

Geotourism Observational Investigation From the Tourist Perspective: A Case Study of Kyushu Area Volcanoes, Japan

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Abstract

Of late, geotourism has become a viable part of global tourism; however, it is still a little-known tourism activity in many parts of the world. Geologists and volcanologists have been studying active volcanoes for years, but it is just in the past several decades that geotourism has become popular with those seeking an interesting and adventurous tourism experience. In the authors' country of residence, Japan, volcanoes are part of the fabric of society in that many people live and work directly around active volcanoes, which have generated keen tourism interest there. Kyushu, where the authors live, contains four active volcanoes that are geo-related tourism destinations; several of them have been given UNESCO Global Geopark (UGGP) status. However, very little research has been conducted among these volcanoes, and, as such, the volcanoes receive little attention globally. To fill this gap, the authors decided to conduct observational investigations of each of the volcanoes to determine the potential for tourism activities. Findings show that all sites had potential to be interesting and informative destinations that offer interesting geo experiences with opportunities for environmental learning.

Keywords: geotourism destinations, active volcanoes, volcano tourism, volcanic observation, Japan volcanoes

1. Introduction

During the past two decades, tourism, and all its forms (including ecotourism, adventure tourism, medical tourism, and food tourism to name a few), has increased globally, introducing dynamic destinations, international food, and unique adventure opportunities to millions of travellers. Although the COVID-19 pandemic paused tourism for two to three years, the world in 2023 appears to be geared towards resuming global tourism activities. One area of tourism that has had little attention over the past decades, and is, therefore, in its infancy, is geotourism. Like ecotourism, there are many definitions of geotourism; however, one accepted definition by tourism researchers has been put forth by the National Geographic Society: "Geotourism is defined as tourism that sustains or enhances the distinctive geographical character of a place—its environment, heritage, aesthetics, culture, and the well-being of its residents" (National Geographic, 2023).

Many areas with notable seismic activity and volcanoes of interest have become defined as Global Geoparks by UNESCO under that paradigm that "geoparks are areas that use the concept of sustainability, value, and the heritage of the earth and recognize the need to protect it" (UNESCO, 2017 in Dowling, 2017). As such, geoparks are geared towards offering both formal and informal education, for adults and students alike, that offer information and awareness that link to other aspects of cultural and intangible heritages. In addition, geotourism has contributed millions of dollars of revenue to the global tourism industry. Research at Kilim Geopark in Malaysia by Yacob et al (2013) finds a high level of satisfaction in tourists for the tourism services offered there. Research into the Chablais UNESCO Global Geopark in 2018 was conducted to raise awareness of the geopark term, to teach awareness of the Chablais area and to promote tourism to the area. The research incorporated a ski activity in which participants were to complete routes in a set time, after which they could exchange ideas with geopark staff. Following this a questionnaire was conducted with the participants. Results found that 90% enjoyed participating in the activities and 70% would continue to frequent the area (Justice, 2018).

One part of the earth that contains many of the world's most active volcanoes is Japan. Japan contains nine UGGPs and 37 Japanese National Geoparks. The authors currently reside in Southwestern Japan on the island of

Kyushu within proximity to two active volcanoes that fall under the UNESCO Global Geopark status: Aso, in Kumamoto and Unzen, in Nagasaki. Two other volcanoes of interest in Kyushu are Sakurajima in Sakurajima-Kinkowan Geopark in Kagoshima (a Japanese National Geopark) and Kuju in Oita that has no classification but is interesting, nonetheless. To the authors' knowledge, very little academic research has been completed on these geoparks as viable tourist destinations and perspectives that include site information, amenities, English information, closeness to risk, and other tourism aspects. Because of the gap in information, the authors decided to investigate four volcanoes in the Kyushu region during investigative trips to each of the volcanoes. The volcanoes (and volcanic areas) under research are: Unzen UGGP, Kuju Mountain Range, Aso UGGP, and Sakurajima-Kinkowan Japanese Geopark. These volcanoes were chosen due to proximity to the authors and also for the diversity in volcanic type, challenge of hiking, and for their ability to raise awareness of Geopark tourism in Japan and to generate interest in visiting UGGP and in Global Geopark tourism.

2. Background of Japan's Geology

Japan is situated along the Pacific Ring of Fire which is home to 452 volcanoes, and it has 75% of the world's active and dormant volcanoes. Given its position atop the huge North American, Pacific, Eurasian and Philippine plates, Japan has always been prone to geological forces. This tectonic activity has created explosive volcanoes, some of which continue to send forth plumes, and occasional booms. According to the Japan Meteorological Agency there are 111 active volcanoes in Japan (JMA, 2016), so it is an interesting part of the world in terms of both age-old volcanic landscapes and present-day eruptive episodes. Dormant since 1707, Japan's Mt. Fuji is a sacred mountain climbed by thousands each year. One legend has it that the volcano was born from the unfinished dream of a giant who wanted to fill the Pacific Ocean (KECIA, 2021).

The Japanese Geoparks Network (JGN) website describes a geopark as: "[a] unified geographical area where sites and landscapes of geological significance are managed with a holistic concept of protection, education and sustainable development" (JGN, 2023). The geosites researched for this paper are all on Kyushu which is the most southerly, and third-largest, island that makes up the Japanese mainland.

While the neighbouring prefectures of Saga, Fukuoka and Miyazaki are also rich in natural beauty, and contain other popular geographical destinations, the geosites chosen for this study are situated directly on the Futagawa-Hinagu fault lines, which have contributed to complex lithology and unique geological landscapes (Aso UGGP, 2012).



Figure 1. Aso Volcano's Location in Relation to Kyushu's Quaternary Volcanoes

Source: Aso UGGP, 2012.

The activity of Quaternary volcanoes spans a period of about 2.5 million years ago to the present day, so it includes active volcanoes. A million years is a megaannum, abbreviated to Ma.

