso Geopark are heated by Aso Volcano and Kuju Volcano. The percentage of magma in these springs is small because of the abundant ground water, but quality varies with the heat source. For example, Kurokawa and Tuetate Onsens in the north somma, whose heat source is Kuju Volcano, are highly carbonated. Jigoku and Tarutama Onsens, located at the foot of the central cones, have acidic springs heated by Aso Volcano. In contrast, granite distributed underground in the vicinity of Uchinomaki Onsen, in the north caldera floor, gives the springs a high sodium bicarbonate content. Many accommodations in Aso Geopark are located near onsens, allowing guests to experience the earth's energy as they relax with delicious food and hot springs.

Fig.2-27 Gush of spring in Asodani valley


Fig.2-26 Jigoku and Tarutama Onsen

Chapter 3

GEOCONSERVATION

3-1 Current or potential pressure on the proposed Geopark

There is no direct pressure on the proposed Geopark area. Because much of the region is already a national park, it is managed by regulatory authorities under the Natural Parks Law. Reports and authorizations are necessary before any development occurs in the area.

Other potential pressures include disasters related to volcanic activity and eruptions. The Mt. Nakadake Geological Site releases a large quantity of volcanic gas even in calm periods, necessitating special attention to avoid harmful health effects. Landslides caused by torrential rain are another potential pressure on the caldera topography. Severe rainstorms occurred in Aso Geopark in 2012, dumping over 400 mm of rainfall on the park in four hours and causing a number of deaths due to the collapse of the caldera wall.

3-2 Current protection status of geological sites whithin the proposed Geopark

The majority of Aso Geopark lies within Aso Kuju National Park, which is overseen by the Ministry of the Environment. Most of the geological heritage sites are protected under the Natural Parks Law, the Law for the Protection of Cultural Properties, or municipal regulations.

In particular, the Mt. Nakadake Geological Site is designated under the Natural Parks Law as a special protection zone. Modifications to geological features and collection of wild plants are strictly regulated. In addition, a number of guidelines and action plans aimed at environmental conservation have been established through cooperation between the public and private sectors. Aso Geopark guides, Natural Park rangers from the Ministry of the Environment, and members of the Natural Parks Foundation are working to conserve and maintain the park's geological sites.

In 2013, all of Aso Geopark was designated by the Cabinet Office as a special district for the maintenance and regeneration of grasslands. This designation allows for the flexible implementation of conservation measures going beyond those specified by particular laws and regulations.

3-2-1 Policy regarding the quarry inside the park

A quarry is located in the caldera wall area. Although it is still in operation today, it will be closed by December 2016 according to an agreement between local municipalities and the quarry company, due to its location within Aso Geopark and the National Park. The company has already begun fundraising for the environmental restoration of the quarry area.

3-2-2 Zoning on national parks

Each geological site located in a national park is typically classified as either a Special Protection, Special Zone Class I – III, or an ordinary area, and development activities are regulated accordingly. Most development activities are banned in Special Protection Zones, including on top of Mt. Nakadake. Collection of rocks, animals and plants is limited strictly in national parks.

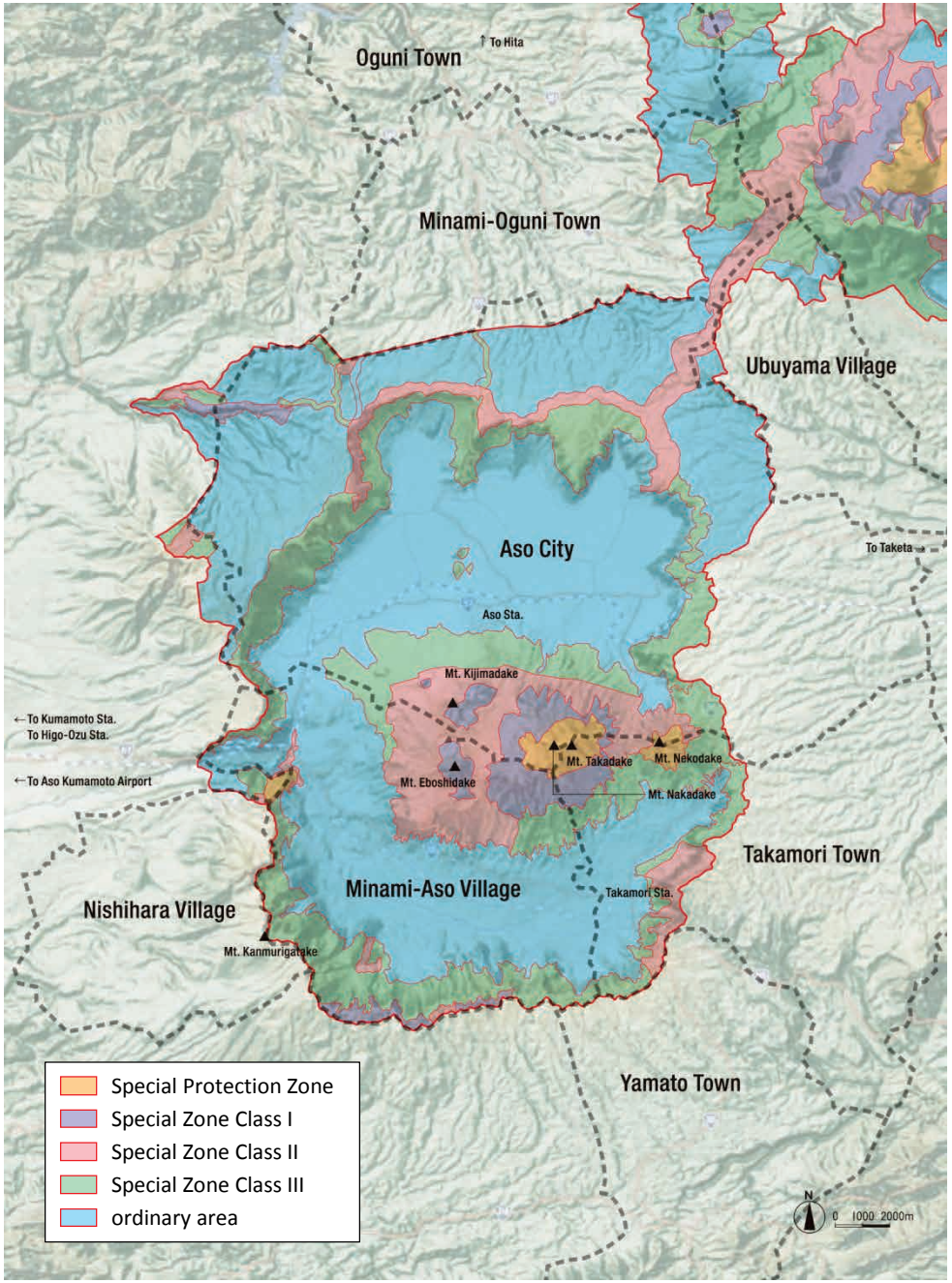


Fig.3-1 Aso Kuju National Park Zoning map

Table 3-1 Zoning of National Parks

Special Protection Zone	Areas with important landscapes preserved in a pristine state. Development is strictly regulated.
Special Zone Class I	Areas in which preservation of landscapes and scenic beauty is a priority second only to Special Protection Zones in importance.
Special Zone Class II	Areas in which special planning is required for agriculture, forestry and fisheries activities.
Special Zone Class III	Areas with comparatively limited need for conservation of scenic beauty, in which forestry, fishing, and agriculture is generally not regulated.
ordinary area	Areas not included in the Special Zones or Coastal Parks but for which landscape preservation is still planned.

