

ALPINE KARST IN EASTCENTRAL KOREA**Jongwoo Oh,**

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Introduction

Karst in Korean peninsula is not widely known. Since karst studies had been initiated a few hundred years ago based on the historic records "Dong Guck Ye Jee Seoung Lam" and "Sae Jong Sill Rok Gee Ri Jee" (1993, Oh), modern cavers during the 60s have inactively started to search on the karst phenomena to the eastern mountaineious areas.

After the Korean Speleological Society was established in 1972, members of the society were widely exploring and researching the karst features. At present, five out of 209 recorded limestone caves are commercially operated for the

visitors. On the other hand, the Pleistocen vulcanospeleoscopic features in the istlands are very characteristics in length and in scales. Other pseudokarst like sea cliff caves and nonlimestone caves also forms.

Distribution of the karstificalton

Distribution of the karst is two different catagoris: holokarst (limestone karst), and pseudokarst (vulcano and nonlimestone karst). In terms of the holokarst, the surface and subsurface karstic formations are sculptured on the major mountain ranges, mostly in the Taebecg and Sobecg Mts., of the east central part of the Korean peninsula (Figure 1). A minor portion of the karstification distributes in the southwestern part, end of the Sobecg Mts., of the the peninsula.

There are three types of the pseudokarst, lava karst, sea cliff karst, and terrestrial karst.

