Current Status and Issues of Mountain Geoparks in Japan

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Abstract

Geoparks constitute projects that promote the protection of heritage sites with geological, geomorphological, rock, fossil, mineral and other earth-science value, as well as to educate the public and promote sustainable development in each region. There is a strong relationship between mountains and geoparks in terms of geological structure, topography, natural disaster characteristics and the cultures these have nurtured. This paper first introduces Tateyama Kurobe Geopark and Itoigawa Geopark as examples of such a relationship. It then describes the current status of geotourism at Tateyama Kurobe Geopark and mountain geotours at Itoigawa Geopark. Nature in the mountains brings not only blessings, but also disasters. Many mountain geoparks in Japan have developed geopark activities with disaster prevention themes. Mt. Kurikoma Area Geopark is introduced as an example. In addition, this paper emphasizes the importance of cooperation between geoparks in Japan and other countries to train and educate young people at their respective geoparks.

Key words: disaster prevention, geoeducation, geohistory, geotourism, geotours, knowledge transfer

1. Introduction

Geoparks constitute projects that promote the protection of heritage sites with geological, geomorphological, rock, fossil, mineral and other earth-science value, as well as to educate the public and promote sustainable development in each region. In particular, education on geoheritage and geoscience, i.e., geoeducation, is one of the most important benefits that geoparks can provide. Geoeducation is often offered through geotourism, which encompasses wider geographical, socioeconomic and cultural contexts (Dowling & Newsome, 2006). Geotourism is one objective of geoparks (e.g., Farsani *et al*., 2012). Geoconservation measures, coupled with tourism promotion, are key elements of geotourism (Hose, 2006). The number of geoparks has been increasing worldwide, including in Japan. Currently, there are 195 UNESCO Global Geoparks in 48 countries (10 in Japan) and 46 Japanese geoparks for domestic use, from Hokkaido to Kyushu (https://geopark.jp/geopark/).

Many of Japan's geoparks are closely related to mountains, and "mountains" is an important keyword for geoparks in Japan. This study examines the current status of the relationship between Japan's geoparks and mountains, the challenges they face, and the future plans for them, based on the discussion in Session 4 "Current status of mountain geoparks and their dissemination to the public" at the International Year of Mountains Plus 20 (IYM+20) Symposium held in Kurobe in December 2022 (Mountain Day Foundation, 2023).

2. Relationship between Geoparks and Mountains

The following is an overview of two Japanese geoparks closely related to mountains, Tateyama Kurobe Geopark and Itoigawa Geopark. The relationship of these two geoparks with the mountains is described.

Tateyama Kurobe Geopark is located in the eastern part of Toyama Prefecture and consists of the 3,000-meter-high Northern Japanese Alps, the 1,000-meter-deep Toyama Bay (i.e., a 4,000-meter difference in elevation across a short horizontal distance) and the Kurobe River, one of Japan's most rapid rivers, which connects them (Tateyama-Kurobe Geopark, 2020). The area has an average annual precipitation of approximately 6,000 mm and one of the highest snowfalls in the world. It is the first place in Japan where existing glaciers were recently confirmed (Fukui *et al*., 2021).

Kurobe River granite, the youngest granite in the world (dating from approximately 800,000 years ago),

was discovered in the Kurobe River basin (Ito *et al*., 2013), suggesting that the uplift rate of the area has been very rapid by world standards. Furthermore, the Midagahara Plateau, which forms Tateyama, was formed by a massive pyroclastic flow from the former Tateyama Volcano, and Tateyama is still designated as an active volcano. Tateyama's volcanic activity and the landforms shaped by the volcano gave birth to Tateyama worship. Thus, the area has many excellent sites where visitors can see the dynamic mountainous landscape, including the uplift of the Northern Japanese Alps, the volcanic activity of Tateyama and the formation of glaciers (Mokudai *et al*., 2015).

The topography, which is unparalleled in other regions of Japan with an elevation difference of 4,000 m over a linear distance of 50 km, has the distinction that natural phenomena occurring in the mountains affect the plains and sea via the rivers. In 1858, an earthquake caused the collapse of a large peak in the Tateyama Caldera and a temporary dam, and the subsequent flood caused by the collapse of the dam resulted in a massive landslide disaster on the Toyama Plain downstream. The disaster was caused by the unique topography and geology of Tateyama and its abundant precipitation. This is an example of a close connection between the mountains and plains downstream.