3-3 Management and maintenance of sites

Cleaning and Inspection

Regular maintenance and inspection of Geosites is organized by the Aso Geopark Guides Association. Local residents are invited to join these events, which furthers awareness and understanding of the sites.

Municipal Activities

Each municipality works to conserve Geosites within its jurisdiction and support maintenance activities by the local community. The Aso Geopark Promotion Council keeps a record of these activities and of the condition of each Geosite.

Ministry of Environment Activities

National Park Rangers and Volunteers maintain and patrol Geosites. The Aso Grassland Restoration Committee, a joint public-private association, works to regenerate the grasslands and educate future grassland managers in the community.

Future Policy

Aso Geopark Promotion Council is collecting data from each of these groups to build a database of Geosite preservation approaches.

3-4 Disaster risk and its management

As the Shimabara Declaration at the 5th International UNESCO Conference on Geoparks in 2012 states, Geopark activities are the most effective way for communities to think about how to coexist with an occasionally hazardous natural environment.
Aso Geopark is more than just a beautiful landscape; it has an important role to play in informing local communities and visitors about the natural disasters that can be expected to occur in the region.

3-4-1 Disaster caused by active volcanoes

Mt. Nakadake crater is a popular destination, drawing about one million visitors annually. However, the crater releases an estimated several hundred tons of volcanic toxic gas a day even during calm periods. In the past, gas poisoning accidents occurred frequently at the site.

In addition, Mt. Nakadake still erupts periodically. Because villages exist within several kilometers of the crater, disaster prevention measures are necessary. The Aso Volcano Disaster Prevention Committee was established to discuss what to do in the event of a volcanic eruption or volcanic gas emission. The committee is chaired by the mayor of Aso and centered in the city of Aso, but also includes representatives from neighbouring municipalities as well as the police and fire departments. The Aso Volcano Disaster Prevention Plan, drawn up by the committee, is currently being implemented. Moreover Japan Meteorological Agency and Kyoto University systemize and fully monitor volcanic activities of Nakadake crater.

Fig.3-2 Volcanic gas of Nakadake Crater

Regulations related to volcanic gas

In 1998 a “Zonal Management Method” was implemented around the crater (Fig3-3). Whenever SO2 concentrations exceed 5ppm, entry to the crater area is regulated. Six SO2 sensors installed around the crater display levels in real time. Only entry to the zones that exceed the regulation concentration is restricted. Thanks to these measures, no fatal accidents related to volcanic gas have occurred since 1998.

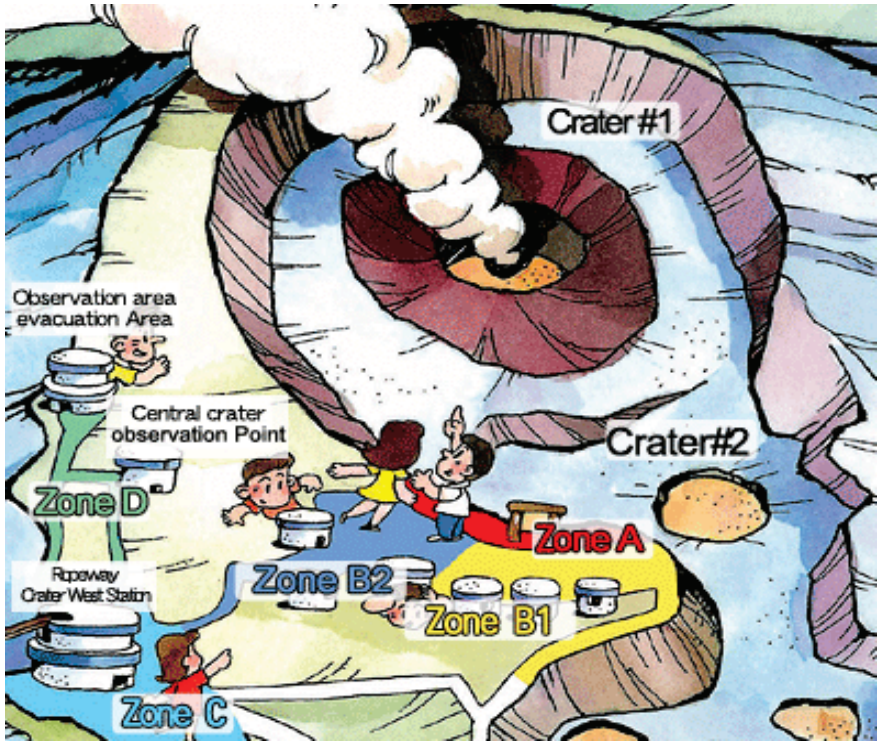


Fig.3-3 Zonal management in Nakadake Crater

Regulations related to eruptions

Standard for regulating entry to the crater area are specified in the Aso Volcano Disaster Prevention Plan. Four levels of regulation exist: no restriction, level one regulation, level two regulation, and prohibition of entry.

Maintenance of hazard maps

Hazard maps of Aso were made in 1995 and updated in 2008. The illustrated map shows locations where cinder fallout and pyroclastic surges are likely to occur during an explosion at Mt. Nakadake, as well as information on the types of volcanic disaster that may occur in surrounding areas, the types of information available concerning the volcano, and evacuation routes and shelters.

3-4-2 Disasters caused by caldera topography and geological features

Many people are drawn to live in Aso by the beauty and natural bounty of the volcano. However, the region is vulnerable not only to eruptions but also to disasters related to its unique topographical features, such as the caldera, volcanic ashe soil, and high altitudes. In July 2012, 25 people living in the caldera died when part of the caldera wall collapsed due to torrential rain. Disasters of a similar scale occur once every few decades, bringing serious damage to the region. Other examples of natural disasters typical to the Aso region are follows.

1. High overall rainfall and frequent torrential rains

Aso is located in the centre of Kyushu. Its highest point is Mt. Takaoka, at 1,592m above sea level, with the caldera floor at 500-600 m and the outer rim of the somma at between nearly 700 m and 900 m. Because of its high vertical interval, annual total precipitation exceeds 3,000 mm.

Fig.3-4 Flooding in a town caused by inundation of the caldera floor

Fig.3-5 Collapse of caldera wall

2. Floods on the caldera floor

Asodani Valley in the north caldera has flat topography, making it particularly vulnerable to flooding when heavy rain causes the Kurokawa River to overflow.

