World Heritage Sites

Protected Areas and World Heritage

JEJU VOLCANIC ISLAND & LAVA TUBES
REPUBLIC OF KOREA

The island is an inactive shield volcano where successive eruptions on its flanks have formed 120 large lava tubes and 360 parasitic cinder and scoria cones all over the island, and a large cliff-like cone of tuff offshore. The tubes contain a variety of both lava and carbonate speleothems, some formed, unusually, by secondary carbonates leached from overlying sands. The mountain summit has endemic relic alpine flora.

Threat to the site: Development of a major naval base on the island.

COUNTRY
Republic of Korea

NAME
Jeju Volcanic Island & Lava Tubes

NATURAL WORLD HERITAGE SERIAL SITE
2006: Inscribed on the World Heritage List under Natural Criteria vii and viii.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE
The UNESCO World Heritage Committee issued the following statement at the time of inscription:

Jeju Volcanic Island and Lava Tubes is a coherent serial property comprising three components. The unequalled quality of the Geomunoreum lava tube system and the exhibition of diverse and accessible volcanic features in the other two components demonstrate a distinctive and important contribution to the understanding of global volcanism.

Criterion (vii): The Geomunoreum lava tube system, which is regarded as the finest such cave system in the world, has an outstanding visual impact even for those experienced with such phenomena. It displays the unique spectacle of multi-coloured carbonate decorations adorning the roofs and floors, and dark-coloured lava walls, partially covered by a mural of carbonate deposits. The fortress-like Seongsan Ilchulbong tuff cone, with its walls rising out of the ocean, is a dramatic landscape feature, and Mount Halla, with its array of textures and colours through the changing seasons, waterfalls, display of multi-shaped rock formations and columnar-jointed cliffs, and the towering summit with its lake-filled crater, further adds to the scenic and aesthetic appeal.

Criterion (viii): Jeju has a distinctive value as one of the few large shield volcanoes in the world built over a hot spot on a stationary continental crust plate. It is distinguished by the Geomunoreum lava tube system, which is the most impressive and significant series of protected lava tube caves in the world and includes a spectacular array of secondary carbonate speleothems (stalactites and other decorations), with an abundance and diversity unknown elsewhere within a lava cave. The Seongsan Ilchulbong tuff cone has exceptional exposures of its structural and sedimentological characteristics, making it a world-class location for understanding Surtseyan-type volcanic eruptions.

The property is well managed and resourced, with a management plan in place for the period 2006-2010 and resources for its implementation. Key management issues include avoiding potential agricultural impact on the underground environment and managing the high number of visitors to the property. There is potential for further extension of the property to include other significant lava tube systems and volcanic features of Jeju.

INTERNATIONAL DESIGNATION

2002: Centre of Jeju Island designated a Biosphere Reserve under the UNESCO Man & Biosphere Programme (83,094 ha).

IUCN MANAGEMENT CATEGORY

Hallasan National Park: IV Habitat/Species Management Area
Mount Halla National Park: V Protected Landscape

BIOGEOGRAPHICAL PROVINCE

Japanese Evergreen Forest (2.2.2)

GEOGRAPHICAL LOCATION

Jeju Island lies 80 km south of the Korean mainland between the East China Sea and the Korea Strait, centred on 33°21'31"N by 126°32'31"E.

DATES AND HISTORY OF ESTABLISHMENT

1962: Manjanggul and Gimnyeonggul Lava Tubes registered as Natural Monuments under the Cultural Properties Protection Act;

1966: Hallasan designated a Natural Monument (9,093 ha);

1970: Hallasan designated a National Park (14,900 ha) under the National Parks Act;

1996: Dangcheomuldonggul Lava Tube declared a Natural Monument;

1997: Hallasan, Ilchulbong Tuff Cone and Bengdwigul Lava Tube declared Absolute Preserved Areas; Ilchulbong declared a County Park;

2000: Ilchulbong Tuff Cone declared a Natural Monument;

2002: Central Jeju designated a UNESCO Biosphere Reserve;

2005: Geomunoreum Volcanic Cone declared a Natural Monument;

2006: Yongcheondonggul Lava Tube declared a Natural Monument.

