

Granites and Tectonics of South Korea*

Ok Joon Kim**

Abstract

South Korea is divided tectonically into four segments. The Kyonggi-Ryongnam massif is composed of Precambrian schists and gneisses and constitutes a base for the succeeding formations. The Okcheon geosynclinal zone in the Kyonggi-Ryongnam massif stretches from southwest to northeast diagonally across the peninsula in a direction known as the Sinian direction. Its northeastern part is composed primarily of Paleozoic to early Mesozoic sedimentary formations and the southwestern part of the late Precambrian Okcheon metamorphic series. The Kyongsang basin occupies the southeast and southwest of the peninsula and is made up of a thick series of Cretaceous terrestrial sedimentary and andesitic rocks. A few small Tertiary basins are scattered in the eastern coastal area and in Cheju Island, and are composed of marine sedimentary and basaltic rocks.

Jurassic Daebo granites intrude the Kyonggi-Ryongnam massif and the Okcheon zone in the Sinian direction, whereas late Cretaceous Bulkuksa granites are scattered randomly in the Kyongsang basin.

1. Geologic Provinces and Geologic Setting

South Korea is divided geologically as well as tectonically into four provinces, namely the Ryongnam-Kyonggi massif, the Okchon geosynclinal zone, the Kyongsang sedimentary basin and the Tertiary basin as shown in fig 1.

The geology of South Korea comprises all geological sequences from early Precambrian to recent except the great break extending from late Ordovician to early Carboniferous periods in which no sedimentary formation is known to be deposited in South Korea (table 1).

The difference between the geological sequences summarized by Prof. Cheong and the present writer lies mostly in the Precambrian geology. The writer in collaboration with colleagues and assistants has been studying on the Precam-

brian stratigraphy and Mesozoic granites, and the results are summarized briefly as below although the sequence is tabulated in the table 1.

1) Mesozoic granites: They were known "Younger Granites" and thought to be Cretaceous age, and so described in all earlier articles up to 1970. The writer had differentiated the "Younger Granites" into the Jurassic and Cretaceous granites, the former is named the Daebo granite and the latter the Bulkuksa granite (1971c). He also pointed out that the Daebo granite is aligned in Sinian direction (NE to SW) across the Korea peninsula in the Precambrian terrains, whereas the Bulkuksa granite is distributed randomly in the Mesozoic Kyongsang sedimentary basin.

2) Precambrian geology: All the Precambrian geology except the Yonchon and Okchon systems had been collectively named "granite gneiss system" by all earlier workers. The writer has also differentiated the granite gneiss system into-

*Geology Department, Yonsei University

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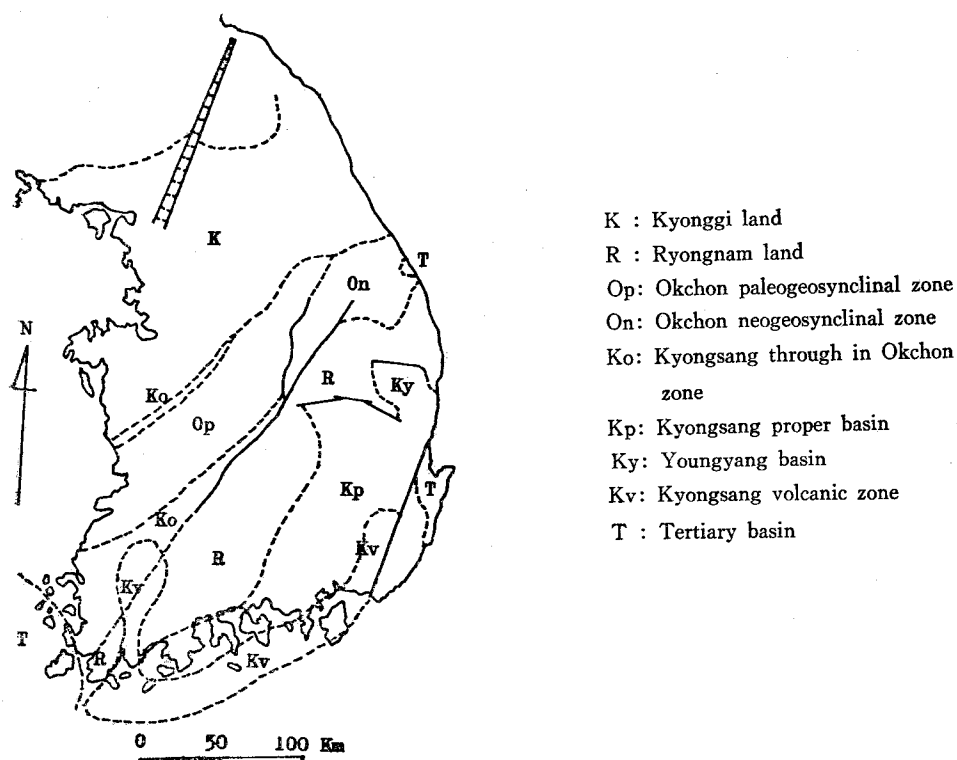