3. Explanation of Geosites Under Investigation

3.1 Kyushu Geosite Locations Overview

In the interest of assessing and creating accessible Geotourism itineraries for visitors to Kyushu seeking out geological attractions and destinations, the scope of this study includes peaks at geosites in the following locations: Unzen Volcanic Area UNESCO Global Geopark in Nagasaki; the locality of Makinoto Pass, Aso-Kuju National Park in Oita; Aso UNESCO Global Geopark in Kumamoto, and; Sakurajima-Kinkowan Geopark in Kagoshima.

The Futagawa fault line runs east-west through Kyushu and includes Mt. Unzen (Nagasaki), Mt. Kinpo (Kumamoto), Mt. Aso (Kumamoto), Mt. Kuju (Oita), Mt. Kokonoe (Oita) and Mt. Tsurumi (Oita). Mt. Kirishima, Mt. Sakurajima and Mt. Kaimon are in Kagoshima, and are all situated along the Hinagu fault line which runs north-south through Kyushu. Of Japan's nine UNESCO Global Geoparks, two feature in this research: Aso UGGP and Unzen Volcanic Area UGGP, in Kumamoto and Nagasaki respectively. Of the 37 Japanese National Geoparks, Sakurajima-Kinkowan Geopark in Kagoshima was also chosen for this study.

3.1.1 Site 1. Mount Fugen. Location: Mount Unzen, Unzen, Shimabara Peninsula, Nagasaki Prefecture, Japan. Classification: UNESCO Global Geopark. Mt. Unzen Activity Period: From 0.5 Ma. Latest eruption: AD 1996. Unzen and its surrounding area was designated as the first national park in Japan in 1934 and its highest peak, the inaccessible Heisei Shinzan, is 1,483 metres high. Mt. Fugen (1,359m) is the second highest peak. The Unzen area was designated as a Global Geopark Network member in 2009, and a UNESCO Global Geopark in 2015.

3.1.2 Site 2. Mount Kuju. Location: Oita Prefecture, Japan. Classification: No geopark classification. Activity Period: From 0.2 Ma. Latest eruption: AD 1996. The second location chosen for this study is Mt. Kuju, situated in the Aso-Kuju National Park, Oita. While not located in a Geopark it is part of the Kuju Mountain Range and Mt. Kuju itself is the second highest peak in Kyushu at 1,786m, so it is both a geologically rich and popular hiking destination. Its neighbouring active crater, Mount Io can be seen to its Northeast.

3.1.3 Site 3. Mount Eboshi. Location: Aso, Kumamoto Prefecture, Japan. Activity Period: From 0.09 Ma. Latest eruption: AD 2020. Eboshi Peak stands next to the Mount Aso crater, which remains active. The peak itself is approximately 238m, and while it is not a long hike, the mountain affords very good views of the active Aso, and is part of the Aso UGGP.

3.1.4 Site 4. Sakurajima. Location: Sakurajima, Kagoshima Prefecture, Japan. Activity Period: From 22,000 yBP Latest eruption: 2023 (ongoing). After a 5-year dormancy since April 2018, Sakurajima has been displaying regular eruptions at the Showa Crater. Sakurajima is not a UNESCO Geopark, but is a Japanese National Geopark, and as such, has a poignant relationship with the people of Kagoshima Prefecture. Height: 1,117m. While it is not possible to hike to the crater, one can experience tremendous views from nearby viewpoints and the Yogan Nagisa Trail.

4. Method

The authors conducted observational research at the four locations mentioned above. The dates of observation were: 12 February, 23 February, 22 March, and 9 April, 2023. The method of research was to hike at the site as a tourist normally would, and approach the volcanic crater as closely as possible. The authors took notes during the trip according to the observation checklist (see Appendix). All pertinent elements were noted, photographs of each area were taken, and discussion was conducted following each excursion. A detailed analysis can be found in the results section. The chosen research methodology of Grounded Theory lends itself well to an observational investigation from a tourist's perspective as it puts forth that: the most obvious is usually the most important. Therefore, by highlighting the usual features and expectations of tourist travel and exploration, and assigning them to volcanic areas so as to examine Geotourism, we can better analyse the data collected to explore relationships between the geosites researched.

Tourists are consciously, and, to some extent, unconsciously concerned with directions, ease of movement, knowledge gained and services available. Thus, the ten main items chosen for the 5-point adequacy scale fall under four main themes, namely: Signage (All, English, Size); Access (By road, To trail); Amenities (Shops, Vending Machines, Benches); and, Information (All, English). As for Signage & Information, phone apps and in-car navigation systems can guide us almost anywhere, but, while on the ground exploring or hiking, discerning our surroundings by using various trail signs, flags or markers is an integral part of self-guided tourism as well as fostering an appreciation for our surroundings. Directions are traditionally indicated through signage, such as

signposts, billboards and natural or man-made landmarks. Of late, traffic information LED displays can give up to date information, as well.

Similarly pamphlets, information boards and maps, both promotional and fixed, including navigational, pictorial and locator maps, contribute to ease of movement and educational needs fulfilling both directional and informational functions. In a geotourism setting, especially around active volcanoes or challenging landscapes, additional signage and boundary markers are needed to alert and inform the tourist by using precautionary symbols or instructive text. Furthermore, signage indicating conservation and preservation activities, in line with sustainability efforts, are highly valued, and even expected, by geotourists.

5. Findings and Observations

This section explains the geoparks that were observed and sets out the findings in the following fashion: first, the background of each area is given; next, the route is explained, followed by trail observations, geological observations, and a brief summary.