LAND TENURE

Hallasan National Park is almost 100% state owned; Geomunoreum Lava Tube System is 48.4% owned by Jeju Province, 51.6% privately owned; and Ilchulbong Tuff Cone is 60% owned by the state and 40% by the Province. The nominated site as a whole is to be supervised by the Jeju World Natural Heritage Management Committee under the Cultural Heritage Administration through the Jeju Provincial Government, but each site is separately managed.

AREA

Core zone: 9,475.3 ha. The buffer zone of 9,370.8 ha is not designated.

Subsite	Core zone	Buffer zone
Hallasan Natural Reserve 33°19′04′′- 33°25′38′′N by 126°32′15′′- 126°38′08′′E	9,093.17 ha	7,347.4 ha
Geomunoreum Lava Tube System 33°26′27′′- 33°33′48′′N by 126°42′54′′- 126°47′33′′E	330.3 ha	1,906.4 ha
Seongsan Ilchulbong Tuff Cone 33°27′05′′- 33°28′09′′N by 126°55′56′′- 126°57′03′′E	51.8 ha	117.0 ha

ALTITUDE

Sea level to 1,950m (Hallasan/Mt. Halla)

PHYSICAL FEATURES

Jeju Island, an oval some 73 km long by 32 km wide, is the low crest of a dormant shield volcano, rising some 3,000m from the ocean bed, formed by an eruption from a magmatic plume under a stationary tectonic plate. Hallasan, the main dome in the middle of the island, is surrounded by a plateau and lava

plains spattered with 368 parasitic cinder and scoria cones formed by fountains of lava, 46 in Hallasan Park alone, and by 120 radial lava flows resulting from small eruptions on the flanks of the shield. Many of the flows, densest on the north and west, run in underground tubes resulting from the channelled eruptions of molten lava. The summit of the mountain is a trachyte dome flanked with columnar jointing, with a shallow grassed crater 550m across, holding a lake. Halfway down, the hillside is peopled with tall trachyte pillars ('the 500 disciples of Buddha'), the eroded remnants of dykes. Elsewhere there are basaltic tuff cliffs and even avian and hominid fossil footprints. The mountain soils are shallow .

The lava flows were formed over a period of 1.2 million years, of fine-grained basalt in the form of great tubes of rock where the outer shell of the flow solidified and a highly fluid pahoehoe lava characteristic of shield volcanoes drained out, leaving a long broken cave-like void in its centre, often with walls deeply striated by lava marks along the line of flow. One of these is nominated, the exceptional 13 km-long Geomunoreum Lava Tube System, formed 300,000-100,000 years ago, and comprising a scoria cone and 8 large lava tubes along one segmented line of flow to the sea. The tubes contain a great variety of lava and carbonate speleothems, the latter more often found in limestone caverns: stalactites and stalagmites both massive and delicate, curtains, helictites and soda straws, lava drops and long round rolls, flowers of calcite and rock pearls. At the seaward end, biogenic minerals leached from overlying sand dunes have seeped in to form striking carbonate formations on the walls: such secondary mineralisation is very unusual. Many of these processes are ongoing. Jeju contains almost every possible type of phreatomagmatic vulcanism, notably, at the eastern end of the island, a large headland cone of tuff (fine ejected fragments) formed 120,000-40,000 years ago, which rises castle-like 179m above the sea, in a circle of cliffs eroded almost to the summit crater. This is Seongsan Ilchulbong Tuff Cone, also nominated, resulting from a Surtseyan type of submarine magmatic explosion which, where eroded, exposes in a clear section through nine layers of tuff the eruptional history of the crater. The island is a natural text-book for the study of volcanoclastic sedimentology and volcanic tube caves.

In this list characterising the main tube-caves of the Geomunoreum system, only Manjang is partly open to the public. The last two were only discovered in the last decade, so many more may yet be found.