Fig. 1. Geological provinces of S. Korea.

granite gneisses and many profer schist formations, and tentatively correlated them as shown in the table 1 (1963, 1969a, 1972). In the Kyonggi massif, the Yonchon system is differentiated into three metamorphic complexes and the other two complexes namely the Jangrak and Chungsong groups have been newly establis-

hed (1973). In the Ryongnam massif area the Ryongnam and Yulri systems are differentiated and tentatively correlated them to the metamorphic complexes in the Kyonggi massif, since no enough age dating on them has been made so as to correlated them exactly (1974).

*Ryongnam is the name of a district in Korea. Japanese pronounced it "Reinan". The tectonic segment named by "Fukien-Reinan massif" appears so often in the geological literatures that the writer is obliged to point out at this proper opportunity that Ryongnam is the correct name and should be correctly used from now on. Recently few Korean geologists began to call "Sobaeksan" instead of "Ryongnam". Ryongnam has been using for many years so that this name must also be discarded.

Lying unconformably on the metamorphic complexes mentioned above is the Okchon system which stretches along the Sinian direction diagonally in the southwestern parts of the Okchon geosynclinal zone. The Okchon system, the most controversial system as to its age and sequence among Korean geologists, is used to be believed as the metamorphosed Paleozoic and Mesozoic formations (T. Kobayashi, 1953; C. M. Son 1969). The writer has, on the contrary, concluded that the system was late Precambrian

age (1968) and pointed out that the uppermost member of the system (Hwanggangri formation) was tillite origin (1969a) and it was supported later by A. J. Reedman et al (1973).

The distribution of the geology of Korea is very briefly summarized below (refer to the geologic and tectonic maps):

Kyonggi massif area: The Precambrian Yonchon system, Jangrak and Chunsong groups and granite gneisses are widely distributed and the Daebo granite is widespread along the Sinian direction across the peninsula.

Ryongnam massif area:* The Precambrian Ryongnam and Yulri systems, granite gneisses and Mesozoic Daebo granite are widespread. The Daebo granite is also aligned along the Sinian Direction, but not so clear as in the Kyonggi massif area.

Okchon Geosynclinal zone: Paleozoic to Mesozoic sedimentary formations are distributed in the northeastern Neogeosynclinal zone and the late Precambrian Okchon system in the southwestern Paleogeosynclinal zone. The Jurassic Daebo and Cretaceous Bulkuksa granites are scattered in both zones.

Kyongsang basin: Cretaceous Terrestrial sedimentary formations and the associated volcanics and tuffs are distributed, and the Cretaceous Bulkuksa granite intrudes randomly into the sediments in the basin.

Tertiary basin: The Neogene sedimentary formations and the associated basaltic flows are distributed in the small Tertiary basins and Jeju island off the peninsula. There also crop out granites but no dating has been done so as to designate them to the proper ages.

2. Tectonics and Related Granites

In the Kyonggi massif area two great unconformities were recognized (O. J. Kim, 1973) and three unconformities were also identified in the Ryongnam massif area (O. J. Kim et al,

1963). The metamorphic rocks separated by these unconformities show a different degree of metamorphism and a different attitude of deformation. Thus, the periods in which the metamorphism and deformation took place in these areas can be categorized into three periods (O. J. Kim, 1972). Nonetheless, it is uncertain as to their exact ages of episodes and whether or not they could exactly be correlated each other in both Precambrian terrains. This is the reason why the geologic structure of both Precambrian terrains is grouped as Pre-Triassic in age, because the structural breaks in Korea are definitely known to have occurred in the end of Triassic (Songrim Disturbance), late Jurassic (Daebo Orogeny), late Cretaceous (Bulkuksa Disturbance) and mid-Tertiary (Yonil Disturbance). The generalized structural pattern is shown in the fig. 3 where the Tertiary structure is not shown because of insignificance.

