

## 10.1 Purpose of the Management Plan

The purpose of the Management Plan is to provide a framework for the care, control and management of nine geosites as the focal points of the Jeju Island Geopark. The plan supports protection of the geosites, development of geotourism and the ongoing economic development of the Jeju Island Geopark in a sustainable manner. The Plan has three main elements as follows: (1) A management structure to ensure that the geosites are managed sustainably and in a coordinated manner throughout the Jeju Island Geopark in association with other natural, cultural, social and economic sites and values; (2) Site management and monitoring concepts to ensure that the natural and cultural values are protected and enhanced for this and future generations; and (3) The establishment of linkages and systems to promote and develop education, tourism and research can work together to promote and enhance an understanding of geological heritage whilst contributing to Jeju's economy and social well-being.

This is an interim Management Plan for the Jeju Island National Geopark. It will generally follow the prescriptions of the Jeju World Natural Heritage Revised Management Plan (2006) which is the formal Plan for the three World Heritage listed geosites and Jeju Geopark Management Plan (2009, 2011).

The Plan will need to address the issues of establishing a Jeju Island Geopark Regional identity; increasing effective information transfer in the product region, facilitating effective community involvement in tourism, increasing awareness of the Jeju Island Geopark in source markets; identifying what is needed to enhance Jeju Island Geopark attractions; identifying what is needed to upgrade access to the Geopark attractions; and identifying what is needed to enhance visitor accommodation and tourism support infrastructure. The plan will also need to identify the location and function of interpretive centers, locations for onsite interpretation, the designation of touring routes and locations requiring significant signage.

## 10.2 Legal Basis for Protection and Management

### 10.2.1 Legal Basis for Protection

The protected areas are protected and managed under the national laws of the Republic of Korea and by the local governments under many specific laws. First of all the Constitution of the Republic of Korea defines the protection and transmission of traditional and national culture as the responsibilities of the country (The Constitution of the Republic of Korea, Article 9). Therefore the protection of cultural heritage is the fundamental responsibility of the nation and the law that specifies this is the Cultural Heritage Protection Act 2007.

In addition to the Cultural Heritage Protection Act and the Jeju World Heritage Revised Management Plan the followings have relevance to the management of natural heritage on Jeju; Natural Parks Act (1980), Special Act on Jeju Free International City (2002), Highlands Management Act (2005), National Land Planning and Utilization Act (2002), Coastal Zone Management Act (1999), Environment Conservation Management Plan for Jeju Province, Jeju Island Biosphere Reserve Management Plan, and the Hallasan National Park Management Plan.

As all the nine geosites are Korean Natural Monuments, the legal basis for protection of geosites ultimately lies with the national Cultural Heritage Protection Act 2007. These Acts are supplemented by regulations, by provincial ordinances and regulations, and by Administrative Directives from the Cultural Heritage Administration. The legal status of each of the nine geosites is shown in the following table (Table 10.1).

Although the nominated properties are being conserved and managed as natural monuments pursuant to the Cultural Properties Protection Act and as national or county parks pursuant to the Natural Parks Act, the properties, together with Hallasan Natural Reserve require special care and attention as they contain a high concentration of valuable plant, animal, mineral resources and landforms. The general provisions of the statutes are as follows:

**Table 10.1** Tenure and status of the nine geosites within the Jeju Island Geopark

Geosite	World Heritage	Man and the Biosphere	National monument number	Other protected area status	Buffer zone present
Hallasan Geosite Cluster	Yes	Yes	182	National park	Yes
Manjang Cave	Yes	No	98		Yes
Cheonjiyeon Waterfall	No	Yes	378 & 379		Yes
Daepodong Columnar Joints	No	No	443	Protected coastal zone	Yes
Seogwipo Formation	No	No	195	Protected coastal zone	Yes
Seongsan Ilchulbong Tuff Cone	Yes	No	420	Nature reserve	Yes
Sanbongsan Lava Dome	No	No	376		Yes
Yongmeori Tuff Ring	No	No	526	Protected coastal zone	No
Suweolbong Tuff Ring	No	No	513	Protected coastal zone	Yes

### 10.2.1.1 Natural Monument

Resources designated by the Cultural Properties Protection Act, based on deliberations by the Cultural Properties Committee, to conserve natural heritage with scientific values that are rare by domestic and international standards. The Cultural Properties Protection Act defines them as animals (including their native habitats, breeding ground and refuges), plants (including their native habitats), minerals, lava tubes, geological features, biological formations and special natural phenomena containing rich historic, scenic or scientific values.