Name	Length	Characteristics
Bengdwi	4,481m	Most labyrinthine tube, passages on three-levels, composite lava flows, speleothems: stalagmites, chambers, bridges, pillars.
Manjang	7,416 m	Two-story cave, to 23 m in width and 18m in height. Huge lava column, lava speleothems: stalactites, stalagmites, helictites, bridges, shelves, flowstone, balls, ropy lava.
Gimnyeong	705 m	S-shaped passage. Lava speleothems: shelves, lava falls, stalactites, cave corals, carbonate sands.
Yongcheon	2,470 m	Lava speleothems: Stalagmites, stalactites, rolls, terraces, shelves, droplets, wall and ceiling pockets, lake. Secondary features formed of leached calcite: soda straws, stalactites, stalagmites, columns, curtains, rimstone pools, cave corals, moonmilk, cave flowers, cave pearls.

CLIMATE

The island has a subtropical oceanic climate, moderated by the Tsushima current from the south, rising with altitude through warm temperate to subarctic. There are four distinct seasons. The average January temperature is 6.2 ^{o}C, the average August temperature is 27.2 ^{o}C, the coasts being the warmest, but the average annual temperature in the site is 11.7^{o}C. Winters are short and relatively warm, with only 17 days of frost. On site rainfall averages 2,044mm and, rising with height, is greatest (2,766mm) on the southeastern slopes of Hallasan. Snow falls between November and May. Half the total precipitation falls in summer low-pressure storms, and spring is continuously drizzly, but long rainstorms are common in winter. Winds are strong especially from the northeast in winter. An average of 2.4 typhoons a year was recorded between 1940-1982, mostly during the late summer monsoon season.

VEGETATION

The flora of Jeju Island shows influences from three different floristic regions: East Asiatic, East Siberian and Indo-Malaysian with plants that evolved on Jeju itself, so it is extremely diverse for so small an area. Jeju Island as a whole has 1,453 vascular plant species with two subspecies, 275 varieties and 65 forms, totalling 1,795 taxa in 214 genera. These include 344 angiosperms, 12 being endemic, and six gymnosperms. 96 vascular species and two genera are endemic; 59, mostly alpine or arctic plants, are found on the mountain. 32 species are at their northern limit and 118 at their southern limit of distribution. Mt. Hallasan rises from subtropical through temperate to subalpine zones. The mountain is largely covered by warm temperate deciduous forest with ninety species of hardwoods. Between 600-800m it is dominated by *Quercus serrata* with gallery forest of yellow chinquapin *Castanopsis cuspidate* var. *sieboldii,* among other species. From 800-1,200m a mixed forest of the hornbeams *Carpinus laxiflora* and *C. tschonoskii*, with Korean maple *Acer pseudosieboldianum* predominates, with a *Camellia japonica* shrub layer. Between 1,200 and 1,400 the same trees occur dominated by Mongolian oak *Q. mongolica*. In this zone *Mankyua chejuense* is a recently reported fern genus endemic to the island.

These are succeeded by a temperate evergreen forest of Korean fir *Abies koreana* from 1,400m which becomes dwarfed as it grades into a subalpine scrub forest with snow azalea *Rhododendron mucronulatum*, Korean azalea *Rhododendron yedoense* var. *poukhanense*, Chinese juniper *Juniperus chinensis*, black crowberry *Empetrum nigrum* var.*japonicum* and the circumpolar pincushion plant *Diapensia lapponica.* Above 1,700m there are alpine relicts, which have speciated by adapting to the harsh climate of very strong winds and the dry soils derived from volcanic ash. Some of these species on Mt. Hallasan are found in northern Japan, northeastern China and Siberia, so it is a useful place to study their migration routes and speciation following the last ice age. On the Ilchulbong tuff cone, one rare endemic is the broomrape *Aeginetia indica*, parasitic on eulalia *Miscanthus sinensis*, found only on Jeju in very limited areas. Over 300 marine plants are recorded on the coast around the cone, several endemic to the region, such as *Dasysiphonia chejuensis*, a red alga, the type locality of which occurs there.