1) Pre-Triassic deformation

In the Kyonggi massif the foliation of the metamorphic complex even within the same system as well as in the different systems bounded by unconformities is so diverse that generalization can not be drawn. However, the prevailing ones trend NNW-SSE direction in the western parts and NNE-SSW direction in the central to eastern parts of the massif. Four major faults trends to NNE-SSW direction but cut by the Daebo granite at the southwestern ends. There is no evidence that the foliation of the complex had been effected by the intrusion of the Daebo granite. In the Ryongnam massif the foliation is also very diverse, but changes to nearly NE-SW direction toward the south-western parts and cut slight-obliquely by the Jeomchon thrust.

2) Triassic deformation (Songrim Disturbance)

In the Okchon Neogeosynclinal zone at east-central region of South Korea, Paleozoic and Triassic sedimentary formations are folded and

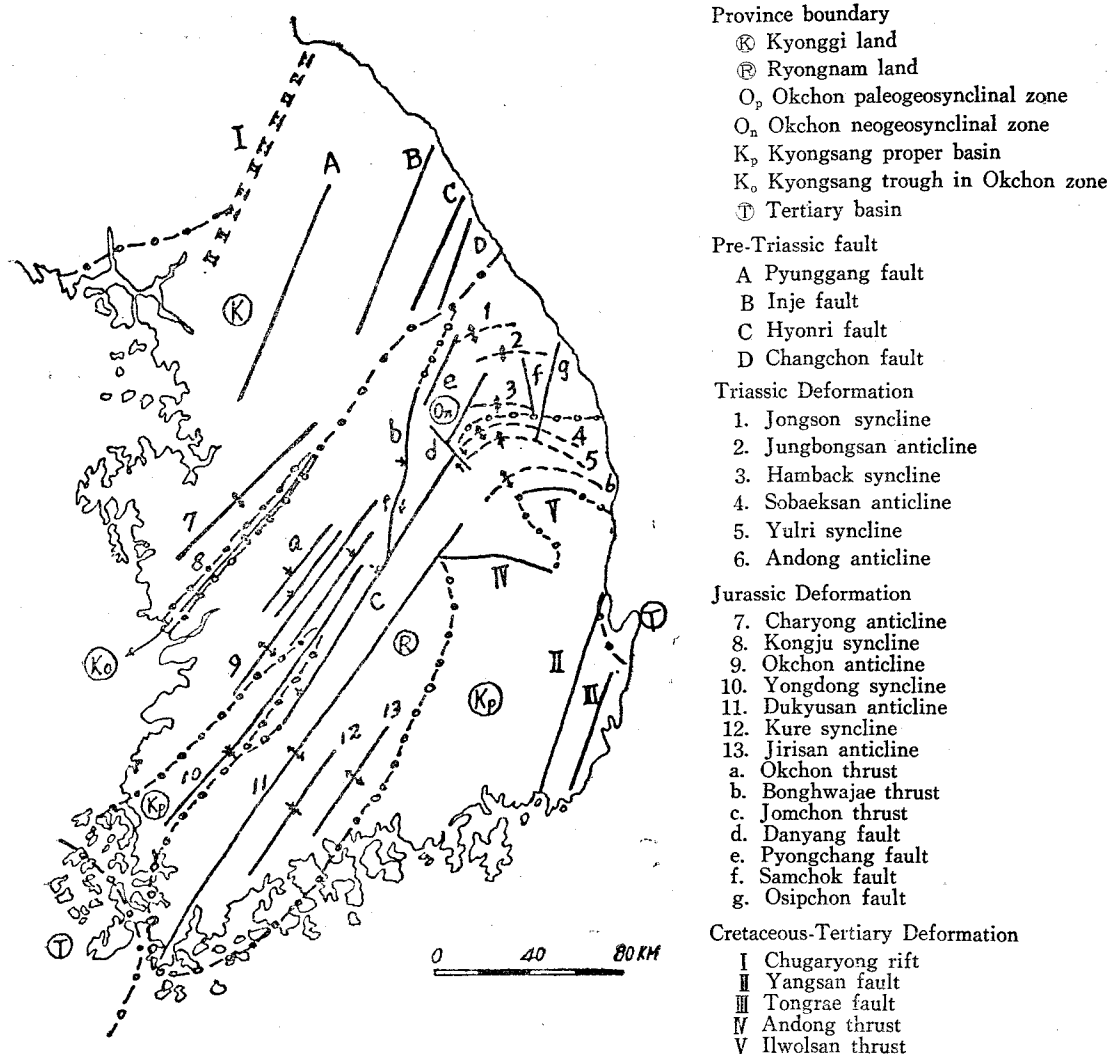


Fig. 3. Geological provinces and structural map of S. Korea

the axis of folds trend west-northwesterly. This deformation is thought to be caused by the Songrim disturbance at the end of Triassic period, since the Jurassic sediments in the area have not been affected by this deformational movement.