Table 1. Characteristics of Hikes/Trails Observed

Items	Mt. Fugen Unzen, Nagasaki	Mt. Kuju Kuju, Oita	Mt. Eboshi Aso, Kumamoto	Mt. Sakurajima, Kagoshima (Yogan Nagisa Trail)
Height	1,359m	1,786m	1,337m elevation from sea level	1,117m
Location	Unzen Volcanic Area UGGP	Kuju Mountain Range	Aso UGGP	Sakurajima-Kinkowan Geopark
Activity Period	From 0.5 Ma	From 0.2 Ma	From 0.09 Ma	From 22,000 yBP
Recent Activity	Eruption: 1996	Ash Fallout: 1996	Ash Fallout: 2020	Minor eruptions: 2023
Trailhead taken	Nita-Toge Pass	Makinoto Pass	Approached from Kusasenri	Approached from Sakurajima Port
Trailhead alternative(s)	Daini-Fukikoshi Pass	Kokonoe Pass Chojabaru Pass Akagawa Onsen Pass	NA	NA
Distance	7.9km	12km	3.9km	3km
Duration	4.5 hours (incl. 1hr rest)	6 hours (incl. 1hr rest)	2 hours 20 mins (incl. 1hr rest)	1.5 hours (incl. 20 min rest)
Incorporated Peaks & Points of Interest (POI)	Mt. Myoken (1,333m) Azami Valley Heisei Shinzan (1,483m)	Mt. Kutsukake (1,503m) Nishi-Senrigahama Lake Oike Mt. Io Crater (1,580m) Tadewara Marsh*	Kusasenri Mt. Naka Crater (1,506m) Aso Volcano Museum Mt. Aso Visitor Center	Sakurajima N.Peak (1,117m) Center Peak (1,060m) Sakurajima S.Peak (1,040m) South Peak Showa Crater Sakurajima Visitor Center Yogan Nagisa Footbath

				Tsukiyomi Shrine*
				Yunohira Observatory*
				Sakurajima-guchi*
				Kurokami Buried Tori*
Other Peaks/POI	Mt. Kunimi (1,347m) Kaza-Ana Lava Caves Unzen Hells* Lake Oshidori* Gensei Numa Marsh*	Mt. Ougi-ga-hana (1,698m) Mt. Hossho (1,762m) Mt. Tengu-gajo (1,780m) Kita-Senrigahama Crater* Bogatsuru Marsh*	Mt. Kishimadake (1,326m) Kusasenri Observation Station	Karasujima Observatory Akamizu Observatory Square Super Magma Road Shiroyama*
Difficulty	Moderately Difficult: Mostly uneven surfaces with dirt, rock and boulders.	Moderately Difficult: Mostly uneven surfaces with dirt, rock and boulders.	Easy: Mostly dirt with occasional unevenness	Easiest: Paved, accessible trail
Incline	1,061m	1,026m	237m	NA
Weather Factor	Compacted snow/ice near summit	Crampons required in winter	Noyaki, Mid-Feb to End of March	Open all-year-round (See below)
Practical Point(s)	Cable car at trailhead. Mt. Heisei Shinzan (1,483m) strictly prohibited.	Rest hut and toilet 2.5 hours in, but toilet requires own toilet bag.	Visitor Center & Museum. Paid parking. Tour buses. Check crater's level beforehand.	Restricted access due to boardwalk construction from 25 May, 2023 through 20 July, 2023. Visitor Center & Shops

POI = Place of Interest *denotes that the POI was located off the trail taken

(Source: Derived from Survey Data, 2023)

yBP = years before present (geological time scale)

5.1 Site 1: Mount Fugen

Unzen Volcanic Area UGGP covers Shimabara Peninsula in Nagasaki Prefecture and contains Shimabara City, Unzen City and MinamiShimabara City, with a total population of approximately 150,000. The Geopark's centre, at Unzen Hells, is 50 km east of Nagasaki City and is accessible by car and bus, and partially by train. From neighbouring Kumamoto and Nagasu ports, ferries can be taken to Shimabara and Taira ports respectively, with Unzen City approximately 20 km away. Shimabara Peninsula was created by volcanic activity around 400,000 years ago and Mt. Unzen is located in its centre, on the outer ring of the Chijiwa Caldera. Mt. Unzen comprises several composite volcanoes; the oldest, Mt. Fugen, the newest, Heisei Shinzan, and Mt. Myoken and Mt. Kunimi. The northern and eastern parts of Mt. Unzen are on a wide, fertile, volcanic fan, used for agriculture (National Parks of Japan, 2016).

In 1991 an eruption killed 43 people when they were engulfed in a pyroclastic flow. Pyroclastic flows in 1990 and 1995 formed Japan's newest volcano, Mt. Heisei Shinzan (1,483m) which is off-limits. Despite relatively recent natural disasters, the Unzen hiking route is a popular one taking in three peaks. (Unzen Volcanic Area UGGP, 2021)

5.1.1 Trail Observations

Visitors to Mt.Unzen’s peaks access Nita-Toge Pass via a one-way road, costing 100 yen. It is possible to hike from Unzen City; it commences as a roadside walk and turns into a hilly scramble. Nita-Toge Pass car park is quite large, but has only toilets and a gift shop.

The trailheads are behind the Nita-Toge Pass Observatory and the route is a loop which can be approached from either end at this point, although it is usual to take the left trail which commences with the ascent of Mt. Myoken (1,333m). The Unzen Ropeway goes up to Mt. Myoken Observatory, with views of surrounding mountains and the Ariake Sea. From this upper ropeway station Mt. Myoken’s peak is a quick walk away, though if hiking from the trailhead it takes about 30 minutes to climb. The trail gets progressively more difficult with branches, overgrowth, mud and steep valley ascents. A detour to Mt. Kunimi (1,347m) adds approximately 40 minutes and involves scaling boulders with chains. Benches at Kunimi-Wakare and Momiji-Jaya junctions provide seating, but there is no toilet after the ropeway station. Summiting Mt. Fugen involves some craginess underfoot, and large boulders, but is well-marked and straightforward. As other groups descend you have to stand aside at times. From atop Mt. Fugen, on a clear day you can spot the neighbouring, smoking summit of Mt. Heisei Shinzan (1,483m). Mt. Fugen’s summit has some tufts of grass and boulders to settle into for a rest, but it is otherwise exposed. An additional loop past the North and West Kaza-Ana Lava Caves is partially accessible, but the Tateiwa-no-Mine Peaks portion was flagged as being precarious, with loose and falling rock warnings posted. Mt. Fugen’s descent is straightforward with Azami-dani Valley on the last straight, and then footpaths, before reaching the Nita-Toge Pass observatory beside the car park.