3. Collapse of the caldera wall

Because the caldera wall is steep and its surface is covered with volcanic ash deposits, it collapses easily even in relatively low rain conditions.

4. Surface mudslides in the grasslands

Volcanic ash soil is common in the grasslands. The juxtaposition of a highly compacted layer of volcanic ash and a softer soil layer creates conditions where erosion and mudslides occur easily.

5. Earthquakes caused by fault activity

The caldera is bistected by the Oita-Kumamoto tectonic line, which runs from northeast to southwest Kyushu. Other faults run through the area surrounding the caldera, particularly to the southwest. Activity on these faults sometimes causes earthquakes.

Fig.3-6 Shallow landslides on grasslands

Fig.3-7 Tateno Gorge, a gap in the somma formed by active faults

A recent example is the Northern Kyushu Earthquake that occurred in 1975, causing serious damage to buildings.

Disaster Prevention

A number of data collection systems have been installed, including precipitation gauges, water-level gauges and live images, as well as erosion control and shore protection infrastructure. Learning from the past damage to communities, preventative evacuation orders are issued for the elderly and disabled when disasters are expected in order to reduce damage.

Disaster Prevention Education

Following the torrential rains in 2012, the Aso Geopark Promotion Council implemented an emergency project to improve community understanding of the regional topography and geological features. Measures included disaster education, an exhibit about the disaster prevention plan, and support for high school students studying the mechanisms by which disasters occur. With support from the local community, plans have been put in place to designate the site of the 2012 disaster a Geosite where visitors can learn about the relationship between the caldera and its human inhabitants.

3-5 List of non-geological sites and their relation to Geosites

Non-geological sites within Aso Geopark are noted in the list of Geosites in Section 2. These sites are referred to as “Geosites” because they relate to Aso’s volcanic topography and geology. By learning about these relationships, visitors gain a deeper understanding of Aso’s natural environment and culture.

3-5-1 Animal and plant diversity

Plants

About 1,600 different plants are believed to grow in the Aso region. This figure represents about 20% of the total for Japan as a whole and 70% of the total for Kumamoto Prefecture. About 600 of these species are found in the grasslands. Aso Geopark is a hot spot for rare species, with 80 of the endangered species listed in the Environment Ministry’s Red Data Book found in the region. Some of Aso’s species originate on mainland China, Shikoku and Honshu, suggesting the possibility that these areas were once contiguous with Kyushu. Continental relic plants and those from northern regions are well suited to the cool climate and grassland environment of Aso, and their presence contributes to the region’s high level of plant diversity.

Fig.3-8 Continental relic plants in Aso (*Tsukushi-matsumoto, Hanashinobu, Yatsushirosou*)

.

Animals

The natural environment in Aso Geopark is characterized by a cool climate and volcanic topography. Within this context, human management and the resilient power of nature have come together to form the semi-natural grasslands. One of the distinguishing features of Aso’s fauna is the presence of animals that make use of this habitat and whose lives are therefore closely related to human lives.

About 300 species of birds have been identified in Kumamoto Prefecture, and about half can be found in Aso. The majority lives in the grasslands. Among the most abundant and easy to spot are the meadow bunting (*ojiro*), chestnut-eared bunting (*hoaka*), and streaked fantail warblers (*sekka*). Japanese reed buntings (*kojurin*), black-browed reed warblers (*koyoshikiri*), and Japanese snipes (*ojishigi*) have also been sighted in the grasslands. Visitors may spot raptors, such as the Japanese sparrowhawk (*shimi*), common buzzard (*nosuri*), and mountain hawk eagle (*kumataka*) (Fig.3-9) eating small grassland animals. The sight of a black-browed reed warbler (*koyoshikiri*) building its nests in silver grass growing along the river is one of Aso’s typical scenes.

Of Kumamoto’s 117 butterfly species, 109 live in Aso. This high figure stems from the presence of both forests and grasslands, a rich natural environment unique to Aso. Species found only in grasslands include leptidea amurensis, blue-and-white flycatcher corbicula (Fig3-9), scarce large blue, and Hayashi hairstreak. All except the Hayashi hairstreak are found within Kyushu only in the Aso and Kuju regions. Dung beetles that feed on cattle and horse manure are also found in the grasslands. Aso’s 47 species of dung beetle include Geotrupes laevistriatus (*senchikogane*), Geotrupes auratus auratus (*osenchikogane*) and Aphodius (*Colobopterus*) quadratus Reiche (*omagusokogane*).

Fig.3-9 Mountain hawk eagle (*kumataka*), blue-and-white flycatcher corbicula

3-5-2 Diversity of culture and history

History of Aso's human inhabitants and intangible folk cultural assets

Remains of Paleolithic communities dating back 30,000 years are distributed on top of the somma. At the time, a rainwater-fed lake on the caldera floor rendered the lowlands unsuitable for settlement. The ensuing history of a gradual shift to the caldera floor can be deciphered through archaeological evidence such as the remains of villages located midway down the somma.

Agriculture is believed to have begun on the marshy caldera floor during the Yayoi period (300 BC – 300 AD) despite the extremely difficult conditions. The unfavorable agricultural conditions likely spurred the development of primitive industry, such as production of burnt paint (red ocher) using limonite mined from the caldera floor. The regional culture included unique features such as graves decorated with pyroclastic flow sediment and red ocher. Many of the important cultural properties in the area surrounding Aso Caldera make use of welded tuff and pyroclastic flow deposits. Some stone bridges are still partially intact thanks to their arched structure, which adds strength.

Aso Shrine is located in a slightly elevated region of the north caldera floor. Settled agricultural communities are believed to have first appeared in this region, followed by Aso's oldest political culture. Even today it remains Aso's administrative center. Aso Shrine is a Shinto shrine dedicated to the deity of Aso. There are many myths related to this deity, who is worshipped as the original pioneer who settled the land, as well as myths that speak of Aso Volcano itself as a deity. These myths reveal an ancient culture that both revered and coexisted with nature. Unique agricultural rituals have also been passed down from ancient times; today those rituals are designated as important intangible folk cultural assets of Japan.

Volcanic activity and religious belief

Many ancient religious names exist for Nakadake Crater, such as Divine Spirit Pond, Ghost Pond, and Pond of the Gods. The fact that people called the crater a pond tells us that water stayed in the crater for long stretches of time during that period; the religious elements of the names stem from the ancient belief that the crater was inhabited by gods. The fact that a visit to the crater was referred to as "going to pray at Oike" ("o" is an honorific prefix; "ike" means pond) also indicates that the crater was a spiritually important place. When large amounts of volcanic ash were emitted, people likened the black ash column to a dragon climbing up to the sky. They believed the dragons were evil omens foretelling famine and epidemics. When sudden violent activity occurs, people still say the gods of the volcano are bringing bad luck.