The western end of those folds are bent to the Sinian direction of Jurassic age. In the northeastern portion of the Ryongnam massif the trend of the Sobaeksan anticline, Yulri syncline and Andong anticline is WNW in general, but it is guessed that they were modified by the Triassic deformation although they might be or-

iginally Precambrian structures.

3) Jurassic deformation (Daebo Orogeny)

The Jurassic deformation caused by the Daebo orogeny was taken place and continued from early Jurassic to early Cretaceous (this was known from the age dating of the Daebo granites). This orogeny is the biggest one in Korea and some of the preceding formations were severely folded and faulted. The nature of the Daebo orogeny is manifested by the distribution of the Jurassic Daedong sedimentary formations and the alignment of the Daebo granites which are

well cropped out along Sinian direction in the Okchon geosynclinal zone and its adjacent Precambrian terrains.

As shown in the tectonic map, four anticlinoriums and three synclinoriums run alternately from the southern border of the Kyonggi massif to the Ryongnam massif through the Okchon zone. The Okchon thrusts are in the Okchon zone, the Bonghwajae thrust bounds the Okchon Paleogeosynclinal zone and Neogeosynclinal zone, and the Jomchon thrust joined by the Bonghwajae thrust bounds the Okchon zone and the Ryongnam massif toward the southwest. These anticlinoriums constitute major mountain ranges and the younger sediments of Jurassic and Cretaceous periods scatter in the few isolated locations in the synclinorium areas.

4) Late Cretaceous to Tertiary deformation

Only minor folds are observed in the Cretaceous Kyongsang sedimentary basin although the sedimentary formations in the basin show homoclinal structure to the southeast in general. The fragmentation of the basin caused by the post-Bulkuksa disturbance resulted in forming of the upthrust at Andong and Ilwolsan, which bound the Precambrian basement and the Cretaceous sediments. Along the Chugaryong rift valley extruded the Cenozoic basalt flows which cover the old river beds. High heat flows are checked along the Yangsan and Tongrae faults (Chang, 1970).

5) Mid-Tertiary deformation (Yonil Disturbance)

The great unconformity has been known to

exist between the lower and upper Miocene formations. The lower formations are wildly folded whereas the upper ones exhibit no sign of deformation. The disturbance of mid-Miocene is known as the Yonil Disturbance.

6) Associated granites

The granites of various geologic time are closely associated with the orogenies in Korea. The ages and the occurrence of the Precambrian granites are not certain although they are relatively estimated as shown in the table 1. The Jurassic Daebo granites, syntectonic plutons of the Daebo orogeny, intruded along the Sinian direction in the cores of the Okchon folded mountain belts and in the Kyonggi-Ryongnam Precambrian land mass (fig. 2).

At the end of Cretaceous and probably extended into early Tertiary the Bulkuksa granites and the associated acidic intrusives intruded in the Kyongsang basin area and the adjacent Okchon zone as small stocks without any pronouncing deformation.

The granites of the Post-Chosun (mid-Paleozoic) and the Songrim disturbance (late Triassic) are expected to exist. In fact the granites of these periods were reported in North Korea recently but not discovered in South Korea thus far. The granites of the Yonil disturbance (mid-Tertiary) are also expected to exist but no age dating has been done enough to find them. The relation of the plutons to various orogenies in South Korea is summarized in the table 2 and the distribution of the granites of Jurassic and Cretaceous ages are shown in the figure 2.