Figure 2. Mt. Fugen Eruption - Nagasaki Prefectural Office Information Board



Figure 3. [No Entry. Restoring Vegetation]



Figure 4. 「保安林」 (Ho-an-rin) Forest Protection

Source: Photos by R. Kai, 2023.

5.1.2 Geological Observations

Despite fog, the gift store exhibits and information boards en route (Figure 2), the views from the lower lookouts, the diverse terrain, and evidence of conservation efforts (Figures 3 & 4) all contribute to the landscape's appealing nature, and a satisfactory day-hike. On past excursions, fumaroles near the summit and Mt. Heisei Shinzan's fumes were visible. At Unzen Hells at the foot of Mt. Unzen, the barren rocks, tinged pale yellow from the sulphuric steam, or red, green and grey from other impurities, certainly create an inferno-esque scene. We visited Gensei Marsh and got close to Oshidori Pond, too, to see its lively effervescence. Due to the naturally-heated hot water from underground geothermal springs the area has many onsens, too.

5.1.3 Summary

The route is challenging in parts and takes you off the main trail to summit Mt. Myoken and Mt. Kunimi. Good balance when encountering stacked boulders, and attention to footing on high, uneven surfaces, is required. Exposure, loose rock and steep inclines are expected, too. Overall the trail is clearly-marked, and, as it is a popular hiking route, expect to meet others. Unzen City, its Hells and other places of interest make this an enjoyable, varied outing with a decent mix of exertion, entertainment and education.

5.2 Site 2: Mount Kuju

Mt. Kuju is located in the Kuju Mountain Range, in Taketa, Oita Prefecture. This volcanic area comprises lava domes and composite volcanoes, and includes many hikeable peaks. Other peaks in the range include Kyushu's highest mountain, Mt. Nakadake (1,781m), Mt. Hossho, Mt. Kurodake, Mt. Inahoshi, Mt. Tengu-gajo, Mt. Mimata, Mt. Kuroiwa and Mt. Taisen. The whole area is often referred to as Kuju. While not situated in a Geopark, Mt. Kuju is a popular tourist spot. Peaks and views entice hikers, and seasonal flora draw crowds. Bogatsuru Marsh and Tadewara Marsh, by Chojabaru Visitor Center, are at the edge of the Kuju Mountain Range. Both are wetlands recognized as Ramsar Sites of International Importance, where an assortment of unique plants thrive. Chojabaru Visitor Center has information on seasonal sightings and the adjoining marsh's boardwalk is an ideal starting point if taking the Kokonoe Trailhead to Mt. Kuju.

5.2.1 Trail Observations

Our observations started at the Makinoto Pass Trailhead where facilities are basic, with toilets and a gift shop, with a hatch serving refreshments. Parking is ample and bus stop signs indicate access via public transport. The initial climb up concrete steps, past trees, opens up to a lookout. After conquering more concrete, grassier heights emerge with old, wooden steps leading up tree-covered Mt. Kutsukake (1,503m). The trail soon turns into a rocky, often muddy, ridgeline with ladders. Some boulders need to be traversed here, too. The ridgeline is often tight due to growth or larger rocks, but is otherwise amply wide. Progressively rocky parts follow upon approaching the ridge between Mt. Ougi-ga-hana (1,698m) on the right and Mt. Hossho (1,762m) on the left.

Opting left, we took the next fork right, down the low-road avoiding Mt. Hossho, through Nishi-senrigahama plateau, towards Mt.Kuju. Crossing the plateau, Mt.Kuju comes into view (Figure 5). After a markedly rocky, sulphur-stained patch you descend under craggy Mt. Hossho (Figure 6). Finally, approximately 2 hours after setting off, the only rest hut and toilet stop appear, at the base of Mt.Kuju. In summer, a donation is typical. But in winter the only option requires your own toilet bag. The Mt.Kuju ascent is steep and rocky, but quite well defined with a permanent rope and deliberate yellow markings. The summit is exposed, but affords great views of the Takeda region and surrounding peaks. We also ventured to Lake Oike crater lake, below Mt.Tengu-gajo. It was still partially frozen at the time of our observation trip (Figure 7), but is usually an unusual turquoise. Retracing the ridge to the rest hut, we took in views of Chojabaru and Kokonoe approaches, and Mt. Io's smoky vent. In the valley you see the Bogatsuru Marsh, and further afield, is the Tadewara Marsh.

Makinoto Pass Trailhead is 5.3km from the Chojabaru Visitor Center. We visited it and walked the marsh's elevated, cedar boardwalk. It is wheelchair accessible, has both long and short courses and is designed to protect the rare ecosystem. (Chojabaru Visitor Center Website, 2023). A hot dip in the foot bath by the centre concluded the day. Visitors hoping to stay in the area have a limited choice of accommodation, and the immediate village area has seen better days, with few amenities.