Aso Shrine is believed to have been founded about 2,300 years ago, and has been overseen by 91 generations of the Aso family. The shrine is the center of religious practice related to the volcano (Fig3-10). Nakadake Crater itself is the main shrine, while the structure on the caldera floor near the crater is a branch.

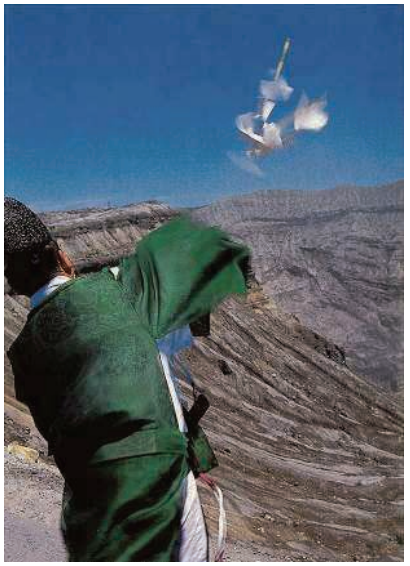


Fig.3-10 Religious practice related to the volcano

The remains of a vast priest's estate called 'Furubochu' (Fig3-11), dating to an era of prosperity several hundred years ago, are situated on the grasslands west of the crater. In the foothills of the central cone group stands a temple with a 1,000-year history, called Saigandenji. Aso Volcano and its surroundings were the centre of a volcano-based religion, and for this reason many historic temples and shrines exist in the area.

Fig.3-11 Furubochu

ECONOMIC ACTIVITY & BUSINESS PLAN

4-1 Economic activity in the proposed Geopark

The proposed geopark is a leading sightseeing spot with about 17 million visitors annually and a service industry centered on tourism. A thriving agriculture sector that takes advantage of the caldera's large open spaces also exists. About half the farm revenue in the region comes from grassland livestock production, which is designated as a Global Important Agriculture Heritage System (GIAHS).

A Unique Agricultural System: Grazing in Grasslands

Japanese brown cattle (Fig.4-1) grazed on the grasslands are raised for beef, but are also important elements of Aso's scenery. The cattle were imported from the Korean Peninsula in ancient times and adapted to the climate of Aso Caldera. Because they are calm and can tolerate a sparse diet and cold climate, they were used in the past as draft animals for agriculture and transportation. Their beef is lean, with less fat than other Japanese beef cattle due to plentiful exercise in the grasslands, and they mature quickly, in two years. Of the approximately 24,500 brown cattle raised annually in Japan, 70% of them, or 17, 258, are raised in Kumamoto (Ministry of Agriculture, Forestry and Fisheries stock raising statistics 2011).

Fig.4-1 Japanese brown cattle in grassland

4-2 Existing and planned facilities for the proposed Geopark

The Aso Volcano Museum is Aso Geopark's base facility, with various satellite facilities throughout the large area.

4-2-1 Existing facilities

Aso Volcano Museum (Aso City)

The museum's exhibits focus on Aso Volcano. The museum is funded by entry fees and donations from the local public utility foundation. Its 30-year history and large scale draw about one hundred thousand paid visitors every year, including 36,000 visitors from abroad (Table 4-1). The unique geography, topography, animals and plants of Aso Geopark are displayed in the museum. The Aso Geopark Promotion Council's office is situated in the museum and functions as the Geopark's administrative center. The building also has a visitor center with free exhibits about Aso and other Geoparks in Japan and the world.

Museum and field tours for tourists and students are led by full time volcanologists, curators and skilled geological interpreters. These staff have also been engaging for many years in educational support for schools around the park. Because Aso is close to Korea and Hong Kong, the museum is an important educational facility for the Asian region as a whole; many visitors come from places without active volcanoes. Museum exhibitions change regularly and include a yearly exhibit on Geoparks.

Table 4-1 Aso Volcano Museum Visitors (2012) Unit: Person

All Visitors	From abroad	Geo-tour participants	Employees
103,840	36,340	12,027	20

Other base facilities

Minami Aso Visitor Center (Takamori Town)

This center, run by the Ministry of the Environment, was established to showcase the nature and livelihoods of Aso Geopark. The centre's Aso Wild Flower Garden offers a natural environment for observing the area's wide variety of flora. The centre functions as Aso Geopark's main botanical museum as well as a base facility for geological tourism in the southern caldera. Curators offer field and garden tours.

Fig.4-2 Minami Aso Visiter Center

Aso Den'en Kukan Eco Museum (Aso City)

This information dispatch and communication facility is run by a non-profit organization commissioned by the municipality. Located in front of JR Aso Station, the museum is designated as a 'Michi-no-eki' (road station) by the Ministry of Land, Infrastructure, Transport and Tourism, as well as a 'Visit Japan' Tourist Information Center by the Japan National Tourism Organization (JNTO). Its activities include distributing information about Aso Geopark and regional historical sites, guiding walks, and selling local specialties such as vegetables and dairy products.

Fig.4-3 Aso Den'en Kukan Eco Museum

Oguni 'Yu Station' (Oguni Town)

This information dispatch and communication facility with an exhibition space is run by a company commissioned by the municipality. The striking facility is located on the site of a former railway station and is built from Oguni Japanese cedar, a regional resource. This is the gateway for visitors from Fukuoka, Oita, and other parts of northern Kyushu.

Fig.4-4 Oguni 'Yu Station'

4-2-2 Informational signs and gate signs

Multilingual signboards were installed in Aso to support tourism even before it became a Geopark. Since starting Geopark activity, additional signboards with geological information have been installed, and projects are under way to improve the quality of existing signs (Fig4-5).

Fig.4-5 Aso Geopark signs

Aso Geopark sign guidelines

The proposed Geopark is situated largely within Aso Kuju National Park. For that reason, under the National Parks Law, installation of signboards requires approval from the Ministry of the Environment. In order to unify the design (including fonts, backing colour and symbols) and other elements of the signs such as quick response codes for cell phone users and universal accessibility, Aso Geopark has established sign guidelines and a sign plan.

4-2-3 Electronic signboard system and rental cycling

Fourteen electronic signboard systems have been installed in the Geopark. The 46-inch touch-panel, internet-linked screens give information on sightseeing, access and geological sites in Japanese, English, Chinese and Korean. A signboard is also installed at JR Hakata Station in Fukuoka, which serves as the gateway for visitors from Honshu (Japan's main island) and Asia. The sign is a useful tool for promoting the Geopark and welcoming visitors.

More than 60 rental bicycles (Fig4-6) are available in Aso Geopark, providing a sustainable transportation option within the area. Electronically assisted bicycles are easy to ride uphill and ideal for elderly visitors.

Fig.4-6 Rental cycling

4-2-4 Grasslands learning and communication centre

The Ministry of the Environment and Aso City plan to open a new facility for learning about grasslands and their relationship with the human community. The facility will also be a center for grassland preservation and regeneration. An information desk for Aso Geopark, geotourism and preservation of Geosites is planned in the center. Scheduled completion date: December 2014.