One of the most important geographical features of Itoigawa Geopark (Itoigawa UNESCO Global Geopark) is the Fossa Magna, a geological trench running north to south across the center of Honshu Island. The western boundary of the Fossa Magna is the Itoigawa-Shizuoka Tectonic Line, and the Itoigawa Geopark is located at its northern end. On opposite sides of the Itoigawa-Shizuoka Tectonic Line, Chubu-Sangaku National Park occupies the older strata west of the line, and Myoko Togakushi National Park, the younger strata east of it. In Itoigawa Geopark, old and young geological formations are evenly distributed, and a variety of topographic and geological features can be observed. Mountainous areas are recognized for their diverse qualities of value, including hot springs, active volcanoes, glacial landforms, karst landforms, alpine flora, mountain worship sites and mines, as well as various strata, rocks and fossils. Itoigawa is known for its jade. Jade originating in the mountains was washed away by landslides and rivers to the coast for hundreds of thousands of years. The jade collected in this manner has been processed since the Jomon period and was carried to all parts of Japan. The Jomon culture is believed to have had the oldest jade culture in the world.

While we can enjoy these blessings of mountains, mountains can also produce disasters. Six years ago, a volcanic eruption produced a plume of ash and caused hot springs to gush out of the volcano and flow into rivers, causing serious damage to river fish and rice paddies below. Disaster prevention from volcanic eruptions at Yakeyama is also an issue facing Itoigawa Geopark.

Thus, there is a deep relationship between geoparks and mountains in terms of geological structure, topography, propensity for natural disasters, and cultures that the mountains have nurtured.

3. Current Status of Mountain Geotourism

3.1 Mountain Geotourism in Tateyama Kurobe Geopark

A major attraction of Tateyama Kurobe Geopark is geotourism in mountainous areas, where visitors can witness geohistory. In the Tateyama area, geotours are organized around the keywords "uplifting mountain," "ice mountain," "fire mountain" and "water mountain."

Figure 1 shows an aerial photograph of the Tateyama Range. The main ridges of the 3,000-m high mountains run from north to south, the Midagahara Plateau extends to the west, and the vast Tateyama caldera depression extends to the southeast of Midagahara. The eye-catching Shomyo Falls gorge has been carved on the northern side of Midagahara. A geological map superimposed on the photograph is shown in Fig. 2. The area of the main ridge in (1) features the distribution of granitic rocks, symbolizing the "uplifting mountain" area. Area (2), extending from Murododaira to the upper part of Midagahara, features the distribution of sediments left by glaciers that once existed, and symbolizes an "ice mountain." Area (3), from Mt. Kunimi to Mt. Tengu and the upper part of Midagahara, features the distribution of lava; and Area (4), covering most of the Midagahara Plateau, features the distribution of welded tuff, which consists of pyroclastic flow deposits. This area, together with the Tateyama caldera, where a volcano is thought to have once existed, symbolizes a "fire mountain." Shyomyo Falls, which boast the highest drop in Japan, are deeply cut into the pyroclastic flow deposits of Midagahara. The sharp, deep V-shaped Shyomyo Valley above it symbolizes the "water mountain." In this way, the natural characteristics symbolized by the four keywords are distributed over a relatively small area in the Tateyama Range, forming a natural mountain landscape that is unique and diverse within Japan (Iida, 2016).

Geotourism was implemented in Tateyama Kurobe Geopark. The following is an overview of the major geotourism activities in the geopark area in accordance with the four keywords mentioned above.

In the "uplifting mountain," visitors can walk along the ridges and observe the widely distributed granite to experience mountains formed by uplift and understand that the shape of the mountains changes depending on the rock type. In the "ice mountain," visitors can experience the world's largest snowfall in the snowy valley with its snow walls and take a geotour to see glacial landforms such as cirques and U-shaped valleys that can be seen everywhere, as well as to visit the existing glaciers and get a sense of the glacierized and glaciated areas. In the

Fig. 1 Aerial view of the west face of the Tateyama Range (source: Tateyama Caldera Sabo Museum)