Figure 5. Nishi-senrigahama with Mt.Kuju (right background) (Photo by R. Kai 2023)



Figure 6. Mt.Hossho and hoarfrost on vegetation (Photo by R. Kai 2023)



Figure 7. Lake Oike below Mt.Tengu-gajo (Photo by J. Morrow 2023)

5.2.2 Geological Observations

Mt. Kuju is an active volcano and although we could not see the actual opening of Mt. Io's crater (1,580m) we observed it smoking steadily, with thin plumes, and the vent area had telltale, sulphuric-yellow tinges. At the fork for Ougi-ga-hana distinct layers of sedimentary rock and soil are visible. Underneath the snow and hardy winter growth, in this segment the colour of the soil stratum varied from dark, almost black, to lighter shades of brown. Animal prints, needle ice columns and hoarfrost also were noted.

5.2.3 Summary

Overall the trail is adequately marked and is not difficult or dangerous if you are sure footed and prepared. However, the vertical kilometre of incline up Mt. Kuju may prove difficult for some, and the distance and time required mean it is a demanding hike. An 'in-and-out' hike from Makinoto Pass to Mt. Kuju usually takes 6 hours or more, covering about 11km. Some guidebooks recommend 8 hours, although experienced hikers often take half that time. We saw hikers in full gear, with poles and crampons. We also encountered some with just a duffle coat and backpack. Although the diverse terrain adds to the enjoyment, the remote nature of this trail deems it a serious one which should be adequately prepared for.

5.3 Site 3: Mount Eboshi

In 2014, the Aso region acquired UNESCO Global Geopark status. Daikanbo, and Futae-no-touge and Mt. Tawara Passes afford scenic views of landscapes formed by volcanic activities over the past 270,000 years, including the huge eruption that occurred 90,000 years ago forming the Aso Caldera. Aso Caldera covers an area of 380km² with a circumference of more than 100 kms and it is the second largest caldera in Japan. The stable nature of the interior lends itself to transport infrastructures with rural communities in Aso City, Takamori Town and Minami Aso (Aso Volcano Museum, 2014 & 2023). While there is no actual Mt. Aso, Aso is the entire area up to the caldera's outer rim (Aso UGPP, 2012). Mt. Eboshi (1,337m) is part of the Aso Gogaku 'Five Peaks'. Other peaks are the nearby, currently inaccessible, Mt. Naka (1,506m), adjacent Mt. Kishima (1,326m), and Mt. Taka (1,529m) and Mt. Neko (1,433m) further afield.

5.3.1 Trail Observations

Our research focuses on the heart of Aso Geopark, where the grassland plains and volcanic clusters intermingle, and craters, crater ponds, marshlands, vents and varied uses of the volcanically rich soil are on view. This location incorporates Mt. Aso Visitor Center and Aso Volcano Museum, Kusasenri Plain and Mt. Eboshi (1,337m), with Mt. Naka (1,506m) viewed from afar. Due to high gas emissions this location was the closest visitors could get to the active crater of Mt. Naka, while staying outside the 1 km restricted zone.

Mt. Eboshi's trail traces the crater rim around Kusasenri (1,140m elevation) and the actual peak is only 238m high. Traversing Kusasenri, we commenced a leisurely hike. Taking about two hours, it is a steady ramble more than a hike, though the terrain is varied and some erosion is visible warranting standard precautions. The west slope, on the Mt. Naka side, is more gradual and solid underfoot. Whereas the east approach inclines more rapidly and is muddy, yet it affords stunning views over Minami Aso and out towards the Ariake Sea.



Figure 8. Mt. Naka crater (information board). (Photo by R. Kai 2023)

5.3.2 Geological Observations

Standing on the periphery of Kusasenri, you can appreciate the magnificence of this formation and its strange topography. Kusasenri is a wide, grassy plain with ponds, which are crater lakes within a crater. The craters filled with ash from Mt. Naka eruptions, creating this plateau in front of Mt. Eboshi. The pond on the west is the floor of the outer, 1 km diameter crater, and the pond on the east is that of the 400m diameter inner crater which was formed when the dacitic lava dome was blown off. The ridge between them, Koma-tate-yama, is the remains of that lava dome (Aso UGGP, 2012). Cows and horses graze here in warmer months, while in winter it is silver - and then scorched! In mid-February to the end of March, the controlled grassland burning ‘noyaki’ takes place to prevent trees and shrubs from taking over. We walked over the charred, black earth. In clear weather Mt. Naka’s smoky plumes are visible. From atop Mt. Eboshi you can catch extended views of the unique, ashen, moon-like landscape surrounding the active crater. Aso Volcano Museum (paid entry) has a live video stream from Mt. Naka’s crater and projects it onto a scaled model (see Figure 8).

5.3.3 Summary

Being able to traverse this picturesque plain, nestled in a crater formed about 30,000 years ago, is somewhat surreal. The views of both Minami Aso and the smouldering Mt. Naka are striking. Kusasenri Observation Station (1100m) is also worth stopping at with its compelling command of Aso Caldera’s western slopes, right down into Tateno Gorge, and, further still, Kumamoto City and Mt. Kimpo, and beyond to Mt. Unzen in Nagasaki across the Ariake Sea. Paid parking, food and souvenir options, as well as the educational Aso Volcano Museum and Mt. Aso Visitor Center, plus Field Tour guides available for bookings, make Kusasenri a point of convergence with bus tour groups and individuals flocking here. For longer or more serious hikes, other peaks can be explored to create a full-day excursion. Offering epic views and clear evidence of the region’s culture, heritage and nature, this is a special place to visit.

5.4 Site 4: Mount Sakurajima

Sakurajima-Kinkowan Geopark is in Kagoshima Prefecture and is a 25-minute ferry from Kagoshima City across Kinko Bay. Here Sakurajima, one of Japan’s most active volcanoes, displays its pep with smoky plumes or ashy splutters. Even so, the approximately 4000 inhabitants along the base, and about 600,000 in Kagoshima City, lead regular lives. Before an eruption in 1914, Sakurajima was an island. The lava flow from this huge eruption, during the Taisho Era, connected the former island to the Osumi Peninsula.