Hallasan Natural Reserve, Geomunoreum Lava Tube System and Seongsan Ilchulbong Tuff Cone are all designated as Natural Monuments, based on the Cultural Properties Protection Act. According to this act, any conservation, management or utilization of cultural properties are performed on the basic principle of maintaining their original forms. Based on the above act, permission from the Administrator of the Cultural Heritage Administration is required for the followings (Article 20): (1) capturing or collecting animals, plants or minerals within an area designated or provisionally designated as a scenic area or a natural monument, or within its protected zone, or carrying them out of such an area or zone; (2) taking any rubbing, or photoprinting of State-designated cultural properties, or making a film of them in such a manner that may affect their preservation; and (3) any acts as prescribed by the Ordinance of the Ministry of Culture and Tourism, which are such acts as altering the current status (including the act of sampling or stuffing the natural monuments) of the State-designated cultural properties (including the protected objects and protected zones, or as affecting their preservation.

For opening to the public of State-designated Cultural Properties (Article 33), when deemed necessary to preserve the State-designated cultural properties and to prevent them from being damaged, the Administrator of the Cultural Heritage Administration may set limits to any opening to the public of the whole or part of relevant cultural properties.

### 10.2.1.2 National and County Parks

A national park is an area that is representative of the nature, ecosystems and culture of Korea and designated and managed by the Minister of Environment pursuant to the Natural Parks Act. A county park is also an area that is representative of the natural ecosystems or scenery of a city or county, and designated and managed by the mayor of the relevant city or county pursuant to the Natural Parks Act.

Hallasan Natural Reserve and Seongsan Ilchulbong Tuff Cone are designated as National Park and County Park respectively under the Natural Parks Act. According to this Act, the State, local governments, persons who undertake park projects or manage park facilities, persons who occupy or use the natural parks, persons who enter the natural parks and persons who reside in the natural parks shall do everything they can in order to protect the natural parks, and maintain and restore order therein. The State and local governments shall designate areas characterized by picturesque scenery and excellent natural ecosystems as natural parks, and conserve and manage such designated natural parks sustainably.

Based on the above act, permission from the Minister of Environment is required for the followings (Article 23). Any person, who intends to perform an act in the park, falling under each of the following subparagraphs will obtain permission from a park management authority under the conditions

as prescribed by the Presidential Decree: (1) newly building, extending, remodeling, reconstructing or relocating structures as well as any other installations; (2) mining minerals and collecting earth, stones and aggregates; (3) clearing land as well as any other act of altering the form and quality of land; (4) cutting timbers or collecting wild plants; (5) putting cattle out on pasture; and (6) damaging the scenery and changing the purpose of use of structures which is feared to impede the conservation and management of a natural park.

Under the above act, following undertakings are strictly prohibited (Article 27): (1) disrupting the present state of any natural park or damaging park facilities; (2) damaging trees and catching wild animals; (3) performing a commercial transaction outside a designated place; (4) camping outside a designated place; (5) parking outside a designated place; (6) cooking outside a designated place; and (7) littering.

The park management authority may, if it is deemed necessary to protect a natural park, restore damaged nature, ensure the safety of persons entering such natural park and enhance the public interest, limit or prohibit access to a certain area of such natural park for persons and vehicles for a fixed period.

### 10.2.1.3 Natural Reserve

A nature reserve is a type of natural monument with rich resources that require protection. More specifically, it is an area that represents the interaction between man and nature with a repository of diverse cultural, historic, scenic, geological and biological evolution processes.

The local governments of Jeju-do (Jeju Province) shall endeavor to enact their basic environment ordinances and to formulate and implement their basic environment preservation plans including matters set forth in the following subparagraphs in order to systematically preserve and manage the natural environment and to ensure that their residents may live healthy and comfortable lives in a pleasant and agreeable natural environment: (1) presentation of the objectives and direction of environmental conservation; (2) analysis of the features of the regional environment and future prospects therefore; (3) plan for the preservation and restoration of the natural environment and ecosystem, etc.; (4) matters concerning the preservation and management of urban and natural sceneries; and (5) matters concerning the management of the Jeju Island Biosphere Reserve designated by UNESCO.

