

UNESCO WORLD NATURAL HERITAGE

Jeju Geomunoreum Lava Tube System

Contents



Part1 **1. Geomunoreum International Trekking**
Welcome to Geomunoreum!_ 06

Part2 **2. Tourist Attractions of Geomunoreum**
Map of Geomunoreum Hiking course_ 12
Peak of Geomunoreum_ 14
Characteristics of Collapse Trenches_ 16
Vertical cave of Geomunoreum_ 23
Roads for logistics_ 26 / Volcanic bomb_ 28
Charcoal kiln site_ 31
Japanese military underground tunnel_ 34
Japanese military stations_ 36
Japanese Aucuba and Star Anise Tree Clusters_ 39
Rubus hongnoensis Nik. Cluster_ 42 / Baengdwigul lava tube_ 45

Part3 **3. Geomunoreum**
Volcanic Activities_ 52 / Vegetation_ 64
Animal Life_ 81 / History and Culture_ 86

Part4 **4. Geomunoreum by geomantic topography**
Guryongnongju type_ 98
Deep philosophic meaning of "Taegeukgil"_ 102
Air hole_ 104
Aloreum in the crater and site of observatory_ 106
Meaning of Guryong full of auspicious signs_ 108
Commentary on Guryong_ 110

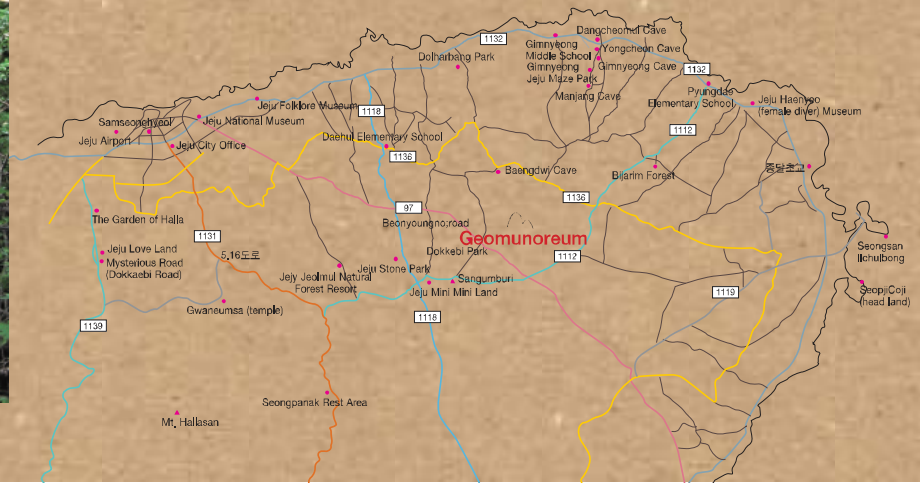
Part5 **5. World Natural Heritage, 'Jeju Volcanic Island and Lava Tubes'**
Mt. Hallasan, Seongsan Ilchulbong Tuff Cone, Geomunoreum Lava Tubes_ 122

Part6 **6. Jeju World Conservation Congress Attracts Global Attention**_ 136



Part 1

Geomunoreum International Trekking





Geomunoreum was designated as UNESCO the World Natural Heritage and is located at Seonheul 2(i)-ri, Jocheon-eup, Jeju. Geomunoreum Lava Tubes designated as the world natural heritage means a lava system distributed at Gujwa-eup and Jocheon-eup of Northeast Jeju. Here includes Jeju"s representative lava tubes such as Manjanggul, Gimnyeonggul, Yongcheongul, Dangcheomulgul, Bengdwigul etc. Geomunoreum assumes the black dismal atmosphere of a thick forest inside of the crater(cone) and connotes the meaning of 'spiritual space'. The geology and ecological resources as well as historical culture such as a charcoal kiln site, a military base for Japanese colonial period, Jeju April 3rd incident remain untouched.

Geomunoreum International Trekking event will be held at this place. Geomunoreum has attracted from foreigners as well as Korean as a new eco-tourist attraction via this international trekking competition since its registration as the world natural heritage, and the town also is full of energy.

2012 marks the fifth anniversary since its launching in 2008. International trekking on Geomunoreum will continue for a month from July 8 to August 5.

This event has been developed every year under the principles of sustainable and efficient use and preservation such as P.R(public relations) for Jeju World Natural Heritage, Eco-tourism and etc. It improves a new trekking culture by practicing thoroughly a pre-reservation system before opening the event and appointing 'natural holiday' once a week. **It operates without pre-reservation during the event, but a visitor should be educated safety education and trekking rules and take an admission ticket before trekking.** Any cooking is not admitted at a trekking course, and also, collection of any plant sample is prohibited. The use of a climbing stick is not admitted for conservation of Geomunoreum.

The visitors' response to this trekking event is very positive as a high quality trekking course. So, the trekking course was modified and supplemented and storytelling was strengthened further so that a visitor can enjoy the true worth of Geomunoreum to the full. This trekking courses which was called 'Course A' and 'Course B' at the 1st event in 2008 have been titled Course A '**Taegeukgil (Scoria cone road)**' and Course B '**Yongamgil (lava road)**' since 2009. The total distance of two courses comes to 13km. 'Taegeukgil' expanding the existing course A is 8km course and was newly designed so that a visitor is able to view the whole view of a crater(cones), the ridge of oreums, lots of oreum(volcanic cone) scenery spread around there. It is the course to circulate the horse's shoe-shaped crater of Geomunoreum and nine peaks at the summit of Geomunoreum. 'Taegeukgil 'was named because the shape of the course going around crater's ridge and Aloreum inside of the crater resembles the pattern of 'Taegeuk (Korean flag)'.

The expected trekking time is about 3~4 hours.

'Yongamgil' is a temporary trekking course during the event. It is total 5 km course from Geomunoreum to an evergreen forest, a raspberry community, entrance of Bengdwigul(lava tube) and Albam(Albamaegi) Oreum alongside the lave road, and the expected trekking time is about 2~3 hours. It was named because it has a Gotjawal(rocky forest) topography formed by lave flow erupted from the crater of Geomunoreum and is able to view primitive forests and rare rocks. A shuttle bus operates 5 km section from 'Kyungduk Homesprings' which is a café located at the last stop of Yongamgil to Trekking Information Center for visitors' convenience.

Facilities for the visitors were largely supplemented. A deck is for protecting the ecological trekking course of Geomunoreum to the maximum. Visitors are safely able to experience the quintessence of the world natural heritage walking on the wooden road. The craters(cones) spread at a glance and the surrounding oreums spread as a panorama make visitors exclaim with admiration by themselves. The thinning of the land afforested by cedar trees has been extended. The thinning of cedar trees is the process to recover Geomunoreum as natural vegetation.

Geomunoreum was selected by Ministry of Environment as one of 20th national eco-tour sights and done by a **government as one of 10th Korean eco-tourism model project areas in 2010**. It concentrates for fostering sustainable and competitive eco-tourism models by developing Korean eco-tourism making use of ecological resources including Korean features. The former minister of Environment, Manee Lee visited in May of 2009, and international celebrities who are taking part in ICC conference of UNESCO MAB(Man and the Bioshpere Programme) experienced this trekking course. Robert Lee who is the vice-president of Jakarta office which generally manages UNESCO Asia & the Pacific area, Hiroyuki Matsuda who is the chairman of Japanese MAB, Wang Ding who is the chairman of Chinese MAB, Hillary who is a director of IUCN(the International Union for Conservation of Nature) at Botswana in South Africa and so on participated in this trekking event. The vice-president, Robert said his impressions after trekking that "I thought sustainable development and usage through experience of Geomunoreum trekking. Many people will learn how they will live harmoniously together with nature via this trekking course".

On May 28, 2011, Prime Minister Kim Hwang-sik visited Geomun-oreum and walked around the trekking course guided by Kim Sang-su, Former head of the village Seonheul 2-ri.

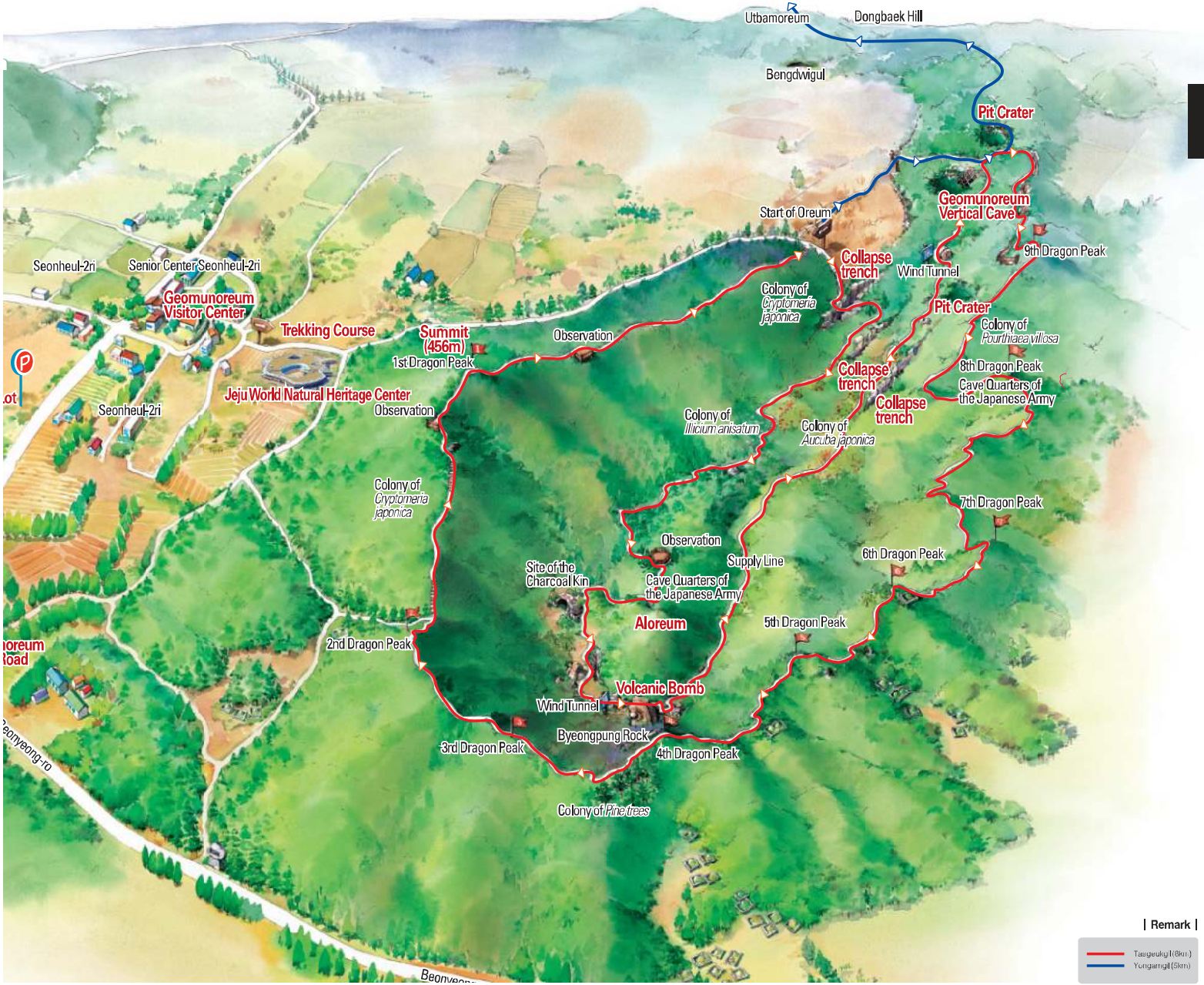


1. Prime Minister, Kim Hwang-sik
2. The former minister of Environment, Manee Lee
3. Governor of Jeju Province, Woo Geunmin
4. Governor of Maomori, Japan
5. Former manager of the team, Eungryong Kim

Tourist Attractions of Geanmoreum

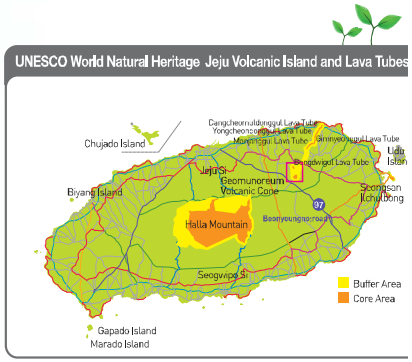
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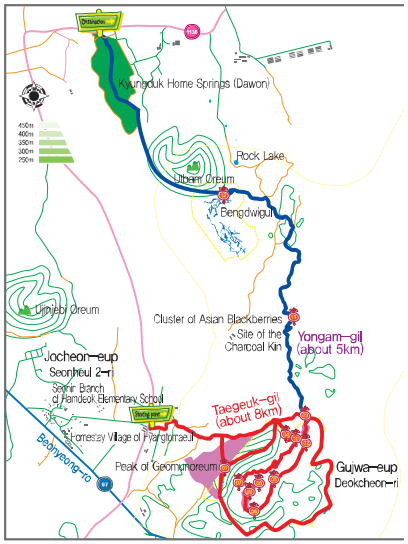
Guide map to explore Geomunoreum



| Remark |

Taegeukgil (8km)
Yongamgil (5km)





Step 1
Peak of Geomunoreum

UNESCO-registered lava tubes Baengdwigul Cave, Manjanggul lava tube, Gimnyeonggul lava tube, Yongcheondonggul lava tube, Dangcheomuldonggul Cave and the Geomunoreum lava tube system were all created by lava flows from Geomunoreum.

Around Jeju Island, there are more than 360 oreums(small volcanic cones) such as Geomunoreum as well as countless others underground. Why, though, is only Geomunoreum know as a "UNESCO World Natural Heritage Geomunoreum Lava Tubes"among so many oreums?

The answer is on the top of Geomunoreum.

On the summit of Geomunoreum, you may see at glance the craters of volcanoes that form the Geomunoreum Lava Tubes made up of more than 10 caves. The fact itself that from this crater, lava flew out and formed Baengdwigul, Manjanggul lava tube, Gimnyeonggul lava tube, Yongcheondonggul lava tube, and Dangcheomuldonggul makes Geomunoreum admirable and holy.

Geomunoreum scoria cone(cinder cone) is a gigantic volcano crater whose ride is 4.4km long and bottom is 1 km in diameter. Inside of the crater is a small scoria cone(oreum) called aloreum, and the entire crater looks like a horse's hood leading to the Northeast. As the lava that gushed to the northern area of the crater flew toward the coast 14km away, it formed narrow and deep valleys in some of the areas, which is called collapse trenches. The collapse trenches are so deep and clear that they are distinguished even in aerial photographs. Besides, this has been a habitat of a variety of animals and plants(see the picture in the next page)

Nine peaks are lined up along with the ridge of Geomunoreum scoria cone. Each of these peaks is made of eruptions(cinder / scoria), which would readily collapse and be weathered by rain and wind. Only 9 peaks have remained over time by weathering.

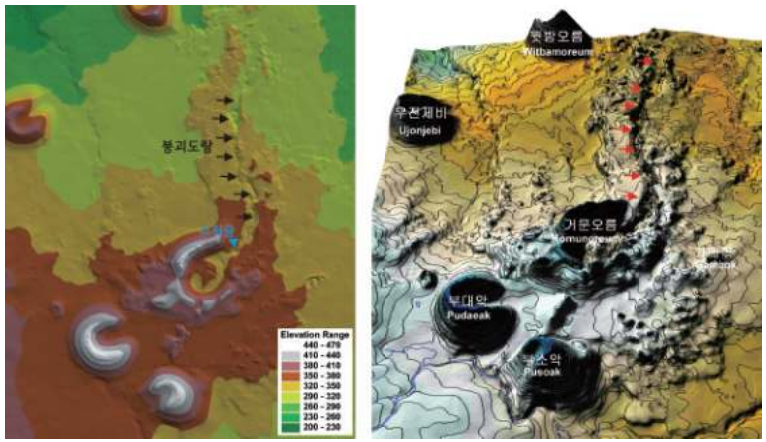


Whole view seen from Geomunoreum photo zone

5-top

Characteristics of Collapse Trenches and Lava Channels

Unique lays such as collapse trench and lava channel have been well developed around the Geomunoreum trekking courses, which also are an habitat of a variety of living things.



Collapse Trenches and Lava Channels on a Topographical Map

How are collapse trenches and lava channels formed?

Along with Geomunoreum crater trekking courses, there are unique lays such as sunken pits under the ground and collapse trenches deep and extended like a valley. Since these original cave-in lays form sunken pits lower than surrounding levels, the stable temperature and humidity remain around the year, and the green, dense forest is distinguished in aerial photographs even during the winter season.

Such unique cave-in lays within Geomunoreum craters are closely related to the volcanic activities of Geomunoreum. Geomunoreum has formed the present geographical features as a series of volcanic eruptions took place.

Eruptive volcanic activity in the early stage would gradually change to non-explosive gushes of lava in the latter stages. Collapse trenches and lava channels are produced in the latter stage of such Geomunoreum volcanic activity. As lava is gushed out of the crater, the amount of lava around the crater is likely to increase or decrease, which would make the roof of a lava tube thinner or unstable. Such a thin roof of a lava tube could collapse readily due to such factors as change in lava supply or intermittent volcanic earthquakes, which would result in lays that look like a deep ditch. This type of topography is called a collapse trench. In general, collapse trenches are extended up to tens of meters or even hundreds of meters while lava channels are limited to narrow areas. The formation process is the same while the extensibility is different from each other.

The surrounding areas of Utsanjeon tube, Manjanggul lava tube, and Yongcheondonggul lava tube, which are all far from the origin of lava, have

few collapse trenches while lava tubes are extended over the area. Since the downstream area has stable supply of lava compared to the upstream area, the cave roofs are thick and stable, and thus remain for a long period with little risk of collapse. In other words, collapse trenches and lava channels were all in a form of lava tube when they were formed. In the upstream area adjacent to the crater, the roof is likely to collapse due to such factors as change in lava supply and volcanic earthquake, and thus a lot of collapse trenches and pits are produced while in the downstream area, the supply of lava maintains stable and thus the thick and stable roofs of lava tubes continue to exist up to the point of forming caves. The unique collapse lays of Geomunoreum, therefore, are a good example which shows how a scoria cone would have been formed and how the lava would have flowed.