The lava karst are distributed in the major

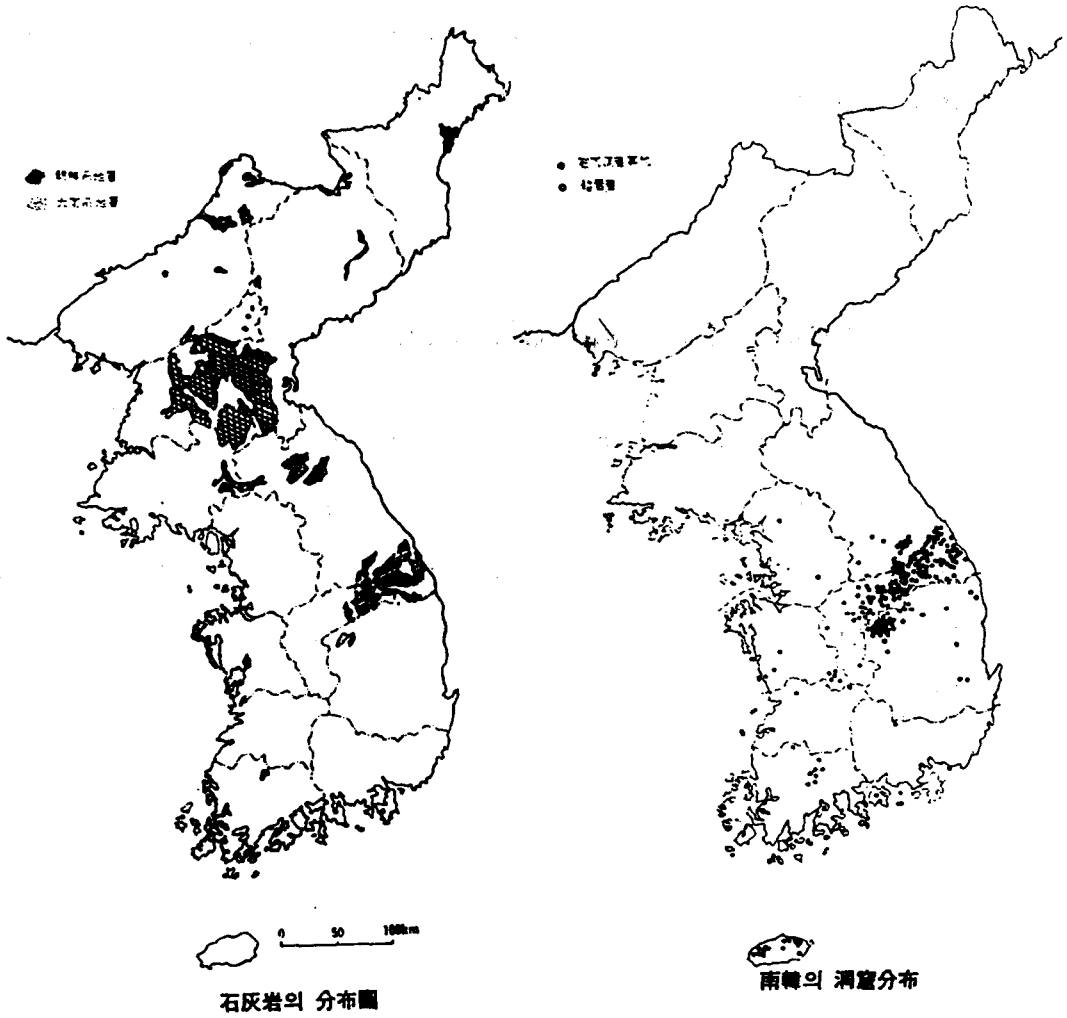


Figure 1. Distribution of the carboante bedrocks and karst in Korea (Hong, 1985).

islands in Cheju Island and Ullnung Island. 62 documented lava caves are in these islands. The second type of the pseudokarst is the karst forms in coasts as the sea-cliff caves. The sea-cliff caves in the islands like Hong Do and east, south and west coast lines. The third type is the nonlimestone caves formed in the Mesozoic bedrocks in Uyi Seung (Oh, 1993 unpublished doc.). Additionally, there are several artificial caves for the military purposes in the DMZ.

Characteristics of the alpine karst

Alpine karst in south Korea is characterized as extensively folded and faulted structure (Oh, 1990). Karst terrain and cave systems are very characteristic because of the superposed folded and faulted limestones caused by geologic activities during the Lower Jurassic Period. Most caves are developed on the intersections between joints and

strikes of overturned and overthrust beds which are mostly Cambro- Ordovician limestones and minor dolostones (Figure 2).

Carbonate rocks consist of CaO (50.0-53.6 %), MgO (1.2-1.4 %), SiO₂ (1.4-5.4 %), and others (Lim, 1992). Thicknesses of Ordovician limestone are usually 1,000-1,300 meters. Hence, abundant caves are very steeper and vertically extended.

Thealpine karst terrains consist of surface (Table 1) and subsurface formations (Table 2). The surface karstification has dolines, uvualas, poljes, karren fields, springs, hum, vertical shaft, and weathered carbonate residual soils. Few karren fields are found on the mountain areas, but they are mostly covered by residuum. It is called as the overburden karst. Covered karren features display significant morphological varieties. These reddish-brown clays (about 1-2 meters thick) covered limestone karren is the typical humid region karstic features.

Depressional features of the alpine karst terrain in south Korea exhibit both a solutional

origin and a collapsed derivation. In particular, the solutional dolines are much bigger than the collapsed ones. Dolines generally appear on the terraces or on the lower-, middle- and high-level mountain depressions (Yoo, 1978). They are mostly clustered. Shapes of dolines are very uniform as very gently curved bowl types, which sometimes have holes to the lower subterranean passages. Sizes of them are mostly 30-50 meters wide and 10-20 meters deep. Small size of the collapsed sinkholes has much smaller than the solutional depressions.

Table 1. Surface karst formations of the limestones in central east Korea (Oh, 1994).

	Dissolutional and fluvial Productions	Others
Surface formations and landforms	<ul style="list-style-type: none"> -cockpit -depressions -hum -karren fields -polje -springs -uvale -Lapie features -Natural bridges -terraces near cavities 	<ul style="list-style-type: none"> -animal bones -archaeological remnants -cave entrances -dropped layers -karst windows -residuum -steeper cavities

Most cave systems are formed in Ordovician limestones. Documented number of limestone caves is 209 (excluded 60 lava caves in Cheju Island).

Caves are mostly about 800-1600 meters long, consist of speleothems like stalactites, stalagmites, columns, flowstones, limestone dams, pools, pisolites, cave pearls, cave corals, helictites and etc. Cave terrains related to the rock structure and the cave development containing conopies, rock terraces, cave meanderings, vadose tubes, bell holes, layerpipings and water table marks (Table 2).

