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Karst in the Korean Peninsula

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Abstract

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 shaft. Speleo-scapes in the internal caves are various. Calcite formations show the water table alternations which indicate the uplifting and erosional base level droppings during at least the Quaternary.

Around cave entrenches there are remnants of the Fluvial terraces on the middle of the hills. These relationship between cave locations and terraces will generate a key to the Plestocene history of the south Korean peninsula. Hence, the Korean karst is turned as "the overburden alpine karst".

Keywords : Alpine caves, Karst, Korean peninsula,

I. INTRODUCTION

Karst in the Korean peninsula exhibits an alpine karst. Physiographically the Korean peninsula displays 70% of mountainous land. Since karst studies in Korea 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 karst have unactively initiated to search for the karst phenomena, such as surficial landforms and subterranean passages to the mid-western part of Whang-Hae-Do and mid-eastern mountainous areas of Gangwon-Do during the 60s(Hong, 1980). Pseudo-karst as vulcano-karst, however, has been excavated on the Cheju Island during the 70s.

After the Korean Speleological Society was established in 1972, members of the society were widely exploring and researching the karst features. At present, nine out of 209 recorded limestone caves are commercially operated for the visitors. On the other hand, the Pleistocen vulcano-speleoscophic features in the Cheju island are very characteristics in length and in scales. Other pseudo-karst like sea cliff caves and non-limestone caves also widely forms.

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1. KARST IN SOUTH KOREA

1) Distribution of the karstificaiton

Distribution of the karst is two different categories: holokarst (limestone karst), and pseudo-karst (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. A minor portion of the karstification distributes in the southwestern part, end of the Sobecg Mts., of the peninsula.

There are three types of the pseudo-karst: lava karst, sea cliff karst, and terrestrial karst. The lava karst is distributed in the Cheju Island and Ullnung Island. 62 documented lava caves are in these Islands. The characteristic of these lava karsts is that containing dissolved carbonate formations in the internal lava caves from the surficial shell ramnents. The second type of the pseudo-karst is the karst forms in coasts as the sea-cliff caves. The sea-cliff caves are distributed in the east, south and west coast lines. These see-cliff caves are distributed almost any kind of geologic lithologic bedrocks. The third type is the nonlimestone caves formed in the terrestrial areas such as meandering river sides, rock shelters, and relict paleo-karsts. Mesozoic bedrocks in Uyi Seung (Oh, 1993 unpublished doc.). Additionally, there are several artificial caves for the military purposes in the DMZ. Distribution of the carbonate bedrocks and karst in Korea (Hong, 1985).

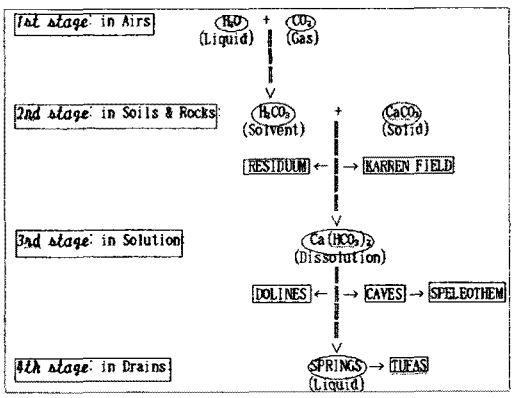

Figure 1. A modified flow chart of the karst process (Oh, 1993)

2) 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 Juristic Period. Most caves are developed on the

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

Formations and landforms	Dissolutional and Fluvial Productions	Others
Surface formations and landforms	-cockpit -depressions -hum -karren fields -polje -springs -uvale -Lapie features -Natural bridges -terraces near cavities	-animal bones -archaeological remnants -cave entrances -dropped layers -karst windows -residuum -steeper cavities

intersections between joints and strikes of overturned and overtrust beds which are mostly Cambro- Ordovician limestones and minor dolostones.

Carbonate rocks consist of Ca (50.0-53.6 %), Mg (1.2-1.4 %), Thicknesses of Ordovician limestone are usually 1,000-1,3000 meters. Hence, abundant caves are very steeper and vertically extended (Figure 1).

