6. Cheju Island (Korea)

Cheju Island lava caves have been systematically surveyed since 1977 as a joint project between the Japan Volcanospeleological Society and Speleological Society of Korea.

Part of the survey results were reported at the Third International Symposium on Vulcanospeleology held in the U.S.A. where the Billemot kul (kul=cave) of Cheju Island has been officially recognized as the world's longest known lava cave, based on the survey result showing the total length to be 11.749m. In the Fourth Symposium, held in Sicily, Italy, delegates requested the next (the Fifth) Symposium to be held on Cheju Island in 1986. However, Korea could not be the host convener under unavoidable circumstances, thus the delayed Symposium has been set to be held in Japan with the post session excursion to Cheju Island in co-operation with the Speleological Society of Korea.

Geography of Cheju Island

Cheju (Jeju or Saishu) Island is situated in the Korean Strait at 126.5° E, 32.5° N, which is at about 80km south of the southern tip of the Korean Peninsula and at about 200 km west of Nagasaki on the western coast of Kyusyu Island. This is the largest island of Korea, a long ellipse in shape with a 73 km east-west major axis and a 31 km north-south minor axis, its perimetre is 263 km and covers 1800km^2. (figure 6-1)

Near the centre of the island is Mt. Halla (or Hanlasan) 1952 m, the highest peak in south Korea. Near the summit of the mountain there is a 400 m size central crater, Paeknoktam or Backlockdam. The fluidal alkaline lava of Mt. Halla, alkali basalts and trachytes, costructs a shield volcano which forms the major part of the island.

Cheju Island is inhabited with nearly 400,000 people of which 150,000 is in Cheju City on the northern coast and some 30,000 in Seogwipo (Seoguipo) City on the southern coast. A paved road joins these two cities through the 800 m high flank of Mt. Halla, also a good paved coastal road enables a round drive of the island in four hours.

The major products of the island used to be cattle, horses, fisheries, mushrooms and black coral, but since 1965 the orange industry has successfully taken a major part. Orange orchards have been greatly helped with irrigation systems using large quantities of well water successfully drilled out since 1970. Owing to the Kuroshio,