There shall not be permitted within the core zone such acts as the construction of a building, setting up of a structure and other facilities, alteration to land form and nature, partition of land, public waters reclamation, logging, exploitation of soil and stones, construction of new roads, or any other acts similar thereto, which may be contrary to the purposes of the designation of such an area: Provided, that this shall not apply where acts which fall under any of the following subparagraphs have been permitted by the Governor (Artic-

le 27): (1) construction works carried out by the State or local governments, such as works for paths up to mountains, promenades, forest paths, roads, public lavatories, pavilions, meteorological observation facilities and park facilities under the Natural Parks Act; (2) afforestation projects carried out as a forest management plan under the Forestry Act, which is not accompanied by logging or alteration to land form and nature; (3) activities performed for the purposes of academic research and study; (4) extension or alteration to the existing buildings in the precincts of a religious establishment which was constructed before the designation of the Absolute Preserved Area; and (5) such other activities as determined by the Jeju Provincial Ordinance insofar as they cause neither damages nor alteration to natural resources.

## 10.2.2 Legal Basis for Management

Since the Jeju Island Geopark was endorsed in 2010, local governments have shown interests to become a member of the Global Network of National Geoparks. Because aspiring geoparks needs financial support, the Ministry of Environment established the a law on geoparks. Even though it is the revised pre-existing legislature for national parks, it can become the basis to support aspiring geoparks financially from the Korea Government. It is the revised one of the National Parks Act (1980) dealing from protection and management of geosites, financial support for national geoparks, endorsement standard of national geoparks to the training and role of geoheritage interpreters (geoparkians). The national geoparks in Korea will be endorsed by the Minister at the Ministry of Environment after submission of proposals by local governments. Also, as in the case of national geoparks of the GGN member, endorsed national geoparks should be revalidated every 4 years. This system will promote active development of national geoparks in the near future.

## 10.3 Management Structure

The Jeju Island Geopark and its constituent geosites must operate within the existing framework of the government of Jeju Special Self-Governing Province, applicable Korean laws and regulations as well as the requirements for the management of the Jeju Volcanic Island and Lava Tubes World Heritage property as set out in the UNESCO World Heritage Convention and in the Revised Management Plan. Should the Jeju Island Geopark be accepted into the Global Geoparks Network the principles and practices of the Network would be applied by the Jeju Special Self-Governing Province.

The Plan sets out the functions of a management structure for the Jeju Island Geopark in association with the manage-

ment of the World Heritage property and with the existing Jeju Island Department of Monuments which will continue to have responsibility for natural and cultural monuments outside the World Heritage and the Jeju Island Geosites. Clearly close cooperation and liaison will be needed between the three departments as there is, inevitably, overlap between their roles and responsibilities. The complete structure will evolve and expand through time as the Geopark evolves and is expanded through the additional geosites to be reviewed and added as outlined in Sect. 2.3.

The three main branches of the Department of Geoparks and their responsibilities are as follows. A promotion and tourism branch which will: (1) develop marketing and promotional events in cooperation with the community and tourism-oriented businesses; (2) cross-promote, where appropriate, related tourism activities; (3) ensure that the activities of the Jeju Island Geopark are in accord with the principles and practices of the Global Geoparks Network; and (4) promote the development of a Korean Geoparks Network and establish links with the Asian Pacific Geoheritage and Geoparks Network. A research, conservation and education branch which will: (1) assess the sites foreshadowed as additional geosites for inclusion in the Jeju Island Geopark; (2) monitor the condition of the geosites and develop maintenance and rehabilitation programs; (3) foster appropriate research on the geosites; (4) review research and other information and convey this to operational staff and volunteer ‘georangers’ to ensure that the Geopark ‘message’ is conveyed effectively to visitors; (5) develop and oversee education programs and materials; and (6) conduct training activities for staff, volunteers and local communities. A management branch which will: (1) oversee the activities of the four geosite visitor centers and the five visitor points; (2) deliver educational activities; (3) conduct special events and promotions; (4) carry out maintenance as appropriate; (5) execute the departmental administrative functions.

The Jeju Island Geopark Council (JIGC) was established, and the council has two branches (Research and planning branch and Tourism and promotion branch). Korea central government, Jeju government, research institute, non-governmental organization, local community council, heritage interpreters’ association and schools are involved in the JIGC. It is responsible for the management of the Jeju Island Geopark together the Department of World Natural Heritage Management. The department is also responsible for the management of the “Man and Biosphere” on Jeju Island. Mt. Halla Research Institute which belongs to the Jeju Special Self-Governing Province has been involved with biological research and monitoring of Mt. Halla. It is hoped that the institute will broaden its research scope more toward geological aspects. Since Mt. Halla is also a national park. Park office of the Mt. Halla National Parks manages tracking courses and visitors.