FAUNA

Continental, Japanese, and southern characteristics coexist in the island's fauna. There are 19 species of mammals, mostly rodents and bats, but including Siberian deer *Capreolus pygargus* and Asian leopard cat *Prionailurus bengalensis euptailurus*. Five mammals are endemic to the island, among them the endemic Jeju weasel *Mustela sibirica quelpartis,* and two bats, greater horseshoe *Rhinolophus ferrumequinum quelpartis* and a cave colony of 30,000 Schreiber's long-fingered bats *Miniopterus schreibersi fuliginosus,* the largest in the country. On the Ilchulbong tuff cone, 220 species of land animals have been recorded. The island as a whole has 7 species of amphibia and 9 reptiles. There are 236 species of birds: 36 residents, 69 passage migrants, 67 winter visitors, 36 summer visitors and 28 vagrants. Three species are globally endangered: imperial eagle *Aquila heliaca* (VU), Steller's sea eagle *Haliaeetus pelagicus* (VU), fairy pitta *Pitta nympha* (VU) and Japanese paradise-flycatcher *Terpsiphone atrocaudata* is near threatened. Among the 1,601 species of insects, 24 are endemic to the island and 204 are arctic species. As with the flora, most animal species endemic to Jeju live on the higher levels of Mt. Hallasan. However, guano and organic sediments, especially near breaks in the tube caves, support troglodytic life: 64 organisms from 54 genera have been found living in the caves, including the nearly endemic Jeju salamander *Hynobius quelpaertensis*, harvestman *Opilio pentaspinulatus,* the millipede *Epanerchodus clavisetosus,* and cave spiders *Nesticella quelpartensis* and *Sinopoda koreana* which are all endemic to Jeju.The Yongcheon cave lake contains copepod crustaceans which have not yet been closely studied. 15 species of stony and 73 species of soft coral are found offshore.

CONSERVATION VALUE

On this inactive shield volcano past eruptions created 120 large lava tubes and 360 parasitic cinder and scoria cones all over the island, and a large cliff-like cone of tuff offshore. The tubes contain carbonate and lava speleothems, some being formed, by secondary carbonates leached from overlying sands. The mountain summit has endemic relic alpine flora. The site overlaps a UNESCO Biosphere Reserve

CULTURAL HERITAGE

Many Paleolithic artifacts have been discovered: stoneware, bronzeware and ironware. From 57 B.C. - 935 A.D., it was part of the Silla empire, and relics of this era remain. The island became independent

until 1105 when it came under the rule of the Koryo then the Joseon dynasties. Its culture and accent are distinctive. A 13th century Mongol invasion left it with a tradition of rearing horses. Seaweed harvesting by its women is another distinctive tradition. The island was known to westerners as Quelpart until the 20th century.

LOCAL HUMAN POPULATION

No-one lives in the core zones; 433 people live in the buffer zones and 7,500 people in the surrounding Biosphere Reserve. The main occupations are cattle and horse-raising, fishing and tourism.

VISITORS AND VISITOR FACILITIES

Four to five million people visit Jeju every year, 1.2 million to Ilchulbong alone. They come for the volcanic features, the local culture, the biodiversity, and as honeymooners. Although access was free in the past, much of the nominated property is now subject to a strict conservation regime because of the fragile nature of the volcanic landscape. Only those limited areas that can accommodate heavy tourism without damage are open to the public. In the Geomunoreum tube system only one out of 7.4 kilometres of the Manjanggul tube is open, receiving 403,000 visitors in 2004. However, there are parking lots, restrooms, information centers, restaurants and shops there and at Ilchulbong where the main trail is paved. On Mt Hallasan which had 689,000 visitors in 2004 there are six trails with wooden and railed boardwalks; also 4 management offices, one also being an information centre, 5 rest areas, 8 shelters, 9 restrooms, a restaurant, shop and parking for over 1,100 cars. Access to the island is by ferry or by air, and to the sites by road. There is ample accommodation on the island. These facilities are to be improved and the sites promoted; an exhibition centre is also planned.