In particular, a pendant located middle of cave walls at the Gosi Cave contain various size of pebbles and clay materials which are strongly cemented (Oh and Chung, 1994). Most pebbles' roundness seems 0.4-0.5, and exhibits noncarbonate rocks such as, garnet, quartzite, and others. These allogenic sediments indicate that the cave channels used to be connected to the Han River stream, thus these kind of caves are called as the vadose caves rather than phreatic

caves. Evidences of the vadose origin will be existing a great size of curvature like cave meanders, differential erosional remnants like rock terraces, and allogenic sedimentary deposition like concreted fluvial sediments on the side of cave walls.

In terms of the provenance of the alpine karst in south Korea, a geologic relation between uplifting land masses and lowering erosional base level must have a strong correlation to the steeper cave development. Mostly active karstification could be occurred during the Pleistocene water table fluctuations. Because of the geologic deformation of the Taebaek and Soback Mountain ranges, the secondary permeability (faults, joints, and layers) mostly takes place to the alpine karstification rather than the primary permeability (pore spaces).

Table 2. Subsurface karst formations of the limestones in central east Korea (Oh, 1994).

Caves	Dissolutional and fluvial productions	Speleothems
Subsurface formations and landforms	<ul style="list-style-type: none"> -anastomoses -bellholes/pockets -chambers -canopies -cave sediments -cave channels -cavities -limpools -ceiling channels -meander trench -multilevel cavities -niches -notches -phreatic tubes= bore passages -phreatic pendants -pools/ponds -rock span -scallops -solutional tubes -sponge work -vadose pendants -vadose tubes -vertical shafts -vertical groovings -water table marks 	<ul style="list-style-type: none"> -anthodites/gypsum flower -aragonite -helictites: accentric -bacon like sheet -cave pearls -cave cotton -cave raft -cave rope -cave blisters -cave corals -cave bubble -colums -conulites -draperies/curtain like stalactites -floating calcite -flowstones -limestone dams -mountain milk -muddy stalagmites -oolites -pisolites -plates -shields -spherical stalacites -splash cup -stalactites -stalagmites -straw/tubular rock and sediments -terraces

Conclusions

Alpine karst in south Korea has many different kinds of surface and subsurface features. The Cambro-Ordovician limestones exhibit significant karstic formations due to their structural deformations although the heavy residuum is covered. The surface karst presents a great size of structural and solutional depressions with a small size of collapsed sinkholes.

Residuum covering over the bedrocks in the alpine karst is another typical feature in the region. It is called as an overburden karst. Overburdens, reddish-brown sticky clays, are generally 1.5-3 meters thick. This thick carbonate residual materials over the bedrocks are the factor due to the surficial erosional rates of the humid climatic regions are lower than that of the tropical climatic region karst. Thus the alpine karst has a few exposure of the karren fields.

Alpine caves, subterranean passages, are extensively controlled by folds and faults. Caves

of the regions demonstrate a significant dip of the passages due to the structural deformations. There are many vertical voids and shafts. Speleoscapes in the internal caves are various. Calcite formations show the water table alternations which indicate the upliftings and erosional base level dropings during at least the Quaternary.

Around cave enterences there are remants of the fluvial terraces on the middle of the hills. These relationship between cave locations and terraces will generate a key to the Pleistocen history of the south Korean peninsula. Hence, the Korean karst is termed as "the overburden alpine karst".

References

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A study of relation karst-topo. and cave distribution around north Korea. Hong S.H. and Oh J.W. 1994. **Dongul** 37: 13-32.

(**Report:** this report on a vulcanokarst in Cheju Island has been issued from Yonhap Press in Korea during late 70s. The report of the lava cave named "manjang gul" is introduced in terms of a commercial view of the vulcanospeleologic features in Korea)

Cheju-do's Manjanggal, the world's Longest Lava Cave

Tourists visiting Korea's resort island of Cheju-do often hear the legend of how the founders of the island's three original clans emerged from holes in the ground. They can even visit the site where three depressions remain in the ground -- one each for the Ko, Yang and Pu families.

It is perhaps fitting, then, that it was a Mr. Pu whose descent into a hole on Cheju-do led to one of the most remarkable recent finds in the field of speleology, the study and exploration of caves.