## 10.4 Potential Pressures on the Geosites

The Jeju Island Geopark is subject to a wide range of pressures being on a relatively small and heavily populated island with a vibrant and developing economy. The legal protection given most of the geosites largely isolates them from direct physical impacts, but off-site disturbances may dramatically impinge upon the aesthetics of the geosites. This is especially the case for the coastal sites. The natural monuments are Designated Tourist Zones and thus outside pressures are subject to strict planning controls.

The Department of Geoparks will liaise closely with the Jeju Government planning authorities and with developers to ensure that impacts on the geosites are minimized consistent with the desire to support sustainable economic development.

### 10.4.1 Natural Processes

Natural environmental processes, including those processes operating on geological timescales, produced the landscapes of Jeju Island and the nine geosites. The most significant of these processes, other than the original volcanic activity, is coastal erosion which directly affects most of the nine geosites (the exceptions being Hallasan, Manjang Cave and the Cheonjiyeon Waterfall). The rates of coastal erosion are such that the six affected geosites will be present for millennia with erosion continuing to expose their salient features.

Manjang Cave has the ever-present possibility (which cannot be predicted) of roof collapse to produce another entrance in addition to the three entrances produced by natural collapse. The Cheonjiyeon Waterfall will continue to retreat at geologically appropriate rates unless human disturbance upstream alters the flow regime. This appears unlikely.

#### 10.4.1.1 Climate Change

Climate change scenarios for Korea, building on observed increases in temperature, sea level rise and increased storminess as well as climatic modeling, suggest that sea level rise and increased frequency and intensity of typhoons and other extreme rainfall events can be confidently expected. These changes will inevitably accelerate the impacts of the natural environmental processes discussed above. Sea level rises will accelerate the rates of coastal erosion and cannot feasibly be ameliorated. Reduced snowpack may reduce the rates of groundwater recharge.

#### 10.4.1.2 Urbanization and Infrastructure Development

Given the development pressures consequent on a growing and dynamic economy the potential impacts on the geosites are large but, because of the legal protection afforded to most

of the geosites, the impacts will largely be confined to off-site visual impacts. The currently unprotected Yongmeori and Suweolbong Tuff Ring Geosites are relatively remote from urban pressures. The Department of Geoparks will liaise closely with the Jeju Government planning authorities and with developers to ensure that impacts on the geosites are minimized. The Designated Tourist Zones provide protection from outside pressures and are subject to strict planning controls.

#### 10.4.1.3 Quarrying

As quarrying is strictly regulated under the various statutes and plans pertaining to the protected areas this will not be an issue except potentially (in the short term) for the Suweolbong and Yongmeori Geosites. A greater danger lies with extractive industries altering the views from a geosite in an inappropriate way. The Department of Geoparks will liaise closely with the Jeju Government planning authorities and with developers to ensure that impacts on the geosites are minimized.

The culturally significant carved stone figures known as Dolhareubang (Jeju Province Folklore Material Number 2) are traditionally life-sized or larger figures, but over recent decades small Dolhareubang 15–20 cm in size (and larger) have been produced as popular souvenirs for the tourist trade. Many other types of stone carvings are produced for the domestic and tourism trade. Stone to supply this industry can be sourced from sites well removed from the current and future geosites. The production and sale of stone carvings in the Jeju Island Geopark is an important traditional industry and will continue within Geopark but outside the current and future geosites.

#### 10.4.1.4 Groundwater Extraction

As none of the geosites rely on hydrostatic support groundwater extraction should not be a threatening process except perhaps for the Cheonjiyeon Waterfall Geosite where there might be a potential to alter flow regimes. However, all of their catchment, surface and underground, is within protected areas.

#### 10.4.1.5 Agriculture and Forestry

Agriculture and forestry are very long-term traditional land uses on Jeju and these activities form the backdrop to many of the geosites. Impacts from these activities are chiefly visual although in the case of the Yongmeori and Suweolbong Geosites there may be minor interactions between visitors and rural activities. Additional protection will be provided by the Department of Geoparks.