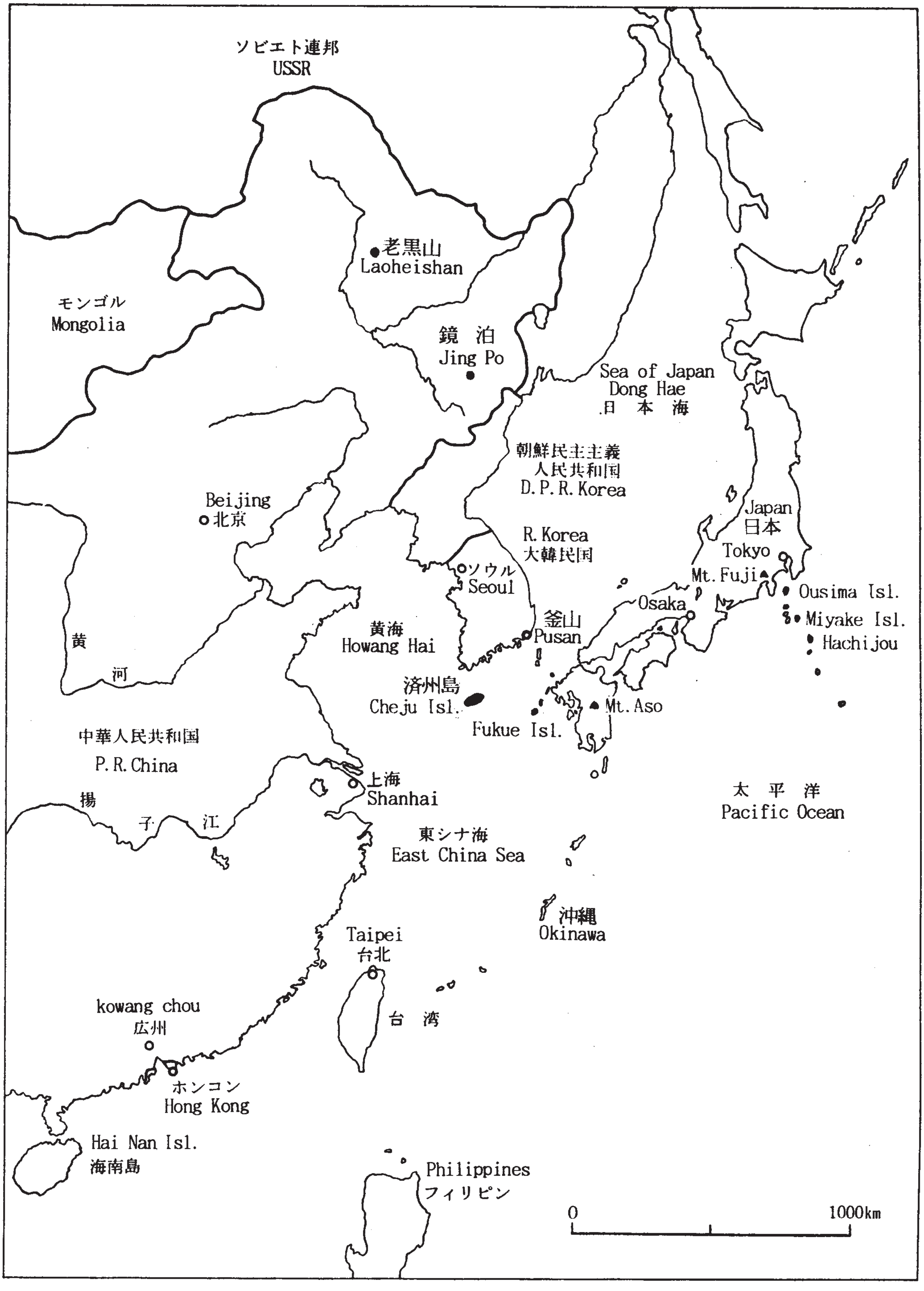


図 6-1 極東地区の火山洞窟所在地図

Fig.6-1 The map of the seats of Volcanic Caves in the Far East area.

the West Pacific warm ocean current, coastal region air temperatures never drop down below freezing point and is favorable to the orange industry, although the upper part of Mt. Halla is covered by snow from November to February.

Annual rain fall at Cheju City on the north-coast is 1450 mm, while Seogwipo City in the south has 1800 mm. The island is windy in all seasons, especially in winter when northerly gales often reach 80 km/h, and the island is even occasionally hit by destructive tyhoon during summer.

Geology of Cheju Island

Lavas of the shield volcano Mt. Halla (or Hanla) covers up most of the island. Historical records of four eruptions in 1002, 1007, 1455 and 1570 A.D. shows the volcano is still active.

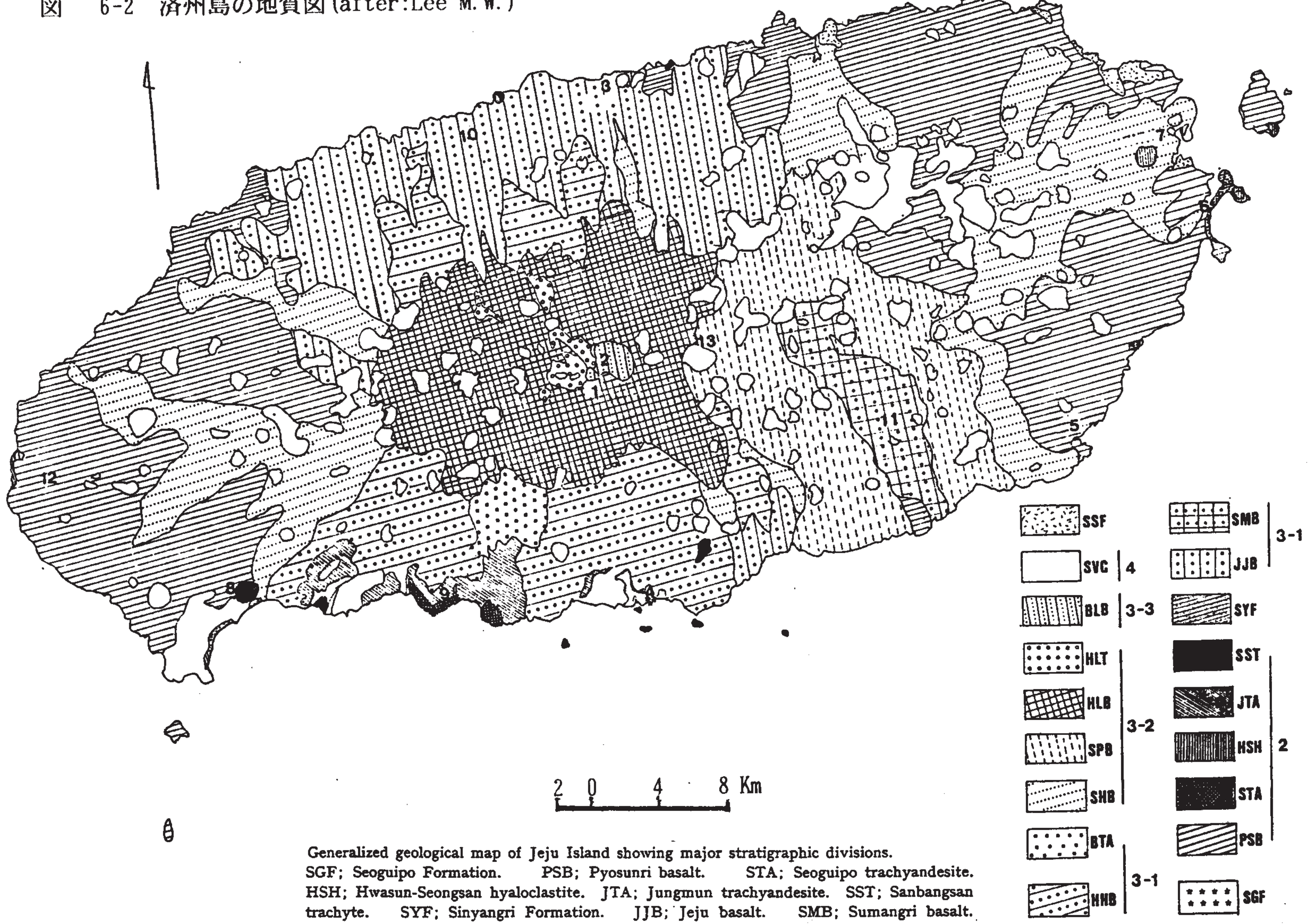
Haraguchi (1930, 1931) first published a Cheju Island geological map, and he also added extended survey results (Haraguchi 1960). He recognized seven rock types in Mt. Halla lavas and set their ages in upper Pleistocene to Holocene. He also clarified that the gently sloped shield has been formed by a large scale eruption of Cheju basalt and Feldspar basalt flow in the initial stages of Mt. Halla activity.