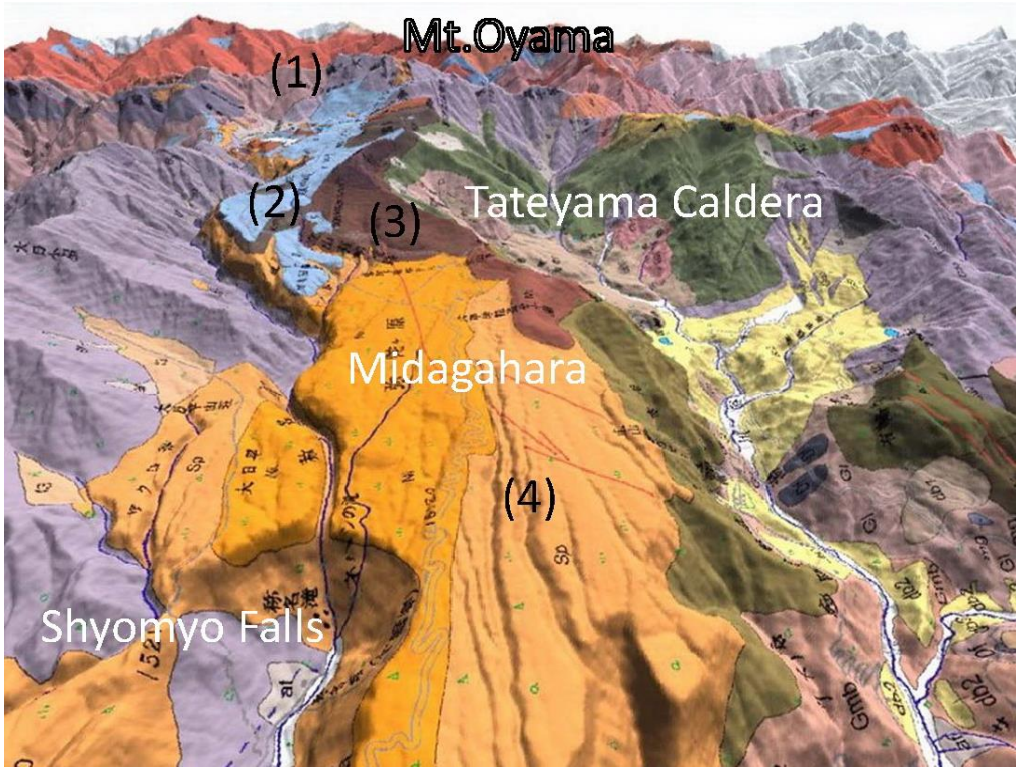


Fig. 2 Geological map of the west face of the Tateyama Range (source: Tateyama Caldera Sabo Museum)
(1) Main ridge showing "uplifting mountain"; (2) Murododaira-Midagahara symbolizing "ice mountain"; and (3) lava plateau and (4) pyroclastic flow area showing "fire mountain."

"fire mountain" area, one can visit the Midagahara Plateau and Murododaira, which were formed by the eruption of a volcano that once existed in the Tateyama caldera, and Jigokudani, an active volcano that continues to produce fumarolic gas, to realize that the volcano encompasses a large area under the influence of volcanic activity in Tateyama. The unique landscapes of Jigokudani, Tamadono Iwaya, Zaimokuishi, and Gaki-no-tanbo (rice fields for hungry ghosts) created by the "fire mountain" show that Tateyama has set the stage

for religious belief since ancient times and a unique culture has developed there. In the "water mountain," visitors to Shyomyo Falls and the surrounding landforms can experience the spectacular scenery of the V-shaped gorge created by abundant water from an annual precipitation averaging 6,000 mm as mentioned earlier, and Shyomyo Falls, which boasts the highest drop in Japan. This allows visitors to recognize that erosion by water is a major driving force in the formation of mountain landforms.

3.2 Mountain Geotours in Itoigawa Geopark

Geotours to the karst landforms of Mt. Kurohime are particularly popular in Itoigawa Geopark. Mt. Kurohime is composed of limestone, so its erosion is pronounced and it is known for its many caves. Vertical caves, including Japan's four deepest caves, are distributed in Maikomidaira, including Shiraren-do Cave, the deepest vertical cave in Japan, at 513 m depth. The caves maintain a cold environment, and alpine plants can be found at an altitude of approximately 600 m. Furthermore, due to the uplift of the land and the large amount of snowfall, there is a vegetation inversion between *satoyama* and alpine plants, creating a unique geotour.