#### 10.4.1.6 Pollution

Gross air or water pollution is unlikely to affect the geosites although a marine oil spill might impact negatively on the coastal geosites in the short term. Of far more importance is

littering especially where the geosites are not provided with visitor facilities or are regularly patrolled as in the case in rural areas and on the margins of some geosites. Special attention will be paid to remove trash within geosites. Seaborne litter is a major issue on some coastal sites but this is beyond remediation by Jeju authorities.

#### 10.4.1.7 Visitor Use

As discussed below (Sect. 10.5, Current management practices and facilities) most of the geosites have at least walking trails and viewing platforms to guide visitors and to protect the sites. In some cases, as at Daepodong, Cheonjiyeon and in Manjang Cave these are very sophisticated and well-maintained structures. In any case, the actual geological features exposed and displayed in the geosites are robust or inaccessible. Collecting of geologic materials is strictly forbidden and the regulations enforced. The fossils at Seogwipo will be protected by patrolling and by enlisting the local community in enforcing the prohibitions on collecting. Graffiti does not appear to be an issue. As mentioned above, littering can be a problem. Recycling opportunities are widespread on the Island. The Geopark will encourage recycling and promote anti-littering campaigns.

The Department of Geoparks will be developing monitoring and maintenance programs and codes of behavior to minimize visitor impacts (see Sect. 10.7, Future Action Plans, below).

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## 10.5 Current Management Practices and Facilities

The array of current management practices and facilities in the nine geosites ranges from outstanding (in the World Heritage sites) to minimal (at Yongmeori and Suweolbong). A summary of these is provided in Table 10.2 above. The more heavily utilized areas are regularly patrolled and maintained, visitor activities and pressures monitored and volunteer georangers will provide some measure of interpretation and protection over and above that provided by interpretation panels and paid staff. The Department of Geoparks will continue to develop and maintain visitor facilities as discussed in Chap. 9 and Sect. 10.6, Future Action Plans, below.

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## 10.6 Future Action Plans

A series of Action Plans, including facility development, will be developed by the Department of Geoparks and relevant specialists to formalize and develop the Jeju Island Geopark. The Action Plans will have a life of five years from date of their adoption. They will form part of the overall Manage-

**Table 10.2** Visitor facilities and practices in the nine geosites

Geosite	Walking trails* +/viewing platforms	Interpretation panels present	Guided tours available	Educational groups specifically catered for	Toilets/food outlets
Hallasan Geosite Cluster	Yes/yes*	Yes	No	Yes	Yes/yes
Manjang Cave	Yes/yes	Yes	Yes	Yes	Yes/yes
Cheonjiyeon Waterfall	Yes* +/yes	Yes	Yes	Yes	Yes/yes
Daepodong Columnar Joints	Yes* +/yes	Yes	Yes	Yes	Yes/yes
Seogwipo Formation	No	Yes	By arrangement	By arrangement	Yes
Seongsan Ilchulbong Tuff Cone	Yes* +/yes	Yes	Yes	Yes	Yes/yes
Sanbongsan Lava Dome	Yes +/yes	Yes	No	Yes	Yes/yes
Yongmeori Tuff Ring	Yes +/no	No	No	No	No/no
Suweolbong Tuff Ring	Yes +/no	No	Yes	Yes	No/no

\*Wheelchair accessible in whole or part

+Part of the Olle trail system (see Sect. 5.2 above)

ment Plan for the Jeju Island Geopark. The Action Plans will include:

### 10.6.1 Developing Visitor Centers

A series of four visitor centers and five visitor points are proposed at the geosites as well as two centralized information centers in Jeju and Seogwipo cities as discussed in Sect. 8.1, Education and Promotion, above. This Action Plan will provide the planning and scheduling for the construction and operation of these sites.

### 10.6.2 Promotion of Geopark and Geosites

This Action Plan will develop a system of promoting the tourism potential of the Jeju Island Geopark through linkages with existing Jeju Island promotion bodies, local communities, travel agents and so on. Linkages between the existing (and future) geosites will be enhanced and formalized. Information and educational materials will be promulgated using printed and multi-media materials as well as advertising campaigns, websites and so on. The Jeju Island Geopark homepage can be found at <http://geopark.jeju.go.kr>.

### 10.6.3 Promoting Education

This important Action Plan will build upon the ideas discussed. It will be developed in association with education au-

thorities, specialists and tourism operators. It will emphasize geopark precepts and philosophies and will include concepts for enhanced guiding and interpretation and for the development of geologically based tours. Many Jeju Island elementary and junior high schools already have active curricula which include environmental education as well as promoting of the geological and other heritage of Jeju Island. The Jeju Island Geopark will assist in further developing these programs.