SCIENTIFIC RESEARCH AND FACILITIES

Studies of the island were sporadic until 1964 when a survey of water resources also surveyed the geology. A Korea - U.K. research team studied Ilchulbong in 1988, and several tubes in good condition have been discovered since, the last in 2005. Since the founding of the Mt. Halla Research Institute in 2001, many surveys and studies have been completed on all aspects of the geology. It is well visited by geologists and speleologists, as it is an ideal laboratory for the study of volcanic processes and geological history from the late Tertiary to late Holocene periods. Scientists visit from the Jeju Vulcanological Institute, the Cave Research Institute of Korea and the Korean Institute of Geological Sciences and Mineral Resources. Its endemic alpine and arctic floras also attract botanists, and studies have also been made on the crater lake, forest restoration, roe deer and folklore.

MANAGEMENT

The sites are under the supervision of the Cultural Heritage Administration through the Jeju Provincial Government, and the Mayors of Bukjeju-gun and Namjeju-gun. They are managed by the Jeju World Natural Heritage Management Committee which coordinates policy through a management plan and in cooperation with the Directors of Hallasan National Park, of Manjanggul in the Geomunoreum Lava Tube System and of Seongsan Ilchulbong Tuff Cone. The management office of each site is primarily responsible for the property. The Management Committee is advised by a Scientific Advisory Committee. The Management Plan for Mt. Hallasan precludes any unlicensed development in the National Park. In the Absolute Preserved Areas all development unless for governmental facilities and forestry is prohibited.

Lands above the tubes is being restored to its natural state and damaged areas on Mt Hallasan have been rehabilitated. Daily visitor numbers are restricted; people are limited to designated trails, campgrounds and parking sites and banned from littering, collecting plants, animals and geological specimens. Information is given out on guided walks, and volunteers are trained as nature interpreters by a conservation and management training program run by the Cultural Heritage Administration. There is regular monitoring on each site of collapses, erosion and visitors numbers and impacts, precipitation (Mt.Hallasan), and in the caves, of the internal climate, fauna and green pollution caused by lighting. The surrounding Biosphere Reserve is part of the East Asian Biosphere Reserve Network (EABRN) of six countries which met on Jeju in 2005 to establish a regional cooperative initiative to improve the management of insular and coastal biosphere reserves in the region.

MANAGEMENT CONSTRAINTS

Natural pressures are not severe and earthquakes are rare. On Hallasan, forest degraded by past grazing and tourist trampling is being restored. The heaviest present impacts are still from trampling

visitors. Trails have to be closed off periodically for rehabilitation. Lighting and humidity in Manjanggul also causes greening of the walls. Caves are monitored for damage by traffic since some are quite near the surface.

A further issue developed during the last decade. The island lies in a strategic position between the Yellow Sea, East China Sea and Sea of Japan, equidistant from Beijing, Taiwan and central Japan. Over strenuous local protests, the government has begun construction of a naval base at Gangjeong village on the southwest coast. It will be capable of holding 20 destroyers equipped with missile systems, and two cruise ships or aircraft carriers, plus accommodation for 7,500 service families and is to be used by the U.S. government as a monitoring centre for the region. Its effects on the local economy are seen as potentially very beneficial, but they conflict with the traditional view of Jeju as an 'Island of Peace' and may considerably increase visitation at the World Heritage site (Jung, 2009; Cha, 2010).

COMPARISON WITH SIMILAR SITES

The main bases for comparison with similar existing World Heritage sites are:

(vii) the beauty of the vegetated volcanic landscape, the high crag of Ilchulbong, the carbonate and lava cave speleothems and Mt. Hallasan's alpine summit flora;

(viii) the importance of its geological processes measured by:

- its past activity as a shield volcano, now a dormant volcanic island, formed, exceptionally, from a magma plume under a stationary tectonic plate and notable for the accessibility, great length, size, variety and unspoiled condition of its lava tubes and laval and carbonate speleothems;
- the volcanic headland of Ilchulbong tuff cone with its geological history exposed by erosion.