Collapse Trenches



Lava and Cracks on the Collapse Trench Walls

Evergreen broad-leaved forest around the path of lava flows and pit crater

Major plant types are *Castanopsis cuspidata var. sieboldii*, Japanese Red Oak[*Quercus acuta* Thunb. ex Murray for. Acuta], Sericeous Newlitse[*Neolitsea sericea (Blume) Koidz*], *Neolitsea sericea (Blume) Koidz*, Common Camellia[*Camellia japonica* L], and Janpanese Eura[*Eurya japonica Thunb*]. Large growing and distinguished plants are Japanese Acuba[*Aucuba japonica Thunb*] and Chinese Anise[*Illicium anisatum*]. The types of lower vegetation include Japanese Shield Fern[*Dryopteris erythrosora (D.C.Eaton) Kuntze*], *Cyrtomium fortunei J.Sm*, Japanese tassel ferns *[Polystichum polyblepharum*], Bamboo Fern[*Coniogramme japonica* (Thunb.) Diels], Tomentose Condorvine[*Marsdenia tomentosa Morr. et Decne.*], Calanthe orchids [*Calanthe discolor* for. *Sieboldii*], *Trachelospermum asiaticum var. intermedium*, *Ardisia japonica*, Japanese ivy[*Hedera rhombea*], and *Gardneria Insularis* Nakai. Rocks in this area are almost fully covered by mosses (bryophyte).

Especially, Japanese Acuba grows in a large cluster that is connected to other communities lined up along the path of lava flows. It is known as the largest cluster of the kind in Korea.

Vegetation in the pit crater

The pits that are located in line along the lava flows are as large as from 20 to 80 meters and 5 to 30 meters deep. The vegetation in the pits shows very distinctive but the vegetation structure and flora are very similar with a very unique plant species.

The outer circle of pits is mostly covered by *Castanopsis cuspidata var.*



pit



Hart's tongue

sieboldii, Japanese Red Oak[*Quercus acuta* Thunb. ex Murray for. Acuta], and *Neolitsea sericea (Blume) Koidz*, while mostly Japanese Acuba grows in clusters on the slope. The vegetation at the bottom of the pit is mostly the ferns such as *Rumohra standishii*, *Dryopteris Crassirhizoma* Nakai, *Dryopteris dickinsii (Franch. & Sav.) C.Chr.*, *Coniogramme intermedia* Hieron., *Asplenium scolopendrium L.* as well as Smoothfruit Mercury[*Mercurialis leiocarpa Sie. et Zucc.*], and *Goodyera Maximowicziana* Makino.

The distinguished species are *Loxogramme grammitoides* (Bak.) C. Christ and *Pleurosoriopsis makinoi* (Maxim. ex Makino) Fomin. In particular *Pleurosoriopsis makinoi* (Maxim. ex Makino) Fomin is known as a plant that is normally observed in the northern section and can only be found near the valleys of Mount Hallasan higher than 800 meters above sea level Considering all of the matters, the vegetation around the pit craters is assessed to have a very unique form consisting of the plants that are normally distributed in the Subtropical Zone or the Temperate Zone when compared to the nearby evergreen broad-leaved forest.



Vegetation in pit

Stop

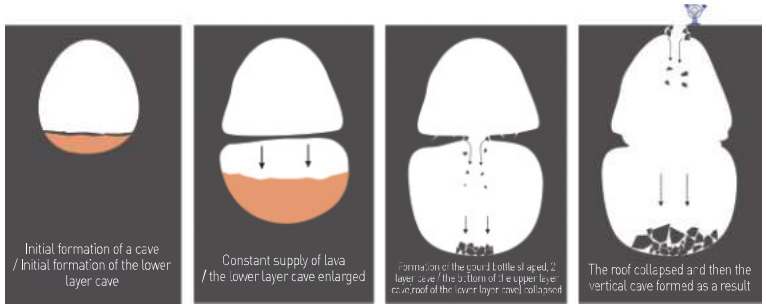
Vertical lava tube

Geomunoreum vertical lava tube is unique, jar-shaped lava tubes in contrast with common lava tubes which are developed horizontally. These are rarely observed in Jeju Island.

Geomunoreum vertical caves are located on the lamp to the north of the horse''s hoofs-shaped crater. Geomunoreum vertical caves are developed vertically, which is different from the horizontal shape of common lava tubes. The diameter of the inlet of a vertical cave is about 2-3m, the depth is about 35m, and the slope is 70-90°. A horizontal cave leading from the ground either upstream or downstream is connected to it.







Formation Process of a Geomunoreum Vertical Cave

The sectional area at the center of a vertical cave looks like a convex gourd bottle. In the formation stage, the vertical cave was a two-layer lava tube, but it late became a gourd bottle shaped cave as the roofs of the first and second layer caves collapsed. Both in the upstream and downstream directions of the vertical cave is the cave-in lay extended 10m deep into the inner part. This cave-in lay was the remains of a lava tube whose roof collapsed later. This is an extension to the vertical cave developed both upstream and downstream.

Geomunoreum vertical caves, therefore, gradually formed a long 2-layer cave as the initially formed lava tube melted down the ground with the supplied lava. As the roof of the cave and the part between the upper and lower layers collapsed, it became a vertical cave.

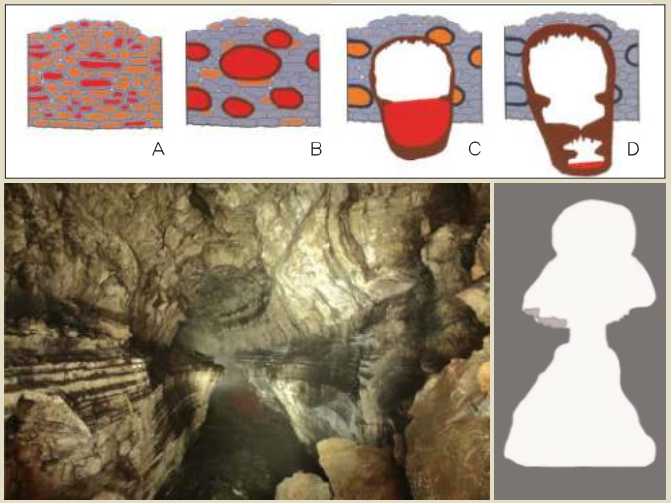


Entrance of vertical cave

Info

Formation of lava tubes

Some lava tubes have the simple structure with short length and small size, and others like Manjanggul lava tube show complex structure with 7km or more length, several tens of meter width and height, and with 2-4 layers. Ideally, these large and complex lava tubes could be made by large-scale lava's frequent flows forming multiple layers. But mainly, small lava flows are accumulated to make small lava tubes in the initial stage and when hot lava flows make their ways to the already-formed tubes, they are molten by the heat to make a large and complex tube. This physical activity of rocks being molten by heat of lava and disappearing is called 'heat erosion'. The photo and section of Manjanggul shows that the cave extended long downward as a form of a key hole since lava continued to flow on the ground of the cave, which gradually melted down and deepened the ground.



Above The picture showing how small lava tubes were molten by heat erosion and joined together to make a large lava tube (Ramon, 2006)
Below Channel of lava in Manjanggul lava tube with the similar cross-section of a keyway or sandglass

Step 4

Roads for Logistics

Japanese colonial military built roads for logistics to connect military fortresses in different places around Jeju and transport supplies.

When they built military facilities such as the tunnel camp in the Geomunoreum crater, they also cons-tructed roads for logistics. It is to transport various supplies through rough and mountainous path to the crater. There still remains the trace of long roads on four sides of the crater with width of around 2 meters.

There is also a type of road that cannot be missed when mentioning about the road for logistics and that is called 'Hachimaki road'.

The 'Hachimaki' road, meaning 'shape wearing a hair-band', is a military road that circumvents Mount Hallasan for Japanese military. Because it looks as if a person is wearing a hair-band on forehead, the road was named as 'Hachimaki' road. Japanese military made Hachimaki road to connect military fortresses and bases that were made in different placed around Mount Hallasan and supply forest resource and other various materials.

Since then, the road has been used for cultivation of shiitake mushrooms and forest tree management. The length is more than 100 kilo meters and still can be seen in various places of Mount Hallasan.

At that time, Japanese soldiers mainly used a horse-pulled iron cart rather than a vehicle for their transportation. Upon their defeat and the subsequent withdrawal to their homeland, they left significant numbers of carts behind. Until the, there were only one or two iron carts were seen in each village of Jeju. Therefore, the carts left behind upon the withdrawal of Japanese military became very useful transportation for Jeju people.



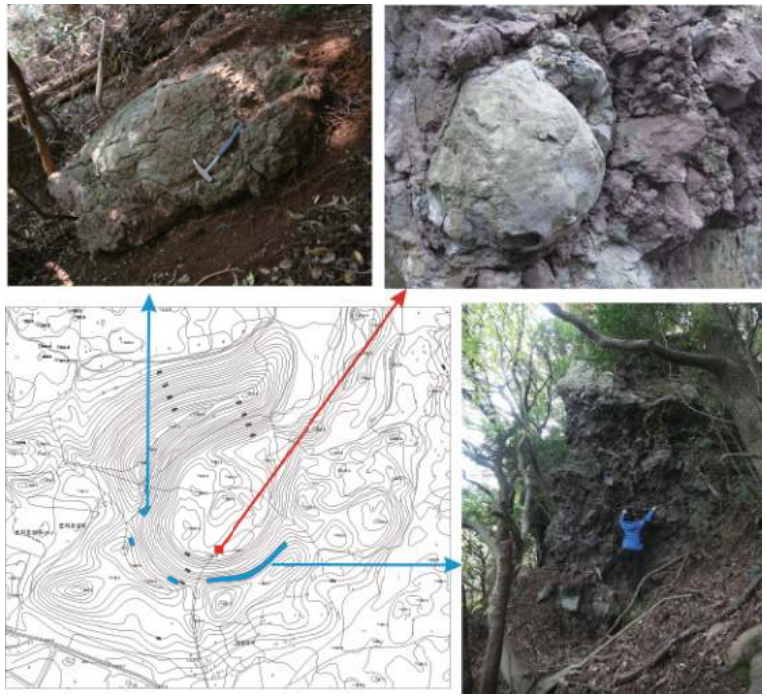
Roads for Logistics

Step 5.

Volcanic Bomb

A volcanic bomb is made of volcanic eruptions which fell on the ground as a mass of bubbles of lava out of the crater turned in the air and became hardened. The large number of volcanic bombs indicates that the eruption was violent.

The shapes of volcanic bombs may vary depending on the spreading speed, size, and wind as they are volcanic eruptions which turned in the air and fell on the ground after lava erupted from the crater. In general, a volcanic bomb is 6.4cm or bigger in size, and mostly it looks like a sweet potato. Most of the volcanic bombs in a trekking course are eruptions in the early stage of Geomunoreum volcanic eruption, and thus they were likely to be curdled with scoria(cinder) erupted around them. The volcanic bombs illustrated in an information board are part of screen rocks of cliff(400m above the sea level) on the wall of Geomunoreum scoria cone that collapsed into the craters. These rocks are agglomerate piled up after volcanic bombs and scoria were curdled like a cattle dung. When the agglomerates were piled up, there were many volcanic bombs already the volcano, and they were curdled to each other as volcanic bombs and scoria continued to erupt, which resulted in the agglomerat. This agglomerate became thicker and



Volcanic bombs at the bottom of a crater. Volcanic bombs around screen rocks(blue), Volcanic bombs rolled from screen rocks down into the crater(red)

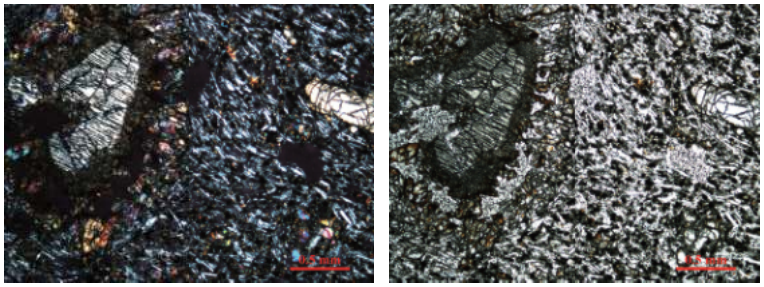
scorched to look like lava (clastogenic lava). The agglomerates scorched on the top of the volcanic bomb were hardened and then collapsed down into the crater, which have remained up to now. In geological research of the agglomerate embracing volcanic bombs, curdled volcanic bombs and scoria are observed inside. To put it another way, it can be said that volcanic bom-

bs in a trekking course are the result that those volcanic bomb on the ground of the agglomerate blocks were collapsed and rolled down to the pathway.

There are tiny black grains within a volcanic bomb, which are minerals called 'pyroxene.' Pyroxenes are made earth's interior and then erupted with magma onto the ground. These indirectly indicate the depth of magma that existed underground mantle.



Pyroxenes within a volcanic bomb



Pyroxenes observed with a microscope

Stop

Charcoal Kiln Site

The arch-shaped charcoal kiln is built by piling basalt stones up and around in a circle. There is an oval-shaped vent in the back side of the kiln.

It is not clear when the people of Jeju began to build a charcoal kiln for making charcoal. However, charcoal production was active at the decline of The Great Korean Empire from 1900 until its demise in 1920. Charcoal production continued to decline until it almost disappeared around the beginning of the 1970's. The charcoal kilns that once shared the joys and sorrows of Jeju people cannot easily be seen in the mid-mountains, and are rarely found in the highlands of Mount Hallasan.

In this aspect, the charcoal kiln that still remains inside Geomunoreum crater is highly valued as an important heritage of Jeju people's lifestyle.

This charcoal kiln helps us guess the original form of Jeju's typical charcoal kiln since it maintains the original structure. The circumference of the kiln is about 25 meters and its height is around 2m.

The arch-shaped charcoal kiln is built by piling basalt stones up and

around in a circle. There is an oval-shaped vent in the back side of the kiln. The inner surface of kiln was coated with mud. There are hand marks clearly visible inside the kiln as people must have slapped mud-putty on the surface to harden the coating, revealing the lifestyle of those days. A rectangular rubblework stands beside the kiln. It is the remains of a cottage that was there to provide a temporary shelter for people making charcoal.

The typical charcoal kiln in Jeju is generally characterized by stacked basalt stones on the firmly-set base of the kiln. The inner wall and ceiling of a kiln are coated with mud to heighten adhesion and keep air circulation inside. A vent of varying size was built outside of the kiln.

Then, what kinds of woods were used to make charcoal in the Geomunoreum kiln?

The woods that are hard and dense while providing long-lasting charcoal fire generally qualify as the best material for charcoal. The types suitable trees: Quercus Japanese Red Oak[*Quercus acuta* Thunb. ex Murray for. acuta.], Red-leaved hornbeam[*Carpinus laxiflora (Sieb. et Zucc.)* Blume var. laxiflora.], Tricuspid Cudrania[*Cudrania tricuspidata Bureau*], Autumn Elaeagnus [*Elaeagnus umbellata* Thunb.]. Although there are few of old and large sized trees among those types that can be found in the proximity of Geomunoreum crater, small trees are frequently seen, which leads to assume that those kinds were used to bake charcoal.

When reflecting today's flora with the deciduous broad-leaved forest on the southeast slope of Geomunoreum and the evergreen broad-leaved forest developed in some parts of the area, there must have been a very flourishing forest around sixty years ago during the period of Japanese occupation.



charcoal kiln site

Step 7.

Japanese military underground tunnel

During the Pacific war, Japanese army established numerous underground tunnels not only in Geomunoreum but also in the entire of Jeju. There are up to 10 Japanese military tunnels in Geomunoreum.

There are up to 10 Japanese military tunnels in Geomu¬ noreum. Among them, the longest one is 60 meters-long, located at 8/10 of the way up the oreum. The 90cm width and 180cm-long tunnel would barely admit a soldier in full kit to go through.

The tunnel was constructed in a caret-shape (¬) towards the peak and it seems to have penetrated the summit. From the entrance of tunnel, the seashore of Seong-san Il-chulbong Sunrise Peak can be seen. Even though it was built through the scoria layer, it is well preserved.

Inside the crater are small hills called Al-Oruem, where six straight tunnels were made. Most of them are 10~15 meters long. The width and height are 140cm, 180cm or so respectively. Excepting tunnels on the oreum itself, tunnels in the vicinity of Geomunoreum place were dug through the rock-bed layer. Due to concerns of collapse, only 1 or 2 out of 10 tunnels may be entered. Past remains were discovered in the tunnel, including 10 angle brackets used to brace the tunnel or to connect supports. There are 3 different sizes of angle brackets attached to the tunnel braces.

The Japanese forces made many underground tunnels throughout Jeju and Geomunoreum during the Pacific War. Among them, Gama Oreum's tunnel in Hankyoung Myun (township) reaches a length of 1.5km. At that time, the Japanese navy established an airfield in Altre, or broad field in Mt. Song-Ak. In the area of Al-Oreum, there is a huge underground tunnel more than 1 km long. There are 360 oreums in Jeju and 120 oreums currently have Japanese military tunnels and facilities.



Tunnel camp of the Japanese military

Step 8.

Japanese Military Stations

Japanese military built many military facilities in different places centered on their stations including the tunnel camp in this area. They all appear to be either directly or indirectly related to the encampment of Japanese military.

The vestige of the thickly mossed rubbleworks is still largely remained around the inside of tunnel in the Geomunoreum crater. The highest rubblework is as high as 2 to 3 meters as if reminding of a wall for a fortress. There is also a rubblework facility like a trench that was built to avoid from canon fired attacks. Uneven lots were landscaped and turned into roads and there are also many remnants of rubbleworks over the building fence in the area.

The structures of rubbleworks that can be found in the area are assumed to be either directly or indirectly related facilities for the encampment of Japanese military along with the constructed tunnel camp.

As described, The Japanese military during the Pacific War constructed many military facilities centered on the stations located in different places of Jeju. Its intention is to fortify the entire island as one fortress.

In other words, the highest Japanese military commanding unit in Jeju, the 58th division, arrived in April 1945 in Jeju. They stationed in Cheju Agriculture School before moved to Eoseungsaengak peak. A large scale tunnel along with a tochka, a military base, is still remained in Eoseungsaengak.

The 96th division was also stationed around Sancheondan of Jeju city area and oversaw the central part of Jeju. The division had troop strength with twelve thousand soldiers and built many tunnel camps around Sancheondan area as well.



Camping ground of the Japanese military

The 111th division stationed at the southwestern part of Jeju, near Moseulpo area. The division has been known as the finest unit among the entered Japanese military divisions to Jeju. The division had twelve thousand troops to occupy the southwestern part of Jeju with its headquarters located around Wonmue-loreum.