4-3 Analysis of geotourism potential of the proposed Geopark

Aso has been a popular tourist destination for many years. A typical visitor tours the dynamic volcanic landscape of Mt. Nakadake and Daikanbo then stays in a local hotel with an onsen. About 17 million people visit annually. However, while ecotourism and other new approaches to tourism have been introduced, visitors tend to go away without an integrated understanding of Aso's cultural, biological, and geological development.

Tourism related to the region's rich geological heritage has a high potential for reinvigorating Aso's regional economy and spurring a reassessment of local resources. In order to further develop geotourism, there is a need to focus not only on isolated sites but also to develop routes that organically link multiple sites, together telling the story of Aso's formation and the relationship between the geology and the lives of its inhabitants.

4-4 Overview and policies for sustainable development

Projects aimed at the sustainable development of Aso Geopark are outlined below. Future plans, including short- and long-term targets, are also listed below (Table 4-2) and can be found in chapter 4-7, the Action Plan.

4-4-1 Model geotourism routes

Five model geotourism routes in Aso Geopark have been developed with the aim of giving visitors an understanding of Aso's story. Each route takes about five hours and mixes elements of geology, folk culture, and intangible cultural assets. The theme of each route is as follows:

A. Nakadake Crater: Feeling the breath of the earth

Observe volcanic topography and geology near the crater; gain a sense of Aso's history of volcanic activity.

B. Tracing the history and impacts of a world-class caldera

Explore magnificent Aso Caldera and the pyroclastic plateau

C. Blessings of Aso Volcano: Ancient life and water

Imagine the lives of Aso's ancient inhabitants while visiting springs and shrines.

D. Human lives and volcanic geography

Observe geographical features formed by lava and pyroclastic flow in the southern caldera and learn about the culture and traditional wisdom of local people.

E. Aso and its myths

Experience the wonder of volcanic topography related to the myths of Aso's pioneer god.

One of the Geopark's short-term targets is to increase the number of model geotourism routes in collaboration with the local community and geoguides, incorporating elements of the regional culture. Information about the project will be shared with the Geoparks Network on an ongoing basis. A long-term target is to turn these routes into regular products offered by travel agencies in the Aso region.

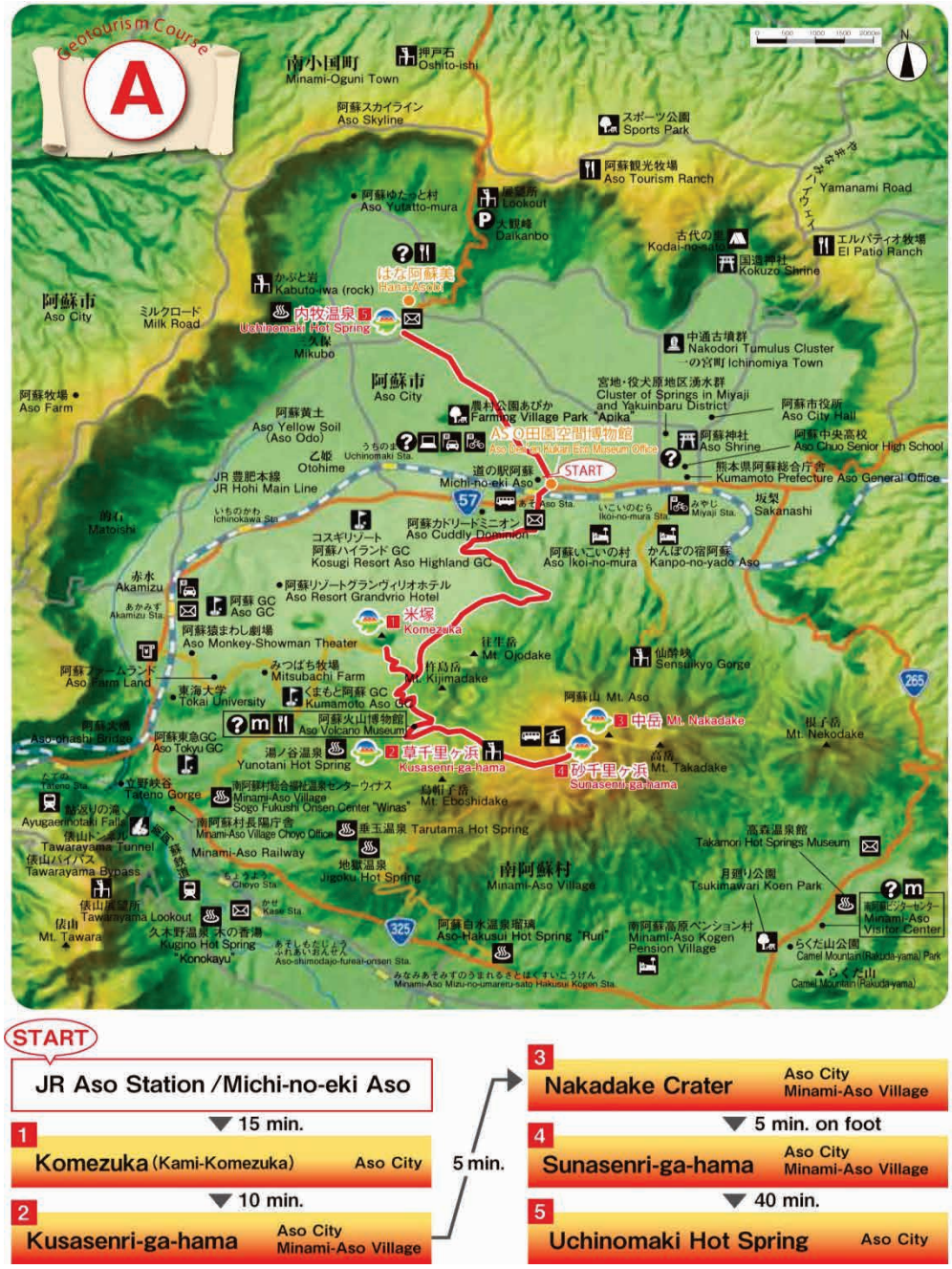


Fig.4-7 Model course A

4-4-2 Geoguides

Even before Geopark activities began, tourism related to Aso's Geosites was thriving in the region, and guides were knowledgeable about earth science, animals and plants in the proposed area. Following Geopark designation, a training program was launched to further educate these nature guides, as well as other interested members of the public.

Fig.4-8 Geoguide training

The program includes classroom lectures as well as practical lessons in the field, and today 42 men and women ranging in age from their 20's to 70's have been certified as geoguides. All are members of the Aso Geopark Guides Association (Fig.4-9), which is managed by the Aso Geopark Promotion Council and is in charge of arranging geotours. Within seven months of the association's establishment more than 300 visitors joined the geotours, and the number is increasing. Guides receive a payment of 5,000 JPY for a full day tour or 4,000 JPY for a half-day. The eventual goal is for these guides to be able to earn their living through guiding work alone.