The alpine karst terrains consist of surface (Table 1) and subsurface formations (Table 2). The surface karstification has dolines, uvulas, 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.

2. KARST IN NORTH KOREA

1) Distribution of the karstificaiton

There are many different geologic stages in terms of karst landform distribution of the North Korea region, such as PreCambrian to Paleozoic sedimentary rocks. Karst distribution of the North Korea based on geologic systems is as follows (Table 3).

Although noncarbonic caves are mainly developed on the cross sections of joints and layers, limestone caves are significantly related to action of the water table, so that they are called as fouvio-caves. It is a special features that a current exhibition of the high leveled mountain caves were

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

Caves	Dissolutional and Fluvial Productions	Speleothems
Subsurface formations and landforms	-anastomoses -bellholes/pockets -chambers -canopies -cave sediments -cave channels -cavities -limpools -ceiling channels -meander trench -multi-level 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	-anthodites/gypsum flower -aragonite -helictites: accentric -bacon like sheet -cave pearls -cave cotton -cave raft -cave rope -cave blisters -cave corals -cave bubble -columes -consulates -draperies/curtain like stalactites -floating calcite -flowstone -limstone dams -mountain milk -muddy stalagmites -oolites -pisolites -plates -shields -spherical stalactites -splash cup -stalactites -stalagmites -straw/tubular rock and sediments -terraces

generated before the erosional base level had been uplifted.

Distribution of the karst landforms is mainly formed on the relationship between geologic bedrocks and surficial topologies. Occurrence of surficial karst topography including sinkholes will provide not only a predictional function of subterranean passages, but also initially cave existing in Korean cases.

Total counted depressions are 1,388 (size: >50meters) and the number of documented caves are 35. Actually there are many dolines are missing due to counting (mainly impossible to do the field works) from the 1:50,000 map scales. It is predictable that if the counting is used in the bigger scaled maps, 3-5 times more

Table 3. Karst distribution of the north Korea based on geologic systems

Systems	Karst Localities	Exhibitions
Ordovician Lower Level Great Limstones	Pyungan-namdo, South of HamKyung-namdo, Northeast of Whanghaedo	Major
Cambrian	East of Whanghaedo	Minor
Upper PreCambrian Middle PreCambrian Lower PreCambrian	-West and mideast of Whanghaedo -North of Kangwondo -Southwest of Pyungan-namdo and Wansan areas, Pyungan-buckdo (Yanpuuing and Eyeju)	Major Minor
PreCambrian	North of Gyunggido Northwest of Ganwondo Middle of Hankyun-namdo Southest of Hankyung-buckdo (Chilbo Mts.)	Minor

dolines will be found. Counting caves in North Korea use documented information so that actually numbers will be more than doubled, because area of the limestones in North Korea is about 10 times bigger than south Korea's limestone areas (Table 5). We can predict that caves in South Korea display >300. Further karst work in the area is needed when the unification is placed in the peninsula.

Table 4. Number of the dolines distribution by areal count

No	Number of Dolines
1	<10
2	11-20
3	31-30
4	41-40
5	51-50
6	51-60
7	61-70
8	71-100
9	101-150
10	151-210

Source: Chosun Chongdog-Bu Map 1/50,000, 1917

Table 5. Geology of the Karst Distribution in North Korea

Geologic Times	Systems	Bedrocks
Cenozoic	Quaternary Tertiary	Lavas Lavas
Mesozoic	Cretaceous	Granites
Paleozoic	Ordovician Cambrian	Lower Great Limestone Yangduck
PreCambrian	-	Sangwon Yeonchun Machunrung Complex Metamorphic

Source: Geology Map in Korea, 1989, National Geography Bureau, p.10

2. CONCLUSIONS

Alpine karst in Korea has many different kinds of surface and subsurface features. The Cambro-Ordovician limestones exhibited 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 1.5-2 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 shaft. Speleo-scapes in the internal caves are various. Calcite formations show the water table alternations which indicate the uplifting and erosional base level droppings during at least the Quaternary.

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