The 121st division mainly controlled the western part of Jeju city while stationed in Nokome area of Aewol-eup with the division's total thirteen thousand troops.

After the Japanese military was fully positioned in Jeju, Jeju people other than the areas where the military divisions were stationed were also mobilized to build tunnel camps and military airport such as Alddrew airport in Moseulpo, the southernmost part of Jeju. The investigation by Korea Truth Commission revealed that more than forty thousand Jeju people including children were commandeered to provide servitude for such projects.

Stop 1

Japanese Aucuba and Star Anise Tree Clusters

Japanese Aucuba [*Aucuba japonica* Thunb.] and the Star Anise Tree [*Illicium religiosum* S. et Z.] are rare ornamental trees that have clustered in Geomunoreum, and such clustering is rarely seen.

Japanese Aucuba Cluste

Japanese Aucuba possesses green leaves and red berries and is used as an ornamental tree. Its distribution is in the southern parts of Japan, Taiwan, China, the coastal areas of Korea, and Jeju. The moisture of the valley and crater provides a rare environment for Aucuba to thrive and cluster. The cluster almost continuously follows the lava channel and makes up 80~90% of the trees in the pit crater area. Although it is true that plants can adjust to their environments, the great success of the Japanese Aucuba cluster within the crater suggests that this habitat is especially suitable for this species. This is surprising because the lava channel and pit crater area aren't fertile. Basalt rocks abound, soil cover is almost absent, and moisture and cold rise up through the porous basalt during the summer. Despite the-

se conditions, the Japanese Aucuba cluster has adjusted to Geomunoreum's unique environment over a long period and has developed its own survival strategy. Today this cluster is thriving.



Flowers of Aucuba Japonica



Cluster of Japanese acuba

Info

Japanese Aucuba [*Aucuba japonica* Thunb.]



Japanese Aucuba [also known in Korean as 'Widetree' and 'Layer tree'] usually grows to a height of 3~4 meters. Its small green branches are thick and lustrous. Two leaves sprout from each stem and the leaves are oval or narrow oval-shaped, without hairs on either side. The leaves are also shiny and serrated at the edges and the base of the leaf has a shallow groove. The red berries are oval-shaped or irregularly oval-shaped and appear on tree branches between November and February. The flowers are divided into both male and female and bloom in March or April. Each flower has 4 petals and grows in clusters at the end of a long stalk. The petals are deep purple and oval-shaped, and the flower ovaries are covered in hairs. The bottom of the Japanese Aucuba can form a cluster structure, and Aucuba usually thrives in areas with deep soil cover, shade, moisture, and fertile soil. Japanese Aucuba is a water-hungry plant, however, and does poorly in dry or cold conditions.

The Star Anise Tree [*Illicium religiosum* S. et Z.]



The Star Anise Tree usually grows to 3~5 meters in height and has a distinctive fragrance in its dark-gray bark. Young branches are green and aren't hairy. The leaves are long and oval-shaped, without hairs on either side, and without serration. The leaves are thick and shiny and give off a fragrance upon maturity. The leaf veins are not clear. The fragrant green and white flowers bloom in March or April and appear in between the leaves. There are 6 sepals and 10~15 flower petals. In September to October, poisonous berries appear in bunches, which give off a special fragrance. Each seed case contains one yellow seed. Star Anise is distributed throughout Japan, Taiwan, China, and Korea. In Korea, it can be found in Jeju, Jindo, and Wando. The wood of Star Anise is used to make Buddhist agate beads and also to make the beads for abacuses. The leaves and branches are used as medicine and fragrance, but the poisonous berries are unfit for consumption. In China and India, the live branches are used as decorations at Buddhist temples and in Japan, the trees are planted near graves to block evil spirits. Compared with Chinese Star Anise [*Illicium verum*], Star Anise has smaller berries and is less fragrant. Chinese Star Anise is quite similar to Star Anise except for the fact that it is not poisonous, so Chinese Star Anise finds its way into foods and is also used as a digestive aid or as a medicine to encourage flatulence. Sometimes Star Anise is confused as Chinese Star Anise, leading to poisoning or skin trouble.

Stop 10.

Rubus hongnoensis Nik. Cluster

Rubus hongnoensis Nakai, a representative plant as a rare species that can be seen in Jeju Gotjawal, grows only in Jeju as Korea's indigenous plant.

***Rubus hongnoensis* Nakai**

Jeju Bramble

This deciduous plant is a kind of shrub and grows as high as from 50 centimeters up to 100 centimeters. Its stems and branches do not have hair or thorn but there are lined spots on the branches. The leaves are not alternately cross. The leaves from new shoots are very long and have 9 to 11 small leaves. The small leaves are oblanceolate and mutiply serrated. The leaves grow out from stems in a shape of multiple layer with 3 to 5 little leaves that have lined spots on both sides of leaves without any hair. One flower shoots out of the end of each branch in white color and the calyx leaves are thin with short multiple hairs, more hairs in the inner side of the



Asian blackberries

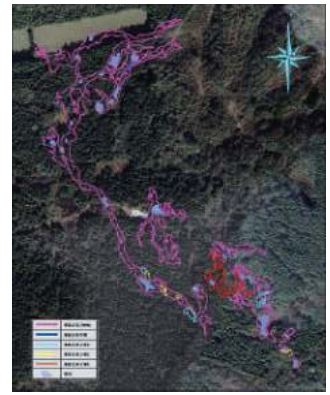
leaves. The plant's fruit gets ripen around July and August and is aggregate fruit kind. The fruit is a round shape and has reticulate wrinkles. The size of ripen fruit is 1.5 millimeters long in yellowish red color. The plant is similar to blackberries[*Rubus croceacanthus*] but distinguished as it does not have thorns and hairs in the stem and leaves.

The plant's scientific name was given as '*hongnoensis*' as it was first collected in Hongno (Cheonjiyeon lake), Seoguipo, Jeju and it is known as Koreas indigenous that is only distributed in Jeju island. In Jeju's Gotjawal area, the plants are easily observed.

Stop 1

Baengdwigul lava tube

Baengdwigul lava tube has the most complicated inner structure among 120 lava caves distributed in Jeju.



Baengdwigul lava tube are occurred in around the lava plateau, which is 300~350m above the sea level, between Witbamoreum and Ujeonjebi and Geomunoreum. The entire tube length is about 4.5km. Baengdwigul lava tube are different from other lava tubes of Jeju Island in terms of shape and formation. Compared to other caves leading to a single channel, these feature the unique formation like that of a complicated maze. Baengdwigul lava tube is situated near to the earth's surface and its thin ceiling(1~2m thicks) collapsed to create 23 skylights. Through 18 spots, people can enter the tube (according to Sohn In-seok, 2000). Inside the tube,

there are traces of human life such as empty cartridges, glass bottles, pots, iron tools. Baengdwigul lava tube is assumed to have been formed initially when many streams of lava from Geomunoreum made their ways to plain plateau to branch off or join again. And then, braided maze structure was supposedly formed when later flowing lava crossed over the previous one.

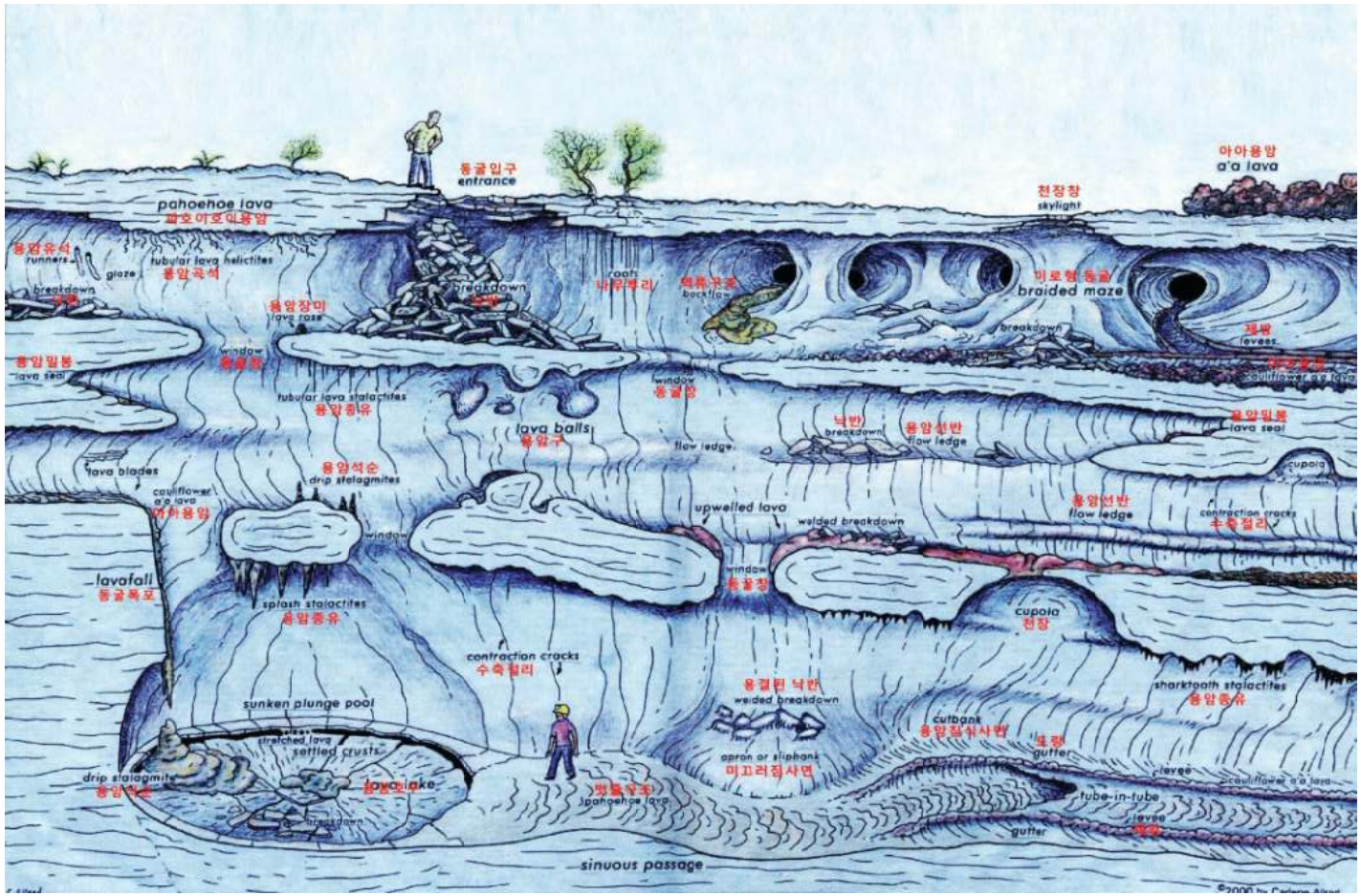




Baengdwigul lava tube



A lava trench within a Baengdwigul lava tube(lava tongue)



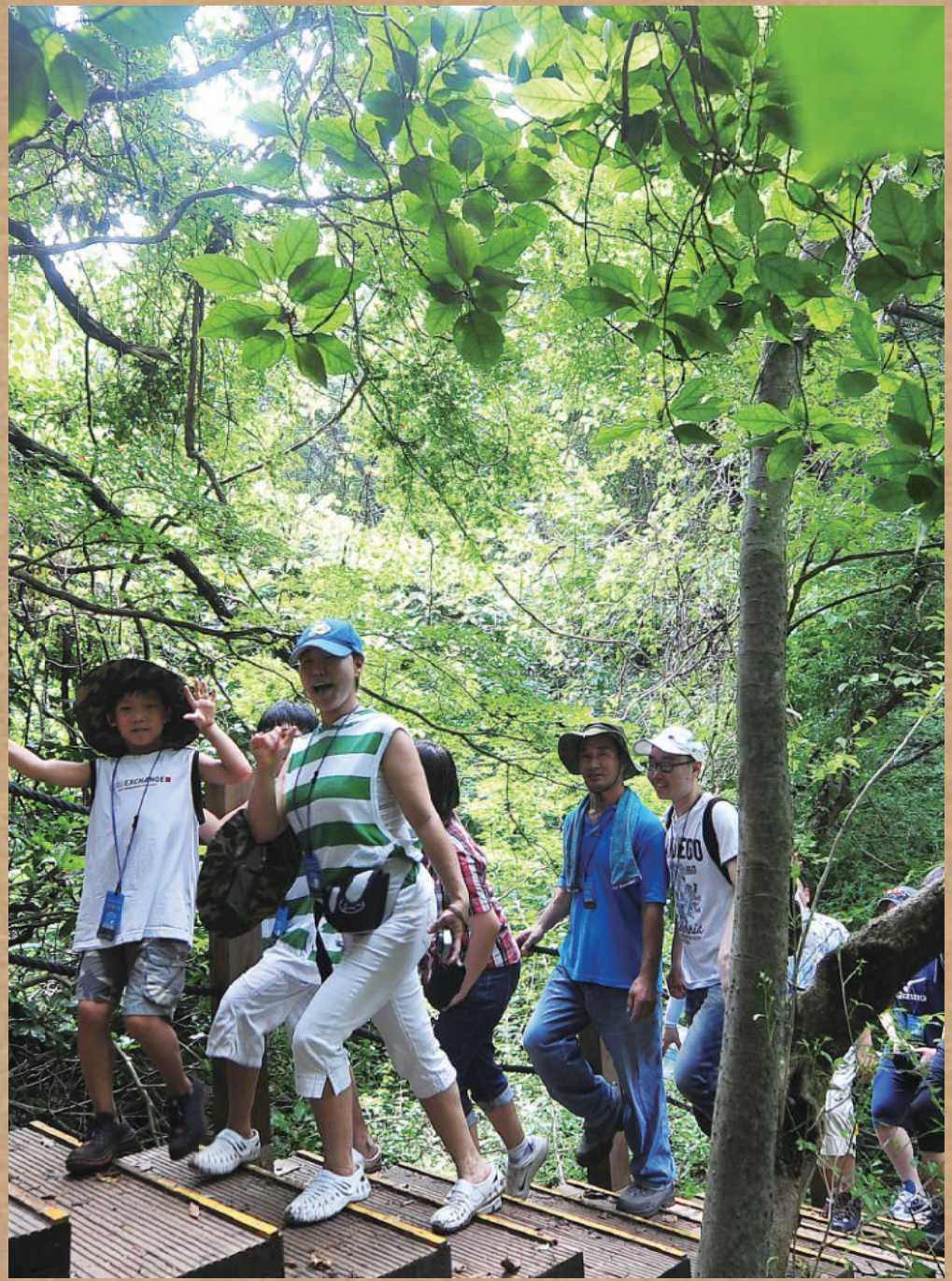
Microforms and products of lava tubes (Carlence Allred, 2000 Revised Edition)

Info

Structure and products of lava tubes

A lava tube creates unique landforms not only in its entrances but also in its inside by influences of lava flows, which are called 'microform of lava tubes'. They include: ropy structure, block lava or block structure, lava column, lava pillar, lava bench, lava levee, lava fall, flowline, gutter, scrape, lining, rockfall, lava bridge, tube-in-tube, (according to National Research Institute of Cultural Heritage, 2007).

On the other hand, lava's flow in the tube creates diverse products on the ceiling, wall or bottoms, which are called 'products of lava tube'. Typical creatures are: lava stalactite, lava stalagmite, lava helictite, lava blister, lava flowstone or runner, gas ball, lava raft (according to National Research Institute of Cultural Heritage, 2007). Products of a lava tube have quite different elements and cause of creation from those of products of a limestone cave, however normally simple addition of lava like a prefix to names of a limestone cave products will do.



Part3

Geomunoreum



3. Geomunoreum

Volcanic activity of Geomunoreum

Formation of Geomunoreum

Geomunoreum scoria cone are a result of going through two basic steps of volcanic activites. In the initial stage of Geomunoreum, violent eruption of strombolian volcanoes resulted in a large amount of scoria(or cinder) and lava. The scoria fountaining within a short time are accumulated around



the crater and form scoria cone. The lava flowing out with scoria eruptions filled up the crater, and then broke the northeast wall of the crater and ran out as the volume of lava and pressure increased. In the mean time, lava flow out along with relatively light scoria, which is similar to the phenomenon where corn flakes flow on the milk within a cup. The rocks accumulated by the lava flowing out are observed around the Geomunoreum World Natural Heritage Center.

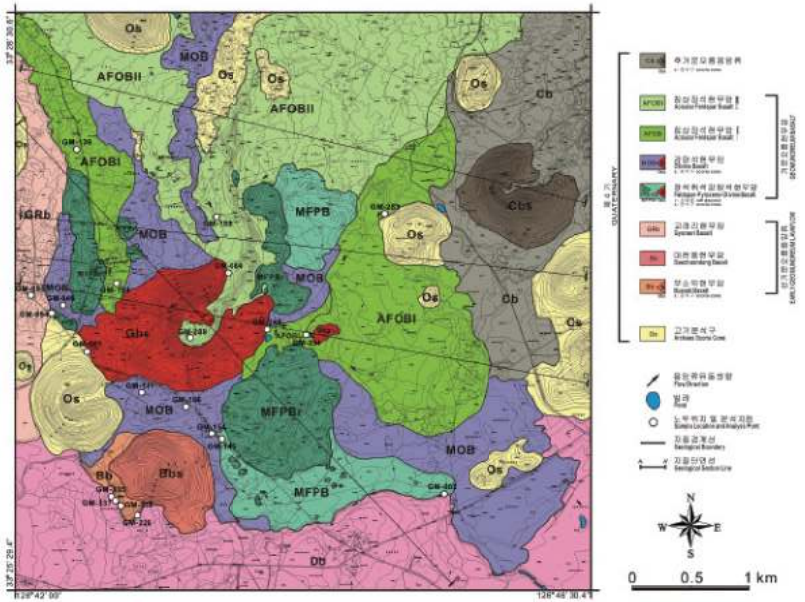


In the medium period of volcanic activity of Geomunoreum, the violence of magma gradually decreased, and the quantity of lava reduced accordingly. Although the amount of lava reduced compared to the initial stage of eruption, however, lava continued to erupt for a long period of time and flew from Geomunoreum into the coast to the northeast.