### 10.6.4 Developing Partnerships

An important function of geopark concept is to create and develop partnerships between geosites, management authorities, scientists, education authorities, local communities and businesses. As an example, the provincial government has recently established a Memorandum of Understanding with the Korean Geological Society to promote and develop the Jeju Island Geopark and to support its inclusion in the Global Geoparks Network. The government of the Jeju Special Self-Governing Province already has many partnerships across the community and this Action Plan will develop protocols and standards for the Jeju Island Geopark 'brand' to ensure that the best and most productive partnerships are achieved. Such standards will include agreements to participate in environmental programs such as recycling, sustainable practices, geopark training activities and so on.

As examples of these standards partnerships will be developed with the following groups:

(1) schools and universities would be encouraged and expected to actively include global geopark principles and practices in their geoscience curricula; (2) hotels and restaurants would actively promote the Jeju Island Geopark and the geosites as well as adopting 'green' environmentally friendly practices; (3) tourist attractions would cross-promote the Jeju Island Geopark and the geosites with the Jeju Special Self-Governing agencies with communications media of appropriate quality; and (4) non-government organizations and local communities would be encouraged to adopt and promote recycling and anti-littering targets and to actively assist with the management and protection of the geosites.

### **10.6.5 Involvement of the Community and Non-Government Organizations**

Various community groups and NGOs are already supporting the Jeju Island Geopark through provision of volunteer georangers and networks such as the Olle walking track system. This Action Plan will seek to expand and further develop links with community bodies. The Department of Geoparks will develop training and information programs for these groups.

### **10.6.6 Code of Ethics for Visitors and Researchers**

This Action Plan will develop codes of ethical practice for visitors, geosite workers and researchers. It will cover such areas as access restrictions, littering, collecting, research protocols and methods, and permit systems for research. They will be promulgated via brochures, information panels and websites.

### **10.6.7 Training of Managers and Guides**

There will be an increased need to have more knowledgeable and better trained employees and volunteer personnel. An Action Plan to enhance training processes and opportunities will be developed and implemented as a high priority.

### **10.6.8 Promoting Research**

Whilst there is already a very considerable body of research on Jeju Island and its geology and geomorphology there are many avenues for ongoing research. There is also the need to investigate further geosite proposals within the Jeju Island Geopark. Promotion of research is an important function of geoparks and this Action Plan will enhance linkages with

academic institutions and specialists to optimize research outcomes and, most importantly, ensure that the results of research are conveyed in an appropriate manner so that they can be used in geosite education and interpretation.

## **10.7 Monitoring Indicators and Monitoring Plan**

Development of clearly identifiable and useful, monitoring indicators for geosite condition, infrastructure condition, visitor satisfaction and of the success or otherwise of knowledge conveyance is a clear requirement. This multi-faceted Action Plan will address these issues in two sub-plans physical matters on one hand (Fig. 10.2) and social conditions on the other. Together they will make up procedures for the ongoing reporting on the Jeju Island Geopark objectives and achievements and effective monitoring plan. It will be necessary to consider the potential impacts of climate change in the monitoring Action Plan. Potential monitoring indicators are set out in the tables below (Table 10.3, 10.4 and 10.5). Effective ongoing maintenance requires the development of protocols, schedules and checklists to ensure the geosites maintain or improve their current condition. This Action Plan will ensure that these are defined and utilized in the better management of the Jeju Island Geopark.