Members of the Guides Association also participate in supplemental training programs and geosite maintentance on a regular basis, as outlined in their yearly plan. The diverse backgrounds of the geoguides, including teachers, nurses and fire fighters, adds individual character to the tours. To ensure that each tour nevertheless is equal in quality and provides visitors with the greatest level of understanding, the association has developed an original guide manual. The guiding group's activities are expanding every year. In the future new guide training program will be implemented and the training program for existing guides will be systemized. Foreign language training is planned to strengthen guide services for foreign visitors, and a central facility for geoguides ,including a place where visitors can sign up for tours is also planned to improve the convenience of the guiding system.

Fig.4-9 Aso Geopark guides Association

4-4-3 Promotion

Aso Design Centre Foundation (ASODC) began promoting tourism featuring Aso Caldera before its designation as a Geopark, The practical know-how gained through this previous promotional work has proven a valuable resource since Geopark activities began, and the foundation has carried out a number of highly acclaimed and innovative promotional campaigns. Taking advantage of the fact that Aso is already a developed tourist destination, ASODC makes a strong effort to promote geotourism in a way that involves both national and local tourist agencies to ensure that tourism contributes to the regional economy.

Fig.4-10 Geobrand design

Airlines

Each year ASODC make a comprehensive business agreement with All Nippon Airways (ANA) to promote the Aso region. This arrangement includes the promotion of Aso Geopark on ANA's website, the sale of tickets that include local bus service to Geosites, and informational displays about the Geopark inside the airplanes. ANA Sales (an affiliate of ANA) and the Aso Geopark Guides Association have collaborated on a popular package tour that includes airline tickets and taxi service, offering a convenient option for visitors from Japan's major cities.

Advertising agencies

The Aso Geopark Promotion Council contracts with professional advertising agencies for the marketing and planning of each project, including the design of leaflets and maps and the planning of a related "geobrand" (Fig.4-10). Collaboration with these agencies also helps Aso Geopark staff improve their skills in terms of designing text and images that effectively generate public interest in the park.

Travel and tourist agencies

ASODC has a business agreement with Japan's largest travel agency, JTB, to work together on monitoring tours (see below for further information) and sell geotourism products. The foundation also works together with local travel agencies to put together geotours featuring accommodation at local inns. This unique collaborative plan also incorporates tours by the Aso geoguides. A variety of other geotourism plans for both big and small groups are also available from several travel agencies. ASODC plans to continue to strengthen its collaboration with travel and tourist agencies in the future.

Local transportation (buses and ropeway)

Many loop line buses operate within the caldera. Since 2012 buses have featured wrap-around images of Aso Geosites to generate excitement among both locals and visitors about the proposed Geopark (Fig.4-11). The park also collaborates with the company operating the Mt. Nakadake ropeway to promote the Geopark at display spaces in their terminals.

Fig.4-11 Aso Geopark bus

Monitoring tours and overseas advisors

Since 2013, ASODC has organized bus tours of the five model courses to research visitor satisfaction. In preparation for joining the Global Geoparks Network, the foundation has also carried out monitoring tours by international students from China, Korea, Taiwan and Europe. As special advisers for Aso Geopark, this network of students is asked to evaluate both the hard and soft elements of the park infrastructure on an ongoing basis in order to improve the visitor experience. (Fig.4-12)

Fig.4-12 Monitoring tours by international students

Promotional activities at events

Aso Geopark has taken part in many promotional campaigns and tourism-related events both inside and outside the local area (Fig.4-13), and plans to continue to do so in the future. Starting in 2014 Aso Geopark will also take part in international travel fairs.

Fig.4-13 Promotional activities at events

4-4-4 Geoeducation

Fig.4-14 explanation of the mechanisms behind caldera formation

The proposed Geopark is a popular destination for school trips because of its unique and diverse geology and topography as well as the opportunity it provides for integrative and active education about the culture, history, and disaster prevention activities of people living in volcanic areas. Eighty-one thousand students, mainly in junior high and high school, visit each year from Japan and other Asian countries. The three most popular destinations for these groups are the Nakadake Geosite, which is well maintained and allows for safe observation of a volcanic crater, the Kusasenri Geosite, ideal for trekking on volcanic topography, and the Daikanbo Geosite, where students can look out over the magnificent caldera. Curators and museum interpreters at Aso Volcano Museum have been leading student study tours for many years, and the continuation of these educational programs is essential. The Aso Geopark Promotion Council plans to continue encouraging children to learn about important regional resources as a key step towards Aso's long-term sustainable development.

Geoeducational support for local students and the educational promotion ordinance.

Volcanic disaster prevention, geological disasters, and the study of regional resources related to the Geopark are part of the curriculum for most elementary and junior high students in the Aso region. For the past seven years, elementary students have had a chance to present what they have learned about geology at an annual symposium; plans to continue the event are in place. With talks from top scientists in many fields, the symposium has become a popular yearly event where children have a chance to get inspired about science.

Municipalities in the Aso region are also home to Japan's first local ordinance aimed at promoting the utilization of regional geological resources in education. Local schools are taking part in the program enthusiastically.

Aso Geopark Promotion Bureau's future goal is to encourage all area schools to use the Geopark as an educational resource.

The Geopark as a school subject and activities of high school Geo Clubs

Starting in 2013 first-year high school students in the area have taken part in a class on Aso Geopark as part of their compulsory curriculum. The educational program includes lectures by curators at the Aso Volcano Museum and staff at the Aso Geopark Promotion Council, as well as self-directed learning. Science club activities have also increased greatly since the establishment of the Geopark. With support from Aso Geopark Promotion Council, science club members have been researching the landslide that took place in 2012. Their research was presented and honored at Kumamoto Prefecture High School Science Club conferences two years in a row, winning second and third prize. Their unique observations and perspective are a positive example for future geo-education curriculum. A project to make original Geopark maps using the results of student research is currently being planned.

Activities of educational organizations

Educational groups belonging to the Aso Geopark Promotion Council are active in implementing their own geological education programs. For example, the 'Elementary Geo Expedition' is a popular summer program launched by the National Aso Youth Friendship Centre in 2012. After completing the program, children are qualified as volunteer Aso Junior Geoguides and can take visitors on tours.

Development of educational materials

Curators at Aso Volcano Museum have taken a unique and innovative approach to visitor education, with easy-to-understand presentations such as an explanation of the mechanisms behind caldera formation that uses flour and balloons (Fig4-14). Aso Geopark Promotion Council is collaborating with Aso Volcano Museum to develop more educational materials that convey key concepts about the Geosites in an easily understood way.

4-4-5 Topographic and geological heritage

Aso Geopark Promotion Council supports the application of national regulations to Geosites in order to ensure their sustainable use. Since Geopark activities began, the major Geosites of Komezuka and Kusasenri have been designated as National Monuments under the Cultural Assets Preservation Act. The Council plans to draw up further regulations to preserve and utilize Geosites in cooperation with stakeholders and those involved in site management.