Geomunoreum Lava Tubes

The crust of lava hardened after its flowing out enhances the heat insulation effect of the lava inside, reduces loss of heat, and lets it flow farther. As a result, lava flows 14km far from Geomunoreum to the northeast coast. In such a process, a number of lava tubes were formed such as Geomunoreum Vertical tube, Baengdwigul lava tube, Utsanjeon tube, Bugoreum tube, Daelim tube, Manjanggul lava

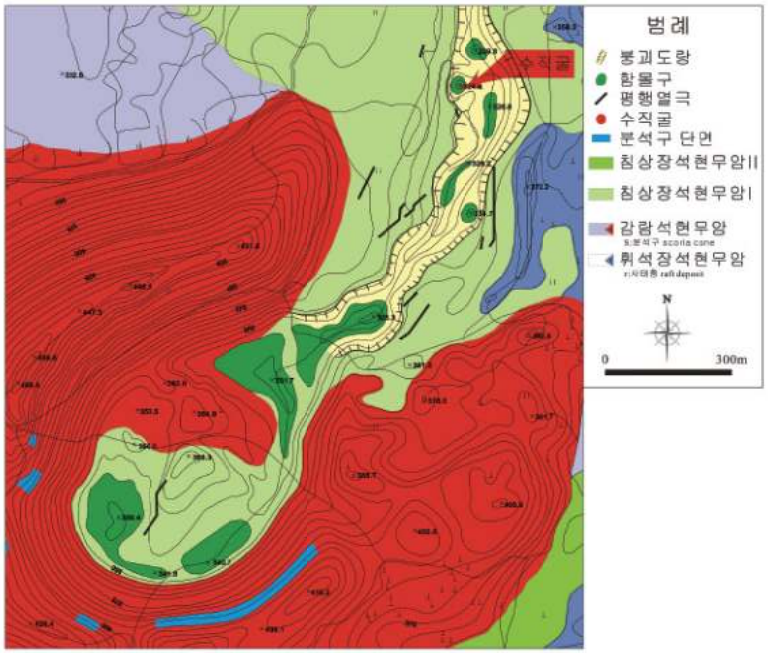


Geological Map of Geomunoreum(2011, Jeju Province)

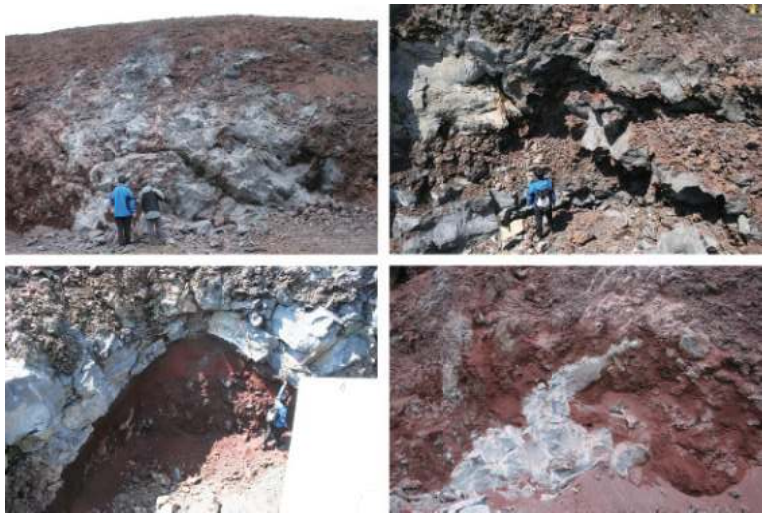
tube, Gimnyeonggul lava tube, Yongcheondonggul lava tube, and Dangcheomuldonggul lava tube.

In other words, Geomunoreum scoria cones a Strombolian type of eruption in the early stage of formation, which causes scoria to fountain, leads to a scoria eruption. At the same time, lava breaks the scoria cone, flows out of it, and forms a horse's hood shaped scoria cone with one side opened. Then the violence decrease subsides in the latter stage although the lava continues to flow and thus forms lava tubes.

As in the case of Geomunoreum, most of the scoria rises around Jeju Island wen through similar volcanic actions: eruption of scoria led to the formation of scoria cones, lava eruptions flew into the coast, which enlarged the island border. This type of volcanic eruption process continues in the Hawaii Islands, whose size is getting bigger accordingly.



Geological Features and Lays around Geomunoreum Craters

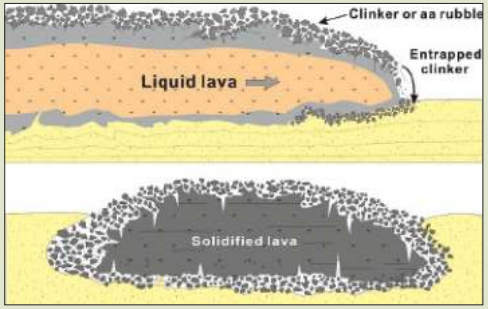


Various Lava Types around Geomunoreum

Info

Pahoehoe lava and Aa lava

Lava in Jeju can be largely divided into two - Pahoehoe lava and Aa lava. The former lava is distributed mainly in the western and eastern parts of Jeju with gentle slope landform, while the latter lava prevails in the area of Seogwipo-si and Jeju-si with steep slope.



Clinkers developed in the upper & lower parts of Aa lava, Parallel section in the proceeding direction(above), Vertical section (below) (Jeon Yong-mun, 2009)

Pahoehoe lava

Pahoehoe lava means smooth, unbroken lava by native Hawaiian language and refers to lava types with less viscosity and big fluidity. Pahoehoe flow makes a small and continual fluid unit known as lobes and toes of lava and forms lava tubes.
Pahoehoe lava shows layered appearance of hydrophilous lava with tens of centimeter to 3m thickness and its surface has plain and smooth features, developing ropy structures. When previously-erupted lava solidifies or encounters impediments with lava pouring continually, Pahoehoe lava increases its internal pressure to inflate its surface and forms tumulus structure, called 'bille'.

Aa lava

Aa lava means stony lava with rough lava burn or blaze by native Hawaiian language and refers to lava types with higher temperature and viscosity compared with Pahoehoe lava. On the boundaries between the upper and lower parts of Aa lava, there typically develops clinker, which is porous broken lava blocks with dark red color and irregular form. Clinker is known to have been formed by auto-brecciation, in which upper surface of lava is broken as inner lava continues to flow while the surface becomes solidified during high viscosity lava's slow flow. When lava flows in its lower parts, the clinker may fall on the bottom to form Aa lava too.

Geomunoreum created Gotjawal and lava tubes.

Geomunoreum not only created a small volcano (Aloreum) along with explosive basalt volcanic activity, also erupted immense volume of lava from its crater. Such lava meandered through to the northeast along the geographical slopes to create particular landform of Gotjawal called Seonheulgot. Thus-formed channel of lava is actually lower than the surrounding land but it looks like a river of green trees when the forest becomes dense. Gotjawal means forest full of stones in Jeju dialect – 'got' is a forest while 'jawal' is a stone like gravel or rocks. In Gotjawal area, there spread large rocks which are too heavy for people to bring and the area could remain as



Geomunoreum Gotjawal(lava stream)

the virgin forest with plenty of trees and plants among big and small rocks. Virgin forest, rocks like this and wet air gave birth to particular area where unique vegetation and own eco system are sustained.

Info

Gotjawal

Gotjawal(lava stream) is a region where rocks are irregularly distributed regardless of the formation or type of lava. A variety of animals and plants coexist in this area, whose conservative value is regarded as high because of the uniqueness of the eco-system.



Geology of Geomunoreum

Around the Geomunoreum scoria cone, there are a number of scoria cones: Budaeak, Busoak, Ujeonjebi, Geochinoreum, Albamoreum, Witbamoreum, Bugoreum, Cheoreum, Sageunioreum. These are individual volcanoes with the traces of lava. It takes a lot of efforts and studies, however, to classify and distinguish such various types of lava, erupted in different periods of time, due to such factors as luxuirance of growth of trees, development of farm lands, and so forth.

Research conducted so far tells Geomunoreum scoria cone was created lastly (except Chaeoreum) among the surrounding scoria cones and erupted lava of alkali basalt. The research adds that it contributed to formation of lava plateau in the eastern part of Jeju Island as it flowed to the north



Lava channel

following its shape and nearby landform. Rocks of Geomunoreum scoria cone are composed of lath-shaped plaigioclase and olivine basalt, and are distributed in a wide area stretching from Geomunoreum through Utsan-jeon Cave, Daelim Cave, Manjanggul lava tube and Yongcheondonggul lava tube.

Volcanic activity history of Geomunoreum

Volcanic activity process of Geomunoreum scoria cone can be grasped on the analogy of that of Puu Oo vent (from 1983 up to now), Kilauea Volcano, Hawaii. Initial eruption aspect of Geomunoreum scoria cone is assumed to have started with explosive fountain pattern and pouring mass of lava for a short time and then making ways, forming lava channel. Scoria created by lava fountain fell on the crater to accumulate and develop to scoria cone. Scoria piled around the crater continued its activity of falling on and accumulation, on the other hand some scoria collapsed inside the crater, bringing about its gradual change and eventual formation of deep valley. Its further volcanic activity, which has lost volatile elements through continuous eruptions, changed to the continual form of erupting small amount of lava for long time. While flowing along the front side of the crater, lava generated low shield to the north by northeast of Geomunoreum.



Lava pit



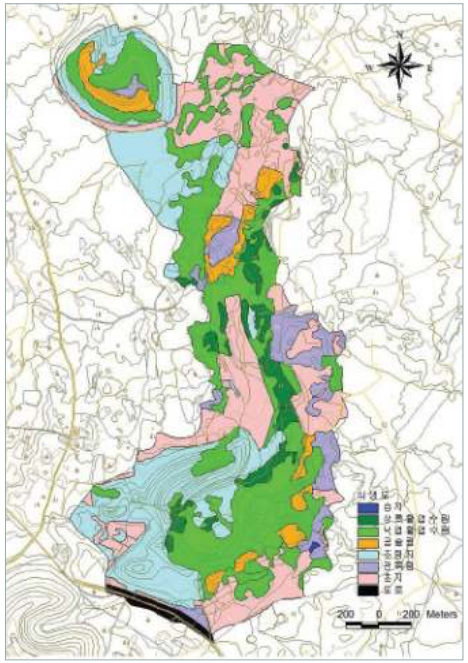
View Over a Geomunoreum Crater

Pahoehoe lava, which made a continuous flow for a long time, carried on with its way following geographical features slowly to form the lava tube.

Thus-formed lava tube maintained its temperature (0.5 ~ 1℃/km) against flow-in of small amount of lava to it because of its remarkable insulation effect and, as a result, lava played an important role of expanding land by flowing a long distance (10km or more).

The Plants of Geomunorem

As an oreum(small mountain) located at 300~460m above sea level, Geomun-oreum consists of natural forests with vegetation of its crater areas forming second growth of forest due to lumbering, burning and reclamation, whereas surrounding oreums normally consist of grassland. Also topographically, it has another oreum called Al-oreum within its relatively wide crater, and canyon of stream of lava which is directed to the northeast the exit of crater forms streamlined valley with continuous lava channels about 3-4km long. Here, funnel-shaped pit craters with a variety of diameters and depths have been developed here and there. Having unique ecological background with these geological and topographical features, Geomun-oreum has the vegetation and flora through which warm-temperature and temperate plants coexist.



Current Vegetation Map of Geomunoreum Area
(source: Go Jeong-gun, etc. 2011)

Vegetation of Geomunoreum

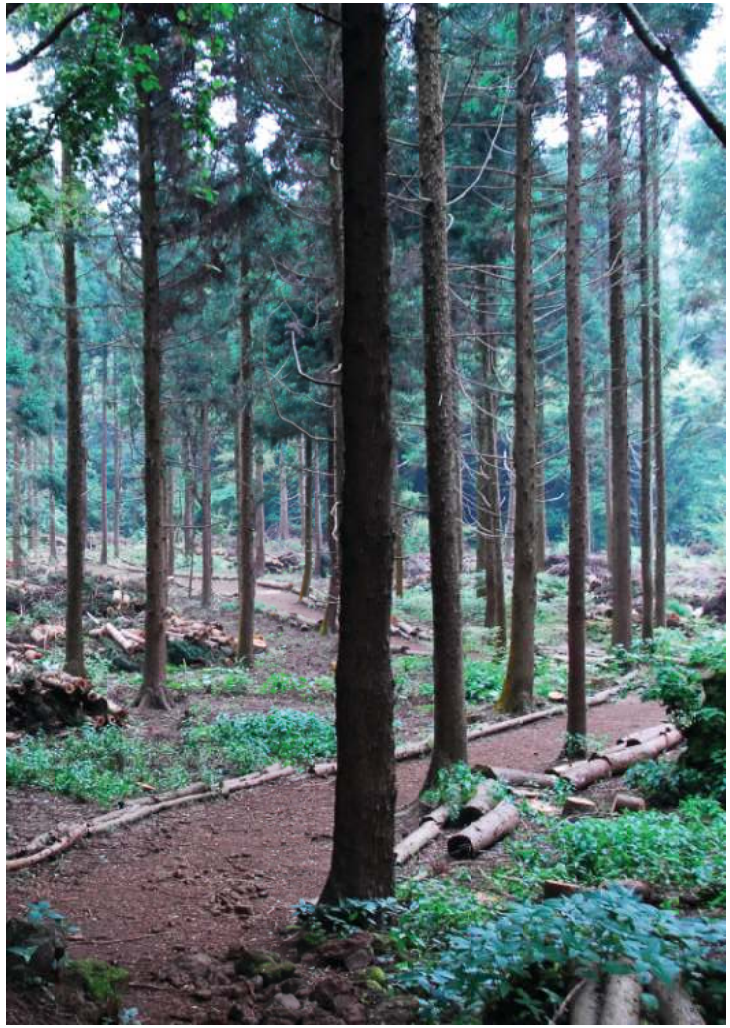
Vegetation of Geomunoreum can be divided by four groups of forest: planted area, deciduous broadleaf forest, evergreen broadleaf forest, shrub forest and grassland. Most of planted area except forest of Japanese black pine consists of Japanese cedar forest and in some places Japanese cypress are distributed.

Classifying by vegetation patterns in planted area, Japanese cypress, Japanese cypress and blackpine take the highest proportion of its total area, and particularly Japanese cedar accounts for 80% of planted area. Planted area shows different heights of trees and growing traits even in a same species of trees. In natural forest, deciduous broadleaf forest has the highest proportion similar to that in planted area and is followed by grassland, shrub forest and evergreen broadleaf forest in its size of area. In deciduous broadleaf and evergreen broadleaf forests, there don't grow any specific species of trees in a large number and it is difficult to divide the tree layers by height of trees, and both forests have structure where various species grow continually and compete.

Japanese cedar forest

Called familiarly 'Sukdaenang' in Juju, it is a needleleaf tree with red bark and straight-growing stems, and has been planted for various purposes including windbreak for a long time. This forest, which has been formed since plantation in the early 1970s, may be said to have a bit low value in terms of its plant diversity.

Japanese cedar plantation area is mostly made of a single species of Japanese cedar. Though, there are the thinned area since 2008 and xylophyte-imported area from nearby forests, which are very limited in its distribution and size. In Japanese cypress forest of the area, Japanese cypress has high relative dominance value of about 80%, showing some mixed species structure with Japanese cedar, and has vegetation structure in which some plants such as Japanese black pine, saw tooth oak, Pourthiaea villosa Decne, silverberry, privet were imported.



Forest of Japanese cedar

On the other hand, in the understory of Japanese cedar forest, various indigenous plants including Dryopteris erythrosora, Polystichum polyblepharum var polyblepharum, Deparia japonica, Calanthe striata R. Br. and strawberry-raspberry grow. As an ideal place for forest bathing while walking along and exposed to the natural energy, the forest provides people with mental freedom by dint of its phytoncide sterilizing effect and green environment.

Japanese black pine forest

Japanese black pine accounts for more than 90% of the forest, which is a very high proportion figure, and the forest shows vegetation structure in which some xylophyte were imported such as saw tooth oak, Albizia julibrissin Durazz, Mallotus japonicus, Platycarya strobilacea Siebold et Zucc, Celtis sinensis Pers, silverberry, Elaeagnus umbellata Thunb, Japanese cypress, Rhus javanica L. And most of native plants imported from nearly forests are characterized by being formed below middle layers of the forest.



Japanese black pine forest

Deciduous broadleaf fores

This forest is concentrated in the northeast slope of inner Geomunoreum crater and outskirts of lava channel. This area has a relatively deep soil layer and plenty of organic matter.

This forest shows a very complex species composition, in which snowbell grows with the largest number, taking around 22.5% of relative dominance value. And it is followed by Cornus kousa F. Buerger ex Mi-



Community of *Pourthiaea villosa*

quel, hornbeam, Mallotus japonicus, Meliosma oldhamii Maxim, maple in its dominance order. But it differs depending on the tree layers. Apart from these trees, there appear also Platycarya strobilacea Siebold et Zucc, Rhamnella frangulioides (Maxim.) Weberb, Lindera erythrocarpa Makino, Cornus macrophylla Wall, Neolitsea aciculata, Euscaphis japonica, Albizia julibrissin Durazz, prunus pendula, Orixa japonica Thunb, Carpinus cordata BL, Pourthiaea villosa (Thunb.) Decne. var. villosa, privet, Celtis sinensis Pers, Neolitsea aciculata, Cinnamomum japonicum Siebold, Q. glauca, Quercus glauca Thunb, Sapium j aponicum (Siebold et Zucc.)Pax et. Hoffm, Meliosma myriantha Siebold et Zucc., S. obassia, wild pear tree, Symplocos chinensis for. pilosa (Nakai) Ohwi.



Evergreen broadleaf forest

On the other side of the understory, there grow various plants including Polystichum tripteron (Kunze) C.Presl, Leptogramma mollissima (Fisch.) Cornopteris crenulatoserrulata, pheasant's-eye, Eranthis byunsanensis B.Sun, Hepatica hing, insularis Nakai, Pseudostellaria coreana (Nakai) Ohwi, Asarum maculatum. Particularly colonies of pheasant's-eye blooming in the early spring, Hepatica insularis Nakai and Eranthis byunsanensis B.Sun produce spectacular scenes and seasonal sensibility in the fall by their foliage.

Evergreen broadleaf fores

This forest is formed in the part of northeast slope of inner crater and along lava channel. Generally, it has very irregular landform and its soil layer is very poor or has not been developed due to piles of rocks about 50cm round, resulting in a formation of pit crater with small amounts of organic matter deposited.