Kinko Bay was once a caldera. About 29,000 years ago a large eruption occurred and, after magma was ejected, the land in the centre sank creating the Aira Caldera. Seawater entered it creating the 200m-deep Kinko Bay. About 3,000 years later, eruptions formed the North Peak (Mt. Kita), and subsequently the South Peak (Mt. Minami). Therefore, while it looks like one mountain, Sakurajima consists of two volcanoes. Due to volcanic activity shifting south, it is from the South Peak that current day eruptions vent (Sakurajima-Kinkowan Geopark, 2023).

5.4.1 Trail Observations

The ferries from Kagoshima City to Sakurajima run frequently. Before crossing, visitors can go to Shiroyama Lookout, beside Shiroyama Hotel, to take in Sakurajima and the city below. Sakurajima Port and Visitor Center has an information desk, shop, cafe and rental bicycles. Cycling is a great way to explore further afield. However,

since it is prohibited to climb Sakurajima, over six hours we combined the short, coastal trail with visits to geosites encircling Sakurajima. Yogan Nagisa Trail takes you on a leisurely three kilometre loop from the Sakurajima Visitor Center near the port. This rugged, blackened coastline was formed from Taisho Lava and flourishes with unique vegetation. Cyclists usually continue down the Super Magma Road, or return by the Sakurajima Lava Street to take in some more sights.

The Sakurajima Island View bus is popular among visitors, with eleven stops around the west and south-western parts of the island, where the majority of geosites are located. From the Yunohira Observatory, which is the highest observation point (373m) accessible to the public, the North and South Peaks, and the active Showa Crater's plumes, loom above, and volcanic ash pads the pavements underfoot. In Sakurajima's eastern Kurokami District, you can see the Kurokami Buried Shrine Gate which indicates just how tremendous the 1914 Taisho Eruption was. The Showa Lava and Showa Crater are viewable from the Kurokami Viewing Point. The 1946 Showa Eruption also changed the landscape on this side of the island and it was from this eruption that the current Showa Crater started its activity (Sakurajima Visitor Center, 2023). Sakurajima-guchi is the point where Sakurajima connects to the Osumi Peninsula. The different soil on both sides creates noticeably distinct plant growth, with secondary forests on the Osumi side and black pine on the Sakurajima side.

The island's north and south sides have schools, hotels past their heyday, and onsen resorts. The Arimura Lava Observatory and promenade in the south is a unique location for viewing both the Taisho and Showa Lava fields. With views of the lava dome, block lava and the Shirasu Tableland, created from pyroclastic flows, it also has differing vegetation from the 30 year period between the eruptions (Sakurajima-Kinkowan Geopark, 2023).



Figure 9. Sakurajima's Peaks viewed from Yunohira Observatory

Source: Photo by R. Kai, 2023.

5.4.2 Geological Observations

Promotional signage and literature spotlights twenty geosites; six are located in Kagoshima City on the Satsuma Peninsula, whereas the other 14 are dotted around 'Sakurajima Island' itself. This research trip took in eight of the 14 around the volcano's base and two across the bay, Shiroyama Lookout and the city tram's 'shirasu utilisation'. Additionally, fourteen places of interest, from the Kagoshima Prefectural Museum, in the city, to Sakurajima International Volcanic Sabo (Debris Flow Control) Center are also featured. The geopark signage and pamphlets use a colourful legend of 6 anthropomorphic rocks to indicate how each geosite is connected to the surroundings, or, as the Sakurajima-Kinkowan Geopark website states: The Relationship Between Volcano and People. The six themes are history and culture, people, industry, the sea, landscape and geology, and nature (Figure 10).

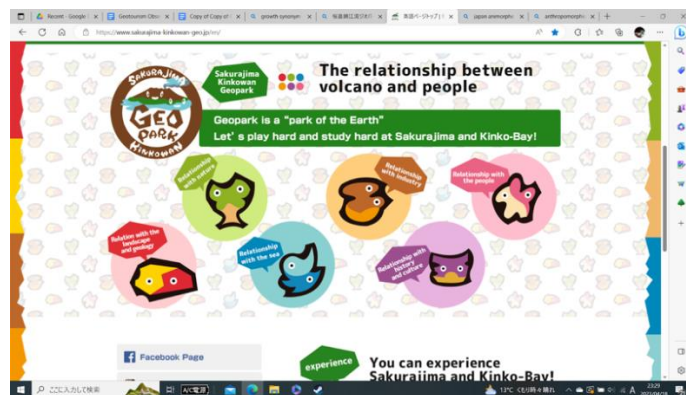


Figure 10. Screenshot taken of Sakurajima-Kinkowan Geopark Official Website (2023)

A notable ‘industry’ connection is the use of shirasu, a white, pumiceous soil from pyroclastic flow deposits, unique to southern Kyushu. Turned into concrete block bases for growing grass below the tram tracks, these ‘shirasu greening bases’ retain water, disperse heat and are pressure-resistant. Therefore, with 30,000 m² of grass, along almost 9 km, this special technique helps combat the problem of the urban ‘heat island effect’ which sees cities recording much higher temperatures than nearby rural areas (Sakurajima-Kinkowan Geopark, 2023). We also spotted these shirasu blocks at Sakurajima Port.

5.4.3 Summary

Despite no hiking, the ability to view Sakurajima from so many angles, at various sites and observatories, really gives a sense of the topography and history of the land, and shows how people naturally coexist with an active volcano and its small eruptions: students wearing helmets for protection; locals putting out yellow ‘Kokuhai Bukuro’ volcanic ash trash bags; dips in one of Japan’s longest foot baths, and; the enormous, round ‘Sakurajima Daikon’ radish, all give tourists a taste of how incomparable, yet viable, life is here. Vibrant, engaging signage and promotional literature, offering various experiences, and valuable information, also show that this Geopark is well-established for Geotourism, despite not being a UGGP.