At the southern coast he found a marine fossiliferous sedimentary bed, Seogwipo Formation, for which he inferred lower Pleistocene age from the molluscan faunal assemblage he described including Turritella saishuensis. Later the fossil fauna have been reexamined and upper Pliocene age is given by Taneda et al (1970), Kim (1972) and Yoon (1988). Alkaline volcanic rock formation underneath the Seogwipo F. is thought to be representing Pliocene volcanic activity. (Figure 6-2)

Haraguchi (1930, 1931) also found that there are several small lava domes of trachy-andesite. These small scale monogenetic volcano lavas are often hornblende-bearing, distributed in south-west and north coastal regions, including the Mt. Sanbang (Sanbasngsan) at the south-west. He postulated the middle Pleistocene age for them and considered them to be the products of weak volcanism prior to the Mt. Halla activity.

Taneda et al (1970) studied petrochemistry and paleomagnetism of Cheju lavas. They confirmed Haraguchi's volcanic successions and measured paleomagnetic pole direction for several lava samples. They found all five lava samples of Mt. Halla, including early stage "alkali basalt" (Pyoseonri basalt of Won, C.K. 1975 and Lee 1982) are "normal" in polarity, while Mt. Sanbang lava showed "reverse" polarity. They postulated that the Mt.

Fig. 6-2 Geological map of Cheju Island
図 6-2 済州島の地質図(after:Lee M.W.)



Generalized geological map of Jeju Island showing major stratigraphic divisions.
SGF; Seoguipo Formation. PSB; Pyosunri basalt. STA; Seoguipo trachyandesite. HSH; Hwasun-Seongsan hyaloclastite. JTA; Jungmun trachyandesite. SST; Sanbangsan trachyte. SYF; Sinyangri Formation. JJB; Jeju basalt. SMB; Sumangri basalt. HHB; Hahyori basalt. TAB; Beobjeongri trachyandesite. SHB; Shiungri basalt. SPB; Seongpanak basalt. HLB; Hallasan basalt. HLT; Hallasan trachyte. BLB; Backlockdam basalt. SVC; Scoria volcanic cones. SSF; Shell-sand Formation.
1; Hallasan. 2; Backlocksam. 3; Jeju. 4; Seoguipo. 5; Pyosunri. 6; Seongsan. 7; Sihungri. 8; Sanbangsan. 9; Jungmun. 10; Kwangyeong. 11; Sumangri. 12; Mosulpo. 13; Seongpanak.

Sanbang lava possibly erupted during the Matsuyama Epoch (0.69-2.50 m.y.).

Won, C.K. (1975) examined the Shinyangri Formation, a fossiliferous shallow marine deposit distributed at the eastern tip of the island, and he inferred the lower-middle Pleistone age to it. As the Shinyangri F. covering the Pyoseonri basalt he set the age of this basalt at lower Pleistocene.