Also here shows a very complex species composition, in which Cinnamomum japonicum Siebold has the highest relative dominance value with 22.5%. It is followed by Illicium anisatum L, Eurya japonica, Quercus glauca Thunb, Castanopsis cuspidata var. sieboldii Nakai, camellia in its relative dominance order. Apart from these, there grow Albizia julibrissin Durazz, Celtis sinensis Pers, styrax, Cornus macrophylla Wall, prunus pendula, Z. ailanthoides, Morus bombycis koidz, Machilus japonica, Cornus kousa F. Buerger ex Miquel, camellia, Ficus erecta Thunb, Z. coreanum, Aucuba, Japanese laurel.

Shrub forest and grassland

Previously, bottom of the crater and some parts of surrounding areas were

used for farmland or ranch, and on its bottom, there grow Orixa japonica Thunb, rubus coreanus, R. coreanus, privet, akebia, honeysuckle, greenbrier, Semiaquilegia adoxoides (DC.) Makino, bracken. In some parts of the lava mouth, there grow Asplenium varians, a vine, Sedum tosaense inserted on the surface of rocks. Particularly Sedum tosaense growing in some areas is herbaceous perennial, which was learned recently to be distributed in Jeju. Centered on the entrance of Geomunoreum, grassland has been formed, where there grow mainly silver grass and pearl mullet.

Flora and Main Plants of Geomunoreum

Geomunoreum has very diverse elements in terms of geological features, landform and vegetation with very high species diversity, and area's ferns in particular show unique flora compared with other areas of similar geological conditions. Plants across subtropical, warm-temperature and temperate climate coexist in the area in terms of geographical botany. This fact demonstrates its biodiversity and is attributable to geological location and various vegetation patterns, landform of rock land, lava channels and pit craters, and impact of microclimate as a result.


grassland

Land plants distributed around Geomunoreum are known to comprise 100 families, 226 genuses and 319 species. Of these, there are eight endemic plants including Cardamine violifolia O. E. Schultz and nine foreign plants. In terms of floristics, there are 89 specific species of plants in total comprising a very high proportion. Of specific species, there are 10 species of Ⅴ class including Gonocormus minutus (Bl.) Bosch, six species of Ⅳ including Microlepia marginata, 29 species of Ⅳ class including 'Hypolepis punctata (Thunb.) Mett, four species of Ⅱ class including Ophioglossum vulgatum L and 40 species of Ⅰ class including Botrychium virginianum (L.) Sw. In the category of specific plants, following species are typically above Ⅳ class; Vandenboschia radicans var. orientalis, Loxogramme grammitoides (Bak.) C. Christ, Loxogramme salicifolia (Mak.) Makino, Aconitum napiforme Lev. et Vnt, Aeginetia indica L, Strobilanthes oligantha MIQ, Calanthe discolor for. sieboldii (Decne.) Ohwi, Common Calanthe, Cyrtosia septentrionalis [Rchb. F] L. A. Garay, Microlepia marginata, Lastrea beddomei (Bak.) Bedd, Corydalis decumbens Pers, strawberry-raspberry, Peracarpa carnosa var. circaeoides.



Above Jeju Fawn's Ear (*Hepatica insularis*) **Below** Fruits of Five-leaf Akebia(Left) Fruits of kadsura(Right)

Habitat of various ferns

Ferns in Geomunoreum are known to comprise 15 families, 31 genuses and 64 species. Compared with other oreums with formed forests, it shows similar or slightly more distribution but there is a big difference in its structure of species. While ferns in other oreums consist of plants which grow in similar environments, as normally observed in Jeju, those in Geomunoreum consist of rare species: ferns distributed in limited areas or very rarely such as Diplazium wichurae (Mett.) Diels and Asplenium; species growing in high altitude in vertical distribution such as Pleurosoriopsis makinoi; rare epiphyte ferns such as Loxogramme saziran Tagawa and Loxogramme grammitoides. It is characterized by its different habitat and coexistence of diverse plants across subtropical, warm-temperature and temperate climate in aspects of geographical botany. Also colony of Arachiodes amabilis identified with rarely one or two individuals in Jeju was confirmed to exist here. Vegetation pattern of ferns generally varies according to air humidity and temperature of the area. Diverse ferns seem to grow and develop widely in



Left *Adonis amurensis Regel et Radde* **Right** Korean eranthis

proper places of this area due to various environments such as lava channels, pit craters or soil layers with humid conditions along with deciduous broadleaf forest with proper lights, and a little dry grassland. Particularly



Lemmaphyllum microphyllum C. Presl(vine)







Above Flower of Elsholtzia splendens Nakai **Below** Fruits of Five-leaf Akebia(Left), Kadsura Flower(Right)

lava channels and pit craters with their high air humidity and a lot of rocks provide ferns with good habitat. On the other hand, it also provides rigid environment to subtropical plants to grow in aspect of temperature as the underground temperature emitted from cracks on rocks maintains almost constant temperature throughout a year, that is it is warm in the summer, while it is too cold to be adapted by plants in the winter.

Various kinds of Calanthe discolor

As a wild orchid growing in Korea, it belongs to group of Calanthe discolor. In the country, there are distributed four species of Calanthe discolor, Calanthe striata R. Br, Calanthe reflexa Max, Calanthe coreana, and breed



Rumohra amabilis fern





Above *Hymenasplenium hondoense (Murakami & Hatanaka) Nakaike* fern
Below *Diplazium nipponicum* fern

crosses. In Jeju, such four species and various breed crossed are distributed. In Geomunoreum, all other groups grow except Calanthe reflexa Max and Calanthe coreana. Calanthe discolor is large in its size among orchids growing in temperature climate and its flowers are very gorgeous.



Above Korean calanthe **Below** a species of hybrid between Korean calanthe and Calanthe orchids(Left), Calanthe orchids(Right)

Animals in Geomunoreum

Ecological axis of Geomunoreum area stretches continuously to the northeast to Seonheul Gotjawal (old- growth forest) around 10km away. The area consists of various vegetation

structures such as evergreen forest, deciduous broadleaf forest, communities of shrubs and the ferns, planted forest of Japanese cedar[*Cryptomeria japonica*] and Japanese black pine[*Pinus thunbergii*] and grassland. And it provides a safe habitat for wild birds and animals like roe deer[*Capreolus capreolus*] and badger[*Meles meles*]. Jeju's ecosystem on land spans vastly

□ Animals in Geomunoreum So Far Identified
(source: World Natural Heritage Conservancy, 2011)

Category	Species	Name of Animals
Mammal	4 Genuses 4 Families 5 Species	Mustela sibirica quelpartis, badger, Cheju striped field mouse, Crocidura suaveolens shantungensis, roe deer
Amphibian	1 Genus 2 Families 3 Species	tree frog, Dybowski's Brown Frog, leopard frog
Reptile	1 Genuses 4 Families 6 Species	cat snake, red-sided water snake, Asian keelback snake, Gloydius ussuriensis Emelianov, lizard, lined grass lizard
Birds	5 Genuses 19 Families 26 Species	kestrel, white-backed woodpecker, pheasant, turtle dove, butcherbird, Siberian blue-tail Tarsiger, golden mountain thrush, pale ouzel, hondo jungle-crow jay, magpie, Korean paradise flycatcher, ashy minivet, swallow, long-tailed tit, brown-eared bulbul, white[silver] eye, bush warbler, short-tailed bush warbler, great tit, titmouse, blue flycatcher, sparrow, goldfinch, greenfinch, green linnet, meadow bunting

from intertidal area through Gotjawal and oreum in Jungsangan to valley forest, deciduous forest of Mt. Hallasan and then subalpine area. Taking that into consideration, Geomuoreum forest, which is located 300-460m above sea level, must have an important ecological value as the typical habitat for wild animals moving between coasts and forests of Mt. Hallasan.

Animal life in Geomuoreum can be divided into two parts - exterior and interior parts of the crater. The former part is composed of planted forest of Japanese cedar, grassland and partly shrubs where pheasant[*Phasianus colchicus karpowi*], mountain bird[*Emberiza cioides*], butcherbird, Rufous turtle dove[*Streptopelia orientalis*], swallow[*Hirundo rustica*], goldfinch[*Carduelis sinica ussuriensis*], jungle crow[*Corvus macrorhynchos*] inhabit. In the sky, there are birds of prey like the Korean





Above Jeju bush warbler **Below** Fairy pitta

Jeju five-colored woodpecker

buzzard[*Buteo buteo japonicas*] occasionally, kestrel[*Falco tinnunculus interstinctus*], hawk[*Falco peregrinus japonensis*], Chinese sparrow hawk[*Accipiter soloensis*], sparrow hawk[*Accipiter nisus*]. Also people can hear the singing sound of cuckoo[*Cuculus canorus*] and Little cuckoo[*Cuculus poliocephalus*], which are sometimes found on top of Japanese cedar or Japanese black pine trees.

Jungle crows, featured by thick beak, tend to appear on peak of oreum or near to it. Their singing sound is elegant and clear compared with that of crows. Mountain birds or butcherbirds induce the other sex with sound, take a rest on pampas grass or stone walls. Accustomed to storing their foods, butcherbirds put sometimes snakes or insects at branches of a tree.

Pheasants like to have earthbath on the way to the peak to clean inside of feathers. As they enjoy the bath in sunny hiking course, people can find their traces by the fallen feathers easily. When walking through hiking course of soil, people can also observe the traces of snakes or excrement of weasels.

Always green forest in Geomunoreum crater provides a good habitat whole through the year for resident birds - Jeju bush warbler[*Cettia diphone cantans*], Brown-eared bulbul[*Hypsipetes amaurotis*], white's ground thrush[*Zoothera dauma*], pale thrush[*Turdus pallidus*], Japanese white-eye[*Zosterops japonicus*], Great tit[*Parus major*], Jeju five-colored woodpecker[*Dendrocopos leucotos*], Eurasian jay[*Garrulus glandarius*]. Particularly, it offers good environments for rare summer migratory birds like Tricolor flycatcher[*Ficedula zanthopygia*], fairy pitta[*Pitta brachyura nympha*] and Japanese paradise flycatcher[*Terpsiphone atrocaudata*] to breed. Jeju bush warbler, which is a typical resident bird representing Jeju,

also known as the messenger of spring, sings most beautifully and clearly among the birds in or out of the Geomunoreum crater. Called as 'hobijaksae' in Jeju dialect, it induces the other sex with pretty sound but once a natural enemy appears in its territory, it makes quite different sound to warn the enemy off. Called as 'dombaksaengi', Japanese white-eye is busy to feed between branches of trees.

It likes to suck honey of camellia in winter. Great tit does not meet its name - looks tiny and cute as if wearing a black necktie. Its singing sound in breeding time is pretty and it has the habit of living in groups of three or four. Brown-eared bulbul is called 'bichi', 'bichu' or 'meongkusilsaengi'. Its sound seems so noisy, but it is the watchman of the forest in the crater. Color of feathers of both sexes looks similar and it lives usually together and makes bowl-shaped nests in vines of arrowroots or Chinese evergreen oak[*Quercus glauca Thunb*]. Jeju five-colored woodpecker has different body color between male and female, male shows the black color on top of head. Its shape of body is evolved to facilitate a free movement among the branches of trees – toes and tail are well developed. People can see the traces of its feeding activity among dead branches of trees.

Japanese paradise flycatcher has distinctly different appearances between both sexes, and male has 30cm longer tail. It builds a nest on Y-shaped strip of branches by binding with dry grass, moss and spider's thread. White's ground thrush has patterns of feathers resembling those of swallowtail. As it sings 'hihi, hihi' like a ghost in the early morning or in the evening, it is also called 'gwisinsae'(ghost bird). As Geomunoreum forest provides roe deer with plenty of feeds and comfortable rest place, it has become the safe



Above Japanese paradise flycatcher **Below** Roe deer

habit roe deer. While visiting there, people can find their footsteps, excrement, resting places together with crying sound.

It feeds mainly on Japanese ivy[*Hedera rhombea*], *Trachelospermum asiaticum var. intermedium*, Korean calanthe[*Calanthe discolor Lindl.*], young buds of *Sasa quelpaertensis*, leaves, which people can observe occasionally. And badger, which is a representing animal breeding underground, called 'jidari' in Jeju dialect, inhibits as well. Its inhibiting traces in underground tunnel or by excrement are found on the slopes of the forest. In addition, there inhabit Cheju Striped Field Mouse[*Apodemus chejuensis*], *Takydromus woeteri*, small stringy snake[*Zamenis spinalis*], *Agkistrodon caliginosa*, Dybowski's Brown Frog [*Rana temporaria dybowskii*], and lava tubes around Geomunoreum have become the bed town of bats including greater horseshoe bat [*Rhinolophus ferrumequinum*]. Geomunoreum forest is the natural heritage we must keep, since it has ecological value as habitat of wild animals and plants as well as the geological value.

The history and culture of Geomunoreum

The area of Geomunoreum is one of the core symbols of tragedy and hardship in the modern history of Jeju. It symbolizes the unalloyed grief and pain of the Japanese occupation and April 3rd incident. Let us look at the area of Geomunoreum. This oreum still bears the scars of war. During the Pacific war (WWII Dec, 1941~Aug, 1945), the Japanese army established military facilities including underground tunnels, gnawing the spirit of oreums up until now. The broad and deep oreums used to be the basis of livelihood for the residents of the region who made charcoal from trees on the oreum and engaged in slash-and-burn farming. The Japanese army built their military installations on the peaceful land and fortified the entire oreum.

The Japanese army planned to use underground fortresses as a last stand against the Allies. The underground tunnels, which can be seen from all directions of the oreum, is a vivid historical venue. Geomunoreum was used as a shelter for the local residents during the April 3rd incident.



Dating back to the past, the area of Geomunoreum used to be a state-run ranch during the Joseon Dynasty. Because of its good location and environment, such as its vast plain, 10 ranches were built in Jeju including 1 ranch in Gujwayup and a second in Jocheon-eup. The oreum draws attention due to the value of its volcanic geology and a habitat for diverse plants. On the other hand, it bears the pain and tragedy of Jeju's mo¬dern history.

The history of Geomunoreum itself is the modern history of Jeju

The period of interest was WWII in Jeju's modern history. At the time, the Japanese Army's 108th brigade headquarters consisting of 6,000 troops was stationed in the oreum. Let us look into the period and historical background of the Japanese troop deployment in Jeju, including Geomunoreum.

The Pacific war broke out because of the surprise Japanese attack on Pearl Harbor. In the midst of the war, the Japanese emperor became aware that Japan was losing the war in 1944. Therefore, in the latter half of the year, they started to construct a huge underground air-raid shelter in Japan including the Matsushiro Headquarters.

As part of these preparations, the strategic importance of Jeju increased. In 1945, Japan began to recognize its defeat, so the the Japanese commander-in-chief order prepared for a last-man-standing operation to defend the Japanese homeland against an attack by US-led Allied forces. The first to

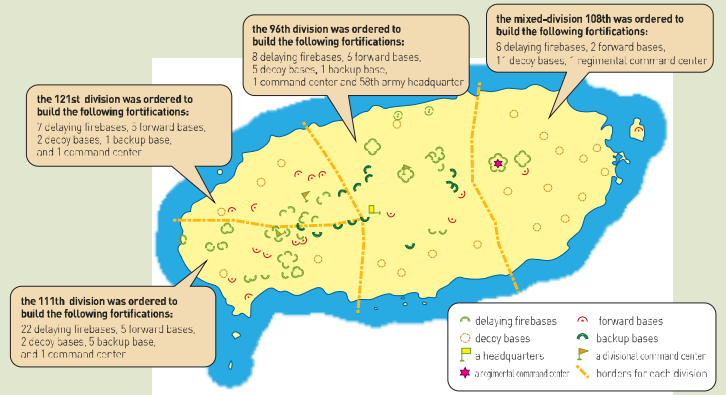


Agricultural land

Info

Old Japanese Army Bases in Jeju

Under the 58th Japanese military re-assignment plan
(around June 15th, 1945)



the 6th defensive perimeter zones were located in the Japanese mainland and Jeju became the 7th and only defensive zone outside Japan.

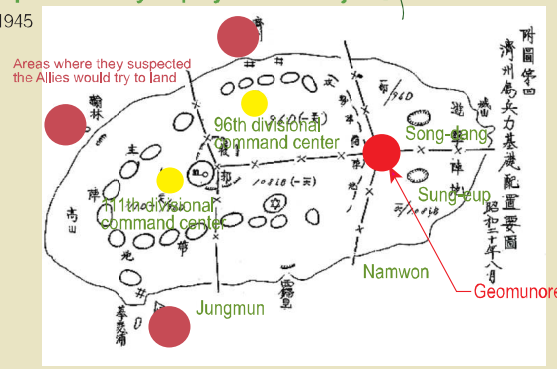
Shortly thereafter, the 58th command center was newly established on April 15th, 1945 and was brought up to full strength by soldiers from the Kwantung Army stationed in Manchu, China and Japan. In August 1945, there were as many as 75,000 Japanese troops posted in Jeju, a number that defies comprehension; to put this number into perspective, Jeju only had a population of 210,000 at that time.

Several different armies were stationed in Jeju, including the 58th Command Center. These were organized into 3 divisions and 1 brigade including the 96th, 111th, 121st Divisions and the 108th Independent Mixed

Info

Map of Japanese Army Deployments in Jeju

In August 1945





The eastern area seen from the peak of Geomumoreum

Brigade. The 108th brigade headquarters was established in the area of Geomunoreum and commanded forces posted in the eastern part of Jeju. The oreum was a regional stronghold. This historical fact can be confirmed on military maps left by Japanese forces and in other documents such as the "Map of Troop De-ployment in Jeju" and the 58th Japanese military re-assignment plan.

With the exception of Jeju, all the defense perimeter zones were located in Japan. Why did Jeju become strategically important?

First Japan recognized the possibility that the US army would land in Jeju. In such a case, the Allies would be in striking distance of Japan. Be-cause Jeju is geographically located between the southern tip of Japan, Chi-na, and the Korean Peninsula it was appreciated as a strategic position.

In the case that US-led Allied forces landed in Jeju and made Jeju a base for their attacks, supplies from China would be cut off, causing the Japane-se General Headquarters to guard against such a possibility

Geographical location of Geomunoreum

Let us look into the military map made by Japanese army during the Pa-cific war.