**Table 10.3** Monitoring indicators for Majang Cave Geosite (show cave area)

Indicators	Periodicity	Report	Investigator
Daily monitoring list by local management office			
Garbage collection	Daily	Monthly	Management office of the Manjang Cave, JSSGP (Jeju Special Self-Governing Province)
Visitors	Daily	Monthly	
Number of visitors			
Number of international visitors (nationalities)			
Number of students by group tour			
Visitor satisfaction			
Pollution	Daily	Annual	Management office of the Manjang Cave, JSSGP
Lampenflora			
Dust			
Lighting	Daily	Annual	Management office of the Manjang Cave, JSSGP
Direction of lighting into eyes			
Cleaning shields and lamps			
Monitoring by specialists			
Manual air monitoring	Monthly	Annual	JSSGP advised by cave research institute
Temperature			
Humidity			
Carbon dioxide contents			
Radon contents (4 times/year, seasonally)			
Water monitoring	Annual	Annual	
Water quality			
Water level (after rain)			
Automatic monitoring of temperature, humidity and carbon dioxide contents	Monthly	Annual	JSSGP advised by cave research institute
Photo monitoring	Annual	Annual	JSSGP advised by cave research institute
Lava speleothems			
Microtopographic features			
Safety controls	Annual	Annual	JSSGP advised by cave research institute
Electrical safety			
Infrastructure safety			
Stability of roof and rockfall			
Crack widening check	Annual	Annual	
Cave fauna monitoring	twice/ year (winter, summer)	Annual	JSSGP advised by cave research institute
Electrical safety check investigation	Every 5 years	Every 5 years	JSSGP advised by specialists
Safety check investigation of infrastructure	Every 5 years	Every 5 years	JSSGP advised by specialists
3D scan of the show cave area	Every 10–20 years	Every 10–20 years	JSSGP advised by specialists
Wild cave area			
Cave water quality	Annual	Annual	JSSGP advised by specialISts
Air monitoring	Seasonal	Annual	



**Table 10.3** (Continued)

Indicators	Periodicity	Report	Investigator
(T, H, CO <sub>2</sub> , Radon contents)			
Ceiling stability and rockfall	Seasonal	Annual	
Crack checking	Seasonal	Annual	
Photomonitoring	Every 5 years	Every 5 years	
Three entrances			
Significant lava speleothems			
3D scan of the wild cave area	Every 10–20 years	Every 10–20 years	
Soil and sediments transported into the cave	Every 5 years	Every 5 years	
Cave fauna	Every 5 years	Every 5 years	
Outside			
Air monitoring	Daily	Monthly	JSSGP advised by specialists
Precipitation & snow fall	If needed	Annual	
Photomonitoring	Annual	Annual	
near three entrances			
Significant lava landforms			
Seismicity	If needed	Annual	
Vibration by automobiles	Every 2 years	Every 2 years	
Vegetation	Every 5 years	Every 5 years	

**Table 10.4** Monitoring Indicators for Mt. Halla, Cheonjiyeon Waterfall and Sanbangsan Geosites

Indicators	Periodicity	Report	Geosite	Monitoring investigator
Daily monitoring list by local management office				
Garbage collection	Daily	Monthly	All	Local management office
Visitors	Daily	Monthly		
Number of visitors				
Number of international visitors				
Number of students by group tour				
Visitor satisfaction				
Safety of infrastructure	Monthly	Annual	All	
Damage of trails	Monthly	Annual	Mt. Halla	
Rockfall near Sanbangulsa	Daily	Monthly	Sanbangsan	
Rockfall before the waterfall	Monthly	Annual	Cheonjiyeon	
Landform change above the waterfall	Monthly	Annual	Cheonjiyeon	
Water level	Daily	Annual	Cheonjiyeon	
Rocks transported by the stream	Daily	Annual	Cheonjiyeon	
Water quality (color, smell)	Daily	Annual	Cheonjiyeon	
Monitoring by Mt. Halla Research Institute				
Air monitoring (T, H & Wind velocity)	Daily	Monthly	All	Mt. Halla Research Institute
Precipitation	Daily	Monthly		
Snow depth	If needed	Annual		

**Table 10.4** (Continued)

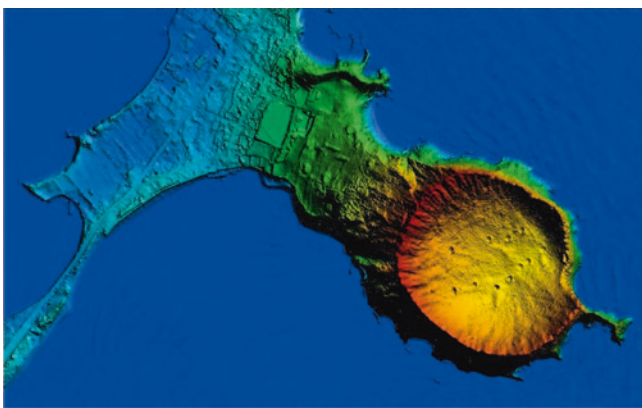
Indicators	Periodicity	Report	Geosite	Monitoring investigator
Water quality check in Baeknokdam	Annual	Annual	Mt. Halla	
Discharge & water quality in Hallasan	Annual	Annual		
Soil quality	Annual	Annual	All	
Photomonitoring	Annual	Annual	All	
Manmade landform change				
Natural landform change				
Valley erosion rate				
Photomonitoring of columnar joints	Annual	Annual	Mt. Halla, Sanbansan	
Monitoring by specialists				
Seismicity	If needed	Annual	All	JSSGP advised by specialists
Volcanic activity	If needed	Annual		
Distribution of animals	Every 3–5 years	Every 3–5 years	All	
Distribution of plants	Every 3–5 years	Every 3–5 years		
Safety of infrastructure	Every 5 years	Every 5 years	All	
Baeknokdam	Every 5 years	Every 5 years	Mt. Halla	
Slope failure				
Soil erosion & sedimentation				
Monitoring morphological features	Every 5 years	Every 5 years	Mt. Halla	
Collapse of trachytic domes				
Collapse of columnar joints				
Cliff retreat	Every 5 years	Every 5 years	Cheonjiyeon	
Valley erosion rate	Annual	Annual	Mt. Halla	
Calculation of maximum capacity of tourists	Annual	Annual	All	