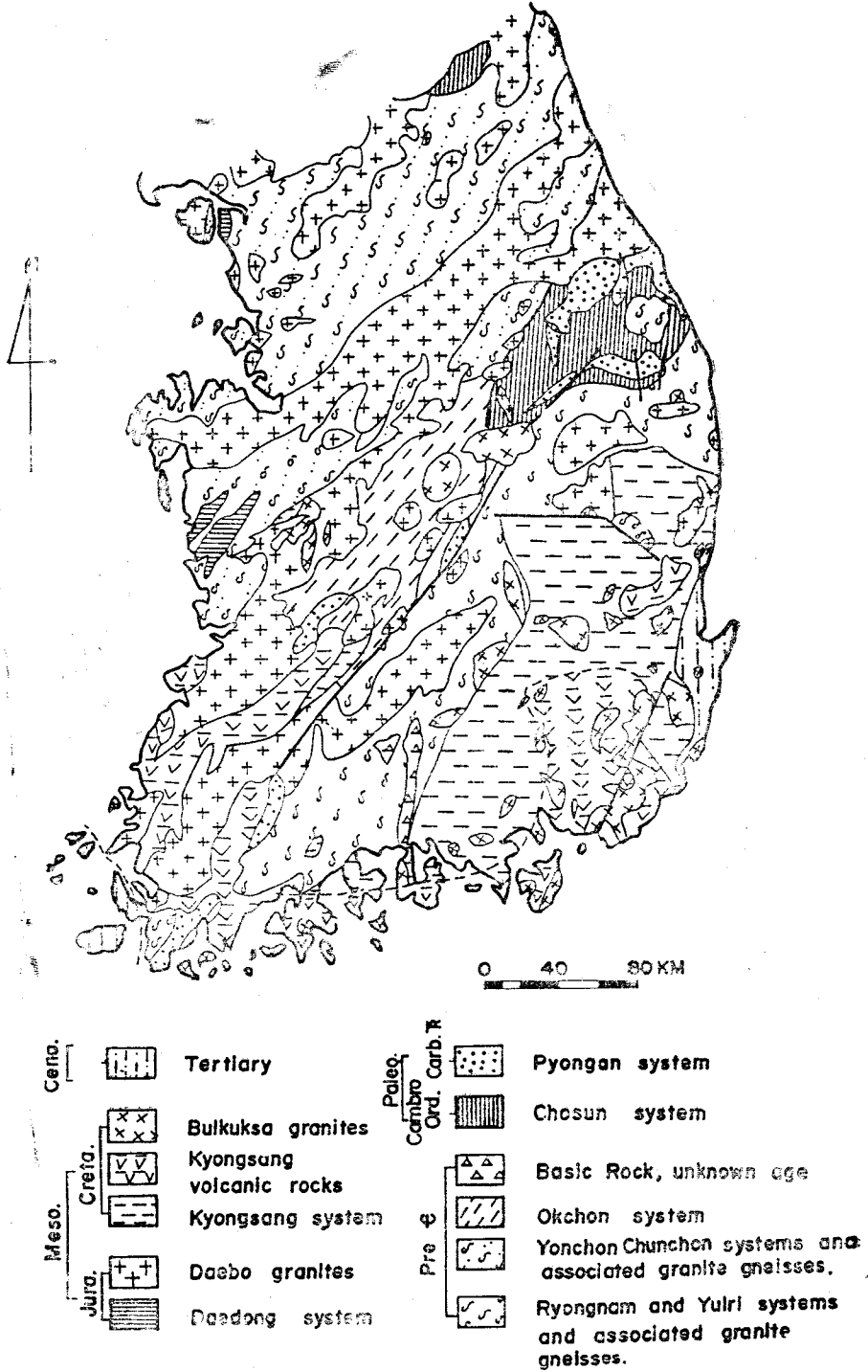


Fig 2. Geologic map of Korea

Table 2. Orogenies and associated igneous rocks in South Korea.

Orogeny	Periods	Granites	Other Igneous Rocks
Yonil disturbance	mid-Tertiary	unknown	basalt, rhyolite
Bulkuksa disturbance	late Cretaceous-early Tertiary	Bulkuksa granites	rhyolite, andesite basalt
Daebo orogeny	Jurassic-early Cretaceous	Daebo granites	hornblendite, andesite
Songrim disturbance	late Triassic	unknown	unknown
Post-Chosun disturbance	late Ordo. early Carb.	unknown	unknown
Post-Sangwon disturbance	end of Precambrian	unknown	unknown
Taebak(Chunsong) disturbance	early late-Precambrian (?)	granite gneisses,	amphibolite(?)
Ryongnam(Jongrak) orogeny	early mid-Precambrian(?)	granite gneisses	serpentinite(?)

南韓의 花崗岩類와 地殼變動

金 玉 準

南韓은 地構造的으로 4개의 地質區로 나누어 진다.

京畿陸塊와 嶺南陸塊는 先캄브리아紀의 片麻岩과 片岩으로 구성되어 있다.

沃川地向斜帶는 소위 支那方向인 西南南東으로 韓半島를 비스듬히 가로지르고 있다. 沃川地向斜帶의 北東部는 주로 古生代와 中生代 초기의 堆積岩層으로 되어있고 西南部는 후기 先캄브리아紀의 變成岩層群으로 되어있다. 慶尙盆地는 白堊紀의 두꺼운 陸成堆積層과 安山岩類로 되어있다.

第三紀의 몇개의 小盆地가 한반도 동남부와 제주도예 分布하고 주로 海成層과 현무암류로 되어있다.

จู라紀의 大寶花崗岩이 京畿陸塊, 嶺南陸塊, 沃川地向斜帶內에 支那方向으로 貫入分布한다. 한편 白堊紀의 佛國寺 花崗岩은 慶尙盆地에 分散分布한다.