3.3 Mountain Geotours to Study Disasters and Disaster Prevention

Nature in the mountains often brings about both disasters and blessings. Many mountain geoparks in Japan have cultivated geopark activities with disaster prevention themes. Mt. Kurikoma Area Geopark is one such example. The impetus for the establishing this geopark was the occurrence of Japan's largest landslide, 1,300 m wide, 150 m high, discharging 7 million m^3 of sediment, which occurred after the Iwate-Miyagi Nairiku Earthquake in 2008. Mt. Kurikoma Area Geopark was created to preserve the traces of the disaster caused by the Aratosawa landslide and to pass on knowledge learned from the disaster to future generations, as well as to use the site for education and academic research and to promote local economic activities. It provides a good example of how as much of the landslide site was preserved as possible through careful coordination with the parties involved.

In Tateyama Kurobe Geopark, as mentioned above, the Tateyama Caldera Sabo Museum, which is the base facility, offers more than 40 geotours every year, allowing visitors to experience the Tateyama caldera, which caused such massive landslide disasters and *sabo* (erosion control) construction work being carried out there (Tateyama Caldera Sabo Museum, 2013). In addition, Itoigawa Geopark also offers geotours on the Yakeyama volcanic disasters and volcanic disaster prevention. Toya-Usu UNESCO Global Geopark in Hokkaido also offers many geotours in a similar context.

4. Challenges Facing Mountain Geotours and Responses to Them

Geotours operating in mountainous areas usually require more safety measures than geotours on the plains, because participants in geotours enter mountainous areas with many external risks. Because of the wide variety of safety measures necessary in the mountains, it is difficult for ordinary geoguides to implement them, and they need the advice of well-trained experts. The mountain geoguiding system in Tateyama Kurobe Geopark should be noted in terms of safety measures. Professional mountain guides certified by the Japan Mountain Guides Association lead geotours in the mountains after acquiring geoguiding knowledge. Accompanied by mountain guides who are well trained in mountain safety measures, it is now possible to operate distinctive mountain geotours safely and effectively, such as the glacier tours in Tateyama. Currently, eight mountain geoguides are registered, and their number is expected to increase in the future. They will develop geotours that take advantage of the merits of the mountains. As this system spreads to mountain geoparks throughout Japan, it will become possible to conduct mountain geotours safely.

In addition, Itoigawa Geopark has raised the issue of the deterioration of mountain trails that lead to geosites as a new challenge for mountain geotours. Aging of local mountaineering club members who have been responsible for trail maintenance and management and the increased burden on mountain lodges have made trail maintenance and management difficult. In the short term, strong administrative support and legislation will be necessary to solve these problems. However, in the mid- to long-term, the geoparks, as the beneficiaries, need to add value to the mountains based on scientific evidence and make them more attractive. This will require the participation of mountain trekking/climbing enthusiasts and geopark staff members in the development of mountain trails.

As a solution to some of the problems mountain geoparks face, it will be important to establish a regional mountain science that integrates the values of mountain geoparks in various fields and communicates their attractiveness.

5. International Contribution through Mountain Geoparks

The distribution of geoparks on each continent is uneven (Pérez-Romero *et al*., 2023). There is the potential to contribute to countries with no geoparks by transferring knowledge, experience and know-how from Japanese geoparks, which include a large number of mountainous areas, to mountainous regions around the world. Taking Nepal as an example, where the concept of a geopark has not yet become widespread, Japanese researchers have been conducting Himalayan studies in various fields, and

the combined scientific basis of their findings can be used to determine the value of potential mountain geoparks in Nepal (Upreti & Yoshida, 2005; Yoshida *et al*., 2011). In addition, it would be possible to seek solutions to unique mountain disasters, such as glacial lake outburst floods (GLOFs), together with local residents and mountain enthusiasts through geopark activities. Sherpas and local guides could gain geoguide knowledge and conduct unique geotours that take advantage of the dynamic mountain characteristics of the Himalayas. It would be possible to develop world-class mountain geotourism that could contribute to local sustainable development.

The main themes addressed in geoparks have been natural resources, geohazards, climate change, education, science, culture, women, sustainable development, local and indigenous knowledge, and geoconservation (UNESCO, 2017). Since these themes are already being featured at Japanese geoparks, we may expect that by disseminating information conveying their know-how, it would be possible to contribute internationally through mountain geoparks. Recently, the number of young people trained in field research has declined in Japan. It is important for Japan as well as many geoparks to cooperate in training and educating young people through their respective geoparks.