**Table 10.5** Monitoring Indicators for Seongsan Ilchunbong Tuff Cone (Seongsan), Seoguipo Formation, Suweolbong Tuff Ring (Suweolbong), Yongmeori Tuff Ring (Yongmeori) and Daepodong Columnar Joints (Daepodong) Geosites

Indicators	Periodicity	Report	Geosite	Monitoring investigator
Daily monitoring list by local management office				
Garbage collection	Daily	Monthly	All	Local management office
Visitors	Daily	Monthly		
Number of visitors				
Number of international visitors				
Number of students by group tour				
Visitor satisfaction				
Safety of infrastructure	Monthly	Annual	All	
Damage of trails	Monthly	Annual	Seoguipo, Suweolbong, and Yongmeori	

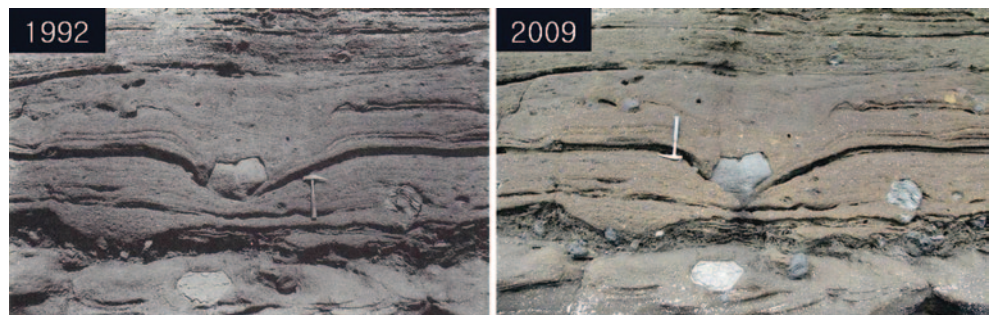
**Table 10.5** (Continued)

Air monitoring (T, H & Wind velocity)	Daily	Monthly	All	
Precipitation	Daily	Monthly	All	
Snow depth	If needed	Annual	All	
Photomonitoring	Annual	Annual	All	
Manmade landform change				
Natural landform change				
Collapse of vertical cliffs				
Monitoring by specialists				
Soil & sediment accumulation	Annual	Annual	Seongsan	JSSGP advised by specialists
Soil quality	Annual	Annual	All	
Photomonitoring of columnar joints	Annual	Annual	Daepodong	
Seismicity	If needed	Annual	All	
Monitoring of plants (invasion, endangered species)	Annual	Annual	Seongsan	
Soil erosion or accumulation near the crater	Annual	Every 5 years	Seongsan	
Safety of infrastructure	Annual	Every 5 years	All	
Fossil conservation	Annual	Annual	Seoguipo	
Erosion by wave actions and typhoons	Annual	Annual	All	
Cliff retreat	Every 5 years	Every 5 years	Cheonjiyeon	
Vegetation cover on outcrop	Annual	Annual	All	
Calculation of maximum capacity of tourists	Annual	Annual	All	



**Fig. 10.1** Monitoring of the Seongsan Ilchulbong Tuff Cone by LiDar. This monitors the changes of vegetation and erosion with a resolution of 50 cm in height and 15 cm in width

**Fig. 10.2** Photomonitoring of the outcrop in the Seongsan Ilchulbong Tuff Cone geosite. Photos were taken in 1992 and 2009





**Fig. 10.3** Monitoring of rockfall in the lava tube cave near the road