The following tables explain observational findings of the authors in terms of a typical five-point Likert scale: 5) highly agreeable; 4) somewhat agreeable; 3) neither agreeable nor disagreeable; 2) disagreeable; 1) highly disagreeable. The figures in the tables are all mean values of each item.

Table 2. Compilation of Observational Findings (Mean Values)

LOCATION & GEOSITE NAME	Unzen, Nagasaki Unzen Volcanic Area UNESCO Global Geopark	Kuju, Oita Kuju Mountain Range	Aso, Kumamoto Aso UNESCO Global Geopark	Sakurajima, Kagoshima Sakurajima-Kinkowan Geopark
Items	Mt. Fugen (7.9km)	Mt. Kuju (12km)	Mt. Eboshi (3.9km)	Yogan Nagisa Trail (3km)
All Signage	3.5	3.5	3	4
English Signage	3.5	3	3.5	4
Size of Signs	3.5	3	3.5	3.5
Access by Road	3	3	4	4
Trail/Site Access	4	4	3.5	4.5

Shops	2	3	3.5	4
Vending Machines	3	3	3.5	4.5
Benches	3.5	3.5	4	4.5
All Information	3.5	3.5	3.5	4
English Information	3	3.5	4	4
Other: Companionship	2	2	4	4

Source: Compiled from survey data, 2023.

Table 3. Compilation of Geotourism Related Observational Findings (Mean Values)

GEOSITE NAME	Unzen Volcanic UNESCO Geopark	Area Global	Kuju Mountain Range	Aso UNESCO Global Geopark	Sakurajima-Kinkowan Geopark
Items	Mt. Fugen (7.9km)		Mt. Kuju (12km)	Mt. Eboshi (3.9km)	Yogan Nagisa Trail (3km)
Geo Accessibility	4.5		4	4.5	4.5
Level of Interest	4		3.5	3.5	4.5
Feasibility of Tours	4		2.5	3.5	5
Frequency of Danger	4		3.5	2	3
Geo Information	3.5		3	3.5	3

Source: Compiled from survey data, 2023.

6. Discussion

It is important to note that neither the individual nor the total ratings given on the 5-point scale should be viewed as being correlated to the overall enjoyment of the Geosites. However, when satisfaction is taken into account, one could examine the values related to signage, access, vending machines, language information (Table 2), and geo accessibility, level of interest, and overall geo information to find that these aspects are most likely satisfying to travellers. For example, although *companionship* was below the mean (2) for two sites it is only indicative of the prevalence of meeting other travellers on the days the research was conducted. While these two sites are remote, more serious hiking routes, they are still popular and are busy during the on-season. That said, it is

important to note that the other two sites which both obtained 4 on the 5-point scale were observed as being visited by GITs (Group Inclusive Tours) alike during the same season.

As for access, the viability to reach each volcano can be interpreted in various ways. *Access by road* could consider the transport infrastructure in relation to the condition of roadways, route possibilities, or lack of, as well as the distance from major cities or public transport hubs. Similarly it could be construed as the viable modes of transport, and associated time and cost, tourists take to get to the site. For the purposes of this study we travelled by car to all sites, however, we did consider public transport options as they were utilised by other tourists we observed. Likewise, as our research focussed mainly on volcanic sites and hiking trails, the topography and associated activities regarding *access to trail* pertains to able-bodied adults. This included parking facilities at the site, distance from public transport options and the markings indicating the trailhead, and the terrain and condition of the pathways besides. While some were clearly marked and signposted, others were more instinctive.

The overall results indicated a generally satisfactory observation in relation to expected access, signage, information and amenities at the four geosites. The close range of mean item scores overall indicates that, despite the noted differences in the total outcome and some items, on the whole, each site was deemed to have adequate or more than adequate data presentation, facilities and transport infrastructures. As previously noted, two different scores for companionship clearly show differences between sites which would appeal more to FITs (Free Independent Travellers) compared to the sites which accommodate more GITs (Group Inclusive Tours).

Looking at the total findings associated with the two UNESCO Global Geoparks (UGGPs), Mt. Eboshi and associated nearby geosites in Aso UGGP, geo accessibility was quite high with a mean of 4.5. In addition, Sakurajima-Kinkowan Geopark means for both geo accessibility and level of interest were both high at 4.5, while feasibility of tours was 5. Similarly Mt.Kuju which is not located in a Geopark, let alone a UNESCO Global Geopark, had a high result for geo accessibility at a value of 4. It should be noted that the two UGGPs in this research cover extremely vast areas, taking in numerous geosites and localities; Unzen Volcanic Area UGGP covers 459.52 km² and Aso UGGP is more than double that at 1,198 km². Therefore the trails and geosites visited for the purposes of this research represent only a portion of the whole UGGPs. Similarly, while the Kuju Mountain Range is about 200 km², the fact that it was a serious, long hike contributed to the fact that the ground covered and geosites visited for this leg of the research accounted for only a fraction of the total area. Conversely, Sakurajima-Kinkowan Geopark is approximately 370 km², but includes a huge body of water (Kinko Bay) over the submerged Aira Caldera and also contains a 2km radius restricted zone around the peaks. Accordingly, this smaller, more specific area of this unique 'Sakurajima Island' lends itself to both half and full-day itineraries as it can be explored by a combination of, or any one of, the transport options: bicycle, bus and car - or even on foot. Having many geosites within walking distance, or a short drive away, and, additionally many situated along the main access routes, means that you can visit more sites and see more while not necessarily covering more ground.