In particular, the grasslands have been designated by the cabinet office as a special area for local revitalization; over the next few years the council will create regulations with local residents regarding the use of related geological and topographical heritage sites. Using these regulations as a model, the council plans to undertake a similar process for all geological sites within Aso Geoapark.

Fig.4-15 Field Research

Every year, with the assistance of consultants, the council carries out field research in the sustainable use of Geosites and utilization of regional resources (Fig.4-15). The research includes academic topics relevant to the use of Geosites and surveys of hazardous sites that need special preservation or maintenance, as well as documentation of their actual condition and any improvements needed. These documents are used as a reference report for the council's own operations and are also given to municipalities involved in Geosite management and other related groups. A system is also in place by which Aso geoguides may report any sudden changes in the Geosites to the council, which then conveys the information to the relevant municipality.

Table.4-2 Summary of policies for sustainable development

	Policies	Long-term Targets
4-4-1 Model Geotourism Routes	・Increase the number of routes in collaboration with local residents and geoguides. ・Develop routes that incorporate regional culture and share these examples with the Geoparks Network.	Propose these as regular products for travel agencies in the Aso region.
4-4-2 Geoguides	・Establish training program for new geoguides. ・Formalize the ongoing training program for existing geoguides. ・Develop multilingual guiding tools and language training. ・Build a base facility and booking service.	Promote popularity of guided geotoursim. Raise guides' income by increasing visitors and improving guiding skills.
4-4-3 Promotion	・Hold regular monitoring tours ・Strengthen collaboration with travel and tourism agencies. ・Participate in international travel fairs	Promote popularity of guided geotoursim. Propose regular products for travel agencies in the Aso region.
4-4-4 Geo-Education	Make original Geopark maps using student research.	Work with area schools to increase geo-education
4-4-5 Topographic and geological heritage	Develop model cases of preservation and utilization. Continue surveys of Geosites.	Manage all Geosites based on regulations related to preservation and utilization

4-5 Policies for and examples of community empowerment in the proposed Geopark

The Aso Geopark Expert Committee has been established to facilitate the sharing of research across disciplines and to discuss comprehensive regulations related to the park. The committee includes local experts on hydrology, biology, history, folklore, disaster prevention, and geological sciences, as well as a member of the Japan Geopark Network.

Fig.4-16 Aso Geopark Expert Committee

The practical operations of the park are overseen by a board of governors that includes representatives from municipal governments and business associations in the region.

ASODC also hosts programs to develop the hospitality industry in Aso. Staff at information centers, hotels, and shops in each municipality take part in yearly workshops designed to improve their hospitality skills and knowledge of the Geosites. These "community concierges" then are able to help visitors make the most of their time in the park based on their individual needs.

4-6 Policies for, and examples of, public and stakeholder awareness in the proposed Geopark

Fig.4-17 lectures aimed at local residences

Fig.4-19 Geo Sketch

Academic advisers and members of the Aso Geopark Promotion Council have been giving lectures aimed at local residences (Fig.4-17) in each municipality within the proposed Geopark area. This has stimulated interest and involvement in Geopark activity. The council also holds symposiums related to Geopark activities at least once a year (Fig4-18), which many local residents participate in. For students, 'Geo Sketch' (Fig4-19) drawing contests and 'Geo Expedition' tours of Geosites are held every year. These events will be continued in the future.

Fig.4-18 Geopark Symposium

Geopark branding

The Promotion Council has created an original Aso Geopark logo (Fig.4-20). This stylized image of the caldera and central volcanic cone group, printed in the park's theme colours, is used for promotional materials and events. Members of the council also frequently use the logo at their independently organized events, which improves name recognition of the park. After becoming a member of the Global Geoparks Network (GGN), the council will work to increase recognition of GGN by adding the GGN logo to its materials.

ASO GeoPARK

Fig.4-20 Geopark logo

In 2012 the council also created a Geopark brand for products that communicate a part of the park's story. Most of the branded products are regional foods, such as milk, and manufactured products related to the Geopark.

Geo-products

The Aso Geopark Promotion Council aims to increase the availability of maps that convey the shape of the caldera in an easily understood format. Birds-eye view maps created in collaboration with a major Japanese map company have become a popular park souvenir (Fig4-21).

Fig.4-21 Birds-eye view map “Aso Geo Art”

PR materials and multilingual communication

Aso Geopark’s PR materials, such as posters, leaflets and DVDs, are available at each of the park’s facilities (Fig.4-22). A comprehensive guidebook of Aso Geopark, which tells the story of the park and of each Geosite, has also been published. Multilingual leaflets are available in English, Chinese (Cantonese and Mandarin), Korean and French.

News and reports about Aso Geopark are posted regularly on the park’s official Facebook page, Twitter account, and website, which was created in 2010. Last year, an automatic translation system was added to the website for translating Japanese to English, Chinese (Cantonese, Mandarin) and Korean. Other promotional materials include original television and radio programs and a quarterly tabloid newspaper, which is distributed throughout the area of the proposed Geopark.

Fig.4-22 PR materials

Networking

Aso Caldera Symposium

There is a strong possibility that a super eruption like the one which formed Aso Caldera will occur again in the future. Aso Geopark has an important role to play in global disaster prevention by sharing the story of its geological history and impacts. In 2013 the first international symposium on super eruptions and calderas was held at Aso Geopark, with Dr. Stephen Self, Vice-President of International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI), as the keynote speaker (Fig.4-23). Among the other invited guests were internationally acclaimed scientists and volcanologists specializing in super eruptions. About 300 participants, including local residents and students, engaged in in-depth discussions at the event. The symposium will be held in future years with the goal of making Aso a mecca of caldera research and interdisciplinary exchange.

Fig.4-23 Aso Caldera Symposium 2013

Communication with other GGN areas

In the summer of 2012, the Promotion Council, in collaboration with Aso Volcano Museum and with major support from GGN and JGN, organized an exhibit titled 'Earth Journey ~ Global and Japanese Geoparks,' (Fig.4-24) About 30 Geoparks in Japan and other countries contributed materials; for some it was an opportunity to improve these materials. Aso Geopark continues to use the exhibit displays to introduce visitors to Geoparks around the world.

Fig.4-24 "The Earth Jouerny" at Aso Volcano Museum

Exhibit exchanges have been carried out with Batur Global Geopark in Indonesia, which has a similar theme as Aso Geopark. An exhibit about calderas around the world is now on display in Aso, and includes materials contributed by Batur Global Geopark. In November 2013, the first APGN student exchange program took place in cooperation with Hong Kong Global Geopark of China, Unzen Volcanic Area Global Geopark and Itoigawa Global Geopark. The Promotion Council actively promotes communication with other Geoparks and plans to make friendship agreements with other parks in the future.