The 58th Japanese military re-assignment plan revealed that the area of Geomunoreum was a stronghold and the eastern part of Jeju was assigned as 'a guerrilla attack position' in the Jeju Troop Deployment map. At the time, the Japanese military viewed Mosulpo as the most likely landing po-int for Allied forces. They set up a suicide operation to fight to the last man to stop the Allied forces from breaking through the coastline. To deter a landing by Allied forces, Japan focused its military preparations in the area of Mosulpo. A back-up base was built inland at Usung-seng-ak and at Mt. Halla, strongholds, forward bases, and decoy bases were constructed.

The eastern part of Jeju was designated as a guerrilla attack zone because it is a mountainous region with many oreums. They intended to resist to the end by using guerilla tactics.

The top of Geomunoreum shows a panoramic view from the coastline to the oreums. This peak can be seen from Seo-woo peak, Jocheon-eup and Seongsan Il-chul Sunrise peak (part of the World Natural Heritage site) where a special forces base was established by the Japanese navy. Because the volcanic crater was very deep, had a good view, and was like a natural fortress it could block direct fire from the Allied forces.



hardened military bases

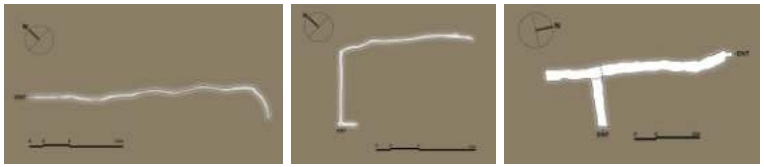
What kind of military facilities were made by the Japanese army?

The primary Japanese military facilities in the area of Geomunoreum are underground tunnels. The tunnel was established from the ridge to the inside of crater including at the peak. It is believed that there are a total of 10 tunnel bases, 50-60 meters deep at 8 different spots on the oreum.

Within the crater itself, there are 10-15 meter tunnels dug into the smaller al-oreums. There are many traces of the previous digging that took place here. It is believed that the piles of basaltic stones massed here and there are the work of Japanese soldiers.

In addition to Geomunoreum, Japanese military tunnels exist in Budae Oreum, An-dol, Bat-dol Oreum and other areas. Around the end of WWII, the 108th Japanese Army Divison built fortifications centered around Geomunoreum. Although more than 60 years have passed, these military facilities are still in good condition.

During the 4.3 incident in Jeju, victims hid in charcoal stoves and old Japanese military caves to escape death, illustrating the historical importance of Jeju stoneworks in history.



Cross-section of a Tunnel Camp





Tunnel in Geomunoreum



Part4

Geomunoreum by geomantic topography



Geomunoreum

4. Nine dragons play with cintamani



Guryongnongju type

According to the Oriental legend, four animals with divine spirit refer to dragon, Chinese phoenix, giraffe and tortoise. Gomunoreum of good omen is a symbolic oreum with energy of dragon and Chinese phoenix among above four mysterious animals, and it is a place where holy spirits converge from Mt. Hallasan. It is where nine dragons generate divine and mysterious changes guarded by the surrounding oreums to the east – Budae, Buso, Golchae, Jocheonmin, Ujinjebi, Gameok, Albam, Utbam, Geochin, Geose-unsaemi, Andol, Batdol, Che, Songdangmin.

Since it displays so many different appearances according to directions and angles of view owing to so much changeable lies of land, it is not easy to figure out its true appearance.

Peaks from all directions undulate and surround Geomunoreum across the ridges and any point looks like a place where a hermit may live, separated from the outward world. In between the center, Aloreum, which may be depicted as cintamani in this landform, rises above to form the valleys in all sides and deep forest – to be the origin of the profound area. Deep valleys connected with high and low ridges continue to make their ways ceaselessly; their beginning and end are beyond measure.

Entering Geomunoreum, people might have an illusion as if they are fallen into maze of Palzindo which Zhuge Liang of China made with eight battle formations in the era of the Three Kingdoms. It is so changeable and

elusive to the worldly eyes with ups and downs of the landform that it may be called as the divine mountain keeping the secrecy of the ancient times.

Looking at its landform, it rises from the southwest, heads to the northwest and ends to the northeast facing main oreum Mt. Hallasan to the west. Its shape of branching off to all the directions of ridges looks like a big spider crawling or stitches of jewelry or, as if nine dragons play with cintamani on the web of many peaks. Rising at the west, its stream flows to the south and turns to the east and then to the northwest to join brooks of Deokcheon, Seonheul, Daecheon, Songdang finally and continues to meander to the east. Surrounded by peaks forming four symbols of ancient constellation - blue dragon, white tiger, black tortoise and vermilion bird-, Aloreum in the crater is a place where vital energy converges and may provide ideal site for a temple or praying house.

Mysterious energy of Geomunoreum spreads its good energy around the place and there are graves here and there to the southern and southeastern edges in particular. Blessed with its energy at any place around Geomunoreum, people may cut a brilliant figure with high official posts or famous scholars and enjoy the prosperity for succeeding generations; it is an auspicious place with promising prosperity. Exploring Geomunoreum often, people can read its various appearances depending on the view angles. For example, it forms the shape of the moon hiding in the clouds, the half-moon coming out of the clouds or nine dragons playing with cintamani- there are diverse geomantic rhetoric expressing Geomunoreum.

As a spiritual place paving the energetic ground of the east, it is an important oreum in which nature, history and culture breathe. Particularly, it is an important place not only in grasping characters of Jeju land in geomantic viewpoint, also in its botanic and geographical value related with biological aspects due to its specific topography. It is a mysterious treasure place of vitality and can be said as a new discovery of Jeju – it needs continuous scientific research jointly in various fields.



Geomunoreum and surrounding oreums

Deep philosophic meaning of "Taegeukgil"

Geomantic meaning of Taegeukgil is very important; in the beginning, the heaven and earth open with dual forces of yin and yang. Flowing slowly like a cloud to become one with nature along the ridges connecting the peaks and then turning around Aloreum, people may feel the movements and changes of the universe and come to experience the principle of Taegeuk.

Taegeuk refers to elements which are substance of materials and objects constituting the universe. Taegeuk, which is limitless space and time, is the base of all things in the universe,

beginning, center and primary of everything. It is ultimateless and supreme ultimate. Its movement gives birth to yang and when it reaches ultimate, it becomes silent, which gives birth to yin. When silence reaches ultimate, it returns to movement. Based on one movement and one silence, yin and yang are divided, and formed. Change of yang and combination of yin bring about the Five Elements of water, fire, tree, metal and earth. Harmony of five energies operate four seasons and the Five Elements are one of yin and yang, which is one of Taegeuk. Basically, Taegeuk is ultimateless. Though the universe is vast with innumerable number of materials in it, the basic is composed of Taegeuk, what the Book of Changes tells as its basic theory.

In other words, Taegeuk, which is an absolute energy as essence of the universe, moves and then yin and yang - minus(-) and plus(+) – interact to create all things in the universe. All things including materials, objects, and all strength, time and space which people can recognize come from Taegeuk, and form Taegeuk by themselves – It is the substance of the universe. An essay "Youyangzazu" written by Duan Chengshi, during the Tang era, China, tells "Arriving at Taegeuk on the wings of Chinese phoenix makes one's cherished dreams to come true." Walking through Taegeukgil hiking course of auspicious signs with the principle of Taegeuk in mind, people may recognize the true nature of the universe and find their true selves.



Geomunoreum crater

Air hole

Chinese phoenix nestles at the place where nine dragons play

According to geomancy, an air hole is the place where vital energy of a dragon, its breath, comes out and it is a kind of hole made by movement of underground strata. It is said frequent movements of dragon generate air holes, energy of which are known to help people to refresh their spirits and remove all the worldly concerns. If people breathe and meditate with peaceful mind at the air hole connected from Mt. Hallasan, they can have smooth blood circulation to strengthen joints and expel migraine, diseases from anger, stress and neurosis.

Earlier, a Chinese book "Shuowen Jiezi" written by Xu Shen, a scholar during the Later Han Dynasty, told "Coming from the eastern wise men's country, Chinese phoenix flies over the four seas through Mt. Kunlun and drinks at River Dishui and cleans feather at River Ruoshui and then sleeps at air hole. Once this bird appears, the whole country becomes very peaceful." Chinese phoenix is an imaginary animal with five colors and five sounds, depicted in the mythologies and legends. This auspicious bird is born between a dragon and a crane. The ancient Chinese geographic book "Shanhai Jing" tells in its chapters of Nanshan Jing, "Mt. Danxue produces plenty of gold and jade.

Rising from here, River Tanshui flows to the south to join Bo Hai. Here, a five-colored bird looking like a fowl is called Chinese phoenix. Each of its body has symbols - virtue by head, righteousness by wings, manners by back, generosity by breast and trust by abdomen.

This bird eats and drinks suitably to order of nature, and sings, dances by itself. Its appearance brings peace to the whole country." In terms of geomancy, Geomunoreum is the symbolic site of dragon and Chinese phoenix. Down the waving ridges of nine dragons and contacting the energy of air hole at citamani-like Aloreum surrounded by auspicious clouds, people may cherish the mindset of virtue, righteousness, good manners, generosity and trust as symbolized by the mysterious bird, and can have appearance and comfort of wise men.



Aloreum in the crater and site of observatory

Look of citamani unveiling among the clouds
Aloreum situated in the crater looks like the moon hiding behind the clouds or resembles

citamani which keeps secrets of the heaven and earth to command all the orders of the universe. It is an elevated place with strong energy flowing from the veins of nine dragons from the east. Surrounded by auspicious clouds, low and high peaks make sometimes nine dragons. It has the appearance of citamani among the glowing clouds with five colors as a landform where good energies converge. The site of Aloreum observatory, which keeps the ancient secret with powerful energy, defies the private facilities and rather suits a big temple or a pray house. When people are tired mentally or physically, deep breathing with concentration here would bring back the sound mind and body to them. The moment they experience the essence of Aloreum together with air hole, they can appreciate the vigor of life and feel the value of New Wellbeing. While passing this place full of mysterious energy of land, they will forget worldly cares and recover fitness of mind and body and also be awakened to the ultimate self. To experience the energy of great nature, Aloreum with the mysterious air hole is a must place to see.



Observatory in Geomunoreum crater



Observatory in Geomunoreum crater

Meaning of Guryong full of auspicious signs

Guryong refers to nine dragons and in terms of geomancy, a dragon means a mountain. It is called Guryong as the winding look of mountain's ridges resembles a wriggling dragon. Culturally, the dragon is rooted as the symbol of spiritual animal in the imaginary world which makes changes and turns of the universe with citamani. Also, it is associated with a creature of fantasy bringing about the good fortunes and protecting the human from misfortune.

The Oriental Book of Changes tells the number of nine is the ultimate number meaning perfection and also the highest number of yang. According to number system allocated to land and heaven in the old times, number of yang is 1,3,5 while number of yin is 2,4. The highest number of yang makes 9 – 1+3+5, and the highest number of yin is 6 – 2+4. From the old times, the Oriental people have thought high of numbers of yang, which are odd numbers, because they meant reason and existence of all the living things. The old ordinary people thought double of number of yang as good fortune and made such dates for the fortune wishing and celebration. For example, these dates fall into that category; January 1 New Year's Day, March 3 Samjinal, May 5 Dano Festival, July 7 Chilseok Festival, September 9 Jungyang Festival. The number of 9, which contains the meaning of operating order of the universe and dynamic usage in the real world, is the principle of the land and heaven, and denotes profound meaning of the Book of Changes as the barometer of the outward world. In this context, meaning of Guryong is change like high and low peaks and also points to aggregate of meandering oreums. Like this, Geomunoreum is heavenly land blessed with immeasurable changes of Guryong and auspicious energy of time and space.



Above Various peaks of Geomunoreum **the Bottom** Meandering ridges of Geomunoreum

Commentary on Guryong

The 1st dragon : Heungnyongsangcheon-bong



The 1st dragon has the appearance of a black dragon flying to the sky. It is the place where the heaven's energy lands as the northern god, and progressive spirits to leap forward for the infinite are cherished. The black dragon is the god of the northern domain governing sprits and wisdom. Given with the energy of this appearance, people may cherish the spirits of making a leap forward in pursuit of a great goal. When people breathe the energy of the land and heaven to the full at this symbolic peak spreading for a new world with flexible confidence, they can maintain mental and physical fitness, and nourish their good spirits.

The 2nd dragon : Baengnyongmanghae-bong

The 2nd dragon has the appearance of a white dragon looking far at the sea. It is the place where auspicious energy is called as the western god and vital energy is brimming as the symbol of righteousness. The white dragon is the god of the western domain bearing all of changes of the universe, and governs moral cause and justice. Given with this energy, people can have the leadership to the great cause and reasonable judgment. People's judgment of right or wrong needs self-confidence that they can make bright and unbiased decision.

Contemplating with broad mind over the eastern mountains and sea, they can get the resolute and dauntless spirits.

The 3rd dragon : Hwangnyongtogi-bong

The 3rd dragon has the appearance of a yellow dragon vomiting auspicious energy. Vomiting energy means that vigorous energy of the earth converges with strength. All things in the universe are created and nourished based on the earth. The yellow dragon is the god of central domain and nourishes all things, governing reason of comprehension and moderation.

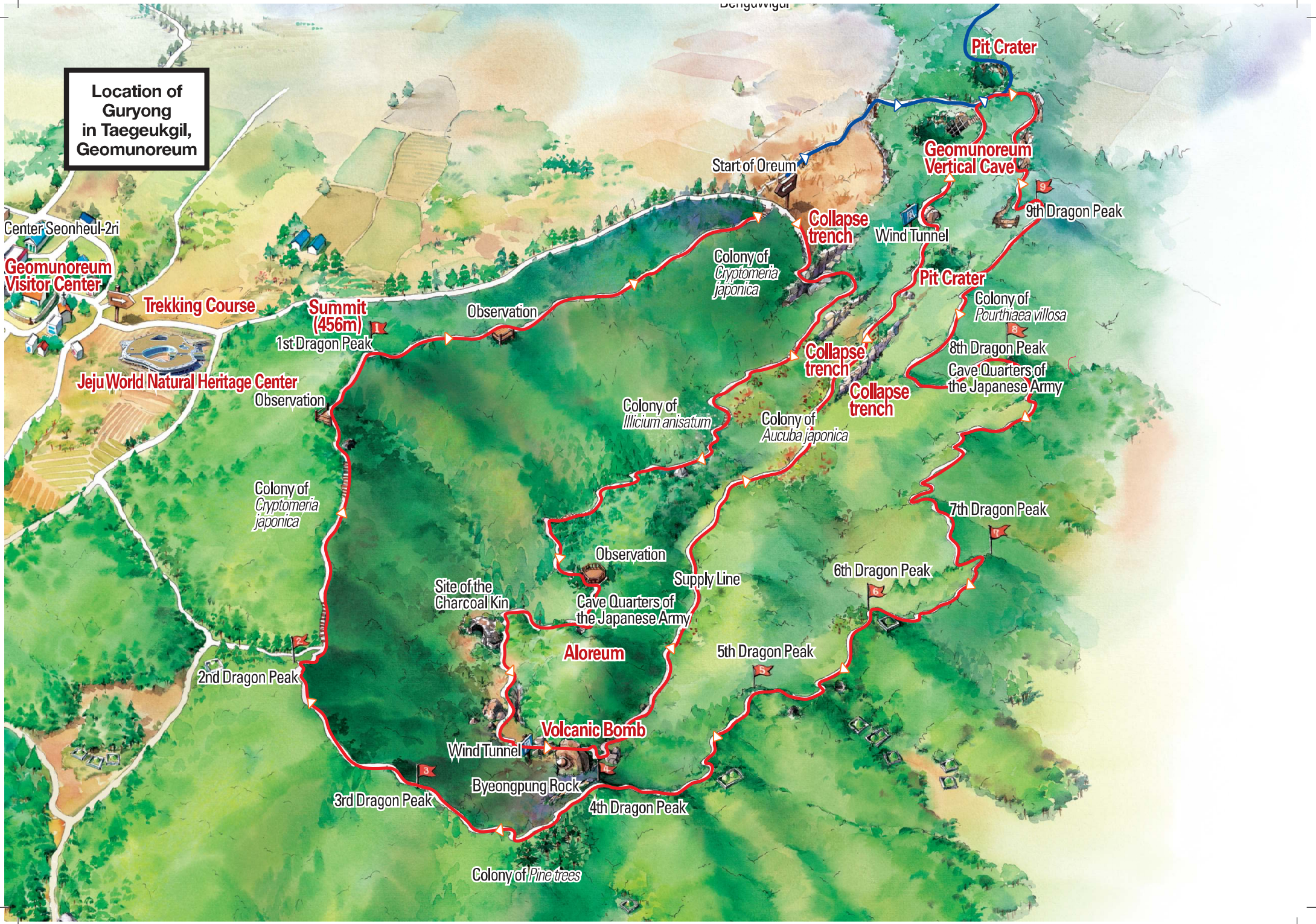
Given with this energy, people can cultivate fine personality with appearances of wise men and nourish spirits of thinking high of basic and duty. They can have the balanced opinion and belief, and broaden their social foothold based on the trust.

Info

Taeeul and Cheoneul

Taeeul
Substance of the universe – basic of all things in the universe. In geomantic terms, it refers to a high and beautiful peak like the shape of a vigorously flying eagle. It is also called Taeeulbong or Taeeulseong.

Cheoneul
Constellation forming Purple Forbidden enclosure. Also called Cheonilseong, it is a god governing the heaven. In geomancy, it refers to a high and beautiful peak.


Location of Guryong in Taegeukgil, Geomunoreum
Pit Crater
Geomunoreum Vertical Cave
Start of Oreum
9th Dragon Peak
Collapse trench
Wind Tunnel
Center Seonheul-2ri
Geomunoreum Visitor Center
Colony of Cryptomeria japonica
Pit Crater
Trekking Course
Summit (456m)
Observation
Colony of Pourthiaea villosa
1st Dragon Peak
8th Dragon Peak
Collapse trench
Cave Quarters of the Japanese Army
Jeju World Natural Heritage Center
Collapse trench
Observation
Colony of Illicium anisatum
Colony of Aucuba japonica
Colony of Cryptomeria japonica
7th Dragon Peak
Observation
Supply Line
6th Dragon Peak
Site of the Charcoal Kin
Cave Quarters of the Japanese Army
Aloreum
5th Dragon Peak
2nd Dragon Peak
Volcanic Bomb
Wind Tunnel
Byeongpung Rock
3rd Dragon Peak
4th Dragon Peak
Colony of Pine trees

The 4th dragon : Hoeryonggojo-bong

The fourth dragon has the appearance of a dragon from the main mountain Hallasan looking back to it. In other words, streams of the dragon, which rise at the main mountain, form the position of a blue dragon and a white tiger on their both sides and then look back to the main mountain. This place has strong energy for good fortune with diverse changes of the dragon's movement. The more changes the veins of land have, the better energy the land obtains, which is the case of this landform. Given with this energy at the place full of bright atmosphere against a backdrop of beautiful nature, people can enjoy healthy life and social success.