6.1 Geotourism Related Observational Findings

For the purposes of this study, Geotourism Related Observational Findings were categorised into, and analysed under, five broad themes (Table 3). Undoubtedly each theme is open to various interpretations in line with the backgrounds, interests, knowledge and experiences of each author. Therefore, while conducting geosite observations, members wrote supplementary notes, took pictures and collected tourism pamphlets which helped to both clarify and challenge varying standpoints, so as to standardise the themes. It should be noted that the kind of tourist the researchers envisioned and remained focused on was an able-bodied, adventurous, adult, hiking enthusiast (not expert), or similar, seeking an enriching, fun, geosite experience. It does no harm to outline the mind-set adopted because humans are individuals, and shared physical abilities and personalities do not always signify shared interpretations, as our research found. While much discussion was had after each geosite visit to determine what approaches each member took when assigning results, all parties seemed to diverge considerably when looking at *frequency of danger* and *geo information*.

Those who gave higher points to *frequency of danger* regarded the environs of an active volcano, and the generally remote, uneven landscape, to be more dangerous. However, the danger element was not threatening and, in fact, added to the appeal of the area and fostered a greater awareness of the phenomena which transformed these areas. In contrast, low scores were given when viewed from the perspective of a tourist who, naturally, fully understands the risks associated with these geosites and therefore, does not dismiss the danger element of an active volcano nor let it have significant weight in considering such scores. Despite the researchers' shared approaches, *geo accessibility* was explored from different tourist perspectives, due to the individual interpretations of the researchers. Nevertheless, the researchers concurred with the assessments

offered up, agreeing that *geo accessibility* was not about physical access and the trail difficulty, but about the variety and distinct features of each geosite, ranging from the types of volcanoes, the soil and rock lithology, and the landscape formations to the sounds of fumarole vents, the smell of sulphur, the eerie absence or delightful sightings of flora and fauna, echoing, overall, the peculiar affect the volcanic areas have on nature. Information presented in trail or observatory signage, and to a lesser extent pamphlets and on-site museums, eg. Aso Volcanic Museum, was also factored in. While still in awe of the formations, a more down-to-earth, less romanticised, sentiment seemed to prevail.

Explicating diverging viewpoints on the *feasibility of tours* brought up two lines of thought, namely indications of established tour infrastructures versus possibilities of tours. Regarding the remote location of Mt. Kuju and the urban-locale of Sakurajima, the points assigned were similar and, therefore, the perspectives converged. However, for Mt. Eboshi and Mt. Fugen views diverged greatly. Higher points for Mt. Eboshi were defended due to the car parking facilities for buses, as well as the Aso Volcano Museum and other amenities which indicate that tours are already operating. Nonetheless, lower points were also asserted due to the trail being short and easy, lending itself to self-guided excursions more so than tours. Similarly, Mt. Fugen attained high points for its transport infrastructure (road access, bus and train) and proximity to Nagasaki and Kumamoto cities, and even Unzen and Shimabara municipalities, as enabling tours. The lower end of the scale was backed by the possibility of bad weather making a long trip, and subsequent hike, disappointing. Furthermore, depending on the mode of transport taken, time-constraints for public transport options needed to be considered. Also the lack of amenities at the trailhead car parking was a possible deterrent for tours - albeit only concerning participants who didn't bring supplies and needed to buy them. *Geo information* also brought up varied responses and raised questions regarding i) what kind of information, as well the ii) placement, iii) frequency, iv) amount of information, v) languages available and vi) need for information. Regarding 'what kind' of *geo information*, only on-site information was deemed suitable. The tendency for a QR code to be added to a Japanese-language info board or pamphlet in place of separate English-language or multi-language inclusions was also factored in. Nonetheless, the usage, or absence, of adequate, informative *geo information* was investigated through signage, info boards along the trails, and on pamphlets and at museums near the trails. Regarding geo information in foreign languages, English, Korean and both Traditional and Simplified Chinese were languages viewed most. English was the default for most signs, although some sign boards did include the others or QR codes for other options. The importance of multi-language options was noticeable at the Nita-Toge Pass Cable Car in Unzen which brings visitors up to an observatory along the Mt. Fugen route. Our trip that day was shrouded in fog and so the commentary, only in Japanese, was deemed inadequate for tourists. Even the Japanese locals were voicing how ineffectual it was as nobody could see anything. The theme which proved the most equivocal was *level of interest*. On one hand, from an individualistic perspective, the actual hike, or journeying throughout the day, and the excitement or satisfaction experienced greatly weighed in. While, on the other hand, a broader look at the various opportunities and options, and the cultural impact for a tourist, was also considered as another essential outlook.

Looking at the relationships among these themes from a tourist's perspective we noticed that expectation, excitement and satisfaction were recurring themes. It must be said that a sense of danger was also thought to appeal to visitors. The researchers decided that while the first two certainly exist, the purpose of this research is aligned with the overall satisfaction of the geosites visited, as echoed in the overarching question of our study.

7. Conclusion

Discussions, individual reflections and differing opinions were shared post-trip which helped develop the systematic and structured organisation of these themes, and subsequently the findings and the relevant analysis.

Although viewpoints varied greatly, discussing differences and similarities helped determine how better to organise observations from a tourist's perspective. Geotourism is still in its infancy, although more and more travellers are exploring the world's wonders as the tourism industry begins to open once again following the COVID-19 pandemic. Through this research, the authors were able to interpret the geo-experience as would-be adventure travellers. The differing interpretations among people sharing the same interests and study focus are inherently part of humankind's diversity. Such diversity among tourists would lend itself to further studies about the various types of geotourism.

Although this research was useful for the future of geotourism, limitations were evident. For example, the nature of geoparks makes approaching active volcanoes dangerous, and therefore, finding appropriate timeframes to visit was difficult. In addition, the lack of completed research into this arena limited the background data from which to draw.

In the future, both observations and questionnaires should be conducted with both tourists and tourism employees. This would not only bring the field of geotourism and geothermal activity to the global mind-set, but would create many opportunities for geotourism research long into the future.

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