Lee (1982a) published a geological map of the island based on his survey and described the volcanic succession. He followed Won (1975) in setting the Pyoseonri basalt at lower Pleistocene. (Table 6-1)

Lee (1982b) chemically analysed 63 lava samples and treated them on variation diagrams. He concluded that there were two cycles of alkali basalt—mugearite — trachyte differentiation in lower to middle Pleistocene and in upper Pleistocene to Holocene.

Won, J.K. et al (1986) measured paleomagnetism on three Mt. Halla summit area trachytes (Backlokdam group) and five Mt. Sanbang group trachytes. They found "normal" for the summit trachytes, and "reverse" for the Mt. Sanbang group lavas. These results cofirmed those of the Taneda et al (1970) attempt. They also measured K—Ar ages using equipment of the Okayama Science University, for a Backlokdam trachyte and three Mt. Sanbang group trachytes. The age was determined at 0.025 ±.003 m.y. and average of 0.733±.05 m.y., respectively. As recently discussed by Nagao & Itaya (1988) and Itaya & Nagao (1988) 0.025 m.y. (=25.000 y) is marginal value for the method and a subject of large errors involved. The "dead" Ar contamination often causing errors to the positive side in the age which is not included in the experimental error value attached.

The Pyoseonri lava represens the largest scale activity in Mt.Halla volcanism and the lava contains a large number of caves. This situation is very similar to the basalt lavas of Mt. Fuji, for which ^{14}C ages have been measured at around 10,000 y.BP.

Evidences such as only low sea cliff developed where Pyoseonri lava reached to the shore, and the "normal" polarity is measured by Taneda et al (1970) indicates that the Pyoseonri lava is unlikely be three quarter of a million years old, but several thousands to a few tens of thousands years old. The Shinyangri Formation molluscan shell has been dated by ^{14}C method at 4780 ±60 y.BP (Yamada, 0.1987, unpublished report) and this age suggests the formation is a Yurakucho-transgression product. Covered by this formation the underneath lava age is restricted at older than 5.000 years.

表　6-1　各研究者の、済州島の主要な火山岩と堆積層の層序の比較表

Table 6-1 The stratigraphic succession of the principal volcanic and sedimentary units in Cheju Island as determined by previous studies (after Lee M.W.)

		Haraguchi (1931)	Taneda (1970)	Won, C. K. (1975)	Lee, M. W. (1982)	Remarks
Recent	Upp.	1007, 1002 activities Groups of small basalt cones	1007, 1002 activities	1007, 1002 activities	1007, 1002 activities Groups of small basalt cone	Old manuscripts of Koryŏ Dynasty
	Low.			Volcanic cone I Volcanic cone II		
Pleistocene	Upp.	Suikido basalt Hallasan basalt Aphanitic basalt Augite basalt Feldspar basalt Cheju basalt	Hallasan basalt Aphanitic basalt Augite basalt Cheju basalt Alkali basalt	Paeknoktam basalt Hallasan trachyandesite Hallasan basalt Sŏngp'anak basalt Shihŭngri basalt Pŏpchŏngri trachyte Hahyori basalt Cheju basalt	Shinyangri Formation Hallasan trachyte Hallasan hawaiite Sŏngp'anak hawaiite Shihŭngri hawaiite Pŏpchŏngri mugearite Hahyori hawaiite Cheju hawaiite	0.025±0.008 Ma
	Mid.	Hornblende trachy-andesite Sanbangsan lava	Sŏgwip'o lava Sanbangsan lava	Shinyangri Formation	Hornblende mugearite Sanbangsan trachyte	0.74 ± 0.023 Ma
				Chungmun trachyte Sŏngsanp'o Formation Sŏgwip'o trachyte P'yosŏnri basalt	Chungmun hawaiite Sŏngsanp'o Formation Sŏgwip'o hawaiite P'yosŏnri alkali basalt	Matsuyama's reversal epoch
	L	Sŏgwipo Formation				
Pliocene	Upp.		Sŏgwip'o Formation	Sŏgwip'o Formation	Sŏgwip'o Formation	
	Mid.	Hallasan alkaline	Hallasan alkali trachyte	Basal basalt	Basal basalt	Boring core (1971)
	Low.					
Pre-Tertiary		Granite?	Granite?	Granite?	Granite?	

Many tree trunk molds were found in Sihungri lava, charcoal has not yet been collected but is likely to be obtainable from these tree molds. ^{14}C dating of Cheju lavas is necessary to clarify the chronology of Mt. Halla volcanic activity.

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