The 5th dragon : Jaryonggomo-bong

The 5th dragon has the appearance of a young dragon looking back home. As all the human beings long for the comfortable bosom of their mothers, this place shows particular energy for retrospect on the past. The earth is a soft and comfortable place like home. With the elapse of time, people are homesick in their later years even away from home and wish to be buried at home. Given with this energy, people have humble and generous mind of self-examination. They will be awakened to think about the ultimate value of life through mediation of principles of the inward world and universe.

The 6th dragon : Jeongnyongchurun-bong

The 6th dragon has the appearance of a red dragon coming out of the clouds with auspicious signs. It looks as if the dragon shows its mysterious appearance with emission of life's energy - in other words, to show the achievements in the outward world after long and painstaking work. The red dragon is the god of the southern domain, governing energy of talents which are to be expressed by ability and conspicuousness. Given with this energy, people attract the social attention and have the passion to express their ability to the world. They will be enlivened to pursue value and happiness of life through the meaning of existence.

The 7th dragon : Waryongnongju-bong

The 7th dragon has the appearance of a lying dragon playing with citamani. This place brims with stability and peace. A comfortable lying means affordability and affluence. While they achieve social stability and then help the neighbors, people can afford to pursue pleasures by hobbies and games. This dragon governs stability, affordability and optimistic temperament. Given with this energy, people will learn to enjoy the life by self-enlightenment. They will embrace life with bright and positive mind and have the optimistic disposition.

The 8th dragon : Cheongnyongeumsu-bong

The 8th dragon has the appearance of a blue dragon drinking water at waterside. This place brims with water energy as a driving force of life. Being thirsty in the course of life means need to fill it with necessaries. According to the theory of the Book of Changes, water is wisdom and falls on the category of spirits. Water has no fixed form but produces limitless changes depending on its place. The blue dragon is the god of the eastern domain, governing spiritual civilization and vitality of all things. Given with this energy, people will have great ambition to realize a grand dream

with progressive character. They will learn the true wisdom to be free from trifles and minor things.

The 9th dragon : Hoeryongeunsan-bong

The 9th dragon has the appearance of a far-traveling dragon hiding behind mountains. This place brims with energy of salvation which allows people to calm themselves, contemplate and get awakened to reasons of nature. This dragon governs energy of self-realization and spiritual ripeness for a free and quiet life. Given with this energy, people will get ultimate awakening and be one with great nature. It refers to the mental stage of being quiet in nature, humbly seeking reason of the universe, detached from the worldly cares. Wise men become really free when they arrive at the stage of selflessness by calming mind, transcending border of life and death. Through insights, people will find ultimate value of life and enjoy true freedom.

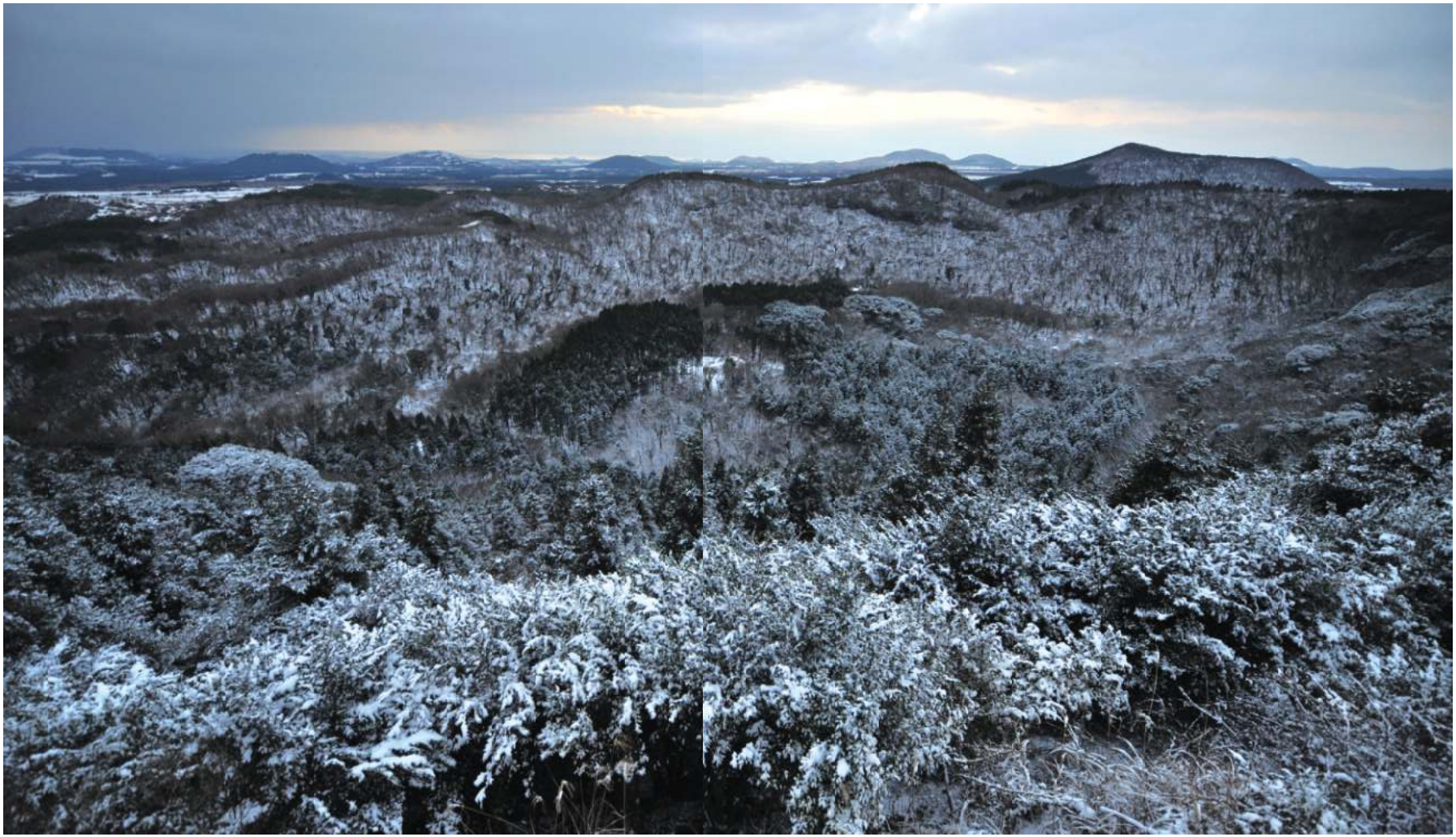


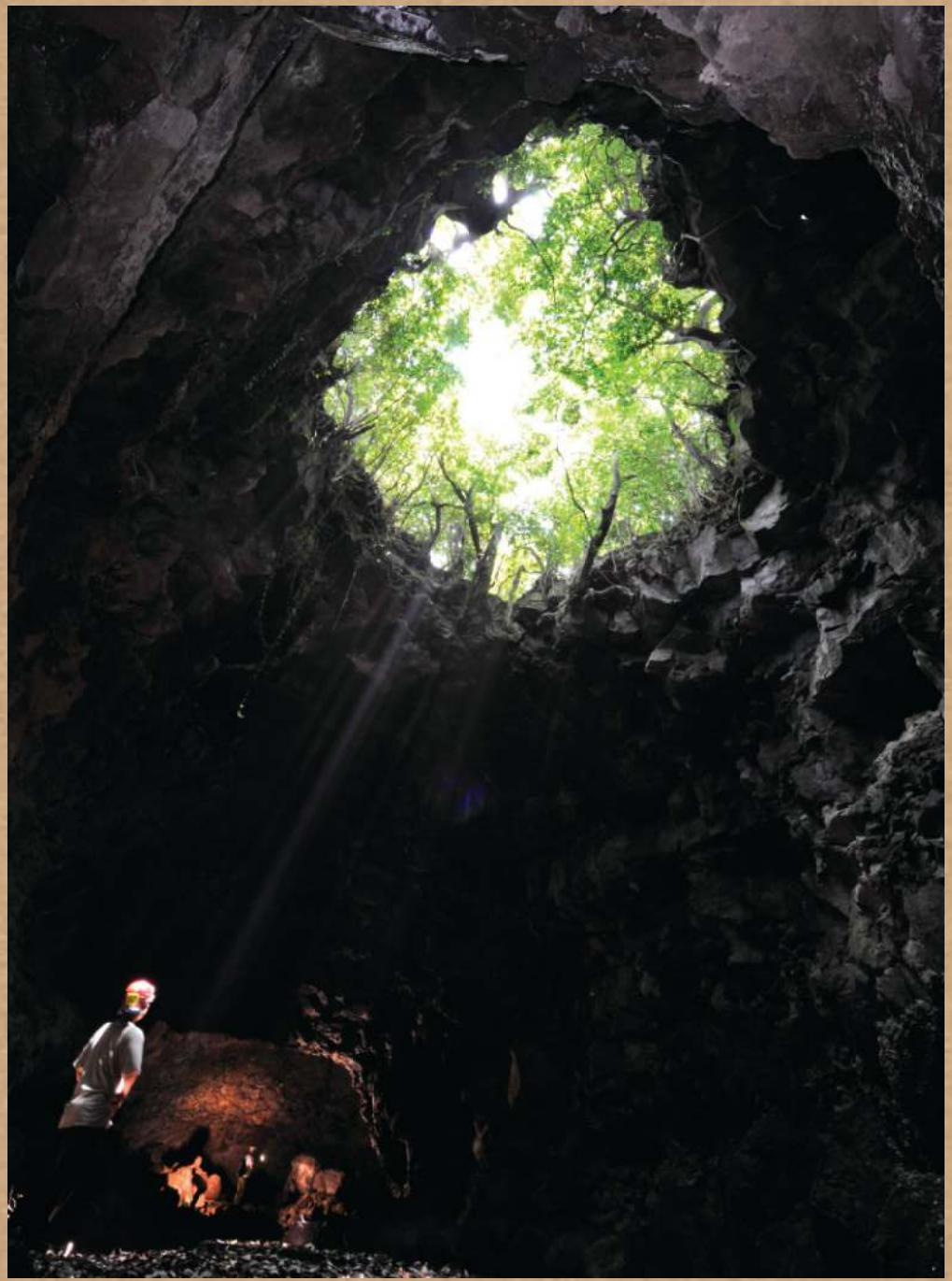
Whole view of Geomunoreum crater

On Geomunoreum

Written by Shin Young-dae

While nine dragons play with cintamani.
Ancient mystery stretches everywhere.
Meandering through all valleys,
High and low peaks make a folding screen.
Where there comes a blind alley,
It continues to peaks to unveil mountains again.
I wonder where is the end of deep forest,
Clouds hanging in the western mountain
Move slow as if knowing the outward.





Part5

World Natural Heritage, 'Jeju Volcanic Island and Lava Tubes'



Geomunoreum

5. World Natural Heritage, 'Jeju Volcanic Island and Lava Tubes'

As a volcanic island located in the farthest southern part of Korea, Cheju-do has a long oval shape to the direction of the east by northeast and has been formed by the volcanic activities from the latter Cenozoic era to the historic times. In the center of the island, there lies Mt. Hallasan 1,950m above sea level together with distribution of 360 or more oreums (volcanic cones) all over the places with diverse sizes and forms. According to the drilling report made throughout the island, there lies bedrock at the bottom of land and the island is constituted of U strata, Seogwipo strata and lava flow in between.

Whole of Jeju-do island forms such a diverse and unique topography that it may be called as a museum of volcano, leading to its registration of World Natural Heritage in the 31st General Assembly of the World Heritage Committee on June 27, 2007 in recognition of its geologic value as well as scenic beauty. As the altitude of Mt. Hallasan changes, a wide variety of

Info

Why Is It a World Heritage?

There are a large number of countries and countless assets that are beautiful and valuable on earth. UNESCO has selectively made a list of assets to be preserved permanently and handed over to the following generations among those beautiful and valuable. This is the very list of world heritages. The fact that something is included in the world heritage list shows that its value to be preserved for the entire humanity has been recognized worldwide. 'Geomunoreum' is one of the great natural heritages, the most valuables to be preserved by all in the world.



Mt. Hallasan Youngsil

vegetation is distributed particularly, and rocks, columnar joints and summit craters already had their geological value highly appraised along with the beautiful scenery. In the meantime, Seongsanilchulbong tuff cone has been evaluated not only for its beautiful landscape, but also for its unique value as a global model showing process of hydrovolcanic eruptions. Also its sunrise is said to produce a very dramatic view. Geomunoreum Lava Tubes was designated as the global heritage to be preserved by the world's cave researchers for the points that it has a well developed cave structure of lava, and it displays a very rare sample of existence of secondary carbonate products inside the cave.

With such a unique volcanic topology, animals and plants also show characteristics that cannot be seen generally on the mainland. The vertical distribution of plants centering on Mt. Hallasan and the clusters of Korean firs [*Abies koreana*] that can be seen in the isolated environment of an island can by seen as biological characteristics of Jeju island. Furthermore, a



distribution of unique basalt lava tubes is home to Jeju's indigenous species such as *Epanerchodus clavisetosus, Opiliopentaspnulatus*, *Nesticus quelpartensis*, and *Heteropoda koreana* and more.

Not only the experts in geology and biology but also many students and visitors are attracted to such characteristics and spectacular views of special artifacts, which led to Jeju's registration as a World Natural Heritage site. The number of visitors amounts to about 5 million visitors every year. However, only very limited areas are open to the public because World Natural Heritage-registered areas are designated as Natural Reserves and most of these areas are state-owned lots under government management.

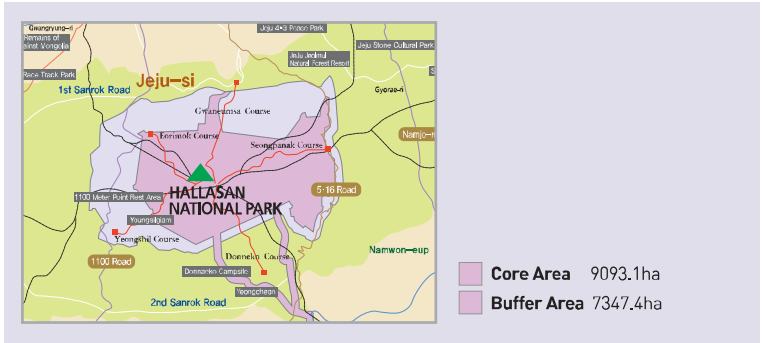
Info



World Natural Heritage sites in Jeju

Evaluated as an Outstanding Universal Value in Volcanic Geology by IUCN, the International Union for Conservation of Nature. The World Heritage Centre (WHC) inducted 'Jeju Volcanic Island and Lava Tubes' into the World Natural Heritage list, Korea's first such registration, during the WHC's 31st conference held in Christchurch, New Zealand on June 27, 2007. The registration is composed of three sites: Mount Hallasan Natural Reserve, Seongsan Ilchulbong tuff cone, and Geomun oreum lava tube system of caves. The Geomun oreum lava tube system includes Geomun oreum, Baengdwi-gul, Manjanggul lava tube, Gimnyeong Cave, Yongcheondonggul lava tube, and Dangcheomul-donggul.

Mount Hallasan Natural Reserve



The feelings and lives of Jeju people are embodied in Mount Hallasan as they have managed to live their lives while adapting to the poor environment. Mt. Halla has also been a mentor for the people of Jeju as it is the subject of stories and legends. That is why the indigenous people have believed that Mount Hallasan refers to Jeju and Jeju is Mount Hallasan.

The body of Mount Hallasan is typical of a shield volcano which became active approximately 300,000~200,000 years ago with a Strombolian type of eruption until the last eruption approximately 25,000 years ago.

Mount Hallasan typically shows the development history of volcanic topography with the features of central eruption and activities of many small



Mt. Hallasan

volcanoes spread around the center. Together with Baekrokdam, the summit crater lake, Mount Hallasan represents various volcanic characteristics such as columnar joints with curios-looking rocks, trachyte domes and lava plateau, and produces a conspicuous landscape along with unique plant life.

Mount Hallasan is also worth a special attention with its geographical distribution of relicts of circumpolar alpine plant in the glacial period and various native species as well. There are 20 families and 32 species of indigenous vegetation in Mount Hallasan Natural Reserve including include *Salix blinii Lev*, *Silene fasciculata Nakai*, *Berberis amurensis var. quelpaertensis Nakai, Trifolium lupinaster for. alpinum Nakai*, Fauriei spurge[*Euphorbia fauriei*], and *Elsholtzia minima Nakai*. The reserve is also a very important place as it is the world's only habitat for Korean firs [*Abies koreana*]. In the Mount Hallasan Natural Reserve, the plants grow in an area of approximately 603 hectares, forming a homogenous species cluster as the biggest forest composed of Korean firs.

Seongsanilchulbong Tuff Cone



Seongsanilchulbong is the worldwide topography showing the birth and history of hydrovolcanism along the cliffs which were created by erosion of the ocean for several thousand years. It is 180m high, about 600m in diameter, with 45° angle of inclination to the maximum and bottom of its crater is 90m above sea level, which shows typical topography of a tuff cone. Across the globe, there are a lot of hydrovolcanoes like Seongsanilchulbong but it is very remarkable to see that it maintains the landform of a tuff cone in good shape and allows people to view precisely its various internal structure made by erosion of waves to its three sides. And worldwide, it provides important data to understand process of eruption and sediment of



Seongsanilchulbong Tuff Cone

hydrovolcanoes.

Generally, volcanic eruption is associated with the image of hot lava flowing from the volcanic crater and its ashes scattering over the sky like mushroom clouds. However, hydrovolcanoes are formed by interaction of magma with either groundwater or surface water (like the sea, lake, river, glacier): when magma meets water, magma or lava cools down sharply and water boils off and these vehement activities cause strong explosion. This phenomenon is called hydrovolcanic activity and around 10 volcanoes among 360 oreum in Jeju-do are made by this hydrovolcanic activity.