Staff training

Since Aso Geopark became a member of JGN in 2009, staff have visited Global Geoparks in Japan and Asia, such as Hong Kong Global Geopark of China, and staff from parks in other countries have visited Aso. These visits have strengthened Aso's connection with other parks. Aso Geopark staff plan to take part in the APGN training workshop in December, 2013.

International Conference

Since attending the 4th International UNESCO Conference on Global Geoparks (Geoparks 4) in Langkawi Geopark in 2010, members of the Aso Geopark Promotion Council have participated in and presented at the GGN and APGN international conferences. Recently members of the Aso Geopark Guides Association have also taken part in these conferences.

Fig.4-25 Presentation on Geoparks 5

Table 4-3 Track record of conference participation

GGN Conference	Participants from Aso Geopark
4th Conference (Langkawi Geopark, Malaysia)	7 participants
5th Conference (Fig.4-25) (Unzen Volcanic Area Geopark)	70 participants, including elementary students and geoguides
APGN Conference	**Participants from Aso Geopark**
2nd Symposium (Dong Van Karst Plateau Geopark, Vietnam)	5 participants
3rd Symposium (Jeju Island Geopark, Korea)	13 participants, including geoguides

4-7. Action Plan

Table 4-4 summarizes plans for the park's future, as detailed in section 4.

Progress will be assessed at the end of each financial year.

Table.4-4 Aso Geopark Action Plan

Category		2013-2014 Short-Term Targets (including ongoing projects)	GGN 2014-2018 Mid-Term Targets	2018 Targets
Maintenance	4-2	Develop signboards and install at all Geosites Develop new base facilities and expand existing facilities (ongoing) Maintain trekking courses(ongoing)	Revise and develop signbords on an ongoing basis. Develop and maintain trekking courses	Complete all Geopark signboards。 Complete maintainance work at all hazardous Geosites
Model Geotourism Routes/ Geoguides	4-4-1 4-4-2	Prepare guide manual Develop guide equipment (ongoing)	Certify new guides. Systemize skill-up training. Develop geotourism routes. Strength language skills to host overseas visitors. Encourage participation of local communities. Develop facilities for geoguides.	Incrementally increase the number of yearly geoourism visitors. Train professional geoguides
Marketing	4-4-3	Collaborate with travel and tourism agencies Market tie-up products (ongoing)	Develop new geotourism collaborations with travel agencies Present Geopark activities to network. Carry out a large-scale survey in urban areas	Develop standard products for travel agencies
Education	4-4-4	Utilize the park as a resource for school education (ongoing) Prepare guidebooks for elementary school students	Develop geoeducational materials for schools. Create a Geopark map linked to regional school classes. Present project results at Geopark conventions etc.	Encourage all schools in the Aso area to utilize the Geopark as an educational resource.
Research	4-4-5 4-5	Host Caldera Symposium (ongoing) Research Geosite resources (ongoing) Host Expert Committee (ongoing)	Develop a framework for encouraging research. Provide opportunities, such as symposiums, for scholars to present their research. Present and promote disaster research.	Publish research papers on an ongoing basis. Develop a support systems for reserchers
Preservation	4-4-5	Develop policies and plans to preserve and utilize Geosites Improve national preservation regulations (ongoing) Promote the utilization of grassland resources (ongoing)	Establish Geosites in disaster areas. Rresearch Geosite resources Develop a plan for site preservation and utilization. Close the quarry and regenerate the quarry area.	Develop and implement preservation and utilization regulations for all of Aso's geological heritage.
Collaboration with local communities	4-6	Host promotional events (ongoing) Oversee the Geopark branding system	Promote the use of the Geopark logo. Host events for Geopark brand certification. Host ongoing regional Geosites seminars. Support the internationalization of the local tourism industry	Encourage independent activities by the local community. Increase sales of Geopark brand products
Networking	4-7	Participate in GGN meetings (ongoing) and share information with other Geoparks (on-going). Host symposium (ongoing)	Emphasize communication with GGN and JGN and make friendship agreements with other parks. Communicate with other volcanic Geoparks at the Caldera Symposium (including aspiring Geoparks) Promote the GGN in the local community. Host future Network conventions	Make friendship agreements with other Geoparks. Attract and host Network conventions

Chapter 5

REASONS FOR JOINING THE GLOBAL GEOPARKS NETWORK

What Aso Geopark will bring to the GGN

1. The opportunity to observe a clearly-shaped, intact caldera and other pyroclastic topography, and by doing so to understand the process of their formation and their impacts on the surrounding areas. Many calderas exist in the world but few share the scale and excellent condition of the Aso Caldera. Aso Geopark's unique geological heritage offers a chance to observe both a caldera created by a super eruption and a range of features created by subsequent volcanic activity, making it an extremely valuable site.

2. Close-up views of an active crater, crater basin, and unique volcanic desert. Nakadake Crater is a world-class Geosite that allows visitors to sense the "breath of the Earth."

3. A rich history of coexistence between humans and volcanoes, including religious rituals and folk culture. The people of Aso have also developed a unique agricultural system, designated as a Globally Important Agriculture Heritage System (GIAHS), through which semi-natural grasslands and their constituent plants have long been maintained.

4. Innovative ideas for Geopark operation and promotion. The proposed Geopark is funded primarily by income from investments from the private sector, but benefits from significant government participation as well. Aso's experience with innovative organizational approaches is a valuable resource for other parks in the GGN.

5. Wisdom and stories from the 70,000 people living inside and outside the caldera. The volcano has shaped human culture for thousands of years – both through the natural blessings it brings in the form of water and diverse plant and animal life, and through the periodic disasters it has caused. Aso has much to offer in terms of disaster prevention knowledge.

6. An innovative system for researching and monitoring volcanic activity that plays an important role during emergencies.

7. Education programs and support for regional schools.

Our mission to GGN

The Aso Caldera and its super eruptions have been studied for many years, yet much remains to be discovered. We aim to advance this research and contribute to the field of volcanology on the international level. Areas for future study and our mission to GGN include magma genesis; differences in deposit from the four super eruptions; the relationship between pyroclastic flow and the caldera; and the likelihood of another super eruption and its possible warning signs.

Sustainable livelihoods for local people: the true goal of Geopark activity

We aspire to become a member of the Global Geopark Network in order to advance the goal of sustainable development in the Aso region. The proposed area has an aging and shrinking population. Our aim is that local residents discover the value of regional resources and contribute to the sustainable development of the region. To do so, we believe it is essential that they deepen their understanding of their rich geological heritage. Joining the GGN will also contribute directly to regional development by drawing new visitors from overseas. We have prepared well for networking with GGN. We believe that through our existing activities and proposed action plan, we will make a significant contribution to the network.

Paris city, France

about 105.4 square kilometres.

Aso Caldera

north-south : about 25 kilometres
east-west : about 18 kilometres
perimeter : over 100 kilometres
total inner area : about 380 square kilometres.

ASO GeoPARK

Application for membership in the Global Geoparks Network

Aso Geopark Promotion Council, JAPAN

A member of Japanese Geopark Network