References

Dowling, R. and Newsome, D. (eds.) (2006) *Geotourism, Sustainability, Impacts and Management*. Elsevier Butterworth-Heinemann, Oxford, UK.

Farsani, N.T., Coelho, C., Costa, C. and de Carvalho, C.N. (2012) Geoprakrs and geotourism: Concepts, theories and paradigms, 5–60, *In*: Farsani, N.T., Coelho, C., Costa, C. and de Carvalho, C.N. (eds.), *Geoparks and Geotourism: New Approaches to Sustainability for the 21st Century*. Brown Walker Press, Boca Raton, U.S.A.

Fukui, K., Iida, H. and Kosaka, T. (2021) Newly identifying active glaciers in the Northern Japanese Alps and their characteristics. *Geographical Review of Japan Series B*, 94(2): 81–95.

Hose, T.A. (2006) Geotourism and interpretation. *In*: Dowling, R. and Newsome, D. (eds.), *Geotourism*, 221–241, Elsevier Butterworth-Heinemann, Oxford, UK.

Iida, H. (2016) Recommendations of Tateyama 'Geotours,' *Mountain Climbing Training*, 31, 151–156 (in Japanese).

Ito, H., Amada, R., Tamura, A., Arai, S., Horie, K. and Hokada, T. (2013) Earth's youngest exposed granite and its tectonic implications: the 10–0.8 Ma Kurobegawa granite. *Scientific Reports*, 3, 1306, https:doi.org/ 10.1038/erep01306

Mokudai, K., Yuhora, K. and Niina, A. (eds.) (2015) *Geoparks of Chubu, Kinki, Chugoku, & Shikoku Regions in Japan*. Kokon-Shoin, Tokyo, Japan. (in Japanese)

Mountain Day Foundation (ed.) (2023) *Report on the International Mountain Plus 20 Symposium in Kurobe*. Mountain Day Foundation, Tokyo, Japan. (in Japanese)

Pérez-Romero, M.E., Álvarez-García, J., Flores-Romero, M.B. and Jiménez-Islas, D. (2023) UNESCO Global Geoparks 22 years after their creation: Analysis of scientific production. *Land*, 12, 671. https://doi.org/10.3390/ land12030671

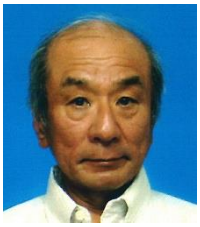
Tateyama Caldera Sabo Museum (2013) *Nature and People in the Joganji River*. (in Japanese)

Tateyama-Kurobe Geopark (2020) *Tateyama Kurobe Geopark Observations*. Tateyama-Kurobe Geopark, Toyama, Japan. (in Japanese)

UNESCO (2017) *What Is a UNESCO Global Geopark?* United Nations Educational, Scientific and Cultural Organization: Paris, France. http://www.globalgeopark.org/aboutGGN/6398.htm (accessed 20 December 2023)

Upreti, B.N. and Yoshida, M. (2005) *Guidebook for Himalayan Trekkers, Ser. No. 1, Geology and Natural Hazards along the Kaligandaki Valley, Nepal*. Department of Geology Tri-Chandra Campus, Tribhuvan University, Nepal.

Yoshida, M., Upreti, B.N. and Raj, S.M. (eds.) (2011) *Guidebook for Himalayan Trekkers, Ser. No. 2, Ecotrekking in the Everest Region, Eastern Nepal.* Department of Geology, Tri-Chandra Campus, Tribhuvan University, Kathmandu, Nepal, in collaboration with Gondwana Institute for Geology and Environment.



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Mr. Hajime Iida studied glaciology at Nagoya University and serves as curatorial manager of the Tateyama Caldera Sabo Museum. He has participated in numerous scientific expeditions to the Himalayas since 1982 to conduct glacier and meteorological surveys. He has proven the existence of glaciers in the Northern Japanese Alps through his long-standing research on snow, ice, and glaciers. He is involved in the planning and operation of geo-tours in the mountains, making use of his research results. He was awarded a Commendation for Excellence from the Minister of the Environment. He is a member of the boards of directors of the Tateyama-Kurobe Geopark and Japan Mountain Guides Association.

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