Info

Magma and lava

Magma is hot liquid rock underground and becomes lava when it erupts above the earth's surface. Magma in liquid rises above earth's surface through unstable crust spots, which marks the beginning of volcanic activity. Explosive eruptions take place because of volatile elements of lava during its initial eruptions and as volatile elements diminish, it changes to form of erupting mainly lava. While most of rocks in Jeju-do consist of lava erupted rather calmy, oreums are formed by explosive eruptions due to volatility of magma.

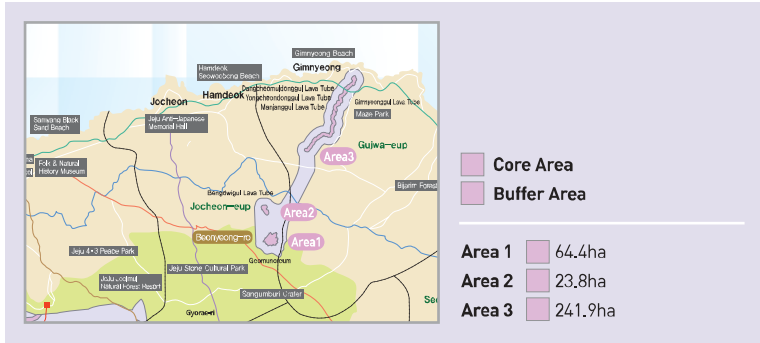
Hydrovolcanic activity

Scene of eruption of a hydrovolcano which is similar to forming process of Seongsanilchulbong (Surtsey, Iceland in 1963). Explosive fuel-coolant interaction between seawater and magma triggers a strong explosion and emits volcanic ashes and materials including plenty of vapor.





Geomunoreum Lava Tube System



It is known as a group of lava tubes formed when lava which erupted several times starting from Geomunoreum flowed to the north by northeast to the ocean along the geological slopes. Based on K-Ar absolute-age dating data obtained at Manjanggul lava tube, its formation is estimated to be sometime between 100,000-300,000 years ago. Its typical lava tubes by proximity to Geomunoreum are: Seonheulsujik Cave, Baengdwigul lava tube, Utsanjeon tube, Bugoreum Cave, Daerim Cave, Manjanggul lava tube, Gimnyeong Cave, Yongcheondonggul lava tube, Dangcheomul Cave.

Each lava tube has its own developed products of lava tube with a wide variety of size and shape. Dangcheomul and Yongcheondongul lava tubes



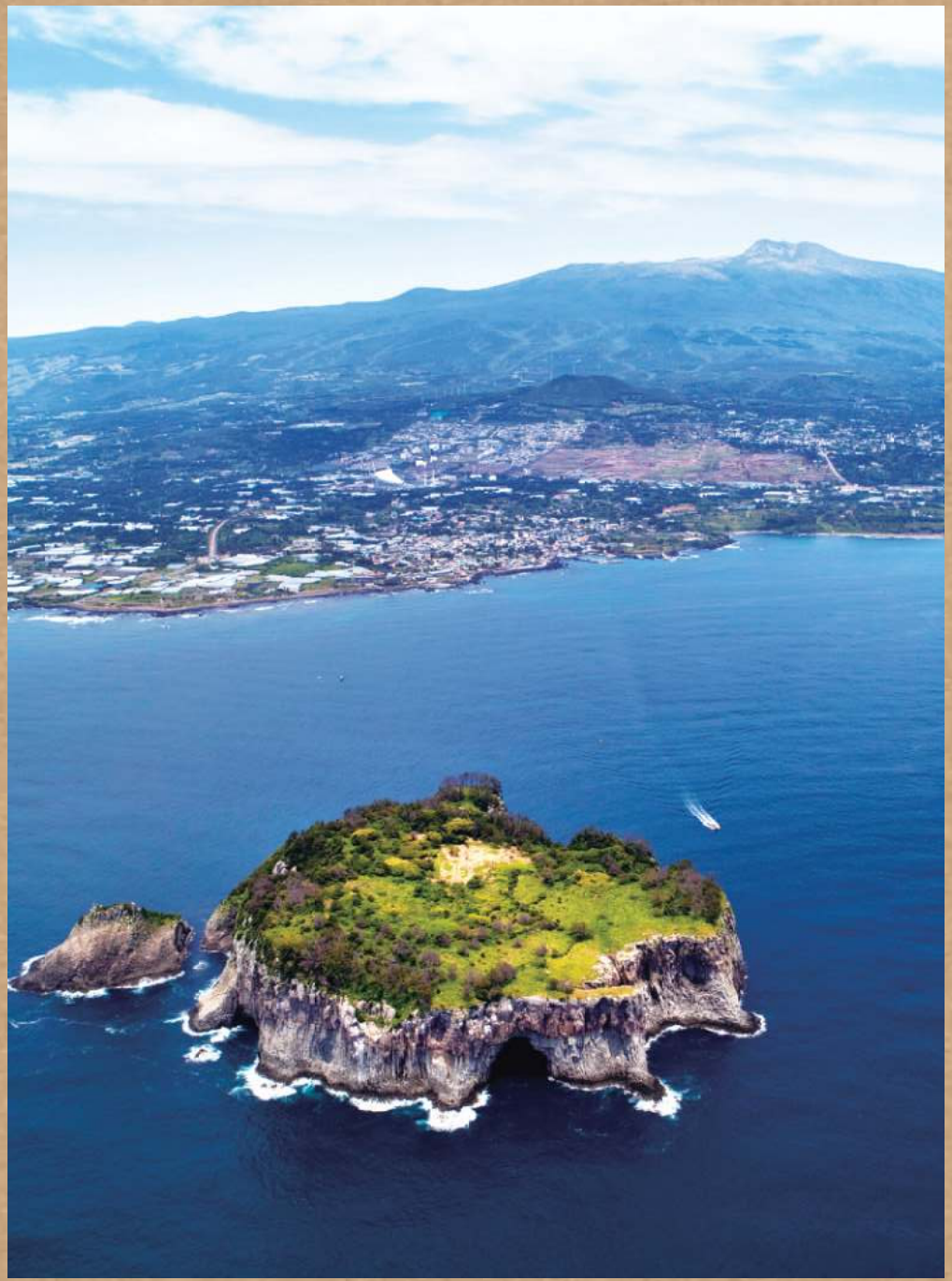
Dangcheomul cave

in particular have formed secondary phase of diverse products of carbonate element, even though they are lava tubes made by volcanic activity, differentiating them from other lava tubes in the world.

Global cave experts highly estimate wonderful beauty of Geomunoreum Lava Tubes in general as well as their outstanding value that enables people to extend scientific understanding and scope to nature.



Geomunoreum by satellite picture



Part 6

Jeju World Conservation Congress Attracts Global Attention



6. Jeju World Conservation Congress Attracts Global Attention

Environmental Festival takes Place across Jeju from 6 to 15 September

Good Chance for World's Environmental Capital and Ecotourism promotion



Signing of WCC Students Voluntary Service

"Invitation to Global Environmental Festival, 2012 Jeju World Conservation Congress" 2012 Jeju World Conservation Congress(WCC) will take place across Jeju from 6 to 15 September. Under the subject of environment, it is a global festival for the world communities to become one. Jeju Convention will be a place for the global communities to share Jeju-do's efforts and implementation intentions to conserve its environment, and discuss directions for planet's environment conservation together with solutions to environmental challenges.

The Congress will be jointly organized by the International Union for Conservation of Nature(IUCN), the Ministry of Environment and Jeju Special Self-Governing Province. During the Congress period, various events including pre-event, World's Conservation Forum, Members Assembly, World Leaders Dialogue and festivals will be held in many places at the same time.

2012 is expected to be a significant year as a turning point of world's environmental policies; Major global environmental policies are estimated to be decided this year. At its center is Jeju.

The year of 2012 has a special meaning related with global environmental issues. First of all, the 'UN Conference on Sustainable Development(RIO+20)', which is expected to suggest future directions of global environmental policies by establishment of systems to deal with green economy, poverty eradication and sustainable development, will be held in Rio de Janeiro on end of June. And then the 11th Ramsar Conven-







tion is due to open in Bucharest, Romania. And the 11th Conference of Parties (COP) to the Convention on Biological Diversity (CBD) will be held in India in October 2012. Thereafter, the 18th COP to UN Framework Convention on Climate Change(UNFCCC) will follow in Qatar.

The reason why world's important environmental conventions attract Jeju people's attention is because Jeju hosts the World Conservation Congress(WCC) of IUCN. Kim Jong-cheon deputy head of the organizing committee of 2012 WCC explained its special meaning: "Jeju's WCC will take place, encompassing outcomes of all other important environmental conferences across the world." 2012 Jeju WCC, which is the largest international conference related with conservation of nature, is set to review past performances and suggest new directions to the world. In Jeju WCC, Jeju Declaration will be announced in which new directions will be proposed together with summary of the Congress results. As a matter of note, the Congress will be an arena to explore and discuss environmental agendas of the country and Jeju. Formal agenda for Jeju includes restoration of Hanon Crater and Gotjawal.

Taking advantage of 2012 Jeju WCC in particular, a draft is due to be proposed in which Jeju will be designated as 'World's Environmental Capital' with harmony of conservation of natureand economic development. And its final outcome is of keen attention. The organizing committee will seek to adopt a resolution for designation of world's environmental capital in the perspective of deduction of a creative, futuristic governance system in the Congress and is further going to derive an agreement to specific criteria for the designation.

In a similar way as IUCN recommends World Natural Heritage, a consensus is expected to be built about objective and reasonable criteria and methods for designation of world's environmental capital. Based on this ground, Jeju plans actual designation as such to be made earliest by 2016 or latest by 2020.



Seongsan Ilchulbong



Stone Wall and Rape Flowers of Jeju

Jeju WCC will provide a golden opportunity for us to publicize Jeju's value in most appropriate way to the international communities. Then what can we show to them?

People around the world will pay attention to Jeju's traditional culture and history, various lifestyle and appearance of Jeju's native people. Furthermore, it is an important opportunity for us boast of and publicize Jeju's excellent natural environment. Jeju is the very place showing its true worth as international protection areas such as World Natural Heritage Site, Biosphere Reserve, World Geopark and Ramsar Wetlands.

If domestic eco-tourism had its bud from Changwon Ramsar Convention, Jeju WCC will offer a golden opportunity for us to publicize Jeju as the best place for eco-tourism. It is another reason why Jeju people should divert their eyes to Jeju WCC which will pave the way for environmental capital and eco-tourism.

For this purpose, it is desperately needed for us to steadily prepare top-notch programs showable to dignitaries participating in WCC from across the globe.

If we can create a program combined with Jeju's unique cultures such as its outstanding environmental resources, diving women, stone walls, it will be a top-notch masterpiece to demonstrate Jeju's real worth to the world, not as a causal event.

Tip

IUCN WORLD CONSERVATION CONGRESS JEJU 2012

What is WCC?

Literally 'Environmental Olympics' of Global Communities

Held Every Four Years...Discuss Planet's Environmental Issues
More than 10,000 Global Environment Leaders Participate from 180 Countries.

The World Conservation Congress(WCC), which is held every four years under the auspices of the International Union for Conservation of Nature(IUCN), is most typical and authenticated environment event. It deals with planet's environmental issues such nature conservation, biological diversity, climate change along with directions for nature conservation. Its significant and wide influence on global communities often lends it name as 'Environmental Olympics'.

Previously, WCC was divided by Members Assembly in which only members participated and Forum centered on conservation issues according to regulations of IUCN. Members Assembly took place 21 times at interval of 2-4 years from 1950. WCC in the form of combination of Members Assembly and Forum commenced from the occasion in Montreal, Canada from 1996 and was followed by occasions in Amman, Jordan in 2000, Bangkok, Thailand in 2004, Barcelona, Spain in 2008 - totalling four occasions up to now. And Jeju Congress marks its fifth occasion.

Number of participating countries and people is on continuous increase in step with growing concern with global environmental issues, and most recent Barcelona Congress had 6,600 participants from 179 countries.

Members Assembly decides whether to adopt resolutions or recommendations to the global communities by a vote. 1996 Assembly had 111 agendas adopted, while in 2000, 2004 and 2008, there were respectively 98, 118, and 136 agenda adopted, all of which were announced either by resolution or recommendation.

The main theme of 2012 WCC is Resilient Nature, while its slogan is 'Nature +'(Nature and extension to diverse themes)

nature+

In ecology, resilience means stability and capability of ecosystem to accommodate disturbances and restore itself. Resilient ecosystem refers to ecosystem whereby perturbation or disturbance below a certain levels is accommodated stably while disturbance reaching a threshold with significant magnitude is restored itself quickly. Resilience has significant implications in nature as well as in human society. Resilience of ecosystem and the society should be taken into consideration at the same time. So, resilience in terms of society-ecosystem dependent system can find its another expression by 'long-term capability of ecosystem to deal with change and sustainability for development'.

IUCN has been providing the global communities with scientific knowledge related with conservation of natureand ecosytem management for last decades. A large number of organizations across the world have been striving to preserve biological diversity and boost resilience of nature. IUCN's role is to bring into relief and expand these endeavors and also to reflect them on policies. 2012 Jeju World Conservation Congress is expected to suggest solutions in coping with the future through information share and strong connection among its members. And at its center lies Official slogan of the



Tip

IUCN WORLD CONSERVATION CONGRESS JEJU 2012

Congress 'Nature+' means free extension to various issues under the large framework of nature. '+' implies a diversity of meanings such as positive ,more, better, added value, works together, can't be apart, urgent. It further implies that this Congress offers opportunity for participants to discuss the core subject in a more diverse and free way under the framework of nature, which will lead to development of the Congress in the long run.

The logo of Jeju Congress, which symbolizes expansion of value of conservation of nature in the appearance of full-blown flower, represents spread of hopes. Overlapped petals means conservation and share, coexistence and cooperation, while traditional patterns and colors represents East Asian cultures and beauty of Korea, as a host country of this Congress. Diverse directions of petals shows value of conservation of nature to be formed from Korea to the world, from the present to the future, from nature to humans.

nature+

What is IUCN?

The World's Most Authoritative Environmental Organization in the Field of conservation of nature

Founded in 1948… Engaged by 11,000 experts

The International Union for Conservation of Nature(IUCN)) was founded to protect global resources and nature in 1948. As the largest environmental organization in the field of conservation of nature, it was founded as a union of governments, governmental organizations and NGOs and is headquartered at Gland, Swiss. It has UN observer status uniquely as a nonprofit organization.

It consists of six commissions under fields of Education and Communication, Environmental Law, Ecosystem Management, Species Survival, Protected Areas, Environmental, Economic and Social Policy. It is literally the world's most authoritative environmental organization, operating offices in more than 60 countries from 8 regions worldwide.

It promotes international cooperation to protect resources and nature, and to prevent extinction of animals and plants. It drafted convention for international trade of endangered animals and plants in 1973, and biodiversity convention in 1982. Also it prepared the first draft for World Charter for Nature to be adopted by the UN General Assembly. Particularly, on request from the UNESCO, it delegates experts to the country applying for World Natural Heritage, and submits its recommendation to the World Heritage Committee based on experts' actual inspection and evaluation. So far their recommendations have almost been passed by the UNESCO. Jeju's World Natural Heritage was registered as per its recommendation.

From 1966 when the country joined the Association of Conservation of Nature, nine organizations across the country are currently actively engaged; the Ministry of Environment, Cultural Heritage Administration, Korea Forest Service, Jeju Special Self-Governing Province, Korea National Park Service,

Tip

Korea Association for Conservation of Nature, Korea Wild Animals Protection Association, Korean Wetlands Society, Great Nature. Professor Kim Seong-il(from Seoul National University), who was nominated as a director in 2009, is now working for IUCN. Since 2007, Korea National Park Service despatched staff to its Asia Region office(at Bangkok) to maintain close cooperation with IUCN.

In IUCN, more than 1,100 members(governments & NGOs) are currently working; there are 1,150 governmental and private organizations from 80 state members, government agency, national NGO, international NGO, partners. Members meet at WCC every four years to discuss policies and future directions of IUCN. Around11,000 experts take part in six commissions voluntarily and at its worldwide offices in more than 60 countries, 1,000 experts are performing their jobs.



nature

Jeju - IUCN 'Special Relationship'

Proposed Mt. Hallasan 'Preserve' Initially in the 1960s

Led to Natural Preserve Designation in 1966
Recommended Registration for World Natural Heritage in 2007

A special relationship is continuing between Jeju and IUCN, organizer of 2012 WCC.

The fact that IUCN contributed greatly to natural preserve designation of Mt. Hallasan in the 1960s is not well known to the ordinary people. Even nowadays, special bond with IUCN has been continuing from recommendation of registration for World Natural Heritage, hosting of WCC to agreement of Asia Climate Change Education Center.

Special relationship between IUCN and Jeju dates back to November, 1963 when Mr William Hart then expert in park design of IUCN chose Mt. Hallasan as a place which needed appropriate measures for protection during his visit to Korea. After that, an expert from the Committee of National Parks under IUCN visited Korea in April following year to discuss procedures of natural preserve designation, which led to full-scale academic research of Mt. Hallasan on the government level(the Ministry of Culture & Public Information) in November 1964.

Purpose of academic research was to investigate natural resources of the mountain and decide its boundary as a basic step for its designation as natural preserve and later a national park. Eventually, Mt. Hallasan was designated as natural preserve(Natural Monument No. 182) in October 1966 and then as a national park in March 1970. The clue was recommendation by IUCN.

'Jeju Volcanic Island and Lava Tubes' in 2007, which was the first ever registered World Natural Heritage in the country was possible by IUCN's recommendation of registration. On the other side of the relationship, Jeju Special Self-Governing Province signed MOU for Asia Climate Change Education Center to establish cooperation partnership with IUCN.

Jeju's hosting possibility of WCC was very low at the beginning stage.

Tip

IUCN WORLD CONSERVATION CONGRESS JEJU 2012

Competing Cancun from Mexico was well known as a world class tour attraction and challenged again following the 4th Congress, and furthermore it began its activities earlier than Jeju. Another burden was that two occasions took place in the Asian region since 1996.

From October 2008 when the Minister of Environment met secretary-general of IUCN, full-scale hosting activities commenced. Central government from the Ministry of Environment, the Ministry of Foreign Affairs & Trade as well as Jueju-do, Korea Commission of IUCN played an important role coping with disadvantageous positions. And finally Jeju succeeded to host WCC. Also the fact that only Jeju-do joined IUCN among local governments - October 2008 - contributed to such success.



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