The biota is rich but not exceptional except in containing many endemic alpine and arctic plants and some unusual and endemic troglodytic fauna.

When designated, Jeju island would be one of at least 23 volcanic World Heritage sites. It is most comparable with the oceanic island shield volcanoes of Hawaii and the Galapagos, both of which formed over a static hot spot and have as many or more exceptional volcanic features as Jeju, and, especially the Galapagos, are richer in many respects. There are twelve other volcanic island World Heritage sites four of which are shield volcanoes: the 2,745m snowbound Mt. Mawson on Heard Island which does have little known lava tubes, the dormant Lord Howe Island seamount group off Australia, Inaccessible and Gough Islands in the south Atlantic and four of the six sub-Antarctic island groups off New Zealand. The last four are much worn away. Two nominated sites, Mt. Teide in the Canary Islands and the Prince Edward Islands off South Africa are also quietly active shield volcanoes.

Most others are associated with subductive tectonic movement or ocean ridge upwelling. These include the Aeolian Islands off Italy, a historical textbook of vulcanology for 200 years, Krakatoa - too continually active to be comparable, Morne Trois Pitons in Dominica with boiling sulphur springs, the Pitons of St. Lucia, again with much sulphurous activity, MacQuarie Island off Australia, a dormant ocean ridge extrusion, and the well eroded cliffs of St Kilda off Scotland. All have several volcanic features of interest, but only the Hawaiian volcanoes are noted for their many long, but largely neglected, lava tubes. Among several well developed examples, especially on Kilauea, some are still flowing with lava. One, Kazamura Cave, at 59 km is the longest tube cave known, with many signs of its structure such as lava falls, but with no mention of lava and carbonate speleothems.

Other World Heritage shield volcanoes of note are among the 19 (out of 34) very active peaks in glaciated Kamchatka, and some of the forested long dormant basaltic volcanic ranges of the Central Eastern Rainforest of Australia. It is not known if these possess well developed lava tubes. The spectacular serial sites of Tongariro in New Zealand, Sangay in Ecuador, and the African Mounts Kenya and Kilimanjoro, Kahuzi and Biega and Nyiragongo and Nyamuragira in Virunga National Park, D.R.Congo are not of shield origin, nor is there available evidence of lava tubes or speleothems. Moreover all the above are too continental in scale and setting to be closely comparable to Jeju.

STAFF

Hallasan National Park Management Service has 1 Director with 19 staff, 11 Researchers, 1 Heritage interpreter and 22 Park rangers. Manjanggul Management Service has 1 Director with 21 staff, 5

Heritage interpreters and an Environmental Management Division of 1 Director with 10 staff; the Culture and Public Relations Division of Bukjeju town has 1 Director with 10 staff. Ilchulbong Management Service has 1 Director with 8 staff and 5 Heritage interpreters. The Tourism Promotion Division of Namjeju town has 1 Director and 7 staff.

BUDGET

In 2005, a direct budget equivalent to US$8,593,277 was provided by the central government for conservation and management of the sites. An additional budget of US$35,650,555 was provided for the general conservation and management of resources relevant to the nominated properties. These may grow in future.

LOCAL ADDRESSES

The Director, Cultural Heritage Administration, 920 Dunsan-dong, Seo-gu, Daejeon, South Korea.

Deputy Supervisor: Director-General, Culture and Sports Bureau, Jeju Provincial Government, 312-1 Yeon-Dong, Jeju, South Korea.

The Director, Hallasan National Park Management Service, San 220-1 Haean-Dong, Jeju, South Korea

The Director, Manjanggul, Management Service, Geomunoreum Lava Tube System, San 67, Gimnyeong-ri, Gujwa-eup, Bukjeju-gun, Jeju, South Korea.

The Director, Ilchulbong, Management Service, Seongsan Ilchulbong Tuff Cone, 114 Seongsan-ri, Seongsan-eup, Namjeju-gun, Jeju, South Korea.

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DATE

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